Appendix E-1 – Approaches and Perspectives on GSI and Other Source Controls

APPROACHES AND PERSPECTIVES ON GSI AND OTHER SOURCE CONTROLS

The sewage overflows from the ALCOSAN and municipal systems result from wet weather. Rain and snow melt get into the municipal combined sewer collection systems through catch basins and other drains, since these systems were designed to carry both wastewater and stormwater. Historically, some streams were culverted and came to be used as combined sewers, resulting in stream inflow consuming valuable conveyance and treatment system capacity. Stormwater can also enter the municipal sanitary sewer systems (SSSs) during wet weather, even though these systems were not designed to carry stormwater. Groundwater infiltrates into the building lateral sewers that connect to the street sewers and into the municipal sewers through cracks and other faults when groundwater levels are high. Stormwater can enter sanitary sewers through illicit cross connections from storm sewers and can flow directly into sewers through low manholes. If the volume of water flowing into sewers during wet weather could be sufficiently reduced, and peak wet weather flows could be attenuated, the need to control sewage overflows using grey infrastructure (pipes, tanks, tunnels, etc.) could decrease.

From the perspective of controlling sewer overflows, green stormwater infrastructure (GSI) and inflow and infiltration (I/I) control through sewer repairs and rehabilitation accomplish the same goal of reducing the volume of water in sewers during wet weather. They both are source controls. This appendix describes the major GSI and I/I source control technologies which can be applied in a wet weather program. This appendix also expands on the national and regional perspectives on controlling Combined Sewer Overflows (CSOs) through green stormwater infrastructure (GSI), as found in Section 2 of this document, as well as the implementation of GSI among the municipal, county, state and federal agencies active within the ALCOSAN service area.

A.1 Approaches to Source Control

A.1.1 Green Stormwater Infrastructure Technologies

Originally referred to as stormwater best management practices (BMPs), today GSI is emerging as an integrated array of techniques that emphasize infiltration and evapotranspiration over decentralized storage as the principal control mechanisms. Some of the early considerations of GSI came about through the practice of Low Impact Development (LID) planning, which merged concepts of stormwater BMPs into property development practices. In a 2004 Report to Congress[A-1], USEPA offered the following with respect to LID techniques:

> "While the concept of using LID to control storm water runoff is familiar, the application of LID techniques for CSO control has been limited (University of Maryland 2002). It is unlikely that LID technologies alone are sufficient to fully

[A-1] USEPA. Report to Congress on the Impacts and Control of CSOs and SSOs. 2004. EPA 833-R-04-001.

control CSOs, yet they have shown promise as part of larger programs in reducing the size of structural controls (e.g. storage). The use of LID as an SSS (separate sanitary system) control is limited to situations in which LID might contribute to inflow control. LID has great potential as a stormwater control for the separate storm sewer system that compliments an SSS."

Contemporary stormwater management planning often includes GSI as a part of comprehensive development and re-development strategies for restoring urban and suburban watersheds through the control of stormwater runoff at its source. GSI technologies mimic natural watershed functions while supplementing the hydraulic and hydrologic needs of surrounding sewer infrastructure. A typical GSI installation will perform some or all of the following functions:

- Intercept stormwater runoff from a designated impervious area;
- Infiltrate stormwater and recharge groundwater aquifers;
- Vegetative absorption of stormwater and associated evapo-transpiration of water back into the air;
- Removal of contaminants through vegetative and soil absorption;
- Evaporation of stormwater back into the air; and
- Slow release of stormwater runoff back to the combined sewer system when design capacity is exceeded.

Figure A-1: Example of Curb Cut-out with Bio-Swale at ALCOSAN Customer Service & Training Building

Green stormwater controls are designed to repair the effects of urbanization on watersheds and to restore natural hydrologic conditions. In doing so, GSI supports several watershed protection functions, including sewer overflow control. When examined as a holistic system, GSI serves as a means of collection, storage, treatment and conveyance which can reduce the size or need for traditional sewerage and related system improvements.

Applications of GSI are designed to fit the surrounding land use and desired functionality at the site. There are several basic types of GSI applications, and from these, various combinations and permutations are

Figure A-2: Example of Green Roof at Carnegie-Mellon University

created for a site-specific installation. Some typical applications include:

- Bio-retention;
- Pervious pavement and related brick or block applications;
- Green roofs;
- Rain gardens;
- Rain barrels;
- Stormwater wetlands; and
- Street tree trenches/stormwater planters/curb bump outs.

For the purpose of sewer overflow control, green stormwater controls provide overflow volume reduction in combined sewered and sanitary sewered systems. Sanitary sewer applications include disconnecting roof leaders, yard drains, sump pumps, and pumped foundation drainage and directing the flows to infiltrate greened areas such as lawns, stormwater planters, and rain gardens. The application of GSI can play an important role in sanitary sewer overflow (SSO) reduction programs. In cases where sewer overflows are not a concern, GSI also plays a role in combined and sanitary sewer systems by reducing runoff contaminants, stream flow variability and resultant aquatic life habitat degradation. As a result, GSI installations are common BMPs applied as a part of municipal separate sanitary sewer system (MS4) National Pollutant Discharge Elimination System (NPDES) permit compliance programs.

As the number of GSI projects grows throughout the country, more is being learned about the direct and indirect benefits of these stormwater management practices. The primary benefits to sewer overflow control programs are reduction of overflow volumes, peak flow rates, and pollutant loadings. Some of the indirect benefits which can be realized through GSI installations include:

- Community benefits through aesthetic enhancements that can increase the quality of urban life and improve property values;
- Health benefits beyond sewer overflow control, such as reduction of urban "heat island" effect and improved air quality;
- Increased urban wildlife habitat;
- Hydrologic benefits through more sustainable watershed management practices which recharge aquifers, reduce storm damage to riparian habitats, and use less energy by limiting the pumping of flows through traditional conveyance and treatment systems;
- Economic opportunities for GSI contractors with sustained maintenance jobs; and
- Low capital investment for residential property owners, encouraging community participation and supporting public education programs.

A.1.2 Other Source Controls

Categorizing source control techniques as GSI is subject to debate depending on how the "green" element is interpreted. For example, pervious pavement or rooftop interception and storage are not particularly green, as they involve no vegetation and therefore no evapotranspirative control elements, but yet they often are included among GSI technologies. In fact, today most source controls and other traditional stormwater BMPs often are considered to be "green" in that they represent a sustainable stormwater management practice.

In addition to the GSI technologies discussed in Section A.1.1, there are several methods of inflow and infiltration (I/I) source control which can benefit both combined (infiltration control) and sanitary sewer areas (inflow and infiltration control). I/I reduction involves the disconnection of inflow sources and the repair or replacement of faulty pipes and appurtenances to reduce groundwater infiltration. I/I reduction can work in conjunction with other GSI controls, and traditional grey infrastructure controls, or they can work as stand-alone solutions.

Both public (municipal street sewers) and private (building lateral sewers) can be subject to inflow sources and groundwater infiltration (GWI). A 2006 Water Environment Federation (WEF) guide[A-2] suggests that all source categories, public and private, must be controlled to adequately address I/I; noting that "if only some of the sources are controlled, then the rainwater often migrates to the nearest uncontrolled source resulting in little, if any, benefit to the sewerage system." This point was reinforced in a study of I/I conducted by the Northern Kentucky Sanitation District No. 1 in 2006.[A-3] The study cited evaluations conducted in five cities in which it was estimated that the percentage of I/I from private property ranged from 20% to 80%. USEPA also estimates that a significant portion of GWI may originate from building lateral pipes – the pipes on private property that connect buildings to the public collection sewers in the streets.[A-4]

In the Pittsburgh region, a source of inflow in the combined sewered areas is the direct connection of streams to the sewer system. During development eras that pre-date ALCOSAN, natural urban streams were sometimes culverted and sanitary and storm lines were directly connected to the culvert, thus transforming them into combined sewers to serve a variety of urban developmental needs. This concept is illustrated in Figure A-3, which displays approximate locations of historic streams within the ALCOSAN service area. The direct stream inflows carry stream base flow and stormwater runoff during wet weather into the combined sewer system, thus taking up hydraulic capacity. These stream inflows also let grit, debris and sediment into the sewer system creating further hydraulic and interceptor maintenance issues. Continued conveyance and treatment of these flows at the Woods Run Wastewater Treatment

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A-2 Water Environment Federation. Guide to Managing Peak Wet Weather Flows in Municipal Wastewater Collection and Treatment Systems. 2006.

A-3 Sanitation District No.1 of Northern Kentucky. Inflow and Infiltration from Private Property. 2006, prepared by Strand Associates, Inc.

A-4 USEPA. Review of Sewer Design Criteria and RDII Prediction Methods. EPA 600/R-08/010. 2008.

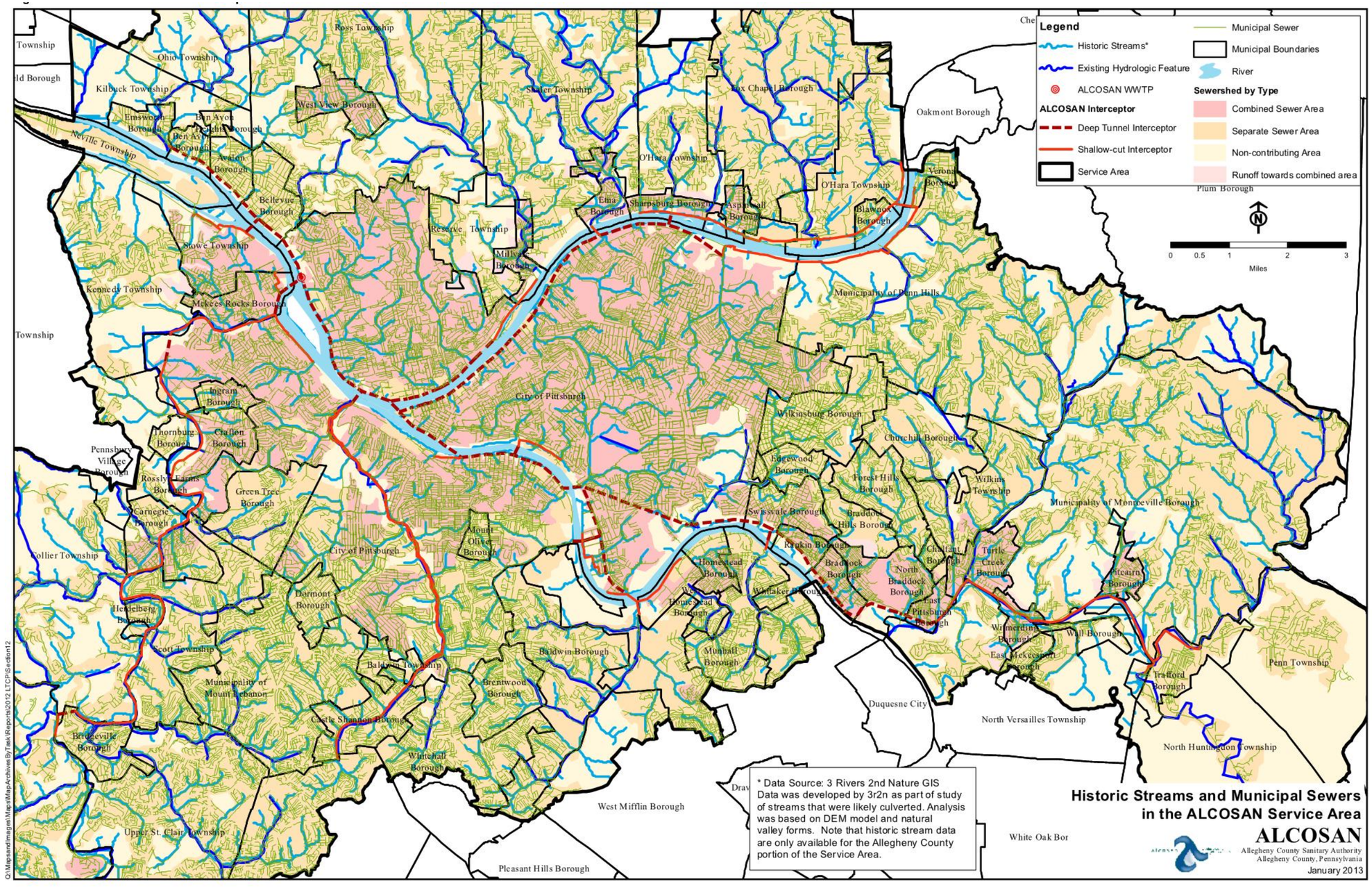

Figure A-3: Historic Stream Map

Plant (WWTP) wastes valuable system capacity and energy while preventing the natural ecological function which preserved, undeveloped streams provide.

To eliminate these unnecessary burdens on the collection system, a stream connection must be removed or rerouted while restoring the ecological functionality of the naturally occurring stream. ALCOSAN has proactively implemented several direct stream inflow removals and stream restoration efforts.

ALCOSAN continues to target control of this inflow source as a high priority overflow control measure in coordination with customer municipalities. An example of a direct stream inflow removal and stream restoration at Jack's Run, located between Bellevue Borough and the City of Pittsburgh, is shown in Figure A-4.

Figure A-4: ALCOSAN Direct Stream Inflow Removal and Stream Restoration at Jack's Run

Controlling GWI is intended to preserve the hydraulic design capacities and reverse the effects of deterioration for pipes in both combined and separate sewer systems.

Techniques to control GWI can involve non-structural and structural rehabilitation of existing pipes and appurtenances such as manholes. Non-structural repairs involve the sealing of leaks around joints of otherwise structurally sound pipes through the remote application of grouts and sealants without excavating the pipes.[A-5] Structural repairs involve the replacement of defective pipe segments or the lining of existing pipes using trenchless technologies. The pipes can be "slip lined" by pulling a flexible plastic inner pipe of slightly smaller diameter through the existing pipe. Building connections are restored after installation by remote devices that cut through the slip lining. Pipe linings can also be "cured in place" in which a thermo plastic resin impregnated felt composite liner is inverted (pulled inside-out) through the pipe and then heat cured using hot air or hot water. Pipe bursting can also be used. Under this technique, a bursting tool is pulled through the existing pipe to break it and make room for a new continuous plastic pipe, often of a somewhat larger diameter, thereby increasing hydraulic capacity.

The ability of municipalities to address infiltration from private property can be limited by legal constraints on the ability to use public funding to improve private properties and by concerns that

[A-5] Optimizing Operation, Maintenance, and Rehabilitation of Sanitary Sewer Collection Systems prepared by the New England Interstate Water Pollution Control Commission, 2003.

publicly funded repairs to private lateral sewers impose a long term maintenance obligation on the municipality. Source reduction is also complicated by building foundation drains and downspouts that may be connected into the sanitary collection sewers and are likely connected in combined collection sewers. Most municipalities have ordinances requiring the documentation that downspouts are not connected to the municipal sanitary sewers at the time of property sale. Downspout disconnection also can be an effective source control which can be coupled with other GSI technologies to ensure adequate drainage and infiltration. Foundation drainage is more complex and can be expensive for a homeowner to address, but is another source control which can reduce the burden on sanitary and combined sewers. These issues led to one creative alternative wherein badly leaking sanitary sewers were repurposed as drainage and new water-tight plastic pipe collection sewers and building laterals are installed. In some cases inflows occur due to storm inlets being improperly connected to the sanitary sewer system. Identifying and disconnecting these improperly connected storm inlets is another source control measure municipalities might employ in eliminating sanitary sewer overflows.

A.2 National and Regional Perspectives on GSI

This sub-section expands on the national and regional perspectives on controlling CSOs through GSI, as found in Section 2 of this document. Included are additional details and other examples of GSI implementation practices found in other cities. This sub-section also expands upon the current roles and responsibilities for the implementation of GSI among the municipal, county, state and federal agencies active within the ALCOSAN service area.

A.2.1 National Perspectives

National Institutional Practices in GSI Implementation

As programmatic GSI implementations have gained in sophistication, examples of implementation practices of other cities have emerged which could be applicable to ALCOSAN and the municipalities.

MUNICIPAL ORDINANCE COORDINATION:

- **USEPA's Water Quality Scorecard provides a municipal self-audit for GSI impediments;**
- **Chicago has developed integrated site plan reviews;**
- **Philadelphia has integrated water, stormwater and sewer planning into zoning permit applications; and**
- **Pittsburgh's stormwater management ordinance requires the maximum feasible use of LID when projects involve public funding.**

Municipal Ordinances and Green Stormwater Infrastructure

A commonly cited concern is the need to update existing municipal codes and ordinances to allow municipalities to implement GSI and meet future water quality objectives. The USEPA has issued its *Water Quality Scorecard*[A-6] to guide municipalities through this assessment of codes, ordinances and practices among varying institutional partners and identify potential inconsistencies. The City of Chicago put this approach into practice through its Department of Environment's review of city-wide development ordinances related to GSI design. Chicago produced a guide with suggestions for avoiding inconsistencies in GSI implementation such as integrated site design plan reviews and GSI

A-6 USEPA. *Water Quality Scorecard* can be accessed at: http://www.epa.gov/smartgrowth/water_scorecard.htm

maintenance requirements in addition to code improvement suggestions to accommodate GSI design.[A-7] The City of Philadelphia requires the approval of water, sewer and stormwater plans prior to issuing zoning permits.[A-8]

Stormwater Management Ordinances

As cities or agencies plan for GSI on a broad scale, there has been a need to modify ordinances that govern stormwater management and flood control for new development and redevelopment in order to accommodate GSI installations. Typical regulations require property owners to manage the quantity of stormwater runoff (and sometimes quality as well) via certain volume-based performance standards or by requiring no increase in post-development run-off. Certain cities require the use of GSI technologies to the maximum extent feasible.

The City of Philadelphia's stormwater regulations were updated in January 2006. The regulations require that every development/redevelopment project initiated within the City limits with an area of disturbance greater than 15,000 square feet must manage the first inch of runoff from the site.[A-9] Philadelphia estimates that 1% of its total land will undergo redevelopment in a given year[A-10], thus this policy is considered part of a long term strategy to be supplemented by other stormwater management options. New York City's GSI program anticipates 5% of its expected city-wide target to come from new development and redevelopment.[A-11] The City of Pittsburgh modified its redevelopment stormwater ordinances[A-12] to encourage private developers to pursue LID strategies and require that publicly funded projects utilize LID to the maximum extent technically feasible.

Design Manuals

Some cities are supplementing their modified ordinances by developing GSI design manuals to provide design and performance standards. These typically expand upon an existing design manual for a city or utility, and include items such as GSI design criteria and performance goals, examples of how to meet these goals, suggestions for designing around common site constraints, descriptions of the required steps for getting the design approved and permitted and lessons learned in applying specific GSI technologies.

There is no federal guidance on how to develop GSI design manuals at a community level. Pennsylvania issued its Stormwater BMP Manual in 2006[A-13], with similar manuals developed in Maryland, Michigan, New York and other states.

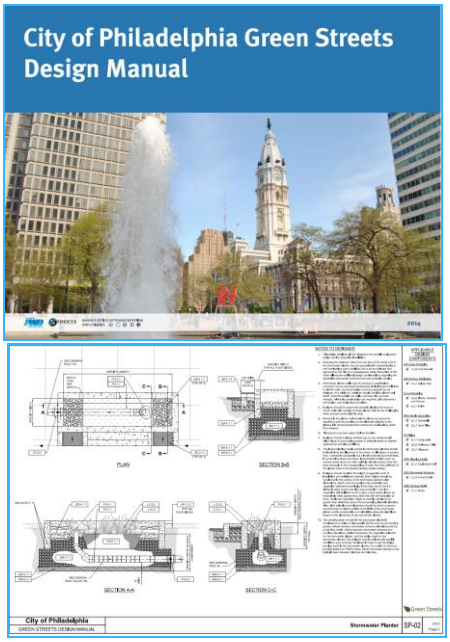

Figure A-5: The City of Philadelphia issued its GSI design manual in 2014

A-7 City of Chicago. *Adding Green to Urban Design,* 2008.
A-8 USEPA. *Green Infrastructure Case Studies*. EPA-841-10-004, 2010, p. 17.
A-9 PWD. *Green City, Clean Waters: Program Summary*, 2011 pg. 39.
A-10 PWD. *Green City, Clean Waters Implementation and Adaptive Management Plan (IAMP)*, 2011.
A-11 The City of New York. *Green Infrastructure Plan,* 2009, p. 5.
A-12 Pittsburgh Zoning Code, §§1003.04-1003.4A, accessed at: http://www.municode.com/Library/PA/Pittsburgh.
A-13 PaDEP. *Stormwater Best Management Practices Manual*, 2006. Section 8.8: "Non-Structural BMP Credits."

At a city level, the Louisville Municipal Sanitation District has issued a comprehensive Green Infrastructure Design Manual which includes design standards and strategies, site selection guidance and key facts on GSI technologies. The City of Philadelphia released its Green Streets Design manual in 2014.

APPROACHES TO GSI MAINTENANCE:

- **GSI on public property is typically maintained by the municipality;**
- **GSI on private property is recorded in the property title (Portland, OR);**
- **Milwaukee installs GSI on easements and provides rebates in exchange for property owners maintaining the GSI; and**
- **Wayne County (MI) issues long-term stormwater maintenance permits.**

Inspection and Maintenance Agreements

Inspection, maintenance and enforcement provisions for GSI are typically established in the municipal or agency ordinance that governs GSI and/or stormwater, but standard legal agreements for maintenance and inspection also have to be developed. For projects that are in the public right-of-way, the city or public authority will typically assume ownership and supply maintenance through its existing staff or contracted services.

As GSI is implemented on private property, maintenance arrangements can take different forms. Cities often develop enforceable agreements in which private property owners are responsible for maintenance. In Portland, OR GSI facilities on privately-owned, non-residential properties are recorded as part of the property title and owners are legally required to maintain them through an arrangement with the Bureau of Environmental Services. Portland conducts regular inspection of these GSI facilities and enforces fines for facilities not in compliance. A similar process is used in Philadelphia private GSI installations.[A-14] Milwaukee provides private businesses with an easement agreement in which they receive a stormwater fee rebate from the City contingent on the business funding proper maintenance. The easement is structured to result in an expected 'net zero' cost to businesses in that the cost to maintain is approximately equal to the stormwater fee rebate.[A-15]

The Wayne County, MI Stormwater Management Standards[A-16] require stormwater management systems to be maintained in perpetuity to ensure that they function effectively as designed and includes various enforcement provisions. The county issues a long-term maintenance permit for each project that identifies, among other items, the limits of the stormwater system, the party responsible for maintenance, and the activities required to ensure that the system functions effectively.

Figure A-6: Ongoing maintenance at the Allegheny County office building's green roof

A maintenance option which has had mixed results in partnerships with non-governmental agencies and community organizations. These partners can provide an enthusiastic and knowledgeable volunteer base, but it is important that they have a long-term ownership and funding responsibility committed to GSI

A-14 Water Department. *Green City, Clean Waters – Implementation and Adaptive Management Plan*, 2011. Section 5.2.1.2 (pg. 5-4).
A-15 The Nature Conservancy. *Greening Vacant Lots: Planning and Implementation Strategies*, 2012, p. 35.
A-16 Accessed at: http://www.waynecounty.com/doe/1172.htm

maintenance. This proved to be successful in Cleveland where The Cleveland Botanic Garden has experience and funding dedicated toward developing summer programs with youth employment. They partnered with the Northeast Ohio Regional Sewer District (NEORSD) to train and employ young people to conduct maintenance for summer jobs, which enhanced community benefit and acceptance of the NEORSD effort within the community.

As part of the City of Philadelphia's *Green City, Clean Waters* plan, the Philadelphia Water Department is seeking opportunities to manage stormwater on vacant land utilizing green stormwater infrastructure.

Figure A-7: Philadelphia is pursuing opportunities to install GSI on vacant or abandoned parcels

Philadelphia's public GSI demonstration projects, identified the need to ensure that GSI is treated as a capital asset, such that it is input into geographic information systems planning databases which other public agencies access. It is also critical that GSI installations be incorporated into the PA One Call database in the event underground construction causes GSI to be temporarily disconnected or otherwise compromised.

Interdepartmental and Interagency Coordination

GSI on public lands such as street rights of way cuts across traditional public works departmental jurisdictions, e.g. the street department, water or wastewater utility, landscaping, etc. Nationally, cities with GSI programs are developing interdepartmental coordination protocols.

Chicago, Philadelphia, and Portland have ongoing Green Streets programs. Portland's Green Streets Program integrates planned capital improvements projects between the City Bureaus of Transportation and Environmental Services to identify opportunities to add GSI into planned transportation improvements.[A-17] Chicago has led an effort to create alleyways which enhance infiltration throughout the city and has determined that the current green alleyway retrofits are cost competitive with traditional asphalt repaving.

The Philadelphia Water Department (PWD) has a pilot liaison program with Streets Department to align capital improvements schedules for road construction with GSI targeted areas where feasible and to standardize cost-sharing and maintenance agreements among the departments. Long-term goals include developing a standard review process for considering green streets enhancements into all transportation projects, and other evaluations reconsidering impervious surface requirements for on-street parking.[A-18]

GSI CUTS ACROSS TRADITIONAL DEPARTMENTAL BOUNDARIES:

- **Streets;**
- **Parks and landscaping;**
- **Wastewater and stormwater;**
- **Parking authorities;**
- **Planning and zoning; and**
- **Community development.**

A-17 *Green Infrastructure Case Studies*, p. 19.
A-18 PWD. *IAMP*, p. 4-25.

Smaller cities such as Santa Monica, CA incorporate GSI into all capital projects due to the small number of staff which review, inspect and approve on-site stormwater management plans.[A-19] Philadelphia's *Green City, Clean Waters* Program is providing an example of evolving partnerships with other public entities such as the Philadelphia Housing Authority, the Department of Parks and Recreation, the Philadelphia Industrial Development Corporation, the School District of Philadelphia and the Southeastern Pennsylvania Transportation Authority among others. PWD's overarching goal is to integrate GSI planning into the long-term planning efforts of these departments and to ensure that maintenance and liability concerns are addressed.

Some of the unique institutional partnership details highlighted in PWD's *Implementation and Adaptive Management Program* include:

- Coordinated tree plantings in priority areas with Philadelphia Parks Department.
- Expand Stormwater Management Incentives Grant and Loan Program with Philadelphia Industrial Development Corporation to better facilitate private property retrofits.
- Work with Licenses and Inspection Plumbing Board to require as-built record drawings of Stormwater Management Plans before issuing certificates of occupancy.
- Exploring public/private partnerships with major universities in PWD service area.

Identify and Work with Effective Neighborhood Partners

Several GSI installations have shown successes through inclusion and partnership of neighborhood organizations and non-governmental organizations. The City of Seattle involves community organizations directly in the planning process and produces completed individual neighborhood plans for GSI. Residents of each neighborhood have had influence on the designs and determined multiple use functions to ensure better acceptance of the GSI installations. Community input in the planning process is also important when neighbors can identify unforeseen issues which can hamper GSI acceptance and performance. The City of Baltimore had installed tall vegetation in a community with street crime issues without working with neighborhood residents on the design. Concerned over the potential for illicit activity, well-intended residents cut down the vegetation, which negatively affected the performance of the installation.[A-20]

Working through Land Banks to Create GSI Opportunities on Vacant Lots

Some cities have enacted measures to develop or work with land banks to implement GSI. Generally speaking, land banks are agencies created for the purpose of having the ability to acquire tax delinquent vacated lands for the purpose of repurposing it for public or private ownership. These single purpose organizations can be structured to work across cross agency and jurisdictional lines. Nationally, land banks which have used their authority to repurpose land for stormwater management using GSI has occurred in Chicago, Genesee County, MI, Cleveland, Detroit and New Orleans. Agreements to implement GSI on vacant lands have been used by the NEORSD and the Detroit Water and Sewerage Department. In January 2013, Governor Corbett signed Pennsylvania

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A-19 *Green Infrastructure Case Studies*, p. 19.
A-20 *Greening Vacant Lots* p. 63.

Act 153 of 2012 into law. This law allows any county, city or borough with a population of at least 10,000 to establish a land bank which would acquire delinquent properties untaxed for 5 years to be used for public or private purposes.[A-21] The Pittsburgh City Council created a land bank on April 14th, 2014.

A.2.2 Regional Perspectives

This sub-section expands on the current roles and responsibilities for the implementation of GSI among the municipal, county, state and federal agencies active within the ALCOSAN service area.

A.2.2.1 ALCOSAN's Roles in Promoting GSI and Other Source Controls

ALCOSAN has taken a lead in advocating flow management practices such as source controls in coordination with its customer municipalities, who have control over the flows ALCOSAN receives. ALCOSAN's advocacy includes provision of technical information and support in developing green concept plans, pursuit of state and federal funds, partnership with municipalities in the implementation of green projects, development and distribution of public education fact sheets, and the construction of GSI at the WWTP. Some examples are summarized below.

Creation of Three Rivers Wet Weather (3RWW)

In 1997, ALCOSAN and the Allegheny County Health Department (ACHD) established the 3 Rivers Wet Weather Demonstration Program (now the 3 Rivers Wet Weather Program) as a 501(c)(3) non-profit corporation to provide technical assistance to the municipalities in addressing overflow compliance challenges, and as a funding mechanism for municipal wet weather control demonstration projects. Initial funding came from a $1.75 million appropriation through USEPA. This funding was matched by $1.43 million in in-kind technical support and administrative support from ALCOSAN and ACHD respectively. In 1999, 3RWWP awarded the first round of 26 municipal demonstration project sub-grants which focused primarily on municipal extraneous flow source reduction.

3RWW's initial focus was on the funding of municipal demonstration projects with an emphasis on source controls through such methods as sewer line replacement, manhole lining and pipe grouting. 3RWW also established stakeholder and advisory panels, and three Basin Groups (northern, eastern, and southern) to help educate public officials and coordinate municipal efforts. In 2004, the municipalities were placed under consent orders that required inspection, assessment and repair of the municipal sewer systems. The orders also required flow monitoring and the development of Municipal Feasibility Studies in coordination with the development of ALCOSAN's WWP.

3RWW developed basin engineering groups to define technical protocols and standards. These efforts evolved to the Feasibility Study Working Group (FSWG) to assist the municipalities in the evaluation of municipal wet weather control alternatives. The FSWG has issued more than twenty technical guidance documents, including Green Infrastructure Solutions and Strategies for CSO Control (Draft Guidance Document No. 21) and Guidelines for Performance of Flow Reduction Cost-Effectiveness Analysis (Guidance Document No. 13).

A-21 *ACT 153 of 2012* accessed at: http://www.legis.state.pa.us/WU01/LI/LI/US/HTM/2012/0/0153..HTM

Technical Information and Support to Municipalities

Acting as an advocate of GSI, ALCOSAN has pursued a variety of efforts to bring GSI to the region throughout the development of the wet weather plan. Seeking to provide technical information and support to municipalities in the evaluation of GSI as a CSO control measure, ALCOSAN hosted a workshop in May of 2010. Municipalities were provided with technical information regarding the benefits of GSI and methods for assessing overflow reduction potential. ALCOSAN also offered partnership in the pursuit of state and federal funds for implementing GSI projects. ALCOSAN originally scheduled two workshops. Unfortunately, few municipalities took advantage of the opportunity and as a result only one workshop was held.

Additionally, ALCOSAN has been integral in securing state and federal funding for a GSI pilot project in West View Borough. ALCOSAN's technical services included the development of green concept plans.

Downspout Disconnection Analysis

In 2005 ALCOSAN provided funding and technical assistance for an investigation examining the impact that disconnecting roof leaders have on CSO volume reduction within the Nine Mile Run watershed. A field investigation was conducted to estimate the percentage of properties with roof leaders directly connected to the combined sewer system using a small area of the sewershed. These results were then extrapolated to a larger sewershed area using GIS technologies and standard assumptions for land use and parcel size to determine which properties represented good candidates for successful disconnection and overflow volume reduction.

Properties which met selected criteria for disconnection were modeled to estimate the impact diverting rooftop runoff to grassed lawn areas would have on downstream CSO volume. Model results suggest that significant CSO volume reduction can be achieved by implementing downspout disconnection programs. This pilot study analysis was presented to an interested municipality and is being considered for expansion to other portions of the ALCOSAN service area. While implementation of a downspout disconnection program would be under municipal authority, ALCOSAN has and will continue to encourage implementation by providing technical resources as described herein.

Direct Stream Inflow Removal and Stream Restoration

ALCOSAN has long been a proponent for elimination of direct stream inflows and partnered with municipalities to fund and administer green stream removal and restoration projects. ALCOSAN has partnered with municipalities, municipal authorities, watershed associations, conservancies and neighborhood groups to complete five stream inflow removal projects and three stream restoration projects. Additionally, there are three ongoing stream inflow removal projects for which ALCOSAN is providing technical assistance in the form of engineering and funding pursuit services by serving as the lead legislative liaison and grant application writer. These efforts can be considered matching local funds under federal funding programs.

Stream restoration projects supported by ALCOSAN include the restoration of Nine Mile Run in Pittsburgh's Frick Park, the restoration of the Jack's Run stream (Pittsburgh and Bellevue) and the first in the area "daylighting" of the culverted stream in Pittsburgh's Sheraden Park. ALCOSAN is

currently supporting three more stream inflow re-routing projects, including an innovative acid mine drainage treatment and reuse project to divert acidic discharges into Dooker Hollow in North Braddock Borough.

LEED Certification and GSI at ALCOSAN WWTP

At ALCOSAN's Woods Run WWTP, two LEED certified buildings have implemented GSI technologies to aid ALCOSAN's understanding of the implementation and maintenance of these technologies. Bio-retention is used in the recently constructed Customer Service and Training Building parking lot and pervious pavement is a feature of the new Operations and Maintenance Building parking lot.

A.2.2.2 Municipal Institutional Innovations

City of Pittsburgh

City of Pittsburgh Stormwater Ordinance[A-22]

The City of Pittsburgh amended its zoning ordinances with respect to stormwater management in 2010, enacting stormwater volume reduction standards and encouraging the adoption of LID strategies to the maximum extent practicable for development and redevelopment projects. Under the amendments, regulated activities equal to or greater than 10,000 square feet in area or publicly funded developments or redevelopments must submit to the City a *Stormwater Management Site Plan* which meets the stormwater management standards designated for that particular regulated activity.

The ordinance targets for water quality control include use of LID strategies for the capture of the first inch of runoff from all impervious surfaces, with infiltration of the first one-half inch encouraged where site conditions permit. Post-development runoff volume may not increase above pre-development levels for all storms equal to or less than the two-year, twenty-hour duration rainfall event. For projects receiving public funds the capture requirement is 1.5 inches, equivalent to the 95th Percentile Rainfall Event. The 95th Percentile Rainfall Event will be recalculated every 5 years. If LID is demonstrated to be technically infeasible to meet the runoff capture requirements then the difference can be met through application of conventional capture technologies.

City Of Pittsburgh Facilities

Like Allegheny County government, Pittsburgh has adopted a general Green Infrastructure plan which includes GSI. The city public works department is responsible for 1,031 miles of streets, 330 buildings, 10 parks and 2,808 parcels of vacant land. Using building codes and tax credits, over 5,030 square feet of green roofs have been installed on 10 public and private buildings in the city since 2001.

The Housing Authority of the City of Pittsburgh has 18 housing communities under its sole control and an additional 8 under public/private partnerships. While the housing authority includes "green" in the director's mission statement, there is no over-arching plan. Each site and project has its own development plan which includes GSI. The Larimer Vision to Action Plan is a good example

A-22 Pittsburgh Zoning Code, §§1003.04-1003.4A

where the Housing Authority incorporated GSI into neighborhood redevelopment. Parks, including a stormwater park, gardens, an urban farm, permeable paving and open "green" space totaling 90 locations sited for GSI are all elements in the plan. HUD awarded a $30 million Choice Neighborhoods grant for implementation of the plan in June, 2014.

Pittsburgh Water and Sewer Authority

In conjunction with the development of its Feasibility Study, the Pittsburgh Water and Sewer Authority (PWSA) hosted a series of three public charrettes to build consensus on identifying and optimizing the GSI opportunities which exist within the city. These charrettes covered technical, financial, legal and institutional aspects of GSI implementation related to PWSA.

Related regional organizations including ALCOSAN participated in the charrettes determining benefits of GSI and addressing perceived impediments to a large scale GSI implementation. The series also assessed the existing local regulatory framework for its conduciveness to the implementation of GSI technologies and made suggestions for how incentives can be strengthened and barriers overcome in the implementation process. The charrette participants identified and discussed a number of potential institutional impediments to GSI within the PWSA service area, e.g.:

- Authority to implement;
- Inter-agency and inter-departmental coordination and collaboration;
- Maintenance costs and responsibilities;
- Public and stakeholder buy-in;
- Monitoring and regulatory compliance documentation; and
- Timing, financing and recognition of private GSI.

PWSA stated its intent to initiate time sensitive grey controls while evaluating the feasibility of GSI. It outlined a short term (five year) plan that involves coordination with ALCOSAN, neighboring municipalities and the regulatory agencies towards GSI initiatives during 2013. Early demonstration projects will also be identified. During years two through four, early demonstration projects will be initiated and a system-wide GSI alternatives assessment performed. During years four and five, the efficacy of the initial projects will be monitored and evaluated by the PWSA and an adaptive management plan update will be developed. The authority also announced that it intends to form a stormwater utility (fee structure).

PWSA'S FIVE YEAR GSI STRATEGY:

- **Initiate time sensitive grey controls;**
- **Evaluate the general feasibility of GSI;**
- **Identify early demonstration projects;**
- **Evaluate the results of early action projects; and**
- **Updated the Adaptive Management Plan.**

Municipality of Mount Lebanon Stormwater Rate Structure

Mt. Lebanon, a separate sewered municipality, established a stormwater utility funded by a dedicated fee though a municipal ordinance created in 2011.[A-23] Stormwater fee revenue can only be spent on capital improvements and operation and maintenance of stormwater infrastructure. The fee is structured such that households pay a monthly flat fee, and larger properties are assessed a fee based on the actual amount of impervious surface. A one-time fee credit is offered for installation of a rain-barrel and a recurring fee credit is offered for installation of larger capacity on-site detention. The fee demonstrates a direct mechanism for generating revenue for stormwater system operation, maintenance and improvement costs.

School Districts

There are 29 independent school districts with 202 buildings in the ALCOSAN service area. Eleven have publically recognized the need for "green" construction or rehabilitation in their budget or capital planning with most efforts usually focused on energy efficiency.

There are a few examples of source control projects coupled with environmental education coordinated with the municipality or economic development corporation. The Baldwin-Whitehall School District, for instance, provided the site for a bio-swale, bio-retention garden and a FocalPoint bio-filtration system at their high school. This project is a good example of multi-jurisdictional cooperation for the successful implementation of GSI, with the CDC, Penn State Center, Port of Pittsburgh, municipal and school district public works departments and students all taking on components to make the project a reality. Expected to capture 200,000 gallons of water, the site occupies 5,000 square feet of land along the flood prone Rt. 51 corridor.

Allegheny County

Allegheny County Countywide Stormwater Management Plan[A-24]

As part of its comprehensive land use plan *Allegheny Places*, Allegheny County is developing a county-wide comprehensive stormwater management program which complies with Pennsylvania Storm Water Management Act 167. To date, the county has completed Act 167 plans for six of its nine designated watersheds within the county. This comprehensive completion and update of all plans is intended to bring efficiency county-wide and will require municipalities to update their planning and zoning codes to conform with the county stormwater management plan within six months of adoption and approval of the plan.

These updates have the potential to further encourage GSI implementation. For instance, the 2010 Plan Update for Girty's Run, Pine Creek, Squaw Run and Deer Creek Watersheds (known as the North Hills Council of Government (COG) Act 167 Plan) includes provisions for new redevelopment projects to reduce impervious cover by 25% with pervious pavement or green roof systems or provide facilities to capture specific post development performance targets. Additionally, the North Hills

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A-23 Mt. Lebanon, Pennsylvania, Ordinance 3187, enacted August 9, 2011.

A-24 As referenced from http://www.alleghenycountyswmp.com/Home.

COG Act 167 Plan offers standardized guidance for stormwater planning on small properties which incorporates best management practices such as bio-retention and pervious pavement.[A-25]

Allegheny County completed a draft Phase 1 report for its Stormwater Management Plan (SMP) in April of 2014. Phase I included the identification of stormwater related problems, watershed characteristics, and control alternatives. Phase II of the planning process will include procedures for the implementation of the SMP, conceptual solutions, and technical standards for stormwater management.[A-26] Each of the 130 municipalities within the county will need to adopt the county SMP and modify any municipal ordinances as necessary to conform therewith.

Allegheny County Health Department

Article XV of the Allegheny County Health Department Rules and Regulations was modified recently to conform with PaDEP's stormwater best management practices.[A-27] While Article XV had required that all roofs, paved areas, yards, courts, courtyards, or areas using a topping or finish capable of collecting water be drained into a separate storm sewer system, or a combined sewer system, structural or non-structural stormwater management practices may be employed as alternatives to connecting with municipal combined or storm sewer systems:[A-28]

> "Where required, all roofs, paved areas, yards, courts, courtyards, or areas using a topping or finish capable of collecting water shall be drained into a separate storm sewer system, or a combined sewer system, as per Section AC 1104.2, where such systems are available. Alternatively, as a green initiative, structural and non-structural storm water management practices separate from a storm sewer or combination sewer may be employed as they comply with Document 363-0330002 Best Management Practices for Stormwater Management issued by the Pennsylvania Department of Environmental Protection or are of a best management practice design that meets or exceeds the requirements of the above noted document and meet the requirements of the Administrative Authority and the local municipality."

Allegheny County Conservation District

In addition to reviewing and enforcing Erosion and Sediment Control Plans and post construction stormwater management plans, the Allegheny County Conservation District has established a small (maximum $10,000) grant program. Partially funded through the Clean Streams Fund (Clean Streams Law fines), green stormwater management projects on public lands are eligible. The District has also sponsored Smart Stormwater Management seminars with the Westmoreland Conservation District and 3 Rivers Wet Weather which are designed for municipal officials.

A-25 Act 167 Stormwater Management Plan Update Report, Prepared for the North Hills Council of Governments, April 2008.

A-26 Draft Allegheny County Stormwater Management Plan Phase 1 Report, Allegheny County Department of Economic Development, April 2014. Prepared by Michael Baker Jr., Inc.

A-27 Document 363-0330- 002 Best Management Practices for Stormwater Management issued by the Pennsylvania Department of Environmental Protection available electronically at http://www.elibrary.dep.state.pa.us/dsweb/View/Collection-8305

A-28 Article 15 Chapter 11 – Storm Drainage Section 1101 AC1 101.2

Other Allegheny County Agencies

Allegheny Green is the comprehensive plan for Allegheny County efforts to reduce pollution, generally, and includes GSI. The Allegheny County Department of Public Works bears the main responsibility for implementation and maintenance of "green" projects covering 820 miles of roads, 19 buildings and 4 parks. With 22 housing communities, the Allegheny County Housing Authority has adopted a specific Green Plan but has not yet installed GSI. The Community College of Allegheny County has 8 campuses and like the Housing Authority has a Green Plan, but no GSI implementation to date. Only the Kane Regional Centers consisting of 4 nursing homes and the County Jail have not developed a specific Green Plan.

Allegheny County and the city of Pittsburgh jointly own and operate the Sports and Exhibition Authority (SEA) controlling 3 sports arenas (2 stadiums), 1 convention center, 2 parks, 2 garages and a redevelopment project in a large city neighborhood.

SEA implemented GSI in their most recent construction projects, the Consol Energy Center and the David L. Lawrence Convention Center, with both buildings receiving Gold Certification under the LEED for New Construction rating system. The 1.5 million square foot convention center has its own wastewater treatment plant. SEA plans to use GSI in their redevelopment of the Lower Hill District neighborhood.

3 Rivers Wet Weather (3RWW)

3 Rivers Wet Weather has played a key role in promoting the use of GSI within the ALCOSAN service area, including:

- GSI Pilot Studies - 3RWW is conducting a detailed evaluation of the potential application for GSI in the combined portions of three sewersheds - Nine Mile Run, McNeilly Run and Girty's Run. The findings are being shared with the municipalities to encourage full consideration of GSI in the municipal feasibility studies;
- 3RWW maintains an inventory of public and private GSI installations around the Pittsburgh area;
- 3RWW has developed GSI evaluation tools such as the Rainways GSI planning tool;
- 3RWW supports and maintains the Green Infrastructure Network, a voluntary partnership of more than 50 organizations, businesses, academic institutions, authorities and local governments;
- 3RWW's annual conference provides an important forum for distributing the latest national and international developments relating to source controls; and
- 3RWW has provided municipal technical training and seminars relating to the planning and implementation of GSI and I/I reduction.

Pennsylvania State Agencies

Pennsylvania Department of Environmental Protection (PaDEP)

PaDEP has general regulatory authority over stormwater management, including GSI, within Pennsylvania through the Pennsylvania Clean Streams Law and its authority under the federal Clean Water Act as delegated by Region III of USEPA. PaDEP also issues regulations and guidance pursuant to the Pennsylvania Stormwater Management Act (Act 167). PaDEP's involvement with GSI includes:

- The promulgation of construction and post-construction erosion and sediment control rules under Chapter 102 of the state administrative code;
- The definition of best management practices;
- The issuance of NPDES discharge permits to sanitary sewered municipalities (MS4) and combined municipalities (CSO Control Policy);
- The financing of stormwater management and CSO control projects through PennVEST, including a 20% reserve for green projects from the federal 2010 state revolving loan fund appropriations; and
- The potential provision of regulatory flexibility in terms of the CSO municipalities' consent orders and agreements.

PennDOT

The Pennsylvania Department of Transportation (PennDOT) outlined its approach to GSI at the 2012 Green Streets Forum.[A-29] PennDOT acknowledged their shared responsibilities with municipalities in urban areas; however PennDOT also pointed out that it has exclusive jurisdiction within its rights-of-way and that municipal stormwater ordinances do not apply to PennDOT. Even so, PennDOT maintains consistency with applicable Act 167 Plans.

PennDOT divides projects into four levels of potential stormwater impacts, ranging from minimal (e.g. bridge and highway restoration) through level four which includes projects with a potential impact to high quality streams. Significantly, CSO impacts are included in level four. PennDOT identifies BMPs for each impact level. Level 3 and 4 impact projects include an array of GSI including but not limited to vegetated swales, infiltration trenches, bio-retention, constructed wetlands, and wet ponds.

Other Pennsylvania State Agencies

The Pennsylvania Department of Military and Veterans Affairs (DMVA) operate a Veteran's Home (there are 6 state-wide) and an office in Pittsburgh. The Pennsylvania National Guard falls under the jurisdiction of this state department.

[A-29] Presentation by Jeffrey S. MacKay, NTM Engineering, Inc. and PennDOT Bureau of Project Delivery at the 2012 Green Streets Forum sponsored by ASL, Chester County Planning Commission, Chester County Water Resources Authority and TMACC, held on February 3, 2012.

DMVA has an Environmental Management Division which addresses environmental impacts of military training, administers compliance with federal, state and local regulations and commits to "pollution materials, effective inventory management, 'green' purchasing and careful planning."[A-30]

The Commonwealth of Pennsylvania operates a State Correction Institute (SCI) on the Ohio River, near the ALCOSAN facility. There is currently no plan or commitment to consider GSI on these grounds.

Federal Agencies

US Environmental Protection Agency

In June of 2012, the USEPA published its *Integrated Municipal Stormwater and Wastewater Planning Approach Framework* (IPF). The IPF encourages sequencing of investments in order to address the most beneficial water quality measures first in an effort to maximize environmental benefit. The IPF also encourages adaptive management techniques to implement the most effective techniques for wet weather control and allow flexibility in capital planning. The practical implications of the IPF on the complex water quality, institutional and financial relationships between CSO control, SSO elimination and stormwater management are evolving.

US Department of Transportation

The current federal transportation bill, Moving Ahead for Progress in the 21st Century (MAP-21), was enacted in July 2012. MAP-21 established a new program to provide for a variety of alternative transportation projects, including many that were previously eligible under separately funded programs. The Transportation Alternatives Program (TAP) replaces the funding from previous programs including Transportation Enhancements, Recreational Trails, Safe Routes to School, and several other discretionary programs, wrapping them into a single funding source.

PENNDOT AND GSI:

- **Joint stormwater responsibilities with the municipalities;**
- **Exclusive jurisdiction in Rights of Way, municipal stormwater ordinances do not apply;**
- **PennDOT project impacts on combined sewer overflows are of high concern; and**
- **Published a draft GSI design manual in 2005.**

TAP provides federal funding for a variety projects defined as transportation alternatives, including projects that prevent, abate and mitigate any type of pollution, address stormwater management and control and prevent or abate water pollution related to highway construction or due to highway runoff. The program is administrated by PennDOT. ALCOSAN procured $800,000 in funding in the Urban Highway Runoff Mitigation program under the 2005 federal transportation bill (T-3). This funding was made possible through the efforts of Congressman Mike Doyle and the Pittsburgh region's Congressional Delegation.

A-30 Adjutant General's Environmental Policy, page 1.

US Army Corps of Engineers

Since 1998 ALCOSAN and the Pittsburgh District of the U.S. Army Corps of Engineers have partnered with the municipalities in the ALCOSAN service area to divert streams away from combined sewer systems, daylight and restore streams and urban riparian habitat and reinvest in municipal sewer systems that are critical to public health and economic redevelopment. Projects have been funded through Section 219 (Civil Works) and Section 206 (Aquatic Habitat Restoration) of the Water Resources Development Act (WRDA). Projects to date include:

- Nine Mile Run Stream Restoration Project;
- Sheraden Park Stream Daylighting and Stream Restoration Project;
- Pine Hollow Stream Inflow Removal Project;
- Homestead Run Trunk Sewer Restoration Project; and
- Aspinwall Sewer Separation Project.

Other U.S. Agencies

Other federal agencies own and operate facilities within the ALCOSAN service area, including the Social Security Administration, the Department of Justice, the U.S. Postal Service (USPS), the Department of Labor and the Department of Energy. The USPS has 49 buildings in the ALCOSAN service area, the largest presence of any Federal Agency. Each agency developed a sustainability plan which included storm water control, but the primary focus was on energy reduction and controlling waste.

Nationally, there are examples of cooperation between federal agencies and local governments for source reduction. For instance, the USPS recently partnered with Jersey City, N.J. to install a demonstration rain garden at the Bergen Station post office.

With three hospitals, two office buildings and one cemetery, the Veterans Administration (VA) also has a significant presence in the ALCOSAN service area. While not as detailed as USPS, the VA Handbook identifies green building technology including GSI as a key element of their purpose and goals.[A-31]

[A-31] VA Handbook 0011, 2011, Strategic Capital Invest Planning Process, p. 3