Low Impact Landscaping for Homeowners

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Mirror Lake Protective Association
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Low Impact Landscaping

- LID Overview
- Raingardens / Bioretention Cells
- Vegetated Buffers
- Other Techniques
- Benefits of LID: Nashoba Brook Watershed Case Study
Lesson #1: It’s Water...Not Trash.

A pile of water.  A pile of trash.
Criminal detention center

School detention

Detention basin
LID Development

Disconnected  
Decentralized  
Distributed

Conservation  
Minimization  
Soil Amendments  
Open Drainage  
Infiltration BMPs  
Vegetative BMPs  
Rain Barrels  
Pollution Prevention

Multiple Systems
Lesson #2: Impervious surfaces...

Latin Root:

Im – per – via

Not – through – way

“Not allowing passage into or through something.”
Lesson #2: Impervious surfaces...
...lead to stormwater problems.

- higher peak flows
- reduced base flows
- higher pollutant loads
Mirror Lake Watershed – Impervious Cover

Watershed Area: 1460 acres
Impervious Area: 45 acres
Impervious Percentage: 3%
Land Use Analysis

- Forest
- Open
- Pasture
- Recreation
- Residential
- Road
- Spray Field
- Water
- Wetland
PHOSPHORUS LOADING BUDGET

• Stormwater Runoff (Land Uses)
• Septic Systems
• Aerial Deposition
• Internal Loading
MIRROR LAKE WATER QUALITY GOAL

Current Conditions: Current P concentration is 8.66 μg/L, which is slightly above the goal of 8.50 μg/L. Current conditions show an increase of 7.5 lbs of P.

Future Conditions: The projected P concentration for 2030 is 9.50 μg/L, an increase of 34 lbs of P.

Goal: The water quality goal is 8.50 μg/L.
• Mirror Lake is **Lower Mesotrophic** (very good)…but it will take hard work to keep it that way:
  - Stormwater Improvements
  - Land conservation
  - Wise development (zoning, ordinances, etc.)

• Small improvements on many sites will add up!
STORMWATER DISCHARGES FROM VARIOUS LAND COVERS

- Urban
- Agricultural
- Agricultural-Forest
- Forest

Discharge vs Time
Typical Annual Water Budget

Forested Land Cover

37.4% Evaporation-Transpiration

Interflow 25.7%

Groundwater 36.6%

Surface

0.3% Runoff
Typical Annual Water Budget

Urbanized Land Cover

- 25% Evaporation-Transpiration
- 30% Surface Runoff
- 30% Interflow
- 15% Groundwater
Low Impact Development (LID)

An ecosystem-based approach to land development and stormwater management

Goal: Mimic pre-development site hydrology
LID Stormwater Controls
Rain Garden Treatment Train Approach

- Raingarden Cell
- Flow Path
- Grass Swale
- Grass Filter Strip
- Storm Drain System
Low Impact Development Stormwater Controls

- Bioretention
- Raingardens/barrels
- Porous surfaces
- Bioretention
Raingardens

A bowl-shaped garden designed to capture and absorb stormwater.
Bioretention Cell

Similar to raingarden, more highly engineered:

- underdrain/riser pipe
- gravel bed
- engineered soils
Street Edge Alternatives (SEA)

Functional Landscape

Reduced Impervious Area

98% Stormwater volume reduction for 2-year storm
“SEA” Street: Maximized space for filtration, recharge and landscape elements
How to Build a Raingarden!

I concreted over the garden, then realized I had nowhere to plant my flowers.
The Vermont Raingarden Manual

http://nsgl.gso.uri.edu/lcsg/lcsgh09001.pdf
Choosing a Raingarden Location

- For roof runoff, garden should be 10 feet from house to prevent basement seepage
- Select a flat area if possible for easier installation
- Call Dig Safe (1-888-DIG-SAFE) 3 days before digging
Choosing a Raingarden Location

- Do not place within wetlands or naturally wet areas
- Avoid disturbing tree roots
- Do not place over a septic tank, leach field or drinking water well
Step 1: Calculate Drainage Area

\[(\text{Length}) \times (\text{Width}) = \text{Drainage Area ft}^2\]

Estimate drainage area from:
- Roof
- Lawn
- Road
- Other (forested, etc.)

This can be tricky! May require observation during rain.
Step 2: Evaluate Soil

**PIT TEST**

- Dig hole 6” deep, fill with water
- Choose new site if water is still standing after 24 hrs
Step 2: Evaluate Soil

IDENTIFY SOIL TYPE

1. Roll handful of moist soil into ball

2. Work soil upwards between thumb and forefinger to form ¼” ribbon of uniform thickness/width

3. Repeat motion until ribbon breaks under its own weight

4. Measure to determine if sand, silt or clay

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>SAND</td>
<td>Soil does not form a ribbon</td>
</tr>
<tr>
<td>SILT</td>
<td>Weak ribbon &lt; 1.5” (before breaking)</td>
</tr>
<tr>
<td>CLAY</td>
<td>Ribbon &gt; 1.5”</td>
</tr>
</tbody>
</table>
Step 3: Calculate Slope

1. Stake uphill and downhill ends of raingarden
2. Level a string between stakes
3. Measure string length and height of string at downhill stake (inches)
4. \((\text{Height} / \text{Length}) \times 100 = \text{Slope}\)
5. Use table for rain garden depth

<table>
<thead>
<tr>
<th>Slope</th>
<th>Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 4%</td>
<td>3-5 in</td>
</tr>
<tr>
<td>5-7%</td>
<td>6-7 in</td>
</tr>
<tr>
<td>8-12%</td>
<td>8 in+</td>
</tr>
</tbody>
</table>
Step 4: Raingarden Sizing

Size Factor \times \text{Drainage Area} = \text{Rain Garden Area}

1. Use table to determine size factor
2. Multiply size factor by drainage area = recommended rain garden size
Step 5: Raingarden Design

1. Any shape, but **must** have level bed

2. Water Entrance
   - Stabilize entry point(s) with stone
   - Direct water to raingarden with:
     - downspout extensions
     - grass /rock-lined swale
     - piping

3. Select Plantings
Shrubs

Red Osier Dogwood      Silky Dogwood      Rugosa Rose      Virginia Rose
Bayberry              Inkberry            Black Chokeberry
Shrubs

Sweet pepperbush  Winterberry holly  Sheep laurel

Highbush blueberry  Mountain laurel  Maple-leaf viburnum
Shrubs

- Meadowsweet
- Northern Arrowood
- Pussy Willow
- Serviceberry
- Highbush Blueberry
Perennial Flowers

- Coneflower
- Black-eyed Susan
- Purple Joe-Pye Weed
- Marsh Blazing Star
- Daisies
- Helenium/Sneezeweed
- Daylilies
Perennial Flowers

New England Aster
White Turtlehead
Boneset

Blue Flag Iris
Cardinal Flower
Wild Bergamot
Foamflower
Groundcovers

Bearberry
Partridgeberry

Virginia Creeper
Lowbush blueberry
Ferns

Cinnamon fern

Royal fern

Christmas fern
Grasses / Sedges

Canada Bluejoint or Reedgrass

Pennsylvania sedge

Narrow-leaved cat-tail
An Easy Daylily Garden Layout

1. Hearts Alive Daylily
   (Hemerocallis 'Hearts Alive')
   Height: 20 inches
   Space: 24 inches
   Bloom: June - July

2. Happy Returns Daylily
   (Hemerocallis 'Happy Returns')
   Height: 18 inches
   Space: 12 inches
   Bloom: June to Frost

3. Orange Sunflower
   (Helianthus helenioides)
   Height: 2-5 feet
   Space: 30 inches
   Bloom: All Summer

4. Catherine Woodbury Daylily
   (Hemerocallis 'Catherine Woodbury')
   Height: 33 inches
   Space: 24 inches
   Bloom: June - August

5. Autumn Joy Sedum
   (Sedum X 'Autumn Joy')
   Height: 16-24 inches
   Space: 18 inches
   Bloom: Late Summer to Frost

6. Gentle Shepherd Daylily
   (Hemerocallis 'Gentle Shepherd')
   Height: 28 inches
   Space: 24 inches
   Bloom: June - July

7. Wands Milkweed
   (Asclepias incarnata)
   Height: 2-3 feet
   Space: 1 foot
   Bloom: June through August

8. New England Aster
   (Aster novae-angliae)
   Height: 4-5 feet
   Space: 2 feet
   Bloom: Midsummer to Frost
1. Compact American Cranberrybush (Viburnum trilobum 'Staley Compact')
   - Height: 4-5 ft
   - Space: 4 ft
   - Blooms: White flowers in spring, deep red fall foliage, red berries into winter, twigs: white

2. Annabelle Hydrangea (Hydrangea arborescens 'Annabelle')
   - Height: 4-5 ft
   - Space: 4 ft
   - Blooms: White flowers, June through July

3. Stella de Oro Daylily (Hemerocallis 'Stella de Oro')
   - Height: 18 inches
   - Space: 12 inches
   - Blooms: May to frost

4. Anthony Waterer Spiraea (Spiraea x bumalda 'Anthony Waterer')
   - Height: 3 ft
   - Space: 3 ft
   - Blooms: Rose-pink flowers, Red leaves in fall

5. Marsh Milkweed (Asclepias incarnata)
   - Height: 2-3 ft
   - Space: 1 ft
   - Blooms: June through August
The Shady Garden Layout

1. Wild Geranium (Geranium maculatum)
   - Height: 1-2 feet
   - Space: 1 foot
   - Blooms: May - June

2. August Lily Hosta (Hosta plantaginea)
   - Height: 18 inches
   - Space: 1 foot
   - Blooms: July - August

3. Golden-Edged Hosta (Hosta fortunei)
   - Height: 1-2 feet
   - Space: 1 foot
   - Blooms: July - August

4. Pink Astilbe (Astilbe amabilis 'Strapneck')
   - Height: 2 feet
   - Space: 2 feet
   - Blooms: June - July

5. Great Blue Lobelia (Lobelia siphilitica)
   - Height: 2 feet
   - Space: 1 foot
   - Blooms: August - September

6. Culver's Root (Veronicastrum virginicum)
   - Height: 3-4 feet
   - Space: 3 feet
   - Blooms: July - August

7. Ostrich Fern (Osmunda regalis)
   - Height: 3 feet
   - Space: 2 feet
   - Blooms: Cool green fronds all summer

8. Lady's Mantle (Achillea Millefolium)
   - Height: 12-18 inches
   - Space: 12 inches
   - Blooms: May - June

9. Stella de Oro Daylily (Hemerocallis 'Stella de Oro')
   - Height: 18 inches
   - Space: 13 inches
   - Blooms: May to Frost
Step 6: Installation

1. Define Borders (string, spray paint)
2. Remove Grass
3. Dig / Level the bed
Step 6: Installation

- When building a raingarden on a slope, create a berm to hold water.

- Level the bed and use the dirt removed to create the berm.
Soils specifications (for bioretention):

Underlying soils should drain >0.25 inches/hr
  - >6 inches soil over 24 hrs

Bioretention soil:
  - 75% sand (ASTM c-33 concrete sand), 25% organic matter (compost)
    Or...
  - 50% sand, 30% topsoil (loam), 20% organic matter
  - Underdrains may be required
Infiltration rate = 5 inches/hour
Figure 3: Level bed with sloping edges. This design requires more space. Only plants that can thrive in drier soil conditions can be planted on the upper slope of this type of raingarden; true rain garden plants will not thrive here.

Figure 4: Level bed without sloping edges. Ideal design for tight spaces.
Step 6: Installation

4. Improve the soil ("Soil Amendment")
   • Till 2-4” compost into native soil

5. Plant (shrubs on approx. 3’ centers)
   • Water immediately

6. Mulch (2”-3”)

Raingardens
Step 7: Maintenance

1. Water new plants regularly until roots are established
2. Weed / replace failed plantings
3. Refresh mulch as needed
Lake Shirley Bioretention Cell
Straw mulch “blanket”
Lake Shirley Bioretention Cell

Lesson: Small is beautiful!
Bioretention cell with overflow
Vegetated Filter Strips / Buffers
Vegetated Buffers

- Pollutant Uptake /Filtering
- Habitat / Wildlife Food Source
- Shading
- Aesthetics
- Physical deterrent to geese
Buffer Design Criteria

• **Aesthetics.** Include a diversity of native shrubs, wildflowers and ground cover that will add visual interest and provide year-round color.

• **Maintain (reasonable) access and views.**

• **Use low-maintenance native plants,** beneficial to wildlife.

• **Maintain a "useable area"** between the homes and buffer for picnic tables, chairs, etc.

• **The wider the better…10’-20’ minimum for filtration**
Mirror Lake Rain Gardens
Staked straw bales to protect the lake from sediment during the buffer installation.

2 days for site preparation and buffer installation.
Lake Shirley, Lunenburg, MA
Case Study: Vegetated Buffer

Lake Wyola
Shutesbury, Massachusetts
State Park Beach Area

*Persistent problems with beach erosion from road runoff*
Shrub Buffer Plantings

- Silky Dogwood
- Red Osier Dogwood
- Bayberry
- Pussy Willow
- Meadowsweet
- Northern Arrowwood
- Sweet Pepperbush
Installation
Fully Stabilized Vegetated Buffer
Other Techniques
Infiltrating Planter Box for Roof Runoff (Plymouth, MA)
3" SHREDDED MULCH
21" ENGINEERED MEDIA
6" UNDERDRAIN STONE
Rain Barrels

- For capture/re-use of roof runoff
- Most barrels average 60 gallons and cost $75 - $125
- Cisterns are much larger systems, often involving pumps and drywell structures.
Porous Pavements (Wilmington MA)

- Interlocking Concrete Pavers
- Porous Asphalt / Concrete
- Flexipave
GravelPave

Turfstone
Dry Well / Infiltration Trench

- Dry wells range in size and complexity from a simple gravel-filled pit or trench to large perforated structures fed by drainage pipes.

- Often used to capture runoff from roof downsputs, driveways.

- Work best in sand/gravel soils.
Soils

Hydrologic Soil Groups

A: Sand, loamy sand or sandy loam soils. High infiltration rates!

B: Silt loam or loam. Moderate infiltration when fully wetted.

C: Sandy clay loam. Poor infiltration when thoroughly wetted.

D: Clay loam, silty clay loam, sandy clay, silty clay or clay. Highest runoff potential, very low infiltration when fully wetted.
Water Bars

- Water bars intercept runoff on sloped pathways and divert it to stable vegetated areas
- Install on sloped paths with concentrated flows
- Construct with 6”-8” diameter timbers and ¾” crushed stone
- Install multiple bars with spacing based on table

<table>
<thead>
<tr>
<th>% Grade</th>
<th>Spacing Between Water Bars (in feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>250</td>
</tr>
<tr>
<td>5</td>
<td>130</td>
</tr>
<tr>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>15</td>
<td>50</td>
</tr>
<tr>
<td>25+</td>
<td>40</td>
</tr>
</tbody>
</table>
Green Roofs

• Can be built almost any flat or low-angle roof.
• Reduce stormwater runoff volume and peak discharge
• Lower heating and cooling costs.
• Cost: $30-$45 per square foot
Soil Amendment

- Any material added to soil to improve water retention, infiltration and structure.

- Add organic matter and nutrients to the soil, which stimulates plant growth.

- Compost can be tilled or added to the surface as a mulch. This “compost blanket” will retain water and improve water quality.

- Reduces need for fertilizer.

- Cost: $15-25 per cubic yard, depending on whether delivery is needed.
Boat Ramps
LID Costs (Installed)

- **Raingarden:**
  - With Stone = $12 sf
  - Without Stone = $10 sf

- **Bioretention Cell:**
  (Unlike raingardens, biocells have piping such as an underdrain to a catch basin)
  - Large (1000+ sf) = $8 sf
  - Medium (500-1000 sf) = $10 sf
  - Small (200-500 sf) = $30 sf
  - Very Small (<200 sf) = $30 sf

- **Porous Pavement:**
  (includes infiltration bed 24” min)
  - Pavers (large area) = $8 sf
  - Pavers (small area) = $12 sf
  - Asphalt (large area) = $7 sf
  - FlexiPave = $8 sf
  - GravelPave = $15 sf

- **Swale:**
  (includes bioretention soil mix)
  - Grass = $8 lf
  - Vegetated/Bioretention = $10 lf

- **Catch Basin Upgrade:**
  - Deep Sump = $3,000 installed
  - Hydrodynamic Separator = $12-15,000 installed

- **Tree Box Filters:**
  (Filterra)
  - $10K per 0.25 ac
Thank you for your time!