MANAGING STORMWATER

Natural Vegetation and Green Methodologies Guidance for Municipalities and Developers V.2.0

2015

Suffolk County, New York

About National Wildlife Federation

The National Wildlife Federation is the United States' largest private, nonprofit conservation education and advocacy organization, with over four million members and supporters, and 48 state and territorial affiliated organizations.

About Citizens Campaign for the Environment (CCE)

CCE is a non-partisan advocacy organization supported by over 80,000 members working to protect public health and the natural environment. For more about CCE please visit our website at www.citizenscampaign.org

Suffolk County Planning Commission

Under state and county law, the Suffolk County Planning Commission is responsible for identifying and promoting county-wide land use values and planning priorities. This includes creating Suffolk County's Comprehensive strategic plan, reviewing major development projects proposed within the County, making recommendations to local municipalities about policies that have regional impact, and developing common municipal approaches to address issues affecting the future of Suffolk County. The County Planning Commission is comprised of 15 members who are nominated by the County Executive and are confirmed by the County Legislature.

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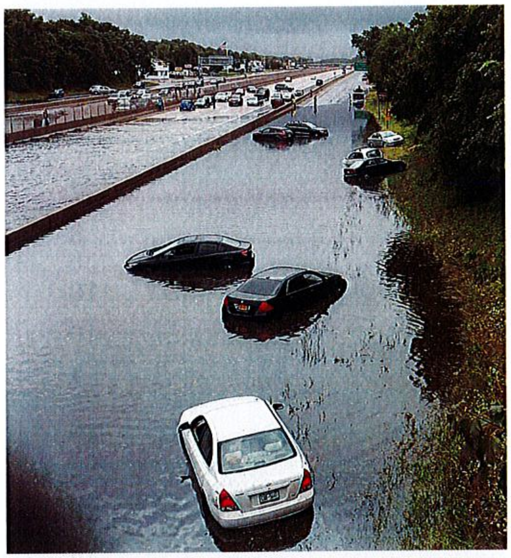
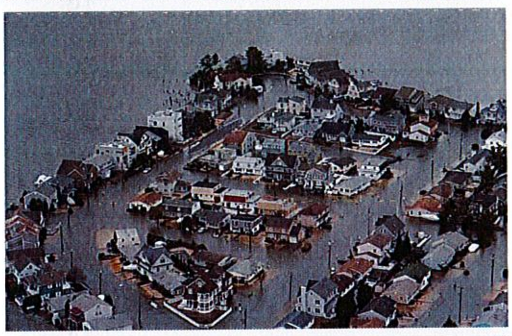
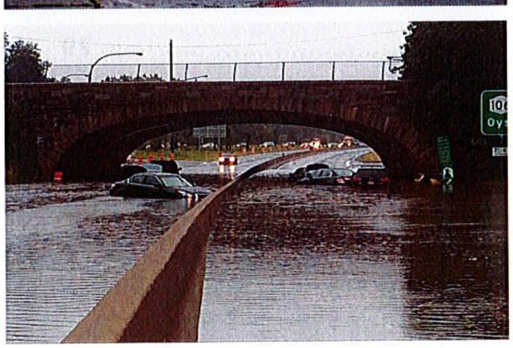






Stormwater pollution is a cause of water quality impairment throughout Long Island's bays, harbors, estuaries, lakes, and rivers. As polluted stormwater runs into water systems, it degrades our water quality, threatening marine life, closing beaches and contributing to closed shellfish beds that help support the local economy. Runoff from stormwater is defined by the U.S. EPA as "generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground. As the runoff flows over the land or impervious surfaces (paved streets, parking lots, and building rooftops), it accumulates debris, chemicals, sediment or other pollutants that could adversely affect water quality if the runoff is discharged untreated" (United States Environmental Protection Agency). In a highly developed area like Long Island there is a high percentage of impervious surfaces, which contributes to more stormwater runoff and limits the ability of water to infiltrate into the ground.

When stormwater runoff travels too quickly over impervious surfaces and flows into harbors, bays and streams, it picks up and carries with it a higher amount of sediment and other pollutants. Pollutants include motor oil, pesticides, debris, harmful bacteria, and nutrients such as nitrogen and phosphorus. This swiftly traveling stormwater can also worsen erosion and flooding, and contributes to the loading of nonpoint source pollutants into harbors, bays, and rivers.

The existing stormwater runoff problem is worsening due to climate change. According to the National Climate Assessment (www.globalchange.gov), "The Northeast has experienced a greater increase in extreme precipitation than any other region in the U.S.; between 1958 and 2010, the Northeast saw more than a 70% increase in the amount of precipitation falling in very heavy events." In the summer of 2014, Long Island experienced a record setting rainfall of 11 inches within 24 hours. As the region experiences wetter weather and more extreme storms, existing stormwater management plans and infrastructure are not designed to account for these changes, but green infrastructure can help manage the current and future precipitation in the region.

What is Stormwater Management?

Under natural conditions, stormwater is absorbed into the ground, where it is filtered and ultimately replenishes aquifers or flows into streams, rivers and estuaries. In developed areas, however, impervious surfaces, such as pavement and building roofs, prevent precipitation from naturally soaking into the ground. Instead, the water runs rapidly into storm drains and drainage ditches. The resulting rush of stormwater discharge can cause infrastructure damage, downstream flooding, and stream bank erosion.

Stormwater management addresses these concerns through a variety of techniques, including strategic site design, measures to control the sources of runoff, and thoughtful landscape planning. Managing stormwater has multiple benefits which include environmental, economic, and human health, including the following:

- Reduced Maintenance & Repair Costs
- Reduced and Delayed Runoff Volumes
- Enhanced Groundwater Recharge
- Pollutant Reductions into rivers, stream, tributaries and bays
- Reduced Sewer Overflow Events
- Increased Carbon Sequestration (ie., carbon storage)
- Urban Heat Island Mitigation and Reduced Energy Demands
- Improved Air Quality
- Additional Wildlife Habitat and Recreational Space.
- Improved Human Health

Stormwater runoff is regulated under the National Pollutant Discharge Elimination System (NPDES), however most states implement the NPDES program as a state program – SPDES. The NPDES program covers the following activities: Municipal Separate Storm Sewer Systems, Construction Activities, and (Large) Industrial activities (United States Environmental Protection Agency). Stormwater runoff from these activities is considered point source pollution, or direct discharge.

Checklist for Addressing Stormwater

Reducing stormwater runoff from direct discharge activities (e.g. pipes that release water directly to waterways) is only part of the solution. Protecting, enhancing, and restoring native vegetation and providing incentives to use green infrastructure to protect groundwater and surface water quality is a key part of successful stormwater management. Groundwater recharge is important to the long-term health and sustainability of communities, and therefore efforts to protect vegetation and recharge areas can result in cost savings for municipalities. The following is a quick checklist to help you start assessing what measures can be taken to protect ground and surface water:

- ☐ Do you have zoning overlay districts specifically devoted to groundwater protection?
- ☐ Do you have written standards for handling storm water to incorporate with deed covenants and restrictions associated with zoning changes?
- ☐ Do your subdivision regulations allow for alternative design, storage and reuse of storm water on development parcels, on planned rights-of-way, and within engineered structures, such as leaching basins, catch basins, recharge basins, or perforated pipe?
- ☐ Do your site plan review requirements permit alternative stormwater design and rainscaping techniques such as temporary parking pavement waivers, roof and pavement drainage structures such as porous pavement, rain gardens, bio-retention basins, bio-swales, and green roofs?
- ☐ Do your codes contain incentives for the retention or re-establishment of existing native plantings and non-disturbance of natural recharge areas?
- ☐ Do your codes contain disincentives to discourage extensive fertilized vegetation, automatic irrigation, impervious surface and urban heat island effect and, conversely, to encourage drought-tolerant plants, no-mow meadowland, upgrade and renewal of natural process for site work?

II. Managing Wet Weather with Green Infrastructure

Green Infrastructure (GI) is described by the Environmental Protection Agency (EPA) as a solution that, "...uses vegetation, soils, and natural processes to manage water and create healthier urban environments" (United States Environmental Protection Agency). Green Infrastructure could include retaining our remaining natural landscapes; restoring or re-creating an environment similar to pre-development conditions, or mimicking natural systems.

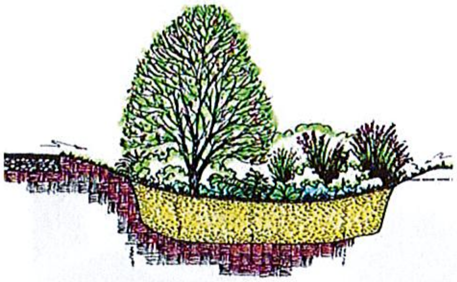
Green infrastructure is an approach to wet weather management that is cost-effective, sustainable, and environmentally friendly. Green Infrastructure management approaches and technologies infiltrate, evapotranspire, capture, and reuse stormwater to maintain or restore natural hydrologic systems.

At the largest scale, the preservation and restoration of natural landscape features (such as forests, floodplains and wetlands) are critical components of green stormwater infrastructure. By protecting these ecologically sensitive areas, communities can improve water quality while providing wildlife habitat and opportunities for outdoor recreation.

On a smaller scale, green infrastructure practices include rain gardens, porous pavements, green roofs, bio-retention basins, bio-swales, conservation and restoration of natural systems, and native/natural landscaping. All of these practices play a vital role in stormwater management while improving and maintaining the environmental quality of surrounding communities.

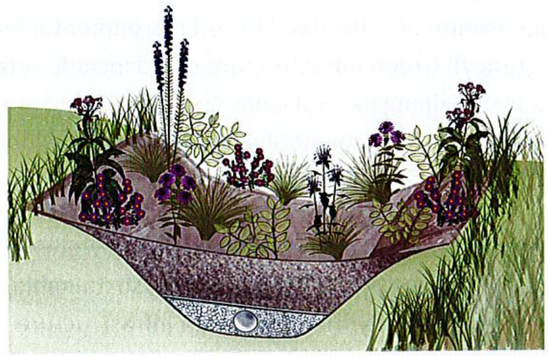
Green infrastructure is often used inter-changeably with the term low-impact development (LID). The EPA defines LID as "a land development approach that works with nature to manage stormwater as close to its source as possible. This development approach aims to conserve and restore natural landscape features, which reduces imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. By implementing LID principles and practices, water can be managed in a way that lessens the impact of built areas and supports the natural movement of water within an ecosystem or watershed" (United States Environmental Protection Agency).

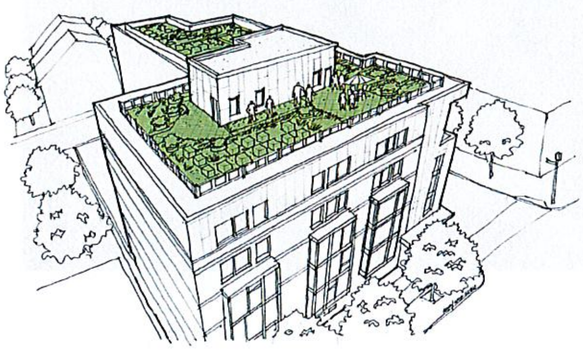
Green Infrastructure Practices



BIO-RETENTION BASIN – An area designed to accept and retain stormwater, to slow or block either its discharge to surface water or its recharge to groundwater, to lessen erosion, allow for filtering of sediments, plant root uptake of nutrients, and biologically control the water. It may be equipped with various overflows or high water level bypasses to transport amounts of water exceeding its holding capacity.

BIO-SWALE – A linear area designed to capture, slow, and distribute flowing water so that plants can absorb the water. These vegetated areas may be supplemented by under drains, overflows or other engineering devices to cope with unusual storm events.

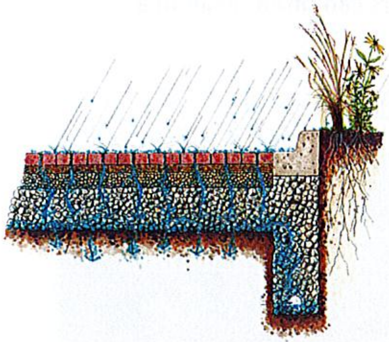




GREEN ROOF – A building roof that is engineered to be covered with low-maintenance growing plants that insulate in winter, cool the building in summer, reduce solar absorption, reduce precipitation run-off surfaces, and improve interior Heating, Ventilating and Air Conditioning (HVAC) efficiency.

GREEN STREETSCAPE — Although streetscapes are traditionally constructed with asphalt or concrete, streets, sidewalks, curbs, and other features can be retrofitted and/ or constructed to incorporate more permeable, natural surfaces. Green streetscapes incorporate sustainable design practices that not only improve the management of stormwater on-site, but have additional benefits, such as improved air quality. Planting of street trees and expanding tree box size, "greening" medians, using porous pavement, and incorporating bioswales and rain gardens into the streetscape design are all be considered features of a green streetscape.

NATIVE/NATURAL LANDSCAPING – This practice encompasses techniques such as planting native plant species, urban forests, drought-tolerant plant species, and native grasses with minimal mowing activity. Typical plant or grass species used in native/ natural landscaping practices are those that have the capacity to thrive with minimal water and are able to store water during extended dry periods, are not introduced from outside the geographical area, and are genetically suited to thrive with little to no maintenance, in the original soils to which it is accustomed.



POROUS/PERMEABLE PAVEMENT – A hard surface with load bearing capacity engineered to allow for the passage of water through pores. Porous pavements are often underlain by carefully engineered layers of crushed rock, fabric filter cloth, piping, or drains. Types of porous pavement may include paving blocks with open corners, lattices, or edges or asphalt/concrete mixes without fine sediments.

RAIN GARDEN – A vegetated area designed to capture and retain stormwater so that plants may absorb the water. These areas are often outfitted with under drains, overflows, or other engineering devices to cope with extreme storm events.

CONSERVATION AND RESTORATION OF NATURAL SYSTEMS – The conservation of natural features in their original state. Natural features that are particularly important in addressing stormwater issues include riparian areas, wetlands, and steep hillsides. The EPA provides an educational and comprehensive report on this at: http://water.epa.gov/infrastructure/greeninfrastructure/upload/gi_action_strategy.pdf

III. COSTS AND BENEFITS OF GREEN INFRASTRUCTURE

One of the biggest issues in recognizing the full potential of using green infrastructure practices in stormwater management is taking into account all of the costs and benefits. This is especially true for identifying the vast benefits that green infrastructures provides for coastal communities because they are difficult to value. Additionally, the full cost of pollution, such as pollutants in stormwater, are externalized and difficult to connect to the polluter, undermining the full costs. These factors can often result in a disconnect between perceived costs and benefits.

Despite these barriers, there are many costs and benefits that have been identified:

Costs	Benefits
• Installation Costs • Maintenance & Lifecycle • Consumer Aesthetic Appeal & Usability	• Reduced Maintenance & Repair Costs • Reduced Runoff Volume & Overflow Events • Environment & Human Health • Wildlife Habitat & Recreational Space • Urban Heat Island Mitigation & Reduced Energy Demands • Job Creation

Costs

INSTALLATION COSTS – The overall costs to implement a project will vary depending on various factors such as size, design, equipment/materials, purpose, and labor requirements. Furthermore, bio-retention basins, bioswales, green roofs, porous pavement, and rain gardens, all have varying costs per square unit because of their different construction, maintenance, and material needs. These factors not only result in cost variations between the different types of green infrastructure, but also among different project sites of the same infrastructure type. In Prince George's County, Maryland, the cost of installing a bio-retention basin on a residential lot subdivision was estimated at $1,075, while the cost of installing a basin on a commercial subdivision lot was estimated at $10,357 (Department of Environmental Resources, Maryland, 2007). This difference in price is due to a difference in size, design, and purpose of the lots.

Estimated costs of installing a green roof start at $10 per square foot for simpler roofing, and $25 per square foot for intensive roofs. Likewise, the installation cost per square yard of porous pavements varies depending on the type of materials used—porous asphalt was quoted at $31.00, porous pavers at $104.31, and porous concrete at $60.75 (Rowe 2009).

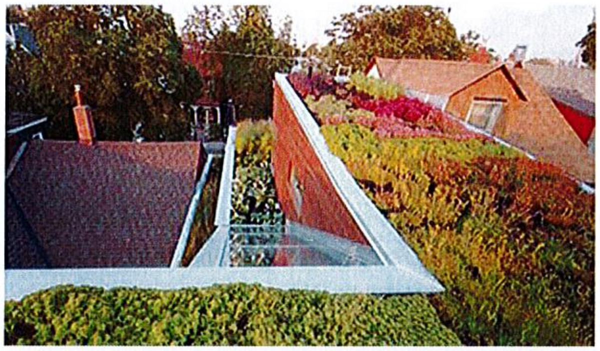
MAINTENANCE & LIFECYCLE – The cost of maintenance also depends on the type of green infrastructure and lifecycle. Green infrastructure maintenance may be more or less expensive than gray infrastructure maintenance when taking into account these two factors. The annual maintenance cost of green roofs range from $0.75 - $1.50 per square foot, which is typically higher than a conventional black roof by $0.21 - $0.31 per square foot (Peck & Kuhn, 2003). These higher costs are a result of maintenance needs of the rooftop vegetation. Porous pavements also incur maintenance costs, especially during winter months when sand and salt can clog pores. Regular maintenance is required to clear these areas. Property owners should provide a budget for maintenance at an annual rate of 1-2% of construction costs (Metropolitan Area Planning Council). In contrast, native/natural landscaping practices, such as planting native and drought tolerant plants, incur almost zero maintenance costs as these plants are suitably adapted for the geographic area.

CONSUMER AESTHETIC APPEAL & USABILITY – While aesthetic appeal and usability are difficult to monetize, consumer satisfaction is an important factor in identifying perceived costs. Consumers or members of the community may be dissatisfied with either the look of green infrastructure or the quality. Many consumers have struggled with getting consistent quality out of porous pavement as it tends to wear out faster than concrete (Clean Water America Alliance, 2011). In the case of native/natural landscaping, uprooting turf grass and replacing lawns with native species typically takes 2-3 years to mature (United States Environmental Protection Agency, 2004). Until then, the area may look sparse or patchy, resulting in dissatisfied consumers.

Benefits

ENVIRONMENT & HUMAN HEALTH – One of the biggest benefits of green infrastructure is the ability to improve and maintain the quality of the environment, specifically water and air. By infiltrating, absorbing, and retaining stormwater, green infrastructure prevents pollutants and nutrients from entering into nearby water systems, subsequently improving water quality. These trends can have huge implications for improved human health as a result of a healthier environment. Many studies have found a strong positive relationship between the amount of green space and human well-being and health in various communities (Tzoulas et al., 2007).

Bio-retention basins, bioswales, rain gardens, porous pavement, and native/natural landscaping, all remove suspended solids, phosphorus, nitrogen, and heavy metals, such as cadmium, copper, lead, and zinc from stormwater. Systems such as bio-retention basins, bioswales, and rain gardens, can remove an average of 80% of the total suspended solids, 60% of total phosphorous, 50% of total nitrogen, and 80% of heavy metals (Upstate Forever). A study in Greenbelt, MD, found removal rates of more than 90% for copper, lead, and zinc, 65-75% removal of phosphorus, and 45-60% removal of nitrogen (United States Environmental Protection Agency, 2000).



WILDLIFE HABITAT & RECREATIONAL SPACE –

Green infrastructure practices are often referred to as "multifunctioning natural habitats" because of their ability to act as both stormwater management tools and conservation tools. Through the use of native plant species, they provide natural habitats for and attract wildlife, as well as serving as an aesthetic commodity to the landscape. The use of bio-retention basins, natural systems, bioswales, green roofs, rain gardens, and native/natural landscaping, have huge implications for butterfly, moth, bird, and insect species that depend upon the services provided. Many of these species are particularly crucial to the health of the environment as they play vital roles as pollinators. Furthermore, building off this idea of improved water quality, green infrastructure also supports many aquatic wildlife, such as fish and invertebrate species, which can only survive under specific ranges in water quality and temperature.

Sylvan Avenue Permeable Project

In 2010, this project was implemented in Ann Arbor, MI, which installed an 800-foot long, 20-foot wide residential porous roadway. After the installation, it was found there was a significantly lower amount of ice and snow which required less plowing and salting of the roadway (Buckley et al., 2011).

REDUCED MAINTENANCE & REPAIR COSTS –

Many of these features (bio-retention basin, bioswales, rain gardens, native/natural landscaping) have lower maintenance (e.g. landscaping, watering, pesticides, and fertilizers) and repair (e.g. replacement, and longer lifecycle) costs in comparison to gray infrastructure. Specifically, bio-retention basins tend to have lower maintenance and liability costs; primarily due to facilities being located at the source rather than at the end of the pipe (Department of Environmental Resources, Maryland, 2007). Bio-retention basins and bioswales only incur maintenance costs of 5-7% of overall construction costs of the infrastructure (United States Environmental Protection Agency, 2006). Likewise, in regions of the country like Long Island that require plowing of snow, porous pavements tend to require little maintenance because melt water is allowed to infiltrate rather than freeze as an ice layer.

Additionally, native/natural landscaping and techniques (rain garden, bioswales, and bio-retention basins) that incorporate native and drought tolerant plants have lower long-term maintenance costs due to reduced irrigation, pesticide, and fertilizer needs. A project in Illinois found a significant decrease in maintenance costs associated with native/natural landscaping than conventional turf grass. The 10-year average maintenance costs per acre of turf grass was estimated at $5,550, while the 10-year average maintenance costs per acre of native/natural landscaping was estimated at only $1,600 (United States Environmental Protection Agency, 2004).

REDUCED RUNOFF VOLUME & OVERFLOW EVENTS – It is estimated that 25% of the $1 billion in annual damages from flooding are linked to stormwater (Federal Emergency Management Agency, 2005). Therefore the infiltration, absorption, and retention abilities of green infrastructure could and currently does have a huge impact on mitigating stormwater damages. Increasing infiltration, absorption, and retention reduces the amount of water energy flowing through local storm sewers and stormwater systems and reduces flooding-related impacts, such as decreased property value, damages to public infrastructure, and repair costs.

In farming operations and the use of greenhouses, phosphorus and nitrogen that crops use and dispense can create run-off with poor water quality. Farmers can use GI to mitigate and filter this run-off. In Eastern Suffolk County, farmers such as Gabrielsen's Country Farm have used bio-swales surrounding greenhouses to control run-off.

Rain gardens reduce stormwater runoff volume by temporarily storing water and returning it to the ground, reducing the immediate volume load on water bodies and the storm drain system by up to 98% which in turn helps to reduce the risk of flash floods (Upstate Forever). In 2008, the Saylors Grove bio-retention basin intercepted 73% (25.4 of 34.8 million gallons) of stormwater runoff and resulted in a significant reduction in rainfall intensity peak flow (Howley).

Porous pavements also play a vital role in reducing runoff. Analyzing the percent of rainfall converted to runoff volume for various pavement scenarios, porous pavement coupled with a bioswale (10%) is much more effective at preventing rainfall from converting to runoff than asphalt (51%), asphalt with a bioswale (34%), and even cement with a bioswale (32%) (Clark & Acomb).

Jordan Cove Watershed

In 2003, a study conducted in this watershed (Waterford, CT), which drains into Long Island Sound, investigated the average infiltration rates of porous pavement in comparison to asphalt. The study concluded that porous pavement (8.1 inches per hour) had a higher average infiltration rate than asphalt (0 inches per hour) (Interlocking Concrete Pavement Institute, 2004).

URBAN HEAT ISLAND MITIGATION & REDUCED ENERGY DEMANDS – Green infrastructure dramatically increases energy efficiency by reducing heating and cooling demands of buildings, resulting in lower energy bills. Additionally, green infrastructures that incorporate the use of trees and urban forests provide added shading that can mitigate the effect of urban heat islands. A typical medium-sized tree absorbs 70-90% of sunlight and reduces the maximum surface temperature of roofs and walls of buildings by 11-25 degrees Celsius (Foster et al., 2011).

Green roofs, in particular, show huge reductions in energy use and costs. Vegetation on green roofs lower the absorption of solar radiation and thermal conductance, which can substantially lower building temperatures during warm periods and decrease energy consumption. During cooler periods, green roofs act as extra insulation, reducing heat loss and increasing energy efficiency. In 2006, commercial and industrial energy costs in the U.S. totaled $202.3 billion, with roughly 50% due to indoor heating and lighting. Widespread implementation of green roofs, with their ability to reduce indoor energy consumption by 7-10% per year, could save the U.S. economy $7-$10 billion per year (US EPA 2006).

American Society of Landscape Architects

In 2006, the American Society of Landscape Architects replaced their existing roof in Washington, DC, with a green roof (pictured below). They observed a 10% reduction in building energy use during the winter months and a 59 degree (F) reduction in temperature during the summer months compared to the previous conventional roof (American Society of Landscape Architects 2012).

JOB CREATION – Due to the vast number of green infrastructure techniques that hold the capability of mitigating stormwater management issues, capacity and expertise is needed in the installation and design, operations and maintenance, and supply chain of these techniques. Similarly, it was found that an investment of $166 million in stormwater projects between 2009-2011 produced an estimated 2,075 jobs in Los Angeles, CA (Burns & Flaming, 2011). Looking at specific types of green infrastructure, installing green roofs on 5% of Chicago's buildings would create almost 8,000 jobs from an investment of $403 million (Hewes, 2008).

PlaNYC

PlaNYC is a sustainability and resilience plan which consists of 127 initiatives to transform New York City into a more sustainable and resilient city. The use of green infrastructure (e.g. green roofs, bioswales, and pervious pavement) was outlined and included in many of the plan's programs to address the city's stormwater issues (PlaNYC, 2014). In 2008, an analysis anticipated the creation of 266 total jobs from investing $23 million in green roofs and 1,446 direct jobs from a $346 million investment in PlaNYC's watershed protection programs (The Louis Berger Group, Inc., 2008).

The Center for Neighborhood Technology and American Rivers has created a helpful guide describing the steps necessary to value many environmental, social, and public health benefits of green infrastructure. The guide includes simple, the illustrative examples to assist municipalities and developers in performing their own calculations. The guide can be found here: http://www.cnt.org/repository/gi-values-guide.pdf

IV. POLICIES AND INCENTIVES TO CATALYZE THE USE OF GREEN INFRASTRUCTURE

Summaries of policies and incentives are included below, with links to the full text.

Regional/Local

CROTON-ON-HUDSON, NY – Croton-on-Hudson's Wetlands and Watercourses ordinance protects wetlands and other natural stormwater management areas in order to prevent water contamination. Croton-on-Hudson uses this ordinance to establish a Water Control Commission. http://www.stormwatercenter.net/Model%20Ordinances/misc_wetlands.htm

TOWN OF EAST HAMPTON, NY – The Town of East Hampton established a Harbor Overlay District to maintain or improve surface water quality. The district is also intended to maintain or improve wildlife habitat in these areas and to maintain or restore these waterways as closely as possible to their natural condition. http://ecode360.com/10414586?highlight=overlay%20districts,overlay%20district,districts,district,harbors,overlay,harbor#10414586

TOWN OF NORTH HEMPSTEAD, NY – The Town of North Hempstead, NY established a Stormwater Control ordinance which requires the consideration and implementation of a stormwater pollution prevention plan (SWPPP) with any land development activity. Specific on-site retention requirements apply with any increase in impervious surface area. http://ecode360.com/9298140

ONONDAGA COUNTY, NY – The Save the Rain program is a comprehensive stormwater management plan intended to reduce pollution to Onondaga lakes and tributaries. This program offers two funding resources directed toward the owners of private property and other municipalities within the county's sewer district; the Green Infrastructure Fund (GIF) and the Suburban Green Infrastructure Program (SGIP). http://savetherain.us/

TOWN OF OYSTER BAY, NY – Oyster Bay's Stormwater Management and Erosion and Sediment Control ordinance seeks to establish minimum stormwater requirements and controls to protect and safeguard the general health, safety, and welfare of the public by reducing stormwater runoff rates and volumes, soil erosion, and nonpoint source pollution through stormwater management practices. http://ecode360.com/26884711?highlight=stormwater

CITY OF BRIDGEPORT, CT – In 2010, the City of Bridgeport launched the BGreen 2020 Initiative, a Sustainability Plan that outlines the policies and actions to be implemented in the next 10 years to improve the quality of life, social equity, and economic competitiveness of the city, while reducing harmful impacts to the environment. Part of the plan addresses making improvements to the region's waterways through enhanced stormwater management and use of green infrastructure.

http://www.bgreenbridgeport.org/storage/documents/Bgreen-2020-2013-Progress-Report.pdf

VERNON, CT – The Town of Vernon has made it a policy to required LID to the maximum extent practicable (MEP) for all projects that fall within current Town regulatory jurisdiction, with the intent of managing stormwater. In the construction, design, and implementation of various gray infrastructures, many Zoning and Subdivision Regulations mandate and suggest the use of low impact development stormwater management practices with the consultation of the Town LID Manual.
http://www.vernon-ct.gov/files/VernonGuidelinesStormWater_2013.pdf

Local Case Studies:

PERMEABLE PAVEMENT, LINDENHURST, NY – The Lindenhurst Library is home to Long Island's first permeable pavement parking lot. The parking lot is designed with permeable paving stones, set in-between gravel, which sits atop 4 layers of different sized gravel. The water is able is infiltrate through the pavement and then the various layers of gravel. This water would otherwise run-off as polluted stormwater into the Great South Bay. The parking lot also has bio-swales surrounding the perimeter with drought resistant plants that help to capture rain water to recharge it into the aquifer. The project was built using $200,000 in stimulus funds, which covered 90% of the construction and engineering costs. To complement the project, solar power is used to light the parking lot at night.

GREEN BUILDING DESIGN, WESTBURY, NY – The "Yes We Can" Community Center is a platinum LEED certified building in North Hempstead that utilizes native vegetation, rainwater collection, permeable paving, recycled water for toilets, a photovoltaic roof, geothermal heating, and solar trees in the parking lot to decrease environmental impacts and lower energy costs. The Center now serves as a leader in green infrastructure and energy efficiency on Long Island and has been featured at several LEED and green infrastructure conferences.

GREEN ROOF INSTALLATION, OLD WESTBURY, NY – A 1,000 foot living green roof was installed at the SUNY Old Westbury campus only a few days before Superstorm Sandy hit in 2012. The roof cost $23,000 to install. The roof withstood a direct hit from the Superstom and successfully drained water and reduced flooding on the campus.

GERARD STREET PARKING LOT, HUNTINGTON, NY – The Town of Huntington has incorporated 6,020 square feet of bioretention areas as part of the reconstruction of the Gerard Street Parking Lot to reduce and treat stormwater runoff. The total cost of constructing these bioretention areas is $262,715, or $43.64 per square foot, representing 18% of the total construction costs for this project. Stormwater quality benefits include the pretreatment of stormwater prior to entering waterways and removal of pollutants such as phosphorus, nitrogen, various dissolved and particulate metals (cadmium, copper, lead, zinc) and some pathogens (coliform, streptococci, E. Coli). Environmental benefits include the reduction of CO2 emissions that would be created by manufacturing conventional precast concrete drainage structures; reduction of the heat-island effect by increasing the amount of landscaping and shade trees; and utilization of recycled plastics in the manufacture of the HDPE drainage structures and pipes installed in bioretention areas.

National

ANNAPOLIS, MD – The City of Annapolis, MD, raised its Stormwater Utility Fee in 2011, and offers a 50% discount on this fee if residential or commercial properties install stormwater management structures or devices on their properties (e.g. green roofs, rain gardens, and infiltration trenches). http://www.ci.annapolis.md.us/government/city-departments/neighborhood-environmental/stormwater-management

LOWER COLORADO RIVER AUTHORITY, TX – The Lake Travis Nonpoint Source Pollution Control Ordinance is aimed at reducing nonpoint source pollution in the Lake Travis area (a watershed near Austin, TX). The Lake Travis watershed is a sub-watershed of the Lower Colorado River. http://www.stormwatercenter.net/Model%20Ordinances/misc_lake_travis.htm

MONTGOMERY COUNTY, MD – Montgomery County has a Rainscapes Program that offers rebates to residential and commercial properties that implement eligible rainscaping techniques to reduce stormwater pollution. The funding comes from the County's Water Quality Protection Charge, a tax property owners pay for the amount of impervious surface on their property. http://www.montgomerycountymd.gov/DEP/water/rainscapes.html

NAPA, CA – Napa's Riparian Habitat ordinance is focused on protecting and restoring native vegetation. Napa's ordinance also takes additional measures to prevent streambank hardening which is detrimental to habitat and accelerates erosion. http://water.epa.gov/polwaste/nps/upload/nps-ordinanceuments-a2c-napa.pdf

RHODE ISLAND – Rhode Island's program is focused on vegetated coastal zone buffers. Rhode Island seeks to protect ecologically sensitive areas and prevent contaminated runoff from non-point source pollution. http://water.epa.gov/polwaste/nps/upload/nps-ordinanceuments-a2b-rhode-island.pdf

WASHINGTON, DC – Washington, DC, offers monetary incentives to homeowners who implement landscape enhancements, such as rain gardens or pervious pavers, which reduce stormwater runoff. Homeowners apply to the program and receive a free audit to determine the best options for their properties and the potential incentive amount. http://green.dc.gov/riversmarthomes

V. FUNDING SOURCES

Since green infrastructure projects provide a variety of benefits beyond simply stormwater management, the funding required to implement projects may come from a variety of sources, such as those related to sustainability, community revitalization, urban wildlife habitat, climate mitigation, and climate resilience and adaptation.

Regional/Local

LONG ISLAND SOUND FUTURES FUND – The Long Island Sound Futures Fund (LISFF) is a competitive grant program administered by the National Fish and Wildlife Foundation. In particular, the Clean Waters and Healthy Watersheds priority area provides funds to, "plan and implement Low Impact Development (LID) and green infrastructure or green street projects." http://www.nfwf.org/lisff/Pages/home.aspx#.VBdHGGO5R6I

Conscience Bay

In 2012, $1.6 million in grants were awarded to state and local government and community groups in New York and Connecticut to improve the health of Long Island Sound. (Long Island Sound Study, 2012). A portion of these funds were allocated to the Conscience Bay Stormwater Treatment & Wetland Enhancement project in the Village of Old Field. With a grant amount of $200,000, 35 subsurface infiltration units connected to 4 curbside basins, and 4 bioswales were installed to treat 194 million gallons of polluted stormwater (National Fish and Wildlife Foundation, 2012).

NEW YORK GREEN INNOVATION GRANT PROGRAM – The New York Green Innovation Grant Program (GIGP) supports projects across the State of New York that utilize unique stormwater infrastructure design and create cutting-edge green technologies. GIGP-funded projects may be found from Buffalo to the end of Long Island, and range from rain gardens to stream "daylighting" projects. http://www.efc.ny.gov/Default.aspx?tabid=461

SUFFOLK COUNTY DRINKING WATER PROTECTION PROGRAM – The purpose of the program is to fund implementation projects that will result in the protection and restoration of surface water quality. This program was extended 13 years through the use of dedicated sales tax extensions. A portion of the total revenues generated annually by the sales tax were dedicated to offsetting the costs associated with implementing environmental programs. http://efc.muskie.usm.maine.edu/conservation_finance/LESSON_5.htm

ONONDAGA COUNTY GREEN INFRASTRUCTURE FUND – As part of the Save the Rain Program, the purpose of the Green Infrastructure Fund is to support the development of green infrastructure and stormwater mitigation practices on private property. This fund applies to applicants and projects within the Clinton, Harbor Brook and Midland Combined Sewersheds (CSS). http://savetherain.us/green-improvement-fund-gif/

Save the Rain

The Onondaga County Save the Rain Green Improvement Fund (GIF) was created for private property development and redevelopment. Since March 2010, 117 applications have been submitted for grant funding. 36 projects have been completed and 54 projects are under contract. There have been 14.2 million gallons of stormwater removed annually from completed projects.

SUBURBAN GREEN INFRASTRUCTURE PROGRAM – The Suburban Green Infrastructure Program supports the development of green infrastructure and stormwater management practices on public property within the Onondaga County sewer district, but outside of the City of Syracuse. This funding option targets municipal entities that are considering planning projects to reduce inflow and infiltration to sanitary sewer systems. http://savetherain.us/sgip/

50/50 STORMWATER MANAGEMENT FUND – This program, funded by the National Fish and Wildlife Federation Chesapeake Bay Stewardship Fund, assists landowners in implementing green infrastructure practices to meet the requirements administered by the City of Binghamton's Urban Runoff Reduction Plan. http://www.binghamton-ny.gov/sites/default/files/files/50_50%20Stormwater%20Fund%20Matching%20Grant%20FAQ.doc_0.pdf

LOCAL WATERFRONT REVITALIZATION PROGRAM – These programs establish a long-term partnership among local government, community-based organizations, and the State to address local revitalization issues. On an annual basis, the Department of State solicits grant applications from local governments for 50/50 matching grants that can be used to advance preparation, refinement, or implementation of these programs. http://www.dos.ny.gov/opd/programs/lwrp.html

WATER QUALITY IMPROVEMENT PROJECT PROGRAM – This is a competitive, reimbursement program that directs funds from the New York State Environmental Protection Fund to projects that reduce polluted runoff, improve water quality, and restore habitat in water systems across New York State. These funds are available to municipalities, municipal corporations, soil and water conservation districts, and non-profit corporations. http://www.dec.ny.gov/pubs/4774.html

National

The US EPA has developed a green infrastructure portal that includes a number of non-federal funding sources and tools. http://water.epa.gov/infrastructure/greeninfrastructure/gi_funding.cfm

CLEAN WATER STATE REVOLVING FUNDS – This program provides loan assistance for wastewater treatment, stormwater management, nonpoint source abatement, and estuary protection projects. The revolving nature of the program is maintained with loan repayments, interest, and federal capitalization grants that are used to fund new projects. http://www.epa.gov/owm/cwfinance/cwsrf/green_if.pdf

NATIONAL DISASTER RESILIENCE COMPETITION – The U.S. Department of Housing and Urban Development will be announcing a national competition that will be funded through the Community Development Block Grant disaster recovery (CDBGDR) appropriation provided by the Disaster Relief Appropriations Act, 2013 (PL 113-2). This program funds communities that have been struck by natural disasters to implement innovative resilience projects to better prepare them for future storms and extreme weather events. http://portal.hud.gov/hudportal/documents/huddoc?id=FactSheet_071514.pdf

ILLINOIS GREEN INFRASTRUCTURE GRANT PROGRAM – Administered by the Illinois EPA, this program's grants are available to local units of government and other organizations to implement green infrastructure to control stormwater runoff for water quality protection in Illinois. The amount of funding available under this program is administered as a reimbursement program. http://www.epa.state.il.us/water/financial-assistance/publications/igig-progress-report.pdf

GREEN INFRASTRUCTURE FOR COASTAL RESILIENCE PILOT GRANT PROGRAM – Provides financial and technical support to better understand and implement natural approaches to mitigating coastal and flooding problems. Grants support the planning, feasibility assessment, design, permitting, construction, and monitoring/evaluation of green infrastructure projects. Grants are available to 78 municipalities within the Massachusetts coastal zone. http://www.mass.gov/eea/agencies/czm/program-areas/stormsmart-coasts/green-infrastructure-grants/

URBAN WATERSHED STEWARDSHIP GRANTS – This program has partnered with the City's Community Challenge Grant Program (CCG) to offer grants for projects which help to manage stormwater using green infrastructure within San Francisco's watershed. Grants support the planning, design, and construction of green infrastructure projects that address stormwater issues as well as provide recreational and education values to the community. http://sfwater.org/index.aspx?page=104

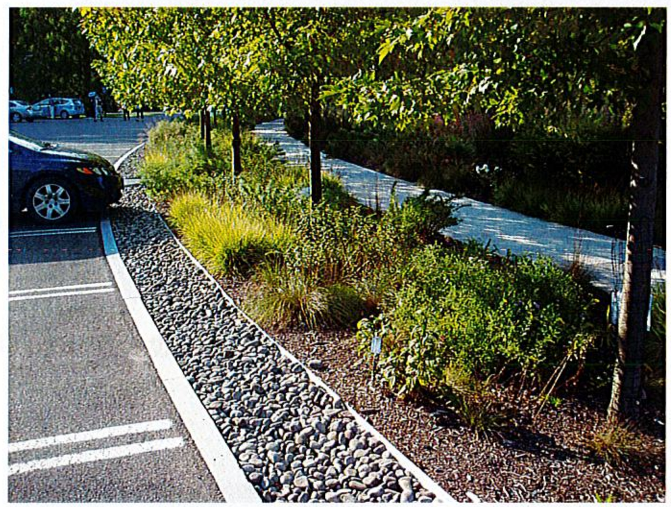
COMMUNITY DEVELOPMENT BLOCK GRANT PROGRAM – This is a flexible program that provides communities with resources to address a wide range of unique community development needs. This program provides annual grants to local governments and States and is comprised of various sub-programs which target more specific needs of the regions and local communities (e.g. climate change threats, water quality, housing availability,etc.) http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs

VI. ACTIONS AND ACTIVITIES

Citizens Campaign for the Environment and National Wildlife Federation hosted two workshops in 2014 focused on catalyzing the use of green infrastructure for stormwater management in the Huntington-Harbor Complex. Included below are ideas that came from these meetings.

Updates to Land Using Planning and Zoning Requirements & Incentives

- Enhance the Department of Environmental Conservation (DEC) approval process to incentivize or require green infrastructure
- Include incentives for green features in bids
- Create model codes and standard expectations
- Develop draft language for municipalities to incorporate into their comprehensive plans, LWRP, and streetscape design
- Downtown revitalization grants can include green infrastructure components
- Include provisions in SPDES permits
- Allow for flexibility in site plans if developers incorporate green infrastructure



Educate and Recognize Leadership in the Development Community

- Develop upfront guidance for developers when they apply for a general permit so they can better understand how their development plans could incorporate green infrastructure from the beginning
- Create recognition and reward programs for developers
- Charge stormwater fees for impervious surfaces

Build Greater Public Awareness about Green Infrastructure

- Develop communications and outreach plan
- Create a green infrastructure tour, create an on-line version as well, list all of the exemplary projects in the area (Good examples include the Onondaga County Program, Save the Rain;Town of Oyster Bay, North Hempstead; and the City of Bridgeport)
- Create a web site and pamphlets to help explain the opportunities, options, and products that are available
- Collect and communicate about local progress on GI to towns throughout Long Island

Partner With Schools and Universities

- Schools present an opportunity for GI projects like food or rain gardens; school parking lots can act as possible demonstration sites
- special construction funding can be available
- Universities and Community Colleges could also be good sites for demonstration projects

VII. OPPORTUNITIES FOR GREEN INFRASTRUCTURE IN HUNTINGTON-HARBOR COMPLEX

Included below are potential sites that could use green infrastructure to mitigate the area's stormwater issues, as well as opportunities for partnerships and outreach efforts.

Potential Green Infrastructure Demonstration Sites

Huntington, NY

MUNICIPAL PARKING LOTS – Municipal parking lots are one of the leading contributors to Huntington's large amount of impervious surfaces, through which rainwater is unable to infiltrate and percolate into the ground. These parking lots allow an immense amount of stormwater to run across the surface, washing away pollutants, and nutrients. These sites have the potential to incorporate permeable pavement with green spaces (e.g. bioswales, bioretention basins, and rain gardens) to maintain the current level of parking spaces. Even though the more cost-effective method may lie in removing tar and implementing green islands, there are products of permeable pavement that use less expensive materials.

RED RESTAURANT – Red Restaurant, located at 417 New York Avenue, Huntington, NY 11743, and its neighboring building have been identified as prospective locations to implement green roofs and solar panels. Red would gain great visibility as a demonstration site and is just one of many multi-story redevelopment projects that are being planned in the area. Red's plan could be a leading example and be expanded to all other development projects that can accommodate green roofs. This idea not only mitigates the town's stormwater issues, but also prevents the reduction in parking spaces.

MAIN STREET & NEW YORK AVENUE PARKING LANES – One of the biggest issues in the village is available parking space. One solution that will maintain parking space and mitigate stormwater issues is to replace the impervious pavement in parking lanes with permeable pavement. Furthermore, implementing rain gardens in front of rain gutters will allow for cleaner water to enter gutters when overflow events occur.

Huntington Bay, NY

FLEET'S COVE & BAY HILLS BEACH ASSOCIATION – Both of these clubs are particularly important as demonstration sites because of their visibility to the public, frequent use, and proximity to Long Island Sound. Each of them have issues related to saltwater intrusion and runoff and have large impervious parking lots, which can exacerbate runoff issues. Suggestions for both of these sites include the installation of permeable pavement, bioswales, and tree boxes to deal with any runoff and decrease the potential for nutrients and pollutants leaching into Long Island Sound. Implementation of backflow protectors and tide gates could prevent saltwater intrusion.

Northport, NY

MAIN STREET PARKING LOTS – Bordering Northport Harbor, the Village of Northport has many large parking lots, with impervious surfaces, directly along the harborfront and all along Main Street, which runs downhill in the direction of the harbor. The elevation and topography of this area poses some real challenges in mitigating stormwater issues as large amounts of water run downhill during major storms. Stormwater collects in these parking lots, increasing the potential of runoff. It is imperative to capture this stormwater uphill before it reaches the harborfront. To add to the complexity of this situation, a 4-foot sea level makes any kind of underground stormwater storage system very difficult to implement. Given these complexities, many parking lots along Main Street, uphill from the harbor, have been identified as potential green infrastructure sites to capture the stormwater before it runs downhill into the harbor.

Opportunities for Partnerships, Outreach, etc.

Key partnerships and outreach efforts were identified as means of advancing the implementation of green infrastructure. These players include schools and universities, municipalities, and churches.

SCHOOLS & UNIVERSITIES – Not only could a number of green infrastructure techniques be installed directly on school properties, but schools provide crucial opportunities to educate the local community. Partnering with universities and colleges can also provide additional educational programs for local schools. For example, the Cornell Cooperative Extension offers a free educational program about stormwater and green infrastructure. For elementary schools, they offer an educational component combined with the hands on activity of building various green infrastructures. Furthermore, local schools that achieve a net zero environmental impact and ensure the environmental and sustainability literacy of their graduates are eligible to receive a recognition award from the U.S. Department of Education through National Wildlife Federation's Green Ribbon Schools awards program. More information on this program is available. http://www.nwf.org/Eco-Schools-USA/About-Eco-Schools-USA/Green-Ribbon-Schools.aspx

CHURCHES – Churches also act as valuable partners because of their outreach capabilities and the fact that they typically own parking lots that can act as possible demonstration sites. Much like schools, churches have the capability to educate and inform individuals directly within the community and to reach a broad audience. The Village of Northport is already working with St. Philip Neri and the Presbyterian Church to install additional catch basins in their parking lots. Many churches have been identified as potential sites because their lots are underutilized most days of the week.

MUNICIPALITIES – A key theme in implementing green infrastructure should be focused on the idea of connectivity – not only how existing and potential projects interconnect, but also how all of the municipalities interconnect and work together to manage stormwater. By working together, municipalities can help mitigate and solve issues related to funding, outreach, education, and recognition. Collaboration amongst multiple municipalities will help to address the many water quality and stormwater issues of the area and help us understand how all of the projects fit together to address these issues.

The Inter-municipal Council (Northport, Asharoken, and Huntington) was created to seek out more funding and to form partnerships with other organizations in order to address many of these issues. Similarly, the Oyster Bay-Cold Spring Harbor Committee is also composed of representatives from neighboring municipalities with the goal of creating partnerships to improve the water quality of the watershed on the North Shore. This committee, in particular, is seeking more representation from residents in the Huntington Harbor region. There is a great opportunity for these councils and committees to work together to apply for funds, potentially do group purchasing, and target the most opportune grants available.

Yet, unwillingness to fully embrace green infrastructure is a limiting factor to the fulfillment of these ideas of connectivity and inter-municipal collaboration. This government push-back against implementation may be due to the lack of information and understanding of the environmental benefits and funding opportunities for green infrastructure. One option to improve on this lack of understanding and knowledge is to hold educational forums to provide this crucial information to government leaders, consultants, and their staff. Topics to be covered in these forums could include funding opportunities, discussions on what's required to apply for grants and how to effectively create an appealing grant proposal, teachings on the steps required to apply for grants, and discussions on the environmental and financial benefits associated with green infrastructure. Furthermore, a "Green Infrastructure Tour" of the area could be held as a beneficial follow-up event in order for everyone to see firsthand what is possible. The key is to educate the leaders in the government who could have the greatest impact.

VIII. ADDITIONAL RESOURCES

General Information on Green Infrastructure

EPA GREEN INFRASTRUCTURE TOOLKIT – http://water.epa.gov/infrastructure/greeninfrastructure/index.cfm#tabs-1

EPA PLANNING AND MODELING GREEN INFRASTRUCTURE FOR COMBINED SEWER OVERFLOW (CSO) CONTROL – http://water.epa.gov/infrastructure/greeninfrastructure/upload/Greening_CSO_Plans.PDF

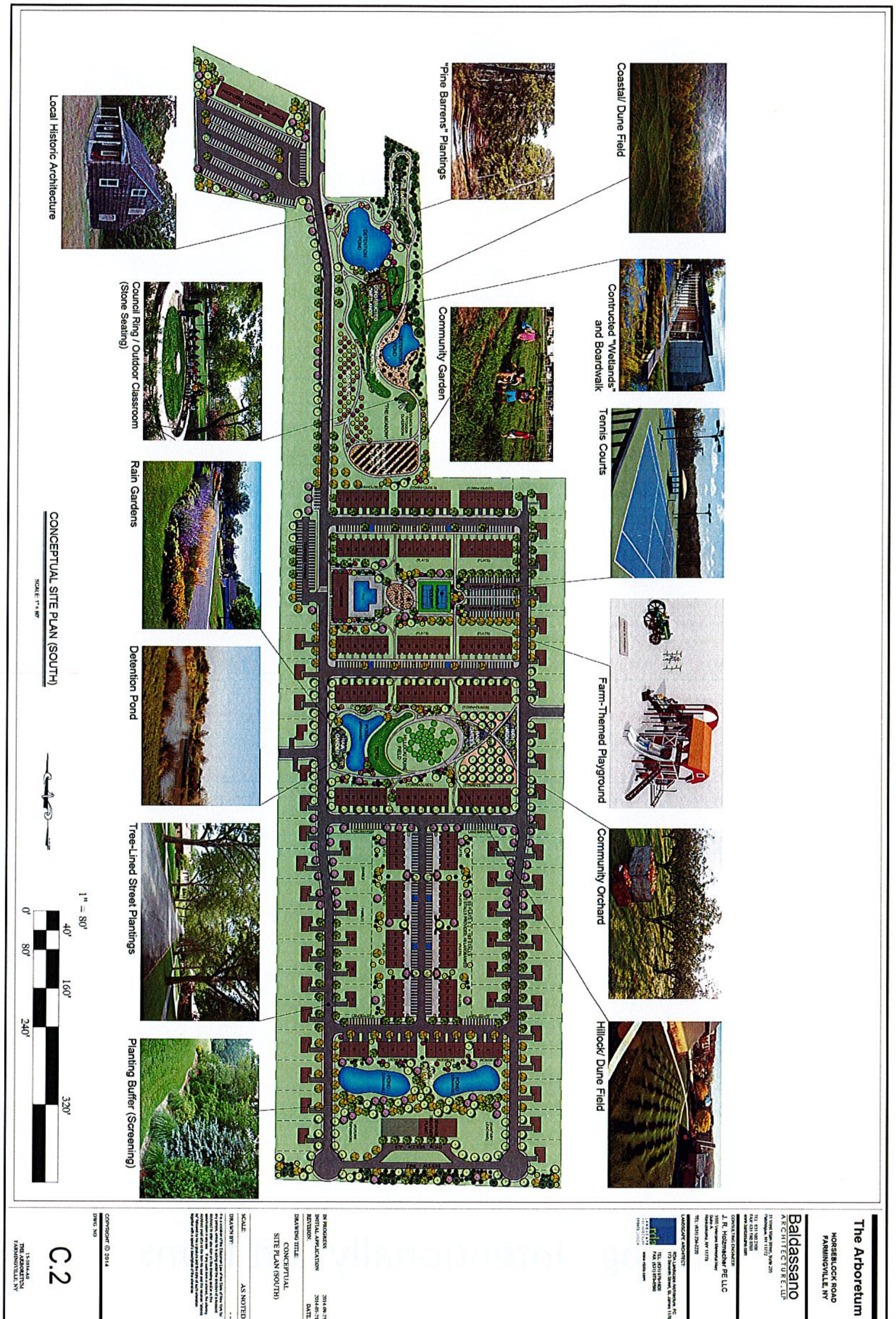
FUNDING SOURCES – http://water.epa.gov/infrastructure/greeninfrastructure/gi_funding.cfm

Information on School and University Programs

EPA CAMPUS RAINWORKS CHALLENGE – Challenge for undergraduate and graduate students. Once again, EPA is inviting student teams to design an innovative green infrastructure project for their campus showing how managing stormwater at its source can benefit the campus community and the environment. http://water.epa.gov/infrastructure/greeninfrastructure/crw_challenge.cfm

GREEN STREETSCAPES – http://www.epa.gov/brownfields/sustain_plts/reports/Streetscapes_Final_7_31_09.pdf

IX. SAMPLE SITE PLAN



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