EPA Region 1 MS4 Stormwater General Permits and LID Training Clinic

Fundamentals of LID
MWRA
Chelsea, MA
April 27, 2011

Low Impact Development (LID)

Community Planning
LID Site Design
LID BMPs
Receiving Waters
Larger Conventional BMPs
Low Impact Development (LID)

LID Site Planning and Design Approach

Objective - to provide a process by which LID is considered at an early stage in the planning process to prevent stormwater impacts rather than mitigate them.
### LID Site Planning and Design Criteria

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Protect undisturbed open space;</td>
</tr>
<tr>
<td>A</td>
<td>Maximize the protection of natural drainage areas, streams, surface waters, wetlands, and buffers;</td>
</tr>
<tr>
<td>A</td>
<td>Minimize land disturbance, locate disturbances in less sensitive areas;</td>
</tr>
<tr>
<td>A/R</td>
<td>Minimize the decrease in the &quot;time of concentration&quot; from pre-construction to post-construction;</td>
</tr>
<tr>
<td>A/R</td>
<td>Minimize soil compaction;</td>
</tr>
<tr>
<td>R</td>
<td>Minimize impervious surfaces;</td>
</tr>
<tr>
<td>M</td>
<td>Provide vegetated conveyance and treatment systems;</td>
</tr>
<tr>
<td>M</td>
<td>Provide low-maintenance landscaping;</td>
</tr>
<tr>
<td>M</td>
<td>Break up or disconnect runoff over impervious surfaces;</td>
</tr>
<tr>
<td>M</td>
<td>Provide source controls to prevent / minimize the release of pollutants into stormwater runoff.</td>
</tr>
</tbody>
</table>
Avoid the Impacts
Preservation of Natural Features & Compact Development

• Preservation of undisturbed areas;
• Preservation of buffers, natural drainage systems;
• Reduction of clearing and grading;
• Locating sites in less sensitive areas;
• Compact development; and
• Working with natural conditions (landscape, hydrology, soils)

Open Space Residential Design
Roads on ridge lines or upland areas
Vegetated drainage swales
Natural drainageways preserved
Houses located on "brow" of ridge
Undisturbed vegetation on slopes

Site Layout and Buildings
Fit to Terrain

Development Located in Less Sensitive Areas

Site Fingerprinting Used to Reduce Clearing and Grading
**Buffers and Stormwater**

Reduce the Impacts
Reduction of Impervious Cover

- Roadway Reduction;
- Sidewalk Reduction;
- Driveway Reduction;
- Cul-de-sac Reduction;
- Building Footprint Reduction; and
- Parking Reduction.
Street Widths and Lengths

Alternative to street sidewalk
Shared driveways reduce total area

Wide cul-de-sac with excessive impervious cover

Photo Copyright 1999, Center for Watershed Protection
Permeable pavers are an alternative
Oversized parking lot with excessive impervious cover

Parking demand ratios dictate parking lot size
Manage the Impacts
Source Controls/Structural Controls

- Disconnection of Impervious surfaces;
- Mitigation of runoff*;
- Stream restoration; and
- Reforestation.

*Practices that rely on natural systems (e.g., bioretention, constructed wetlands, infiltration, filtering)

Rain Gardens
Rain Barrels and Cisterns

Source: http://www.rdrop.com/users/krishna/rainwatr.htm

Green/blue Roofs
Green/blue Roofs

Stream Restoration
Stream Daylighting

Reforestation
Street Trees

New England Examples

- Zero Discharge project in Barnstable, MA;
- LID Retrofit in Plymouth Harbor, MA;
- Pilot installations at Silver Lake in Wilmington, MA
- Costs and Benefits
BIORETENTION AREA 2

Horsley Witten Group, Inc.
Existing Conditions and Site Constraints

- 4.5 acre drainage area - 33% imperviousness
- Residential & commercial properties
- Heavily trafficked site
- Close proximity to Plymouth Harbor Coastal Bank
- Steep grades and poor soils (Urban Fill)

Stormwater Design Features

- Bioretention facility designed as primary treatment
- 990 square-feet of treatment area
- Sized to treat ½-inch of runoff
- Low flows directed through diversion structure
- High flows bypass bio to prevent scouring & erosion
- Bio designed w/ underdrain system due to poor soils
- Steep grades accommodated w/ boulder wall
- Designed to fit in w/ surrounding landscape
Bioretention Area

Diversion Structure

- Retrofit of existing structure
- ½-inch water quality event directed to bio
- High flows bypass to existing outlet
Bioretention Planting Plan
Underdrain and Stone Placement

Filter Media Placement and Bio Plantings
Silver Lake
Wilmington, MA

- Silver Lake
  - Watershed Area: 132 acres
  - Pond Area: 28.5 acres
  - Watershed/Lake Ratio = 4.6:1

- Ipswich River Watershed

LID Technologies Demonstrated
Pre-Construction Conditions

- Porous Pavers
- Porous Asphalt
- Bioretention Cells
- Standard Asphalt
- GravelPave
- Flexi-Pave
- Vegetated Water Quality Swales

Image downloaded from Google Earth™

Parking Lot Improvements
Infiltration Test Results

<table>
<thead>
<tr>
<th>Location</th>
<th>Infiltration Rate (in/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bioretention Cell 1</td>
<td>22.73</td>
</tr>
<tr>
<td>Bioretention Cell 2</td>
<td>21.94</td>
</tr>
<tr>
<td>Raingarden</td>
<td>12.38</td>
</tr>
</tbody>
</table>

Note: ASTM D3385-94 provides accurate results for soils with infiltration rates between 0.0014 and 14.17 in/hr.
Low Impact Development
Does it really work?

Glen Brook Green (Jordan Cove)
Research/Demo Project

LID Cluster

Conventional

- 12 lots clustered on 6.9 acres
- Designed to minimize site runoff
**But Does It Work?**

Adapted from J. Clausen, UConn

---

**Some LID Cost Comparisons**
(as recently reported in Stormwater Magazine)

<table>
<thead>
<tr>
<th>Conventional Design Savings</th>
<th>LID Design Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Mobilization</td>
<td>• Site clearing and grading (earthwork)</td>
</tr>
<tr>
<td>• Professional services</td>
<td>• Temporary E&amp;SC</td>
</tr>
<tr>
<td>(design and construction</td>
<td>• Drainage infrastructure (pipes and inlets)</td>
</tr>
<tr>
<td>observation)</td>
<td>• Curbing</td>
</tr>
<tr>
<td>• Detention ponds</td>
<td>• Site stabilization</td>
</tr>
<tr>
<td>• Landscaping</td>
<td>• Paving?</td>
</tr>
<tr>
<td>• Paving?</td>
<td>• Maintenance?</td>
</tr>
<tr>
<td>• Maintenance?</td>
<td></td>
</tr>
</tbody>
</table>

*But it really Depends*
LID Cost Savings a Function of Design and Expertise

- Is the project a Conservation Development (OSRD) with reduced disturbance?
- How much LID is incorporated (pervious pavers, swales, natural area preservation, etc)?
- How complicated are the designs? Is multiple staging required?
- Are there unusual site constraints (slopes, soils, shallow groundwater, etc)?
- Is density going to be affected?
- How much expertise exists in your region?
- How much maintenance is required?
- Are the local codes compatible with LID?