Retrofit Applications

Retrofits can be incorporated into a wide range of land use settings and sites, including within the roadway right-of-way (ROW) as well as on public and privately-owned developed parcels of land. The following sections summarize common ROW and parcel-based retrofit applications.

Roads and Right-of Way Retrofits

Retrofit opportunities exist along most types of roads. The road functional classification (interstate, arterial, collector, and local), intensity of adjacent development (urban, suburban, rural), and other right-of-way characteristics will dictate the suitability of retrofit types and specific structural stormwater BMPs.

Divided Highways

Open spaces associated with highway ROW areas such as medians, shoulders, and interchanges present opportunities to incorporate new stormwater BMPs. Opportunities also exist to retrofit existing linear stormwater conveyances (i.e., grass drainage channels) and detention basins, such as the drainage channel retrofits described in the previous section, to provide increased retention and enhanced treatment of stormwater. Traffic, safety, and maintenance access are important considerations for determining appropriate locations for highway ROW retrofits. Common retrofit approaches for highway ROW areas include:

- Pavement disconnection to a vegetated filter strip or other qualifying pervious area adjacent to the highway (i.e., simple disconnection).
- Conversion of existing grass swales to water quality swales or linear bioretention using check dams and other modifications.
- Conversion of existing dry detention basins to infiltration basins or stormwater ponds or wetlands.
- Installation or new linear vegetated stormwater BMPs in grassed medians.
- Replacing older style catch basins with deep-sump, hooded catch basins or infiltrating catch basins.
- Retrofit of drainage system outfalls that discharge directly to receiving waterbodies using off-line retention or treatment stormwater BMPs.

Urban Roads

Roads and streets in urban settings such as downtown areas, village centers, and heavily developed commercial corridors present a variety of retrofit opportunities as well as some unique challenges associated with urban development. Urban landscape features such as streets, sidewalks, parkways, and green spaces can be modified to be multi-functional by incorporating small-scale vegetated surface stormwater BMPs (also referred to as “green infrastructure” or

"green stormwater infrastructure) to provide retention and filtration of stormwater, while achieving other functions such as accommodating bicycle lanes, providing traffic calming, and aesthetic/streetscape improvements (i.e., "green streets" approaches). Given limited space and numerous physical constraints that typically exist in urban settings, opportunities also exist for subsurface retrofits within the ROW to intercept, store belowground, and infiltrate stormwater that would otherwise enter the existing drainage system using underground infiltration systems located below the road surface or sidewalks.

Urban roads with limited vegetation/trees, wide roads and sidewalks, and large amounts of impervious area tend to be good candidates for retrofits. Common retrofit approaches for urban roads include:

- Addition of bioretention stormwater planters, bioswales, and tree filters within existing green space between the road and sidewalks.
- Creation of bioretention bump outs to reduce impervious area, manage stormwater, provide traffic calming, and improve pedestrian safety.
- Use of curb inlets to intercept and divert surface runoff into new off-line stormwater BMPs, while using the existing drainage system as the overflow to convey runoff from larger storm events.
- Use of permeable pavement for on-street parking stalls, sidewalks, crosswalks, etc.
- Use of underground infiltration systems (chambers and infiltrating catch basins) below roads and sidewalks in areas with inadequate land area or space to accommodate surface practices.
- Narrowing of wide sidewalks and re-grading to vegetated filter strips.

Surface and subsurface utilities can pose significant challenges to the design, construction, and maintenance of stormwater BMPs, especially in urban areas. Utility management should be considered early in the planning and design of urban retrofits. Effective planning and design of urban retrofits should include the following considerations:

- Coordinate with public and private utilities to determine the presence of existing utilities within the project limits as well as design and construction requirements for utility-related construction.
- Locate existing utilities during the design phase.
- Verify separation requirements between proposed stormwater BMPs and existing on-site utilities with the utility owner.

- Where stormwater BMP are proposed with sidewalks, utility poles should be at the back of the sidewalk. Where possible, locate utilities outside the sidewalk limits. Sidewalks should continue to meet accessibility requirements following the installation of the retrofits.
- If fire hydrants are present near the proposed stormwater BMPs or must be relocated, coordinate with the local fire department/district and water utility owner for design and construction requirements.
- Consider the potential for conflict with overhead utilities. These conflicts include both permanent fixed objects and constructability issues. Consult the utility pole owner, and NESC & OSHA guidelines.
- Relocating utilities should be carefully considered during the selection of a stormwater BMP. Relocation can be costly and requires early coordination with the utility owner. The proposed relocation design must be reviewed and approved by the utility owner.
- The configuration of a stormwater BMP must allow utility owner access to all mains and service laterals for maintenance.
- Infiltrating BMPs should not be sited adjacent to or above existing utility trenches, which can result in "short circuiting" of the BMP drainage mechanisms if preferential flow is through the bedding material of the utility trench. Impermeable liners can be used to minimize the potential for short-circuiting.

Residential Subdivisions

Many older residential subdivisions have wide roads, traditional curb and gutter drainage systems, limited existing vegetation/trees, and limited stormwater quality controls. Opportunities exist to reduce or disconnect impervious areas within the ROW, coupled with potential on-lot improvements that can be made by private property owners to further disconnect driveways, roof, patios, etc. from the municipal drainage system. Common retrofit approaches for residential subdivisions and similar suburban residential neighborhoods include:

- Narrowing road widths and replacing sidewalks on one side of the road with vegetated filter strips or water quality swales.
- Replacing older style catch basins with deep-sump, hooded catch basins or infiltrating catch basins.
- Elimination of curbing and closed drainage systems.
- Addition of bioretention stormwater planters, bioswales, and tree filters within existing green space between the road and sidewalks.
- Creation of bioretention bump outs to reduce impervious area, manage stormwater, provide traffic calming, and improve pedestrian safety.

- Conversion of large, paved cul-de-sac bulbs to vegetated surfaces or installation of bioretention of infiltration BMPs within these areas.
- Providing incentives for homeowners to disconnect roof leaders and runoff from other impervious surfaces on their lots using simple disconnection, rain barrels, dry wells, and permeable pavement.

Parcel Based Retrofits

Parking lots and building roof areas (i.e., large impervious areas that are directly connected to the existing drainage system) provide numerous opportunities for potential for parcel-based stormwater retrofits on public and private property. All of the retrofit types described in the previous section – conversion of existing impervious areas to pervious areas, simple disconnection, and addition of new stormwater BMPs – can be implemented as parcel-based retrofits.

Publicly owned (e.g., municipal- or state-owned) parcels typically offer the most immediate potential for retrofits because they avoid the cost of land acquisition, the need for cooperation with private landowners, and allow the municipal or state jurisdiction to have direct control over retrofit construction and maintenance. Certain types of private parcels such as institutional facilities (e.g., private colleges and universities) and commercial properties with large impervious areas may be good candidates for retrofits but require landowners who are willing to construct and maintain the retrofits. Stormwater utility fees and associated impervious area reduction credits can be used to incentivize retrofits on private property.

Parking Lots

Parking lots in municipal, commercial, and institutional land use settings can be ideal candidates for a wide range of stormwater retrofits. Sites with excess or under-utilized parking provide opportunities for conversion of impervious areas to pervious areas and the use of pervious pavement in parking stalls or overflow parking areas. Small-scale infiltration and treatment BMPs (bioretention, tree filters, water quality swales, etc.) can be added to existing landscaped areas in parking islands and around the perimeter of parking lots, depending on the configuration of the existing storm drainage system and location of drainage structures relative to the existing green space. Curb cuts and grading can be used to disconnect portions of parking lots by re-directing sheet-flow to adjacent vegetated areas. Parking lots also provide opportunities for subsurface retrofits (infiltrating catch basins and underground infiltration systems) where space is limited, or existing surface drainage structures are not conveniently located.

Repaving or replacement of existing parking lots, as well as redevelopment of older commercial properties (often designed with excess parking, high impervious coverage, and limited stormwater controls) are good opportunities for incorporating retrofits in conjunction with other planned infrastructure improvements. Common examples of parking lot stormwater retrofits include:

Incorporating Bioretention into Parking Lot Islands and Landscaping. Parking lot islands and landscaped areas can be converted into functional bioretention areas, tree filters, and dry water quality swales using curb cuts located upgradient of existing catch basins.

Removing Curbing and Adding Slotted Curb Stops. Curbs along the edges of parking lots can sometimes be removed or slotted to re-route runoff to vegetated areas, buffer strips, or bioretention facilities. The capacity of existing swales may need to be evaluated and expanded as part of this retrofit option.

Incorporating New BMPs around the Perimeter of Parking Lots. New retention and treatment BMPs such as infiltration trenches and basins, bioretention, tree filters, and dry water quality swales can often be incorporated into the green space around the perimeter of parking lots provided there is adequate setbacks to adjacent properties and infrastructure.

Use of Permeable Paving Materials. Existing conventional pavement in overflow parking or other low-traffic areas can sometimes be replaced with alternative, permeable materials. Site-specific factors including traffic volumes, soil permeability, maintenance, sediment loads, and land use must be carefully considered for the successful application of permeable paving materials for retrofit applications.

Installation of Subsurface Retrofits. Underground infiltration systems such as infiltration chambers can be installed below parking lots on space-constrained sites. Existing catch basins can also be retrofitted or replaced with infiltrating catch basins.

Building Roof Areas

Building roofs that are directly connected to the storm drainage system are ideal candidates for disconnection using infiltration BMPs, stormwater reuse BMPs, or green roof installations. In residential settings, roof runoff can typically be disconnected by re-directing downspouts to lawn areas, rain gardens, dry wells, or rain barrels. Commercial and institutional buildings typically generate larger volumes of runoff and contain high pollutant levels, requiring adequate pretreatment and more space for surface infiltration/filtration systems or larger underground infiltration systems. Common examples of stormwater retrofits for building rooftops include:

- Disconnecting residential roof downspouts and re-directing them to existing vegetated areas (i.e., simple disconnection), dry wells, or rain barrels.
- Disconnecting roof leaders from larger commercial and institutional buildings, which are often hard piped into the existing storm drainage system, and re-directing them to existing vegetated areas (i.e., simple disconnection), infiltration basins, bioretention cells, or underground infiltration systems.
- Capture of roof runoff at sites with landscaped areas or turf fields (e.g., schools, playgrounds, outdoor recreational facilities) using cisterns and stormwater reuse systems for irrigation to reduce runoff volumes and municipal water usage.

- Conversion of flat building roof areas to vegetated roofs using modular green roof systems.