



WASHINGTON STATE MUNICIPAL STORMWATER CONFERENCE

# DETERMINING STORMWATER BMP INFILTRATION RATES: REQUIREMENTS, APPROACHES, EMERGING METHODS, AND CURRENT RESEARCH

MAY 16, 2017



# Experience Background

- Primarily Eastern Washington
- Focus on stormwater, LID, and the built environment
- Specializing in construction documents for:
  - PS&E on public projects
  - Site design in support of vertical construction
  - Private development

# Reference Materials

My experience and approach is primarily based upon the following manuals:



**Spokane Regional  
Stormwater Manual**  
Chapter 4



**WSDOT Highway Runoff  
Manual**  
4-5.4



**Eastern Washington  
LID Guidance  
Manual**  
Appendix B



**Stormwater  
Management Manual  
for Eastern Washington**  
Table 5.4.1

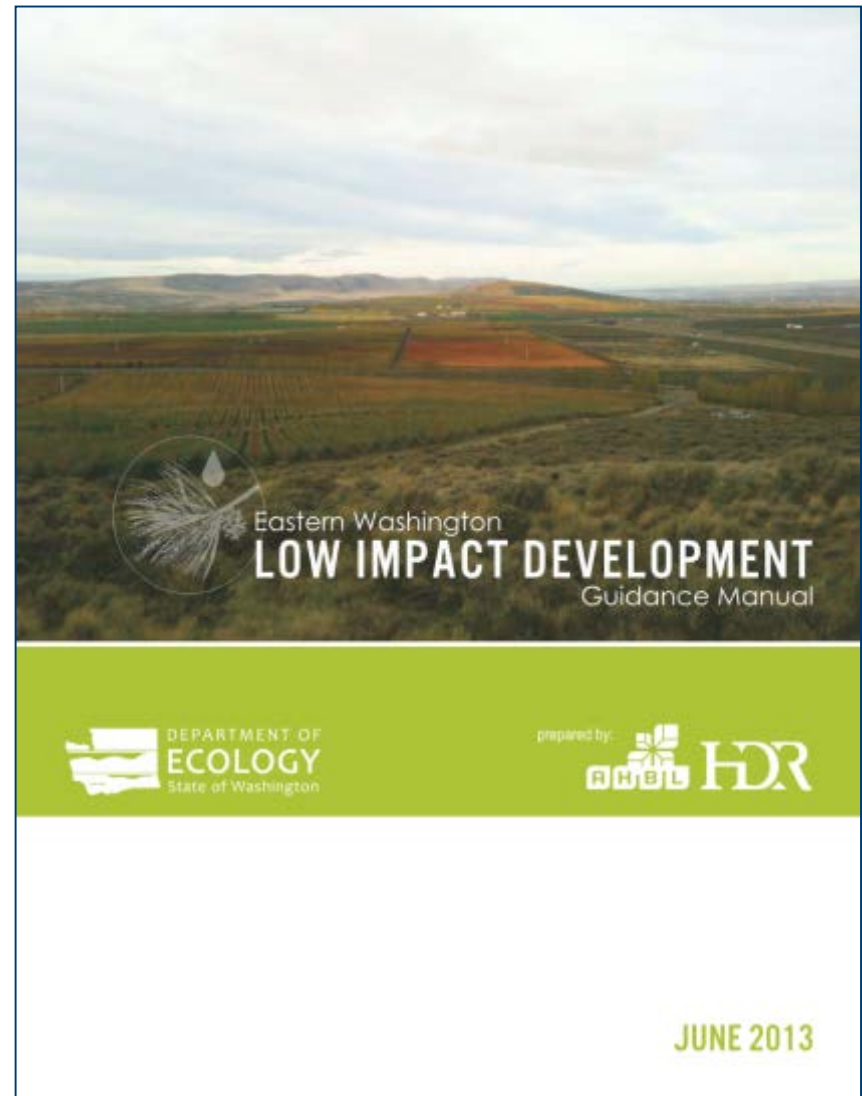
# Spokane Regional Stormwater Manual

- SRSM Chapter 4.3.1
- Spokane 200 method
- Full scale drywell test
- Test pit method
- Single ring infiltrometer test
- Swale flood test



# Eastern Washington LID Guidance Manual

- Adapted from SWMMWW
- Small scale PIT
- Large scale PIT
- Soil grain size method



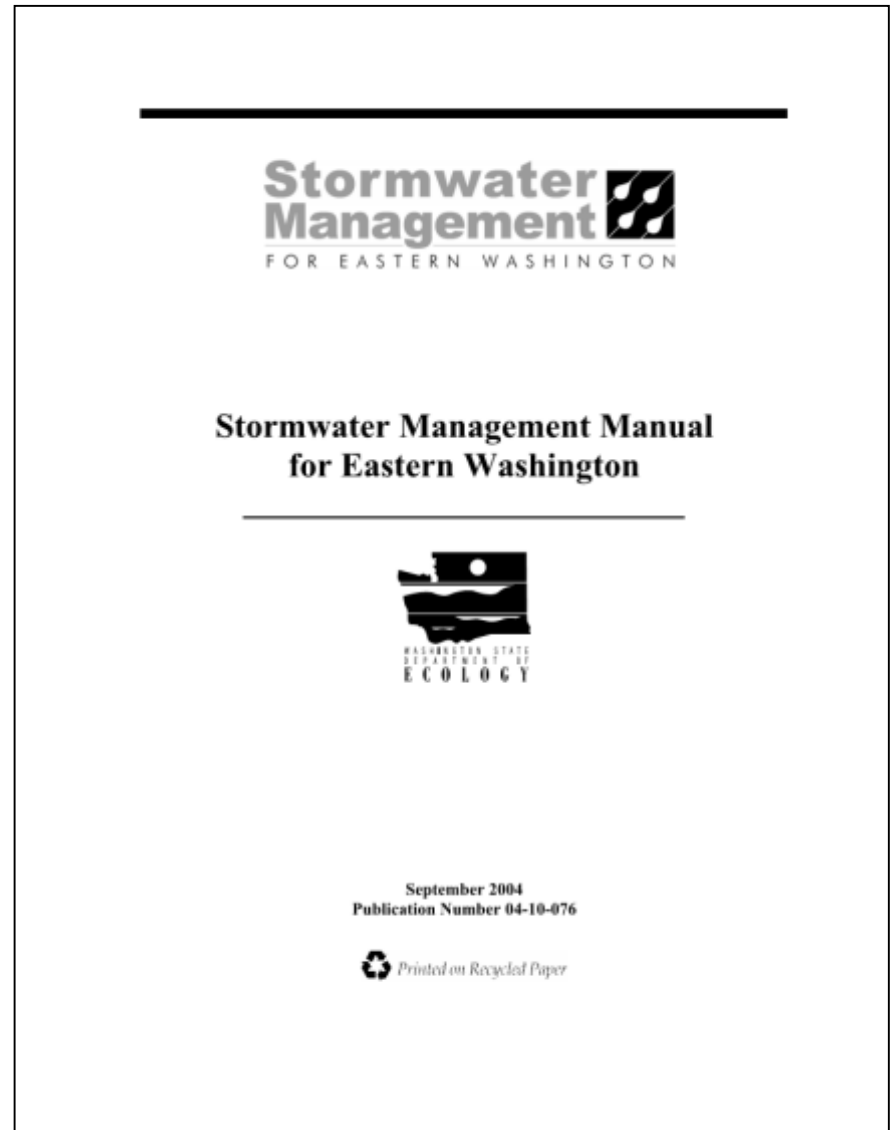
# WSDOT HRM

- WSDOT HRM Section 4-5.4

1. **Detailed Approach for Determining Infiltration Rates.** A detailed analysis that allows you to consider the type of hydrograph used (continuous or single-event); the depth to the groundwater table; the  $K_{sat}$  of the underlying soils of the facility; the site-specific hydraulic gradient for the facility; and the facility geometry.
2. **Simplified Approach for Determining Infiltration Rates.** This method generally follows Ecology's [SWMMWW](#) and commonly produces a more conservative facility size.
3. **Determining Infiltration Rates for Soil Amendment BMPs.** This method follows a standard ASTM and has been accepted by Ecology.

# SWMMIEW

- Presumptive rates per Table 5.4.1
- Appendix 6B
  - Flow chart for reference
  - Generally refers to Spokane County Guidelines for Stormwater Management which has been superseded by the SRSM



# Eastern Washington Concerns



Population centers in arid climates with hot dry summers

Drought tolerant plants and establishment



Access to existing discharges limited (MS4's, water bodies)





# Design Process

- Review NRCS web soil survey
- Review nearby well logs
- Speak to experts knowledgeable about site vicinity drainage
- Consider limited subsurface explorations
- Conceptual design and modeling
- Prepare an exploration plan
- Refine and update design



# System Sensitivity Summary

*1 ACRE IMPERVIOUS SITE*

*DRAINING TO A 2000 SF INFILTRATION POND*

*SPOKANE COUNTY SCS TYPE II 25 YEAR 24 HOUR STORM*

**0.25 IPH**

3.05 ft max depth  
6,100 cf storage  
required

**1 IPH**

2.15 ft max depth  
4,300 cf storage  
required

400% increase  
30% reduction

**4 IPH**

1.40 ft max depth  
2,800 cf storage  
required

800% increase  
54% reduction

# System Sensitivity Summary

1 ACRE IMPERVIOUS SITE

DRAINING TO A 2000 SF INFILTRATION POND

SPOKANE COUNTY SCS TYPE IA 25 YEAR 24 HOUR STORM

0.25 IPH

3.02 ft max depth  
6,040 cf storage  
required

1 IPH

1.58 ft max depth  
3,160 cf storage  
required

400% increase  
48% reduction

4 IPH

0.32 ft max depth  
640 cf storage  
required

800% increase  
89% reduction

# System Sensitivity Summary

1 ACRE IMPERVIOUS SITE

DRAINING TO A 2000 SF INFILTRATION POND

RICHLAND SCS TYPE IA 25 YEAR 24 HOUR STORM

0.25 IPH

1.98 ft max depth  
3,960 cf storage  
required

1 IPH

0.78 ft max depth  
1,560 cf storage  
required

400% increase  
60% reduction

4 IPH

0.14 ft max depth  
280 cf storage  
required

800% increase  
93% reduction

# Preferred Methodology



Based upon BMP, hydraulic loading, and soil



Appropriate timing and phasing



Appropriate for the project

Test Methodology:	Considerations:
a. Grain size analysis	<ul style="list-style-type: none"> <li>▪ Doesn't account for site conditions (soil structure, restrictive layers...)</li> <li>▪ Relatively inexpensive</li> <li>▪ Testing at multiple depths possible</li> </ul>
b. Single ring infiltrometer	<ul style="list-style-type: none"> <li>▪ Accounts for site conditions</li> <li>▪ Relatively inexpensive</li> <li>▪ Primarily suitable for surface testing</li> <li>▪ Results may not be applicable if significant disturbance</li> </ul>
c. In-place test (drywell and swale flood test)	<ul style="list-style-type: none"> <li>▪ Accounts for site conditions</li> <li>▪ Increased cost if facilities require construction</li> <li>▪ Results most easily correlated to similar facilities</li> <li>▪ Timing can be difficult. Requires existing facility</li> <li>▪ Primarily useful for phased projects</li> </ul>
d. PIT test	<ul style="list-style-type: none"> <li>▪ Accounts for site conditions</li> <li>▪ More time consuming, generally more expensive</li> <li>▪ Requires significant water sources</li> <li>▪ May be difficult to complete on site with high infiltration</li> </ul>
e. Presumptive rates	<ul style="list-style-type: none"> <li>▪ Doesn't account for site conditions</li> <li>▪ Very inexpensive</li> <li>▪ Requires detailed knowledge of general area geology</li> </ul>

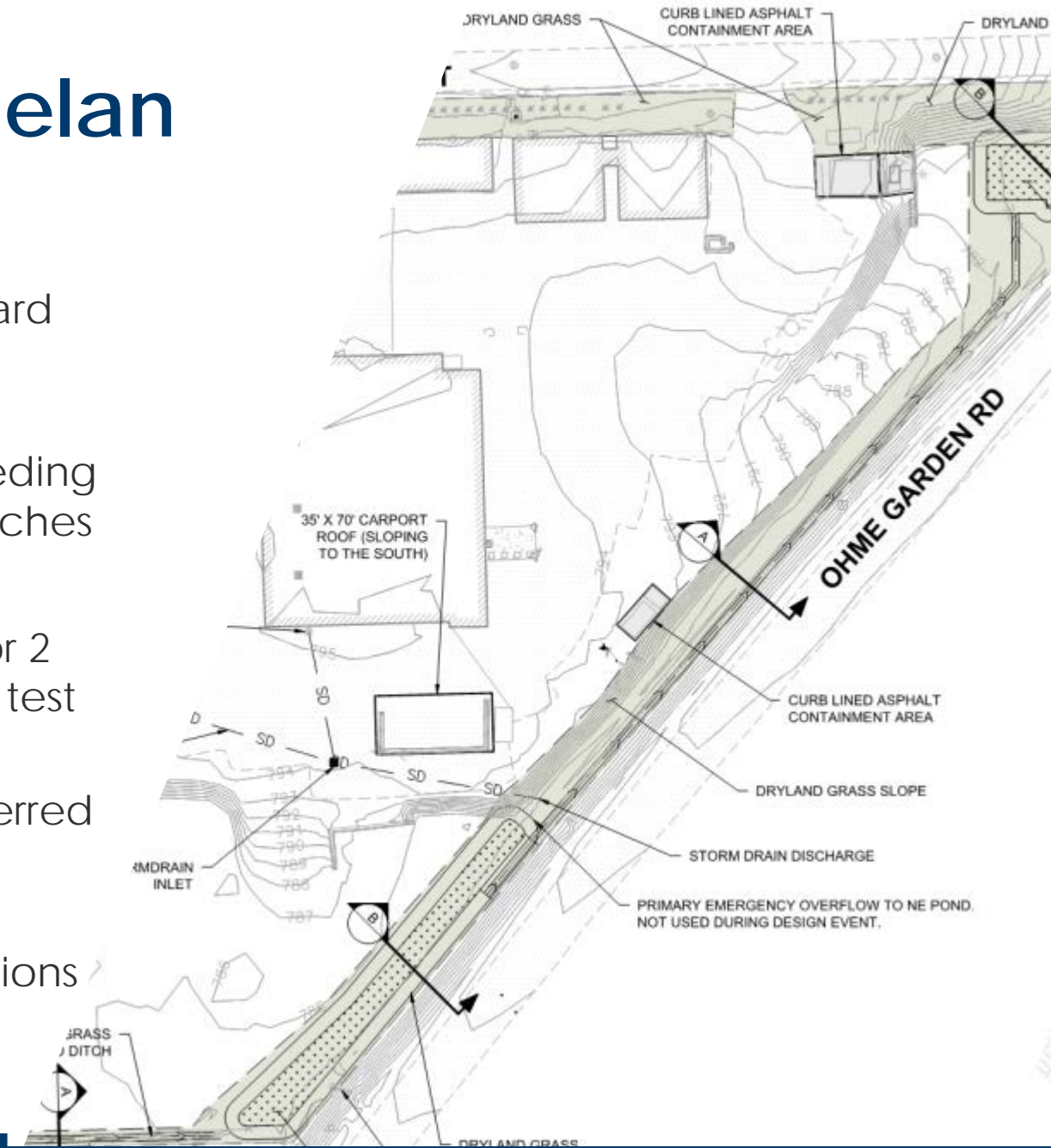
# Examples

- Spokane Valley PIT test
  - Water supply insufficient to maintain water surface
  - Soils in mapped “pre-approved” location
- Pillar Rock Estates
  - Vicinity largely shallow bedrock
  - County staff aware of paleochannel
  - Targeted borings established pond location



# Example – Chelan Sunnyslope

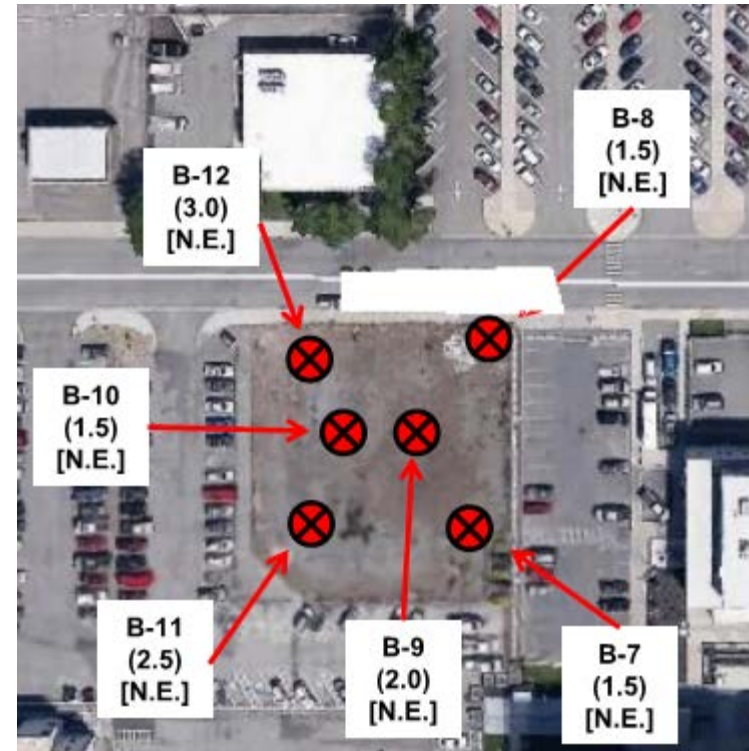
- 10 acre maintenance yard with limited stormwater infrastructure
- Offsite discharges exceeding capacity of roadside ditches
- Limited budget
- Geotech had budget for 2 PIT tests, 2 observational test pits
- Concept identified preferred solution
- One day of field work provided recommendations





# Example – Detail

- Project located where presumptive approach is commonly implemented
- 0.5 acres of impervious surface
- Key site concern was groundwater depth, anticipated at 15 feet BGS
- Observed infiltration rate of 36 IPH
- Alternative methodology?



A blue-tinted photograph of a natural landscape. In the foreground, there are various plants and rocks. A path or streambed winds through the middle ground. The background is filled with tall evergreen trees. The word "QUESTIONS?" is written in large, white, bold, sans-serif capital letters across the center of the image. A solid blue horizontal bar is at the bottom of the page.

**QUESTIONS?**