Appendix B
Item 1

Green Infrastructure Practices

According to NYSDEC, the latest addition to their Design Manual[1] is intended to address runoff reduction and the planning and design of green infrastructure. The three main elements of LID strategies that have been the focus of this document, and will be addressed in this section, can be found within Chapter 5 of the 2010 Stormwater Management Design Manual. They are:

1. Preservation of Natural Features
2. Reduction of Impervious Cover
3. Green Infrastructure Techniques

1. Preservation of Natural Areas

The first step in any LID design is identifying which areas in a site are appropriate for development and which should be preserved. This can be done by way of a site assessment or consulting a pre-existing Natural Resource Inventory, if one has been created for the project area. Creating an inventory of natural resources is a terrific first step for communities that have not already done so because it is easier to evaluate a proposed project using existing data than to repeatedly get relevant data for specific parcels every time there is a proposed project. Information or data for soils, wetlands/waterbodies, floodplains, other sensitive areas, streets, historic structures, zoning, agricultural districts, tax parcels, aerial photos, topography, geology, etc. varies from county to county and between municipalities. Data of this type is usually managed or held by: Town and Village halls, Soil and Water Conservation Districts, Planning, Economic Development, Watershed Affairs, Cornell Cooperative Extension, USDA Web Soil Survey, local libraries, historical societies, Chambers of Commerce or visitor/tourist information centers.

The table below summarizes the contents of Chapter 5.1 of the 2010 Design Manual.

Table 1 - Planning Practices for Preservation of Natural Areas and Conservation

Practice	Description
Preservation of Undisturbed Areas	Delineate and place into permanent conservation undisturbed forests, native vegetated areas, riparian corridors, wetlands and natural terrain.
Preservation of Buffers	Define, delineate and preserve naturally vegetated buffers along perennial streams, rivers, shorelines and wetlands.
Reduction of Clearing and Grading	Limit clearing and grading to the minimum amount needed for roads, driveways, foundations, utilities and stormwater management facilities.
Locating Development in Less Sensitive Areas	Avoid sensitive resource areas such as floodplains, steep slopes, erodible soils, wetlands, mature forests and critical habitats by locating development to fit the terrain in areas that will create the least impact.
Open Space Design	Use clustering, conservation design or open space design to reduce impervious cover, preserve more open space and protect water resources.
Soil Restoration	Restore the original properties and porosity of the soil by deep till and amendment with compost to reduce the generation of runoff and enhance the runoff reduction performance of post-construction practices.

[1] Found at http://www.dec.ny.gov/chemical/29072.html

2. Reducing Impervious Surfaces

The importance of minimizing impervious surface coverage has been stated throughout the document. The table below summarizes the contents of Chapter 5.2 of the 2010 Design Manual[2].

Table 2 - Planning Practices for Reduction of Impervious Cover	
Practice	**Description**
Roadway Reduction	Minimize roadway widths and lengths to reduce site impervious area.
Sidewalk Reduction	Minimize sidewalk lengths and widths to reduce site impervious area.
Driveway Reduction	Minimize driveway lengths and widths to reduce site impervious area.
Cul-de-sac Reduction	Minimize the number of cul-de-sacs and incorporate landscaped areas to reduce the impervious cover.
Building Footprint Reduction	Reduce the impervious footprint of residences and commercial buildings by using alternate or taller buildings while maintaining the same floor to area ratio.
Parking Reduction	Reduce imperviousness on parking lots by eliminating unneeded spaces, providing compact car spaces and efficient parking lanes, minimizing stall dimensions, using porous pavement surfaces in overflow parking areas, and using multi-storied parking decks where appropriate.

[2] Found at http://www.dec.nv.gov/chemical/29072.html

3. Green Infrastructure Practices

There are wide-ranging green infrastructure techniques for protecting and utilizing the natural environment in development. The contents of Chapter 5.3 of the 2010 Design Manual[3] provides information on where and how different practices are utilized, as summarized in the table below.

Table 3 - Green Infrastructure Techniques for Runoff Reduction

Practice	Description
Conservation of Natural Areas	Retain the pre-development hydrologic and water quality characteristics of undisturbed natural areas, stream and wetland buffers by restoring and/or permanently conserving these areas on a site.
Sheet flow to Riparian Buffers or Filter Strips	Undisturbed natural areas such as forested conservation areas and stream buffers or vegetated filter strips and riparian buffers can be used to treat and control stormwater runoff from some areas of a development project.
Vegetated Swale	The natural drainage paths, or properly designed vegetated channels, can be used instead of constructing underground storm sewers or concrete open channels to increase time of concentration, reduce the peak discharge, and provide filtration.
Tree Planting / Tree Pit	Plant or conserve trees to reduce stormwater runoff, increase nutrient uptake, and provide bank stabilization. Trees can be used for applications such as landscaping, stormwater management practice areas, conservation areas and erosion and sediment control.
Disconnection of Rooftop Runoff	Direct runoff from residential rooftop areas and upland overland runoff flow to designated pervious areas to reduce runoff volumes and rates.
Stream Daylighting	Stream Daylight previously-culverted/piped streams to restore natural habitats, better attenuate runoff by increasing the storage size, promoting infiltration, and help reduce pollutant loads.
Rain Gardens	Manage and treat small volumes of stormwater runoff using a conditioned planting soil bed and planting materials to filter runoff stored within a shallow depression.
Green Roofs	Capture runoff by a layer of vegetation and soil installed on top of a conventional flat or sloped roof. The rooftop vegetation allows evaporation and evapotranspiration processes to reduce volume and discharge rate of runoff entering conveyance system.
Stormwater Planters	Small landscaped stormwater treatment devices that can be designed as infiltration or filtering practices. Stormwater planters use soil infiltration and biogeochemical processes to decrease stormwater quantity and improve water quality.
Rain Barrels and Cisterns	Capture and store stormwater runoff to be used for irrigation systems or filtered and reused for non-contact activities.
Porous Pavement	Pervious types of pavements that provide an alternative to conventional paved surfaces, designed to infiltrate rainfall through the surface, thereby reducing stormwater runoff from a site and providing some pollutant uptake in the underlying soils. When designed in accordance with the design elements in section 5.3.11, the WQv for the contributing drainage area is applied towards the runoff reduction.

[3] Found at http://www.dec.ny.gov/chemical/29072.html

Appendix B
Item 2

LID/GI Selection Matrices

Table 4 - Selecting Appropriate Practices for Different Land Use Types

LID Practices	Single Family Residential Lot	Small Non-Residential/ Multifamily Lot	Existing Development
Underdrain Soil Filters			
Bioretention System	O	●	◉
Rain Garden	●	O	◉
Swale	●	●	◉
Vegetated Buffer	●	●	●
Infiltration Practices[1]			
Dry well	●	●	●
Infiltration Trench	◉	●	●
Pervious Pavement	●	●	◉
Rain Barrel/ Cistern	●	●	◉
Green Roof	O	●	●
Stormwater Planter	O	●	●
Micro-bio Inlet	O	O	●

Key: ● = suitable, ◉ = sometimes suitable with careful design, O = rarely suitable

1. Infiltration practices are not appropriate in wellhead protection zones, and must have pretreatment to remove sediments that can clog the system unless the practice collects rooftop runoff only.

(Selection Matrix 1 from the LID Guidance Manual for Maine Communities, Horsley Witten Group, 2007)

Table 5 - Selecting Appropriate Practices for Different Runoff Source Areas

LID Practices	Rooftop	Non-Rooftop Impervious Areas	Disturbed Pervious Areas (Lawn)
Underdrain Soil Filters			
Bioretention System	●	●	●
Rain Garden	●	●	●
Swale	●	●	●
Vegetated Buffer	●	●	●
Infiltration Practices[1]			
Dry well	●	O	O
Infiltration Trench	●	●	O
Pervious Pavement	O	●	O
Rain Barrel/ Cistern	●	O	O
Green Roof	●	O	O
Stormwater Planter	●	O	O
Micro-bio Inlet	O	●	●

1. Infiltration practices are not appropriate in wellhead protection zones, and must have pretreatment to remove sediments that can clog the system unless the practice collects rooftop runoff only.

Key: ● = suitable, O = unsuitable

(Selection Matrix 2 from the LID Guidance Manual for Maine Communities, Horsley Witten Group, 2007)

Table 6. LID Practices Context Matrix

Low Impact Design (LID) Practices:	Preserve Undisturbed Areas	Preserve Buffers	Reduce Clearing and Grading	Locate in less Sensitive Areas	Open Space Design	Soil Restoration	Roadway Reduction	Sidewalk Reduction	Driveway Reduction	Cul-de-sac Reduction	Building Footprint Reduction	Parking Reduction	Vegetated Swale	Tree Planting and Tree Pit	Disconnection of Rooftop Runoff	Stream Daylighting	Rain Gardens and Bioretention	Green Roof	Stormwater Planter	Rain Barrel and Cistern	Porous Pavement
Locations:																					
- Hamlet Centers and Village Areas		X	X			X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
- Rural Land Development	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X			X	X
- Single Family Residential	X	X	X	X	X	X		X	X				X	X	X		X			X	X
- Multifamily and Commercial	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
- Well-drained Areas	X	X	X	X	X	X	X	X	X	X	X	X	X		X		X				X
- Poorly-drained Areas	X	X	X	X	X	X	X	X	X	X	X	X		X				X	X	X	
- Waterways, Waterbodies and Wetlands	X	X	X	X	X											X					
- Roads and Driveways				X	X		X	X	X	X			X								X
- Parking Areas and Pedestrian Ways				X				X				X	X	X			X		X		X
- Landscaped and Lawn Areas	X	X	X	X	X	X								X		X	X				
- Steep Slopes, Walls and Rocky Areas	X	X	X	X	X		X											X	X	X	
- Patios, Pools and Other Impervious Improvements				X										X			X		X		X
- Roofs															X			X		X	

(Table 6 from the Low Impact Development Guide for the Mountaintop Better Site Design Roundtable)

Appendix C

Monitoring and Maintenance[1]

6. Inspection and Upkeep

6.1. Construction Inspection and Monitoring

Inspection and monitoring of construction projects is important to ensure that erosion and sediment control measures are installed, working properly, and being maintained to prevent sedimentation in local streams, lakes, rivers and wetlands. There are four levels of inspection that should take place during a construction project:

6.1.1. Contractor monitoring

Under the New York State Stormwater Construction General Permit, GP-0-10-001, an owner or operator of a construction site disturbing one acre or more of soil must have a "trained contractor" on site each day that soil disturbing activities are taking place. The "trained contractor" must have an approved wallet card that certifies that he has taken 4 hours of an approved NYSDEC erosion and sediment control class every 3 years. These classes are offered periodically by the Soil and Water Conservation Districts. See the NYSDEC Stormwater Training Calendar at: http://www.dec.ny.gov/chemical/8699.html

6.1.2. Owner/operator inspections

Under the New York State Stormwater Construction General Permit, GP-0-10-001, certain construction projects must be inspected once every 7 days by a "Qualified Professional". "Qualified Professionals" are knowledgeable about the principles and practices of erosion and sediment control, including a licensed Professional Engineer (PE), licensed Landscape Architect (RLA), a Certified Professional in Erosion and Sediment Control (CPESC), or a soil scientist. If projects disturb more than 5 acres at any one time, they must be inspected twice every 7 days by a Qualified Professional.

6.1.3. Compliance inspections – municipality

Code Enforcement Officers in Mountaintop municipalities that have local erosion and sediment control or clearing and grading laws can enforce those laws as part of their regular site inspections. In municipalities that don't have such a law, Code Enforcement Officers can report problems and violations to NYSDEC or NYCDEP and

[1] From Chapter 6 of the Low Impact Development Guide found at http://www.gcswcd.com/images/stories/pdf/wap/mbsdw/lid_guide_final_9_28_11.pdf

request a compliance inspection by those agencies. Code Enforcement Officers can also ensure that the Owner/operator of a construction site is conducting the required weekly inspections by requesting copies of the weekly reports prepared by the owner or his/her consultant.

6.1.4. Compliance inspections – NYSDEC or NYCDEP

NYSEC and NYCDEP periodically conduct inspections to determine if a construction project meets the GP-0-10-002 and New York City Water Supply Watershed requirements. The inspections are often driven by complaints from adjacent landowners or community members. NYSDEC compliance inspectors focus on determining whether:

- The project is causing water quality standard violations;
- The required Stormwater Pollution Prevention Plan (SWPPP) includes appropriate erosion and sediment controls and, to some extent, post construction controls;
- The owner/operator is complying with the SWPPP;
- Where required, self-inspections are being properly performed; and
- Where self-inspections are required, the owner/operator responds appropriately to the self-inspector's reports.[30]

6.2. Maintenance of Stormwater Practices and Plantings

Stormwater management practices and green infrastructure techniques will not continue to function unless they are maintained. Sediment and trash must be cleaned out periodically. Plants and mulch may need to be replaced. Inlets and outlets should be cleaned of debris. Dams should be checked for cracks and animal burrows. If a SWPPP is required for the development of a site, it must include a maintenance plan for all of the stormwater management measures.

Each stormwater management practice is somewhat different in the requirements and schedule for maintenance, therefore the NYSSWDM includes a description of maintenance requirements for every practice in the manual. In addition, the NYSSWDM Appendix G provides a series of maintenance worksheets that can be used in the field for stormwater ponds, stormwater wetlands, infiltration practices, filtering practices such as bioretention, and conveyance systems such as swales.

[30] "Construction Stormwater Inspection Manual," NYSDEC, Version 1.05 (8/27/07)