Statewide LID Training Program

INTERMEDIATE LID TOPICS: NPDES PHASE I AND PHASE II PERMIT REQUIREMENTS

WESTERN WASHINGTON

INSTRUCTORS

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Senior Engineer
Key project experience: Stormwater monitoring, design, and NPDES Permit compliance

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Staff Engineer
Key project experience: Stormwater planning, design, and NPDES Permit compliance
LEARNING OBJECTIVES

1. Understand which BMPs are considered on-site SW Management BMPs and which LID BMPs can also be used to meet Minimum Requirement (MR) #6 and/or MR #7.

2. Gain a general understanding of Element #13 of MR #2.

3. Gain an in-depth understanding of the on-site stormwater management (MR #5) requirements.

4. Gain an in-depth understanding of the LID O&M requirements.
# LOGISTICS

## SCHEDULE

- 4-hour training with one break

## OTHER LOGISTICS

- Restroom location
- Food
- Turn off cell phones
- Sign in and sign out

### Statewide LID Training Program

#### PROGRAM OVERVIEW

- 2012: Public and private partners engage state legislature to fund program
- June 2012: LID Training Steering Committee convened
- 2014: Training program built from state LID Training Plan.

#### OVERVIEW OF PROGRAM

- Implemented first round of trainings (September 2014 through May 2015)
- 49 trainings provided in western and eastern WA first year
- 45 trainings offered in western and eastern WA in current phase (through June 2016)
- Three levels: Introductory, Intermediate, and Advanced
- Statewide LID Certificate now available
## Statewide LID Training Program

### OVERVIEW OF PROGRAM

<table>
<thead>
<tr>
<th>PROJECT LEAD</th>
<th>CORE TEAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herrera</td>
<td>Cascadia</td>
</tr>
</tbody>
</table>

### ADDITIONAL TRAINING SUPPORT

- CH2M
- Kinkle & Company
- Kindred Hydro
- MU</n>

### INTRODUCTORY

- 2.1 Introduction to LID for Inspection & Maintenance Staff
- 2.1 Introduction to LID for Inspection & Maintenance Staff
- 2.2 Introduction to LID for Developers & Money for Grates

### INTERMEDIATE

- 3.3 Intermediate LID Bioretention
- 3.4 Intermediate LID Permeable Pavement
- 3.5 Intermediate LID Water Quality & Vegetated Roofs
- 3.6 Intermediate LID Hydrologic Modeling

### ADVANCED

- 5.0 Advanced Topics for Long-Term LID Assessment
- 5.1 Advanced Topics in LID Design: Bioretention
- 5.2 Advanced Topics in LID Design: Permeable Pavement
- 5.3 Advanced Topics in LID Design: Water Quality & Vegetated Roofs
- 5.4 Advanced Topics in LID Design: Vegetated Roofs
- 5.5 Advanced Topics in LID Design: Hydrologic Modeling

### OVERVIEW OF PROGRAM

- Topics: Intermediate
- Design: Advanced
- Layout: Advanced
- Operations: Advanced
- Collection Systems: Advanced
- Site Planning: Advanced
- Vegetated Roofs: Advanced
- Hydrologic Modeling: Advanced
- Bioretention: Advanced
- Permeable Pavement: Advanced
- LID Design: Advanced
- LID Assessment: Advanced
- LID Planning: Advanced

### INTRODUCTORY

- 2.1 Introduction to LID for Inspection & Maintenance Staff
- 2.1 Introduction to LID for Inspection & Maintenance Staff
- 2.2 Introduction to LID for Developers & Money for Grates

### INTERMEDIATE

- 3.3 Intermediate LID Bioretention
- 3.4 Intermediate LID Permeable Pavement
- 3.5 Intermediate LID Water Quality & Vegetated Roofs
- 3.6 Intermediate LID Hydrologic Modeling

### ADVANCED

- 5.0 Advanced Topics for Long-Term LID Assessment
- 5.1 Advanced Topics in LID Design: Bioretention
- 5.2 Advanced Topics in LID Design: Permeable Pavement
- 5.3 Advanced Topics in LID Design: Water Quality & Vegetated Roofs
- 5.4 Advanced Topics in LID Design: Vegetated Roofs
- 5.5 Advanced Topics in LID Design: Hydrologic Modeling

### OVERVIEW OF PROGRAM

- Topics: Intermediate
- Design: Advanced
- Layout: Advanced
- Operations: Advanced
- Collection Systems: Advanced
- Site Planning: Advanced
- Vegetated Roofs: Advanced
- Hydrologic Modeling: Advanced
- Bioretention: Advanced
- Permeable Pavement: Advanced
- LID Design: Advanced
- LID Assessment: Advanced
- LID Planning: Advanced
AGENDA

permit background and definitions
minimum requirement #3
minimum requirement #5
O&M requirements
code updates
jeopardy
wrap up

PERMIT BACKGROUND AND DEFINITIONS
NPDES MUNICIPAL STORMWATER PERMIT
National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permits (2013-2018 permit cycle)

<table>
<thead>
<tr>
<th>Municipal Stormwater Permittees in Washington State</th>
<th>Western Washington Phase II Permittees</th>
<th>Eastern Washington Phase II Permittees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle</td>
<td>2 Cities</td>
<td>10 Cities</td>
</tr>
<tr>
<td>Tacoma</td>
<td>5 Counties</td>
<td>5 Counties</td>
</tr>
<tr>
<td>Clark County</td>
<td></td>
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</tr>
<tr>
<td>King County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pierce County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Snohomish County</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Secondary Permittees: Approximately 45; such as ports and universities

To see a listing of permittees visit

PERMIT BACKGROUND AND DEFINITIONS
NPDES MUNICIPAL STORMWATER PERMIT: Minimum Requirements (MRs)

1. Preparation of Stormwater Site Plans
2. Construction Stormwater Pollution Prevention Plan (SWPPP)
3. Source Control of Pollution
4. Preservation of Natural Drainage Systems and Outfalls
5. On-Site Stormwater Management
6. Run-off Treatment
7. Flow Control
8. Wetlands Protection
9. Operations and Maintenance
NPDES MUNICIPAL STORMWATER: MR #1

• MR #1: Preparation of Stormwater Site Plans
  • Prepare a Stormwater Site Plan for local governmental review in accordance with Volume 1, Chapter 3 of the SWMMWW
  1. Site Analysis: Collect and Analyze Information on Existing Conditions
  2. Prepare Preliminary Development Layout
  3. Perform Off-site Analysis (at local government’s option)
  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

NPDES MUNICIPAL STORMWATER: MR #2 and MR #5

• MR #2 – Construction SWPPP
  • New element #13 is now required by Construction Stormwater General Permit (CSWGP): Protect LID BMPs from sediment and compaction

• MR #5 – On-site Stormwater Management
  • Infiltrate, disperse, and retain runoff on-site to the extent feasible

NPDES MUNICIPAL STORMWATER: MR #6, #7, and MR #9

• MR #6 – Runoff Treatment
  • Provide water quality treatment for pollution-generating areas

• MR #7 – Flow Control
  • Control peak flows and duration

• MR #9 – Operations and Maintenance
  • Provide an O&M manual for all proposed stormwater treatment and flow control BMPs/facilities
DEFINITIONS

Hard Surface
• Impervious surfaces, permeable pavements, or vegetated roofs

Pollution-Generating Hard Surface (PGHS)
• Pollutant-generating hard surfaces subject to vehicular use, industrial activities, material storage
• Pollution-generating impervious surfaces (PGIS) and pollution-generating permeable pavement

Pollution-Generating Impervious Surface (PGIS)
• Pollutant-generating impervious surfaces subject to vehicular use, industrial activities, material storage
• Roofs subject to venting significant amounts of dusts, mists, or fumes from manufacturing, commercial, or other indoor activities
DEFINITIONS

Pollution-Generating Pervious Surface (PGPS)
• Non-imperious surface subject to vehicle use, industrial activities, pesticides, fertilizers, erosion
• Pollution-generating permeable pavement, lawn and landscaped areas, golf courses, parks, sports fields

Pollution-Generating Impervious Surface (PGIS)
Hard Surface

Pollution-Generating Hard Surface (PGHS)

Pollution-Generating Pervious Surface (PGPS)

Surface Type
Pollution-Generating Impervious Surface (PGIS)
Hard Surface
Pollution-Generating Hard Surface (PGHS)
Pollution-Generating Pervious Surface (PGPS)

On-Site Stormwater Management BMPs
• Used to help meet MR #5
• May be used to help meet MR #6 and/or MR #7
• “On-site Stormwater Management BMPs” = LID BMPs

“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, vegetated roofs, minimum excavation foundations, and water re-use.” Western Washington Phase II Municipal Stormwater Permit
<table>
<thead>
<tr>
<th>On-Site Stormwater Management BMPs:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Rain Gardens (BMP T5.14A)</td>
</tr>
<tr>
<td>• Bioretention (BMP T5.14B)</td>
</tr>
<tr>
<td>• Permeable Pavement (BMP T5.15)</td>
</tr>
<tr>
<td>• Vegetated Roofs (BMP T5.17)</td>
</tr>
<tr>
<td>• Downspout Full Infiltration (BMP T5.10A)</td>
</tr>
<tr>
<td>• Downspout Dispersion (BMP T5.10B)</td>
</tr>
<tr>
<td>• Perforated Stub-Out Connections (BMP T5.10C)</td>
</tr>
<tr>
<td>• Concentrated Flow Dispersion (BMP T5.11)</td>
</tr>
<tr>
<td>• Sheet Flow Dispersion (BMP T5.12)</td>
</tr>
<tr>
<td>• Compost Amended Soils (BMP T5.13)</td>
</tr>
</tbody>
</table>

**On-Site Stormwater Management BMPs:**

- **Permeable Pavement (BMP T5.15):** 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.

- **Vegetated Roofs (BMP T5.17):** Vegetated roofs (also known as ecoroofs and green roofs) are thin layers of engineered soil and vegetation constructed on top of conventional flat or sloped roofs.

- **Downspout Full Infiltration (BMP T5.10A):** Trench or drywell designs intended only for use in infiltrating runoff from roof downspout drains.

- **Downspout Dispersion (BMP T5.10B):** Downspout dispersion systems are splash blocks or gravel-filled trenches, which serve to spread roof runoff over vegetated pervious areas.

- **Perforated Stub-Out Connections (BMP T5.10C):** A length of perforated pipe within a gravel-filled trench that is placed between roof downspouts and a stub-out to the local drainage system.
DEFINITIONS

On-Site Stormwater Management BMPs:

• **Concentrated Flow Dispersion (BMP T5.11):** Dispersion of concentrated flows from driveways or other pavement through a vegetated pervious area attenuates peak flows by slowing entry of the runoff into the conveyance system, allowing for some infiltration, and providing some water quality benefits.

• **Sheet Flow Dispersion (BMP T5.12):** The simplest method of runoff control. This BMP can be used for any impervious or pervious surface that is graded to avoid concentrating flows.

• **Post-Construction Soil Quality and Depth (BMP T5.13):** Regain greater stormwater functions post development, providing increased treatment of pollutants that result from development and habitation, and minimizing the need for some landscaping chemicals, thus reducing pollution through prevention.

• **Rain Gardens (BMP T5.14A):** Rain gardens are non-engineered, shallow, landscaped depressions with compost-amended soils and adapted plants.

• **Bioretention (BMP T5.14B):** Bioretention areas are shallow landscaped depressions, with a designed soil mix and plants adapted to the local climate and soil moisture conditions, that receive stormwater from a contributing area.
**PERMIT BACKGROUND AND DEFINITIONS**

**DEFINITIONS**

**Rain Garden vs. Bioretention**

- **Rain Gardens (BMP T5.14A)**
  - Usually do not include under-drains
  - May use less restrictive soil mix guidelines (e.g., existing soil augmented with compost and sand)
  - Can only be used to meets MR #5 requirement

- **Bioretention (BMP T5.14B)**
  - Often includes surface and subsurface infrastructure
  - Designed soil mix
  - Meets requirements for MR #5, #6, and #7

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**PERMIT BACKGROUND AND DEFINITIONS**

**DEFINITIONS**

**SW Treatment & Flow Control BMPs/Facilities (MR #6 and/or MR #7):**

- “Detention facilities, treatment BMPs/facilities, bioretention, vegetated roofs, and permeable pavements that help meet Appendix I Minimum Requirements #6 (treatment), #7 (flow control), or both”

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**PERMIT BACKGROUND AND DEFINITIONS**

**DEFINITIONS**

**Subset of On-site Stormwater Management BMPs used to meet MR #6 or MR #7**

<table>
<thead>
<tr>
<th>Onsite SW Management BMP</th>
<th>Flow Control Credit</th>
<th>Treatment Credit</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil Amendment</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Dispersion</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Retaining &amp; Planting Trees</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Rainwater Harvesting</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Bioretention</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Permeable Pavement</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Vegetated Roofs</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

1. Meets basic, enhanced and phosphorus treatment when infiltrating through soil per Ecology treatment requirements
2. Where permeable pavement is over soils meeting the suitability criteria or a treatment layer is included
3. Also considered as Treatment & Flow Control BMPs/Facilities (additional requirements in regard to long term inspection, monitoring, and maintenance apply)
### AGENDA

- Introduction
- Permit background and definitions
- Minimum requirement #2
- Minimum requirement #3
- O&M requirements
- Code updates
- Jeopardy
- Wrap up

### MINIMUM REQUIREMENT #2

<table>
<thead>
<tr>
<th>#1 Preparation of Stormwater Site Plans</th>
<th>#2 Construction Stormwater Pollution Prevention Plan</th>
<th>#3 Source Control of Pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>#4 Preservation of Natural Drainage Systems and Outfalls</td>
<td>#5 On-site Stormwater Management</td>
<td>#6 Runoff Treatment</td>
</tr>
<tr>
<td>#7 Flow Control</td>
<td>#8 Wetlands Protection</td>
<td>#9 Operation and Maintenance</td>
</tr>
</tbody>
</table>
MINIMUM REQUIREMENT #2: 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 BMPs

New Element also required by the CSWGP

MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

- Install/maintain erosion & sediment control BMPs to protect bioretention, rain gardens, and permeable pavement
- Chapter 3, Section 3.3.3, of Volume II

MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

- Fully restore BMPs if they accumulate sediment during construction
- Keep construction equipment and foot traffic off bioretention, rain garden, and permeable pavement
**MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs**

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

**Suggested planning and sequencing techniques**

- Re-vegetation: plant when vegetation will establish quickly (late fall, winter, or early spring); fertilize and protect plants, restrict heavy equipment on areas designated for re-vegetation; provide soil amendments if necessary

**Suggested planning and sequencing techniques (cont.)**

- Inspections: Pre-construction, routine, and post-construction inspections to verify measures for protecting LID BMPs have been taken
- Soils: preserve and/or utilize areas of the site with nutrient rich soils
MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested erosion and sediment control techniques:
- Clearing/grading: limit in areas designated for LID; avoid grading that results in steep, continuous slopes; incorporate natural topographic depressions into the development
- Sequencing: complete construction and ESC activities in one section of the site before moving on to another section

MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested erosion and sediment control techniques (cont.)
- Access roads: reduce number and width and locate in areas where future roads will be placed (unless utilizing permeable pavement)
- Soils: do not disturb rich native topsoil; if excavation is necessary, stockpile and cover topsoil for use after construction

MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested excavation techniques
- Operate machinery next to the BMP to excavate
- Do not use heavy equipment with narrow tracks, narrow tires, or lugged high pressure tires
- Use draglines and trackhoes
MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested excavation techniques (cont.)
- Rake or scarify sidewalls and bottom area to restore infiltration rates
- Permanently stabilize up-gradient disturbed areas before excavating to final grade

MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested permeable pavement protection techniques
- Use protective surfaces (e.g., waterproof tarps and steel plates) over permeable pavement areas used for construction staging
- Do not drive sediment-laden construction equipment on the base material or pavement
- Do not allow sediment-laden runoff on permeable pavements or base materials

MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested permeable pavement protection techniques (cont.)
- Once the pavement is finished and set:
  - Cover the pavement surface with plastic and geotextile to protect from other construction activities
  - Close and protect the pavement area until the site is permanently stabilized
- Protect road subgrade from over compaction and sedimentation if permeable pavement roads are used for construction access
MINIMUM REQUIREMENT #2: Element #13, Protect LID BMPs

Suggested bioretention and rain garden protection techniques

- Use lightweight, low ground-contact pressure equipment
- Rip the base at completion to scarify soil
- Do not place bioretention soil mix if saturated or during wet periods
- If compacted, aerate the bioretention soil before planting

Q&A

AGENDA

- introduction
- permit background and definitions
- minimum requirement #1
- minimum requirement #5
- O&M requirements
- code updates
- jeopardy
- wrap up
MINIMUM REQUIREMENT #5

LID addressed on 3 levels:
1. Site & Subdivision
   - MR #5
2. Development Codes
   - Incorporate LID into codes
3. Watershed Scale
   - Watershed scale planning (Phase I’s only)

MINIMUM REQUIREMENT #5

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

*Note: additional thresholds for replaced hard surfaces apply to application of Min. Requirements #6 and #7
MINIMUM REQUIREMENT #5
Redevelopment Thresholds

Min. Requirements #1 - #9:

- ≥ 5,000 sq. ft. new 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

*Note: additional thresholds for replaced hard surfaces apply to application of Min. Requirements #6 and #7

MINIMUM REQUIREMENT #5
Implementation options:

- List #1
- List #2
- LID Performance Standard

MINIMUM REQUIREMENT #5

MR #5 applies to:

Projects triggering MR #1-#5 only
- List #1 or LID Performance Standard Applies

Projects triggering MR #1-#9
- List #2 or LID Performance Standard Applies
MINIMUM REQUIREMENT #5

Revisions to MR #5 since the 2005 SWMMWW:
- More detailed design criteria
- Lists #1 and #2
- LID Performance Standard
- Infeasibility criteria
- Limited applicability in flow control exempt areas

MINIMUM REQUIREMENT #5: Flow Control Exempt Projects

- Implement the following BMPs where feasible:
  - BMP T5.13: Post-Construction Soil Quality and Depth
  - BMP T5.11A, B, or C: Downspout Full Infiltration, Downspout Dispersion Systems, or Perforated Stub-out Connections
  - BMP 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.
- If the project triggers only MRs #1 - #5, No additional requirements.
- If the project triggered only MR #7, See flow chart for MR #7.

MINIMUM REQUIREMENT #5: Projects Triggering MR #1-5

- Does the project developer choose to meet the LID Performance Standard?
  - Yes
  - No project developer chose List #1
    - Yes
    - No, the project triggered only MR #7
      - See flow chart for MR #7.
  - No project developer chose List #1
    - No, the project triggered only MR #7
      - See flow chart for MR #7.

- Does the project discharge to Flow Control Exempt Waters (per Minimum Requirement (MR) #7)?
  - Yes
  - No

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

Based on Ecology SWMMWW Presentation

MINIMUM REQUIREMENT #5: Projects

- Did the project developer choose to meet the LID Performance Standard?
  - Yes
  - No

- Does the project trigger only MRs #1 - #5?
  - Yes
  - No, the project triggered only MR #7
    - See flow chart for MR #7.
  - No project developer chose List #1
    - No, the project triggered only MR #7
      - See flow chart for MR #7.

- Does the project discharge to Flow Control Exempt Waters (per Minimum Requirement (MR) #7)?
  - Yes
  - No

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

Based on Ecology SWMMWW Presentation
### MINIMUM REQUIREMENT #5: Projects

**Triggering MR #1-#9**

<table>
<thead>
<tr>
<th>Project Type &amp; Location</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development (new or redevelopment) on any parcel inside the UGA, or development outside the UGA on a parcel less than 5 acres</td>
<td>LID Performance Standard and BMP T5.13 OR List #2 (applicant option)</td>
</tr>
<tr>
<td>Development (new or redevelopment) outside the UGA on a parcel of 5 acres or larger</td>
<td>LID Performance Standard and BMP T5.13</td>
</tr>
</tbody>
</table>

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**MINIMUM REQUIREMENT #5: Projects**

**Triggering MR #1-#9**

**Diagram**

**MINIMUM REQUIREMENT #5: LIST OPTION**

<table>
<thead>
<tr>
<th>Lawn and Landscaped Areas</th>
<th>Roofs</th>
<th>Other Hard Surfaces</th>
</tr>
</thead>
</table>

Consider all the BMPs in the order listed and use the first BMP that is considered feasible.
MINIMUM REQUIREMENT #5: LIST #1

Lawn and Landscaped Areas

1. Soil Quality and Depth (BMP T5.13)

Roofs

1. Full Dispersion or Downspout Full Infiltration (T5.30 or T5.10A)
2. Rain Gardens or Bioretention (T5.14A or B)
3. Downspout Dispersion Systems (T5.10B)
4. Perforated Stub-out Connections (T5.10C)

Other Hard Surfaces

1. Full Dispersion (T5.30)
2. Permeable Pavement, Rain Gardens, or Bioretention
   - (T5.15, T5.14A, T5.14B)
   - Rain Garden or Bioretention area > 5% of drainage area
3. Sheet Flow Dispersion, or Concentrated Flow Dispersion (T5.12 or T5.11)

Source: Ecology SWMMWW Presentation

MINIMUM REQUIREMENT #5: LIST #2

Lawn and Landscaped Areas

1. Soil Quality and Depth (BMP T5.13)

Roofs

1. Full Dispersion or Downspout Full Infiltration (T5.30 or T5.10A)
2. Bioretention (T5.14B)
3. Downspout Dispersion Systems (T5.10B)
4. Perforated Stub-out Connections (T5.10C)

Other Hard Surfaces

1. Full Dispersion (T5.30)
2. Permeable Pavement (T5.15)
3. Bioretention (T5.14B)
4. > 5% of drainage area
5. Sheet Flow Dispersion, or Concentrated Flow Dispersion (T5.12 or T5.11)

MINIMUM REQUIREMENT #5: LID PERFORMANCE STANDARD

Match pre-developed durations from 8% of the 2-year peak flow to 50% of the 2-year peak flow

Flow Control Standard addresses higher, less frequent stormwater flows

LID Performance Standard addresses lower, more frequent stormwater flows

Source: Ecology SWMMWW Presentation
MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA

- The feasibility of each LID BMP is determined by:
  1. Infeasibility Criteria (bioretention, rain gardens, permeable pavement, downspout infiltration)
     - Some infeasibility criteria require a geotechnical evaluation and written recommendation
  2. Design Criteria
  3. BMP Limitations
  4. Competing Needs Criteria (Volume V, Chapter 5)

MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA

- Bioretention and rain gardens

  Requires 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

MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA

- Bioretention and rain gardens

  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 50 feet from top of slopes that are greater than 20% & over 10 feet of vertical relief
  - Within 10 feet of small on-site disposal drainfield, including reserve areas
  - On a slope ≥ 8%
  - (NEW) Based on local government geographic designation of high GW or inadequate infiltration rates
**MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA**

### Bioretention and Rain Gardens

Criteria not requiring justification, but possibly professional services

- Within certain areas with soil or groundwater contamination
- Within 100 feet of a closed or active landfill
- Within 100 feet 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

---

### Permeable Pavement

Requires 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

---

### Permeable Pavement

Criteria not requiring justification, but possibly professional services

- Area designated as erosion or landslide hazard
- Within 50 feet from top of slopes greater than 20%
- Known soil or groundwater contamination
- Fill soils that can be unstable when saturated
- At multi-level parking garages and over culverts & bridges
- Where saturated conditions within 1 foot of bottom of base course
MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA

**Permeable Pavement**

Criteria not requiring justification, but possibly professional services

- **(NEW)** Roads that receive more than very low traffic volumes and more than very low truck traffic (>400 vehicles on average daily and through truck traffic)
- Native soils don't meet soil suitability criteria
- Infiltration less than 0.30 in/hr
- Soils unsuitable for loads when saturated
- Replacing impervious unless NON-PGIS over soil > 4in/hr

---

**MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA**

**Permeable Pavement**

Criteria not requiring justification, but possibly professional services

- In high use sites
- Areas with "industrial activity"
- Where concentrated spill risk is higher
- Routine heavy sand applications in frequent snow zones
- **(NEW)** Based on local government geographic designation of high GW or inadequate infiltration rates

---

**MINIMUM REQUIREMENT #5: INFEASIBILITY CRITERIA**

**Downspout full infiltration systems**

- Feasible if the following are met:
  - ≥ 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 to the seasonal high groundwater table
  - The system can meet the minimum design criteria specified
MINIMUM REQUIREMENT #5:
INFEASIBILITY CRITERIA
Post-construction soil quality & depth

• Infeasible on till soil slopes greater than 33%
MINIMUM REQUIREMENT #5:
RAIN GARDEN SIZING

Rain Garden Handbook for Western Washington Sizing Method:
1. Determine soil infiltration rate using simple infiltration test
2. Determine the drainage area
   • Driveway
   • Rooftop
   • Landscape areas
   • Other drainage areas
3. Determine rainfall depth in your area
4. Decide on ponding depth (6 or 12 inches)
5. Use Rain Garden Sizing Chart

Ecology Minimum Sizing Requirement:
“Size rain garden to have horizontally projected surface area below the overflow which is at least 5% of the total surface area draining to it.”

MINIMUM REQUIREMENT #2 and #5 QUIZ

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
</table>

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O&M 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

O&M REQUIREMENTS: Vary By Permittee

- Phase II requirements are somewhat less extensive
- Secondary permittee requirements vary

Timeline for updating maintenance standards

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implement maintenance standards</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Adopt or update ordinance or other enforceable documents</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Implement practices, policies, &amp; procedures to reduce SW impacts associated with runoff*</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Requirements for O&M including (but not limited to): pipe cleaning, cleaning conveyance structures, sediment and erosion control, and vegetation management.
### O&M REQUIREMENTS: Plan Review

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Verify maintenance plan completed &amp; O&amp;M responsibility assigned</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Verify submission of maintenance instructions</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Verify that O&amp;M manual is complete</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Review and approve declaration of covenant (including design details, figures and maintenance instructions) and grant of easement</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### O&M REQUIREMENTS: Inspection

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Legal authority to inspect private stormwater facilities and enforce maintenance standards</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Conduct post-construction inspections to ensure proper installation</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

### O&M REQUIREMENTS: Inspection (continued)

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conduct inspections during construction in new residential developments*</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Conduct ongoing annual inspections</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Perform spot checks for potentially damaged BMPs owned/operated by Permittee after major storm events</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Every 6 months until 90% of the lots are constructed or when construction is stopped and the site is fully stabilized.
O&M REQUIREMENTS: Enforcement

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforce compliance with maintenance standards as needed based on inspection</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

O&M REQUIREMENTS: Training

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Train staff involved in plan review, permitting, construction site inspections, &amp; enforcement</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Implement an ongoing training program for employees who have primary O&amp;M job functions that may impact SW quality</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

O&M REQUIREMENTS: Record Keeping

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Keep records of inspections and enforcement actions (e.g., inspection reports, notices of violations)</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
O&M REQUIREMENTS: Mapping

<table>
<thead>
<tr>
<th>Requirement</th>
<th>On-site SW Management BMPs</th>
<th>SW Treatment &amp; Flow Control BMPs/Facilities (MR #6 and/or MR #7)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scale drawing of the lot(s) and public ROW that show BMP locations</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Map BMPs owned/operated by Permittee</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Map connections between BMPs and tributary conveyances *</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

*Phase I Only

O&M REQUIREMENTS: Minimum
Requirement #9

- A site specific O&M Manual is required for proposed treatment and flow control stormwater facilities
- The O&M Manual should include:
  - Description of facility
  - What it does
  - How it works
  - Maintenance tasks and frequencies
  - Maintenance log format
- Must be made available for inspection by the local government

O&M REQUIREMENTS: LID O&M Guidance Document

- LID O&M Guidance Document includes:
  - Facility description
  - Key maintenance considerations to ensure facility function
  - Key operations to ensure facility function
  - Maintenance standards and procedures tables
  - Equipment and materials list
  - Administrative tools and guidance
AGENDA

- introduction
- permit background and definitions
- minimum requirement #1
- minimum requirement #5
- O&M requirements
- code updates
- jeopardy
- wrap up

LID CODE REVIEW: Permit Requirements

- Review, revise, and create effective local development-related codes, rules, standards, or other enforceable documents to incorporate and require LID principles and LID BMPs.
- Intent of the revisions shall be to make LID the preferred and commonly-used approach to site development.
- Minimize impervious surface, native vegetation loss, and stormwater runoff.

LID CODE REVIEW: Permit Requirements

- Submit a summary of the results of the review and revision process which includes the following (at a minimum):
  - A list of participants (job title, brief job description, and department represented)
  - Codes, rules, standards, and other enforceable documents reviewed
  - Revisions made to those documents to incorporate and require LID principles and LID BMPs.
LID CODE REVIEW: Permit Requirements

- The summary shall include:
  - Existing requirements for LID principles and LID BMPs in development-related codes.
- The summary shall be organized as follows:
  a) Measures to minimize impervious surfaces.
  b) Measures to minimize loss of native vegetation.
  c) Other measures to minimize stormwater runoff.

LID CODE REVIEW: Timeline

- Different deadlines for Phase I and Phase II permittees.

<table>
<thead>
<tr>
<th>Phase I</th>
<th>Phase II</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per Section S5.C.5.b of the Phase I Permit</td>
<td>Per Section S5.C.6.1 of the Phase II Permit</td>
</tr>
<tr>
<td>Most</td>
<td>Lewis Co. and Cowlitz Co.</td>
</tr>
</tbody>
</table>

* = Or GMA update deadline

LID CODE REVIEW: Timeline

- Summary Report:
  - Most Phase II’s: March 2017.
  - Lewis and Cowlitz Counties and new permittees (City of Lynden and City of Snoqualmie): March 2018.
AGENDA

introduction
permit background and definitions
minimum requirement #1
minimum requirement #5
O&M requirements
code updates
jeopardy
wrap up
Statewide LID Training Program

COURSE CATALOG

INTRODUCTORY

2.1 Introduction to LID for Inspection & Maintenance Staff

INTERMEDIATE

3.1 Intermediate LID Topics: BMPs & Site \& T & R Requirements

3.2 Intermediate LID Design: Bioswales

3.3 Intermediate LID Design: Permeable Pavement

3.4 Intermediate LID Design: Site Hydrology \& Vegetated Roofs

3.5 Intermediate LID Design: Hydrologic Modeling

ADVANCED

5.0 Advanced Topics for Long-term LID Operations: Bioretention

5.1 Advanced Topics for Long-term LID Operations: Permeable Pavement

5.2 Advanced Topics in LID Design: Site Hydrology Modeling

5.3 Advanced Topics in LID Design: Site Hydrology \& Vegetated Roofs

5.4 Advanced Topics in LID Design: Site Assessment, Planning \& Layout

5.5 Advanced Topics in LID Design: Rainwater Collection Systems \& Vegetated Roofs

OVERVIEW OF PROGRAM

ONLINE EVALUATION

- An online evaluation will be sent to you within 5 days following this training

http://www.wastormwatercenter.org/lidswtrainingprogram/
Two certificates:
• LID Design certificate
• Long-term LID Operations certificate

Sign out! You must do this to confirm completion of today's training!

For information on training and other resources, visit the Washington Stormwater Center website:
http://www.wastormwatercenter.org

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Further questions? Contact:
training@cascadiaconsulting.com
(206) 449-1163