LID Evaluation and Analysis

University Surface Parking Lot

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Project Regulatory Background

- Site is located on urban waterfront property within the Metro Bay Region in Providence, Rhode Island subject to Coastal Resources Management Council (CRMC) Urban Coastal Greenway Policy (UCG)

- CRMC UCG provide development projects the option to:
  - Follow Coastal Buffer Setback Regulations; or
  - Use the UCG option, which clarifies and streamlines regulatory process for urban coastal development and creates greater flexibility in meeting CRMC requirements
Urban Coastal Greenway Policy Purpose

- Encourages redevelopment of the Metro Bay Region shoreline in order to promote reuse of abandoned or underutilized Brownfield sites;
- Discourages over-development of Rhode Island’s rural and suburban green spaces; and
- Protects existing natural coastal habitat in the Metro Bay Region
Urban Coastal Greenway Policy
Requirements for Metro Bay Region Projects

- 15% Minimum Vegetation Coverage
- Implementation of LID Techniques for Stormwater Management
- Public Access to the Shoreline
- Designated Urban Coastal Greenway with Native and Sustainable Vegetation
Project Site Background

- Site is a university located within the Urban Coastal Greenway of the Metro Bay Region
- ~110-acre university campus situated on a former industrial property
- Woodard & Curran was contracted by the university to evaluate LID techniques under UCG Policy for 13-acres of proposed surface parking facilities at the campus.
Site Characteristics

- Urban fill soils of variable infiltration capabilities
- High groundwater table
- Topographically flat
- Public water supply
Evaluation of Low Impact Development (LID) Techniques

- Porous Asphalt Pavement
- Bio-retention Ponds
- Underground Infiltration
LID Evaluation Criteria

- Suitability for the Site
- Performance of the LID technique
- Cost
- Maintenance
Porous Asphalt Pavement
Porous Pavement - How it Works

1” porous leveling course
1” porous top course
2” porous binder
Crushed Stone Reservoir (~6”)
Gravel Sub-Base for permeability >2.5 ft/day
Optimal Porous Pavement Site Requirements

- Site usage low volume/low speed
- Underlying soils field-verified permeability between 0.25-3.0 inches per hour
- Depth to bedrock >4 feet from base of system
- On-site slopes <5%
- Depth to seasonal high water table >3 feet from base of system
- Situated >100 feet from public water supply wells, > 10 feet from building foundations
- Protection from wind-blown sediments
Porous Pavement Maintenance Requirements

- Vacuum sweeping and/or pressure washing
- Use environmentally benign deicers in lieu of salt
- Monthly inspection of pavement surface for deterioration
- Inspection after storm events to ensure functionality
Porous Pavement Advantages

- Reduced amount of cuts and fills on existing flat sites
- Reduced amount of stormwater infrastructure such as piping, catch basins, retention ponds, curbing, etc.
- Decreased need for plowing and salting
- Increased groundwater recharge
- Increased skid resistance/traction
Porous Pavement Disadvantages

- Lower load-bearing capacity than conventional asphalts
- Limitations to de-icing procedures
- Premium costs associated with maintenance requirements
- Potential for pavement surface clogging
- Accidental seal coating or similar surface treatment will cause failure
Bio-Retention Ponds
How it Works

- Pond Empties Within an Adequate Time Period in all Seasons
- Plants Selected for Your Area—Tolerate Extended Inundation as Well as Dry Periods.
- No Compaction At Bottom of Excavation!
- Subsoil Has Sufficient Hydraulic Conductivity
- Groundwater Table Below Sub-basin in All Seasons
- Basin Soil Is Free Draining
- Basin + “Rapid Infiltration” Contains First Flush
- Sufficient Bypass Capacity for Large Storms
Optimal Bio-Retention Pond Site Requirements

- Use for small sub-drainage areas. RI agencies recommend <5 acres; others <2 acres
- Depth to seasonal high water table should be > 2 feet from the pond invert (>4 feet in ponds without underdrains)
- On-site slopes should be <20%
Bio-Retention Pond Maintenance Requirements

- Routine periodic maintenance of landscaped areas – i.e. weeding, pruning, and mulch replacement
- Annual inspections to observe health of trees and shrubs and system functionality
- Surface should be rototilled or cultivated if standing water is observed >48 hours
- Removal of accumulated sediment and debris periodically
Bio-Retention Pond Advantages

- Pollutant treatment for solids, metals, nutrients and hydrocarbons
- Increased groundwater recharge for unlined systems
- Reduction of “urban heat” effects
- Ease of maintenance
- Can be lined if infiltration is prohibited on a contaminated site
Bio-Retention Pond Disadvantages

- Not applicable for steeply sloped sites
- Not conducive for receiving piped stormwater
- Shallow pond depth demands more land area than traditional water quality pond
Underground Infiltration
How it Works
Optimal Underground Infiltration Site Requirements

- Depth to seasonal high groundwater should be >3 feet from bottom of the system
- Underlying soil infiltration capacity should range from 0.3 – 7.5 inches per hour, clay content <30%, and silt/clay content <40%
- Storage chambers have minimum and maximum requirements (StormTech® minimum cover is 18 inches and maximum cover is 8 feet)
- Site slopes should be <15%
Site Requirements cont’d

Recommended Setbacks:

- 100 feet from on-site sewage disposal systems
- 400 feet from community wells
- 100 feet from private wells
- 25 feet from any property line
- 20 feet from any structure (50 ft from residential)
- 200 feet from surface water bodies
- 50 feet from a designated CRMC buffer zone
Underground Infiltration Maintenance Requirements

- Bi-annual inspection of pretreatment devices and chambers
- Cleaning of pretreatment devices performed as necessary
- Removal of accumulated sediment >3 inches
Underground Infiltration Advantages

- Increased groundwater recharge
- Flexibility in system location and configuration (i.e. the system can be configured and located as needed to best suit the application)
Underground Infiltration Disadvantages

- Requires pretreatment to minimize maintenance
- Restricted accessibility for maintenance (sediment removal)
- If clogging cannot be corrected by high pressure flushing replacement of the system would be required
- Requires piping system infrastructure to collect and direct the stormwater into the system
- Some states require an Underground Injection Control permit
Cost Comparison
Costing Methodology

- Consistent costs that would be required for all LID techniques were not considered (i.e. grading, pavement striping)
- Capital cost estimates for varying components of LID techniques were considered
Capital Cost Variations Among LID Techniques (March 2008)

- Least Expensive – Porous Pavement
- Bio-Retention Ponds + 7%
- Underground Infiltration +15%
- Maintenance costs expected to be greatest for porous pavement systems
Evaluation
Evaluation of LID Techniques

- Site Suitability – Porous pavement and Bio-Retention most suitable for variable groundwater elevation
- Performance – Bio-Retention most reliable design
- Cost – Porous pavement least capital cost
- Maintenance – Bio-Retention easiest maintenance
Conclusions
- All three LID techniques were viable choices for the parking lot
- Initial costing for each LID technique was comparable
- Bio-Retention Ponds were ultimately chosen by the client because of their ability to accommodate the variable groundwater table and relatively low maintenance costs