Low Impact Development:
Integrated Management Practices

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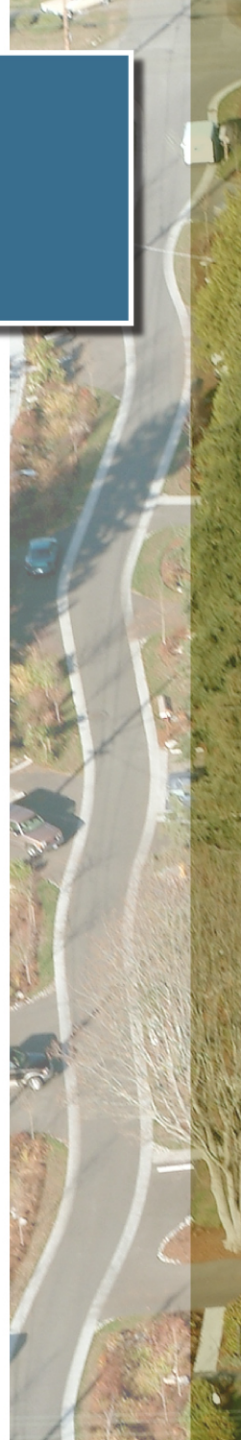
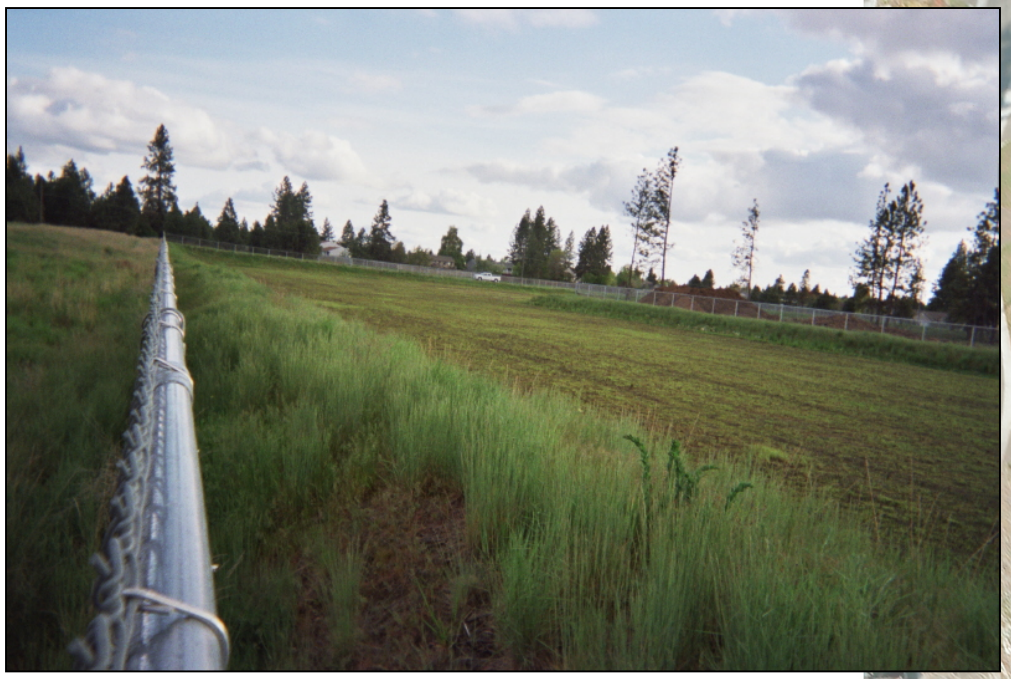
Discussion Topics

- Brief history of structural stormwater management
- The Low Impact Development (LID) alternative to ponds, ponds, ponds…
- LID for Hydromodification Management:
  - State of Washington
  - City of Portland, Oregon
  - Prince George's County, Maryland
- Contra Costa approach builds on the best ideas from these programs



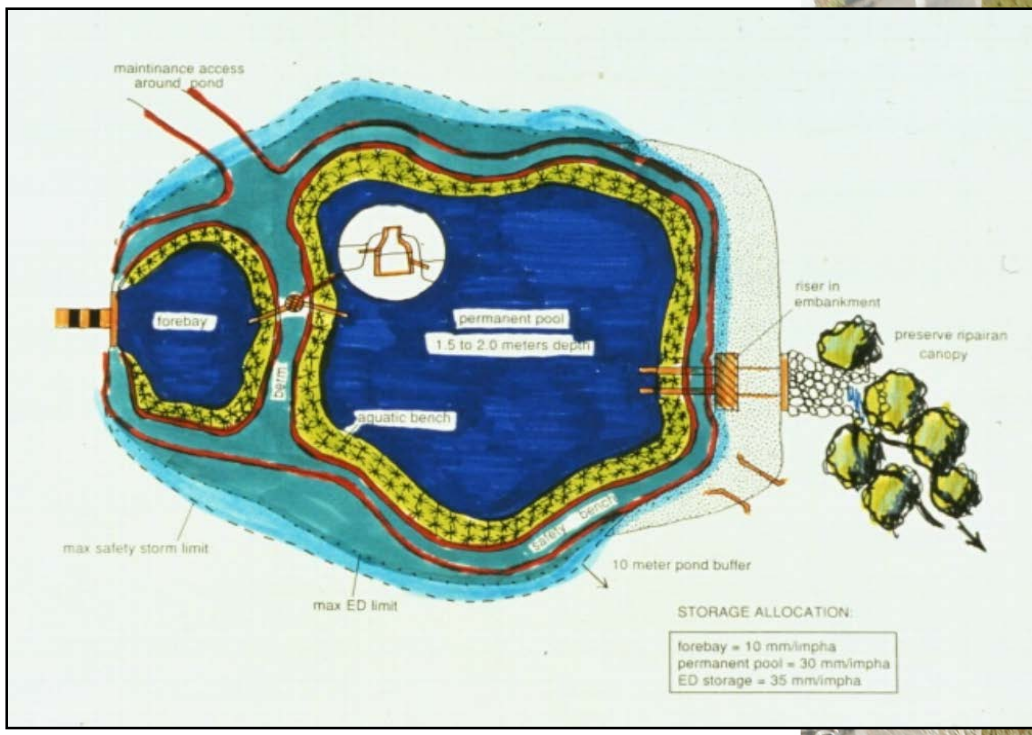
Brief History

- Pre-1990's
  - Northwest: Detention ponds for peak rate control
  - California: Emphasis on conveyance to regional channel systems



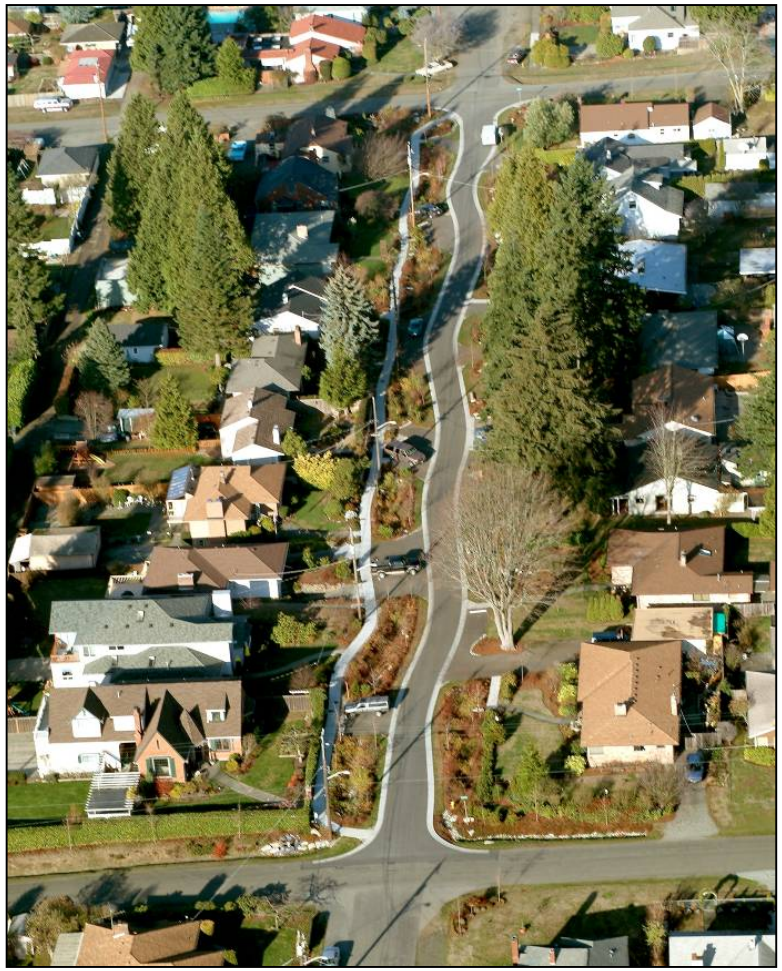
Brief History (Cont'd)

- 1990's (NPDES Triggers New Thinking)
  - **Northwest**: Treatment and hydromodification added, new analytical tools, salmon also a driver
  - **California**: Structural controls appear for stormwater treatment



Brief History

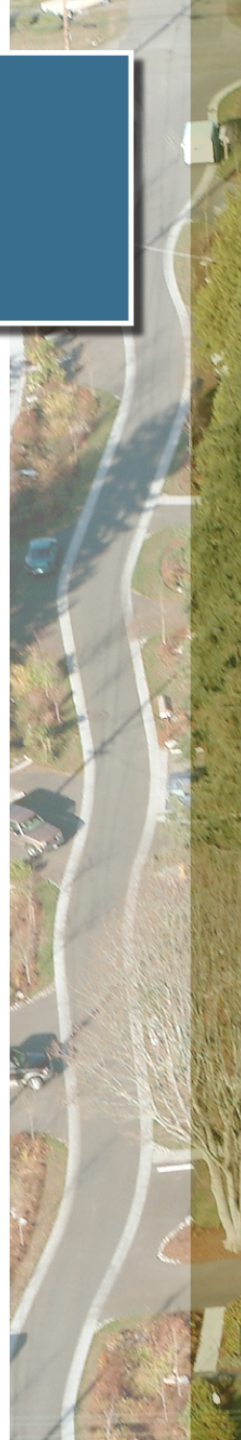
- Late 1990's to Now (Convergence)
  - LID gains traction
  - Guidance Manuals proliferate! (Start at the Source 1999, Prince George's County 1999)
  - Numerous "pilot studies"
  - California: NPDES hydromod req'ts kick-in



So what do we mean by LID….

Low impact development is a stormwater management strategy that emphasizes conservation and use of existing natural site features integrated with distributed, small-scale stormwater controls to more closely mimic natural hydrologic patterns in residential, commercial, and industrial settings.

Source: (Puget Sound Action Team 2005)



Example of an LID Strategy

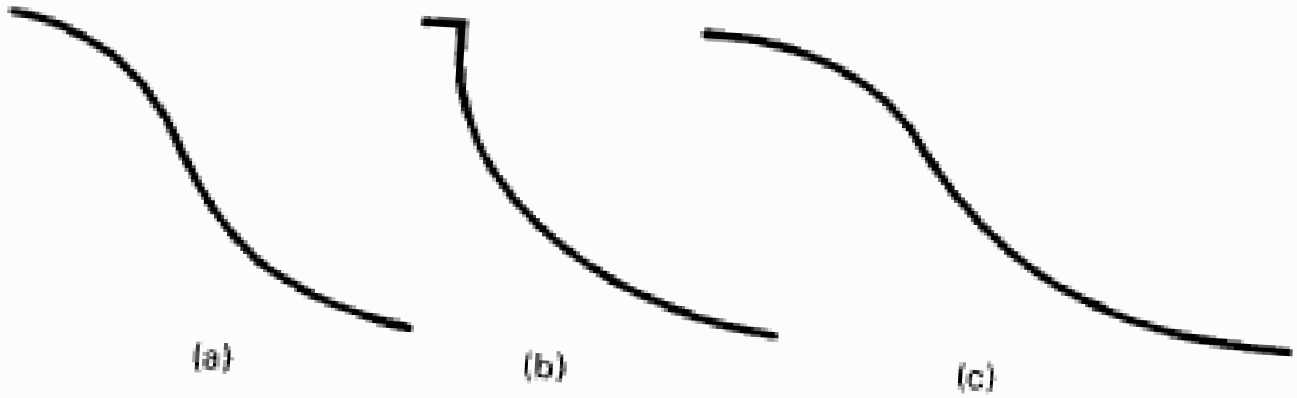
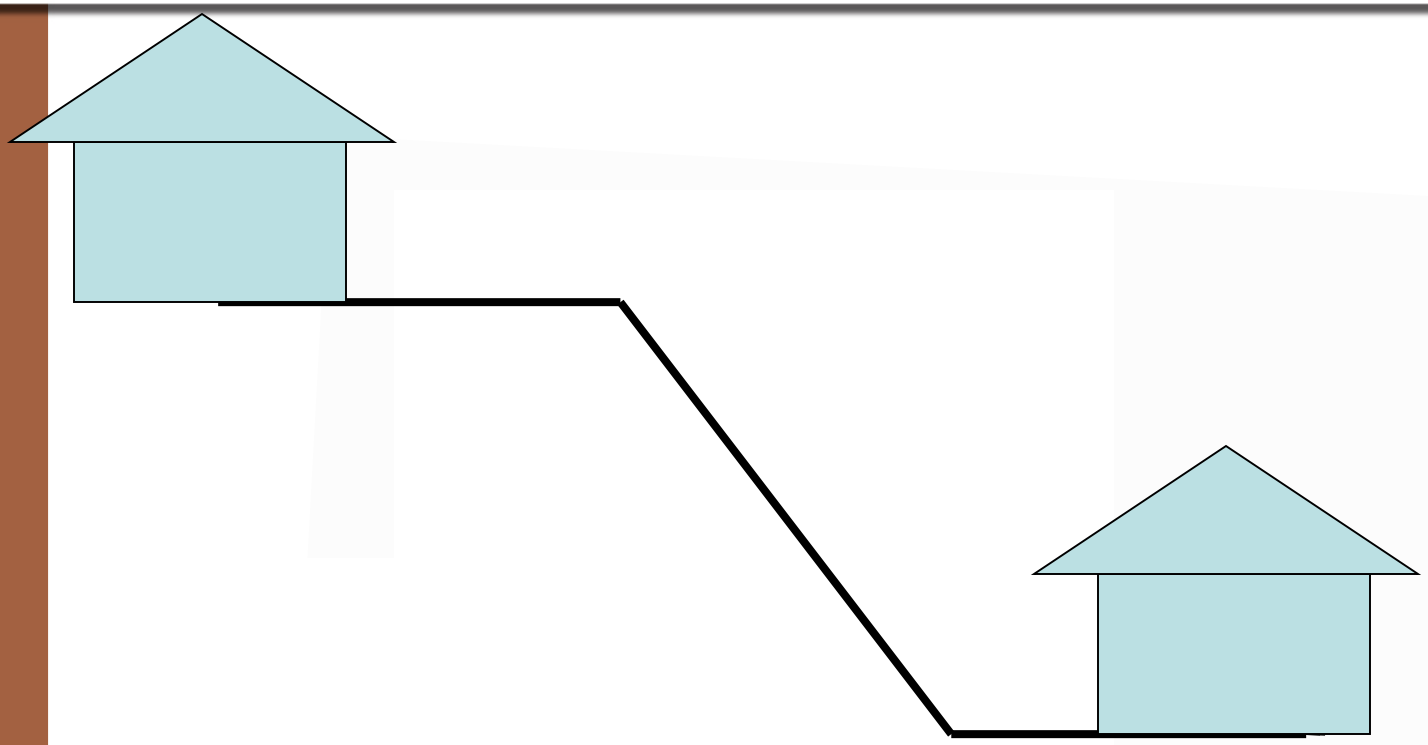
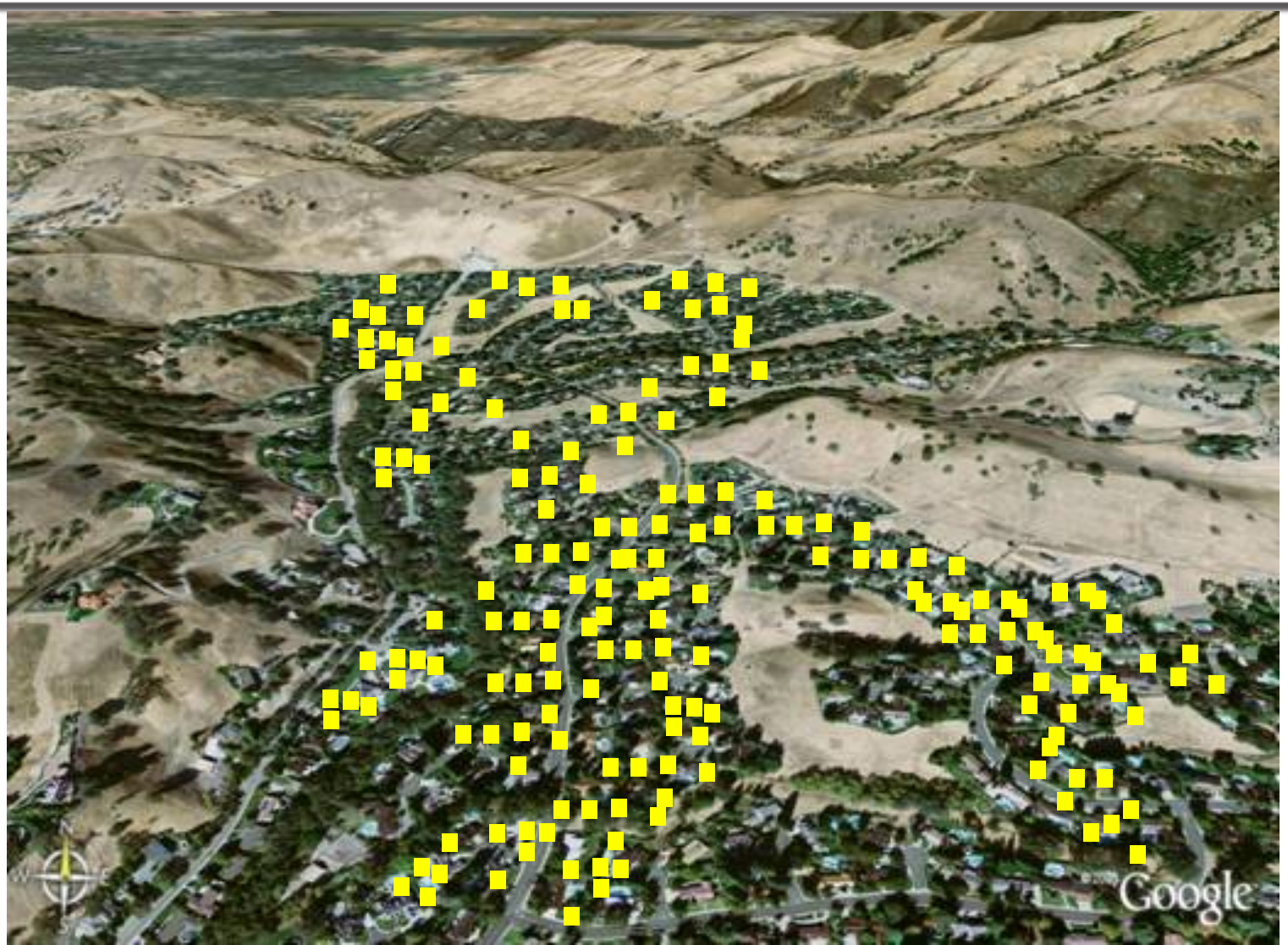


Fig. 1.6 Effect of slope shape on erosion potential. (*a*) Convex slope; (*b*) concave slope; (*c*) stable slope. (Adapted from 5)

Example of an LID Strategy



Example of an LID Strategy



Why is LID so hot right now?

- Minimizes changes to natural hydrology
- Controls pollutants at the source
- Soil contact optimal for pollutant removal

Treatment Facility	TSS	Dissolved Metals incl. Cu, Zn	Total Phosphorus	Pesticides/ Fungicides	Hydro-carbons incl. O&G, PAH
Wet Pond	■	+	+		+
Wet Vault	■				
Biofiltration	■	+	+	+	+
Sand Filter	■	+	+		+
Constructed Wetland	■	■	+	■	■
Leaf Compost Filters	■	+		■	■
Infiltration[2]	■	+		+	+
Oil/Water Separator					■
Bio-infiltration	■	■	+	■	■

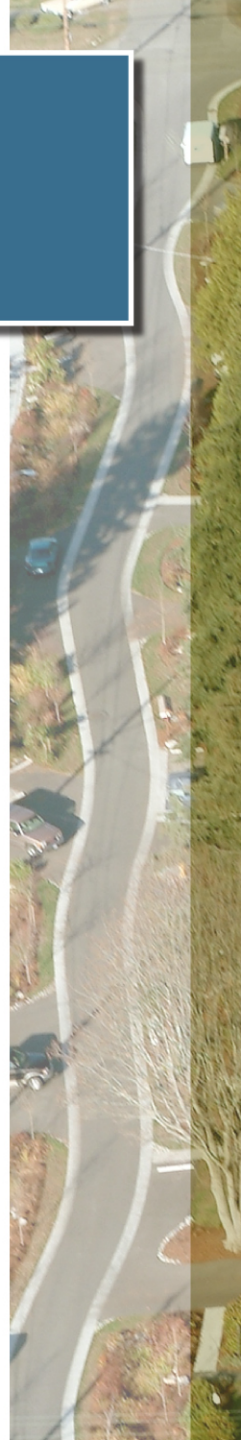
Footnotes:
■ *Significant Process*
\+ *Lesser Process*

Why is LID so hot right now?

- Aesthetics and public acceptance
- Vectors (e.g., mosquitoes)
- Reuse potential

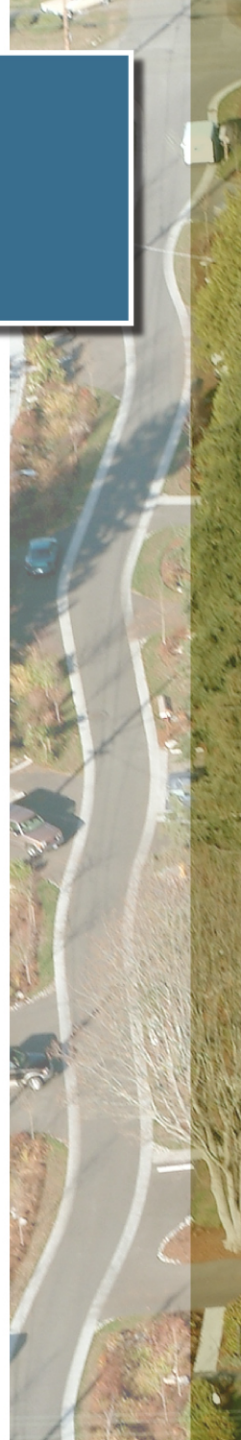
So what does LID look like?....

- Site assessment
- Site planning and layout
- Vegetation protection and maintenance
- Clearing and grading
- Distributed and integrated management practices (IMPs)
- Maintenance and Education



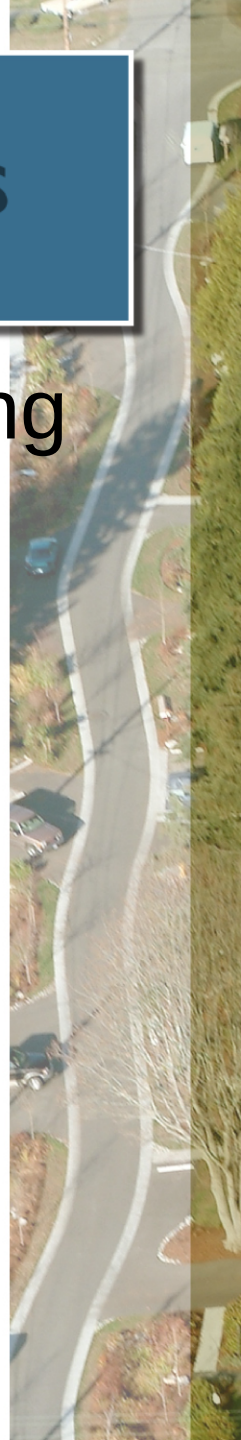
Today's Emphasis….

- Site planning and layout – Hydrology as the "organizing principle"
  - Road, driveway and parking layouts
  - Street trees
  - Lot Layout
  - Building design
  - Collection system with…
- Distributed and integrated management practices (IMPs)



Integrated Management Practices

- Examples (Yes, people are really building these things…)
  - Highly urban environment (Growing Vine)
  - Road runoff (SEA Streets, Viewlands)
  - Parking lots (Auburn Library)
  - College campus (Olympic College)
- Spokane – LID since 1979



Growing Vine Street

Bio downspout

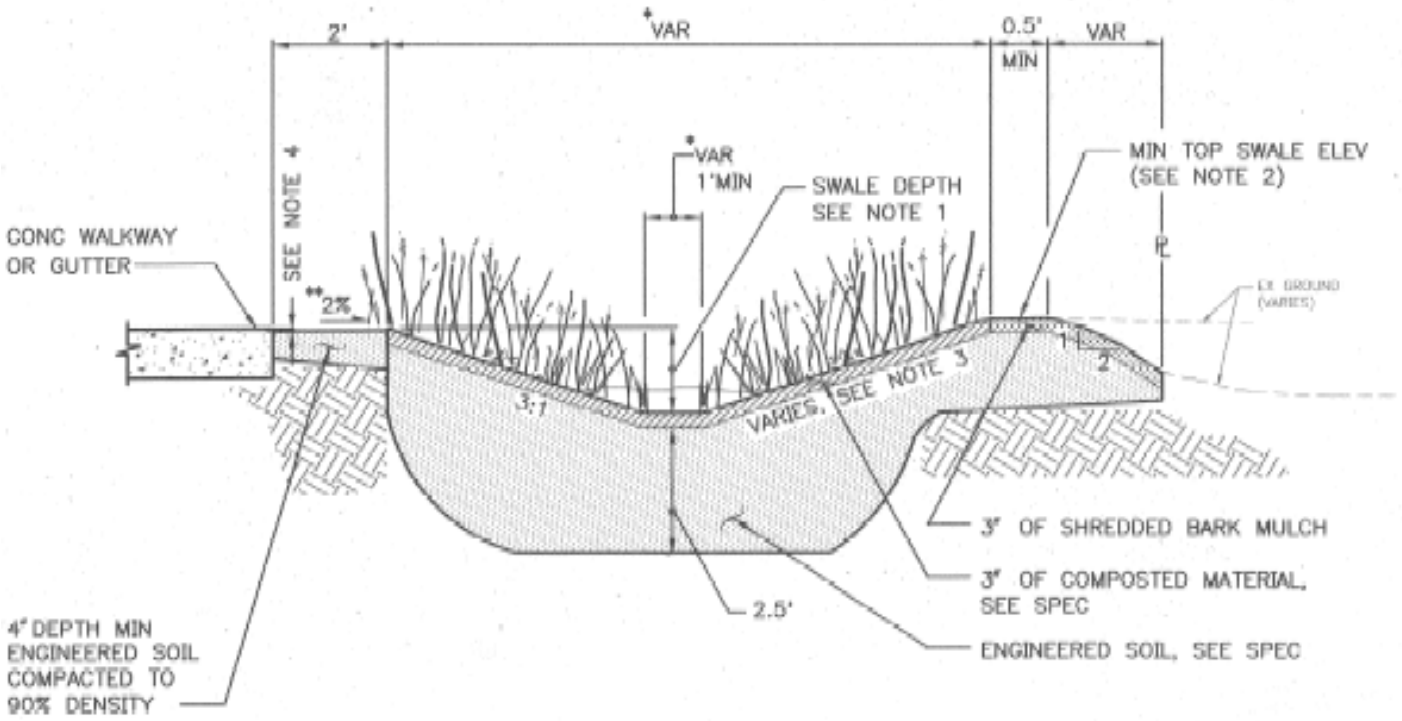
Bio downspout Cistern & Cascade

SEA Street Before

SEA Street After

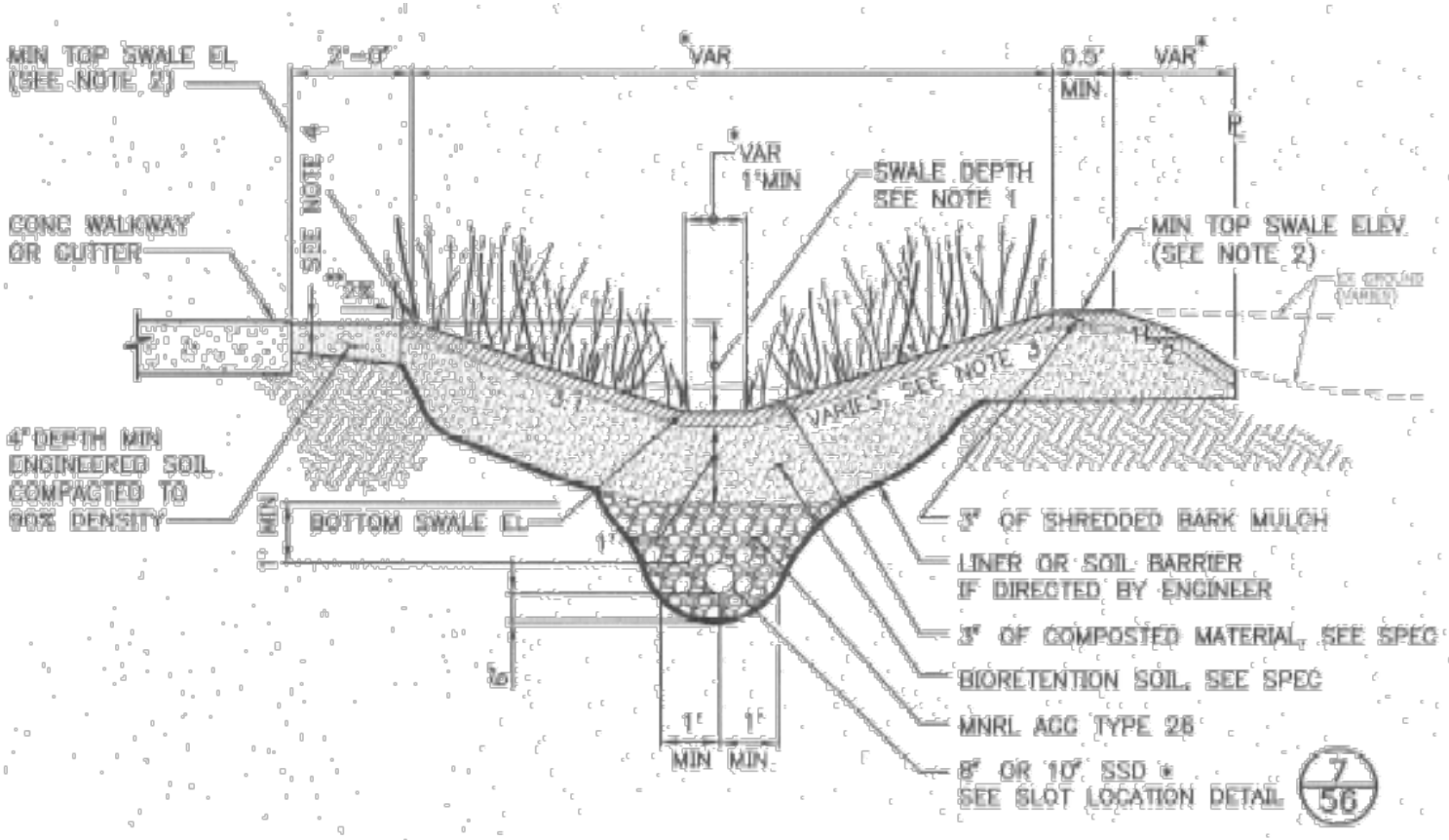
SEA Streets

SEA-Street



ENGINEERED SOIL SWALE 3
SCALE: ½" = 1'-0" 19,27,33

SEA-Streets

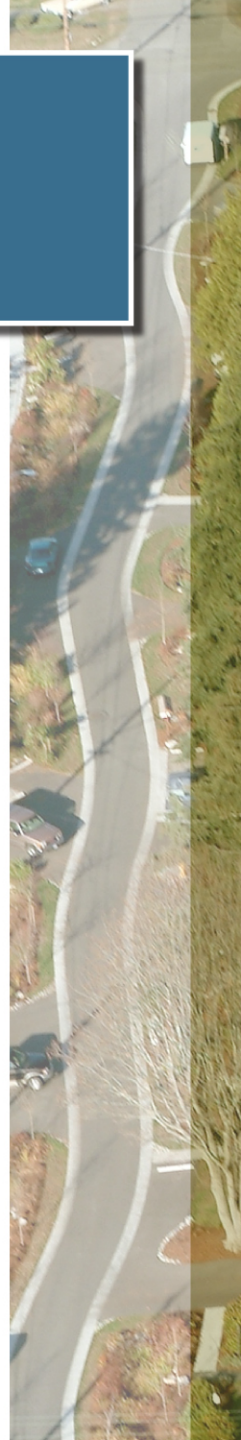


BIORETENTION SWALE W/ SSD 2/27

SCALE: ½" = 1'-0"

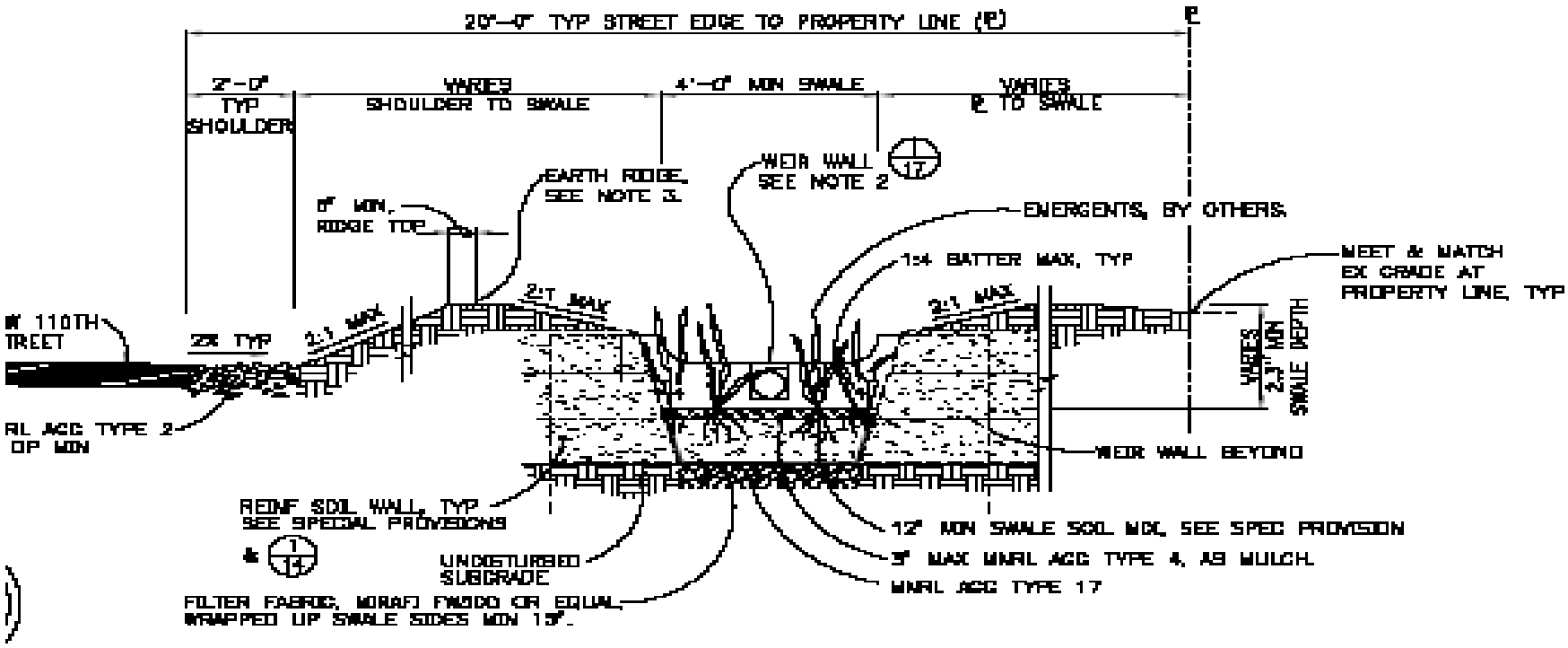
SEA-Streets Initial Performance

- Monitoring showed 98% reduction in runoff for small storms
- Commensurate water quality benefits
- Traffic calming
- Neighborhood enhancement



Viewlands Cascade

Viewlands Cascade



SECTION A–A12

TYPICAL SWALE SECTION LOOKING DOWNSTREAM TO WEIR WALL

SCALE: 1"=2'-0"

Auburn Library

“Stacked” system: Lined bioswale overflows into underlying infiltration pipe

Olympic College

Lined Bioswale

Sheet flow into swale

Infiltration basin

Spokane Has Successfully Used Bio-Infiltration Since 1979

>8,000 Bio-infiltration facilities installed to protect Sole Source Aquifer

Lesson: Improve design standards and integrate with other codes

- Fine tune standards over time
- Address conflicts with building code

Lesson: Aesthetics increase public acceptance and success

Attractive landscape features less likely to be filled in by property owner

Lesson: Educate Contractors and Facility Owners

- Intended function and proper design

- Installation procedures
- Proper maintenance

Lesson: Inspect facilities during and after construction

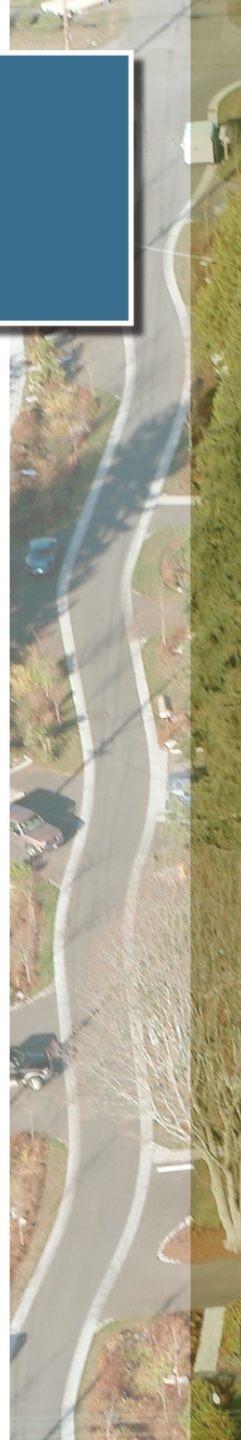
- Full time staff person hired for inspections

Lesson: Provide regulatory authority to ensure long-term performance

- City ordinance requires owners to maintain swales
- Allows City to maintain facilities and charge owners

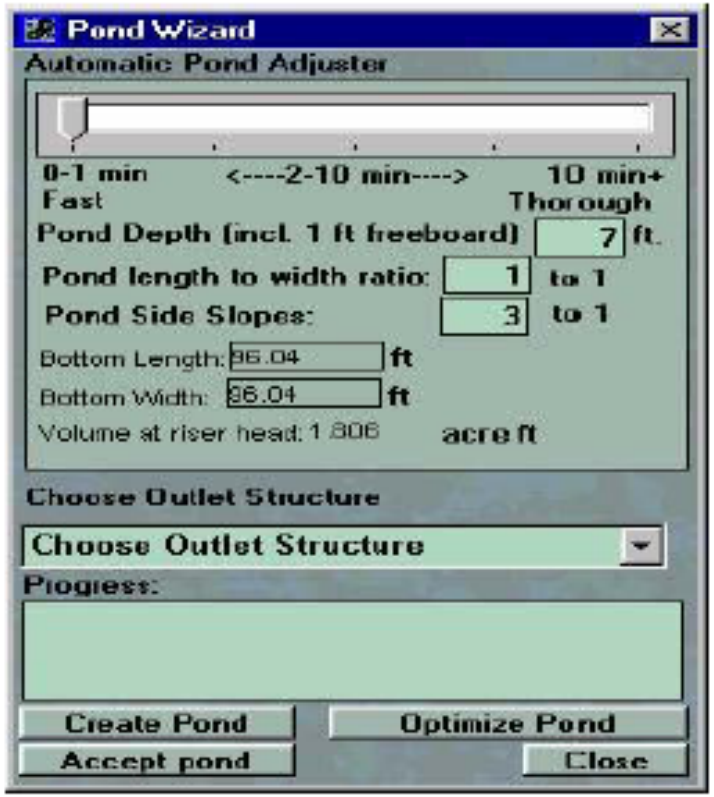
IMPs for Hydromodification Management

- Existing Stormwater Programs with emphasis on LID for Hydromod control
  - State of Washington
  - City of Portland, Oregon
  - Prince George's County, Maryland



State of Washington

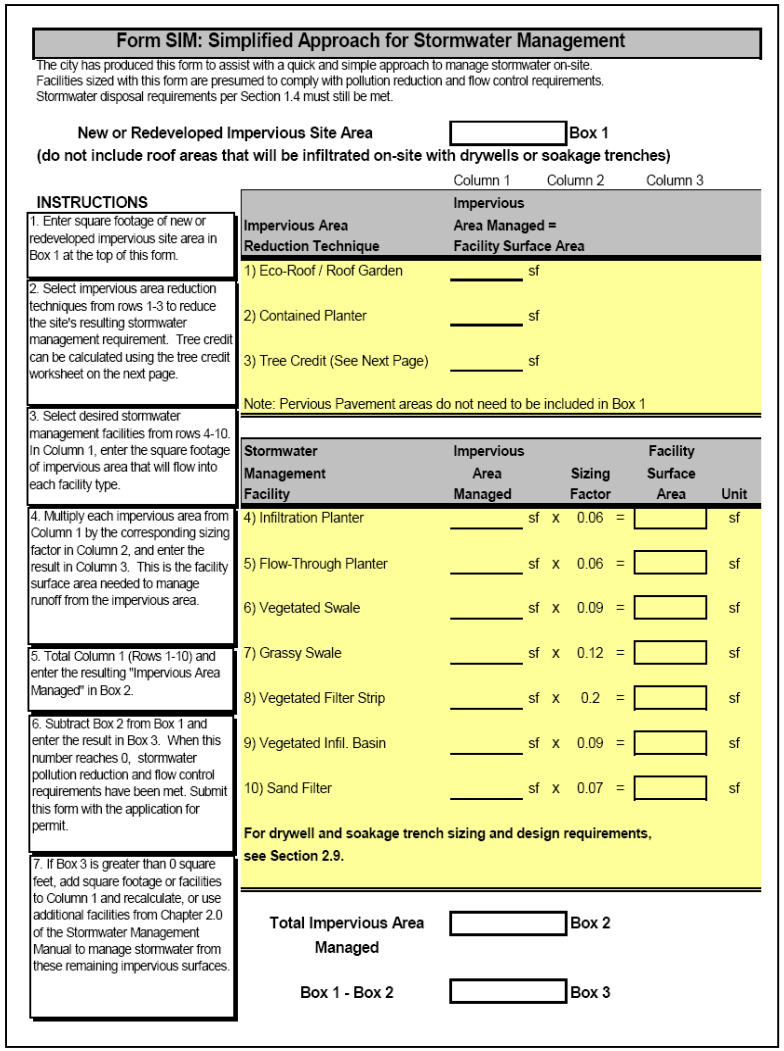
- Continuous hydrology volume/duration control
- Challenge: difficult to extend modeling tool to dozens of distributed IMPs



Pond Wizard

City of Portland, Oregon

- Easy to use tool encourages LID
- Hydromod control assumed, no continuous analysis to support



Form SIM: Simplified Approach for Stormwater Management

The city has produced this form to assist with a quick and simple approach to manage stormwater on-site. Facilities sized with this form are presumed to comply with pollution reduction and flow control requirements. Stormwater disposal requirements per Section 1.4 must still be met.

New or Redeveloped Impervious Site Area _____ **Box 1**

(do not include roof areas that will be infiltrated on-site with drywells or soakage trenches)

INSTRUCTIONS

1. Enter square footage of new or redeveloped impervious site area in Box 1 at the top of this form.
2. Select impervious area reduction techniques from rows 1-3 to reduce the site's resulting stormwater management requirement. Tree credit can be calculated using the tree credit worksheet on the next page.
3. Select desired stormwater management facilities from rows 4-10. In Column 1, enter the square footage of impervious area that will flow into each facility type.
4. Multiply each impervious area from Column 1 by the corresponding sizing factor in Column 2, and enter the result in Column 3. This is the facility surface area needed to manage runoff from the impervious area.
5. Total Column 1 (Rows 1-10) and enter the resulting "Impervious Area Managed" in Box 2.
6. Subtract Box 2 from Box 1 and enter the result in Box 3. When this number reaches 0, stormwater pollution reduction and flow control requirements have been met. Submit this form with the application for permit.
7. If Box 3 is greater than 0 square feet, add square footage or facilities to Column 1 and recalculate, or use additional facilities from Chapter 2.0 of the Stormwater Management Manual to manage stormwater from these remaining impervious surfaces.

	Column 1	Column 2	Column 3
Impervious Area Reduction Technique	**Impervious Area Managed = Facility Surface Area**		
1) Eco-Roof / Roof Garden	_____ sf		
2) Contained Planter	_____ sf		
3) Tree Credit (See Next Page)	_____ sf		

Note: Pervious Pavement areas do not need to be included in Box 1

Stormwater Management Facility	**Impervious Area Managed**		**Sizing Factor**		**Facility Surface Area**	**Unit**
4) Infiltration Planter	_____ sf	x	0.06	=		sf
5) Flow-Through Planter	_____ sf	x	0.06	=		sf
6) Vegetated Swale	_____ sf	x	0.09	=		sf
7) Grassy Swale	_____ sf	x	0.12	=		sf
8) Vegetated Filter Strip	_____ sf	x	0.2	=		sf
9) Vegetated Infil. Basin	_____ sf	x	0.09	=		sf
10) Sand Filter	_____ sf	x	0.07	=		sf

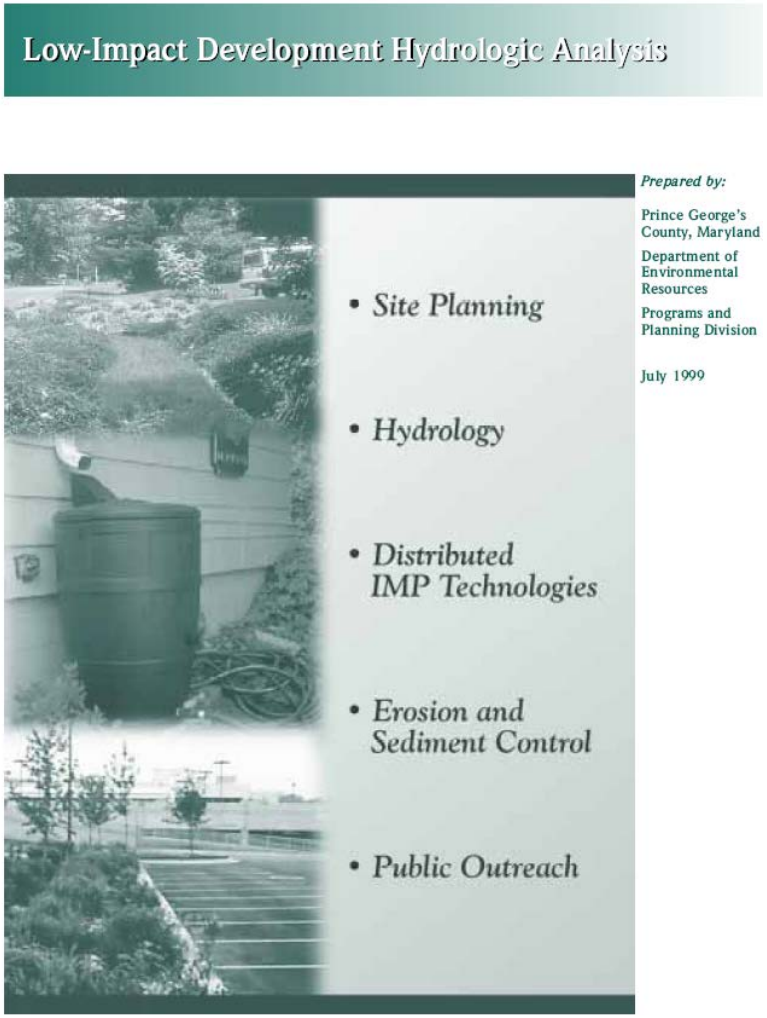
For drywell and soakage trench sizing and design requirements, see Section 2.9.

Total Impervious Area Managed _____ **Box 2**

Box 1 - Box 2 _____ **Box 3**

Prince George's County, Maryland

- Event based
- Cumbersome calculations steps
- No continuous, duration analyses



Contra Costa Clean Water Program

- Challenge:
  - Rapidly develop technically rigorous method and easy to use tools
- Approach:
  - Hybrid of WA/OR
  - Continuous hydrology, duration analysis
  - User friendly