Low Impact Development Practices

Michael Dietz, Ph.D.
CT Nonpoint Education for Municipal Officials (NEMO)
Center for Land Use Education and Research

May 8, 2013

Town of Bolton Planning and Zoning Commission

CLEAR

University of Connecticut
Cooperative Extension System
College of Agriculture and Natural Resources

Center for Land Use Education and Research

CLEAR's Mission:
To provide information, education and assistance to land use decision makers in support of balancing growth and natural resource protection.

University of Connecticut
- College of Agriculture, Dept. of Extension
- College of Agriculture, Dept. of Natural Resources & the Environment
- Connecticut Sea Grant

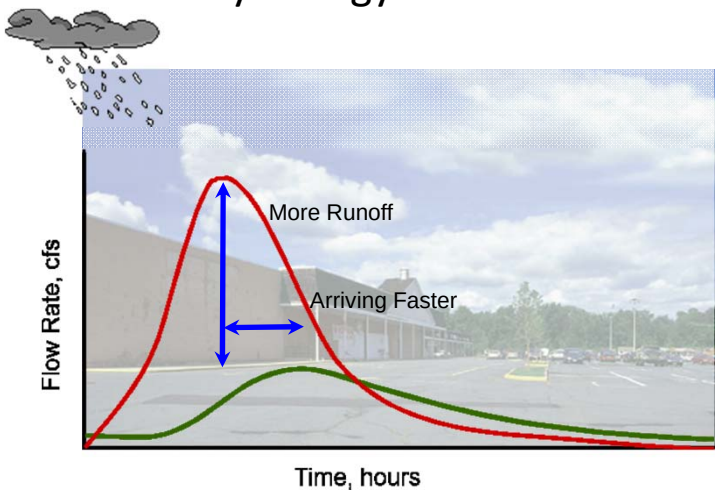
- Connecticut NEMO
- National NEMO Network
- Geospatial Training Program
- Land Use Academy
- Extension Forestry Program
- Lab for Earth Resource Information Systems

http://clear.uconn.edu


The "Old Era" of Water Pollution
Point Source Pollution

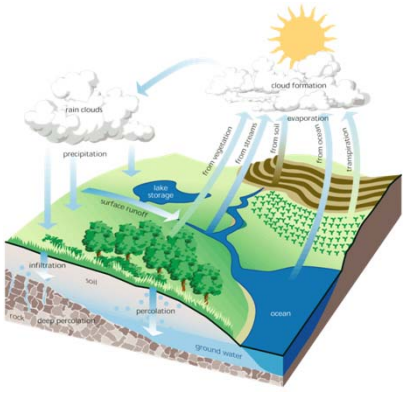

Nonpoint Source Pollution
Polluted Runoff is the #1 Water Quality Problem in the U.S.*
* USEPA

Why stormwater matters: hydrology



Low Impact Development (LID) Site Planning and Design Concepts

- The Goal: To preserve pre-development hydrology
  - Runoff volume and rate
  - Groundwater recharge
  - Stream baseflow
  - Runoff water quality



Low Impact Development Practices

- Permeable paving systems

Pervious asphalt at CT State Capitol

Pervious concrete at CT State Capitol

Pre-cast pervious concrete

- "Stormcrete" from Porous Technologies (Yarmouth, ME)

Residential Rain Gardens

Waterford, CT

Maryland

Photo courtesy of
Steve Trinkaus

Alternate cul-de-sac

Ponding area

- Ponding is OK, but should be gone within 3-4 hours

Siting a rain garden

Rain garden placement

- Must be at least 10 feet from foundation with basement or where top of foundation is below ponding level (25 feet away recommended for bioretention)
- Avoid placing within 15ft of septic system or 25 ft to private drinking well
- Site to most effectively catch storm runoff
- Consider overflow

Important site considerations for rain gardens

- Avoid areas with:
  - Shallow (<3 feet) depth to bedrock
  - Seasonal high water table (<2ft from bottom)
  - Chronically wet soils (a rain garden is not a wetland!)
- Be aware of the infiltration capacity of native soils
- Watch for steep slopes

Overflow

- For rain gardens, typically adjacent turf or wooded area
  - Avoid concentrating flow-spread it out to reduce erosion potential

Soils

Percolation test:

Steps:

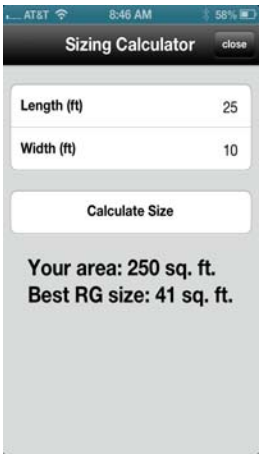
1. Dig a hole 12 inches deep by 6 inches in diameter.
2. Fill hole with water and let stand until all the water has drained into the ground.
3. Refill the empty hole with water again. Measure the depth of water with a ruler.
4. Check the depth of water with a ruler every hour for 4 hours.
5. Calculate how many inches of water drained per hour.

1 to 2 inches of water draining per hour is ideal

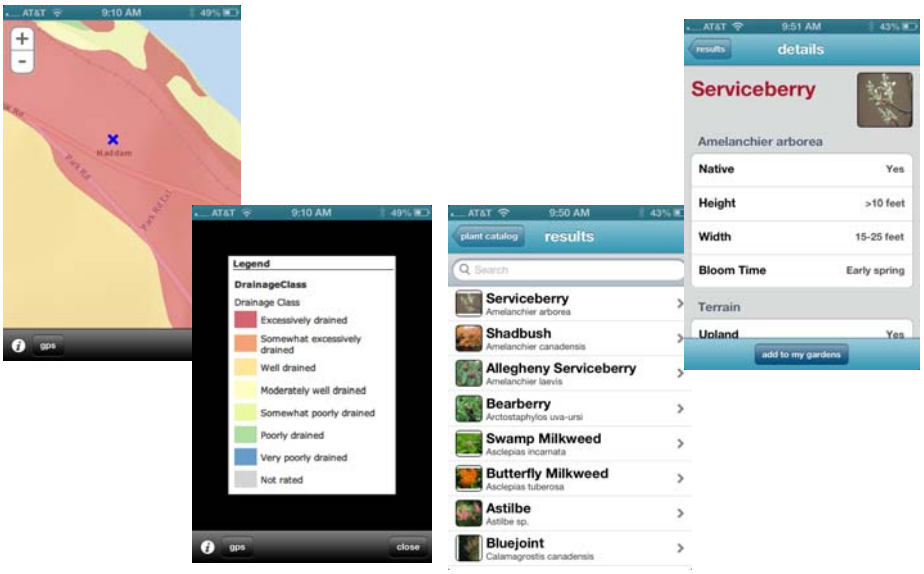
Soils

- Send sample to county Extension Office for sand/silt/clay and/or nutrient analysis
- **Sandy or loamy soils best, but others can be used with amendments**

Smartphone app!



Rain garden app



Important factors with rain gardens

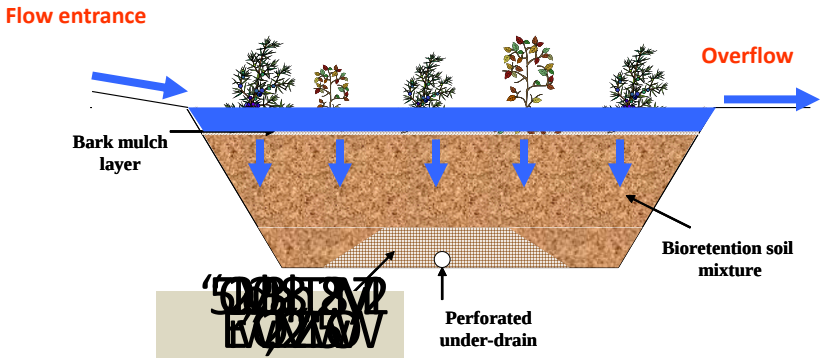
- SOIL COMPACTION before, during construction

Soil Amendments

- For compaction, loosen up and remove some of the compacted soil, and replace with bioretention media
  - For new residential construction, assume this is the case!
- For clay soils:
  - Make garden larger, and amend with compost
  - Excavate and install bioretention media & underdrain

Bioretention specifics

Bioretention profile



Bioretention soil mix

- PGC Bioretention Manual defines bioretention soil mix as follows:
  - Coarse sand: 50-60%
  - Leaf compost: 20-30%
  - Topsoil (<5% clay): 20-30%

Custom bioretention blends available

- Read Custom Soils
  - www.readcustomsoils.com
  - 4:3:2 blend of Sand:topsoil:compost
  - Classified as loamy sand
    - 87% sand, 8 % silt, 5% clay
    - 2.5% organic matter
- Agresource
  - http://www.agresourceinc.com/
  - Rich Simcich – 800-313-3320
- Grillo Organic in Milford, CT
  - http://grilloservices.com/
  - 50% sharp sand, 25% compost, 25% topsoil (<5% clay)
  - 203-877-5070

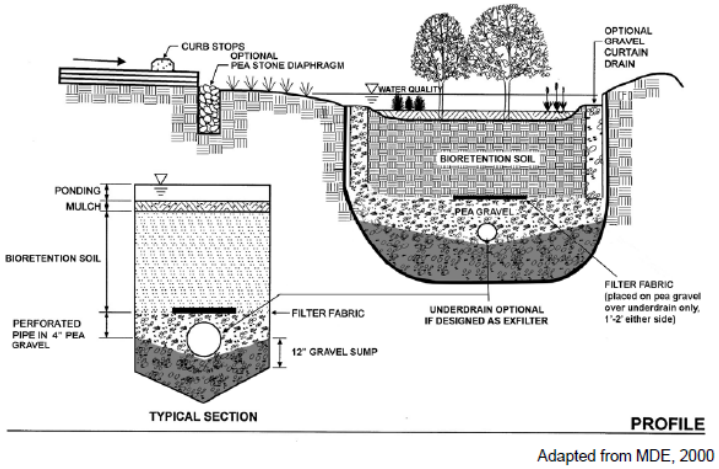
Underdrains

- Purpose is to reduce potential for extensive surface ponding
- Highly recommended for commercial/urban bioretention
- Slotted (ADS) or perforated (PVC) pipe at bottom or just above bottom of bioretention, surrounded by crushed stone

N2

Underdrains

- Drain to grade (best) or stormwater system (OK)
- Engineering specs available



Adapted from MDE, 2000

From RI Stormwater Manual (2010)

Slide 34

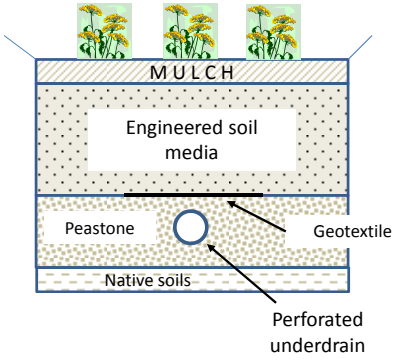
N2 bioret

Nemostudent, 3/17/2011

Underdrains

Filter fabric…

- Only if specified, placed above underdrain
  - Usually not needed for residential sites
  - Don't line bioretention, don't wrap underdrain pipe
  - Non-woven geotextile



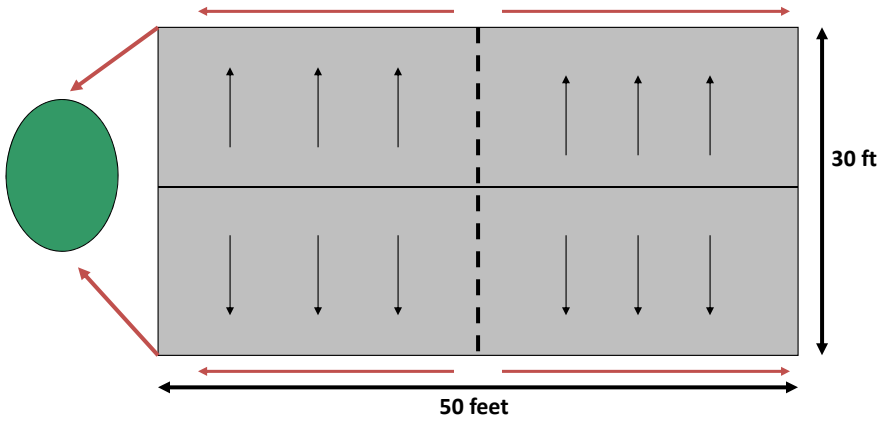
Sizing Your Rain Garden

How Big Should it Be?

- Simple method
  - Sized to store 1 inch of runoff from 100% impervious watersheds
- Runoff coefficient method
  - From PGC Bioretention manual, CT DEP Stormwater Quality Manual (2005)

Simple Sizing

- Calculate area of roof feeding to garden

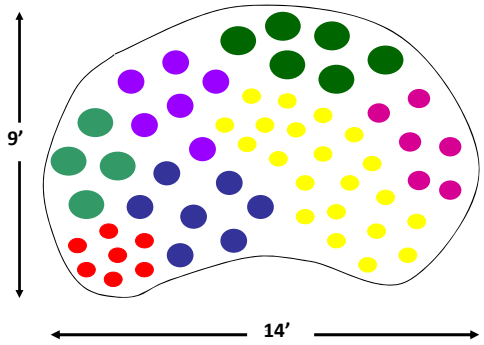


Simple Sizing, continued

- 50 feet x 30 feet = 1500 square feet
- 1500 feet / 2 = 750 square feet
  - This is because only half the roof contributes to the garden
- 750 square feet / 6 = **125 square feet**
  - This just sizes the garden to hold 1 inch of water from the roof in a 6 inch deep rain garden

Sizing, continued

- 125 square feet
  - Garden can be shaped in a variety of ways



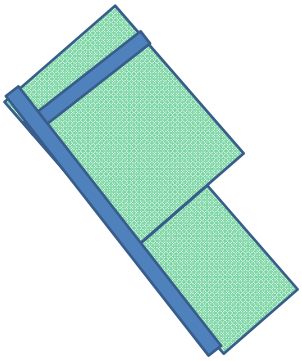
For Mixed-Use Drainage Areas

- Based on "Water Quality Volume"
  - 1 inch
- Use equation $WQ_v = [(P)(R_v)(A) / 12]$
  - P= 1.0 inch
  - $R_v = 0.05 + 0.009(I)$
  - I=Percent impervious (1-100)
  - A=Total watershed area (square feet)

From Bioretention Manual (Prince George's County, 2009)

Rain garden with mixed-use drainage area

Measurements



- Large rectangle
  - 108’ x 68’ = 7,344 ft^2
- Small rectangle
  - 41’ x 80’ = 3,280 ft^2
- Total area = **10,624 ft^2**
- Sidewalks
  - 10’x175’ & 8’x75’ = 2,350 ft

Calculate WQv

- WQ_v = [(P)(R_v)(A) / 12]
  - P= 1.0 inch
  - R_v= 0.05 + 0.009(22) = 0.248
  - A=10,624

  = [(1)(0.248)(10,624)/12]= **220 ft^3**

  For 6" deep garden, double it = **440 ft^2**

Installation sequence

Installation

- Call hotline to locate underground utilities (at least 3 days in advance) **1 – 800 – DIG - SAFE**
- Mark area to be dug
- Plan for labor
  - Smaller gardens can be dug by hand or equipment can be rented for larger gardens

Mark out & plan for flow

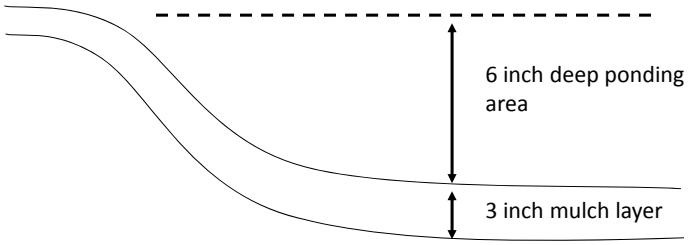
Remove turf

- Can be saved for berm

Remove soil

- Foot traffic only – this is really important
- Plan where to put it!

Depth



****May need to add compost if soils aren't great *****

Berm if necessary

Plants

- Native or well-adapted non-natives
- Plants that like wet feet, but can tolerate extended dry periods
- NOT wetland plants!
- Can use different plantings for different parts of rain garden

Install plants

Mulch

- Best is aged, shredded hardwood bark mulch
  - About 2-3 inches in depth
- NOT pine bark nuggets!
  - They float

Construct flow entrance

Worcester Youth Center site before:

De-paving

Excavate

Add underdrain

Filled with bioretention mix

50% coarse sand

25% leaf compost

25% topsoil

Complete!

A well-installed rain garden…

- Has open flow paths, overflow and an adequately sized storage area
- Has proper materials installed
- Has NON-COMPACTED soils!
- Is only used after the surrounding site is stabilized
- Has proper plantings/ground cover
- Has a provision for short term care (watering)

Maintenance

- Short term
  - Water plants until they get established
  - Remove any invasives
- Long term
  - Trim plants as desired
  - Remove invasives
  - Remulch as needed
  - **Maintain flow paths and storage**

Resources

- NEMO/CFE Rain Garden page
  http://nemo.uconn.edu/raingardens
- Webinars
  http://clear.uconn.edu/webinars/CLEARseries
- LID Inventory
  http://nemonet.uconn.edu