

# Incorporating LID Into Codes

Professional Training

City of Bellevue

2017 Storm and Surface Water Engineering Standards Update

Presented By:

**Rick Watson, Bellevue Utilities**

**Robin Kirschbaum, RKI**



**ROBIN KIRSCHBAUM, INC.**

water { planning  
engineering

City of Bellevue, WA, City Hall

March 7, 2017

# Presentation Overview

- Review NPDES Permit requirements
- Bellevue's approach to updating Codes and Standards
- Tools to Assist Developers and Reviewers
- SSWES updates
- Comments and questions
- Closing remarks and next steps



*145<sup>th</sup> Place SE, Bellevue, WA*

# Acknowledgements

## **Code Updates:**

Transportation  
Development Services  
Utilities  
Parks

## **Storm and Surface Water Engineering Standards:**

City of Bellevue  
Robin Kirschbaum, RKI  
Jenny Saltonstall, AESI

## **Project Manager:**

Rick Watson, City of Bellevue  
Robin Kirschbaum, RKI

## **Interagency Coordination:**

Transportation  
Utilities  
Development Services  
Parks

## **Thanks to the following for their contributions:**

Washington State Department of Ecology  
King County  
Kitsap County  
City of Seattle



# Review Permit Requirements

# Phase II Permit Requirements



*Redmond Overlake Village LID Roadway Retrofit*

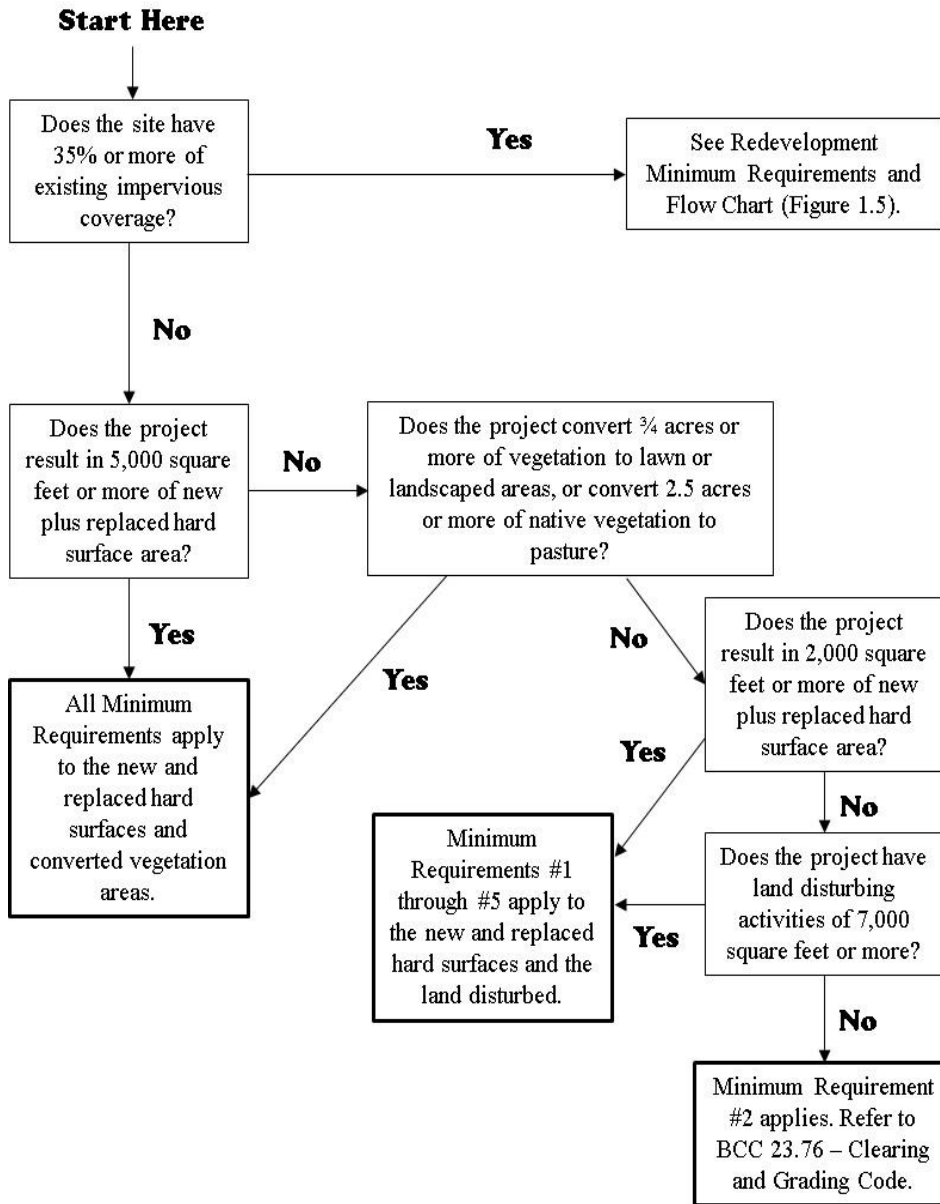
- Review, revise, and make effective
  - Codes, standards, ordinances, and other enforceable documents
  - Incorporate and require LID
- Make LID the preferred and commonly-used approach
- Minimize impervious surface, native vegetation loss, and stormwater runoff

# Phase II Permit Requirements (Cont.)

- Adopt updated codes, standards, ordinances, etc. by December 31, 2016
- Submit report to Ecology by March 31, 2017 summarizing:
  - List of participants
  - Codes, rules, standards, and other enforceable documents reviewed
  - Revisions made to incorporate and require LID



*NE Geneva Street, Suquamish, WA*



# Minimum Requirements Applicability

Based on:

- New and replaced hard surface
- Land disturbing activity
- Converted vegetation
- Project value

# LID Requirements for MR #5

## Projects that Trigger MR #1-5 (Only):

- **Projects with**
  - 2,000 SF to ≤5,000 SF hard surface  
OR
  - ≥7,000 SF disturbance
- **Requirement**
  - Option 1 - Use List #1 OR
  - Option 2 – Demonstrate LID Performance Standard
    - Requires engineer to run model and design BMPs
    - Bioretention required instead of rain gardens
    - Typ. requires high infiltration rates
- **Rain gardens or bioretention sizing** – Set ponding area ≥ 5% drainage area

### List #1

#### Lawn and landscaped areas

- Post-Construction Soil Quality and Depth (BMP T5.13)

#### Roofs

- Full Dispersion (BMP T5.30) or Downspout Full Infiltration (BMP T5.10A)
- **Rain Gardens or Bioretention**
- Downspout Dispersion (BMP T5.10B)
- Perforated Stub-out Connection (BMP T5.10C)

#### Other hard surfaces

- Full Dispersion (BMP T5.30)
- Permeable Pavement or **Rain Gardens or Bioretention**
- Sheet flow dispersion (BMP T5.12) or Concentrated Flow Dispersion (BMP T5.11)



# LID Requirements for MR #5

## Projects that Trigger MR #1-9:

- **Projects with**
  - $\geq 5,000$  SF hard surface OR
  - $\geq \frac{3}{4}$  acre converted vegetation
- **Requirement**
  - Option 1 – Use List #2 OR
  - Option 2 – Use LID Performance Standard and BMP T5.13
- **Bioretention sizing** – Set ponding area  $\geq 5\%$  drainage area

### List #2

#### Lawn and landscaped areas

- Post-Construction Soil Quality and Depth (BMP T5.13)

#### Roofs

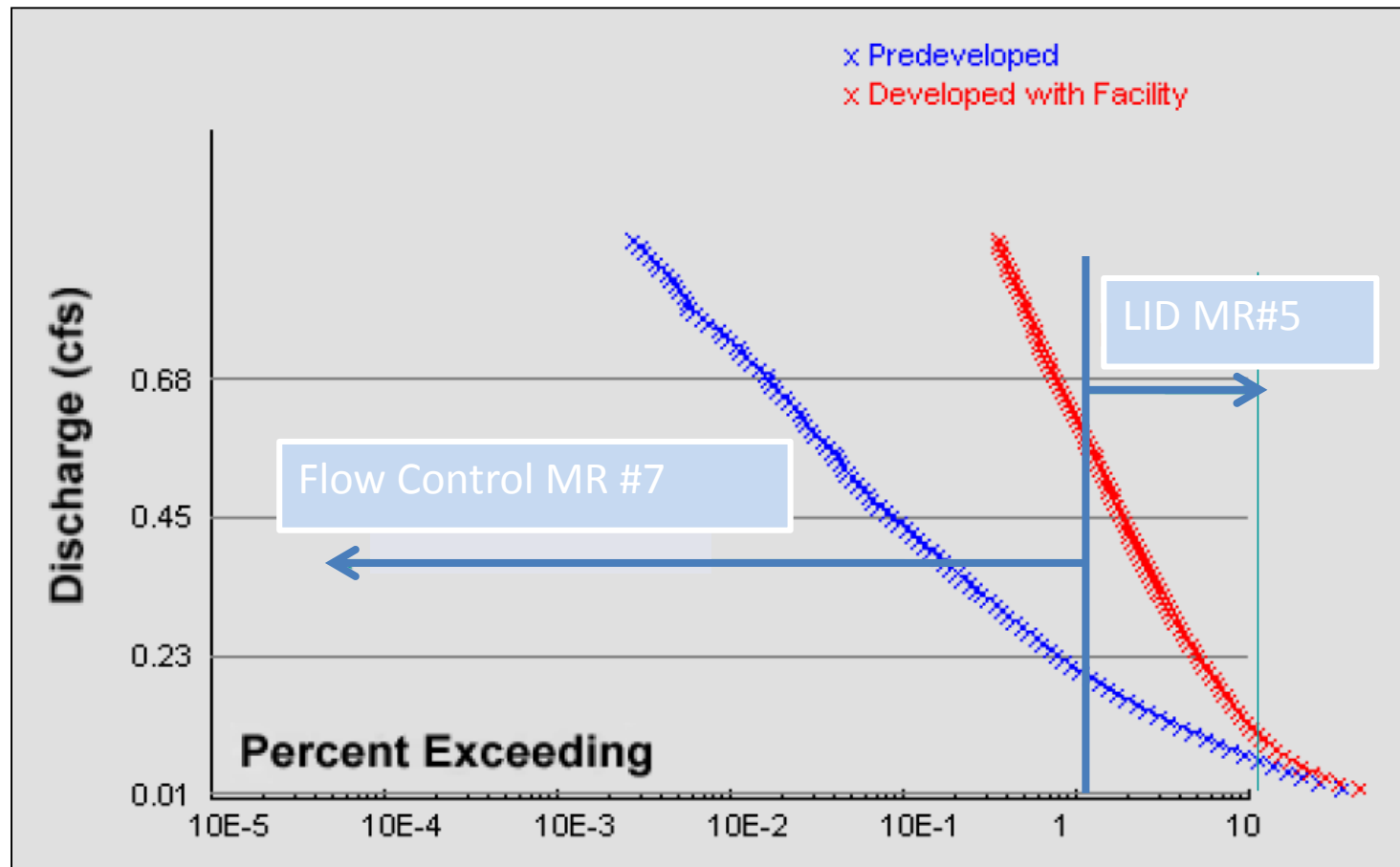
- Full Dispersion (BMP T5.30) or Downspout Full Infiltration (BMP T5.10A)
- **Bioretention**
- Downspout Dispersion (BMP T5.10B)
- Perforated Stub-out Connection (BMP T5.10C)

#### Other hard surfaces

- Full Dispersion (BMP T5.30)
- Permeable Pavement
- **Bioretention**
- Sheet flow dispersion (BMP T5.12) or Concentrated Flow Dispersion (BMP T5.11)

# LID Performance Standard

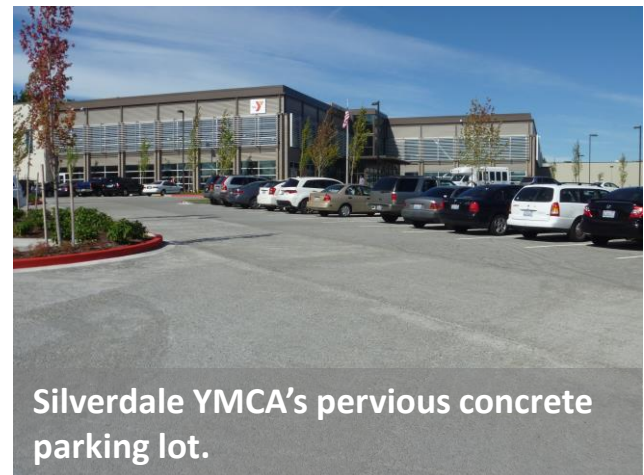
Match 8% 2-yr to 50% 2-yr pre-developed durations

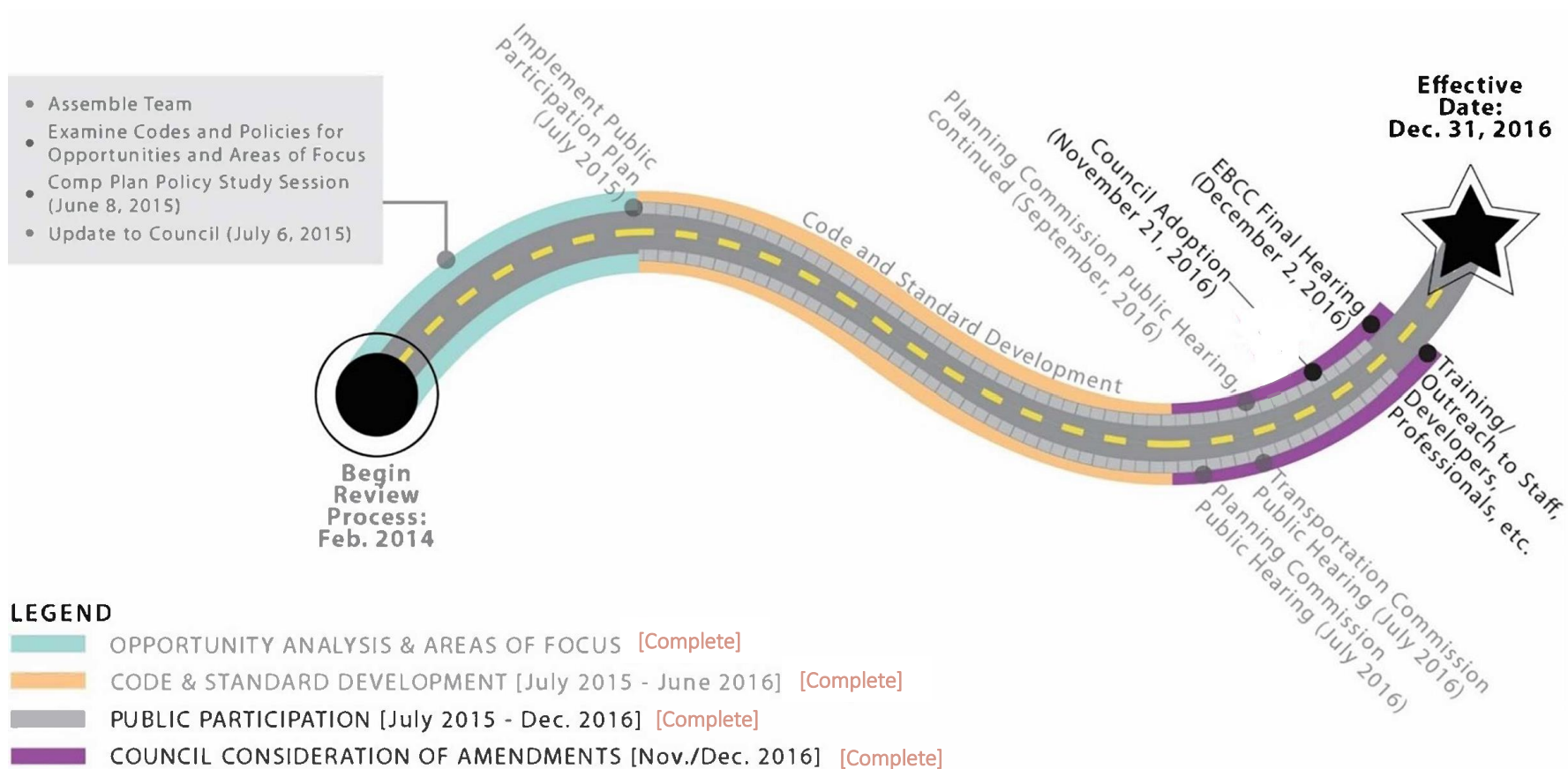


# What is LID?

“Stormwater and land use management strategy that ... mimics pre-disturbance hydrologic processes of infiltration, filtration, storage, evaporation and transpiration by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices that are integrated into a project design...”

*Source: Western WA Phase II MS4 Permit, Effective 2013*





# Bellevue's Approach to Updates

# Review Codes & Standards



*Lewis creek Visitor Center,  
Image courtesy of Tom Kuykendall, Bellevue Parks*

- Stormwater Code
- Land Use Code
- Transportation Code
- Clearing & Grading Code
- Surface Water Code
- Transportation Design Standards
- Storm and Surface Water Engineering Standards

# 2017 SSWES Update Approach

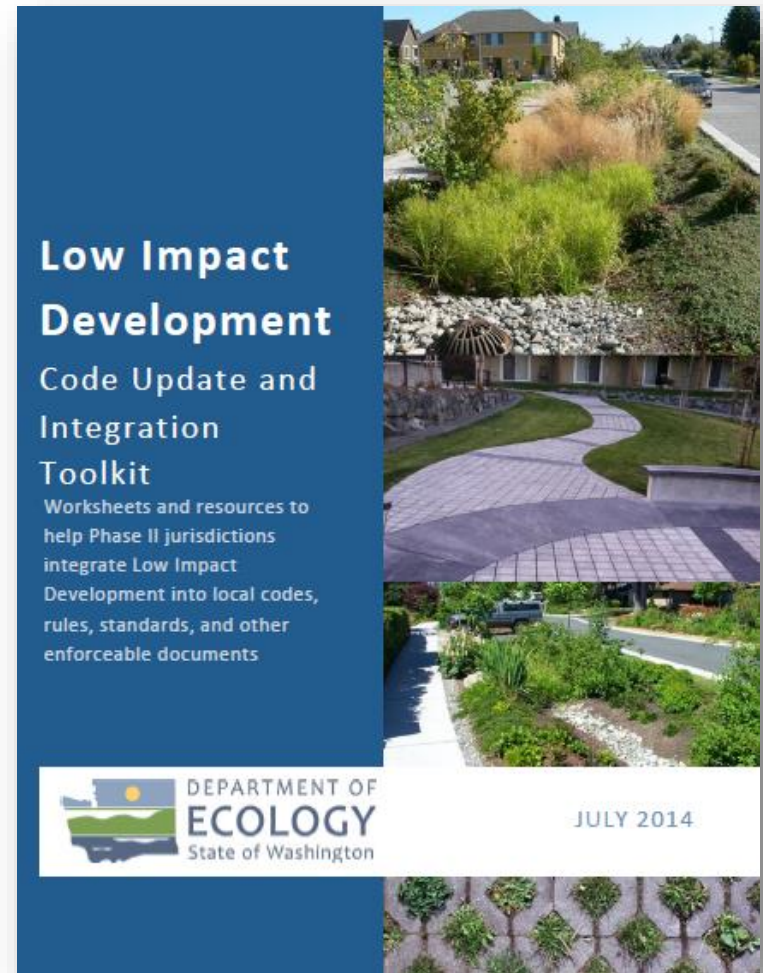
- Adopted the 2014 amendment of the 2012 Stormwater Management Manual for Western Washington (DOE manual)
- Implemented local updates where appropriate:
  - Conveyance;
  - Grading;
  - Land use code;
  - Sensitive areas;
  - Geotechnical/soils analysis procedures;
  - Etc.



*Street closure due to flooding. Photo from the 2012 City of Bellevue Stormwater Management Guidelines.*

# Implementation Process

- Outreach
- Review and update
  - Application materials
  - Permit review bulletins
  - Process flow charts
  - Permitting information
  - Etc.
- Training
  - City staff
  - Professionals
- Develop tools
  - Infiltration infeasibility map
  - Infiltration feasibility checklist
  - Etc.





# City of Bellevue Tools



# Tools

- Infiltration Infeasibility Study
- Infiltration Feasibility Assessment Checklist
- Site Assessment and Planning Packet
- 2017 Storm and Surface Water Engineering Standards



associated  
earth sciences  
incorporated

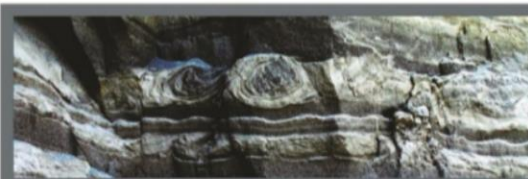


*Infiltration Infeasibility Analysis and Technical Report*

**CITY OF BELLEVUE**  
**INFILTRATION INFEASIBILITY STUDY**  
Bellevue, Washington

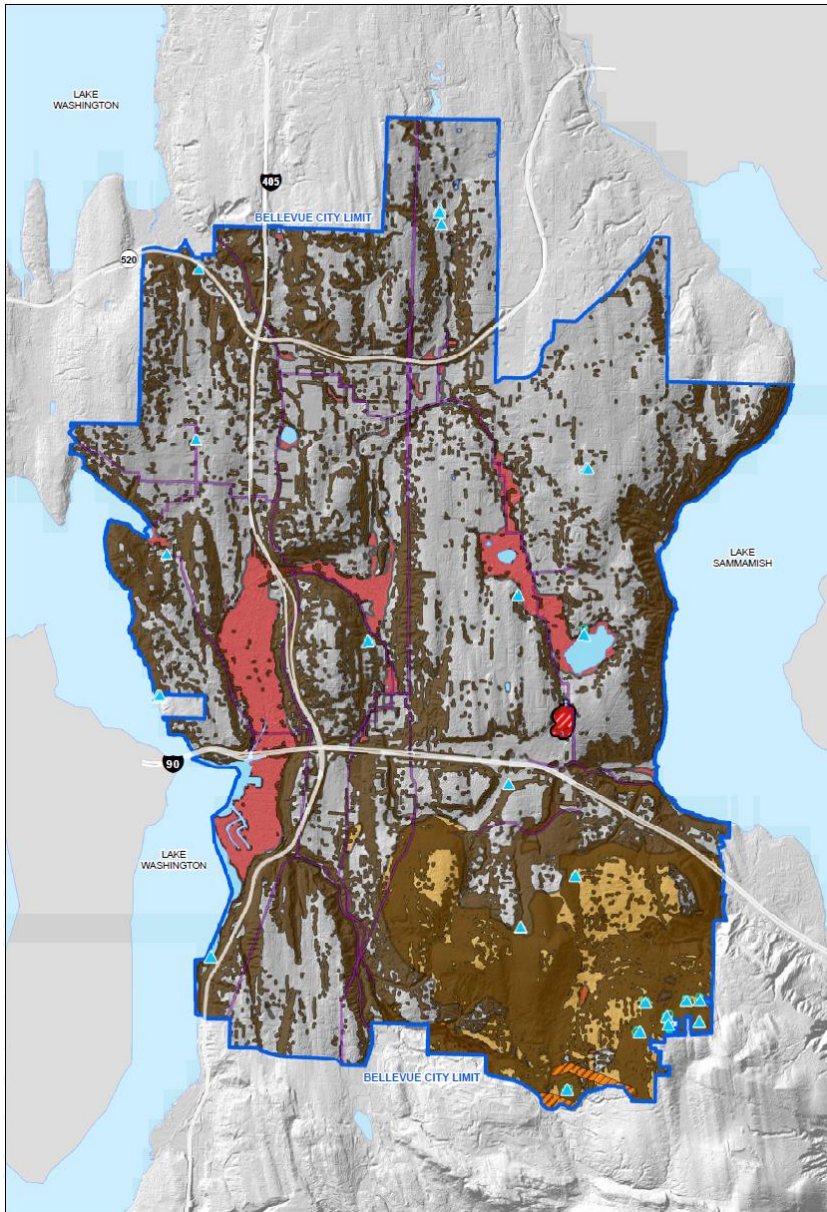
Prepared For  
**CITY OF BELLEVUE UTILITIES DEPARTMENT**

Project No. KH150173A  
April 20, 2016



Associated Earth Sciences, Inc.  
911 5th Avenue  
Kirkland, WA 98033  
P (425) 827 7701  
F (425) 827 5424

# Infiltration Infeasibility Study



## LEGEND:

### INFEASIBLE AREAS

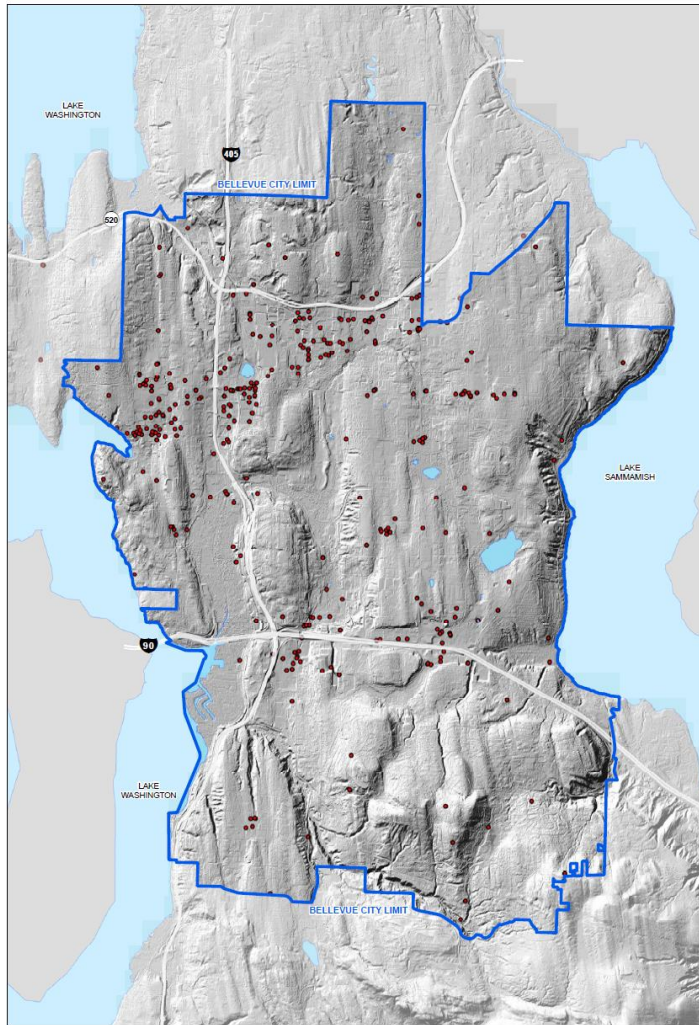
- ▲ WATER WELL
- ▨ WATER WELL: 100 FOOT BUFFER
- ▨ COAL MINE SUBSIDENCE ZONE 2
- ▨ UTILITY: 50 FOOT BUFFER
- ▨ 25% SLOPE OR LANDSLIDE HAZARD: 50 FOOT BUFFER
- ▨ WETLAND, SHALLOW GROUNDWATER
- ▨ LANDFILL: 200 FOOT BUFFER
- ▨ SHALLOW BEDROCK: MULTIPLE DATA SOURCES

LOCATIONS AND DISTANCES SHOWN ARE APPROXIMATE

DATA SOURCES / REFERENCES:  
DESCRIBED IN INFILTRATION INFEASIBILITY  
ANALYSIS AND TECHNICAL REPORT

Source: AESI 2016.

# Infiltration Infeasibility Study




**LEGEND:**

- POTENTIAL CONTAMINATION OR HAZARDOUS MATERIALS STORAGE

Source: AESI 2016.

# Site Assessment and Planning



**BELLEVUE SURFACE WATER ENG**  
Site Assessment and Planning Packet

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**Instructions for completing this packet:**

- This packet is to be completed during preliminary site assessment and planning, and preliminary land use planning application
- See Appendix D1 for definitions of terms used in this packet
- See Chapter D2 for submittal requirements

**The Goals of this packet are to:**

- Provide basic project information
- Document how the project proposes to minimize:
  - Impervious surfaces
  - Loss of native vegetation
  - Stormwater runoff
- Demonstrate how the project proposes to comply with Minimum Requirement #5 –On-site Stormwater Management

**A. APPLICANT INFORMATION**

Company/Agency/Owner: \_\_\_\_\_  
 Contact Person: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 Email: \_\_\_\_\_  
 Signature: \_\_\_\_\_  
 Date: \_\_\_\_\_

**B. PROJECT INFORMATION**

Permit No. (provided by City): \_\_\_\_\_  
 Project Address or Project Boundaries: \_\_\_\_\_  
 Parcel No.: \_\_\_\_\_  
 Project Type:  
 Residential     Commercial     Industrial     Public  
 Project is:  
 New or redevelopment     Remodel     Retrofit  
 Combination (describe: \_\_\_\_\_)

0042043A-0916  
APPENDIX D-2 SITE ASSESSMENT AND PLANNING PACKET  
A02 - PAGE 1)

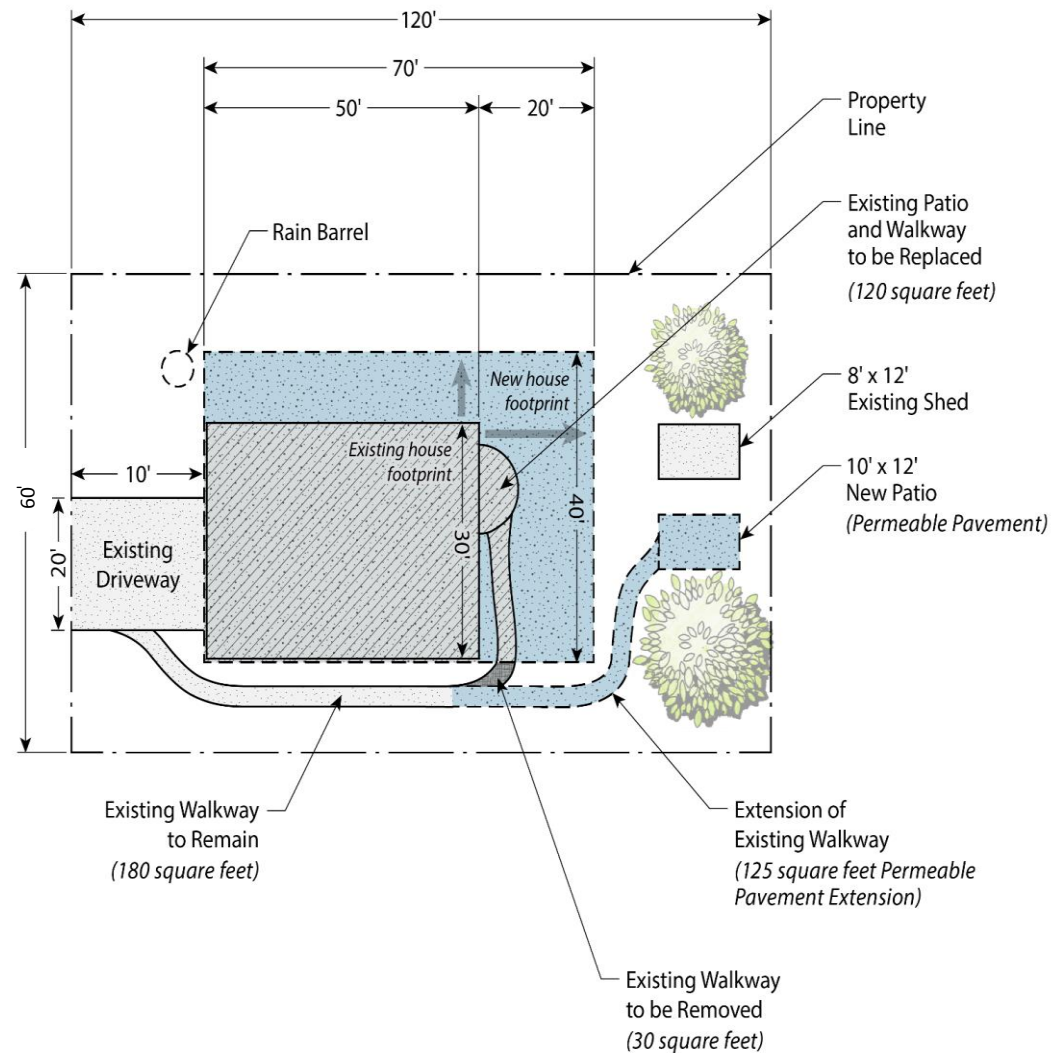
## Site Assessment and Planning Packet:

- Reviewed during:
  - Preliminary site assessment and planning
  - Preliminary land use planning application
  
- Goals
  - Document how project will minimize:
    - Impervious surfaces
    - Loss of native vegetation
    - Stormwater runoff
  - Document planning as needed to meet MR #5

# Site Assessment and Planning

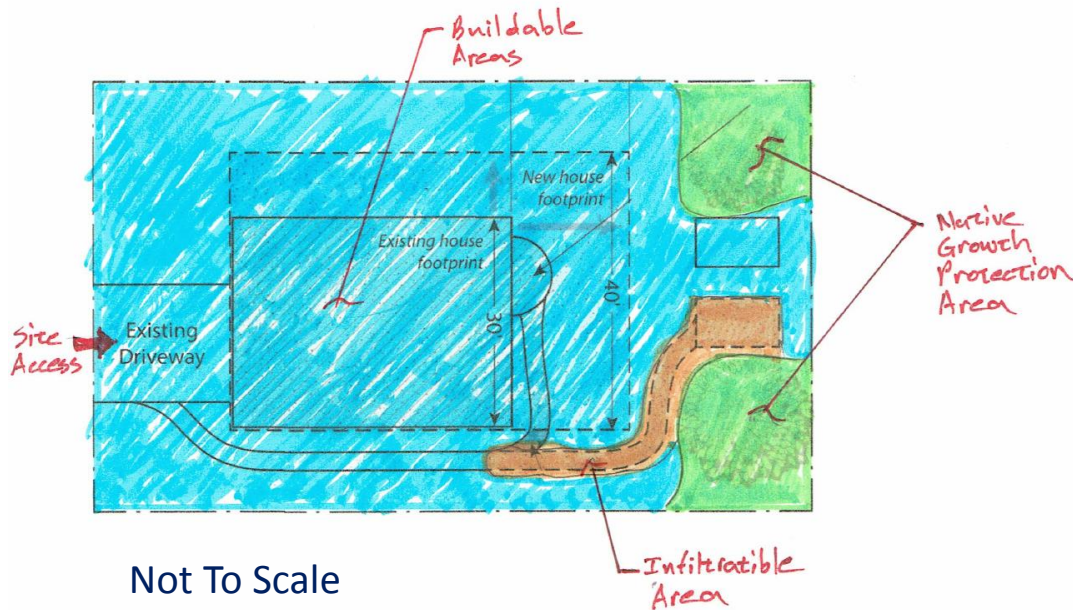
## Hypothetical Project Example

- Single Family Residential house new project near downtown Bellevue
- Illustrate Parts C, E, and F of planning packet



# Site Assessment and Planning

## Part C – Composite Site Map (Example)



### Notes:

\* Easements to be added in future revision

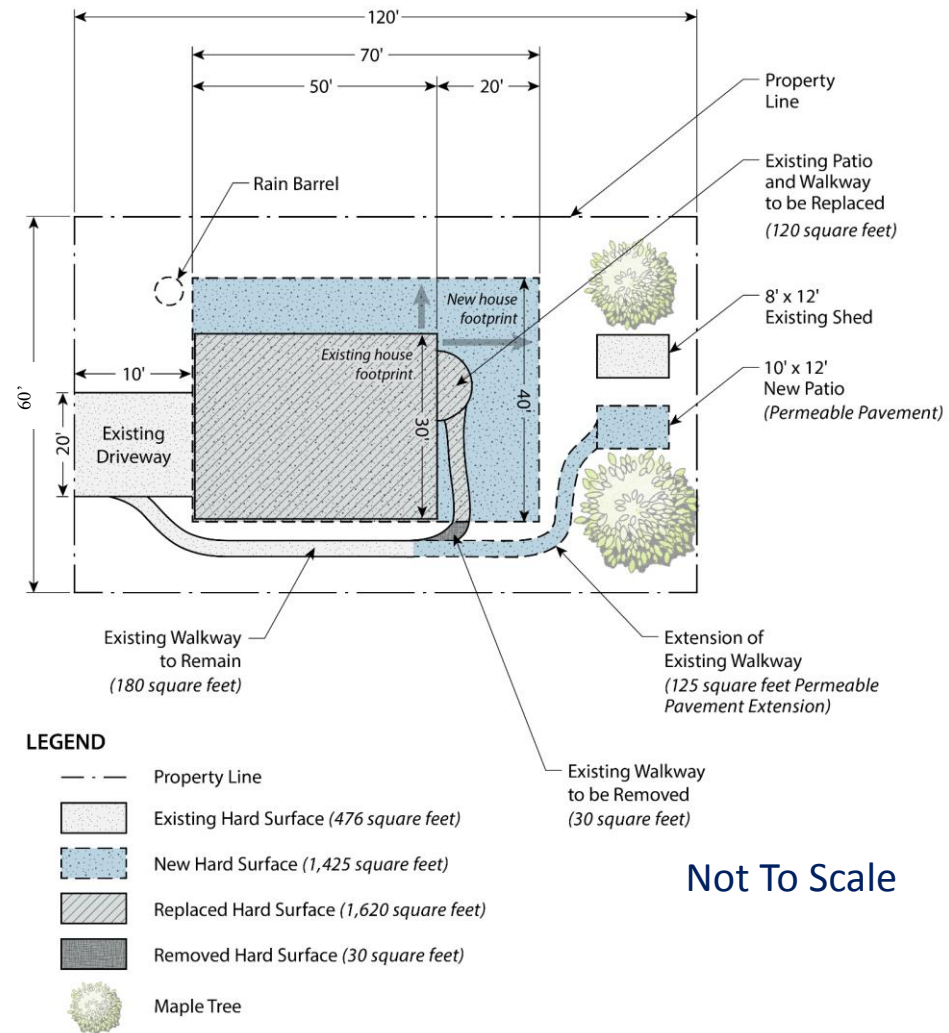
Composite map based on review of:

1. Project boundaries and structures
2. Soils
3. Critical areas
4. Dewatering
5. Topography
6. Hydrologic patterns and features
7. Vegetation
8. Land use controls
9. Access
10. Utility availability and easements

# Site Assessment and Planning

## Part E – Existing and Proposed Site Land Cover Areas (Example)

- Delineate individual surface types
- Example:
  - Existing hard surface, remain – 476 SF
  - Existing hard surface, remove – 30 SF
  - New hard surface – 1,425 SF
  - Replaced hard surface – 1,620 SF
  - **Total New + Replaced = 3,045 SF** (1,425 + 1,620)
- Important Note: Total New  $\neq$  (i.e., not equal to) Proposed – Existing



# Site Assessment and Planning

## Part E – Existing and Proposed Site Land Cover Areas (Example)

Surface Type	Existing Condition	Proposed Condition	Change
<b>Vegetated Areas</b>			
Tree canopy (SF)	200	200	
Number of trees (#)	2	2	
Landscape area (SF)	4,874	3,479	
Total project site vegetated area (SF)	5,074	3,679	1,395 ↓
Total project site vegetated area (%)	70%	51%	27% ↓
<b>Hard Surface Areas</b>			
Hard surface (SF)	2,126	3,521	1,395 ↑
Total project site hard area (%)	30%	49%	66% ↑



# Site Assessment and Planning

## Part F – Feasibility/Infeasibility Evaluation (Example)

BMP	Feasible	Infeasible	N/A	Rationale
Post-Construction Soil Quality and Depth	✓			
Full Dispersion		✓		Limited space
Downspout Dispersion		✓		Limited space
Sheet Flow Dispersion		✓		Limited space
Concentrated Flow Dispersion		✓		Limited space
Bioretention		✓		Limited space
Permeable Pavement	✓			May be feasible, review of setback requirements needed during siting/design
Perforated Stubout Connection	✓			
Vegetated Roofs			✓	Not required
Minimal Excavation Foundations			✓	Not required
New Trees	✓			
Retained Trees	✓			
Rainwater Harvesting	✓			

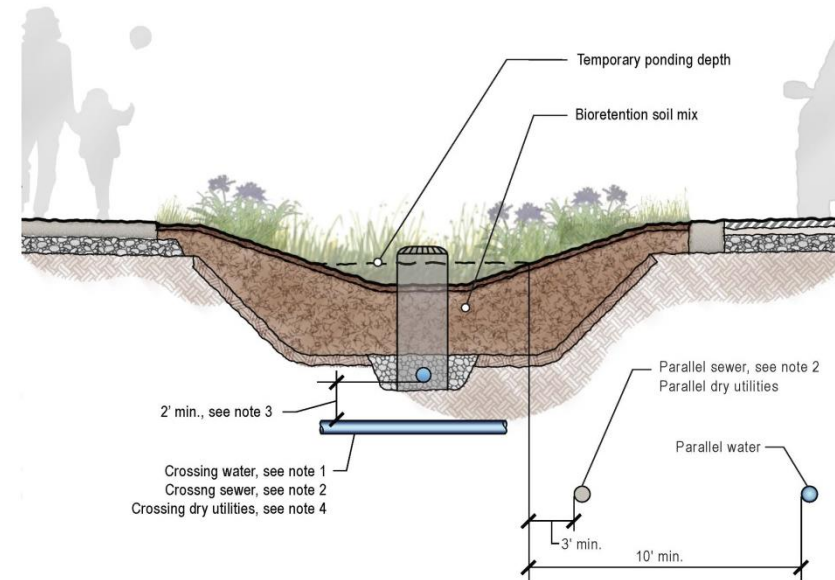


# Storm and Surface Water Engineering Standards

# Organization of the SSWES

## Chapters

- D1 – General
- D2 – Submittals
- D3 – Hydrology
- D4 – Conveyance
- D5 – BMP Design
- D6 – Materials
- D7 – Methods
- D8 – Natural Systems



Source: LID Technical Guidance Manual for Puget Sound.

# Organization of the SSWES (Cont.)

## Appendices

D1 – Definitions, References, & Abbreviations

D2 - Site Assessment and Planning

D3 - Title Block

D4 - Standard Notes

D5 - Drafting Standards

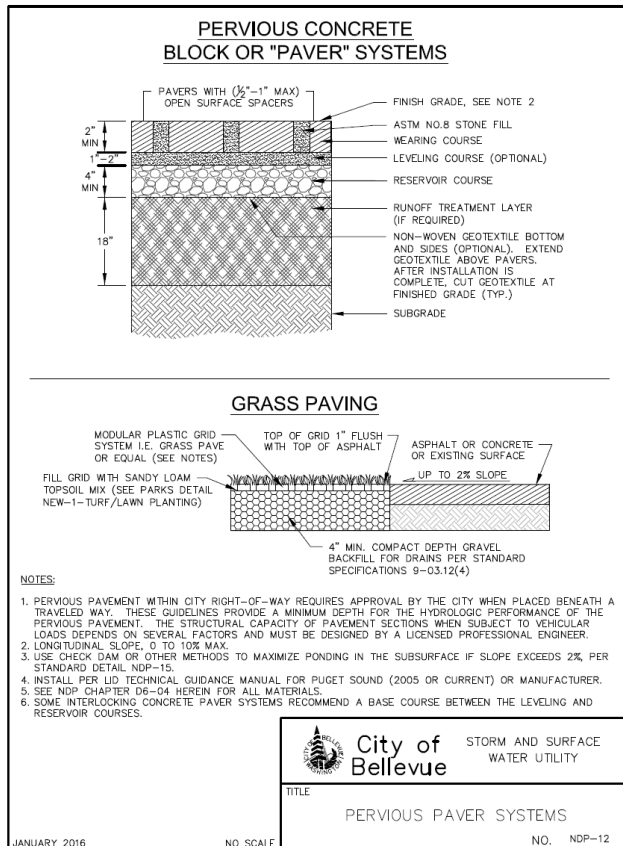
D6 - Approved Materials List

D7 - Reference Standards

D8 - Standard Details

D9 - LID BMP Infeasibility Criteria

D10 - Infiltration Testing

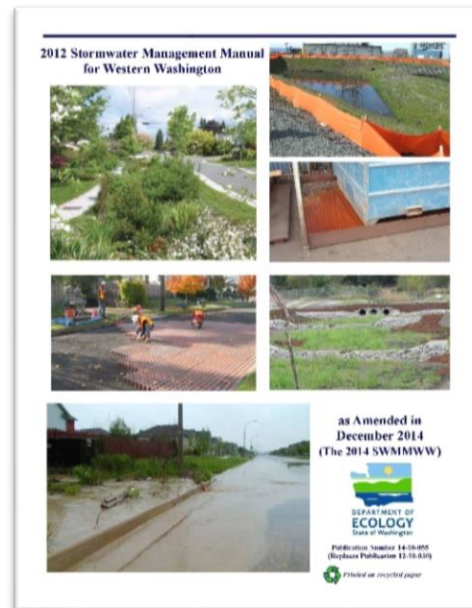


*Standard Detail NDP -12 – Pervious Paver Systems, from Appendix D8 (Example).*

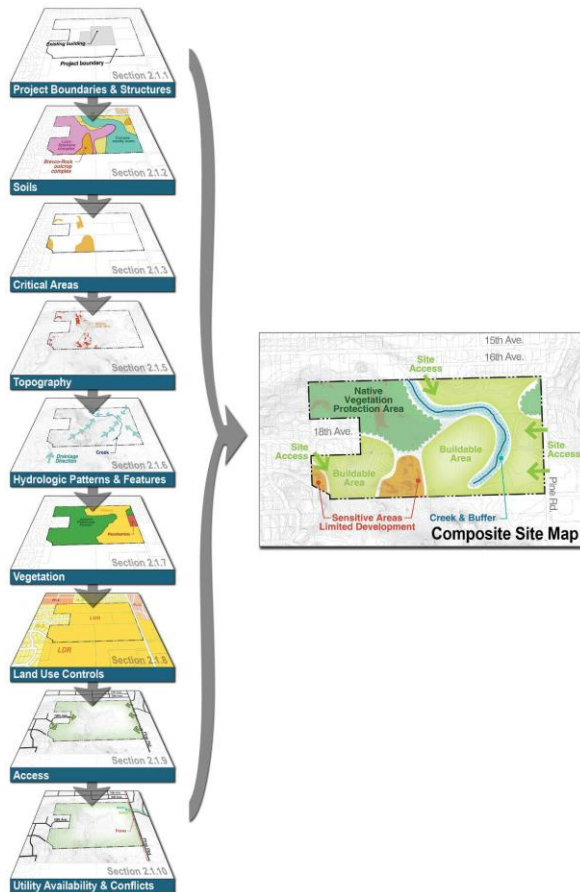
# Reference Manuals

Use in conjunction with relevant design manuals:

- Stormwater Management Manual for Western Washington (DOE Manual)
- LID Technical Guidance Manual for Puget Sound
- Western Washington LID Operations and Maintenance (O&M)
- WSDOT Hydraulics Manual



# Site Assessment & Planning

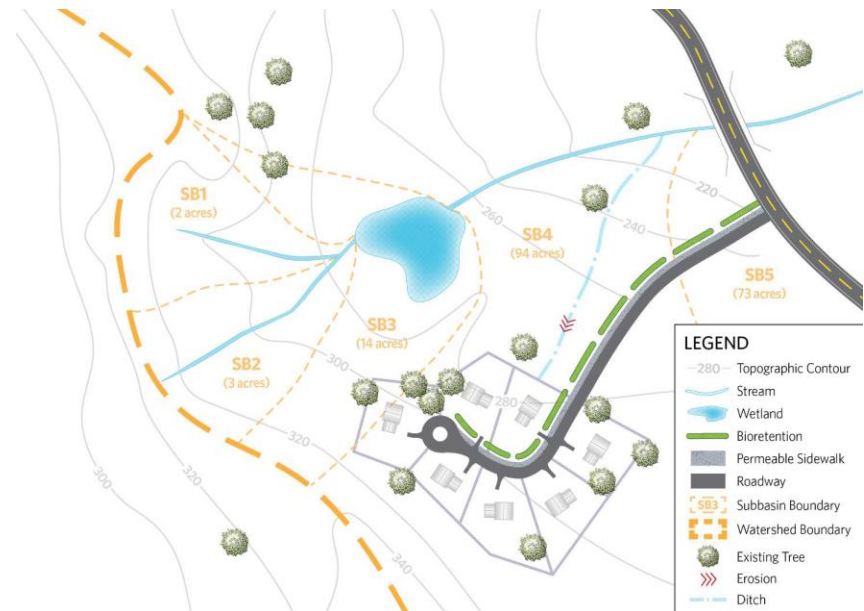


- Project Boundaries and Structures
- Soils
- Critical Areas
- Topography
- Hydrologic Patterns & Features
- Vegetation
- Land Use Controls
- Access
- Utility Availability & Conflicts


# Hydrologic Patterns and Features

Show on map the following features:

- Streams
- Wetlands
- Native soils and vegetation
- Seeps
- Springs
- Closed depressions
- Drainage swales and ditches
- Signs of erosion



# Site Assessment and Planning



**BELLEVUE SURFACE WATER ENG**  
Site Assessment and Planning Packet

---

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**A. APPLICANT INFORMATION**

Company/Agency/Owner: \_\_\_\_\_

Contact Person: \_\_\_\_\_

Address: \_\_\_\_\_

Phone: \_\_\_\_\_

Email: \_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**B. PROJECT INFORMATION**

Permit No. (provided by City): \_\_\_\_\_

Project Address or Project Boundaries: \_\_\_\_\_

Parcel No.: \_\_\_\_\_

Project Type:

Residential     Commercial     Industrial     Public

Project is:

New or redevelopment     Remodel     Retrofit

Combination (describe): \_\_\_\_\_

AW2018A-0918
APPENDIX D-2 SITE ASSESSMENT AND PLANNING PACKET
A02 - PAGE 1

Site Assessment and Planning Packet submittal includes:

- A. Applicant Information
- B. Project Information
- C. Site Composite Map
- D. Existing Site Inventory and Analysis Checklist
- E. Existing and Proposed Site Land Cover Areas
- F. Potential LID BMP Matrix

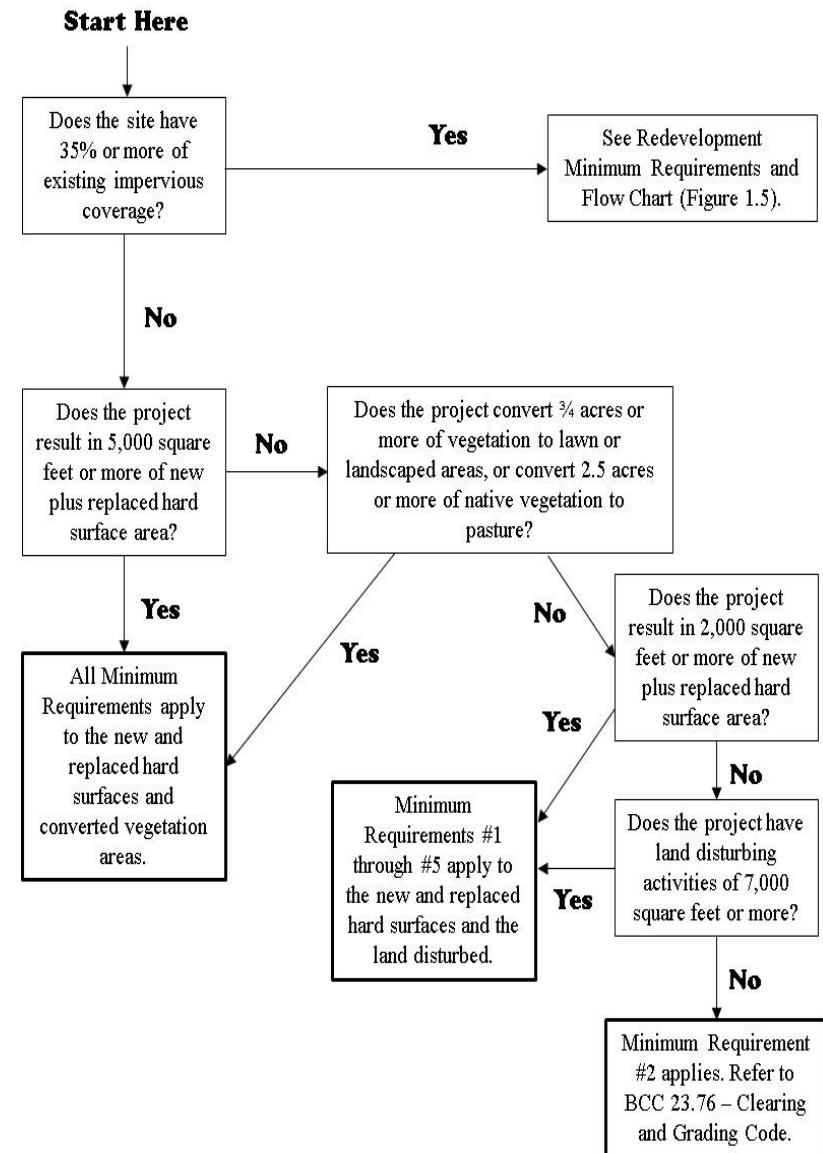


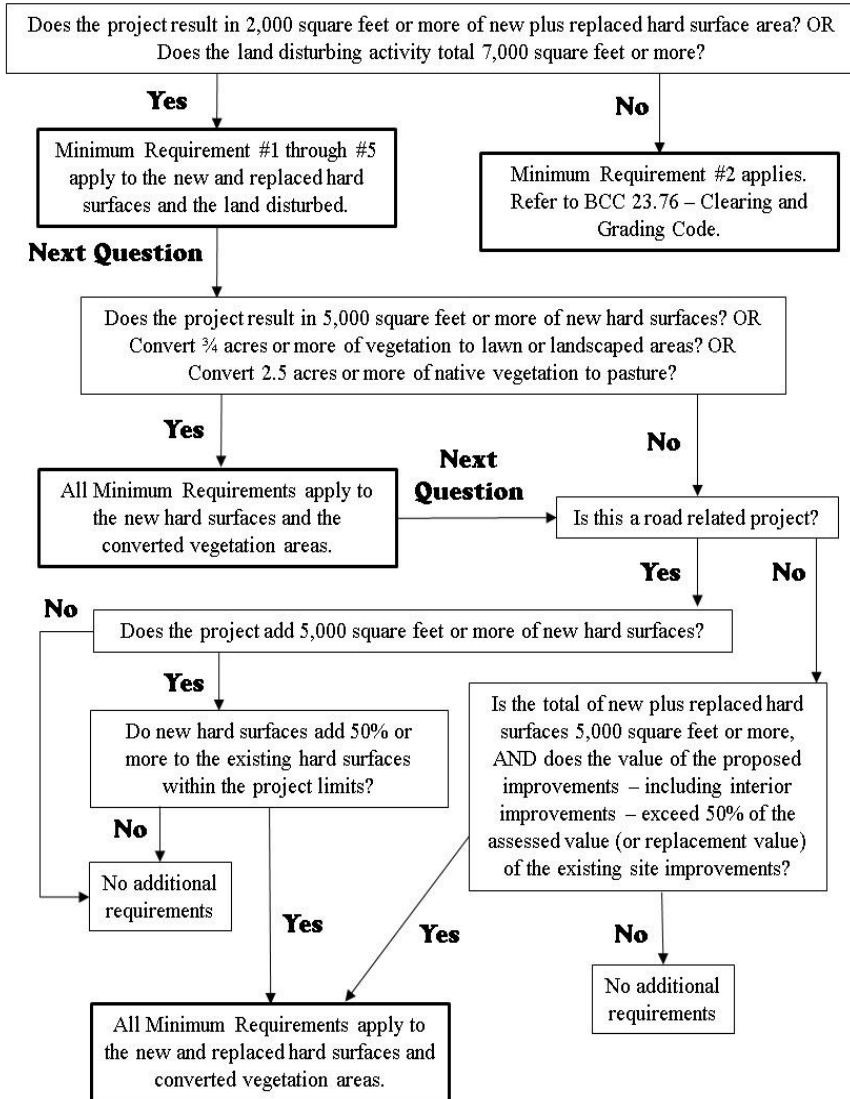
# Determine Minimum Requirements Applicability

- ❑ *Step 1* – Define the boundaries of the project site
- ❑ *Step 2* – Identify the receiving water and downstream conveyance
- ❑ *Step 3* – Review minimum requirement exemptions
- ❑ *Step 4* – Perform site assessment and planning
- ❑ *Step 5* – Calculate new plus replaced hard surface and native vegetation conversion
- ❑ *Step 6* – Calculate new plus replaced pollution generating surface
- ❑ *Step 7* – Determine which minimum requirements apply

# New Development Projects

- **MR #2 (Construction Stormwater Pollution Prevention)** – Applies to all projects
- **MR #1-5** – Applies to new and replaced hard surfaces and the land disturbed, for:
  - $\geq 2,000$  SF new plus replaced hard surface area; or
  - $\geq 7,000$  SF land disturbing activity.
- **MR #1-9** – Applies to new and replaced hard surfaces and converted vegetation areas, for:
  - $\geq 5,000$  SF new plus replaced hard surface area; or
  - $\geq \frac{3}{4}$  acres vegetation converted to lawn or landscaped areas; or
  - $\geq 2.5$  acres native vegetation converted to pasture.

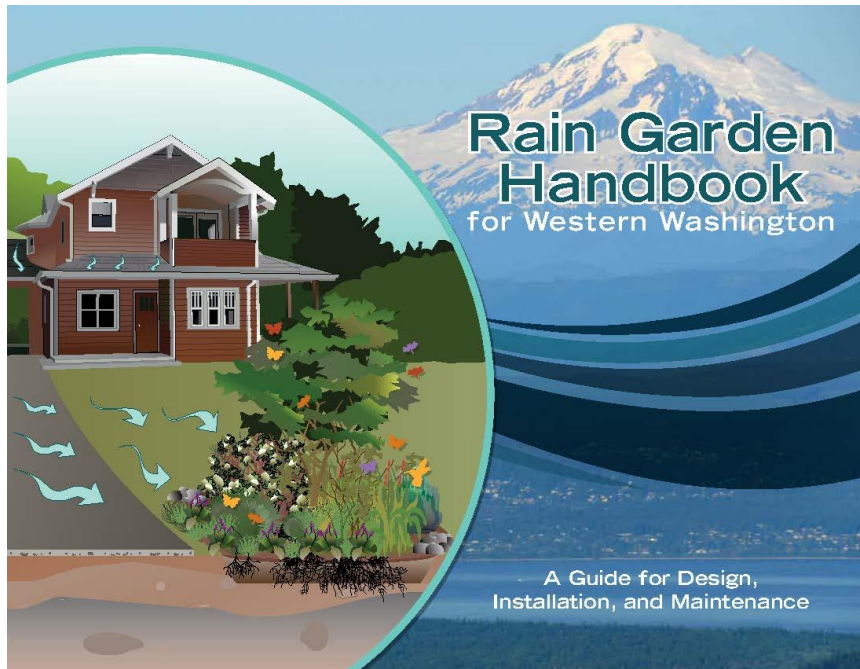




# Redevelopment Projects

- **MR #2 (Construction Stormwater Pollution Prevention)** – Applies to all projects
- **MR #1-5** – Applies to new and replaced hard surfaces and the land disturbed, for:
  - $\geq 2,000$  SF new plus replaced hard surface area; or
  - $\geq 7,000$  SF land disturbing activity.
- **MR #1-9** – Applies to new hard surfaces and converted vegetation areas, for:
  - $\geq 5,000$  SF new hard surface area; or
  - $\geq \frac{3}{4}$  acres vegetation converted to lawn or landscaped areas; or
  - $\geq 2.5$  acres native vegetation converted to pasture.

# Stormwater BMP Design



Use Chapter D5 in conjunction with:

- Stormwater Management Manual for Western Washington (Ecology Manual)
- LID Technical Guidance Manual
- Western Washington LID Operations and Maintenance (O&M)
- Rain Garden Handbook for Western Washington Homeowners (Rain Garden Handbook)
- Guidance for Underground Injection Control Wells that Manage Stormwater

# Select BMPs

1. Determine Dispersion Feasibility
2. Determine Infiltration Feasibility
3. Select BMPs for On-site Stormwater Management
4. Select BMPs for Flow Control
5. Select BMPs for Water Quality Treatment



Images from Integrating LID Into Local Codes; A Guidebook for Local Governments, Puget Sound Partnership, 2013.

# Dispersion Feasibility Assessment



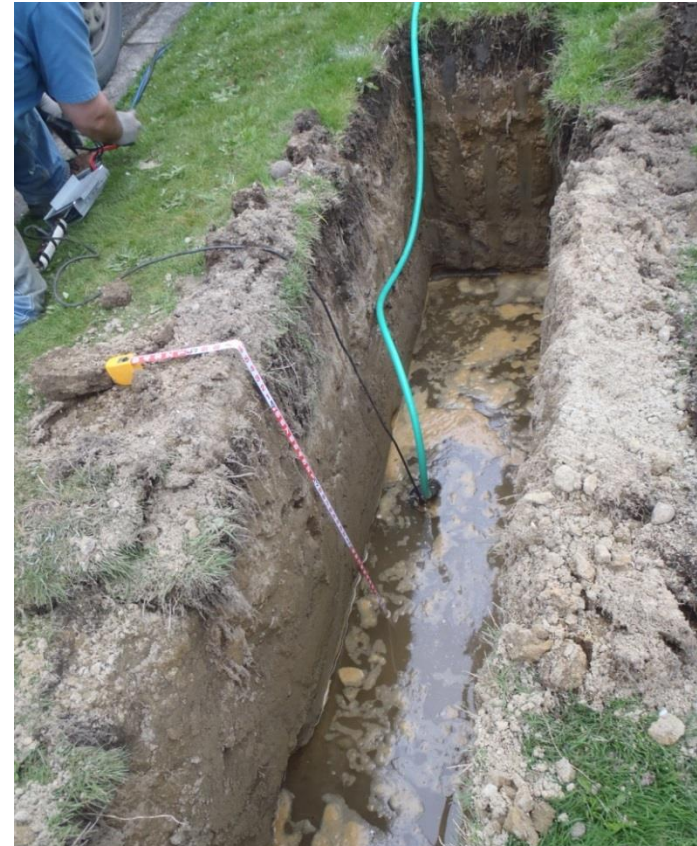
Image from Eastern WA LID Guidance Manual, Ecology 2013.

Evaluate horizontal setback requirements

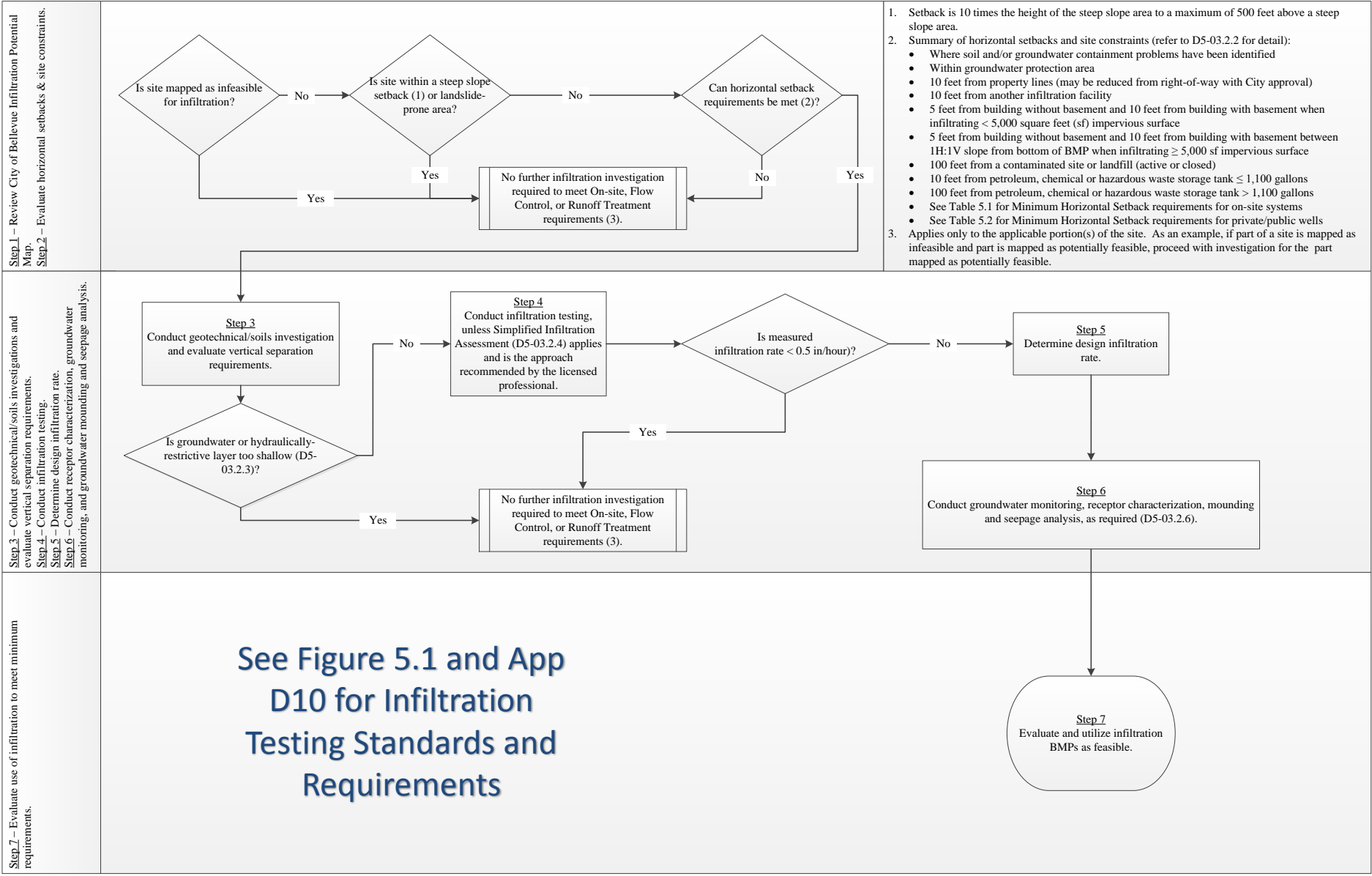
- Horizontal setbacks – Vary by BMP
- Flow path requirements
  - Full dispersion – 100'
  - Sheet flow dispersion – 10'
  - Concentrated flow dispersion – 25'
- Site constraints – Steep slopes, septic, landfills, etc.

# Infiltration Feasibility Assessment

1. Review the City of Bellevue's infiltration infeasibility map
2. Evaluate horizontal setbacks and site constraints
3. Conduct geotechnical/soils investigation
4. Conduct infiltration testing
5. Determine design infiltration rate
6. Conduct groundwater monitoring, receptor characterization, and mounding analysis, if applicable
7. Evaluate use of infiltration to meet minimum requirements



*Photo by AESI for SPU's Ballard NDS Project*





# LID BMP Infeasibility Criteria

## Excerpts from Appendix D9 of the SSWES (DRAFT).

BMP	Infeasibility Criteria	Additional Information from Applicant
Post Construction Soil Quality and Depth	<ul style="list-style-type: none"> <li>Portions of the site comprised of till soils with slopes greater than 33% can be considered infeasible for this BMP.</li> </ul>	
Full Dispersion	<ul style="list-style-type: none"> <li>The infeasibility criteria for “All Dispersion BMPs” (Table D9.1) apply.</li> <li>The design criteria for full dispersion (Volume V of the DOE Manual, BMP T5.30) cannot be met.</li> <li>A 65 to 10 ratio of the native vegetation area to the impervious area is unachievable.</li> <li>A minimum native vegetation flow path length of 100 feet (25 feet for sheet flow from a non-native pervious surface) is unachievable.</li> </ul>	
Downspout Dispersion	<ul style="list-style-type: none"> <li>The infeasibility criteria for “All Dispersion BMPs” (Table D9.1) apply.</li> <li>The design criteria for splashblock or trench downspout dispersion (Volume III of the DOE Manual, BMP T5.10B) cannot be met.</li> <li>There are no downspouts.</li> <li>The flow path setbacks to property lines, structures and other flow paths (Section D5-03.1) cannot be achieved.</li> </ul> <p><u>Splashblock Dispersion</u></p>	

• • •

See App D9 for Complete Set  
of Criteria



# Construction SWPPP – Clearing & Grading Permit

## New 13th Element:

1. Preserve Vegetation/Mark Clearing Limits
2. Establish Construction Access
3. Control Flow Rates
4. Install Sediment Controls
5. Stabilize Soils
6. Protect Slopes
7. Protect Drain Inlets
8. Stabilize Channels and Outlets
9. Control Pollutants
10. Control Dewatering
11. Maintain BMPs
12. Manage the Project
- 13. Protect LID BMPs**



*Sand bags prevent silt-laden flow from entering the bioretention facility. Green construction fencing prevents compaction due to foot traffic.*



# Discussion

# Surface Water Engineering Standards

Download from the City's website:

[http://www.bellevuewa.gov/utilities\\_codes\\_standards\\_intro.htm](http://www.bellevuewa.gov/utilities_codes_standards_intro.htm)

- 2017 SSWES
- City of Bellevue Infiltration Potential Map

# THANK YOU!

**Robin Kirschbaum, PE, LEED AP, ENV SP**  
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<http://www.robinkirschbaum.com/>  
phone: 206-406-1862



*Photo courtesy of Tom Kuykendall, City of Bellevue Parks*



**ROBIN KIRSCHBAUM, INC.**

water { planning  
engineering