**Street Alternatives:
Seattle Public Utilities
Natural Drainage
System Program**

Seattle
Public
Utilities

Urbanization of Puget Sound

1972   1986   1996

Applied, Analysis Inc. --- http://www.discover-aai.com/index.htm

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Endangered and threatened species of Puget Sound –
orca, chinook (steelhead, chum, coho, etc.)

Natural Drainage Systems

**Tries to make
this…**

**…function like
this.**

Seattle's Natural Drainage System Program

City Right-of-Way
•Residential Neighborhood – NDS Grids
   –SEA Street Prototype
   –Cascade Prototype
   –Lessons Learned through projects
•High density Neighborhood– High Point
•Commercial Area – Swale on Yale
Private Property
•Private Parking Lots – Northgate Mall
•Stormwater Code Revisions to encourage LID
•Lakewood Pilot Project
•Private Incentives – RainWise Program

Tracy Tackett, Low Impact Development Program Manager

Opportunities within a watershed

upland sites

public infrastructure
systems

subsurface drainage

creeks

large receiving water bodies

Before   After
SEA St: 2nd Ave NW between 117th & 120th Streets, aerial looking north

Curvilinear Template

Who to Involve
Street Design, Landscape Architects, Other Utilities, …

SEA Street monitoring results for two years:

99%

reduction in total runoff volume

NW110th Carkeek Cascade

Existing Systems

Carkeek **Cascade** at NW 110th

Combined with flow through water quality channel

Different from SEA Street – lots more water, steeper slopes

Major Lesson Learned, Street Guidelines

Major Lesson Learned, Soil Wrap Wall specs

Water Quantity and Quality Monitoring by UW (Cameron Chapman) – great performance

Major Lesson Learned, modeling
- Less runoff than anticipated
- Higher average annual infiltration rate

Broadview Green Grid

Monitoring location

Sub-basin drainage area = 32 acres

SEA Streets and Cascades

Major Design Change

Sidewalk adjacent street

Major Lesson Learned, Native Soils

Major Lesson Learned, Native Soils

Major Lesson Learned, Native Soils

Major Lesson Learned, Native Soils

Sub-basin drainage area = **32 acres**

Native Soil Infiltration Rates

Modified Full
Scale Field Testing
(PIT)

Field flexibility - Subsurface Pipe

Major Lesson Learned, Bioretention Soils

Major Lesson Learned, need better modeling

November 11?, 2004

Pinehurst Project Area
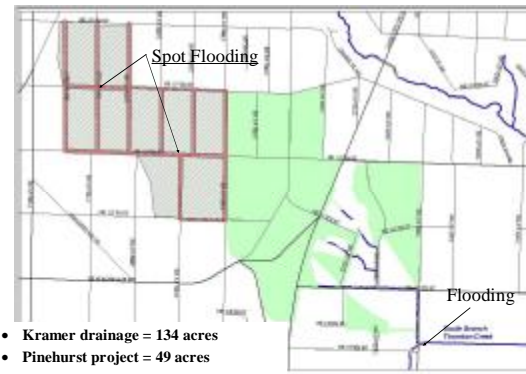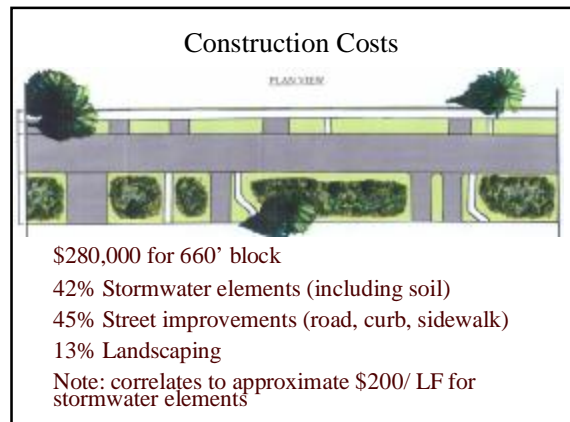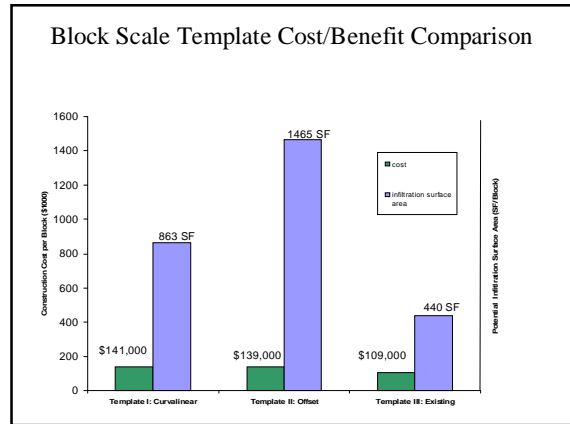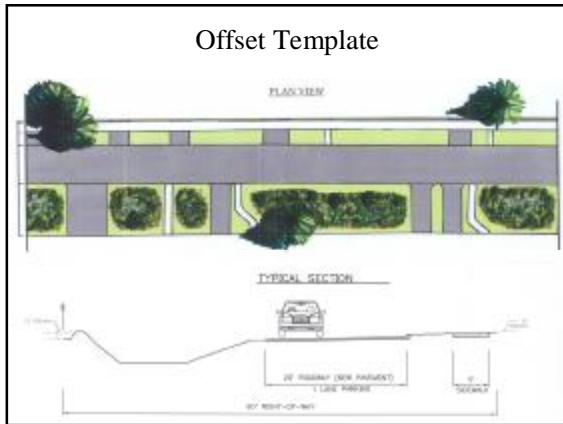
Spot Flooding

Flooding

- **Kramer drainage = 134 acres**
- **Pinehurst project = 49 acres**

Offset Template

Block Scale Template Cost/Benefit Comparison

Major impact to residents during construction!

Construction Costs

$280,000 for 660' block

42% Stormwater elements (including soil)

45% Street improvements (road, curb, sidewalk)

13% Landscaping

Note: correlates to approximate $200/ LF for stormwater elements

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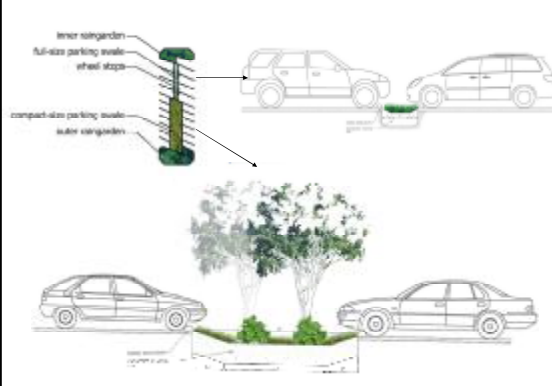- Commercial Area – Swale on Yale

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More Project Information:

http://www.ci.seattle.wa.us/util/
naturalsystems/

Natural System Program
High Priority Watersheds

North:
Piper's Creek
Watershed

South:
Longfellow Creek
Watershed

Longfellow Creek
Watershed

*High Point
Redevelopment*

- **130-acre site**
- **new right-of-way**
- **1,600 units**
- **65% impervious area**
- **9% of watershed**

High Point Natural Drainage Strategies
Housing: Block-level Design

High Point Neighborhood

Case Study: High Point Redevelopment, Seattle, WA
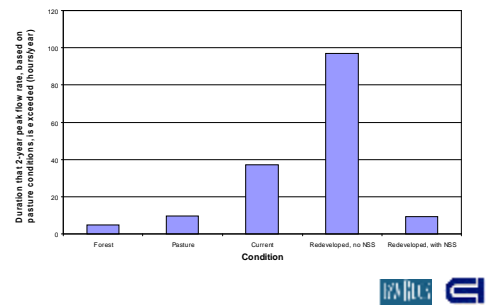
Porous Concrete
Roadway
Demonstration

Who to work with – Permitting and enforcement procedures in place prior to construction

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Right-of-Way - Commercial Neighborhood

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Telescope Swale Details

Private Property: parking lots

http://www.ci.seattle.wa.us/dpd/Sustainable_Building

Rainwise Incentives Program

- Rainwater cisterns
- Green roofs
- Biortention
- Bioswales
  - Peak reduction
  - Peak and volume reduction
- Compost amended soil
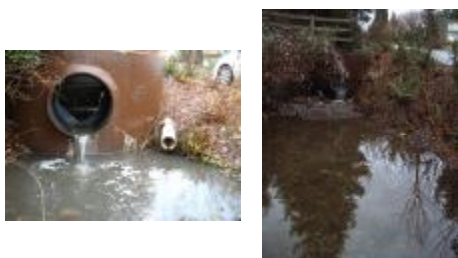- Porous pavement
- Reduction of impervious surface area
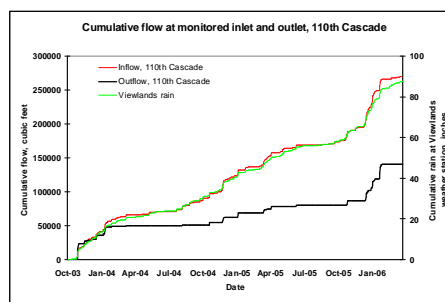
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Major Lesson Learned, Stewardship

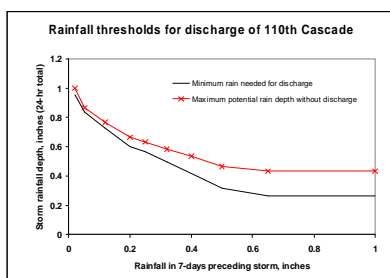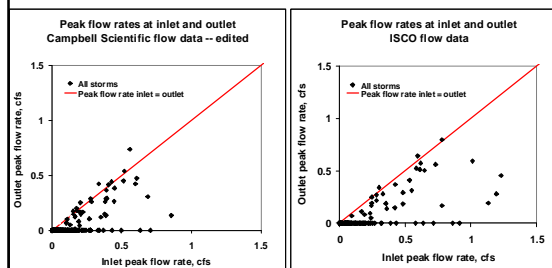## Water Quality Monitoring by UW

Results: runoff retention

- System retains at least 48% of all inflows

Results: outlet hydrology

- Discharge in only 49 of 235 storms
- Fully retains storms up to 1" in dry conditions
- Fully retains storms up to 0.3" in any condition
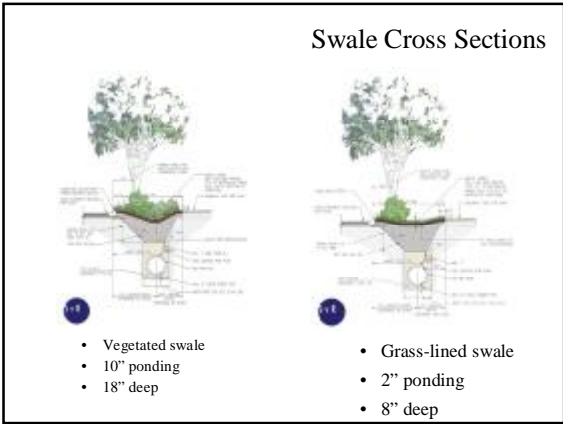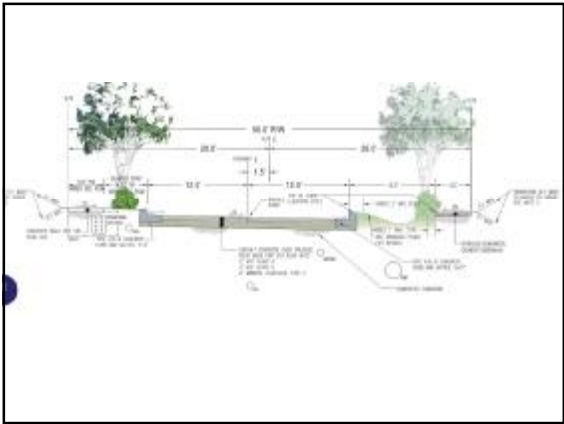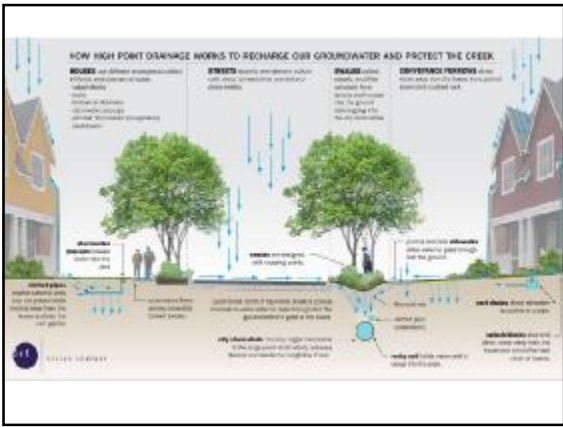
Results – peak flow reduction

Water Quality Results:
Conservative estimates of percent reduction in mass loading

Pollutant	Method 1	Method 2, 3*
TSS	84 (72-92)	89, 86*
TN	63 (53-74)	67
TP	63 (49-74)	73
Copper	83 (77-88)	83
Zinc	76 (46-85)	84
Lead	90 (84-94)	89
Motor oil	92 (86-97)	93

Results: typical outflow quality from 110th Cascade (mg/L)

Pollutant	Range
TSS	10 – 40
TN	0.6 – 1.4
TP	0.09 – 0.23
SRP	0.02 – 0.05
Total copper	0.004 – 0.008
Dissolved copper	0.002 – 0.005
Total zinc	0.04 – 0.11
Dissolved zinc	0.02 – 0.06
Total lead	0.002 – 0.007
Dissolved lead	< 0.001
Motor oil	0.11 – 0.33

High Point Neighborhood

Vertical Mar 17

Swale Cross Sections

- Vegetated swale
- 10" ponding
- 18" deep

- Grass-lined swale
- 2" ponding
- 8" deep

Porous Concrete Roadway