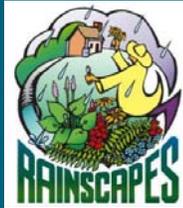


# ESD-LID Fundamentals



Landscape Professionals Training Series

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## TOPICS

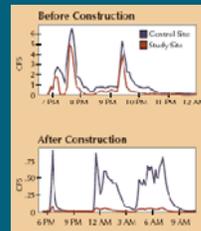


LID approach  
LID Toolbox  
Plant Selection  
Design considerations  
Maintenance

## LOW IMPACT DESIGN (LID)/ ENVIRONMENTAL SITE DESIGN (ESD) = SOURCE CONTROL STORMWATER MANAGEMENT

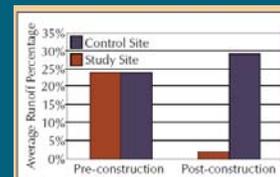
- LID = preserve and restore predevelopment hydrology
- Control Stormwater at the source
- Infiltrate
- Store
- Reuse
- Work with soils and plants to restore hydrology and reduce runoff volume

## LID - MAKING A DIFFERENCE BURNSVILLE MN PAIRED WATERSHED STUDY



**Before:** Measured in cubic feet per second (CFS), runoff volumes from a 2.7-inch rainfall in August 2002 demonstrate the control watershed and the study watershed have similar runoff levels.

**After:** A 1.4-inch rainfall in June 2004 demonstrates the rainwater gardens have reduced runoff by approximately 90 percent.



There is a 93 percent reduction in the overall runoff volume from the study watershed since the rainwater gardens were installed.

Source: [www.burnsville.org](http://www.burnsville.org)

## Site Assessment

- Pay particular attention to off-site drainage crossing property
- seasonal high water table
- Weed seed sources



## ESD/LID SITE EVALUATION

IS WATER LEAVING THE PROPERTY?

IS WATER COMING ONTO THE PROPERTY FROM OTHER PLACES?

**Is there an ESD/LID plan for the property?**

What are the goals of the Maintenance effort?

Definite drainage problem to solve?

Sustainable landscape practices desired?

## What Does ESD/LID Look Like?



How does it function?

- LID Toolbox
- Site Fingerprinting
- Maintain Natural Flow lines
- Rain Gardens and Bioretention
- Permeable Pavement
- Decentralized source controls
- Bioretention
- Landscaped swales
- .....

## ESD/LID takes a treatment train approach



## GUTTER FEEDS RAIN GARDEN/ CONSERVATION PLANTING



## TECHNIQUES: *DOWNSPOUT DIVERSION*



Simple approach may work – redirect  
downspout flow with flexible tubing  
Carefully inspect grading to avoid basement  
seepage and lot to lot drainage problems

More engineered (and costlier) solutions:  
Dry wells  
French drains

## TECHNIQUES:

### *SOIL RECONDITIONING AND AMENDMENTS-*

- Mass grading during construction leaves little or no top-soil and compacted yards
- Intensive turf-grass culture can lead to highly compacted soils
- Test: Soil nutrients, organic content and compaction
- **Add: Organic material and aeration**
- Restore soil health, function, and infiltration
- Initial focus on research and background
- Core samples can reveal if it's a clay 'lens'

*state level effort to have compost amended soils admitted as a SWM BMP*

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## SUSTAINABLE PLANTING AND MAINTENANCE STRATEGIES AND PRACTICES

- Manual weeding in Bioretention and Rain Gardens
- Plant for Multiple values
- Provide space for mature sizes
- Mulching for conservation
- Preparing the soil now, saves energy and water later
- Incorporating many types of ecological service functions into the master planting design/ site plan





## Technique: *Conservation Landscaping/ Bayscapes*

- Regionally Native Species
- Removal of Turf Grass – Less Maintenance
- Seasonal Interest – Successive Bloom
- Improved Stormwater Infiltration
- Reduce Pollutant Loads
- Habitat Diversity
- Many Sources of Info
- Many Related Ecosystem Benefits
  - Air Quality, Energy, Pollinators, Biodiversity



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## PESTICIDES/ HERBICIDES



- Homeowners use 10X more per acre than farmers
- 67 million lbs applied on lawns each year
- 2/3 users dispose of excess in trash, remainder down drains
- Detectable limits found in 5-10% of wells



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## NATIVE/ NATURALIZED CONSERVATION LANDSCAPING



- <http://www.fws.gov/ChesapeakeBay/Bayscapes.htm>

### Evaluation

- Evaluate soil drainage
- Determine where the water is coming from and where it is headed
- Note:
  - Slope
  - Exposure
  - Land cover quality
  - Points of erosion
  - Opportunities to slow the flow

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Slope for conservation landscape conversion prepped, compost blanket applied, plants laid out



## Conservation Landscape on a slope - reducing runoff



Purple coneflower 'Magnus'

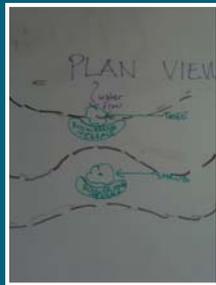


Pink Muhly Grass & Purple coneflower



Switchgrass 'Heavy Metal', Orange coneflower, Cardinal Flower

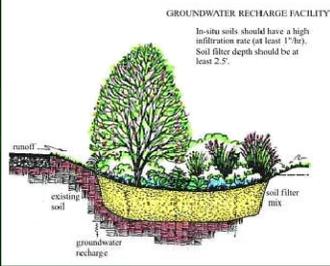
## What if you want to slow the flow without removing or regrading the whole slope?



Contour gardening directing the rain barrel overflow to the planted areas



# Technique: *Rain Gardens*



**GROUNDWATER RECHARGE FACILITY**  
In-situ soils should have a high infiltration rate (at least 1"/hr). Soil filter depth should be at least 2.5'.



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## Rain Gardens = special form of conservation landscape

- Requires perc test
- Saucer shaped garden designed to have temporary ponding.
- May require a soil exchange
- Sized to treat a minimum of the 1.5" rainstorm but the goal is to treat the 2.7" rainstorm volume from impervious surface contributing to rain garden (1 year storm)



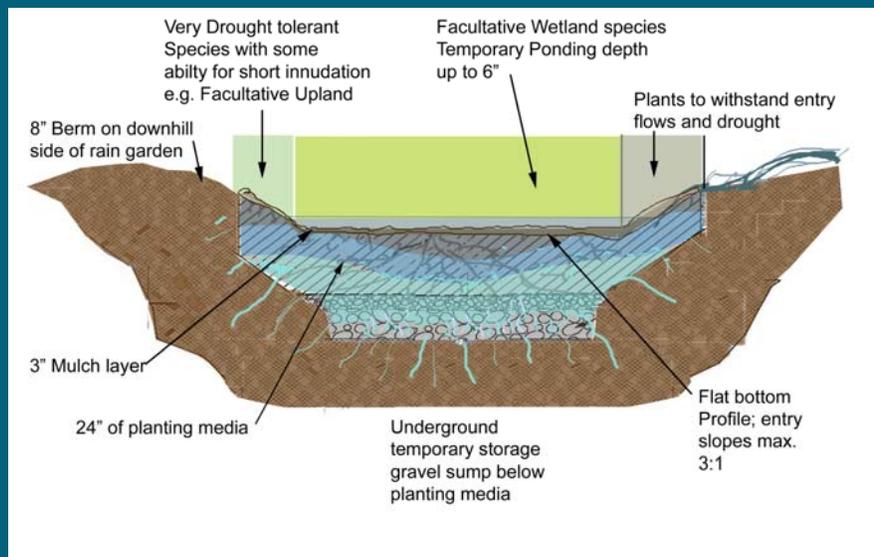
## Rain Gardens = small distributed approach to runoff management

- Sized to catch a specified amount of water (maximum of 10,000 sf drainage area)
- Designed to remove pollutants
- Stormwater management at the site level
- Stormwater as a site amenity in its own right

[EPA's fact sheet](#) on bioretention shows the following removal rates:

- Total Phosphorous: 70%-83%
- Metals (Copper, Zinc, Lead): 93%-98%
- Total Kjeldahl Nitrogen (TKN): 68%-80%
- Total Suspended Solids: 90%
- Organics: 90%
- Bacteria: 90%

## RAIN GARDEN SECTION





Soil replacement rain garden

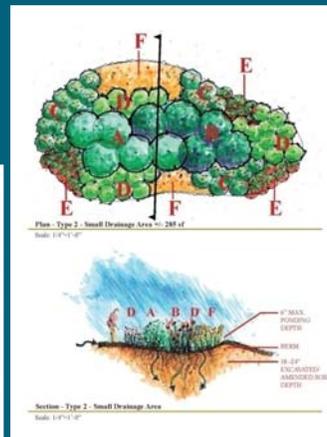


Non-underdrained rain garden



Underdrained rain garden – also called micro-bioretentation

## Rain Gardens - planting



## EVALUATION: PARTS MAINTENANCE

Overflow design – to rock  
it or not?



Private retrofit – Spring green up  
Check inlets



Rain Garden Spring ; overflow turf is  
in good shape

Head upstream to look for places to reduce the flow



Troubleshooting installations



## BIORETENTION



Construction  
Maintenance  
Renovation



Protect the media  
during construction



Seasonal debris



Logistics with Roadway  
retrofits – where do the  
workers go?

## ROADWAY LID BIORETENTION AND RAIN GARDEN RETROFITS



Seasonal debris – sand, leaves, acorns, trash - can clog a system

## MAKE SURE THE SYSTEM IS NOT BYPASSING THE PARTS OR BEING OVERWHELMED BY UPSTREAM FLOW





## KENSINGTON LIBRARY BIORETENTION

- Simple shapes
- Dry well
- Armored slopes for heavy flows

## EVALUATION: CHECKING FOR CLOGS

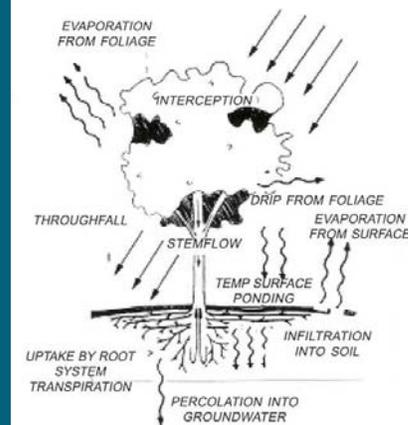


Prolonged saturation can collapse bioretention soil and require replacement or other extreme measures

## TECHNIQUES: *URBAN TREE CANOPY*



- Some research has shown every 5% increase in urban tree canopy can produce as much as a 2% runoff reduction
- Multiple benefits in water quality, air quality, urban heat island effects, and property values.
- As a starting point, take care of the trees you already have!



## URBAN TREES Site and Tree Evaluation

- Remove straps from the tree after the first growing season
- Fertilize if required with slow release tree fertilizer
- Mulch properly –no volcanoes



## Pavement Removal

- Remove pavement,
- Decompact soil
- Add compost



- Replant area with turf, native plants or a native tree
- Places to reduce pavement:
  - Patios
  - Driveways
  - Walkways
  - Courtyards

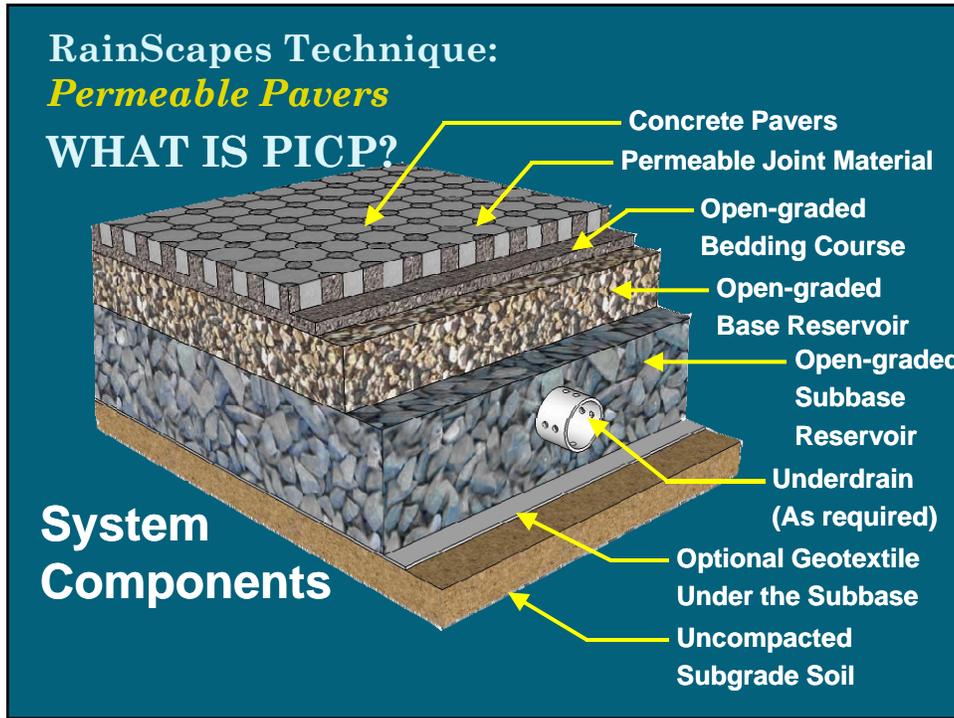


## Pavement Removal

### Evaluation:

- 
- Evaluate:
  - Slope
  - Exposure
  - Soil compaction
- Determine the best surface replacement material
- Do not leave exposed soil; ensure cover after 7-10 days
- Stabilize all slopes promptly





## Water Quality Results

- Oils: below lab detection limits
- Lead & zinc significantly lower than asphalt runoff
- Deicing salts
  - Requires less than asphalt
  - Highly mobile regardless of pavement
  - Maintain sufficient separation between PICP bottom & water table

Performance Evaluation of Permeable Pavement and a Bioretention Swale  
 Seneca College, King City, Ontario

Prepared by Toronto and Region Conservation Authority      May 2007  
 Waters Report #2

● [www.trca.on.ca](http://www.trca.on.ca)

## PERMEABLE PAVER RETROFITS Evaluation

Evaluate slope (< 5%)  
Check for foundation clearance  
Perform percolation test

Keep surfaces clean  
Replenish aggregate (washed #8/9)  
seasonally as needed  
Check for clogs

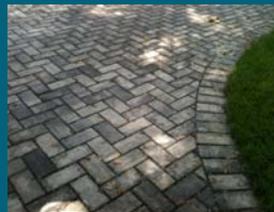
**Installation to be done to  
icpi.org standards**



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## PERMEABLE PAVEMENTS

- Check for debris seasonally
- Make sure that the edges drain towards the pavement
- Don't blow clippings onto the pavement
- Vacuum or pressure wash annually



## GREEN ROOFS

### Evaluation



- Do a media test
- Prolonged sogginess can collapse the green roof media
- Do shade analysis if plants are not thriving
- Weed out woody volunteers promptly
- Protect the roof membrane; no shovels

## GREEN ROOFS



- Recommend to Provide maintenance agreement with installation
- Monthly weeding the first year is typical



## Water Harvesting – Cisterns & Rain Barrels



Must manage for mosquitoes

Will be part of the permitted SWM plans of new developments

Needs to be unhooked in the winter

Needs safe place for overflow

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## CISTERNS

### EVALUATION

- Foundation area - level
- Size of cistern appropriate?
  - Design storm
- Drainage area
- Grade around the barrel location
- Overflow area?

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## RAIN BARREL USE, CARE & INSPECTION

- Drip Irrigation, Indoor and Outdoor Plants, Water Gardens
  - What about edible gardens?
- Tandem Barrels
- Empty Barrel on Regular Basis
- Be sure to direct water to a naturalized or permeable surface
- Check Fittings, Hoses
- Mosquito Patrol—Gutters!



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## DRY WELLS



Conform to DPS standards

For RainScapes Must be voluntary

<http://permittingservices.montgomerycountymd.gov/permittingservices/pdf/ControlOfWaterRunoffOnSmallLots.pdf> )

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## DRY WELLS – SITE EVALUATION



- Depth to groundwater
- Distance from foundation
- Perc. rate
- Types – downspout flow recipient or driveway runoff recipient
- Place to overflow

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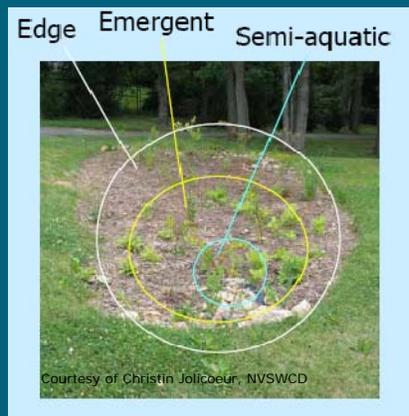
## PLANTS PLANTS PLANTS ...KNOW WHERE THEY SHOULD GO

- Evaluation of plants in bioretention
- Is it a plant problem or a design problem?
- Special situations
  - Roadside/ parking lots
  - Schools
  - Lowest maintenance ever



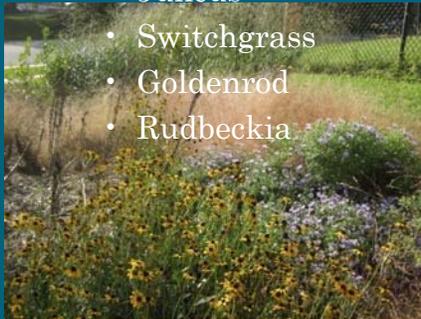
## PLANNING FOR RESTORATION CHOOSE PLANTS WISELY CHARACTER AND PLACEMENT

- Consider why this facility needs replanting
- Plant selection issue?
- Layout not maintainable?
- Mulch gone?
- Microclimates? - Site specificity
  - Border (edge)
  - Slope (emergent)
  - Center (semi-aquatic)



## SALT TOLERANCE

- Waxmyrtle
- Yaupon holly
- Spartina
- Juncus
- Switchgrass
- Goldenrod
- Rudbeckia



## MASSES OF PLANTS LIMITED DIVERSITY SPACE BETWEEN MASSES TO MOVE



Aspen Hill Library, 2 weeks after planting

## DESIGN GARDENS FOR MAINTENANCE EASE

- Easy access to and around the garden
- Flow should enter the garden as sheet flow or should be slowed down prior to entry if coming in via a swale
- Deeply rooted vegetation that is adapted to the conditions



Edge Maintenance- should be manual



Slowing the flow before entry

## ISSUE: WEEDING –



covered more in  
depth in  
Montgomery  
College Course

Arora  
Hills HOA  
– 1<sup>st</sup>  
Inspection

## New crops for a growing market

- Growing Plants for Stormwater Management and Watershed Restoration
- New aesthetic possibilities with Native plants





Rain Gardens and other LID techniques can enhance property values

## Summary: RainScapes add stormwater management to a site beautifully

- Rain Gardens
- Conservation Landscapes
- Cisterns
- Tree Canopy
- Rain Barrels
- Green Roofs
  - Helps to Achieve Total Maximum Daily Loads (TMDLs)
  - TMDLs set pollutant reduction goals
  - Bacteria, sediment, nutrients, with trash under development
  - Reduces pollution
  - Increase use of Environmental Site Design (ESD) to the maximum extent practicable (MEP)
  - Assure public input and stewardship opportunities



*Inspection and Maintenance are key factors in success*

- Water ponding for more than 24 hours may indicate a problem
- Erosion usually occurs where flow is concentrating
- Check soil pH every few years to ensure that soil media is not too acidic
- Inspect plant health and aerate as needed
- Mulch by hand 1 or 2X/year (remove old mulch)

## How do RainScapes Projects and Permitted ESD/LID projects differ?

	Rainscapes Projects 	Permitted (DPS) SWM projects
<b>Program</b>	Rebate program for installing voluntary practices	Part of Stormwater Plan for building construction
<b>Design</b>	Countywide - Projects required for permit approval are not eligible (e.g. DPS Stormwater); Design for 1-2.7" of water quantity control	Designed for ESD water quality and quantity control per MDE- Chapter 5
<b>Project Types</b>	9 types of projects qualify for rebates; other types are encouraged but not rebate eligible	Includes large scale projects (ponds) and ESD/LID (rain gardens)

Questions?



- [www.rainscapes.org](http://www.rainscapes.org)
- [rainscapes@montgomerycountymd.gov](mailto:rainscapes@montgomerycountymd.gov)
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