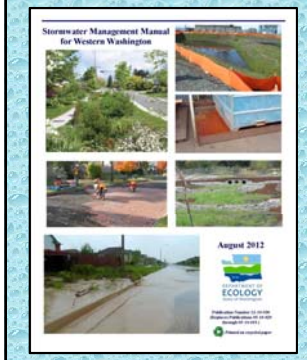
DEPARTMENT OF ECOLOGY State of Washington

2012 Stormwater Management Manual for Western Washington (SWMMWW)



WELCOME

Overview Training
March – May 2013

http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

1

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

2

DEPARTMENT OF ECOLOGY State of Washington

Workshop Handouts

Training Website

- Today's agenda
- Today's PowerPoint Presentation
- Errata for the 2012 SWMMWW
- Excerpt of Volume II BMPs by SWPPP Element Tables
- Excerpt Volume I Threshold Figures
- Cross references between the Muni Permits and the 2012 SWMMWW
- Focus on the 2012 SWMMWW
- Workshop Evaluation Form

SWMMWW Website

- Response to Comments on the Draft 2012 SWMMWW
- Spreadsheet of Changes from the 2005 to 2012 SWMMWW

3

DEPARTMENT OF ECOLOGY State of Washington

Helpful Websites

SWMMWW 2012 Website
http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

Workshop Website
http://www.ecy.wa.gov/programs/wq/stormwater/municipal/EcyWorkshops.html

DEPARTMENT OF ECOLOGY State of Washington

LID Training and Assistance Plan

Legislature funding LID training - $1 M for 5 years

- Ecology working with: AWC, WSAC, BIAW, AWB, Environmental Groups & WA Stormwater Center
- Local govts – engineering review and maintenance
- Building industry – design and construction

2013 training

- Develop 5 year training plan
- Additional WWHM trainings
- Additional operations & maintenance for LID BMPs trainings
- Elected officials, landscapers / nurseries, compost providers, and realtors trainings

5

DEPARTMENT OF ECOLOGY State of Washington

Objectives of the Manual

Provide Technical Guidance	Control Quality & Quantity of Runoff	Protect Water Quality

Why revise the Manual?

Low Impact Development	Match Current Permit Language	Improve Clarity of Existing Guidance

6

DEPARTMENT OF ECOLOGY State of Washington

Manual Revision Public Involvement Process

LID Advisory Process for Western WA
2009 - 2010

Listening Sessions
August - September 2010

Preliminary Draft LID Comment Period
May - June 2011

Formal Public Comment Period
November 4, 2011 - February 3, 2012

Final Manual & Response to Comments
August 1, 2012

Overview Trainings on Final Manual
March – May 2013

Additional Trainings on Final Manual
Possibly in March 2014

7

DEPARTMENT OF ECOLOGY State of Washington

Municipal Stormwater Permit Timelines

Adopt new site & subdivision stormwater codes → **Phase I:** June 30, 2015 → Phase II: December 31, 2016*

Review and revise development-related codes, rules & standards → **Phase I:** June 30, 2015 → **Phase II: December 31, 2016***

*** Or GMA update deadline, whichever is later**

8

DEPARTMENT OF ECOLOGY State of Washington

Western Washington permittees covered under the following permits will be affected:	When the 2012 SWMMWW takes effect for each permit:
Municipal Stormwater Permits	• Phase I - June 30, 2015 • Phase II - December 31, 2016 or GMA update deadline, whichever is later
Industrial Stormwater General Permit (ISGP)	Possibly, upon reissuance of the ISGP (current permit expires January 1, 2015)
Construction Stormwater General Permit (CSWGP)	Possibly, upon reissuance of the CSWGP (current permit expires December 31, 2015)
Sand and Gravel General Permit	Possibly, upon reissuance of the Sand and Gravel General Permit (current permit expires October 1, 2015)
Boatyard General Permit	Possibly, upon reissuance of the Boatyard General Permit (current permit expires May 31, 2016)

9

DEPARTMENT OF ECOLOGY State of Washington

10

DEPARTMENT OF ECOLOGY State of Washington

Volume IV

Source Control BMPs

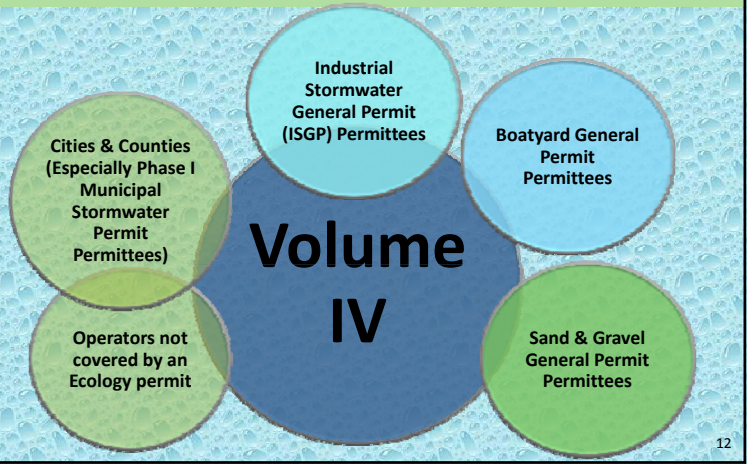
Focus on preventing stormwater pollution

Helps local governments and businesses to control urban sources of both conventional and toxic pollutants in stormwater

11

DEPARTMENT OF ECOLOGY State of Washington

Who cares about Volume IV?



12

DEPARTMENT OF ECOLOGY State of Washington

Main Changes in Volume IV

- Applicable (mandatory)
- Coordinated language with requirements in the general permits
- Revisions for Clarity
- Numbered the BMPs

13

DEPARTMENT OF ECOLOGY State of Washington

Volume IV

- Chapter 1 Introduction
- Chapter 2 Operational and Structural Source Control BMPs
- Appendices
- Chapter 2.1 Applicable (Mandatory) Operational Source Control BMPs
- Chapter 2.2 Pollutant Source-Specific BMPs

14

DEPARTMENT OF ECOLOGY State of Washington

Volume IV – Section 1.3 How to Use this Volume

Entity:	Use Volume IV to:
•ISGP Permittees • Boatyard General Permit Permittees • Sand & Gravel General Permit Permittees	• Identify applicable (mandatory) and recommended operation and structural BMPs. • Develop and implement Stormwater Pollution Prevention Plans (SWPPPs)
Writers of Industrial and Boatyard SWPPPs	**Include Source Control BMPs listed as applicable (mandatory) in SWPPPs**
Local Governments (Phase I Municipal Stormwater Permittees)	May require commercial, industrial, and multifamily properties to use the source control BMPs in Volume IV
Operators of commercial, industrial, and multifamily properties not covered by an Ecology permit	Develop SWPPPs based on local requirements

15

Volume IV – Section 1.6 Distinction Between Applicable BMPs and Recommended BMPs

DEPARTMENT OF ECOLOGY State of Washington

Depending on Permit Type the requirements to use "applicable" source control BMPs varies

- For sites covered under the following permits "applicable" means "mandatory"
  - Industrial Stormwater General Permit
  - Boatyard General Permit
- Sites under the follow permit must use BMPs to achieve AKART and compliance with stormwater discharge limits
  - Sand and Gravel General Permit
- Equivalent manuals must include the "applicable" BMPs (or equivalent BMPs)
  - Phase I Cities & Counties

16

Volume IV – Chapter 2 Selection of Operational & Structural Source Control BMPs

DEPARTMENT OF ECOLOGY State of Washington

Under the ISGP

If sampling triggers a corrective action

Operators should consider

Level 1 (operational) BMPs | Level 2 (structural) BMPs

To fulfill permit requirements & reduce pollution concentrations

17

Volume IV – Section 1.5 Treatment BMPs for Specific Pollutants

DEPARTMENT OF ECOLOGY State of Washington

Required to install additional treatment BMPs to comply with the ISGP?

Also Consider:

- Additional Source Control BMPs in Volume IV
- Treatment BMPs in Volume V
- Turbidity & Sediment Control BMPs in Volume IV

18

Volume IV – Section 2.1 Applicable (Mandatory) Operational Source Control BMPs

DEPARTMENT OF ECOLOGY State of Washington

Section 2.1 Revised and Added BMPs

Applicable (Mandatory) BMPs

- Vacuum sweeping quarterly
- Do not connect floor drains to storm drains, surface water, or ground

Additional good housekeeping BMPs

- Promptly repair/replace/reseal damaged paved areas
- Pressure wash impervious surfaces and properly dispose of washwater

Recommended Additional BMPs

- Locate spill kits within 25 ft of fueling/fuel transfer areas
- Provide secondary containment for all chemical liquids, fluids, & petroleum products
- Complete monthly inspections and keep records on site

19

Volume IV – Section 2.2 Pollutant Source Specific BMPs

DEPARTMENT OF ECOLOGY State of Washington

Revised and Added BMPs

S401 BMPs for the Building, Repair, and Maintenance of Boats and Ships

- Revised language to refer to the Boatyard General Permit & ISGP
- New applicable operational BMP about boat washing

S403 BMPs for Commercial Composting

- Removed outdated references

20

Volume IV – Section 2.2 Pollutant Source Specific BMPs

DEPARTMENT OF ECOLOGY State of Washington

S405 BMPs for Deicing and Anti-icing Operations – Airports & Streets

New applicable BMPs for Airport Runways / Taxiways

- Avoid excessive application of de/anti-icing chemicals, which could contaminate stormwater
- Store & transfer de/anti icing materials on an impervious containment pad and/or under cover

New Recommended Additional BMPs for Airport Runways / Taxiways

- Include limits on toxic materials and phosphorous in the specifications for de/anti-icers
- Use anti-icing materials rather than deicers if it will result in less adverse environmental impact
- Select cost-effective de/anti-icers that cause the least adverse environmental impact

21

Volume IV – Section 2.2 Pollutant Source Specific BMPs

DEPARTMENT OF ECOLOGY State of Washington

Revised and Added BMPs

S414 BMPs for Maintenance & Repair of Vehicles & Equipment

- New Applicable Operational BMP – remove liquids from vehicles retired for scrap
- Listed specific additional applicable BMPs

S424 BMPs for Roof/Building Drains at Manufacturing & Commercial Buildings

- New Applicable Operational BMP – sweep the area routinely to remove any zinc residuals
- New Applicable Structural Source Control BMP – Paint/coat galvanized surfaces per Ecology publication #08-10-025

Volume IV – Section 2.2 Pollutant Source Specific BMPs

DEPARTMENT OF ECOLOGY State of Washington

Revised and Added BMPs

S431 BMPs for Washing & Steam Cleaning Vehicles / Equipment / Building Structures

- Revised guidance to clarify that the ISGP prohibits the discharge of processed wastewater to ground water or surface water
- Removed Figure 2.15 Uncovered Wash Area

New S433 BMPs for Pools, Spas, Hot Tubs & Fountains

- New description of pollutant source
- New applicable operational BMPs
- New applicable structural source control BMPs

Volume IV – Appendices

DEPARTMENT OF ECOLOGY State of Washington

Appendix IV-A – Commercial Composting (SIC 2875)

- New potential pollutant generating sources

Appendix IV-B

- Removed outdated Table

Appendix IV-E NPDES Stormwater Discharge Permits:

- Edits to make guidance consistent with municipal and industrial stormwater permits

Appendix IV-G Street Waste:

- Minor revisions for clarity
- Reorganized the disposal of street waste liquids section

DEPARTMENT OF ECOLOGY State of Washington

Questions?

25

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

26

DEPARTMENT OF ECOLOGY State of Washington

Volume II
Construction Stormwater Pollution Prevention

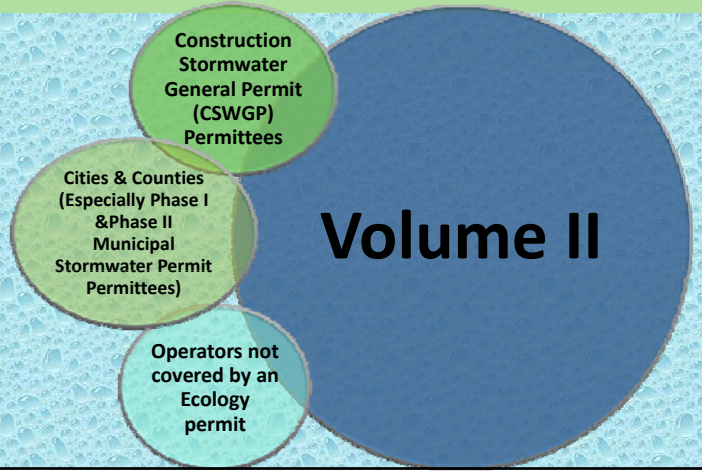
Managing stormwater impacts from construction activities

Helps site operators create Construction Stormwater Pollution Prevention Plans (SWPPPs)

27

DEPARTMENT OF ECOLOGY State of Washington

Who cares about Volume II?



28

DEPARTMENT OF ECOLOGY State of Washington

Volume II

Chapter 1 Introduction	Chapter 2 Regulatory Requirements	Chapter 3 Planning • Steps to produce a Construction SWPPP • Section 3.3.3 Describes Construction SWPPP Elements	Chapter 4 Best Management Practices (BMPs) Standards & Specifications • Section 4.1 Source Control BMPs • Section 4.2 Runoff Conveyance & Treatment BMPs	Resources & Appendices

29

DEPARTMENT OF ECOLOGY State of Washington

Volume II – Construction SWPPPs

A Construction SWPPP is required if the construction project:

- Must have coverage under the CSWGP
- Meets certain thresholds & is in an area covered by a municipal stormwater permit
- Is a significant contributor of pollutants to waters of the state
- Is located in an area where the local permitting authority requires a Construction SWPPP

30

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #2

Prepare a Construction Stormwater Pollution Prevention Plan (SWPPP)

- **Added new Element #13 to protect LID BMPs / facilities**
- **Updated language for consistency with the CSWGP**

DEPARTMENT OF ECOLOGY State of Washington

Construction SWPPPs have to include 12 (13) Elements:

#1 Preserve Vegetation / Mark Clearing Limits	#2 Establish Construction Access	#3 Control Flow Rates	#4 Install Sediment Control
#5 Stabilize Soils	#6 Protect Slopes	#7 Protect Drain Inlets	#8 Stabilize Channels & Outlets
#9 Control Pollutants	#10 Control De-Watering	#11 Maintain BMPs	#12 Manage the Project

#13 Protect Low Impact Development ← **New Element Not required by the CSWGP**

32

DEPARTMENT OF ECOLOGY State of Washington

Source Control BMPs (Volume II)

Table 4.1.1: Source Control BMPs by SWPPP Element

BMP or Element Name	Element #1 Preserve Vegetation/Mark Clearing Limits	Element #2 Establish Construction Access	Element #5 Stabilize Soils	Element #6 Protect Slopes	Element #8 Stabilize Channels and Outlets	Element #9 Control Pollutants	Element #11 Maintain BMPs	Element #12 Manage the Project	Element #13 Protect Low Impact Development
BMP C101: Preserving Natural Vegetation	✓								
BMP C102: Buffer Zones	✓								✓
BMP C103: High Visibility Plastic or Metal Fence	✓								✓
BMP C105: Stabilized Construction Entrance / Exit		✓							
BMP C106: Wheel Wash		✓							
BMP C107: Construction Road/Parking Area Stabilization		✓							
BMP C120: Temporary and Permanent Seeding			✓	✓					
BMP C121: Mulching			✓	✓					
BMP C122: Nets and Blankets			✓	✓	✓				
BMP C123: Plastic Covering			✓						
BMP C124: Sodding			✓						
BMP C125: Topsoiling / Composting			✓						
BMP C126: Polyacrylamide for Soil Erosion Protection			✓						

Runoff Conveyance & Treatment BMPs (Volume II)

Table 4.2.1: Runoff Conveyance and Treatment BMPs by SWPPP Element

BMP or Element Name	Element #3 Control Flow Rates	Element #4 Install Sediment Controls	Element #6 Protect Slopes	Element #7 Protect Drain Inlets	Element #8 Stabilize Channels and Outlets	Element #9 Control Pollutants	Element #10 Control De-Watering	Element #13 Protect Low Impact Development
BMP C200: Interceptor Dike and Swale			✓					✓
BMP C201: Grass-Lined Channels			✓					✓
BMP C202: Channel Lining					✓			
BMP C203: Water Bars	✓		✓				✓	
BMP C204: Pipe Slope Drains			✓					
BMP C205: Subsurface Drains			✓					
BMP C206: Level Spreader			✓				✓	
BMP C207: Check Dams	✓		✓		✓			✓
BMP C208: Triangular Silt Dike (Geotextile Encased Check Dam)			✓					✓
BMP C209: Outlet Protection	✓				✓			
BMP C220: Storm Drain Inlet Protection				✓				
BMP C231: Brush Barrier		✓						✓
BMP C232: Gravel Filter Berm		✓						

DEPARTMENT OF ECOLOGY State of Washington

Element #1 Preserve Vegetation / Mark Clearing Limits

BMP C102: High Visibility Plastic or Metal Fence

- Added high visibility silt fencing

35

DEPARTMENT OF ECOLOGY State of Washington

Element #2 Establish Construction Access

BMP C105: Stabilized Construction Entrance

- Construction entrances at each residence
- Do not use crushed concrete

BMP C106: Wheel Wash

- Do not discharge wheel wash water to surface or ground water

36

DEPARTMENT OF ECOLOGY State of Washington

Element #3 Control Flow Rates

BMP C207: Check Dams

- When installing check dams impound & bypass upstream water flow away from the work area

BMP C235: Wattles

- Expanded this section to include other types of wattles beyond straw

37

DEPARTMENT OF ECOLOGY State of Washington

Element #4 Install Sediment Controls

BMP C250: Construction Stormwater Chemical Treatment

- Only use chemicals approved per Ecology's Chemical Technology Assessment Protocol (CTAPE)
- Revised guidance for Polymer Batch Treatment
- Revised sizing criteria for chemical treatment systems

BMP C251: Construction Stormwater Filtration

- Revised sizing criteria for filtration treatment systems

38

DEPARTMENT OF ECOLOGY State of Washington

Element #5 Stabilized Soils

BMP C120: Temporary and Permanent Seeding

- Revised & emphasized seeding times
- Don't use plastic sheeting over seeded areas

BMP C121: Mulching

- Increase mulch thickness until ground is not visible
- Added wood straw & wood strand mulch

BMP C125: Topsoiling / Composting

- Revised to include composting
- Specified organic content

Text shifts between BMPs

39

DEPARTMENT OF ECOLOGY State of Washington

Element #5 Stabilize Soils & Element #6 Protect Slopes

BMP C123: Plastic Covering

- Mitigate increased runoff volumes & velocities
- Tie bags together instead of staking

BMP C124: Sodding

- Revised compost guidance

40

DEPARTMENT OF ECOLOGY State of Washington

Element #7 Protect Drain Inlets

BMP C220: Storm Drain Inlet Protection

- Provide inlet protection for lawn & yard drains during construction

Element #8 Stabilize Channels and Outlets

Only change was to BMP C207: Check Dams

41

DEPARTMENT OF ECOLOGY State of Washington

Element #9 Control Pollutants

BMP C151: Concrete Handling

- Refer to the CSWGP for pH monitoring requirements
- Use forms for concrete pours within 15-feet of surface waters

BMP C154: Concrete Washout Area

- Do not washout concrete trucks onto the ground, or in storm drains, ditches, streets, or streams

42

DEPARTMENT OF ECOLOGY State of Washington

Element #9 Control Pollutants

BMP C252: High pH Neutralization Using Co_2 & BMP C253: pH Control for High pH Water

New

- Causes of high pH
- Reasons for pH Neutralization
- Treatment Process
- Disposal methods: infiltrate, disperse, or send to sanitary sewer or concrete batch plant

43

DEPARTMENT OF ECOLOGY State of Washington

Element #10 Control De-Watering

BMP C236: Vegetative Filtration

- This BMP provides guidance on how best to use vegetated areas to filter turbid stormwater or dewatering water

44

DEPARTMENT OF ECOLOGY State of Washington

Element #11 Maintain BMPs
Element #12 Manage the Project

BMP C150: Materials on Hand

- Base measures and quantities on the size of the construction site

BMP C160: Certified Erosion and Sediment Control Lead

- Removed CESCL training and certification guidance – Ecology planning to update this in a separate document

45

DEPARTMENT OF ECOLOGY State of Washington

Element #13 Protect Low Impact Development

New Element #13

- **Added to Minimum Requirement #2**
- Required by the Municipal Stormwater Permits
- Install/maintain erosion & sediment control BMPs to protect bioretention, rain gardens, and permeable pavement BMPs

DEPARTMENT OF ECOLOGY State of Washington

Element #13 Protect Low Impact Development

New Element #13

- Fully restore BMPs if they accumulate sediment during construction
- Keep construction equipment and foot traffic off bioretention, rain garden, & permeable pavement BMPs

DEPARTMENT OF ECOLOGY State of Washington

Element #13 Protect Low Impact Development

New Element #13

- Keep muddy equipment off pavement or base material
- Keep runoff off permeable pavements
- Keep heavy equipment off final grades (don't compact it)

DEPARTMENT OF ECOLOGY State of Washington

Removed BMPs

- BMP C103: Stake and Wire Fence
- BMP C180: Small Project Construction Stormwater Pollution Prevention
- BMP C230: Straw Bale Barrier

49

DEPARTMENT OF ECOLOGY State of Washington

50

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

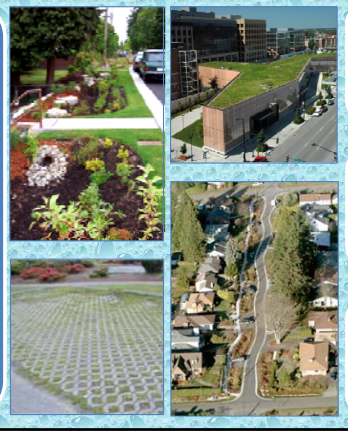
51

Volume I – Section 2.3 Definitions

DEPARTMENT OF ECOLOGY State of Washington

Low Impact Development

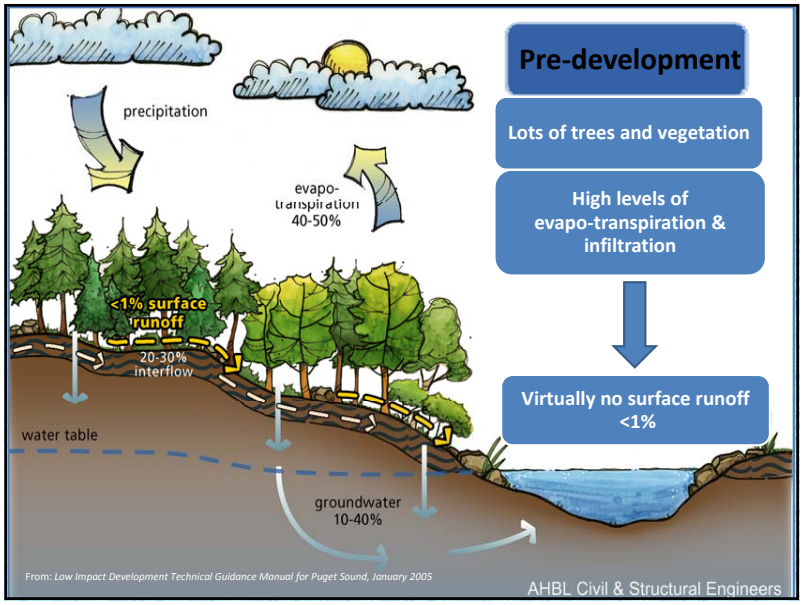
Allows stormwater to flow vertically into the ground, rather than horizontally as runoff

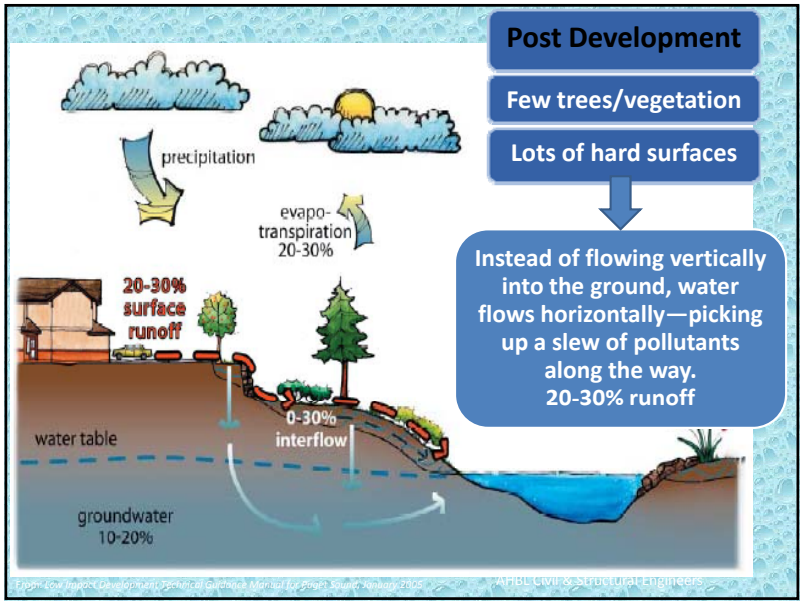


Applies at the parcel and subdivision scale

Uses on-site natural features

Integrates small-scale engineered controls

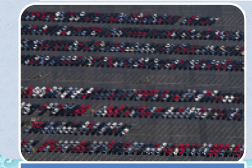




Volume I – Section 2.3 Definitions

DEPARTMENT OF ECOLOGY State of Washington

Hard Surface



Impervious Surfaces

Pervious Pavements

Vegetated (Green) Roofs

Pollution-Generating Hard Surface (PGHS)

- PGIS, PG pervious pavements
- Vehicle use, industrial activities, material storage

55

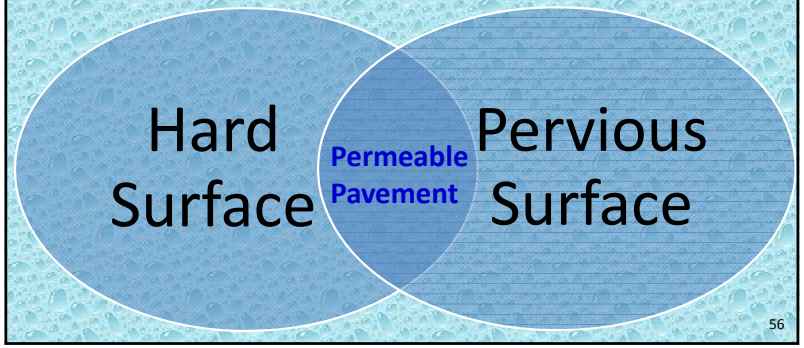
Volume I – Section 2.3 Definitions

DEPARTMENT OF ECOLOGY State of Washington

Pervious Surface

Pervious Surfaces

- Pollution-generating pervious surfaces (PGPS)



56

Volume I – Section 2.3 Definitions

DEPARTMENT OF ECOLOGY State of Washington

Bioretention vs. Rain Garden

Bioretention

- Engineered Soil Mixture
- LID Performance Standard
- Use For Projects Triggering Minimum Requirements #1-9

Retain & Pass Stormwater through a soil mixture

Rain Garden

- Use For Projects Triggering Minimum Requirements #1-5

57

Volume I – Section 2.4 Project Thresholds

DEPARTMENT OF ECOLOGY State of Washington

When are stormwater requirements triggered?

Depends upon size of project → Amount of hard surfaces → Extent of land disturbed

58

Volume I – Section Figure 2.4.1

DEPARTMENT OF ECOLOGY State of Washington

New Development Thresholds

Min. Requirements #1 - # 9:

- ≥ 5,000 sq. ft. new and replaced hard surface area, or
- ≥ 3/4 acre vegetation to lawn/landscape, or
- ≥ 2.5 acres native vegetation to pasture

Min. Requirements #1 - #5:

- ≥ 2,000 sq. ft. new and replaced hard surface area, or
- ≥ 7,000 sq. ft. land disturbance

Min. Requirement #2 -Erosion control

- All projects (No submittal for projects < 2,000/7,000)

59

Volume I – Section Figure 2.4.2

DEPARTMENT OF ECOLOGY State of Washington

Redevelopment Thresholds

New hard surface or converted pervious

- Same thresholds as "New Development"

Replaced hard surfaces

- MR #1 - #5 – Same as "New Development"

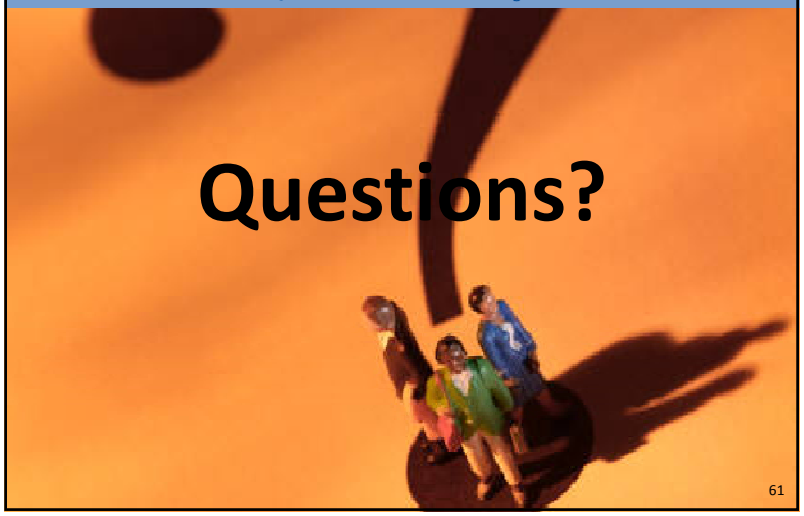
Replaced hard surfaces:
MR #6 - #9 (Treatment and Flow Control) only if:

- New + replaced hard surfaces ≥ 5,000 sq. ft., AND proposed improvements value > 50% of existing improvements value
- For roads, new hard surfaces ≥ 5,000 sq. ft., and ≥ 50% of existing hard surface area

60

DEPARTMENT OF ECOLOGY State of Washington

Questions?



61

Volume I – Section 2.5 Minimum Requirements

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirements

#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

62

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #5 On-site Stormwater Management

Employ On-site Stormwater Management BMPs to infiltrate, disperse, and retain stormwater runoff on-site to the extent feasible

In MSW Permit, LID addressed on 3 levels:

- **Site & subdivision**
- Development Codes
- Watershed Scale

Revisions from the Draft Manual

- BMP Lists #1 and #2
- Infeasibility Criteria now in manual
- Limited applicability in flow control exempt areas

63

Flow Chart for Determining LID MR #5 Requirements

Flow Control Exempt Waters

Does the project discharge to Flow Control Exempt Waters (per Minimum Requirement (MR) #7)?

Yes

REQUIRED: Implement the following BMPs where feasible:

- BMP T5.13: Post-Construction Soil Quality and Depth
- BMP T5.10A, B, or C: Downspout Full Infiltration, Downspout Dispersion Systems, or Perforated Stub-out Connections
- BMP T5.11 or T5.12: Concentrated Flow Dispersion or Sheet Flow Dispersion

NOT REQUIRED: Achievement of the LID Performance Standard. Applying the other BMPs in List #1 or List #2.

No

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit.)

No, the project triggered only MR #2

No additional requirements

Yes

No, the project triggered MRs #1 - #9.

64

Projects subject only to MR #1 - #5

Flow Chart for Determining LID MR #5 Requirements

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit.)

Yes

Did the project developer choose to meet the LID Performance Standard?

No, project developer chose List #1.

REQUIRED: For each surface, consider the BMPs in the order listed in **List #1** for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

Yes

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2012 SWMMWW or the LID Technical Guidance Manual for Puget Sound except for Rain Gardens (the use of Bioretention is acceptable).

REQUIRED for Projects Triggering MR #1-9*: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

DEPARTMENT OF ECOLOGY State of Washington

List #1

Lawn and landscaped areas:

- Soil Quality and Depth (T5.13)

Glacial till: high in runoff and poor turf quality

Same soil with 30% compost added. Up to 50% less runoff. Turf still healthy 4 years later

Photos: UW Test Plots

66

DEPARTMENT OF ECOLOGY State of Washington

List #1

Roofs: Consider in order listed; use first feasible

- **Full Dispersion or Downspout Full Infiltration (T5.30 or T5.10A)**
- **Rain Gardens or Bioretention (T5.14A or B)**
  - **≥ 5% of drainage area**
- **Downspout Dispersion Systems (T5.10B)**
- **Perforated Stub-out Connections (T5.10C)**

67

DEPARTMENT OF ECOLOGY State of Washington

List #1 (Continued)

Other Hard Surfaces (driveways, roads, patios, walks, parking lot) consider in order listed; use first feasible

- **Full Dispersion (T5.30)**
- **Permeable pavement, or Rain Gardens, or Bioretention**
  - **(T5.15, T5.14A, T5.14B)**
  - **Rain Garden or Bioretention area ≥ 5% of drainage area**
- **Sheet Flow Dispersion, or Concentrated Flow Dispersion (T5.12 or T5.11)**

68

DEPARTMENT OF ECOLOGY State of Washington

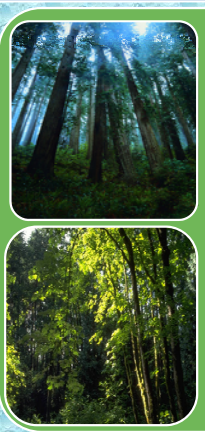
Other Hard Surfaces

Walks / Patios | Driveways | Parking Lots | Roads

69

DEPARTMENT OF ECOLOGY State of Washington

LID Performance Standard



Match post-development discharge durations to pre-developed durations from 8% of the 2-year flow to 50% of the 2-year flow

- **Pre-development generally a forested land cover**

70

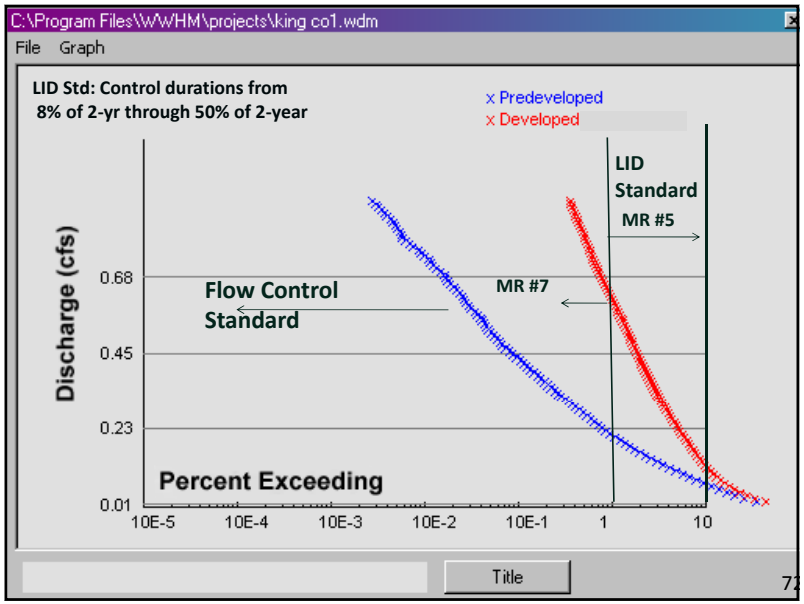
DEPARTMENT OF ECOLOGY State of Washington

LID Performance Standard vs Flow Control Standard

LID Performance Standard addresses the lower, more frequent stormwater flows (8% of 2-year through 50% of the 2-year)

Flow Control Standard addresses the higher, less frequent stormwater flows (50% of the 2-year through the full 50-year)

71



72

DEPARTMENT OF ECOLOGY State of Washington

Projects Triggering MR #1 - #9

Project Type & Location	Requirement
Development (new or redevelopment) on any parcel inside the UGA, or development outside the UGA on a parcel less than 5 acres	LID Performance Standard and BMP T5.13 **OR** List #2 (applicant option)
Development (new or redevelopment) outside the UGA on a parcel of 5 acres or larger	LID Performance Standard and BMP T5.13

73

Flow Chart for Determining LID MR #5 Requirements — Projects subject to MR #1 - #9 inside the UGA

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit.)

No, the project triggered MRs #1 - #9.

Is the project inside the UGA?

Yes

Did the project developer choose to meet the LID Performance Standard?

Yes

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2012 SWMMWW or the LID Technical Guidance Manual for Puget Sound except for Rain Gardens (the use of Bioretention is acceptable).

REQUIRED for Projects Triggering MR #1-9*: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

No, project developer chose List #2.

REQUIRED: For each surface, consider the BMPs in the order listed in **List #2** for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

74

Flow Chart for Determining LID MR #5 Requirements — Projects subject to MR #1 - #9 outside the UGA on < 5 acres

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit.)

No, the project triggered MRs #1 - #9.

Is the project inside the UGA?

No, the project is outside the UGA

Did the project developer choose to meet the LID Performance Standard?

Yes

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2012 SWMMWW or the LID Technical Guidance Manual for Puget Sound except for Rain Gardens (the use of Bioretention is acceptable).

REQUIRED for Projects Triggering MR #1-9*: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

No, project developer chose List #2.

REQUIRED: For each surface, consider the BMPs in the order listed in **List #2** for that type of surface. Use the first BMP that is considered feasible.

NOT REQUIRED: Achievement of the LID Performance Standard.

75

DEPARTMENT OF ECOLOGY State of Washington

List #2

Same as List #1 with two changes:

- Rain Gardens not an option
- Other Hard Surfaces:
  - Permeable Pavement is 2nd priority
  - Bioretention is 3rd priority
- Vegetated roof deleted

76

Flow Chart for Determining LID MR #5 Requirements

Projects subject to MR #1 - #9 outside the UGA on a parcel ≥ 5 acres

Does the project trigger only MRs #1 - #5? (Per Figure 3.2 or Figure 3.3 in Appendix 1 of the 2013-2018 WWA Phase II Permit & Phase I Permit.)

No, the project triggered MRs #1 - #9.

Is the project inside the UGA?

No, the project is outside the UGA

Is the project on a parcel of 5 acres or larger?

Yes

REQUIRED: Meet the LID Performance Standard through the use of any BMP(s) in the 2012 SWMMWW or the LID Technical Guidance Manual for Puget Sound except for Rain Gardens (the use of Bioretention is acceptable).

If the project can't meet the LID Performance Standard, it must be redesigned to meet the LID performance standard or an exception / variance must be approved.

REQUIRED: Apply BMP T5.13 Post-Construction Soil Quality and Depth.

NOT REQUIRED: Applying the BMPs in List #1 or List #2.

DEPARTMENT OF ECOLOGY State of Washington

Questions?

Next: LUNCH!!

After lunch: LID Design & Infeasibility Criteria

78

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

79

DEPARTMENT OF ECOLOGY State of Washington

Manual References for Phase I - S5.C.5.a.ii and Phase II - S5.C.4.a.ii (see handout)

- (a) Site planning requirements (Vol. I, Ch. 3)
- (b) BMP selection criteria (Vol. II - V)
- (c) BMP design criteria (Vol. II – V)
- (d) BMP infeasibility criteria (Vol. III & V)
- (e) LID competing needs criteria (Vol. V)
- (f) BMP limitations (Vol. II – V)

80

DEPARTMENT OF ECOLOGY State of Washington

Volume III vs. Volume V

Volume III
- Hydrologic Analysis
- WWHM
- Detention Facilities
- Design Saturated Hydraulic Conductivity
- Site Suitability Criteria

- BMP Selection, Design, & Infeasibility Criteria
- BMP Limitations

Volume V
- LID Competing Needs Criteria
- Filtration Treatment Facilities
- Wetpool Facilities
- Oil & Water Separators
- Emerging Technologies

81

DEPARTMENT OF ECOLOGY State of Washington

Agenda for this Section

Volume V

LID Competing Needs Criteria

Volume III & Volume V

LID BMP Infeasibility Criteria	LID BMP Limitations & Design Criteria

Volume V – Section 5.3.1 On-Site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

LID Infeasibility Criteria – Competing Needs

Page 5-2, Volume V, of the 2012 SWMMWW

Requirement of the following federal or state laws, rules and standards:

Historic Preservation & Archaeology Laws	Federal Superfund	Washington State Model Toxics Control Act	Federal Aviation Administration for Airports	Americans with Disabilities Act

83

Volume V – Section 5.3.1 On-Site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

LID Infeasibility Criteria – Competing Needs

Page 5-2, Volume V, of the 2012 SWMMWW

Existing local codes may supersede or reduce the LID requirement if:

The LID requirement conflicts with special zoning district design criteria

- Special zoning district design criteria must be adopted & implemented per a community planning process

84

Volume V – Section 5.3.1 On-Site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

LID Infeasibility Criteria – Competing Needs

Page 5-2, Volume V, of the 2012 SWMMWW

On-site Stormwater Management BMPs can be superseded or reduced when in conflict with:

Public health and safety standards	Transportation regulations to maintain the option for future expansion or multi-modal use of public rights-of-way	Local Critical Area Ordinance that provides protection of tree species

85

DEPARTMENT OF ECOLOGY State of Washington

Questions?

Next: LID Infeasibility Criteria & Design Criteria

86

Volume V – Chapter 7 BMPs for Infiltration & Bioretention Treatment

DEPARTMENT OF ECOLOGY State of Washington

Bioretention & Rain Gardens Infeasibility Criteria

See BMP T7.30 Beginning on Page 7-7, Volume V, of the 2012 SWMMWW

Require site Geotech evaluation & written recommendation

- Erosion, slope failure, or flooding
- Threaten pre-existing underground utilities, structures, roads
- No safe overflow pathway
- Threaten existing below grade basements or shoreline structures

87

Volume V – Chapter 7 BMPs for Infiltration & Bioretention Treatment

DEPARTMENT OF ECOLOGY State of Washington

Bioretention and Rain Garden Infeasibility Criteria

Criteria not requiring justification, but possibly professional services

Where not compatible with surrounding drainage system – government decision	Where facility would be in an area designated as an erosion hazard or landslide hazard	Within 10 feet of small on-site disposal drainfield, including reserve areas
On a slope ≥ 8%	Within 50 ft. from top of slopes that are greater than 20% & over 10 ft of vertical relief	Within certain areas with soil or groundwater contamination

88

Volume V – Chapter 7 BMPs for Infiltration & Bioretention Treatment

DEPARTMENT OF ECOLOGY State of Washington

Bioretention and Rain Garden Infeasibility Criteria

Criteria not requiring justification, but possibly professional services

- Within 100 ft. of a closed or active landfill
- Within 100 ft. of a drinking water well, or spring used for drinking water
- Where field testing indicates less than 0.30 in/hr initial infiltration rate
- Where less than the minimum vertical separation to groundwater or other impervious layer

89

Volume V – Chapter 7 BMPs for Infiltration & Bioretention Treatment

DEPARTMENT OF ECOLOGY State of Washington

Design Criteria BMP T7.30 Bioretention Cells, Swales, and Planter Boxes

- Flow Entrance & Presettling
- Bottom Area and Side Slopes
- Ponding Area
- Surface Overflow
- Default Bioretention Soil Media
  - Mineral aggregate & Compost
- Criteria for Custom Bioretention Soil Mixes
- Soil Depth
- Underdrains – optional (not desired)
- Plants
- Mulch
- Installation Procedures
- Maintenance Criteria

90

Volume V – Ch. 7 BMPs for Infiltration & Bioretention

DEPARTMENT OF ECOLOGY State of Washington

Bioretention Monitoring

Performance:

- Significant removal of TSS, Dissolved Zn, F. coli.,
- Removal of some PAHs, Phthalates
- Significant increases of Total P, Ortho P, Dissolved Cu, NO3(short term)

Short Term Management Strategy:

- No underdrains for discharge unless to Basic Treatment Water
- Caution for drinking water wells: setback; cumulative impact

Long-term Strategy:

- Reduce Cu and P thru source control or treatment

91

Volume V – Chapter 7 BMPs for Infiltration & Bioretention Treatment

DEPARTMENT OF ECOLOGY State of Washington

Design Guidelines BMP T7.30 Bioretention Cells, Swales, and Planter Boxes

Methods To Determine Subgrade Infiltration Rates

Method 1:

Small bioretention cells:
- Small-scale Pilot Infiltration Test (PIT)

Large bioretention cells:
- Multiple small or one large scale PIT
- Take small-scale PIT measurements at several locations

Bioretention swales:
- Approx. 1 small-scale PIT per 200 ft. of swale

Method 2 – only useable for sites with outwash soils:

Small bioretention cells:
- Use grain size analysis method in Section 3.3.6 of Volume III based on one soil test pit / boring

Large bioretention cells:
- Use grain size analysis method in Section 3.3.6 of Volume III based on more than one soil test pit / boring

Bioretention swales:
- Approx. 1 soil test pit / boring per 200 ft. of swale

92

Volume V – Chapter 7
BMPs for Infiltration & Bioretention Treatment

DEPARTMENT OF ECOLOGY State of Washington

Design Criteria BMP T7.30 Bioretention Cells, Swales, and Planter Boxes

Methods for Bioretention Soil Infiltration Rate

Default Bioretention Soil Media (Page 7-15)

- 3 inches/hour for design (long-term) rate if drainage area less than
  - 10,000 ft2 impervious surface
  - 5,000 ft2 PGIS
  - ¾ acre lawn/landscape
  - 2.5 acres pasture
- 1.5 inches/hour for design if drainage area exceeds above amounts

Custom Soil Media (Page 7-17)

- Use ASTM D 2434 – Permeability of Granular Soils – as amended
- Use ASTM D 1557 – Lab Compaction of Soil Using Modified Effort
- See Appendix V – B.

93

Volume V – Section 5.3.1
On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

LID Infeasibility Criteria – BMP T5.15 Permeable Pavement

Beginning on Page 5-16, Volume V, of the 2012 SWMMWW

Require site Geotech evaluation & written recommendation

- Erosion, slope failure, or flooding
- Where adjacent impervious pavements compromised
- Threaten below grade basements
- Fill soils that can be unstable when saturated
- Excessively steep slopes meeting certain conditions
- Threaten pre-existing underground utilities tanks, road sub-grades
- Inadequate strength for heavy loads at industrial facilities

94

Volume V – Section 5.3.1
On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

LID Infeasibility Criteria – BMP T5.15 Permeable Pavement

Criteria not needing justification but possibly professional services

- Within an area designated as erosion or landslide hazard
- Within 50' from top of slopes greater than 20%
- At sites with known soil or ground water contamination
- At multi-level parking garages, and over culverts & bridges
- Where saturated conditions within 1' of bottom of base course
- Where road is classified as arterial or collector (see state RCW's)
- Where native soils don't meet soil suitability criteria (SSC-6)
- Where field testing indicates less than 0.30 in/hr infiltration

95

Volume V – Section 5.3.1
On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

LID Infeasibility Criteria – BMP T5.15 Permeable Pavement

Criteria not needing justification, but possibly professional services

- Where soils unsuitable for loads when saturated; CBR of 5% OK – residential street
- Replacing impervious unless NON-PGIS over soil > 4in/hr
- "High use Sites"
- Areas with "industrial activity"
- Where concentrated spill risk is higher (gas stations, truck stops)
- Routine heavy sand applications in frequent snow zones (not Puget Sound lowlands)

96

Volume V – Section 5.3.1 On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

Design Criteria – BMP T5.15 Permeable Pavement

Beginning on Page 5-13, Volume V, of the 2012 SWMMWW

Wearing Layers - See LID Manual

- Porous Asphalt
- Pervious Concrete
- Permeable Interlocking Concrete Pavement and Aggregate Pavers
- Grid/lattice systems

Base Materials - See LID Manual

Separation or Bottom Filter Layer (optional)

Subgrade – don't overcompact!

Drainage Conveyance -- fail safe designs

Acceptance Test

97

Volume V – Section 5.3.1 On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

BMP Limitations & Design Requirements

Beginning on Page 5-30, Volume V, of the 2012 SWMMWW

BMP T5.30 Full Dispersion

Retain 65% of the site in a forested or native condition

Minimize impervious surfaces to less than 10% of development site for rural single family residential

98

Volume V – Section 5.3.1 On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

BMP Limitations & Design Guidelines

Beginning on Page 5-7, Volume V, of the 2012 SWMMWW

BMP T5.13: Post-Construction Soil Quality & Depth

Infeasible on till soil slopes greater than 33%

99

Volume III – Section 3.1.1 Downspout Full Infiltration Systems

DEPARTMENT OF ECOLOGY State of Washington

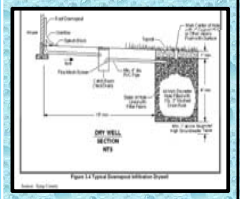
LID Infeasibility Criteria – BMP T5.10A Downspout Full Infiltration Systems

Beginning on Page 3-4, Volume III, of the 2012 SWMMWW

Downspout Full Infiltration Systems are considered feasible if the following are met:

Follow the Procedure for Evaluating Feasibility

- ≥ 3 feet of permeable soil from the proposed final grade to the seasonal high groundwater table
- ≥ 1-foot of clearance from the expected bottom elevation of the infiltration trench or dry well
- The system can meet the minimum design criteria specified



100

Volume III – Section 3.1.2 Downspout Dispersion Systems

DEPARTMENT OF ECOLOGY State of Washington

Volume III – Section 3.1.3 Perforated Stub-out Connections

BMP Limitations & Design Guidelines

Beginning on Page 3-11, Volume III, of the 2012 SWMMWW

BMP T5.10B: Downspout Dispersion

Feasible on most subdivision lots

Beginning on Page 3-11, Volume III, of the 2012 SWMMWW

BMP T5.10C: Perforated Stub-out Connections

Not appropriate when seasonal water table is < 1 ft. below trench bottom

101

Volume V – Section 5.3.1 On-site Stormwater Management BMPs

DEPARTMENT OF ECOLOGY State of Washington

Volume V – Section 5.3.1 On-site Stormwater Management BMPs

BMP Limitations & Design Guidelines

Beginning on Page 5-3, Volume V, of the 2012 SWMMWW

BMP T5.11: Concentrated Flow Dispersion

- Use where flow can be dispersed through vegetation
- 50' Flow Path Length Recommended
- Distance from septic systems

Beginning on Page 5-5, Volume V, of the 2012 SWMMWW

BMP T5.12: Sheet Flow Dispersion

- Use for flat / moderately sloped surfaces
- ≤ 2:1 Imperv/veg area ratio
- Distance from septic systems

102

DEPARTMENT OF ECOLOGY State of Washington

Other LID BMPs in Vol. V, Ch. 5 & LID Manual

- BMP T5.16 Tree Retention & Tree Planting
- BMP T5.17 Vegetated Roofs
- BMP T5.18 Reverse Slope Sidewalk
- BMP T5.19 Minimal Excavation Foundations

- BMP T5.20 Rainwater Harvesting

103

DEPARTMENT OF ECOLOGY State of Washington

104

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

105

DEPARTMENT OF ECOLOGY State of Washington

LID – Case Study

Objective: Evaluate MR#5 for a 10-Acre Single Family Subdivision

106

LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

General Project Conditions:

- **The project does not discharge to a Flow Control Exempt Water**
- **All Minimum Requirements will apply to the project**
- **The project is inside the UGA**
- The site does not have any existing impervious area
- The project is a New Development

Per the MR#5 Flow Chart Use Either:

- The LID Performance Standard
- **List #2**

107

LID Case Study - Assumptions

DEPARTMENT OF ECOLOGY State of Washington

Zoning Code & City Standards:

- The maximum density is 44 units
- Meet the setbacks and building area allowed by the local zoning code
- Roads as narrow as allowed per the fire code
- Roads will have two sidewalks
- Provide a parking lane only on one side of the street

Table B-1. Planning and Design Assumptions for Single-Family Residential Subdivision.

Zone	R-4.5-0
Density Requirements[1]	
Min. Density (DU/acre)	4
Max. Density (DU/acre)	6.73
Average lot size (sf)[2]	7,602
Lot Requirements	
Min. Lot Area (sf)	6,000
Average Min. Lot Width (ft)	20
Average Min. Lot Depth (ft)	60
Setback Requirements	
Front Yard Arterial (ft)	25
Front Yard at Other (ft)	20
Side Yard (ft)	5
Rear Yard (ft)	15
Max. Building Height (ft)	35
Coverage	
Max. Land Coverage	35%
Parking Spaces[3]	4
Parking Space Size (ft)	8x20
Right-of-way	
ROW Minimum (ft)	50
Street Width (ft)	28 (i.e. 2 x 10-ft travel lanes + 8-ft parking lane)
Min. Sidewalk (ft)	5 x 2
Planting Strip (ft)	5 x 2
Curb & Gutter (ft)	1 x 2

Notes:
1. Density calculation based on gross area minus right-of-way and other easements.
2. Calculation based on maximum allowable density, not in municipal code.
3. 2 enclosed spaces, 2 spaces in driveway apron

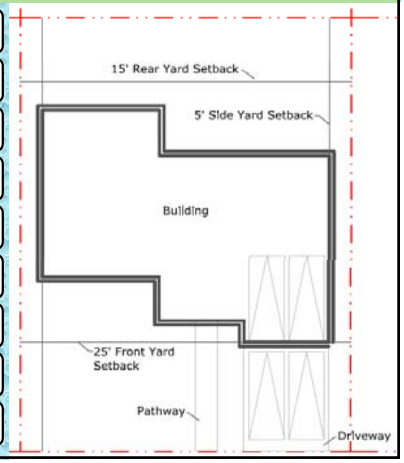
108

LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

Typical Single-Family Residence Plan:

- Project area slopes are less than 5%
- Lot Size: 7,500 sf
- Building Area: 2,579 sf
- Max. Building Coverage: 35%
- Roof Area (1-ft Overhang): 2,820 sf
- Driveway Area: 462 sf
- Sidewalk / Path Area: 145 Sf
- Landscape Area: 4,073 sf
- Total Hard Surface Area: 3,427 sf



LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

Typical Single-Family Residence Plan:

- **Project area slopes are less than 5%**
- Lot Size: 7,500 sf
- Building Area: 2,579 sf
- Max. Building Coverage: 35%
- Roof Area (1-ft Overhang): 2,820 sf
- Driveway Area: 462 sf
- Sidewalk / Path Area: 145 Sf
- Landscape Area: 4,073 sf
- Total Hard Surface Area: 3,427 sf

Per List #2 – Lawn & Landscaped Areas:

BMP T5.13: Post-Construction Soil Quality & Depth

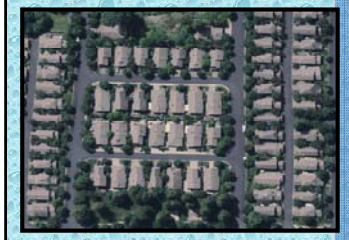
- Project slopes are less than 33%
- **BMP T5.13 feasible for all lawn & landscaped areas**

110

DEPARTMENT OF ECOLOGY State of Washington

List #2

Roofs: Consider in order listed; use first feasible



- **BMP T5.30 Full Dispersion or BMP T5.10A Downspout Full Infiltration**
- **BMP T5.14B Bioretention**
  - **≥ 5% of drainage area**
- **BMP T5.10B Downspout Dispersion Systems**
- **BMP T5.10C Perforated Stub-out Connections**

111

LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

Typical Single-Family Residence Plan:

Per List #2 – Roofs (& Other Hard Surfaces):

BMP T5.30: Full Dispersion

- Zoning code allows residential plan & building areas
- Developer did not choose to retain 65% of the site
- BMP T5.30 not feasible for project site

112

LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

A Site specific soils analysis was completed:

Soils Analysis General Results:

- Uniform Class C – **till soil** across the site
  - Initial Infiltration Rate = 0.3 inches / hour
- The depth to groundwater is adequate for LID BMPs
- Soil meets the site suitability criteria for infiltration
- No areas prone to erosion, slope failure, or flooding

Per List #2 – Roofs:

BMP T5.10A: Downspout Full Infiltration

- Volume III, Page 3-4 of the 2012 SWMWW: If the lots or site does not have outwash soils, and full dispersion is not feasible, then consider the next lower priority on the List.
- BMP T5.10A not feasible for project site

113

DEPARTMENT OF ECOLOGY State of Washington

List #2

Roofs: Consider in order listed; use first feasible

- ~~**BMP T5.30 Full Dispersion or BMP T5.10A Downspout Full Infiltration**~~
- **BMP T5.14B Bioretention**
  - **≥ 5% of drainage area**
- **BMP T5.10B Downspout Dispersion Systems**
- **BMP T5.10C Perforated Stub-out Connections**

114

LID Case Study – Is Bioretention Feasible for this Project?

DEPARTMENT OF ECOLOGY State of Washington

Compare the Biofiltration infeasibility criteria to the Project Conditions

BMP T7.30 infeasibility criteria

- ~~Site-specific Geotech evaluation recommendation~~
  - ~~Erosion, slope failure, or flooding~~
- ~~Distance to groundwater~~
  - ~~< 1' for small drainages; < 3' for larger drainages~~
- ~~Field testing: < 0.3 in/hr~~
- ~~Incompatible with surrounding drainage~~
- ~~Lack of space in redevelopment~~
- ~~Lack of space in the right-of-way for public road projects~~

Based on the Soils Analysis General Results - The first 3 infeasibility criteria don't apply

Based on the zoning criteria, site conditions, & because the project is a new development - The second 3 infeasibilty criteria don't apply

115

LID Case Study – Is Bioretention Feasible for this Project?

DEPARTMENT OF ECOLOGY State of Washington

Compare the Biofiltration infeasibility criteria to the Project Conditions

BMP T7.30 infeasibility criteria

- ~~Where existing structures, utilities, or roadways would be threatened~~
- ~~Within an area designated as an erosion hazard or landslide hazard~~
- ~~Within areas where ground water drains to an erosion / landslide hazard area~~
- ~~On a slope ≥ 8%~~
- ~~Within 50 ft. from top of slopes that are greater than 20% & over 10 ft of vertical relief~~
- ~~Within certain areas with soil or groundwater contamination~~

Based on the:

- Soils Analysis General Results
- Zoning criteria
- Site conditions
- Project is a new development

These infeasibilty criteria don't apply

116

LID Case Study – Is Bioretention Feasible for this Project?

DEPARTMENT OF ECOLOGY State of Washington

Compare the Biofiltration infeasibility criteria to the Project Conditions

BMP T7.30 infeasibility criteria

- ~~Within 100 ft. of a closed or active landfill~~
- ~~Within 100 ft. of a drinking water well, or spring used for drinking water~~
- ~~Within 10 ft. of small on-site sewage disposal drainfield/ reserve area~~
- ~~Within 10 ft. / 100 ft of an underground tank & connecting pipes depending on tank size~~

None of the Bioretention infeasibilty critera were applicable therefore BMP T5.14 is feasible.

Based on the:

- Soils Analysis General Results
- Zoning criteria
- Site conditions
- Project is a new development

These infeasibilty criteria don't apply

117

DEPARTMENT OF ECOLOGY State of Washington

List #2

Roofs: Consider in order listed; use first feasible

The Bioretention area must be at least 5% of the roof area

- ~~**BMP T5.30 Full Dispersion or BMP T5.10A Downspout Full Infiltration**~~
- **BMP T5.14B Bioretention**
  - **≥ 5% of drainage area**
- **BMP T5.10B Downspout Dispersion Systems**
- **BMP T5.10C Perforated Stub-out Connections**

Roof Area= 2,820 sf

Bioretention Area = 0.05 * 2,820 sf = 141 sf

118

DEPARTMENT OF ECOLOGY State of Washington

List #2

Other Hard Surfaces consider in order listed; use first feasible

- ~~**BMP T5.30 Full Dispersion**~~
- **BMP T5.15 Permeable Pavement**
- **BMP T5.14B Bioretention**
  - **≥ 5% of drainage area**
- **BMP T5.12 Sheet Flow Dispersion or BMP T5.11 Concentrated Flow Dispersion**

119

LID Case Study – Is Permeable Pavement Feasible for this Project?

DEPARTMENT OF ECOLOGY State of Washington

Compare the Permeable Pavement infeasibility criteria to the Project Conditions

BMP T5.15 Infeasibility criteria

- ~~Site-specific Geotech evaluation recommendation~~
  - ~~Erosion, slope failure, or flooding~~
- ~~Field testing < 0.5 in/hr~~
- Arterial or Collector
- ~~< 1' to base course bottom~~
- ~~Soils don't meet suitability criteria – SSC-6~~
  - ~~Local gov option for inserting a treatment layer~~
- ~~At sites with slopes of ≥ 5%, 10%, or 12% depending on pavement material~~

Based on the:

- Soils Analysis General Results
- Site conditions

These infeasibilty criteria don't apply

- Arterial or Collector infeasibilty criteria applies for the existing arterial

120

LID Case Study – Is Permeable Pavement Feasible for this Project?

DEPARTMENT OF ECOLOGY State of Washington

Compare the Permeable Pavement infeasibility criteria to the Project Conditions

BMP T5.15 Infeasibility criteria

- ~~Fill soils are used that can become unstable when saturated~~
- ~~Underlying soils are unsuitable for supporting traffic loads when saturated~~
- ~~On excessively steep slopes meeting certain conditions~~
- ~~At multi-level parking garages, and over culverts & bridges~~
- ~~In heavy loading areas at industrial facilities if the pavement doesn't have sufficient strength~~
- ~~Within 10 ft. / 100 ft of an underground tank & connecting pipes depending on tank size~~
- ~~If the site function will result in excessive sediment deposition (Sand & Gravel Yards)~~
- ~~At "high use sites", areas with "industrial activity", & areas with concentrated pollutant spills are likely~~

Based on the:

- Soils Analysis General Results
- Site conditions

These infeasibilty criteria don't apply

121

LID Case Study – Is Permeable Pavement Feasible for this Project?

DEPARTMENT OF ECOLOGY State of Washington

Compare the Permeable Pavement infeasibility criteria to the Project Conditions

BMP T5.15 Infeasibility criteria

- ~~Where existing structures, utilities, or roadways would be threatened~~
- ~~Within an areas where ground water drains to an erosion / landslide hazard area~~
- ~~Areas prone to sedimentation during the winter or from steep slopes~~
- ~~Within 50 ft. from top of slopes that are greater than 20%~~
- ~~Within certain areas with soil or groundwater contamination~~
- ~~Within 100 ft. of a closed or active landfill~~
- ~~Within 100 ft. of a drinking water well, or spring used for drinking water~~
- ~~Within 10 ft. of small on-site sewage disposal drainfield/ reserve area~~

Based on the:

- Soils Analysis General Results
- Site conditions

These infeasibilty criteria don't apply

122

DEPARTMENT OF ECOLOGY State of Washington

List #2

Other Hard Surfaces consider in order listed; use first feasible

Permeable pavement feasible for parcels & Right-of-way

- ~~**BMP T5.30 Full Dispersion**~~
- **BMP T5.15 Permeable Pavement**
- **BMP T5.14B Bioretention**
  - **≥ 5% of drainage area**
- **BMP T5.12 Sheet Flow Dispersion or BMP T5.11 Concentrated Flow Dispersion**

123

LID Case Study

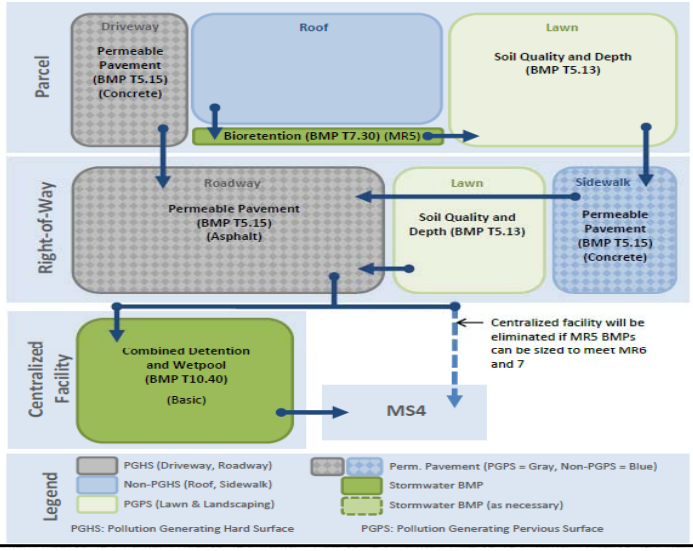
DEPARTMENT OF ECOLOGY State of Washington

To meet Minimum Requirement #5 Per List #2:

Lawn & Landscaped Areas:	• USE BMP T5.13 Post-Construction Soil Quality & Depth
Roofs:	• Use BMP T5.14B Bioretention • Each lot will have a ≈ 141 sf bioretention facility
Other Hard Surfaces:	• Use BMP T5.15 Permeable Pavement

124

Figure A-2. Residential - Till



125

LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

Could meet Minimum Requirement #5 Per LID Performance Standard

Match post-development discharge durations to pre-developed durations from 8% of the 2-year flow to 50% of the 2-year flow

- **Use WWHM 2012 to model surfaces & select BMPs**
- **Most likely will have to use some LID BMPs such as bioretention or permeable pavement**
- **Could consider the use of Rainwater Harvesting or Green Roofs**

126

LID Case Study

DEPARTMENT OF ECOLOGY State of Washington

Other Minimum Requirements:

Don't forget Minimum Requirements #1-4 & #6-9 Still Apply Too!

Protect Bioretention & Permeable Pavement Facilities through Element #13 of the Construction SWPPP (MR #2)	A centralized facility is likely still required to Meet MRs #6 & #7	Provide an O&M Manual for Bioretention & Permeable Pavement facilities per MR #9

127

DEPARTMENT OF ECOLOGY State of Washington

128

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

129

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #1 Preparation of Stormwater Site Plans

Use site-appropriate development principles to retain native vegetation and minimize impervious surfaces to the extent feasible.

Local codes will change to incorporate certain LID principles.

Prepare a Stormwater Site Plan for local government review

130

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #1 Preparation of Stormwater Site Plans

1. ***Analyze Existing Site Conditions***
2. ***Preliminary Site Layout***
3. Off-site Analysis
4. Determine applicable Min. Requirements
5. ***Prepare Permanent Stormwater Control Plan***
6. Prepare Construction SWPPP
7. ***Complete Plan***
8. Check for Compliance

131

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Section 3.1.1: Site Analysis

Survey

Soils Report

- Professional (on-site sewage designer OK if only MR #1 - #5)
- Surveys, test pits, borings
- Ksat field tests or grain size analysis
- Depth to restrictive layer – need winter data
- Lateral flow assessment (MR #1 - #9)
- Vegetation survey of any protected areas

132

Volume III

DEPARTMENT OF ECOLOGY State of Washington

New! Section 3.4: Stormwater – related Site Procedures and Design Guidance for Bioretention/Rain Garden

Small Commercial: one small-scale PIT
Large Commercial: small-scale PIT every 5,000 sq. ft.

Residential: small-scale PIT at each potential site

- Per 200 feet for long, narrow layout; e.g. road ROW
- Groundwater thru wet season – adequate clearance?

Correction factor for native soils ; CFv = 0.33 to 1

WWHM guidance

Legal Documentation

133

Volume III

DEPARTMENT OF ECOLOGY State of Washington

New! Section 3.4: Site Procedures for Permeable Pavement

Sites where only MR 1 – 5 apply:

- Infiltration test per 5,000 sq. ft./wet season ground water

Commercial sites where MR 1 – 9 apply:

- Small-scale PIT per 5000 sq. ft.; at least 1 per site

Residential sites where MR 1 – 9 apply

- Small-scale PIT per 200 ft of road & every lot
- Criteria for reduction of test frequency
- Groundwater thru wet season

134

Volume III

DEPARTMENT OF ECOLOGY State of Washington

New! Section 3.4: Site Procedures for Permeable Pavement

- Assignment of Infiltration Correction Factors
- Soil Suitability Confirmation
- Project Submission Requirements
- WWHM Modeling
- Legal Documentation

135

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #1 Preparation of Stormwater Site Plans

1. ***Analyze Existing Site Conditions***
2. ***Preliminary Site Layout***
3. Off-site Analysis
4. Determine applicable Min. Requirements
5. ***Prepare Permanent Stormwater Control Plan***
6. Prepare Construction SWPPP
7. ***Complete Plan***
8. Check for Compliance

136

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Section 3.1.5: Permanent SW Control Plan

Site Hydrology for Projects under MR 1 – 5 only:

- Drawings for location of all On-site SW BMPs & drainage areas
- Design details, figures, maintenance instructions (recordable documents)
- Justification for infeasibility decisions, OR
- Demo compliance with LID Perf. STD if applicable

137

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Section 3.1.5: Permanent SW Control Plan

Site Hydrology for Projects under MR 1 – 9

- Summary
- Perf Stds, Treatment, Lists
- LID Features
- Flow Control System (MR #7)
- Water Quality System (MR #6)
- Conveyance System

138

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #1 Preparation of Stormwater Site Plans

1. ***Analyze Existing Site Conditions***
2. ***Preliminary Site Layout***
3. Off-site Analysis
4. Determine applicable Min. Requirements
5. ***Prepare Permanent Stormwater Control Plan***
6. Prepare Construction SWPPP
7. ***Complete Plan***
8. Check for Compliance

139

Volume I – Chapter 3 Preparation of Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Section 3.1.7 Complete SW Site Plan

O&M manuals for all "stormwater treatment and flow control facilities"

- Includes bioretention, permeable pavement, & vegetated roofs that help meet MR #6 or #7.

Declaration of Covenant & Grant of Easement

- For all stormwater treatment & flow control facilities
- For all other on-site stormwater management BMPs
- Signed & recorded for each lot

140

Volume I – Chapter 3
Preparation of
Stormwater Site Plans

DEPARTMENT OF ECOLOGY State of Washington

Section 3.1.7 Complete Stormwater Site Plan

Track lot obligations

- Plat/short plat approvals
- Deed info & restrictions
  - Covenant & Easement
  - Drawings, design details, maintenance instructions

141

DEPARTMENT OF ECOLOGY State of Washington

142

Presentation Agenda

Introduction & Volume IV	10:00 AM
Volume II – Construction	10:15 AM
Break	10:45 AM
Low Impact Development (LID) in Volume I	11:00 AM
Lunch	11:45 AM
LID Design & Infeasibility Criteria in Volumes III & V	12:45 PM
LID Case Study	1:15 PM
Break	2:00 PM
Site Planning & Field Procedures for LID	2:15 PM
Non-LID Changes to Volumes I, III, & V	2:45 PM
Adjourn	3:30 PM

143

DEPARTMENT OF ECOLOGY State of Washington

Volume I

Minimum Requirement #6 Treatment	Minimum Requirement #7 Flow Control for Stream Channel Protection	Minimum Requirement #8 Wetlands Protection	Minimum Requirement #9 Operation and Maintenance	Exceptions & Variances

144

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #6 – Runoff Treatment

Construction of stormwater treatment facilities is required for:

- Projects in which the total of, pollution-generating **hard** surface (**PGHS**) is 5,000 square ft. or more in a threshold discharge area of the project
- Projects in which the total of pollution-generating pervious surfaces (PGPS) – **not including permeable pavements** – is ¾ of an 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

Changed "impervious" to "hard"

Permeable pavement in the 1st bullet; exempted from 2nd bullet

Threshold sizes are the same

Table eliminated because it isn't necessary anymore. Projects are already subject to MR #5.

145

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #6 – Runoff Treatment

Pollution-generating permeable pavement > 5,000 sq ft in a "Threshold Discharge Area" must comply thru:

- Infiltrate into soils that meet "suitability criteria," or through a treatment layer
- Demo compliance w/ runoff model
  - WWHM/MGS Flood

Ecology does **not** want mini-treatment facilities

Other Changes

- Treatment Facility Sizing re-worded for clarity.
- WQ Design Storm Volume & WQ Design Flow Rate further defined.

146

DEPARTMENT OF ECOLOGY State of Washington

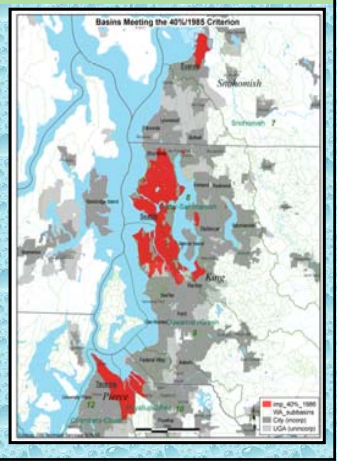
Minimum Requirement #7 – Flow Control

Thresholds

- 0.1 cfs increase to consider all effective hard and converted vegetation
- Or a 0.15 cfs increase threshold for 15-minute time steps.

Reference Appendix I-F

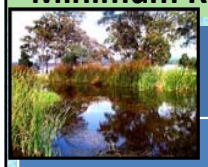
- Map identifies basins eligible to use "existing land cover"
- Basins > 40% total impervious area since 1985



147

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #8 – Wetlands Protection



Use Guidesheets #1 - #3 in Appendix I-D

#1 Criteria For Excluding Wetlands From Serving as a Treatment/Flow Control BMP/Facility	#2 Criteria For Including Wetlands as a Treatment/Flow Control BMP/Facility	#3 Wetland Protection Guidelines
		• 3A – General Guidelines • 3B – Hydrology Guidelines

148

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #8 – Wetlands Protection

Guidesheet 3B: Hydrology guidelines

- Daily influent volume not more than 20% higher or lower than the pre-project volumes.
- Monthly influent volume not more than 15% higher or lower than the pre-project volumes
- Use WWHM 2012 to perform analyses

149

DEPARTMENT OF ECOLOGY State of Washington

Minimum Requirement #9 – Operation and Maintenance

No Major Changes

- Provide O&M Manuals for stormwater facilities & BMPs
  - Refer to Table 4.5.2 Maintenance Standards in Volume V (Page 4-31)
- Grant for additional maintenance standards for LID BMPs
  - Free Trainings on LID Maintenance Coming Soon!

150

DEPARTMENT OF ECOLOGY State of Washington

Exceptions / Variances

Consistent with Municipal Stormwater Permits → Severe and unexpected economic hardship
- Criteria listed

→ Not increase risk to public, not injurious to other properties and water quality → Least possible exception to comply w/intent

151

DEPARTMENT OF ECOLOGY State of Washington

152

DEPARTMENT OF ECOLOGY State of Washington

Volume III

Chapter 1 Introduction	Chapter 2 Hydrologic Analysis	Chapter 3 Flow Control Design	Resources & Appendices
		• **Revised!** Section 3.3 Infiltration Facilities for Flow Control & Treatment • **New!** Section 3.4 Stormwater-related Site Procedures and Design Guidance for Bioretention & Permeable Pavements	**Appendices III-B & III-C Updated**

Updated WWHM!

153

DEPARTMENT OF ECOLOGY State of Washington

Western Washington Hydrology Model - 2012

Major Updates include:

- Compatibility with Windows 7
- LID modeling and Compliance with LID Standard
- Wetland Flow Matching Criteria

154

DEPARTMENT OF ECOLOGY State of Washington

WWHM 2012

New LID Modeling Elements/Icons for:

- Permeable Pavement
- Vegetated Roof
- Bioretention
- Embankments/Slopes

155

Wetland Flow Criteria

DEPARTMENT OF ECOLOGY State of Washington

Western Washington Hydrology Model

Minimum Requirement #8 Specifies:

- Daily Discharge Deviation +/- 20%
- Monthly Discharge Deviation +/- 15%

Flows = Surface + Interflow + Groundwater

156

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3 Infiltration Facilities for Flow Control and for Treatment

Purpose

- Steps to evaluate prospective infiltration sites
  - For infiltration
  - For treatment
- Procedures for Infiltration testing
- Design steps and details

Applicability

- Ponds/basins, trenches, vaults, tanks
- Bioretention and permeable pavement where referenced in Sect. 3.4
- Not to roof downspout infiltration trenches (see BMP T5.10A)

157

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.4: Steps for the Design of Infiltration Facilities – Simplified Approach

- Applies to sites < 1 acre
- No groundwater mounding analysis
- Steps remain same, but references updated guidance
- Last step now includes conducting performance testing

158

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.5: Site Characterization Criteria

Subsurface characterization

- Minimum test hole depths & extent of soils characterization
  - Deference to judgment of the professional
- Groundwater monitoring wells
  - One wet season, unless historical data
  - 3 wells for flow direction & gradient, unless …
- If Grain Size Analysis Method
  - 1 analysis per soil layer in each test hole to 2.5x max water depth, but not < 6 feet

Infiltration rate determination

- References updated section 3.3.6

159

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.6: Design Saturated Hydraulic Conductivity

Large-scale Pilot Infiltration Test

- Drainage areas ≥ 1 acre
- Field procedures

Small-scale Pilot Infiltration Test

- Drainage area < 1 acre
- Bioretention or Permeable Pavement
- Soils with high infiltration rate
- Field procedures

160

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.6 (con't)

Soil Grain Size Analysis Method (only unconsolidated soils)

- For each soil layer up to 2.5x water depth, but not < 6 ft
- D10, D60, D90, Fines
- Equation to estimate Ksat for each layer
- Equation to estimate effective average Ksat

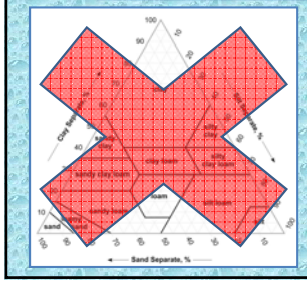
161

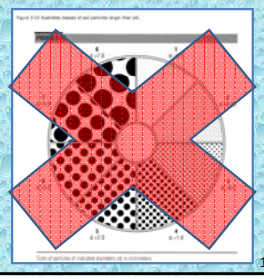
DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.6 (con't)

Options removed

- USDA Soil texture-based estimates
- Estimates based on D10 size





162

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.6 (con't)

Correction factors to Initial Infiltration Rate Estimate

Converts field results to a long-term estimate

- CFv - Site variability & # of tests: 0.33 to 1.0
- CFt - Test Method: 0.4 to 0.75
- CFm - Influent Control: 0.9
- CF_T = CFv x CFt x CFm: 0.12 to 0.68

Correction factors for Grain Size Method

- CF_T = CFv x CFm: 0.3 to 0.9

163

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.7: Site Suitability Criteria

SSC-4: Max infiltration rates for treatment

- Measured (initial) rate increased from 2.4 to 9 in/hr
- Design (Long-term) rate increased from 2 to 3 in/hr

SSC-6: Soil Physical & Chemical Suitability for treatment

- Organic content changed from unspecified to a minimum of 1.0%.
- CEC retained at $\geq$ 5 meq/100 g.
- Depth of soil retained at $\geq$ 18 inches, but 12 inches OK for permeable pavement not accepting run-on.

164

DEPARTMENT OF ECOLOGY State of Washington

Section 3.3.8: Detailed Approach to Infiltration Design

Steps 1 – 5: same as Simplified Approach

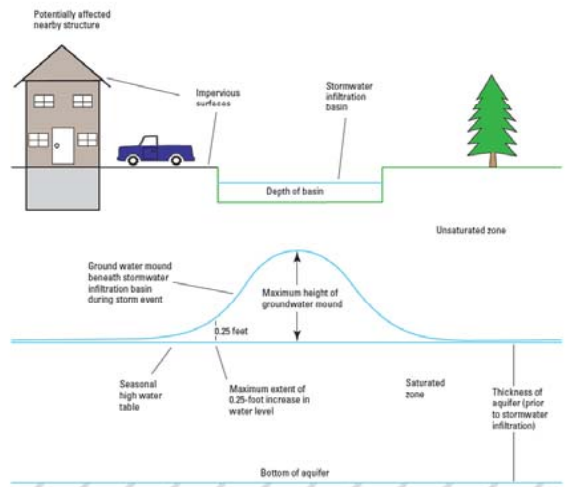
Steps 6 – 9: unchanged or clarified

New Step 10: Groundwater Mounding Analysis

Drainage area > 1 acre and < 15 feet to groundwater or low permeability stratum	MODRET or equivalent	Testing & Monitoring

165

Simulation of Groundwater Mounding Beneath Hypothetical Stormwater Infiltration Basins



166

DEPARTMENT OF ECOLOGY State of Washington

167

DEPARTMENT OF ECOLOGY State of Washington

Volume V – Other Changes

Revised the Treatment Facility Selection Flow Chart	Renamed Ecology Embankment to Media Filter Drain	Removed Catch Basin Inserts	Removed Amended Sand Filter	Removed Narrow Area Filter Strip	Separate design criteria for Basic Filter Strip and Compost-amended Vegetated Filter Strips (CAVFS)

168

DEPARTMENT OF ECOLOGY State of Washington

Other Changes in Volume V

Revised Design Criteria for:

- BMP T7.40 Compost-amended Vegetated Filter Strips (CAVFS)
- BMP T8.10 Basic Sand Filter Basin
- BMP T8.20 Sand Filter Vault
- BMP T8.40 Media Filter Drain
- BMP T10.10 Wet Pond

169

DEPARTMENT OF ECOLOGY State of Washington

Other Changes in Volume V

Enhanced Treatment

Revised performance goal for dissolved metals

- > 30% dissolved copper removal
- > 60% dissolved zinc removal

Emerging Technologies & TAPE (Chapter 12)

- Revised description of the TAPE review/approval process
- Removed all discussion of previously approved technologies
- Visit website for approved devices:

http://www.ecy.wa.gov/programs/wq/stormwater/newtech/index.html

170

DEPARTMENT OF ECOLOGY State of Washington

Questions?

Thank you!

You can also e-mail additional questions to Carrie Graul at: carrie.graul@ecy.wa.gov

http://www.ecy.wa.gov/programs/wq/stormwater/manual.html

171