DEPARTMENT OF ECOLOGY
State of Washington

Statewide LID Training Program

INSTRUCTORS

REBECCA DUGOPOLSKI, PE

Senior Engineer

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

HERRERA

KATHY GWILYM, PE

Principal Civil Engineer

Key project experience: Complete street design, LID and permeable pavements for public works and private projects

MIG | SvR

AGENDA

introduction

permeable pavement O&M

O&M costs

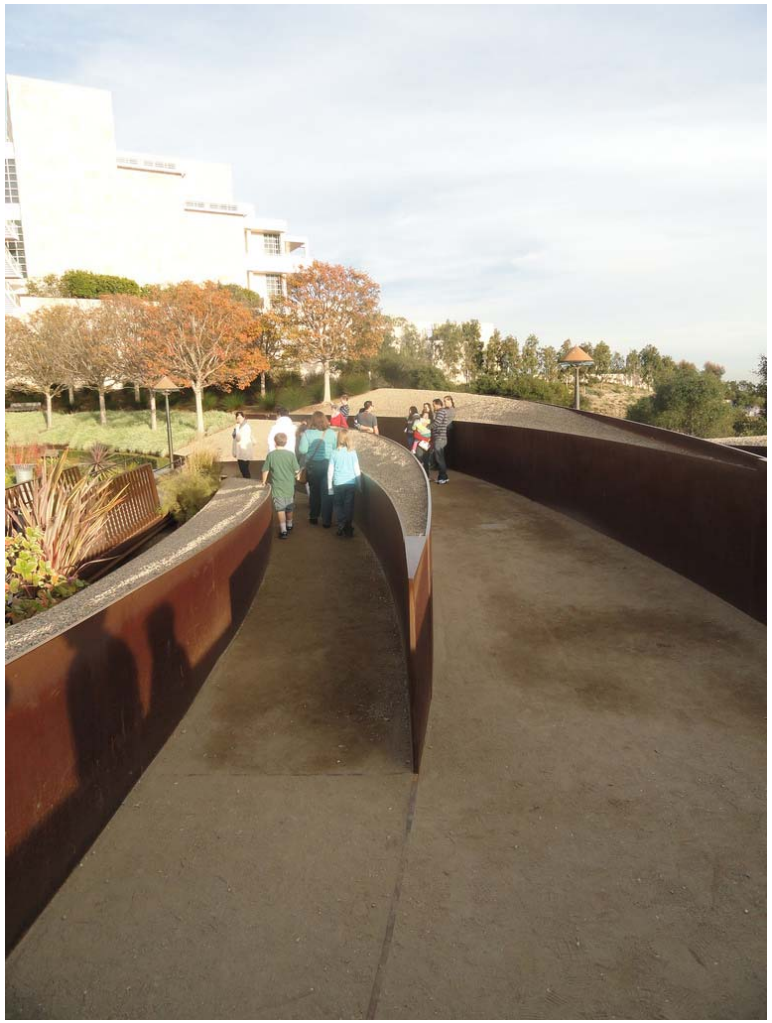
administrative tools

wrap up & field exercises

LEARNING OBJECTIVES

1. Understand the structure and function of permeable pavement components.
2. Gain an in-depth understanding of the primary inspection activities and tools to maintain permeable pavement function over time.
3. Know the primary maintenance requirements for permeable pavement.
4. Identify maintenance problems and associated solutions necessary for long-term function of permeable pavement areas.

LOGISTICS



SCHEDULE

- Classroom training: 9:00-12:00
- Lunch (provided): 12:00-12:45
- Classroom training: 12:45-1:30
- Field exercises: 1:30-3:30

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.**
- **2012-2013: Washington State LID Training Plan developed: www.wastormwatercenter.org/lid-background**
- **2014: Training program built from state LID Training Plan.**

Statewide LID Training Program

PROGRAM OVERVIEW

- 49 trainings in western and eastern WA in 2014-2015.
- 42 trainings in western and eastern WA in 2015-2016.
- 39 trainings offered in western and eastern WA in 2017.
- Three levels: Introductory, Intermediate, and Advanced.
- Statewide LID Certificate now available.

Statewide LID Training Program

OVERVIEW OF PROGRAM

PROJECT LEAD

HERRERA

CORE TEAM

CASCADIA CONSULTING GROUP

WASHINGTON STORMWATER CENTER

ADDITIONAL TRAINING SUPPORT

ch2m

MIG | SvR

associated earth sciences incorporated

City of Puyallup, State of Washington

Kindred Hydro

MITHŪN

Mutual Materials® Trusted Since 1900

Leaping Frog Films

Statewide LID Training Program

OVERVIEW OF PROGRAM

INTRODUCTORY

- 2.1 Introduction to LID for Inspection & Maintenance Staff

INTERMEDIATE

- 3.1 Intermediate LID Topics: NPDES Phase I & II Requirements
- 3.2 Intermediate LID Design: Bioretention
- 3.3 Intermediate LID Design: Permeable Pavement
- 3.4 Intermediate LID Design: Site Assessment, Planning & Layout
- 3.5 Intermediate LID Design: Rainwater Collection Systems & Vegetated Roofs
- 3.6 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: Bioretention
- 5.3 Advanced Topics in LID Design: Permeable Pavement
- 5.4 Advanced Topics in LID Design: Site Assessment, Planning & Layout
- 5.5 Advanced Topics in LID Design: Rainwater Collection Systems & Vegetated Roofs
- 5.6 Advanced Topics in LID Design: Hydrologic Modeling
- 6.2 Advanced Topics in LID Design: Bioretention Media and Compost Amended Soils

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- 3.6 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: Bioretention
- 5.3 Advanced Topics in LID Design: Permeable Pavement
- 5.4 Advanced Topics in LID Design: Site Assessment, Planning & Layout
- 5.5 Advanced Topics in LID Design: Rainwater Collection Systems & Vegetated Roofs
- 5.6 Advanced Topics in LID Design: Hydrologic Modeling
- 6.2 Advanced Topics in LID Design: Bioretention Media and Compost Amended Soils

Statewide LID Training Program

DEPARTMENT OF ECOLOGY
State of Washington

ADVANCED TOPICS FOR LONG-TERM LID OPERATIONS: PERMEABLE PAVEMENT

5.1

introduction

permeable pavement O&M

O&M costs

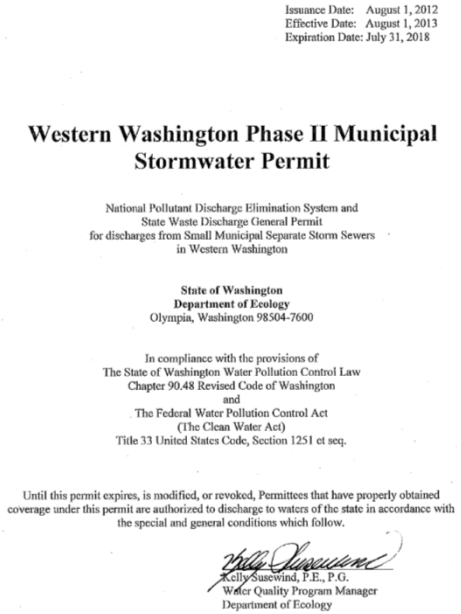
administrative tools

wrap up & field exercises

TOPICS

Intro to LID

NPDES Permit



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Western Washington Phase II Municipal Stormwater Permit

National Pollutant Discharge Elimination System and
State Waste Discharge General Permit
for discharges from Small Municipal Separate Storm Sewers
in Western Washington

State of Washington
Department of Ecology
Olympia, Washington 98504-7600

In compliance with the provisions of
The State of Washington Water Pollution Control Law
Chapter 90.48 Revised Code of Washington
and
The Federal Water Pollution Control Act
(The Clean Water Act)
Title 33 United States Code, Section 1251 et seq.

Until this permit expires, is modified, or revoked, Permittees that have properly obtained coverage under this permit are authorized to discharge to waters of the state in accordance with the special and general conditions which follow.

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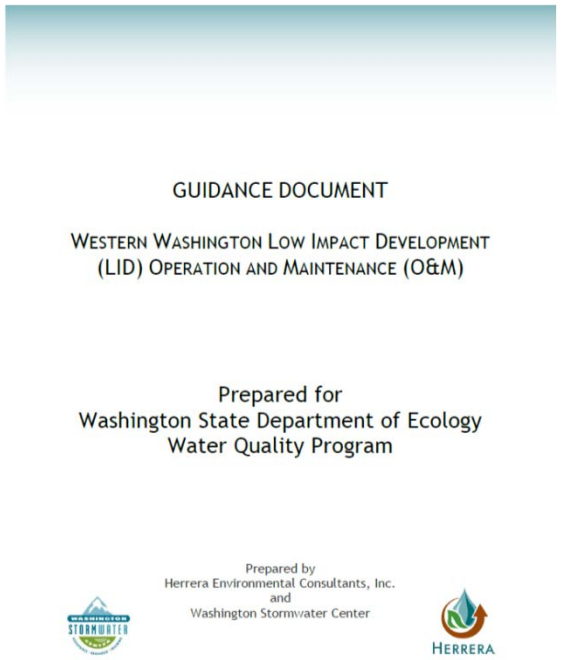
Water Quality Program Manager
Department of Ecology

LID O&M Guidance Document



GUIDANCE DOCUMENT

WESTERN WASHINGTON LOW IMPACT DEVELOPMENT
(LID) OPERATION AND MAINTENANCE (O&M)

Prepared for
Washington State Department of Ecology
Water Quality Program

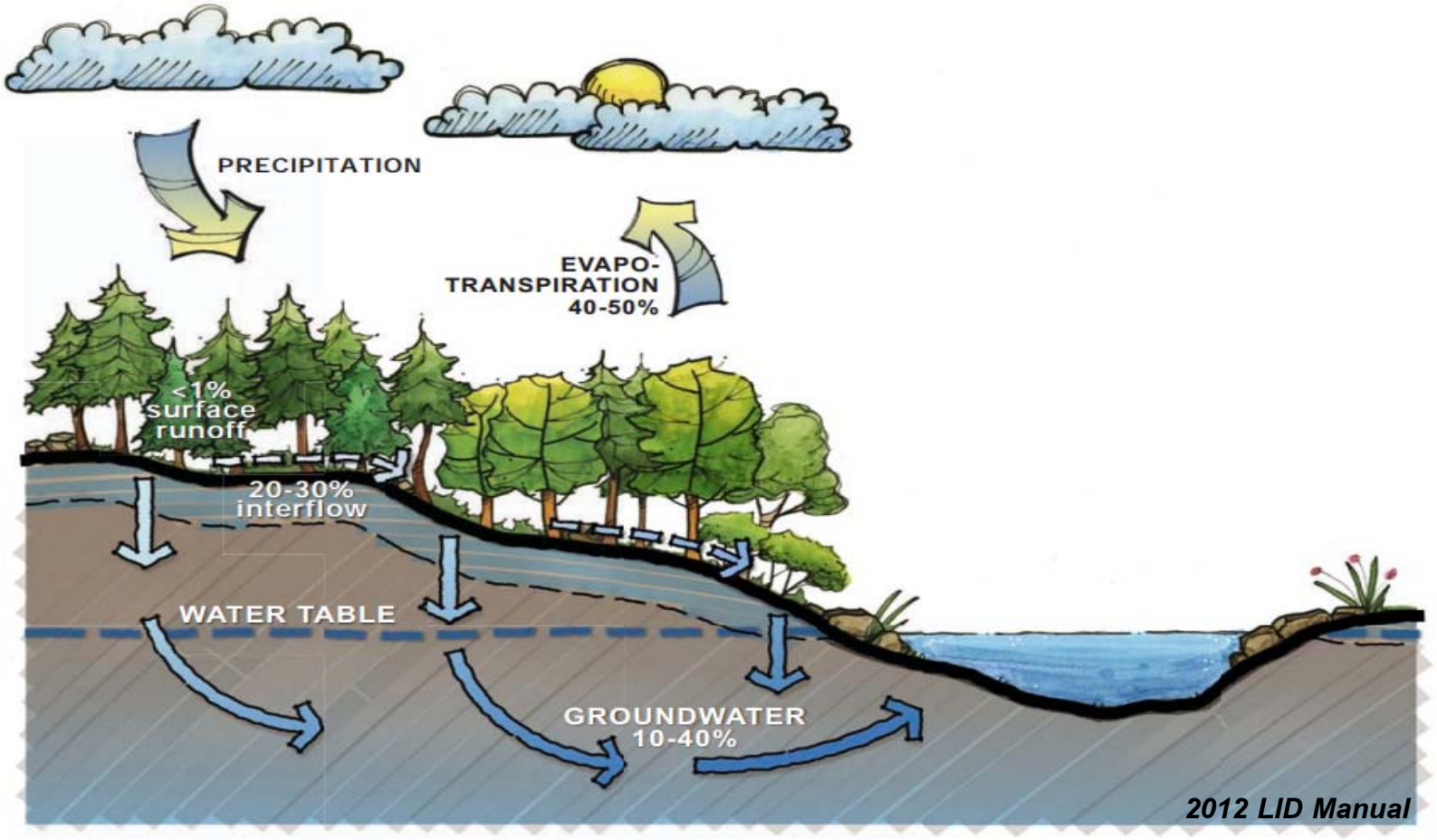
Prepared by
Herrera Environmental Consultants, Inc.
and
Washington Stormwater Center

HERRERA

LOW IMPACT DEVELOPMENT (LID):
Introduction to Principles

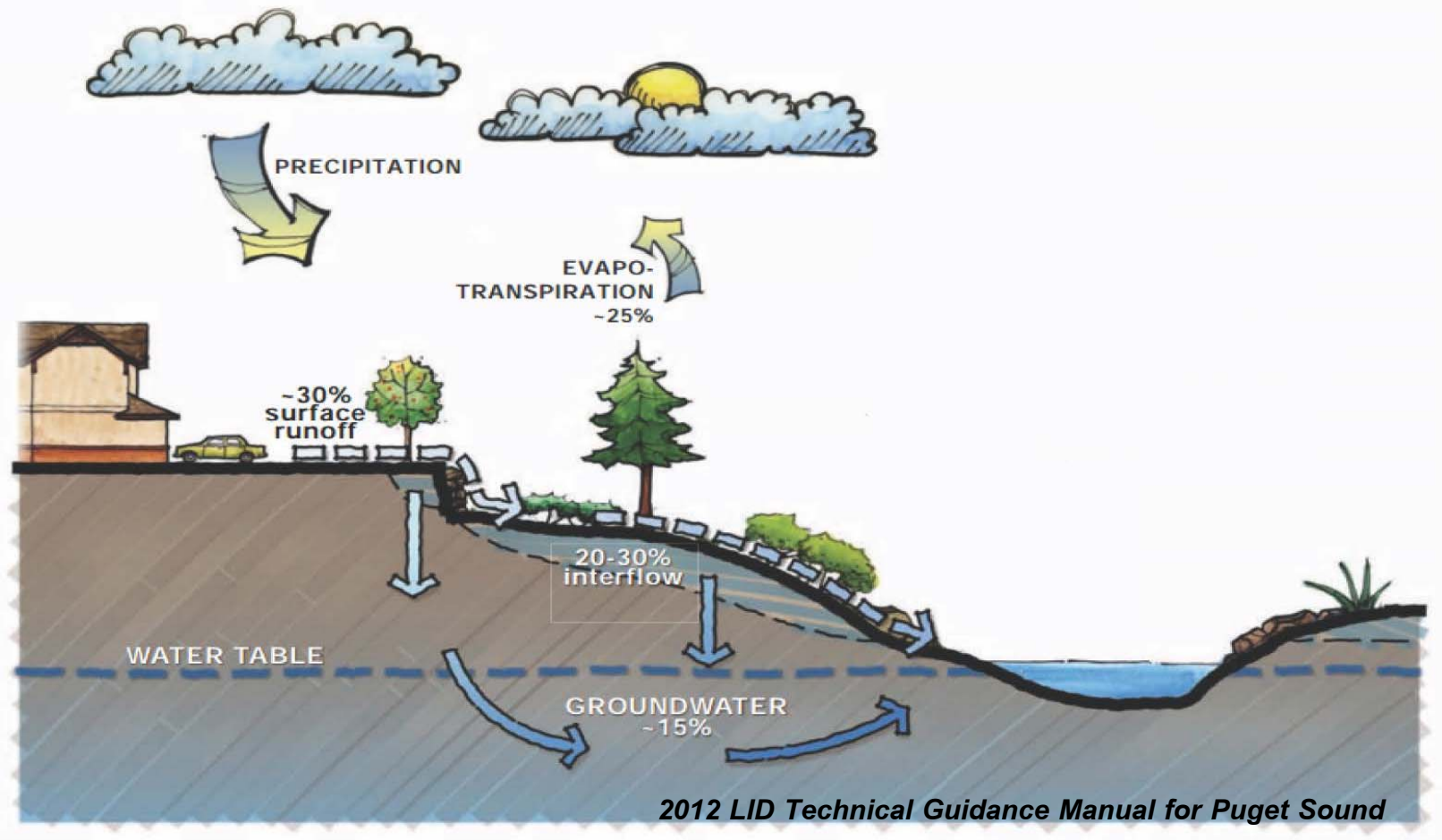
- **Site design & planning techniques emphasizing conservation**
- **Use of small-scale engineered controls to closely mimic pre-development hydrologic processes**
- **Careful assessment of site soils and strategic site planning to best use those soils for stormwater management**

LID: Introduction to Principles: Pre-developed Forest Hydrology



2012 LID Manual

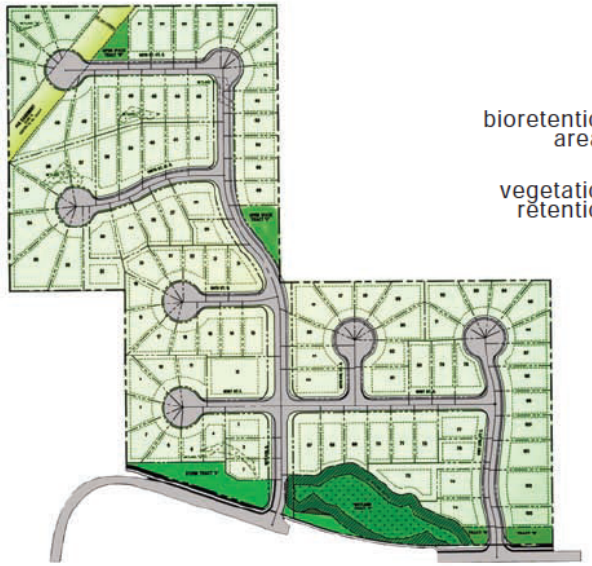
LID: Introduction to Principles: Developed Condition Hydrology

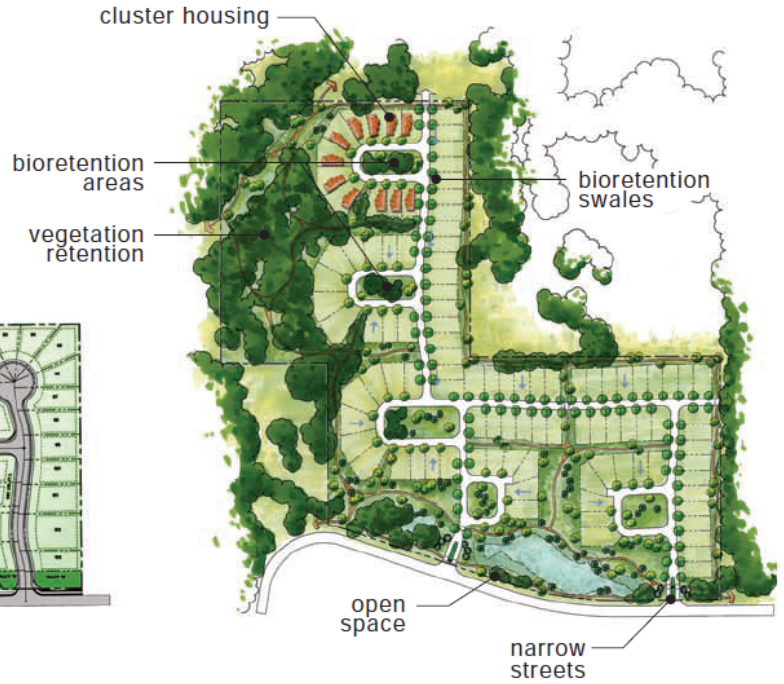


2012 LID Technical Guidance Manual for Puget Sound

LID: Site Design and Planning Techniques

- **Minimize disturbance**
- **Reduce impervious surface**
- **Protect and restore native soils and vegetation**
- **Manage stormwater close to the source**

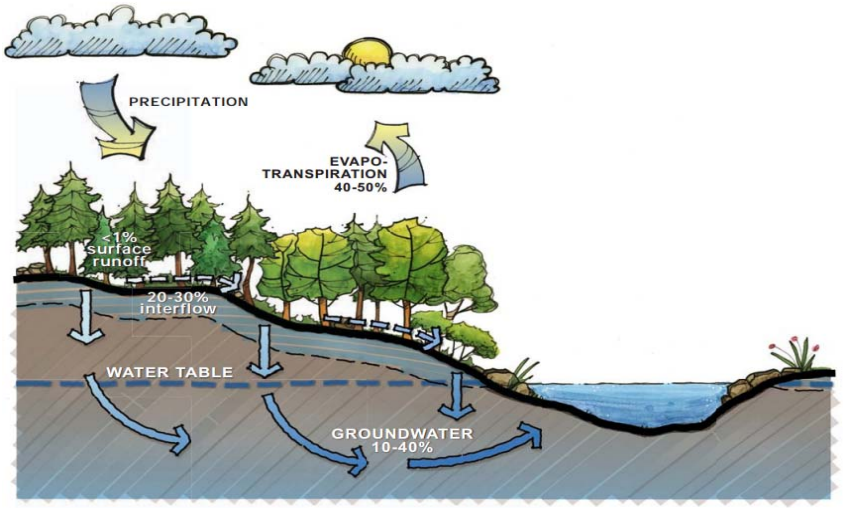




Traditional ***LID***

LID: Small-Scale Engineering Controls

- **Infiltration**
- **Filtration**
- **Storage**
- **Evaporation**
- **Transpiration**



Conserve or regain pre-developed hydrologic functions

Synonyms for LID BMPs:

***G**reen **S**tormwater **I**nfrastructure **(GSI), I**ntegrated **M**anagement **P**ractices **(IMPs),** and On-Site Stormwater Management BMPs*

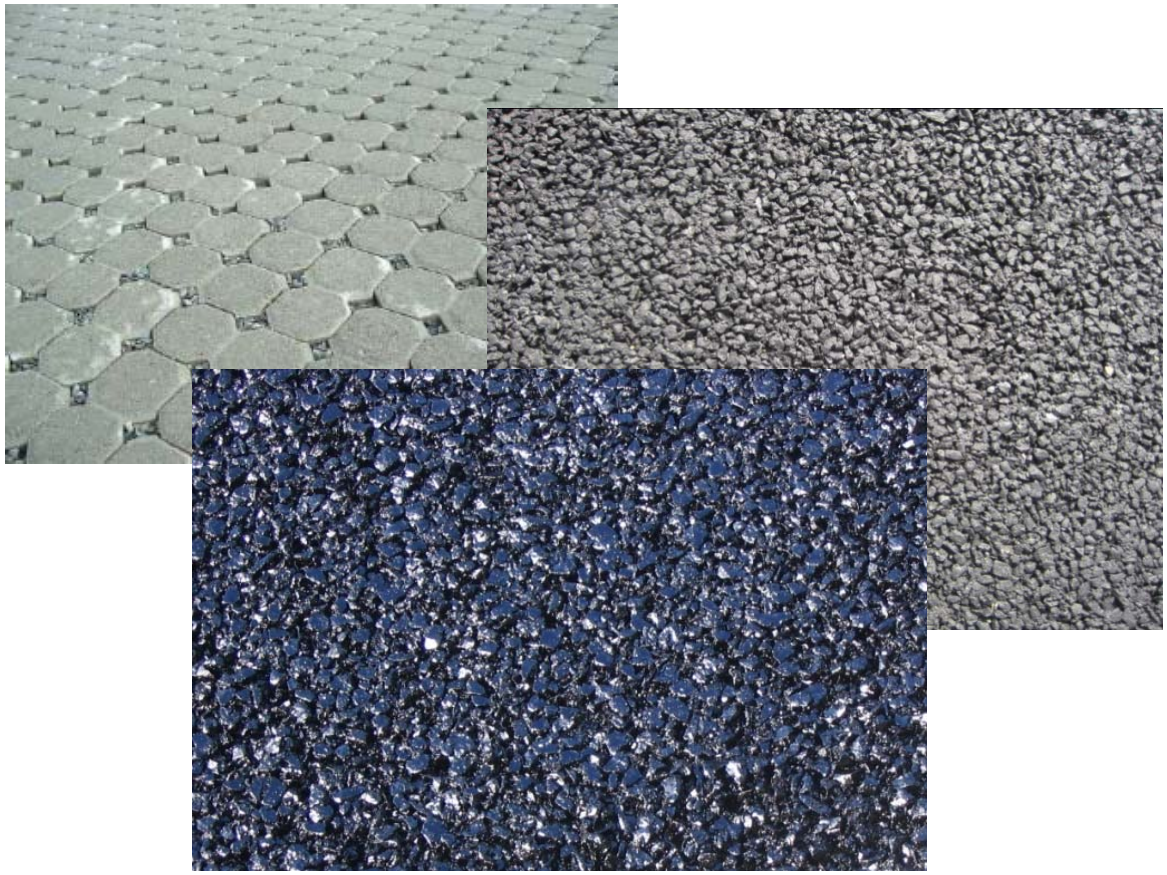
LID: Best Management Practices (BMPs)

- Rain Gardens (BMP T5.14A)
- Bioretention (BMP T5.14B)
- Permeable Pavement (BMP T5.15)
- Vegetated Roofs (BMP T5.17)
- Downspout Full Infiltration (BMP T5.10A)
- Downspout Dispersion (BMP T5.10B)
- Concentrated Flow Dispersion (BMP T5.11)
- Sheet Flow Dispersion (BMP T5.12)
- Compost Amended Soils (BMP T5.13)

Park Place

LID: Permeable Pavement

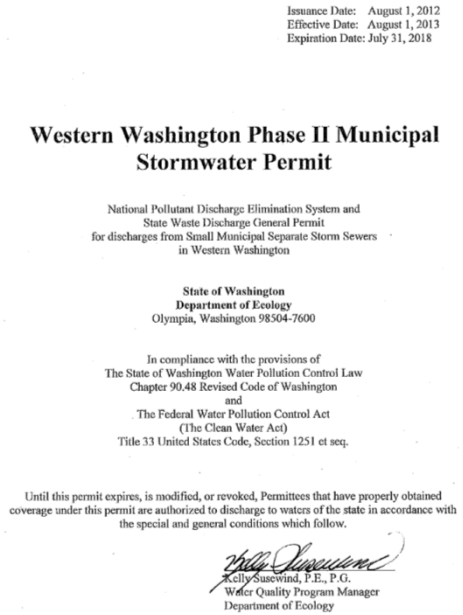
- **Infiltration**
- **Filtration**
- **Storage**
- **Evaporation**
- Transpiration



TOPICS

Intro to LID

NPDES Permit



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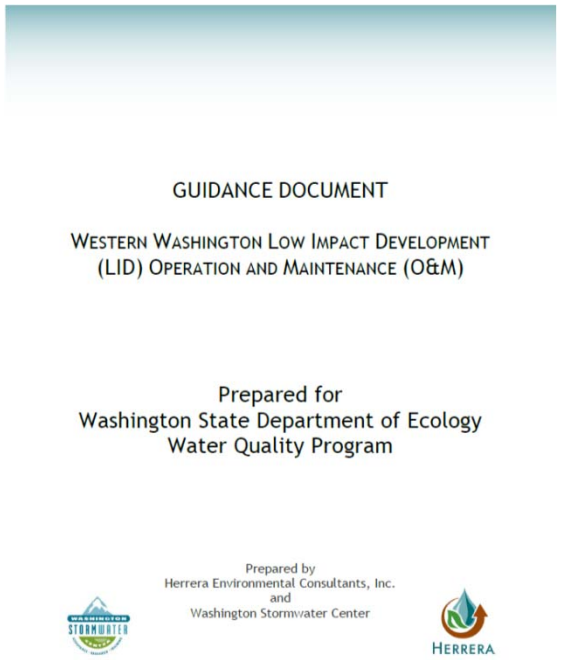

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NPDES PERMIT LID O&M REQUIREMENTS:
Western WA NPDES Permit

National Pollutant Discharge Elimination System (NPDES) Municipal Stormwater Permits

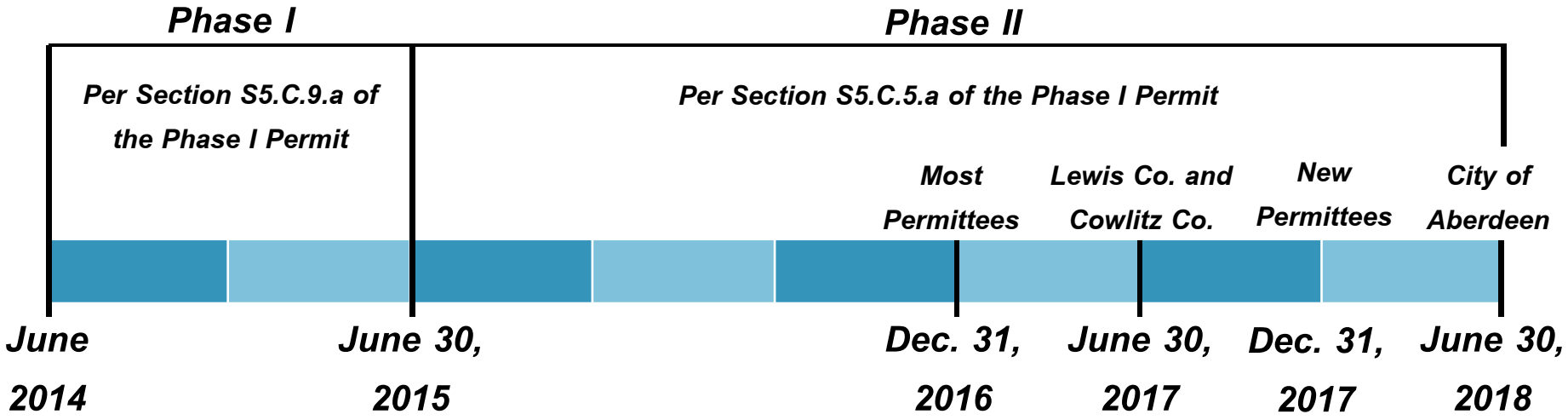
Municipal Stormwater Permittees in Washington State		
Phase 1 Permittees	**Western Washington Phase II Permittees**	**Eastern Washington Phase II Permittees**
Seattle Tacoma Clark County King County Pierce County Snohomish County WSDOT	82 Cities 5 Counties WSDOT	18 Cities 5 Counties
Secondary Permittees: Approximately 45; such as ports and universities		

To see a listing of permittees visit
http://www.ecy.wa.gov/programs/wq/stormwater/municipal/MuniStrmWtrPermList.html

NPDES PERMIT LID O&M REQUIREMENTS:
Requirements Vary By Permittee

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

Timeline for updating maintenance standards



NPDES PERMIT LID O&M REQUIREMENTS:
Requirements Vary By BMP Classification

- **On-site Stormwater Management BMPs**

- **Stormwater Treatment and Flow Control BMPs/Facilities**

NPDES MUNICIPAL STORMWATER PERMIT: Minimum Requirements (MRs)

1. Preparation of Stormwater Site Plans
2. **Construction SWPPP**
3. Source Control
4. Preserve natural Drainage
5. **On-Site Stormwater management**
6. **Run-off Treatment**
7. **Flow Control**
8. Wetlands Protection
9. O&M

NPDES PERMIT LID O&M REQUIREMENTS:
Minimum Requirements (MRs)

- **MR #2 – Construction Stormwater Pollution Prevention Plan (SWPPP)**
  - Protect LID BMPs from sediment and compaction
- **MR #5 – On-site Stormwater Management**
  - Infiltrate, disperse, and retain runoff on-site to the extent feasible

Lotus Springs

NPDES PERMIT LID O&M REQUIREMENTS:
Minimum Requirements (MRs)

- **MR #6 – Runoff Treatment**
  - Water quality treatment for pollution-generating areas
- **MR #7 – Flow Control**
  - Control of flow peaks and flow durations

NPDES PERMIT LID O&M REQUIREMENTS:
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**

NPDES PERMIT LID O&M REQUIREMENTS:
On-site Stormwater Management BMPs

- **Includes the following LID BMPs:**
  - Rain Gardens (BMP T5.14A)
  - Bioretention (BMP T5.14B)
  - Permeable Pavement (BMP T5.15)
  - Vegetated Roofs (BMP T5.17)
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  - Compost Amended Soils (BMP T5.13)

DEFINITIONS

On-site SW Management BMPs (LID BMP)

- *"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

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 1 Minimum Requirements #6 (treatment), #7 (flow control), or both"*

Western Washington Phase II Municipal Stormwater Permit

DEFINITIONS

Subset of On-site Stormwater Management BMPs used to meet MR #6 or MR #7 (may also be used to meet MR #5)

Onsite SW Management BMP	Flow Control Credit	Treatment Credit[1]
Soil Amendment	X	
Dispersion	X	X
Retaining & Planting Trees	X	
Rainwater Harvesting	X	
Bioretention[3]	**X**	**X**
Permeable Pavement[3]	**X**	**X[2]**
Vegetated Roofs [3]	**X**	

[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 SW Treatment & Flow Control BMPs/Facilities (additional requirements in regard to long term inspection, operations, and maintenance apply)

NPDES PERMIT LID O&M REQUIREMENTS:
O&M Standards

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

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

NPDES PERMIT LID O&M REQUIREMENTS:
Plan Review

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

NPDES PERMIT LID O&M REQUIREMENTS: Inspection

Requirement	On-site SW Management BMPs	SW Treatment & Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Legal authority to inspect private stormwater facilities and enforce maintenance standards	X	X
Conduct post-construction inspections to ensure proper installation	X	X

NPDES PERMIT LID O&M REQUIREMENTS: Inspection (continued)

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

*Every 6 months until 90% of the lots are constructed or when construction is stopped and the site is fully stabilized

NPDES PERMIT LID O&M REQUIREMENTS: Enforcement

Requirement	On-site SW Management BMPs	SW Treatment & Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Enforce compliance with maintenance standards as needed based on inspection		X

NPDES PERMIT LID O&M REQUIREMENTS: Training

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

NPDES PERMIT LID O&M REQUIREMENTS:
Record Keeping

Requirement	On-site SW Management BMPs	SW Treatment & Flow Control BMPs/Facilities (MR #6 and/or MR #7)
Keep records of inspections and enforcement actions (e.g., inspection reports, notices of violations)	X	X

NPDES PERMIT LID O&M REQUIREMENTS: Mapping

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

*Phase I Only

TOPICS

Intro to LID

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LID O&M GUIDANCE DOCUMENT: Objective

- **Support permittees in implementing LID maintenance programs**
- **Provide specific O&M guidance so permittees can create maintenance standards that preserve facility function**
- **Note: Jurisdictions may want to tailor the tables in the O&M guidance document to address varying levels-of-service**

LID O&M GUIDANCE DOCUMENT: Development

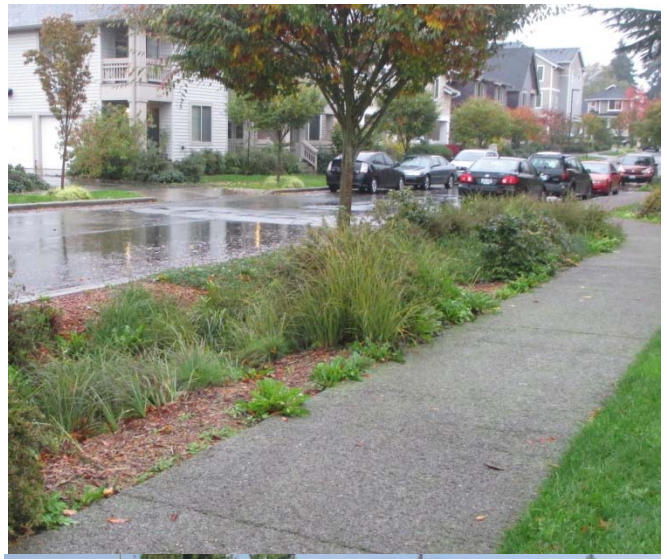
- **Two advisory committees**
  - LID Maintenance Advisory Committee
  - LID Maintenance Administrative Issues Advisory Committee
- **Best available information**
  - Advisory committee input
  - Literature review
  - Targeted surveys sent to jurisdictions, contractors/ landscapers, and vendors
- **Guidance will evolve over time**

LID O&M GUIDANCE DOCUMENT: Content

- **Summary of NPDES Permit Requirements**
- **Maintaining LID BMPs**
  - Bioretention facilities
  - Rain gardens
  - Permeable pavement
  - Vegetated roofs
  - Downspout infiltration systems
  - Downspout, sheet flow, and conc. dispersion systems
  - Compost amended soils
- **Programmatic & Administrative Guidance**

LID O&M GUIDANCE DOCUMENT: Content

- **BMP description**
  - How water moves through facility
- **Key maintenance considerations to ensure facility function**
  - Function by BMP component
  - Key maintenance by BMP component
- **Key operations to preserve facility function**



Photos provided by MIG SvR

LID O&M GUIDANCE DOCUMENT:
Maintenance Standard and Procedures

Table 8 (continued). Maintenance Standards and Procedures for Permeable Pavement.

Component	Recommended Frequency [a]		Condition when Maintenance is Needed (Standards)	Action Needed (Procedures)
	Inspection	Routine Maintenance		
Inlets/Outlets/Pipes (cont'd)				
Overflow	B		Native soil is exposed or other signs of erosion damage are present at discharge point	Repair erosion and stabilize surface
Aggregate Storage Reservoir				
Observation port	A, S		Water remains in the storage aggregate longer than anticipated by design after the end of a storm	If immediate cause of extended ponding is not identified, schedule investigation of subsurface materials or other potential causes of system failure.
Vegetation				
Adjacent large shrubs or trees		As needed	Vegetation related fallout clogs or will potentially clog voids	• Sweep leaf litter and sediment to prevent surface clogging and ponding • Prevent large root systems from damaging subsurface structural components
		Once in May and Once in September	Vegetation growing beyond facility edge onto sidewalks, paths, and street edge	Edging and trimming of planted areas to control groundcovers and shrubs from overreaching the sidewalks, paths and street edge improves appearance and reduces clogging of permeable pavements by leaf litter, mulch and soil.
Leaves, needles, and organic debris		In fall (October to December) after leaf drop (1-3 times, depending on canopy cover)	Accumulation of organic debris and leaf litter	Use leaf blower or vacuum to blow or remove leaves, evergreen needles, and debris (i.e., flowers, blossoms) off of and away from permeable pavement

[a] Frequency: A= Annually; B= Biannually (twice per year); S = Perform inspections after major storm events (24-hour storm event with a 10-year or greater recurrence interval).
[b] Inspection should occur during storm event.

LID O&M GUIDANCE DOCUMENT:
Equipment and Materials List

Table 9. Permeable Pavement Equipment and Materials List.	
Equipment to address clogging of wearing course, such as:	***Weed / vegetation removal equipment, such as:***
☐ Hand held pressure washer or power washer with rotating brushes (not recommended for open-celled aggregate-filled systems) ☐ Walk-behind vacuum (sidewalks) ☐ Pure vacuum sweeper ☐ ShopVac (small areas) ☐ Combined higher pressure wash and vacuum system	☐ Weeding tools ☐ Weed burner ☐ Edging and trimming equipment to control groundcover and other vegetation from extending onto pavement surface
Equipment to remove sediment, debris, and leaf litter, such as:	***Additional equipment for grass-filled open-celled grid systems***
☐ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ☐ Push broom (can also be used to spread and clean aggregate in gravel-filled open-celled grid and permeable paver systems) ☐ Brush broom (course bristled broom) to remove moss ☐ Leaf blower	☐ Mower or mulch mower ☐ Topdress grass seed ☐ Compost ☐ Replacement grid segments
Erosion control equipment (to stabilize adjacent landscaped areas and protect pavement from sediment inputs)*	***Additional equipment for gravel-filled open-celled grid systems***

LID O&M GUIDANCE DOCUMENT:
Skills and Staffing

- List of general skills required
- List of additional specialized skills
- Staffing survey estimates (e.g., crew hours per facility, per linear foot, or per square foot)

Skills Needed for Maintenance of Permeable Pavement

- Sweeper and equipment operation
- Commercial driver's license (CDL)
- Landscaping skills (e.g., general plant care) for grass-filled open-celled grid systems
- Engineer and/or landscape architect for major maintenance

Photo provided by MIG SvR

introduction

permeable pavement O&M

O&M costs

administrative tools

wrap up & field exercises

TOPICS

- Types
- How the system works
- Maintenance considerations for facility function
- General maintenance for all
- Routine maintenance activities specific to each type
- Corrective maintenance activities
- Equipment and material recommendations
- Skills

TYPES & TERMS

Pervious Concrete

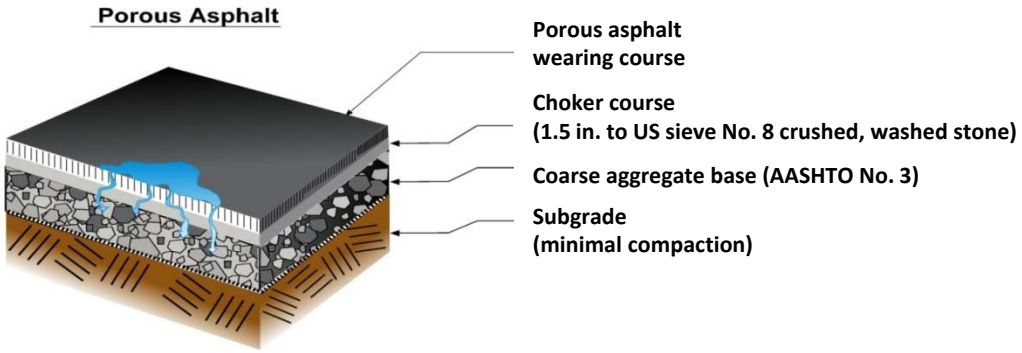
Porous Asphalt

Permeable Interlocking Concrete Pavers

Open Celled Systems (Flexible & Rigid)

Photos provided by MIG SvR

TYPES: Porous Asphalt

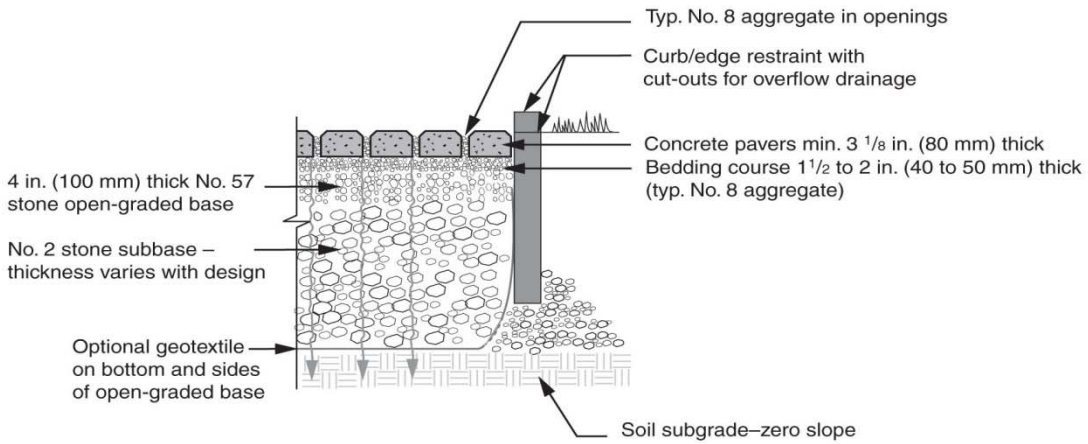


- Flexible, non-proprietary.
- Placement is similar to conventional asphalt but need large quantity.
- Typically used for parking and light traffic loads; however, has been used for medium and heavy applications.
- Initial infiltration rate: 200+ inches/hour.

TYPES: Pervious Concrete

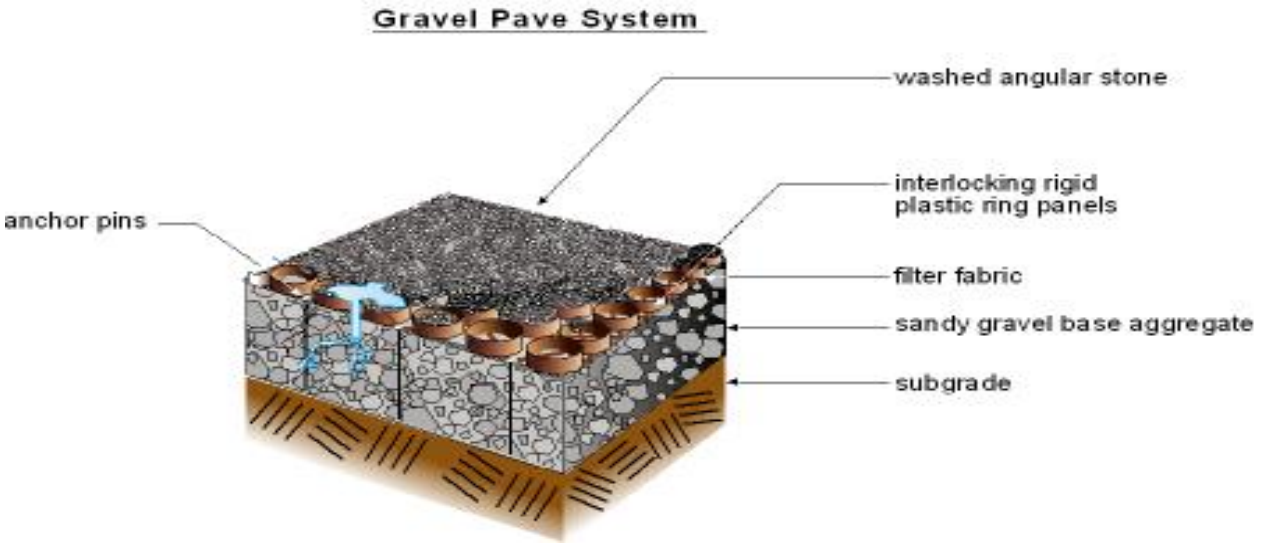
- Rigid, non-proprietary.
- Placement differs from conventional. Small batches feasible.
- 3/8” typical (round or crushed) aggregate w/o to minimal fines. Admixtures (optional) to increase workability and strength.
- Initial infiltration rate 200+ inches/hour.

TYPES: Permeable Interlocking Pavers



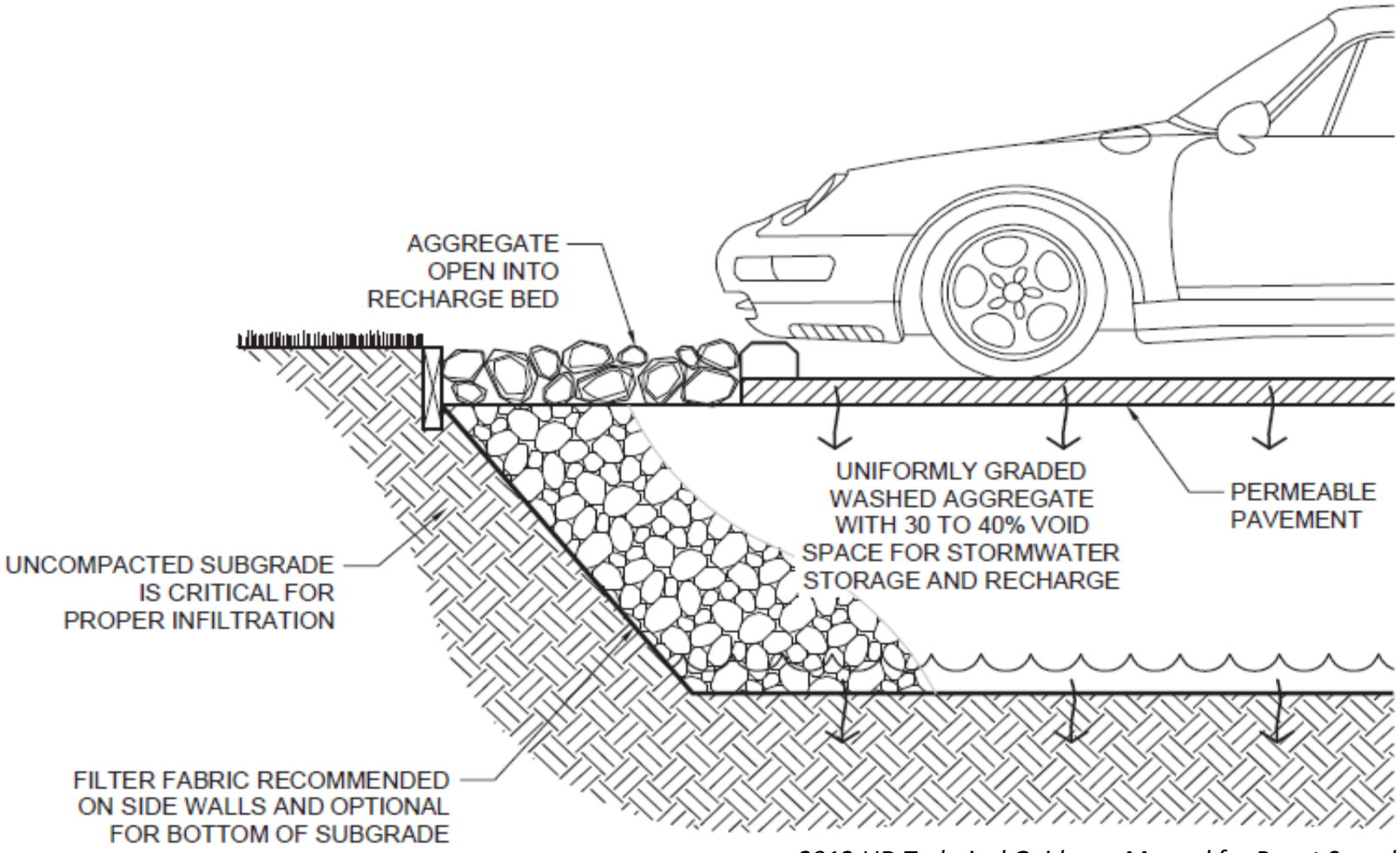
- Flexible, proprietary.
- Capable of high vehicle loads. Used for lower speeds.
- High-density concrete that interlock and transfer vertical loads to surrounding pavers.
- Clean aggregate (w/o fines) filled within the openings/gaps.
- Initial infiltration rates can vary depending upon paver type.

TYPES: Plastic Grids



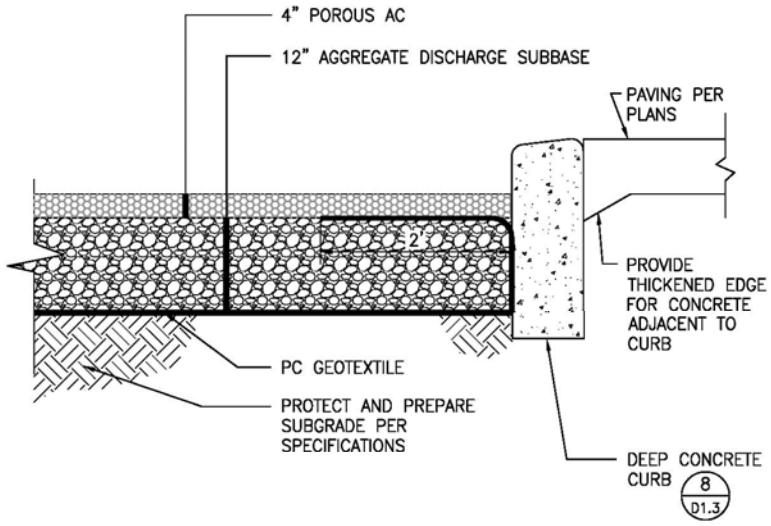
- Flexible, proprietary.
- Plastic grid filled with clean gravel (w/o fines) or soil and planted with grass.
- Trails, paths, maintenance access in a park, parking.
- Highest percent voids.

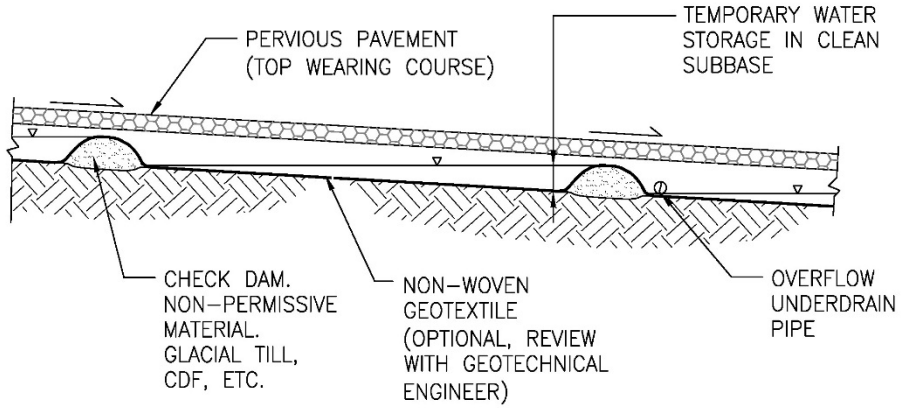
HOW THE FACILITY WORKS



2012 LID Technical Guidance Manual for Puget Sound

HOW THE FACILITY WORKS





- **Sections vary – check as-builts**
  - **Top Wearing Course**
  - **Leveling Course?**
  - **Sub-base (storage)**
  - **Water quality treatment layer?**
  - **Geotextile?**
  - **Native soil**
- **Storage within Sub-base**
  - **Slope conditions – check dams**
- **Overflow (pipe or structure)**

Break

INTRODUCTION TO MAINTENANCE

- "The maintenance of LID facilities is essential to ensure that design stormwater management and other benefits continue over the full lifecycle of the installation."
- What to look for?
  - Drainage Function
  - Safety
  - Aesthetics
- Is it different?
- Long term infiltration capacity can remain high; however……

O&M TRANSITION

- **O&M starts at the Planning phase**
  - Who? How? Why? What? Where?
- **Transitioning from Construction to O&M**
  - Purpose?
  - What are the regulatory reporting requirements?
  - Record/As-built?
  - Training new staff
  - Mapping

Photos provided by MIG SvR

GENERAL: Protection of Surface

Inform crews about protecting permeable pavements.

Use tarps/cover under stockpiles.

Photos provided by MIG SvR

GENERAL: Adjacent Stabilization

Maintain stabilization of adjacent areas to protect from sediment transport.

- **Proactive vs. reactive.**
- **Address the source.**

Photos provided by MIG SvR

GENERAL: Vegetation Migration & Rooting

- **Ground Cover Migration.**
- **Cover if Hydroseeding.**
- **Options for Maintenance:**
  - Modify planting plan and remove invasive plants.
  - Maintain adjacent landscaping.

Ground cover migration happens even with conventional pavement

Photos provided by MIG SvR

GENERAL: Moss Growth

- Be careful with expectations
- Moss is present regardless of pavement type in PNW
- More prevalent in shady areas and under trees
- Monitor
- Remove if its observed to affect drainage and impacts safety
- Some is okay
- Perception on Aesthetics can vary

GENERAL: Moss Growth

- **If severe, options for removal:**
  - Pressure washing (concrete)
  - Weed burner
  - Sweeping (during dry periods)
  - Vacuuming (effectiveness varies)
- **During planning & design, consider impacts of shade to maintenance frequency.**

Non-Pervious Concrete urban sidewalk with moss

GENERAL: Moss Growth

Photos provided by MIG SvR

Installed ~10 years ago
12516 NE 90th Street

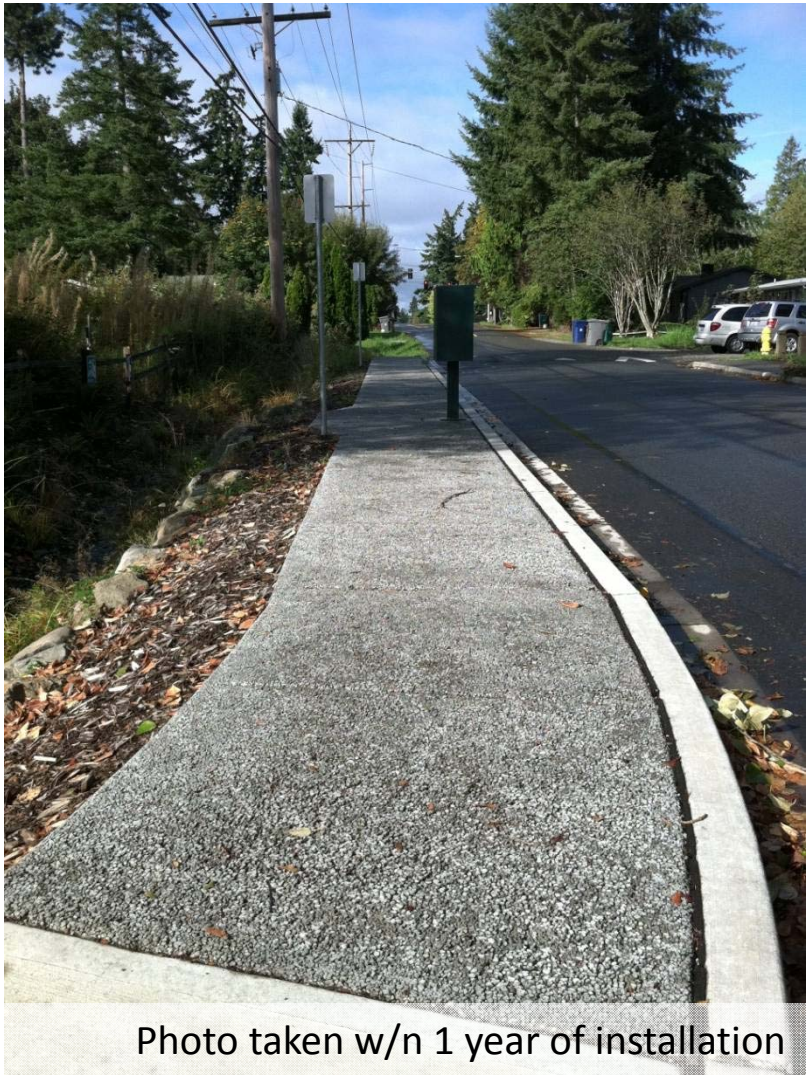
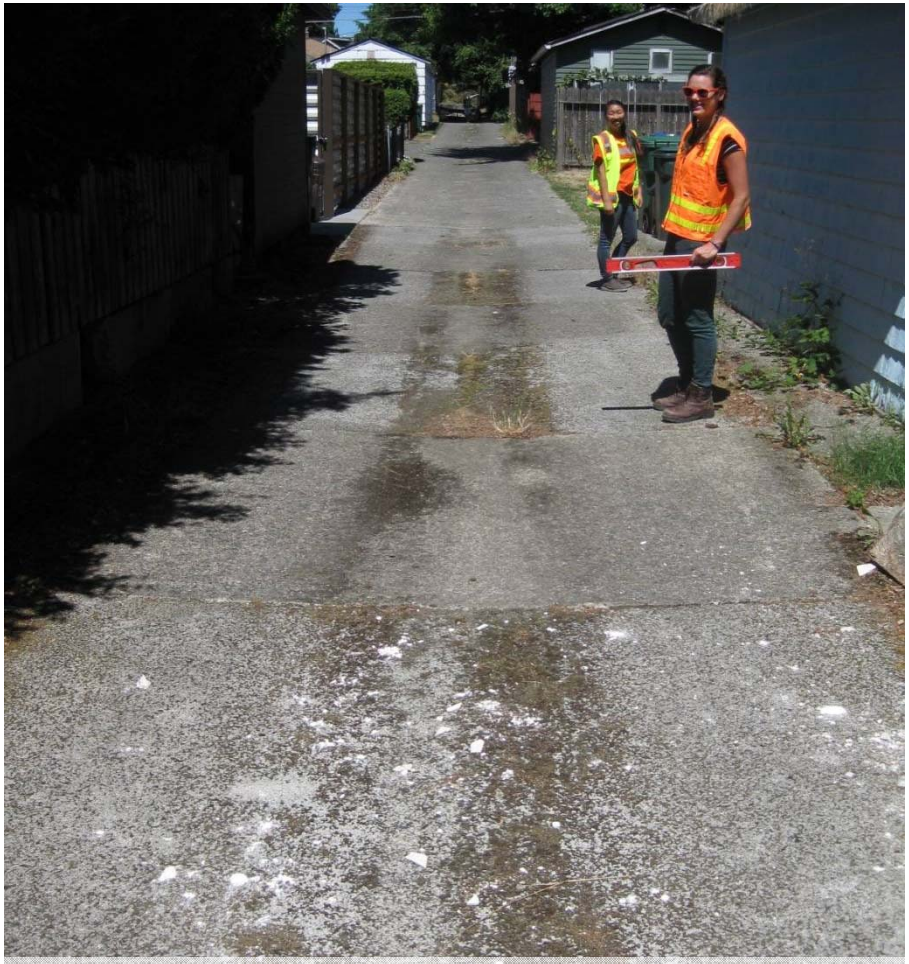
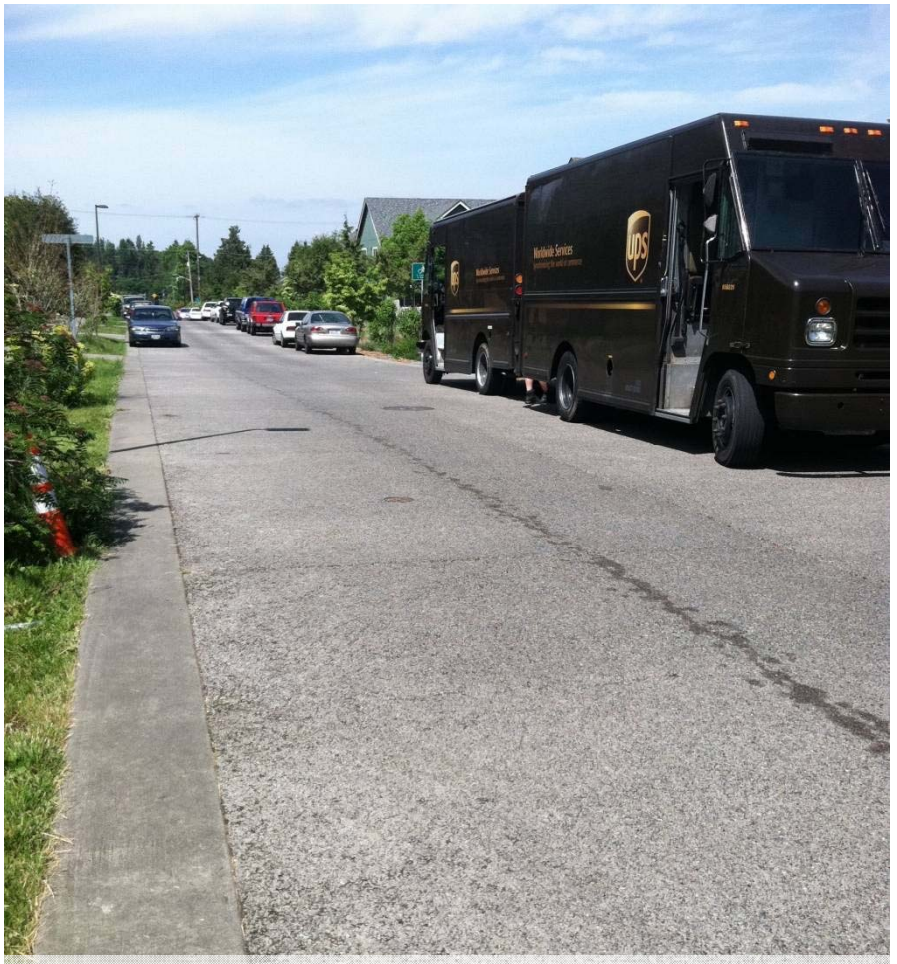


Photo taken w/n 1 year of installation

GENERAL: Moss Growth



Installed in 2010 – no routine maintenance, Photo July 2014



Installed in 2005 – no routine maintenance. Photo May 2014.

Photos provided by MIG SvR

GENERAL: Protection From Staining

- **Applies to pavers, asphalt, cement concrete. Same as conventional pavements.**
- **During construction, keeping pervious concrete covered for curing & protection can lead to some discoloration but fades with time.**
- **Avoid placement of organic/compost material on pavement.**

Staining from compost spilling onto pervious concrete

Photos provided by MIG SvR

GENERAL: Snow Removal

- **Modify snow management procedures.**
- **Avoid sanding since it will clog the system, except in cases of emergencies/ safety issues (vacuum sediment as soon as possible after melt).**
- **Avoid sanding adjacent streets since tires will track it onto the porous pavement.**
- **Avoid stockpiling snow on porous pavement.**

Photo provided by MIG SvR

GENERAL: Snow Removal

- Adjust snow plow height to avoid scratching.
- UNH reported up to 75% decrease in salt use but it will depend on site conditions (shade, location etc).
- Permeable sub-base provides drainage.
- Voids in wearing course provides space for freeze thaw.
- Installed in cold climates such as Iowa, Pennsylvania, Colorado, Ohio, Lake Tahoe.

Photo provided by MIG SvR

GENERAL: Snow Removal

Parking Lot, Denver, CO – Next AM Following 12” Snow

Pervious Concrete

Conventional Asphalt

Photos courtesy of National Ready Mixed Concrete Association and slide courtesy of Center for Portland Cement Concrete Pavement Technology, 2005 via John Kevern at National Concrete Pavement Technology, Iowa State University

GENERAL: Drainage Function Inspection

- **Inspect drainage function in the rain and identify areas for maintenance:**
  - Is there runoff from the surface?
  - Is water still ponding on the surface 1 hour after rain has stopped?
  - Is there ponding water in the observation port 24 hours after the rain has stopped?
- **If ponding, then corrective action required for cleaning surface.**


Photo provided by MIG SvR

GENERAL: Drainage Function Inspection

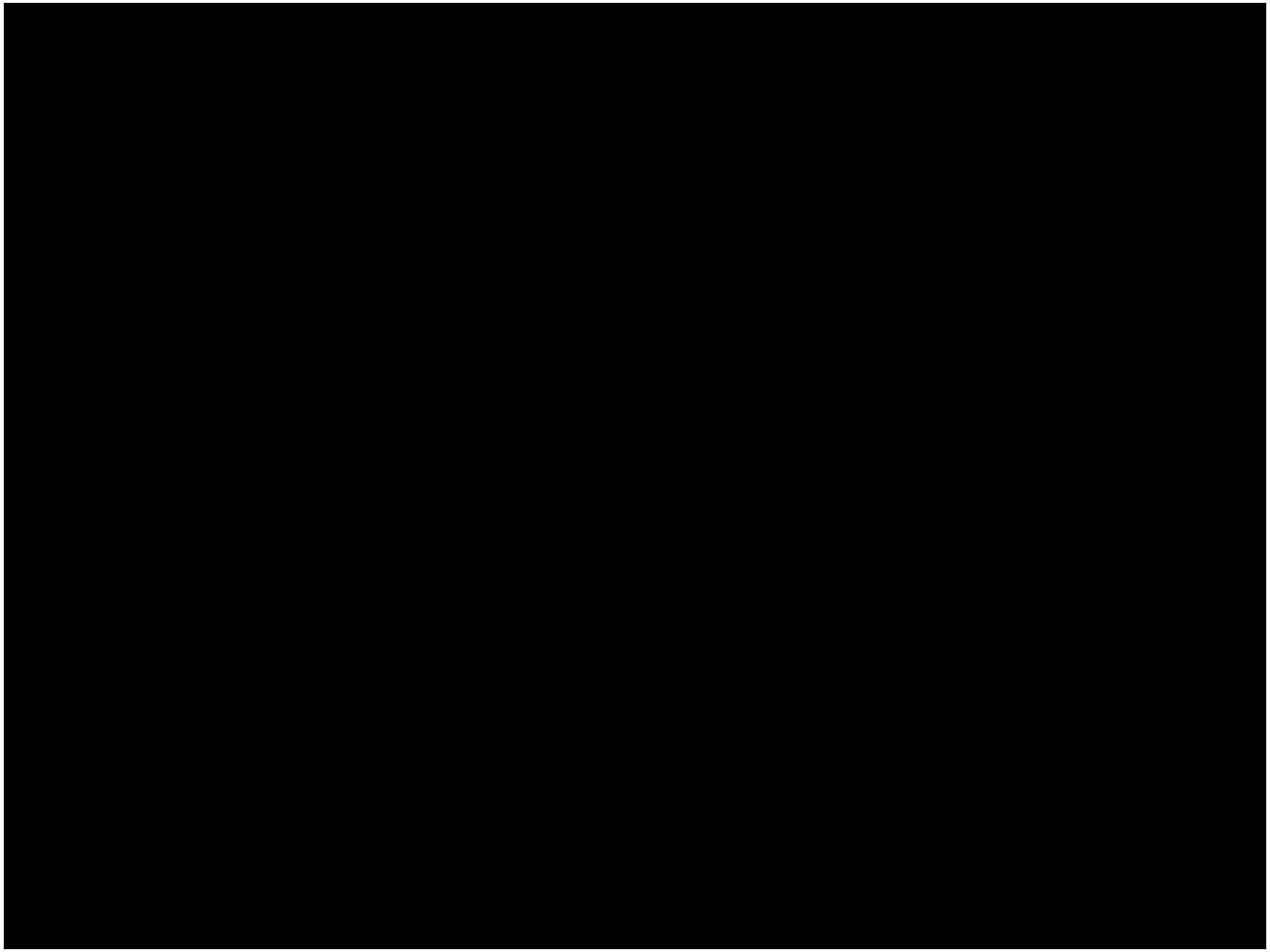
- **Video/photos of overall area during rain event.**
- **If no ponding on the surface then its flowing through top wearing course.**

Photos provided by MIG SvR

GENERAL: Drainage Function Inspection

Video provided by MIG SvR

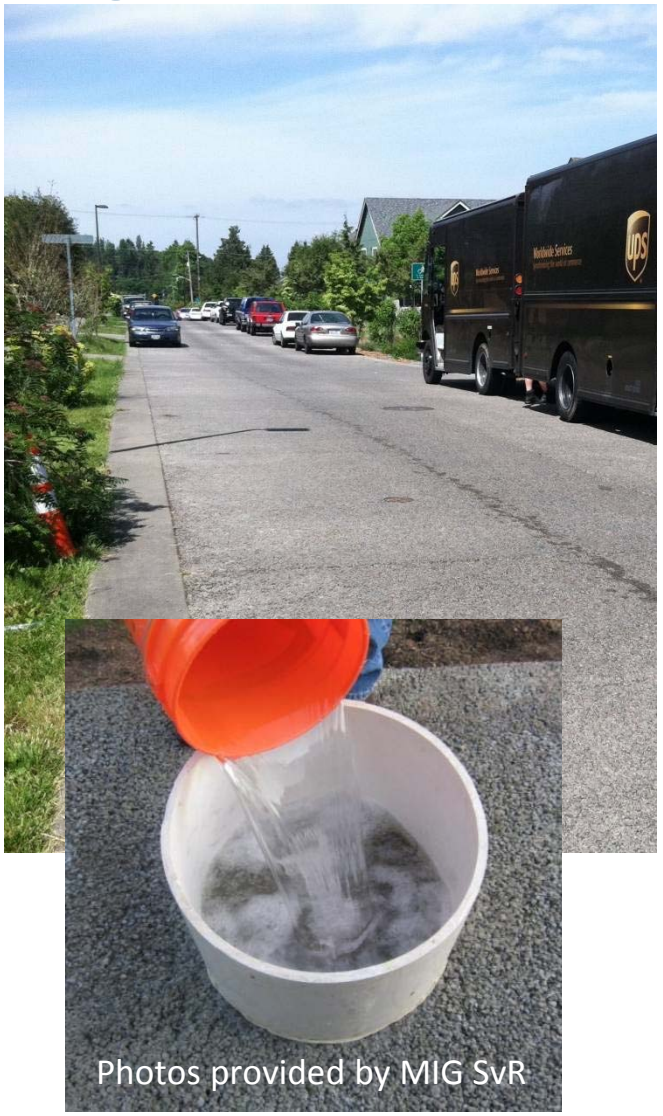
GENERAL: Drainage Function Inspection



Video provided by MIG SvR

GENERAL: Drainage Function Inspection

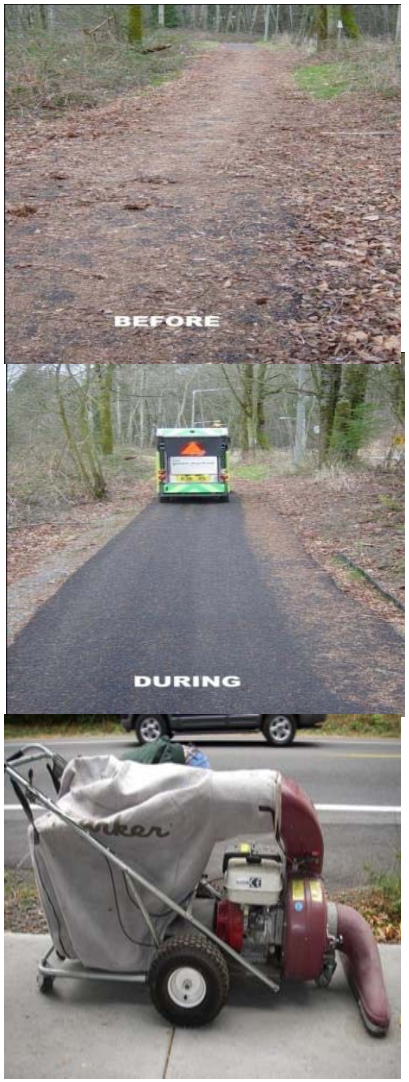
- **Inspect drainage function in dry weather**
  - Cylinder test: ASTM C1701 results indicate an infiltration rate of 10 inches per hour or less then corrective action required.
  - Test the surface infiltration rate using ASTM C1701 (perform 1 test/installation but not < 1 test/2,500 sf).
  - Run cylinder tests over multiple areas
  - Turn on sprinklers/garden hose to test larger area?
  - Does water pool or drain out?



Photos provided by MIG SvR

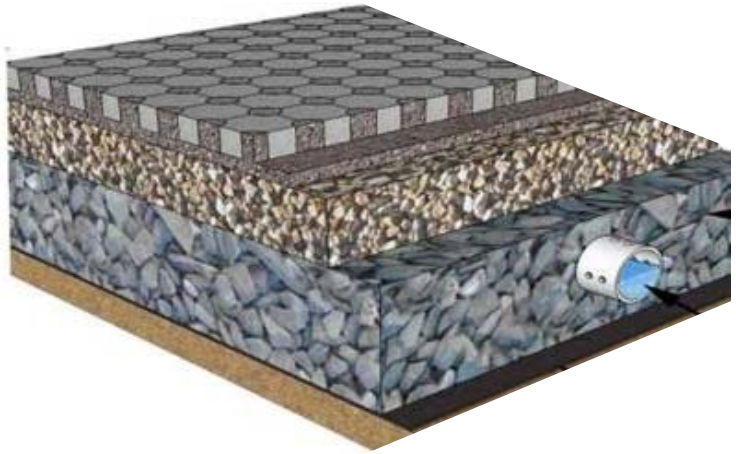
GENERAL: Corrective Action for Drainage

- **If not draining through top wearing course then corrective maintenance options include:**
  - Pressure wash and/or vacuum system
  - Hand held pressure wash or power wash with rotating brushes
  - Pure vacuum sweeper (calibrated to not dislodge wearing course aggregate)
  - Gravel grid and pavers – removing and replacing aggregate



GENERAL: Under- and Elevated-Drains

- **Under-drain/Elevated drain is clogged:**
  - Jet clean or rotary cut debris/roots from under-drain.
  - Clean flow restrictor/orifice.
  - Identify the source of the blockage and take actions to prevent future blockages.
- **If pipe daylights, check for erosion damage at discharge point:**
  - Identify source of problem.
  - Repair erosion and stabilize surface.



GENERAL: Under- and Elevated- Drains

- **Water remains in storage aggregate longer than anticipated:**
  - Inspect standpipes for under-drain.
  - Inspect drains.
  - If structural problems possible schedule investigation of subsurface materials or other potential causes of extended ponding.

GENERAL: Inspect Overflow/Backup System

- **Check overflow drainage path:**
  - **What is the flow path if water does not infiltrate?**
  - **If has under-drain pipes, verify they are draining**
  - **Verify that the overflow structure is not plugged.**

Photos provided by MIG SvR

GENERAL NON-ROUTINE: Utility Cuts

- **Temporary Patch**
- **Protect adjacent porous to remain**
- **Permanent Panel replacement**
- **Permanent Restoration: Use same material as original, except use conventional asphalt for porous asphalt**

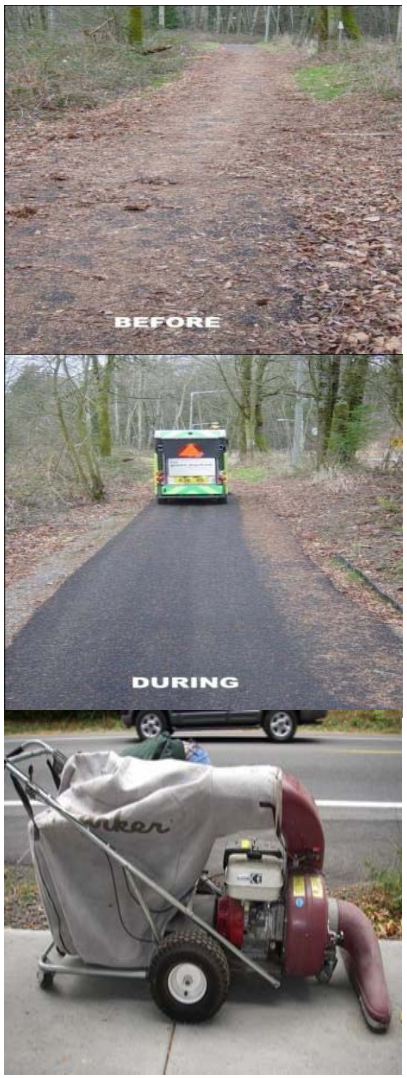
Photos provided by MIG SvR

ROUTINE AND CORRECTIVE MAINTENANCE BY COMPONENT

- Pavement surface:
  - Porous Asphalt and Pervious Concrete
  - Permeable Interlocking Concrete Pavers
  - Open Celled Gravel grid
  - Open Celled Grass grid

ROUTINE: Porous Asphalt & Pervious Concrete

- **Cleaning surface debris:**
  - **Large areas:** vacuum sweep (regenerative air or high efficiency vacuum)
  - **Small areas:** walk behind vacuums, shop vacs, hand held pressure washer or power washer with rotating brushes
  - **Frequency:** 1-2 times annually or as determined by site conditions
  - Consult with equipment manufacturer/rep for optimum operation



ROUTINE: Porous Asphalt & Pervious Concrete

- No overlay
- No black topping/sealing
- May need to re-stripe parking lot more frequently

Photos provided by MIG SvR

NON-ROUTINE: Pervious Concrete Structural

- Major cracks or trip hazards and concrete spalling and raveling
- Determine cause
- Replace panel with porous material if feasible
- Modify operations?

Photos provided by MIG SvR

NON-ROUTINE: Raveling at Construction Joints

- Consult with industry, engineer
- Patch?
- Cut out and replace with new panel (pervious concrete)
- Replace with conventional asphalt?

Photos provided by MIG SvR

NON-ROUTINE: Drainage Function Rehabilitation

- **Consult with industry, engineer**
- **Significant decline in infiltration when system is not routinely maintained**

ROUTINE: PICP & Pavers

- **Routine maintenance (cleaning surface debris)**
  - **Large areas:** vacuum sweep (regenerative air or high efficiency vacuum)
  - **Small areas:** walk behind vacuums, shop vacs
  - **Frequency:** 1-2 times annually or as determined by site conditions
  - Consult with equipment manufacturer/rep for optimum operation
  - Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints
  - Vacuum surface openings in dry weather to remove dry, encrusted sediment

ROUTINE: PICP & Pavers

- **Routine maintenance (vegetation)**
  - Remove weeds if they start to affect drainage performance
  - Aesthetics
  - Do not use herbicides (this is a stormwater facility)
  - Weed burner
  - Vinegar? (small applications)
  - Larger gaps between pavers easier for removal of weeds (shovel)

Photos provided by MIG SvR

CORRECTIVE: PICP & Pavers

- **Clogged wearing course**
  - Review overall performance of the facility.
  - If water ponds or flows off pavement surface during rain event, corrective maintenance or testing is needed.
  - Dry Weather: Test the surface infiltration rate using ASTM C1781 (perform 1 test/installation but not < 1 test/2,500 sf).

CORRECTIVE: PICP & Pavers

- **Clogged wearing course**
  - Corrective maintenance options include:
    - Pure vacuum sweeper.
    - Pressure wash and vacuum system calibrated to remove all visible sediment (likely 2-3 cm of aggregate) in the joints or infiltration cells.
  - Replace aggregate in joints or infiltration cells per manufacturer specifications.

NON-ROUTINE: PICP & Pavers

- **Utility work**
  - Pavers can be removed individually and replaced after work is complete
  - Clean sub-base material (no to minimal fines)

NON-ROUTINE: PICP & Pavers

- **Structural integrity**
  - **Loss of aggregate material between paver blocks:** Refill per manufacturer's recommendations.
  - **Paver block missing or damaged:** Remove individual damaged paver blocks by hand and replace or repair per manufacturer's recommendations.
  - **Surface settling:** May require resetting.

NON-ROUTINE: PICP & Pavers

- **Structural integrity and snow**
  - **The structure of the top edge of the paver blocks reduces chipping from snowplows.**
  - **Skids on the corner of plow blades are recommended.**

ROUTINE: Gravel Grid

- **Cleaning surface debris**
  - **Large areas:** vacuum sweep? (regenerative air or high efficiency vacuum)
  - **Small areas:** walk behind vacuums, shop vacs, rake, leaf blower
  - **Frequency:** 1-2 times annually or as determined by site conditions
  - Consult with equipment manufacturer/rep for optimum operation
  - Vacuum settings may have to be adjusted to prevent excess uptake of aggregate from paver openings or joints
  - Vacuum surface openings in dry weather to remove dry, encrusted sediment
  - Maintain aggregate 0.25 inches above grid structure

CORRECTIVE: Gravel Grid

- **Clogged wearing course**
  - Observe the pavement system after a rain event (testing infiltration rate using ASTM C1701 likely not applicable).
  - Corrective action needed, if ponding on surface or water flows off aggregate surface during rain event.

CORRECTIVE: Gravel Grid

- **Clogged wearing course**
  - Use vacuum system calibrated to remove all visible sediment (likely 2-3 cm of aggregate).
  - Replace aggregate per manufacturer specifications (usually 0.25 inches above grid structure).

NON-ROUTINE: Gravel Grid

- **Structural integrity**
  - **Grid damaged:**
    - Remove pins (if present), pry up grid segments, and replace grid, pins and gravel
    - Replace grid segments where three or more adjacent rings are broken or damaged
  - **Loss of aggregate material:** Refill per manufacturer's recommendations (usually 0.25 inches above grid structure)

ROUTINE: Grass Grid

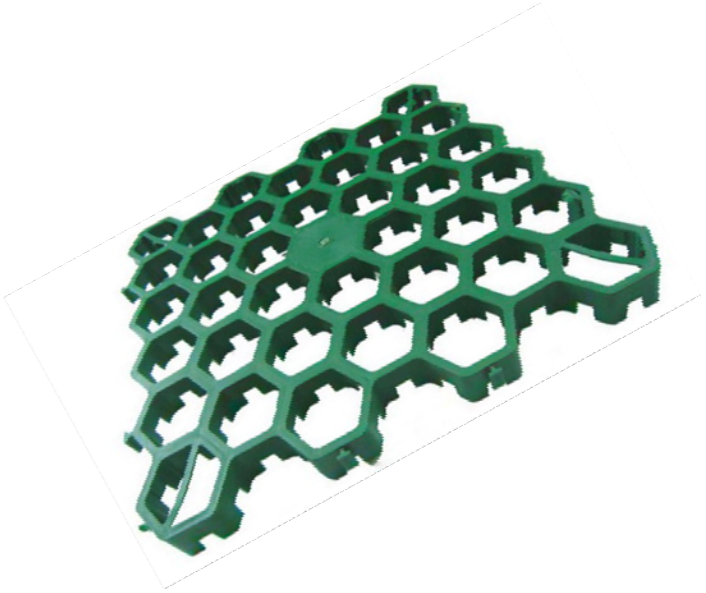
- **Cleaning surface debris**
  - **Large and small areas:** rakes, leaf blowers.
  - Consult manufacturer guidelines.
  - **Frequency:** 1-2 times annually or as determined by site conditions.
  - Maintain soil/sand slightly below grid structure.

CORRECTIVE: Grass Grid

- **Clogged wearing course**
  - Observe the grass pavement system after a rain event (testing infiltration rate using ASTM C1701 likely not applicable).
  - Corrective action needed if ponding on surface or water flows off grass surface during rain event.
  - Follow manufacturer's guidelines for repairing surface.

NON-ROUTINE: Grass Grid

- **Structural integrity**
  - **Grid damaged:**
    - Remove pins (if present), pry up grid segments, and replace grid, pins and grass.
    - Replace grid segments where 3 or more adjacent rings are broken or damaged
  - **Grass growth:**
    - Mulch mower
    - Top dress with 0.5 inches of compost if nutrient deficient (do not use fertilizer)
  - **Surface settling:** May require resetting



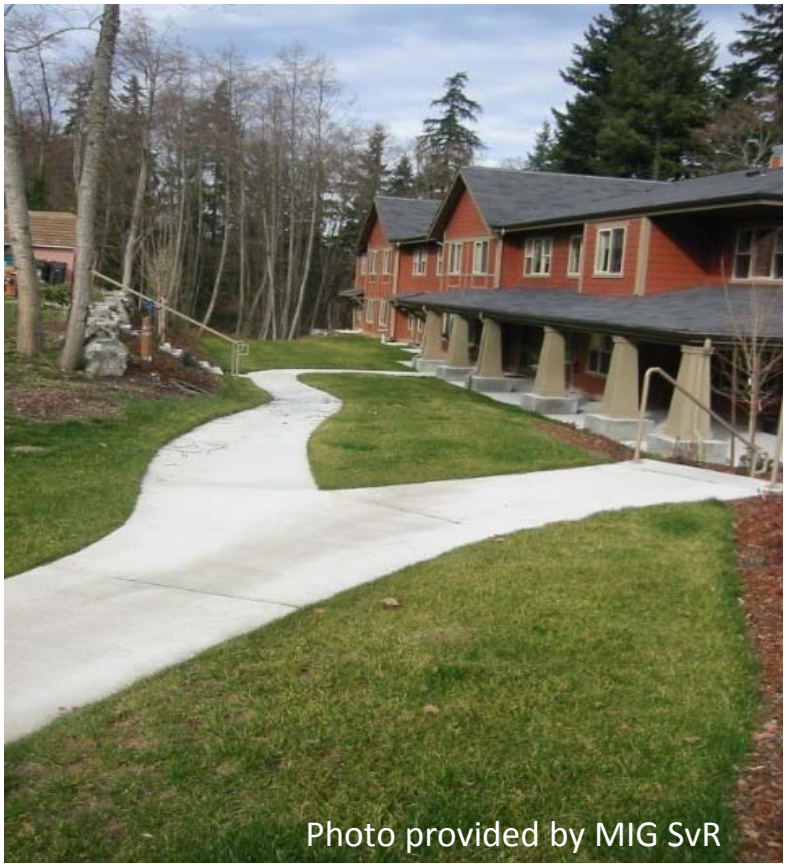
NON-ROUTINE: Grass Grid

- **Structural integrity**
  - **Poor grass coverage:**
    - Restore growing medium, reseed or plant and/or amend vegetated area as needed.
    - Traffic loading may be inhibiting grass growth; reconsider traffic loading if feasible.
    - Growing media elevation should be maintained slightly below grid structure.
    - Consult manufacturer/sales representative.
    - May need occasional reseeding.

Photo provided by MIG SvR

NON-ROUTINE: Grid Systems

- **Structural integrity and snow**
  - Snow plows should use skids to elevate the blades to prevent loss of aggregate and damage to the grid.



Fire lane/Maintenance road for housing site. Geoweb® Cellular Confinement system adjacent to walk

EQUIPMENT & MATERIALS

Table 9. Permeable Pavement Equipment and Materials List.

Equipment to address clogging of wearing course, such as:

- ☐ Hand held pressure washer or power washer with rotating brushes (not recommended for open-celled aggregate-filled systems)
- ☐ Walk-behind vacuum (sidewalks)
- ☐ Pure vacuum sweeper
- ☐ ShopVac (small areas)
- ☐ Combined higher pressure wash and vacuum system

Equipment to remove sediment, debris, and leaf litter, such as:

- ☐ High efficiency regenerative air or vacuum sweeper (roadways, parking lots)
- ☐ Push broom (can also be used to spread and clean aggregate in gravel-filled open-celled grid and permeable paver systems)
- ☐ Brush broom (course bristled broom) to remove moss
- ☐ Leaf blower

*Erosion control equipment (to stabilize adjacent landscaped areas and protect pavement from sediment inputs)**

- ☐ Erosion control matting
- ☐ Rocks
- ☐ Mulch
- ☐ Plants
- ☐ Landscaping tools
- ☐ Tarps (to protect pavement in area of landscaping from clogging, e.g., mulch stockpiles)

Pipe/structure inspection and maintenance equipment

- ☐ Hand tools
- ☐ Wrench or manhole opener (for opening manhole lids, grates, etc.)
- ☐ Flashlight
- ☐ Mirror (for viewing pipes without entering structure)
- ☐ Garden hose
- ☐ Plumbing snake
- ☐ Measuring tape or ruler

Weed / vegetation removal equipment, such as:

- ☐ Weeding tools
- ☐ Weed burner
- ☐ Edging and trimming equipment to control groundcover and other vegetation from extending onto pavement surface

Additional equipment for grass-filled open-celled grid systems

- ☐ Mower or mulch mower
- ☐ Topdress grass seed
- ☐ Compost
- ☐ Replacement grid segments

Additional equipment for gravel-filled open-celled grid systems

- ☐ Rakes and shovels
- ☐ Aggregate to replace material after vacuuming or to replenish material in high use areas
- ☐ Replacement grid segments
- ☐ Wheelbarrow (for transporting replacement aggregate)

Additional equipment for permeable paver systems

- ☐ Rakes and shovels
- ☐ Extra pavers and bedding material
- ☐ Aggregate to replace materials between pavers after vacuuming
- ☐ Wheelbarrow (for transporting replacement aggregate)

Snow removal equipment, such as:

- ☐ Plow with skids to prevent damage to permeable pavement
- ☐ Snow blower

EQUIPMENT & MATERIALS: Routine Maintenance

Equipment to address clogging of wearing course, such as:

- Hand held pressure washer or power washer with rotating brushes
- Walk-behind vacuum
- Pure vacuum sweeper
- Brush broom
- Combined higher pressure wash and vacuum system

Walk–behind vacuum: photo provided by SPU

EQUIPMENT & MATERIALS: Routine Maintenance

Equipment to remove sediment, debris, and leaf litter, such as:

- High efficiency regenerative air or vacuum sweeper
- Push broom
- Brush broom
- Leaf blower

EQUIPMENT & MATERIALS: Routine Maintenance

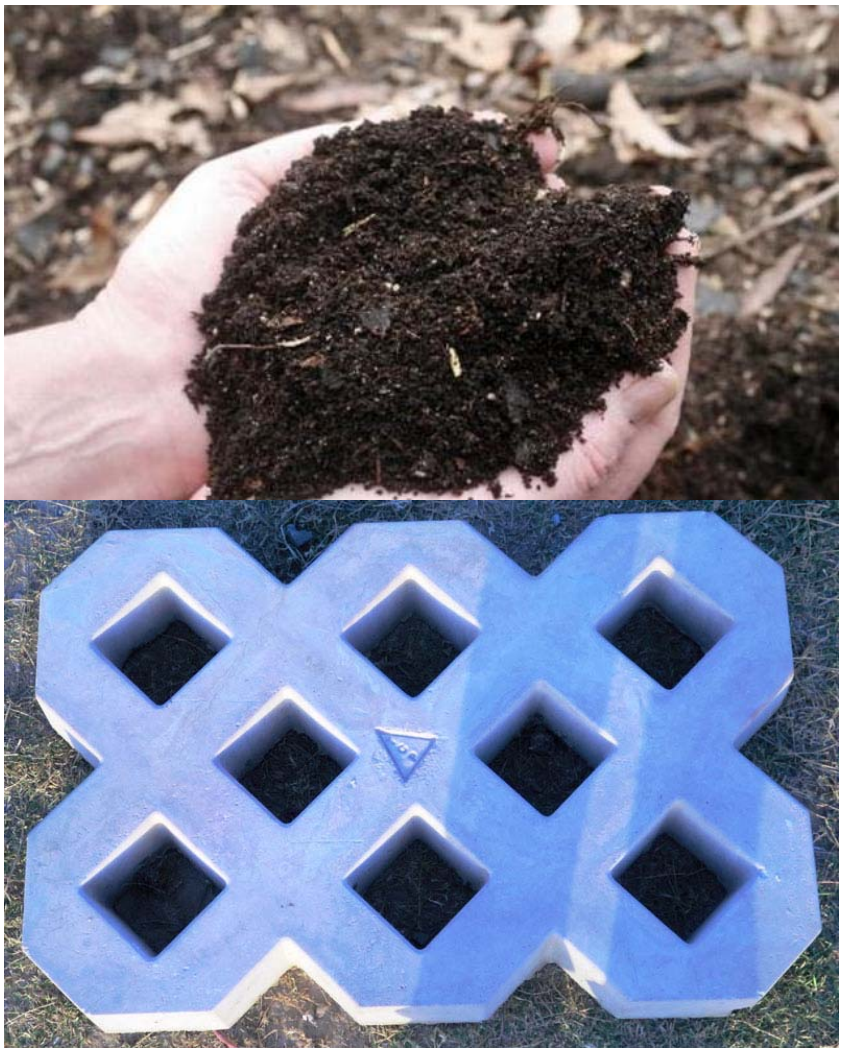
Weed/vegetation removal equipment, such as:

- Weeding tools
- Weed burner
- Edging and trimming equipment control groundcover and other vegetation)

EQUIPMENT & MATERIALS: Routine Maintenance

Additional equipment for grass-filled open-celled grid systems, such as:

- Mower or mulch mower
- Topdress grass seed
- Compost
- Replacement grid segments



EQUIPMENT & MATERIALS: Routine Maintenance

Additional equipment for gravel-filled open-celled grid systems, such as:

- Rakes and shovels
- Replacement grid segments
- Replacement aggregate
- Wheelbarrow (for transporting replacement aggregate)

EQUIPMENT & MATERIALS: Routine Maintenance

Additional equipment for permeable paver systems, such as:

- Rakes and shovels
- Extra pavers and bedding material
- Replacement aggregate
- Wheelbarrow (for transporting replacement aggregate)

EQUIPMENT & MATERIALS: Routine Maintenance

Snow removal equipment, such as:

- Plow with skids to prevent damage to permeable pavement
- Snow blower

EQUIPMENT & MATERIALS: Routine Maintenance

Pipe/structure inspection and maintenance equipment:

- Hand tools
- Wrench or manhole opener
- Flashlight
- Mirror
- Garden hose
- Plumbing snake
- Measuring tape or ruler

EQUIPMENT & MATERIALS: Corrective Maintenance

- Elgin's Whirlwind (pure vacuum sweeper)
- Bunyan B.I.R.D. vacuum attached to vactor truck (10 gpm): $7,800 + power if not on vactor
- Total Pervious Solutions (formerly Paragon Industries)
- Stay tuned … supply and demand affect technology

EQUIPMENT & MATERIALS: Corrective Maintenance

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EQUIPMENT & MATERIALS: Corrective Maintenance

Erosion control equipment:

- Erosion control matting
- Rocks
- Mulch
- Plants
- Landscaping tools
- Tarps (to protect pavement)

Photo provided by MIG SvR

EQUIPMENT & MATERIALS: City of Olympia

2006 Study Findings:

- Leaf/Litter vacuums are more effective than sweepers with dust control vacuum systems.
- Vacuum machines had difficulty removing leaf piles when they were more than 2 to 3 inches thick.

City of Olympia maintenance memo

EQUIPMENT & MATERIALS: City of Portland

N Gay Avenue & Westmoreland Projects:

- Pavers, porous asphalt and pervious concrete public streets
- 1X to 2X/year - Vacuum sweepers used to collect fines:
  - Tymco's 500x, Schwarze's A7000, Elgin's Crosswind J-Plus
- Infiltration testing with flusher truck
- "Vegetation growth in pavers did not appear to hinder infiltration on Rex St." (~63 in/hr)

Photos provided by City of Portland

SKILLS

- Sweeper and equipment operation
- Commercial driver's license (CDL)
- Landscaping skills (e.g., general plant care) for grass-filled open-celled grid systems
- Engineer and/or landscape architect for major maintenance

Photo provided by MIG SvR


Q&A


Lunch

introduction

permeable pavement O&M

O&M costs

administrative tools

wrap up & field exercises

CONVENTIONAL VS LID O&M ACTIVITIES

Conventional	LID
Sweeping	Sweeping/ clean surface debris
Repair structural damage	Unclog wearing course
Typically Streets Department maintains roadways	Unclog drain and inspect for damage
	Run-on from adjacent landscaping

O&M FREQUENCIES

	Conventional	Pervious
Tacoma Residential Streets	2 x/year	2x/year
Tacoma Arterials	Every 6 weeks	Every 6 weeks
Puyallup Streets	Monthly	Monthly
Puyallup Sidewalks		Annually sweep with walk behind
Monroe Streets	Varies (Daily in fall)	Same as conventional + additional sweeping by cyclone

Source: Jessica Knickerbocker, City of Tacoma
Mark Palmer, City of Puyallup
Vince Bertrand, City of Monroe, 360-863-4552

O&M COST FACTORS

- Current street sweeping practices for conventional
- Site location and surrounding conditions
- Amount of run-on and source of run-on
- Equipment
- Level of service for aesthetics
- Quality of the initial installation
- Other

O&M LOCAL INFORMATION SHARING

- ROADMAP - Luanne Coachman

  e-mail: luanne.coachman@kingcounty.gov
- APWA Stormwater Managers Committee

  Bruce Wulkan and Paul Fendt chairs, Google group: https://groups.google.com/forum/#!forum/apwa-stormwater
- Permeable Pavements for Puget Sound, Google group: https://groups.google.com/forum/#!forum/permeable-pavements-for-puget-sound
- Industry reps
- Other agencies

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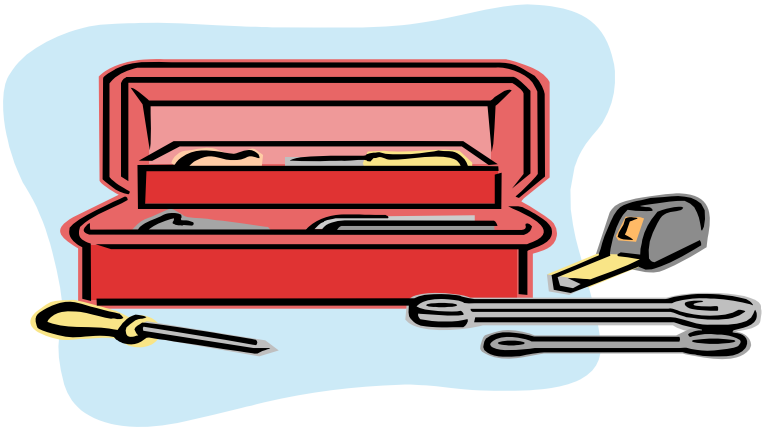
TOPICS

- Inspection checklist examples
- Record keeping and tracking
- Interpreting plans and as-builts
- Inspection programs



INSPECTION CHECKLIST EXAMPLES

Inspection and Maintenance Requirements for Permeable Pavement

Maintenance Checklist

Maintenance Component	Conditions When Maintenance is Needed	Action Needed	Satisfactory	Unsatisfactory	Comments
Surface/Wearing Course (cont.)					
Porous asphalt or pervious concrete	• Routine maintenance	Clean surface debris from pavement surface using one or a combination of the following methods: • Remove sediment, debris, trash, vegetation, and other debris deposited onto pavement (rakes and leaf blowers can be used for removing leaves) • Vacuum/sweep permeable paving installation using: ◊ Walk-behind vacuum (sidewalks) ◊ High efficiency regenerative air or vacuum sweeper (roadways, parking lots) ◊ ShopVac or brush brooms (small areas) • Hand held pressure washer or power washer with rotating brushes Follow equipment manufacturer guidelines for when equipment is most effective for cleaning permeable pavement. Dry weather is more effective for some equipment.			

INSPECTION CHECKLIST EXAMPLES

Private Natural Drainage Practices Maintenance Inspection
PERVIOUS/POROUS PAVEMENTS

Drainage System ID:		***Basin:***
Inspected by:	**Date & Time of this Inspection:**	
Parcel Name:	Map:	
Address:		
Contact Name & Company:		
Contact's Address:	Contact's Phone:	
Contact's Email:	As-Built Plan Available	Yes ☐ No ☐
Date of Last Inspection:	**Does site need maintenance action?**	Ok ☐ Action Required ☐
Weather at time of this inspection:	**Does site need follow-up inspection upon completion of maintenance?**	Ok ☐ Action Required ☐
Amount of Rain Precipitation (inches) in last 48 hours (note source for information):		

1. Site Conditions/General		
Maintenance Manual and Maintenance log being maintained by Owner/Owner Rep?	Ok ☐ Action Required ☐	Comment:
Site's Impervious Areas (pavement, buildings, roads, driveways, walks) appear consistent with areas per original plan?	Ok ☐ Action Required ☐	Comment:
Types of Porous Pavement on Site	Porous Cement Concrete ☐ Porous Asphalt Concrete ☐ Pavers☐ Rigid Open-Celled paving grid with gravel infill☐ Rigid Open-Celled paving grid with vegetative infill☐ Flexible paving grids with gravel infill☐ Flexible paving grids with vegetative infill☐ Other☐ _____	
Porous pavement type per original design?	Ok ☐ Action Required ☐	If changes have been made was it replaced with porous pavement? If not, why?
Pavement has not been overlaid or sealcoated?	Ok ☐ Action Required ☐	Comment:
Areas draining to porous pavement appear stabilized and with no evidence of eroded soil?	Ok ☐ Action Required ☐	Comment:
Is there sediment/debris spilled onto pavement?	Ok ☐ Action Required ☐	Comment:
2. Observation Port(s)		
Are number of Observation ports per as-built plan?	Ok ☐ Action Required ☐	Comment:
If it has not rained for 72 hours, has the water drained out of the observation port?	Ok ☐ Action Required ☐	Comment:
If it was raining during site visit, is the distance between top of observation port and max. water level in port within minimum per design? See O&M for design max. water surface level in port.	Ok ☐ Action Required ☐	Comment:
3. Inlets & Drainage Structures		
Complete COB Inspection Checklist for storm drain structures.		
4. Porous Pavement Surface		
Pavement/cells are cracked/damaged to the extent of requiring repair?	Ok ☐ Action Required ☐	Comment:
Is settlement observed?	Ok ☐ Action Required ☐	Comment:
Is surface clean from large debris (leaves, garbage, soil stockpiles)?	Ok ☐ Action Required ☐	Comment:
Is surface clogged/sealed (e.g.fine sediment in voids of porous asphalt and cement concrete)?	Ok ☐ Action Required ☐	If clogged, conduct water test and determine if water infiltrates or runs off pavement. Comment:
For pavers with vegetative infill, plants appear healthy?	Ok ☐ Action Required ☐	Comment:
Is moss under control? Some moss can be present as long as water is still able to infiltrate through pavement and that the moss is not a slipping hazard during wet weather.	Ok ☐ Action Required ☐	Comment:
Are weeds under control and vegetation not growing in non-vegetative wearing courses?	Ok ☐ Action Required ☐	Comment:
Gravel filled Pavers/Cells: Are weeds under control?	Ok ☐ Action Required ☐	Comment:
Gravel filled Pavers/Cells: Is gravel filled up to cell height or greater?	Ok ☐ Action Required ☐	Comment:
5. Other Observations:		

INSPECTION CHECKLIST EXAMPLES

CITY OF PUYALLUP

Office of the City Engineer
333 South Meridian
Puyallup WA 98371
www.cityofpuyallup.org

Permeable Pavement Inspection Checklist
(to be used with annual reporting)

Please complete this form by March 31st of each year and mail attention to: Joy Rodriguez at the above address along with the photographs discussed in the Maintenance Plan, or email a scanned copy of this completed form and photographs to: jrodriguez@ci.puyallup.wa.us.

Property Information	
Property Owner:	Phone:
Street Address:	City, State & Zip:
Email:	

	Permeable Pavement Inspection Checklist	Y	N	Comments
1.	Have you removed any stray trash, litter, or yard waste from your permeable pavement?			
2.	Have any pavers fractured or broken this year?			
3.	If so, did you replace the paver(s), and with what paver/material?			
4.	Is there any evidence of erosion, or aggregate joint materials being washed away?			
5.	Is the aggregate joint material still in place and within 3mm of the surface?			

INSPECTION CHECKLIST EXAMPLES

Name(s) of Inspectors: _____
Date of Inspection: _____
Location of the permeable pavement facility: _____
Surface/wearing course type: _____
Address or Intersection: _____
Age of permeable pavement facility: _____
Permeable pavement facility area (ft. × ft.): _____
Time since last rainfall (hr): _____
Quantity of last rainfall (in): _____

Site Sketch (include curbs, islands, trees, north arrow, etc.)

INSPECTION CHECKLIST EXAMPLES

Based on visual assessment of the site, answer the following questions and take photographs of the site:

Surface/Wearing Course

1. Are there indications of any of the following on the surface of the permeable pavement facility? (If yes, mark on site sketch)
   - ☐ Excessive sediment
   - ☐ Moss growth
   - ☐ Cracks, trip hazards, or concrete /asphalt spalling
   - ☐ Trash and debris
   - ☐ Leaf accumulation
   - ☐ Settlement of surface
   - ☐ Other: _____
   - ☐ None

2. Is there ponding on the surface of the permeable pavement? ☐ Yes ☐ No

   If yes, describe the potential reasons for ponded water below (leaf or debris build up, non-functional underdrain, groundwater input, illicit connection, inadequate capacity in facility, etc.)

RECORD KEEPING & TRACKING

- Parcel information
- City/County permit (ROW and/or building permit)
- Relevant sections of the Stormwater Site Plan
- “As-builts” or “record drawings” (individual lots and public ROW)
- Legal agreements (covenants, easements)

RECORD KEEPING & TRACKING

- Location information (GPS data, digital maps)
- Project O&M manual (where applicable)
- Maintenance logs (typically included in a Project O&M Manual)
- Inspection forms
- Enforcement documents

INTERPETING PLANS & AS-BUILTS

- How to interpret construction plans, installation photos, and as-builts.

INSPECTION PROGRAMS

- **Immediately post-construction** for all LID BMPs - installed per plan and functioning properly.
- **Every 6 months** (until 90% of lots are constructed) for permanent Stormwater Treatment and Flow Control BMPs/Facilities in new residential developments - identify maintenance needs and enforce maintenance standards.
- **Ongoing annual** inspections for all Stormwater Treatment and Flow Control BMPs/Facilities (MR #6 and/or MR #7).


Q&A

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Statewide LID Training Program

COURSE CATALOG

www.wastormwatercenter.org/lidswtrainingprogram/

DEPARTMENT OF ECOLOGY
State of Washington

Statewide LID Training Program

OVERVIEW OF PROGRAM

INTRODUCTORY

- 2.1 Introduction to LID for Inspection & Maintenance Staff

INTERMEDIATE

- 3.1 Intermediate LID Topics: NPDES Phase I & II Requirements
- 3.2 Intermediate LID Design: Bioretention
- 3.3 Intermediate LID Design: Permeable Pavement
- 3.4 Intermediate LID Design: Site Assessment, Planning & Layout
- 3.5 Intermediate LID Design: Rainwater Collection Systems & Vegetated Roofs
- 3.6 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: Bioretention
- 5.3 Advanced Topics in LID Design: Permeable Pavement
- 5.4 Advanced Topics in LID Design: Site Assessment, Planning & Layout
- 5.5 Advanced Topics in LID Design: Rainwater Collection Systems & Vegetated Roofs
- 5.6 Advanced Topics in LID Design: Hydrologic Modeling
- 6.2 Advanced Topics in LID Design: Bioretention Media and Compost Amended Soils

Statewide LID Training Program

ONLINE EVALUATION

- **An on-line evaluation will be sent to you within 5 days following this training.**
- **Feedback will help to refine future trainings.**

Statewide LID Training Program

CERTIFICATE

Two certificates:

- **LID Design certificate.**
- **LID Operations and Maintenance certificate.**

You will receive an e-mail with login information following relevant courses.

LID Certificate Program Policies Page:
www.wastormwatercenter.org/lid-certificate-policies

Remember to sign in and sign out!

Statewide LID Training Program

ONLINE RESOURCES

For information on training and other resources, visit the Washington Stormwater Center website:

www.wastormwatercenter.org

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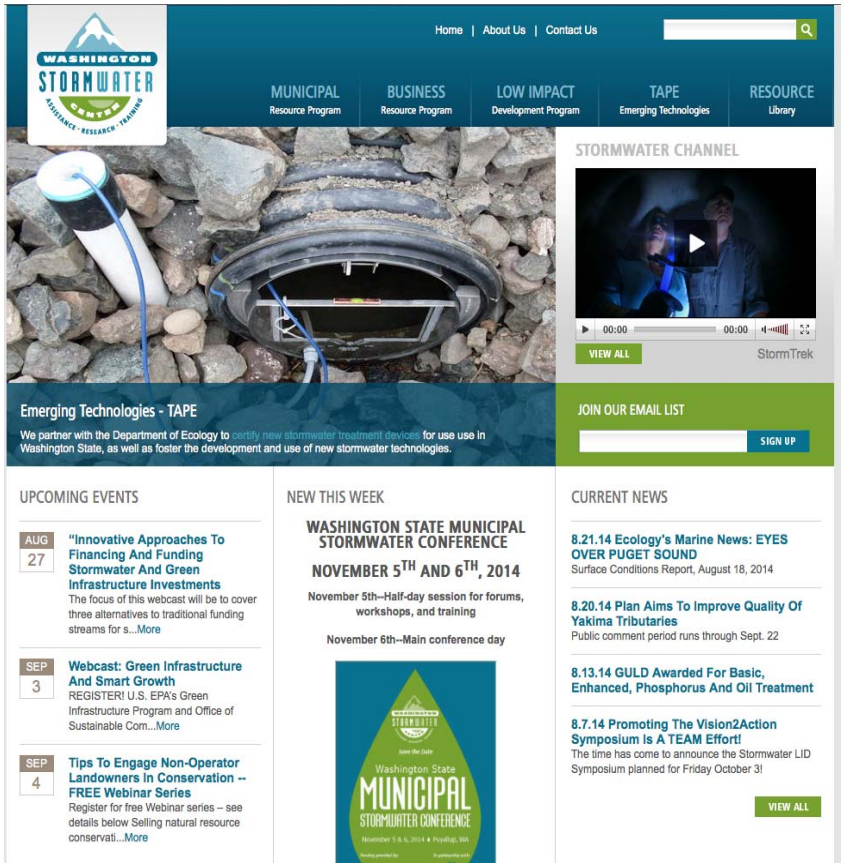

Statewide LID Training Program

QUESTIONS

Further questions? Contact:

training@cascadiaconsulting.com

(206) 449-1163


Field Exercises
Site Inspection
Infiltration Tests
Equipment Demos