Making the Invisible Visible: Seattle's Green Stormwater Infrastructure

Presented by:

Tracy Tackett

Green Stormwater Infrastructure Program Manager

RESTORE OUR WATERS
SEATTLE PUBLIC UTILITIES
COMBINED SEWER OVERFLOW REDUCTION

Green Stormwater Infrastructure (GSI)

- GSI toolbox overview
- GSI projects in the separated system
- GSI standardization
- GSI for CSO reduction

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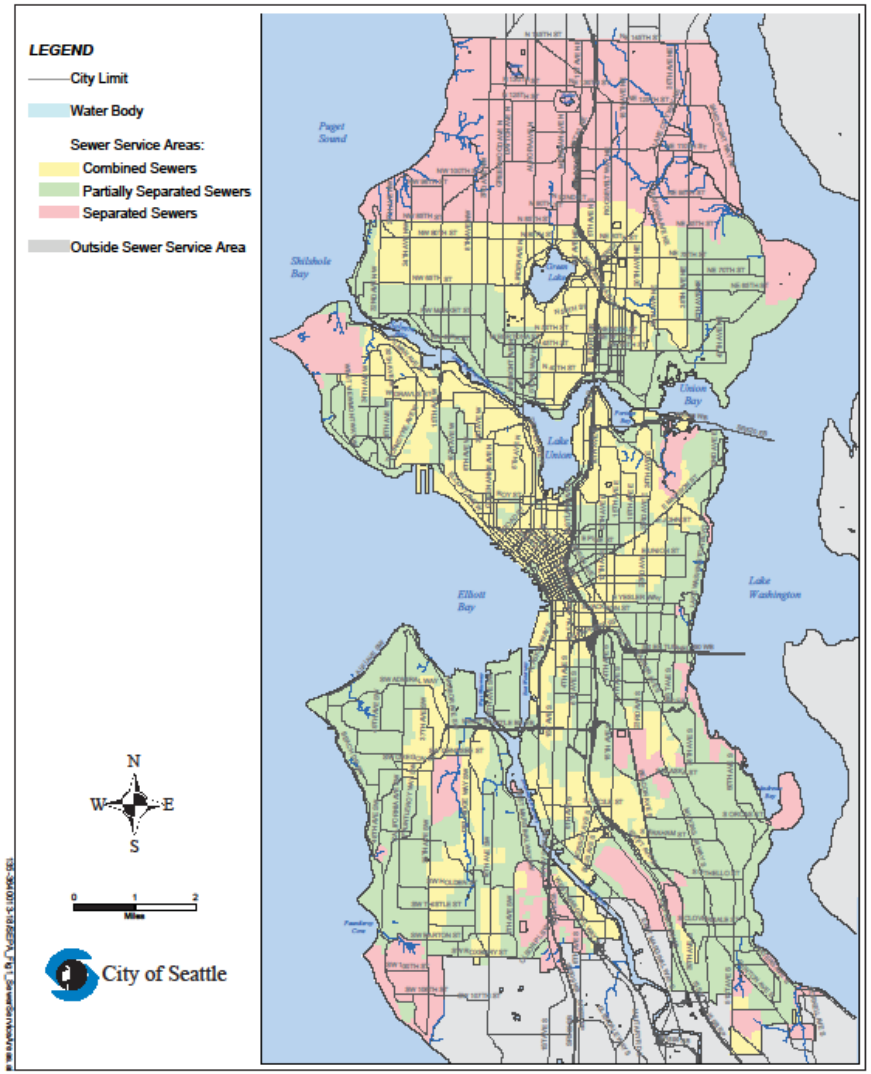

City Sewer System

- Combined and Partially Separated (2/3 of City)
- Separated (1/3 of City)

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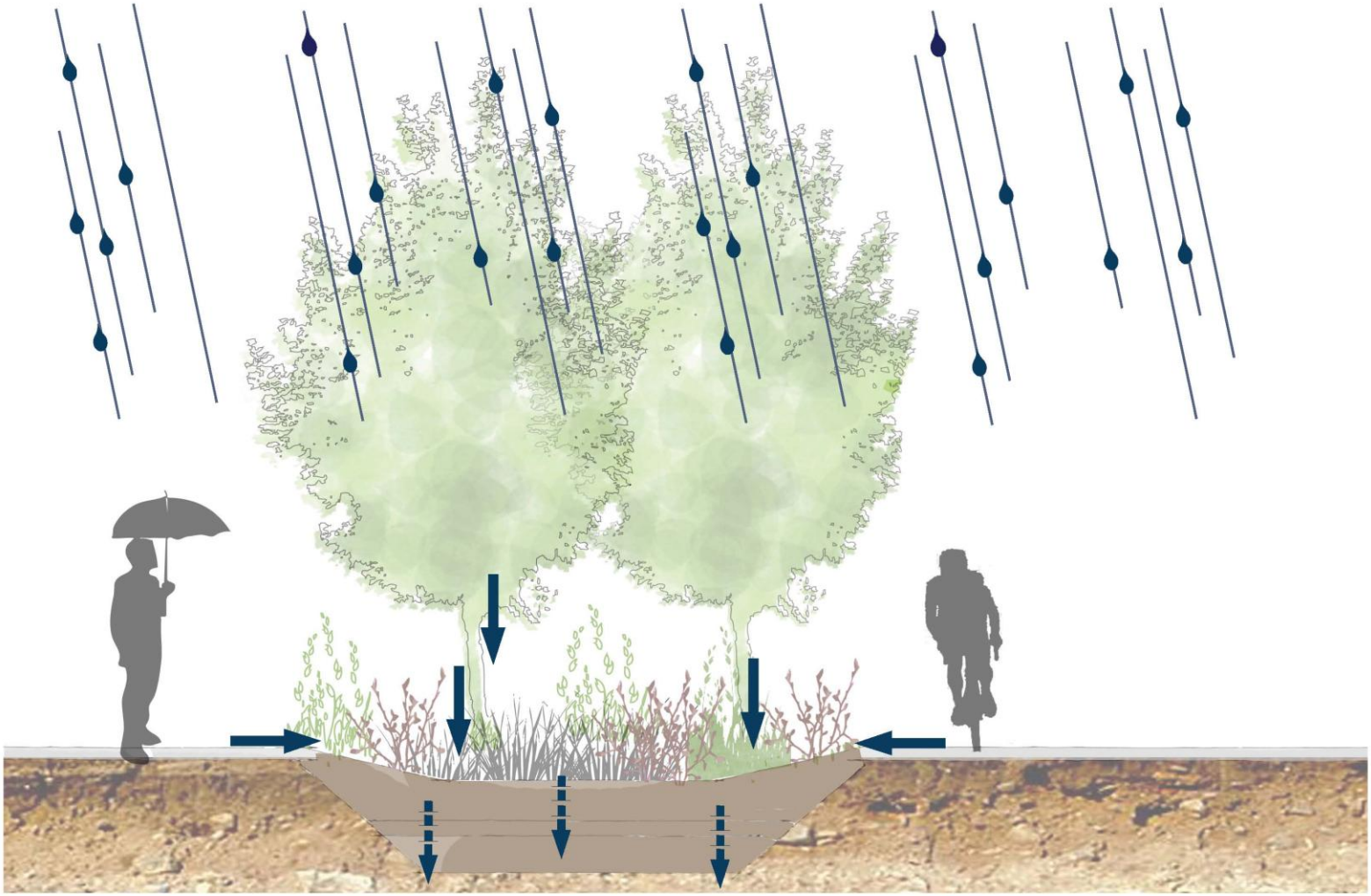

infiltration | bioretention cells without underdrain

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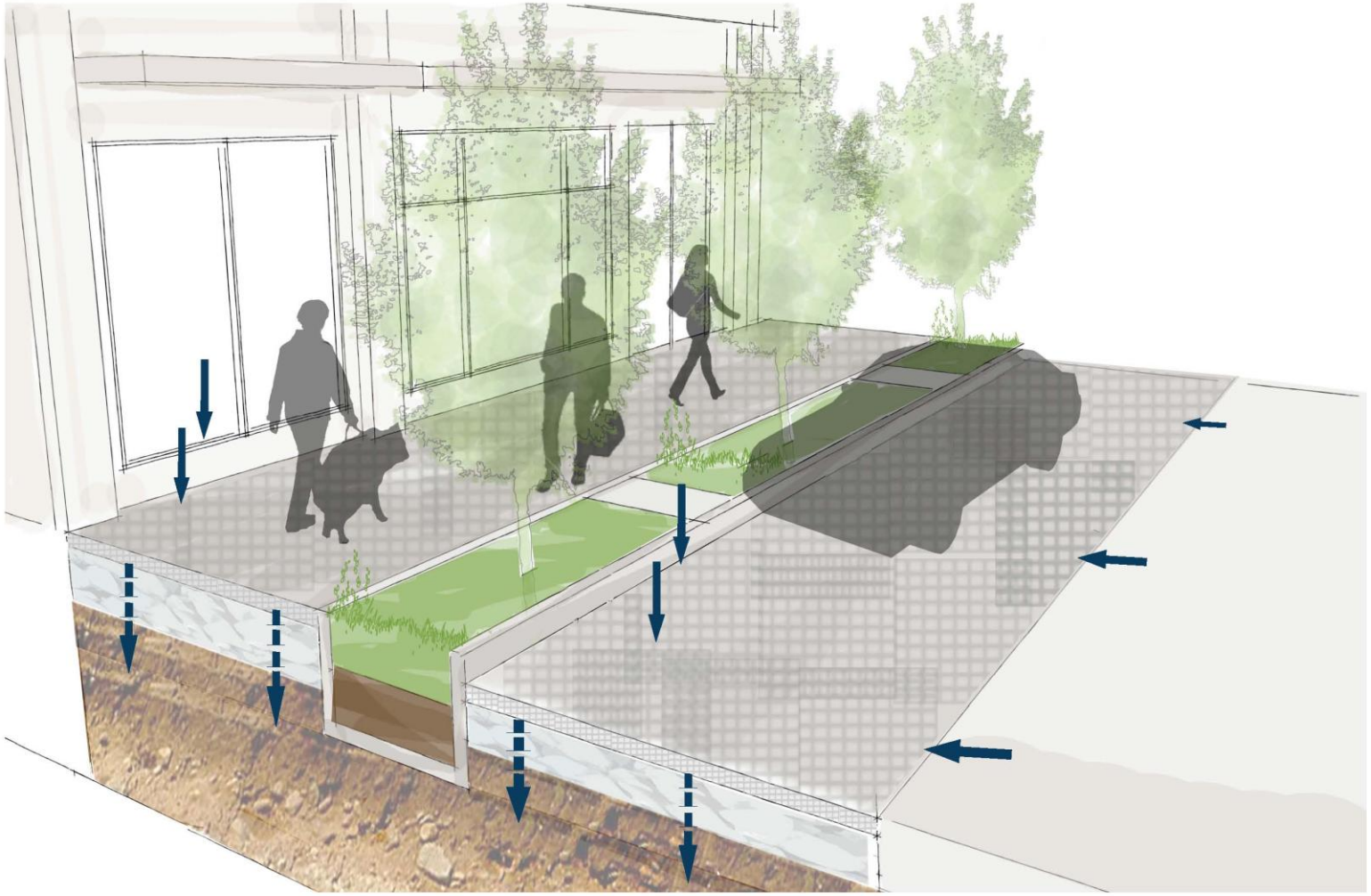

infiltration | permeable pavement facilities

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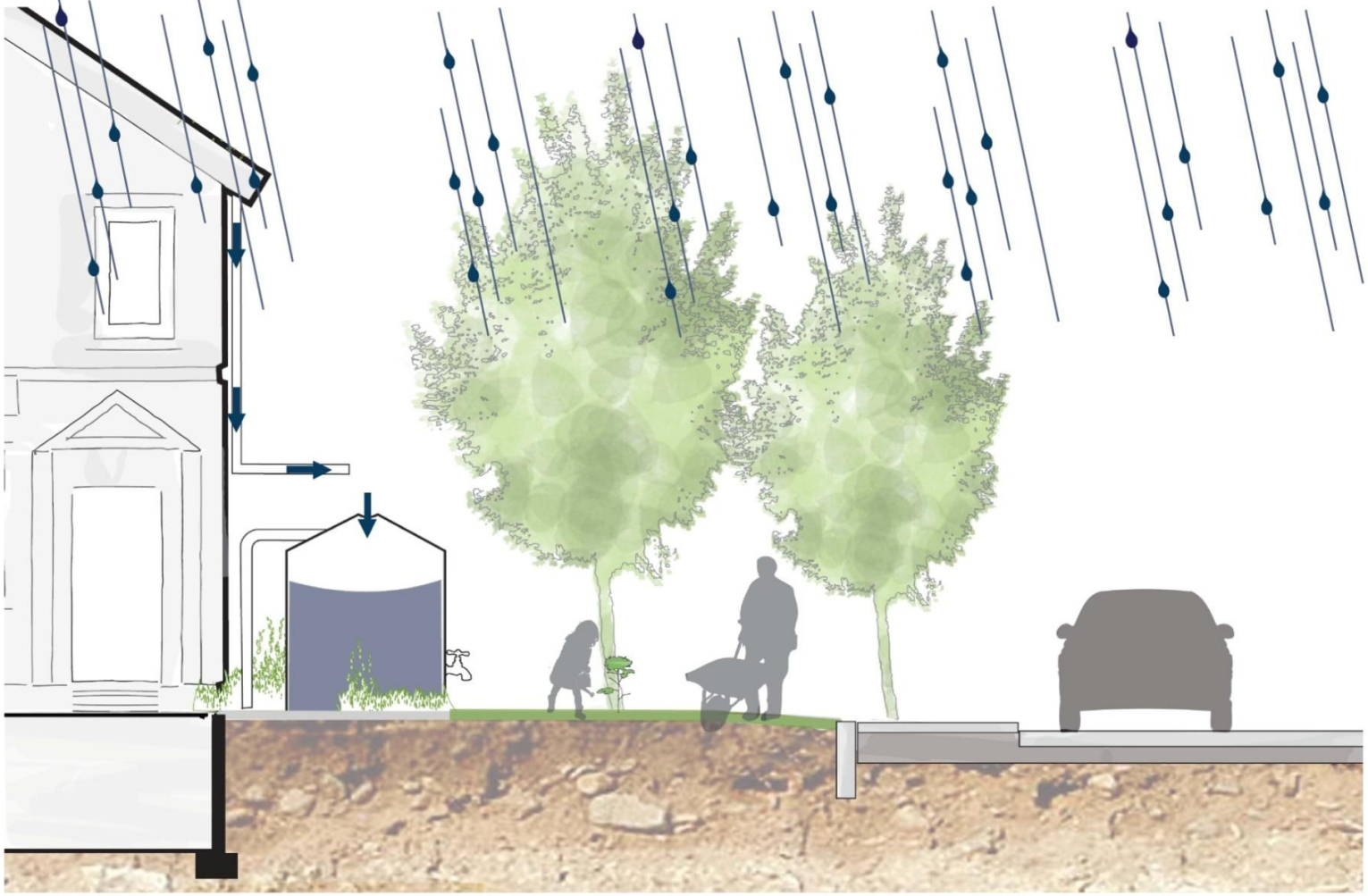

reuse | rainwater harvesting

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reduce | trees + compost-amended soils

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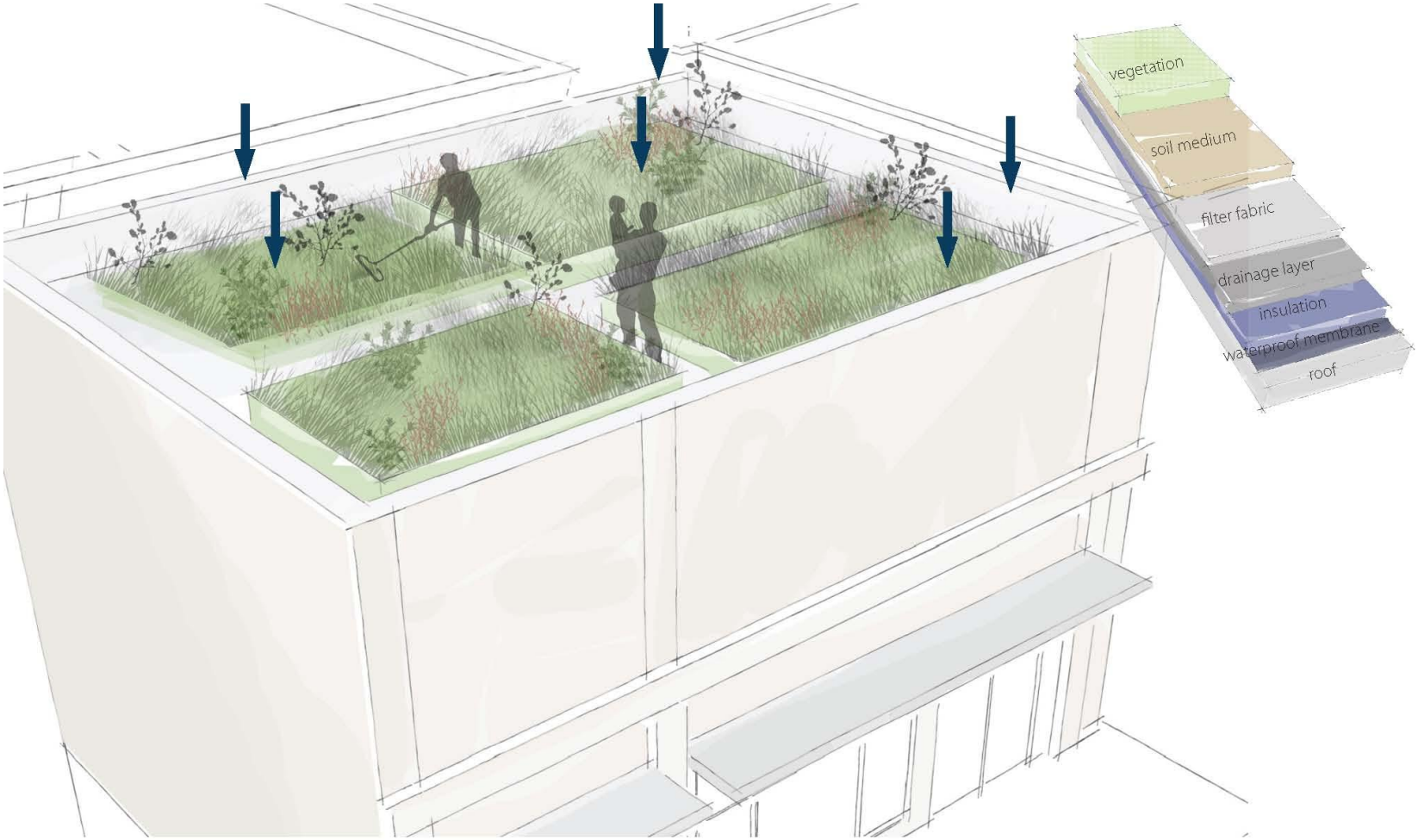

reduce | green roofs

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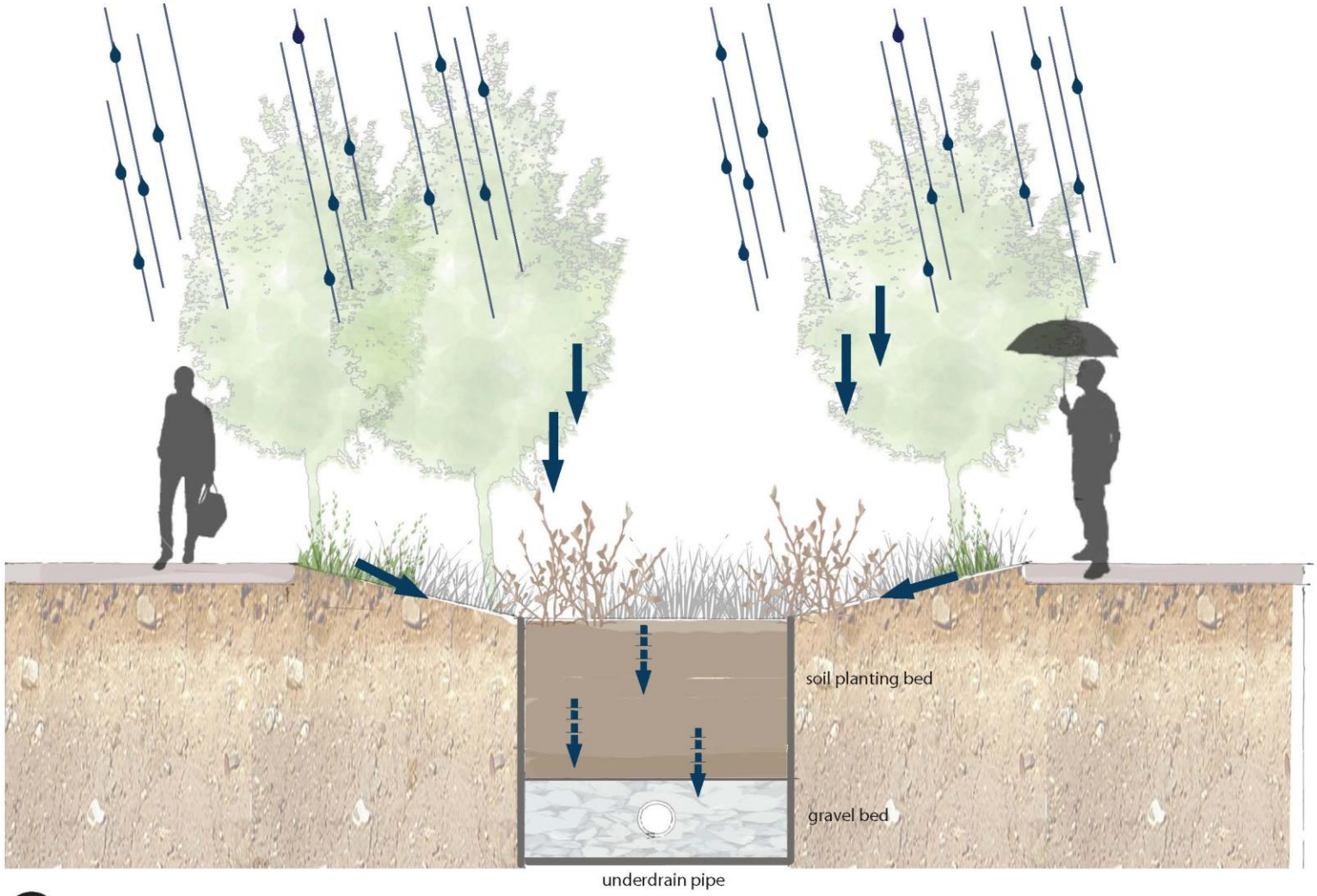

slow+clean | bioretention cells with underdrain

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GSI for CSO Reduction

	Stormwater Goals via Stormwater Code	CSO Reduction
Bioretention/ Rain Garden	✓	✓
Permeable Pavement	✓	✓
Rainwater Harvesting/ Detention Cistern	✓	✓
Trees	✓	
Greenroofs	✓	
Bioretention with Underdrain	✓	

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GSI for Creeks

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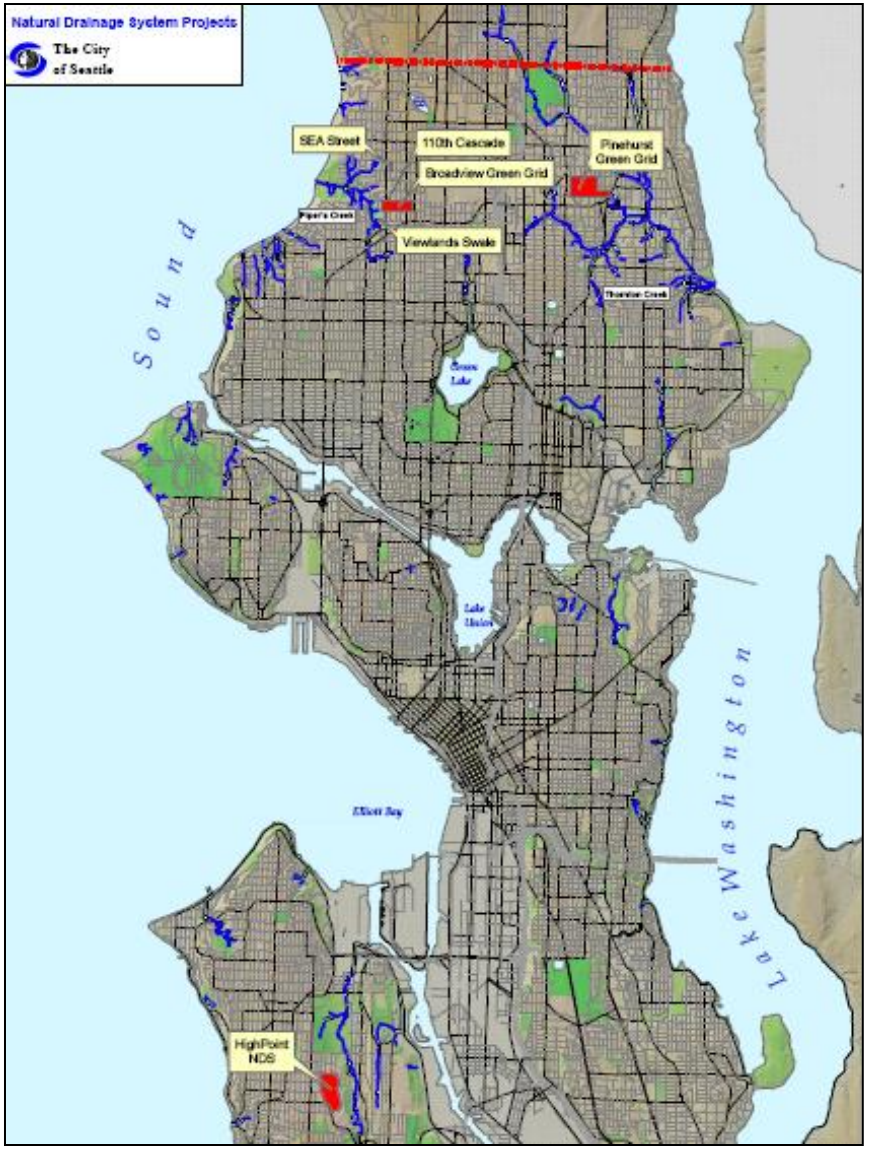
Natural Drainage Systems

- Initiated 1999 for **creek restoration**
- Pilot blocks
- Pilot catchments
- Pilot partnering
- National leaders



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Natural Drainage Systems

Building GSI Experience and Knowledge

Project	Project Drainage Area
SEA Street #1	2.3 acres
NW 110th Cascade	28 acres
Broadview Green Grid	32 acres
Pinehurst Green Grid	49 acres
High Point	129 acres

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SEA Street

- Constructed in 2000
- 660 linear feet
- 2.3-acre drainage
- 99-percent reduction in runoff volume

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NW 110th Cascade

- Constructed 2003
- 1400 linear feet
- 28-acre drainage
- 48-74 percent reduction in runoff volume
- Released water in only 49 of 235 storms

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NW 110th Monitoring

- Water quality monitoring, removal rates based on mass loading (and no 'biofiltration plants"):
  - total suspended solids (TSS), 84%;
  - total nitrogen,63%;
  - total phosphorus, 63%;
  - total copper, 83%; dissolved copper, 67%;
  - total zinc, 76%; dissolved zinc, 55%;
  - total lead, 90%; and
  - motor oil, 92%.

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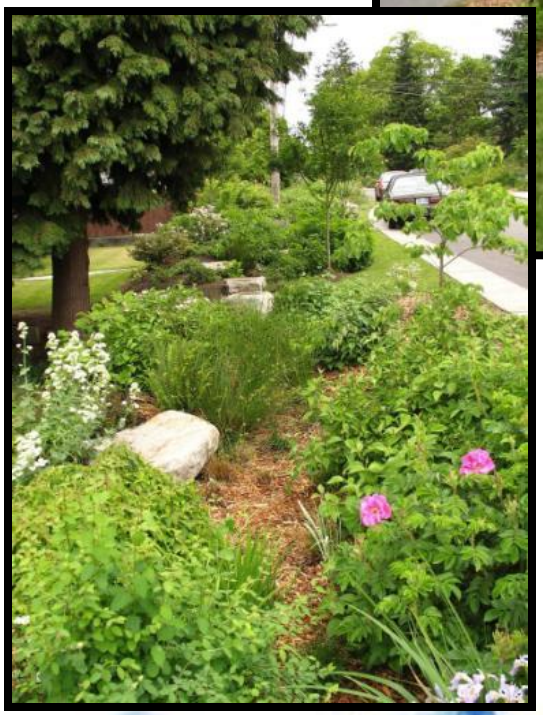
Broadview Natural Drainage System

- Constructed 2004
- 4,500 linear feet
- 32-acre drainage



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Pinehurst Natural Drainage System

- Constructed 2005
- 3,800 linear feet
- 49-acre drainage
- Infiltrate 82 percent average annual volume (9.7 million gallons)

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High Point

- Constructed 2005-2009
- Seattle Housing Authority project
- 120 acres of compact mixed-income development

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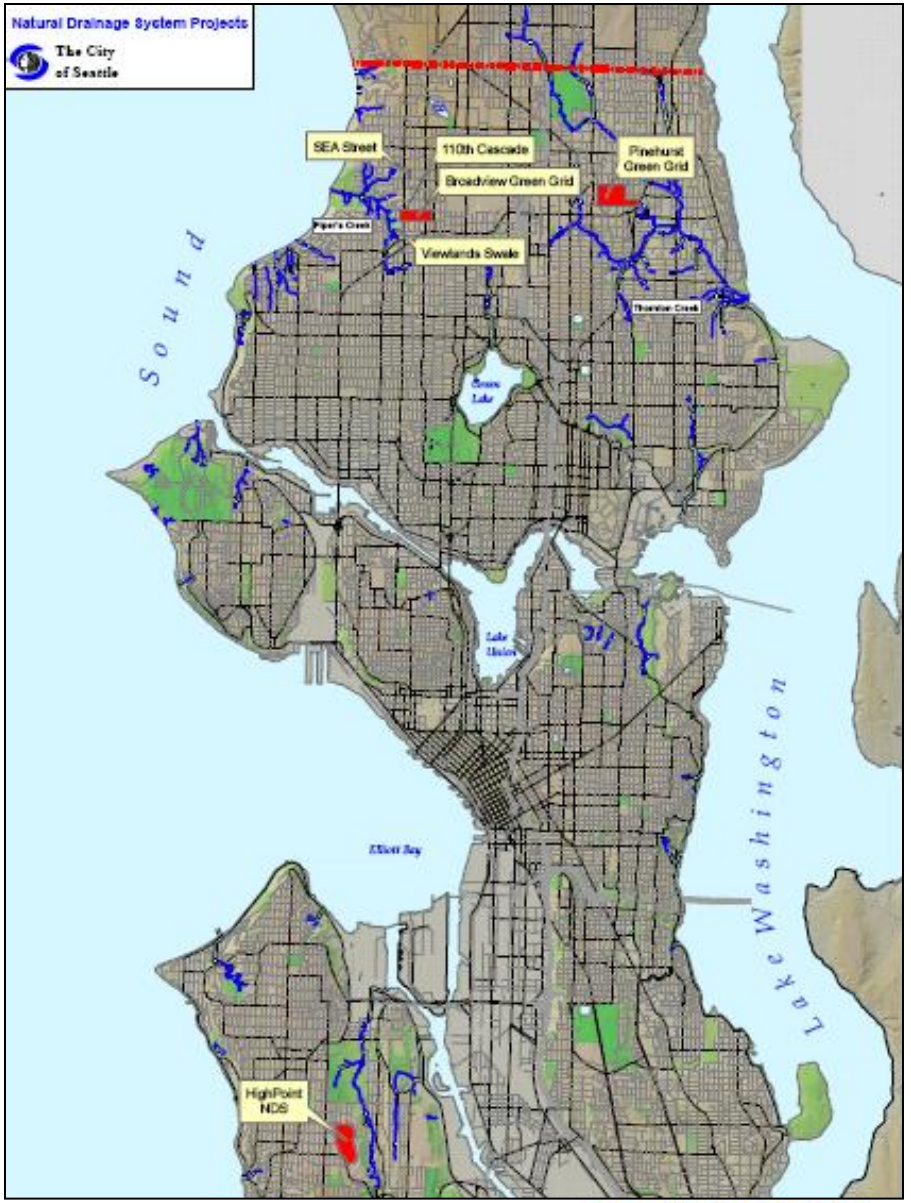
Citywide Natural Drainage Systems

- 232 acres



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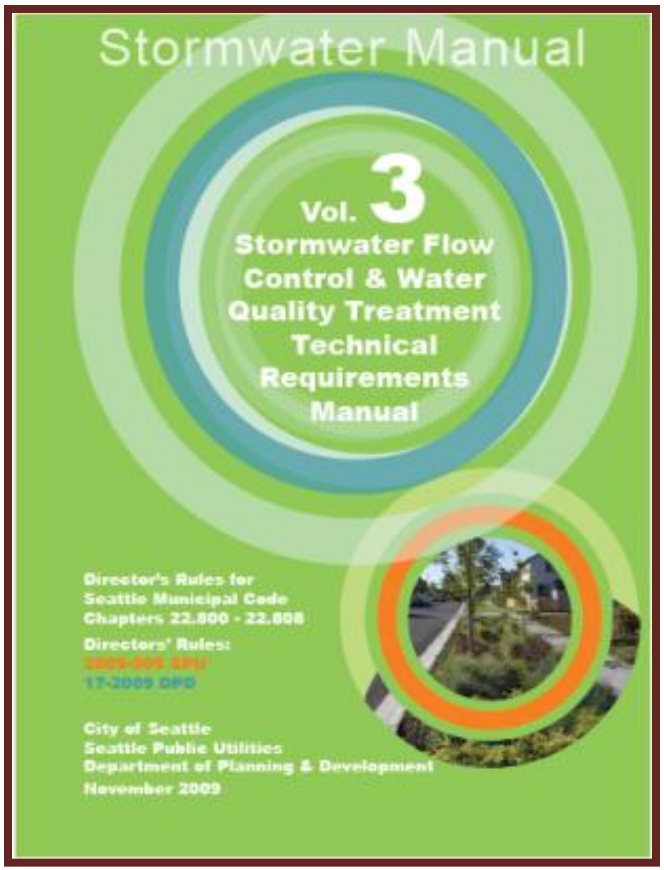
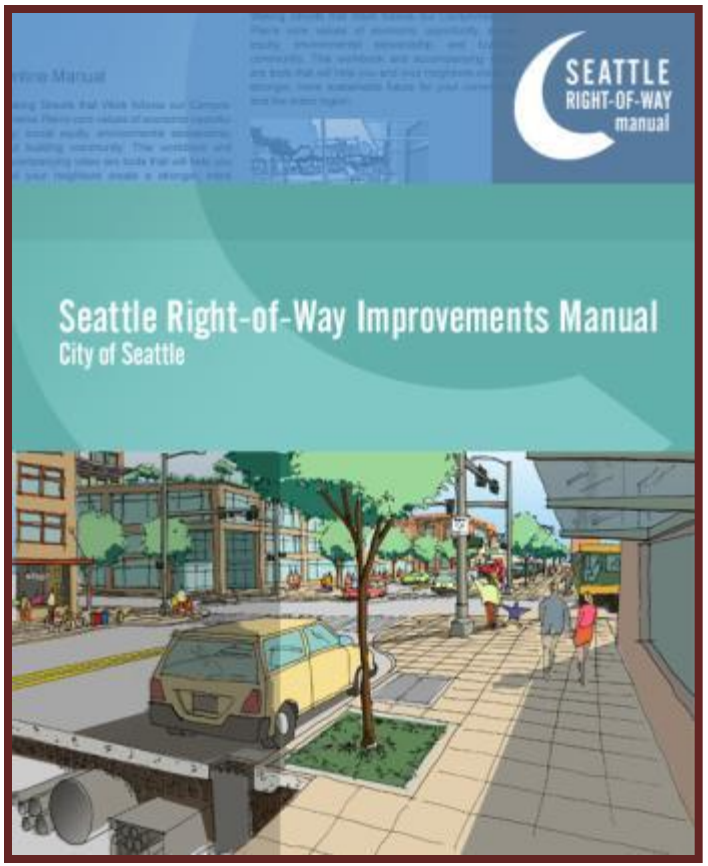
GSI Standardization





seattle.gov/util/greeninfrastructure

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GSI for CSO Reduction

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Combined vs. Partially Separated

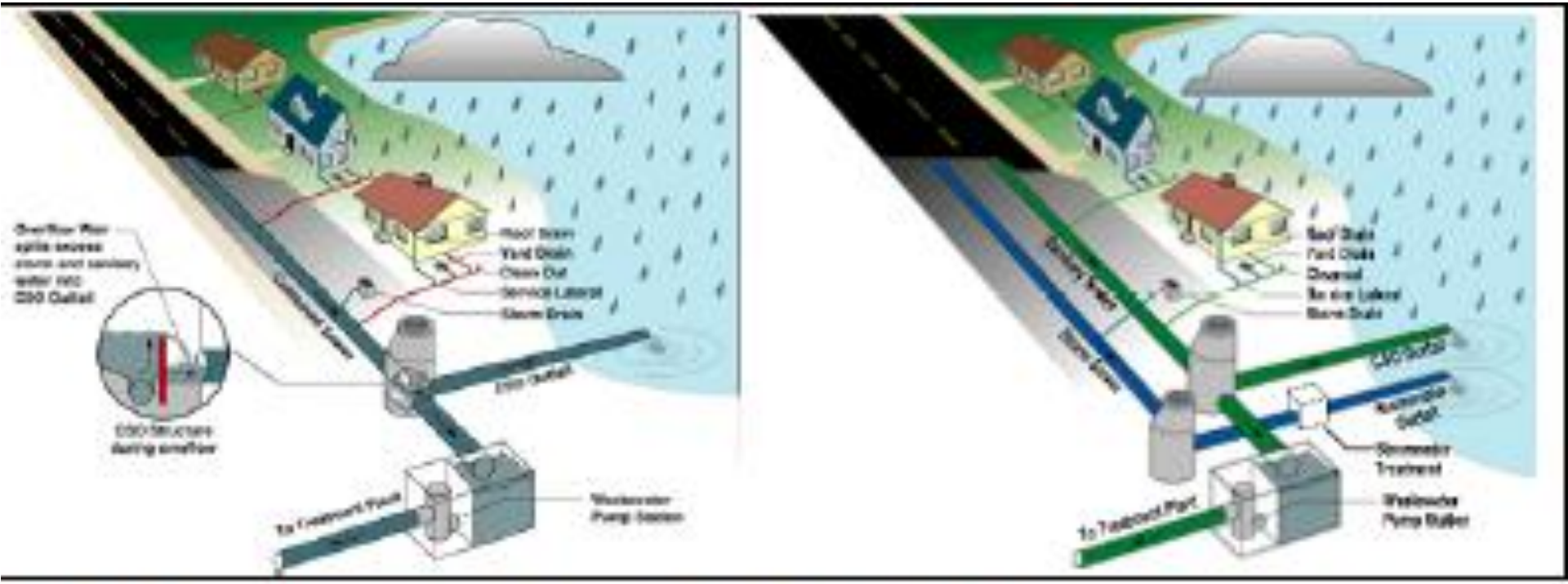

Figure 5-7. Typical Combined (left) and Separated (right) Sewer Systems

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COMBINED SEWER OVERFLOW REDUCTION

Green Stormwater Infrastructure

Fully Combined Area

- Private Property
  - RainWise to manage flows
- Public Property
  - Permeable Pavement Alleys
  - Roadside Raingardens
  - Natural Drainage Systems (only if no existing curb and gutter)

Partially Separated Area

- Private Property Only
- RainWise – primarily to disconnect flows and direct to street

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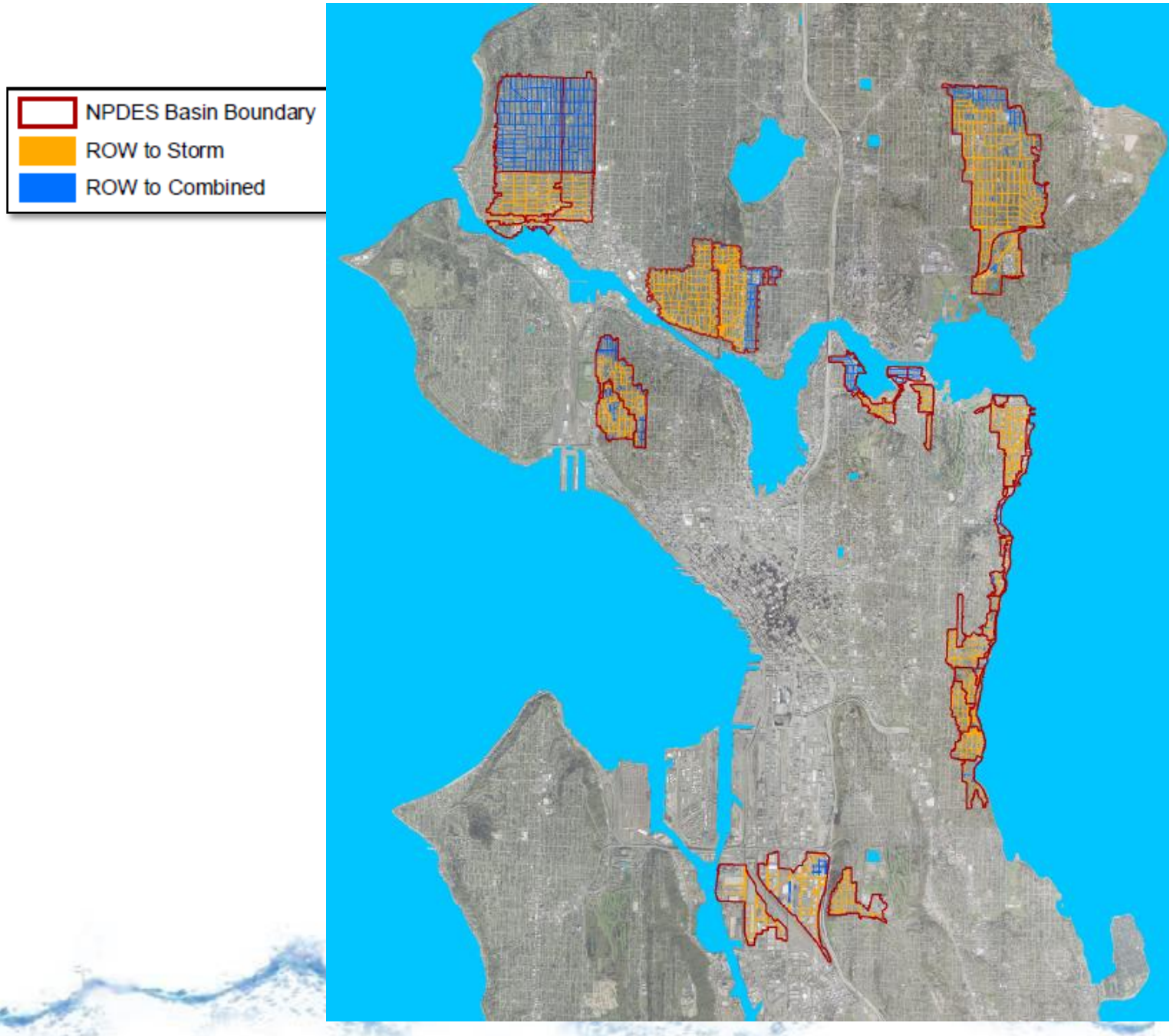

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Public Rights-of-Ways

- Roadside Raingardens
- Permeable Pavement Alleys

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Roadside Raingarden Planting Strip Concept Street

Before

After

Images courtesy King County

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Roadside Raingarden Curb Bulbs

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Roadside Raingardens
planting strip vs. curb bulbs

- Existing Planting Strip
  - No parking Impact
  - Applicable with 9.5-feet minimum width
- Curb Bulb
  - Use when need larger raingarden footprint

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Public Sensitivities to Roadside Raingardens

- Resistance to any changes
- Standing water
- Loss of parking
- Change in aesthetics
- Signs are intrusive

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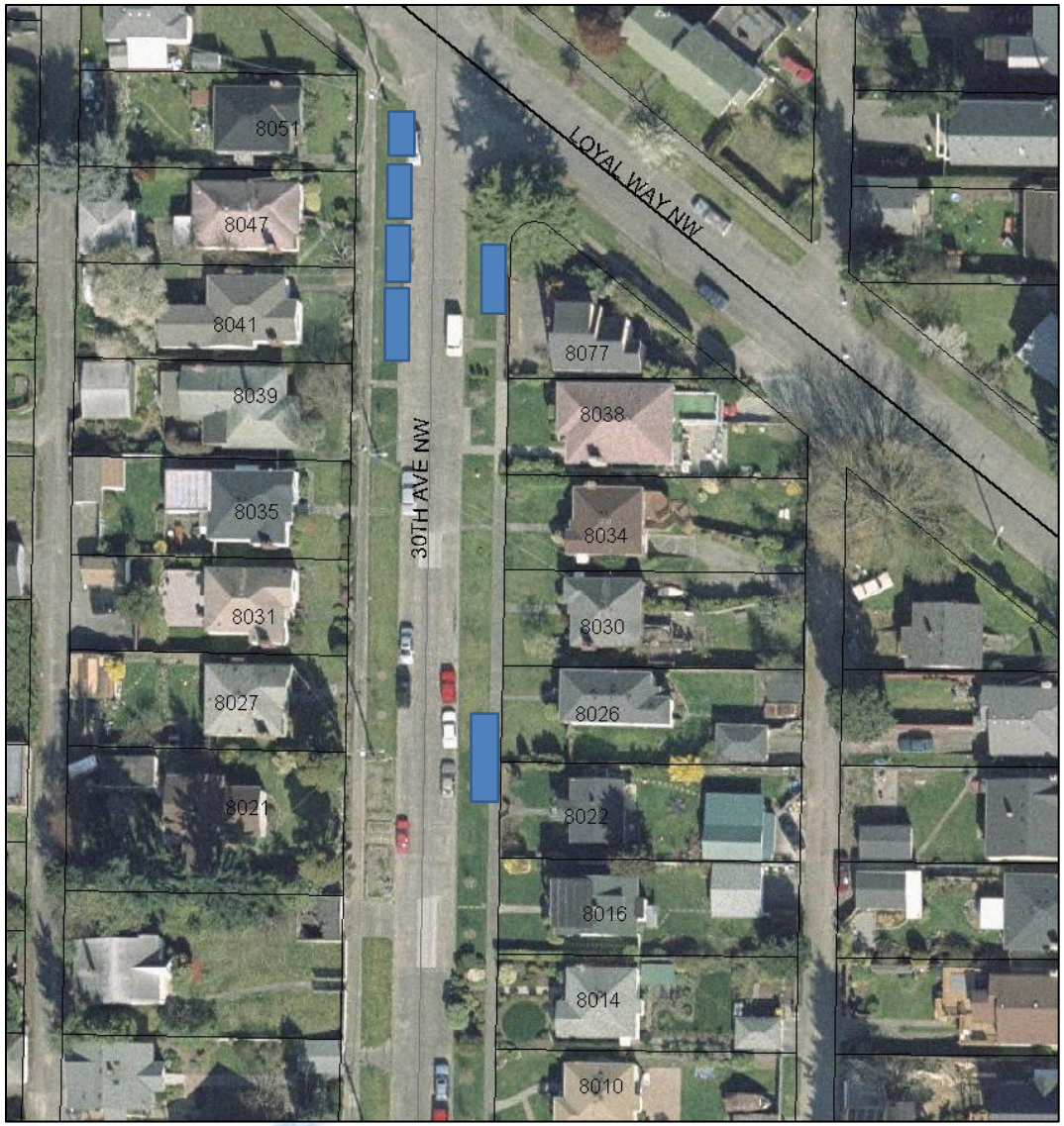
Loyal Way NW & 30th Ave NW (Ballard)



Raingarden Types

- Raingarden with the existing curb line and planting strip
- Raingarden with modified curb and planting strip
- No parking area

Prepared November 2009

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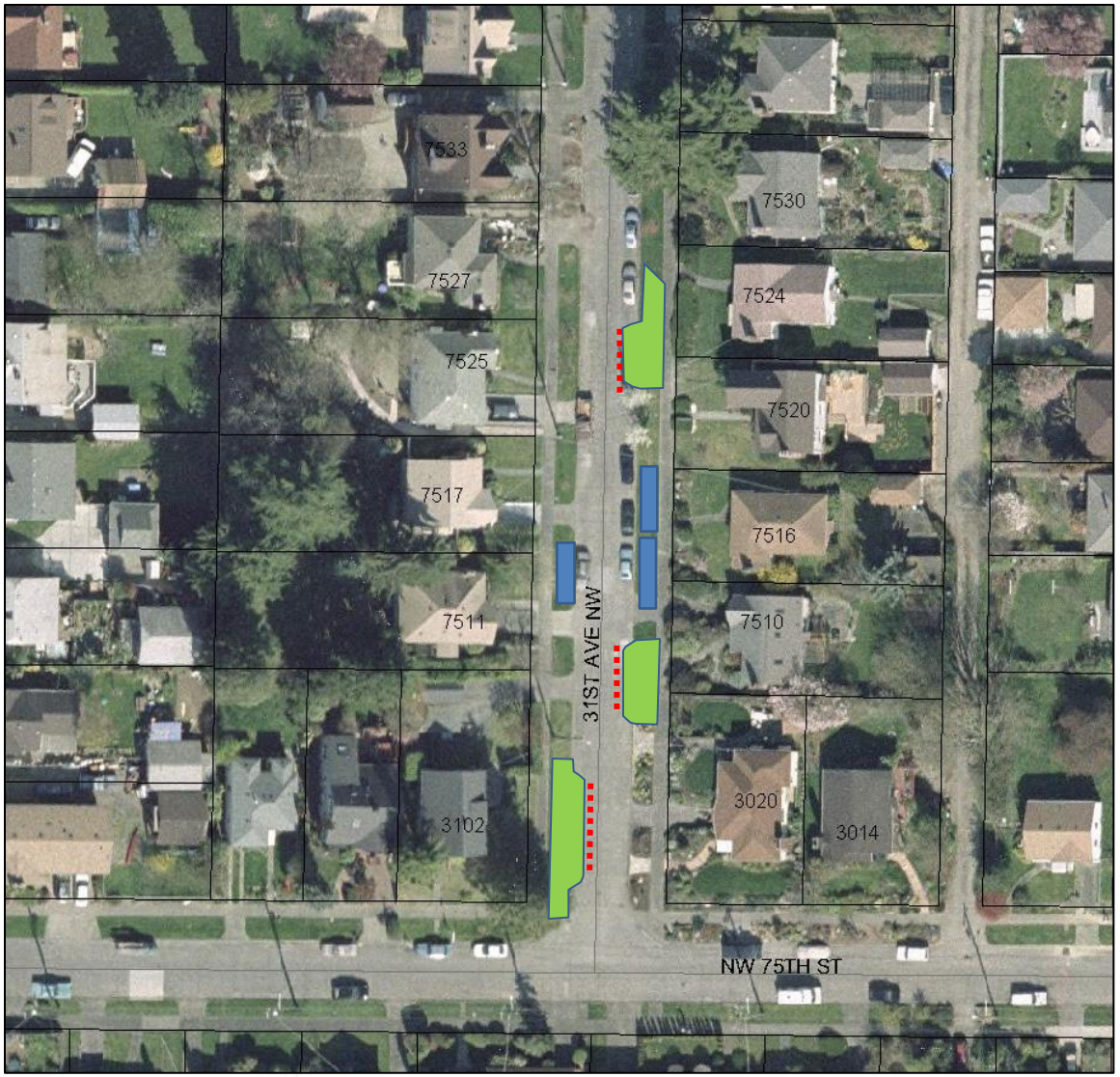
NW 75th St & 31st Ave NW in Ballard



Raingarden Types

- Raingarden with the existing curb line and planting strip
- Raingarden with modified curb and planting strip
- No parking area

Prepared November 2009

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COMBINED SEWER OVERFLOW REDUCTION

Roadside Raingardens Effectiveness Estimates

- Step 1: Roadway connected to combined sewer
- Step 2: Technically feasible
  - Infiltration restrictions
  - Site restrictions (slope less than 7 percent, existing large trees)
- Step 3: Participation estimates

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Roadside Raingardens
Participation: Voluntary vs. Mandatory

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Permeable Pavement Alleys Effectiveness Estimates

- Step 1: Alley connected to combined sewer
- Step 2: Technically feasible
- Step 3: Participation estimates: not applicable

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Permeable Pavement: Step #2 Technical Feasibility

- Slope
- Debris loading
- Structural conflicts, retaining walls
- Dense utilities
- Alley width

GSI on Private Property

RainWise – Rebates for Property Owners

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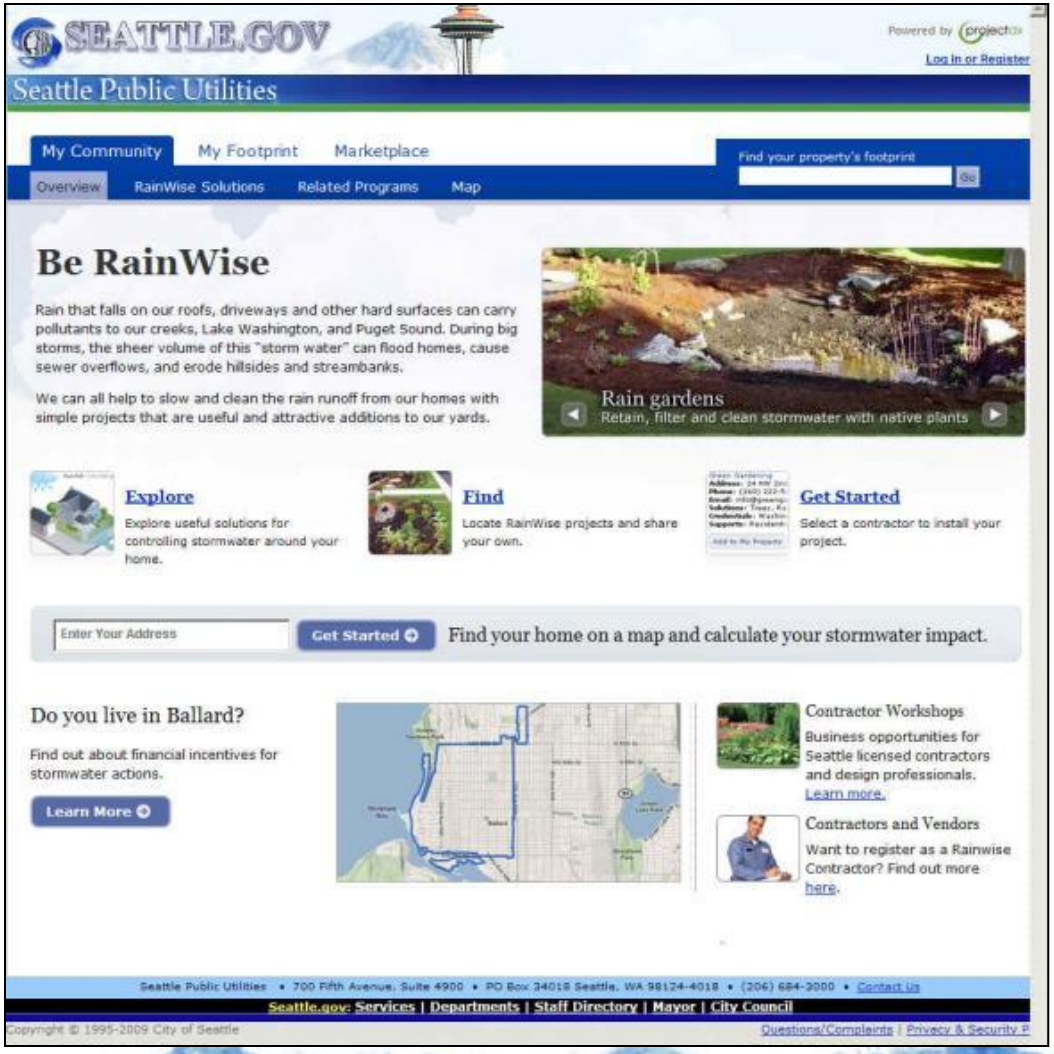
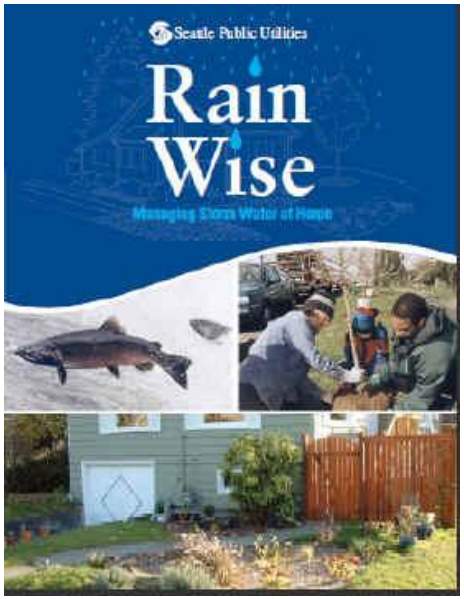
RainWise: Rainwise.seattle.gov





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RainWise Effectiveness Estimates

- Step 1: Roof connected to combined sewer
- Step 2: Technically feasible
- Step 3: Participation estimates

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RainWise: Step #2 Technical Feasibility

- Roof area that can be directed to a GSI ‘tool’
- Infiltration restrictions
- Site restrictions /Space

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RainWise Feasibility: Site Restrictions

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RainWise Participation Estimates

- Low = 1 percent
- High = 30 percent
- Why not 100%?
  - Volunteer program
  - Landscape choices, aesthetics
  - Concern that will cause wet basements
  - Rebate level and turnaround time
  - Awareness

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RainWise Promotion

- Variety of tools to maximize participation
  - Direct mail to all eligible households (4x/year)
  - Listserv messages via e-mail
  - Demonstration projects (Sunset Hill Community Club, Loyal Heights Elementary)
  - Local media (Ballard News-Tribune, local blogs)
  - Point-of-sale promotions at local businesses
  - Presence at Ballard Sunday Market
  - Trusted advocates (Groundswell, Sustainable Ballard)
  - November 6 – Ballard RainWise Roadshow

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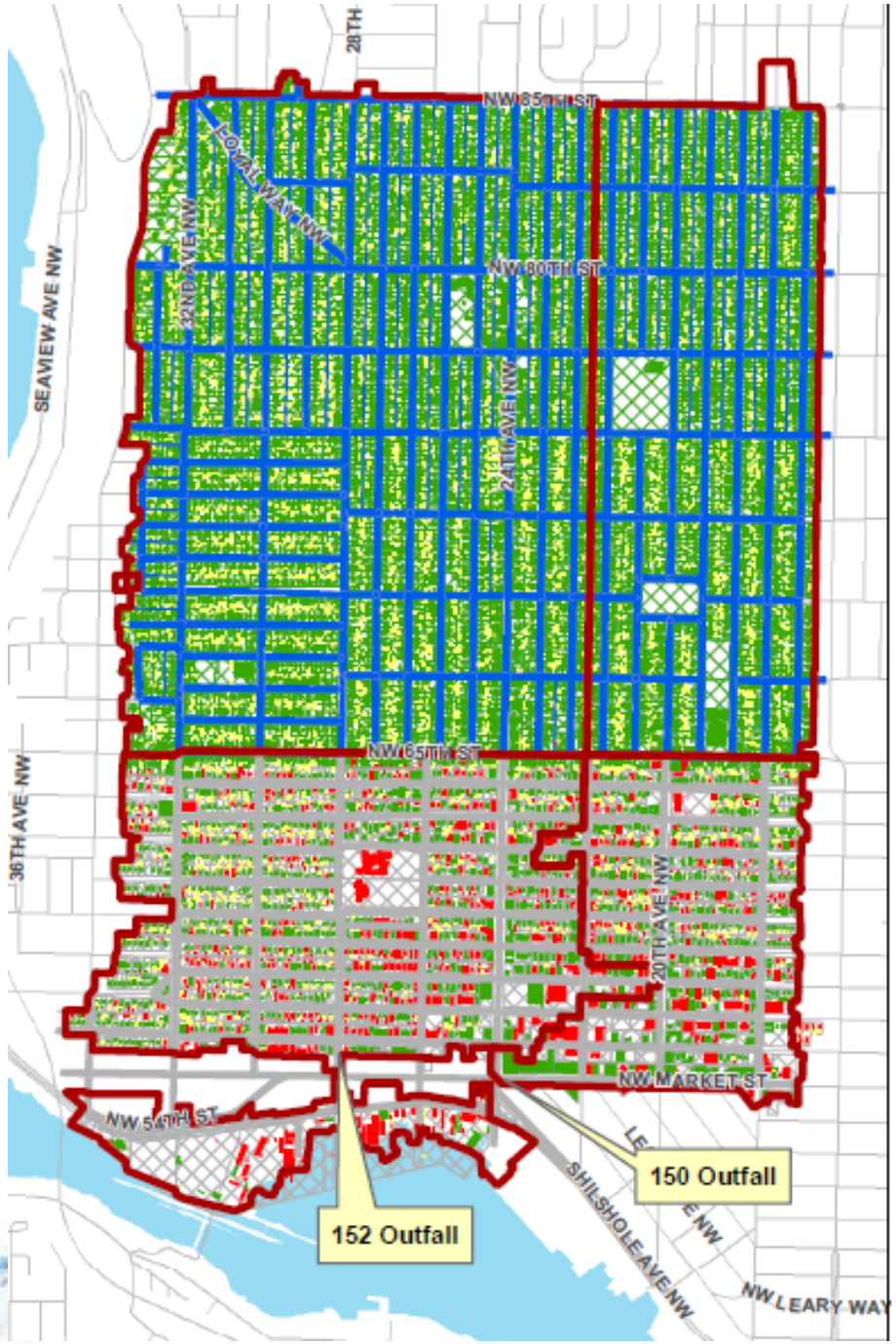
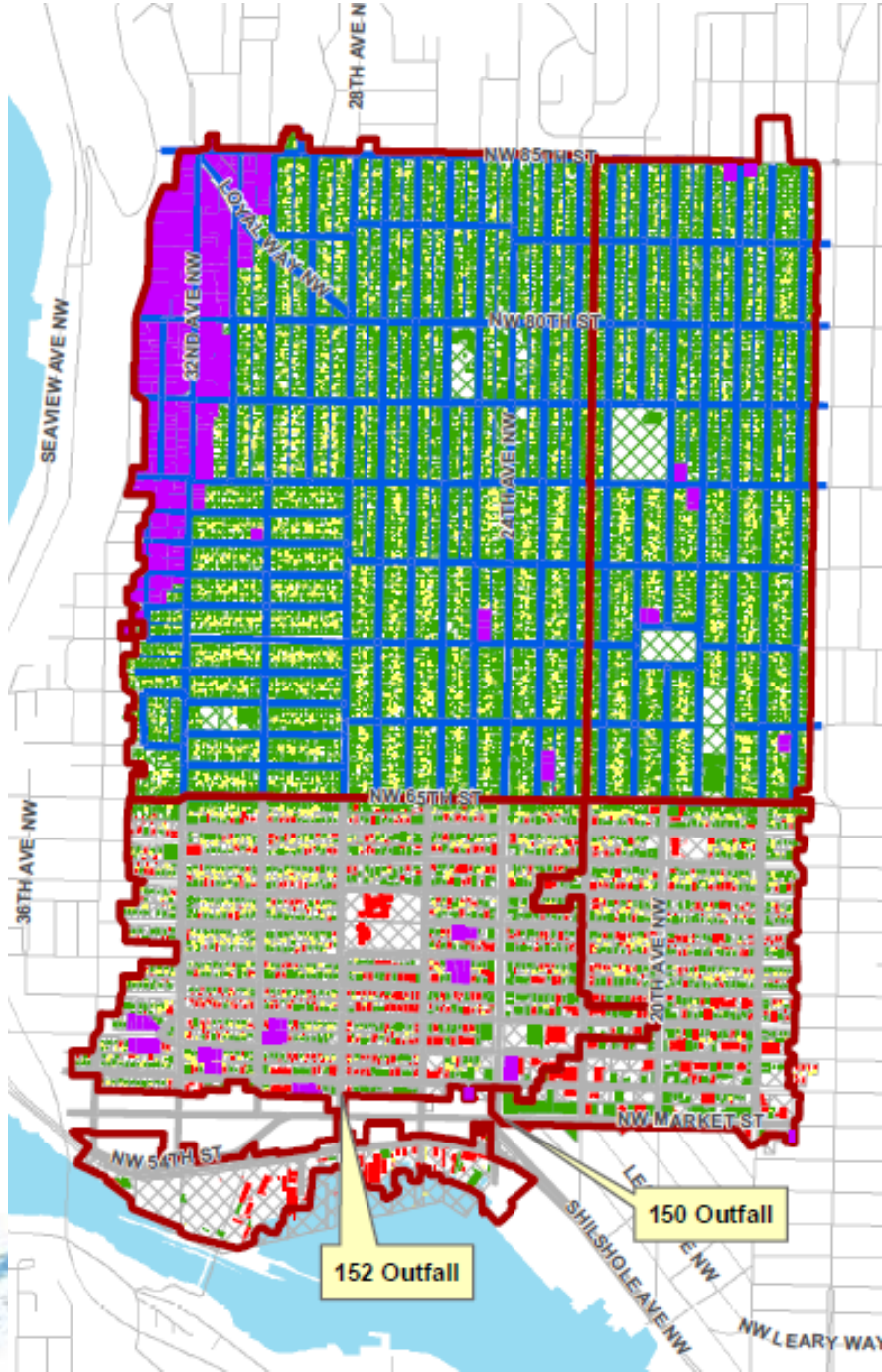
Ballard

- Step 1: Connectivity to combined sewer

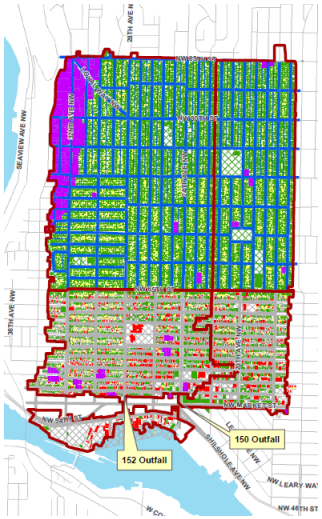


Ballard

- Step 2: Technical Feasibility
  - Step 2a: Infiltration Restrictions



Ballard



- Step 2: Technical Feasibility
  - Step 2b: GSI practice specific feasibility

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Ballard

- Step 3: Participation Estimates
  - Step 3a: Roadside Raingardens
    - High: 60%
    - Low:30%
  - Step 3b: RainWise
    - High: 35%
    - Low: 15%

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Fremont/Wallingford

- Step 1: Connectivity to combined sewer

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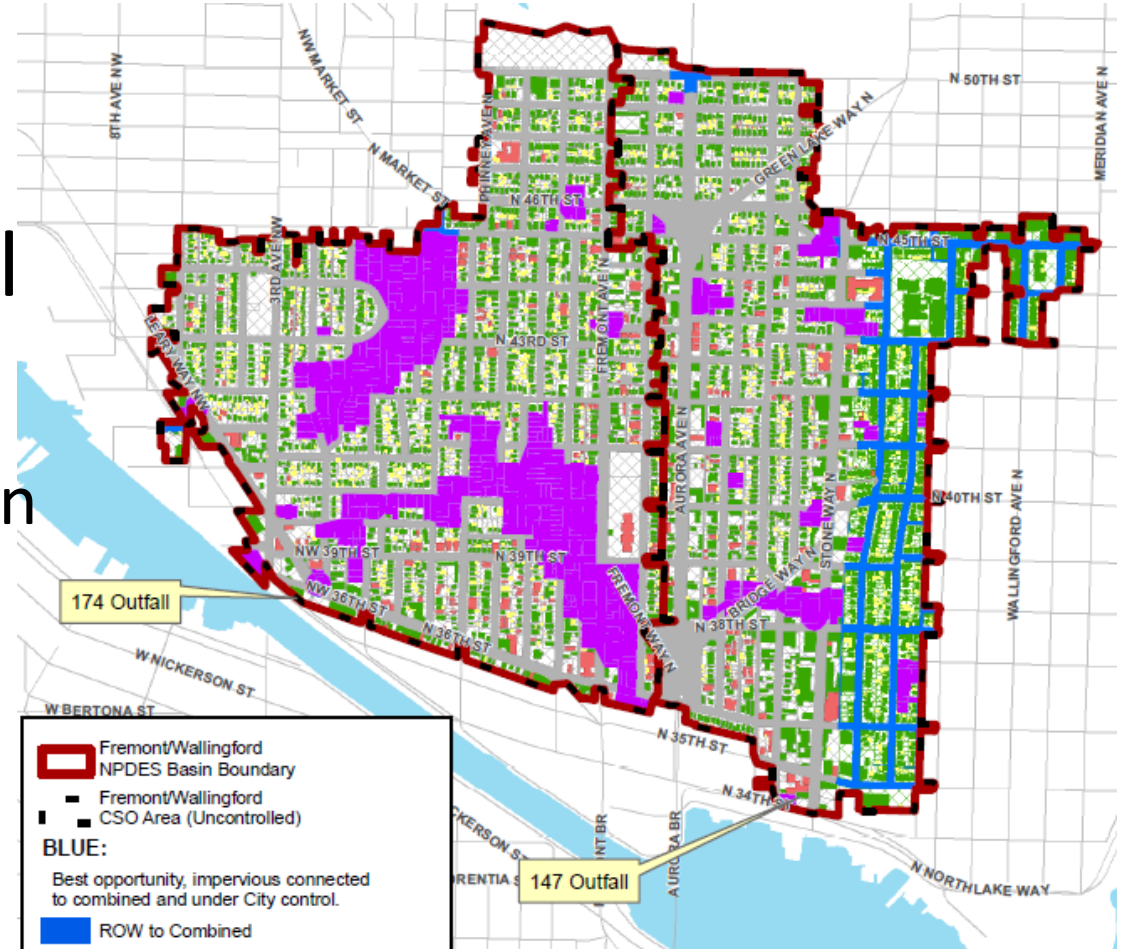
Fremont/Wallingford

- Step 2: Technical Feasibility
  - Step 2a: Infiltration Restrictions



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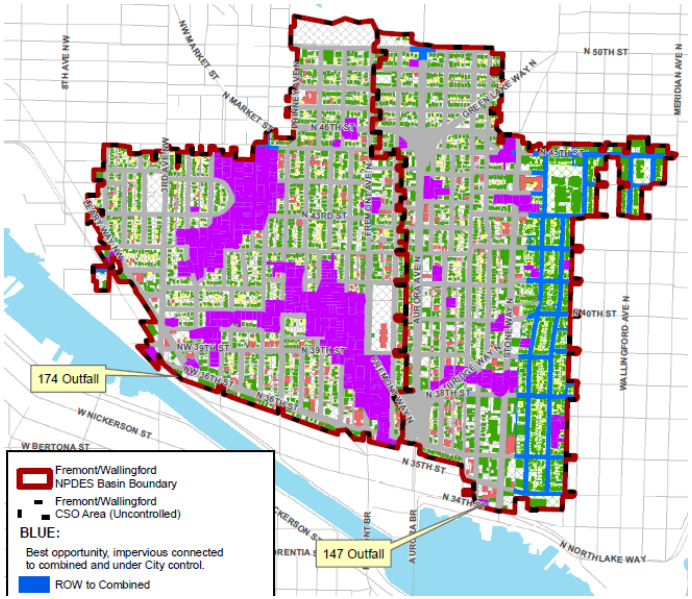
Fremont/Wallingford
Participation Estimates



- Roadside raingardens participation estimate 5%
- Planting strips too narrow
- Parking evaluation not yet conducted but anticipate majority of streets would NOT meet the criteria for parking policy memo

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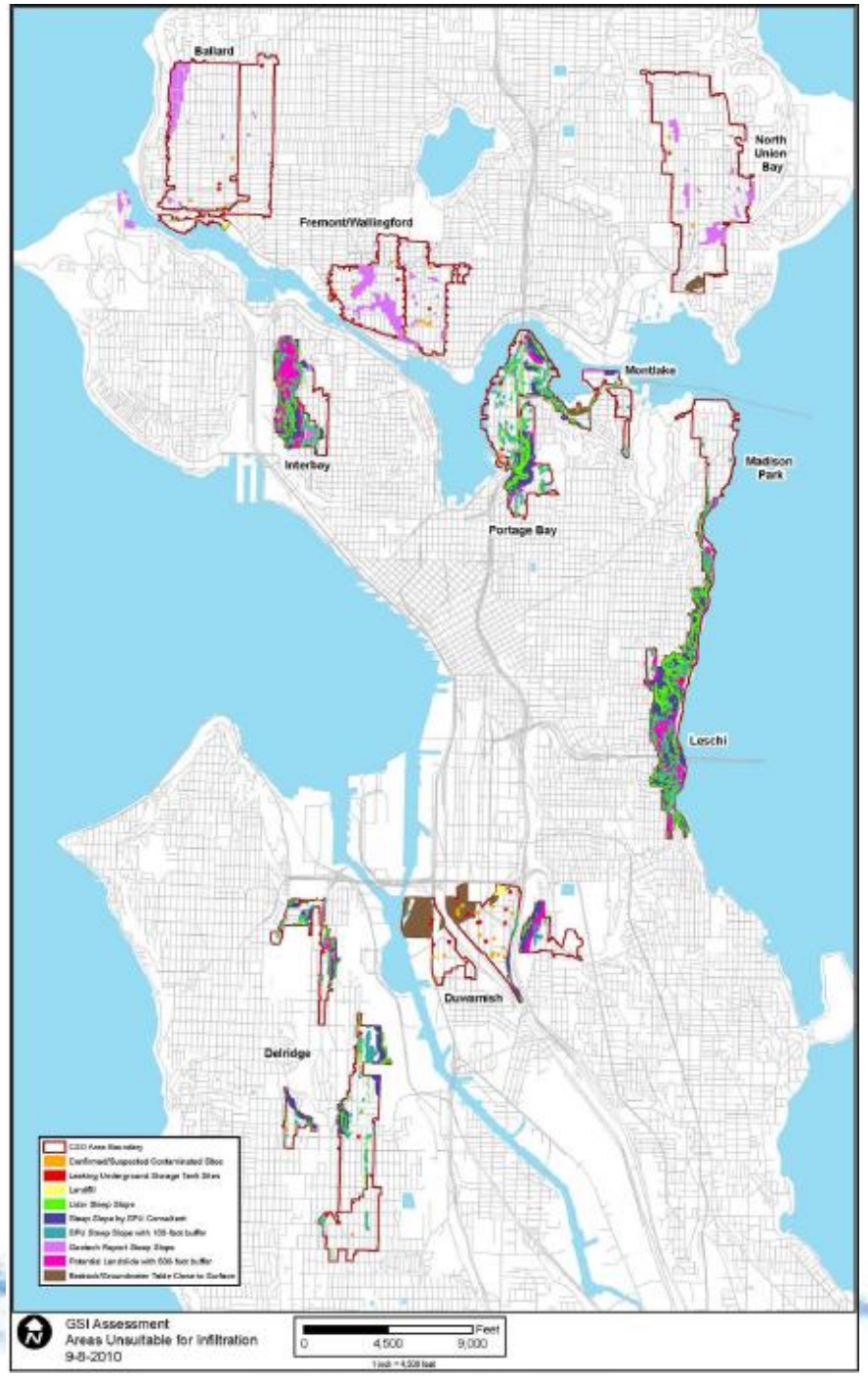

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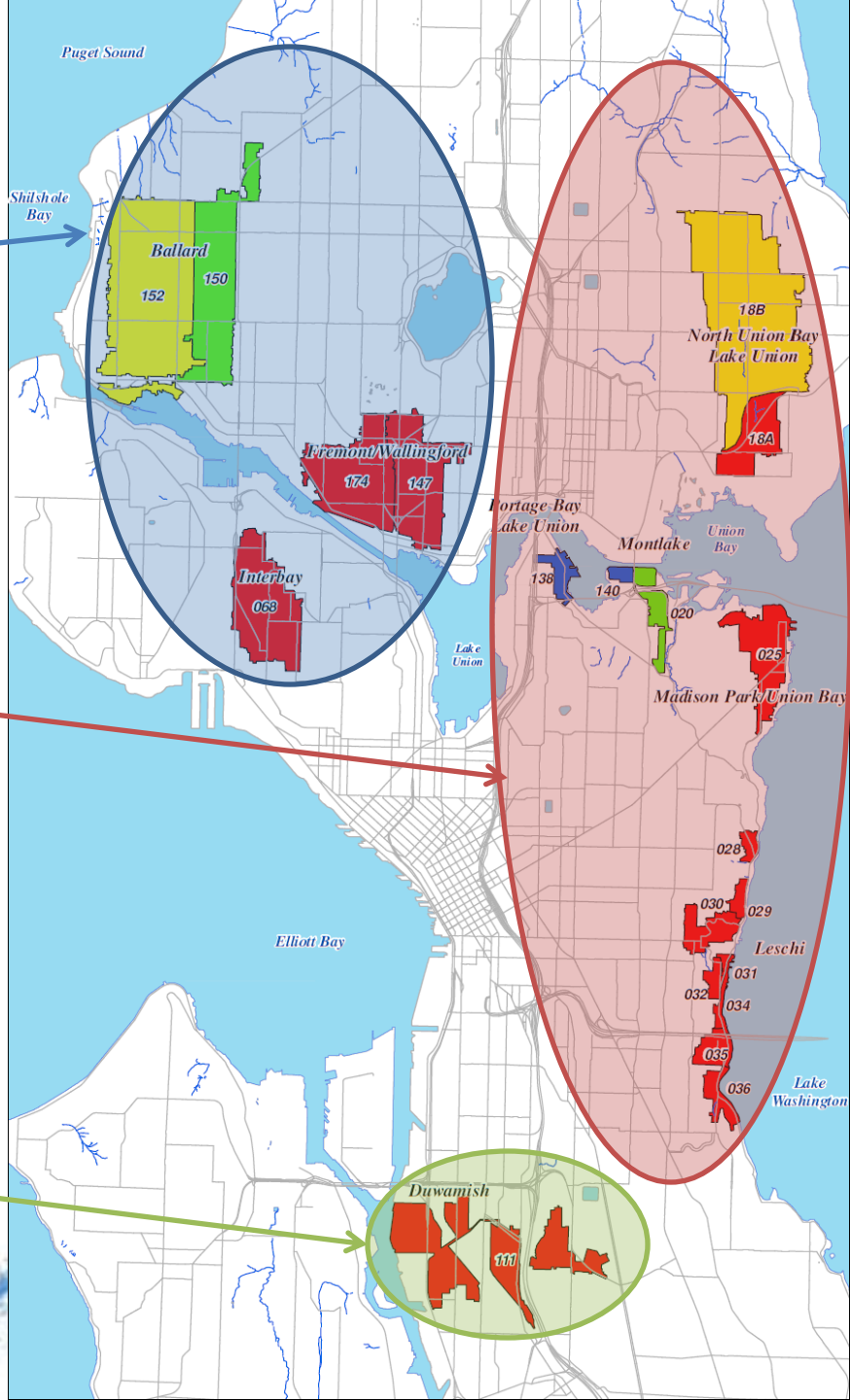
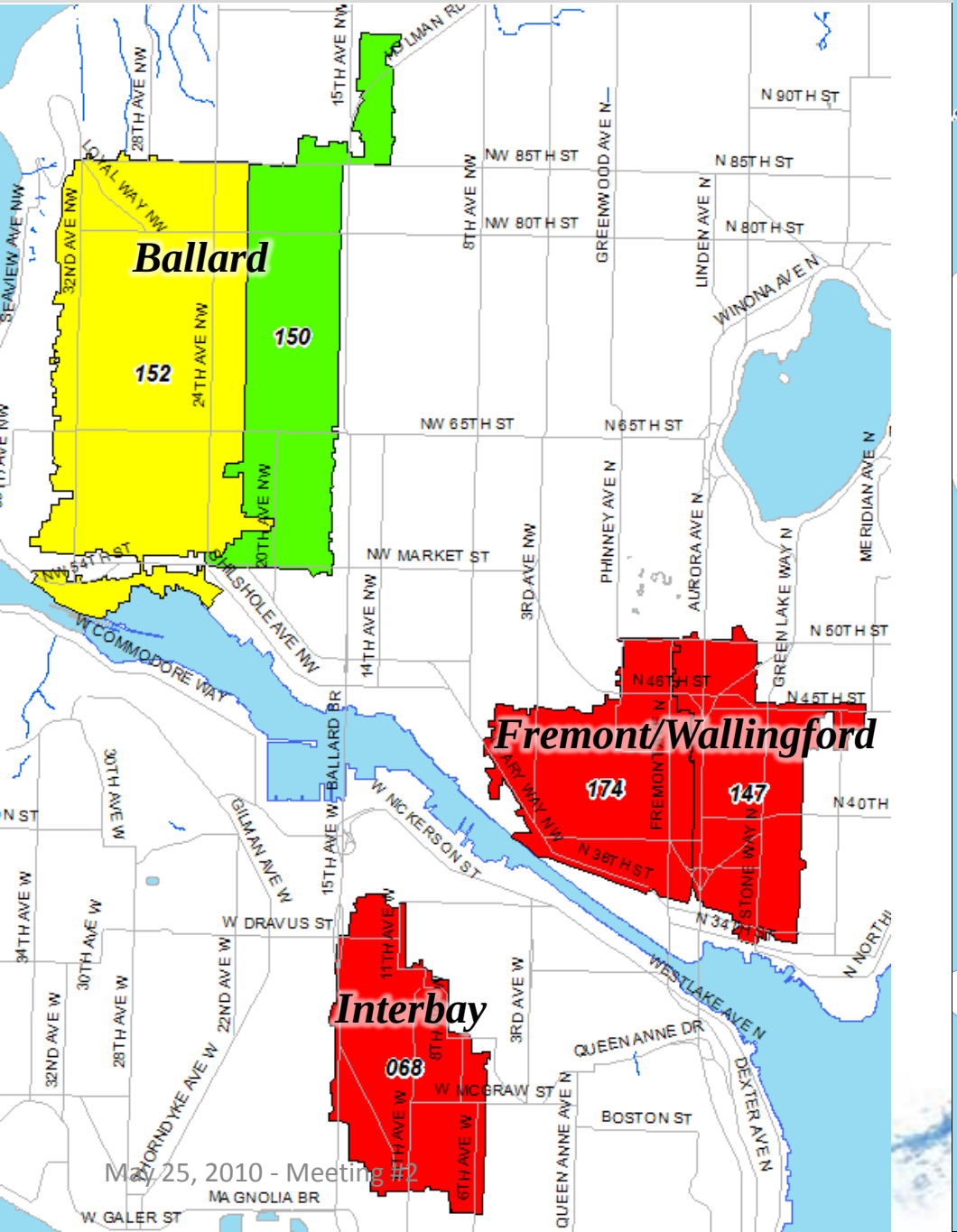
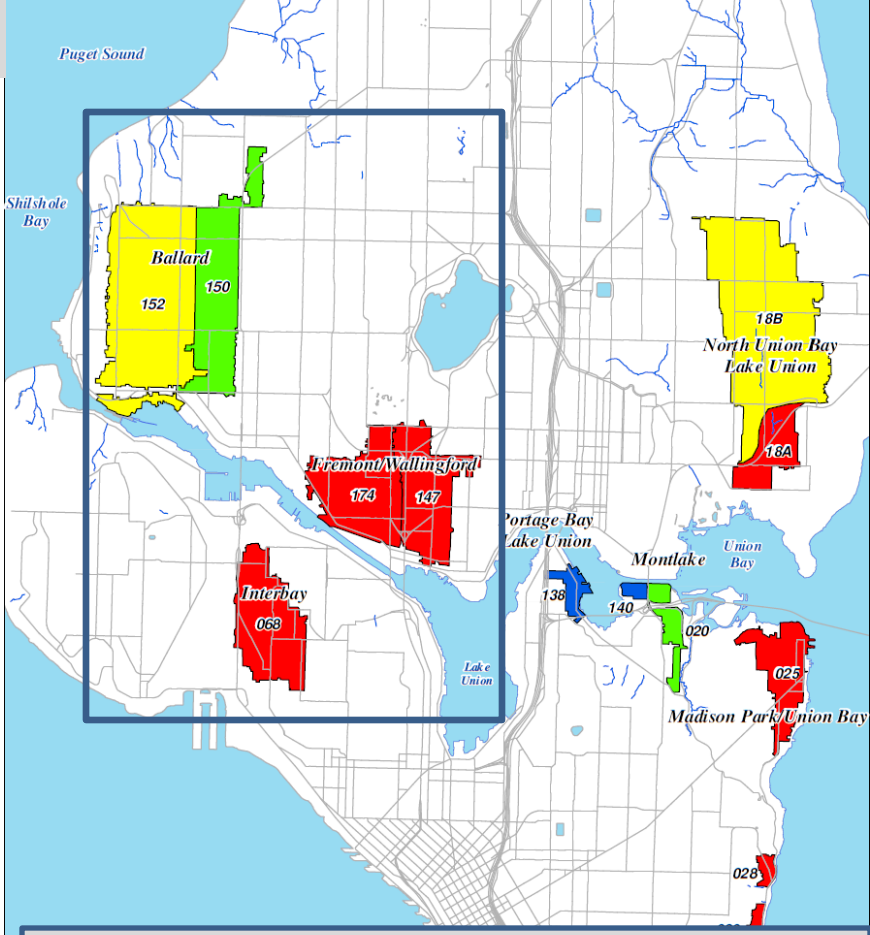
GSI Potential for CSO Control Planning Areas

- Area 1
  - Ballard
  - Fremont/Wallingford
  - Interbay
- Area 2
  - North Union Bay
  - Portage Bay
  - Madison Park/Union Bay
  - Montlake
  - Leschi
- Area 3
  - Duwamish



Planning Area 1: GSI Potential for CSO Control

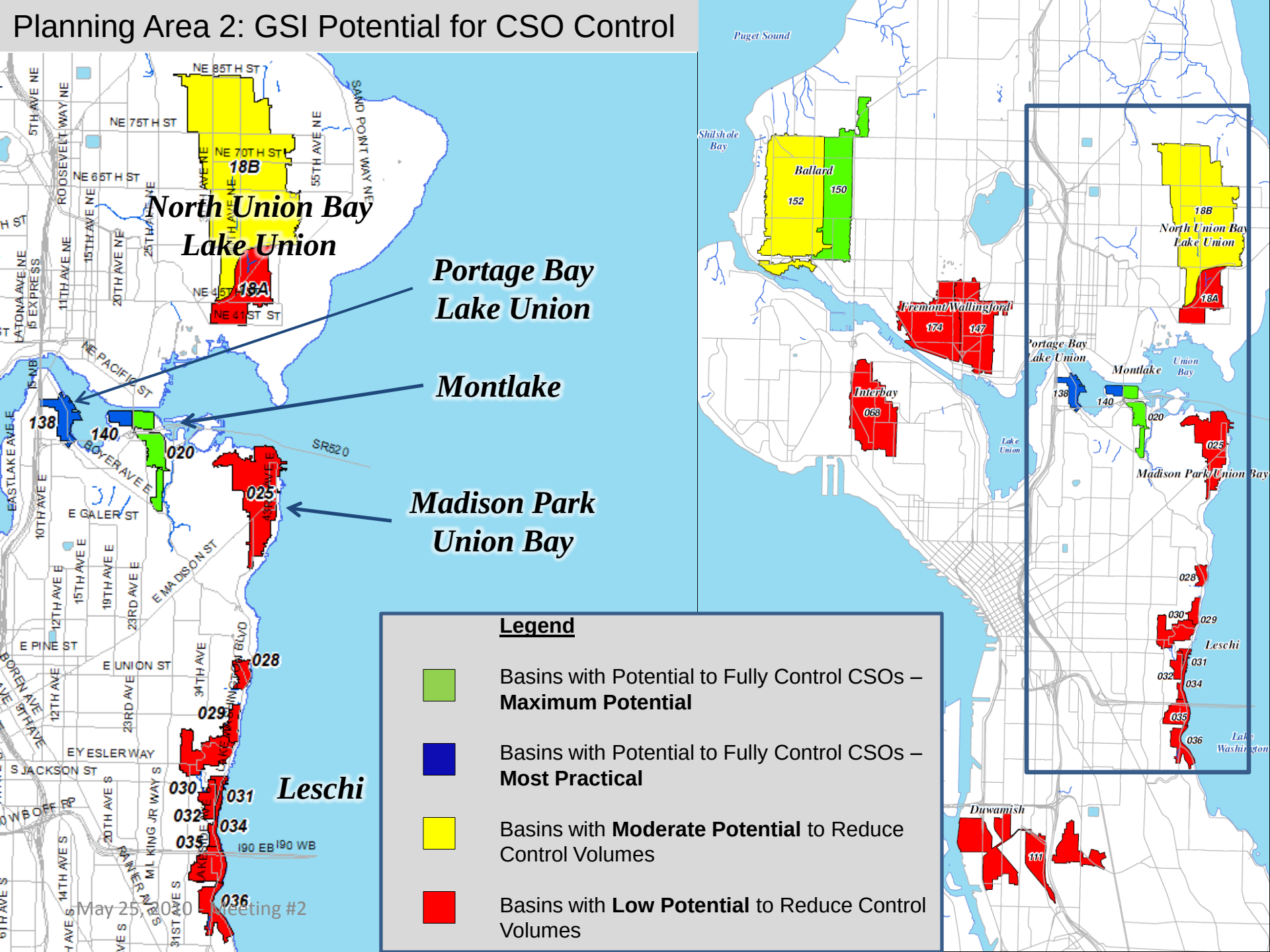




Legend

- Basins with Potential to Fully Control CSOs – **Maximum Potential**
- Basins with Potential to Fully Control CSOs – **Most Practical**
- Basins with **Moderate Potential** to Reduce Control Volumes
- Basins with **Low Potential** to Reduce Control Volumes

Planning Area 2: GSI Potential for CSO Control



Legend

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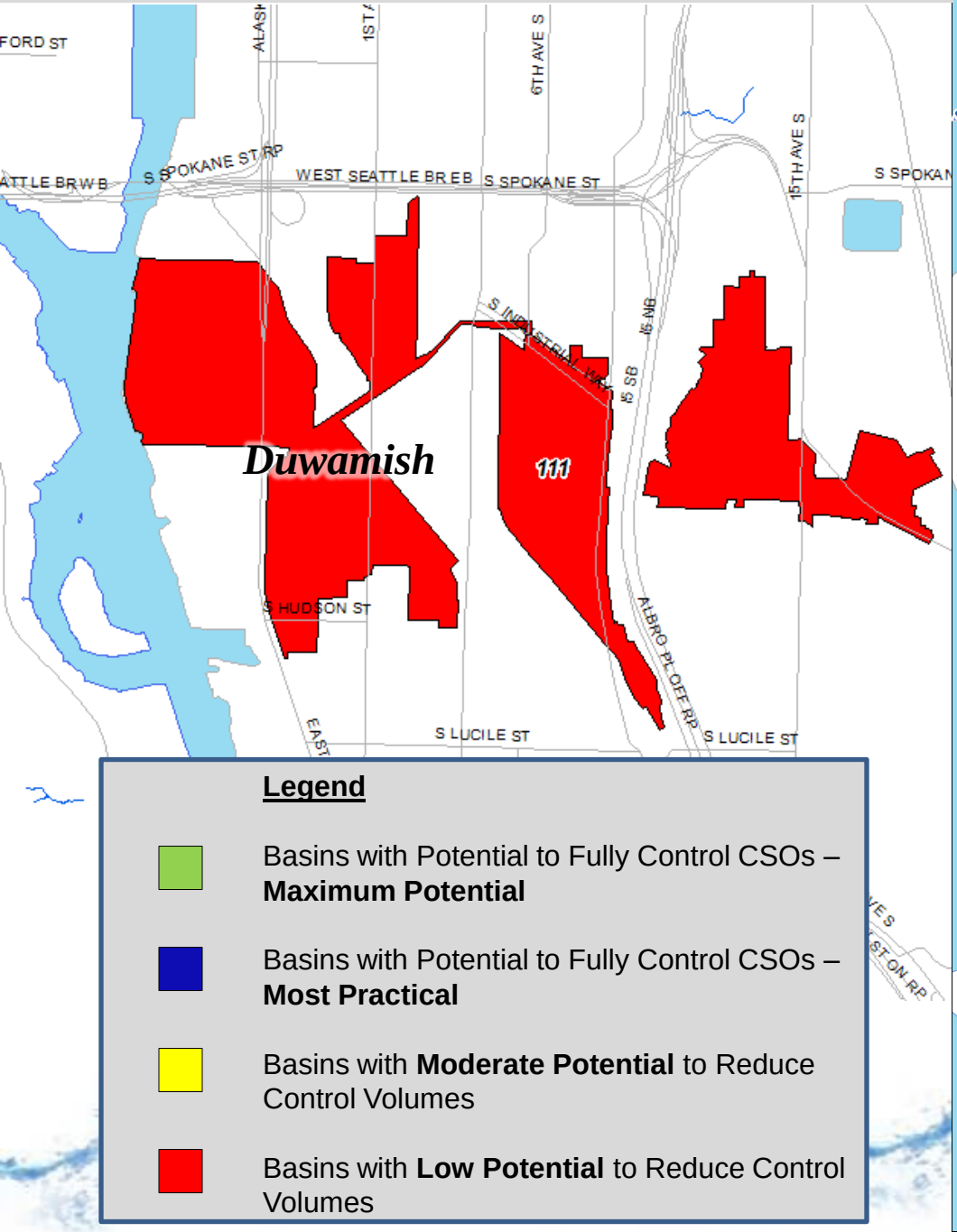
Planning Area 3: GSI Potential for CSO Control



Legend

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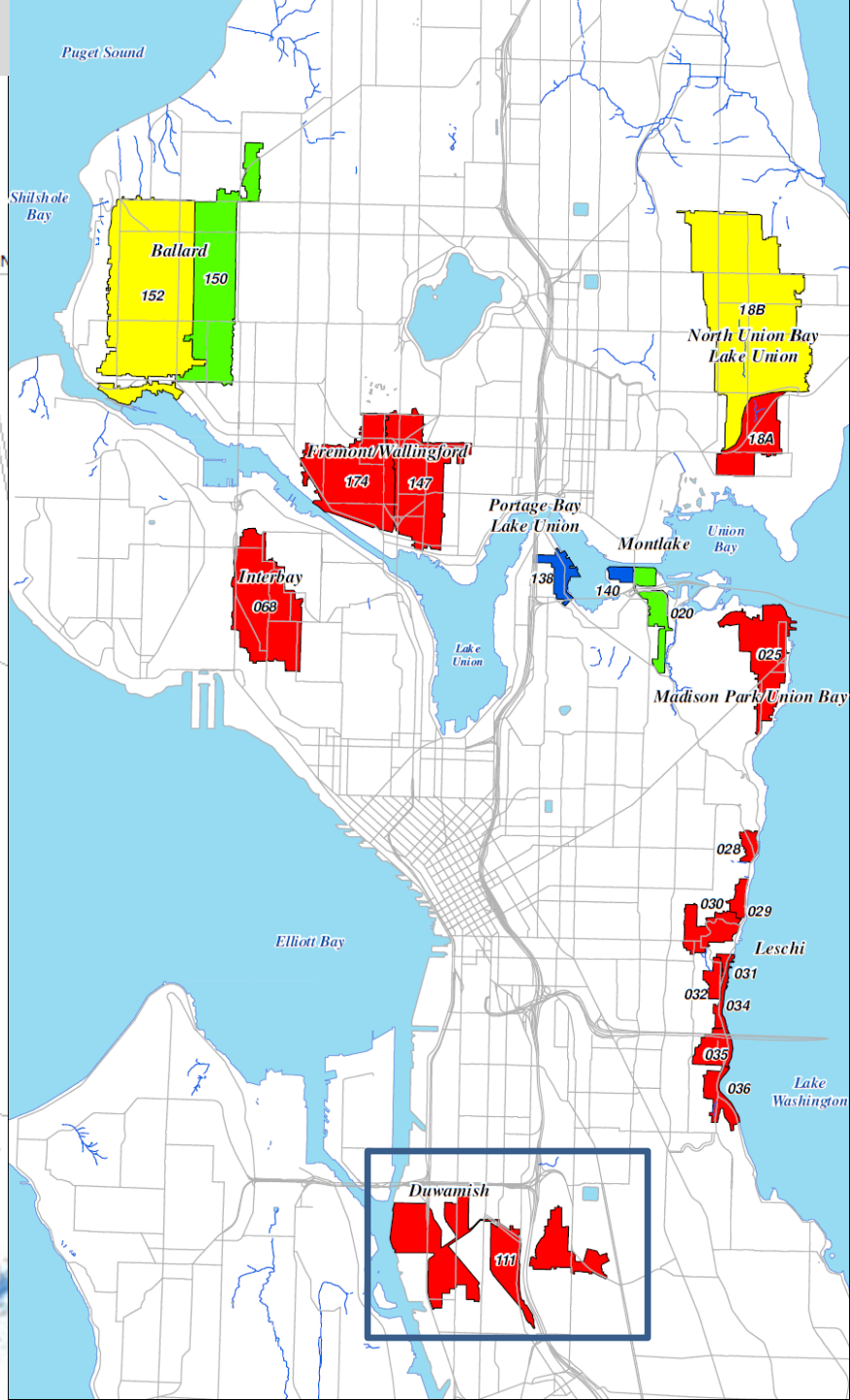

Other benefits of GSI

- Significant reduction in total volume of combined stormwater flows
  - Water quality benefit
  - Energy savings from decreased pumping and Wastewater Treatment costs
- Increased awareness about stormwater and impacts
- Increased green space (increased walkability, increased habitat)

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GSI Roll Out: Leading with Green

- 2010
  - Ballard Roadside Raingardens, Phase 1
  - Ballard RainWise
- 2011
  - Ballard Permeable Pavement Alleys, Phase 1
  - Windermere RainWise
  - Montlake RainWise, Roadside Raingardens and Perm Pvmt Alley
  - North Union Bay RainWise
- 2012
  - Ballard Roadside Raingardens, Phases 2-5
  - Interbay RainWise
  - Genesee RainWise
  - Henderson RainWise
  - Fremont/Wallingford RainWise
- 2014
  - Ballard Permeable Pavement Alleys, Phase 2

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Tracy Tackett
GSI Program Manager
Tracy.Tackett@seattle.gov

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