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Port of Seattle Aviation Environmental Programs

Seattle Tacoma International Airport
Stormwater Management Manual for Port Aviation Division

Acknowledgements

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Stormwater Management Manual for Port Aviation Division Property

Port of Seattle Aviation Division

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PREFACE

Introduction

The *Stormwater Management Manual for Port Aviation Division Property* (Manual) serves as a guidance document for how the *Stormwater Management Manual for Western Washington* (Ecology Manual) should be implemented on Port Aviation property. This Manual contains appropriate revisions to address the infrastructure and regulatory conditions at the Seattle-Tacoma International Airport. The Ecology Manual has been adopted by the Port of Seattle (Port) together with this Manual. Adoption and administering development in accordance with the Ecology Manual and this Manual complies with elements of the Port's National Pollutant Discharge Elimination System (NPDES) permit.

The Ecology Manual and this Manual will be implemented consistent with the Port's building permit process and the Interlocal Agreement with the City of SeaTac. This *Stormwater Management Manual for Port Aviation Division Property* applies to development proposals within Seattle-Tacoma International Airport (STIA) and other Port Aviation Division properties and defines the requirements for drainage review and design of stormwater facilities.

This Manual is based on Volumes I through V of the Ecology Manual. Volumes II through V of this Manual make extensive references to their corresponding volumes in the Ecology Manual, with revisions to those volumes contained in this Manual. Unless otherwise noted, the term "local jurisdiction" in Volumes II through V of the Ecology Manual can be considered to mean "Port of Seattle" in this Manual. The Washington State's (WSDOT) *Aviation Stormwater Design Manual* was also used as guidance when preparing this manual, particularly with respect to managing wildlife hazards near airports.

Purpose and Need of This Document

The development of this Manual was the method the Port used to comply with its NPDES permit, which establishes regulations set forth in the permit application requirements for stormwater discharges associated with industrial activity. Figure I-1.4.1 of Volume I of this Manual shows the STIA area retrofitted in order to comply with the Port's NPDES permit. The Retrofit Area includes the areas at the airport that were fully retrofitted with water quality and flow control best management practices (BMPs) to meet the requirements of Part 2 Condition S9.C.2 of the Port's NPDES Permit, modified October 7, 2005, and Condition J.1.C of Water Quality Certification #1996-4-02325-2 for the Third Runway and other 1997 Master Plan Update Improvement projects. These retrofit BMPs were completed in accordance with the *Stormwater AKART Analysis* (RW Beck, 2006) and *Stormwater Engineering Report* (RW Beck, March 2006). These reports are discussed in Sections 1.2.2.2 and 1.2.2.3.

This Manual contains requirements related to preparation of Temporary Erosion and Sediment Control (TESC) and the design of water quality source controls, flow control, water quality treatment and conveyance systems. This Manual requires implementation of low impact

development (LID) flow control BMPs for managing stormwater to the extent allowed by local site conditions.

Applicability and Use of This Manual

Port staff will use this Manual in reviewing Stormwater Site Plans, checking BMP designs, and providing technical advice to project proponents.

Federal, state, and local permits may refer to the Ecology Manual or the BMPs contained in the Ecology Manual. In those cases, affected permit-holders or applicants should use this Manual for specific guidance on how to comply with those permit conditions.

Land development and redevelopment projects are implemented on STIA properties generally following the procedure shown in Table I-P.1.1. The procedure involves several STIA departments and may also include the City of SeaTac under provisions of the Interlocal Agreement between the Port and the City. Projects on Port properties within other jurisdictions near STIA may also require coordination with those jurisdictions. Projects associated with STIA are implemented in several planning and design phases.

This Manual is applicable to all land development and redevelopment projects occurring within areas subject to the STIA's NPDES permit. This Manual will also apply to projects occurring outside of those areas subject to the STIA's NDPES when the Port is responsible for permit administration in accordance with the current Interlocal Agreement between the Port and City of SeaTac or other authorities.

As shown in Table I-P.1.1, at the preliminary design phase, or possibly earlier, a determination will be made as to whether the Port has responsibility for stormwater design review or whether another jurisdiction has responsibility. For projects on Port property within the City of SeaTac, the jurisdictional determination will be made via the Preliminary Design Review Conference Checklist process under the provisions of the Port's Interlocal Agreement with the City.

Other Port Design Standards

Figure I-P.1.1 lists several other Port design standards and guidelines that may apply to projects, but that are not covered in this Manual. Project proponents should refer to the following Port web site for the most current list of standards and guidelines:

https://www.portseattle.org/Business/Construction-Projects/Airport-Tenants/Pages/Reference-Documents.aspx

Figure I-P.1.1. Other Design Guidelines and Standards for Airport Projects

Note: This list is provided for reference purposes only and is only current as of the date of this Manual. Project proponents should refer to the Port website to make sure they are using the current standards.

Design Guidelines

This group of documents describes design guidelines that should be followed for any airport project.

- Regulations for Airport Construction 2004. Compendium of procedures, rules, regulations, and standards to be followed for all Port and tenant projects that are constructed at STIA. These regulations focus primarily on the construction phase, with separate design guidelines and standards addressing design requirements (see this and the following section).
- Design Guidelines 2001. Describes the comprehensive vision for design criteria at STIA.
- Landscape Design Guidelines 1999. Guidelines for landscape design and installations at STIA .
- Port of Seattle Health and Safety Manual. Guide to contract safety requirements and the Port of Seattle Fire Department as it relates to construction.
- Section 01 35 29 – Safety Management. Tenant document bidding requirements, contract forms, and conditions of the contract.
- Dining and Retail Design Guidelines – Guidelines to provide quality standards and communicate an overall design aesthetic for dining and retail development.
- Interlocal Agreement City of SeaTac – agreement between the Port and City of SeaTac which jointly establishes landuse and zoning, surface water management, critical areas, transportation, SEPA, public safety, material haul and Master Plan & Comprehensive Development Plan Interagency Cooperation & Development Provisions.

Design Standards

This group of documents defines design standards that must be followed for any airport project.

- Architecture Standards 2008. Standards for architectural design, materials and finishes selection at STIA
- CAD Standards 2014
- Casework Standards 2003. Standards for casework design and material selection at STIA
- Communications Systems Standards 2014. Standards for communication system design and equipment selection at STIA. Includes appendices for tenant guidelines and communications labeling standards.
- Electrical System Standards 2015. Standards for electrical system design and equipment selection at STIA
- Industrial Waste and Storm Drainage Systems Standards 2002. Standards for design and equipment selection for industrial waste and storm drain systems at STIA
- Landscape Standards 2006. Standards for landscape design, installation, equipment selection and plant selection at STIA.
- Mechanical Systems Standards 2015. Standards for mechanical system design and material selection at Sea-Tac Airport

- Radio Frequency Standards 2005. Standards for radio frequency system design and equipment selection at STIA
- Rental Car Facility (RCF) Tenant Design and Construction Standards 2012 – Design and construction standards for tenants of the consolidated rental car facility. These Standards are supplemental to existing Design Standards for the unique features of the rental car facility.
- Restroom Design Standards 2015 – Standards for architectural design of public restrooms at STIA. Plumbing fixtures and fittings are included in the Mechanical Systems Standards 2014. The Restroom Design Standards are currently being revised.
- Signage Standards 2011. Standards for signage design, layout configuration, graphics, symbols, installation and material selection at STIA
- Stormwater Management Manual – Standards for design of stormwater management.
- Water and Sanitary Sewer Systems Standards 2003. Standards for domestic water and sanitary sewer system design, installation, and material selection at Sea-Tac Airport

Table I-P.1.1.

TABLE I-P.1.1

IMPLEMENTATION OF STORMWATER MANAGEMENT MANUAL

	Activities During Project Definition and Design Stages					
	Project Definition	**PreDesign**	**15% Design**	**30% Design**	**60% Design**	**90% Design**
Project Manager	Perform an initial assessment of the Applicable Minimum Requirements (from decision charts in 2-2 and 2-3)	Determine responsibility for stormwater review.	Prepare and submit Stormwater Site Plan that addresses applicable minimum requirements (determine TESC from decision chart 2-4; flow control from decision chart 2-5; treatment from decision chart 2-6)[2]	Apply to POS Building Department for Certification of Port Standards		Apply to POS Building Department for Building Permit
	Review site selection, opportunities, and constraints with project sponsor, Enivronmental, and F&I	Determine the Applicable Minimum Requirements that need to be addressed (from decision charts 2-2 and 2-3)	Submit Application for Connection to F&I			
	Determine the potential design scope of work and A/E services related to stormwater facilities	Submit Preliminary Design Review Conference (PDRC) checklist to Building Department[1]	Perform SWM Consultation with the City Sea-Tac per ILA			
Facilities and Infrastructure	Coordinate with the PM on performing the initial assessment of the Applicable Minimum Requirements	Review the scope of potential stormwater facilities; perform a preliminary life-cycle cost analysis of options	WISE review	WISE review	WISE review	WISE review
Environmental	Perform NEPA / SEPA assessment, and coordinate with the PM on performing the initial assessment of the Applicable Minimum Requirements	Approve the Applicable Minimum Requirements that need to be addressed	* Review and approve Stormwater Site Plan			
Maintenance			Review Minimum Requirement No. 9 – Operation and Maintenance			
Building Department		Review PDRC checklist		Review application for Certification of Port Standards		Review application for Building Permit
Construction Management			Review Minimum Requirement No. 2 – Construction SWPPP			
City of SeaTac			Perform SWM Consultation with the POS per ILA			

1. Per Interlocal Agreement with the City of SeaTac
2. Final review and approval of all Minimum Requirements included in the Stormwater Site Plan

Manual Organization

The information presented in this Manual is organized as follows:

- **Volume I – Minimal Technical Requirements and Site Planning**: This volume stipulates stormwater management requirements for Port projects to comply with the Port's NPDES permit.
- **Volume II – Construction Stormwater Pollution Prevention**: Volume II covers BMPs for short-term stormwater management at construction sites.
- **Volume III – Hydrologic Analysis and Flow Control Design/BMPs**: Volume III covers hydrologic analysis and BMPs to control flow volumes from developed sites.
- **Volume IV – Source Control BMPs**: Volume IV addresses BMPs to minimized pollution generated by potential pollution sources at developed sites.
- **Volume V – Runoff Treatment BMPs**: Volume V presents BMPs to treat runoff that contains sediment or other pollutants from developed sites.

Chapter 1
INTRODUCTION

1.1 Objective

The objective of this Manual is to set forth the measures necessary to control the quantity and quality of stormwater produced by new development and redevelopment such that they comply with water quality standards and contribute to the protection of beneficial uses of the receiving waters. Application of the appropriate minimum requirements and Best Management Practices (BMPs) identified in this manual are necessary but sometime insufficient measure to achieve these objectives.

Water quality standards include:

- Chapter 173-200 of the Washington Administrative Code (WAC), Water Quality Standards for Ground Waters of the State of Washington
- Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington
- Chapter 173-204 WAC, Sediment Management Standards

This Manual includes minimum requirements for measures necessary to control stormwater discharges from new development and redevelopment to storm drain systems. This Manual also covers requirements for the discharge of stormwater to the Industrial Waste System (IWS) at Seattle-Tacoma International Airport (STIA).

Volume I of this Manual identifies minimum requirements for development and redevelopment projects of all sizes and provides guidance concerning how to prepare and implement stormwater site plans. These requirements are, in turn, satisfied by the application of Best Management Practices (BMPs) from Volumes II through V. Projects that follow this approach will apply reasonable, technology-based and water-quality-based BMPs to reduce the adverse impacts of stormwater.

The Washington State's (WSDOT) *Aviation Stormwater Design Manual* was also used as guidance when preparing this manual, particularly with respect to the design of flow control and runoff treatment (BMPs) and managing associated wildlife hazards at and around airports.

1.2 Organization of this Manual

1.2.1 Overview of Manual Content

To accomplish the objective described in Section 1.1, the Manual includes the following:

- *Minimum Requirements* that cover a range of issues, such as preparation of Stormwater Site Plans, pollution prevention during the construction phase of a project, control of potential

pollutant sources, treatment of runoff, control of stormwater flow volumes, protection of wetlands, and long-term operation and maintenance. The Minimum Requirements applicable to a project vary depending on the type and size of the proposed project.

- *Best Management Practices (BMPs)* that can be used to meet the minimum requirements. BMPs are schedules of activities, prohibitions of practices, maintenance procedures, managerial practices, or structural features that prevent or reduce adverse impacts to waters of Washington State. BMPs are divided into those for short-term control of stormwater from construction sites, and those addressing long-term management of stormwater at developed sites. Long-term BMPs are further subdivided into those covering management of the volume and timing of stormwater flows, prevention of pollution from potential sources, and treatment of runoff to remove sediment and other pollutants.
- *Guidance on how to prepare and implement Stormwater Site Plans.* The Stormwater Site Plan is a comprehensive report that describes existing site conditions, explains development plans, examines potential off-site effects, identifies applicable Minimum Requirements, and proposes stormwater controls for both the construction phase and long-term stormwater management. The project proponent submits the Stormwater Site Plan to the Port, who use the plan to evaluate a proposed project for compliance with stormwater requirements.

1.2.2 Organization of this Manual

Volume I of this Manual serves as an introduction and covers several key elements for developing the Stormwater Site Plan submittal to the Port. Following this introduction, Volume I contains three additional chapters. Chapter 2 identifies the Minimum Requirements for stormwater management at all new development and redevelopment projects. Chapter 3 describes the Stormwater Site Plan and provides step-by-step guidance on how to develop this plan. Chapter 4 describes the process for selecting BMPs for long-term management of stormer flows and quality. Appendices are included to support these topics. Volume I also includes the Glossary for all five volumes of the Manual.

The remaining volumes of this Manual cover BMPs for specific aspects of stormwater management. Volumes II through V are structured as addendums to the corresponding volumes of the Ecology Manual. **Therefore, project proponents should obtain and review all portions of the Ecology Manual that are referenced in this Manual.**
Volumes II through V of this Manual are organized as follows:

- Volume II of this manual is an addendum that adds to or amends Volume II of the Ecology Manual, which covers BMPs for short-term stormwater management at construction sites.
- Volume III is an addendum to Volume III of the Ecology Manual, which covers hydrologic analysis and BMPs to control flow volumes from developed sites.
- Volume IV is an addendum to Volume IV of the Ecology Manual, which addresses BMPs to minimize pollution generated by potential pollution sources at developed sites.

- Volume V is an addendum to Volume V of the Ecology Manual and presents BMPs to treat runoff that contains sediment or other pollutants from developed sites.

1.3 Applicability to Aviation Properties

This Manual is applicable to projects conducted on areas subject to STIA's individual National Pollution Discharge Elimination System (NPDES) Waste Discharge Permit No. WA-002465-1 (STIA NPDES Permit) as well as other projects on Port Aviation Division property consistent with the provisions and procedures of the Port's building permit process and the Interlocal Agreement with the City of SeaTac. It applies to most types of land development, including commercial, industrial, and roads.

This Manual is based on the Department of Ecology's Stormwater Management Manual for Western Washington (Ecology Manual) (Department of Ecology, 2014) and provides guidance on how the Ecology Manual is to be implemented at the STIA. It integrates requirements of STIA's NPDES Permit, the City of SeaTac interlocal agreement (ILA), and the Des Moines Creek Basin Plan. Administering and implementing development in accordance with the Ecology Manual and this Manual complies with associated elements of the Port's NPDES permit.

The Ecology Manual was originally developed in response to a directive of the Puget Sound Water Quality Management Plan (PSWQA 1987 et. seq.). The Puget Sound Water Quality Authority (since replaced by the Puget Sound Partnership, PSP) recognized the need for overall guidance for stormwater quality improvement. It incorporated requirements in its plan to implement a cohesive, integrated stormwater management approach through the development and implementation of programs by local jurisdictions, and the development of rules, permits and guidance by Ecology.

The Puget Sound Water Quality Management Plan included a stormwater element (SW-2.1) requiring Ecology to develop a stormwater technical manual for use by local jurisdictions. The Ecology Manual was originally developed to meet this requirement. Ecology has found that the concepts developed for the Puget Sound Basin are applicable throughout western Washington.

Information describing how this Manual relates to the Puget Sound Water Quality Management Plan (now the Puget Sound Action Agenda) is included in the Ecology Manual.

The Washington State Department of Transportation (WSDOT) Aviation Stormwater Design Manual was also used as guidance when preparing this manual, particularly with respect to managing wildlife hazards near airports.

1.4 STIA NPDES Permit

STIA has been regulated under an NPDES permit since 1980. The Port of Seattle's NPDES Permit No. WA-002465-1 regulates stormwater discharges associated with industrial and construction activities at the STIA. The STIA NPDES Permit is reissued every five years. The most recent

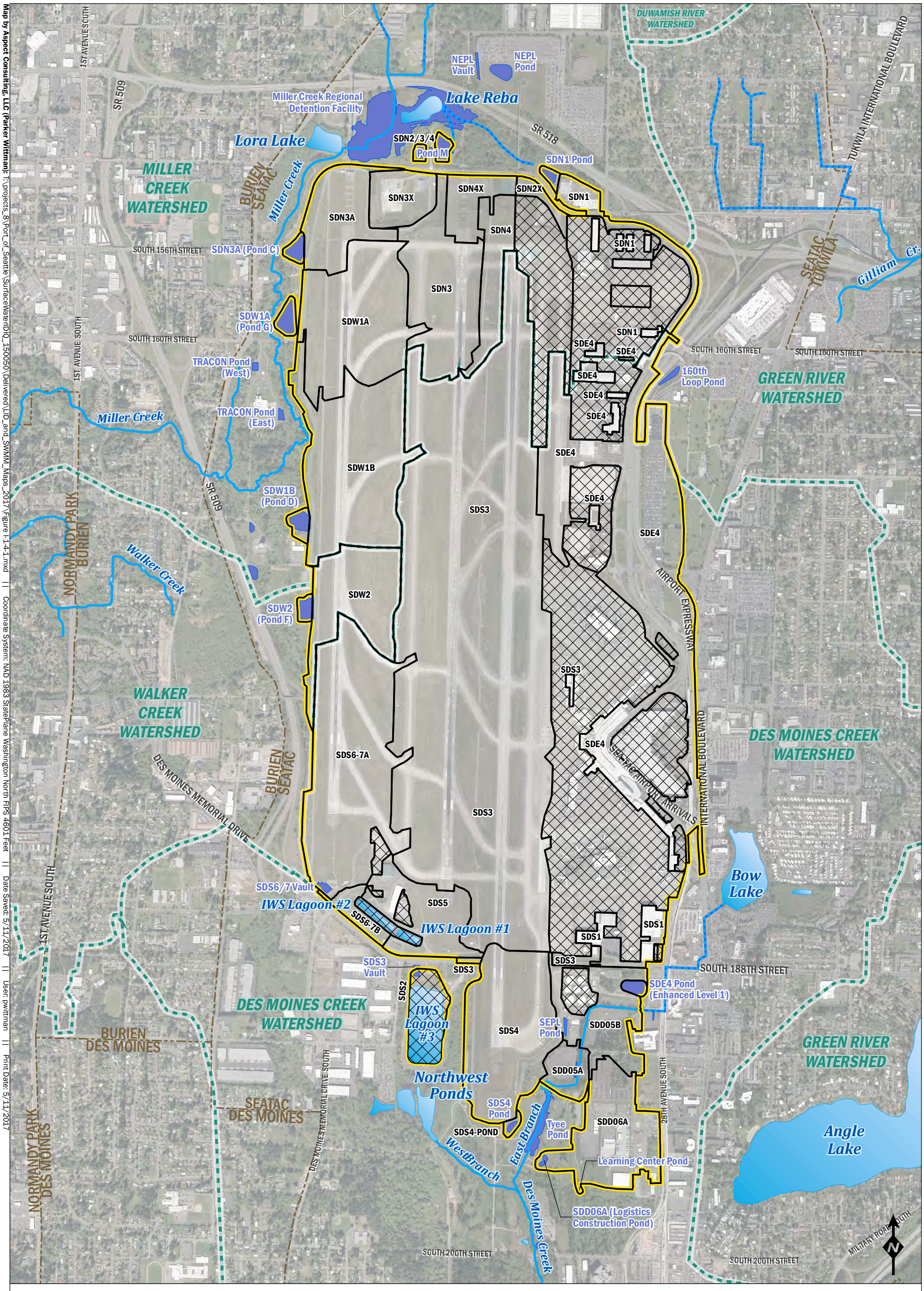
effective permit can be found on Ecology's website at http://www.ecy.wa.gov/programs/wq/permits/northwest_permits.html. The permit is organized into three sections:

- Part I - applies to Airport Industrial Wastewater System (IWS) discharges to Puget Sound and municipal sewer system.
- Part II - applies to Industrial Stormwater and regulates stormwater from areas associated with airport industrial activities discharging directly or indirectly to Des Moines, Miller, or Walker Creeks, Northwest Pond or Lake Reba.
- Part III - applies to Construction Stormwater, which includes construction stormwater and dewatering water from construction sites that drain to the SDS.

In general, individual NPDES permits authorize discharges from specific outfalls to regulated receiving waters. Therefore, the aerial extent of coverage for each of these parts is determined by the outfalls identified in the permit and their associated subbasins. Every five years when the permit is renewed, the Port and Ecology reexamine the extent of permit coverage and adjust as needed.

The aerial extent of permit coverage as of February 2016 for Parts I and II of the Airport's Individual Permit is shown in Figure I-1.4.1. Because it was not possible to identify construction outfall locations in advance of construction projects, the Port monitors specific stream segments for compliance with construction-related effluent limits (Part III). These segments are specified in the Individual Permit and are illustrated on Figure I-1.4.2 and discussed further in Section 1.7.4.

In addition to authorizing direct discharge to receiving waters, the STIA NPDES permit authorizes the discharge of certain industrial wastewaters to the Midway Sewage Treatment Plant. Authorized discharges to Midway along with monitoring and discharges limitations are described in STIA Permit Part I Condition S1.C.



NPDES Permit Application Boundary and STIA Retrofit Area

Storm Drainage Subbasin

Industrial Waste System (IWS) Area

Watershed Boundary

Flow Control Facilities

Conveyance

Stream

Surface Waterbody

City Limit

FIGURE I-1.4.1

STIA Retrofit Area and Storm Drainage System Subbasins

Volume I - Minimum Technical Requirements and Site Planning

0 700 1,400

Feet

MAP BY: Aspect CONSULTING

Port of Seattle

Map by Aspect Consulting, LLC (Parker Wittman): T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure I-1-4-1.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017

Map by Aspect Consulting, LLC (Parker Wittman): T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure I-1-4-2.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017

Tub Lake
DUWAMISH RIVER WATERSHED
SR 509
TUKWILA INTERNATIONAL BOULEVARD
L28
L28-A
L28-B
NEPL Pond
NEPL Vault
Miller Creek Regional Detention Facility
M14
M14-A
Lake Reba
Lora Lake
Pond M
L30
L30-A
L30-B
L30-C
L30-D
L30-E
SDN1 Pond
SR 518
MILLER CREEK WATERSHED
Miller Creek
M15
M15-A
M15-B
M16
M16-A
L29
L29-A
G28
G28-A
SDN3A (Pond C)
M17
M17-A
Gilliam Cr.
G26
G27
G27-A
SDW1A (Pond G)
TRACON Pond (West)
M19
M19-A
160th Loop Pond
GREEN RIVER WATERSHED
M18
M18-A
TRACON Pond (East)
Miller Creek
M20
M20-A
M21
M21-A
SDW1B (Pond D)
Walker Creek
W22
W22-A
SDW2 (Pond F)
W23
W23-B
W24
W24-A
AIRPORT EXPRESSWAY
INTERNATIONAL BOULEVARD
DES MOINES CREEK WATERSHED
WALKER CREEK WATERSHED
D29
Bow Lake
1ST AVENUE SOUTH
SDS6/7 Vault
IWS Lagoon #2
IWS Lagoon #1
SDS3 Vault
D10
D10-A
D-10B
SDE4 Pond (Enhanced Level 1)
SOUTH 188TH STREET
IWS Lagoon #3
D11
D11-A
SEPL Pond
D9
Northwest Ponds
D5
D5-A
D5-B
D4
D4-A
SDS4 Pond
D12
D12-A
D12-B
SDD06A (Logistics Construction Pond)
Tyee Pond
East Branch
West Branch
Des Moines Creek
D13
D13-A
D13-B
Learning Center Pond
D7
D7-A
Angle Lake
ORILLIA ROAD SOUTH

122°20'0"W 47°28'30"N
122°19'45"W
122°19'30"W
122°19'15"W
122°19'0"W
122°18'45"W
122°18'30"W
122°18'15"W
122°18'0"W
122°17'45"W
122°17'30"W
122°17'15"W
122°17'0"W
122°16'45"W 47°28'30"N
47°28'15"N
47°28'0"N
47°27'45"N
47°27'30"N
47°27'15"N
47°27'0"N
47°26'45"N
47°26'30"N
47°26'15"N
47°26'0"N
47°25'45"N
47°25'30"N
122°20'0"W 47°25'15"N
122°16'45"W 47°25'15"N

Industrial Waste System (IWS) Area
Watershed Boundary
Flow Control Facilities
Surface Waterbody
Conveyance
Stream

122°20'0"W 47°28'30"N
15 Arc-Second Latitude/Longitude Grid
(coordinates represent the center of each cell row/column)

W22 W22-A
Grid Cell with Permitted Outall(s)

FIGURE I-1.4.2
STIA NPDES Construction Permit Coverage
Volume I - Minimum Technical Requirements and Site Planning

0 750 1,500
Feet

MAP BY: Aspect CONSULTING
Port of Seattle

1.5 STIA Stormwater Management Systems

Stormwater at STIA is collected by one of two drainage systems: the stormwater drainage system (SDS) and the IWS. The following paragraphs describes each system and provides the general rules for determining into which system a project must drain. Under some circumstances, the Port may require the stormwater runoff from a site to drain to the sanitary system. The project proponent shall contact the Port's Environmental Program Manager to confirm which system is appropriate for their project.

1.5.1 Industrial Waste System

The IWS consists of a collection and conveyance system, a high and low strength BOD waste stream segregation system, three storage lagoons, an industrial wastewater treatment plant (IWTP) that includes dissolved air flotation, a direct discharge to Puget Sound through the Midway Sewer District's outfall and an alternate discharge to King County's Renton Treatment plant for the high strength BOD waste stream.

IWS flow is runoff collected from the North and South Service Basins which mainly consists of stormwater runoff from terminal air cargo, deicing areas, hangars, and maintenance areas. Due to the nature of activities in these areas, the water collected has variable levels of spilled fuel, de-icing/frost chemicals, and wash water and other minor process water sources. These flows are collected in a drain system and conveyed to the storage lagoons for subsequent treatment in the IWTP.

The IWTP was originally designed and constructed in 1963/1964 for the purpose of capturing and treating fuel spills. Since then, its storage and DAF treatment capacity has been enlarged. Most recently, the high and low strength BOD waste stream segregation system and alternate discharge to King County's Renton Treatment Plant have been added in compliance with AKART for aircraft deicing fluids and associated stormwater. The STIA NPDES Permit Part I defines effluent limits for low strength BOD waste streams discharging to Puget Sound.

The IWS utilizes the Midway Sewer District's Des Moines Creek Wastewater Treatment Plant (WWTP) outfall for low strength BOD discharges to Puget Sound. The outfall is covered under NPDES Waste Discharge Permit No. WA0020958. In 2002 URS prepared an Outfall Modeling Technical Memorandum No. 1 (TM-1) that documented mixing zone and hydraulics analyses performed in support of the Des Moines Creek WWTP Outfall Project for the Midway Sewer District (District) and identified the design criteria established for the new diffuser design. The outfall, now completed and in use, serves both the District and STIA's IWTP.

Subsequent to the preparation of TM-1, the original modeling was updated using the most current dilution modeling software. The September 2006 addendum was prepared to provide an updated mixing zone analysis for the final diffuser configuration to verify compliance with water quality standards in the mixing zone limits in accordance with the requirements of the NPDES discharge permits.

Based on the results of the reasonable potential calculations using the model-derived dilution factors and effluent analysis, the new outfall diffuser was found to provide adequate mixing to meet Washington State water quality standards. The final dilution factors to be applied for the new outfall were determined to be 72 for the acute boundary and 202 for the chronic boundary based on year 2020 District flows and maximum IWTP flows. These dilutions translate to an acute critical effects concentration (ACEC) of 1.4% and a chronic critical effects concentration (CCEC) of 0.50% for whole effluent toxicity (WET) bioassays for both the District and IWTP discharges. Appropriate BMPs for IWS operations are included in STIA's *Stormwater Pollution Prevention Plan* (SWPPP). The most current version of the SWPPP can be downloaded at http://www.portseattle.org/Environmental/Water-Wetlands-Wildlife/Stormwater/Documents/STIA_SWPPP_current.pdf.

1.5.2 Stormwater Drainage System

Part II of the permit covers stormwater associated with approximately 1,200 acres of the stormwater drainage system. Stormwater runoff is from roads, runways, taxiways, airfield, rooftops, cargo operations, flight kitchens, and other areas associated with airport industrial activities. Stormwater runoff is treated using ponds, grass swales, and other passive stormwater treatment methods. Treated stormwater discharges to freshwater streams, wetlands, and lakes around the airport.

The Airport stormwater management system underwent significant modifications over the last 15 years in response to NPDES permit conditions and requirements of a Section 401 Water Quality Certification issued in association with the 1997 Master Plan Update (MPU). A number of studies and planning documents were completed to enable these modifications. Significant studies and planning documents relevant to the current Airport stormwater management system and this Manual are described below.

1.5.2.1 Comprehensive Stormwater Management Plan

The Comprehensive Stormwater Management Plan (CSMP) (Parametrix 2001) provided a management plan of stormwater quantity and quality as required to mitigate potential effects to the environment from the 1997 MPU improvements at STIA.

Two documents were prepared that amend the CSMP: *Proposed Design Refinements to the Comprehensive Stormwater Management Plan Master Plan Update Improvements Seattle-Tacoma International Airport Des Moines Creek Basin* (Parametrix, August 2004) and *Proposed Design Refinements to the Comprehensive Stormwater Management Plan Master Plan Update Improvements Seattle-Tacoma International Airport Miller/Walker Creek Basins* (Parametrix, June 2005).

The Des Moines Creek amendment allowed the use of the Des Moines Creek Basin Plan's Regional Detention Facilities that modified the flow control requirements for the Des Moines Creek basin, refined land use assumptions used for analysis, and provided other design refinements for various other facilities described in the CSMP.

The Miller/Walker Creek amendment refined the land use, updated flow control facility sizing, modified subbasin boundaries, converted several proposed detention facilities from vaults to ponds, and modified the locations of some of the facilities for improved constructability.

1.5.2.2 AKART Analysis

As a condition of the NPDES Permit issued to the Port in 2003, an analysis supporting the definition of all known available and reasonable methods of stormwater treatment (AKART) for STIA industrial stormwater discharges was required. Information included in the *Seattle-Tacoma International Airport Stormwater AKART Analysis* (RW Beck. January 2005) assisted Ecology's determination of AKART. The AKART Analysis was technology-based and concluded that "in general, on-site basic treatment is most cost effective and should be applied to the greatest extent practical".

1.5.2.3 Stormwater Engineering Report

The findings of the AKART Analysis were advanced by conducting water quality analyses to determine what BMPs, if any, were required beyond AKART to meet water quality effluent limits at the points of compliance. The resulting *Stormwater Engineering Report* (RW Beck, March 2006) (Engineering Report) was prepared in conformance with WAC 173-240-130, Industrial Facilities.

The engineering analysis in the Engineering Report evaluated individual NPDES drainage basins to determine whether the basin meets AKART and, if not, what BMPs would be needed to bring the basin to AKART. The analysis also determined what, if any, additional BMPs (i.e., Enhanced treatment menu BMPs) were required to meet NPDES effluent limits. These additional water quality BMPs have since been constructed.

1.5.2.4 Site-Specific Water Quality Objectives

In 2008, the Port conducted site-specific studies for copper and zinc (*Derivation of Site-Specific Water Quality Objectives and Effluent Limits for Copper in Stormwater*, Nautilus Environmental, 2008; *Derivation of Site-Specific Water Quality Objectives and Effluent Limits for Zinc in Stormwater*, Nautilus Environmental, 2008) to derive appropriate limitations and monitoring requirements for the NPDES permit. Based on these studies, water effects ratios (WERs), metal translators (dissolved to total ratios) and appropriate hardness values were determined for sites located in Des Moines, Miller and Walker Creek drainages. Site-specific water quality objectives were derived for each site by adjusting the generic State of Washington water quality criterion to account for site-specific conditions. The resulting site-specific water quality objectives have been included as final effluent limits in the Airport's NPDES permit.

1.5.2.5 Design of Stormwater Facilities

Several stormwater facilities were designed and constructed based on recommendations from the Comprehensive Stormwater Management Plan and the Engineering Report. The design basis,

including drainage area and land use as well as other design parameters for 12 regional facilities, 11 of which are regulated by NPDES, discharging into the Des Moines or Miller/Walker drainage basin are documented in *Technical Information Supporting the Design of Stormwater Ponds Serving the Seattle Tacoma International Airport* (SAIC, 2013). The Port maintains this document to include the current land use parameters for the basins tributary to the regional facilities. This document should be referred to in order to determine the current status of the regional facilities, current land cover, and subbasin size.

1.6 Authorized Discharges

1.6.1 Authorized Discharges to the Industrial Waste System

In accordance with the STIA NPDES Permit, industrial wastewater runoff may result from any process or activity of industry that includes, but is not limited to, water used for industrial processes such as pipe integrity pressure testing; vehicle and aircraft wash water; stormwater contaminated with fuel, lubricants, fire-fighting foam, cleaning agents, aircraft and ground water from ground water well construction and monitoring; and leachate from solid waste decant facilities. In addition, construction stormwater, if treatable by the IWTP, may be discharged to the IWS.

1.6.2 Authorized Discharges to Stormwater Drainage Systems

STIA NPDES Permit authorized discharges to the Stormwater Drainage System include stormwater and stormwater associated with construction and industrial activities that have the ability to meet discharge limits specified in the permit. In addition, the following non-stormwater discharges are conditionally approved provided the discharge is otherwise consistent with the terms and conditions of the discharge limits.

- Discharges from emergency firefighting activities.
- Fire protection system flushing, testing, and maintenance.
- Discharges of potable water, including water line flushing, provided that water line flushing is dechlorinated prior to discharge.
- Uncontaminated groundwater or spring water.
- Uncontaminated air conditioning or compressor condensation.
- Irrigation drainage.
- Discharges associated with dewatering of foundations, footing drains, or utility vaults where flows are not contaminated with process materials such as solvents.
- Incidental windblown mist from cooling towers that collects on rooftops or areas adjacent to cooling the tower. This does not include intentional discharges from cooling towers such as piped cooling tower blowdown or drains.

Prohibited discharges include industrial wastewater, domestic wastewater, noncontact cooling water discharges and process water. Industrial wastewater discharges include, but are not limited to, truck wash water, tire bath wastewater, wheel wash water, equipment wash water, petroleum products and chemical wastes. Illicit discharges including spills of oil or hazardous substances are also prohibited.

In general, fueling and deicing must occur within areas that discharge to IWS. With Port Aviation Environmental department approval, fueling and deicing of emergency aircraft or other aircraft such as Airforce One, may occur within areas that drain to the SDS if standard operating procedures are followed. Standard operating procedures include blocking all catch basins downstream of the aircraft, collecting any material that reaches the ground and disposing of it according to all local, state and federal regulations. A copy of the complete SOP is available from the Aviation Environmental Department.

Process water is any water, which, during manufacturing or processing, comes into direct contact with or results from the production or use of any raw material, intermediate product, finished product, byproduct, or waste product. Waters that are often plumbed to stormwater, but should not be, include boiler blowdown. These should be discharged to sanitary.

Covered areas, including those for vehicle parking (with the exception of the parking garage), should not be connected to the stormwater drainage system. Covered fueling areas and covered vehicle service areas must not be connected to the stormwater drainage system. Perimeter stormwater drains around the covered areas should be provided to minimize stormwater run-on and or tracking into the covered area.

Drainage from areas that are bermed in order to provide secondary containment for storage of fuel or other raw material storage may be discharged to stormwater provided mechanisms are in place to ensure spilled materials do not enter the drainage system. These systems and their design must be compliant with other regulations including those related to spill prevention, control and countermeasures.

1.7 Development of Best Management Practices for Stormwater Management

The method by which the Manual controls the adverse impacts of development and redevelopment is through the application of best management practices (BMPs). BMPs are defined as schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.

BMPs that involve construction of engineered structures are often referred to as facilities in this Manual. For instance, the BMPs referenced in the menus of Chapter 3 in Volume V are called treatment facilities.

The primary purpose of using BMPs is to protect beneficial uses of water resources through the reduction of pollutant loads and concentrations, through reduction of discharges (volumetric flow rates) causing stream channel erosion, and through reductions in deviations from natural hydrology. If it is found that, after the implementation of BMPs advocated in this Manual, beneficial uses are still threatened or impaired, then additional controls may be required.

A complete summary description of all STIA BMPs is contained in the Airport SWPPP. The most current version of the SWPPP can be downloaded at http://www.portseattle.org/Environmental/Water-Wetlands-Wildlife/Stormwater/Documents/STIA_SWPPP_current.pdf.

Part II Condition S5 of STIA's Individual NPDES Permit requires that new projects and facilities apply the minimum requirements outlined in the Ecology Manual as described further in Chapter 2. In doing so project proponents must implement BMPs that are either presumed or demonstrated to be protective. In addition, the permit requires the Port to monitor outfall water quality and imposes numeric effluent limits to ensure discharges satisfy state and federal stormwater requirements. Limit exceedances are considered permit violations and require corrective actions.

1.7.1 Source Control BMPs

Source control BMPs typically prevent pollution, or other adverse effects of stormwater, from occurring. Ecology further classifies source control BMPs as operational or structural. Examples of source control BMPs include methods as various as using mulches and covers on disturbed soil, putting roofs over outside storage areas, and berming areas to prevent stormwater run-on and pollutant runoff.

It is generally more cost effective to use source controls to prevent pollutants from entering runoff, than to treat runoff to remove pollutants. However, since source controls cannot prevent all impacts, some combination of measures will always be needed.

1.7.2 Treatment BMPs

Treatment BMPs include facilities that remove pollutants by simple gravity settling of particulate pollutants, centrifugal separation, filtration, biological uptake, and media or soil adsorption. Treatment BMPs can accomplish significant levels of pollutant load reductions if properly designed and maintained.

The Engineering Report (RW Beck, March 2006) contains a detailed description of those treatment BMPs constructed in order to retrofit the entire Airport for water quality treatment in accordance with Part II Condition S9 of NPDES modified October 7, 2005. Treatment BMPs as described in that document may have been added to or modified as required for recent Airport development.

1.7.3 Flow Control BMPs

Flow control BMPs typically control the volume, rate, frequency, and flow duration of stormwater surface runoff. The need to provide flow control BMPs depends on whether a development site

discharges to a stream system or wetland, either directly or indirectly. Stream channel erosion control can be accomplished by BMPs that detain runoff flows and also by those which physically stabilize eroding streambanks. Both types of measures may be necessary in urban watersheds. Only the former type is covered in this Manual.

Construction of a detention pond is the most common means of meeting flow control requirements. Construction of an infiltration facility is the preferred option but is feasible only where more porous soils are available. The concept of detention is to collect runoff from a developed area and release it at a slower rate than the rate at which it enters the collection system. The reduced release rate requires temporary storage of the excess amounts in a pond with release occurring over a few hours or days. The volume of storage needed is dependent on:

1. The size of the drainage area;
2. The extent of disturbance of the natural vegetation, topography, and soils and creation of effective impervious surfaces (surfaces that drain to a stormwater collection system); and
3. How rapidly the water is allowed to leave the detention pond, i.e., the target release rates.

The 1992 Ecology manual focused primarily on controlling the peak flow release rates for recurring intervals of concern – the 2, 10 and 100 year rates. This level of control did not adequately address the increased duration at which those high flows occur because of the increased volume of water from the developed condition as compared to the pre-developed conditions.

To protect stream channels from increased erosion, it is generally necessary to control the durations over which a stream channel experiences geomorphically significant flows such that the energy imparted to the stream channel does not increase significantly. Geomorphically significant flows are those that are capable of moving sediments. **For much of the Port area, the flow control standard includes controlling flow durations. However, in the Des Moines Creek basin, the flow control standard includes control of peak flows rather than durations.** The size of such a facility can be reduced by changing the extent to which a site is disturbed.

In regard to wetlands, the goal is to not alter the natural hydroperiod. This requires the control of input flows such that the wetland is within certain elevations at different times of the year and short-term elevation changes are within the desired limits. If the amount of surface water runoff draining to a wetland is increased because of land conversion from forested to impervious areas, it may be necessary to bypass some water around the wetland in the wet season. (Bypassed stormwater must still meet flow control and treatment requirements applicable to the receiving water.) If however, the wetland was fed by local ground water elevations during the dry season, the impervious surface additions and the bypassing practice may cause variations from the dry season elevations.

Because Ecology found it is difficult to model water surface elevation changes, especially for riverine and slope wetlands, the new regulatory strategy is to simply try to match the pre-project surface and ground water inputs that drive the water surface elevations in wetlands. Estimates of what should be done to match inputs requires the use of a continuous runoff model. It remains to be seen whether the available continuous runoff models are sufficiently accurate to determine

successful flow management strategies. Even if the modeling approaches are sufficient, it will be a challenge to simulate pre-project hydrology after significant development has occurred.

Flow control BMPs serving the Airport are described in the *Technical Information Supporting the Design of Stormwater Ponds Serving the Seattle Tacoma International Airport* along with current land cover and subbasin acreages. This document was originally developed by SAIC in 2013 and is regularly updated by the Port. Project proponents can contact Port Environmental to receive a copy of the most current version.

1.7.4 Construction Stormwater BMPs

Construction stormwater BMPs can be source control, treatment or flow control BMPs. Examples include stabilized construction entrances, silt fences, check dams, and sediment traps. Volume II contains construction stormwater BMPs.

Part III of the Airport's NPDES Permit includes requirements for untreated and treated construction stormwater discharges to the storm drainage system. In addition, Part III also includes requirements for projects infiltrating runoff to groundwater from portable batch plant and/or concrete crusher operations.

The permit covers discharges at particular outfalls. These outfalls are listed on Figure I-4.1.2. The figure shows a 15-minute grid system covering the general airport vicinity. If a project discharges to a receiving water body within a grid box containing a covered outfall, the project is also covered by the Port's permit. Latitude and longitude of the perimeter grid box centroids are provided to help project proponents locate permitted outfalls. If the project is located outside of this permit boundary a general construction stormwater permit may be required.

The Port maintains a *Programmatic Construction Stormwater Pollution Prevention Plan* (SWPPP) that describes all the components of the Port of Seattle construction stormwater management program at STIA. In addition, the permit requires project-specific SWPPPs for construction activity that disturbs one or more acres. Project-specific SWPPPs consist of the following elements

- Monitoring Plan
- Hazardous Materials Management (HMMP) Specification
- Contractor Erosion and Sediment Control Plan (CESCP) Specification

The Port Aviation Environmental Permit Manager determines if a monitoring plan is required for a project during design review. Contract specifications are used to clearly define the regulatory requirements to the construction contractor. The HMMP and CESCP specifications are included in construction contracts and are the guidelines for the contractor to develop the contractor's Hazardous Materials Management Plan and the contractor's Erosion and Sediment Control Plan. Notice to Proceed is not issued until these plans have been approved. The Airport's construction stormwater management program is described further in the addendum to Volume II of this Manual.

1.7.5 On-site Stormwater Management BMPs

On-site stormwater management BMPs can be either treatment or flow control BMPs. BMPs in this category serve to infiltrate, disperse, and retain stormwater runoff on-site. Examples include low impact development (LID) and green stormwater infrastructure (GSI) such as bioretention, rain gardens, and permeable pavements in Chapter 5, of Volume V of the Ecology Manual. Other examples include downspout infiltration, downspout dispersion, and perforated sub-out connections in Chapter 3, of Volume III of the Ecology Manual. Ecology LID BMPs are restricted in use at STIA due to FAA regulations and other competing needs, and they may also be limited in application at STIA by LID infeasibility criteria. Guidelines for their competing needs limitations and feasibility for LID BMP selection in the various STIA operating zones are provided in the *Low Impact Development Guideline, Seattle-Tacoma International Airport* (STIA LID Guideline) (Robin Kirschbaum 2017).

Although WSDOT's *Aviation Stormwater Design Manual* does not specifically address on-site stormwater management and GSI BMPs, it does provide relevant information on measures needed to minimize wildlife hazards that will affect BMP design and the ability of a BMP to be implemented at STIA.

1.8 Relationship of this Manual to Federal, State, and Local Regulatory Requirements

This Manual is provided as guidance for making sure projects are in compliance with federal, state, and local stormwater quantity and quality regulations. Regulations that affect stormwater design are discussed in the following subsections. Refer to the Ecology Manual for additional discussion of the relationship of the Ecology Manual to Federal, State, and Local Regulatory Requirements

1.8.1 NPDES Permits

Ecology is delegated by the U.S. Environmental Protection Agency (EPA) as the state water pollution control agency, responsible for implementing all federal and state water pollution control laws and regulations. Wastewater and stormwater discharges are regulated primarily by discharge permits, which stipulate specific limits and conditions of allowable discharge.

A discharge permit is required for disposal of waste material into "waters of the state," which include rivers, lakes, streams, and all underground waters and aquifers. Ecology has developed a number of NPDES permits to regulate stormwater discharges to waters of the state. These include:

- Municipal Stormwater General Permits;
- Industrial Stormwater General Permits;
- Construction Stormwater General Permits; and
- Individual Permits.

The state has the option to require or allow a permittee to obtain coverage under an individual permit. Individual permits are typically written to industrial or public jurisdictions for a specific wastewater or stormwater discharge at a specific location and are tailored to regulate the pollutants of concern.

STIA discharges to local receiving waters and industrial wastewater discharges to the Midway Sewage Treatment Plant are authorized by an individual permit as described above in Section 1.3.

Refer to the Ecology Manual for a description of the other permits for stormwater discharges.

General Permits - Coverage Outside of the Port's Individual Permit

Stormwater discharges from Port Aviation Division properties located outside of those areas covered by the Port's Individual NPDES Stormwater Permit are regulated by one or more other NPDES Stormwater General Permits. The project proponent should refer to the Port's current NPDES Stormwater Individual Permit to determine the area covered by this permit. Stormwater discharges from Port Aviation Division properties outside the areas covered by the Airport's Individual permit, depending on the activity, may need to obtain coverage under one or more of the following General permits:

- Western Washington Phase II Municipal Stormwater Permit for those jurisdictions where a project is located (refer to Figure I-4.1.1 for city boundaries);
- Industrial Stormwater General Permit; or
- Construction Stormwater General Permit.

Any clearing, grading, or excavating that will disturb one or more acres outside of the area covered by STIA's Individual NPDES Permit and have a discharge of stormwater from the project site to surface water or into storm drainage systems that discharge to a surface water must obtain coverage under Ecology's Construction Stormwater General Permit. The permit requires application of stabilization and structural practices to reduce the potential for erosion and the discharge of sediments from the site. The stabilization and structural practices cited in the permit are similar to the minimum requirements for sedimentation and erosion control in Volume I of this Manual.

1.8.2 Endangered Species Act

With the listing of multiple species of salmon as threatened or endangered across much of Washington State, and the probability of more listings in the future, implementation of the requirements of the Endangered Species Act will affect urban stormwater management. Provisions of the Endangered Species Act that may apply directly to stormwater management include the Section 4(d) rules, Section 7 consultations, and Section 10 Habitat Conservation Plans (HCP).

Under Section 4(d) of the statute, the federal government issues regulations to provide for the conservation of the species. A 4(d) rule may require new development and redevelopment to comply with specific requirements.

Under Section 7 of the statute, all federal agencies must insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of any endangered or threatened species (or a species proposed for listing), nor result in the destruction or adverse modification of designated critical habitat. The responsibility for initially determining whether jeopardy is likely to occur rests with the "action" agency. If an action "may affect" a listed species, the "action" agency must consult with the National Oceanic and Atmospheric Administration Fisheries Service (NOAA Fisheries)), or the U.S. Fish and Wildlife Service (USFWS) depending on the species involved, to determine whether jeopardy is likely to occur.

Where NOAA Fisheries or USFWS believes that jeopardy would result, it must specify reasonable and prudent alternatives to the action that would avoid jeopardy if any such alternatives are available. If the "action" agency rejects these, the action cannot proceed.

Under Section 10 of the ESA, through voluntary agreements with the federal government that provide protections to an endangered species, a non-federal applicant may commit an "incidental take" of individuals of that species as long as it is incidental to an otherwise lawful activity (such as developing land or building a road). This provision of the ESA may help resolve conflicts between development pressures and endangered species protection. A "Habitat Conservation Plan" (HCP) is an example of this type of agreement. Under an HCP, the applicant's plan must:

- Outline the impact that will likely result from the taking;
- List steps the applicant will take to minimize and mitigate such impacts, and funding available to implement such steps; and
- Include alternative actions the applicant considered and reasons alternative acts are not being used.

The federal government may grant a permit if it finds that the taking will be incidental; the applicant will minimize and mitigate impacts of taking; and the applicant will ensure that adequate funding for the conservation plan will be provided. The USFWS and NOAA Fisheries may require additional measures as necessary or appropriate for purposes of the plan.

1.8.3 Clean Water Act Section 404 Permit

In 1972, Section 404 of the Clean Water Act established a program to regulate the discharge of dredged or fill material into waters of the United States. The Clean Water Act defined waters of the United States to include tributaries to navigable waters, interstate wetlands, wetlands which could affect interstate or foreign commerce, and wetlands adjacent to other waters of the United States.

The program to obtain a permit to discharge dredged or fill material into waters of the United States is jointly administered by the U.S. Army Corps of Engineers and the Environmental Protection Agency. The Corps is responsible for the day-to-day administration and permit review and EPA provides program oversight. The fundamental rationale of the program is that no discharge of dredged or fill material should be permitted if there is a practicable alternative that

would be less damaging to aquatic resources or if significant degradation would occur to the nation's waters. Permit review and issuance follows a sequence process that encourages avoidance of impacts, followed by minimizing impacts and, finally, requiring mitigation for unavoidable impacts to the aquatic environment. This sequence is described in the guidelines in Section 404(b)(1) of the Clean Water Act.

1.8.4 Clean Water Act Section 303(d) and Total Maximum Daily Load (TMDL)

Every two years, all states are required to prepare a list of water bodies that do not meet water quality standards. This list is often referred to as the 303(d) list because the process is described in Section 303(d) of the Clean Water Act.

The assessed waters are listed in categories that describe the status of water quality. Category 5 listings are polluted waters whose beneficial uses, such as drinking, recreation, aquatic habitat, and industrial use, are impaired by pollution. Category 5 waters require a water cleanup plan, also known as the total maximum daily load (TMDL). Category 2 identifies waters of concern where there is some evidence of a water quality problem, but not enough to require production of a water quality improvement (WQI) project.

The following water bodies in the vicinity of STIA are identified as Category 2 and 5 on the 2016 303(d) list, which is the current listing as of the writing of this Manual.

- Des Moines Creek upstream of 200th street to East and West Branch confluence
  - Copper (Category 5)
  - Dissolved oxygen (Category 5)
  - Bacteria (Category 5)
  - Temperature (Category 2)
  - Ammonia (Category 2)
  - Zinc (Category 2)
- Des Moines Creek East Branch
  - Copper (Category 5)
  - Dissolved oxygen (Category 5)
  - Bacteria (Category 5)
- Des Moines Creek West Branch
  - Dissolved Oxygen (5)
  - Bacteria (Category 5)
  - Temperature (Category 5)

  - pH (Category 5)
- Northwest Ponds
  - Total phosphorous (Category 5)
- Miller Creek upstream of 1st Avenue
  - Copper (Category 2)
  - Zinc (Category 2)

Project proponents shall review the current 303(d) list at the time of the project to determine if there are any changes. Also, as of the writing of this Manual, no TMDLs have been performed; however, the Project Proponent shall check to see if any TMDLs have been completed at the time of the project and if any further water quality restrictions apply.

1.8.5 Section 401 Water Quality Certifications

For projects that require a fill or dredge permit under Section 404 of the Clean Water Act, Ecology must certify, as provided for in section 401 of the Act, to the permitting agency, the U.S. Army Corps of Engineers, that the proposed project will not violate water quality standards. In order to make such a determination, Ecology may do a more specific review of the potential impacts of a stormwater discharge from the construction phase of the project and from the completed project. As a result of that review, Ecology may condition its certification to require:

- Application of the minimum requirements and BMPs in this Manual; or
- Application of more stringent requirements.

1.8.6 Hydraulic Project Approvals

Under Chapter 77.55 RCW, the Hydraulics Act, the Washington State Department of Fish and Wildlife has the authority to require actions when stormwater discharges related to a project would change the natural flow or bed of state waters. The implementing mechanism is the issuance of a Hydraulic Project Approval (HPA) permit. In exercising this authority, Fish and Wildlife may require:

- Compliance with the provisions of this Manual; or
- Application of more stringent requirements that they determine are necessary to meet their statutory obligations to protect fish and wildlife.

1.8.7 Requirements Identified through Watershed/Basin Planning

A number of the requirements of this Manual can be superseded by the adoption of ordinances and rules to implement the recommendations of watershed plans or basin plans. Several plans in addition to the CSMP (see Section 1.5.2.1) have been prepared for the area in and around STIA.

The plans are listed below. The requirements from the plans listed have either been incorporated into this Manual or have been superseded by this Manual. However, the project proponent should be aware that subsequent updates to these plans or the development of new basin plans may result in requirements that supersede the requirements in the Manual.

Des Moines Creek Basin Plan (1997)

The Port, King County, the Cities of Des Moines and SeaTac, and more recently, the Washington State Department of Transportation (WSDOT) participated in a series of ILAs to create a Des Moines Creek Basin Plan (Basin Plan) to design, permit, and construct a number of projects subject to the Agreements. The objectives of these efforts have been to identify and address existing drainage, flooding, erosion, fish habitat, and water quality issues in the creek from a regional, basin-wide approach.

A Regional Detention Facility, high-flow bypass pipeline, stream habitat enhancement and restoration, and Marine View Drive culvert replacement has been constructed. The Regional Detention Facility, portions of the high flow bypass pipeline, and the stream habitat enhancement and restoration were constructed on Port property.

Hydrologic Analysis of Des Moines Creek Regional Detention Facility Using the HSPF Model

Subsequent to the Des Moines Creek Basin Plan described previously, King County conducted studies to establish basin-specific standards for Des Moines Creek. These studies considered the performance of the Regional Detention Facility, the bypass, and potential for erosion in Des Moines Creek. Based on these studies and recommendations, Ecology approved Enhanced Level 1 as the default flow control standard for Des Moines Creek. Enhanced Level 1 includes matching pre- and post-development peak flows for 2-, 10-, and 100-year flows. This report states Stormwater Control Facilities associated with the airport expansion are assumed to be Enhanced Level 1 Standard. Future development in the Des Moines Creek Basin will be Level 1 Standard. Predevelopment land use for Des Moines Creek basin is defined as 1994 land use.

Gilliam Creek Basin Stormwater Management Plan (March 2001)

This plan, prepared for the City of Tukwila by Herrera Environmental Consultants and R. W. Beck, provides a description of the existing conditions in the Gilliam Creek drainage basin with respect to stormwater runoff characteristics, water quality, and fish habitat. It also provides prioritized recommendations for improving the conditions in the basin.

City of Tukwila Comprehensive Surface Water Management Plan (February 2013)

The Purpose of this plan is to provide a strategic framework for management within the City of Tukwila. The plan describes drainage basins within the City, surface water problems, capital projects to address problems, surface water regulations and policies, and operations and maintenance.

City of SeaTac Stormwater Management Program Plan (March 2016)

This document represents the third Stormwater Management Program Plan (SWMP Plan) prepared by the City of SeaTac (City) in accordance with the 2013 to 2018 National Pollutant Discharge Elimination System (NPDES) Western Washington Phase II Municipal Stormwater Permit (Permit) issued on August 1, 2012, which became effective on August 1, 2013, and has a Modification Date of January 16, 2014. The SWMP Plan includes numerous actions and activities with the overall goal of reducing the discharge of pollutants from its municipal separate storm sewer system (MS4) to the maximum extent practicable (MEP), while meeting all known available and reasonable technologies (AKART) requirements and protecting the water quality.

1.8.8 Port of Seattle/City of SeaTac Interlocal Agreement

The Port and the City of SeaTac have entered into an ILA to coordinate common interests in stormwater management, transportation, and other matters. The Agreement provides a framework for determining whether the Port of the City will be the permit authority on development projects. When the Port is the permit authority then this Manual will apply to stormwater facility design and review. City of SeaTac's adopted manual and local ordinances will apply when the City is the permit authority. A consultation process between the Port and the City may be used to assist in the determination of the permit authority and during the design review of stormwater facilities.

1.8.9 Underground Injection Control Authorizations

To implement provisions of the federal Safe Drinking Water Act (see Federal UIC regulations, 40 CFR, Part 144), Ecology has adopted rules (Chapter 173-218 WAC) for an underground injection control (UIC) program. For more information visit Ecology's home page for the UIC program at http://www.ecy.wa.gov/programs/wq/grndwtr/uic/ and "Guidance for UIC Wells that Manage Stormwater" at http://www.ecy.wa.gov/pubs/0510067.pdf.

According to WAC 173-218-030 UIC well is defined as "a well that is used to discharge fluids into the subsurface. A UIC well is one of the following: (1) A bored, drilled or driven shaft, or dug hole whose depth is greater than the largest surface dimension; (2) An improved sinkhole; or (3) A subsurface fluid distribution system (contains perforated pipe or similar structure)."

Depending upon the manner in which it is accomplished, the discharge of stormwater into the ground can be classified as a Class V injection well. For more information and for a listing on potential stormwater facilities that may have Class V classification refer to the memorandum available at http://www.ecy.wa.gov/programs/wq/stormwater/municipal/resources/EP_Amemo infiltrationclassvwells.pdf.

Chapter 2
MINIMUM REQUIREMENTS FOR NEW DEVELOPMENT AND REDEVELOPMENT

This chapter identifies the 10 Minimum Requirements for stormwater management applicable to new development and redevelopment sites within and outside of the STIA Retrofit Areas. The Minimum Requirements are:

1. Preparation of Stormwater Site Plans
2. Construction Stormwater Pollution Prevention
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems and Outfalls
5. On-Site Stormwater Management
6. Runoff Treatment
7. Flow Control
8. Wetlands Protection
9. Operation and Maintenance
10. Off-Site Analysis and Mitigation (Applicable to Non-Retrofit Areas)

Depending on the type and size of the proposed project, different combinations of these minimum requirements apply. In general, projects on small sites are required to control erosion and sedimentation from construction activities and to apply simpler approaches to treatment and flow control of stormwater runoff from the developed site. Controlling flows from small sites is important because the cumulative effect of uncontrolled flows from many small sites can be as damaging as those from a single large site.

The airport has unique conditions when evaluating applicable Minimum Requirements. There are potential exemptions for redevelopment within retrofit area and site specific criteria for construction stormwater management, low impact development, flow control performance, and runoff treatment BMPs. Coordinate with Environmental when evaluating Minimum Requirements.

The airport has site specific criteria for development and redevelopment projects. There are a number of stormwater management restrictions due to the nature of airport activities, individual NPDES permit, Port specific and FAA requirements. Coordinate with Aviation Environmental staff for project specific requirements and assistance evaluating applicable Minimum Requirements.

Large sites must provide erosion and sedimentation control during construction, permanent control of stormwater runoff from the developed site through selection of appropriate Best Management Practices (BMPs) and facilities, and other measures to reduce and control the on-site and off-site impacts of the project. Sites being redeveloped must generally meet the same minimum requirements as new development for the new hard surfaces and pervious surfaces converted to lawn or landscaped areas. Redevelopment projects must also provide erosion control, source control, and on-site stormwater management for the portion of the site being redeveloped. In addition, if the redevelopment meets certain cost or space (as applied to roads or airfield)

thresholds, updated stormwater management for the new and replaced redeveloped pervious and hard surfaces must be provided. There may also be situations in which additional controls are required for sites, regardless of type or size, as a result of basin plans or special water quality concerns.

Development projects are to demonstrate compliance with these requirements through the preparation of Stormwater Site Plans (SSPs). These plans are described in detail in Chapter 3. Two major components of an SSP are a Construction Stormwater Pollution Prevention Plan (SWPPP) and a Permanent Stormwater Control Plan (PSCP). The Construction SWPPP shall identify how the project intends to control pollution generated during the construction phase only, primarily from erosion and sediment. The PSCP shall identify how the project intends to provide permanent BMPs for the control of pollution from stormwater runoff after construction has been completed. Project proponents must submit these plans for review by the Port if they add or replace 2,000 square feet or more of hard surface or disturb 7,000 square feet or more of land.

Section 2.4 provides additional information on applicability of the Minimum Requirements to different types of sites.

2.1 Municipal Stormwater Permits

Municipal Stormwater Permits are only applicable outside of the area covered by the Port's Individual Permit. Refer to Section 1.4 for the aerial extent of the Port's permit. For area outside of the Port's permit coverage, refer to the local jurisdiction's Phase II Municipal Stormwater Permit in conjunction with the City of SeaTac Interlocal Agreement, where applicable.

2.2 Exemptions

Unless otherwise indicated in this Section, the practices described in this section are exempt from the Minimum Requirements, even if such practices meet the definition of new development or redevelopment.

Forest practices:

Forest practices regulated under Title 222 WAC, except for Class IV General forest practices that are conversions from timber land to other uses, are exempt from the provisions of the minimum requirements.

Commercial agriculture:

Commercial agriculture practices involving working the land for production are generally exempt. However, the conversion from timberland to agriculture, and the construction of impervious surfaces are not exempt.

Pavement Maintenance:

The following road and airfield pavement maintenance practices are exempt:

- pothole and square cut patching,
- overlaying existing asphalt or concrete pavement with asphalt or concrete without expanding the area of coverage,
- shoulder grading,
- reshaping/regrading drainage systems,
- crack sealing,
- resurfacing with in-kind material without expanding the hard surface road prism,
- pavement preservation activities that do not expand the road prism and
- vegetation maintenance.

The following road and airfield maintenance practices are not categorically exempt. The extent to which the Manual applies is explained for each circumstance.

- *Removing and replacing a paved surface to base course or lower, or repairing the pavement base:* If impervious surfaces are not expanded, Minimum Requirements #1 through #5 apply.
- *Extending the pavement edge without increasing the size of the road prism, or paving graveled shoulders:* These are considered new impervious surfaces and are subject to the Minimum Requirements that are triggered when the thresholds identified for new or redevelopment projects are met.
- *Resurfacing by upgrading from dirt to gravel, asphalt, or concrete; upgrading from gravel to asphalt, or concrete; or upgrading from a bituminous surface treatment ("chip seal") to asphalt or concrete:* These are considered new impervious surfaces and are subject to the Minimum Requirements that are triggered when the thresholds identified for new or redevelopment projects are met.

Underground utility projects:

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics are only subject to Minimum Requirement #2, Construction Stormwater Pollution Prevention.

Projects within IWS Footprint:

Areas draining to IWS are exempt from Minimum Requirements #1 through #10. Contact the Port Facilities and Infrastructure Department for IWS considerations and requirements.

2.3 Definitions Related to Minimum Requirements

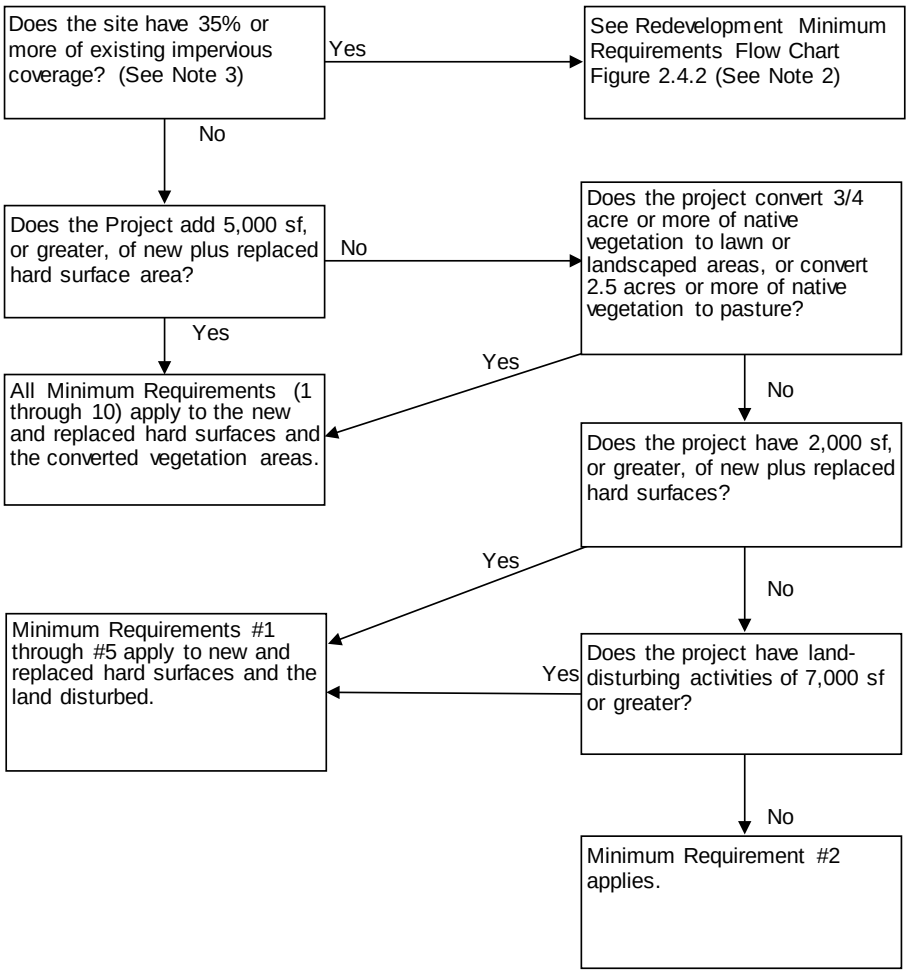
Terms that Ecology presented in this section of previous versions of the Ecology Manual have been moved to the glossary. Refer to the Glossary in Appendix I-G of this volume for definitions.

2.4 Applicability of the Minimum Requirements

Not all of the Minimum Requirements apply to every development or redevelopment project. The applicability varies depending on the type and size of the project. This section identifies thresholds that determine the applicability of the Minimum Requirements to different projects. Use the flow charts in Figures I-2.4.1, I-2.4.2 and I-2.4.3 to determine which of the Minimum Requirements apply. The Minimum Requirements are presented in Section 2.5.

Use the thresholds in Figures I-2.4.1, I-2.4.2 and I-2.4.3 at the time of application for a subdivision, plat, short plat, building permit, or other construction permit. The plat or short plat approval shall identify all stormwater BMPs that are required for each lot. For projects involving only land disturbing activities, (e.g., clearing or grading), the thresholds apply at the time of application for the permit allowing or authorizing that activity. Note the exemption in Section 2.2 for forest practices other than Class IV General.

Figure I-2.4.1. Determining Applicable Minimum Requirements for New Development Outside the STIA Retrofit Area[1]

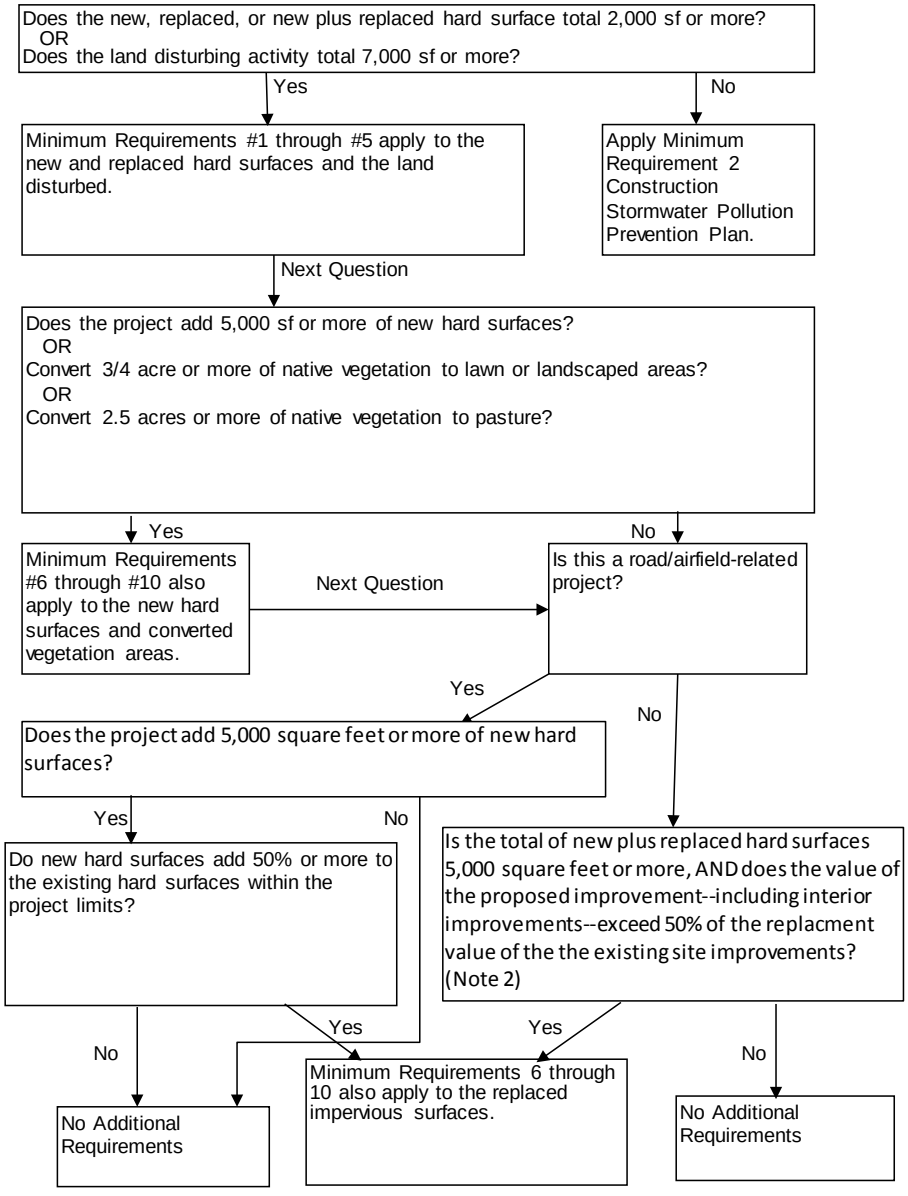


1. For purposes of this manual, the project site is the portion of the area within the construction limits that drains to surface or storm water. The portion of the area within the construction limits that drains to IWS is not including in the definition of project site. Activities that require runoff to drain to the IWS include aircraft fueling, maintenance, or deicing onsite. Refer to Section 1.2 for further explanation of authorized discharges to the IWS.

2. The majority of the airport is located within a single parcel (KC 2823049016). The parcel has greater than 35 percent impervious coverage. Therefore, all projects within this area are considered redevelopment.

3. The initial screening to determine if the project is new or redevelopment is based on the "site" (i.e., the parcel in which the project is located). Subsequent screening to determine minimum requirements is based on the threshold discharge areas within the "Project site" (i.e., the limits of land-disturbing activities, new hard surfaces or replaced hard surfaces).

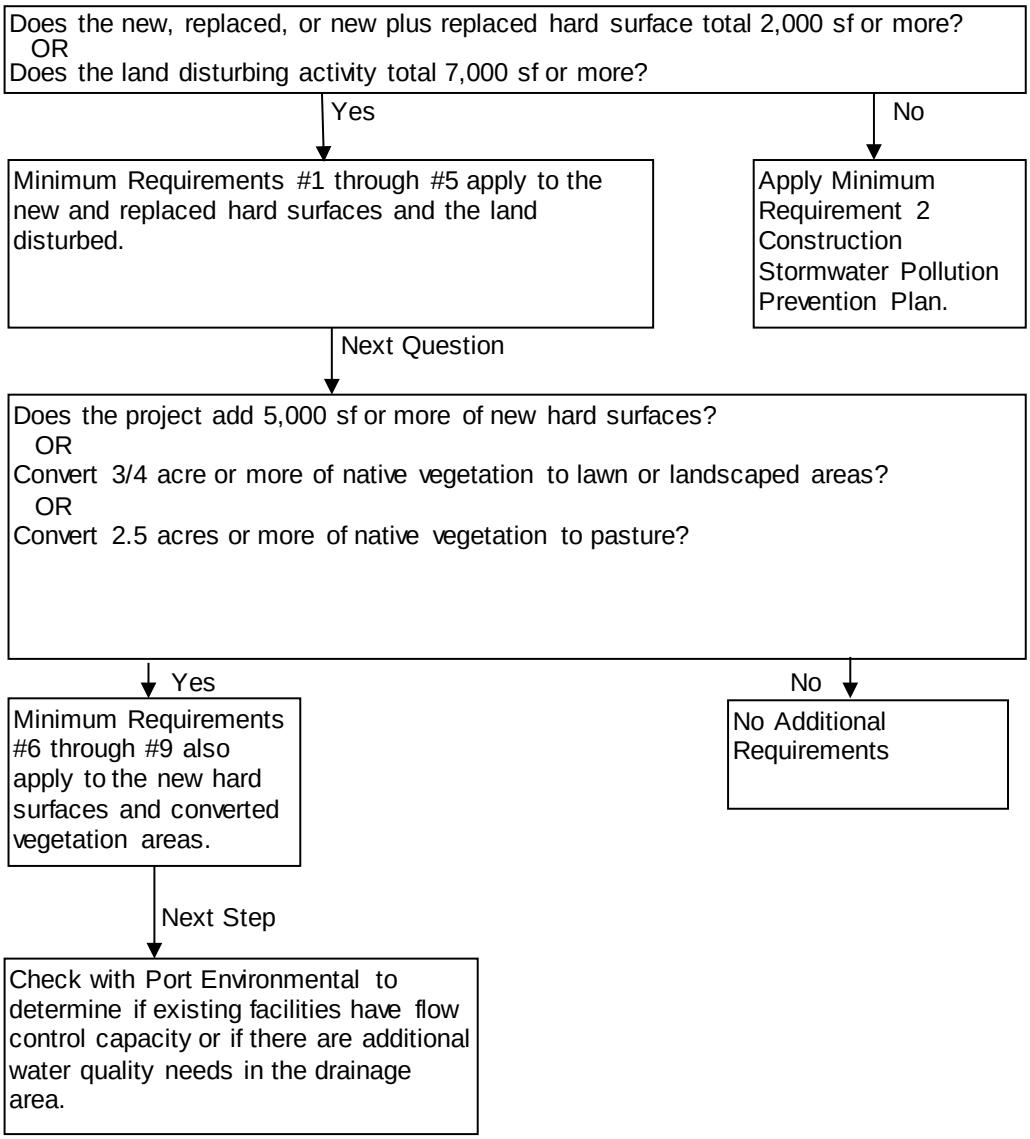
Figure I-2.4.2. Determining Applicable Minimum Requirements for Redevelopment Outside the Retrofit Area[1]



1. For purposes of this manual, the project site is the portion of the area within the construction limits that drains to surface or storm water. The portion of the area within the construction limits that drains to IWS is not including in the definition of project site. Activities that require runoff to drain to the IWS include aircraft fueling, maintenance, or deicing onsite. Refer to Section 1.2 for further explanation of authorized discharges to the IWS.

2. The assessed value of the existing and proposed site improvements is based on the improvements within the project site.

Figure I-2.4.3. Determining Applicable Minimum Requirements for Projects within the Retrofit Area[1]



1. For purposes of this manual, the project site is the portion of the area within the construction limits that drains to surface or storm water. The portion of the area within the construction limits that drains to IWS is not including in the definition of project site. Activities that require runoff to drain to the IWS include aircraft fueling, maintenance, or deicing onsite. Refer to Section 1.2 for further explanation of authorized discharges to the IWS.

New Development Outside of Retrofit Area

All new development shall comply with Minimum Requirement #2.

The following new development shall comply with Minimum Requirements #1 through #5 for the new and replaced hard surfaces and the land disturbed:

- **Results in 2,000 square feet, or greater, of new, replaced, or new plus replaced hard surface area, or**
- **Has land-disturbing activity of 7,000 square feet or greater.**

The following new development shall comply with Minimum Requirements #1 through #10 for the new and replaced hard surfaces and the converted vegetation areas:

- **Results in 5,000 square feet, or greater, of new plus replaced hard surface area, or**
- **Converts ¾ acre, or more, of vegetation to lawn or landscaped areas, or**
- **Converts 2.5 acres, or more, of native vegetation to pasture.**

Supplemental Guidelines

Regional stormwater facilities may be used as an alternative method of meeting Minimum Requirements 6, 7, and 8, through documented engineering reports detailing how the proposed regional facilities meet these requirements for the sites that drain to them. Such facilities must be operational prior to and must have capacity for new development.

Basin planning is encouraged and may be used to tailor Minimum Requirements: #5 On-site Stormwater Management, #6 Runoff Treatment, #7 Flow Control, and/or #8 Wetlands Protection. Basin planning may be used to support alternative treatment, flow control and/or wetland protection through construction of regional stormwater facilities. Such facilities must be operational prior to and must have capacity for new development.

Where new development projects require improvements (e.g., frontage improvements) that are not within the same threshold discharge area, the Port may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area that drains to the same receiving water.

2.4.1 Redevelopment Outside the Retrofit Area

All redevelopment shall comply with Minimum Requirement #2.

The following redevelopment shall comply with Minimum Requirements #1 through #5 for the new and replaced hard surfaces and the land disturbed:

- **Results in 2,000 square feet, or greater, of new, replaced, or new plus replaced hard surface area, or**
- **Has land-disturbing activity of 7,000 square feet or greater.**

The following redevelopment shall comply with Minimum Requirements #1 through #10 for the new hard surfaces and converted pervious areas:

- **Adds 5,000 square feet or more of new hard surface area, or**
- **Converts ¾ acre, or more, of vegetation to lawn or landscaped areas, or**
- **Converts 2.5 acres, or more, of native vegetation to pasture.**

The Port may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For public roads projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.

Additional Requirements for the Project Site

For road and airfield-related projects, runoff from the replaced and new hard surfaces (including pavement, shoulders, curbs, and sidewalks) and the converted vegetated areas shall meet all the Minimum Requirements if the new hard surfaces total 5,000 square feet or more and total 50 % or more of the existing hard surfaces within the project limits. The project limits for road projects shall be defined by the length of the project and the width of the right–of-way.

Requirements for the retrofitted airfield are discussed in Section 2.3.4. Additional requirements specified in this section would only come into effect for airfield projects outside of the Retrofit Area. With respect to minimum requirement determinations, airfield surfaces are considered the same as road surfaces.

The assessed value of existing and proposed site improvements is based on the improvements within the individual project site.

Other types of redevelopment projects shall comply with Minimum Requirements #1 through #10 for the new and replaced hard surfaces and converted vegetated areas if the total of new plus replaced hard surfaces is 5,000 square feet or more, and the valuation of proposed improvements – including interior improvements – exceeds 50 percent of the assessed value of the existing site improvements. If a regional facility exists, the Port may exempt a redevelopment project from compliance with Minimum Requirements #5 On-site Stormwater Management, Minimum Requirement #6 Runoff Treatment, Minimum Requirement #7 Flow Control, and/or Minimum Requirement #8 Wetlands Protection as applied to the replaced hard surfaces.

Objective

Redevelopment projects outside of the retrofit area have the same requirements as new development projects in order to minimize the impacts from new surfaces. To avoid discouraging redevelopment projects, the Port does not require that replaced surfaces be brought up to new stormwater standards unless the applicable cost or space (as applied to roads or airfield) thresholds are exceeded. As long as the replaced surfaces have similar pollution-generating potential, the amount of pollutants discharged should not be significantly different. However, if the

redevelopment project scope is sufficiently large that the cost or space criteria noted in this section of the Manual are exceeded, it is reasonable to require that the replaced surfaces be brought up to current stormwater standards. This is consistent with other utility standards. When a structure or property undergoes significant remodeling, local governments often require the site to be brought up to new building code requirements (e.g., on-site sewage disposal systems, fire systems).

Supplemental Guidelines

If runoff from new hard surfaces, converted vegetation areas, and replaced hard surfaces (where the applicable cost or space threshold has been exceeded) is not separated from runoff from other existing surfaces within the project site or the site, the guidance in Appendix III-B of Volume III for off-site inflow shall be used to size the detention facilities.

Regional stormwater facilities may be used as an alternative method of meeting Minimum Requirements 6, 7, and 8, through documented engineering reports detailing how the proposed facilities meet these requirements for the sites that drain to them. Such facilities must be operational prior to and must have capacity for new development.

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics should not be subject to redevelopment requirements except construction site erosion control.

Project proponents are also encouraged to review all road projects for changes in elevations or drainage flow path that could cause flooding, upland or stream erosion, or changes to discharges to wetlands. For example, adding curbs will result in redirecting flows and could possibly cause new downstream impacts. The project proponent should review the design and modify if possible to avoid or mitigate those impacts.

2.4.2 Redevelopment Inside the STIA Retrofit Area

All projects within the STIA Retrofit Area shall comply with Minimum Requirement #2.

The following projects within the Retrofit Area shall comply with Minimum Requirements #1 through #5 for the new and replaced hard surfaces and the land disturbed:

- **Results in 2,000 square feet, or greater, of new, replaced, or new plus replaced hard surface area, or**
- **Has land-disturbing activity of 7,000 square feet or greater.**

The following projects within the Retrofit Area shall comply with Minimum Requirements #1 through #10 for the new hard surfaces and converted pervious areas:

- **Adds 5,000 square feet or more of new hard surface area, or**
- **Converts ¾ acre, or more, of vegetation to lawn or landscaped areas, or**
- **Converts 2.5 acres, or more, of native vegetation to pasture.**

The Port may allow the Minimum Requirements to be met for an equivalent (flow and pollution characteristics) area within the same site. For public roads projects, the equivalent area does not have to be within the project limits, but must drain to the same receiving water.

Objective

Redevelopment projects located within the STIA Retrofit Area must comply with Minimum Requirements #1 through #10 to minimize the impacts from new surfaces. The STIA Retrofit Area is served by regional stormwater facilities which at time of construction met land use development requirements. The Port will review the project to determine if a Minimum Requirement exemption is feasible based upon the capacity of the existing regional facilities and the water quality needs in the basin. The Port may institute an upper limit on the extent to which this exemption may be a full exemption or a partial exemption.

The STIA Retrofit Area is served by regional stormwater facilities. The Port will review projects within the Retrofit Area to determine if a Minimum Requirement exemption (full or partial) is feasible.

Each regional facility's flow control and water quality treatment measures are detailed within *Stormwater Engineering Report* (RW Beck, March 2006).

To avoid discouraging redevelopment projects, the Port does not require that replaced surfaces be brought up to new stormwater standards unless the applicable cost or space (as applied to roads or airfield) thresholds are exceeded. All replaced surfaces within the Retrofit Area are considered up to current standards with the exception of the standards associated with Minimum Requirement 5 – On-site Stormwater Management.

Supplemental Guidelines

If runoff from new hard surfaces, converted vegetation areas, and replaced hard surfaces (where the applicable cost or space threshold has been exceeded) is not separated from runoff from other existing surfaces within the project site or the site, the guidance in Appendix III-B of Volume III for off-site inflow shall be used to size the detention facilities.

Underground utility projects that replace the ground surface with in-kind material or materials with similar runoff characteristics should not be subject to redevelopment requirements except construction site erosion control.

Project proponents are also encouraged to review all road projects for changes in elevations or drainage flow path that could cause flooding, upland or stream erosion, or changes to discharges to wetlands. For example, adding curbs will result in redirecting flows and could possibly cause new downstream impacts. The project proponent should review the design and modify if possible to avoid or mitigate those impacts.

2.5 Minimum Requirements

This section describes the minimum requirements for stormwater management at development and redevelopment sites as well as sites within the Retrofit Area. Section 2.4 should be consulted to

determine which requirements apply to any given project. Figures I-2.4.1, I-2.4.2 and I-2.4.3 should be consulted to determine whether the minimum requirements apply to new surfaces, replaced surfaces or new and replaced surfaces. Volumes II through V of this manual present BMPs for use in meeting the Minimum Requirements.

Throughout this chapter, requirements are written in bold and supplemental guidelines that serve as advice and other materials are <u>not</u> bold.

2.5.1 Minimum Requirement #1: Preparation of Stormwater Site Plans

All projects meeting the thresholds in Section 2.4 shall prepare a Stormwater Site Plan for the Port's review. Stormwater Site Plans shall use site-appropriate development principles, as required and encouraged by local development codes, to retain native vegetation and minimize impervious surfaces to the extent feasible. Stormwater Site Plans shall be prepared in accordance with Chapter 3 of this volume and submitted no later than the 30% design stage as shown in Table I-P.1.1.

Objective

The 2,000 square foot threshold for hard surfaces and 7,000 square foot threshold for land disturbance trigger the requirement of a Stormwater Site Plan. Note that the scope of the Stormwater Site Plan only covers compliance with Minimum Requirements #2 through #5 if the thresholds of 5,000 square feet of hard surface, conversion of ¾ acre of vegetation to lawn or landscape, or conversion of 2.5 acres of native vegetation to pasture are not exceeded.

Supplemental Guidelines

Projects proposed by departments and agencies within the Port must comply with this requirement. The Port shall determine the process for ensuring proper project review, inspection, and compliance by its own departments and agencies.

2.5.2 Minimum Requirement #2: Construction Stormwater Pollution Prevention

Thresholds

All new development and redevelopment projects are responsible for preventing erosion and discharge of sediment and other pollutants into receiving waters.

The Port's Programmatic Construction Stormwater Pollution Prevention Plan (SWPPP) requires project-specific SWPPPs. For projects in which the new, replaced, or new plus replaced hard surfaces total 2,000 square feet or more, or disturb 7,000 square feet or more of land, the project proponent must prepare a project-specific construction SWPPP, but the need for the monitoring plan as a part of the SWPPP will be determined by Port Environmental and Construction staff. For projects that disturb more than one (1) acre of total land area, the full SWPPP, including the monitoring plan will be required. All projects involving exterior construction must meet the Port's Erosion and Sediment Control Plan Specification requirements.

The Port has prepared a *Programmatic Construction Stormwater Pollution Prevention Plan (March 2016)* in accordance with the requirements of the NPDES Permit. This document describes all the components of the Port of Seattle construction stormwater management program at Seattle-Tacoma International Airport (STIA).

For projects that add or replace less than 2,000 square feet of hard surface or disturb less than 7,000 square feet of land, project proponents are not required to prepare a construction SWPPP, but must still meet Erosion and Sediment Control Plan Specification requirements.

General Requirements

The SWPPP is generally composed of the following five documents:

- **Monitoring plan (if the site is larger than 1 ac)**
- **Pollution Prevention Plan (PPP)**
- **Contractor Erosion and Sediment Control Plan (CESCP)**
- **Contract plan sheets**
- **Contract specifications**

These documents are prepared by the entities responsible for their implementation and are developed with the intent of being implemented independently of each other. The Port prepares the monitoring plan. The contractor prepares and implements the PPP and CESCP based on the project-specific contract specifications. In addition to the five documents listed above, the contractor must also develop a Construction Water Management Plan (CWMP), if determined necessary by the Port. The contractor must submit the PPP, CESCP, and CWMP to the environmental staff and the erosion control and stormwater engineer for acceptance prior to submittal to the resident engineer for issuance of the Notice to Proceed.

Project Requirements - Construction SWPPP Elements**

Ecology requires that all construction projects meet the 13 BMP elements described below, and that the construction SWPPP includes either those BMPs that address each element or a justification as to why a particular element does not apply to the project. Depending on the project site, multiple BMPs for each element may be needed. The Port requires, through its specifications, that the contractor implement BMPs that address the 13 BMP elements outlined in this section. The site-specific construction SWPPP, which should include the contractor's PPP and CESCP, must include specific BMPs that meet the Port's specifications, which in turn meet Ecology's 13 BMP elements. A detailed fact sheet for each BMP can be found in the SWMMMWW (Ecology 2014 [Volume II, Chapter 4, Section 4.1]). These fact sheets include specifications and installation requirements for each BMP. The contractor may copy the fact sheet for each BMP used and include it in their SWPPP.

The project designer, working with the erosion control and stormwater engineer and environmental management personnel, must select BMPs that specifically address each of these elements, and include installation locations and schedules for maintenance and removal in the contract plans and specifications.

Element No. 1 – Mark Clearing Limits

To protect adjacent properties and reduce the area of soil exposed to construction, the limits of construction should be clearly marked before land-disturbing activities begin. Trees that are to be preserved, as well as all sensitive areas and their buffers, should be clearly delineated, both in the field and on the plans. In general, natural vegetation and native topsoil should be retained in an undisturbed state to the maximum extent possible.

Element No. 2 – Establish Construction Access

Construction access or activities occurring on unpaved areas should be minimized, and project access points should be stabilized to prevent the tracking of sediment onto public roads. In addition, vacuum sweepers should be used at all times and wheel washing used as needed to prevent sediment trackout from the project.

Element No. 3 – Control Flow Rates

In order to protect properties and waterways downstream of the project site, stormwater discharges from the site should be controlled. During the design phase, it is determined whether the project designer or the contractor shall be responsible for determining and specifying control measures, as appropriate. All contractor provided control measures are reviewed as part of the CESCP or CWMP prior to implementation. This element is typically addressed in the CESCP, and flow control measures and modifications are approved by the resident engineer before any pumping or site discharge is allowed.

Element No. 4 – Install Sediment Controls

All stormwater runoff from disturbed areas should pass through appropriate sediment removal BMPs and be tested to verify compliance with turbidity and pH limits before leaving the construction site, or prior to being discharged to an infiltration facility.

In addition, sediment should be removed from paved areas in and adjacent to construction work areas either manually or using vacuum sweepers, as needed. Its removal will prevent sediment from being tracked away from the site on vehicle tires, and from entering runoff from adjacent streets.

Whenever possible, sediment-laden water should be discharged into relatively level, vegetated areas onsite.

In some cases, sediment discharge in concentrated runoff can be controlled using permanent stormwater BMPs (e.g., infiltration swales, ponds, trenches). Sediment loads can limit the effectiveness of some permanent stormwater BMPs, such as those used for infiltration or biofiltration; however, those BMPs designed to remove solids by settling (e.g., wet ponds or detention ponds) can only be used during the construction phase when approved by the Port. When permanent stormwater BMPs are used to control sediment discharge during construction, the structure should be protected from excessive sedimentation with adequate ESC BMPs. Any accumulated sediment should be removed after construction is complete and the permanent stormwater BMP has been re-stabilized with vegetation per applicable design requirements once the remainder of the site has been stabilized.

Element No. 5 – Stabilize Soil

Exposed and unworked soil should be stabilized with the application of effective BMPs to prevent erosion throughout the life of the project. At no time should turbid or contaminated water from a construction site be allowed to discharge without testing per Specification 01 57 13, TESC.

The resident engineer and the erosion control and stormwater engineer should monitor the condition of the site to determine when and how exposed soil must be stabilized. In general, exposed soil is stabilized at the end of the shift before a holiday or weekend, if needed, based on weather forecasts.

In general, cut and fill slopes should be stabilized as soon as possible, and soil stockpiles should be temporarily covered with plastic sheeting. All stockpiled soil should be stabilized against erosion; protected using sediment trapping measures; and, where possible, located away from storm drain inlets, waterways, and drainage channels.

Element No. 6 – Protect Slopes

All cut and fill slopes should be designed, constructed, and protected in a manner that minimizes erosion. The project designer is responsible for designing cut and fill slopes and developing contract plan sheets that show the contractor how to construct the slopes. The resident engineer should verify that the contractor is building slopes per plans.

Element No. 7 – Protect Drain Inlets

All storm drain inlets and culverts made operable during construction should be protected—using temporary plugs, phasing, and/or inlet protection—to prevent unfiltered or untreated water from entering the drainage conveyance system. Pre-installation meetings should be held with the resident engineer and contractor to determine the appropriate BMPs. All catch basins within the project boundary and on all haul roads outside the project boundary should be protected with catch basin inserts.

Element No. 8 – Stabilize Channels and Outlets

All temporary onsite conveyance channels should be designed, constructed, and stabilized to prevent erosion from the expected peak 10-minute velocity of flow from a Type 1A, 10-year, 24-hour recurrence-interval storm for the developed condition. Alternatively, a 10-year, 1-hour peak flow rate indicated by an approved continuous runoff simulation model, increased by a factor of 1.6, can be used for the design flow. Stabilization, including armoring material, adequate to prevent erosion of outlets, adjacent stream banks, slopes, and downstream reaches should be provided at the outlets of all conveyance systems and shown on the contract plans.

Element No. 9 – Control Pollutants

All pollutants, including waste materials and demolition debris, that occur onsite should be handled and disposed of by the contractor in a manner that does not cause contamination of stormwater. Good housekeeping and preventative measures should be followed to ensure that the site is kept clean, well-organized, and free of debris. If required, BMPs to be implemented to control specific sources of pollutants include the following:

- **Vehicles, construction equipment, and/or petroleum product storage/dispensing**
  - **All vehicles, equipment, and petroleum product storage/dispensing areas must be inspected regularly in order to detect any leaks or spills and identify maintenance needs to prevent leaks or spills.**
  - **Onsite fueling tanks and petroleum product storage containers must include secondary containment.**
  - **Spill prevention measures, such as drip pans, must be used when conducting maintenance and repair of vehicles or equipment.**
  - **When performing emergency repairs onsite, temporary plastic must be placed beneath and, if raining, over the vehicle.**
  - **Contaminated surfaces must be cleaned immediately following any discharge or spill incident.**
- **Chemical storage**
  - **Any chemicals stored in the construction areas must conform to the appropriate source-control BMPs listed in Volume IV of the SWMMWW (Ecology 2014). In**

Western Washington, all chemicals onsite must be covered, contained, and protected.

- **Application of agricultural chemicals, including fertilizers and pesticides, must be conducted in a manner and at application rates that do not result in loss of chemicals to stormwater runoff. Manufacturers' recommendations for application procedures and rates must be followed.**

- **Excavation and tunneling spoils dewatering waste**
  - **Dewatering BMPs and BMPs specific to excavation and tunneling (including the handling of contaminated soils) are discussed under Element 10.**
- **Demolition**
  - **Dust released from demolished sidewalks, buildings, or structures must be controlled using dust control measures.**
  - **Storm drain inlets that carry dust, soil, or debris and are vulnerable to stormwater discharge must be protected using storm drain inlet protection.**
  - **Process water and slurry resulting from saw cutting and surfacing operations must be prevented from entering the waters of the state through the implementation of saw cutting and surfacing pollution prevention measures.**
- **Concrete and grout**
  - **Process water and slurry resulting from concrete work must be prevented from entering the waters of the state through the implementation of concrete-handling measures.**
- **Sanitary wastewater**
  - **Portable sanitation facilities should be firmly secured, regularly maintained, and emptied as necessary.**
  - **Wheel wash or tire bath wastewater should be discharged to a separate onsite treatment system, or to the sanitary sewer as part of wheel wash implementation.**
- **Solid waste**
  - **Solid waste should be stored in secure, clearly marked containers.**
- **Other**
  - **Other BMPs should be administered as necessary to address any additional onsite pollutant sources.**

Element No. 10 – Control Dewatering

All dewatering water from open-cut excavation, tunneling, foundation work, trenches, or underground vaults should be discharged into a controlled conveyance system prior to discharge to a sediment trap or sediment pond. Channels should be stabilized per Element

No. 8. Clean, non-turbid dewatering water should not be routed through stormwater sediment ponds, but should be discharged to systems tributary to the receiving waters of the state in a manner that does not cause erosion, flooding, or a violation of state WQS in the receiving water. Highly turbid dewatering water from soil known or suspected to be contaminated, or from use of construction equipment, should be monitored and treated as required for the specific pollutants based on the receiving waters into which the discharge will occur. Such monitoring and record keeping is the responsibility of the contractor.

The dewatering of soil known to be free of contamination should trigger the implementation of BMPs to trap sediment and reduce turbidity. At a minimum, geotextile fabric socks/bags/cells should be used to filter this material.

Element No. 11 – Maintain BMPs

All temporary and permanent erosion and sediment control BMPs should be inspected, maintained, and repaired as needed to ensure continued performance in accordance with their intended function. Maintenance and repair should be conducted in accordance with each particular BMPs specification. Visual monitoring of the BMPs should be conducted daily and within 24 hours of any stormwater or non-stormwater discharge from the site.

All TESC BMPs should be removed within 30 days after final site stabilization is achieved, or after temporary BMPs are no longer needed. Trapped sediment should be removed or stabilized onsite. Disturbed soil resulting from the removal of BMPs or vegetation should be permanently stabilized.

Element No. 12 – Manage the Project

ESC BMPs for this project have been designed based on the following principles:

- **Design the project to fit the existing topography, soils, and drainage patterns.**
- **Emphasize erosion control rather than sediment control.**
- **Minimize the extent of the area exposed and the duration of its exposure.**
- **Keep runoff velocities low.**
- **Retain sediment onsite.**
- **Thoroughly monitor the site and maintain all erosion and sediment control measures.**
- **Schedule major earthwork during the dry season.**

In addition, project management will incorporate the key components listed below:

- **Phasing of construction**
  - **The construction project should be phased to the extent practicable in order to prevent soil erosion and, to the maximum extent possible, the transport of sediment from the site during construction.**

- **Revegetation of exposed areas and maintenance of that vegetation should be an integral part of the clearing activities during each phase of construction.**
- **From October 1 through April 30 of a given year, clearing, grading, and other soil-disturbing activities are allowed if—to the satisfaction of the resident engineer, project designer, environmental managers, and erosion control and stormwater engineer—silt-laden runoff will be prevented from leaving the site through a combination of the following:**
  - **Site conditions, including existing vegetative coverage, slope, soil type, and proximity to receiving waters**
  - **Limitations on activities and the extent of disturbed areas**
  - **Proposed ESC measures**
- **Based on the information provided and/or local weather conditions, the resident engineer may expand or restrict the seasonal limitation on site disturbance.**

- **Coordination with utilities and other jurisdictions**
  - **Care should be taken to coordinate with utilities, other construction projects, and the local government jurisdiction in preparing the project SWPPP and scheduling the construction work.**
- **Inspection and monitoring**
  - **All BMPs should be inspected, maintained, and repaired daily to ensure continued performance in accordance with their intended function. Site inspections should be conducted by the CESCL, who is knowledgeable in the principles and practices of ESC. This person should have the skills necessary to:**
    - **Assess the site conditions and construction activities that could impact the quality of stormwater.**
    - **Assess the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges.**
  - **The CESCL should be onsite or on-call at all times.**
  - **Whenever inspection and/or monitoring reveals that the BMPs identified in the project SWPPP are inadequate due to the actual or potential discharge of a significant amount of any pollutant, appropriate BMPs or design changes should be implemented as soon as possible.**
- **Maintaining an updated construction SWPPP**
  - **The project SWPPP should be retained onsite or within reasonable proximity to the site.**

- **The project SWPPP should be modified whenever there is a change in the design, construction, operation, or maintenance of the construction site that has, or could have, a significant effect on the discharge of pollutants to waters of the state.**

The project SWPPP should be modified if, during inspections or investigations conducted by the CESCL, resident engineer, environmental managers, erosion-control and stormwater engineer, or applicable local or state regulatory authority, it is determined that the SWPPP is ineffective in eliminating or significantly minimizing pollutants in stormwater discharges from the site. The project SWPPP should be modified as necessary to include additional or modified BMPs designed to correct identified problems. Revisions to the project SWPPP should be completed within 24 hours after the inspection.

Element No. 13 – Protect Low Impact Development BMPs

All low-impact development (LID) BMPs should be protected through the installation and maintenance of ESC BMPs on portions of sites that drain to the LID BMPs. In design, LID BMPs should be identified on the ESC sheets to protect the BMPs. In order to retain the infiltration rate of the soils under LID facilities, construction equipment and foot traffic should be excluded from LID BMPs. Lawn and landscaped areas should also be protected from compaction through the exclusion of construction equipment. Erosion should be controlled and sediment from surrounding land should not be introduced into LID facilities.

Muddy construction equipment and sediment-laden runoff should not be allowed on permeable pavements or base materials. Any pavement that is fouled with sediments or is no longer able to pass an initial infiltration test should be cleaned in accordance with the SWMMWW or the manufacturer's instructions.

Objective

To control erosion and prevent sediment and other pollutants from leaving the site during the construction phase of a project and to comply with NPDES Construction Stormwater Discharge Limits. To have fully functional stormwater facilities and BMPs for the developed site upon completion of construction.

Supplemental Guidelines

If a Construction SWPPP is found to be inadequate (with respect to erosion and sediment control requirements), then the Port will require that other BMPs be implemented, as appropriate.

Based on the information provided and/or local weather conditions, the Port may expand or restrict the seasonal limitation on site disturbance. The Port shall take enforcement action - such as a notice of violation, administrative order, penalty, or stop-work order under the following circumstances:

- If, during the course of any construction activity or soil disturbance during the seasonal limitation period, sediment leaves the construction site causing a violation of the surface water quality standard; or
- If clearing and grading limits or erosion and sediment control measures shown in the approved plan are not maintained.

Coordination with Utilities and Other Contractors - The primary project proponent shall evaluate, with input from utilities and other contractors, the stormwater management requirements for the entire project, including the utilities, when preparing the Construction SWPPP.

2.5.3 Minimum Requirement #3: Source Control of Pollution

All known, available, and reasonable source control BMPs must be applied to all projects. Source control BMPs must be selected, designed, and maintained according to this Manual.

Objective

The intent of source control BMPs is to prevent stormwater from coming in contact with pollutants. They are a cost-effective means of reducing pollutants in stormwater, and, therefore, should be a first consideration in all projects.

Supplemental Guidelines

An adopted and implemented basin plan or a Total Maximum Daily Load (TMDL, also known as a Water Clean-up Plan) may be used to develop more stringent source control requirements that are tailored to a specific basin.

Source Control BMPs include Operational BMPs and Structural Source Control BMPs. See Volume IV for design details of these BMPs. For construction sites, see Volume II, Chapter 4.

Selection of materials that may come in contact with stormwater is also important to reduce the amount of pollutants that enter the stormwater system. Projects are required to meet the metal source control requirements in the Port's special coatings and the chain link fence technical specifications.

Structural source control BMPs should be identified in the stormwater site plan and should be shown on all applicable plans submitted for Port review and approval.

If new construction is located in exterior weather-exposed area over hard surfaces, and includes copper, galvanized steel, or zinc in any other form, obtain concurrence from the Port for the specified material's use and coatings to prevent copper, zinc, or other potential metals contamination of stormwater entering the drainage system at the STIA. Alternatively, specify alternative materials consistent with Ecology-approved source control BMPs in Volume IV. Lead is not permitted in any material applications.

2.5.4 Minimum Requirement #4: Preservation of Natural Drainage Systems and Outfalls

Natural drainage patterns shall be maintained, and discharges from the project site shall occur at the natural location, to the maximum extent practicable. The manner by which runoff is discharged from the project site must not cause a significant adverse impact to downstream receiving waters and downgradient properties. All outfalls require energy dissipation.

Objective

To preserve and utilize natural drainage systems to the fullest extent because of the multiple stormwater benefits these systems provide; and to prevent erosion at and downstream of the discharge location.

Supplemental Guidelines

Creating new drainage patterns results in more site disturbance and more potential for erosion and sedimentation during and after construction. Creating new discharge points can create significant stream channel erosion problems as the receiving water body typically must adjust to the new flows. Diversions can cause greater impacts than would otherwise occur by discharging runoff at the natural location.

Where no conveyance system exists at the adjacent downgradient property line and the discharge was previously unconcentrated flow or significantly lower concentrated flow, then measures must be taken to prevent downgradient impacts. Drainage easements from downstream property owners may be needed and should be obtained prior to approval of engineering plans.

Where no conveyance system exists at the abutting downstream property line and the natural (existing) discharge is unconcentrated, any runoff concentrated by the proposed project must be discharged as follows:

a. If the 100-year peak discharge is less than or equal to 0.2 cfs (0.3 cfs using 15 minute time steps) under existing conditions and will remain less than or equal to 0.2 cfs under developed conditions, then the concentrated runoff may be discharged onto a rock pad or to any other system that serves to disperse flows.

b. If the 100-year peak discharge is less than or equal to 0.5 cfs (0.75 cfs using 15 minute time steps) under existing conditions and will remain less than or equal to 0.5 cfs under developed conditions, then the concentrated runoff may be discharged through a dispersal trench or other dispersal system, provided the applicant can demonstrate that there will be no significant adverse impact to downhill properties or drainage systems.

c. If the 100-year peak discharge is greater than 0.5 cfs for either existing or developed conditions, or if a significant adverse impact to downgradient properties or drainage systems is likely, then a conveyance system must be provided to convey the concentrated runoff across the downstream properties to an acceptable discharge point (i.e., an enclosed drainage system or open drainage feature where concentrated runoff can be discharged without significant adverse impact).

Stormwater control or treatment structures should not be located within the expected 25-year water level elevations for salmonid-bearing waters. Such areas may provide off-channel habitat for juvenile salmonids and salmonid fry. Designs for outfall systems to protect against adverse impacts from concentrated runoff are included in Volume V, Chapter 4.

2.5.5 Minimum Requirement #5: On-Site Stormwater Management

Projects that trigger Minimum Requirement #5 shall evaluate and use Low Impact Development (LID) BMPs in accordance with the thresholds, standards, and criteria provided in the STIA LID Guideline to infiltrate, disperse, and retain stormwater runoff on-site to the extent feasible without causing flooding or erosion impacts. FAA regulations and other STIA competing needs are included in the STIA LID Guideline that restrict the use of LID BMPs at STIA, including requirements to minimize hazardous attraction of wildlife. These competing needs and various feasibility criteria contained in the STIA LID Guideline shall be assessed for new development and redevelopment proposals to determine the need for new LID BMPs (beyond those that currently exist). The STIA LID Guideline provides step-by-step guidance for the selection and implementation of feasible LID BMPs (where required). The selected LID BMPs shall be reviewed with Port Environmental staff for concurrence throughout the Stormwater Site Plan development process, and be subsequently incorporated into new development and redevelopment project designs.

Objective

To use inexpensive practices on individual sites to reduce the amount of disruption of the natural hydrologic characteristics of the site.

Supplemental Guidelines

"Flooding and erosion impacts" include impacts such as flooding of septic systems, crawl spaces, living areas, outbuildings, etc.; increased ice or algal growth on sidewalks/roadways; earth movement/settlement, increased landslide potential; erosion and other potential damage.

Recent research indicates that current techniques in residential, commercial, and industrial land development cause gross disruption of the natural hydrologic cycle with severe impacts to water and water-related natural resources. Based upon gross level applications of continuous runoff modeling and assumptions concerning minimum flows needed to maintain beneficial uses, watersheds must retain the majority of their natural vegetation cover and soils, and developments must meet the Flow Control Minimum Requirement of this chapter in order to avoid significant natural resource degradation in lowland streams.

2.5.6 Minimum Requirement #6: Runoff Treatment

Thresholds

When assessing a project against the following thresholds, only consider those hard and pervious surfaces that are subject to this minimum requirement as determined in Section 2.4 of this chapter.

The following projects require construction of stormwater treatment facilities:

- **Projects in which the total of pollution-generating hard surface (PGHS) is 5,000 square feet or more in a threshold discharge area of the project, or**
- **Projects in which the total of pollution-generating pervious surfaces (PGPS) – not including permeable pavements - is ¾ acre or more in a threshold discharge area, and from which there will be a surface discharge in a natural or man-made conveyance system from the site.**

Projects within the Retrofit Area that can demonstrate the existing regional runoff treatment facility has sufficient capacity to meet project requirements are exempt from Minimum Requirement #6. Check with Port Environmental to confirm capacity of existing facilities.

Treatment Facility Sizing

Size stormwater treatment facilities for the entire area that drains to them, even if some of those areas are not pollution-generating, or were not included in the project site threshold decisions (Section 2.4 of this chapter) or the treatment threshold decisions of this minimum requirement.

Water Quality Design Storm Volume:

The volume of runoff predicted from a 24-hour storm with a 6-month return frequency (a.k.a., 6-month, 24-hour storm). Wetpool facilities are sized based upon the volume of runoff predicted through use of the Natural Resource Conservation Service curve number equations in Chapter 2 of Volume III, for the 6-month, 24-hour storm. Alternatively, when using an approved continuous runoff model, the water quality design storm volume shall be equal to the simulated daily volume that represents the upper limit of the range of daily volumes that accounts for 91% of the entire runoff volume over a multi-decade period of record.

Water Quality Design Flow Rate:

- ***Preceding Detention Facilities or when Detention Facilities are not required:*** **The flow rate at or below which 91 percent of the runoff volume, as estimated by an approved continuous runoff model, will be treated. Design criteria for treatment facilities are assigned to achieve the applicable performance goal (e.g., 80 percent TSS removal) at the water quality design flow rate. At a minimum 91% of the total runoff volume, as estimated by an approved continuous runoff model, must pass through the treatment facility(ies) at or below the approved hydraulic loading rate for the facility(ies).**
- ***Downstream of Detention Facilities:*** **The water quality design flow rate must be the full 2-year release rate from the detention facility.**

Treatment Facility Selection, Design, and Maintenance

Stormwater treatment facilities shall be:

- Selected in accordance with the process identified in Chapter 4 of Volume I, and Chapter 2 of Volume V.
- Designed in accordance with the design criteria in Volume V, and
- Maintained in accordance with the maintenance schedule in Volume V.

Additional Requirements

Direct discharge of untreated stormwater from pollution-generating hard surfaces to groundwater is prohibited, except for the discharge achieved by infiltration or dispersion of runoff through the use of On-site Stormwater Management BMPs, in accordance with Chapter 5, Volume V and Chapter 7, Volume V; or by infiltration through soils meeting the soil suitability criteria in Chapter 3 or Volume III.

Objective

The purpose of runoff treatment is to reduce pollutant loads and concentrations in stormwater runoff using physical, biological, and chemical removal mechanisms so that beneficial uses of receiving waters are maintained and, where applicable, restored. When site conditions are appropriate, infiltration can potentially be the most effective BMP for runoff treatment.

Supplemental Guidelines

See Volume V for more detailed guidance on selection, design, and maintenance of treatment facilities. The water quality design storm volume and flow rates are intended to capture and effectively treat about 90 percent to 95 percent of the annual runoff volume in Western Washington. See Appendix I-B for background on their derivation.

Volume V includes performance goals for Basic, Enhanced, Phosphorus, and Oil Control treatment, and a menu of facility options for each treatment type. Treatment facilities that are selected from the appropriate menu and designed in accordance with their design criteria are presumed to meet the applicable performance goals.

An adopted and implemented basin plan or a Total Maximum Daily Load (TMDL - also known as a Water Clean-up Plan) may be used to develop runoff treatment requirements that are tailored to a specific basin. However, treatment requirements shall not be less than that achieved by facilities in the Basic Treatment Menu (see Volume V, Chapter 3).

The Port conducted a site-specific study to establish water quality objectives for each receiving water body. The resulting objectives have been incorporated into the STIA NPDES permit. As a result, runoff from projects that discharged to NPDES outfalls are subject to numeric effluent limits. Projects must provide treatment as necessary to ensure those effluent limits are not exceeded.

The Port conducted a site-specific study to establish water quality objectives specific to each receiving water body through the development of water effects ratios (WERs). The resulting site-specific water quality objectives have been incorporated into the STIA NPDES permit. Treatment facilities applied consistent with this Manual are presumed to meet the requirement of state law to provide all known available and reasonable methods of treatment (RCW 90.52.040, RCW 90.48.010). This technology-based treatment requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with NPDES limits; state water quality standards, Chapter 173-201A WAC; state groundwater quality standards, Chapter 173-200 WAC; state sediment management standards, Chapter 173-204 WAC; and the underground injection control program, Chapter 173-218 WAC. Additional treatment to meet those standards may be required by federal, state, local governments, or the Port. The project proponent shall check with the Port to determine the water quality treatment standard required for the project.

Treatment facilities applied consistent with this manual are presumed to meet the requirement of state law to provide all known available and reasonable methods of treatment (RCW 90.52.040, RCW 90.48.010). This technology-based treatment requirement does not excuse any discharge from the obligation to apply whatever technology is necessary to comply with state water quality standards, Chapter 173-201A WAC; state ground water quality standards, Chapter 173-200 WAC; state sediment management standards, Chapter 173-204 WAC; and the underground injection control program, Chapter 173-218 WAC. Additional treatment to meet those standards may be required by federal, state, or local governments.

Infiltration through use of On-site Stormwater Management BMPs can provide both treatment of stormwater, through the ability of certain soils to remove pollutants, and volume control of stormwater, by decreasing the amount of water that runs off to surface water. Infiltration through engineered treatment facilities that utilize the natural soil profile can also be very effective at treating stormwater runoff, but pretreatment must be applied and soil conditions must be appropriate to achieve effective treatment while not impacting groundwater resources. See Chapter 6 of Volume V for pretreatment design details.

Discharge of pollution-generating surfaces into a dry well, after pretreatment for solids reduction, can be acceptable if the soil conditions provide sufficient treatment capacity. Dry wells into gravelly soils are not likely to have sufficient treatment capability. They must be preceded by at least a basic treatment BMP. See Volume V, Chapters 2 and 7 for details.

Impervious surfaces that are “fully dispersed” in accordance with BMP T5.30 in Volume V are not considered effective impervious surfaces. Impervious surfaces that are “dispersed” in accordance with BMPs T5.10B, T5.11, and T5.12 in Section 5.3.1 of Volume V are still considered effective surfaces though they may be modeled as pervious surfaces if flow path the lengths meet

the specified minima. See Volume III, Appendix III-C for a more complete description of hydrologic representation of On-site Stormwater Management BMPs.

2.5.7 Minimum Requirement #7: Flow Control

Applicability

Projects must provide flow control to reduce the impacts of stormwater runoff from hard surfaces and land cover conversions. The requirement below applies to projects that discharge stormwater directly, or indirectly through a conveyance system, into a fresh waterbody.

Projects within the Retrofit Area that can demonstrate the existing regional flow control facility has sufficient capacity to meet project requirements are exempt from Minimum Requirement #7. Check with Port Environmental to confirm capacity of existing facilities.

Flow Control is not required for projects that discharge to a water in Appendix I-E - Flow Control-Exempt Receiving Waters subject to the following restrictions:

- **Direct discharge to the exempt receiving water does not result in the diversion of drainage from any perennial stream classified as Types 1, 2, 3, or 4 in the State of Washington Interim Water Typing System, or Types "S", "F", or "Np" in the Permanent Water Typing System, or from any category I, II, or III wetland; and**
- **Flow splitting devices or drainage BMP's are applied to route natural runoff volumes from the project site to any downstream Type 5 stream or category IV wetland:**
  - **Design of flow splitting devices or drainage BMP's will be based on continuous hydrologic modeling analysis. The design will assure that flows delivered to Type 5 stream reaches will approximate, but in no case exceed, durations ranging from 50 percent of the 2-year to the 50-year peak flow.**
  - **Flow splitting devices or drainage BMP's that deliver flow to category IV wetlands will also be designed using continuous hydrologic modeling to preserve pre-project wetland hydrologic conditions unless specifically waived or exempted by regulatory agencies with permitting jurisdiction;**
- **The project site must be drained by a conveyance system that is comprised entirely of manmade conveyance elements (e.g., pipes, ditches, outfall protection) and extends to the ordinary high water line of the exempt receiving water;**
- **The conveyance system between the project site and the exempt receiving water shall have sufficient hydraulic capacity to convey discharges from future build-out conditions (under current zoning) of the site, and the existing condition from non-project areas from which runoff is or will be collected;**
- **Any erodible elements of the manmade conveyance system must be adequately stabilized to prevent erosion under the conditions noted above.**

If the discharge is to a stream that leads to a wetland, or to a wetland that has an outflow to a stream, both this requirement and Minimum Requirement #8 apply.

The Project Proponent may petition the Port and Ecology to exempt projects. A petition must justify the proposed exemption based upon a hydrologic analysis that demonstrates that the potential stormwater runoff from the exempted area will not significantly increase the erosion forces on the stream channel nor have near field impacts.

Thresholds

When assessing a project against the following thresholds, consider only those impervious, hard, and pervious surfaces that are subject to this minimum requirement as determined in Section 2.4 of this chapter.

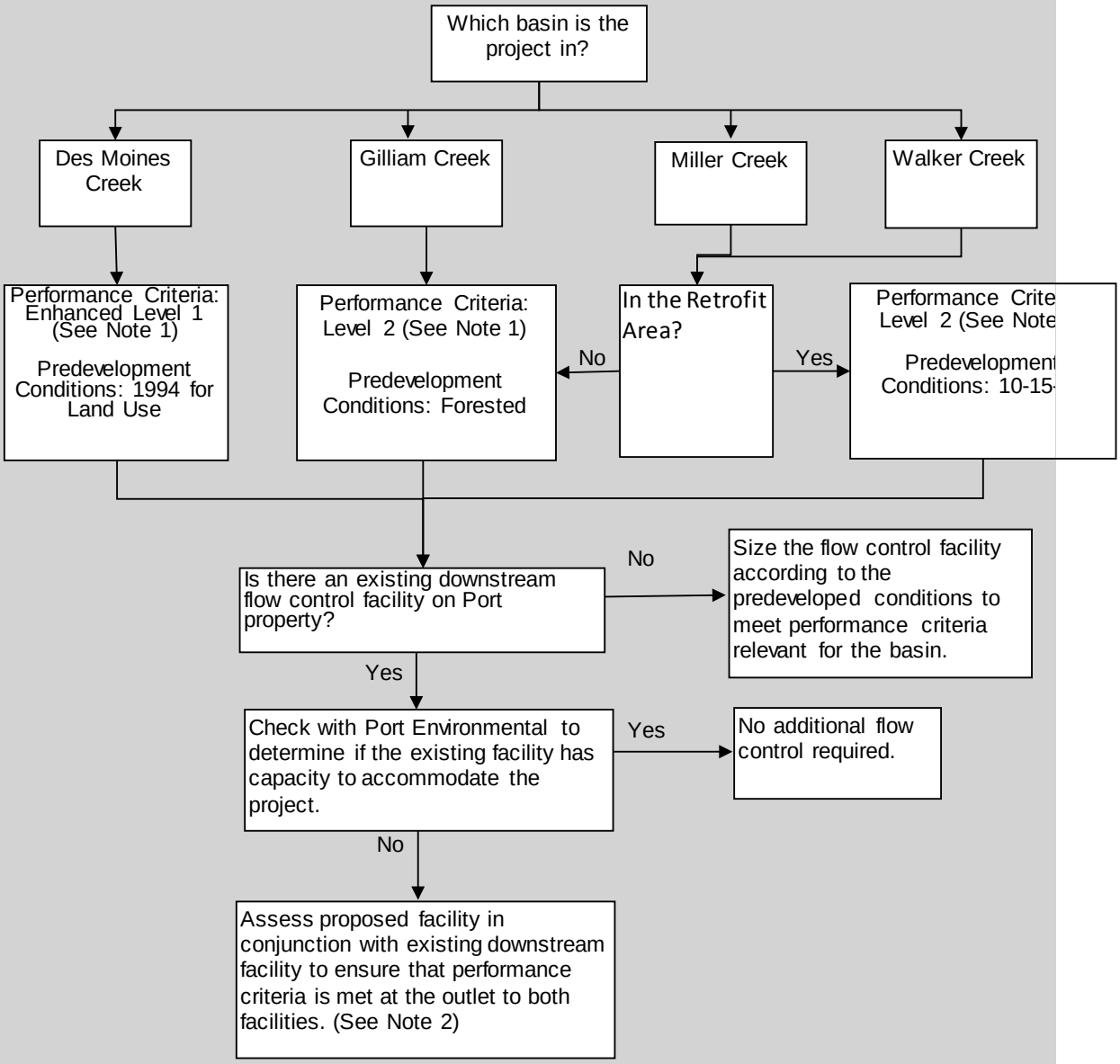
The following circumstances require achievement of the standard flow control requirement for the Port:

- **Projects in which the total of effective impervious surfaces is 5,000 square feet or more in a threshold discharge area, or**
- **Projects that convert ¾ acre or more of vegetation to lawn or landscape, or convert 2.5 acres or more of native vegetation to pasture in a threshold discharge area, and from which there is a surface discharge in a natural or man-made conveyance system from the site, or**
- **Projects that through a combination of effective hard surfaces and converted vegetation areas cause a 0.10 cfs increase in the 100-year flow frequency from a threshold discharge area as estimated using the Western Washington Hydrology Model or other approved model and one-hour time steps (or a 0.15 cfs increase using 15-minute time steps).**

  The 0.10 cfs (one-hour time steps) or 0.15 cfs (15 minute time steps) increase should be a comparison of the post-project runoff to the existing conditions runoff. For the purpose of applying this threshold, the existing conditions is the predevelopment conditions as shown in the standard requirements below.

Figure I-2.5.2 shows how to determine the performance criteria and pre-development conditions to use at the project site.

Figure I-2.5.1. Determining Flow Control Performance Criteria and Pre-Development Conditions



1. See Appendix I-G for definitions of Level 1, Enhanced Level 1 and Level 2 flow control requirements.
2. If the existing facility in Miller or Walker basins has insufficient capacity, the predevelopment conditions for the new facility shall be forested conditions.

References

- Proposed Design Refinements to the Comprehensive Stormwater Management Plan Master Plan Update Improvements, Seattle-Tacoma International Airport, Des Moines Creek Basin (Parametrix, August 2004)
- Proposed Design Refinements to the Comprehensive Stormwater Management Plan Master Plan Update Improvements, Seattle-Tacoma International Airport, Miller/Walker Creek Basin (Parametrix, June 2005)

The pre-developed condition to be matched shall be:

- **The 1994 land use conditions within the Des Moines Creek basin.**
- **10-15-75 (10 percent Effective Impervious Area, 15 percent Grass and 75 percent Forest) where using existing Port flow control facilities in the Miller Creek and Walker Creek basins within the Retrofit Area.**
- **Forested land cover for the Gilliam Creek basin, and Miller and Walker Creek basins outside the Retrofit Area.**

STIA has basin-specific flow control standards. Project proponent shall coordinate with the Port Environmental to assess potential project-specific flow control needs.

Western Washington Alternative Requirement

An alternative requirement may be established through application of watershed-scale hydrological modeling and supporting field observations. Possible reasons for an alternative flow control requirement include:

- **Establishment of a stream–specific threshold of significant bedload movement other than the assumed 50 percent of the 2-year peak flow;**
- **Zoning and Land Clearing Ordinance restrictions that, in combination with an alternative flow control standard, maintain or reduce the naturally occurring erosive forces on the stream channel; or**
- **A duration control standard is not necessary for protection, maintenance, or restoration of designated and existing beneficial uses or Clean Water Act compliance.**

Additional Requirement

Flow Control BMPs shall be selected, designed, and maintained according to Volume III of this manual.

Objective

To prevent increases in the stream channel erosion rates that are characteristic of natural conditions (i.e., prior to disturbance by European settlement). The standard intends to maintain the total amount of time that a receiving stream exceeds an erosion-causing threshold based upon historic rainfall and natural land cover conditions. That threshold is assumed to be 50 percent of the 2-year peak flow. Maintaining the naturally occurring erosion rates within streams is vital, though by itself insufficient, to protect fish habitat and production.

Supplemental Guidelines

Reduction of flows through infiltration decreases stream channel erosion and helps to maintain base flow throughout the summer months. However, infiltration should follow the guidance in this manual to reduce the chance that groundwater quality is threatened by such discharges.

The Port has implemented regional stormwater facilities to meet of Minimum Requirements 6, 7, and 8 in the Retrofit Area for the land use at the time the facilities were constructed. If the project

is in the Retrofit Area, the Port may exempt a project from compliance with Minimum Requirements for flow control as applied to new hard surfaces. Compliance with Minimum Requirements for flow control for replace hard surfaces is not required in the Retrofit Area. The Port may institute an upper limit on the extent to which this exemption may be a full exemption or a partial exemption with respect to how requirements are applied. In order for the Port to do this, the regional facility must be shown to fulfill those requirements that are being exempted or lessened for the project. To determine whether a full or partial exemption is warranted, the Port shall consult the *Technical Information Supporting the Design of Stormwater Ponds Serving the Seattle Tacoma International Airport* (current version) to determine the land use used to design the regional facility. If the current land use tributary to a regional facility, modified as proposed by the project, is less impactful the land use used to size the regional facility, the project may be exempt. If the design parameters can accommodate some, but not all of the proposed change resulting from a project, the project may be partially exempt.

Hydrologic and hydraulic models have already been developed for much of the Retrofit Area. The use of the Port-developed models is required within the Retrofit Area and is recommended outside the Retrofit Area but within the Des Moines and the Miller/Walker Creek basins. Port-developed models are available for Des Moines and Miller/Walker Creek. HSPF calibration parameters for Des Moines Creek and Miller/Walker Creek are provided in Appendix III-D of Volume III. These models are available from the Port for use by the project proponent. In areas not covered by one of the Port's existing hydrologic models and Western Washington Hydrology Model (WWHM), or other approved runoff model is used, its documentation files should be provided to the Port as part of the Stormwater Site Plan. Volume III includes a description of WWHM. The model provides ways to represent On-Site Stormwater Management BMPs described in Volume III and V, and the Port's policy for low-impact development techniques are described in Appendix C of Volume III. Using those BMPs reduces the predicted runoff rates and volumes and thus also reduces the size of the required flow control facilities. It is recommended that the HSPF calibration parameters be used if using WWHM when modeling a project within Des Moines Creek or Miller/Walker Creek basins both inside and outside of the Retrofit Area. The calibration parameters are different than the standard parameters in WWHM.

Application of sufficient types of On-Site Stormwater Management BMPs can result in reducing the effective impervious area and the converted vegetation areas such that a flow control facility is not required. Application of "Full Dispersion," per the Ecology Manual, also results in eliminating the flow control facility requirement for those areas that are "fully dispersed."

See the guidelines in Appendix I-D for Minimum Requirement #8 and directions concerning use of the Western Washington Hydrology Model for information about the approach for protecting wetland hydrologic conditions.

Diversions of flow from perennial streams and from wetlands can be considered if significant existing (i.e., pre-project) flooding, stream stability, water quality, or aquatic habitat problems would be solved or significantly mitigated by bypassing stormwater runoff rather than providing stormwater detention and discharge to natural drainage features. Bypassing should not be considered as an alternative to applicable flow control or treatment if the flooding, stream stability,

water quality, or habitat problem to be solved would be caused by the project. In addition, the proposal should not exacerbate other water quality/quantity problems such as inadequate low flows or inadequate wetland water elevations. The existing problems and their solution or mitigation as a result of direct discharge should be documented by a stormwater engineer or scientist after review of any available drainage reports, basin plans, or other relevant literature. The restrictions in this minimum requirement on conveyance systems that transfer water to an exempt receiving water are applicable in these situations. Approvals by all regulatory authorities with relevant permits applicable to the project are necessary.

Ecology hopes to publish guidance concerning basin studies to develop basin-specific flow control strategies intended to stabilize stream channels and provide flows intended to protect and restore beneficial uses such as fish resources. The recommendations made in basin plans should be consistent with the requirements and intent of the federal Clean Water Act, the State Water Pollution Control Act, and any other applicable natural resources statutes, such as the Federal Endangered Species Act.

2.5.8 Minimum Requirement #8: Wetlands Protection

Applicability

The requirements below apply only to projects whose stormwater discharges into a wetland, either directly or indirectly (through a conveyance system).

Thresholds

The thresholds identified in Minimum Requirement #6, Runoff Treatment, and Minimum Requirement #7, Flow Control, shall also be applied to determine the applicability of this requirement to discharges to wetlands.

Standard Requirement

Projects shall comply with Guide Sheets #1 through #3 in Appendix I-D. The hydrologic analysis shall use the existing land cover condition to determine the existing hydrologic conditions unless directed otherwise by a regulatory agency with jurisdiction.

Additional Requirements

Stormwater treatment and flow control facilities shall not be built within a natural vegetated buffer, except for:

- **Necessary conveyance systems as approved by the Port, or**
- **As allowed in wetlands approved for hydrologic modification and/or treatment in accordance with Guide Sheet 2 in Appendix I-D.**

An adopted and implemented basin plan, or a Total Maximum Daily Load (TMDL, also known as a Water Clean-Up Plan) may be used to develop requirements for wetlands that are tailored to a specific basin.

Designs and plans must be consistent with the *Seattle-Tacoma International Airport Wildlife Hazards Management Plan* and the *Restrictive Covenants for Seattle-Tacoma International Airport Mitigation Sites*. These documents are available from the Aviation Environmental Programs group at Seattle-Tacoma International Airport.

The plant selection can be found in Appendix I-D and on the Port's website at: http://www.portseattle.org/community/environment/wildlife.shtml.

Objective

To ensure that wetlands receive the same level of protection as any other waters of the state. Wetlands are extremely important natural resources which provide multiple stormwater benefits, including groundwater recharge, flood control, and stream channel erosion protection. They are easily impacted by development unless careful planning and management are conducted. Wetlands can be severely degraded by stormwater discharges from urban development due to pollutants in the runoff and also due to disruption of natural hydrologic functioning of the wetland system. Changes in water levels and the frequency and duration of inundations are of particular concern.

Supplemental Guidelines

Appendix I-D, "Wetlands and Stormwater Management Guidelines," shall be used for discharges to natural wetlands and wetlands constructed as mitigation. While it is always necessary to pre-treat stormwater prior to discharge to a wetland, there are limited circumstances where wetlands may be used for additional treatment and detention of stormwater. These situations are considered in Guide Sheet 2 of Appendix I-D.

Note that if selective runoff bypass is an alternative being considered to maintain the hydroperiod, the hydrologic analysis must consider the impacts of the bypassed flow. For instance, if the bypassed flow is eventually directed to a stream, the flow duration standard, Minimum Requirement #7, applies to the bypass.

2.5.9 Minimum Requirement #9: Operation and Maintenance

An operation and maintenance manual (O&M manual) that is consistent with the provisions in the Port's *Stormwater Facilities, Inspections, Maintenance, and Operations Procedures Manual* and with Volume V of this Manual shall be provided for proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified. At private facilities, a copy of the O&M manual shall be retained on-site or within reasonable access to the site, and shall be transferred with the property to the new owner. For Port facilities, a copy of the O&M manual shall be retained in Port's Aviation Facilities and Infrastructure Department and the Aviation Maintenance Department. In coordination with the Facilities and Infrastructure Department, the Maintenance Department shall add the new facility to the Port's MAXIMO maintenance management system. For private facilities, a log of maintenance activity that indicates what actions were taken shall be kept and be available for inspection by the Port.

Objective

To ensure that stormwater control facilities are adequately maintained and operated properly.

Supplemental Guidelines

Inadequate maintenance is a common cause of failure for stormwater control facilities. The description of each BMP in Volumes II, III, and V includes a section on maintenance. Chapter 4 of Volume V includes a schedule of maintenance standards for drainage facilities.

2.5.10 Minimum Requirement #10: Off-Site Analysis and Mitigation (Applicable to Outside Retrofit Area)

Development projects that discharge stormwater off-site shall submit an off-site analysis report that assesses the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and that proposes appropriate mitigation of those impacts. An initial qualitative analysis shall extend downstream for the entire flow path from the project site to the receiving water or up to one mile, whichever is less. If receiving water is within one-quarter mile, the analysis shall extend within the receiving water to one-quarter mile from the project site. The analysis shall extend one-quarter mile beyond any improvements proposed as mitigation. The analysis must extend upstream to a point where any backwater effects created by the project cease. Upon review of the qualitative analysis, the Port may require that a quantitative analysis be performed.

The Off-Site Analysis, along with the other elements of the Stormwater Site Plan, should begin during the project pre-design stage in coordination with the Aviation Facilities and Infrastructure Department and the Environmental Department.

The existing or potential impacts to be evaluated and mitigated shall include:

- **Conveyance system capacity problems;**
- **Localized flooding;**
- **Upland erosion impacts, including landslide hazards;**
- **Stream channel erosion at the outfall location; and**
- **Violations of surface water quality standards as identified in a Basin/Watershed Plan or a TMDL (Water Clean-Up Plan), or violations of groundwater standards in a wellhead protection area.**

Objective

To identify and evaluate off-site water quality, erosion, slope stability, and drainage impacts that may be caused or aggravated by a proposed project, and to determine measures for preventing impacts and for not aggravating existing impacts. Aggravated shall mean increasing the frequency of occurrence and/or severity of a problem.

Supplemental Guidelines

Projects shall be required to initially submit, with the permit application, a qualitative analysis of each downstream system leaving a site. The analysis shall accomplish four tasks:

Task 1 – Define and map the study area

Submission of a site map showing property lines; a topographic map (at a minimum a USGS 1:24000 Quadrangle Topographic map) showing site boundaries, study area boundaries, downstream flow path, and potential/existing problems.

Task 2 – Review all available information on the study area

This shall include all available basin/watershed plans, groundwater management area plans, drainage studies, floodplain/floodway FEMA maps, wetlands inventory maps, Critical Areas maps, stream habitat reports, salmon distribution reports, etc.

Task 3 – Field inspect the study area

The design engineer shall physically inspect the existing on-site and off-site drainage systems of the study area for each discharge location for existing or potential problems and drainage features. An initial inspection and investigation shall include the following activities:

- Investigate problems reported or observed during the resource review.
- Locate existing/potential constrictions or capacity deficiencies in the drainage system.
- Identify existing/potential flooding problems.
- Identify existing/potential overtopping, scouring, bank sloughing, or sedimentation.
- Identify significant destruction of aquatic habitat (e.g., siltation, stream incision).
- Collect qualitative data on features such as land use, impervious surface, topography, soils, presence of streams, wetlands.
- Collect information on pipe sizes, channel characteristics, drainage structures.
- Verify tributary drainage areas identified in Task 1, above.
- Contact the Port's Water Resources Manager, local government office, neighboring property owners, and residents about drainage problems.
- Note date and weather at time of inspection.

Task 4 – Describe the drainage system, and its existing and predicted problems

For each drainage system component (e.g., pipe, culvert, bridge, outfall, pond, vault) the following shall be covered in the analysis: location, physical description, problems, and field observations.

All existing or potential problems (e.g., ponding water, erosion) identified in Tasks 2 and 3 above shall be described. The descriptions shall be used to determine whether adequate mitigation can be identified, or whether more detailed quantitative analysis is necessary. The following information shall be provided for each existing or potential problem:

- Magnitude of or damage caused by the problem
- General frequency and duration
- Return frequency of storm or flow when the problem occurs (may require quantitative analysis)
- Water elevation when the problem occurs
- Names and concerns of parties involved
- Current mitigation of the problem
- Possible cause of the problem
- Whether the project is likely to aggravate the problem or create a new one.

Appendix I-I, "Off-Site Analyses," contains general baseline off-site analyses for Gilliam, Des Moines, Walker and Miller creeks. Project proponents may use these analyses as a starting point to prepare project-specific analyses. If the project proponent's off-site analysis includes the areas covered in Appendix I-I, the information may serve as the off-site analysis provided the project proponent independently verifies that information is still accurate.

Upon review of the off-site analysis, the Port may require mitigation measures deemed adequate for the problems, or a quantitative analysis, depending upon the presence of existing or predicted flooding, erosion, or water quality problems, and on the proposed design of the on-site drainage facilities. The analysis shall repeat Tasks 3 and 4 above, using quantitative field data including profiles and cross-sections.

The quantitative analysis shall provide information on the severity and frequency of an existing problem or the likelihood of creating a new problem. It shall evaluate proposed mitigation intended to avoid aggravation of the existing problem and to avoid creation of a new problem.

2.6 Optional Guidance

Not used

2.7 Adjustments

Adjustments to the Minimum Requirements may be granted prior to permit approval and construction. The Port may grant an adjustment provided that a written finding of fact is prepared by the Port which demonstrates that:

- **The adjustment provides substantially equivalent environmental protection.**
- **The objectives of safety, function, environmental protection and facility maintenance, based upon sound engineering, are met.**

2.8 Exceptions/Variances

Exceptions to the Minimum Requirements may be granted prior to permit approval and construction. The Port may grant an exception following legal public notice of an application for an exception, legal public notice of the administrator's decision on the application, and a written finding of Port's decision to grant an exception.

The Port may grant an exception to the minimum requirements if such application imposes a severe and unexpected economic hardship. To determine whether the application imposes a severe and unexpected economic hardship on the project applicant, the Port must consider and document- with written findings of fact – the following:

- **The current (pre-project) use of the site, and**
- **How the application of the minimum requirement(s) restricts the proposed use of the site compared to the restrictions that existed prior to the adoption of the Minimum Requirements; and**
- **The possible remaining uses of the site if the exception were not granted; and**
- **The uses of the site that would have been allowed prior to the adoption of the minimum requirements; and**
- **A comparison of the estimated amount and percentage of value loss as a results of the minimum requirements versus the estimated amount and percentage of value loss as a results of requirements that existed prior to adoption of the minimum requirements; and**
- **The feasibility for the owner to alter the project to apply the minimum requirements.**

In addition, any exception must meet the following criteria:

- **The exception will not increase risk to the public health and welfare, nor be injurious to other properties in the vicinity and/or downstream, and to the quality of waters of the state; and**
- **The exception is the least possible exception that could be granted to comply with the intent of the Minimum Requirements.**

Supplemental Guidelines

The adjustment and exception provisions are an important element of the plan review and enforcement programs. They are intended to maintain a necessary flexible working relationship between the Port and applicants. The Port considers these requests judiciously, keeping in mind both the need of the applicant to maximize cost-effectiveness and the need to protect off-site properties and resources from damage.

Chapter 3
PREPARATION OF STORMWATER SITE PLANS

The Stormwater Site Plan is the comprehensive report containing all of the technical information and analysis necessary for the Port to evaluate a proposed new development or redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics. The scope of the Stormwater Site Plan also varies depending on the applicability of Minimum Requirements as described in Chapter 2 (see Section 2.4).

This chapter describes the contents of a Stormwater Site Plan and provides a general procedure to prepare the plan. The Port's templates (three) for Stormwater Site Plan development for projects within the retrofit area are provided in Appendix 3A. The specific Best Management Practices (BMPs) and design methods and standards to be used are contained in Volumes II through V of this manual. The content of, and the procedures for preparing a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) are covered in detail in Chapter 3 of Volume II. Guidelines for selecting BMPs are given in Chapter 4 of this volume.

The goal of this chapter is to provide a framework for uniformity in plan preparation. Such uniformity will promote predictability and help secure prompt Port review and approval. Properly drafted engineering plans and supporting documents will also facilitate the operation and maintenance of the proposed system long after its review and approval.

State law requires that engineering work be performed by or under the direction of a professional engineer licensed to practice in Washington State. Plans involving construction of treatment facilities or flow control facilities (detention ponds or infiltration basins), structural source control BMPs, or drainage conveyance systems generally involve engineering principles and shall be prepared by or under the direction of a licensed engineer. Construction SWPPPs that involve engineering calculations must also be prepared by or under the direction of a licensed engineer.

Port-Provided Stormwater Site Plan Database and Analyses

Within the STIA Retrofit Area, and in other areas as available, the Port will provide the following information beneficial to Stormwater Site Plan preparation:

- Current aerial photo coverage consistent with the Port's Environmental Management Information System (EMIS) database
- Best available ground surface elevation data such as LiDAR and Port topographic survey data and mapping (typically within the STIA Retrofit Area)
- Impervious and pervious land cover characteristics from the Port's EMIS (typically within the STIA Retrofit Area)
- Available geologic and hydrogeologic information and mapping (Booth and Waldron 2004) (Aspect Consulting 2008) (Cardno and Aspect Consulting 2016)

- Available project infiltration testing and design rates (Hart Crowser 2000) (Landau 2003) (Hart Crowser 2007) (Otak 2013) (GeoEngineers 2014) (Pacific Groundwater Group 2015) (Cardno and Aspect Consulting 2016)

The Port has previously completed stormwater retrofit improvements and supporting analyses within the STIA Retrofit Area (Retrofit Area) that are part of prior Stormwater Site Plans and associated modeling and design reports (RW Beck 2008) (SAIC 2013). Therefore, for preparation of Stormwater Site Plans serving STIA, refer to information in those Port-supplied documents prior to collecting additional data or conducting additional project-specific analyses. The applicable Retrofit Area guidance for each component of the Stormwater Site Plan is included in the step-by-step guidance provided in Section 3.2.

Note: FAA requirements, regulations, and limitations specific to STIA zones, facilities and critical areas zones limit the feasibility of LID at STIA. These site constraints are detailed in the STIA LID Guideline

3.2 Stormwater Site Plans: Step-by-Step

The steps involved in developing a Stormwater Site Plan are:

1. Site Analysis - Collect and Analyze Information on Existing Conditions
2. Prepare Preliminary Development Layout
3. Perform Off-Site Analysis
4. Determine Applicable Minimum Requirements
5. Prepare a Permanent Stormwater Control Plan
6. Prepare a Construction Stormwater Pollution Prevention Plan
7. Complete the Stormwater Site Plan
8. Check Compliance with All Applicable Minimum Requirements

The level of detail needed for each step depends upon the project size as explained in the individual steps. A narrative description of each of these steps follows.

Step 1. Site Analysis - Collect and Analyze Information on Existing Conditions

Site analysis results shall be submitted as part of an Existing Conditions Summary and a site map within the Stormwater Site Plan submittal (see Step 7). Part of the information in this step should be used to help prepare the Construction Stormwater Pollution Prevention Plan. The authorized project reviewer for the Port or local government with jurisdiction may choose to waive certain components required in this section as appropriate.

Low impact development site design is intended to complement the predevelopment conditions on the site. However, not all sites are appropriate for a complete LID project, as FAA requirements, regulations, limitations, and site conditions will determine the

feasibility of using LID techniques. The development context shall be established by an initial site analysis consistent with the requirements of this section.

The initial inventory and analysis process will provide baseline information necessary to design strategies that utilize areas most appropriate to evaporate, transpire, and infiltrate stormwater, and achieve the goal of restoring the pre-development natural hydrologic conditions on the site.

Projects located within the STIA Retrofit Area may use the site survey database and base mapping provided by the Port which includes many of the Item 1 survey elements listed above. Additional project-specific information can be added to supplement the required base map items.

The site analysis shall include, at a minimum, the following information for projects required to meet Minimum Requirements 1 – 5:

1) A survey prepared by a registered land surveyor (or other qualified professional) showing:
   - Existing Port, public and private development, including utility infrastructure on and adjacent to the site if publicly available.
   - Minor hydrologic features, including seeps, springs, closed depression areas, and drainage swales.
   - Major hydrologic features with a streams, wetland, and water body survey and classification report showing wetland and buffer boundaries consistent with the requirements of the Port or local jurisdiction.
   - Note that site visits should be conducted during winter months and after significant precipitation events to identify undocumented surface seeps or other indicators of near surface ground water.
   - Flood hazard areas on or adjacent to the site, if present.
   - Geologic Hazard areas and associated buffer requirements as defined by the Port or local jurisdiction.
   - Aquifer and wellhead protection areas on or adjacent to the site, if present.
   - Topographic features that may act as natural stormwater storage, infiltration or conveyance.

   Contours for the survey are as follows:
   - Up to 5 percent slopes, one-foot contours
   - Five percent to 10 percent slopes, two-foot contours.
   - Over 10 percent to less than 20 percent slopes, five-foot contours.
   - Twenty percent or greater slopes, 10-foot contours.

- Elevations shall be at 25-foot intervals.

2) A soils report prepared by a professional soil scientist certified by the Soil Science Society of America (or an equivalent national program), a locally licensed on-site sewage designer, or by other suitably trained persons working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. The report shall identify:

   a) Underlying soils on the site utilizing soil surveys, soil test pits, soil borings, or soil grain size analyses (see http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm for soil survey information).

   b) The results of saturated hydraulic conductivity (Ksat) testing to assess infiltration capability and the feasibility of rain gardens, bioretention, and permeable pavement. Testing should occur between December 1 and April 1. Use small-scale Pilot Infiltration Test (PIT), or other small-scale test acceptable to the Port or local jurisdiction. Grain size analyses may substitute for infiltration tests on sites with soils unconsolidated by glacial advance.

      Note: NRCS soils data is not available within the STIA airfield area since significant soils modification has occurred with airport construction. Limited NRCS soils data are available for surrounding Port properties. Please also refer to soils data within the Retrofit Area as summarized below.

      The certified soils professional or engineer can exercise discretion concerning Ksat testing if in their judgement, information exists confirming that the site is unconsolidated outwash material (high infiltration rates) and there is adequate depth to groundwater (3 feet minimum from bottom of a rain garden, bioretention, or permeable pavement installation unless otherwise approved by the Port).

   c) The results of testing for a hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for a rain garden, bioretention facility, or permeable pavement. Testing with a monitoring well or an excavated pit must extend to a depth of at least 3 feet below the estimated bottom elevation of a rain garden/bioretention excavation and at least 3 feet below the subgrade surface of a permeable pavement. This analysis should be performed in the winter season (December 21 through March 21). The optimum time to test for depth to groundwater is usually late winter and shortly after an extended wet period. Site historic information and evidence of high groundwater in the soils can also be used.

      Note: This testing only applies where LID facilities are considered feasible and consistent with the STIA LID Guideline.

This testing only applies where LID facilities are considered feasible and consistent with the STIA LID Guideline.

3) If there are native soil and vegetation protection areas proposed for the site, provide a survey of existing native vegetation cover by a licensed architect, arborist, qualified biologist or project proponent identifying any forest areas on the site and a plan to protect those areas. The preserved area should be placed in a separate tract or protected through recorded easements.

This requirement will typically not apply within the Retrofit area since the pervious area soils have been modified for airport facilities construction, and native vegetation typically does not exist. If those areas are present, they are managed in accordance with FAA regulations and requirements for eliminating obstructions and foreign object debris (FOD), and controlling hazardous wildlife attractants.

The site analysis shall include, at a minimum, the following information for projects required to meet Minimum Requirements 1 –9:

1) A survey prepared by a registered land surveyor or civil engineer showing:
   - Existing Port, public and private development, including utility infrastructure on and adjacent to the site if publicly available,
   - Minor hydrologic features, including seeps, springs, closed depression areas, and drainage swales.
   - Major hydrologic features with a streams, wetland, and water body survey and classification report showing wetland and buffer boundaries consistent with the requirements of the Port or local jurisdiction.
   - Note that site visits should be conducted during winter months and after significant precipitation events to identify undocumented surface seeps or other indicators of near surface ground water.
   - Flood hazard areas on or adjacent to the site, if present.
   - Geologic Hazard areas and associated buffer requirements as defined by the Port or local jurisdiction.
   - Aquifer and wellhead protection areas on or adjacent to the site, if present.
   - Topographic features that may act as natural stormwater storage, infiltration or conveyance.

   Contours for the survey are as follows:
   - Up to 5 percent slopes, one-foot contours
   - Up to 2 percent slopes, one-foot contours.
   - Five percent to 10 percent slopes, two-foot contours.

- Over 10 percent to less than 20 percent slopes, five-foot contours.
- Twenty percent or greater slopes, 10-foot contours.
- Elevations shall be at 25-foot intervals.

2) A soils report prepared by a professional soil scientist certified by the Soil Science Society of America (or an equivalent national program), a locally licensed on-site sewage designer, or by other suitably trained persons working under the supervision of a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. The report shall identify:

NRCS soils data is not available within the STIA airfield area since significant soils modification has occurred with airport construction. Limited NRCS soils data are available for surrounding Port properties. Please also refer to soils data within the Retrofit area as summarized below.

a) Underlying soils on the site utilizing soil surveys, soil test pits, soil borings, or soil grain size analyses (see http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm for soil survey information).

Prepare detailed logs for each test pit or soil boring and a map showing the location of the test pits or borings. Logs must include depth of pit or boring, soil descriptions, depth to water (if present), and presence of stratification. Depth should extend to a minimum of 3 feet below estimated bottom elevation of bioretention facilities and road subgrade. Logs must substantiate whether stratification does or does not exist. The licensed professional may consider additional methods of analysis to substantiate the presence of stratification.

Projects located within the Retrofit Area may use geologic and groundwater information compiled or referenced in the Port's *STIA Infiltration Feasibility Assessment* as input to the soils report to address Item 2 elements. This should substantially reduce or eliminate the need for project-specific geologic and infiltration testing that may be required, typically only where applicable to LID facilities that are considered feasible and consistent with the STIA LID Guideline.

Soil stratigraphy should be assessed for low permeability layers, highly permeable sand/gravel layers, depth to ground water, and other soil structure variability necessary to assess subsurface flow patterns. Soil characterization for each soil unit (soil strata with the same texture, color, density, compaction, consolidation and permeability) should include:

- Grain size distribution
- Textural class

- Percent clay content
- Cation exchange capacity
- Color/mottling
- Variations and nature of stratification

b) The results of saturated hydraulic conductivity (Ksat) testing to assess infiltration capability and the feasibility of rain gardens, bioretention, and permeable pavement. Testing should occur between December 1 and April 1. Use small-scale Pilot Infiltration Test (PIT), or other small-scale test acceptable to the Port or local jurisdiction. Grain size analyses may substitute for infiltration tests on sites with soils unconsolidated by glacial advance.

   Placement of Ksat tests should be carefully considered to reduce cost. A few strategically placed soil test pits and saturated hydraulic conductivity test sites are generally adequate for initial site assessment and for smaller sites (e.g., less than an acre). On larger project sites, a more detailed soil assessment and additional Ksat testing may be necessary to direct placement of impervious surfaces such as structures away from soils that can most effectively infiltrate stormwater, and placement of permeable pavement roads, parking lots, driveways, walks, and bioretention/rain gardens over those soils. See Section 3.4 in Volume III of this manual for more details. The Ksat tests are also necessary as input to the runoff model to predict the benefits of LID BMPs which infiltrate.

c) The results of testing for a hydraulic restriction layer (groundwater, soil layer with less than 0.3 in/hr Ksat, bedrock, etc.) under possible sites for a rain garden, bioretention facility, or permeable pavement. If the general site assessment cannot confirm that the seasonal high ground water or hydraulic restricting layer will be greater than 3 feet below the bottom of the bioretention, or greater than 3 feet below the bottom of the lowest gravel base course of permeable pavement, monitoring wells or excavated pits should be placed strategically to assess depth to ground water. This analysis should be performed during the wet season prior to construction. Monitoring with a continuously logging censor between Dec. 21 and Mar. 21 provides the most thorough information. Monitoring for lesser time periods can be accepted but increases risk. Site historical data regarding ground water levels can be

> This testing only applies where LID facilities that are considered feasible and consistent with the *STIA LID Guideline.* The certified soils professional or engineer can exercise discretion concerning Ksat testing if in their judgement, information exists confirming that the site is unconsolidated outwash material (high infiltration rates) and there is adequate depth to groundwater (3 feet minimum from bottom of a rain garden, bioretention, or permeable pavement installation unless otherwise approved by Port Environmental).

used in lieu of field testing if the data are reliable and sufficient. Also, soil evidence of historical ground water elevations may be used.

Special considerations are necessary for highly permeable gravel areas. Signs of high ground water will likely not be present in gravelly soils lacking finer grain material such as sand and silt. Test pit and monitoring wells may not show high ground water levels during low precipitation years. Accordingly, sound professional judgment, considering these factors and water quality treatment needs, is required to design multiple and dispersed infiltration facilities on sites with gravel deposits.

d) If on-site infiltration may result in shallow lateral flow (interflow), the conveyance and possible locations where that interflow may re-emerge should be assessed by a professional engineer, geologist, hydrogeologist, or engineering geologist registered in the State of Washington. Available geologic and groundwater information in the Port's EMIS database is compiled in the Port's STIA Infiltration Feasibility Assessment. This may require placement of groundwater monitoring wells to determine existing groundwater gradients and flow. In general, a minimum of three wells associated with three hydraulically connected surface or groundwater features, are needed to determine the direction of flow and gradient.

> Additional Groundwater monitoring may apply where LID facilities are considered feasible and consistent with the *STIA LID Guideline.*

3) If there are native soil and vegetation protection areas proposed for the site, provide a survey of existing native vegetation cover by a licensed architect, arborist, qualified biologist or project proponent identifying any forest areas on the site and a plan to protect those areas. The preserved area should be placed in a separate tract or protected through recorded easements for individual lots.

Step 2. Prepare Preliminary Development Layout

Based upon the analysis of existing site conditions, locate the buildings, roads, parking lots, and landscaping features, on-site stormwater management BMPs, and preliminary location of stormwater treatment and retention/detention facilities for the proposed development. Consider the following points when laying out the site:

- Fit development to the terrain to minimize land disturbance;
- Confine construction activities to the least area necessary, and away from critical areas;
- Preserve areas with natural vegetation (especially forested areas) as much as possible;
- On sites with a mix of soil types, locate impervious areas over less permeable soil (e.g., till), and try to restrict development over more porous soils (e.g., outwash) or take advantage of them by locating bioretention/rain gardens and permeable pavement over them (only where those facilities are considered feasible and consistent with the STIA LID Guideline);

- Cluster buildings together;
- Minimize impervious areas; and
- Maintain and utilize the natural drainage patterns.

The development layout designed here will be used for determining threshold discharge areas, for calculating whether size and flow rate thresholds under Minimum Requirements #6, #7, and #8 are exceeded (see Chapter 2), and for the drawings and maps required for the Stormwater Site Plan.

Coordinate with Port Environmental on project-specific preliminary design development layout associated with stormwater facilities. Also, refer to Chapters 2 and 3 in the LID Technical Guidance Manual Hannahfor Puget Sound (2012) for more detail. Note that the LID Technical Guidance Manual for Puget Sound (2012) is for additional information purposes only. You must follow the guidance in this manual if there are discrepancies between this manual and the LID Technical Guidance Manual for Puget Sound (2012).

Step 3. Perform an Off-Site Analysis

The Port may require an off-site analysis for projects beyond the Retrofit Area that discharge stormwater off-site. The phased off-site analysis approach outlined in Minimum Requirement #10 is recommended to determine if there are any flow or water quality problems that may affect how stormwater is mitigated on-site.

This phased approach relies first on a qualitative analysis. If the qualitative analysis indicates a potential problem, the Port may require mitigation or a quantitative analysis. For more information, see Section 2.5.10.

Appendix I-I, "Off-Site Analyses," contains general baseline off-site analyses for Gilliam, Des Moines, Walker and Miller Creeks. Project proponents may use these analyses as a starting point to prepare project specific analyses. If the project proponent's off-site analysis includes the areas covered in Appendix I-I, the information may serve as the off-site analysis provided the project proponent independently verifies that information is still accurate.

Step 4. Determine and Read the Applicable Minimum Requirements

Section 2.4 establishes project size thresholds for the application of Minimum Requirements to new development and redevelopment projects. Figures I-2.4.1 through I-2.4.3 provide the same thresholds in a flow chart format. Based on the preliminary layout, determine whether Minimum Requirements #1 through #5 apply to the project, or whether Minimum Requirements #1 through #10 apply.

Projects within the STIA Retrofit Area have the same requirements as new and re-development projects in order to minimize the impacts from new surfaces. However, within the STIA Retrofit Area, regional facilities have been constructed which bring the replaced surfaces up to new stormwater standards. Therefore, replaced surfaces aren't required to be brought up to new stormwater standards. As long as the replaced surfaces have similar pollution-generating potential, the amount of pollutants discharged should not be significantly different.

Note the Following Port Specific Criteria:

The Port's regional stormwater facilities may be used as an alternative method of meeting Minimum Requirements 6, 7, and 8, through documented engineering reports prepared by the proponent detailing how the proposed facilities meet these requirements for the proposed sites and other existing sites that drain to them. Such facilities must be operational prior to and must have capacity for new development. The Port has implemented regional stormwater facilities to meet Minimum Requirements 6, 7, and 8 in the Retrofit Area (for the land use at the time the facilities were constructed). The Port has also developed engineering reports detailing the flow control and water quality treatment provided by existing regional facilities (SAIC 2013). After the proponent provides this analysis for the proposed project, the Port will review the proponent's project and analysis to determine the appropriate level of existing stormwater facility's available capacity for use by the proponent's project.

Step 5. Prepare a Permanent Stormwater Control Plan

Select stormwater control BMPs and, for projects subject to Minimum Requirements #1 through #10, treatment and flow control facilities that will serve the project site in its developed condition. The selection process for treatment and flow control facilities is presented in detail in Chapter 4 of this volume and Chapter 2 of Volume V.

The Port's templates for Stormwater Site Plan Development, inclusive of Permanent Stormwater Control Plans for projects within the retrofit area are provided in Appendix 3A. Detailed guidelines for sizing flow control facilities are presented in Volume III.Appendix F of Volume III lists the Port-developed computer models that are available to facilitate sizing of flow control facilities in the Des Moines Creek and Miller/Walker Creek basins.

A preliminary design of the on-site stormwater management BMPs and treatment/flow control facilities is necessary to determine how they will fit within and serve the entire preliminary development layout. After a preliminary design is developed, the designer may want to reconsider the site layout to reduce the need for construction of facilities, or to reduce the size of the facilities by reducing the amount of hard – especially impervious - surfaces created and increasing the areas to be left undisturbed. After the designer is satisfied with the BMP and facilities selections, the information must be presented within a Permanent Stormwater Control Plan for review with the Port. The Permanent Stormwater Control Plan should contain the following sections.

Permanent Stormwater Control Plan – Existing Site Hydrology

If flow control facilities are proposed to comply with Minimum Requirement #7, provide a listing of assumptions and site parameters used in analyzing the pre-developed site hydrology. The acreage, soil types, and land covers used to determine the pre-developed flow characteristics, along with basin maps, graphics, and exhibits for each subbasin affected by the project should be included. The pre-developed conditions must be those noted in Figure I-2.5.2.

Provide a topographic map, of sufficient scale and contour intervals to determine basin boundaries accurately, and showing:

- Delineation and acreage of areas contributing runoff to the site;
- If there are existing downstream regional flow control and/or treatment facilities, delineation and acreage of areas contributing runoff to those facilities;
- Flow control facility location (proposed and existing, if any);
- Outfall (for proposed and existing facility, if any);
- Overflow route; and
- All natural streams and drainage features.

The direction of flow, acreage of areas contributing drainage, and the limits of development should be indicated. Each basin within or flowing through the site should be named and model input parameters referenced.

Permanent Stormwater Control Plan – Developed Site Hydrology

All Projects

Note the Following Port Specific Criteria:

Total areas of effective impervious surfaces, pollution-generating impervious surfaces, and pollution-generating pervious surfaces must be tabulated for each threshold discharge area for which On-Site Stormwater Management BMPs are the sole stormwater management approach. These are needed to verify that the thresholds for application of treatment facilities (Minimum Requirements #6 [Runoff Treatment] and #8 [Wetlands Protection]) and flow control facilities (Minimum Requirements #7 [Flow Control] and #8 [Wetlands Protection]) are not exceeded.

In addition, for sites that have an existing downstream flow control and/or treatment facilities, provide the existing and design total areas of effective impervious surfaces (if a flow control facility), or pollution-generating hard surface and pollution-generating pervious surfaces (if a treatment facility) to those facilities in tabular form. The Port will provide the design and existing conditions drainage and land cover areas from the EMIS database and design report documenting that information for existing facilities.

If the Port determines that the project drains to an existing Port facility that appears to have additional capacity, the project proponent shall consult with Port Environmental to determine if the existing facility may be used by the project to partially or fully meet the flow control requirements for the project.

Projects and Threshold Discharge Areas within Projects that Require Treatment and Flow Control Facilities:

Provide narrative, mathematical, and graphic presentations of model input parameters selected for the developed site condition, including acreage, soil types, and land covers, road layout, and all drainage facilities.

Developed basin areas, threshold discharge areas, and flows should be shown on a map and cross-referenced to computer printouts or calculation sheets. Developed basin flows should be listed and tabulated.

Any documents used to determine the developed site hydrology should be included. Whenever possible, maintain the same basin name as used for the pre-developed site hydrology. If the boundaries of a basin have been modified by the project, that should be clearly shown on a map and the name modified to indicate the change.

Final grade topographic maps shall be provided. Finished floor elevations should be shown where they are relevant.

Permanent Stormwater Control Plan – Performance Standards and Goals

If treatment facilities are proposed, provide a listing of the water quality menus used (Chapter 3, Volume V). If flow control facilities are proposed, provide a confirmation of the flow control standard being achieved. Where LID facilities application is considered feasible and consistent with the STIA LID Guideline, indicate which priority LID BMPs will be applied under Minimum Requirement #5. Where LID facilities application is found to not be required consistent with the STIA LID Guideline, document the competing needs and infeasibility criteria basis for that outcome.

Where LID facilities application is considered feasible and consistent with the *STIA LID Guideline,* indicate which priority LID BMPs will be applied under Minimum Requirement #5.

Permanent Stormwater Control Plan – On-site Stormwater Management LID Features

A description of the proposed project including:

1. Project narrative showing how the project will fulfill the requirements for On-site Stormwater Management to the extent feasible.
2. Total area of Native Vegetation retained.
3. Provide a scale drawing of the location of On-site Stormwater Management BMPs and the areas served by them.
4. For projects where LID BMPs are determined to be feasible, select the priority LID BMPs for use under Minimum Requirement #5 using step-by-step procedures contained in the STIA LID Guideline. Where not determined as feasible, provide an explanation and documentation of the competing needs and infeasibility criteria basis for that outcome, and, where needed, include a citation of unsuitable site conditions for LID BMPs application in a soils report. Depending on the type and design of the selected LID BMP (where feasible), it may also contribute to satisfying Minimum Requirement #6 and/or #7.
5. Provide design details, figures, and maintenance instructions for each On-site Stormwater Management BMP.
6. Areas of disturbed soils to be amended (NOTE: All lawn and landscape areas are to meet BMP T5.13. Use of compost is one way to meet this requirement).

Permanent Stormwater Control Plan – Flow Control System

Provide a drawing of the flow control facility and its appurtenances. This drawing must show basic measurements necessary to calculate the storage volumes available from zero to the maximum head, all orifice/restrictor sizes and head relationships, control structure/restrictor placement, and placement on the site. Provide sufficient details on the drawings to show how the facility conforms to design criteria in Volume III for detention facilities or infiltration facilities. If distributed bioretention facilities and/or storage below permeable pavement are used to help meet the LID performance standard option of

Minimum Requirement #5, and/or Minimum Requirement #7, drawings are necessary to confirm accurate representation in the runoff model. Identify locations and approximate size of all permeable pavement surfaces and bioretention facilities to be installed as part of this project Supporting areas such as the flow paths for dispersion BMPs should also be shown.

Include computer printouts, calculations, equations, references, storage/volume tables, and/or graphs as necessary to show results and methodology used to determine the storage facility volumes.

If there is a downstream Port flow control facility within the STIA Retrofit Area that must work in conjunction with any proposed flow control facilities, the provided results must show the combined operation of the facilities and show that flow control requirements are not exceeded downstream of both the existing and proposed facilities.

Hydrologic and hydraulic models have already been developed for much of the STIA Retrofit area. For projects within the STIA Retrofit Area, the project proponent is required to use the Port-developed models for that area. Use of these models is also recommended for projects outside of the STIA Retrofit area, but within either the Des Moines or Miller/Walker Creek basins. These models are available from the Port upon request. Where one of the Port's existing models, the Western Washington Hydrology Model (WWHM), or other approved runoff model is used, its documentation files should be included.

Permanent Stormwater Control Plan – Water Quality System

Provide a drawing of the proposed treatment facilities, and any structural source control BMPs. The drawing must show overall measurements and dimensions, placement on the site, location of inflow, bypass, and discharge systems. If distributed bioretention facilities and/or infiltration below pollution-generating hard surfaces are used to help meet treatment requirements, drawings are necessary to confirm accurate representation in the runoff model. Identify locations and approximate dimensions of those facilities to be installed as part of this project, including those that will be installed on individual lots by subsequent contractors.

Include WWHM or other approved model printouts, calculations, equations, references, and graphs as necessary to show the facilities are designed consistent with the Volume V requirements and design criteria. If bioretention and/or infiltration through adequate soils (see Site Suitability Criteria in Section 3.3, Volume III) below pollution-generating hard surfaces will be used to help meet treatment requirements, the runoff model output files must include the volume of water that has been treated through those BMPs. The summation of those volumes and the volume treated through a centralized, conventional treatment system must meet or exceed 91% of the total stormwater runoff file. The total stormwater runoff file includes:

- Stormwater that has infiltrated through a bioretention facility and stormwater that has infiltrated through adequate soils below pollution-generating hard surfaces.
- Stormwater that passes through a properly sized treatment facility. Note that stormwater that is re-collected below a bioretention facility and routed to a centralized treatment facility should not be counted twice.
- Stormwater that does not receive treatment due to bypass of, or overflow from a treatment facility or a bioretention facility (if the overflow is not subsequently routed to a treatment facility).

Permanent Stormwater Control Plan – Conveyance System Analysis and Design

Present an analysis of any existing conveyance systems, and the analysis and design of the proposed stormwater conveyance system for the project. At a minimum, present an analysis of on-site hydrologic connectivity of surficial conveyance channels and/or pipes, and points of concentration. If the Port or local government requires an off-site analysis, include the results of the analysis here. This information should be presented in a clear, concise manner that can be easily followed, checked, and verified. All pipes, culverts, catch basins, channels, swales, and other stormwater conveyance appurtenances must be clearly labeled and correspond directly to the engineering plans. Indicate where the project conveyance system ties into the Port's existing conveyance system.

Step 6. Prepare a Construction Stormwater Pollution Prevention Plan

Projects that add or replace less than 2,000 square feet of impervious surface or disturb less than 7,000 square feet of land are not required to prepare a construction SWPPP, but must still develop on-site construction management BMPs that pertain to the project site. Projects that disturb more than one acre must implement a monitoring plan as described in the Port's Programmatic Construction Stormwater Pollution Prevention Plan.

> Projects in which the new, replaced, or new plus replaced impervious surfaces total 2,000 square feet or more, or disturb 7,000 square feet or more of land must prepare a project-specific construction SWPPP.

An adequate Construction SWPPP includes a narrative and drawings. The narrative is a written statement to explain and justify the pollution prevention decisions made for a particular project. The narrative contains concise information concerning existing site conditions, construction schedules, and other pertinent items that are not contained on the drawings. The drawings and notes describe where and when the various BMPs should be installed, the performance the BMPs are expected to achieve, and actions to be taken if the performance goals are not achieved.

The Construction SWPPP must address the 13 Elements listed in Section 2.5.2 – Minimum Requirement #2 of this Volume, unless site conditions warrant an exemption and this is clearly justified in the narrative of the Construction SWPPP. These elements are described in detail in Volume II, Chapter 3. They cover the general water quality protection strategies

for limiting site impacts, preventing erosion and sedimentation, and managing activities and sources.

On construction sites that discharge to surface water, the primary consideration in the preparation of the Construction SWPPP is compliance with the Construction Stormwater Discharge Limitations contained in the Port's NPDES Permit. The step-by-step procedure outlined in Volume II, Section 3.3 is recommended for the development of these Construction SWPPPs. A checklist is contained in Volume II, Section 3.3 that may be helpful in preparing and reviewing the Construction SWPPP.

The Port NPDES Permit has project-specific effluent limits.

On construction sites that infiltrate all stormwater runoff, the primary consideration in the preparation of the Construction SWPPP is the protection of the infiltration facilities from fine sediments during the construction phase and protection of groundwater from other pollutants. Several of the other elements are very important at these sites as well, such as marking the clearing limits, establishing the construction access, and managing the project.

Step 7. Complete the Stormwater Site Plan

The Stormwater Site Plan encompasses the entire submittal to the Port. It includes the following documents:

Project Overview

The project overview must provide a general description of the project, predeveloped and developed conditions of the site, site area and size of the improvements, and the pre- and post-developed stormwater runoff conditions. The overview should summarize difficult site parameters, the natural drainage system, existing downstream flow control and/or water quality treatment facilities, whether it is inside or outside the Retrofit Area and drainage to and from adjacent properties, including bypass flows.

A vicinity map should clearly locate the property, identify all roads bordering the site, locate nearby existing water quality treatment and/or flow control facilities, show the route where stormwater runs off-site to the local natural receiving water, and show significant geographic features and sensitive/critical areas (streams, wetlands, lakes, steep slopes, etc.).

A site map, using a minimum USGS 1:2400 topographic map as a base, should display:

- Acreage and outlines of all drainage basins, including the downstream flow control and/or treatment facilities if they exist;
- Existing stormwater drainage to and from the site;
- Routes of existing, construction, and future flows at all discharge points; and
- The length of travel from the farthest upstream end of a proposed storm drainage system to any proposed flow control and treatment facility.

- Flow control and/or water quality treatment facilities that are either nearby or may be impacted by the project.
- A soils map should show the soils within the project site as verified by field testing (where required). Soil Survey maps may be used where available. However, it is the designer's responsibility to ensure that the soil types of the site are properly identified and correctly used in the hydrologic analysis.

Existing Conditions Summary

This is the summary described previously under Step 1. It should include:

- The natural receiving waters to which the stormwater runoff discharges, either directly or eventually (after flowing through the downstream conveyance system); and
- Any area-specific requirements established in local plans, ordinances, or regulations or in Water Clean-up Plans approved by Ecology.

Off-Site Analysis Report

This is the report described previously in Step 3.

Permanent Stormwater Control Plan

This is the plan described previously in Step 5.

Construction Stormwater Pollution Prevention Plan

This is the plan described previously in Step 6.

Special Reports and Studies

Include any special reports and studies conducted to prepare the Stormwater Site Plan (e.g., soil testing, infiltration testing, depth to groundwater, wetlands delineation).

Other Permits

Include a list of other necessary permits and approvals as required by other regulatory agencies, if those permits or approvals include conditions that affect the drainage plan, or contain more restrictive drainage-related requirements.

Operation and Maintenance Manual

Submit an operation and maintenance manual for each flow control, treatment, and/or bioretention facility. The manual should contain a description of the facility, what it does, and how it works. The manual should include as-built drawings that at a minimum include the site location, facility overview, and, if applicable, operational drawings showing valve orientation for all possible operational scenarios including but not limited to normal operation, spill containment, system bypass for maintenance, and specific detail drawings showing key system components. The I&O&M manual contains inspection and maintenance forms for common BMP types on and around STIA. These forms can be used as a guide in identifying and describing the maintenance tasks and recommended frequencies of each task associated with each BMP type.

Include a recommended maintenance activity log in the Port's format that will indicate what actions will have to be taken.

The manual must be kept within the Port's Aviation Environmental, Facilities and Infrastructure, and Maintenance Departments, available for inspections conducted by the Port.

Step 8. Check Compliance with All Applicable Minimum Requirements

A Stormwater Site Plan as designed and implemented should specifically fulfill all Minimum Requirements applicable to the project. The Stormwater Site Plan should be reviewed to check that these requirements are satisfied.

3.3 Plans Required After Stormwater Site Plan Approval

This section includes the specifications and contents required of those plans submitted after the Port has approved the original Stormwater Site Plan.

3.3.1 Stormwater Site Plan Changes

If the designer wishes to make changes or revisions to the originally approved Stormwater Site Plan, the proposed revisions shall be submitted to the Port prior to construction. The submittals should include the following:

- Substitute pages of the originally approved Stormwater Site Plan that include the proposed changes.
- Revised drawings showing any structural changes.
- Any other supporting information that explains and supports the reason for the change.

3.3.2 Final Corrected Plan Submittal

If the project included construction of conveyance systems, LID BMP facilities, treatment facilities, flow control facilities, or structural source control BMPs, the applicant shall submit a final corrected plan ("as-builts") to the Aviation Project Management Group if the facility is part of a project managed by the Project Management Group, otherwise submit to Aviation Facilities and Infrastructure. These should be engineering drawings that accurately represent the project as constructed. These corrected drawings must be professionally drafted revisions that are stamped, signed, and dated by a licensed civil engineer registered in the state of Washington.

As-built plans must be submitted to the Aviation Project Management Group if the facility is part of a project managed by the Project Management Group, otherwise, submit it to Aviation Facilities and Infrastructure.

Chapter 4
BMP AND FACILITY SELECTION PROCESS FOR PERMANENT STORMWATER CONTROL PLANS

4.1 Purpose

The purpose of this chapter is to provide guidance for selecting permanent Best Management Practices (BMPs) and facilities for new development and redevelopment sites (including retrofitting of redevelopment sites). The task of selecting BMPs and facilities is necessary to complete the Permanent Stormwater Control Plan — one of the major components of a Stormwater Site Plan. The details for how to complete the other major component — a Construction Stormwater Pollution Prevention Plan — are included in Chapter 3 of Volume II of this manual.

The Port's pollution control strategy is to emphasize pollution prevention first, through the application of source control BMPs. Then the application of appropriate treatment and flow control facilities fulfills the statutory obligation to provide "all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the State of Washington" (RCW 90.48.010). This statutory requirement is generally known by an acronym – AKART.

The remainder of this chapter presents seven steps in selecting Source Control BMPs, Treatment Facilities, and Flow Control Facilities. Refer to the STIA LID Guideline for guidance on selection of LID BMPs and their feasibility for projects application.

4.2 BMP and Facility Selection Process

Step 1. Determine and Read the Applicable Minimum Requirements

Section 2.4 establishes project size thresholds for the application of Minimum Requirements to new development and redevelopment projects. Figures I-2.4.1 through I-2.4.3 of Volume I provide the same thresholds in a flow chart format. The total combined new hard surfaces, replaced hard surfaces, and converted vegetation areas determine which minimum requirements apply to the project.

Step 2. Select Source Control BMPs

Refer to Volume IV for details on Source Control BMPs. If the project involves construction of areas or facilities to conduct any of the activities described in Section 2.2 of Volume IV, the "applicable" structural source control BMPs described in that section must be constructed as part of the project. In addition, if the specific business enterprise that will occupy the site is known, the "applicable" operational source control BMPs must also be described. Structural source control BMPs should be identified in the stormwater site plan and should be shown on all applicable plans submitted for Port or local government review and approval.

The project may have additional source control responsibilities as a result of area-specific pollution control plans (e.g., watershed or basin plans, water clean-up plans, groundwater management plans, lakes management plans), ordinances, and regulations.

Step 3. Determine Threshold Discharge Areas and Applicable Requirements for Treatment, Flow Control, and Wetlands Protection

Minimum Requirements #6 (Runoff Treatment) and #7 (Flow Control) have size thresholds that determine their applicability (see Sections 2.5.6 and 2.5.7). Minimum Requirement #8 (Wetlands Protection) uses the same size thresholds as those used in #6 and #7. Those thresholds determine whether certain areas (called "threshold discharge areas") of a project must use treatment and flow control facilities, designed by a professional engineer. Minimum Requirement #5 (On-Site Stormwater Management BMPs) (see Section 2.5.5) also applies. Under that requirement, LID facilities need to be evaluated for feasibility under the STIA LID Guideline. The application of most LID BMPs within the Retrofit Area is typically incompatible with FAA regulations, airport design criteria and operations safety requirements. Where feasible, some design modifications to those BMPs are typically needed.

Step 3-A. Read The Definitions In Appendix I-G – Glossary and Notations. Understand the following terms: effective impervious surface, impervious surface, hard surface, pollution-generating impervious surface (PGIS), pollution-generating hard surface, pollution-generating pervious surface (PGPS), converted vegetation area, and threshold discharge area.

Step 3-B. Outline the Threshold Discharge Areas. Determine the threshold discharge areas for your project site.

Step 3-C. Determine the Amount of Pollution-Generating Hard Surfaces (Including Pollution-Generating Permeable Pavements) and Pollution-Generating Pervious Surfaces (Not Including Permeable Pavements). For each threshold discharge area, generate these areas. Compare those totals to the categories in Section 2.5.6 to determine where treatment facilities are necessary. Note that On-Site Stormwater Management LID BMPs (Minimum Requirement #5) are applicable above certain minimum thresholds of site area land surface change and where application of those BMP is determined to be feasible.

Step 3-D. Compute the Total Area of Effective Impervious Surface and Converted Vegetation Areas in each Threshold Discharge Area. Compare those totals to the project thresholds in Section 2.5.7 to determine where flow control facilities (Minimum Requirements #7 and #8) are necessary. If neither threshold for flow control facilities (Minimum Requirement #7) is exceeded, proceed to Step 3-F. If one of the thresholds is exceeded, proceed to Step 4 below.

Step 3-E. For each Threshold Discharge Area, Use an Approved Continuous Runoff Model (E.G. HSPF, WWHM, MGSFLOOD) to Determine Whether There Is an Increase of 0.1 cfs in the 100-Year Return Frequency Flow. This is the threshold when using 1-hour time steps. If using 15-minute time steps, the threshold is a 0.15 cfs increase. This requires a comparison to the 100-year return frequency flow predicted for project versus for the existing (pre-development, not the historic) land cover condition of the same area. If the above threshold is exceeded, flow control – Minimum Requirements #7 (Flow Control) and #8 (Wetland Protection) – are potentially required. See the "Applicability" sections of those minimum requirements. Note that On-site Stormwater Management LID BMPs (Minimum Requirement #5) are applicable above certain minimum thresholds of site area land surface change and where application of those BMPs is determined to be feasible.

Consult with Port Environmental for specific guidance on hydrologic modeling for 100-year return frequency peak flows determination within the STIA retrofit area including approximate 100-year unit discharge estimates from hard (impervious) and pervious surfaces that can be used as initial guidance for project improvements peak flow effects evaluation

This task requires properly representing the hard surfaces, and the converted vegetation areas in the runoff model. Hard surfaces include impervious surfaces, permeable pavements, and vegetated roofs. Impervious surface area totals are entered directly. Permeable pavements are entered as lawn/landscaping areas over the project soil type if they do not have any capability for storage in the gravel base. Permeable pavements with storage capability should use the permeable pavement "element" in the model. An "element" is provided for vegetated roofs also. See Appendix III-C in Volume III, and the WWHM user's manual for guidance concerning proper representation of LID BMPs in approved computer models.

Step 3-F. Determine if a Downstream Regional Facility Exists That Will Satisfy Treatment, Flow Control and/or Wetland Protection Requirements. Consult the Port to determine if an existing detention and/or water quality facility is located downstream of the proposed project. An existing downstream flow control and/or water quality facility may have additional capacity to accommodate all or part of the additional flow from a proposed project.

These existing facilities were designed as part of STIA Retrofit Area improvements to serve a specific acreage of effective impervious surfaces, pollution-generating impervious surfaces, and pollution generating pervious surfaces and to meet certain performance standards for flow control and water quality treatment. Provide the Port with area values from Steps 3-D and 3-E. The Port will use these values for initial assessment of whether the downstream facility has adequate capacity to accommodate all or part of the project runoff. The Port will compare the total area the facility was designed to serve with the total area currently served by the facility plus the new area proposed by the project. If the

proposed project adds impervious surfaces, converted pervious surface, pollution-generating impervious surfaces, and/or pollution generating pervious surfaces to the subbasin that result in total values that are less than or equal to the respective design basis values (or subsequent updates), then the project may not need to provide additional flow control and/or runoff treatment.

If the Port determines that an existing downstream facility can accommodate the project's surface water runoff and meet the flow control and water quality treatment requirements of this Manual, proceed to Step 6.

If the Port determines that an existing downstream facility can accommodate the project's surface water runoff and meet the flow control but not water quality treatment requirements of this Manual, proceed to Step 5.

If the Port determines that an existing downstream facility can accommodate the Project's surface water runoff and meet the water quality treatment but not flow control requirements of this Manual, proceed to Step 4 but skip Step 5.

If there is no existing downstream facility or it cannot accommodate the Project's surface water runoff for the flow control or water quality treatment requirements of this Manual, proceed to Step 4.

Step 4. Select Flow Control BMPs and Facilities

A determination should have already been made whether Minimum Requirement #7 and/or Minimum Requirement #8 apply to the project site. On-Site Stormwater Management BMPs from the STIA LID Guideline, which provide a runoff volume reduction and flow control benefit, must be applied beyond certain minimum thresholds of site area land surface change and where application of those BMPs is determined to be feasible in accordance with Minimum Requirement #5. In addition, flow control facilities must be provided for discharges from those threshold discharge areas that exceeded the thresholds outlined in Section 2.5.7. See Figure I-2-5.2 to determine flow control performance criteria and pre-development conditions for the various Port basins. Use an approved continuous runoff model (e.g. HSPF, WWHM, and MGSFlood). Details describing how to size and design the facilities can be found in Chapter 3 of Volume III.

Consult with Port Environmental for STIA-approved hydrologic models and subbasin-specific model calibration parameters to be applied in analyzing runoff for sizing and design of flow control facilities

The following paragraphs describe a selection process for those facilities.

Step 4-A. Determine Whether Runoff Can Infiltrate. There are two possible options for infiltration. The first option is to infiltrate runoff through rapidly draining soils that do not meet the site characterization and site suitability criteria for providing adequate treatment. See Chapter 3 of Volume III for design criteria for infiltration facilities intended to provide flow control without treatment. In this case, a treatment facility must be provided prior to discharge into the ground through infiltration. The treatment facility could be located off-line with a capacity to treat the water quality design flow rate or volume (see Volume V, Chapter 4) to the applicable performance goal (see Volume V, Chapter 3). Volumes or flow rates in excess of the treatment design volume or flow rate would bypass untreated into the infiltration facility. Note that wetpool treatment facilities are always designed to be on-line. The infiltration facility must provide adequate volume such that the flow duration standard of Minimum Requirement #7, or the water surface elevation requirements of Minimum Requirement #8 will be achieved.

Projects located within the Retrofit Area may use the *STIA Infiltration Feasibility Assessment* as guidance for general infiltration suitability criteria, including mapped depiction of those areas. Site-specific subsurface investigations and infiltration testing may also be required to confirm projects infiltration feasibility and potential needs for treatment prior to infiltration.

The second option is to infiltrate through soils that meet the site characterization and site suitability criteria in Chapter 3 of Volume III. The facility would be designed to meet the requirements for treatment and flow control. However, since such a facility would have to be located on-line, it would be quite large in order to achieve the flow duration standard of Minimum Requirement #7. Therefore, this option will, in most cases, be cost- and space-prohibitive.

For projects where LID BMPs are determined to be feasible, select the priority LID BMPs for use under Minimum Requirement #5 using step-by-step procedures contained in the STIA LID Guideline. Where not determined as feasible, provide an explanation and documentation of the competing needs and infeasibility criteria basis for that outcome, and, where needed, include a citation of unsuitable site conditions for LID BMP application in a soils report. Depending on the type and design of the selected LID BMP (where feasible), it may also contribute to satisfying Minimum Requirement #6 and/or #7. **If infiltration facilities for flow control are planned, the flow control requirement has been met. Proceed to Step 5.**

If infiltration facilities are not planned, proceed to Step 4-B.

Step 4-B. Use a Continuous Hydrologic Model to Size a Detention Facility. Continuous models such as HSPF or other Ecology-approved models such as the Western Washington Hydrologic Model (WWHM) or MGS Flood Model shall be used. The appropriate model parameters shall be used, consistent with the calibrated HSPF basin models. The Port-developed models contain appropriate model parameters and can be used within the STIA Retrofit Area as well as for areas within the Des Moines, Miller and Walker drainage basins outside the Retrofit Area. Refer to Appendix III-F of Volume III for the list of the Port-developed models and Chapter 2 of Volume III for an explanation of the use of the WWHM.

The more the site is left undisturbed, and the less impervious surfaces are created, the smaller the detention facility. Additional incentives are given within the model for reducing the disruption of the natural hydrology through the use of On-site Stormwater

LID facilities in accordance with the STIA LID Guideline are required beyond certain minimum thresholds of site area land surface change and where application of those BMPs is determined to not be limited by competing needs and feasible as part of Minimum Requirement #5. LID BMPs typically benefit runoff flow control and treatment from a developed site. Therefore, additional incentives are provided for the runoff modeling for design of flow control facilities when using LID technologies.

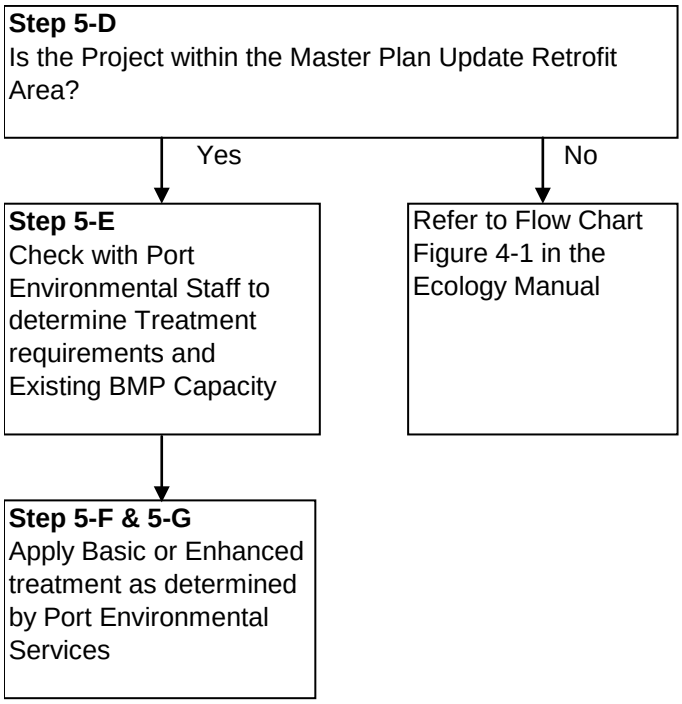
If an existing downstream Port flow control facility was identified, the project proponent must analyze the operation of the existing and proposed flow control facilities in series. The use of the Port-developed models will facilitate this analysis because they include many of the existing detention facilities. The proposed flow control facility must be designed such that it meets the requirements at its outlet and the outlet of the existing downstream flow control facility.

If a downstream runoff treatment facility was identified in Step 3-E and can accommodate runoff from the proposed project, proceed to Step 6.

Step 5. Select Treatment Facilities

Please refer to Figure I-4.2.1. Use the step-by-step process outlined in Figure V-2.1.1 of Volume V of the Ecology Manual to determine the type of treatment facilities applicable to the project.

Figure I-4.2.1. Runoff Treatment Facility Selection



Step 5-A. Determine the Receiving Waters and Pollutants of Concern Based on Off-Site Analysis. To obtain a more complete determination of the potential impacts of a stormwater discharge, an Off-Site Analysis as discussed in Chapter 2 of Volume I (Section 2.6.2) shall be performed. Determine the natural receiving waters for the stormwater drainage from the project site (groundwater, wetland, lake, stream, salt water). This is necessary to determine the applicable treatment menu from which to select treatment facilities. If the discharge is to the local municipal storm drainage system, the receiving waters for the drainage system must be determined.

Off-site Analysis is not required within the Retrofit Area, but the Port may require it for projects on Port properties beyond the Retrofit Area. Consult with Port Environmental to determine that need for this analysis considering basin-specific areas modified by the project

The project proponent shall verify whether any type of water quality management plans and/or local ordinances or regulations have established specific requirements for the receiving waters. Examples of plans to be aware of include:

- Watershed or Basin Plans: These can be developed to cover a wide variety of geographic scales (e.g., Water Resource Inventory Areas, or subbasins of a few square miles). They can be focused solely on establishing stormwater requirements (e.g., "Stormwater Basin Plans"), or can address a number of pollution and water

quantity issues, including urban stormwater (e.g., Puget Sound Non-Point Action Plans).

- Water Clean-Up Plans: These plans establish a Total Maximum Daily Load (TMDL) of a pollutant or pollutants in a specific receiving water or basin, and to identify actions necessary to remain below that maximum loading. These plans may identify discharge limitations or management limitations (e.g., use of specific treatment facilities) for stormwater discharges from new and redevelopment projects.
- Ground Water Management Plans (Wellhead Protection Plans): To protect ground water quality and/or quantity, these plans may identify actions required of stormwater discharges.
- Lake Management Plans: These plans are developed to protect lakes from eutrophication due to inputs of phosphorus from the drainage basin. Control of phosphorus from new development is a likely requirement in any such plans.

An analysis of the proposed land use(s) of the project should also be used to determine the stormwater pollutants of concern. Table 4-1 lists the pollutants of concern from various land uses. Refer to Tables 4-2 and 4-3 for treatment options within the STIA Retrofit Area. See Figure V-2.1.1 of Volume V for treatment options outside the STIA Retrofit Area. Review these treatment options after determining which treatment requirements apply to the project. Those decisions are made in the steps below.

Step 5-B: Determine if an Oil Control Facility/Device is Required. The use of oil control devices and facilities is dependent upon the specific land use proposed for development.

Oil Control facilities at STIA are required for "high-use sites" as defined by project-specific criteria included in this section

Where Applied: The Oil Control Menu (see Volume V, Section 3.2 for more details) applies to projects that have "high-use sites." High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include:

- An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area.
- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil. Some examples are discussed below:
- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.). Some examples are discussed below:

In general, all-day parking areas are not intended to be defined as high use sites, and should not require an oil control facility.

- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

  The traffic count can be estimated using information from "Trip Generation," published by the Institute of Transportation Engineers, or from a traffic study prepared by a professional engineer or transportation specialist with experience in traffic estimation. See: http;//www.ite.org/.

- The following land uses may have areas that fall within the definition of "high use sites" and require oil treatment. Further, these sites require special attention to the oil control treatment selected. Refer to Volume V, Section 3.2 for more details.
  - Industrial machinery and equipment areas
  - Aircraft maintenance areas
  - Fueling stations
  - Vehicle maintenance and repair sites
  - Construction businesses (paving, heavy equipment storage and maintenance, storage of petroleum products)

If oil control is required for the site, please refer to the General Requirements in Chapter 4 of Volume V. The general requirements may affect the design and placement of facilities on the site (e.g., flow splitting). Then see Chapter V-11 of the Ecology Manual for guidance on the proper selection of options and design details.

If an Oil Control Facility is required, select and apply an appropriate Oil Control Facility. Please refer to the Oil Control Menu in Section 3.2 of Volume V. After selecting an Oil Control Facility, proceed to Step 5-C.

If an Oil Control Facility is not required, proceed directly to Step 5-C.

Step 5-C. Determine if Infiltration for Pollutant Removal is Practicable. Refer to the infiltration treatment design criteria in the Site Suitability Criteria SSC in Section 3.3.7 of Volume III. Also refer to STIA-specific FAA regulations and other infiltration limitations along with LID BMPs technical feasibility criteria in the STIA LID Guideline.

Infiltration can be effective at treating stormwater runoff, but soil properties must be appropriate to achieve effective treatment. This effectiveness is discussed in *SSC-6 Soil Physical and Chemical Feasibility* for Treatment.

Infiltration facilities at STIA should be initially evaluated based on criteria and findings in the *STIA Infiltration Feasibility Assessment*. Project-specific infiltration facilities evaluation and testing may also be required.

The infiltration facility must also be checked to ensure that it does not adversely impact ground water resources. These are discussed in:

- SSC-2 Ground Water Protection Areas
- SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer
- SSC-1 Setback Criteria

These suitability criteria check the location and depth to bedrock, the water table, or impermeable layers (such as glacial till), and the proximity to wells, foundations, and septic tank drainfields.

Unstable slopes can preclude the use of infiltration (discussed in *SSC-7 Seepage Analysis and Control*).

Infiltration treatment facilities must be preceded by a pretreatment facility, such as a presettling basin or vault, to reduce the occurrence of plugging. An oil/water separator may serve for pre-settling if it is also necessary for oil control. More frequent maintenance would be necessary to remove solids. Any of the basic treatment facilities, and detention ponds designed to meet flow control requirements, can also be used for pre-treatment (See Chapter 4 of Volume V).

If infiltration is planned, refer to the General Requirements in Chapter 4 of Volume V. These requirements may affect the design and placement of facilities on your site. Infiltration through soils that do not meet the site suitability criteria SSC-6 in Section 3.3.7 of Volume III is allowable as a flow control BMP. Use of infiltration through such soils is acceptable provided:

- The flow control only infiltration facility is not within ¼ mile of a phosphorus-sensitive receiving water.

  When flow control only infiltration facility is within ¼ miles of a phosphorus-sensitive water body, phosphorus treatment is required. Refer to the phosphorus treatment menu in Section 3.3 of Volume V for the special treatment needed prior to infiltration.

- The flow control only infiltration facility is not within ¼ mile of a fresh water body designated for aquatic life use or that has an existing aquatic life use.
- Note: When flow control only infiltration facility is within ¼ mile of such a fresh water body, enhanced treatment is required as described in Step 5-G.

- The appropriate level of treatment for the land use precedes the infiltration. Refer to Step 5-E for the treatment needed prior to infiltration.

Infiltration can also be used as part of other treatments and flow control measures. For example, infiltration through the bottom of a detention/retention facility for flow control can also help reduce direct discharge volumes to streams and reduce the size of the facility.

If infiltration is practicable, select and apply pretreatment and an infiltration facility.

If infiltration is not practicable, proceed to Step 5-D.

Step 5-D. Determine if the Project is within the STIA Retrofit Area. Refer to Figure I-4.1.1 to determine if the project is within the STIA Retrofit Area.

If the project is within the STIA Retrofit Area, proceed to Step 5-E.

If the project is not within the STIA Retrofit Area, consult the current Department of Ecology Stormwater Management Manual.

Step 5-E. Consult Port Environmental Staff to determine Treatment Requirements and BMP Capacity. Consult with Port Environmental to determine if water quality treatment requirements are for basic or enhanced treatment. Also determine if downstream facilities have capacity that can be utilized.

If Basic Treatment is required proceed to Step 5-F.

If Enhanced Treatment is required proceed to Step 5-G.

Step 5-F. Select a Basic Treatment Facility. Refer to the Basic Treatment Menu in Volume V, Section 3.5. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

Consult with Port Environmental to determine whether downstream treatment facilities have capacity to be used, and if not, whether the project requires basic or enhanced treatment facilities use

After selecting a Basic Treatment Facility, refer to the General Requirements in Chapter 4 of Volume V. These requirements may affect the design and placement of the facility on the site.

For guidance on additional factors that can affect treatment facility selection, refer to Section 2.2 of Volume V.

If the project is part of a larger planned development of adjacent areas that will benefit from a regional of subbasin treatment approach, consult with Port Environmental.

You have completed the treatment facility selection process. Proceed to Step 6.

5-G. Select an Enhanced Treatment Facility. Refer to the Enhanced Treatment Menu in Volume V, Section 3.4 to select an appropriate Enhanced Treatment facility. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

If you have selected an Enhanced Treatment facility, refer to the General Requirements in Chapter 4 of Volume V. These requirements may affect the design and placement of the facility on the site.

You have completed the treatment facility selection process. Proceed to Step 6.

Step 6. Review Selection of BMPs and Facilities

The list of treatment and flow control facilities, and the list of source control BMPs should be reviewed. The site designer may want to re-evaluate site layout to reduce the need for construction of facilities, or the size of the facilities by reducing the amount of impervious surfaces created and increasing the areas to be left undisturbed.

Step 7. Complete Development of Permanent Stormwater Control Plan

The design and location of the BMPs and facilities on the site must be determined using the detailed guidance in Volumes III, IV, and V. Operation and Maintenance manuals for each treatment and flow control facility are necessary. Refer to Chapter 3 and the Stormwater Site Plan Templates in Appendix 3A for guidance on the contents of the Stormwater Site Plan, which includes the Permanent Stormwater Control Plan and the Construction SWPPP inclusive of Erosion and Sediment Control Plan.

Appendix I-A
GUIDANCE FOR ALTERING THE MINIMUM REQUIREMENTS THROUGH BASIN PLANNING

Consult the Ecology Manual.

Appendix I-B
RAINFALL AMOUNTS AND STATISTICS

Consult the Ecology Manual.

Appendix I-C
BASIC TREATMENT RECEIVING WATERS

Consult the Ecology Manual.

Appendix I-D
GUIDELINES FOR WETLANDS WHEN MANAGING STORMWATER

Consult Ecology Manual with addition of the following STIA limitations.

Landscape planting zones at STIA including the Landscape Exclusion Zone (LEZ) and Limited Landscaping Zone (LLZ) are limited by various Federal regulations and FAA circular requirements, and that information can be found on the Port's website.

http://www.portseattle.org/Environmental/Water-Wetlands-Wildlife/Documents/wildlife-plantingzones.pdf

The current approved plant list can be found on the Port's website:
http://www.portseattle.org/Environmental/Water-Wetlands-Wildlife/Pages/Wildlife-Management.aspx

Appendix I-E
FLOW CONTROL-EXEMPT SURFACE WATERS

Consult the Ecology Manual.

Appendix I-F
BASINS WITH 40% OR MORE TOTAL IMPERVIOUS AREA AS OF 1985

Consult the Ecology Manual.

Appendix I-G
GLOSSARY AND NOTATIONS

The following terms are provided for reference and use with this manual. They shall be superseded by any other definitions for these terms adopted by ordinance, unless they are defined in a Washington State WAC or RCW, or are used and defined as part of the Minimum Requirements for all new development and redevelopment.

- **AASHTO classification:** The official classification of soil materials and soil aggregate mixtures for highway construction, used by the American Association of State Highway and Transportation Officials.
- **Absorption:** The penetration of a substance into or through another, such as the dissolving of a soluble gas in a liquid.
- **Adjacent steep slope:** A slope with a gradient of 15 percent or steeper within five hundred feet of the site.
- **Adjustment:** A variation in the application of a Minimum Requirement to a particular project. Adjustments provide substantially equivalent environmental protection.
- **Administrator:** The local government official(s) authorized to make decisions in regard to Adjustments and Exceptions/Variances.
- **Adsorption:** The adhesion of a substance to the surface of a solid or liquid; often used to extract pollutants by causing them to be attached to such adsorbents as activated carbon or silica gel. Hydrophobic, or water-repulsing adsorbents, are used to extract oil from waterways when oil spills occur. Heavy metals such as zinc and lead often adsorb onto sediment particles.
- **Aeration:** The process of being supplied or impregnated with air. In waste treatment, the process used to foster biological and chemical purification. In soils, the process by which air in the soil is replenished by air from the atmosphere. In a well aerated soil, the soil air is similar in composition to the atmosphere above the soil. Poorly aerated soils usually contain a much higher percentage of carbon dioxide and a correspondingly lower percentage of oxygen.
- **Aerobic:** Living or active only in the presence of free (dissolved or molecular) oxygen.
- **Aerobic bacteria:** Bacteria that require the presence of free oxygen for their metabolic processes.
- **Aggressive plant species**: Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to native species in this manual.
- **Airfield**: Area located within the Airport Operations Area fence line.
- **Air Operations Areas (AOA):** Any area of an airport used or intended to be used for landing, takeoff, or surface maneuvering of aircraft.
- **Airport Certification Manual (ACM):** The ACM is a document that FAA requires airports to produce in accordance with requirements contained in Title 14, Code of Federal Regulations

(CFR) Part 139, Certification of Airports. The ACM serves as the bridge between the requirements of Part 139 and their application to a particular airport, taking into account the airport's size, type/level of activity, and configuration. For additional information, please refer to FAA Advisory Circular (AC) 150/5210-22 (FAA 2004c).

- **Airport wildlife biologist:** A qualified airport wildlife biologist is a wildlife biologist capable of conducting a hazardous wildlife assessment. For certificated airports, this biologist must meet the qualifications in FAA Advisory Circular 150/5200-36 (FAA 2006c).
- **Airports District Office (ADO):** The Seattle ADO is responsible for Idaho, Oregon, and Washington and may be reached at:

  U.S. Department of Transportation

  Federal Aviation Administration

  Northwest Mountain Region

  Seattle Airports District Office

  1601 Lind Avenue, S.W., Suite 250

  Renton, WA 98057-3356

  Voice: (425) 227-2650

  Fax: (425) 227-1650

- **Airside:** Any location where aircraft operations, fueling, maintenance, or support activities are conducted. The area beyond security and/or passport control. The AOA is included in the airside area.
- **Algae:** Primitive plants, many microscopic, containing chlorophyll and forming the base of the food chain in aquatic environments. Some species may create a nuisance when environmental conditions are suitable for prolific growth.
- **Algal bloom**: Proliferation of living algae on the surface of lakes, streams or ponds; often stimulated by phosphate over-enrichment. Algal blooms reduce the oxygen available to other aquatic organisms.
- **American Public Works Association (APWA):** The Washington State Chapter of the American Public Works Association.
- **Anadromous:** Fish that grow to maturity in the ocean and return to rivers for spawning.
- **Anaerobic**: Living or active in the absence of oxygen.
- **Anaerobic bacteria:** Bacteria that do not require the presence of free or dissolved oxygen for metabolism.
- **Annual flood:** The highest peak discharge on average which can be expected in any given year.

- **Antecedent moisture conditions:** The degree of wetness of a watershed or within the soil at the beginning of a storm.
- **Anti-seep collar**: A device constructed around a pipe or other conduit and placed through a dam, levee, or dike for the purpose of reducing seepage losses and piping failures.
- **Anti-vortex device**: A facility placed at the entrance to a pipe conduit structure such as a drop inlet spillway or hood inlet spillway to prevent air from entering the structure when the pipe is flowing full.
- **Applicable BMPs:** As used in Volume IV, applicable BMPs are those source control BMPs that are expected to be required by local governments at new development and redevelopment sites. Applicable BMPs will also be required if they are incorporated into NPDES permits, or they are included by local governments in a stormwater program for existing facilities.
- **Applicant:** The person who has applied for a development permit or approval.
- **Appurtenances:** Machinery, appliances, or auxiliary structures attached to a main structure, but not considered an integral part thereof, for the purpose of enabling it to function.
- **Apron:** The area of an airport where aircraft are parked, unloaded or loaded, refueled, or boarded.
- **Aquifer:** A geologic stratum containing ground water that can be withdrawn and used for human purposes.
- **Arterial:** A road or street primarily for through traffic. The term generally includes roads or streets considered collectors. It does not include local access roads which are generally limited to providing access to abutting property. See also RCW 35.78.010, RCW 36.86.070, and RCW 47.05.021.
- **As-built drawings:** Engineering plans which have been revised to reflect all changes to the plans which occurred during construction.
- **As-graded:** The extent of surface conditions on completion of grading.
- **BSBL:** See Building set back line.
- **Background:** A description of pollutant levels arising from natural sources, and not because of man's immediate activities.
- **Backwater:** Water upstream from an obstruction which is deeper than it would normally be without the obstruction.
- **Baffle:** A device to check, deflect, or regulate flow.
- **Bankfull discharge**: A flow condition where streamflow completely fills the stream channel up to the top of the bank. In undisturbed watersheds, the discharge conditions occur on average every 1.5 to 2 years and controls the shape and form of natural channels.
- **Base flood**: A flood having a one percent chance of being equaled or exceeded in any given year. This is also referred to as the 100-year flood.

- **Base flood elevation**: The water surface elevation of the base flood. It shall be referenced to the National Geodetic Vertical Datum of 1929 (NGVD).
- **Baseline sample:** A sample collected during dry-weather flow (i.e., it does not consist of runoff from a specific precipitation event).
- **Basic water quality treatment** (versus *enhanced water quality treatment*)**:** The Washington State Department of Ecology's performance goal is to achieve 80 percent removal of total suspended solids for influent concentrations that are greater than 100 mg/l, but less than 200 mg/l. For influent concentrations less than 100 mg/l, the facilities are intended to achieve an effluent goal of 20 mg/l total suspended solids.
- **Basin plan**: A plan that assesses, evaluates, and proposes solutions to existing and potential future impacts to the beneficial uses of, and the physical, chemical, and biological properties of waters of the state within a basin. Basins typically range in size from 1 to 50 square miles. A plan should include but not be limited to recommendations for:
  - Stormwater requirements for new development and redevelopment;
  - Capital improvement projects;
  - Land Use management through identification and protection of critical areas, comprehensive land use and transportation plans, zoning regulations, site development standards, and conservation areas;
  - Source control activities including public education and involvement, and business programs;
  - Other targeted stormwater programs and activities, such as maintenance, inspections and enforcement;
  - Monitoring; and
  - An implementation schedule and funding strategy.

A plan that is "adopted and implemented" must have the following characteristics:

- It must be adopted by legislative or regulatory action of jurisdictions with responsibilities under the plan;
- Ordinances, regulations, programs, and procedures recommended by the plan should be in effect or on schedule to be in effect; and,
- An implementation schedule and funding strategy that are in progress.

At STIA, existing relevant basin plans include:

- *Des Moines Creek Basin Plan* (King County, 1997)
- *Miller Walker Creeks Basin Plan* (King County, Port of Seattle, et al, 2006)
- *Gilliam Creek Basin Stormwater Management Plan* (Herrera, 2001)

- **Bearing capacity:** The maximum load that a material can support before failing.

- **Bedrock**: The more or less solid rock in place either on or beneath the surface of the earth. It may be soft, medium, or hard and have a smooth or irregular surface.
- **Bench:** A relatively level step excavated into earth material on which fill is to be placed.
- **Berm:** A constructed barrier of compacted earth, rock, or gravel. In a stormwater facility, a berm may serve as a vertical divider typically built up from the bottom.
- **Best management practice (BMP):** The schedules of activities, prohibitions of practices, maintenance procedures, and structural and/or managerial practices, that when used singly or in combination, prevent or reduce the release of pollutants and other adverse impacts to waters of Washington State.
- **Biochemical oxygen demand (BOD):** An indirect measure of the concentration of biologically degradable materials present in organic wastes. The amount of free oxygen utilized by aerobic organisms when allowed to attack the organic material in an aerobically maintained environment at a specified temperature (20°C) for a specific time period (5 days), and thus stated as BOD5. It is expressed in milligrams of oxygen utilized per liter of liquid waste volume (mg/l) or in milligrams of oxygen per kilogram of waste solution (mg/kg = ppm = parts per million parts). Also called biological oxygen demand.
- **Biodegradable:** Capable of being readily broken down by biological means, especially by microbial action. Microbial action includes the combined effect of bacteria, fungus, flagellates, amoebae, ciliates, and nematodes. Degradation can be rapid or may take many years depending upon such factors as available oxygen and moisture.
- **Bioengineering:** The combination of biological, mechanical, and ecological concepts (and methods) to control erosion and stabilize soil through the use of vegetation or in combination with construction materials.
- **Biofilter**: A designed treatment facility using a combined soil and vegetation system for filtration, infiltration, adsorption, and biological uptake of pollutants in stormwater when runoff flows over and through. Vegetation growing in these facilities acts as both a physical filter which causes gravity settling of particulates by regulating velocity of flow, and also as a biological sink when direct uptake of dissolved pollutants occurs. The former mechanism is probably the most important in western Washington where the period of major runoff coincides with the period of lowest biological activity.
- **Biofiltration:** The process of reducing pollutant concentrations in water by filtering the polluted water through biological materials.
- **Bioinfiltration:** The process of reducing pollutant concentrations in water by infiltrating the polluted water through grassy vegetation and soils into the ground.
- **Biological control:** A method of controlling pest organisms by means of introduced or naturally occurring predatory organisms, sterilization, the use of inhibiting hormones, or other means, rather than by mechanical or chemical means.

- **Biological magnification:** The increasing concentration of a substance along succeeding steps in a food chain. Also called biomagnification.
- **Bioretention BMP:** Engineered facilities that store and treat stormwater by passing it through a specified soil profile, and either retain or detain the treated stormwater for flow attenuation. Refer to Chapter 7 of Volume V for Bioretention BMP types and design specifications.
- **Biosolids**: Municipal sewage sludge that is a primarily organic, semisolid product resulting from the wastewater treatment process, that can be beneficially recycled and meets all applicable requirements under Chapter 173-308 WAC. Biosolids includes a material derived from biosolids, and septic tank sludge, also known as septage, that can be beneficially recycled and meets all applicable requirements under Chapter 173-308 WAC. For the purposes of Chapter 173-308 WAC, semisolid products include biosolids or products derived from biosolids ranging in character from mostly liquid to fully dried solids.
- **Bollard**: A post (may or may not be removable) used to prevent vehicular access.
- **Bond**: A surety bond, cash deposit or escrow account, assignment of savings, irrevocable letter of credit or other means acceptable to or required by the manager to guarantee that work is completed in compliance with the project's drainage plan and in compliance with all local government requirements.
- **Borrow area:** A source of earth fill material used in the construction of embankments or other earth fill structures.
- **Buffer**: The zone contiguous with a sensitive area that is required for the continued maintenance, function, and structural stability of the sensitive area. The critical functions of a riparian buffer (those associated with an aquatic system) include shading, input of organic debris and coarse sediments, uptake of nutrients, stabilization of banks, interception of fine sediments, overflow during high water events, protection from disturbance by humans and domestic animals, maintenance of wildlife habitat, and room for variation of aquatic system boundaries over time due to hydrologic or climatic effects. The critical functions of terrestrial buffers include protection of slope stability, attenuation of surface water flows from stormwater runoff and precipitation, and erosion control.
- **Building setback line (BSBL):** A line measured parallel to a property, easement, drainage facility, or buffer boundary, that delineates the area (defined by the distance of separation) where buildings or other obstructions are prohibited (including decks, patios, outbuildings, or overhangs beyond 18 inches). Wooden or chain link fences and landscaping are allowable within a building setback line. In this manual the minimum building setback line shall be 5 feet.
- **CIP:** See Capital Improvement Project.
- **Capital Improvement Project or Program (CIP):** A project prioritized and scheduled as a part of an overall construction program or, the actual construction program.

- **Catch basin**: A chamber or well, usually built at the curb line of a street, for the admission of surface water to a sewer or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.
- **Catchline**: The point where a severe slope intercepts a different, more gentle slope.
- **Catchment:** Surface drainage area.
- **Cation Exchange Capacity (CEC)**: The amount of exchangeable cations that a soil can absorb. Units are milli-equivalents per 100 g of soil, typically abbreviated simply as meq. Soil found to have a CEC of 5 meq at pH 7 will have CEC < 5 meq when pH < 7.
- **CESCL**: See Certified Erosion and Sediment Control Lead
- **Certified Erosion and Sediment Control Lead (CESCL):** Means an individual who has current certification through an approved erosion and sediment control training program that meets the minimum training standards established by the Washington Department of Ecology (Ecology) (see BMP C160 in Volume II). A CESCL is knowledgeable in the principles and practices of erosion and sediment control. The CESCL must have the skills to assess site conditions and construction activities that could impact the quality of stormwater and the effectiveness of erosion and sediment control measures used to control the quality of stormwater discharges. Certification is obtained through an Ecology approved erosion and sediment control course. Course listings are provided online at Ecology's web site.
- **Channel**: A feature that conveys surface water and is open to the air.
- **Channel, constructed**: Channels or ditches constructed (or reconstructed natural channels) to convey surface water.
- **Channel, natural**: Streams, creeks, or swales that convey surface/ground water and have existed long enough to establish a stable route and/or biological community.
- **Channel stabilization**: Erosion prevention and stabilization of velocity distribution in a channel using vegetation, jetties, drops, revetments, and/or other measures.
- **Channel storage**: Water temporarily stored in channels while enroute to an outlet.
- **Channelization**: Alteration of a stream channel by widening, deepening, straightening, cleaning, or paving certain areas to change flow characteristics.
- **Check dam**: Small dam constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel scour, and promote deposition of sediment.
- **Chemical oxygen demand (COD):** A measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water. The COD test, like the BOD test, is used to determine the degree of pollution in water.
- **Civil engineer**: A professional engineer licensed in the State of Washington in Civil Engineering.

- **Civil engineering**: The application of the knowledge of the forces of nature, principles of mechanics and the properties of materials to the evaluation, design and construction of civil works for the beneficial uses of mankind.
- **Clay lens**: A naturally occurring, localized area of clay which acts as an impermeable layer to runoff infiltration.
- **Clearing**: The destruction and removal of vegetation by manual, mechanical, or chemical methods.
- **Clearway (CWY)**: A defined rectangular area beyond the end of a runway cleared or suitable for use in lieu of runway to satisfy takeoff distance requirements. This is the region of space above an inclined plane that leaves the ground at the end of the runway.
- **Closed depression**: An area which is low-lying and either has no, or such a limited, surface water outlet that during storm events the area acts as a retention basin.
- **Cohesion**: The capacity of a soil to resist shearing stress, exclusive of functional resistance.
- **Coliform bacteria**: Microorganisms common in the intestinal tracts of man and other warm-blooded animals; all the aerobic and facultative anaerobic, gram-negative, non-spore-forming, rod-shaped bacteria which ferment lactose with gas formation within 48 hours at 35°C. Used as an indicator of bacterial pollution.
- **Commercial Agriculture:** Those activities conducted on lands defined in RCW 84.34.020(2), and activities involved in the production of crops or livestock for wholesale-commercial trade. An activity ceases to be considered commercial agriculture when the area on which it is conducted is proposed for conversion to a nonagricultural use or has lain idle for more than five (5) years, unless the idle land is registered in a federal or state soils conservation program, or unless the activity is maintenance of irrigation ditches, laterals, canals, or drainage ditches related to an existing and ongoing agricultural activity.
- **Common Plan of Development or Sale**: A site where multiple separate and distinct construction activities may be taking place at different times on different schedules and/or by different contractors, but still under a single plan. Examples include: 1) phase projects and projects with multiple filings or lots, even if the separate phases or filings/lots will be constructed under separate contract or by separate owners (e.g., a development where lots are sold to separate builders); 2) a development plan that may be phased over multiple years, but is still under a consistent plan for long-term development; 3) projects in a contiguous area that may be unrelated but still under the same contract, such as construction of a building extension and a new parking lot at the same facility; and 4) linear projects such as roads, pipelines, or utilities. If the project is part of a common plan of development or sale, the disturbed area of the entire plan must be used to determine permit requirements.
- **Compaction**: The densification, settlement, or packing of soil in such a way that permeability of the soil is reduced. Compaction effectively shifts the performance of a hydrologic group to a lower permeability hydrologic group. For example, a group B hydrologic soil can be

compacted and be effectively converted to a group C hydrologic soil in the way it performs in regard to runoff.

Compaction may also refer to the densification of a fill by mechanical means.

- **Compensatory storage**: New excavated storage volume equivalent to the flood storage capacity eliminated by filling or grading within the flood fringe. Equivalent shall mean that the storage removed shall be replaced by equal volume between corresponding one-foot contour intervals that are hydraulically connected to the floodway through their entire depth.
- **Compost**: Organic material that has undergone biological degradation and transformation under controlled conditions designed to promote aerobic decomposition at a solid waste facility in compliance with the requirements of .Chapter 173-350 WAC, or biosolids composted in compliance with Chapter 173-308 WAC. Composting is a form of organic material recycling. Natural decay of organic solid waste under uncontrolled conditions does not result in composted material. (Note: Various BMPs have restrictions on the percentage of biosolids in compost, or do not allow biosolids in compost.)
- **Comprehensive planning**: Planning that takes into account all aspects of water, air, and land resources and their uses and limits.
- **Conservation district**: A public organization created under state enabling law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries, usually a subdivision of state government with a local governing body and always with limited authority. Often called a soil conservation district or a soil and water conservation district.
- **Constructed wetland**: Those wetlands intentionally created on sites that are not wetlands for the primary purpose of wastewater or stormwater treatment and managed as such. Constructed wetlands are normally considered as part of the stormwater collection and treatment system.
- **Construction Stormwater Pollution Prevention Plan**: A document that describes the potential for pollution problems on a construction project and explains and illustrates the measures to be taken on the construction site to control those problems.
- **Contour**: An imaginary line on the surface of the earth connecting points of the same elevation.
- **Converted vegetation (areas):** The surfaces on a project site where native vegetation, pasture, scrub/shrub, or unmaintained non-native vegetation (e.g., Himalayan blackberry scotch broom) are converted to lawn or landscaped areas, or where native vegetation is converted to pasture.
- **Conveyance**: A mechanism for transporting water from one point to another, including pipes, ditches, and channels.
- **Conveyance system**: The drainage facilities, both natural and man-made, which collect, contain, and provide for the flow of surface and stormwater from the highest points on the land down to a receiving water. The natural elements of the conveyance system include swales and small drainage courses, streams, rivers, lakes, and wetlands. The human-made elements of the

conveyance system include gutters, ditches, pipes, channels, and most retention/detention facilities.

- **Cover crop**: A close-growing crop grown primarily for the purpose of protecting and improving soil between periods of permanent vegetation.
- **Created wetland**: Means those wetlands intentionally created from non-wetland sites to produce or replace natural wetland habitat (e.g., compensatory mitigation projects).
- **Critical Areas**: At a minimum, areas which include wetlands, areas with a critical recharging effect on aquifers used for potable water, fish and wildlife habitat conservation areas, frequently flooded areas, geologically hazardous areas, including unstable slopes, and associated areas and ecosystems.
- **Critical Drainage Area**: An area with such severe flooding, drainage and/or erosion/sedimentation conditions that the area has been formally adopted as a Critical Drainage Area by rule under the procedures specified in an ordinance.
- **Critical reach**: The point in a receiving stream below a discharge point at which the lowest dissolved oxygen level is reached and stream recovery begins.
- **Culvert**: Pipe or concrete box structure that drains open channels, swales or ditches under a roadway or embankment. Typically with no catch-basins or manholes along its length.
- **Cut:** Portion of land surface or area from which earth has been removed or will be removed by excavating; the depth below original ground surface to excavated surface.
- **Cut-and-fill:** Process of earth moving by excavating part of an area and using the excavated material for adjacent embankments or fill areas.
- **Cut slope**: A slope formed by excavating overlying material to connect the original ground surface with a lower ground surface created by the excavation. A cut slope is distinguished from a bermed slope, which is constructed by importing soil to create the slope.
- **DNS**: See Determination of Nonsignificance.
- **Dead storage**: The volume available in a depression in the ground below any conveyance system, or surface drainage pathway, or outlet invert elevation that could allow the discharge of surface and stormwater runoff.
- **Dedication of land**: Refers to setting aside a portion of a property for a specific use or function.
- **Degradation:** (Biological or chemical) The breakdown of complex organic or other chemical compounds into simpler substances, usually less harmful than the original compound, as with the degradation of a persistent pesticide. (Geological) Wearing down by erosion. (Water) The lowering of the water quality of a watercourse by an increase in the pollutant loading.
- **Degraded (disturbed) wetland (community):** A wetland (community) in which the vegetation, soils, and/or hydrology have been adversely altered, resulting in lost or reduced functions and values; generally, implies topographic isolation; hydrologic alterations such as hydroperiod alteration (increased or decreased quantity of water), diking, channelization,

and/or outlet modification; soils alterations such as presence of fill, soil removal, and/or compaction; accumulation of toxicants in the biotic or abiotic components of the wetland; and/or low plant species richness with dominance by invasive weedy species.

- **Denitrification**: The biochemical reduction of nitrates or nitrites in the soil or organic deposits to ammonia or free nitrogen.
- **Depression storage**: The amount of precipitation that is trapped in depressions on the surface of the ground.
- **Design engineer**: The professional civil engineer licensed in the State of Washington who prepares the analysis, design, and engineering plans for an applicant's permit or approval submittal.
- **Design flow rate**: The maximum flow rate to which certain runoff treatment BMPs are designed for required pollutant removal. Biofiltration swales, vegetated filter strips, and oil/water separators are some of the runoff treatment BMPs that are sized based on design flow rate.
- **Design storm**: A prescribed hyetograph and total precipitation amount (for a specific duration recurrence frequency) used to estimate runoff for a hypothetical storm of interest or concern for the purposes of analyzing existing drainage, designing new drainage facilities or assessing other impacts of a proposed project on the flow of surface water. (A hyetograph is a graph of percentages of total precipitation for a series of time steps representing the total time during which the precipitation occurs.)
- **Detention**: The release of stormwater runoff from the site at a slower rate than it is collected by the stormwater facility system, the difference being held in temporary storage.
- **Detention facility**: An above or below ground facility, such as a pond or tank, that temporarily stores stormwater runoff and subsequently releases it at a slower rate than it is collected by the drainage facility system. There is little or no infiltration of stored stormwater.
- **Detention time**: The theoretical time required to displace the contents of a stormwater treatment facility at a given rate of discharge (volume divided by rate of discharge).
- **Determination of Nonsignificance (DNS)**: The written decision by the responsible official of the lead agency that a proposal is not likely to have a significant adverse environmental impact, and therefore an EIS is not required.
- **Development:** Means new development, redevelopment, or both. See definitions for each.
- **Discharge**: Runoff leaving a new development or redevelopment via overland flow, built conveyance systems, or infiltration facilities. A hydraulic rate of flow, specifically fluid flow; a volume of fluid passing a point per unit of time, commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, gallons per day, or millions of gallons per day.
- **Discharge Point**: The location where a discharge leaves the Permittee's MS4 through the Permittee's MS4 facilities/BMPs designed to infiltrate.

- **Dispersion**: Release of surface and stormwater runoff such that the flow spreads over a wide area and is located so as not to allow flow to concentrate anywhere upstream of a drainage channel with erodible underlying granular soils.
- **Ditch**: A long narrow excavation dug in the earth for drainage with its top width less than 10 feet at design flow.
- **Divide, Drainage**: The boundary between one drainage basin and another.
- **Drain**: A buried pipe or other conduit (closed drain). A ditch (open drain) for carrying off surplus surface water or ground water.
- **(To) Drain**: To provide channels, such as open ditches or closed drains, so that excess water can be removed by surface flow or by internal flow. To lose water (from the soil) by percolation.
- **Drainage**: Refers to the collection, conveyance, containment, and/or discharge of surface and stormwater runoff.
- **Drainage basin**: A geographic and hydrologic subunit of a watershed.
- **Drainage channel**: A drainage pathway with a well-defined bed and banks indicating frequent conveyance of surface and stormwater runoff.
- **Drainage course**: A pathway for watershed drainage characterized by wet soil vegetation; often intermittent in flow.
- **Drainage easement**: A legal encumbrance that is placed against a property's title to reserve specified privileges for the users and beneficiaries of the drainage facilities contained within the boundaries of the easement.
- **Drainage pathway**: The route that surface and stormwater runoff follows downslope as it leaves any part of the site.
- **Drainage review**: An evaluation by Plan Approving Authority staff of a proposed project's compliance with the drainage requirements in this manual or its technical equivalent.
- **Drainage, Soil**: As a natural condition of the soil, soil drainage refers to the frequency and duration of periods when the soil is free of saturation; for example, in well-drained soils the water is removed readily but not rapidly; in poorly drained soils the root zone is waterlogged for long periods unless artificially drained, and the roots of ordinary crop plants cannot get enough oxygen; in excessively drained soils the water is removed so completely that most crop plants suffer from lack of water. Strictly speaking, excessively drained soils are a result of excessive runoff due to steep slopes or low available water-holding capacity due to small amounts of silt and clay in the soil material. The following classes are used to express soil drainage:
  - Well drained - Excess water drains away rapidly and no mottling occurs within 36 inches of the surface.

  - Moderately well drained - Water is removed from the soil somewhat slowly, resulting in small but significant periods of wetness. Mottling occurs between 18 and 36 inches.
  - Somewhat poorly drained - Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time. Mottling occurs between 8 and 18 inches.
  - Poorly drained - Water is removed so slowly that the soil is wet for a large part of the time. Mottling occurs between 0 and 8 inches.
  - Very poorly drained - Water is removed so slowly that the water table remains at or near the surface for the greater part of the time. There may also be periods of surface ponding. The soil has a black to gray surface layer with mottles up to the surface.
- **Drawdown**: Lowering of the water surface (in open channel flow), water table or piezometric surface (in ground water flow) resulting from a withdrawal of water.
- **Drop-inlet spillway**: Overall structure in which the water drops through a vertical riser connected to a discharge conduit.
- **Drop spillway**: Overall structure in which the water drops over a vertical wall onto an apron at a lower elevation.
- **Drop structure**: A structure for dropping water to a lower level and dissipating its surplus energy; a fall. A drop may be vertical or inclined.
- **Dry weather flow**: The combination of ground water seepage and allowed non-stormwater flows found in storm sewers during dry weather. Also that flow in streams during the dry season.
- **EIS**: See Environmental Impact Statement.
- **ESC:** Erosion and Sediment Control (Plan).
- **Earth material**: Any rock, natural soil or fill and/or any combination thereof. Earth material shall not be considered topsoil used for landscape purposes. Topsoil used for landscaped purposes shall comply with ASTM D 5268 specifications. Engineered soil/landscape systems are also defined independently.
- **Easement**: The legal right to use a parcel of land for a particular purpose. It does not include fee ownership, but may restrict the owner's use of the land.
- **Ecology**: Washington State Department of Ecology.
- **Effective impervious surface:** Those impervious surfaces that are connected via sheet flow or discrete conveyance to a drainage system. Impervious surfaces are considered ineffective if:
  - The runoff is dispersed through at least 100 feet of native vegetation in accordance with BMP T5.30 – "Full Dispersion," as described in Chapter 5 of Volume V;
  - Residential roof runoff is infiltrated in accordance with Downspout Full Infiltration Systems in BMP T5.10A in Volume III; or

- Approved continuous runoff modeling methods indicate that the entire runoff file is infiltrated.

- **Embankment**: A structure of earth, gravel, or similar material raised to form a pond bank or foundation for a road.
- **Emergent plants**: Aquatic plants that are rooted in the sediment but whose leaves are at or above the water surface. These wetland plants often have high habitat value for wildlife and waterfowl, and can aid in pollutant uptake.
- **Emergency spillway**: A vegetated earth channel used to safely convey flood discharges in excess of the capacity of the principal spillway.
- **Emerging technology**: Treatment technologies that have not been evaluated with approved protocols, but for which preliminary data indicate that they may provide a necessary function(s) in a stormwater treatment system. Emerging technologies need additional evaluation to define design criteria to achieve, or to contribute to achieving, state performance goals, and to define the limits of their use.
- **Energy dissipater**: Any means by which the total energy of flowing water is reduced. In stormwater design, they are usually mechanisms that reduce velocity prior to, or at, discharge from an outfall in order to prevent erosion. They include rock splash pads, drop manholes, concrete stilling basins or baffles, and check dams.
- **Energy gradient**: The slope of the specific energy line (i.e., the sum of the potential and velocity heads).
- **Engineered soil/ landscape system**: This is a self-sustaining soil and plant system that simultaneously supports plant growth, soil microbes, water infiltration, nutrient and pollutant adsorption, sediment and pollutant biofiltration, water interflow, and pollution decomposition. The system shall be protected from compaction and erosion. The system shall be planted and/or mulched as part of the installation.

  The engineered soil/plant system shall have the following characteristics:

  a. Be protected from compaction and erosion.

  b. Have a plant system to support a sustained soil quality.

  c. Possess permeability characteristics of not less than 6.0 and 2.0 inches/hour for hydrologic soil groups A and B respectively (per ASTM D 3385). C is 0.6 inches per hour, and D is less than 0.6 inches/hour, both of which are less than the 1 inch per hour recommended infiltration rate at the airport.

  d. Possess minimum percent organic matter of 12, 14, 16, and 18 percent (dry-weight basis) for hydrologic soil groups A, B, C, and D, respectively (per ASTM D 2974).

- **Engineering geology**: The application of geologic knowledge and principles in the investigation and evaluation of naturally occurring rock and soil for use in the design of civil works.

- **Engineering plan**: A plan prepared and stamped by a professional civil engineer.
- **Enhancement**: To raise value, desirability, or attractiveness of an environment associated with surface water.
- **Enhanced runoff treatment, enhanced water quality treatment** (versus *basic water quality treatment*): The use of runoff treatment BMPs designed to capture dissolved metals at a higher rate than basic treatment BMPs.
- **Environmental Impact Statement (EIS):** A document that discusses the likely significant adverse impacts of a proposal, ways to lessen the impacts, and alternatives to the proposal. They are required by the national and state environmental policy acts when projects are determined to have significant environmental impact.
- **Erodible granular soils**: Soil materials that are easily eroded and transported by running water, typically fine or medium grained sand with minor gravel, silt, or clay content. Such soils are commonly described as Everett or Indianola series soil types in the SCS classification. Also included are any soils showing examples of existing severe stream channel incision as indicated by unvegetated streambanks standing over two feet high above the base of the channel.
- **Erodible or leachable materials:** Wastes, chemicals, or other substances that measurably alter the physical or chemical characteristics of runoff when exposed to rainfall. Examples include erodible soils that are stockpiled, uncovered process wastes, manure, fertilizers, oily substances, ashes, kiln dust, and garbage dumpster leakage.
- **Erosion**: The wearing away of the land surface by running water, wind, ice, or other geological agents, including such processes as gravitational creep. Also, detachment and movement of soil or rock fragments by water, wind, ice, or gravity. The following terms are used to describe different types of water erosion:
  - Accelerated erosion - Erosion much more rapid than normal or geologic erosion, primarily as a result of the influence of the activities of man or, in some cases, of the animals or natural catastrophes that expose bare surfaces (e.g., fires).
  - Geological erosion - The normal or natural erosion caused by geological processes acting over long geologic periods and resulting in the wearing-away of mountains, the building up of floodplains, coastal plains, etc. Synonymous with natural erosion.
  - Gully erosion - The erosion process whereby water accumulates in narrow channels and, over short periods, removes the soil from this narrow area to considerable depths, ranging from 1 to 2 feet to as much as 75 to 100 feet.
  - Natural erosion - Wearing away of the earth's surface by water, ice, or other natural agents under natural environmental conditions of climate, vegetation, etc., undisturbed by man. Synonymous with geological erosion.
  - Normal erosion - The gradual erosion of land used by man which does not greatly exceed natural erosion.

  - Rill erosion - An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils. See Rill.
  - Sheet erosion - The removal of a fairly uniform layer of soil from the land surface by runoff.
  - Splash erosion - The spattering of small soil particles caused by the impact of raindrops on wet soils. The loosened and spattered particles may or may not be subsequently removed by surface runoff.
- **Erosion classes (soil survey):** A grouping of erosion conditions based on the degree of erosion or on characteristic patterns. Applied to accelerated erosion, not to normal, natural, or geological erosion. Four erosion classes are recognized for water erosion and three for wind erosion.
- **Erosion and sedimentation control (ESC):** Any temporary or permanent measures taken to reduce erosion; control siltation and sedimentation; and ensure that sediment-laden water does not leave the site.
- **Erosion and sediment control facility**: A type of drainage facility designed to hold water for a period of time to allow sediment contained in the surface and stormwater runoff directed to the facility to settle out so as to improve the quality of the runoff.
- **Escarpment**: A steep face or a ridge of high land.
- **Estuarine wetland**: Generally, an eelgrass bed; salt marsh; or rocky, sandflat, or mudflat intertidal area where fresh and salt water mix. (Specifically, a tidal wetland with salinity greater than 0.5 parts per thousand, usually semi-enclosed by land but with partially obstructed or sporadic access to the open ocean).
- **Estuary**: An area where fresh water meets salt water, or where the tide meets the river current (e.g., bays, mouths of rivers, salt marshes, and lagoons). Estuaries serve as nurseries and spawning and feeding grounds for large groups of marine life and provide shelter and food for birds and wildlife.
- **Eutrophication:** Refers to the process where nutrient over-enrichment of water leads to excessive growth of aquatic plants, especially algae.
- **Evapotranspiration**: The collective term for the processes of evaporation and plant transpiration by which water is returned to the atmosphere.
- **Excavation**: The mechanical removal of earth material.
- **Exception**: Relief from the application of a Minimum Requirement to a project.
- **Exfiltration**: The downward movement of runoff through the bottom of an infiltration BMP into the soil layer or the downward movement of water through soil.
- **Existing site conditions**: the conditions (ground cover, slope, drainage patterns) of a site as they existed on the first day that the project entered the design phase.
- **FIRM**: See Flood Insurance Rate Map.

- **Fertilizer**: Any material or mixture used to supply one or more of the essential plant nutrient elements.
- **Fill**: A deposit of earth material placed by artificial means.
- **Filter fabric**: A woven or nonwoven, water-permeable material generally made of synthetic products such as polypropylene and used in stormwater management and erosion and sediment control applications to trap sediment or prevent the clogging of aggregates by fine soil particles.
- **Filter fabric fence**: A temporary sediment barrier consisting of a filter fabric stretched across and attached to supporting posts and entrenched. The filter fence is constructed of stakes and synthetic filter fabric with a rigid wire fence backing where necessary for support. Also commonly referred to in the Washington Department of Transportation standard specifications as "construction geotextile for temporary silt fences."
- **Filter strip**: A grassy area with gentle slopes that treats stormwater runoff from adjacent paved areas before it concentrates into a discrete channel.
- **Flocculation**: The process by which suspended colloidal or very fine particles are assembled into larger masses or floccules which eventually settle out of suspension. This process occurs naturally but can also be caused through the use of such chemicals as alum.
- **Flood:** An overflow or inundation that comes from a river or any other source, including (but not limited to) streams, tides, wave action, storm drains, or excess rainfall. Any relatively high stream flow overtopping the natural or artificial banks in any reach of a stream.
- **Flood control**: Methods or facilities for reducing flood flows and the extent of flooding.
- **Flow control BMP (facility)**: A drainage facility designed to mitigate the impacts of increased surface water and stormwater runoff flow rates generated by development. Flow control facilities area designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, and then release it to the conveyance system at a controlled rate.
- **Flood control project**: A structural system installed to protect land and improvements from floods by the construction of dikes, river embankments, channels, or dams.
- **Flood frequency:** The frequency with which the flood of interest may be expected to occur at a site in any average interval of years. Frequency analysis defines the "n-year flood" as being the flood that will, over a long period of time, be equaled or exceeded on the average once every "n" years.
- **Flood fringe**: That portion of the floodplain outside of the floodway which is covered by floodwaters during the base flood; it is generally associated with slower moving or standing water rather than rapidly flowing water.
- **Flood hazard areas**: Those areas subject to inundation by the base flood. Includes, but is not limited to streams, lakes, wetlands, and closed depressions.

- **Flood Insurance Rate Map (FIRM**): The official map on which the Federal Emergency Management Agency has delineated many areas of flood hazard, floodway, and the risk premium zones.
- **Flood Insurance Study:** The official report provided by the Federal Emergency Management Agency that includes flood profiles and the FIRM.
- **Flood peak**: The highest value of the stage or discharge attained by a flood; thus, peak stage or peak discharge.
- **Floodplain**: The total area subject to inundation by a flood including the flood fringe and floodway.
- **Flood-proofing**: Adaptations that ensure a structure is substantially impermeable to the passage of water below the flood protection elevation that resists hydrostatic and hydrodynamic loads and effects of buoyancy.
- **Flood protection elevation**: The base flood elevation or higher as defined by the local government.
- **Flood protection facility**: Any levee, berm, wall, enclosure, raise bank, revetment, constructed bank stabilization, or armoring that is commonly recognized by the community as providing significant protection to a property from inundation by flood waters.
- **Flood routing**: An analytical technique used to compute the effects of system storage dynamics on the shape and movement of flow represented by a hydrograph.
- **Flood stage**: The stage at which overflow of the natural banks of a stream begins.
- **Floodway:** The channel of the river or stream and those portions of the adjoining floodplains that are reasonably required to carry and discharge the base flood flow. The portions of the adjoining floodplains which are considered to be "reasonably required" is defined by flood hazard regulations.
- **Flow control BMP (or facility):** A drainage facility designed to mitigate the impacts of increased surface and stormwater runoff flow rates generated by development. Flow control facilities are designed either to hold water for a considerable length of time, and then release it by evaporation, plant transpiration, and/or infiltration into the ground, or to hold runoff for a short period of time, releasing it to the conveyance system at a controlled rate.
- **Flow duration:** The aggregate time that peak flows are at or above a particular flow rate of interest. For example, the amount of time that peak flows are at or above 50% of the 2-year peak flow rate for a period of record.
- **Flow frequency**: The inverse of the probability that the flow will be equaled or exceeded in any given year (the exceedance probability). For example, if the exceedance probability is 0.01 or 1 in 100, that flow is referred to as the 100-year flow.
- **Flow path**: The route that stormwater runoff follows between two points of interest.

- **Forebay**: An easily maintained, extra storage area provided near an inlet of a BMP to trap incoming sediments before they accumulate in a pond or wetland BMP.
- **Foreign Object Debris (FOD)**: Any object, live or not, located in an inappropriate location in the airport environment that has the capacity to injure airport or air carrier personnel and damage aircraft.
- **Forest practice**: Any activity conducted on or directly pertaining to forest land and relating to growing, harvesting, or processing timber, including but not limited to:
    a. Road and trail construction.
    b. Harvesting, final and intermediate.
    c. Precommercial thinning.
    d. Reforestation.
    e. Fertilization.
    f. Prevention and suppression of diseases and insects.
    g. Salvage of trees.
    h. Brush control.
- **Forested communities(wetlands):** In general terms, communities (wetlands) characterized by woody vegetation that is greater than or equal to 6 meters in height; in this manual the term applies to such communities (wetlands) that represent a significant amount of tree cover consisting of species that offer wildlife habitat and other values and advance the performance of wetland functions overall.
- **Freeboard:** The vertical distance between the highest designed water surface elevation and the elevation of the crest of the facility. For example, in pond design, freeboard is the vertical distance between the emergency overflow water surface and the top of the pond embankment.
- **Frequently flooded areas:** The 100-year floodplain designations of the Federal Emergency Management Agency and the National Flood Insurance Program or as defined by the local government.
- **Frost-heave**: The upward movement of soil surface due to the expansion of water stored between particles in the first few feet of the soil profile as it freezes. May cause surface fracturing of asphalt or concrete.
- **Frequency of storm (design storm frequency):** The anticipated period in years that will elapse, based on average probability of storms in the design region, before a storm of a given intensity and/or total volume will recur; thus a 10-year storm can be expected to occur on the average once every 10 years. Sewers designed to handle flows that occur under such storm conditions would be expected to be surcharged by any storms of greater amount or intensity.
- **Fully controlled limited access highway**: A highway where the right of owner or occupants of abutting land or other persons to access, light, air, or view in connection with the highway

is controlled to give preference to through traffic by providing access connections with selected public roads only, and by prohibiting crossings or direct private driveway connections at grade. (See WAC 468-58-010)

- **Function(s)**: The ecological (physical, chemical, and biological) processes or attributes of a wetland without regard for their importance to society (see also values). Wetland functions include food chain support, provision of ecosystem diversity and fish and wildlife habitat, flood flow alteration, ground water recharge and discharge, water quality improvement, and soil stabilization.
- **Gabion:** A rectangular or cylindrical wire mesh cage (a chicken wire basket) filled with rock and used as a protecting agent, revetment, etc., against erosion. Soft gabions, often used in streambank stabilization, are made of geotextiles filled with dirt, in between which cuttings are placed.
- **Gage or gauge**: Device for registering precipitation, water level, discharge, velocity, pressure, temperature, etc. Also, a measure of the thickness of metal; e.g., diameter of wire, wall thickness of steel pipe.
- **Gaging station**: A selected section of a stream channel equipped with a gage, recorder, or other facilities for determining stream discharge.
- **Geologist**: A person who has earned a degree in geology from an accredited college or university or who has equivalent educational training and has at least five years of experience as a practicing geologist or four years of experience and at least two years post-graduate study, research or teaching. The practical experience shall include at least three years' work in applied geology and landslide evaluation, in close association with qualified practicing geologists or geotechnical professional/civil engineers.
- **Geologically hazardous areas**: Areas that because of their susceptibility to erosion, sliding, earthquake, or other geological events, are not suited to the siting of commercial, residential, or industrial development consistent with public health or safety concerns. Geometrics The mathematical relationships between points, lines, angles, and surfaces used to measure and identify areas of land.
- **Geotechnical professional civil engineer**: A practicing, geotechnical/civil engineer licensed as a professional Civil Engineer with the State of Washington who has at least four years of professional employment as a geotechnical engineer in responsible charge, including experience with landslide evaluation.
- **Grade:** The slope of a road, channel, or natural ground. The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared for the support of construction such as paving or the laying of a conduit.
- **(To) Grade**: To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation.

- **Gradient terrace**: An earth embankment or a ridge-and-channel constructed with suitable spacing and an acceptable grade to reduce erosion damage by intercepting surface runoff and conducting it to a stable outlet at a stable nonerosive velocity.
- **Grassed waterway:** A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses, used to conduct surface water from an area at a reduced flow rate. See also biofilter.
- **Ground water**: Water in a saturated zone or stratum beneath the land surface or a surface waterbody.
- **Ground water recharge:** Inflow to a ground water reservoir.
- **Ground water table**: The free surface of the ground water, that surface subject to atmospheric pressure under the ground, generally rising and falling with the season, the rate of withdrawal, the rate of restoration, and other conditions. It is seldom static.
- **Gully**: A channel caused by the concentrated flow of surface and stormwater runoff over unprotected erodible land.
- **Habitat**: The specific area or environment in which a particular type of plant or animal lives. An organism's habitat must provide all of the basic requirements for life and should be protected from harmful biological, chemical, and physical alterations.
- **Hardpan:** A cemented or compacted and often clay-like layer of soil that is impenetrable by roots. Also known as glacial till.
- **Hard Surface:** An impervious surface, a permeable pavement, or a vegetated roof.
- **Harmful pollutant:** A substance that has adverse effects to an organism including immediate death, chronic poisoning, impaired reproduction, cancer or other effects.
- **Head (hydraulics):** The height of water above any plane of reference. The energy, either kinetic or potential, possessed by each unit weight of a liquid, expressed as the vertical height through which a unit weight would have to fall to release the average energy possessed. Used in various compound terms such as pressure head, velocity head, and head loss.
- **Head loss:** Energy loss due to friction, eddies, changes in velocity, or direction of flow.
- **Heavy metals:** Metals of high specific gravity, present in municipal and industrial wastes that pose long-term environmental hazards. Such metals include cadmium, chromium, cobalt, copper, lead, mercury, nickel, and zinc.
- **High-use site:** High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include:
  - An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area;
  - An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil;

  - An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.);
  - A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.
- **Highway:** A main public road connecting towns and cities.
- **Hog fuel**: Wood-based mulch.
- **Horton overland flow**: A runoff process whereby the rainfall rate exceeds the infiltration rate, so that the precipitation that does not infiltrate flows downhill over the soil surface.
- **HSPF: Hydrological Simulation Program-Fortran.** A continuous simulation hydrologic model that transforms an uninterrupted rainfall record into a concurrent series of runoff or flow data by means of a set of mathematical algorithms, which represent the rainfall-runoff process at some conceptual level.
- **Humus** Organic matter in or on a soil, composed of partly or fully decomposed bits of plant tissue or from animal manure.
- **Hydraulic Conductivity** The quality of saturated soil that enables water or air to move through it. Also known as permeability coefficient.
- **Hydraulic gradient** Slope of the potential head relative to a fixed datum.
- **Hydrodynamics** Means the dynamic energy, force, or motion of fluids as affected by the physical forces acting upon those fluids.
- **Hydrograph** A graph of runoff rate, inflow rate or discharge rate, past a specific point over time.
- **Hydrologic cycle** The circuit of water movement from the atmosphere to the earth and return to the atmosphere through various stages or processes as precipitation, interception, runoff, infiltration, percolation, storage, evaporation, and transpiration.
- **Hydrologic Soil Groups** A soil characteristic classification system defined by the U.S. Soil Conservation Service in which a soil may be categorized into one of four soil groups (A, B, C, or D) based upon infiltration rate and other properties.
  - Type A: Low runoff potential. Soils having high infiltration rates, even when thoroughly wetted, and consisting chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.
  - Type B: Moderately low runoff potential. Soils having moderate infiltration rates when thoroughly wetted, and consisting chiefly of moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission.
  - Type C: Moderately high runoff potential. Soils having slow infiltration rates when thoroughly wetted, and consisting chiefly of soils with a layer that impedes downward

movement of water, or soils with moderately fine to fine textures. These soils have a slow rate of water transmission.

- Type D: High runoff potential. Soils having very slow infiltration rates when thoroughly wetted, and consisting chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a hardpan, till, or clay layer at or near the surface, soils with a compacted subgrade at or near the surface, and shallow soils or nearly impervious material. These soils have a very slow rate of water transmission.[1]

[1] Vladimir Novotny and Harvey Olem. *Water Quality Prevention, Identification, and Management of Diffuse Pollution*, Van Nostrand Reinhold: New York, 1994, p. 109.

- **Hydrology:** The science of the behavior of water in the atmosphere, on the surface of the earth, and underground.
- **Hydroperiod:** A seasonal occurrence of flooding and/or soil saturation; it encompasses depth, frequency, duration, and seasonal pattern of inundation.
- **Hyetograph:** A graph of percentages of total precipitation for a series of time steps representing the total time in which precipitation occurs.
- **Illicit discharge:** All non-stormwater discharges to stormwater drainage systems that cause or contribute to a violation of state water quality, sediment quality or ground water quality standards, including but not limited to sanitary sewer connections, industrial process water, interior floor drains, car washing, and greywater systems.
- **Impact basin:** A device used to dissipate the energy of flowing water. Generally constructed of concrete in the form of a partially depressed or partially submerged vessel, it may utilize baffles to dissipate velocities.
- **Impervious:** A surface which cannot be easily penetrated. For instance, rain does not readily penetrate paved surfaces.
- **Impervious surface:** A non-vegetated surface area that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development. A non-vegetated surface area which causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development. Common impervious surfaces include, but are not limited to, rooftops, walkways, patios, driveways, parking lots or storage areas, concrete or asphalt paving, gravel roads, packed earthen materials, and oiled, macadam or other surfaces which similarly impede the natural infiltration of stormwater. Open, uncovered retention/detention facilities shall not be considered as impervious surfaces for purposes of determining whether the thresholds for application of minimum requirements are exceeded. Open, uncovered retention/detention facilities shall be considered impervious surfaces for purposes of runoff modeling.
- **Impoundment**: A natural or man-made containment for surface water.

- **Improvement:** Streets (with or without curbs or gutters), sidewalks, crosswalks, parking lots, water mains, sanitary and storm sewers, drainage facilities, street trees and other appropriate items.
- **Industrial Activities**: Industrial activities are defined in the Industrial Stormwater General Permit. Industrial activities at the airport include aircraft and ground vehicle maintenance, fueling, washing, aircraft and ground deicing/anti-icing, and miscellaneous airport-related activities.
- **Industrial Waste System (IWS):** The system to collect, convey and treat stormwater runoff from areas where industrial activities are performed.
- **Infiltration**: Means the downward movement of water from the surface to the subsoil.
- **Infiltration facility (or system):** A drainage facility designed to use the hydrologic process of surface and stormwater runoff soaking into the ground, commonly referred to as a percolation, to dispose of surface and stormwater runoff.
- **Infiltration rate:** The rate, usually expressed in inches/hour, at which water moves downward (percolates) through the soil profile. Short-term infiltration rates may be inferred from soil analysis or derived from field measurements. Long-term infiltration rates are affected by variability in soils and subsurface conditions at the site, the effectiveness of pretreatment or influent control, and the degree of long-term maintenance of the infiltration facility.
- **Ingress/egress:** The points of access to and from a property.
- **Inlet:** A form of connection between surface of the ground and a drain or sewer for the admission of surface and stormwater runoff.
- **Insecticide:** A substance, usually chemical, that is used to kill insects.
- **Interception (Hydraulics):** The process by which precipitation is caught and held by foliage, twigs, and branches of trees, shrubs, and other vegetation. Often used for "interception loss" or the amount of water evaporated from the precipitation intercepted.
- **Interflow:** That portion of rainfall that infiltrates into the soil and moves laterally through the upper soil horizons until intercepted by a stream channel or until it returns to the surface for example, in a roadside ditch, wetland, spring or seep. Interflow is a function of the soil system depth, permeability, and water-holding capacity.
- **Intermittent stream:** A stream or portion of a stream that flows only in direct response to precipitation. It receives little or no water from springs and no long-continued supply from melting snow or other sources. It is dry for a large part of the year, ordinarily more than three months.
- **Invasive weedy plant species:** Opportunistic species of inferior biological value that tend to out-compete more desirable forms and become dominant; applied to non-native species in this manual.
- **Invert:** The lowest point on the inside of a sewer or other conduit.

- **Invert elevation:** The vertical elevation of a pipe or orifice in a pond that defines the water level.
- **Isopluvial map:** A map with lines representing constant depth of total precipitation for a given return frequency.
- **Jurisdictional wetland:** A jurisdictional wetland as defined under Section 404 of the Clean Water Act is a wetland that is connected to a Water of the United States (WOUS) using the U.S. Army Corps of Engineers (Corps) definition of WOUS. If an area meets the three standard wetland criteria (hydric soils, hydrology, and hydrophytic vegetation) and is connected to a WOUS, then it is considered a jurisdictional wetland and is regulated by the Corps. Because the connectedness of a wetland to a WOUS is not always easily defined, it is critical to get a jurisdictional determination, in writing, from the Corps, as early as possible in the project planning process.
- **Lag time:** The interval between the center of mass of the storm precipitation and the peak flow of the resultant runoff.
- **Lake:** An area permanently inundated by water in excess of two meters deep and greater than 20 acres in size as measured at the ordinary high water marks.
- **Land-disturbing activity:** Any activity that results in a change in the existing soil cover (both vegetative and non-vegetative) and/or the existing soil topography. Land-disturbing activities include, but are not limited to, clearing, grading, filling, and excavation. Compaction that is associated with stabilization of structures and road construction shall also be considered a land-disturbing activity. Vegetation maintenance practices, including landscaping maintenance and gardening, are not considered land-disturbing activity. Stormwater facility maintenance is not considered land disturbing activity if conducted according to established standards and procedures.
- **Landside:** Areas of the airport outside of the airside that is accessible to the general public (e.g., parking, rental car lots, and terminals).
- **Landslide**: Episodic downslope movement of a mass of soil or rock that includes but is not limited to rock falls, slumps, mudflows, and earthflows. For the purpose of these rules, snow avalanches are considered to be a special case of landsliding.
- **Landslide hazard areas**: Those areas subject to a severe risk of landslide.
- **Leachable materials**: Those substances that, when exposed to rainfall, measurably alter the physical or chemical characteristics of the rainfall runoff. Examples include erodible soils, uncovered process wastes, manure, fertilizers, oil substances, ashes, kiln dust, and garbage dumpster leakage.
- **Leachate:** Liquid that has percolated through soil and contains substances in solution or suspension.
- **Leaching**: Removal of the more soluble materials from the soil by percolating waters.

- **Legume**: A member of the legume or pulse family, Leguminosae, one of the most important and widely distributed plant families. The fruit is a "legume" or pod. Includes many valuable food and forage species, such as peas, beans, clovers, alfalfas, sweet clovers, and vetches. Practically all legumes are nitrogen-fixing plants.
- **Level 1 flow control requirement:** Level 1 flow control is designed to control flood flows at their current levels and to maintain peak flows within the capacity of the conveyance system for most storm events. Specifically, Level 1 flow control requires maintaining the predevelopment peak flow rates for the 2-year and 10-year runoff events.
- **Level 1 Enhanced flow control requirement:** Level 1 Enhanced flow control is the same as Level 1 flow control but includes maintaining the predevelopment peak flow rates for the 100-year runoff event.
- **Level 2 flow control requirement:** Level 2 flow control is designed to control the durations of geomorphically significant flows and thereby maintain predevelopment channel and streambank erosion rates. The flow that initiates transport of channel sediments varies from channel to channel, but one-half of the 2-year flow is considered a good general estimate of the erosion-initiating flow. Specifically, Level 2 flow control requires maintaining the durations of high flows at their predevelopment levels for all flows greater than one-half of the 2-year peak flow up to the 50-year peak flow. Also, the peak flow rates for the 2-year and the 10-year runoff events are intended to be maintained when applying Level 2 flow control.
- **Level pool routing**: The basic technique of storage routing used for sizing and analyzing detention storage and determining water levels for ponding water bodies. The level pool routing technique is based on the continuity equation: Inflow – Outflow = Change in storage.
- **Level spreader**: A temporary ESC device used to spread out stormwater runoff uniformly over the ground surface as sheet flow (i.e., not through channels). The purpose of level spreaders is to prevent concentrated, erosive flows from occurring, and to enhance infiltration.
- **LID**: See Low Impact Development
- **Local government**: Any county, city, town, or special purpose district having its own incorporated government for local affairs.
- **Low flow channel**: An incised or paved channel from inlet to outlet in a dry basin which is designed to carry low runoff flows and/or baseflow, directly to the outlet without detention.
- **Low Impact Development (LID):** A stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation, and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design.
- **Low Impact Development (LID) Best Management Practices:** Distributed stormwater management practices, integrated into a project design, that emphasize pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration. LID BMPs include, but are not limited to, bioretention/rain gardens, permeable pavements, roof

downspout controls, dispersion, soil quality and depth, minimal excavation foundations, vegetated roofs, and water re-use.

- **Low Impact Development (LID) Principles:** Land use management strategies that emphasize conservation, use of on-site natural features, and site planning to minimize impervious surfaces, native vegetation loss, and stormwater runoff.
- **Low permeability liner:** A layer of compacted till or, compacted clay, concrete, or a geomembrane.
- **Lowest floor:** The lowest enclosed area (including basement) of a structure. An area used solely for parking of vehicles, building access, or storage, in an area other than a basement area, is not considered a building's lowest floor, provided that the enclosed area meets all of the structural requirements of the flood hazard standards.
- **MDNS:** A Mitigated Determination of Nonsignificance (See DNS and Mitigation).
- **Maintenance:** Repair and maintenance includes activities conducted on currently serviceable structures, facilities, and equipment that involves no expansion or use beyond that previously existing and results in no significant adverse hydrologic impact. It includes those usual activities taken to prevent a decline, lapse, or cessation in the use of structures and systems. Those usual activities may include replacement of dysfunctional facilities, including cases where environmental permits require replacing an existing structure with a different type structure, as long as the functioning characteristics of the original structure are not changed. One example is the replacement of a collapsed, fish blocking, round culvert with a new box culvert under the same span, or width, of roadway. In regard to stormwater facilities, maintenance includes assessment to ensure ongoing proper operation, removal of built up pollutants (i.e., sediments), replacement of failed or failing treatment media, and other actions taken to correct defects as identified in the maintenance standards of Chapter 4, Volume V. See also Pavement Maintenance exemptions in Section 2.2 of Volume I.
- **Manning's equation**: An equation used to predict the velocity of water flow in an open channel or pipelines:

  $V = (1.486R^{2/3}S^{1/2})/ n$

  where:

  V is the mean velocity of flow in feet per second

  R is the hydraulic radius in feet

  S is the slope of the energy gradient or, for assumed uniform flow, the slope of the channel in feet per foot; and

  n is Manning's roughness coefficient or retardance factor of the channel lining.
- **Mass wasting**: The movement of large volumes of earth material downslope.
- **Master drainage plan:** A comprehensive drainage control plan intended to prevent significant adverse impacts to the natural and manmade drainage system, both on and off-site.

- **Mean annual water level fluctuation:** Derived as follows:
    1. Measure the maximum water level (e.g., with a crest stage gage, Reinelt and Horner 1990) and the existing water level at the time of the site visit (e.g., with a staff gage) on at least eight occasions spread through a year.
    2. Take the difference of the maximum and existing water level on each occasion and divide by the number of occasions.
- **Mean depth:** Average depth; cross-sectional area of a stream or channel divided by its surface or top width.
- **Mean velocity:** The average velocity of a stream flowing in a channel or conduit at a given cross-section or in a given reach. It is equal to the discharge divided by the cross-sectional area of the reach.
- **Measuring weir:** A shaped notch through which water flows are measured. Common shapes are rectangular, trapezoidal, and triangular.
- **Mechanical analysis:** The analytical procedure by which soil particles are separated to determine the particle size distribution.
- **Mechanical practices:** Soil and water conservation practices that primarily change the surface of the land or that store, convey, regulate, or dispose of runoff water without excessive erosion.
- **Media filter:** A filter that includes material for removing pollutants (e.g., compost, gypsum, perlite, zeolite, or activated carbon).
- **Media filter drain:** A stormwater treatment facility constructed in the pervious shoulder area of a roadway, consisting of a vegetation-covered French drain containing filter media. Also referred to as an ecology embankment.
- **Metals:** Elements, such as mercury, lead, nickel, zinc and cadmium, which are of environmental concern because they do not degrade over time. Although many are necessary nutrients, they are sometimes magnified in the food chain, and they can be toxic to life in high enough concentrations. They are also referred to as heavy metals.
- **Microbes:** The lower trophic levels of the soil food web. They are normally considered to include bacteria, fungi, flagellates, amoebae, ciliates, and nematodes. These in turn support the higher trophic levels, such as mites and earthworms. Together they are the basic life forms that are necessary for plant growth. Soil microbes also function to bioremediate pollutants such as petroleum, nutrients, and pathogens.
- **Mitigation:** Means, in the following order of preference:
    a. Avoiding the impact altogether by not taking a certain action or part of an action;
    b. Minimizing impacts by limiting the degree or magnitude of the action and its implementation, by using appropriate technology, or by taking affirmative steps to avoid or reduce impacts;

c. Rectifying the impact by repairing, rehabilitating or restoring the affected environment;

d. Reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and

e. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments.

- **Modification, modified (wetland):** A wetland whose physical, hydrological, or water quality characteristics have been purposefully altered for a management purpose, such as by dredging, filling, forebay construction, and inlet or outlet control.
- **Monitor:** To systematically and repeatedly measure something in order to track changes.
- **Monitoring:** The collection of data by various methods for the purposes of understanding natural systems and features, evaluating the impacts of development proposals on such systems, and assessing the performance of mitigation measures imposed as conditions of development.
- **Mulch:** A layer of organic material or aggregate applied to the surface of soil. Its purpose is any or all of the following:
  - To conserve soil moisture or temperature
  - To improve the fertility and health of the soil
  - To reduce weed growth
  - To hold fertilizer, seed, and soil in place
  - To enhance the visual appeal of the area.

  Types of mulches used in this manual include: Chipped site vegetation, compost, hydromulch, wood-based or wood straw, wood strand, straw, and aggregate.
- **NGPE:** See Native Growth Protection Easement.
- **NGVD:** National Geodetic Vertical Datum.
- **NPDES:** The National Pollutant Discharge Elimination System as established by the Federal Clean Water Act.
- **NPDES Outfall:** The discharge point and monitoring location for a storm drainage subbasin at STIA regulated by Part II of the Port's NPDES Permit, which addresses non-construction stormwater runoff. Refer to the Port's current permit for a list of the permitted outfalls.
- **National Pollutant Discharge Elimination System (NPDES):** The part of the federal Clean Water Act, which requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and, in Washington State, are administered by the Washington State Department of Ecology.

- **Native Growth Protection Easement (NGPE):** An easement granted for the protection of native vegetation within a sensitive area or its associated buffer. The NGPE shall be recorded on the appropriate documents of title and filed with the County Records Division.
- **Native vegetation:** Vegetation comprised of plant species, other than noxious weeds, that are indigenous to the coastal region of the Pacific Northwest and which reasonably could have been expected to naturally occur on the site. Examples include trees such as Douglas fir, western hemlock, western red cedar, alder, big-leaf maple, and vine maple; shrubs such as willow, elderberry, salmonberry, and salal; and herbaceous plants such as sword fern, foam flower, and fireweed.
- **Natural location**: Means the location of those channels, swales, and other non-manmade conveyance systems as defined by the first documented topographic contours existing for the subject property, either from maps or photographs, or such other means as appropriate. In the case of outwash soils with relatively flat terrain, no natural location of surface discharge may exist.
- **New development:** Land-disturbing activities, including Class IV - general forest practices that are conversions from timber land to other uses; structural development, including construction or installation of a building or other structure; creation of hard surfaces; and subdivision, short subdivision and binding site plans, as defined and applied in Chapter 58.17 RCW. Projects meeting the definition of redevelopment shall not be considered new development.
- **Nitrate (NO3):** A form of nitrogen which is an essential nutrient to plants. It can cause algal blooms in water if all other nutrients are present in sufficient quantities. It is a product of bacterial oxidation of other forms of nitrogen, from the atmosphere during electrical storms and from fertilizer manufacturing.
- **Nitrification:** The biochemical oxidation process by which ammonia is changed first to nitrites and then to nitrates by bacterial action, consuming oxygen in the water.
- **Nitrogen, Available:** Usually ammonium, nitrite, and nitrate ions, and certain simple amines available for plant growth. A small fraction of organic or total nitrogen in the soil is available at any time.
- **Non-effective pollution-generating impervious surface (PGIS)**: Those new, applicable replaced, or existing PGIS surfaces that are being managed by dispersion areas meeting the dispersion BMP criteria in Ecology's Stormwater Management Plan for Western Washington. The equivalent area concept generally applies to engineered dispersion areas and may apply to natural dispersion areas, as described in the following: The existing site currently collects runoff in the ditch or pipe and discharges to a surface water. By changing this condition to a natural dispersion situation through sheetflow or channelized flow dispersion, a surface discharge is eliminated, resulting in a flow control improvement. Equivalent area trades for natural dispersion are allowed for this specific case.
- **Nonpoint source pollution:** Pollution that enters a waterbody from diffuse origins on the watershed and does not result from discernible, confined, or discrete conveyances.

- **Normal depth:** The depth of uniform flow. This is a unique depth of flow for any combination of channel characteristics and flow conditions. Normal depth is calculated using Manning's Equation.
- **NRCS Method**: A single-event hydrologic analysis technique for estimating runoff based on the Curve Number method. The Curve Numbers are published by NRCS in Technical Release No. 55: Urban Hydrology for Small Watersheds, 1986. With the change in name to the Natural Resource Conservation Service, the method may be referred to as the NRCS Method.
- **Nutrients:** Essential chemicals needed by plants or animals for growth. Excessive amounts of nutrients can lead to degradation of water quality and algal blooms. Some nutrients can be toxic at high concentrations.
- **Object-Free Area (OFA):** An area on the ground centered on a runway, taxiway, or a taxi lane centerline provided to enhance the safety of aircraft operations by having the area free of aboveground objects protruding above the Runway Safety Area (RSA) edge elevation, except for objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.
- **Off-line facilities:** Water quality treatment facilities to which stormwater runoff is restricted to some maximum flow rate or volume by a flow-splitter.
- **Off-site:** Any area lying upstream of the site that drains onto the site and any area lying downstream of the site to which the site drains.
- **Off-system storage:** Facilities for holding or retaining excess flows over and above the carrying capacity of the stormwater conveyance system, in chambers, tanks, lagoons, ponds, or other basins that are not a part of the subsurface sewer system.
- **Oil control:** The treatment of stormwater runoff with BMPs to remove oil, grease, and total petroleum hydrocarbons (TPH).
- **Oil/water separator:** A vault, usually underground, designed to provide a quiescent environment to separate oil from water.
- **On-line facilities**: Water quality treatment facilities, which receive all of the stormwater runoff from a drainage area. Flows above the water quality design flow rate or volume are passed through at a lower percent removal efficiency.
- **On-site:** The entire property that includes the proposed development.
- **On-site Stormwater Management BMPs:** As used in this chapter, a synonym for Low Impact Development BMPs.
- **Operational BMPs**: Operational BMPs are a type of Source Control BMP. They are schedules of activities, prohibition of practices, and other managerial practices to prevent or reduce pollutants from entering stormwater. Operational BMPs include formation of a pollution prevention team, good housekeeping, preventive maintenance procedures, spill prevention and clean-up, employee training, inspections of pollutant sources and BMPs, and record keeping. They can also include process changes, raw material/product changes, and recycling wastes.

- **Ordinary high water mark**: The term ordinary high water mark means the line on the shore established by the fluctuations of water and indicated by physical characteristics such as a clear, natural line impressed on the bank; shelving; changes in the character of soil destruction on terrestrial vegetation, or the presence of litter and debris; or other appropriate means that consider the characteristics of the surrounding area.

  The ordinary high water mark will be found by examining the bed and banks of a stream and ascertaining where the presence and action of waters are so common and usual, and so long maintained in all ordinary years, as to mark upon the soil a character distinct from that of the abutting upland, in respect to vegetation. In any area where the ordinary high water mark cannot be found, the line of mean high water shall substitute. In any area where neither can be found, the channel bank shall be substituted. In braided channels and alluvial fans, the ordinary high water mark or substitute shall be measured so as to include the entire stream feature.

- **Organic matter**: Organic matter as decomposed animal or vegetable matter. It is measured by ASTM D 2974. Organic matter is an important reservoir of carbon and a dynamic component of soil and the carbon cycle. It improves soil and plant efficiency by improving soil physical properties including drainage, aeration, and other structural characteristics. It contains the nutrients, microbes, and higher-form soil food web organisms necessary for plant growth. The maturity of organic matter is a measure of its beneficial properties. Raw organic matter can release water-soluble nutrients (similar to chemical fertilizer). Beneficial organic matter has undergone a humification process either naturally in the environment or through a composting process.

- **Orifice**: An opening with closed perimeter, usually sharp-edged, and of regular form in a plate, wall, or partition through which water may flow, generally used for the purpose of measurement or control of water.

- **Outfall**: A point source as defined by 40 CFR 122.2 at the point where a discharge leaves the Permittee's MS4 and enters a surface receiving waterbody or surface receiving waters. Outfall does not include pipes, tunnels, or other conveyances which connect segments of the same stream or other surface waters and are used to convey primarily surface waters (i.e., culverts).

- **Outlet**: Point of water disposal from a stream, river, lake, tidewater, or artificial drain.

- **Outlet channel:** A waterway constructed or altered primarily to carry water from manmade structures, such as terraces, tile lines, and diversions.

- **Outlet protection:** A protective barrier of rock, erosion control blankets, vegetation, or sod constructed at the conveyance outlet.

- **Outwash soils:** Soils formed from highly permeable sands and gravels.

- **Overflow:** A pipeline or conduit device, together with an outlet pipe, that provides for the discharge of portions of combined sewer flows into receiving waters or other points of disposal, after a regular device has allowed the portion of the flow which can be handled by interceptor sewer lines and pumping and treatment facilities to be carried by and to such water pollution control structures.

- **Overflow rate:** Detention basin release rate divided by the surface area of the basin. It can be thought of as an average flow rate through the basin.
- **Overtopping:** To flow over the limits of a containment or conveyance element.
- **Partially controlled limited access highway**: A highway where the right of owner or occupants of abutting land or other persons to access, light, air, or view in connection with the highway is controlled to give preference to through traffic to a degree that, in addition to access connections with selected public roads, there may be some crossings and some private driveway connections at grade. (See WAC 468-58-010)
- **Particle Size:** The effective diameter of a particle as measured by sedimentation, sieving, or micrometric methods.
- **Peak discharge**: The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.
- **Peak-shaving**: Controlling post-development peak discharge rates to pre-development levels by providing temporary detention in a BMP.
- **Percolation**: The movement of water through soil.
- **Percolation rate:** The rate, often expressed in minutes/inch, at which clear water, maintained at a relatively constant depth, will seep out of a standardized test hole that has been previously saturated. The term percolation rate is often used synonymously with infiltration rate (short-term infiltration rate).
- **Permanent Stormwater Control (PSC) Plan**: A plan which includes permanent BMPs for the control of pollution from stormwater runoff after construction and/or land disturbing activity has been completed
- **Permeable Pavement:** Pervious concrete, porous asphalt, permeable pavers or other forms of pervious or porous paving material intended to allow passage of water through the pavement section. It often includes an aggregate base that provides structural support and acts as a stormwater reservoir.
- **Permeable soils:** Soil materials with a sufficiently rapid infiltration rate so as to greatly reduce or eliminate surface and stormwater runoff. These soils are generally classified as SCS hydrologic soil types A and B.
- **Person:** Any individual, partnership, corporation, association, organization, cooperative, public or municipal corporation, agency of the state, or local government unit, however designated.
- **Perviousness:** Related to the size and continuity of void spaces in soils; related to a soil's infiltration rate.
- **Pervious Surface:** Any surface material that allows stormwater to infiltrate into the ground. Examples include lawn, landscape, pasture, native vegetation areas, and permeable pavements.

- **Pesticide:** A general term used to describe any substance - usually chemical - used to destroy or control organisms; includes herbicides, insecticides, algicides, fungicides, and others. Many of these substances are manufactured and are not naturally found in the environment. Others, such as pyrethrum, are natural toxins that are extracted from plants and animals.
- **pH:** A measure of the alkalinity or acidity of a substance which is conducted by measuring the concentration of hydrogen ions in the substance. A pH of 7.0 indicates neutral water. A 6.5 reading is slightly acid.
- **Physiographic:** Characteristics of the natural physical environment (including hills).
- **Plan Approval Authority:** The Plan Approval Authority is defined as that department within local government that has been delegated authority to approve stormwater site plans.
- **Planned unit development (PUD)**: A special classification authorized in some zoning ordinances, where a unit of land under control of a single developer may be used for a variety of uses and densities, subject to review and approval by the local governing body. The locations of the zones are usually decided on a case-by-case basis.
- **Plat:** A map or representation of a subdivision showing the division of a tract or parcel of land into lots, blocks, streets, or other divisions and dedications.
- **Plunge pool:** A device used to dissipate the energy of flowing water that may be constructed or made by the action of flowing. These facilities may be protected by various lining materials.
- **Point discharge:** The release of collected and/or concentrated surface and stormwater runoff from a pipe, culvert, or channel.
- **Point of compliance:** The location at which compliance with a discharge performance standard or a receiving water quality standard is measured.
- **Pollution**: Contamination or other alteration of the physical, chemical, or biological properties, of waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive or other substance into any waters of the state as will or is likely to create a nuisance or render such waters harmful, detrimental or injurious to the public health, safety or welfare, or to domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.
- **Pollution-generating hard surface (PGHS):** Those hard surfaces considered to be a significant source of pollutants in stormwater runoff. See the listing of surfaces under pollution-generating impervious surface.
- **Pollution-generating impervious surface (PGIS):** Those impervious surfaces considered to be a significant source of pollutants in stormwater runoff. Such surfaces include those which are subject to: vehicular use; industrial activities (as further defined in the glossary); storage of erodible or leachable materials, wastes, or chemicals, and which receive direct rainfall or the run-on or blow-in of rainfall; metal roofs unless they are coated with an inert, non-leachable

material (e.g., baked-on enamel coating); or roofs that are subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities..

- **Pollution-generating pervious surface (PGPS):** Any non-impervious surface subject to vehicular use, industrial activities (as further defined in the glossary); or storage of erodible or leachable materials, wastes or chemicals that receive direct rainfall or run-on or blow-in of rainfall, use of pesticides and fertilizers or loss of soil. Typical PGPS include permeable pavement subject to vehicular use, lawns and landscaped areas including: golf courses, parks, cemeteries, and sports fields (natural and artificial turf).
- **Pre-developed condition:** The native vegetation and soils that existed at a site prior to the influence of Euro-American settlement. The pre-developed condition shall be assumed to be forested land cover unless reasonable, historic information is provided that indicates the site was prairie prior to settlement. At STIA, the definition of pre-developed conditions depends on where the project is located. For Des Moines Creek basin, pre-developed conditions are the existing conditions within Port property as of 1994. The pre-developed condition for the Gilliam Creek basin is forested land cover. The pre-developed conditions for the Miller Creek and Walker Creek basins for projects within the Retrofit Area can be mitigated with an existing Port facility are considered 10-15-75 (10 percent Effective Impervious Area, 15 percent grass, and 75 percent forest). Otherwise pre-developed conditions within the Miller Creek and Walker Creek basins are forested.
- **Prediction:** For the purposes of this document an expected outcome based on the results of hydrologic modeling and/or the judgment of a trained professional civil engineer or geologist.
- **Pretreatment:** The removal of material such as solids, grit, grease, and scum from flows prior to physical, biological, or physical treatment processes to improve treatability. Pretreatment may include screening, grit removal, settling, oil/water separation, or application of a Basic Treatment BMP prior to infiltration.
- **Priority peat systems:** Unique, irreplaceable fens that can exhibit water pH in a wide range from highly acidic to alkaline, including fens typified by Sphagnum species, Ledum groenlandicum (Labrador tea), Drosera rotundifolia (sundew), and Vaccinium oxycoccos (bog cranberry); marl fens; estuarine peat deposits; and other moss peat systems with relatively diverse, undisturbed flora and fauna. Bog is the common name for peat systems having the Sphagnum association described, but this term applies strictly only to systems that receive water income from precipitation exclusively.
- **Professional civil engineer**: A person registered with the state of Washington as a professional engineer in civil engineering.
- **Project:** Any proposed action to alter or develop a site. The proposed action of a permit application or an approval, which requires drainage review.
- **Project site (limits):** That portion of a property, properties, or right-of-way subject to land-disturbing activities, new hard surfaces, or replaced hard surfaces. For the purposes of this manual, the project site is the area within the construction limits that drains to surface or storm

water. The portion of area within the construction limits draining to IWS is not included in the definition of project site.

- **Properly Functioning Soil System (PFSS)**: Equivalent to engineered soil/landscape system. This can also be a natural system that has not been disturbed or modified.
- **Puget Sound basin:** Puget Sound south of Admiralty Inlet (including Hood Canal and Saratoga Passage); the waters north to the Canadian border, including portions of the Strait of Georgia; the Strait of Juan de Fuca south of the Canadian border; and all the lands draining into these waters as mapped in Water Resources Inventory Areas numbers 1 through 19, set forth in WAC 173-500-040.
- **R/D:** See Retention/detention facility.
- **Rain Garden:** A non-engineered, shallow, landscaped depression, with compost-amended native soils or imported soils, and adapted plants. The depression is designed to pond and temporarily store stormwater runoff from adjacent areas, and to allow stormwater to pass through the amended soil profile.
- **Rare, threatened, or endangered species**: Plant or animal species that are regional relatively uncommon, are nearing endangered status, or whose existence is in immediate jeopardy and is usually restricted to highly specific habitats. Threatened and endangered species are officially listed by federal and state authorities, whereas rare species are unofficial species of concern that fit the above definitions.
- **Rational method**: A means of computing storm drainage flow rates (Q) by use of the formula Q = CIA, where C is a coefficient describing the physical drainage area, I is the rainfall intensity and A is the area. This method is no longer used in the technical manual.
- **Reach**: A length of channel with uniform characteristics.
- **Receiving Waterbody or Receiving Waters:** Naturally and/or reconstructed naturally occurring surface water bodies, such as creeks, streams, rivers, lakes, wetlands, estuaries, and marine waters, or groundwater, to which a MS4 discharges.
- **Recharge**: The addition of water to the zone of saturation (i.e., an aquifer).
- **Recommended BMPs**: As used in Volume IV, recommended BMPs are those BMPs that are not expected to be mandatory by local governments at new development and redevelopment sites. However, they may improve pollutant control efficiency, and may provide a more comprehensive and environmentally effective stormwater management program.
- **Redevelopment:** On a site that is already substantially developed (i.e., has 35 percent or more of existing hard surface coverage), the creation or addition of hard surfaces; the expansion of a building footprint or addition or replacement of a structure; structural development including construction, installation or expansion of a building or other structure; replacement of hard surface that is not part of a routine maintenance activity; and land-disturbing activities.
- **Regional:** An action (here, for stormwater management purposes) that involves more than one discrete property.

- **Regional detention facility:** A stormwater quantity control structure designed to correct existing surface water runoff problems of a basin or subbasin. The area downstream has been previously identified as having existing or predicted significant and regional flooding and/or erosion problems.

  This term is also used when a detention facility is sited to detain stormwater runoff from a number of new developments or areas within a catchment.

- **Release rate:** The computed peak rate of surface and stormwater runoff from a site.

- **Replaced hard surface:** For structures, the removal and replacement of hard surfaces or foundation. For other hard surfaces, including airfield runways, taxiways, or ramps, the removal down to bare soil or base course, and replacement.

- **Replaced impervious surface:** For structures, the removal and replacement of impervious surfaces down to the foundation. For other impervious surfaces, the removal down to bare soil or base course and replacement.

- **Residential density**: The number of dwelling units per unit of surface area. Net density includes only occupied land. Gross density includes unoccupied portions of residential areas, such as roads and open space.

- **Restoration:** Actions performed to reestablish wetland functional characteristics and processes that have been lost by alterations, activities, or catastrophic events in an area that no longer meets the definition of a wetland.

- **Retention:** The process of collecting and holding surface and stormwater runoff with no surface outflow.

- **Retention/detention facility (R/D):** A type of drainage facility designed either to hold water for a considerable length of time and then release it by evaporation, plant transpiration, and/or infiltration into the ground; or to hold surface and stormwater runoff for a short period of time and then release it to the surface and stormwater management system.

- **Retrofit Area:** The Retrofit Area refers to the areas of the airport that were retrofitted with water quality BMPs to meet the requirements of the Port's 401 Certification for the 3rd Runway. Due to the retrofit effort, projects within the Retrofit Area may need to comply with different requirements than those outside this area. Refer to Section 2.4.3.

- **Retrofitting:** The renovation of an existing structure or facility to meet changed conditions or to improve performance.

- **Return frequency:** A statistical term for the average time of expected interval that an event of some kind will equal or exceed given conditions (e.g., a stormwater flow that occurs every 2 years).

- **Rhizome:** A modified plant stem that grows horizontally underground.

- **Riffles:** Fast sections of a stream where shallow water races over stones and gravel. Riffles usually support a wider variety of bottom organisms than other stream sections.

- **Rill:** A small intermittent watercourse with steep sides, usually only a few inches deep. Often rills are caused by an increase in surface water flow when soil is cleared of vegetation.
- **Riprap:** A facing layer or protective mound of rocks placed to prevent erosion or sloughing of a structure or embankment due to flow of surface and stormwater runoff.
- **Riparian:** Pertaining to the banks of streams, wetlands, lakes, or tidewater.
- **Riser:** A vertical pipe extending from the bottom of a pond BMP that is used to control the discharge rate from a BMP for a specified design storm.
- **Road and Airfield-Related Project:** Project affecting roads, runways, taxiways, service roads, ramps and anything subject to airfield vehicular traffic.
- **Rodenticide**: A substance used to destroy rodents.
- **Runoff:** Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes and wetlands as well as shallow ground water. As applied in this manual, it also means the portion of rainfall or other precipitation that becomes surface flow and interflow.
- **Runoff treatment:** Pollutant removal to a specified level via engineered or natural stormwater management systems.
- **Runoff treatment BMP:** A BMP specifically designed for pollutant removal.
- **Runway Object Free Area (ROFA):** An area on the ground centered on a runway centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located for air navigation or aircraft ground maneuvering purposes.
- **Runway Protection Zone (RPZ):** An area off the runway end to enhance the protection of people and property on the ground.
- **Runway Safety Area (RSA).** A defined surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway.
- **SCS:** Soil Conservation Service (now the Natural Resources Conservation Service), U.S. Department of Agriculture
- **SCS Method**: See NRCS Method.
- **SEPA:** See State Environmental Policy Act.
- **Salmonid:** A member of the fish family Salmonidae. Chinook, Coho, chum, sockeye and pink salmon; cutthroat, brook, brown, rainbow, and steelhead trout; Dolly Varden, kokanee, and char are examples of salmonid species.
- **Sand filter:** A man-made depression or basin with a layer of sand that treats stormwater as it percolates through the sand and is discharged via a central collector pipe.
- **Saturated hydraulic conductivity:** The rate of movement of water through a saturated porous medium.

- **Saturation point**: In soils, the point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount.
- **Scour:** Erosion of channel banks due to excessive velocity of the flow of surface and stormwater runoff.
- **Sediment:** Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits, and is transported by, suspended in, or deposited by water.
- **Sedimentation:** The depositing or formation of sediment.
- **Sensitive area:** Any area designated by a federal, state, or local government as having unique or important environmental characteristics that may require additional protective measures (also see *critical areas*). These areas include but are not limited to:
  - "Critical habitat" as defined in Section 3 of the federal Endangered Species Act of 1973.
  - Designated "critical water resources" as defined in 33 CFR Part 330, Nationwide Permit Program.
  - Water bodies designated as "impaired" under the provision of Section 303d of the federal Clean Water Act enacted by Public Law 930523.
  - Wellhead protection zones as defined under WAC 246-290, Public Water Supplies.
  - Area identified in local critical area ordinances or in an approved basin plan.
- **Sensitive emergent vegetation communities:** Assemblages of erect, rooted, herbaceous vegetation, excluding mosses and lichens, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as sundew and, as well as a number of species of Carex (sedges).
- **Sensitive life stages:** Stages during which organisms have limited mobility or alternatives in securing the necessities of life, especially including reproduction, rearing, and migration periods.
- **Sensitive scrub-shrub:** vegetation communities: Assemblages of woody vegetation less than 6 meters in height, at least some of whose members have relatively narrow ranges of environmental requirements, such as hydroperiod, nutrition, temperature, and light. Examples include fen species such as Labrador tea, bog laurel, and cranberry.
- **Settleable solids:** Those suspended solids in stormwater that separate by settling when the stormwater is held in a quiescent condition for a specified time.
- **Sheet erosion:** The relatively uniform removal of soil from an area without the development of conspicuous water channels.
- **Sheet flow:** Runoff that flows over the ground surface as a thin, even layer, not concentrated in a channel.

- **Shoreline development:** The proposed project as regulated by the Shoreline Management Act. Usually the construction over water or within a shoreline zone (generally 200 feet landward of the water) of structures such as buildings, piers, bulkheads, and breakwaters, including environmental alterations such as dredging and filling, or any project which interferes with public navigational rights on the surface waters.
- **Short circuiting**: The passage of runoff through a BMP in less than the design treatment time.
- **SIC code**: Standard industrial classification code developed by the U.S. Department of Commerce to classify types of industry. Now often the code is used by environmental agencies to assign regulatory requirements.
- **Siltation:** The process by which a river, lake, or other waterbody becomes clogged with sediment. Silt can clog gravel beds and prevent successful salmon spawning.
- **Site:** The area defined by the legal boundaries of a parcel or parcels of land that is (are) subject to new development or redevelopment. For road projects, the length of the project site and the right-of-way boundaries define the site.
- **Slope:** Degree of deviation of a surface from the horizontal; measured as a numerical ratio, percent, or in degrees. Expressed as a ratio, the first number is the horizontal distance (run) and the second is the vertical distance (rise), as 2:1. A 2:1 slope is a 50 percent slope. Expressed in degrees, the slope is the angle from the horizontal plane, with a 90° slope being vertical (maximum) and 45° being a 1:1 or 100 percent slope.
- **Sloughing:** The sliding of overlying material. It is the same effect as caving, but it usually occurs when the bank or an underlying stratum is saturated or scoured.
- **Soil:** The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. See also topsoil, engineered soil/landscape system, and properly functioning soil system.
- **Soil amendments:** Materials that improve soil fertility for establishing vegetation or permeability for infiltrating runoff.
- **Soil group, hydrologic:** A classification of soils by the Soil Conservation Service into four runoff potential groups. The groups range from A soils, which are very permeable and produce little or no runoff, to D soils, which are not very permeable and produce much more runoff.
- **Soil horizon:** A layer of soil, approximately parallel to the surface, which has distinct characteristics produced by soil-forming factors.
- **Soil profile:** A vertical section of the soil from the surface through all horizons, including C horizons.
- **Soil structure:** The relation of particles or groups of particles which impart to the whole soil a characteristic manner of breaking; some types are crumb structure, block structure, platy structure, and columnar structure.

- **Soil permeability:** The ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil.
- **Soil stabilization:** The use of measures such as rock lining, vegetation or other engineering structures to prevent the movement of soil when loads are applied to the soil.
- **Soil Texture Class:** The relative proportion, by weight, of particle sizes, based on the USDA system, of individual soil grains less than 2 mm equivalent diameter in a mass of soil. The basic texture classes in the approximate order of increasing proportions of fine particles include: sand, loamy sand, sandy loam, loam, silt loam, silt, clay loam, sandy clay, silty clay, and clay.
- **Sorption:** The physical or chemical binding of pollutants to sediment or organic particles.
- **Source control BMP:** A structure or operation that is intended to prevent pollutants from coming into contact with stormwater through physical separation of areas or careful management of activities that are sources of pollutants. This Manual separates source control BMPs into two types. Structural Source Control BMPs are physical, structural, or mechanical devices, or facilities that are intended to prevent pollutants from entering stormwater. Operational BMPs are non-structural practices that prevent or reduce pollutants from entering stormwater. See Volume IV for details.
- **Spill control device:** A Tee section or turn down elbow designed to retain a limited volume of pollutant that floats on water, such as oil or antifreeze. Spill control devices are passive and must be cleaned-out for the spilled pollutant to actually be removed.
- **Spillway:** A passage such as a paved apron or channel for surplus water over or around a dam or similar obstruction. An open or closed channel, or both, used to convey excess water from a reservoir. It may contain gates, either manually or automatically controlled, to regulate the discharge of excess water.
- **State Environmental Policy Act (SEPA) RCW 43.21C:** The Washington State law intended to minimize environmental damage. SEPA requires that state agencies and local governments consider environmental factors when making decisions on activities, such as development proposals over a certain size and comprehensive plans. As part of this process, environmental documents are prepared and opportunities for public comment are provided.
- **Steep slope:** Slopes of 40 percent gradient or steeper within a vertical elevation change of at least ten feet. A slope is delineated by establishing its toe and top, and is measured by averaging the inclination over at least ten feet of vertical relief. For the purpose of this definition:

  The toe of a slope is a distinct topographic break in slope that separates slopes inclined at less than 40% from slopes 40% or steeper. Where no distinct break exists, the toe of a steep slope is the lowermost limit of the area where the ground surface drops ten feet or more vertically within a horizontal distance of 25 feet; AND

  The top of a slope is a distinct topographic break in slope that separates slopes inclined at less than 40% from slopes 40% or steeper. Where no distinct break exists, the top of a steep slope

is the uppermost limit of the area where the ground surface drops ten feet or more vertically within a horizontal distance of 25 feet.

- **Stopway (SWY):** A defined rectangular surface beyond the end of a runway prepared or suitable for use in lieu of runway to support an aircraft without causing structural damage to the aircraft during an aborted takeoff.
- **Storage routing:** A method to account for the attenuation of peak flows passing through a detention facility or other storage feature.
- **Storm drains:** The enclosed conduits that transport surface and stormwater runoff toward points of discharge (sometimes called storm sewers).
- **Storm frequency:** The time interval between major storms of predetermined intensity and volumes of runoff for which storm sewers and other structures are designed and constructed to handle hydraulically without surcharging and back flooding; e.g., a 2-year, 10-year or 100-year storm.
- **Storm sewer:** A sewer that carries stormwater and surface water, street wash and other wash waters or drainage, but excludes sewage and industrial wastes. Also called a storm drain.
- **Stormwater:** That portion of precipitation that does not naturally percolate into the ground or evaporate, but flows via overland flow, interflow, pipes and other features of a stormwater drainage system into a defined surface waterbody, or a constructed infiltration facility.
- **Stormwater drainage system:** Constructed and natural features which function together as a system to collect, convey, channel, hold, inhibit, retain, detain, infiltrate, divert, treat or filter stormwater.
- **Stormwater facility:** A constructed component of a stormwater drainage system, designed or constructed to perform a particular function, or multiple functions. Stormwater facilities include, but are not limited to, pipes, swales, ditches, culverts, street gutters, detention ponds, retention ponds, constructed wetlands, infiltration devices, catch basins, oil/water separators, and biofiltration swales.
- **Stormwater Management Manual for Western Washington (Stormwater Manual):** This manual, as prepared by Ecology, contains BMPs to prevent, control or treat pollution in stormwater and reduce other stormwater-related impacts to waters of the State. The Stormwater Manual is intended to provide guidance on measures necessary in western Washington to control the quantity and quality of stormwater runoff from new development and redevelopment. This manual is based on the 2014 Stormwater Management Manual for Western Washington.
- **Stormwater Program**: Either the Basic Stormwater Program or the Comprehensive Stormwater Program (as appropriate to the context of the reference) called for under the Puget Sound Water Quality Management Plan.
- **Stormwater Site Plan:** The comprehensive report containing all of the technical information and analysis necessary for regulatory agencies to evaluate a proposed new development or

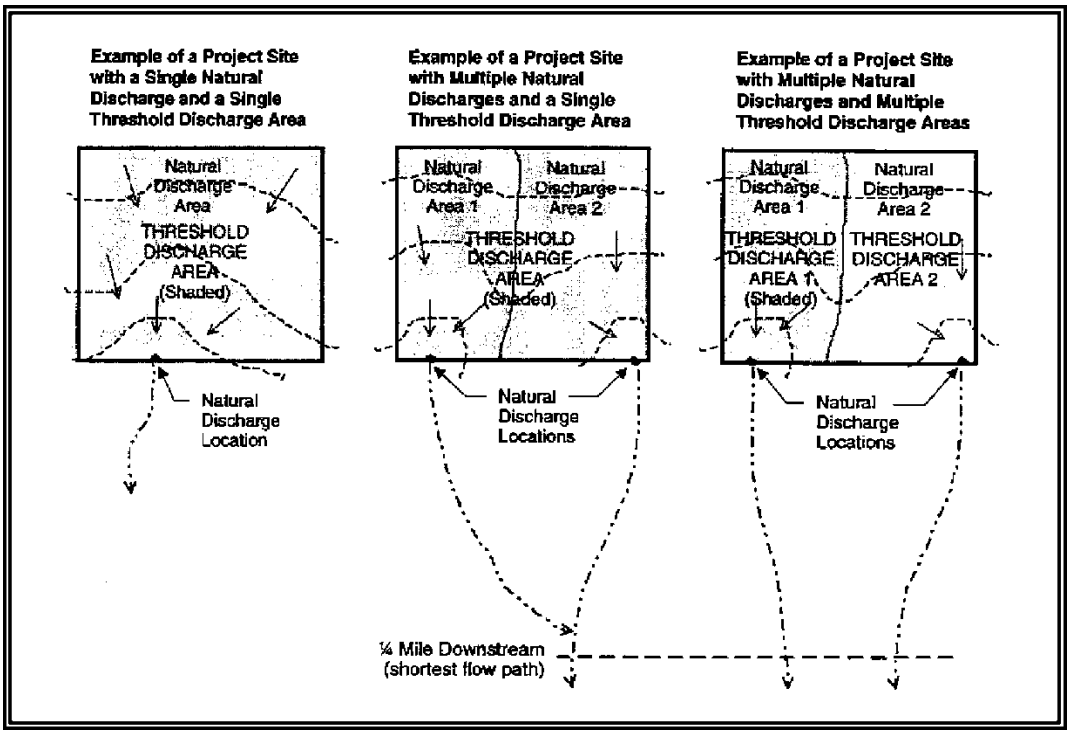
redevelopment project for compliance with stormwater requirements. Contents of the Stormwater Site Plan will vary with the type and size of the project, and individual site characteristics. It includes a Construction Stormwater Pollution Prevention Plan (Construction SWPPP) and a Permanent Stormwater Control Plan (PSC Plan). Guidance on preparing a Stormwater Site Plan is contained in Chapter 3 of Volume I.

- **Started Construction:** In the context of this manual, "started construction" means the site work associated with, and directly related to the approved project has begun. For example: grading the project site to final grade or utility installation. Simply clearing the project site does not constitute the start of construction.
- **STIA:** Seattle-Tacoma International Airport.
- **Stream gaging:** The quantitative determination of stream flow using gages, current meters, weirs, or other measuring instruments at selected locations. See Gaging station.
- **Streambanks:** The usual boundaries, not the flood boundaries, of a stream channel. Right and left banks are named facing downstream.
- **Streams:** Those areas where surface waters flow sufficiently to produce a defined channel or bed. A defined channel or bed is an area that demonstrates clear evidence of the passage of water and includes, but is not limited to, indicated by hydraulically sorted sediments or the removal of vegetative litter or loosely rooted vegetation by the action of moving water. The channel or bed need not contain water year-round.

  This definition is not meant to include irrigation ditches, canals, stormwater runoff devices or other entirely artificial watercourses unless they are used to convey streams naturally occurring prior to construction. Those topographic features that resemble streams but have no defined channels (i.e.., swales) shall be considered streams when hydrologic and hydraulic analyses done pursuant to a development proposal predict formation of a defined channel after development.
- **Structure:** A catch basin or manhole in reference to a storm drainage system.
- **Structural source control BMPs:** Physical, structural, or mechanical devices or facilities that are intended to prevent pollutants from entering stormwater. Structural source control BMPs typically include:
  - Enclosing and/or covering the pollutant source (building or other enclosure, a roof over storage and working areas, temporary tarp, etc.).
  - Segregating the pollutant source to prevent run-on of stormwater, and to direct only contaminated stormwater to appropriate treatment BMPs.
- **Stub-out:** A short length of pipe provided for future connection to a storm drainage system.
- **Subbasin:** A drainage area that drains to a water-course or waterbody named and noted on common maps and which is contained within a basin.

- **Subcatchment:** A subdivision of a drainage basin (generally determined by topography and pipe network configuration).
- **Subdrain:** A pervious backfilled trench containing stone or a pipe for intercepting ground water or seepage.
- **Subgrade:** A layer soil used as the underlying base for a BMP.
- **Subsoil:** The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil), in which roots normally grow. Although a common term, it cannot be defined accurately. It has been carried over from early days when "soil" was conceived only as the plowed soil and that under it as the "subsoil."
- **Substrate:** The natural soil base underlying a BMP.
- **Surcharge**: The flow condition occurring in closed conduits when the hydraulic grade line is above the crown of the sewer.
- **Surface and stormwater:** Water originating from rainfall and other precipitation that is found in drainage facilities, rivers, streams, springs, seeps, ponds, lakes, and wetlands as well as shallow ground water.
- **Surface and stormwater management system:** Drainage facilities and any other natural features that collect, store, control, treat and/or convey surface and stormwater.
- **Suspended solids:** Organic or inorganic particles that are suspended in and carried by the water. The term includes sand, mud, and clay particles (and associated pollutants) as well as solids in stormwater.
- **Swale:** A shallow drainage conveyance with relatively gentle side slopes, generally with flow depths less than one foot.
- **Taxiway Object Free Area (TOFA):** An area on the ground centered on a taxiway centerline provided to enhance the safety of aircraft operations by having the area free of objects, except for objects that need to be located for air navigation or aircraft ground maneuvering purposes.
- **Taxiway Safety Area (TSA):** A defined surface alongside the taxiway prepared or suitable for reducing the risk of damage to an aircraft unintentionally departing the taxiway.
- **Terrace:** An embankment or combination of an embankment and channel across a slope to control erosion by diverting or storing surface runoff instead of permitting it to flow uninterrupted down the slope.
- **Threshold discharge area:** An on-site area draining to a single natural discharge location or multiple natural discharge locations that combine within one-quarter mile downstream (as determined by the shortest flow path). The examples in Figure I-G.1 illustrate this definition. The purpose of this definition is to clarify how the thresholds of this manual are applied to project sites with multiple discharge points.

Figure I-G.1. Threshold Discharge Areas



- **Tightline:** A continuous length of pipe that conveys water from one point to another (typically down a steep slope) with no inlets or collection points in between.
- **Tile, Drain**: Pipe made of burned clay, concrete, or similar material, in short lengths, usually laid with open joints to collect and carry excess water from the soil.
- **Tile drainage:** Land drainage by means of a series of tile lines laid at a specified depth and grade.
- **Till:** A layer of poorly sorted soil deposited by glacial action that generally has very low infiltration rates.
- **Time of Application:** In context of this manual, "application" means, at a minimum, a complete project description, site plan, and if applicable, SEPA checklist.
- **Time of concentration:** The time period necessary for surface runoff to reach the outlet of a subbasin from the hydraulically most remote point in the tributary drainage area.
- **Topography**: General term to include characteristics of the ground surface such as plains, hills, mountains, degree of relief, steepness of slopes, and other physiographic features.
- **Topsoil:** The upper portion of a soil, usually dark colored and rich in organic material. It is more or less equivalent to the upper portion of an A horizon in an ABC soil.
- **Total dissolved solids:** The dissolved salt loading in surface and subsurface waters.

- **Total Maximum Daily Load (TMDL) – Water Cleanup Plan:** A calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant's sources. A TMDL (also known as a Water Cleanup Plan) is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can be used for the purposes the State has designated. The calculation must also account for seasonable variation in water quality. Water quality standards are set by states, territories, and tribes. They identify the uses for each waterbody, for example, drinking water supply, contact recreation (swimming), and aquatic like support (fishing), and the scientific criteria to support that use. The Clean Water Act, section 303, establishes the water quality standards and TMDL programs.
- **Total Petroleum Hydrocarbons (TPH) TPH-Gx:** The qualitative and quantitative method (extended) for volatile ("gasoline") petroleum products in water; and TPH-Dx: The qualitative and quantitative method (extended) for semi-volatile ("diesel") petroleum products in water.
- **Total solids:** The solids in water, sewage, or other liquids, including the dissolved, filterable, and non-filterable solids. The residue left when the moisture is evaporated and the remainder is dried at a specified temperature, usually 130°C.
- **Total suspended solids:** That portion of the solids carried by stormwater that can be captured on a standard glass filter.
- **Touchdown:** Section at the end of the runway where aircraft tires first meet the runway.
- **Toxic:** Poisonous, carcinogenic, or otherwise directly harmful to life.
- **Tract**: A legally created parcel of property designated for special nonresidential and noncommercial uses.
- **Trash rack:** A structural device used to prevent debris from entering a spillway or other hydraulic structure.
- **Travel time:** The estimated time for surface water to flow between two points of interest.
- **Treatment BMP or Facility:** A BMP that is intended to remove pollutants from stormwater. A few examples of treatment BMPs are Wetponds, oil/water separators, biofiltration swales, and constructed wetlands.
- **Treatment liner**: A layer of soil that is designed to slow the rate of infiltration and provide sufficient pollutant removal so as to protect ground water quality.
- **Treatment train**: A combination of two or more treatment facilities connected in series.
- **Turbidity:** Dispersion or scattering of light in a liquid, caused by suspended solids and other factors; commonly used as a measure of suspended solids in a liquid.
- **Underdrain:** Plastic pipes with holes drilled through the top, installed on the bottom of an infiltration BMP, which are used to collect and remove excess runoff.

- **Undisturbed buffer:** A zone where development activity shall not occur, including logging, and/or the construction of utility trenches, roads, and/or surface and stormwater facilities.
- **Undisturbed low gradient uplands:** Forested land, sufficiently large and flat to infiltrate surface and storm runoff without allowing the concentration of water on the surface of the ground.
- **Unstable slopes:** Those sloping areas of land, which have in the past exhibited, are currently exhibiting, or will likely in the future exhibit, mass movement of earth.
- **Unusual biological community types:** Assemblages of interacting organisms that are relatively uncommon regionally.
- **Urbanized area:** Areas designated and identified by the U.S. Bureau of Census according to the following criteria: an incorporated place and densely settled surrounding area that together have a maximum population of 50,000.
- **U.S. EPA**: The United States Environmental Protection Agency.
- **Values:** Wetland processes or attributes that are valuable or beneficial to society (also see Functions). Wetland values include support of commercial and sport fish and wildlife species, protection of life and property from flooding, recreation, education, and aesthetic enhancement of human communities.
- **Variance:** See Exception.
- **Vegetated filter strip**: A facility designed to provide runoff treatment of conventional pollutants (but not nutrients) through the process of biofiltration.
- **Vegetation:** All organic plant life growing on the surface of the earth.
- **Vehicular Use:** Regular use of an impervious or pervious surface by motor vehicles. The following are subject to regular vehicle use: roads, unvegetated road shoulders, bike lanes within the traveled lane of a roadway, driveways, parking lots, unrestricted access fire lanes, vehicular equipment storage yards, and airport runways.

  The following are not considered subject to regular vehicle use: paved bicycle pathways separated from and not subject to drainage from roads for motor vehicles, restricted access fire lanes, and infrequently used maintenance access roads.
- **Waterbody:** Surface waters including rivers, streams, lakes, marine waters, estuaries, and wetlands.
- **Water Cleanup Plan:** See Total Maximum Daily Load
- **Water quality:** A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.
- **Water quality design storm:** The 24-hour rainfall amount with a 6-month return frequency. Commonly referred to as the 6-month, 24-hour storm.

- **Water quality standards:** Minimum requirements of purity of water for various uses; for example, water for agricultural use in irrigation systems should not exceed specific levels of sodium bicarbonate, pH, total dissolved salts, etc. In Washington, the Department of Ecology sets water quality standards.
- **Watershed:** A geographic region within which water drains into a particular river, stream, or body of water. Watersheds can be as large as those identified and numbered by the State of Washington Water Resource Inventory Areas (WRIAs) as defined in Chapter 173-500 WAC.
- **Water table:** The upper surface or top of the saturated portion of the soil or bedrock layer, indicates the uppermost extent of ground water.
- **Weir:** Device for measuring or regulating the flow of water.
- **Weir notch:** The opening in a weir for the passage of water.
- **Wetland:** Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands do not include those artificial wetlands intentionally created from non-wetland sites, including, but not limited to, irrigation and drainage ditches, grass-lined swales, canals, detention facilities, wastewater treatment facilities, farm ponds, and landscape amenities, or those wetlands created after July 1, 1990, that were unintentionally created as a result of the construction of a road, street, or highway. Wetlands may include those artificial wetlands intentionally created from non-wetland areas to mitigate the conversion of wetlands.
- **Wetland edge**: Delineation of the wetland edge shall be based on the U.S. Army Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1, U.S. Army Engineers Waterways Experiment Station, Vicksburg, Miss. (1987)
- **Wetponds and wetvaults:** Drainage facilities for water quality treatment that contain permanent pools of water that are filled during the initial runoff from a storm event. They are designed to optimize water quality by providing retention time in order to settle out particles of fine sediment to which pollutants such as heavy metals absorb, and to allow biologic activity to occur that metabolizes nutrients and organic pollutants.
- **Wetpool**: A pond or constructed wetland that stores runoff temporarily and whose normal discharge location is elevated so as to maintain a permanent pool of water between storm events.
- **Wildlife hazard assessment**: A wildlife hazard assessment, identified as an ecological study in FAA Title 14 Code of Federal Regulations, part 139.337(a), is conducted by a wildlife damage management biologist when any of the following events occurs on or near the airport:
  - An air carrier aircraft experience multiple wildlife strikes;
  - An air carrier aircraft experiences substantial damage from striking wildlife;
  - An air carrier aircraft experiences an engine ingestion of wildlife; or

- Wildlife of a size, or in numbers, capable of causing an event described in (1), (2), or (3) (above) is observed to have access to any airport flight pattern or aircraft movement area.

- **Wildlife hazard management plan:** Pending results and approval of a wildlife hazard assessment, an airport may be required to produce a wildlife hazard management plan. This is a document that addresses the specific issues/requirements prescribed in the FAA Title 14 Code of Federal Regulations, part 139.337. A summary of the requirement for wildlife hazard management plan can be found at:

  http://www.faa.gov/airports_airtraffic/airports/regional_guidance/central/airport_safety/part139/best_practice/wildlife/media/Summary_Wildlife_Management.pdf.

- **Zoning ordinance:** An ordinance based on the police power of government to protect the public health, safety, and general welfare. It may regulate the type of use and intensity of development of land and structures to the extent necessary for a public purpose. Requirements may vary among various geographically defined areas called zones. Regulations generally cover such items as height and bulk of buildings, density of dwelling units, off-street parking, control of signs, and use of land for residential, commercial, industrial, or agricultural purposes. A zoning ordinance is one of the major methods for implementation of a comprehensive plan.

Appendix I-H
EXISTING WATER QUALITY TREATMENT BMPS

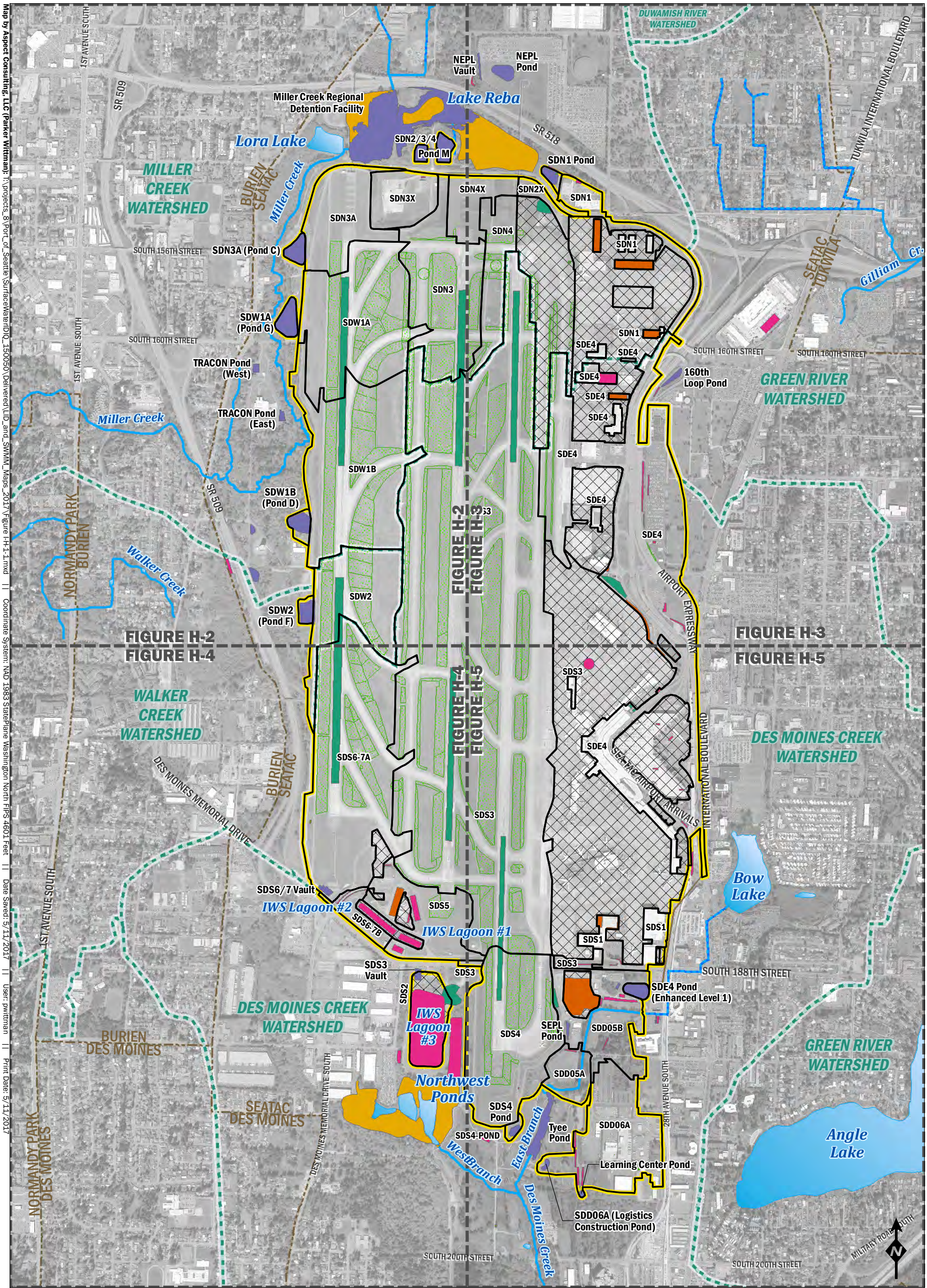


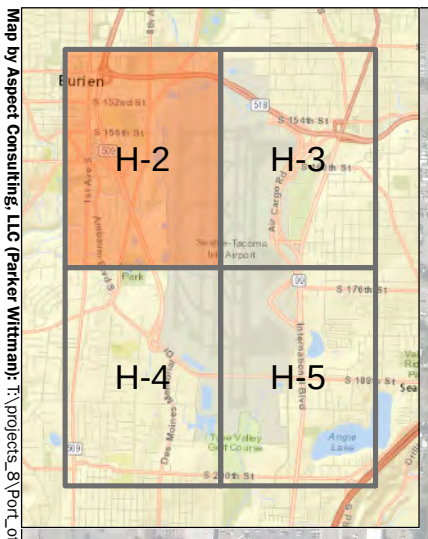
FIGURE I-H.1.1
Index Base Map for Water Quality Structural BMP Facilities at STIA

Volume I - Minimum Technical Requirements and Site Planning

0 700 1,400
Feet

MAP BY: Aspect CONSULTING

Port of Seattle



NPDES Permit Application Boundary and STIA Retrofit Area
Storm Drainage Subbasin
Watershed Boundary
Conveyance
Stream
Surface Waterbody
City Limit

BMPs
Operational Source Control
Spill Control
Stormwater Peak Runoff Rate and Volume Control
Treatment
Treatment (Filter Strips)

BMP Description/Name (BMP ID Number)

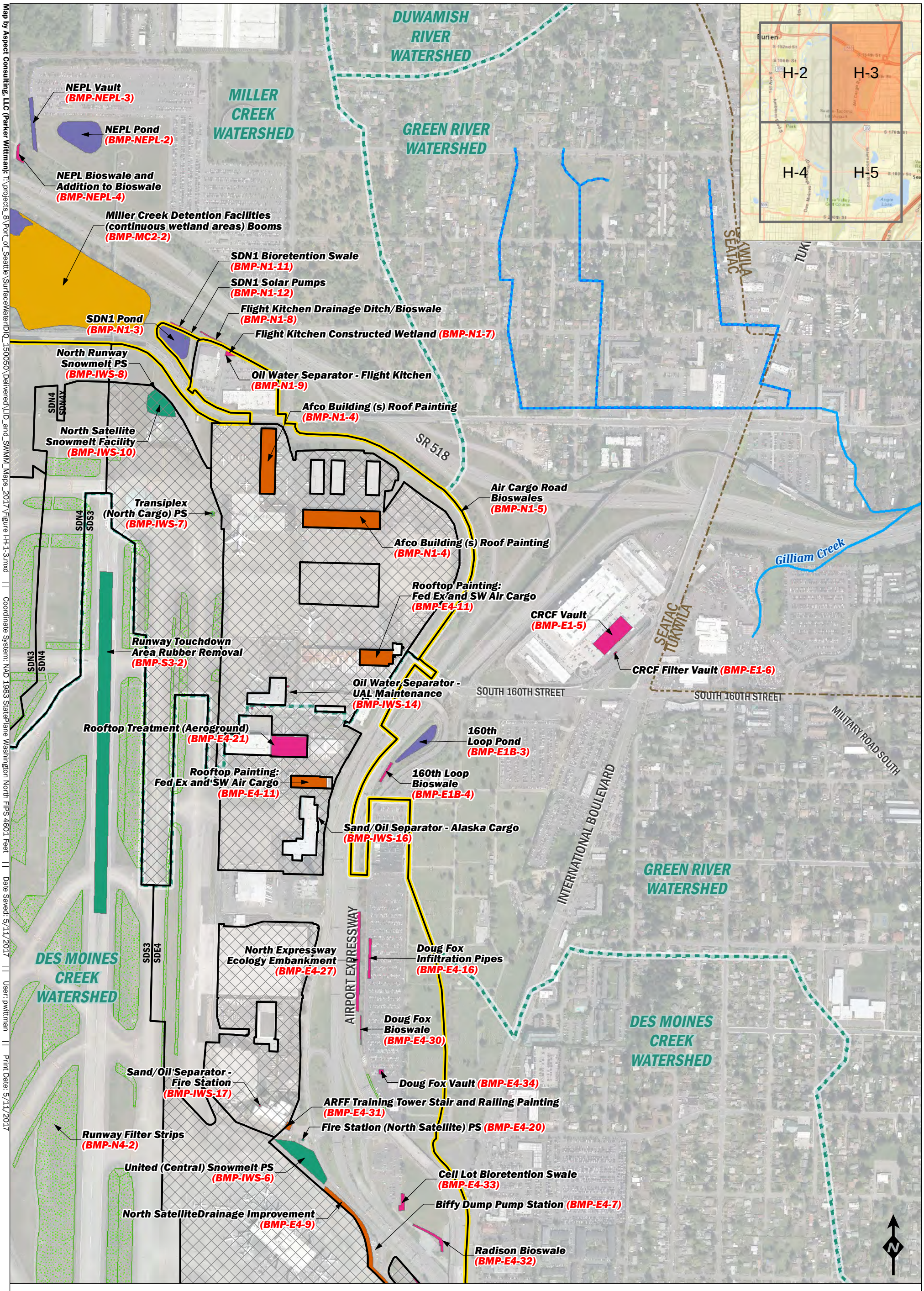
FIGURE I-H.1.2
Water Quality Structural BMP Facilities at STIA (Northwest)
Volume I - Minimum Technical Requirements and Site Planning

0 325 650
Feet

MAP BY: Aspect CONSULTING
Port of Seattle

Map by Aspect Consulting, LLC (Parker Wittman): T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure I-H-1-2.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017

Map by Aspect Consulting, LLC (Parker Wittman); T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure I-H-1-3.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017



NPDES Permit Application Boundary and STIA Retrofit Area
Storm Drainage Subbasin
Industrial Waste System (IWS) Area
Watershed Boundary
Conveyance
Stream
City Limit

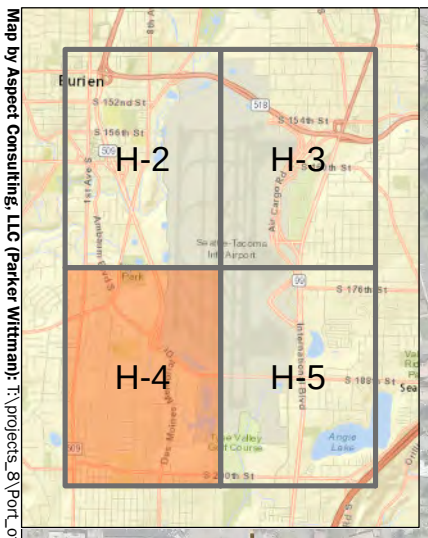
BMPs
Operational Source Control
Spill Control
Stormwater Peak Runoff Rate and Volume Control
Structural Source Control
Treatment
Treatment (Filter Strips)

BMP Description/Name (BMP ID Number)

FIGURE I-H.1.3
Water Quality Structural BMP Facilities at STIA (Northeast)
Volume I - Minimum Technical Requirements and Site Planning

0 325 650
Feet

MAP BY: Aspect CONSULTING
Port of Seattle



DES MOINES MEMORIAL DRIVE

SR 509

SDW2

SDS6-7A

SDS3

DES MOINES CREEK WATERSHED

Runway Touchdown Area Rubber Removal (BMP-S6/7-4)

Runway Touchdown Area Rubber Removal (BMP-S3-2)

WALKER CREEK WATERSHED

Walker Creek Low Flow Well (BMP-W2A-1)

BURIEN SEATAC

Weyerhaeuser Bioswale (BMP-S3-10)

Runway Filter Strips (BMP-S3-7)

SDS3A Vault (BMP-S3-9)

SDS5

Starling Road Bioswales (BMP-D67-1)

SDS6-7B

SDS6/7 Vault (BMP-S6/7-2)

Runway Filter Strips (BMP-S5-3)

IWS Lagoon 2 (BMP-IWS-3)

Oil Water Separator - Decant Station (BMP-IWS-11)

Snow shed Structural Source Control (BMP-S5-2)

IWS Lagoon 1 (BMP-IWS-2)

Industrial Wastewater Treatment Plant (BMP-IWS-1)

Starling Road Bioswale 2 (BMP-S5-5)

SDS3 Vault (BMP-S3-3)

Sand Storage Water Quality Vault (BMP-IWS-15)

Snowmelt area - Lagoon 3 (BMP-IWS-23)

IWS Lagoon 3 (BMP-IWS-4)

SDS2 Biofiltration (BMP-S2-1)

Biofiltration channel (BMP-S3-4)

Northwest ponds (Flood Area)/RDF Booms (BMP-D7-1)

Northwest Ponds

West Branch

1ST AVENUE SOUTH

NORMANDY PARK

BURIEN

DES MOINES

SEATAC

SOUTH 200TH STREET

N

NPDES Permit Application Boundary and STIA Retrofit Area
Storm Drainage Subbasin
Industrial Waste System (IWS) Area
Watershed Boundary
Stream
Surface Waterbody
City Limit

BMPs

Low Stream Flow Mitigation
Operational Source Control
Spill Control
Stormwater Peak Runoff Rate and Volume Control
Structural Source Control
Treatment
Treatment (Filter Strips)

BMP Description/Name (BMP ID Number)

FIGURE I-H.1.4

Water Quality Structural BMP Facilities at STIA (Southwest)

Volume I - Minimum Technical Requirements and Site Planning

0 325 650
Feet

MAP BY: Aspect CONSULTING

Port of Seattle

Map by Aspect Consulting, LLC (Parker Wittman): T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure I-H-1-4.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017

Map by Aspect Consulting, LLC (Parker Wittman): T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure I-H-1-5.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017

IWS Pipe Network (BMP-IWS-5)
Bioswale (next to UA Fuel Farm) (BMP-E4-14)
NCBL (North Cruise ship Bus Lot) Infiltration/Sand filter (BMP-E4-19)
North Bagwell Pump Station (BMP-E4-6)
NER Stormwater Quality Vault (BMP-E4-28)
NER Stormwater Liftsation (BMP-E4-29)
Dog Exercise Area (BMP-E4-2)
Terminal Garage Section A Vault (BMP-IWS-19)
North Exit Toll Plaza Vault (BMP-IWS-9)
Center Lift Station (GARAGE) (BMP-IWS-24)
Terminal Garage Section D Vault (BMP-IWS-20)
Terminal Garage Section E Vault (BMP-IWS-21)
SDE4-IWS flow splitter (IWS-overflow-1)
South Lift Station (Garage/IWS Pump Station) (BMP-E4-8)
Runway Touchdown Area Rubber Removal (BMP-S4-2)
Air Cargo Rd N. Bioswale for STEP (BMP-E4-12)
Air Cargo Rd S. Bioswale for STEP (BMP-E4-13)
Paint Alaska Rooftop and HVAC I-Beams (BMP-S1-3)
STEP StormFilter Vault (BMP-E4-24)
Paint Alaska Rooftop and HVAC I-Beams (BMP-S1-3)
North Alaska Bioswale (BMP-S1-4)
60-inch Diversion Pipe (BMP-E4-25)
South Alaska Bioswale (BMP-S1-7)
Delta (fmr NW) Air Hangar/Cargo (Water Quality Vault 1) (BMP-S1-5)
S. 188th St. Bioswale (BMP-S3-8)
Delta (Fmr NW) Air Hangar/Cargo (Water Quality Vault 2) (BMP-S1-6)
South Sea-Tac Substation Detention Pipe and Infiltration (BMP-E4-4)
POS Tank Farm Spill Control Containment (BMP-IWS-22)
SDE4 Pond (Enhanced Level 1) (BMP-E4-5)
South Snowmelt (Tank Farm) PS (BMP-IWS-18)
SDE4 Stormfilter Vault (BMP-E4-22)
SDE4/Emergency Pond Overflow Swale (BMP-E4-15)
SDS1 Bioswale (fmr SDE4/S1) (BMP-S1-8)
SEPL EXP Bioswale (BMP-D4a-3)
Runway Filter Strips (BMP-S4-4)
Alaska Airlines/28th Ave Treatment Vault (BMP-D4a-2)
SEPL Pond (BMP-D5b-1)
S. 192nd St. Bioswale (BMP-D5b-2)
Alaska Airlines/28th Ave Detention Vault (BMP-D4a-1)
SEPL Bioretention Swale (BMP-D5b-3)
SDS4 Oil Water Separator (BMP-S4-5)
South Remote Employee Parking Facility Expansion Pond (BMP-D5a-1)
Tyee Pond (BMP-D6-1)
Flow Splitter with Oil Control - Logistics (BMP-D6a-3)
SDS4 Pond (BMP-S4-3)
Bus Maintenance Facility OWS (BMP-D6a-5)
Logistics Construction Bioswales (3) (BMP-D6a-2)
SDS4 Bioswale (BMP-S4-7)
Distribution Center Bioswale (BMP-D6a-4)
SDD06A (Logistics Construction Pond) (BMP-D6a-1)
Logistics Construction Bioswales (3) (BMP-D6a-2)
Des Moines Creek Low Flow Well (BMP-D13-1)
Learning Center Pond (BMP-D13-2)
S. 200th Detention Pond (BMP-D13-4)

H-2 H-3 H-4 H-5

SDS5 SDS3 SDS3 SDS5 SDS1 SDD05B SDD05A SDD05B SDD06A

SOUTH 188TH STREET
INTERNATIONAL BOULEVARD
26TH AVENUE SOUTH
MILITARY ROAD SOUTH
SOUTH 200TH STREET
East Branch
East Branch
Des Moines Creek
Bow Lake
Angle Lake
DES MOINES CREEK WATERSHED
GREEN RIVER WATERSHED

NPDES Permit Application Boundary and STIA Retrofit Area
Storm Drainage Subbasin
Industrial Waste System (IWS) Area
Watershed Boundary
Conveyance
Stream
Surface Waterbody
City Limit

BMPs
Low Stream Flow Mitigation
Operational Source Control
Stormwater Peak Runoff Rate and Volume Control
Structural Source Control
Treatment
Treatment (Filter Strips)
Other

BMP Description/Name (BMP ID Number)

FIGURE I-H.1.5
Water Quality Structural BMP Facilities at STIA (Southeast)
Volume I - Minimum Technical Requirements and Site Planning

0 325 650
Feet

MAP BY: Aspect CONSULTING
Port of Seattle

Appendix I-I
OFF-SITE ANALYSES

Tables

Figures

Section 1
Introduction

Purpose

Minimum Requirement #11 (Section 2.5.11 of the Manual) requires the project proponents to prepare an off-site analysis report that assesses the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and that proposes appropriate mitigation of those impacts. This Off-Site Analysis appendix provides project proponents with an outline (Section 2 of this Appendix) to use in preparing their analysis documentation. In addition, this appendix provides information regarding the creeks that will likely receive runoff from future projects on Port-owned property. This information can be used by the project proponent as a starting point to gathering all available information on the study area (Off-Site Analysis Task 2) in order to prepare a project-specific Off-Site Analysis.

Project proponents are required to provide information assessing the potential off-site water quality, erosion, slope stability, and drainage impacts associated with the project and proposing appropriate mitigation of those impacts. The Off-Site Analysis shall initially comprise of a qualitative analysis of the system from the project site extending to a point at least a quarter mile downstream from where runoff from the project enters one of the four receiving streams identified in this appendix. In addition, the analysis shall extend upstream from the project site to a point where any backwater effects created by the project cease.

Note that upon review of the qualitative analysis, the Port may require that a quantitative analysis be performed. If this is the case, the Project Proponent shall coordinate with the Port to determine the extent of the quantitative analysis.

How to Use this Appendix

As discussed above, the intention of this appendix is to provide guidance to help project proponents prepare an off-site analysis, per Section 2.5.11 of the Manual, and to summarize information already available to provide the project proponent with a starting point to prepare a project-specific Off-Site Analysis. The project proponent will be required to tailor the information provided here to the information within the bounds of an Off-Site Analysis for their project. In addition, the project proponent is required to supplement the information provided here with current information, including project-specific information.

Guidance on how a project proponent can adapt the information provided on this appendix for a project-specific analysis is provided in Section 2. This section includes a recommended outline as well as a description of what each subsection should contain.

Sections 3 through 6 include specific information available at the time of publication for each of the major creeks in the vicinity of Seattle-Tacoma International Airport (STIA). These creeks are:

Des Moines Creek, Miller Creek, Walker Creek and Gilliam Creek. The user is advised that conditions can change either as a result of mitigation projects, recent floods and/or the change of infrastructure. The proponent is responsible for verifying current conditions and making sure that the downstream analyses correctly represents existing conditions.

References Reviewed for this Document

A good portion of this appendix is an assembly of existing information excerpted from other documents including:

- Herrera Environmental Consultants, Inc., and R. W. Beck, Inc. *Gilliam Creek Basin Stormwater Management Plan.* Prepared for City of Tukwila. March 2001.
- Huitt-Zollars, Inc. *South 160th St. Loop Ramp/NER Phase 1.* Prepared for Port of Seattle. April 2006.
- King County, City of SeaTac, City of Des Moines, and Port of Seattle. *Des Moines Creek Basin Plan*. November 1997.
- King County, City of Burien, City of Normandy Park, City of SeaTac, Port of Seattle, and Washington State Department of Transportation. *Miller and Walker Creeks Basin Plan*. Executive Proposed Plan. February 2006.
- Parametrix, Inc. *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements*. Prepared for Port of Seattle. December 2000.
- CH2M Hill and Herrera Environmental Consultants, Inc. *City of Tukwila Comprehensive Stormwater Management Plan*. Prepared for the City of Tukwila. November 2003.
- Herrera Environmental Consultants, Inc. *SR 518/SeaTac Airport to 1-5/1-405 Interchange Hydraulics Repor*t. Prepared for Parsons Brinckerhoff Quade & Douglas, Inc. and Washington Department of Transportation. January 2007.

Section 2
Recommended Off-Site Analysis Outline

This section contains a recommended outline for the Off-Site Analysis based on Section 2.5.11 of the Manual. This outline organizes the information gathered in the four tasks described in Section 2.5.11. Those four tasks are:

- Define and map the study area
- Review all available information on the study area
- Field inspect the study area
- Describe the drainage system, and its existing and predicted problems.

See the appropriate creek section of this appendix for specific information known at the time this appendix was published.

1. Study Area

The first section of the Off-Site Analysis shall be used to describe the study area including the area contributing runoff to the site and the flow path to a point a quarter mile downstream. The project proponent may use the information in the subsequent creek sections of this appendix as appropriate, tailoring and supplementing the information to provide project-specific information. The project proponent shall also include a site map showing property lines as well as a topographic map (at minimum a USGS 1:24000 Quadrangle Topographic map) showing site boundaries, study area boundaries, downstream flowpath and potential/existing problems.

2. Review of All Available Information

This section will list all the documents reviewed and people contacted in preparation of the Off-Site Analysis. The information gathered from those documents and people shall be included as appropriate in the other sections of the report.

3. Field Inspection

A field inspection conducted by the project proponent shall be reported in this section of the Off-Site Analysis. The field inspection shall include a description of the channel for a quarter mile downstream. In conducting the field inspection the project proponent shall:

- Investigate problems reported or observed during the resource review.
- Locate existing/potential constrictions or capacity deficiencies in the drainage system.
- Identify existing/potential flooding problems.

- Identify existing potential overtopping, scouring, bank sloughing or sedimentation.
- Identify significant destruction of aquatic habitat (e.g., siltation, stream incision).
- Collect qualitative data of features such as land use, impervious surface, topography, soils, presence of streams, wetlands.
- Collection information on pipe sizes, channel characteristics, drainage structures.
- Verify tributary areas.
- Contact the local government office with drainage review authority, neighboring property owners, and residents to obtain information about drainage problems.
- Note date and weather at time of inspection.

The field inspection shall also include a catalog of photographs with a map indicating where the photographs were taken. The photographs shall be noted to indicate location and direction the photograph was taken.

4. Summary of Problems

All existing or potential problems shall be described in this section. The following information should be provided for each existing or potential problem:

- Magnitude of or damage caused by the problem.
- General frequency and duration.
- Return frequency of storm or flow when the problem occurs (may require quantitative analysis).
- Water elevation when the problem occurs.
- Names and concerns of parties involved.
- Current mitigation of the problem.
- Possible cause of the problem.
- Whether the project is likely to aggravate the problem or create a new one.

Upon review of this analysis, the Port may require mitigation measures deemed adequate for the problems or a quantitative analysis, depending upon the presence of existing or predicted flooding, erosion or water quality problems, and on the proposed design of the on-site drainage facilities. A quantitative analysis (refer to Section 2.5.11 of the Manual), if required, shall provide information on the severity and frequency of an existing problem or the likelihood of creating a new problem. A quantitative analysis should also evaluate proposed mitigation intended to avoid aggravation of the existing problem and to avoid creation of a new problem.

The information provided in the following specific creek sections describes known problems at the time of the publication of this document. The project proponent shall review and tailor the information provided to reflect current problems within the bounds of the Off-Site Analysis for

their specific project. Since the information provided herein may not be current at the time of the project, it is the project proponent's responsibility to determine whether a problem listed has already been addressed.

In addition, the project proponent is required to determine if there is updated or supplemental information available, which shall be added to this section. This should include reviewing all available basin plans, groundwater management area plans, drainage studies, floodplain/floodway FEMA map, wetland inventory maps, Critical Areas maps, stream habitat reports, salmon distribution reports, etc.

Sections 3 through 6 of this Appendix provide a compilation of known problems for each basin, based on information prepared as a part of previous studies.

Section 3
Des Moines Creek

Study Area

The Des Moines Creek watershed covers 5.8 square miles including most of the Seattle-Tacoma International Airport (STIA). The Miller Creek basin area is shown in Figure 3-1, which is excerpted from the *Des Moines Creek Basin Plan* (King County 1997).

STIA is located in the headwaters of Des Moines Creek and contributes runoff to both the East and West Branch. The East Branch of Des Moines Creek begins at the outlet to Bow Lake and flows via an enclosed pipe system southwest to International Boulevard where it heads south. The East Branch then crosses S 188th Street and heads west just south of the SDE4 Stormwater Facility where the creek daylights from an enclosed pipe system and continues via an open channel.

The SDE4 Facility discharges into the East Branch. On the west side of the facility, the East Branch turns south and flows through the Tyee Valley Golf Course. In the golf course, the East Branch enters the Tyee Pond where outflows are directed to one of three locations. Low to moderate flows from the Tyee Pond are directed back to the East Branch of Des Moines Creek which continues on and joins the West Branch of the creek just south of the Des Moines Creek Regional Detention Facility (RDF). Once flows exceed approximately 7 cfs, a portion of the outflow from Tyee Pond is diverted to a bypass pipeline discharging directly to Puget Sound. When the outflow from the pond exceeds abut 40 cfs, excess flows are discharged to the Des Moines Creek RDF. The SDS4 Stormwater Facility detains flow from the airport and discharges into the Tyee Pond Overflow diversion pipe.

The West Branch of Des Moines Creek conveys flow from approximately 1,000 acres of airport and other highly urbanized land into the RDF. Included are detention facilities serving SDS3, SDS3A and SDS6/7. From the RDF, the West Branch flows southeast in a channelized reach to where it joins the East Branch at the Tyee Golf Course.

From the confluence of the two branches, Des Moines Creek continues south across S 200th Street into a wetland area on the north side of Des Moines Creek Park. Several hundred feet south of S 200th Street, the gradient of the creek changes. To this point, the gradient of the channel is less than about 3 percent. Below this point, the gradient increases from 3 to 5 percent. The creek then continues south through the park in a steep ravine. At the south end of the park, the creek turns and head west towards Des Moines Memorial Drive and SR 509. The creek crosses under SR 509 into the Des Moines Beach Park and then continues flowing southwest into the Puget Sound. A senior center is located within the Des Moines Creek Park and is situated directly over the creek.

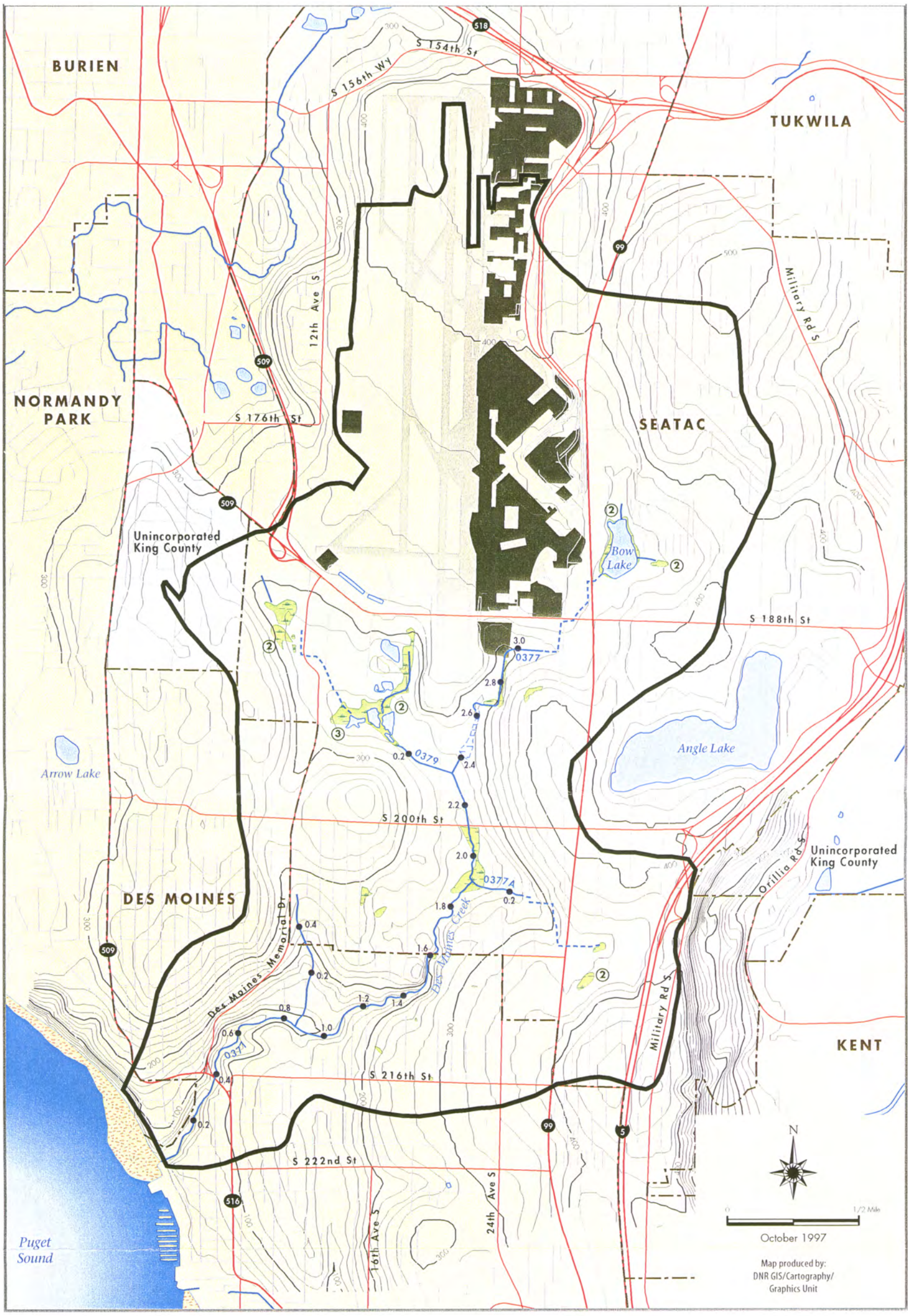


Figure 1-2

DES MOINES CREEK BASIN
Water Features

- Basin Boundary
- Stream
- Piped Stream
- 0377 Stream Number
- ● 2.6 River Mile
- 20-foot Contour
- Incorporated Area
- Industrial Wastewater System
- Lake
- R/D Facility
- Wetland
- ② Wetland Rating (where available)

Base Map Notes:
All updates register to USGS DLG

Wetland Sources:
Port of Seattle Wetland Mapping, 1995
Map does not include wetland #22

Stream and Pipe Location Sources:
USGS Digital Line Graph
King County Basin Recon Program, 1987
Aerial Photos, 1989
Port of Seattle Field Mapping, 1995

Roadway Sources:
USGS Digital Line Graph
Aerial Photos, 1989

Industrial Wastewater System Source:
Port of Seattle Comprehensive Stormwater and Industrial Wastewater Plan

Contour Lines Source:
USGS Digital Elevation Model

Incorporated Areas Source:
King County GIS coverage

9710DMwf12 WG

Figure I-I.3.1. Des Moines Creek Watershed
Source: Des Moines Creek Basin Plan (King County et al. 1997), Figure 1-2

Existing Drainage Problems

The following existing flooding problem descriptions are excerpted from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-2):

> Flooding problems have been reported in the Des Moines Creek Basin. However, flooding is not common in most reaches because the creek has been buffered from development and has few road crossing that could restrict flow (Des Moines Creek Basin Committee 1997). Flooding problems tend to be localized in the upper portions of the watershed, where drainage pipes are undersized. Flooding as been reported at three locations in the basin: 1) near the mouth of Des Moines Creek at the senior center buildings adjacent to Des Moines Creek Beach Park (which floods during a 2-year or greater event); 2) the Tyee Valley Golf Course; and 3) road flooding along S 188th Street west of the tunnel. The City of Des Moines has proposed removing the senior center from the floodplain to prevent flooding at this location.

The following existing erosion problem descriptions are excerpted from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, pages P-2 through P-3):

> The Des Moines Creek Basin Plan describes significant erosion problems along the creek corridor that were identified during or prior to 1997 [Table 3-1]. Erosion problems are most severe in the ravine reach of Des Moines Creek, where the creek is confined to a narrow valley and fill for a sewerline encroaches on the channel. However, in general these erosion locations are localized problems related to development adjacent to the creek.
>
> King County (1987a) also noted that landslides are common in the lower portion of the basin in steep ravines created where the exposed slope meets the water table [creating seeps]. These landslides are causing slope failures to migrate uphill and increase the potential for damage in the upper portions of the basin.

Table I-I.3.1
Summary of Erosion Problems in Des Moines Creek

River Mile[1]	Problem Type	Description
R.M. 0.05	Bank Erosion	Localized bank erosion upstream of pedestrian bridge
R.M. 0.38	Bank Erosion	Road shoulder failure site.
R.M. 0.63	Bank Erosion	Road shoulder failure site.
R.M. 1.00	Bank Erosion	Trail crossing is eroding the banks.
R.M. 1.14-1.16	Slope Failure	Slope is encroaching into the channel and constricting width.
R.M. 1.25-1.48	Bank Erosion	Riprap along the right bank is failing
R.M. 1.38	Bank Erosion	Road shoulder failure site.
R.M. 1.39	Slope Failure	Slope failure on right bank
R.M. 1.67	Bank Erosion	Road shoulder failure site
R.M. 1.68	Bank Erosion	Backwater eddy at the end of riprap is eroding bank.
R.M. 1.73	Bank Erosion	Erosion impacting road and riprap.
R.M. 1.93	Bank Erosion	Narrow, deep, debris channel with many partial debris jams.
R.M. 1.97	Bank Erosion	Braided reach with flanking erosion around debris jams.
R.M. 2.06	Bank Erosion	Numerous sites where high flows are eroding banks.

Source: Des Moines Creek Basin Plan (King County 1997), Table P-1

[1] Refer to Figure 3-1 in this appendix for river mile locations

In addition, there is a table in the *Des Moines Creek Basin Plan* (King County 1997), which lists problems at the time the plan was assembled. This is a potential source of information regarding problems in the area however, significant improvements in the basin have occurred since 1997 that may have corrected many of the problems listed.

Section 4
Miller Creek

Study Area

The entire Miller Creek basin area is shown in Figure 4-1, which is excerpted from the *Miller and Walker Creeks Basin Plan* (King County 2006).

The following description of Miller Creek is from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-4):

> Miller Creek's headwater begins at Arbor Lake at S 124th Street and Second Avenue S. Miller Creek is intermittent until several thousand feet north of SR 518, where the confluence with a tributary from Tub Lake provides annual flow. Below SR 518, Miller Creek receives water from the Miller Creek Detention Facility. In the reach between the Miller Creek Detention Facility outlet and SW 156th Street, Miller Creek has been highly channelized and confined by riprap, footbridges and culverts. The low gradient reach above SW 156th Street has a bed composed predominantly of fine sediments. This reach frequently floods adjacent property.
>
> Between SW 156th Street and S 160th Street, the creek is located in a narrow ravine and is confined in several places by riprap and residential development. At one location within this reach, the creek passes over shallow till, forming an approximately 3-foot waterfall. From S 160th Street to First Avenue S, the creek is less confined by residential development and has a wider valley. There is no evidence of severe erosion or flooding problems in this reach.
>
> The culvert under 1st Avenue S is restricted by debris. Immediately upstream from the restricted culvert, the channel bed contains large deposits of fine sand and silt. If this debris is cleared from the culvert, there is a risk of bed mobilization of the fines and deposition in downstream reaches. Below the culvert the channel grade increases and Miller Creek forms a step/pool morphology. At SW 175th Place the creek flows into a private park. The confluence of Walker and Miller creeks is located within the park just upstream of Puget Sound.

Existing Drainage Problems

For existing problems in the Miller Creek Basin, it is recommended that the project proponent review the Miller and Walker Creek Basin Plan, particularly Appendix C.

The following excerpt is from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-5):

> Flooding problems have been identified approximately 1,000 ft downstream of Lake Reba, where residential houses are flooded during high flows (SeaTac 1997). Local

> flooding problems have also been reported at SW 150th Street and SW 152nd Street and upstream of SW 160th Street in locations where yard waste constricts the channel (Port of Seattle, 1996; King County 1987b). Flooding also occurs at the Hermes and S 142nd Street depressions (King County 1987b).

The following excerpt is from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-5):

> Landsliding has been a problem in the Miller Creek ravine located between Miller Creek R.M. 0.7 and 1.7. [See Figure 4-1.] Landsliding in these ravines occurs in locations where the slope intersects the water table (King County 1987b). Erosion has also been reported on the bank opposite the sewerline that constricts the valley of Miller Creek (King County 1987b). This erosion, as well as mass wasting that is resulting in the migration of the ravines uphill, has been accelerated by stormwater (King County 1987). Erosion has been reported to have caused property damage at two locations in the basin south of S 160th Street and east of First Avenue S, where high velocity flows destroyed an outfall and S 140th Street, where Miller Creek has been eroding the banks downstream of a reach lined with concrete (King County 1987b).

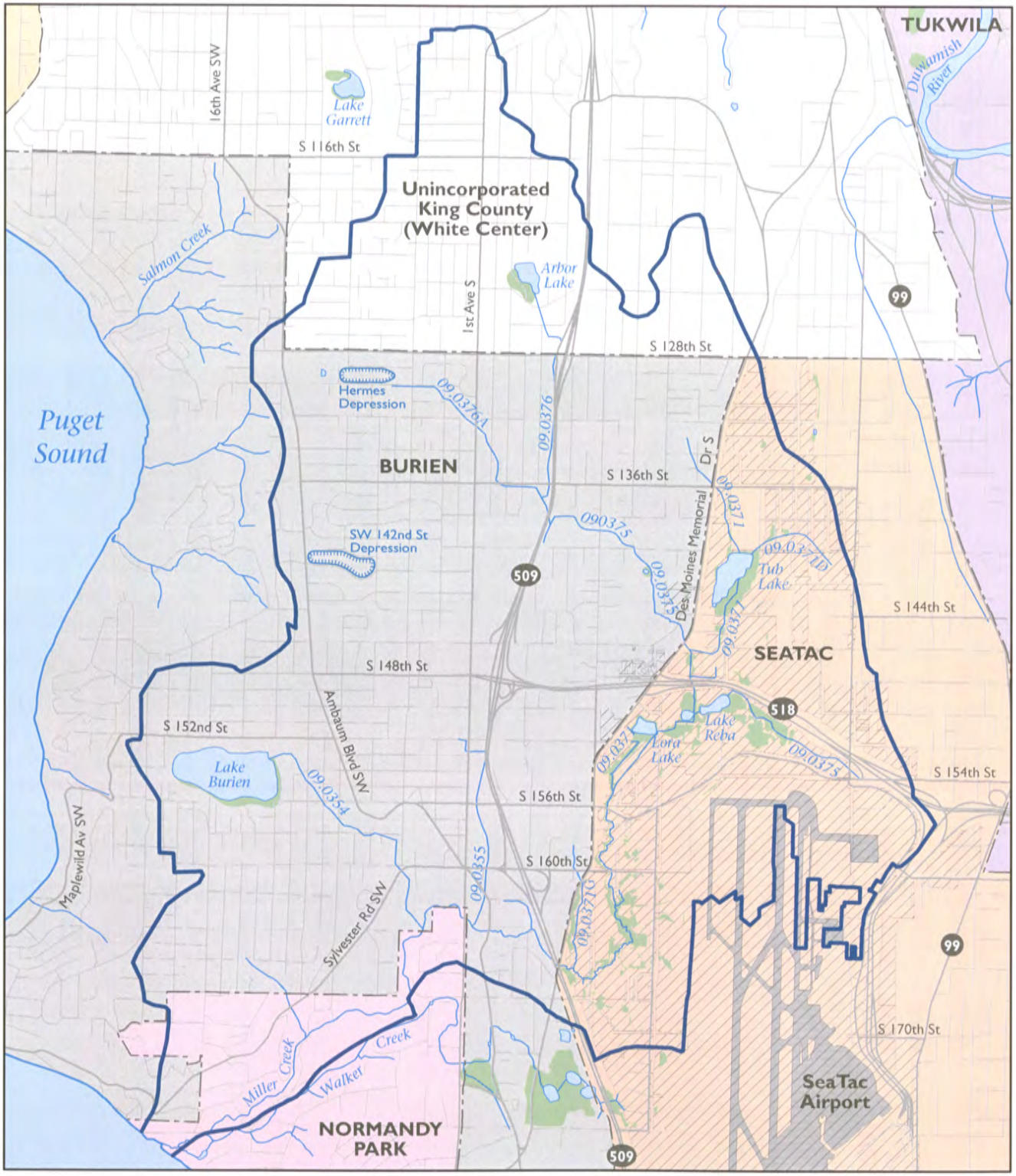


EXHIBIT 3-1

Miller Creek Basin

Basin Boundary

090375 Stream/Tributary Number

Lake/Open Water

Wetland

Depression

Port of Seattle Owned Parcels

N

0 1/4 1/2 Mile

July 2005

King County
Department of Natural Resources and Park

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Map prepared by King County DNRP GIS and WLR Visual Communications & Web Units
File name: 0507MCMap_3-1.eps wgs, sk

Figure I-I.4.1. Miller Creek Watershed

Source: Miller and Walker Creeks Basin Plan (King County et al. 2006), Figure 3-1

Section 5
Walker Creek

Study Area

The entire Walker Creek basin area is shown in Figure 5-1, which is excerpted from the *Miller and Walker Creeks Basin Plan* (King County 2006).

The following description of Walker Creek is from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-6):

> Walker Creek, a main tributary of Mill Creek, drains an approximate 234-acre wetland. The stream originates in Wetland 43 west of SR 509, and flows for approximately 1.3 miles southwest and generally parallel to Miller Creek. Several small drainages originate east of SR 509 Wetland 43. Walker Creek terminates at its confluence with Miller Creek less than 500 feet upstream of Puget Sound. The contributing basin, above and including Wetland 43, provides a source of baseflow to Walker Creek during summer months. Stream flow rates are typically highest between October and April during the wet season and lowest between May and September (Port of Seattle, 1996). Walker Creek receives stormwater runoff originating from residential and commercial development within the basin, including SeaTac Airport, which has likely increased the frequency and magnitude of peak flow events.
>
> Parametrix, Inc. staff walked portions of the creek in September 2000. In the lower gradient upper reaches, Walker Creek flows through confined rock-hardened banks, several culverts, and along roadside ditches. As the gradient increases, Walker Creek flows through a ravine downstream of 1st Avenue S. Field evaluations of this area could not be conducted due to lack of access on private property. As the gradient decreases below the ravine and above the confluence with Miller Creek, the stream is confined by urban development, including yards, ditches and culverts.

Existing Drainage Problems

For existing problems in the Miller Creek Basin, it is recommended that the project proponent review the *Miller and Walker Creek Basin Plan*, particularly Appendix C.

The following is from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-6):

> No flooding problems were identified in the Walker Creek basin (Port of Seattle 1996; King County 1987b).

The following is from the *Comprehensive Stormwater Management Plan STIA Master Plan Update Improvements* (Parametrix 2000, page P-6):

> Landsliding has been reported in the ravine located between R.M. 0.5 and 0.7 in locations where the slope intersects the water table (King County 1987b). [See Figure 5-1.]

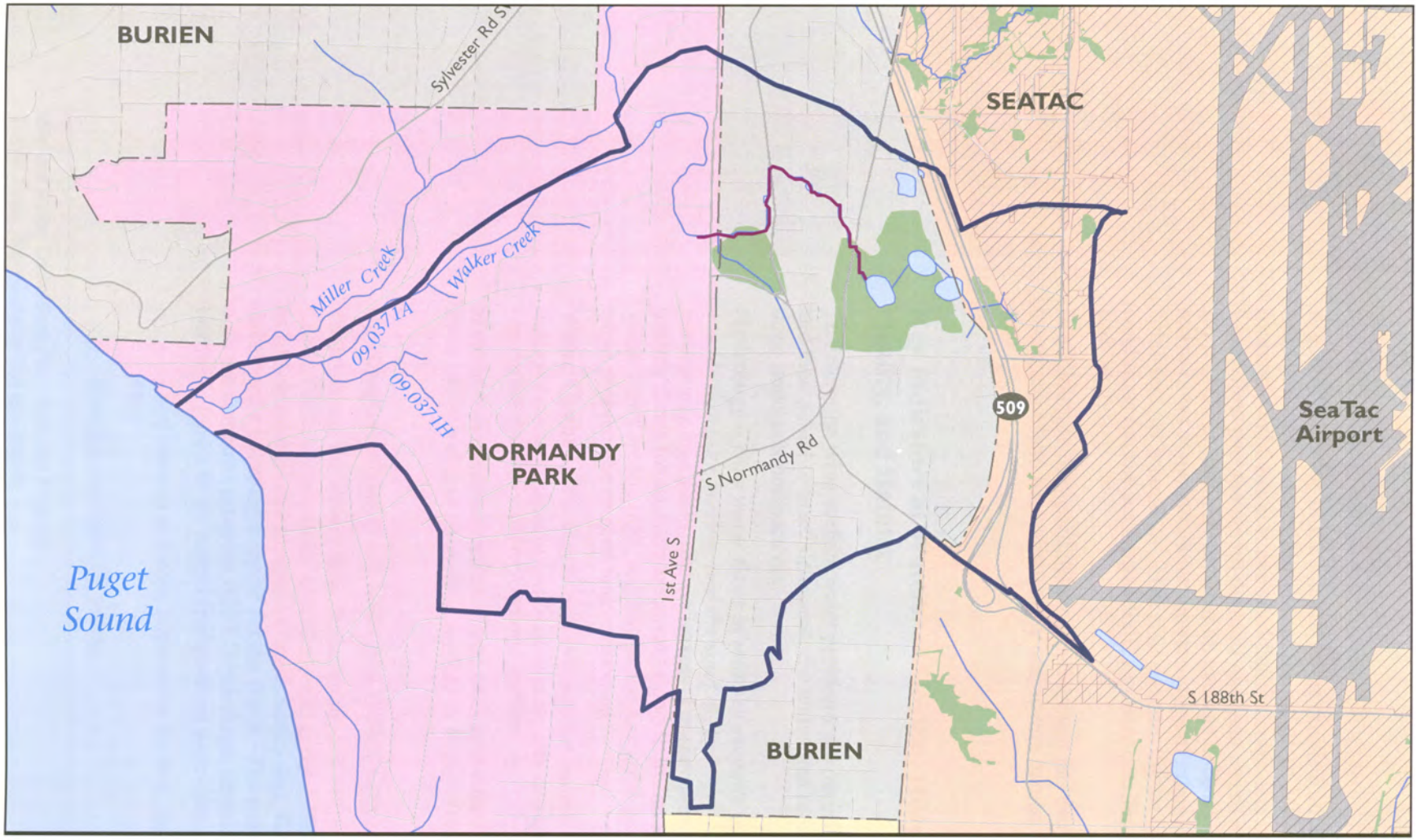

EXHIBIT 3-2

Walker Creek Basin

Basin Boundary

090373 Stream/Tributary Number

Lake/Open Water

Wetland

Port of Seattle Owned Parcels

N

0 1/4 1/2 Mile

July 2005

King County

Department of Natural Resources and Parks

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Map prepared by King County DNRP GIS and WLR Visual Communications & Web Units

File name: 0507MCMap_3-2.eps wgc, sk

Figure I-I.5.1. Walker Creek Watershed

Source: Miller and Walker Creeks Basin Plan (King County et al. 2006), Figure 3-2

Section 6
Gilliam Creek

Study Area

The Gilliam Creek Drainage basin is located partially (27 percent) in the City of SeaTac with the remainder located in the City of Tukwila and has a total area of about 1783 acres. According to the *City of Tukwila Comprehensive Surface Water Management Plan* (CH2M Hill 2003, page C-7):

> The portion of the basin located north of I-405 and east of I-5 is made up mostly of residential developments, with some commercial areas located along Southcenter Boulevard. The portion of the basin west of I-5, with the exception of the Tukwila International Boulevard corridor, is made up of mostly residential developments. Commercial developments are located along the Tukwila International Boulevard corridor. The Southcenter Mall and other commercial areas have been developed in the portion of the basin east of I-5 and south of I-405.

The Northwest Tributary of Gilliam Creek begins around 148th Street and 29th Avenue S in the Riverton Heights area of The City of Tukwila. Refer to Figure 6-1, which is excerpted from the *Gilliam Creek Basin Stormwater Management Plan* (Herrera 2001). Parallel tributaries flow south in enclosed pipe system to 154th Street near STIA airport where they combine into one tributary and flows east along 154th Street. The tributary continues east across SR 99 and joins with more flow from the north. The Northwest Tributary then crosses under 154th Street, and continues in a southeast direction first in an open channel and then a piped system to the confluence with the Southwest Tributary on the north side of SR 518.

The Southwest Tributary collects the flow along SR 99 and 160th Street at its headwaters south of SR 518 near STIA. The flow from these areas is conveyed via an open channel that heads northeast from Military Road to SR 518 which it crosses via an enclosed pipe system. The Southwest Tributary meets the Northwest Tributary on the north side of SR 518.

From the confluence of the two tributaries, Gilliam Creek continues to flow east in an open channel along SR 518 where it joins the South Tributary and then crosses under 154th Street. On the north side of SR 518, the creek is joined by the flow from the North Tributary. The creek then enters an enclosed drainage system along 154th Street and continues flowing east. The creek crosses over 154th Street and daylights briefly before crossing back to the north side near 52nd Avenue S where is joined by flow from the I-5 West Subbasin. From here, Gilliam Creek crosses under the I-5 interchange with SR 518 in an enclosed pipe system. On the east side of the interchange, the creek is joined by flow from the I-5 East Subbasin and the Crystal Springs Subbasin. From here, the creek parallels I-405 and heads east passed Southcenter Mall via a primarily open channel until it discharges into the Green River.

The following is excerpted from the *Gilliam Creek Basin Stormwater Management Plan* (Herrera 2001):

> The Gilliam Creek basin has few large stormwater detention facilities capable of reducing peak flows in the stream. A two-cell stormwater detention and treatment pond located at South 152nd Street and 42nd Avenue South discharges to the north tributary of Gilliam Creek. Several ponds provide some amount of flow control. Undersized culverts and pipe inlets at two locations in the main stem of Gilliam Creek also provide some degree of incidental flow control as stream water backs up in these areas during large storm events. These undersized inlets are 42nd Avenue South culvert and the pipe inlet just downstream of the confluence with the north tributary of Gilliam Creek (KCM, 1993).

ntb\HEC34\991-8\Basin Mgmt Plan

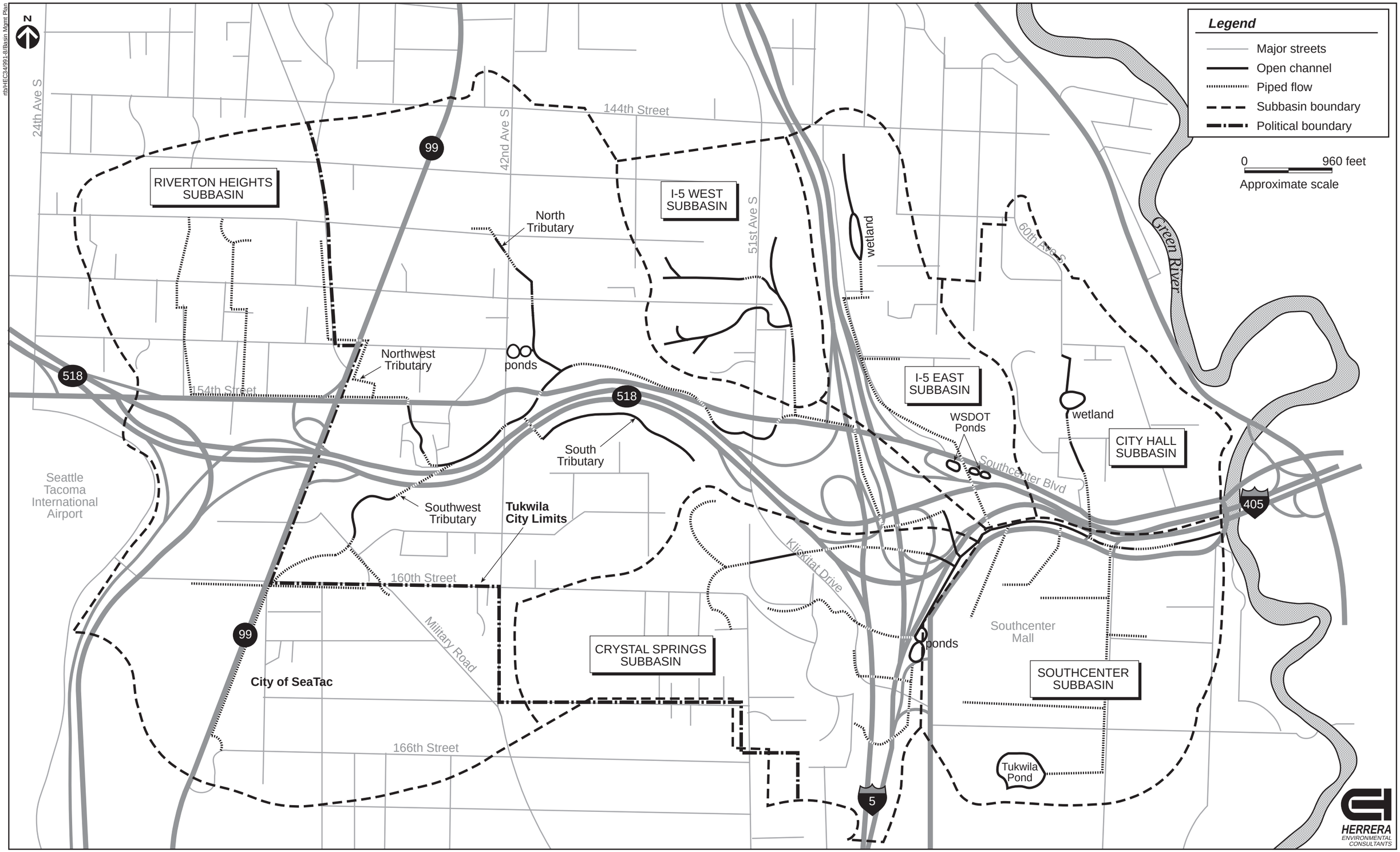


Figure 2. Gilliam Creek basin characteristics.

Figure I-I.6.1. Gilliam Creek Watershed

Source: Gilliam Creek Basin Stormwater Management Plan (Herrera 2001), Figure 2

Existing Drainage Problems

The following is excerpted from the *SR 518/SeaTac Airport to 1-5/1-405 Interchange Hydraulics Report* (Herrera 2007, pages 3-8 through 3-9) describes the problems noted by City of Tukwila and WSDOT staff downstream of the SR 518 project:

> Neither Tukwila nor WSDOT personnel identified any particular areas that require routine maintenance or that exhibit regular flooding. However, some City of Tukwila maintenance personnel expressed concern for some potentially undersized culverts on Tukwila property, located downstream of the SR 518 project area (Howat 2006). Referenced culverts included:
>
> - The 36-inch-diameter concrete culvert that conveys Gilliam Creek beneath
> - 42nd Avenue South
> - The 30-inch-diameter corrugated metal pipe that currently conveys the main stem of Gilliam Creek beneath the Park Place by the Woods Apartments
> - The 36-inch-diameter concrete culvert that conveys the main stem of Gilliam Creek from the manhole drop structure (drainage feature 17 shown on Figure 2-2) located between SR 518 and Southcenter Boulevard to an outfall in the open channel reach of Gilliam Creek just west of 51st Avenue South.
>
> In addition, a downstream analysis (PB 2005) completed for the proposed Gilliam Creek regional detention facility noted potential conveyance capacity constrictions at the following locations within the conveyance system:
>
> - The 30-inch-diameter concrete culvert that conveys the main stem of Gilliam Creek beneath the Southcenter Boulevard crossing, located approximately 450 feet east of 42nd Avenue South
> - The 30-inch-diameter concrete pipe that currently conveys the main stem of Gilliam Creek beneath the Park Place by the Woods Apartments
> - The 48-inch-diameter culvert (pipe material unknown) that conveys the main stem of Gilliam Creek from approximately 52nd Avenue South, underneath the I-5/I-405 interchange, to the outfall location east of I-5.
>
> Although the City of Tukwila is planning to replace the Gilliam Creek culvert at 42nd Avenue South (CH2M Hill and Herrera 2003), this site has not experienced any recent flooding.

Also in the *SR 518/SeaTac Airport to 1-5/1-405 Interchange Hydraulics Report* (Herrera, 2007) that the field investigation found some culverts underneath the I-5/I-405 interchange were found to be accumulating fine sediment and surcharging. In addition, it was found that the drain pipes along either side of the eastbound SR 518 to north bound I-405 ramp were clogged or partially clogged with sediment. Also, the 12-inch-diameter (south side of the ramp) and 18-inch-diameter

(north side of the ramp) culverts were found to be undersized to convey the combination of flow and sediment that drains to them. It was also noted that the numerous ditches and catch basin/storm drain systems throughout the project area appear to be in good condition, without signs of bank erosion, clogging, or ponding.

The following problem identification description for Gilliam Creek is excerpted from the *City of Tukwila Comprehensive Stormwater Management Plan (*CH2M Hill 2003, pages C-12 and C-13):

> **Flooding**
>
> City staff identified the northwest entrance of the Southgate Mall and Andover Park West adjacent to the mall as potential flooding areas. The pipe that serves as the outlet to Gilliam Creek for the storm drainage system in the northwest section of the mall parking lot was constructed with a reverse slope in the mid 1960s. This system has the potential to flood the parking lot and 2 or 3 businesses. The outlet for the storm drainage systems located in Andover Park West was also constructed with a reverse slope, which has resulted in accumulation of sediment and debris in the pipes. Failure of this system would cause flooding along a highly used arterial street.
>
> Annual flooding of several businesses and arterial streets southeast of Southgate Mall was identified by City staff, and in Gilliam Creek Basin Stormwater Basin Plan and the 1993 Surface Water Management Comprehensive Plan. Causes of flooding are inadequate hydraulic capacity in the existing storm drainage systems due to undersized pipes and culverts and/or an accumulation of sediment and debris.
>
> Flooding of the Park Place by the Woods Apartment complex, located north of Southcenter Boulevard and between TIB and I-5 was identified in previous basin plans. One flooding incident at this location occurred when vandals clogged the storm drainage pipe inlet. Also, the storm drainage pipe located under the apartment complex is old and believed to be in poor condition. Failure of this privately owned pipe would cause flooding of the apartment complex living areas and adjacent parking lot, and Southcenter Boulevard.
>
> Flooding in the residential area, located northeast of the TIB and SR 518 interchange, was identified by City staff. The cause is reported to be damaged and undersized storm drainage.
>
> **Fish Habitat**
>
> Woody debris and other habitat features in the channel in the lower reach of Gilliam Creek below the crossing of I-5 (which is impassable to fish) have been repeatedly washed away by high flows. This lower reach exhibits sediment deposition that is likely related to the erosion occurring in the steeper portions of the watershed upstream. This reach was also impacted by sediments in runoff from major construction work on I-5 in 1997. A 9-foot-diamter flap gate and concrete splash pad are located at the mouth of Gilliam Creek at the Green River. The gate renders the mouth impassable to adult fish.

Because of the relatively high cost to improve fish habitat on Gilliam Creek, the City has focused its fish habitat enhancement and fish population recovery efforts on Riverton and Southgate Creeks. Until such time that flows are significantly attenuated and stormwater quality is markedly improved, Gilliam Creek will continue to be of limited value for fish and other aquatic organisms.

Water Quality

Of all the watercourses in the City, Gilliam Creek is considered to have experienced the greatest degree of alteration due to human influences and watershed development. Although much of its watershed is undeveloped due to steep slopes, the areas that are developed have a significantly adverse effect on water quality and aquatic habitat. As documented in the *Gilliam Creek Stormwater Management Plan* (Herrera, 2001), untreated runoff from impervious areas has significantly degraded water quality. These areas include numerous arterial streets with intensive traffic usage (including Tukwila International Boulevard) and associated commercial development, parking lots in the Westfield Mall area, and Interstates 5 and 405. High flows from these area, coupled with steep channel gradients in the upper portion of the watershed, have also caused channel bed and bank erosion.

A summary of surface water management issues excerpted from the *City of Tukwila Comprehensive Stormwater Management Plan* (CH2M Hill 2003) is shown in Table 6-1 and on Figure 6-2

Table I-I.6.1
Summary of Gilliam Creek Surface Water Management Issues

ID	Project Location	Source	Problem Type	Problem Description
G-F1	Andover Park W	Gilliam Creek Basin Stormwater Management Plan, March 2001, by Herrera (Project D3) 1993 Surface Water Management Comprehensive Plan (Project G2)	Flooding	Existing storm drain system has been damaged.
G-F2	North of Southcenter Blvd. and east of 42nd Ave S	Gilliam Creek Basin Stormwater Management Plan, March 2001, by Herrera (Project D4) 1993 Surface Water Management Comprehensive Plan (Project C2)	Flooding/Water Quality	Erosion and flooding in downstream drainage system.
G-F5	Gilliam Creek crossing at 42nd Ave SE (between S 154th St and HWY 518)	1993 Surface Water Management Comprehensive Plan (Project C1)	Flooding	Existing culvert has inadequate capacity.
G-F6	Tukwila Parkway at northwest Southcenter Mall access	City of Tukwila Public Works	Flooding	Outlet pipe for Southcenter Mall Drainage System has a reverse slope.
G-F7	From 42nd Av. S. to Tukwila International Boulevard S. 146th St, S. 148th St., S. 150th St., S. 152nd St.	City of Tukwila Public Works	Flooding	Existing storm drainage system has inadequate capacity resulting in road and private property flooding.
G-F8	Andover Park W. and Tukwila Parkway	City of Tukwila Public Works	Flooding	ROW flooding in the area of Tukwila Parkway, Andover Park W, Andover Park E, and Strander Boulevard during large storm events.
G-FH1	Outlet of Gilliam Creek to Green River	Gilliam Creek Basin Stormwater Management Plan, March 2001, by Herrera (Project H2) 1993 Surface Water Management Comprehensive Plan (Project G3)	Flooding/Habitat	Flap gates are fish barriers. Flap gates close during when the Green River is at high levels causing flooding in Gilliam Creek.
G-WQ1	Basinwide, particularly in vicinity of Tukwila International Boulevard and Southcenter Mall	Gilliam Creek Basin Stormwater Management Plan, March 2001, by Herrera	Water Quality	High levels of pollutants in basin runoff - notably fecal coliform bacteria throughout the basin, and copper and zinc in runoff from the Tukwila Int'l Blvd. area are degrading water quality in Gilliam Creek
G-H1	Along Tukwila Parkway between I-5 culvert and outfall to Green River	Gilliam Creek Basin Stormwater Management Plan, March 2001, by Herrera (Project H3)	Habitat	Lack of habitat diversity and riparian vegetation
G-H2	South of S 154th St near 52nd Ave S intersection	Gilliam Creek Basin Stormwater Management Plan, March 2001, by Herrera (Project H5)	Habitat	Lack of riparian vegetation

Source: City of Tukwila Surface Water Management Comprehensive Plan (CH2M Hill 2003), Table C-10.

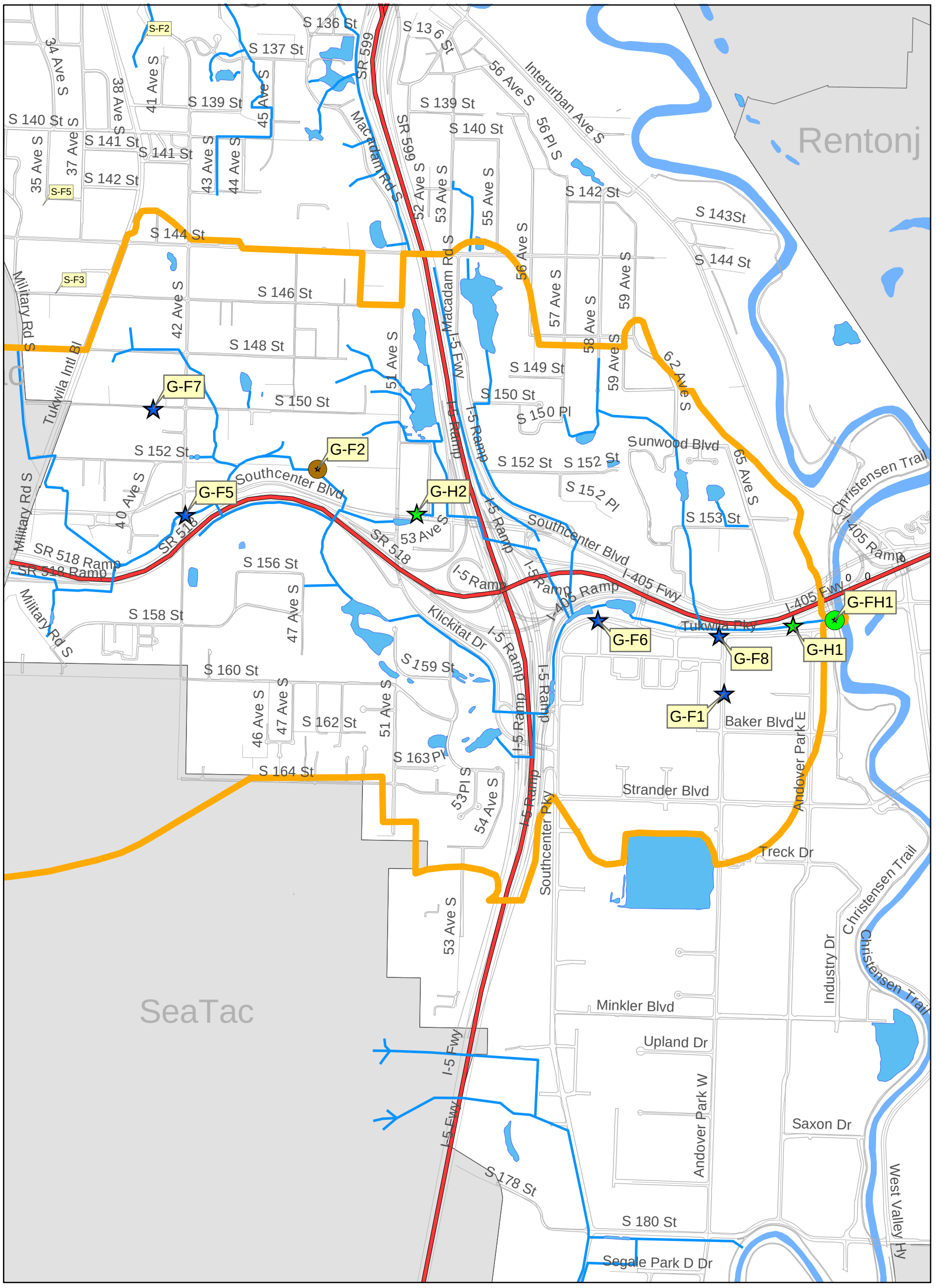


Figure I-I.6.2. Gilliam Creek Surface Water Management Issues

Source: City of Tukwila Comprehensive Surface Water Management Plan (CH2M Hill 2003), Figure C-4

Table 6-2 is a list of identified drainage and habitat problems in the Gilliam Creek basin excerpted from the *Gilliam Creek Basin Stormwater Quality Management Plan* (Herrera 2001, page 15):

> Most of the Gilliam Creek drainage basin consists of highly developed urban land uses, including single- and multifamily residential areas, commercial and office areas, and roadway surfaces. These types of urban land uses are characterized by large areas of impervious surfaces associated with roads, parking lots, sidewalks, and rooftops. Impervious surfaces convey rainfall to receiving water much more quickly than do pervious land uses such as undeveloped forest and open space, causing increased peak flows and runoff volumes. This is evident in Gilliam Creek where scour and erosion characterize the upper reaches of the stream, resulting in sediment deposition and flooding in the lower reaches. These problems of upstream erosion and downstream sedimentation are exacerbated by the topography of the basin, which has a relatively steep stream channel slopes in the upper basin and a flat channel gradient in the lower basin.

Table I-I.6.2
Existing Problems – Gilliam Creek

ID	Location	Problem Description	Solutions	References
D1	Outlet of Gilliam Creek to the Green River (near intersection of Tukwila Pkwy and Christensen Rd)	Flooding occurs in streets and commercial properties in the Southcenter area.	Construction of a 250 cfs pump station with fish passage facilities to keep the water surface elevation in Gilliam Creek below the flood elevation of the business district. Reanalysis of the pump station capacity needed due to changing basin conditions since this alternative was analyzed.	KCM 1986 pp. 34 KCM 1993 pp. 3-5 (Gilliam Project 3)
D2	Open channel between 40th Ave S. and 42nd Ave S	High flows during peak storm events and intensive development without implementation of water quality or detention facilities have resulted in poor water quality, erosion of the roadways and streambanks, and siltation within the stream corridor.	Construction of in-stream ponds behind new dams for peak flow control and water quality treatment upstream of 42nd Ave S. Incorporate biofiltration swale adjacent to lower pond for improved treatment of low flows.	Perteet 1994 pp. 2-3
D3	Andover Park W	Significant settling (1–2 feet) of existing 48-inch storm drain line following construction of the pipeline has required extensive maintenance for silt removal. Surcharging of pipe occurs due to reduced conveyance capacity. Localized flooding is expected to worsen as buildout occurs.	Replacement of the most severely settled portions with 760 feet of 60-inch pipe from Tukwila Parkway to Strander Blvd.	KCM 1986 pp.17-18
D4	Confluence of main stem and north tributary of Gilliam Creek, north of S 154th St and east of 42nd Ave S	30-inch diameter pipe underneath the apartment complex is severely surcharged during the 25-year design storm.	Construction of a detention facility in the ravine immediately upstream of the culvert entrance to provide approximately 1.2 million cubic feet of storage volume.	KCM 1986 pp.18-19 KCM 1993 p. 3-6 (Crestview Project 2)
D5	Strander Blvd near Andover Park E	Flooding occurs at the intersection due to an undersized drain line that cannot pass peak runoff for the 25-year storm.	Replacement of existing 1,100 feet of 12-inch pipe with a 36-inch pipe at the same slope.	KCM 1986 p.17 KCM 1993 p. 3-5 (Gilliam Project 1)
D6	James Christensen Rd	Flooding occurs in the business district.	Construction of a 15 cfs pump station with fish passage facilities to limit surcharging of pipe system below the flood elevation of the business district.	KCM 1986 pp. 39-42 KCM 1993 p. 3-5 (Gilliam Project 3)
D7	12-inch drain line paralleling 49th Ave S between north of S 160th St and the projection of S 158th St	City maintenance crew is unaware of any drainage problem in this area.	Replacement of a failing 12-inch corrugated metal pipe (CMP) with an 18-inch concrete pipe. Proposed solution does not appear to be necessary.	KCM 1993 p. 3-6 (Crestview Project 4)
D8	12-inch drain line flowing east through the intersection north of S 160th St and 53rd Ave S	City maintenance crew is unaware of any drainage problem in this area.	Replacement of a 12-inch CMP with a 21-inch concrete pipe. Proposed solution does not appear to be necessary.	KCM 1993 p. 3-6 (Crestview Project 5)
D9	Ditch paralleling 54th Ave S between Slade Way and S 166th St	Undersized conveyance system may lead to flooding.	Upgrade of existing ditch and construction of detention facility to prevent runoff from tributary area from exceeding the limited capacity of downstream receiving network.	KCM 1993 p. 3-6 (Crestview Project 6)

Table I-I.6.2 (continued)

ID	Location	Problem Description	Solutions	References
D10	S 146th St from Military Rd S to SR-99	When the capacity of the existing 12-inch collection system is exceeded, the excess flow runs down the west side of SR-99 until it can reenter the drainage network at a point that has reserve capacity.	Replacement of the 12-inch pipeline system with a 15-inch pipeline in order to contain the peak storm flow for the 25-year, 24-hour storm event, based upon ultimate development from the tributary subbasin area.	KCM 1993 pp. 3-7 to 3-8 (Cascade View Project 2)
D11	Swale located along S 150th St between 45th Ave S and the north tributary of Gilliam Creek.	The existing roadside ditch/culvert system is inadequate for the future, fully developed 25-year, 24-hour storm event.	Construction of a combination swale/piped underdrain system is proposed consisting of a 12-inch underdrain with a 1.5-foot deep swale located above the underdrain pipe. Proposed road improvement project in this area should address this problem.	KCM 1993 p. 3-8 (Cascade View Project 4)
D12	S 154th St near 42nd Ave S	The existing 30-inch culvert is undersized to pass peak runoff.	Upgrade existing 30-inch diameter culvert to 48-inch diameter to minimize surcharging. This culvert has been retrofitted with a trashrack and overflow structure to promote limited ponding and avoid culvert blockage. This solution should be reanalyzed based on potential new regional detention facilities upstream. Added detention may reduce peak flows enough to make this proposed solution unnecessary.	KCM 1986 p. 17
D13	42nd Ave S near S 154th St	The existing 36-inch culvert is undersized to pass peak runoff.	Upgrade existing 36-inch diameter culvert to 48-inch diameter to accommodate peak flows under future land use conditions. This solution should be reanalyzed based on potential new regional detention facilities upstream. Added detention may reduce peak flows enough to make this proposed solution unnecessary.	KCM 1986 p. 16
D14	Open channel within Southwicke apartment complex, between S 154th St and 40th Ave S	Existing open channel carries the northwest tributary of Gilliam Creek. High peak flows from undetained runoff cause channel scour, erosion, and flooding problems in downstream portions of the stream.	Creation of an in-channel detention facility was proposed; however, this area would not provide a significant amount of detention because it is a narrow, fairly steep ravine with no room for expansion.	Perteet 1994 p. 14
D15	Area around S 156th St to S 158th St and 44th Ave S to 46th Ave S	Several drainage problems in the area have resulted from undersized or lacking roadside drainage and moderate bank erosion.	Construction of a detention facility to attenuate peak runoff and a new down drain in order to stabilize the eroding hillside. Design and construction of the down drain has been defined in the city's 1993 comprehensive plan.	KCM 1993 p. 3-6 (Crestview Project 3)
H1	Section of north tributary between 150th St S and 152nd St S	The existing ravine that carries the north tributary of Gilliam Creek is undergoing severe channel erosion and bank sloughing.	Construction of log check dams in channel and placement of riprap on weak bank sections.	KCM 1993 p. 3-8 (Cascade View Project 3)

Table I-I.6.2 (continued)

ID	Location	Problem Description	Solutions
D16	Intersection of 42nd Ave S and S 146th St, northwest and southwest corners	Untreated, undetained runoff from developed land has led to channel scour, bank erosion, poor water quality and flooding in the Gilliam Creek system.	Construction of detention or detention/treatment ponds.
D17	Culvert on north tributary to Gilliam Creek at S 150th St	Untreated, undetained runoff from developed land has led to channel scour, bank erosion, poor water quality and flooding in the Gilliam Creek system.	Construction of in-channel detention and/or treatment pond at upstream side of road is not feasible in this location.
D18	Existing water quality/detention ponds at 42nd Ave S and S 152nd St	Existing detention/treatment ponds are undersized relative to upstream drainage area.	Expansion of existing facilities is not feasible due to site constraints.
D19	Northwest corner of 52nd Ave S and S 154th St intersection	Untreated, undetained runoff from road surfaces is aggravating flooding and water quality problems downstream.	Construction of detention/ treatment pond for 51st Ave S road runoff
D20	North tributary of Gilliam Creek, west of entry to West Colonial Village apartments, on south side of S 154th St, near SR-99	Water quality degradation has occurred, due to untreated runoff from commercial land uses.	Construction of biofiltration swale for water quality treatment along S 154th St next to apartment complex.
D21	Commercial and office-park areas along SR-99, in the vicinity of S 154th St and 52nd Ave S, and in the Southcenter area	Untreated, undetained runoff from parking lots and commercial land is causing channel scour, erosion, flooding and degraded water quality in the basin.	Construction of onsite water quality treatment and/or detention facilities for areas not draining to regional facilities.
D22	Southwest tributary of Gilliam Creek near the intersection of Old Military Rd and S 158th St	Untreated, undetained runoff from parking lots and commercial land has led to channel scour and degraded water quality in the southwest tributary of Gilliam Creek.	Construction of regional detention facility, either underground vaults or a surface pond in the existing ravine.
D23	SR-99 between S. 146th St and S. 152nd St.	Undetained runoff from road surface is aggravating erosion and flooding problems downstream.	Construction of underground detention tanks within the road right-of-way to detain runoff.
D24	SR-99 between S 146th St and S 152nd St	Untreated runoff from road surface is aggravating water quality problems downstream.	Construction of underground water quality treatment vaults within the road right-of-way to treat runoff.
H2	Outlet of Gilliam Creek to Green River	Flap gate and culvert limit fish migration.	Installation of fish ladder leading to existing flap gate and replacement of flap gate with self-regulating tide gate.
H3	Lower reach of Gilliam Creek, along Tukwila Parkway between I-5 culvert and outlet to Green River	Channel substrate insufficient for salmonid spawning, lack of juvenile rearing habitat.	Replacement of existing channel substrate with spawning gravels, creation of off-channel refuge areas by excavating a portion of the stream bank and anchoring large rootwads and woody debris. Increase sinuosity of stream.
H4	North tributary to Gilliam Creek at southwest corner of 42nd Ave S and S 148th St	Garbage, channel scour, and invasive vegetation have degraded the aesthetic benefit of this stream channel section.	Removal of trash, clearing of dense undergrowth, and replanting of riparian vegetation to improve aesthetic value.
H5	Open channel in main stem of Gilliam Creek south of S 154th St near 52nd Ave S intersection	Lack of riparian vegetation degrades the resident fish habitat function of this stream channel section.	Planting of riparian vegetation and temporary irrigation to shade stream and improve aesthetic value of this stream reach.
H6	Lower reach of Gilliam Creek, at confluence of main stem and Crystal Springs tributary	Creek is degraded by poor water quality and high flood flows; poor fish rearing habitat.	Construction of a pond to improve water quality, reduce peak flows, and improve fish habitat conditions.

Source: Gilliam Creek Basin Stormwater Management Plan (Herrera 2001), Table B-1

Volume II
Construction Stormwater Pollution Prevention

Stormwater Management Manual for Port Aviation Division Property

Port of Seattle Aviation Division

Volume II
CONSTRUCTION STORMWATER POLLUTION PREVENTION

Revisions and Addenda

Volume II of this Manual references Volume II of the Ecology Manual with the following modifications. Users should refer to this Manual and the Ecology Manual for requirements related to construction stormwater pollution prevention design and implementation.

II-2.2 Construction Stormwater Pollution Prevention Plans

Add the following text after the third paragraph of this section:

STIA Construction Stormwater Pollution Prevention Plan Requirements

The Port has prepared a *Programmatic Construction Stormwater Pollution Prevention Plan* (SWPPP) for STIA in accordance with the requirements of the NPDES Permit. The *Programmatic SWPPP* describes all components of the Port construction stormwater management program at STIA. It contains three primary components:

- Monitoring Plan
- Hazardous Materials Management Plan (HMMP) Specification
- Contractor Erosion and Sediment Control Plan (CESCP) Specification

The Port Programmatic Construction SWPPP can be accessed at: http://www.portseattle.org/Environmental/Water-Wetlands-Wildlife/Stormwater/Documents

In addition, the NPDES Permit requires the preparation of project-specific Construction SWPPPs for construction activity that disturbs one or more acres. The SWPPPs are prepared for construction contracts by the project proponent and are implemented by the construction contractor. However, the Port is still responsible for overseeing the development and implementation of Construction SWPPPs in accordance with the NPDES Permit.

The construction contract specification requirements are used to clearly define the NPDES Permit regulatory response requirements of the construction contractor. The specifications provide the specific requirements for the contractor's development of the HMMP and the CESCP.

The Port follows separate construction-related requirements depending on whether the project is located within or outside of the Retrofit Area (see sections below). Refer to Figure 1-1 in Volume I to determine whether a project is inside or outside the Retrofit Area. Also refer to Figures 2.4.1 through 2.4.3 of Volume I to determine how *Minimum Requirement #2 – Construction Stormwater Pollution Prevention* applies within and outside of the Retrofit Area. Section 2.5.2 of Volume I of this Manual describes the thresholds for

Minimum Requirement #2 application, including the requirements for and components of the project-specific *Construction SWPPP* applicable beyond the Port's *Programmatic Construction SWPPP*. That section also summarizes the required Best Management Practice (BMP) elements (13 total) of the *Construction SWPPP*, and describes other supplemental guidelines applicable to its preparation.

The project proponent and construction contractor are required to implement and comply with the *Programmatic SWPPP and Construction SWPPP* components, including installation and maintenance of required construction stormwater BMPs. Notice-to-proceed with construction is not issued until the *Construction SWPPP* has been approved. They are also responsible for maintaining and updating the *Construction SWPPP* components, and for any required supplemental BMPs determined necessary by the Port to maintain project construction discharge compliance under the NPDES Permit.

The Project Proponent should refer to Volume II of the Ecology Manual for additional information on BMP design, construction, and maintenance. Where other passive construction stormwater BMPs are not expected to provide adequate discharge water quality control, the Port may require the use of construction stormwater chemical treatment (Ecology Manual BMP C250) and/or construction stormwater filtration (Ecology Manual BMP C251) to meet the NPDES Permit construction stormwater discharge limits from the project site.

Projects Within the Retrofit Area

For projects in which the new, replaced, or new plus replaced hard surfaces total 2,000 square feet or more, or that disturb 7,000 square feet or more of land, the project proponent must prepare a project-specific construction SWPPP. The need for the monitoring plan as a part of the SWPPP will be determined by Port Environmental and Construction staff. For projects that disturb more than 1 acre of total land area, the full SWPPP, including the monitoring plan will be required. All projects involving exterior construction must meet the Port CESCP specification requirements.

For projects that add or replace less than 2,000 square feet of hard surface or disturb less than 7,000 square feet of land, project proponents are not required to prepare a construction SWPPP, but must still meet CESCP specification requirements.

The specific requirements of the Port's Programmatic Construction SWPPP supersede the similar requirements of Chapters 1-3 of Volume II of the Ecology Manual.

Projects Outside of the Retrofit Area

Construction projects outside of the retrofit area which have a discharge of stormwater from the project site to surface water, and where the new, replaced, or new plus replaced hard surfaces total 2,000 square feet or more, or that will disturb 7,000 square feet or more of land, must obtain coverage under Ecology's Construction Stormwater General Permit. The permit requires application of stabilization and structural practices to reduce the potential for erosion and the discharge of sediments from the site. Coverage under the Construction Stormwater General Permit is required for any clearing, grading, or excavating that will disturb one or more acres of land area, and that will discharge stormwater from the site into surface water(s), or into storm drainage systems that

discharge to a surface water. Lower area thresholds or other requirements for SWPPP preparation may apply based on applicable local jurisdiction stormwater management requirements.

The Project Proponent should follow the requirements provided in Volume II of the Ecology Manual in its entirety including development of the *Construction SWPPP* in accordance with applicable local jurisdiction requirements. Where other passive construction stormwater BMPs are not expected to provide sufficient discharge control, the Port may require the use of construction stormwater chemical treatment (Ecology Manual BMP C250) and/or construction stormwater filtration (Ecology Manual BMP C251) to meet the Construction General Stormwater Permit discharge limits from the project site.

Volume III
Hydrologic Analysis and Flow Control Design/BMPs

Stormwater Management Manual for Port Aviation Division Property

Port of Seattle Aviation Division

Volume III
HYDROLOGIC ANALYSIS AND FLOW CONTROL DESIGN/BMPs

Revisions and Addenda

Volume III of this Manual references Volume III of the Ecology Manual with the following modifications. Users should refer to this Manual and the Ecology Manual for requirements related to hydrologic analysis and flow control design.

III-1.1 Purpose of this Volume

Add	The Port of Seattle Aviation Division does not construct residential development so that any references in Volume III to: "single family residential development", "single family subdivision", and "subdivision single family" are not relevant

III-1.3 How to Use this Volume

Add after first paragraph	Figure III-1.3.1 is provided in this Manual to illustrate existing flow control facilities at STIA within the prior Master Plan Update Retrofit Area (Retrofit Area). This storage capacity and design criteria for each detention pond facility are presented in the *Technical Information Supporting the Design of Stormwater Ponds Serving the Seattle Tacoma International Airport* (Port of Seattle 2013) that is maintained and periodically updated by Port Environmental.

III-2.1 Minimum Computational Standards

Add to Item 1 after Table III-2.1.1	The use of the Port-developed models is required within the Retrofit Area and is recommended outside the Retrofit Area within the Des Moines and the Miller/Walker Creek basins. Hydrologic and hydraulic models have been developed for areas in and around aviation properties. Calibrated Hydrologic Simulation Program – FORTRAN (HSPF) models have been prepared for Miller, Walker, and DesMoines Creek basins. The calibration parameters are specific to each basin and must be used appropriately in the approved continuous models (HSPF, WWHM, and MGSFlood). The hydrologic parameters to use in each basin are contained in Table III-2.1.2. Project proponents should contact Port Environmental for the most current HSPF models that are available for Port properties. Stormwater Management Models (SWMM) have been prepared for portions of the Port storm drain system. SWMM models are periodically updated or expanded as new projects require. Project proponents should contact Port Environmental to obtain the latest models that are available. If an existing downstream Port flow control facility is identified (see Figure III-

1 in this Manual), the project proponent must analyze the operation of the existing flow control facility and proposed flow control facility in series. The use of the Port-developed models will facilitate this analysis because they include many of the existing detention facilities. The proposed flow control facility must be designed such that it meets the requirements at its outlet and the outlet of the existing downstream flow control facility.

III-3.2.1 Detention Ponds – Design Criteria – General

Add

5. To comply with FAA regulations, detention ponds must be designed to accommodate bird deterrent measures such bird netting and/or bird balls. The Project Proponent may petition the Port to exempt an open pond from this requirement on a case by case basis. When bird balls are proposed, the Project Proponent must ensure that the outlet structures are designed to prevent plugging of the pond outlet with the bird balls and to ensure that bird balls will not exit the pond via the outlet. Port Bird Deterrent System requirements, design criteria, and cover system standard plans are provided in Appendix III-D in this Manual.

Appendix III-B: Western Washington Hydrology Model

Delete Entire "Standard Residential" paragraph (not applicable to STIA)

Delete Entire "Runoff Credits" discussion (not applicable to STIA)

Appendix III-D: Bird Deterrent System

Add New Appendix III-D provided in this Manual

Table III-2.1.2
HSPF Parameters Applicable To Areas In and Around The Seattle-Tacoma International Airport

Land Segment [1]	LZSN (in)	INFILT (in/hr)	LSUR (ft)	SLSUR	KVARY (1/in)	AGWRC (1/day)	INFEXP	INFILD	DEEPFR	BASETP	AGWETP	CEPSC (in)	UZSN (in)	NSUR	INTFW	IRC (1/day)	LZETP	RETSC (in)
DesMoines Creek [2]																		
TF	4.5	0.200	200	0.100	0.5	0.996	2	2	0.55	0	0.0	0.2	0.500	0.35	3	0.50	0.70	*na*
TG	4.5	0.075	400	0.100	0.5	0.996	2	2	0.55	0	0.0	0.1	0.250	0.25	3	0.50	0.25	*na*
OF	5.0	2.000	200	0.050	0.3	0.996	2	2	0.55	0	0.0	0.2	0.500	0.35	0	0.70	0.70	*na*
OG	5.0	0.800	200	0.050	0.3	0.996	2	2	0.55	0	0.0	0.1	0.500	0.25	0	0.70	0.25	*na*
AF	7.5	0.020	300	0.070	0.0	0.996	2	2	0.55	0	0.0	0.1	0.280	0.25	6	0.15	0.60	*na*
SA	4.0	2.000	200	0.001	0.5	0.996	10	2	0.55	0	0.7	0.2	3.000	0.50	1	0.70	0.80	*na*
EIA	*na*	*na*	500	0.010	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	0.10	*na*	*na*	*na*	0.1
Miller Creek [3]																		
TF	9.0	0.320	400	0.100	0.5	0.996	2	2	0.33	0	0.0	0.2	0.750	0.35	9	0.70	0.70	*na*
TG	9.0	0.120	400	0.100	0.5	0.996	2	2	0.33	0	0.0	0.1	0.375	0.25	9	0.70	0.25	*na*
OF	10.0	2.000	400	0.050	0.3	0.996	2	2	0.33	0	0.0	0.2	0.750	0.35	0	0.70	0.70	*na*
OG	10.0	0.800	400	0.050	0.3	0.996	2	2	0.33	0	0.0	0.1	0.750	0.25	0	0.70	0.25	*na*
AF	7.5	0.020	300	0.070	0.0	0.996	2	2	0.33	0	0.0	0.1	0.280	0.25	6	0.15	0.60	*na*
SA	8.0	2.000	100	0.001	0.5	0.996	10	2	0.33	0	0.7	0.1	2.250	0.50	1	0.70	0.80	*na*
EIA	*na*	*na*	100	0.010	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	0.10	*na*	*na*	*na*	0.1
Walker Creek [4]																		
TFM	4.5	0.080	400	0.100	0.5	0.996	2	2	0.00	0	0.0	0.2	0.500	0.35	2	0.15	0.70	*na*
TGM	4.5	0.030	400	0.100	0.5	0.996	2	2	0.00	0	0.0	0.1	0.250	0.25	2	0.15	0.25	*na*
OF	5.0	2.000	400	0.050	0.3	0.996	2	2	0.00	0	0.0	0.2	0.500	0.35	0	0.50	0.70	*na*
OG	5.0	0.800	400	0.050	0.3	0.996	2	2	0.00	0	0.0	0.1	0.500	0.25	0	0.50	0.25	*na*
AF	7.5	0.020	300	0.070	0.0	0.996	2	2	0.33	0	0.0	0.1	0.280	0.25	6	0.15	0.60	*na*
SA	4.0	2.000	100	0.001	0.5	0.996	10	2	0.00	0	0.7	0.1	3.000	0.50	1	0.70	0.80	*na*
EIA	*na*	*na*	100	0.010	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	0.10	*na*	*na*	*na*	0.1
Gilliam Creek [5]																		
TFM	4.5	0.080	400	0.100	0.5	0.996	2	2	0.00	0	0.0	0.2	0.500	0.35	6	0.50	0.70	*na*
TGM	4.5	0.030	400	0.100	0.5	0.996	2	2	0.00	0	0.0	0.1	0.250	0.25	6	0.50	0.25	*na*
OF	5.0	2.000	400	0.100	0.3	0.996	2	2	0.00	0	0.0	0.2	0.500	0.35	0	0.70	0.70	*na*
OG	5.0	0.800	400	0.100	0.3	0.996	2	2	0.00	0	0.0	0.1	0.500	0.25	0	0.70	0.25	*na*

Table III-2.1.2
HSPF Parameters Applicable To Areas In and Around The Seattle-Tacoma International Airport

Land Segment [1]	LZSN (in)	INFILT (in/hr)	LSUR (ft)	SLSUR	KVARY (1/in)	AGWRC (1/day)	INFEXP	INFILD	DEEPFR	BASETP	AGWETP	CEPSC (in)	UZSN (in)	NSUR	INTFW	IRC (1/day)	LZETP	RETSC (in)
SA	4.0	2.000	100	0.001	0.5	0.996	10	2	0.00	0	0.7	0.2	3.000	0.50	1	0.70	0.80	*na*
EIA	*na*	*na*	400	0.010	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	0.10	*na*	*na*	*na*	0.1

Notes:

[1] Land Segment definitions:

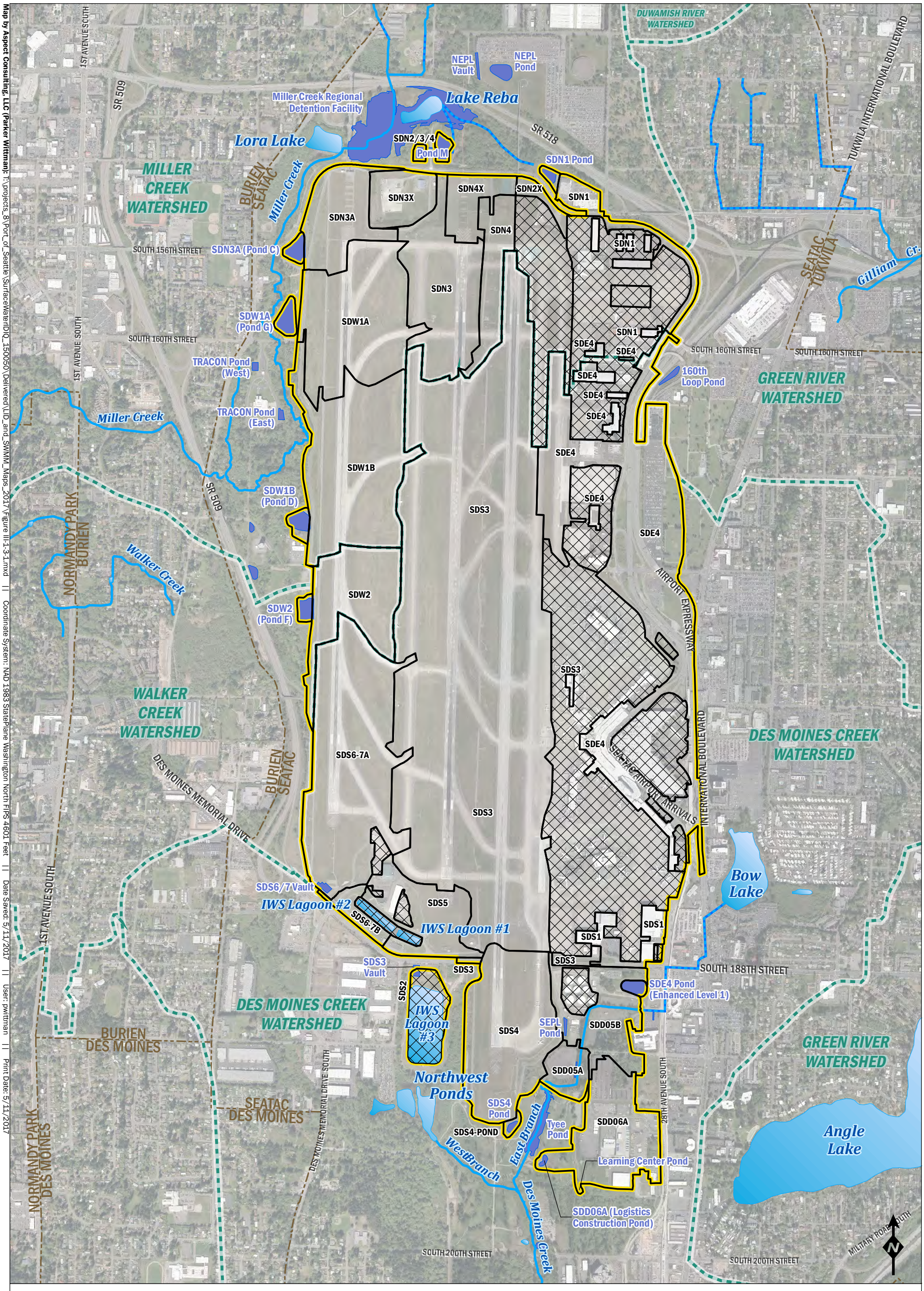
- TF Forest covered till-derived soils
- TFM Forest covered till-derived soils, moderate slope (6 to 15%)
- TG Grass covered till-derived soils
- TGM Grass covered till-derived soils, moderate slope (6 to 15%)
- OF Forest covered outwash soiils, moderate slope
- OG Grass covered outwash soils, moderate slope
- AF Fill areas within the airport (primarily airfield)
- SA Saturated areas (wetlands), flat sloped (<5%)
- EIA Effective impervious surfaces

[2] HSPF parameters calibrated to Des Moines Creek

[3] HSPF parameters calibrated to Miller Creek

[4] HSPF parameters calibrated to Walker Creek

[5] HSPF parameters applicable to Gilliam Creek basin. Values are based on the regionalized HSPF parameters.



NPDES Permit Application Boundary and STIA Retrofit Area

Storm Drainage Subbasin

Industrial Waste System (IWS) Area

Watershed Boundary

Flow Control Facilities

Conveyance

Stream

Surface Waterbody

City Limit

FIGURE III-1.3.1
Flow Control Facilities at STIA

Volume III - Hydrologic Analysis and Flow Control Design/BMPs

0 700 1,400

Feet

MAP BY: Aspect CONSULTING

Port of Seattle

Map by Aspect Consulting, LLC (Parker Wittman): T:\projects_8\Port_of_Seattle\SurfaceWaterIDIQ_150050\Delivered\LID_and_SWMM_Maps_2017\Figure III-1-3-1.mxd || Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet || Date Saved: 5/11/2017 || User: pwittman || Print Date: 5/11/2017

Appendix III-D: Bird Deterrent System

To meet FAA regulations, a bird deterrent system such as bird balls and/or bird control netting combined with pond liner shall be included in the design of open water ponds or vaults with a water surface area greater than 1,000 square feet at either the elevation of the primary outlet or at the elevation of the water surface design elevation. The Project Proponent may petition the Port to exempt an open pond or other structure from this requirement on a case-by-case basis.

D.1 Bird Balls

When bird balls are proposed, the Project Proponent must ensure that the outlet structures are designed to prevent bird balls from plugging of the outlet or exiting the pond via the outlet. The Project Proponent shall consult with the Port for approved bird ball materials and sizes.

D.2 Bird Netting

When bird netting is proposed, the extent and location of bird control netting shall be indicated on the drawings. The work shall include the requirements for furnishing and installing all items and components of a complete bird control netting system.

Design Criteria

The bird control netting system on each pond shall be coordinated with pond grading, retaining wall construction, access road, and utility conflicts. The design shall include location of the posts, wire cables, netting, and other features and shall be designed by a Washington State licensed engineer.

BIRD NETTING POSTS

The height, diameter, thickness and grade of the steel posts shall be designated on the drawings or provided in the specifications.

WIRE ROPE CABLES

Wire rope cables supporting the netting shall be Type 302 stainless steel wire rope 1x19 strand core. The size shall be indicated on the drawings.

NETTING

A. Netting shall be made of UV-treated black nylon, knotted to a 2-inch nominal mesh size. Netting shall weigh no more than 0.02 pounds per square foot.

B. Netting shall have a continuous rope border.

C. Netting shall be provided in as large sections as possible to minimize field joints.

MISCELLANEOUS HARDWARE

A. All hardware for wire rope connections, including wire rope clips, thimbles, eye bolts, and turnbuckles, shall be stainless steel.

B. All hardware for tying and installing netting shall be stainless steel or non-metallic.

GENERAL REQUIREMENTS

A. During construction, concrete around posts shall be allowed to cure a minimum of five days prior to tensioning cables.

B. Concrete used in anchorage of posts shall be 2,500 psi 28-day test, standard ready mixed concrete from an approved plant.

INSTALLATION

A. Posts shall be installed vertically in concrete with a minimum depth of embedment indicated on the drawings and designed by a Washington State licensed engineer. In unpaved areas, the concrete shall be struck off two inches above the surrounding grade. In paved areas it shall be struck off flush with the paving. The top of the concrete shall be trowelled smooth, with a slight slope away from the posts.

B. Cables shall be attached to turnbuckles with at least 3-inch cable turnback, secured with stainless steel rope clamps, and wrapped with thermal tape such that no sharp ends protrude. Tension of the cables should be until lowest point of sag is at the level of the berm.

C. During installation, tension of the wire rope cables shall be to the sag indicated on the drawings. Care should be taken not to over-tighten the cables.

D. Netting shall be installed over the cables to provide a taut low sag while providing tension to the netting in both (perpendicular) directions. Netting shall be connected to the bottom perimeter wire rope with hog rings or nylon wire ties or as recommended by netting manufacturer with a maximum spacing of 2 inches to maintain taut netting.

E. Field splices of netting shall allow tensioning across splice and leave no gaps. Separate nets shall be connected at a maximum spacing of 6 inches.

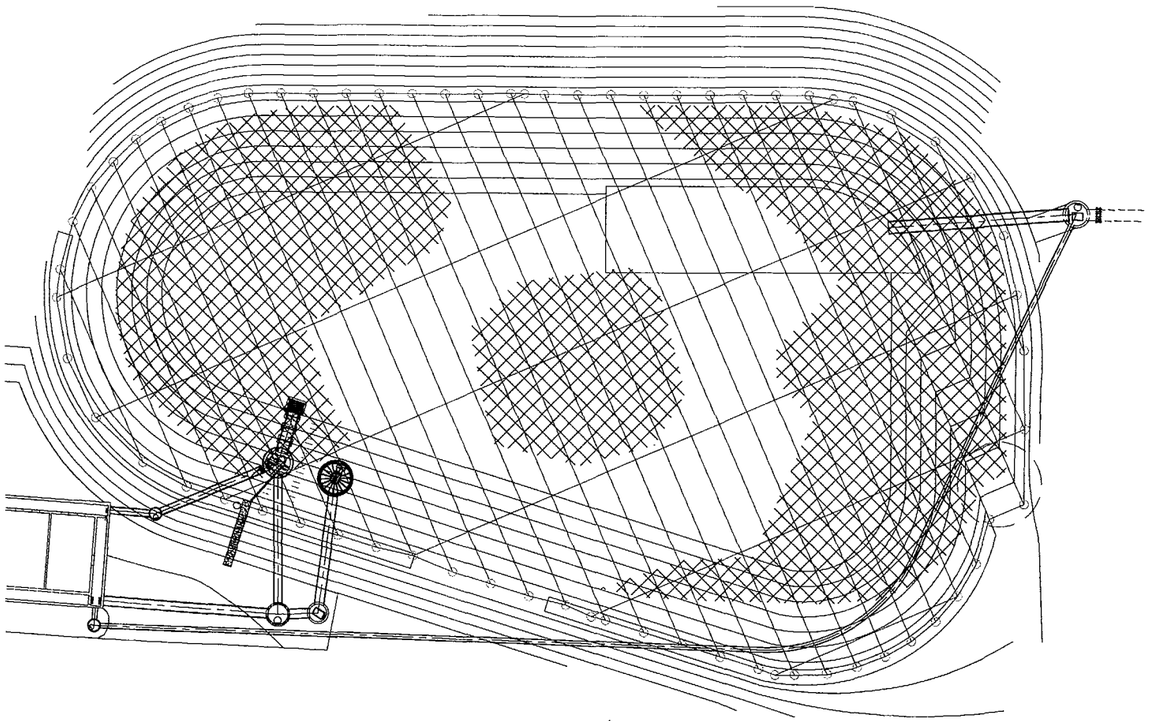
F. Netting slack may be taken up by rolling netting around bottom perimeter wire rope prior to attaching or as otherwise approved.

G. Netting shall be attached to the upper perimeter cable at 2-foot intervals by positioning cable inside a clip hinge, rolling netting twice, and snapping clip shut around rolled netting.

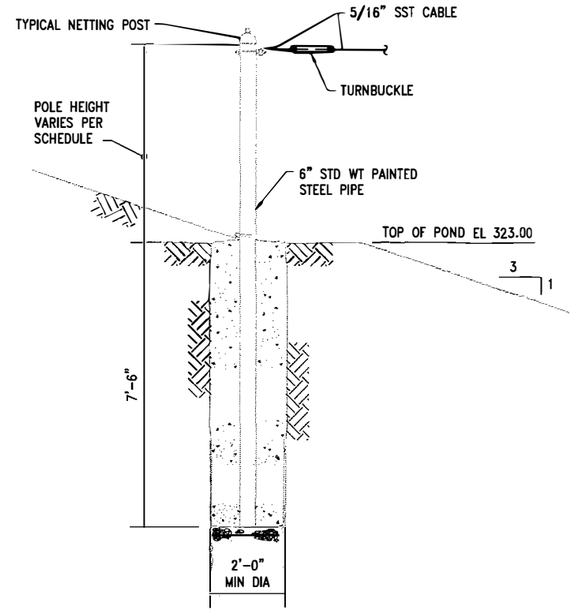
H. Netting shall be secured to cables using hog rings at regular intervals. If netting is obtained in panels, panels shall be lapped a minimum of 12 inches. Splice shall be secured with twine at 2-inch intervals.

I. Wire rope hardware which makes sharp contact with netting shall be protected by covering with a weatherproof protective cover.

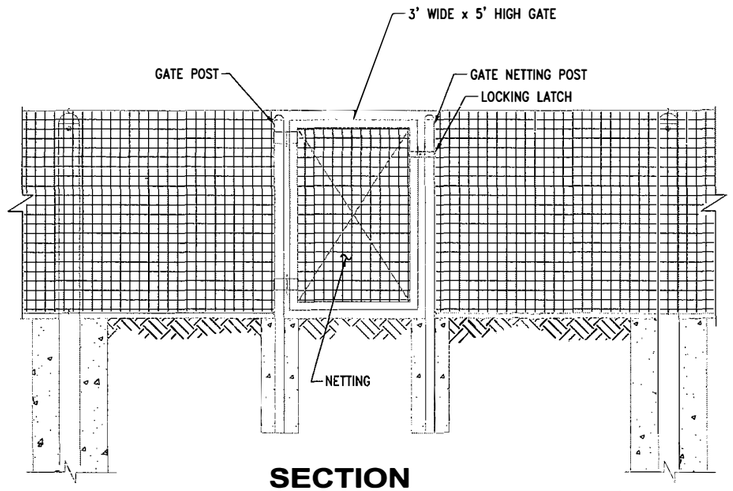
Figure III-D.1 provides details of a typical bird netting system. The engineer shall specify the steel support posts, wire rope cables, miscellaneous hardware, concrete and concrete mix, embedment depth of the steel posts, and any other specifications to address the specific needs of the proposed project.



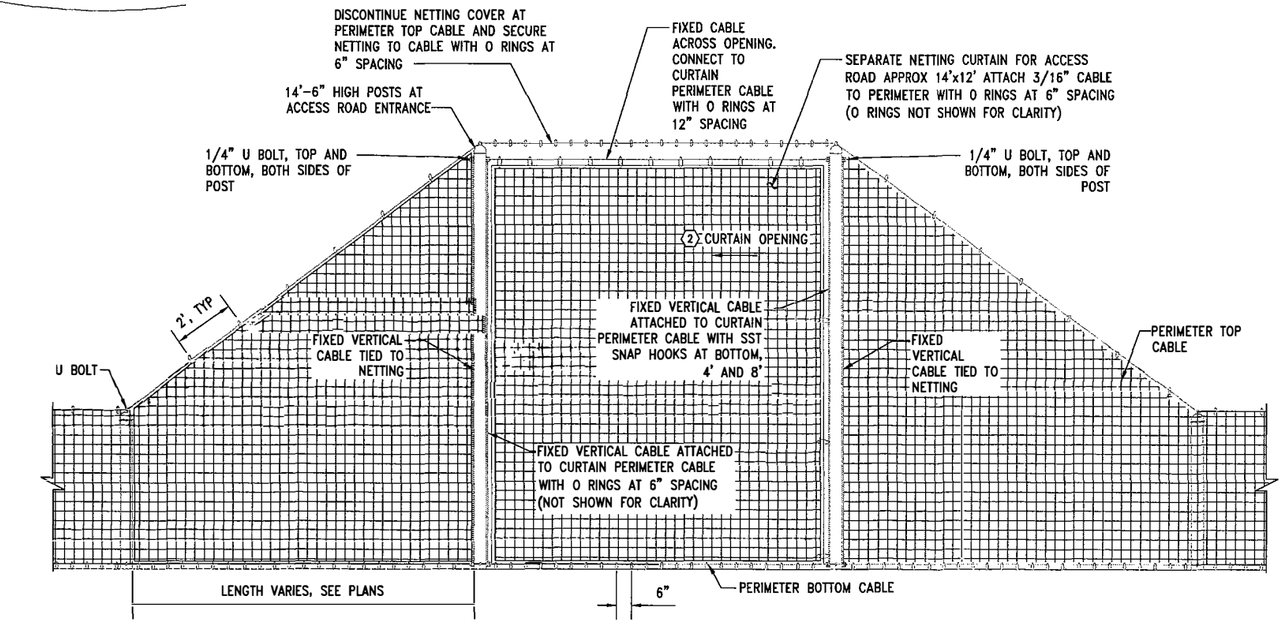
TYPICAL PLAN
SCALE: 1"=60'-0"



SECTION
NETTING POST FOUNDATION
SCALE: 1/4" = 1'-0"



SECTION
PERSONNEL ACCESS GATE
SCALE: 1/4" = 1'-0"



DETAIL
ACCESS ROAD
ENTRANCE CURTAIN
SCALE: NTS

Figure III-D.1
Pond Cover System
Plan and Details
Design Manual
Port of Seattle

R·W·BECK

Volume IV
Source Control BMPs

Stormwater Management Manual for Port Aviation Division Property

Port of Seattle Aviation Division

Revisions and Addenda

Volume IV of this Manual references Volume IV of the Ecology Manual in its entirety, with the following addition. Users should refer to this Manual and the Ecology Manual for requirements related to source control design and implementation.

The following addition should be referenced by project proponents when selecting and implementing source control Best Management Practices (BMPs) at STIA.

IV-1.4 Operational and Source Control BMPs

Add after the third paragraph	If new construction is located in exterior weather-exposed area over hard surfaces, and includes copper, galvanized steel, or zinc in any other form, obtain concurrence from the Port for the specified materials use and coatings to prevent copper, zinc, or other potential metals contamination of stormwater entering the drainage system at the STIA. Alternatively, specify alternative materials consistent with Ecology-approved source control BMPs in Volume IV. Lead is not permitted in any material applications.

Volume V
Runoff Treatment BMPs

Stormwater Management Manual for Port Aviation Division Property

Port of Seattle Aviation Division

Revisions and Addenda

Volume V of this Manual references Volume V of the Ecology Manual with the following modifications. Users should refer to this Manual and the Ecology Manual for requirements related to runoff treatment BMP design.

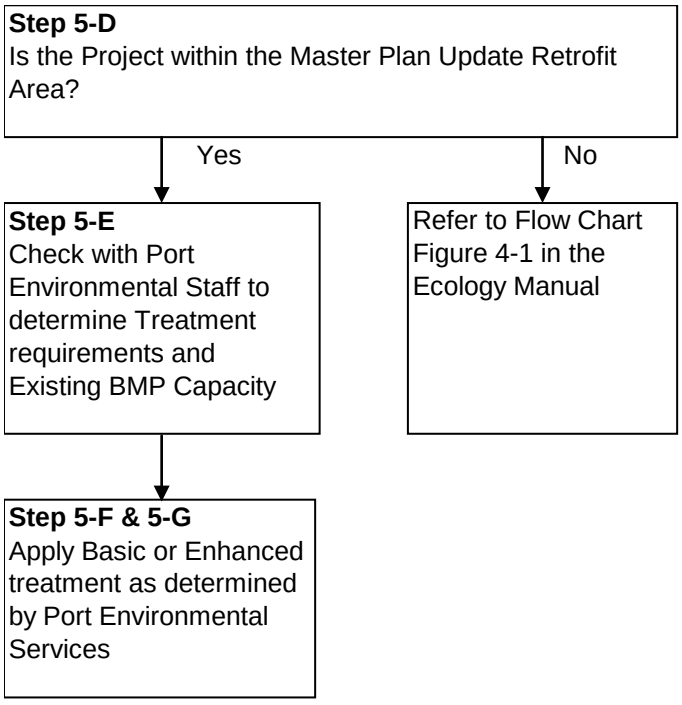
V-2.1 Step by Step Selection Process for Treatment Facilities

Delete this section in its entirety and replace with the following text:

Note: This step-by-step process also appears in Volume I, Chapter 4 of this Manual.

Please refer to Figure V-2.1.2. Then use the treatment facility selection flow chart in Figure V-2.1.1 of the Ecology Manual to determine the type of treatment facilities applicable to the project.

Figure V-2.1.2. STIA Runoff Treatment Facility Selection



Step 5-A. Determine the Receiving Waters and Pollutants of Concern Based on Off-Site Analysis. To obtain a more complete determination of the potential impacts of a stormwater discharge, an Off-Site Analysis as discussed in Chapter 2 of Volume I (Section 2.6.2) shall be performed. Determine the natural receiving waters for the stormwater drainage from the project site (groundwater, wetland, lake, stream, salt water). This is necessary to determine the applicable treatment menu from which to select treatment facilities. If the discharge is to the local municipal storm drainage system, the receiving waters for the drainage system must be determined.

Off-site Analysis is not required within the Retrofit Area, but the Port may require it for projects on Port properties beyond the Retrofit Area. Consult with Port Environmental to determine that need for this analysis considering basin-specific areas modified by the project

The project proponent shall verify whether any type of water quality management plans and/or local ordinances or regulations have established specific requirements for the receiving waters. Examples of plans to be aware of include:

- Watershed or Basin Plans: These can be developed to cover a wide variety of geographic scales (e.g., Water Resource Inventory Areas, or subbasins of a few square miles). They can be focused solely on establishing stormwater requirements (e.g., "Stormwater Basin Plans"), or can address a number of pollution and water quantity issues, including urban stormwater (e.g., Puget Sound Non-Point Action Plans).
- Water Clean-Up Plans: These plans establish a Total Maximum Daily Load (TMDL) of a pollutant or pollutants in a specific receiving water or basin, and to identify actions necessary to remain below that maximum loading. These plans may identify discharge limitations or management limitations (e.g., use of specific treatment facilities) for stormwater discharges from new and redevelopment projects.
- Ground Water Management Plans (Wellhead Protection Plans): To protect ground water quality and/or quantity, these plans may identify actions required of stormwater discharges.
- Lake Management Plans: These plans are developed to protect lakes from eutrophication due to inputs of phosphorus from the drainage basin. Control of phosphorus from new development is a likely requirement in any such plans.

An analysis of the proposed land use(s) of the project should also be used to determine the stormwater pollutants of concern. Table 4-1 lists the pollutants of concern from various land uses. Refer to Tables 4-2 and 4-3 for treatment options within the STIA Retrofit Area. See Figure 2.1.1 of Volume V for treatment options outside the STIA Retrofit Area. Review these treatment options after determining which treatment requirements apply to the project. Those decisions are made in the steps below.

Step 5-B: Determine if an Oil Control Facility/Device is Required. The use of oil control devices and facilities is dependent upon the specific land use proposed for development.

Oil Control facilities at STIA are required for "high-use sites" as defined by project-specific criteria included in this section

Where Applied: The Oil Control Menu (see Volume V, Section 3.2 for more details) applies to projects that have "high-use sites." High-use sites are those that typically generate high concentrations of oil due to high traffic turnover or the frequent transfer of oil. High-use sites include:

- An area of a commercial or industrial site subject to an expected average daily traffic (ADT) count equal to or greater than 100 vehicles per 1,000 square feet of gross building area.
- An area of a commercial or industrial site subject to petroleum storage and transfer in excess of 1,500 gallons per year, not including routinely delivered heating oil. Some examples are discussed below:
- An area of a commercial or industrial site subject to parking, storage or maintenance of 25 or more vehicles that are over 10 tons gross weight (trucks, buses, trains, heavy equipment, etc.). Some examples are discussed below:

  In general, all-day parking areas are not intended to be defined as high use sites, and should not require an oil control facility.

- A road intersection with a measured ADT count of 25,000 vehicles or more on the main roadway and 15,000 vehicles or more on any intersecting roadway, excluding projects proposing primarily pedestrian or bicycle use improvements.

  The traffic count can be estimated using information from "Trip Generation," published by the Institute of Transportation Engineers, or from a traffic study prepared by a professional engineer or transportation specialist with experience in traffic estimation. See: http;//www.ite.org/.

- The following land uses may have areas that fall within the definition of "high use sites" and require oil treatment. Further, these sites require special attention to the oil control treatment selected. Refer to Volume V, Section 3.2 for more details.
  - Industrial machinery and equipment areas
  - Aircraft maintenance areas
  - Fueling stations
  - Vehicle maintenance and repair sites
  - Construction businesses (paving, heavy equipment storage and maintenance, storage of petroleum products)

If oil control is required for the site, please refer to the General Requirements in Chapter 4 of Volume V. The general requirements may affect the design and placement of facilities on the site (e.g., flow splitting). Then see Chapter V-11 of the Ecology Manual for guidance on the proper selection of options and design details for oil-water separators.

If an Oil Control Facility is required, select and apply an appropriate Oil Control Facility. Please refer to the Oil Control Menu in Section 3.2 of Volume V. After selecting an Oil Control Facility, proceed to Step 5-C.

If an Oil Control Facility is not required, proceed directly to Step 5-C.

Step 5-C. Determine if Infiltration for Pollutant Removal is Practicable. Refer to the infiltration treatment design criteria in the Site Suitability Criteria SSC in Section 3.3.7 of Volume III. Also refer to STIA-specific FAA regulations and other infiltration limitations along with LID BMPs technical feasibility criteria in the STIA Stormwater LID Guideline.

Infiltration can be effective at treating stormwater runoff, but soil properties must be appropriate to achieve effective treatment. This effectiveness is discussed in *SSC-6 Soil Physical and Chemical Feasibility* for Treatment.

The infiltration facility must also be checked to ensure that it does not adversely impact ground water resources. These are discussed in:

Infiltration facilities at STIA should be initially evaluated based on criteria and findings in the *STIA Infiltration Feasibility Assessment*. Project-specific infiltration facilities evaluation and testing may also be required.

- SSC-2 Ground Water Protection Areas
- SSC-5 Depth to Bedrock, Water Table, or Impermeable Layer
- SSC-1 Setback Criteria

These suitability criteria check the location and depth to bedrock, the water table, or impermeable layers (such as glacial till), and the proximity to wells, foundations, and septic tank drainfields.

Unstable slopes can preclude the use of infiltration (discussed in *SSC-7 Seepage Analysis and Control*).

Infiltration treatment facilities must be preceded by a pretreatment facility, such as a presettling basin or vault, to reduce the occurrence of plugging. An oil/water separator may serve for pre-settling if it is also necessary for oil control. More frequent maintenance would be necessary to remove solids. Any of the basic treatment facilities, and detention ponds designed to meet flow control requirements, can also be used for pre-treatment (See Chapter 4 of Volume V).

If infiltration is planned, refer to the General Requirements in Chapter 4 of Volume V. These requirements may affect the design and placement of facilities on your site. Infiltration through soils that do not meet the site suitability criteria SSC-6 in Section 3.3.7 of Volume III is allowable as a flow control BMP. Use of infiltration through such soils is acceptable provided:

- The flow control only infiltration facility is not within ¼ mile of a phosphorus-sensitive receiving water.

  When flow control only infiltration facility is within ¼ miles of a phosphorus-sensitive water body, phosphorus treatment is required. Refer to the phosphorus

treatment menu in Section 3.3 of Volume V for the special treatment needed prior to infiltration.

- The flow control only infiltration facility is not within ¼ mile of a fresh water body designated for aquatic life use or that has an existing aquatic life use.
- Note: When flow control only infiltration facility is within ¼ mile of such a fresh water body, enhanced treatment is required as described in Step 5-G.
- The appropriate level of treatment for the land use precedes the infiltration. Refer to Step 5-E for the treatment needed prior to infiltration.

Infiltration can also be used as part of other treatments and flow control measures. For example, infiltration through the bottom of a detention/retention facility for flow control can also help reduce direct discharge volumes to streams and reduce the size of the facility.

If infiltration is practicable, select and apply pretreatment and an infiltration facility.

If infiltration is not practicable, proceed to Step 5-D.

Step 5-D. Determine if the Project is within the STIA Retrofit Area. Refer to Figure 1-1 to determine if the project is within the STIA Retrofit Area.

If the project is within the STIA Retrofit Area, proceed to Step 5-E.

If the project is not within the STIA Retrofit Area, consult the current Department of Ecology Stormwater Management Manual.

Step 5-E. Consult Port Environmental Staff to determine Treatment Requirements and BMP Capacity. Consult with Port Environmental to determine if water quality treatment requirements are for basic or enhanced treatment. Also determine if downstream facilities have capacity that can be utilized.

If Basic Treatment is required proceed to Step 5-F.

If Enhanced Treatment is required proceed to Step 5-G.

Step 5-F. Select a Basic Treatment Facility. Refer to the Basic Treatment Menu in Volume V, Section 3.5. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

Consult with Port Environmental to determine whether downstream treatment facilities have capacity to be used, and if not, whether the project requires basic or enhanced treatment facilities use

After selecting a Basic Treatment Facility, refer to the General Requirements in Chapter 4 of Volume V. These requirements may affect the design and placement of the facility on the site.

For guidance on additional factors that can affect treatment facility selection, refer to Section 2.2 of Volume V.

If the project is part of a larger planned development of adjacent areas that will benefit from a regional of subbasin treatment approach, consult with Port Environmental.

You have completed the treatment facility selection process. Proceed to Step 6.

5-G. Select an Enhanced Treatment Facility. Refer to the Enhanced Treatment Menu in Volume V, Section 3.4 to select an appropriate Enhanced Treatment facility. Select an option from the menu after reviewing the applicability and limitations, site suitability, and design criteria of each for compatibility with the site.

If you have selected an Enhanced Treatment facility, refer to the General Requirements in Chapter 4 of Volume V. These requirements may affect the design and placement of the facility on the site.