Rhode Island Stormwater Design and Installation Standards Manual

RIDOT Workshop
LID Site Planning and Design Strategies: How to Meet Minimum Standard No. 1
July 13, 2011

Horsley Witten Group, Inc.
Low Impact Development (LID)

Community Planning

LID Site Design

LID BMPs

Receiving Waters

Larger Conventional BMPs
Low Impact Development (LID) (with a linear emphasis)

Traditional

LID

Design

BMPs
Minimum Standard No. 1
LID Site Planning and Design Strategies

• Must be used to the maximum extent practicable;
• Reduce runoff;
• Document compliance, and why elements not incorporated in Accordance with Checklist in Appendix A of Manual;
• Define what mitigation is offered.

Horsley Witten Group, Inc.
Avoid the Impacts
Preservation of Natural Features & Compact Development

- Preservation of undisturbed areas;
- Preservation of buffers, natural drainage systems;
- Reduction of clearing and grading;
- Working with natural conditions (landscape, hydrology, soils).
- Compact development; and
- Locating sites in less sensitive areas;
Linear examples of avoidance
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
Wide cul-de-sac with excessive impervious cover
Oversized parking lot with excessive impervious cover
Parking demand ratios dictate parking lot size
Manage the Impacts
Source Controls/Structural Controls

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

*Practices that rely on natural systems (e.g., bioretention, WVTS, infiltration, filtering)
Bioretention or a Rain Garden?

• Bioretention involves:
  - Amended soils;
  - Complex sizing calculations (e.g. modeling);
  - Detailed engineering specifications;
  - Sophisticated conveyance devices (flow splitters, underdrains, overflow inlets, etc).

• Rain Garden:
  - Generally doesn’t involve the above- usually a shallow depression in native soils, or modestly amended soils (but might contain some of the above features)

Beware of what something is called: One person’s Bioretention is another person’s Rain Garden
LID Practice Variants: Porous Pavement
Impervious Cover Disconnection

Mild vegetated slopes
Adjacent to small parking lots, roadways, bike paths, and sidewalks

Source: City of Portland, OR
Stream Daylighting
Street Trees
LID Stormwater Credits

LID Site Design Credit:
Disconnected Rooftop Runoff
Disconnected Non-Rooftop Runoff

Credit can be used to reduce or eliminate $R_{e_v}$ and $WQ_{v}$ storage requirements.
LID Stormwater Credits

- Still need to meet other Standards;
- Must maintain engineering “standard of care” and “good drainage design;”
- Direct runoff over qualifying pervious areas (QPAs); and
- LUHPPL runoff not eligible for credit.
QPA Definition

- Fully stabilized natural or landscaped vegetated area;
- Correlated with NRCS Curve Numbers for “good hydrologic condition”
- Minimum of 4 inches of top soil or organic material;
- Located outside of regulated wetland areas and buffer areas (i.e., not permitted with the 50 ft perimeter wetland);
- Turf areas seeded with low-maintenance grassed adapted to New England.
Qualified Pervious Areas?

QPAs can be over a flow length (concentrated flow) or across an area (sheet flow).

- For concentrated flow: Calculate the required minimum length.
- For sheet flow: Calculate the required minimum length and width.
- For linear projects (bike paths/sidewalks) length = width
Establishing QPAs
Credit Restrictions

• Qualifying Pervious Area (QPA) located 10 ft from bldg foundation;

• Every 1,000 sq ft of impervious area must have at least 75 linear feet pervious flow and be longer than the contributing flow length (min length = 1,000 sf/75' = 13.3'/sq ft); and

• Can be no overlap for QPA (i.e., can’t direct 2 different areas to the same QPA);
• Res Lots > 6,000 ft\(^2\);
• Slope of QPA < 5.0%;
• QPAs located over A or B soils;
• No construction traffic over QPA;
• O&M Plan required;
• QPA cannot be a wetland resource; and
• QPA must be controlled by the owner/applicant
Stormwater Credit (Recharge; Re_v)

- Two Methods:
  - Percent Volume - storage provided based on volume required for Re_v and/or WQ_v
  - Percent Area (Re_a) - required impervious area to drain to a QPA based on:

\[ \text{Re}_a = \left( F \right) \left( I \right), \text{ where} \]

- \( F = \) Recharge Factor based on soils (dimensionless)
- \( I = \) Impervious area (in acres or ft^2)
Recharge Methods

% Volume versus % Area Methods

1. Calculate volume based on HSG (Re_v)
2. Calculate area method: Re_a = (F)(I); where F = recharge factor and I site impervious area.
3. Site area draining to a QPA is subtracted from Re_a
4. Divide new Re_a by Re_v: (Re_a / Re_v)
5. Multiply fraction by original Re_v to obtain volume that must be treated by conventional structural practice.
Example Calculation

Given: a 40' x 60' gable single family rooftop, with 4 downspouts at each corner:

• What is the minimum QPA as Sheet flow?
• What is the minimum QPA length through a vegetated Swale?
For Sheet Flow: Minimum width is the longer of the two dimensions: i.e., 30 feet.

For Shallow Concentrated Flow: Minimum length  = \( \frac{A}{13.3} = \frac{600 \text{ ft}^2}{13.3} = 45 \text{ feet} \).
Example Calculation

Given: non-rooftop impervious area = 1.9 ac lying over HSG A soils, 0.9 ac are disconnected to discharge to QPAs:

• What is the required $Re_v$ to be managed by a structural practice?
  - $Re_v = 1'' (F)(l)/12 = 1'' (0.60)(1.9 ac)/12 = 0.095 ac-ft (4,138 ft³)
  - $Re_a = (F)(l) = (0.60)(1.9 ac) = 1.14 ac

Answer: 1.14 ac - 0.9 ac = 0.24 ac

New $Re_v = 0.24 ac/1.14 ac (4,138 ft³) = 871 ft³
Sidewalk Example

- R/W
- QPA
- 4x4
- 4'
- Sidewalk
- Road