PUGET SOUND PARTNERSHIP

WASHINGTON STATE

Overview of Low Impact Development

Bruce Wulkan, Stormwater Program Manager

Harbor Seal / Tim Zurowski.
Young children combing the beach for sealife / Ian Wilson.
Pigeon Guillemot / Tim Zurowski.

Presentation Overview

- Overview of Low Impact Development (LID): Principles, objectives, origins and practices
- Benefits and costs
- Current regional issues
- Resources available

LID Basics

- Definition: Stormwater management and land development strategy applied at the parcel and subdivision scale that emphasizes conservation and use of on-site natural features integrated with engineered, small-scale hydrologic controls to more closely mimic pre-development hydrologic functions.
- Goal: Prevent measurable harm to aquatic resources from development.

LID Technical Guidance Manual for Puget Sound, 2005

LID Flow Control & Treatment Objectives

- Flow Control: Match pre-development forested hydrologic conditions (or prairie) over full range of storm intensities & durations.
  - May not be possible to meet objective everywhere. Protecting vegetation is key!
  - Rural: Protect 65% mature native vegetation
  - Higher density: Protect as much as possible and use full complement LID techniques.
- Treatment Objective: Meet or exceed Ecology's standard of 80%TSS removal.

LID Technical Guidance Manual for Puget Sound, 2005

LID Strategies

- Protect native vegetation & soils, natural drainages.
- Plan site to protect critical areas, minimize total impervious surface area & eliminate effective impervious area.
- Manage stormwater close to source with multiple, distributed, small techniques.
- Maintain practices and educate landowner.

LID Technical Guidance Manual for Puget Sound, 2005

LID Approach vs. Conventional

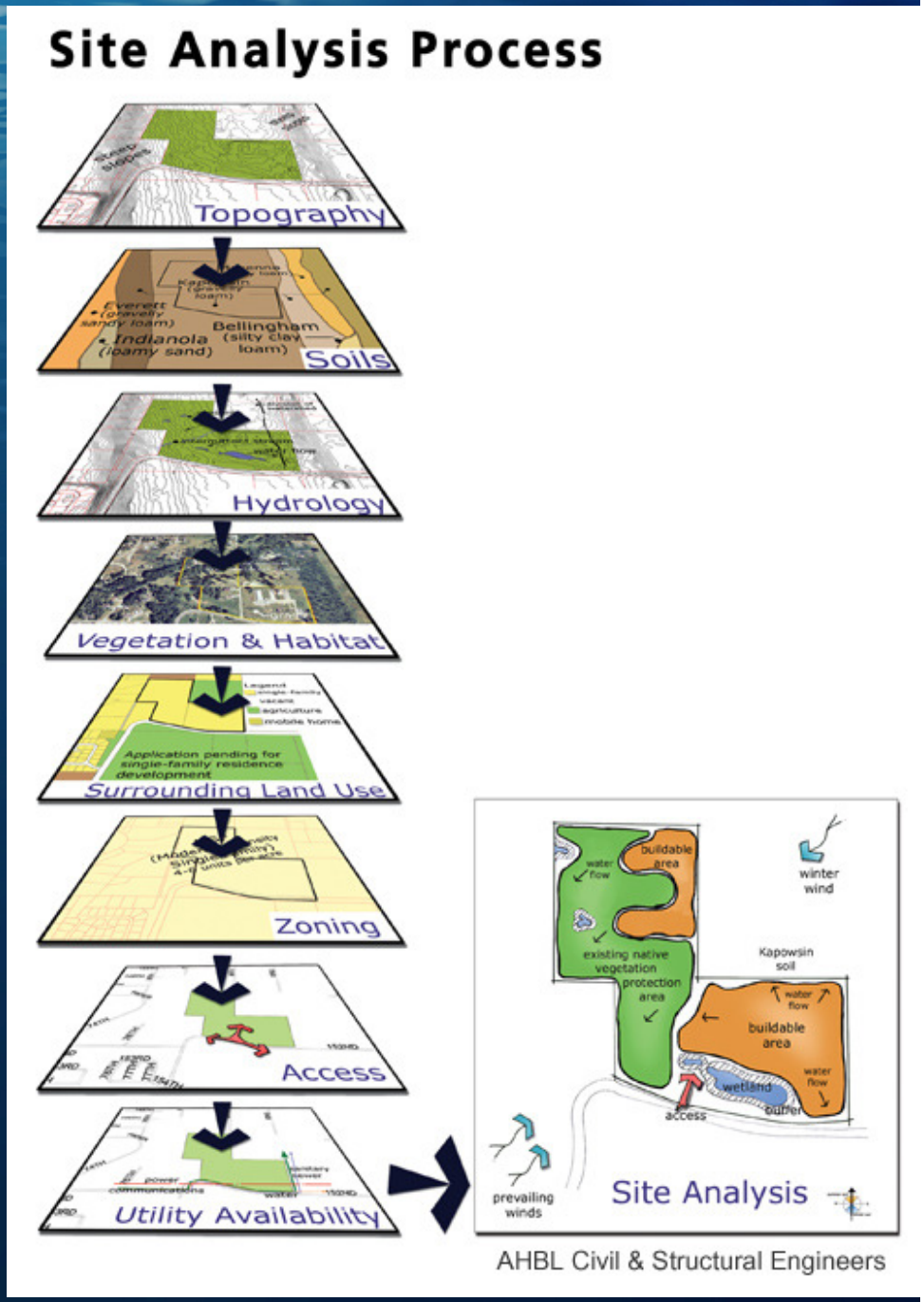
- LID: not just narrowing road or using a rain garden
- Entirely different approach than traditional, collect and convey stormwater management
- Build stormwater management into site design, and manage stormwater where it falls
- Generally requires more upfront site analysis
- Best results when multiple disciplines & departments collaborate early in the process
- Can result in very attractive projects, communities
- Can be very cost-effective

LID vs. Conventional

AHBL Civil &Structural Engineering

From LID Technical Guidance Manual for Puget Sound, 2005

Upfront analysis is important



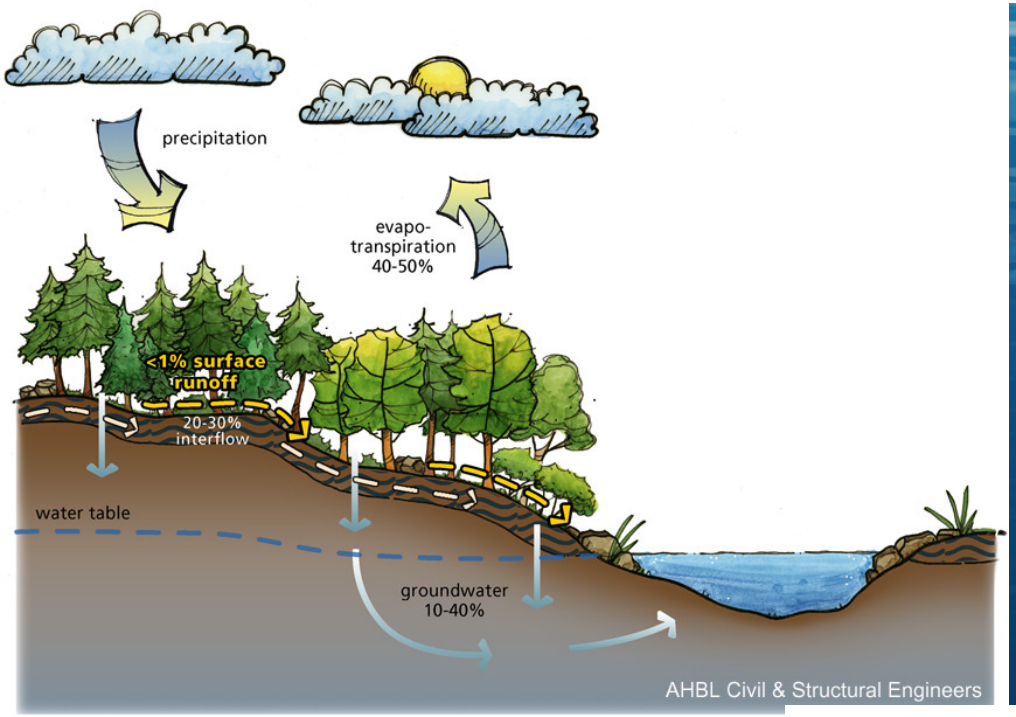
Origins of LID

- Developed by Prince Georges County, MD in 1990s
- Developed there largely for treatment and more cost-effective management
- Here, introduced for better flow control, treatment, more cost-effective control & several other reasons

Reasons for LID's Popularity Here (including the Benefits of LID)

- Reason #1: Decline of resources. Our resources are declining and current mitigation efforts are not entirely effective.

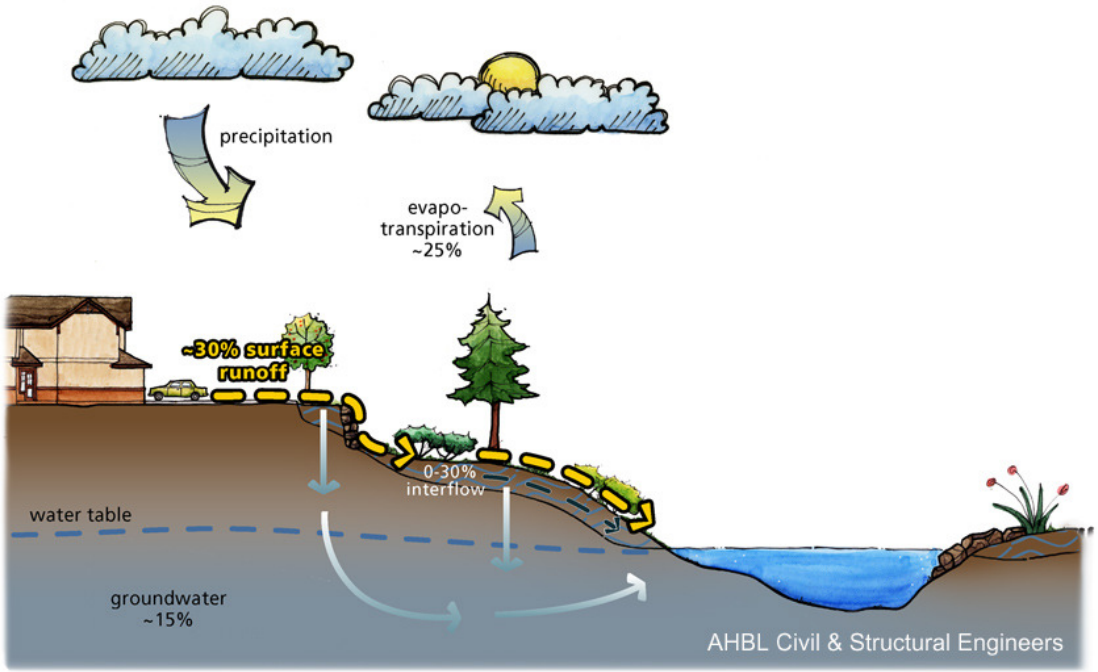
Photo by Al Latham



Conventional development can completely change a site's hydrology…

…changing infiltration and evapotranspiration to surface runoff.

LID Technical Guidance Manual for Puget Sound, 2005



Reason #2: Existing isn't that hot.

Existing conventional stormwater BMPs (e.g., ponds and vaults) are costly, take up a lot of space, and aren't particularly attractive.

Photo by Stuart Glasoe

Reason #3: LID is effective.

- LID techniques manage stormwater very well and provide multiple benefits.
  - "Seattle Natural Drainage Systems"
  - "Portland Sustainable Stormwater Management"
  - WSU Extension monitoring of Hylebos project & new LID research center
  - PS Partnership, then LID, then Learn more/resources

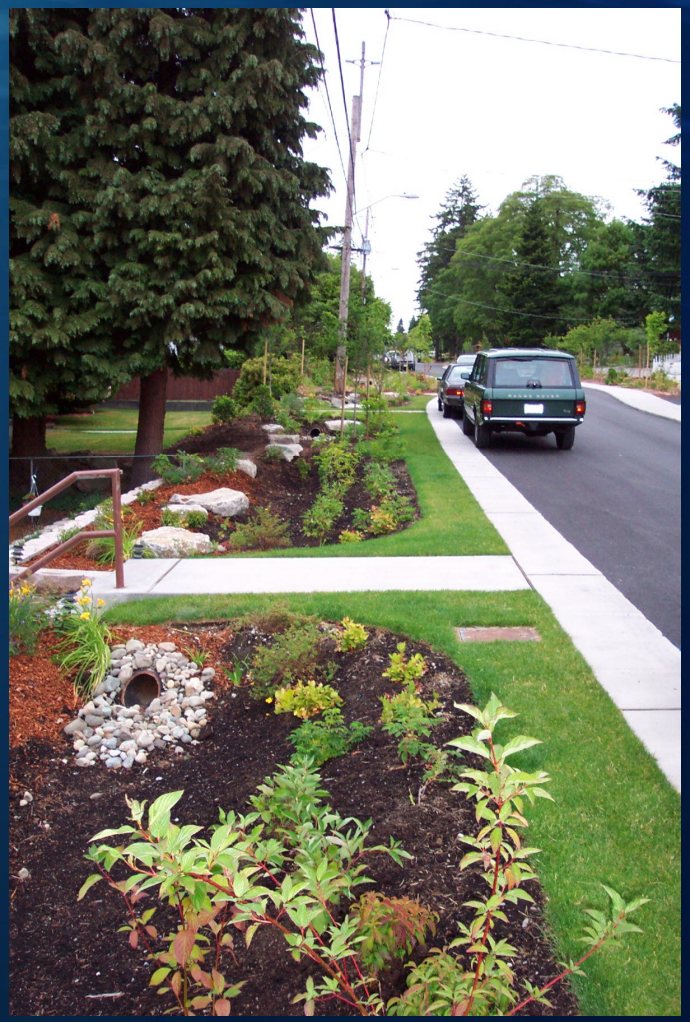


Photo courtesy Seattle Public Utilities

LID Performance

- Volume and runoff
  - Bioretention can capture and treat 100% small storms, reduce volume & reduce peak flows.
    - SEA Streets reduced volume 99% over several years.
  - Pervious pavement can infiltrate virtually 100% of storms (Booth & Brattebo). Even with reduced infiltration over time, largest storms infiltrate.
  - Rooftop rainwater harvest reduces or eliminates roof contribution of runoff.
  - Vegetated roofs can reduce peak flows 95%, & annual volumes 55-63% (Portland).
  - By reducing volume, also reduces pollutants.

LID Performance

- Removal of pollutants
  - Bioretention typically removes 90%+ metals and hydrocarbons (Davis and others).
  - Bioretention shown to be highly effective at removing bacteria (Davis).
  - Removal of nutrients is highly variable in bioretention (numerous studies).
    - Requires special design for nutrient (N and P removal)
  - Pervious pavement significantly reduces metals, hydrocarbons and suspended solids (Brattebo, numerous others).

Reason #4: LID can be very cost-effective.

- EPA: “Reducing Stormwater Costs through Low Impact Development (LID) Strategies and Practices, Pub. # EPA 841-F-07-006, Dec 07 (800) 490-9198
- Puget Sound case studies: “Natural Approaches to Stormwater Management”, PS Partnership, 2003. www.psp.wa.gov. Follow links to LID resources.
- Bellingham finds rain gardens cheaper: “Reining in the Rain”, PS Partnership, 2004.

Developer saved $260,000 by using pervious concrete at a residential subdivision in Sultan (Strafford Place).

Photo by Bruce Wulkan

LID Costs (cont.)

- Economics of Low-impact Development: A Literature Review, ECONorthwest, November 2007.
  - LID can cost less to install, have lower O&M costs, & provide more cost-effective management than conventional controls.
  - Included review & comparison of installation costs, life cycle costs & cost/benefit.

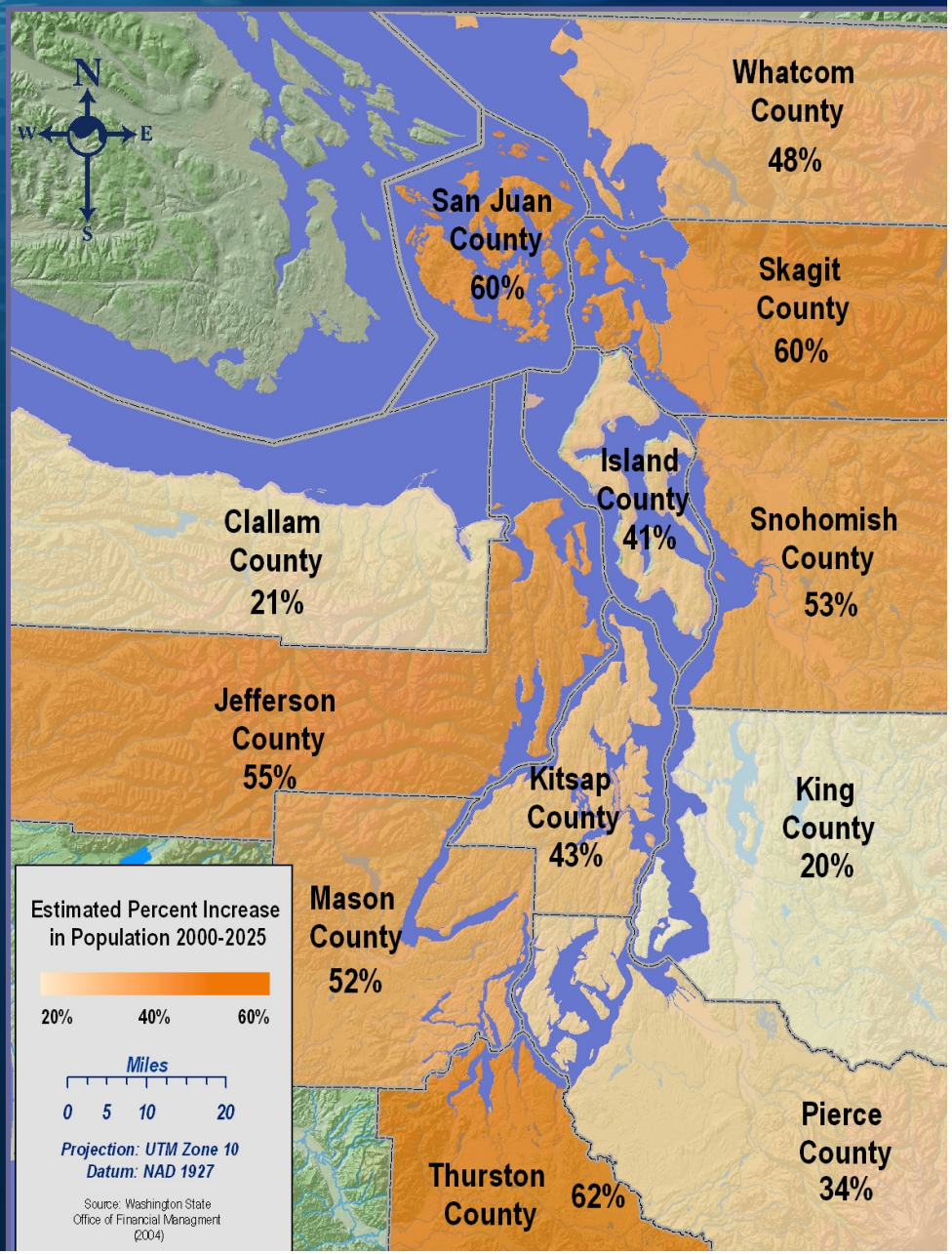
Reason #5: LID looks better.

LID projects typically contain more greenery, so they're usually more attractive. This is very important for communities.

Photo by Bruce Wulkan

Reason #6: We're growing fast…

…and we better figure out how we want the Puget Sound region to look like for our kids and grandkids.



Current most popular integrated management practices

1. Healthy soils
2. Bioretention
3. Permeable pavement
4. Dispersion
5. Rainwater harvesting
6. Vegetated roofs
7. Minimal excavation foundations

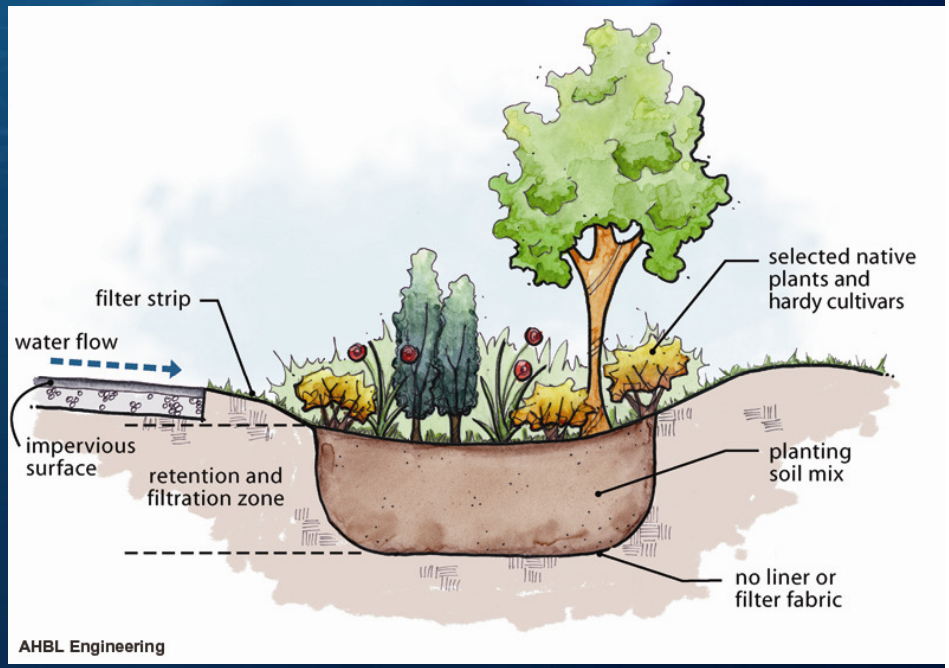
Current Most Common Practices
1. Maintaining healthy soil

- For all soils not covered by hard surfaces
- Required by permit
- Ecology manual: BMP T5.13
- Preserve first! Cheaper.
- If not possible, then:
  - Stockpile and reapply; or
  - Add 2-3” compost; or
  - Import 8” compost amended topsoil.
  - Till in to 12” depth.
- Better product for customer, better for environment
- http://www.buildingsoil.org/

Photo courtesy Seattle Public Utilities

Current Most Common Practices
2. Bioretention, aka “Rain Gardens”

- Min. 18” engineered soil mix & selected plants
- “Work Horse” of LID
- Very cost-effective
- Adds esthetics & value
- Versatile, flexible
- Excellent for both flow control & treatment
  - Plants and soil store water, take up pollutants
  - Ecology-approved enhanced treatment BMP
  - Detention “credit” in WWHM currently being updated



From LID Technical Guidance Manual for Puget Sound, 2005

Can be cells, or rain gardens…

Photos by Bruce Wulkan

…or swales

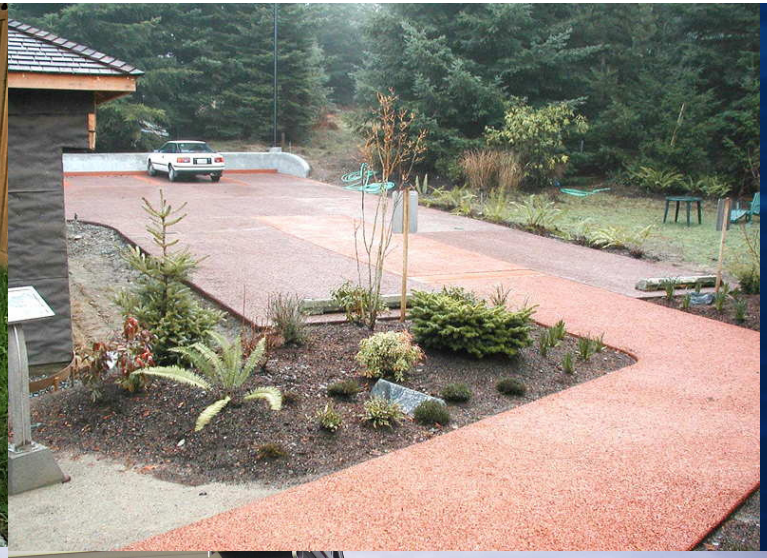
Key Bioretention Resources

- *Rain Garden Handbook for Western WA,* WSU Extension Pierce County, 2007.
- Bioretention soil mix guidelines, 2009
  - Download at: http://www.psp.wa.gov/
- LID Technical Guidance Manual for Puget Sound: http://www.psp.wa.gov/documents.php
- Seattle work: Google “Seattle Natural Drainage Systems”

Current Most Common Practices
3. Pervious Pavement

- Pavement without fines, pavers, open grid systems.
- Includes pervious concrete, pavers, porous asphalt, plastic grid systems.
- If below grade and if no underdrain, good detention credit in stormwater models, and satisfies treatment needs.
- Costs reducing; should continue with increased demand. Need to factor in reduced SW facilities needs.

Photo by Bruce Wulkan

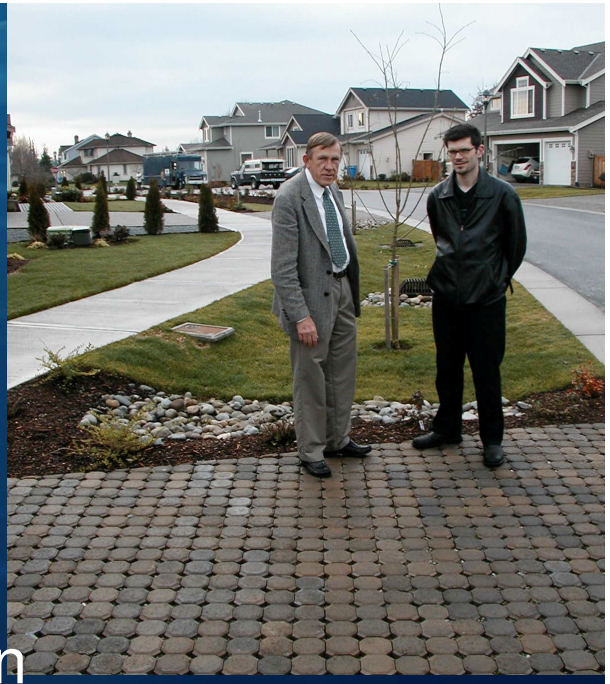


Pervious concrete applications: Sidewalks, Parking lots, bike lanes, residential streets.

Photos by Chris May, Greg McKinnon, Bruce Wulkan, Curtis Hinman

Porous asphalt used in parking lots and city streets.

Photos by Bruce Wulkan, Colleen Mitchell



Pervious pavers used in parking lots and driveways

Photos by Bruce Wulkan, Chris May, Kathy Taylor

Grid systems, such as gravel pave and grass pave.

Photo courtesy Boeing

Resources for Pervious Pavement

- LID Technical Guidance Manual
- Pervious concrete: Andy Marks, Concrete Council, andrew.marks@comcast.net. Also Bruce Chattin, WA Aggregates & Concrete Assoc., bchattin@washingtonconcrete.org
- Porous asphalt: Currently no regional association reps to use as resources. Could contact Dave Bell, Lakeside Industries or John Grisham, Woodworth & Co.
- Pavers and grid systems: Currently no regional association reps. Could contact Dave Parisi, Mutual Materials

4. Dispersion

- Directing runoff into native vegetation
- Full dispersion for entire site: Preserve 65% native vegetation, limit 10% impervious area
  - Flow & treatment standards satisfied
- Full dispersion for portion of site: Sliding scale for vegetation & allowable impervious
- Ways to route roof runoff over amended soils to reduce detention needed.
- Road projects have options too

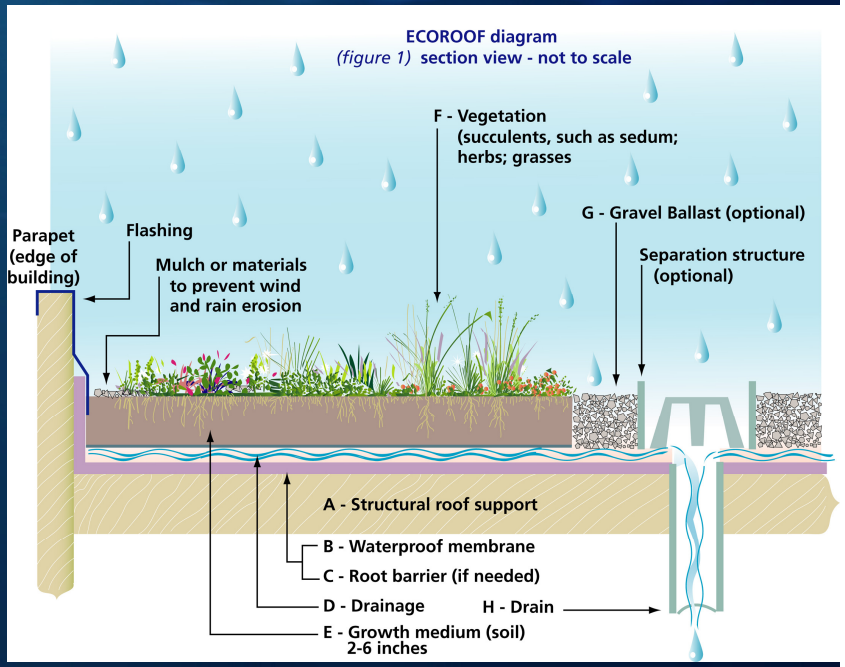
5. Rooftop Rainwater Harvesting

- Long history of use
- 2 purposes: Water conservation & eliminates or reduces roof runoff
- Residential, commercial and industrial uses
- Collected water used for irrigation, toilets, washing machines or potable
- Some sites - only way to match pre-development hydrology
- Necessary for San Juan County, other places
- CH2M 2001 study valuable

Photo courtesy of Tim Pope

6. Vegetated Roofs (or green roofs, or eco-roofs)

- Intensive: 6”+ of soil; often have shrubs or trees
- Extensive: 1-5”; plants adapted to harsh conditions (sedum)
- Common in Germany, Europe
- Waterproof membrane, drain layer, media, plants
- Helps with stormwater, but must factor in other: (Energy, lifespan, recreation, heat island, habitat)
- Flow credit only okay



LID Guidance Manual for Puget Sound

7. Minimal Excavation Foundations

- Driven piles & connector at or above grade
- Piles reach solid soil without need to excavate
- Allows soil layers to remain loose and accept water
- Good flow credit if roof water directed upslope (modeled as pasture)
- However, not very common

Photo by Tom Holz

Flow control credits

- In order to get credits, must follow design guidelines.
- See LID Technical Guidance Manual Chapter 7 or Appendix III-C of Ecology manual for how to represent LID techniques in model.
- Possible to get rid of pond altogether. In many cases, though, pond will just be reduced in size.

Reminder: LID is not enough

- Effective growth management planning
- Watershed scale assessment, protection
- Adequate standards – ’05 Ecology manual or equivalent
- Ongoing maintenance (like conventional)
- Education of landowners, if on private land
- Understand some sites aren’t suitable for infiltration (steep bluffs, very tight soils, high groundwater)
- Other elements of local, comprehensive stormwater program

Current Regional Policy on LID

- LID was introduced to region roughly around 2000.
- At first, encouraged and promoted.
- Now, it will be required where feasible.
- Why? Aug 08: Pollution Control Hearings Board issues final decisions on numerous appeals of municipal NPDES stormwater permits
- Phase I permit must be modified to require non-structural controls, including LID, where feasible.
- http://www.eho.wa.gov/Decisions.aspx#srch. Follow links to “phase I final order”

Current Regional Policy on LID

- Feb 09: Pollution Control Hearings Board issues final decision on phase II permit. Ecology must require actions in permit to prepare phase II permittees for greater LID implementation in future permits.
- Ecology established 2 stakeholder committees to advise.
- Meetings October 2009 – August 2010.
- Ecology proposal on how to add LID requirements to permits: http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LIDstandards.html
- Or google: “LID Standards Process”

Resources to help: Partnership's LID Technical Assistance

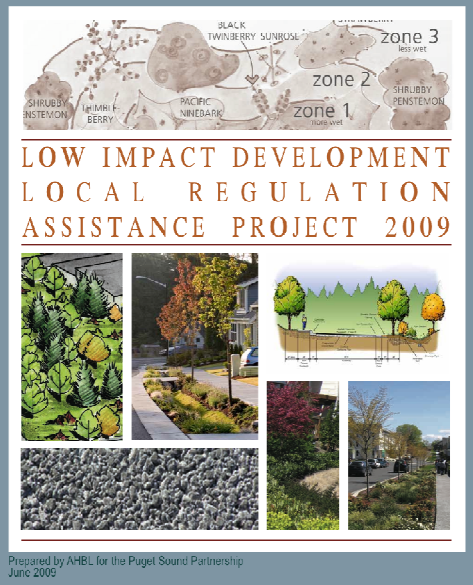
- Professional training: Through WSU Extension Pierce County
  - In '07-09, 1100 attended the LID Technical Class Series
  - 4-part class on all aspects
  - 125 received certification
  - Most complete in nation
- 2009-11, all classes at WSU Puyallup.
- 2011 classes just announced.
- Partnership funding 50% fees.

Photo by Bruce Wulkan

Partnership's LID Technical Assistance

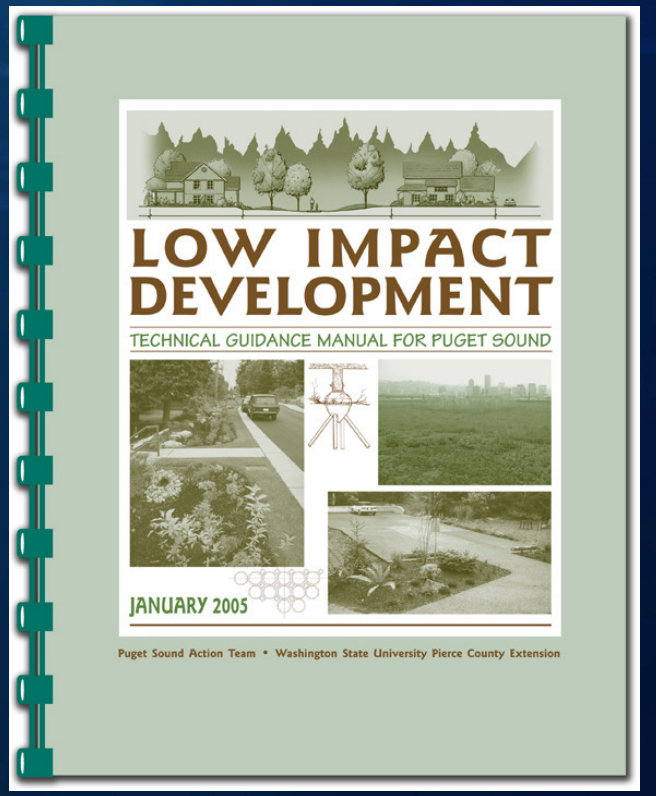
Local Regulation Assistance

- Goal: Increase use of LID by removing local code hurdles.
- Revised & new ordinances, road designs, O&M & cost info, more.
- 2005-09: Helped 36 cities, towns and counties in total.
- Summaries at www.psp.wa.gov.
- July 2011, new "how to" guidebook and model ordinances.



Partnership's LID Technical Assistance

- Technical guidance: New LID guidance manual in July 2011, with WSU Extension & others.
- Includes new flow credits, treatment for LID techniques.
- Education: New LID for homeowners guidebook in July 2011.



Things We're Still Working on…

1. Determining exactly how, & how much, to require LID.
2. Integrating LID into local codes.
3. Ensuring we provide the best technical guidance.
4. Training local staff to review LID project proposals, and inspect during and after construction.
5. Training staff that will maintain LID techniques.
6. Training developers, builders and contractors to design and build LID appropriately.
7. Working to protect native vegetation and limit impervious surfaces while respecting property rights.
8. Understanding effectiveness of LID, and limitations.
9. Sharing information on projects: successes and challenges.