THE CITY OF SCRANTON & SCRANTON SEWER AUTHORITY

STORMWATER MANAGEMENT (MS4 & CSO) SYSTEM REVIEW

A PHASE ONE ASSESSMENT AND RECOMMENDATION REPORT FOR EFFICIENT MANAGEMENT & SUSTAINABLE INFRASTRUCTURE

OCTOBER 31, 2013

The City of Scranton
&
Scranton Sewer Authority

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October 31, 2013

Prepared for:

The City of Scranton

The Scranton Sewer Authority

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EXECUTIVE SUMMARY

Introduction

Municipalities across Pennsylvania have aging and neglected stormwater infrastructure systems that they struggle to maintain while simultaneously trying to balance other costly community priorities. For many communities, effectively managing stormwater is most often accomplished with limited resources, leaving municipal staff responsible for creating a sustainable stormwater program from little dedicated revenue. Compounding this problem is the increase in even more stringent regulations, including the newly issued National Pollutant and Discharge Elimination System Municipal Separate Storm Sewer System (NPDES MS4) Permits that municipalities anticipate receiving in 2013. Added to this regulatory requirement, localities must also address Total Maximum Daily Load (TMDL) allocations and Watershed Implementation Plans (WIP).

In Pennsylvania, permitted communities must also develop a Chesapeake Bay Pollutant Reduction Plan (CBPRP) and implement stormwater management plans. For both large and small municipalities in Pennsylvania holding a MS4 permit, dealing with aging infrastructure and the potential for more stringent regulations has left many with the realization that collaboration is necessary in order to cost-effectively address future regulatory changes and still manage stormwater. Stormwater management in the City of Scranton has an additional layer of complexity, since the City is comprised of both a MS4 and a Combined Sewer System (CSS), which is owned and operated by the Scranton Sewer Authority (SSA). Both the City and the SSA play an integral role in local efforts to improve water quality in the Lackawanna River, and are under stringent federal and state requirements to do so.

These aforementioned factors prompted the City of Scranton to request the technical assistance of the Environmental Finance Center (EFC) located at the University of Maryland; the Lackawanna River Corridor Association (LRCA) – a local watershed organization located within the City; and McLane Associates – a Scranton-based landscape architecture firm with extensive experience in environmental consulting and green infrastructure practices. These partners were asked to enhance the City's stormwater management program, by focusing on several factors including fiscal responsibility, and infrastructure management, and to identify opportunities for implementing green infrastructure practices to help improve water quality and reduce the flow of stormwater into the already over-burdened system.

With many partners committed to helping this process, it became evident that improving local water quality was just as important as managing the stormwater flowing across the City's landscape. Although the historically important yet environmentally damaging coal mining, iron smelting, and railroad industries of years past no longer exist, the nearby Lackawanna River remains negatively impacted from years of degradation and from an aging stormwater infrastructure. With the City already facing fiscal strain, building a comprehensive stormwater program and improving the water quality remains a daunting, yet necessary task.

The SSA owns the entire stormwater and sewer system infrastructure within the City. However, the City holds the responsibility of meeting the MS4 permit requirements, whereas the SSA must comply with CSS permit requirements. This unique complexity has resulted in management inefficiencies over the years. The project partners took a very close look at the local dynamics and capacity of each organization, which resulted in recommendations focused on improving the efficiency and cost-effectiveness of leveraging the expertise and staff across the two agencies.

This effort was funded by the National Fish & Wildlife Foundation's (NFWF) Chesapeake Bay Stewardship Fund. Through this fund, NFWF piloted the Chesapeake Bay Local Government Capacity Building Initiative

(LGCBI), which connects communities with appropriate technical assistance providers to assist in the implementation of projects that improve water quality in local and regional streams. This year-long study included extensive partner meetings; data analysis of the fiscal components of the current stormwater program; research on the current implementation of the City's MS4 permit; an inventory assessment of the stormwater infrastructure and identification of green infrastructure opportunities; and the identification of education and outreach strategies.

Findings and Recommendations

The findings and recommendations contained in this report represent the culmination of each of the project partner's year-long analysis. The EFC completed a management and financial analysis; the LRCA completed a sub-watershed inventory and analysis; McLane Associates completed a green infrastructure inventory and analysis; and Hatala Associates focused on environmental education. Together, the individual analyses provide a framework for the City of Scranton to move forward in implementing a more cost-effective stormwater program into the future. The results of each analysis are summarized below.

Stormwater Management & Financing Feasibility Analysis
The City's aging stormwater system, limited capacity and resources to manage stormwater, and complexity of ownership and management of the system make the City a unique case study. At the beginning of this study, the EFC Project Team's goal was to provide the City with a financing strategy to pay for the administrative and technical costs necessary to properly manage stormwater. Although there are many recommendations contained in this report, once the EFC Project Team gathered the data and met with municipal staff and other stakeholders, it was clear that much of the data needed to develop specific financing recommendations was not available. Much of this was due to the City's limited capacity and resources to manage stormwater and the fragmented structure in which the stormwater program currently operates.

Stormwater Infrastructure – To improve the stormwater infrastructure the City must fully understand the MS4 components, from the location and number of outfalls and inlets to the pipe characteristics. The SSA has an extensive mapping system for the CSS portion of the system but the MS4 remains unmapped. Funding to complete approximately 30% inventory of the MS4 system was made available through this study and was completed by the LRCA with assistance from McLane Associates and the SSA. The EFC Project Team found that all project partners were eager to understand the system to begin a more strategic plan to properly manage stormwater over time.

> Recommendation: Complete the inventory of the entire system so that repairs and replacements can be properly prioritized.

Stormwater Management – At the beginning of this study, the EFC Project Team found that the City lacked the capacity and resources to properly manage stormwater. While the City is ultimately responsible for implementing the components of the MS4 permit, there have been many partners involved in the process, including the SSA, which has led to a fragmented system and has made it difficult for the City to remain accountable. Many of the requirements not currently being met could be attainable through a more efficient and streamlined program.

> Recommendation: The City and SSA should work to develop a memorandum of understanding (MoU) in the near-term to begin to develop a comprehensive stormwater program. While an MoU will begin to build a comprehensive stormwater program, it is not a long-term solution. The EFC recommends that a more efficient and permanent solution would be to transfer the MS4 permit from the City to the SSA.

Stormwater Financing – Currently, general fund allocations for stormwater programming in the City of Scranton are not adequate for the City to properly manage stormwater in the near- and long-terms. As priorities shift and costs rise, the City needs to determine a more sustainable plan to pay for stormwater. In order to enhance the level of service to meet future anticipated regulatory requirements, the City must more aggressively invest in administration, operations & maintenance, and capital projects to repair and replace its infrastructure.

> <u>Recommendation</u>: The City must supplement its current funding approach with a dedicated stormwater fee to support a more strategic and comprehensive stormwater program, and incorporate cost-saving strategies including the green infrastructure and educational opportunities contained in this report to ensure the stormwater management program's viability.

Subwatershed Inventory & Analysis

Through this effort the LRCA conducted in-field data collection and inventoried the MS4 system along the Lackawanna River Corridor. This corridor is essential to understanding the impact of stormwater runoff as it flows directly into the Lackawanna River.

> <u>Recommendation</u>: The City should implement the watershed and stream recommendations provided in this report. These projects were identified by subwatershed through the LRCA's in-field data collection.

Green Infrastructure Inventory & Analysis

Green infrastructure projects can be catalysts to help transform streetscapes and run-down areas into safer, healthier, and more-aesthetically pleasing centers and corridors while also handling stormwater. Not only will green infrastructure improve water quality but it can also improve quality of life in these urban areas. At the broad scale, it can enhance the overall network of green spaces from parks and riparian areas and the crucial links and corridors with green streets and trails. The City, SSA and Dunmore Borough have successfully implemented several green infrastructure practices, but they are fragmented at best.

> <u>Recommendation</u>: Through this study, McLane Associates has identified a strategic approach to green infrastructure and has highlighted multiple opportunities throughout the City. To help alleviate the overburdened stormwater system and improve local water quality, it is recommended that a strategic green infrastructure implementation plan, which builds upon this study, be completed and adopted.

Environmental Education Program

The City's MS4 permit requires public education and outreach as well as public participation and involvement. The SSA has been working closely with the LRCA to develop a public outreach strategy in order to meet the SSA's Long Term Control Plan (LTCP) obligations, whereas the City and its partners have been addressing public outreach and involvement for the MS4 permit requirements through a broad, piecemeal approach. Without a proper strategy for implementation, the City has been unable to generate the community buy-in necessary for investing in properly managed stormwater, which may be one of the most important components of a successful stormwater program.

> <u>Recommendation</u>: Since effective public outreach is one of the most important components of a successful stormwater program, the City should continue working with its local partners to develop and implement a public education and participation strategy that begins with broad outreach and

transitions to a more targeted, strategic approach. The LRCA and Hatala Associates should implement the strategies developed through this effort, through collaboration, with the City and the SSA to meet both the MS4 and CSO public outreach obligations.

Conclusion

This effort has enabled the City to better understand its existing MS4 system, and it provides recommendations for creating a comprehensive and sustainable MS4 program. It is important to continue collaboration with established partners to leverage financial and other resources, as well as, expertise to more efficiently implement a MS4 program. The report also addresses the importance of the SSA in managing the Combined Sewer System and it's potential to play a significant role in the MS4 system as well. Additionally, if the Phase 1 recommendations and strategies contained in this report are implemented successfully, the City of Scranton will be on a path to meeting stormwater requirements and enhancing local water quality.

CHAPTER 1: INTRODUCTION

Background

Project Description

Regulatory Requirements

Report Organization

Background

Current State of Gray Infrastructure

The majority of the existing stormwater infrastructure within the City of Scranton and the Borough of Dunmore was constructed before 1950, meaning both sewage waste and stormwater runoff are combined into one Combined Sewer System (CSS) and transported to the wastewater treatment plant. An estimated 63% of Scranton's sewers are combined. The other 37% is considered Municipal Separate Storm Sewer System (MS4).

In general, the gray infrastructure that comprises the storm sewer system is aging and needed improvements are required. When possible, new construction projects are encouraged to separate the CSS into the MS4 system.

Combined Sewer System (CSS) & Combined Sewer Overflows (CSO)
As urban areas grow so does the percentage of impervious surfaces and the volume of stormwater entering the sewer and stormwater systems. The main issue surrounding the CSS occurs during larger storms when the system is unable to handle the influx of stormwater. When the CSS reaches capacity, to prevent flooding of the Wastewater Treatment Plant (WWTP), the excess water is diverted into watercourses through CSOs. The prevalence of overflows and the associated untreated and non-filtered water released during these high rainfall events has documented negative environmental impacts on waterways. Besides lowered water quality, they also create altered hydrographs with steeper rising and falling limbs, which translates into more erosion and flooding.

Scranton Sewer Authority (SSA)
The SSA is responsible for the CSO system in Scranton and Dunmore. It was formed in 1967 and directed in 1968 to implement plans for a wastewater treatment plant and interceptor sewers. The project was completed in 1970 and provided the first wastewater treatment for Scranton and Dunmore. Before this, raw wastewater from the City was discharged directly into the Lackawanna River.[1]

Today, the SSA service area is about 13,400 acres (21 square miles), serves about 86,000 people, and has over 275 miles of sewer lines.[2] The SSA is a 20-million gallon a day rated WWTP that provides service to over 30,000 customers. It also owns and maintains over 275 miles of collection and interceptor sewers. It is the goal of the SSA to "provide our customers with the highest quality service available. That is why we are constantly trying to find new and better ways to protect your environment, and to better serve you, our customer."[1]

Municipal Separate Storm Sewer System (MS4)
The City of Scranton is responsible for the MS4. This system took the place of the CSS, and it is separate from the sewer system. It takes water runoff and directs it into surrounding rivers and streams. Even though it does not contribute to CSO events it still creates pollution problems for the river. When runoff crosses over parking lots and paved areas it often picks up contaminants, and without filtration options like vegetation and soil, the polluted stormwater is sent directly into the water body. The velocity and rate of stormwater is also problematic and it increases erosion and flooding.

Project Description

Project Funding

The National Fish and Wildlife Foundation (NFWF) is an independent 501(c)(3) nonprofit organization, created by Congress in 1984. NFWF is governed by a 30-member Board of Directors approved by the Secretary of the Interior. It has become one of the world's largest conservation grant-makers. NFWF specializes in bringing all parties to the table – individuals, government agencies, nonprofit organizations and corporations. Currently, NFWF is "accelerating local implementation of the most innovative, sustainable and cost-effective strategies to restore and protect water quality and vital habitats within the Chesapeake Bay Watershed" and has thus far invested close to $75 million dollars in grants to non-profits, local governments and state agencies.[3]

NFWF is funding the City of Scranton's assessment of its aging storm sewer system and its management structure, as well as, facilitating the identification of opportunities to integrate green infrastructure practices throughout the City. Long-term assessments of installed green infrastructure will determine whether this "green" approach will cost-effectively reduce flooding and improve local water quality.

Project Goal

The prevailing goal of this project is a Phase 1 assessment of the management of the MS4 and CSS system with recommendations for a cost-effective solution for efficient management and sustainable infrastructure within Scranton. Implementation strategies like green infrastructure for new construction and the retrofit of existing development will be discussed in general terms and for specific priority parcels, as well. Additionally, this project supports and facilitates ongoing implementation of the SSA's Long Term Control Plan (LTCP).

Specific tasks and deliverables for this project include:

- An inventory, analysis and review of portions of the MS4/CSS via stream walks, background research and Geographic Information Systems (GIS);
- Update of existing GIS mapping with new MS4 and CSO data;
- Determination of key "priority areas" within the MS4 and CSO systems;
- Preparation of a green infrastructure strategy plan that highlights proposed types and locations (identification of demonstration projects and a catchment area case study)
- Creation of a management and feasibility strategy plan; and
- Preparation of an environmental education strategy plan.

Regulatory Requirements Governing Stormwater in Pennsylvania

There are numerous state and federal regulations mandating that control measures are put in place to properly manage and treat stormwater. However, these regulations require communities to elevate their stormwater programs to a level of service beyond the capacity and resources required to manage the system effectively. The following is a description of the stormwater-related regulations that municipalities must balance with their other municipal obligations and costs.

In general, the Clean Water Act (CWA) passed by Congress in 1972 and amended in 1977 is the over-arching guidance document. This Act requires municipalities to obtain permits for the management and discharge of stormwater into the streams, rivers and lakes of the United States.

Total Maximum Daily Loads (TMDLs)

The Clean Water Act requires impaired waterways to be regulated with pollution diets of the substance responsible for impairing the body of water. In the Chesapeake Bay region, nitrogen, phosphorus, and sediment have been deemed as the primary culprits to declining water quality. In order to satisfy the commitment made by the Obama Administration under Executive Order 15308 to protect and restore the Chesapeake Bay, TMDLs establish load allocations for nitrogen, phosphorus, and sediment for impaired waterways. Sources of pollution include run-off from agriculture, wastewater facilities, septic systems, and stormwater.

Watershed Implementation Plans (WIPs)

In order to address the TMDLs, WIPs are required by jurisdictions to account for how they plan to meet their pollution allocations. The Phase II WIPs require the states to subdivide the allocation loads to the county level, allowing for a more localized approach to reduction. The counties are then responsible for implementing and financing best management practices (BMPs) to meet reduction goals.

Municipal Separate Storm Sewer System (MS4) Permits

As precipitation flows over impervious surfaces, it picks up chemicals, debris, sediment, and other pollutants that when left untreated, could harm local waterways. Municipalities often convey their stormwater through MS4s, which discharge untreated runoff into local waterways.

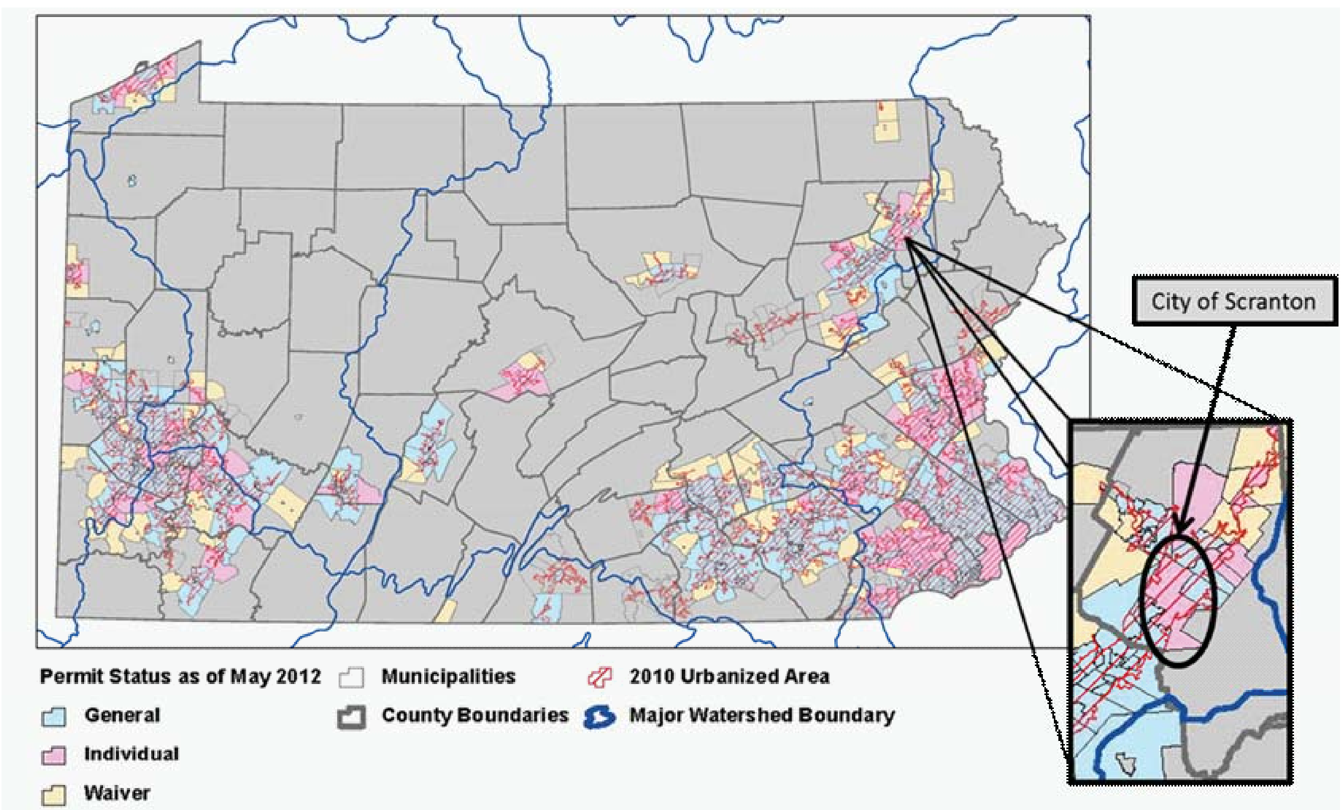
As part of the CWA, the National Pollutant Discharge Elimination System (NPDES) Stormwater Program regulates stormwater discharge from municipal sources. Adherence to a NPDES Permit Policy is required in urbanized areas throughout Pennsylvania. Municipalities must obtain MS4 permits to discharge stormwater and to prevent other harmful pollutants from entering a MS4. The MS4 permit addresses and attempts to curtail the non-point, urban pollution responsible for lower water quality. These permits must be maintained in order to discharge stormwater from the City's MS4 in waters of the Commonwealth.

The regulations require that six categories of BMPs be implemented through a stormwater management program. The six Minimum Control Measures (MCMs), each with specific BMPs, include:

- Public Education
- Public Involvement
- Illicit Discharge Detection and Elimination
- Construction Site Stormwater Runoff Management
- Post Construction Stormwater Management
- Good Housekeeping and Pollution Prevention

MS4 permits are further divided by what type of community they cover, namely Phase I or Phase II. Phase I communities are medium and large cities or counties with a population density of 100,000 or more and obtain individual permits. Phase II communities are smaller communities in or outside urbanized areas and are regulated by general permits. As shown in Figure 1, the City of Scranton is located in the center of the Scranton urbanized area and operates under an individual permit.

Figure 1: Map of all MS4 Permitted Municipalities in Pennsylvania, 2010



Combined Sewer Overflow (CSO) Control Policy

The CSO Control Policy provides guidance on how to comply with pollution control goals of the CWA. The SSA has prepared and has started implementation of their LTCP to meet the standards required by the CSO Control Policy.

The main goal of the LTCP is to minimize the amount of untreated water released into the Lackawanna River, while meeting water quality standards set by the CWA. In order to attain the water quality standards, the SSA proposes a combination of the following approaches:

1 - Upgrade and expand the wastewater treatment plant
2 - CSO regulator adjustments
3 - In-line and off-line box culvert storage units
4 - Strategic sewer separation
5 - Above ground storage tanks
6 - Interceptor rock traps
7 - Source controls to reduce the quantity of wet weather flow that enters the CSS
8 - Operation and maintenance activities consistent with the required MCMs

Chesapeake Bay Compliance Plan

Under the federal Clean Water Act, the Chesapeake Bay is listed as an impaired waterway. Pennsylvania, Delaware, Maryland, New York, Virginia, West Virginia, and the District of Columbia have made a commitment under the Chesapeake 2000 Agreement to help improve water quality by reducing the level of nutrients – specifically nitrogen, phosphorus and sediments – that pollute the Bay and cause “Dead Zones”.

Chesapeake Bay Pollution Reduction Plans (CBPRP)

The Pennsylvania MS4 permit program requires MS4s that discharge into waterways that drain to the Bay to also prepare and implement a CBPRP. In order to meet the load allocations required by the TMDLs, the submitted CBPRP must include the implementation of BMPs to reduce nitrogen, phosphorous, and sediment. The CBPRP is what connects the MS4 permit to the TMDL regulation, ensuring nutrient and sediment reduction from the urban sector.

Chapter 102: The Erosion and Sediment Standards

In addition to the CBPRP, another requirement in the MS4 is taken from Chapter 102 in the Pennsylvania Code. The purpose of Chapter 102 is to protect Pennsylvania’s surface waters from sediment and stormwater pollution. This is achieved through BMPs that decrease erosion and sedimentation as well as managing post construction stormwater runoff. Chapter 102 is incorporated in the MS4 permit via MCMs 4 and 5, construction site stormwater run-off control and post-construction stormwater management in new development and redevelopment, respectively.

Act 167: Stormwater Management Plan

Pennsylvania Act 167, known as the stormwater management plan, provides regulation for land and water use for flood control and stormwater management purposes. The plan requires counties to prepare, update, and adopt plans for stormwater management. Implementation of a stormwater plan under Act 167 helps municipalities meet their MS4 permit regulations, namely their MCMs. Having a written plan is integral to a successful stormwater management program in order to fully comprehend the requirements of the MS4 permit and the steps necessary to achieve compliance. Act 167 acts as a guideline to help municipalities adopt a plan.

Senate Bill 351 (SB 351)

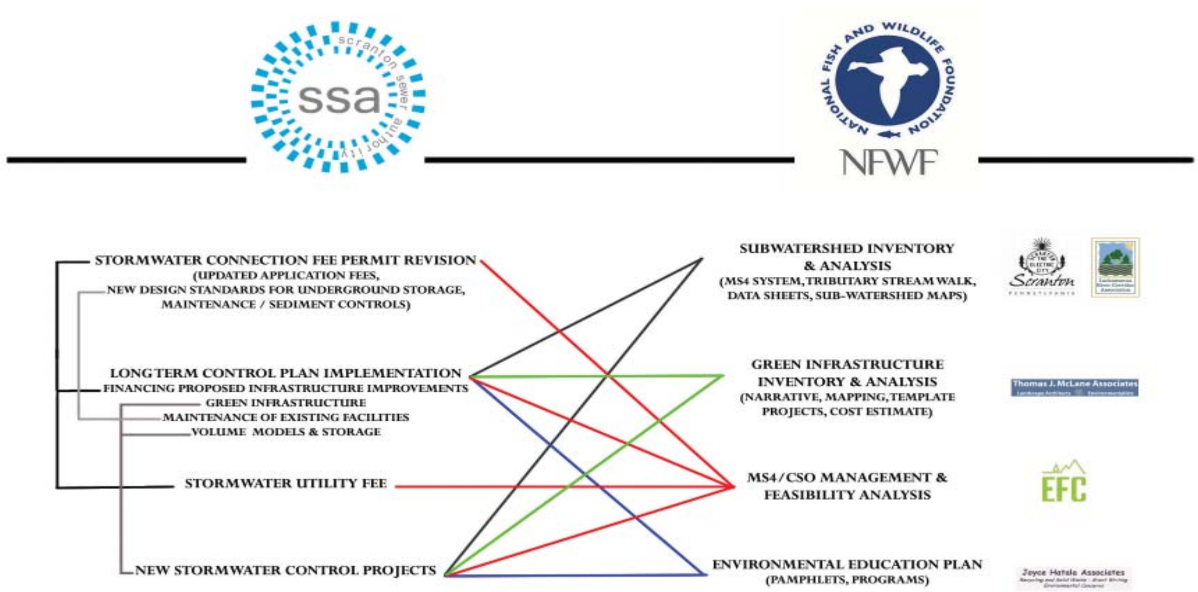
On July 9th, 2013 Governor Corbett of Pennsylvania signed SB 351 into law after a 49-1 victory in the Senate and a 135-66-1 vote for the bill in the House. SB 351 serves to amend Title 53, which lays out the general rights and authorities of municipalities in Pennsylvania. In particular, SB 351 provides a municipality with the legal authorization to create stormwater authorities, whereas, prior to Senate Bill 351, municipalities were reluctant to create an authority due to the threat of litigation and non-legitimacy.

The passage of SB 351 paves the way for municipalities to implement a stormwater authority that would be able to collect revenue from users in order to pay for the maintenance of stormwater conveyance systems and install and maintain BMPs to treat the stormwater. Having a dedicated revenue stream for stormwater is important for municipalities in which stormwater system maintenance does not receive adequate funding from general funds or grants. Therefore, it is important that municipalities have the option to take care of stormwater management in terms of both compliance and environmental stewardship.

Report Organization

The report is organized into sections that are interconnected yet stand-alone to some extent. This allows the report users to utilize the whole document or specific topics of interest. The goal is to provide a comprehensive document that is also very user-freindly and functional for both the City of Scranton and the SSA. For example, Figure 2 depicts how this report relates to and facilitates the SSA's agenda. The primary chapter of importance is Chapter 2, which will provide a management and financing strategy into the future. Supporting information is provided in the following three chapters (3, 4, & 5), which can be individually referenced. The Executive Summary, provided above, will be a thorough but abbreviated review of the assessments and recommendations.

Figure 2. Explains how the NFWF project relates to the SSA's Long Term Control Plan.



Report Chapters

Chapter 2: Stormwater Management & Financing Feasibility Analysis
The Environmental Finance Center at the University of Maryland completed an assessment of the existing stormwater management structure within the City of Scranton. Then a recommendation strategy was prepared and presented by the EFC for the City of Scranton and SSA. The assesment and recommendation did not include the Borough of Dunmore; however, Dunmore should consider adopting similar management and financial strategy as the city of Scranton.

Chapter 3: Subwatershed Inventory & Analysis
General background information about the Lackawanna River Watershed is presented. The in-field data collection and inventory was completed by the Lackawanna River Corridor Association (LRCA). Their review was specific to the MS4 system.

Chapter 4: Green Infrastructure Inventory & Analysis
A Green Infrastructure & Analysis was prepared by McLane Associates to highlight the current state and the potential for green infrastructure to address goals of the SSA's Long Term Control Plan (CSO system) and the City of Scranton's MS4 system. All city-owned parcels were visited and potential green infrastructure projects were identified. Then multiple demonstration projects (15 in total) were conceptually developed to highlight the versatility of projects at a variety of scales.

Chapter 5: Environmental Education Program
Hatala Associates prepared a synopsis of the existing Environmental Education Program. The activities and strategies in the program can be used by the SSA and the City of Scranton for educating rate payers and citizens, respectively. The implementation of these strategies will help the City and SSA meet several NPDES permit requirements.

Chapter 6: Conclusion
This chapter concisely summarizes the document and guides the reader into thinking about the needed techniques and strategies for implementation. Explains that this document is a first phase toward improving the management and infrastructure condition and capacity of the City of Scranton's and the SSA's stormwater management system.

Appendices:
Four appendices, A, B, C and D, are included at the end of the document. They present the EFCs fact sheet and recommendations for budgeting, inventory data sheets from the streamwalks, the green infrastructure inventory, and a few examples of environmental education materials respectively.

CHAPTER 2:
Stormwater Management & Financial Feasibility Analysis

Stormwater Management & Financing Feasibility Study Findings

Stormwater Management & Financing Recommendations

Stormwater Management & Financing Feasibility Study Findings

Background

The City of Scranton enlisted the EFC to develop a long-term financing strategy that supports a local comprehensive stormwater management program. The EFC's expertise in conducting financial assessments with communities facing challenges paying for the large costs associated with properly managing stormwater ranges from small, rural municipalities to large, urban cities. The City's ageing stormwater system, limited capacity and resources to manage stormwater, and complexity of ownership and management of the system make the City a unique case study. Although there are similarities to other communities, the EFC had to modify its typical protocol for assessing municipal stormwater programs to ensure that the City was provided with the most appropriate and tangible recommendations.

At the beginning of this study, the goal was to provide the City with a financing strategy to pay for the administrative and technical costs necessary to properly manage stormwater. Although there are many recommendations contained in this report, once the EFC gathered the data and met with municipal staff and project partners, it was clear that much of the data needed to develop specific recommendations was not available. Additionally, while the City holds the responsibility of meeting the MS4 permit requirements, the SSA ownership of the entire stormwater and sewer system infrastructure within the City adds a unique complexity resulting in management inefficiencies.[4] Therefore, it was determined by the EFC Project Team that the recommendations for the City focus on program management in order to first develop a framework for understanding the components of its system and then determine the most cost-effective strategy to properly manage stormwater in the long run.

Throughout the study, the goal transpired to help the City of Scranton assess its current municipal stormwater program and provide the City with recommendations to enhance the current program and implement cost-saving measures to create a comprehensive and sustainable stormwater program. This goal ensures that the City has additional resources and capacity to improve and maintain a higher level of service to its residents and businesses and address all stormwater-related compliance activities.

Assessment of the City of Scranton's Current Stormwater Program

In Scranton's new individual NPDES MS4 permit being issued in the fall of 2013, there will be six minimum control measures (MCMs) consistent with those found in the old permit. The following six MCMs are the elements contained in the NPDES MS4 permit that outline specific areas the community must address:

- Public Education & Outreach
- Public Participation & Involvement
- Illicit Discharge Detection & Elimination (IDD&E)
- Construction Site Runoff Control
- Post Construction Runoff Control
- Pollution Prevention/Good Housekeeping

For each MCM, there are specific stormwater BMPs that the City of Scranton can implement to comply with its permit. Although there is flexibility to implement BMPs that fit the needs and resources within the community, there are significant costs associated with addressing each MCM.

The EFC Project Team worked closely with municipal staff and project partners to determine the current level of service for each MCM. A discussion of the overall stormwater program findings are found below.

Overall Stormwater Program Findings

Stormwater Infrastructure

Like many Pennsylvania cities, and cities across the country, Scranton has experienced the economic prosperity and hardships of a "boom and bust" economy. With mining, textiles and a variety of other industries taking hold in the early part of the 20th century, Scranton grew rapidly, in turn, creating impervious surface and the need to continuously control runoff from rain and storm events to help protect local water quality and meet federal and state regulations. As the City has grown over the years, the infrastructure has been expanded but not upgraded. In some cases, part of the stormwater conveyance system is more than 100 years old and is comprised of both a CSS and MS4, subsequently contributing to poor water quality. Additionally, the SSA owns the entire CSS and MS4 infrastructure system and maintains the approximate 63 percent of the system that is a CSS, while the City maintains the non-combined MS4 component representing approximately 37 percent of the system.[5]

In late 2010, the U.S. Environmental Protection Agency (EPA) established a "Chesapeake Bay" TMDL requirement accelerating the reduction of nutrients and sediments over the next 15 years.[6] All states in the Chesapeake Bay watershed, including Pennsylvania and subsequently the City of Scranton, must adhere to reducing the amount of stormwater, among other requirements, from entering local waterways and ultimately the Chesapeake Bay. Given the City's antiquated stormwater infrastructure it will become increasingly difficult to meet existing regulations, let alone any new regulations enacted by the state or federal government. To ensure that these goals are being met, the Pennsylvania Department of Environmental Protection (DEP) is requiring all MS4 permit holders to develop a specific pollutant reduction plan for the Chesapeake Bay. Additionally, it is anticipated that more stringent requirements will take effect when the DEP issues new MS4 permits in the fall of 2013.

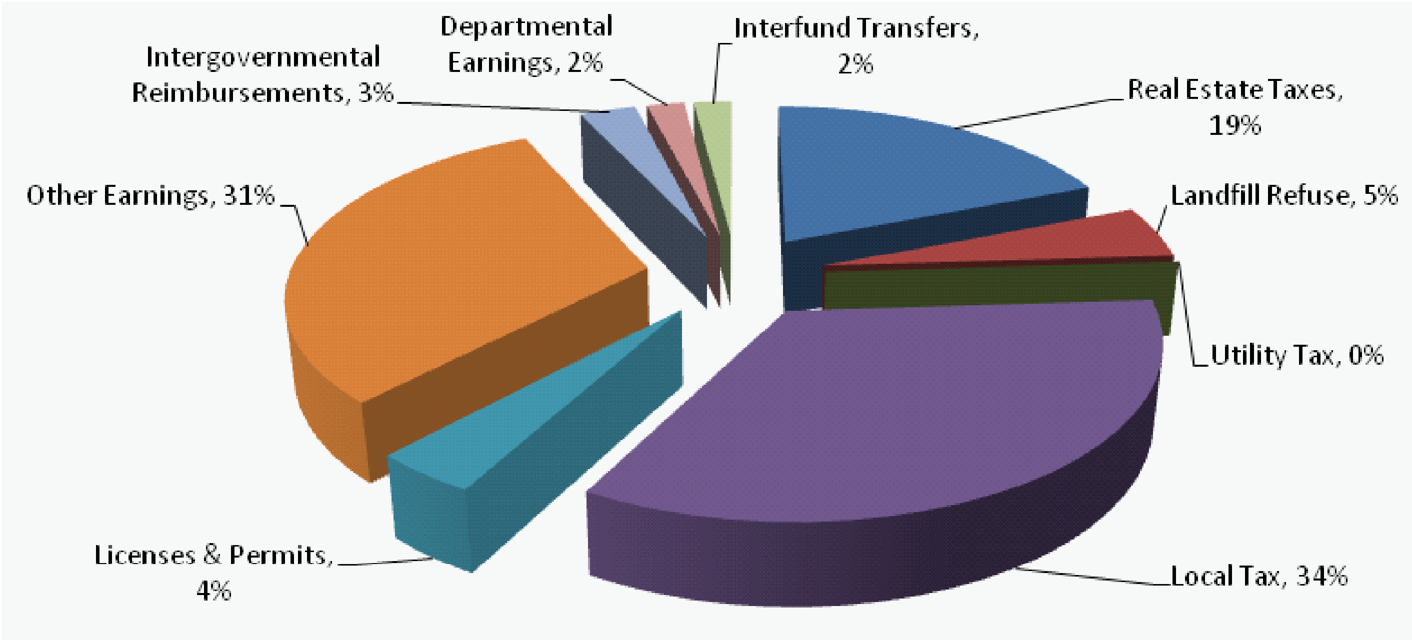
To begin to overcome these challenges and improve the stormwater infrastructure, as identified by the project partners, the City must fully understand the MS4 components, from the location and number of outfalls and inlets to the pipe characteristics. The SSA has an extensive mapping system for the CSS portion of the system but the MS4 remains unmapped. Funding to complete an approximately 30% inventory of the MS4 system was made available through this project and was completed by the LRCA with assistance from McLane Associates and the SSA. The EFC Project Team found that all project partners were eager to understand the system to begin a more strategic plan to properly manage stormwater over time. However, the EFC Project Team highly recommends that completing the inventory of the entire system be prioritized.

Current Funding for Stormwater

Preparing for new permit requirements and maintaining the existing stormwater system bears significant costs. The current method of funding stormwater in the City of Scranton is partially through grant funding and leveraging relationships with local organizations, but with the majority of the revenue derived from general fund appropriations. The City also has a Capital Improvement Plan (CIP) that includes flood protection and stormwater projects. Funding for capital projects comes from either transfers from the operating budget or bond financing. The EFC Project Team found that while there was a large amount of funding appropriated for a variety of capital projects, they are often pushed back each year or funded only when grants become available.

Therefore, the primary revenue utilized to support the City's stormwater-related activities comes from the General Fund. General Fund revenue comes from several sources such as real estate taxes, licenses, and permits (see Figure 3 for breakdown). This revenue is then distributed to sources as appropriate and deemed necessary; the City departments with the largest expenditures are: Public Safety -- Police (32%), Public Safety -- Fire (31%), Public Works (16%), and Business Administration (15%) . [7]

Figure 3: City of Scranton's 2013 Operating Revenue Breakdown[8]



Currently, general fund allocations for stormwater programming in the City of Scranton are not adequate for the City to properly manage stormwater in the near- and long-terms. As priorities shift and costs rise, the City needs to determine a more sustainable plan to pay for stormwater.

In order to enhance the level of service to meet future anticipated regulatory requirements, the City must more aggressively invest in administration, operations & maintenance, and capital projects to repair and replace its infrastructure. The City must supplement its current funding approach with a dedicated stormwater fee to support a more strategic and comprehensive stormwater program, and incorporate cost saving strategies to ensure the stormwater management program's viability. See the stormwater management and financing recommendations section of this chapter for a more detailed discussion of how the City should finance its enhanced stormwater program.

Current Capacity for Handling Stormwater

At the beginning of this study, the EFC Project Team found that the City lacked in the capacity and resources to properly manage stormwater. While the City is ultimately responsible for implementing the components of the MS4 permit, there have been many partners involved in the process which has led to a fragmented system and has made it difficult for the City to remain accountable. Additionally, through participation in this study, and the staff's commitment to improving its stormwater program, the EFC Project Team found that many of the requirements not currently being met could be attainable through a more efficient and streamlined program.

Partners that have been involved and are currently involved with this study in helping to meet stormwater requirements within the City include:

- City of Scranton – currently holds the MS4 permit, is responsible for meeting the permit requirements and is currently in charge of most of the administrative and technical tasks. This includes the City Planning Department, Public Works and the City's contracted engineer.
- Scranton Sewer Authority (SSA) – owns the entire CSS and MS4 infrastructure system. SSA is in charge of the CSS and the Long Term Control Plan (LTCP) for the City and the surrounding Dunmore Borough. There is overlap in the activities of the SSA and the City.
- Lackawanna River Corridor Association (LRCA) – currently conducts public outreach and education for both the City and the SSA's permit requirements. LRCA also contracts with Hatala Associates - a consultant helping to write a comprehensive public education, participation and outreach strategy.
- McLane Associates – as part of this study, McLane and Associates has been an integral partner in helping to identify "green infrastructure" (GI) practices that could be incorporated into the City's stormwater program. GI practices will help reduce the amount of impervious surface to allow for greater infiltration of stormwater runoff into the ground, as well as provide many additional benefits such as cost savings, beautification, and stormwater education through the implementation of visible projects throughout the City.

The EFC Project Team found very few City staff currently work on managing stormwater. The City Planning Department has one person who coordinates the administrative activities, such as reporting and coordinating with the Pennsylvania DEP and other partners to meet MS4 requirements, whereas the Department of Public Works (DPW) handles the implementation and maintenance such as basin cleanouts, street sweeping and structural issues. The Public Works stormwater maintenance staff is comprised of a 4-person "basin crew" to handle cleanouts and repairs and a 2-person street sweeping team, however it was found by the EFC Project Team that only one street sweeping staff member was allocated in the City's 2013 Operating Budget.[9] Both departments work closely with the contracted consulting engineer through Ceco Associates, Inc. to help address the technical components of the MS4 Permit.

In meeting with City staff, the EFC Project Team found that the City Planner and the Director of Public Works are very knowledgeable about the MS4 permit requirements. However, the EFC Project Team found that the City lacks the capacity, in terms of staff, to properly maintain the permit requirements. It was expressed to EFC staff that the DPW had to reduce the number of staff on their basin and sweeper crews.

While the City lacks in capacity and organizational structure to handle stormwater management activities, the SSA has been playing a major role in assisting with and maintaining the functions of the stormwater system. As owner of the entire stormwater and sewer infrastructure system, and its maintenance of the 63 percent CSS component, the SSA has built a more efficient management structure to deal with both the stormwater and sewer components. Due to its autonomy, the SSA has established a rate structure for residential sewer service, maintains an up-to-date inventory and a map of the CSS system, retains engineers, and has purchased equipment, such as vacuum trucks to conduct inlet cleanouts. See Chapter 5 for a more detailed discussion of how the City should restructure its current management efforts to appropriately manage stormwater.

MCM Findings: 1. Public Education & Outreach
Through this effort, LRCA and Hatala Associates began to develop a comprehensive public education and outreach strategy for the City's stormwater program. The EFC Project Team found that the City currently has a web site dedicated to the City's MS4 system that was developed by LRCA. While this web site provides general stormwater information and resources, a more robust and strategic strategy is necessary for the community to become aware and educated on the importance of managing stormwater.

During the project, a written Public Education & Outreach Plan was drafted and LRCA hosted its annual River Fest. In addition, LRCA and Hatala Associates developed outreach materials and disseminated these materials at local events. The EFC Project Team also provided resources to share examples of successful outreach materials and activities and developed a fact sheet for the City (see Attachment A).

The EFC Project Team found that in many aspects of the City' stormwater program, there is minimal internal capacity within the local government to implement activities associated with the MCMs. This holds true for MCM 1. LRCA currently works with both the City and SSA to provide the public outreach and education components that are necessary to properly address both the LTCP and MS4 permit. While the EFC Project Team found this partnership necessary to help promote stormwater through public outreach, it is essential that both the City and SSA take a more proactive role in disseminating stormwater information to a broad audience and targeted stakeholders; have a presence at local events; and track all activities. Ultimately the City is held accountable for MCM 1 and needs to be a leader in educating the community and elected officials about the importance of managing stormwater.

The EFC Project Team found that in other municipalities in Pennsylvania, effective outreach means targeting specific groups such as elected officials, developers, farmers, businesses, schools, and home owners associations (HOAs), as different messages resonate with each audience. The City should focus first on developing an approach to educating a broad audience, and then transition to a more targeted approach.

MCM Findings: 2. Public Participation & Involvement
Similar to MCM 1, LRCA and Hatala Associates began to develop a comprehensive public involvement and participation strategy for the City's stormwater program through this effort. During the project, a written Public Participation & Involvement Plan was drafted and LRCA hosted its annual River Fest.

LRCA and Hatala Associates plan to hold at least two focus groups in the upcoming year to begin a dialogue with targeted stakeholders and work with local groups such as the Lackawanna County Conservation District (LCCD), the local public service television station, neighboring municipalities, and the Pennsylvania State Extension to help spread the word and engage the community. In addition, an annual public meeting should be held where the public can give their input; at least one annual public event such as a stream clean-up, tree planting, or watershed day should be developed with all partners playing an active role in planning the event; and all activities should be tracked by LRCA and the City.

Again, similar to MCM 1, the City and SSA partner with LRCA to implement activities associated with MCM 2 and do not take a proactive role in these activities. While the EFC Project Team found this partnership necessary to engage the general public and targeted groups, it is essential that both the City and SSA take a more proactive role. Ultimately the City is held accountable for MCM 2, and needs to be a leader in hosting events that engage the community and generate valuable feedback to help tailor the stormwater program as it is implemented over time.

MCM Findings: 3. Illicit Discharge Detection & Elimination

One of the fundamental components of MCM 3 is to have a comprehensive map of the municipality's conveyance system. Without knowing the number and location of outfalls and pipe system, a municipality cannot properly detect and eliminate illicit discharges. The EFC Project Team found all project partners eager to fully inventory the conveyance system and develop a robust map. Since the SSA has an extensive map of the combined system and software to map the system, this organization should take the lead in finalizing the map.

Aside from having a comprehensive map, in order to properly address MCM 3 at least 20% of the City's outfalls must be inspected each year and there must be a formal process in place for inspecting and handling illicit discharges and receiving public notifications. The City currently has limited capacity to address the components of this MCM in-house. The management recommendations contained later in this report will ensure the level of service for MCM 3 improves. Once the City has a map of its system, it can work with SSA to ensure all outfalls are inspected on schedule, and a formal process is in place for detecting and eliminating illicit discharges.

MCM Findings: 4. Construction Site Runoff Control

In Pennsylvania, the county conservation districts review and approve all Erosion & Sediment Control Plans for new development and are tasked with inspecting construction sites. Thus, municipalities are limited by the resources at the conservation district to meet this MCM. It is important to note, however, that while the conservation district typically reviews, approves, and inspects all new development, the municipality is still held accountable for this MCM. Because of this, municipalities should inspect sites in addition to the conservation district and file all projects separately to help with their MS4 annual reporting.

The EFC Project Team found that Scranton's contracted engineer typically works with the LCCD to review, inspect, and approve land development plans, but does not work with the LCCD to ensure the specific Erosion & Sediment Controls are met for projects.

It is important for the MS4 permit holder to work closely with the LCCD to inspect construction sites and track all projects with stormwater controls separately. By filing MS4-related projects into a separate system and tracking projects in-house, the time needed to compile the MS4 Permit Annual Report will be minimized and organizational efficiency will improve.

MCM Findings: 5. Post Construction Site Runoff Control

Once a project completes its construction phase, there must be a formal procedure for ensuring all stormwater BMPs were implemented as designed. The MS4 permit holder must keep an inventory of all post construction stormwater management (PCSM) BMPs and inspect privately-owned BMPs to ensure maintenance is conducted over time. Through this effort, LRCA worked with the City to review all past construction projects and develop an electronic inventory of all PCSM BMPs. While this proves a daunting task and is not yet complete , having an inventory will help the City ensure BMPs are inspected on a routine schedule.

Once the inventory of all existing BMPs is complete, the City must continue to track all PCSM BMPs. While finalizing the inventory, the City should simultaneously develop a written procedure to inspect all PCSM BMPs to ensure they were built as designed, and ensure a proper maintenance schedule is in place for all BMPs. It was conveyed to the EFC Project Team that the City currently relies on the design engineer to ensure the PCSM BMPs are implemented as designed and maintained over time. The City should take a proactive role in inspecting and tracking all projects.

For those BMPs that are publically-owned, an Operations & Maintenance Schedule (O&M) must be developed, which will be discussed in the MCM 6 findings below. For all privately-owned BMPs, the City should develop a more formal maintenance agreement that clearly defines who is responsible for maintaining a PCSM BMP. The EFC Project Team learned that there are currently notes on who will maintain the privately-owned PCSM BMPs on the engineers' plans. A formal agreement that clearly conveys to all parties during a pre-construction meeting, and again during a post-construction meeting, whose responsibility it is to conduct maintenance, will help the City improve its existing level of service and ensure proper maintenance is being conducted on all PCSM BMPs.

Lastly, in order to accelerate the use of green infrastructure practices by developers and residents, the City and its partners should share educational information and host trainings for these stakeholders on all stormwater management regulations, LID, and GI alternatives.

MCM Findings: 6. Pollution Prevention/ Good Housekeeping

To meet the goals of MCM 6, a municipality must develop an O&M program that includes regular cleaning of inlets, drains, and ditches; annual street sweeping; and scheduled BMP maintenance, and provide employee training on proper stormwater management. The EFC Project Team found that due to the limited resources being invested for stormwater management by the City, much of the O&M activities are conducted on an as-needed, emergency basis. The basin crew within the Department of Public Works (DPW) conducts maintenance of BMPs, while the street sweeping crew sweeps the streets bi-annually. Currently, the SSA cleans the basins that are within the CSO system and provides some maintenance to the MS4 system and always provides help in emergency situations.

When meeting with municipal staff, the EFC Project Team found staff eager to more fully address MCM 6, but strapped with limited staff capacity and equipment within the DPW to dedicate to managing stormwater. In order for the Public Works staff to develop and implement an O&M program, additional staff is required.

The DPW currently has two street sweepers and a support vehicle for each sweeper, all of which are outdated. The municipal staff shared with the EFC Project Team that they want to increase the street sweeping frequency, but in order to do so would need additional equipment and staff. The EFC Project Team found that the SSA currently has the in-house staff, vacuum equipment, and asset management and GIS software to handle much, if not all, of the MS4 O&M program, and provides the supplemental help with ensuring stormwater maintenance is implemented at present.

An essential component of meeting MCM 6 is to implement projects within the municipality to prevent pollution and improve water quality, thus helping meet TMDL allocations and CBPRP activities. Incorporating green infrastructure projects is also becoming an integral part of pollution prevention, especially in highly urbanized areas like the City of Scranton. One of the main drivers in the City participating in this effort was to receive help in identifying projects, both green and gray, that will help the City improve local water quality. Through this effort, many projects have been identified and should be incorporated into the City's stormwater program moving forward. The City must also continue working with partners to prioritize projects based on cost efficiency and effectiveness.

Anticipated Changes to the MS4 Permit

The PA DEP requires all MS4 permitted municipalities to develop a CBPRP by the summer 2014. The purpose of this plan is to help municipalities strategically implement projects that improve local and regional water quality. The EFC Project Team found that the municipalities typically contract this plan out to their engineer, and there has been minimal guidance provided to municipalities about what should go into the plan.

In addition to developing a CBPRP, it is anticipated that more stringent requirements will take effect when the new MS4 permits are issued in the fall of 2013. In Maryland, the Department of the Environment (MDE) included a new requirement in its new permit cycle – a 20% impervious area restoration requirement. MDE anticipates that this impervious area restoration, designed to increase the level of runoff managed from existing impervious areas, will require implementing a number of stormwater BMPs. These BMPs will be either nonstructural practices (like diverting runoff from impervious areas to vegetated areas, bioswales, and tree planting) or more traditional structural practices (i.e. stormwater ponds, bio-retention facilities). Based on information received from MDE and Maryland municipalities, it is anticipated that a similar requirement be included in Pennsylvania.

Consideration of Funding Methods for Stormwater in the City of Scranton

Properly managing stormwater is considered an essential service, but one that is often unseen or misunderstood by residents and businesses in a community. Stormwater infrastructure requires upgrades and maintenance that is on par with the needs, costs, and annual maintenance as similar services such as wastewater, drinking water, or transportation. However, stormwater is rarely funded to the extent that any of these other services typically are, thus leaving a considerable gap in a stormwater program's level of service to the community.

Assessment of Possible Revenue Sources and Funding Methods
Recognizing that the current funding method of having stormwater compete for general fund appropriations with other community priorities and relying on occasional grant awards is clearly not sustainable, the EFC Project Team explored the possibility of using other revenue and funding sources. Although many financing options were explored, only a few cover the costs of capital and operations and maintenance, as highlighted in Table 1 below:

Table 1: Funding Sources, Coverage of Costs, and Features

Funding Source	Coverage of Cost Type		Features
	Capital Improvements	Operations & Maintenance	
Grants	Yes	No	Not guaranteed, highly competitive, not sustainable in the long-term
PENNVEST Loan Program	Yes	No	Not guaranteed, highly competitive, must repay often with interest
Bond Financing	Yes	No	Dependent on fiscal capacity, can utilize for large, long-term expenditures, must repay with interest
General Fund	Yes	Yes	Not equitable, competes with other community priorities, changes from year-to-year
Permit Review Fees	No	No	Not significant revenue, may deter development
Inspection Fees	No	No	Not significant revenue, may deter development
Stormwater Utility Fee	Yes	Yes	Generates ample revenue, sustainable, dependable, equitable, requires significant public dialogue

While a host of fee systems exist to pay for local stormwater programs, not all provide sufficient revenue to support the large costs associated with a comprehensive stormwater management program. While all of the above were found to be useful in funding a specific portion of the entire stormwater management program, in the case of Scranton only a stormwater utility fee is considered by the EFC Project Team as being able to generate a large enough pot of money to be capable of funding the entire program. A dedicated fee should be supplemented with additional funding sources such as grants, loans, and bond financing for large capital projects.

Consideration for Using General Fund Appropriations for Stormwater

As mentioned above, reliance on general fund appropriations as the primary resource for the City of Scranton's stormwater program means that stormwater continues to compete with other higher community priorities leaving the program vulnerable to budget cuts, particularly in future years when new stormwater regulations and nutrient reduction requirements will increase the price tag significantly. The General Fund is derived primarily from taxes and the issue of equity and fairness of who pays for stormwater and how much they pay is not taken into consideration. In other words, those paying into the General Fund are not paying based on their contribution to the problem of stormwater. In fact, many large properties, such as churches, schools, and government properties are not paying any taxes and therefore not paying anything towards services related to stormwater.

Scranton suffers from fiscal instability, and the City adopted a new Recovery Plan in August 2012 to create a path for the City's fiscal recovery.[10] Additional revenue is needed to support basic government expenditures to function properly, let alone support a stormwater program. In the 2013 Operating Budget, the City calls for a 12% tax increase, which emphasizes the City's need to generate additional revenue to pay for basic services.[11] With general funds fluctuating from year to year and the revenue sources that make up the General Fund varying in amount, stormwater management is unlikely to ever be adequately funded solely from this source. Although this is seen in many communities, the fiscal strain within the City exacerbates the issue of adequately paying for stormwater with general fund appropriations.

Consideration of a Stormwater Utility Fee

Since the 1970s, one of the most popular methods of paying for stormwater has been a stormwater utility fee. A stormwater utility fee, sometimes called a service charge, is a separate accounting structure with a dedicated source of funds collected and used only for the purpose of managing stormwater. In its most recent report, the Western Kentucky University Stormwater Utility Survey identified more than 1,400 stormwater utilities nationwide.[12]

The national trend has been to move away from relying solely on taxes for these programs and charge a fee that is stable, adequate to cover the costs of managing the program, and most importantly, equitable. A utility has increasingly become the choice for supporting stormwater programs because it is the clearest way to connect level of service/use (runoff) with the fee to be imposed. This type of fee-for-service has been implemented successfully for water, sewer, and solid waste/recycling programs, and has proven highly effective for stormwater, as well.

The EFC Project Team believes that a stormwater utility, often known in Pennsylvania as a stormwater authority, is the most equitable financing mechanism because it distributes program costs associated across all properties who contribute in some way to stormwater. Taxes and other fee systems often exclude certain properties from paying, such as those that are tax exempt, yet these properties are still contributing runoff to the system, and often at a rate far greater than that of the average residence.

How a Stormwater Fee Works

The basic premise behind a community's stormwater program is that all property owners receive some benefit from the system being maintained; therefore, all properties should be required to participate in the cost of maintaining that service. Most stormwater fee rates are therefore based on the size, or footprint, of the structural part of a property. This physical part of the property is known as impervious surface and includes all of the hard surfaces of a property such as a roof, patio, paved area, or sidewalk. The reason for basing a fee on impervious surface is that a hard surface does not allow water to infiltrate into the ground, thereby increasing the volume and flow of stormwater that a community must manage.

Effective stormwater fees make a direct connection between the anticipated expenses to properly manage the system and the revenue generated. In other words, the fee should be determined by the level of revenue needed to deliver stormwater management services to the community, with some allowance for the level to which a property contributes to runoff.

There are several ways to calculate a stormwater utility rate. The most simple, fair, and common method is based on a parcel's amount of impervious surface – the extent to which a parcel contributes to runoff. When implemented, the fee may take the form of a flat or tiered rate structure, or some combination of both. An Equivalent Residential Unit (ERU) is a unit of measure based on the average single family dwelling. A specific fee level is attached to an ERU, and the number of ERUs on a given property often serves as the basis for the stormwater charge.

In many cases for residential properties, a flat fee is often recommended over exact parcel based measurements due to the level of program development and administrative burden that would be involved. Determining the fee for commercial properties, or non-residential parcels, is typically done by calculating the exact amount of impervious surface on the site and then dividing the amount of impervious surface that was calculated for residential properties to determine the number of ERUs for a particular property. The property is then charged a rate (often the same as the residential flat rate) per ERU.

Implementing a stormwater user fee is a national trend on the increase in the U.S., primarily because these fee structures, if designed correctly, will collect a sufficient amount of revenue to support program costs in the most equitable manner possible. Also, utility-based stormwater programs tend to be more efficient, as the responsibility for managing stormwater is coordinated in one program rather than piecemeal across several departments. In the case of Scranton, a stormwater user fee would create an adequate and stable source of funding dedicated solely to stormwater and allow for a comprehensive program that is consistent in funding from year to year, and meets all regulatory requirements, nutrient reduction needs, and community goals.

Table 2 below shows current stormwater user fees in Pennsylvania, including their ERU rate and total revenue collected.

Table 2: Stormwater User Fee Examples in Pennsylvania[13]

Community (Year established)	Population	Fee Structure	Revenue Generated/ Year
City of Meadville, Crawford County (2012)	13,616	Single family detached residential = $90/year All other developed non-single family detached parcels = $90/year/ERU, where 1 ERU = 2,660ft^2 impervious surface Reference: Meadville Stormwater Management User Fee Ordinance	Unknown
Mount Lebanon, Allegheny County (2011)	33,137	Single family, townhouse, or duplex = $8/month All other properties = $8/month/ERU, where 1 ERU = 2,400ft^2 impervious surface Reference: Mt. Lebanon Stormwater Fee Ordinance	Unknown
City of Philadelphia (2010)	1,536,471	Residential = $13.48/month Non-residential = Gross Area: $0.526/500ft^2 Impervious Area: $4.145/500ft^2 Monthly Billing: $2.53 per account Reference: PWD Stormwater Billing & Stormwater Fact Sheet	$655,000
City of Lancaster, Lancaster County (2013)	59,263[14]	Single-family residential = $4-$12/quarter Multi-family residential = $12-$19/quarter Typical commercial = $237/quarter Tiered rate structure for all properties where 1 ERU = 1,000ft^2 Reference: The Cost of Dealing with Stormwater	Not implemented yet
Jonestown Borough, Lebanon County, PA (2012)	1,329[15]	Single-family, townhouse, or duplex = $70/year in year 1; $80/year in years 2-4 All other properties = $70/year/ERU in year 1; $80/year/ERU in years 2-4, where 1 ERU = 3,100ft^2 Reference: Stormwater Information	Unknown

Legal Basis in Pennsylvania Enabling Stormwater Authorities

The five stormwater user fee examples listed above are the only known stormwater utilities within Pennsylvania, and are in various stages of development and implementation. Historically, paying for stormwater has been a contentious issue within the state, since it is unclear whether such dedicated fees are enabled by state legislation.

In PA, utilities are typically regulated by the Pennsylvania Utility Commission (PUC), and the PUC will not at this time regulate stormwater. Thus, the creation of dedicated fees for stormwater often comes under the guise of an authority.

The contention, then, lies in the language written into the Pennsylvania Municipality Authorities Act, which states:

> "§5607. Purposes and powers
>
> (a) Scope of projects permitted.--Every authority incorporated under this chapter shall be a body corporate and politic and shall be for the purposes of financing working capital; acquiring, holding, constructing, financing, improving, maintaining and operating, owning or leasing, either in the capacity of lessor or lessee, projects of the following kind and character and providing financing for insurance reserves:
>
> (1) Equipment to be leased by an authority to the municipality or municipalities that organized it or to any municipality or school district located wholly or partially within the boundaries of the municipality or municipalities that organized it.
>
> (2) Buildings to be devoted wholly or partially for public uses, including public school buildings, and facilities for the conduct of judicial proceedings and for revenue-producing purposes.
>
> (3) Transportation, marketing, shopping, terminals, bridges, tunnels, flood control projects, highways, parkways, traffic distribution centers, parking spaces, airports and all facilities necessary or incident thereto.
>
> (4) Parks, recreation grounds and facilities.
>
> (5) Sewers, sewer systems or parts thereof.
>
> (6) Sewage treatment works, including works for treating and disposing of industrial waste…."[16]

The Act does not differentiate between sanitary and storm sewer systems, thus creating much debate over the years as to whether storm sewer systems can be financed through an authority. A further discussion as to the legality of stormwater authorities is essential within a locality before imposing a stormwater fee, however, not the focus of this report.

In April 2013, historic legislation (Senate Bill 351) passed by a vote of 49-1 that enables stormwater authorities at the municipal level. Without this legislation, municipalities were reluctant to move forward in setting up a dedicated stormwater fee. This legislation paves way for municipalities to implement dedicated fees to ensure that stormwater is managed adequately and more cost efficiently in the long run, and it is anticipated that stormwater user fees will begin to develop more rapidly in the state than ever before due to SB 351.

Stormwater Management & Financing Recommendations

Stormwater Management Recommendations

In order to adequately address the administrative components of the MS4 permit, and to better maintain the entire stormwater system, the City and SSA should better leverage the expertise and resources available within both organizations. If done so collectively, the City and SSA should work to develop a memorandum of understanding (MoU) in the near term to begin to develop a comprehensive stormwater program. While a MoU will begin to build a comprehensive stormwater program, it is not a long-term solution. The EFC Project Team recommends that a more efficient and permanent solution would be to transfer the MS4 permit from the City to the SSA. With a permanent transfer to the SSA, the EFC Project Team recommends investing in hiring a stormwater coordinator which will allow focus on stormwater-related tasks, creating greater efficiency overall.

Phase 1 – City Maintains MS4 Permit in near-term
A near-term solution, such as a MoU, will begin to align both the City and SSA to better manage stormwater and ultimately prepare SSA to handle most, if not all, requirements of the MS4 permit through a permanent transfer. In the near-term approach, the City would maintain the permit and would ultimately be held responsible for meeting all of the requirements held within. This approach would allow the partners who have been involved in helping meet stormwater requirements to continue their involvement but through a written agreement. By clearly defining each partners' roles, it will begin to define a more sustainable approach in building the City's stormwater program. These partners include the SSA, LRCA and McLane Associates and their responsibilities as described earlier in this Chapter.

Phase 2 – Transfer MS4 Permit to SSA
In the case of a transfer to the SSA, the SSA would then be held responsible for meeting the permit requirements. To implement a transfer, the SSA needs to put its solicitor in touch with the Northeast Regional DEP's legal team. The EFC Project Team spoke with the Deputy Director of the Pennsylvania Municipal Authorities Association (PMAA) and an environmental engineer with the Northeast Regional DEP office, both of whom confirmed that a legal permit transfer is possible since the SSA owns the entire MS4 system. Through a permanent transfer, the EFC Project Team recommends that the City and other partners continue to play an active role in helping to address stormwater requirements. These partnerships will result in more cost-effective strategies that will leverage monies at both the City level and through SSA rate payers. For more information on partners' roles and leveraging monies, see recommendations for program funding needs below.

Stormwater Financing Recommendations

Program Funding Needs
To identify the necessary components of an enhanced stormwater program for the City of Scranton, the EFC Project Team worked with project partners to conduct a comprehensive review of all aspects of current spending on stormwater management. When considering the level of stormwater management service identified as necessary in the City, the EFC Project Team found that current budgeting practices are not adequate in meeting the existing regulatory requirements. By adopting the management recommendations

contained in this report, the City will be able to implement a more comprehensive stormwater management program into the future.

In order to assign costs to activities associated with properly managing stormwater, the EFC Project Team first needed to identify the costs of both existing and future activities. In conducting this gap analysis, the EFC Project Team found it difficult to collect meaningful data, which is a direct function of the City's current program being fragmented across many organizations. However, the limited data available shed light on the need to develop a financing structure that did not rely on City funds, since a much larger investment is needed in all aspects of managing stormwater.

The City and SSA will need to go through the initial budget developed by the EFC Project Team to determine the costs associated with the identified activities, and whose responsibility it will be to implement each activity in the near-term. The following section describes the recommended budget items that the EFC Project Team identified as being crucial in helping the City to properly manage stormwater in a more cost-effective and sustainable way, broken down into contractual services, personnel, capital improvements, and operations & maintenance (O&M). Since the EFC Project Team recommended a phased-in approach to transferring the MS4 permit, the budget was developed with this long-term goal in mind. See Appendix A for the Initial Stormwater Budget.

Contractual services

Since there have been and will continue to be many local partners working toward managing stormwater in the City of Scranton, the EFC Project Team pulled out specific services into a separate budget section. The following contracts should be developed and/or continued and should be included in the overall stormwater program budget:

1. Lackawanna River Corridor Association

   The EFC Project Team worked directly with the LRCA Executive Director to determine the costs associated with the administrative and technical components that the LRCA will assist with into the future (see Appendix A for itemized costs). The annual cost to conduct all public outreach and engagement activities (MCMs 1 & 2) is $63,880. The annual cost (in years 1-3) to finish the system mapping and develop a prioritized water quality improvement project list is $32,000. The EFC Project team recommends an annual review of these contractual services, since the administrative tasks will be ongoing, while the technical tasks should be completed by year 3.

2. City of Scranton

   Since the EFC Project Team is recommending a phased-in transfer of the MS4 permit to the SSA, it is recommended that the SSA then contract with the City of Scranton to continue specific tasks (through a modified MoU). These tasks include two components: (1) contract with the City Engineer and/or Inspector to conduct construction inspections (in tandem with the LCCD), since this is currently being completed by the City and (2) contract with the Public Works basin crew to develop an O&M schedule for publically-owned BMPS and continue maintaining all publically-owned PCSM BMPs. It is highly recommended by the EFC Project Team that these tasks remain at the City, and be supported using general fund appropriations. If the City uses general funds, there will be much less of an administrative burden on both the SSA and the City, and the EFC Project Team recommends the continued investment with general funds to keep the stormwater program financing structure diversified.

3. McLane Associates

Through this study, McLane Associates developed a set of green infrastructure recommendations for the City. The EFC Project Team recommends the SSA work with McLane Associates to implement the projects identified in the study.

Personnel
The EFC Project Team recommends the SSA hire a stormwater coordinator once the permit is officially transferred to them. Since the MS4 permit activities are fragmented across partners, having a coordinator in-house will help improve the organizational efficiency of all partners and ensure all tasks are met. The EFC Project Team also recommends the SSA hire additional technical staff once the permit is transferred. Although the SSA currently has staff to meet its LTCP, likely additional staff will be needed to handle all LTCP and MS4 permit activities. The EFC Project Team estimated at least two staff will be needed, but the SSA will need to determine internally the existing capacity and how many are needed to fill the gap in the marginal workload being added. Such tasks that the EFC Project Team recommends be taken on by the SSA include illicit discharge inspections, street sweeping, cleaning, etc.

The SSA will need to consider hiring an additional administrative staff person to handle billing if a dedicated fee is implemented and a GIS staff person to determine rates based on parcel-specific land use information. It is unknown whether the SSA currently has this internal capacity. Lastly, the SSA will need to consider the existing staff time that will be utilized for stormwater-related activities and factor those costs into its stormwater budget.

Capital improvements
The EFC Project Team recommends the SSA purchase outfall location identifiers once all outfalls are identified to improve tracking and monitoring. In addition, the SSA should contract with local firm(s) to implement prioritized water quality improvement projects and green infrastructure projects, as determined through this and other efforts being conducted by project partners to escalate the restoration efforts in local streams and the Chesapeake Bay. Once identified, these projects should be implemented through a capital improvement plan over time.

The EFC Project Team also recommends the SSA determine which existing equipment can be utilized to implement MS4 activities, and which equipment will need to be purchased. For example, the City has two old street sweepers. If the SSA takes on street sweeping activities once the permit is transferred, the SSA can purchase the City's sweepers or purchase new equipment. The SSA will also need to determine if it wants to set aside equipment reserve funds to purchase equipment on a scheduled basis over time, or if it wants to purchase equipment up-front.

Operations & Maintenance (O&M)
Any equipment – old or new – purchased by the SSA will need to be maintained each year, and these costs should be included in the O&M section of the budget. These costs will be included once it is determined what equipment, if any, will be purchased.

The SSA currently has both management and GIS software that should be utilized for the MS4. Since the MS4 makes up approximately 37% of the entire system, the EFC Project Team recommends factoring in 37% of the software costs annually into the stormwater program budget. For example, since the SSA pays $50,000 annually for its ArcMap License, $18,500 of that total cost should be factored into the stormwater budget. Additional costs that need considered by the SSA are testing materials for illicit discharge and finishing the stormwater system mapping (although these costs likely include personnel costs only).

Stormwater User Fee Rate Structure Analysis

Why This Study is Recommending a Stormwater User Fee for the City of Scranton

It became clear early on in the study that the City of Scranton needs to invest in properly managing stormwater, and that there are very limited resources available currently to invest at the level that is needed to improve water quality and meet all stormwater compliance activities. With this understanding by all project partners, the EFC Project Team recommends the City create a dedicated stormwater user fee that will distribute the costs of paying for repairs and improvements in proportion to the types of land uses that are contributing to stormwater management needs.

The more impervious surface that a property has, the more stormwater it generates and the more responsible the property owner is to help the community manage stormwater. As private driveways, parking lots, swimming pools, decks, and other such structures allow residents and businesses to enjoy additional living and working conveniences, the burden of maintaining and repairing the infrastructure that supports those additional structures and surfaces should be shared by those contributing to the problem rather than the community at large. Just as a property owner is responsible for paying its share of waste disposal, water use, or electricity consumed, so should they recognize and be accountable for the stormwater created from their built environment. In an urbanized city with substantial impervious surface, a dedicated user fee allows for the clearest and most equitable way to connect level of service/use (runoff) with an associated fee.

Once it became clear that there was a significant need to have a dedicated funding source to cover the stormwater costs in City of Scranton, the EFC Project Team considered what financing mechanism would be most appropriate to generate these funds. The EFC Project Team initially considered assessing a property tax, but since the value of a property is not an indicator of the amount of runoff, the property tax was not seen to be the most equitable way to pay for a stormwater program. And given the fiscal strain within the City, adding to the already increasing taxes was deemed unfeasible.

Billing Recommendations

Since enabling legislation was passed very recently in Pennsylvania, there are few examples that exist in the state to use as a model for implementing dedicated stormwater user fees. In Pennsylvania, the government structure creates so many small, autonomous municipalities with unique circumstances based on municipality type. In the past, cities, boroughs, and home rule municipalities have had an easier time passing ordinances to set up stormwater fees in the state. Since the City of Scranton is a city with a Home Rule Charter, it will have a much easier time implementing a dedicated fee compared to other municipalities in the state. Considering the management recommendations, the EFC Project Team recommends the SSA implement the stormwater fee by adding it to the existing sewer bill that it sends to its customers.

Rate Structure Analysis

Although a specific cost estimate for the stormwater program was not generated, the EFC Project Team recommends implementing a fee to improve the current level of service. This fee could be set low to begin generating revenue, and once the City and the SSA has a better understanding of costs and responsibilities, the rate structure should be reevaluated.

In determining an equitable funding strategy for collecting revenue to pay for stormwater related expenditures, the EFC Project Team reviewed available data on all parcels located in the City provided by the City Planner. The parcel data (land use and land area) was based on 2010 tax assessments collected from the City of Scranton and the impervious data for each parcel was extracted from 2010 aerial photographs taken by the University of Vermont Spatial Analysis Lab for a project conducted by the Pennsylvania Department of Conservation and Natural Resources (DCNR). The EFC Project Team calculated potential revenue using a flat rate fee for parcels classified residential, and an impervious-based fee for all other parcels (non-residential)[17]. The EFC Project Team worked with the land use codes from the original data, as this framework will be easy for the City and the SSA to implement moving forward.

Summary of recommended rate structure for residential properties

The decision to recommend a flat rate fee for residential properties was not made lightly. After reviewing the large number of residential units and the many different types of residential properties located within the City, the EFC Project Team became concerned that a parcel-specific fee structure would require additional capacity on the part of the City to properly estimate the total impervious surface for all 21,623 residential properties in the City. Based on our experience working in other communities, it was agreed that calculating the level of impervious surface on every residential property would cause significant administrative burden. In addition to this being an overwhelming effort, the EFC Project Team agreed that the risk of errors on bills could cause confusion about the billing calculation and increase the risk of complaints from the residential population. Given the high costs associated with stormwater management, the EFC Project Team estimated revenue using an annual flat fee between $25 and $70 so that the project partners could get a sense of how much a fee would generate when they are ready to move forward using national standards[18].

Summary of recommended rate structure for non-residential properties

Because the size and nature of non-residential units vary widely, the EFC Project Team suggests that a parcel-based rate structure that takes a parcel's specific level of impervious surface into account to be the fairest method of assessing the stormwater fee on these properties. The parcel data provided to the EFC Project Team should be utilized, since it will allow the SSA to generate parcel-specific fees based on impervious surface. For all 5,893 non-residential parcels, it is recommended that a user fee be assessed based on the actual impervious surface of the property.

After conducting a sensitivity analysis[19] using various fee structures, the EFC Project Team found that there are many options for the City to set its initial rates. It is recommended that the Estimated Residential Unit (ERU) be set at 2,984 square feet since that number represents the average impervious surface of all residential properties in the City. The EFC Project Team estimated revenue using an annual impervious-based fee between $25/ERU and $70/ERU. With so many questions still left unknown, it is recommended that the fee be reviewed and adjusted as needed after each year. Another variable to be considered in terms of rate adjustment is the impact of a credit system, if it is implemented as typically recommended when setting up a dedicated stormwater fee.

Estimated total revenue from all properties

The estimated total revenue generated is distributed between residential and non-residential properties and is calculated as follows:

Residential – The residential properties should be assessed a flat fee starting between $25 and $70 to generate the minimal revenue needed to support the large costs associated with managing stormwater. The final rate chosen by City of Scranton should be consistent with the non-residential rate.

Table 3 shows the revenue yield for all rate scenarios developed by the EFC Project Team.

Table 3: Annual Residential Property Revenue Potential

$25	$30	$35	$40	$45
$540,575	$648,690	$756,805	$864,920	$973,035
$50	**$55**	**$60**	**$65**	**$70**
$1,081,150	$1,189,265	$1,297,380	$1,405,495	$1,513,610

The residential fee is based on the assumption that an average residential property has 2,984 square feet of impervious surface and, therefore, all properties are billed for 1 ERU per year. The fee at which 1 ERU is set will be determined once the City determines the specific costs that should be supported using a dedicated user fee.

Non-Residential – According to data provided by the City, there are just below 6,000 non-residential properties in the City of Scranton. This data source gave not only the land area for each property in the City, but the impervious and pervious land area on each property. Given this data, the EFC Project Team was able to calculate the actual charge for each property, and sum this data to provide actual revenue estimates. The equation used to estimate the non-residential rate for each property is:

Parcel impervious surface / 2,984 square feet = # ERUs x rate = annual non-residential fee

Table 4 shows the revenue yield for all rate scenarios developed by the EFC Project Team.

Table 4: Annual Non-Residential Property Revenue Potential

Property type	$25	$30	$35	$40	$45
Commercial	$517,112	$620,534	$723,956	$827,379	$930,801
Industrial	$82,034	$98,441	$114,848	$131,255	$147,661
Ag/Vacant/Blank	$214,616	$257,539	$300,463	$343,386	$386,309
Total	$813,762	$976,514	$1,139,267	$1,302,019	$1,464,771
	$50	**$55**	**$60**	**$65**	**$70**
Commercial	$1,034,223	$1,137,646	$1,241,068	$1,344,490	$1,447,913
Industrial	$164,068	$180,475	$196,882	$213,289	$229,695
Ag/Vacant/Blank	$429,232	$472,155	$515,079	$558,002	$600,925
Total	$1,627,524	$1,790,276	$1,953,028	$2,115,781	$2,278,533

The total revenue potential for all fee structures is shown in Table 5 below.

Table 5: Total Revenue Potential

	$25	$30	$35	$40	$45
Residential	$540,575	$648,690	$756,805	$864,920	$973,035
Non-Residential	$813,762	$976,514	$1,139,267	$1,302,019	$1,464,771
Total Revenue (1-year)	$1,354,337	$1,625,204	$1,896,072	$2,166,939	$2,437,806
	$50	**$55**	**$60**	**$65**	**$70**
Residential	$1,081,150	$1,189,265	$1,297,380	$1,405,495	$1,513,610
Non-Residential	$1,627,524	$1,790,276	$1,953,028	$2,115,781	$2,278,533
Total Revenue (1-year)	$2,708,674	$2,979,541	$3,250,408	$3,521,276	$3,792,143

For the fee to be adequate as well as equitable, the total expenditures should as closely equal the total revenue as possible. The City must first determine which expenditures should be included in the stormwater program budget, and which aspects of the program it wants to invest before assigning a fee structure.

It is important to note that if City of Scranton funds this program entirely by the user fee, then the fee would need to be set higher to pay for existing costs and the additional investments needed to support an adequate stormwater management program. It is highly recommended by the EFC Project Team that the City continue to supplement the program using general fund appropriations and all project partners seek grant funds where possible. This will decrease the user fee, minimizing any community backlash.

CHAPTER 3: SUBWATERSHED INVENTORY & ANALYSIS

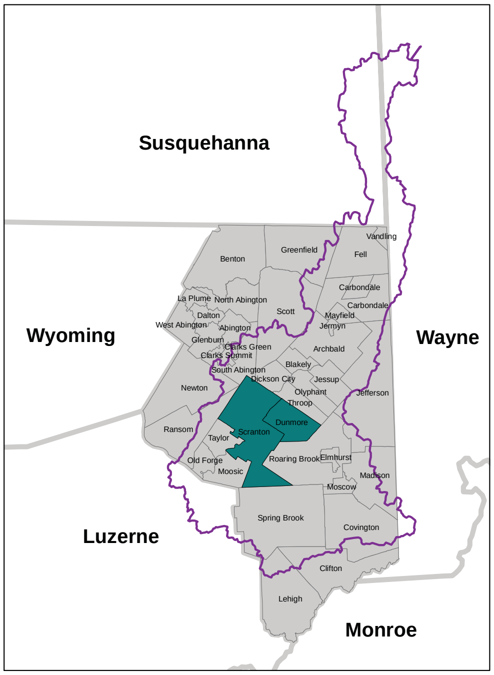
Lackawanna River Watershed

Preliminary MS4 Inventory & Assessment

Watershed and Stream Recommendations

Lackawanna River Watershed

History



The Lackawanna River (USGS -HUC # 02-05-01-07) is a fifth order tributary of the North Branch Susquehanna River. The Lackawanna River watershed covers a 350 square mile area in the Ridge and Valley and Appalachian Plateau province in four Northeast Pennsylvania counties. The 62 mile long Lackawanna River rises on the plateau north of Forest City in Susquehanna and Wayne Counties. It flows through Stillwater Gap off the plateau and into the Lackawanna Valley, a large geosyncline, which is part of the Ridge and Valley physiographic province. From Stillwater Gap the east and west branches of the Lackawanna confluence to form the main stem of the river. It then flows for forty miles through an extensive urbanized area that includes the Cities of Carbondale, Scranton and Pittston, and large urban Boroughs such as Dunmore, Dickson City, Forest City and Archbald. Its confluence with the Susquehanna River is located between Duryea and Pittston at Coxton Point in Luzerne County. This area drains the upper half of the Northern Anthracite Coalfield. The Susquehanna River is the largest tributary of the Chesapeake Bay.

The geology dates to the Carboniferous Era with anthracite coal inter bedded with shales and sandstones forming the Llewellyn Formation along the axis of the Lackawanna Valley. The ridge lines and the head waters areas along the plateau are Devonian with conglomerates, underlain with sandstones and shales of the Catskill Formation. The geologic stratigraphy exhibits folding characteristic of the Ridge and Valley province.

The region was glaciated numerous times, the most recent period ending about 12,000 years before the present. Soils are predominantly well drained along the center of the valley thinning out to bedrock ledge along the ridgelines.

Vegetative cover is Appalachian Forest with a mix of northern and southern communities. The headwaters of the river and major tributary streams are characterized by forested wetland bog complexes. Some of these have been excavated and impounded as ice ponds and water supply reservoirs.

The fauna is typical eastern North American species that have adapted to human population influences. White tailed deer, black bear, fox, raccoon and beaver are common. The range of common avian larger species include: wild turkey, ruffed grouse, great blue heron, mallard and merganser ducks, kingfisher, and Canada goose. Osprey is seen on occasion as is bald eagle, recently reintroduced in the Susquehanna Basin by U.S. Fish and Wildlife Service. The Lackawanna Fishery is dominated by the wild brown trout an introduced European species that has acclimated in the Lackawanna River. Native brook trout are also found in the river but more so smaller tributary streams.

The Lackawanna River has over 100 tributary streams from first order runs to third and fourth order creeks that drain important sub watersheds. Roaring Brook is the largest tributary. It drains a watershed of 52 square miles and flows westerly off the North Pocono Plateau through Cobb's Gap in the Moosic Mountains and on through Dunmore and Scranton. Roaring Brook flows through the Nay Aug Gorge featuring the Nay Aug Falls a National Natural Geologic Landmark.

Spring Brook is the second largest tributary. It drains an undeveloped, heavily forested area of the city of Scranton to the southeast of Montage Mountain. Stafford Meadow Brook, Leggett's Creek, Keyser Creek and Meadow Brook are also tributaries to the Lackawanna that flow through or confluence with the Lackawanna within the boundaries of Scranton and Dunmore.

These sub watersheds that flow through Scranton and Dunmore are strategic parts of the communities MS4 green infrastructure. There are summary discussions and recommendations regarding these watersheds later in this chapter.

The resource heritage represented by the presence of coal continues to affect the geology, hydrology, ecology and economy of the Lackawanna Valley. From a point just northeast of Forest City to a point southeast of Nanticoke, the Lackawanna Syncline is underlain by the Northern Anthracite Coal Field, the largest deposit of Anthracite Coal on the planet. The urban centers of the Scranton, Wilkes-Barre Metropolitan region developed during the 19th and early 20th Century around the Anthracite Coal mining industry. The co-located impacts of urbanization and coal mining continue to be the major variables affecting water quality and aquatic habitat in the Lackawanna and Susquehanna Rivers in northeastern Pennsylvania.

The Anthracite Industry collapsed following the Second World War. In 1957 an economic intersection affected the anthracite coal market whereby the costs of pumping to dewater the mines in the northern field exceeded the price per ton for deep mined coal that was available on the market. Over the next five years many of the publicly traded companies that had been the blue chips of the industry dissolved or collapsed into bankruptcy. On January 24, 1959 the Knox Mine Disaster occurred along the Susquehanna River in Pittston. Coal was being mined in a seam below the bed of the Susquehanna River when the river bed broke open and flooded the mines. This event is seen as the coup de grace that ended the industry.

On November 1, 1961 the Moffat Coal Company, a large privately held mining concern, notified the Commonwealth of Pennsylvania that it was terminating the operation of all mine pumping operations in the Lackawanna Basin portion of the Northern Field. Moffat had been operating its own pumps and the pumps of adjacent operations that had ceased business. Over the winter of 1961-62 the entire complex of subterranean mine voids from Pittston to Forest City filled with ground water and large amounts of flow from the Lackawanna River and its many tributaries. It has been estimated in numerous studies during the past 50 years that upwards of one third of the fresh water stream flow in the Lackawanna River watershed infiltrates through fissures in rock strata below the river and tributary stream beds and flows through the underground mine voids until it finds an outlet in the form of a mine opening or borehole.

That portion of the mine workings under the City of Scranton is now known as the Metropolitan Scranton Mine Pool (MSMP). It extends from an anticlinal feature known as the Moosic Anticline near the Borough of Old Forge northeastward under Scranton and Dunmore to the Boroughs of Archbald, Jessup, and Blakely. Recent research conducted by the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) and the Susquehanna River Basin Commission (SRBC) estimates that the MSMP may contain 128 billion gallons of water. That would make it the largest water body in Pennsylvania, larger by two times than Lake Wallenpaupack or Raystown Lake.

Following the cessation of mine pumping and the flooding of the MSMP by early 1962 there were mine drainage related flooding problems in the Lower Lackawanna Watershed that were adversely affecting private property, roadways and public safety. There was not a single drainage outlet at a location to control the level of inundation in the lower portion of the MSMP. In order to address these problems, state and federal agencies agreed that a borehole would be installed where the strata of the Moosic Anticline crested in the bed of the Lackawanna River at Old Forge. Between May and September 1962, a 42 inch diameter borehole was drilled to a depth of 107 feet, penetrating a coal seam known locally as the Red Ash #2 vein.

Since September of 1962, The Old Forge Borehole as it is known has allowed the discharge of an average of 60 million gallons of mine water per day from the MSMP into the Lackawanna River. This mine water contains an average of 3.8 tons of iron oxide in solution per day. Upon entering the river the dissolved iron oxide in the mine water reacts with dissolved oxygen in the river water and precipitates out of solution to form an accreted orange and yellow colored sludge on the riverbed. The river water deprived of sufficient levels of dissolved oxygen cannot sustain aquatic habitat of sufficient capacity to support a fishery. The Lower Lackawanna River is supporting a few fish and macro invertebrates but in numbers that are severely depressed due to low dissolved oxygen levels and increased embededness of the cobble substrate along the benthic horizon.

In 2009 PA DEP established a TMDL for iron in the Lower Lackawanna River related to the loading form the Old Forge Borehole and nearby Duryea Breach. The loading calculation indicated that the iron load is over 1000% the allowable maximum.

The Commonwealth of Pennsylvania developed the Clean Streams Law of 1937. This law has served as a template for the federal Clean Water Act of 1972. As Pennsylvania began to enforce the Clean Streams Law, State officials notified local municipalities of the need to develop modern sanitary treatment plants. The municipal sewer systems along the Lackawanna River communities including Scranton and Dunmore had been developed between the 1860s and 1900. All of these sewers, following accepted practice of the day were designed to flow by gravity to the nearest stream or river. Municipalities dragged their feet in compliance to the Clean Streams Law. Many municipal officials argued that they would comply as soon as the Commonwealth forced the Coal companies to stop polluting our waters with coal mine waste and drainage.

With the cessation of coal mining along the Lackawanna in 1961, that argument was no longer an acceptable excuse, not that it had been one prior to 1961. Scranton and Dunmore formed the SSA in 1967. A large 20 million gallon per day treatment works were constructed along the river off Breck Street and an extensive collection pipeline system was built along the river banks and along several larger tributaries between 1967 and 1972.

These trunk sewer lines intercept the discharge of the street sewers and convey those flows to the treatment plant. The street sewers are however combined and receive extensive storm water flows from catch basins and storm drain systems on private residential, commercial, industrial and institutional properties. There are approximately 80 locations on the system in Scranton and Dunmore that are CSO points. There are an additional 40 CSO points on the Lackawanna River Basin Sewer Authority (LRBSA) system upstream of Scranton and an equal number below Scranton on the Lower Lackawanna Valley Sewer Authority (LLVSA) system.

The SSA is spending 40 million dollars rebuilding the treatment plant as of 2013 to comply with biological nutrient reduction requirements for the Chesapeake Bay Program. The SSA will expend another 140 million dollars over the next 25 years to comply with the need to reduce and eliminate over 90% of the incidences of CSO events. An extensive system of precast concrete cisterns will be installed below street grade and at points along the trunk line to retain combined sanitary and storm water flows for subsequent treatment. Additionally, numerous CSO discharge points will be eliminated and storm water inflows to the combined system will be reduced by a large scale introduction of green infrastructure and storm water best management practices. LRCA is working with the SSA to conduct a public outreach, involvement and education program related to the Long term Control Plan for the CSO system. That program is a template for expansion to address the needs for public involvement on the MS4 systems in Scranton and in other communities in the watershed. The other sewer authorities serving the Lackawanna Watershed are also making significant system and treatment plant improvements.

Lackawanna River Corridor Association (LRCA)

In 1987, the residents of the Lackawanna River Watershed created the LRCA, in order to promote the restoration and conservation of the Lackawanna River and its watershed resources. Their projects and successes are accessible in more detail at www.lrca.org.

The LRCA has worked proactively with other community groups and public agencies to plan and promote projects that address the issues of water pollution, recreation, community development, land and water conservation, pubic involvement with their river and watershed, and the public policy decision making that affects the river and watershed. The mission of the LRCA is to involve citizens of the watershed with conservation and stewardship of the River, its tributaries and water resources.

The goals that define their mission include: clean up the river environment; aid in the development of the 40-mile Lackawanna River Heritage Trail; create partnerships among government, businesses and community groups promoting conservation and recreation; develop partnerships with schools, universities, and the general public to promote environmental and conservation education to better understand our relationship with the local environment; and advocate for the conservation of open space and natural habitat throughout the watershed.

In 1989, the LRCA completed a “Citizens Master Plan for the Lackawanna” This plan advanced five goals for the river and the community: Clean up the environmental problems that had degraded the river; Educate the community on the value of the river as a community asset; Develop a 40 mile trail and greenway along the river; Build partnerships among government, business and community interests to promote public involvement with the clean up and greenway trail development; Conserve open space and natural areas across the watershed.

In 1990, Lackawanna County incorporated the Lackawanna Heritage Valley Authority (LHVA) with a broad mission to interpret the cultural, social and environmental heritage of the Lackawanna Valley. Community Task Force that helped to create the LHVA shared a strong interest in the river with the LRCA. This partnership grew during the 1990’s and is helping to develop the Lackawanna River Heritage Trail and Greenway. A greenway is a multi objective initiative that involves the acquisition of old railroad and mining properties along the river and tributaries the cleanup of those properties and the development of pedestrian /bicycle trails, river access sites and other recreational amenities. The public ownership and management of greenways also forms what is now recognized as part of a community’s critically important green infrastructure. Greenways are an important economic asset in the many benefits that they can provide to a community. The Lackawanna River Trail and Greenway is beginning to have measurable effects for the community as a whole and specifically for those neighborhoods where sections have been developed.

In 1991, the LRCA collaborated with LHVA and National Park service to inventory abandoned rail lines along the river as a first step towards the 40 mile trail. This work led to the creation of the Rail Trail Council of Northeast Pennsylvania (RTC NEPA) and the acquisition of 40 miles of the former Delaware and Hudson railroad in the upper Lackawanna watershed. LRCA collaborated with the Army Corps of Engineers in 1993 to further advance plans for the Lackawanna Greenway Trail and the cleanup of Mine Drainage and Combined Sewer Overflows. In 1995, the LRCA incorporated an affiliate, the Lackawanna Valley Conservancy to acquire and protect river corridor land and watershed resource lands. These lands and the work of the LVC further compliment the multi objective goals to create the Lackawanna River Greenway.

Through the beginning of the 21st century the LRCA continued building partnerships and involving the community with the River. Collaboration with the Scranton Dunmore MS4 Assessment is a part of a continuing and growing understanding of the values that proactive public involvement and green infrastructure bring to our community.

The LRCA is collaborating with EPCAMR and SRBC to develop resources and designs leading to the construction of a mine drainage treatment plant to address the flows of AMD at the Old forge Borehole and the Duryea Breach. As of 2013 several studies have been completed that document the flow volumes and water chemistry of the Old Forge and Duryea AMD's. Presently LRCA, EPCAMR and SRBC are have prepared funding requests to federal and state agencies for land acquisition and treatment plant design work. Collaborations with private sector interests are also being developed with opportunities for iron oxide material processing and other water resource and energy related concepts under consideration.

During the last 20 years, the water quality of the Lackawanna River has greatly improved. The River has once again become a public asset and it is a beneficial, unifying feature for the towns throughout the Lackawanna Valley. The entirety of out project area, Scranton and Dunmore, is located within the Lackawanna River watershed. The urban environment and the associated stormwater runoff has direct negative effects on the water quality of the Lackawanna River and the Chesapeake Bay. Water quality and habitat quality studies within the Watershed have been conducted for nearly 20 years by professionals and volunteers (LRCA, University of Scranton, EPA, SRBC, PA DEP, LCCD, *et. al.*). The results of the studies show the aquatic health of the river and tributary streams is good-to-excellent in the upper reaches of the watershed and remains a moderate aquatic health down to Scranton. Downstream from Scranton to Pittston, the rivers aquatic health declines quickly due to acid mine drainage (AMD) from the Old Forge bore hole, CSOs, and urban stormwater.[20]

Lackawanna River Watershed

Lackawanna River Corridor

PA DEP defines a watercourse as any channel of conveyance of surface water having defined bed and banks, whether natural or artificial, with perennial or intermittent flow. The main watercourse flowing through the site area is the Lackawanna River. The Lackawanna River Corridor refers to the floodplain areas and the portions within the Lackawanna River Watershed that drain directly to the Lackawanna River via sheet flow, gray infrastructure, or small channels that are not formally named by the PA DEP via Chapter 93. This area has been referred to as the "Zero Watershed" in several studies. It includes the following drainage areas that are assessed in this report:

- I-81 Swale
- Pine Brook
- Philo Creek
- Minooka Run
- Carter Creek
- Greenbush Run
- Walmart Tributary
- Scranton/Dickson City Basins
- Mount Pleasant Run

Subwatersheds

A subwatershed is a segment or portion of the larger watershed encompassing a tributary or tributaries to the Lackawanna River. The Lackawanna River has seven named tributary streams that drain portions of the City of Scranton and Dunmore and confluence with the River. The Subwatersheds of importance for this project are:

Spring Brook
- Green Run

Stafford Meadow Brook
- Mountain Lake Run

Keyser Creek
- Lucky Run
- Lindy Creek

Roaring Brook
- Little Roaring Brook
- East Mountain Run

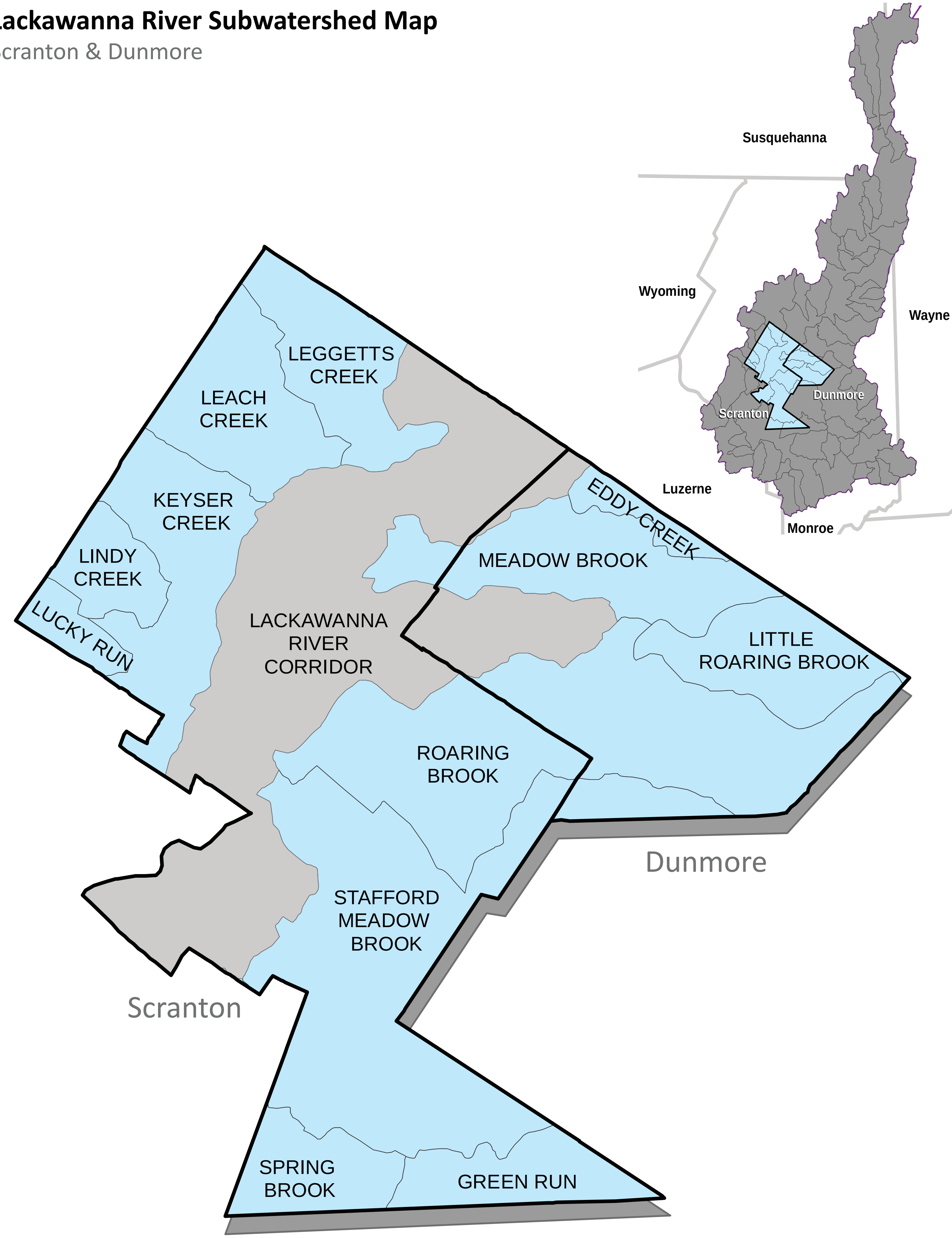
Leggett's Creek
- Leach Creek
- Clover Hill Creek

Meadow Brook

Eddy Creek

Lackawanna River Subwatershed Map

Scranton & Dunmore



Preliminary MS4 Inventory and Assessment for Scranton

Resources, Approach and Methodology

Resources

As the LRCA and the project partners began to examine the status and the extent of the Municipal Separate Storm Sewer System (MS4) in the City of Scranton, several factors emerged that influenced the approach, methodology and scope of work. The primary factor is the absence of any previous comprehensive assessment or management system that would facilitate the city's compliance with storm water permitting and reporting requirements. A second significant factor relates to the extent and status of the Combined Sewer System (CSS) in the City and the integration of the CSS and MS4 Systems in both the City of Scranton and the adjacent Borough of Dunmore and the conveyance of ownership of both the CSS and MS4 systems in Scranton and Dunmore to the Scranton Sewer Authority (SSA) in 1968 as part of the establishment of the SSA.

A third factor is the lack of understanding and definition of the discrete components that taken together constitute the MS4 system in Scranton and Dunmore. A fourth factor is the changes to the management of stormwater in Pennsylvania over the past 30 years and the relationship and responsibility of the various storm water stakeholders, developers and all classes of property owner with the municipal government and the status and influence of the Municipalities Planning Code, PA Act 167 (that established local and regional stormwater management plans), and municipal ordinance on the interface between private and public storm water systems.

In order to begin to understand the Scranton/Dunmore MS4 System, LRCA first conducted interviews with staff and elected officials from the Borough, the City and the Sewer Authority to determine what information presently existed on the MS4 system.

Three important resources were identified:

1. The SSA has developed a geographic information system data base using ESRI ARC INFO mapping software to map and collect data for the entire CSS and the related CSOs. This survey work has been under way for several years as part of the development of the CSO LTCP. This work is establishing a map and data base on the entire CSS infrastructure and also it is identifying adjacent MS4 related infrastructure. This system will form the foundation of an asset management system for the SSA's CSS/CSO system and can be expanded to include the MS4 system in both Scranton and Dunmore. The supervisory capacity of the SSA staff to manage the GIS system is highly qualified and the system to date is highly functional. There are recommendations elsewhere in this plan to continue to expand the capacity of the SSA and to advance this system towards and overall CSS and MS4 Asset Management System.

2. The City Planning Commission has an inventory of subdivision development plans that include E&S control plans and storm water system plans. These plans go back to the inception of the Act 167 Plan for the Lackawanna Watershed circa 1990. The inventory of plans is not complete and much of it is on paper rolls. Several newer submissions and all future submissions will require electronic copies in addition to paper hard copies. Some of this is supplemented by plans reviewed by the

Lackawanna County Planning Commission and the Lackawanna County Conservation District. Some of the developments submitted and approved have not been built or have been built differently than is exhibited on the approved plan documents as reviewed by LRCA.

3. A large amount of MS4 information exists as personal/institutional memory in the person of municipal staff and various Engineers who have served as Municipal Engineer for the City or Borough over the past 20 years or more. Some of this information is anecdotal and difficult but not impossible to quantify or qualify. Other information was obtained by survey staff through interaction with neighborhood residents and property owners during the course of fieldwork.

The LRCA looked to its experience with the development of the Lackawanna River Citizens Master Plan in 1988, The Lackawanna River Greenway Reconnaissance Study completed with the Corps of Engineers in 1993 and the Lackawanna River Watershed Conservation Plan completed by LRCA in 2001.

A primary component of the previous planning work had been an examination of historical information and data. Therefore, as part of the work to develop a Stormwater Management plan for the City of Scranton and the Borough of Dunmore, The LRCA conducted research to review historical mapping that would help to identify the location and extent of the natural stream corridors that were tributary to the Lackawanna River and exhibited on available maps that were prepared in the later part of the 19th century as the urbanization and industrialization of the Lackawanna Valley was underway. Historical aerial reconnaissance photo imagery was also reviewed.

Three map bases and an on-line aerial photo archive were reviewed:

1. The Scranton Quadrangle of the Second Pennsylvania Geologic Survey surveyed in 1889, published in 1893 by the US Coast and Geodetic Survey.
2. Various Sanborn Insurance Rating Maps for Scranton and Dunmore published decennially by the Sanborn Insurance Map Company.
3. The Scranton City Atlas of 1898 published by Graves and Steinbarger.
4. The Penn Pilot Aerial Photography Archive from the 1930's through the 1950's for the Scranton area was also reviewed to examine landscape, topographic and hydrological impacts associated with the extensive underground and surface strip mining that occurred in the vicinity of Scranton during the first half of the 20th century.

These maps and the information they contain on historical topography, hydrology, development and infrastructure were compared to contemporary quadrangles, satellite and aerial imagery and SSA and Lackawanna County Arc Info data to help inform the field work of our Stream Walk Surveys.

With an understanding of the geophysical characteristics and historical impacts as background, the LRCA conducted its field work by walking along the shoreline and banks of each tributary stream in segments beginning at its confluence and proceeding upstream to its source water area or to the extent of the municipal boundaries of Scranton and Dunmore. On occasion this included survey data collection in and along the boundaries with adjacent municipalities where stream channels or stormwater facilities were situated along the municipal boundary.

Approach
LRCA's approach to defining the MS4 system begins in the water column, pools, riffles and benthic horizon and along the banks of the Lackawanna River and its tributaries. It extends from there upstream in the built and natural environments. The Lackawanna River is the major receiving water for the Scranton/Dunmore CSS and MS4 systems. The larger named tributaries and sub tributaries to the Lackawanna are the next level of survey.   The third level of MS4 is the extensive road and catch basin network. The fourth level are the privately owned stormwater conveyance and detention systems.

It is important to note that survey work was not conducted along the Lackawanna River itself as part of this inventory; the exception being the areas adjacent to the confluences of the tributary streams that were the starting points for those surveys. The SSA and consulting engineers working on the CSO LTCP and engineers working on the flood control projects had previously collected geo-physical data on outfalls to the river. LRCA had also conducted stream walks that had identified and assessed these outfalls during work on the Watershed Conservation Plan. Recently the Lackawanna Valley Chapter of Trout Unlimited collaborated with the Scranton Department of Public works to secure GPS locations and photo reference these outfalls.

Also, it should be noted that LRCA includes in the second level, a number of first and second order streams that are exhibited on historical mapping and that have over the past 100 years been converted into underground sewer culverts as part of the CSS and as MS4 drainages. These streams in the urbanized area of Scranton have been referred to as the "Zero Watershed" of the Lackawanna in several recent engineering studies of the Lackawanna Watershed.

For purposes of this assessment and to advance responsible and accountable water resource management, these formerly unnamed tributaries have been assigned names. Projects have been recommended that can contribute towards the restoration of these stream corridors as part of the overall MS4 Plan for Scranton and Dunmore.

It becomes evident through historical studies of the settlement of this portion of the Anthracite Region in Northeastern Pennsylvania that the combination of Coal Mining and Urban Development in the late 19th and early 20th centuries resulted in extremely destructive impacts on the watercourses in both the Lackawanna and Wyoming Valley.

Coal mining impacts have completely obliterated the sources and courses of numerous small drainages. All streams that flow over underground mine workings loose measureable amounts of their freshwater flow as infiltration through fissures in substrate to the flooded subterranean mine voids that underlie the region. In many smaller streams the rate of infiltration exceeds the source flow and the streams exhibit dry channels except during and shortly after major precipitation events. Strip Mining has excoriated many reaches of several smaller streams; completely obliterating the natural topography and drainage gradients.

In many cases these conditions are evident in close proximity to urban neighborhoods that developed near by the coal mine sites in the late 19th and early 20th centuries. Here the exigent urban need was to control and channel drainage of all types away from homes and businesses and towards the river. Various types of swales, brick and stone masonry culverts and later metal pipe and concrete pipe culverts were developed to channel these remnant creeks through the neighborhoods. All of these structures are well past their service life. Many of these structures are collapsed and dysfunctional often causing property damage and nuisance conditions for adjoining property owners.

In contrast to this, all of the larger tributaries do carry a nearly natural level of base flow, support designated uses, and have good portions of their floodplains and riparian corridors intact. However there are urban encroachments, unwisely deposited fill materials, trash and litter in many stream corridor locations. Extensive culvert systems are evident on Meadow Brook in Green Ridge and Stafford Meadow Brook in South Scranton. Roaring Brook and the Lackawanna River have significant portions of their channels and riparian corridors developed as flood control structures. The recently completed Scranton Flood Control works developed by the Corps of Engineers have setbacks where practicable on most reaches and allow the retention of a narrow riparian corridor along the toe of slope. The Lackawanna maintains its designated uses and supports a vibrant fishery for wild brown trout.

LRCA classifies a third and fourth level of MS4 facilities as well. Included in the third level are the streets, curb line gutters and catch basins that are part of the CSS and MS4 systems. The survey field work recorded these in proximity to the outfalls and bridges that were encountered as the stream walks proceeded along the stream channels. Extensive street scape data was not collected since this work has been developed as part of the CSO LTCP. There are many newer small MS4 collection systems associated with bridges and roadways that are owned by PA Department of Transportation (PENNDOT) and others that are along newer city or county owned roads and bridges. There is a need to include the management BMPs for PENNDOT infrastructure as well as city and county owned roads and bridges in the overall understanding of the Scranton/Dunmore MS4 Plan.

The fourth level of MS4 facilities are those that are on private property, developed over the past 25 years since the adoption of the Act 167 Stormwater Ordinance. LRCA collaborated with the City Planner to inventory the hard copies of the planning documents on file with the Planning Commission for approved projects. LRCA survey staff photocopied several informational pages from each plan submittal and filed them into a binder. Information in these files was then put into an excel spreadsheet to record the name, address location, facility type (open or closed). The facilities were then geo-referenced onto a map by sub watershed to facilitate site reviews and field visits.

There are over 80 approved storm water facilities on private properties in Scranton and Dunmore. These facilities vary in size, type and method of outlet. Many MS4 outlet into the CSS system since there may be no other alternative based on location and proximity to a natural watercourse.

The other main variable is whether the facility has an open or closed detention system. Some larger commercial developments on the periphery of the city have large open basins. Many smaller commercial sites in the more built up neighborhoods have underground cistern detention systems usually installed under parking lots. There are no established procedures or methods for the regular inspection and maintenance of these systems. Some of the larger open basin systems have the potential to help facilitate perennial flow regimes to assist in the restoration of aquatic habitats in several of the degraded streams examined by this survey.

Methodology

The field work for the stream walks was conducted between December 2012 and October 2013 by LRCA Staff with technical assistance from SSA Staff as needed to download data from GPS equipment. LRCA utilized Trimble brand Juno 3-B GPS units with integral cameras that were provided in kind for the survey inventory by the SSA. Data has been uploaded into the SSA GIS Data Base. This data has then been available for down load to LRCA desktop PCs for use in the assessment analysis that supports this MS4 Plan report. Some of these ARC Map files are converted to pdf files and included on CD in the Plan appendices.

The Standard Operating Procedure (SOP) for the stream walks was to begin at the point of confluence of the tributary stream with the river or receiving stream and then work upstream by walking along the shoreline or stream bank where accessible. At locations where private property or structural and topographic issues limited access, reconnaissance views were made from upstream or downstream locations to assess stream conditions and identify any pipes of outfalls. In some cases staff used hip waders or “creek shoes” to walk in the streambed to survey and identify pipes or outfalls. (See SOP for Trimble Units in appendix for details on that equipment and procedures.)

Project Team Field Day: Field walk with GPS units

Logs were kept in the Trimble units that identified the sub watershed being surveyed, date of the survey, staff names, weather conditions, stream and riparian corridor characteristics, adjacent land uses and subjective estimates of percentage of impervious surface in the upland drainage area.

All pipes and outfalls into the stream were spatially referenced and photographed as were all bridges and culvert inlets and outlets. At bridge locations, catch basins and manholes were spatially referenced and photographed. In conjunction with the survey and identification field work, LRCA staff conducted an Illicit Discharge Detection & Elimination (IDD&E) response and notified SSA Staff as is part of our SOP when conducting field work. This augments the SSA’s IDD&E activities and results in a rapid response by SSA to identify and eliminate any and all dry weather flows or other illegal flows and discharges to receiving waters.

During the course of this work four potential IDD&Es were noted. Follow up indicated that two were water utility dead end line pressure relief flows or water utility service line leaks, one was an industrial NPDES permit of HVAC condensation another one was an industrial plant leak not associated with the SSA or MS4 system and one was a blocked CSS syphon.

Several of the culvertized “lost streams” or previously unnamed tributaries that had been assigned as part of the “Zero Watershed” were challenging to locate and trace. Once several reference points were identified however, looking for evidence such as catch basins, swales, and un-maintained vegetated corridors between residential and commercial parcels and review of county tax parcel plats helped to reestablish the location of these streams.

General Summary For The Tributary Streams In The Scranton/Dunmore MS4 Area:

Stormwater from the City of Scranton and the Borough of Dunmore reaches the Lackawanna River directly or by flowing to and through one or several tributary or sub tributary streams:

- Keyser Creek and its tributaries Lucky Run and Lindy Creek
- The Zero Watershed West including: Wal-Mart Tributary, Mt. Pleasant Run, Philo Creek, Green Bush Run, The Scranton–Dickson City Basins and Commerce Run

- Leggett's Creek and its tributaries Leach Creek and Clover Hill Creek
- The CSOs of the SSA CSS system
- The Zero Watershed East including Minooka Run, Pine Brook, Carter Creek and the I-81 Swale
- Stafford Meadow Brook and its tributary, Mountain Lake Run
- Roaring Brook and its tributaries, East Mountain Run and Little Roaring Brook
- Meadow Brook
- Spring Brook and Green Run*
- Eddy Creek**

*Spring Brook and Green Run: Portions of the City of Scranton drain into Spring Brook and its tributary Green Run. This area within the corporate boundaries of Scranton is undeveloped, very steeply sloped, heavily forested and difficult to access. For those reasons LRCA staff conducted a reconnaissance using Google Map Satellite Imagery. No development or urban storm water sources were identified. LRCA's recommendations for this area is that it and adjacent tracts in Roaring Brook and Spring Brook Townships should be preserved as un-developed open space in the context of the Luzerne –Lackawanna Bi County Open Space and Outdoor Recreation Plan of 2004. Use of SSA green infrastructure funding to match state funding should be considered for conservation acquisitions in this area.

**Eddy Creek: Only a small portion of Dunmore Borough drains into Eddy Creek therefore LRCA did not conduct a stream walk on Eddy Creek. A stream-walk survey narrative, summary and recommendations for Eddy Creek are contained in the Lackawanna River Conservation Plan of 2001. Those recommendations remain valid. PA DEP Bureau of Abandoned Mine Reclamation (BAMR) is proposing additional work on Eddy Creek in the near future.

The one significant stormwater outfall into Eddy Creek that is partially generated in Dunmore is the storm water collection system of the Keystone Sanitary Landfill. A brief summary for Eddy Creek includes GPS locational data and site photography of the discharge point of that facility, which is located 800 feet northeast of Marshwood Road.

The River and several of the larger named tributaries including Roaring Brook, Little Roaring Brook, Stafford Meadow Brook and Leggett's Creek seem to attain and maintain their designated uses as cold water fisheries (CWF) or trout stocked fisheries (TSF) under Chapter 92 of Pennsylvania's Water Quality designations.

It is unlikely that any of the following streams named or unnamed could meet designated uses since they have no perennial flow due to flow loss to the underground mine pools: Keyser Creek, Lucky Run, Lindy Creek, Philo Creek, Green Bush Run, Minooka Run, and Carter Creek.

General Recommendations For Tributary Stream Management

The following recommendations related to tributary management can facilitate the attainment of MS4 program goals and permit requirements. A shift to incorporating green infrastructure technologies and sustainable BMPs in all aspects of the Scranton/Dunmore MS4 program will help attain greater values for water quality flowing across the impervious surfaces and through the collection swales and detention systems. In addition to green infrastructure technologies, such BMPs as an effective and frequent street sweeping program; a more effective construction and post construction inspection program; litter control programs and public outreach and involvement programs will measurably improve the quality of storm water reaching the receiving streams and the river.

The expansion of a stakeholders group developed by LRCA and SSA as part of the Public Outreach and Public involvement work associated with the CSO LTCP is recommended to include the MCMs for those objectives through the MS4 Program.

A major tributary stream management and restoration program is recommended to address the complete dysfunction of many of the smaller tributaries. This program should include acquisition of easements or fee purchases to allow better management of stream corridors. The Lackawanna Valley Conservancy (LVC) a land trust affiliated with the LRCA has the capacity to act with private land owners and public agencies to engender these types of conservation arrangements.

The extent of ownership by the City and Borough of open space and stream corridor lands by fee or easement is very likely greater than is recognized. Other tracts of land along these corridors may be remnants of mining and railroad company owned properties that remain in an abandoned condition. A review of this survey's findings is recommended to determine if the extent of publicly owned rights of way and parcels can be more fully understood with title searches and be demarcated by full metes and bounds survey conducted by a Registered Land Surveyor on behalf of the municipalities or the SSA.

A restoration program using federal funding through the Abandoned Mine Land program involving the federal Office of Surface Mines (OSM) and the PA DEP BAMR and or the Bureau of Restoration and Conservation (BCR) with the physical restoration and abatement of abandoned mine impacts is recommended for all or portions of nine streams: Keyser Creek, Lucky Run, Lindy Creek, Philo Creek, Carter Creek, Leach Creek and Minooka Run, Meadow Brook and the Wal-Mart Tributary.

Other stream channel, stream bank and habitat restoration projects are recommended to be developed for Stafford Meadow Brook, Leggett's Creek, Roaring Brook and Meadow Brook to be financed through matching grant programs through Penn Vest, Local Share funds and Act 13 funding to match the SSA CSO LTCP green infrastructure program. Opportunities to involve private developers with stream restoration work should be advanced where possible.

General Summary For The Privately Owned stormwater Systems:

Less than 10 of the privately owned facilities were physically surveyed as part of this phase of MS4 work. These were open basins and the swales, catch basins and inlets that drained to the basins. Several outlet structures were also examined but not inspected with a specific protocol. Most basins that LRCA examined seemed to be functioning under wet weather conditions to meet most of their volumetric design criteria. Several exhibited signs of regular maintenance such as mowing and outlet maintenance to remove sediment and debris. Most did not seem to be maintained as they were overgrown with herbaceous and woody vegetation. Two had outlet structures that appeared to be collapsed and dysfunctional.

General Recommendations For Privately Owned Stormwater Systems:

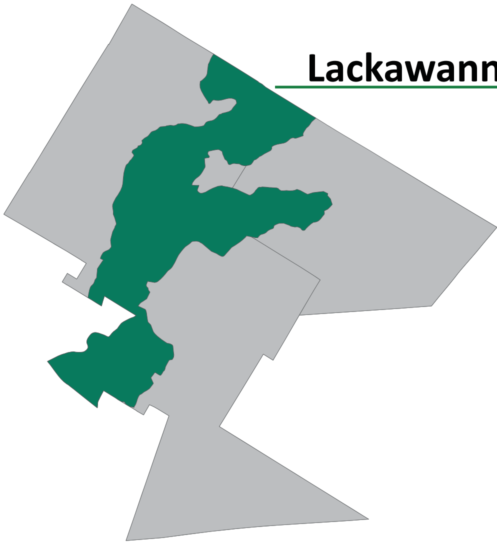
The stormwater management ordinances of Scranton and Dunmore should be unified and integrated to be consistent with the needs of the SSA for management and permitting requirements of the CSS system and in recognition of the recommended transfer of permit jurisdiction for the MS4 system from the municipal public works agencies to the Sewer Authority. Methodologies, protocols and defined responsibilities for operation and maintenance, reporting and inspections of privately owned storm water systems needs to be reworked and made consistent in municipal ordinance language and Sewer Authority regulations.

The use of green infrastructure and green sustainable BMPs for private storm water management and systems needs to be promoted actively to the business community, institutional property owners and developers. The use of green infrastructure and open basins to compliment natural habitat and water quality values needs to be integrated with a stream corridor restoration program and tied into the public open space and recreation greenway network.

The public agencies should consider an outreach and assistance to the development, business and institutional community to assist with restoration of open natural channels integrated with separate storm culverts to convey storm water from otherwise landlocked areas to a nearby receiving stream.

Specific Summaries For The Tributary Streams In The Scranton/Dunmore MS4 Area:

A summary of existing conditions for tributary streams to the Lackawanna River within the City of Scranton and the Borough of Dunmore are provided on the following pages.



Lackawanna River Corridor

A field survey of The Lackawanna River Corridor, also referred to as the "Zero Watershed" were not completed as part of this report. However, the LRCA did survey and walk tributary streams and channels with in the Lackawanna Corridor. All outfalls into the Lackawanna River in Scranton have been identified and documented as past of the SSA CSO LTCP.

The Lackawanna River Corridor

I-81 Swale

Flooding along Boulevard Ave. near I-81 swale

I-81 Swale

- 4 Mi.2 watershed
- Confluence with Lackawanna River at RM 15
- 1st Order Tributary

Summary

The I-81 Swale is a significant, manmade tributary watershed to the Lackawanna River. It was developed in 1996 as part of the reconstruction of Interstate 81/380/84/ US Route 6 Junction in Dunmore. Prior to that the upper portion of the highway area was part of the Meadow Brook watershed. The middle portion was part of the Carter Creek watershed. When the Interstate was built in 1960 drainage that would have been carried by Meadow Brook was diverted into the Underwood Mine Drainage tunnel through a borehole drilled in the O'Neil Highway interchange. The major highway development of 1996 required an entirely new approach resulting in what is referred to here as the I -81 Swale.

Minooka Run

- 2 Mi.2 watershed
- Confluence with Lackawanna River at RM 7.4
- 1st Order Tributary

Summary

Minooka Run is a first order tributary to the Lackawanna River. It is severely degraded as a natural stream channel with intermittent flow associated with storm events. Remnants of the original watercourse are evident at its confluence with the Lackawanna River where it passes under the NEPA Rail Authority's Lackawanna Valley line below the dead end of McCarthy Street. The Stone Arch Culvert that conveys the watercourse under the railroad is in excellent condition for its age. It is estimated to be 125 years old.

Upstream of this stone arch, the Run may have descended in elevation through an Appalachian hemlock-rhododendron ravine. It appears that the original course to and through this ravine was very likely destroyed by strip mine excavations in the mid-20th century. The outlet of the stream is now located approximately 800 feet upstream along the Lackawanna River. At this location there is swale that is producing a very significant erosion of coal mine overburden down a steep grade to the rail corridor. At this point, the erosion outwash surcharges a small culvert under the rail road and spreads sedimentary debris along the track structure.

Minooka Run At Birney Avenue

The area at the head of grade near the dead end of McCarthy Street carries the right of way of the Crane Street sewer interceptor trunk line down grade to the Sewer Treatment Plant which is located about one half mile upstream along the Lackawanna river. The sewer line has been experiencing serious wash outs where the mining era relocation of the Minooka Run channel cuts down grade undercutting the sewer line. The Sewer Authority has stabilized the erosion channel by installing and grouting 12” Rip Rap stone and mine refuse stone with concrete. Sewer Authority and Rail Authority crews conduct occasional maintenance on the surcharged culvert as well. However at the time of this survey, December 2012, this material had surcharged the swale and culvert under the rail corridor and it was evident that outwash of this material was over toping the rail structure.

Remnants of Minooka Run are evident as storm water drainage swales along parcel boundaries and in association with storm water detention basins associated with a nursing home and town house development north of the intersection of Davis Street and McCarthy Street.

Minooka Run Stone Arch

There is physical evidence of a swale at an undeveloped lot that is for sale at 2924 Colliery Avenue. There is a remnant of the original stream channel evident for two blocks to the east of this point through a small city park extending upstream to a concrete bridge under passing Cedar Avenue and an open channel continuing to a culvert outlet near the intersection of Burke Street and Murphy Court. Upstream of this point the culvert seems to follow Burke Street past Pittston Avenue and Hamm Court to a brush covered swale along an electric utility pole line adjacent to a trucking business across Cemetery Avenue from the Polish National Catholic Cemetery. Above the Cemetery, the headwaters likely rose from springs in the area of the YMSof R Park along Kane Street and the US Post Office / Scranton Mail Facility along

Minooka Run

Mount Pleasant Run

- 1 Mi.2 watershed
- Confluence with Lackawanna River at RM 11
- 1st Order Tributary

Summary

Mount Pleasant Run the name given in this plan to what had been a first order tributary to the Lackawanna River. It exists today as a series of stormwater conveyance swales and detention basins developed by PENN DOT as part of the replacement of the Mulberry Street Bridge and relocation of a portion of the North Scranton Expressway and Seventh Avenue constructed in 1990. The sub watershed was further enhanced by the development of the Mount Pleasant Business Park and its stormwater facilities by the Scranton –Lackawanna Industrial Building Company (SLIBCO) an affiliate of the Greater Scranton Chamber of Commerce in 2006 and continuing to date.

Mount Pleasant Run flowing through wetland mitigation

While there is no watercourse in evidence at this location on the 1893 Scranton Quadrangle the contour lines indicate the likelihood that there had been a stream in these neighborhoods in Scranton. Portions of such a stream are exhibited on several plates of the 1890 Scranton City Atlas and Sanborn Insurance rating maps in the vicinity of Howell Street between Swetland Street and Pettibone Street. There is a trunk sewer line that discharges through CSO #016 that runs along this approximate corridor today.

Carter Creek

- 1.5 Mi.2 watershed
- Confluence with Lackawanna River at RM 14.1
- 1st Order Tributary

Carter Creek

Summary

Carter Creek is the name given by LRCA to a previously unnamed first order tributary to the Lackawanna that flows in a 1.5 square mile watershed from the a point where the boundaries of Scranton, Throop and Dunmore meet near Olyphant Avenue and Interstate 81. It flows to confluence with the river near the intersection of Raines Street and Boulevard Avenue. It is named in recognition of the Carter Ax Works, a company that manufactured tools and axes in a plant along Parker Street in the mid to late 19th Century.

The original sources were springs along the hillside east of Olyphant Avenue. The natural hydrology was destroyed by the development of the Price Pancost Colliery and the Marvin Colliery in the late 1880's through the 1920's. The remnants of the original drainage pattern were eliminated by the construction of Interstate 81 in 1960. An underground mine fire was burning in an area between Olyphant Avenue and Marywood University in the 1940's through the 1960's. It is believed to have burnt out by the late 1970's. The surface area of stripping overburden was reclaimed by PA DEP BAMR in 2003.

The middle portion of Carter Creek flows in a remnant open channel parallel to Olyphant Avenue and receives sheet flow from the reclaimed mine land area and from stormwater basins on the Marywood University Campus. Carter Creek flows into an underground culvert system at the intersection of Parker Street and Olyphant Avenue. The culvert flows under the Parker Street roadway through Boulevard Avenue and connects to the Raines Street CSO outlet along the east bank of the Lackawanna River adjacent to the Advanced Textiles Plant.

Upland areas contain newly developing parts of the Marywood University Campus and athletic fields, the medium density residential neighborhood along North Washington Avenue, Fairfield Street, Olyphant Avenue, Parker Street, Raines Street and Boulevard Avenue. A small city park, Crowley Park, is located at the end of Washington Avenue. This site was used as a city dump and landfill between 1920 and 1960. The Green Ridge Little League Field is located next to Crowley Park on Highnett Place.

Greenbush Run

- 1 Mi.2 watershed
- Confluence with Lackawanna River at RM 14.6
- 1st Order Tributary

Summary

Greenbush Run is a previously unnamed first order tributary stream in North Scranton. Its sources were springs along the hillside near Rockwell Avenue along the Scranton Dickson City Boundary adjacent to Interstate 81. It is exhibited on the 1893 Second Geologic Survey Quadrangle of Scranton. The original hydrology and watercourse were disrupted by coal mining and urbanization around 1890 through 1920. What remained of the headwaters area was altered by the construction of the interstate highway in 1960.

Greenbush Run

A few traces of the stream can be found along Greenbush Street and Reese Street in low lying wooded lots. There is evidence of water flow and ephemeral ponding through and along several lots. There are also flows of storm water through swales and from improved and unimproved lots on nearby Wilbur Street that drain into the remnant Greenbush Run watercourse. There are numerous separate storm drainage inlets and outlets along these undeveloped lots that appear to be similar in character to City of Scranton funded OECD infrastructure projects circa 1975-1990. These storm drainage improvements flow in separate storm culverts, catch basins and storm pipes through the intersection of Greenbush Street, Reese Street near Mulley Avenue and on down grade to North Main Avenue. Some of these flows are diverted into a separate storm culvert under and along North Main to the point where it crosses Leggett's Creek. Other portions of the separate storm culverts may flow into a stone arch culvert that emerges on the western embankment of the Lackawanna River adjacent to the pre-cast concrete business near two abandoned colliery bridges once associated with the Marvin Colliery of the Hudson Coal Company. It is very likely that this circa 1890 stone arch contains the original creek bed. Stafford Avenue.

Philo Creek

- 2 Mi.2 watershed
- Confluence with Lackawanna River at CSO #7 Philo Street Regulator
- 1st Order Tributary

Summary

Philo Creek is a name given by LRCA to a previously unnamed tributary that rose in springs on the hillside on the west side of the river in the Tripp's Park /Bull's Head Neighborhoods in North Scranton. A small watercourse in that area is evident on the 1893 edition of the Second Geological Survey Quadrangle for Scranton.

The original headwaters area was used as agricultural fields prior to 1850. The Lackawanna Railroad was constructed across this tributary just below its headwaters in 1852-54. Agricultural land use changed to coal mining by 1890. Below the railroad grade to the river, a mixed residential and commercial neighborhood known locally as Bull's Head had developed at the intersection of Providence Road and North Main Avenue by the 1820's.

Public water supply and municipal sewer systems were developed in the 1880's and 1890's for this area. It is likely that the open channel of Philo Creek was put into the sewer culvert sometime in the late 1890's.

There is remnant of the original open channel of Philo Creek that is approximately 400 feet in length. It runs from the berm of the North Scranton Expressway through a series of drops over rock ledges and down cuts in burnt Culm (coal mine tailings). The basin of one splash pool features a vein of coal and evidence of infiltration of flow into subterranean fissures. Following this the channel enters an inlet into a storm culvert and eventually enters the CSO that discharges at the Philo Street regulator. This Creek is a poster child for the worst case scenario of the worst horror stories to befall a creek in the Anthracite Coal region of Pennsylvania.

By 2001 the headwaters area had been reclaimed from its use as abandoned mine land and developed into a residential sub-division, Tripp's Park Estates. The developer had secured the Pennsylvania Keystone Opportunity Zone Program (KOZ) status for the subdivision. It is about 80% built out with median to higher income single family suburban type homes.

The stormwater collection system for Tripp's Park Estates consists of open grassy and rock lined swales running along several parcel boundaries and a typical curb, catch basin-culvert system that conveys separated storm water flows to an open basin in the lower end of the development. This basin then discharges into a culvert and catch basin system on Court Street that is conveyed for 300 feet in a 48" diameter galvanized corrugated metal culvert that runs below grade along the berm of the North Scranton Expressway to discharge into the 400 foot remnant of the original creek channel.

Philo Creek

Shortly after the initial build-out of the subdivision and the installation of its storm water management system, the region experiences a series of heavy rain events including Hurricane Ivan. The flows from these storms surcharged the inlet at the dead end of Price Street and flowed on the surface across several residential properties downgrade of the inlet towards Philo Street.

Local residents believed that the developer of the subdivision and the stormwater system were major contributing factors to the flood damages they incurred. There were some deficiencies later identified with the outlet structure that may have contributed to the flooding. The neighbors filed suit for damages and the court found in their favor. This coincided with a bankruptcy filing by the developer.

Philo Creek: evidence of erosion

While most of the development had been built out, there are several lots still available that have been conveyed to other builders. The exact legal status and ownership of the storm water conveyance system and basin are undetermined at present. There have been no enhancements or modifications or apparent maintenance to the stormwater system and it is not clear who is responsible for its long term operation and maintenance.

This discussion is included here because it is illustrative of the constraints and challenges to development and redevelopment of numerous properties in and around Scranton that are affected by the impacts associated with abandoned mine land and inadequate public infrastructure. Many other smaller in-fill development sites are also "Land-Locked" in relationship to outlets for storm water drainage to the river and natural tributary streams. The only available alternative in most cases is the eventual discharge into the Combined Sewer System. While the detention cistern system being developed as part of the CSO LTCP will insure that upwards of 85% of these flows are treated at the STP, the diversion of separate storm flows from the CSO system and their treatment through green infrastructure systems may be more effectively addressed through a comprehensive MS4 management program that is adequately capitalized.

Pine Brook

- 2.6 mi.2 watershed
- Confluence with Lackawanna River at RM 11.2
- 1st Order Tributary

Summary

Pine Brook is included in the Scranton /Dunmore MS4 Stream Survey because it presents many opportunities for the application of green technologies as part of the SSA CSO/LTCP. Pine Brook was once a natural stream originating in springs and wetlands along glacial terraces and the ridge line above Dunmore Corners. Beginning in the late 1880s, it was converted into a stone and brick masonry arch culvert its entire length. The only portion of Pine Brook to see daylight today is the final 40 feet at its confluence with the Lackawanna River near Olive Street. The balance is in an approximate 8 foot high by 4 feet wide masonry arch culvert buried up to 30 feet below the street grade as it ascends towards Dunmore Corners from its confluence with the Lackawanna River at Sandy Banks. The culvertization of Pine Brook into a sewage conveyance allowed the late 19th and early 20th century development of the central portion of Dunmore borough, which otherwise had no convenient outlet for its sewerage and storm water.

Pine Brook

Pine Brook

Scranton/Dickson City Basins

- < 10 Mi.2 watershed
- Confluence with Lackawanna River downstream side of west bank pier footer of I-81 overpass

Summary

The storm water systems along Viewmont Mall and Commerce Boulevard are included here because these facilities are within the municipal boundary of Scranton and serve properties that lie within both Scranton and Dickson City. The two large basins below Viewmont Mall adjacent to the Staples / Best Buy complex are located in the area that once functioned as the headwaters source of Greenbush Run.

The lower basins that serve Sam's Club and Lowe's were once part of another small un-named tributary that is here in called Commerce Run. That stream rose in springs that were altered by mining on the Storr's Colliery. Commerce Run, which exhibits on the 1893 Scranton Quadrangle confluence with the Lackawanna River at the approximate location of the I-81 overpass.

Scranton/Dickson City Basin

Scranton/Dickson City Basin

Wal-Mart Tributary

- 1 Mi.2 watershed
- No confluence with Lackawanna River
- 1st Order Tributary

Summary

This previously un-named tributary seems to be exhibited on the 1893 Second Geological Survey Quadrangle for Scranton. What remains of this small watershed and its stream channel is a trash strewn ditch with a substrate of mine tailings. Its sources may once have been springs along the ridge above South Main Avenue where Saint Ann's Monastery is now located. Most of the watercourse in located in the Borough of Taylor. It is included in this assessment due to its proximity to the City of Scranton. It runs along the municipal boundary and receives stormwater and CSO from both Scranton and Taylor.

The upper watercourse from the area on the hillside where the source springs once ran has been obliterated by the development of the residential neighborhoods. The lower reach watercourse has been destroyed by mining operations associated with the Dodge Mine and the Bellevue Colliery once operated as part of the Glen Alden Coal Company.

The remnant middle reach of the watercourse is an extremely degraded stream. It begins near the intersection of Colan Court and South Main Avenue. It flows between Colan Court and the parking lot of a new Wal–Mart plaza.

The stream flows entirely through a substrate composed of mining wastes and overburden with a sediment coating of grit from local streets. Mixed in with this bed load are all types of urban street litter as well as larger illegally dumped debris such as construction waste and large woody debris of fallen trees along failed portions of the stream embankments.

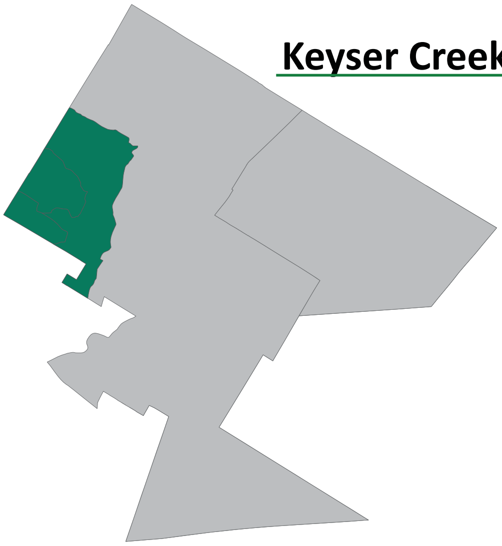
The shopping plaza owners are building a new system of storm water culverts, swales, and detention basins as a remediation for stormwater flows that were not anticipated in their subdivision planning approval process. Following the opening of the facility, they experienced excessive sheet flow into their property from the adjacent public roadways. This caused the erosion of several engineered slopes and demonstrated the need for redesign, re-permitting and enlargement of their stormwater conveyance and detention system and the number and location of its discharge outlets. Contractors for the Wal-Mart Plaza developer are building the new collection and detention system in a way that will compliment further reclamation work by public agencies on the stream channel.

Wal-mart Tributary

Below the outfall of the new storm detention facility, the channel passes into a 48 inch galvanized culvert under the main line of the D&H / Canadian Pacific Railroad's Taylor Rail Yard. The inlet of the culvert is blocked with debris up to 75% of its opening. There are signs that larger flows may be surcharging along the track ballast. After passing through the rail culvert the channel passes for several hundred feet in a graded trapezoidal trough through red ash and coal mine waste rock and then flows into an apparent natural channel through rock ledges and splash pools in a heavily wooded riparian canopy.
After flowing several hundred feet in this wooded area the stream flows over a rock ledge and down into a 60 foot deep coal mine stripping pit from which it does not emerge on the surface. When the stream does carry water, during and after storm events, the water flows down into this stripping pit and infiltrates through fractured rock strata at the base of the pit into the subterranean mine pool complex that underlies Scranton and most of the central Lackawanna Valley.

Wal-mart Tributary

There is no evidence of the presence of a stream channel associated with this watercourse down grade of the stripping pit to the river. There is no evidence of a culvert or other underpass that would have accommodated this stream evident along the former Central Railroad of New Jersey, now Lackawanna River Heritage Trail along the riverbank.



Keyser Creek

- 8.58 mi2 watershed
- Confluence with Lackawanna River at RM 7.3
- 2nd Order Tributary

Summary

Keyser Creek drains a large portion of West Scranton that had been heavily impacted by Coal Mining and Railroad facilities for over 120 years. Keyser Creek and its tributary streams lose all of their dry weather flows to infiltration into the subterranean mine pool complex. Storm events bring flows above the rate of infiltration for various periods during and after storm events. This critical hydrographic cycle transports large quantities of sediment load consisting of mining overburden materials and coal mine waste. The Luzerne Street Pumping station and related CSO points are another source of pollutants. There have been several stream channel flood control projects on Lindy Run and Lucky Run that have addressed some of the flow loss issues on some but not all portions of those tributaries.

The installation of several large open stormwater detention basins at industrial facilities and trucking depots provide some potential for green infrastructure retrofits. Older industrial sites in this area do not have storm water facilities or have inadequate facilities. The City of Scranton maintains a stormwater pumping station along Merrifield Avenue near Jackson Street to move storm flows under a railroad grade to discharge into the Creek.

Keyser Avenue is a local arterial serving the industrial parks and numerous trucking facilities. It carries the heaviest traffic load of any arterial in Lackawanna County both by vehicles per day and weight. Keyser Creek carries the storm loads from this roadway. Presently PENNDOT is reconstructing a several mile reach of Keyser Avenue in Scranton and Taylor. Opportunities for green infrastructure in this busy corridor need attention.

Keyser Creek

Keyser Creek

Lindy Creek

- < 10 mi.2 watershed
- Confluence with Keyser Creek at RM 2.5
- 1st Order Tributary

Summary

Lindy Creek shares similar characteristics to the headwaters reach of Keyser Creek and the other tributary Lucky Run. All three streams originate from springs along the ridgeline and slopes of the West Mountain in Ransom and Newton Townships. The West Mountain is a 2000 to 2300 foot elevation that forms the western flank of the Lackawanna Valley and is a portion of the Allegheny Front Range. All three Keyser Creek source streams drop quickly and steeply from their origins at 2000 feet to the course of the main channel at 850 foot elevation. The upper courses drop an average of 400 feet per mile in their two mile run down the mountainside to the relatively flat Keyser Valley. From their confluences with the main stem of the Creek, the drop averages only 40 feet per mile in the next four mile to the confluence with the Lackawanna River. Fortunately the slopes of the West Mountain are relatively undeveloped and heavily forested.

Lindy Creek

Heavy storm events can send large volumes of water off the mountain and transport a good amount of natural bed load down to the flatter reaches of the main stem. As the streams cross the boundary into the coal measures they interface with mine sediments and their channels experience flow loss in dry weather periods. Wet weather brings with it higher flows and the capacity to transport coal mine sediments. These sediments then settle out in the shallow gradient of the main stem of Keyser Creek and add to the instability of that channel and contribute further to habitat loss.

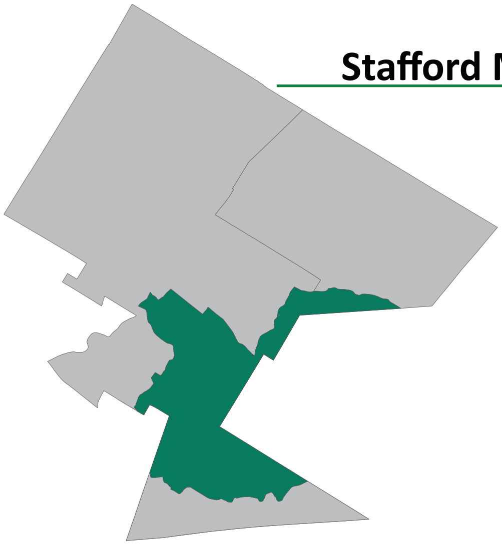
Lucky Run

- < 10 mi2 watershed
- Confluence with Keyser Creek at RM 2
- 1st Order Tributary

Lucky Run

Summary

Lucky Run is a steep gradient tributary of Keyser Creek draining a mostly forested area of West Mountain. It receives runoff from a section of the Pennsylvania Turnpike immediately above McDade Park. A short reach through McDade Park has been restored to reduce flow loss to the underground mine pool adjacent to the Lackawanna Coal Mine Tour site. Lucky Run is considered a Qualified Hydrological Unit and is eligible for the application of Mine Reclamation "set aside" funds through the federal Office of Surface Mines (OSM). Please see the related summary and recommendations for Lucky Run and Keyser Creek for additional discussion of these topics.



Stafford Meadow Brook

- 14.11 mi.2 watershed
- Confluence with Lackawanna River at RM 9.2
- 2nd Order Tributary

Summary

Stafford Meadow Brook (SMB) is a significant second order tributary to the Lackawanna River. It confluences on the east bank of the river in South Scranton approximately one half mile downstream of the Roaring Brook Confluence. It flows from its source waters in Bear Swamp, an important wetland/bog complex off PA Route 307 in Roaring Brook Township. It flows westerly through the Moosic Mountain ridge. There are several thousand acres of forested lands that were once owned and protected by the water utility. However, these lands are now privately owned and may be subject to sale and development. As SMB passes into Scranton, near East Mountain, it features Lake Scranton a 300 acre water supply reservoir and water filtration plant owned and operated by the Pennsylvania American Water Company (PAWC).

As SMB flows out of Lake Scranton, it passes between East Mountain and Montage Mountain again in a heavily forested area that is partially protected as watershed buffer land by the PAWC and as recreation land that is part of the Montage Mountain ski area. An out of service reservoir, the Number Five Reservoir, provides water for snow making at the adjacent ski area. SMB continues for another mile in woodland prior to passing under Interstate 81 and entering the high to medium density South Scranton Neighborhood near Stafford Avenue and Brook Street.

Stafford Meadow Brook

SMB flows in its natural channel for another one half mile and is then routed through a concrete box culvert under the Scranton School District's McNichols Elementary Plaza. It emerges from the closed culvert into natural channel with concrete flood walls near East Elm Street and Gallagher Court.

From this location it flows in open channel in a steep 30 foot deep ravine through culverts and bridges at the following streets courts and intersections: South Webster Avenue, East Elm Street and Herz Court, Prospect Avenue and East Locust Street, and then, Pittston Avenue. The stone arch culvert under Pittston Avenue was replaced with a concrete culvert in 2006 following damages to the stone arch culvert from Hurricane Ivan. Below Pittston Avenue, SMB is controlled again by an impoundment structure known as the Brook Street Debris Basin. Several dams were once located along this reach of SMB in the mid to late-19th century that were used by the SMB Ice Company. Below the Debris Basin, SMB flows in an open rectangular concrete culvert under Cedar Avenue, Remington Avenue, the Northeastern Pennsylvania Railroad Authority Lackawanna Valley line and South Washington Avenue. It confluences with the River through the South Scranton Flood Control Levee off South Washington Avenue.

Mountain Lake Run

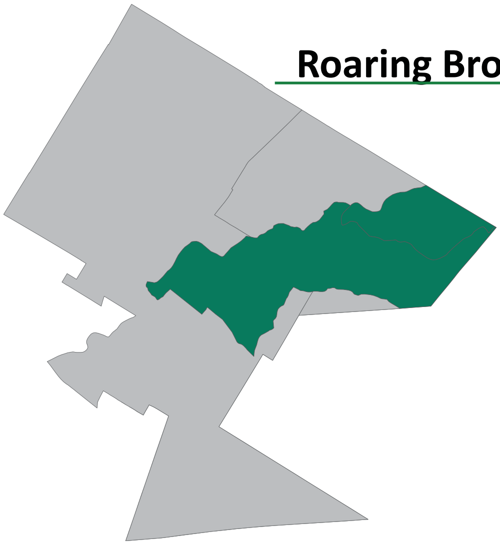
- 2 Mi.2 watershed
- Confluence with Stafford Meadow Brook
- 1st Order Tributary

Summary

Mountain Lake Run is a first order tributary of Stafford Meadow Brook. Its source Mountain Lake is a two acre spring fed pond that had been augmented by an impoundment berm by the East Mountain Coal Company in the late 19th century. Mountain Lake receives stormwater flows from land and roadways in the adjacent low density residential neighborhood and from undeveloped forested properties in a several hundred acre catchment area.

Mountain Lake Run

The run drops from Mountain Lake down gradient to the Mattes Community Center where it passes



through some historic WPA era stone walls and enters a culvert system, for the balance of its one mile run to its confluence with Stafford Meadow Brook near the I-81 Cemetery Bridges.

Mountain Lake Run

Roaring Brook

- 53.68 mi.2 watershed
- Confluence with Lackawanna River at RM 9.7
- 3rd Order Tributary (largest)

Summary

A majority of the storm water that flows into Roaring Brook is associated with the Combined Sewer System in Scranton and Dunmore. The SSA Long Term Control Plan for Combined Sewer Overflows (LTCP / CSO) will provide a significant order of control and treatment for these flows in future years. There are numerous opportunities for some of these flows to be managed and reduced with the LTCP's green infrastructure program.

The other major storm water input to Roaring Brook is generated from the Interstate Highway and Expressway. There are presently no controls on these sources. The proposed reconstruction and widening of the I-81 corridor should provide opportunities to upgrade the storm water management of the interstate corridor through Scranton and Dunmore.

Roaring Brook

Roaring Brook

Little Roaring Brook

- 8 mi.2 watershed
- Confluence with Roaring Brook at RM 4
- 2nd Order Tributary

Summary

Little Roaring Brook flows in a predominantly forested and undeveloped watershed along the flank of Moosic Mountain. This area above the Dunmore No. 1 Reservoir was formerly protected as watershed land owned by the water utility. Since 1999 it has been transferred to private ownership. The water company retains a 500 foot buffer strip surrounding the reservoir. To date there have not been any development plans proposed for the upstream properties. From the Dunmore No. 1 Reservoir at Dunham Drive and Tigue Street to its confluence with Roaring Brook, LRB flows through the Sport Hill neighborhood of Dunmore Borough. Sport Hill, running along East Drinker Street, is a mixed residential and commercial neighborhood. The predominant land use feature affecting L RB is the interstate highway system with portions of the junction of Interstates 81, 84, 380 and US Route 6.

Roaring Brook

Little Roaring Brook flows under Dunham Drive, the Interstate Highways, an out of service rail right of way, and Drinker Street. Sediment accumulation and drainage from the highways seems to have engendered a wetland accretion adjacent to the RR corridor upstream of Drinker Street. This area had been an informal “sand lot” baseball field in the 1960’s. Below Drinker Street, Little Roaring Brook falls through a small gorge with a remnant hemlock and rhodora community, waterfalls, and splash pools. The adjacent residential uses also show signs of urban debris and yard waste disposal and the advance of invasive species, primarily Japanese Knotweed.

East Mountain Run

- 4 Mi.2 watershed
- Confluence with Roaring Brook at RM 2
- 1st Order Tributary

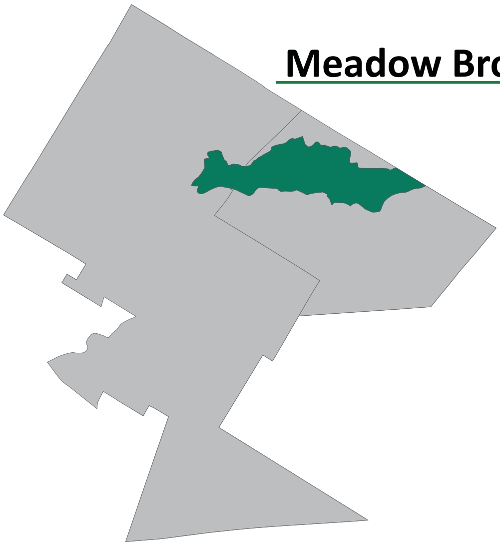
Summary

East Mountain Run is the name applied to a previously unnamed tributary to Roaring Brook. It rises from springs on the Ridge of East Mountain near Robinson Park and Mountain Lake Estates. The Mountain Lake Estates Stormwater detention pond and nearby wetlands are also integral features supporting a perennial flow in this Run. There are some WPA era knapped rock channel works uphill of East Mountain Road. The Run flows into and through the storm culvert system recently upgraded as part of the reconstruction (2002-2004) of East Mountain Road. This stormwater system collects storm flows from the local roadway network and discharges into the lower portion of the Run at the intersection of East Mountain Road and Lynnwood Avenue. The channel flows steeply through a 20 acre undeveloped woodland

East Mountain Run

area to pass under Moosic Street, PA Route 307. Below Moosic Street, it flows in a deeply incised (30 foot deep) ravine through undeveloped wooded parcels, under an abandoned railroad girder bridge and into a 48 inch galvanized and RCP culvert system under the interchange of I-81 and the Central Scranton Expressway. Upon exiting the culvert system at milepost 185, it cascades over a 60 foot high ledge into a splash pool in Roaring Brook.

East Mountain Run



Meadow Brook

- 2.45 mi.2 watershed
- Confluence with Lackawanna River at RM 12.0
- 1st Order Tributary

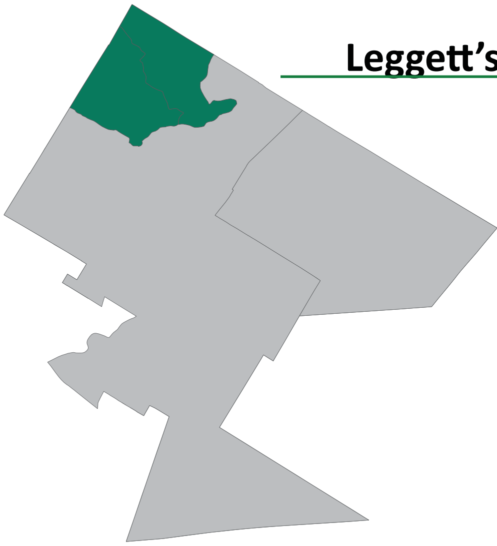
Summary

Meadow Brook has some aspects in common with Pine Brook. Both are on the eastern bank of the river with the Meadow Brook confluence about a mile upstream of Pine Brook. Meadow Brook was culvertized between the late 1880's and 1900 as the suburban residential neighborhoods of Green Ridge and Hollywood were developed along the world's first commercial electric trolley line. Fortunately, the middle reach of Meadow Brook through the Forest Hill Cemetery was spared encased in a culvert. Its upper middle reach was culvertized through the Dunmore Cemetery to the area of the Blakely Street interchange with Interstate 81. The upstream extent and the location of the main invert to the culvertized reach in Dunmore Cemetery were not determined during the course of this survey. The headwaters of Meadow Brook were sourced from an area of springs and wetland bogs at the base of Moosic Mountain. The natural habitat and drainage functions of these headwaters were destroyed by the Pennsylvania Coal Company's Gypsy Grove Colliery beginning in the 1880's. Today, the headwaters area land use is dominated by the Keystone Landfill and Interstate 81.

There is evidence of a tributary that ran from the main stem in the Forest Hill Cemetery northward through what is now the campus of Marywood University to the vicinity of the Penn State Worthington Scranton Campus This tributary stream was totally obliterated by the operations of the Price-Pancost Coal Company in the 1890's, the construction of Interstate 81 and grading and filling associated with the development of the Marywood Campus in the 1960's.

Meadow Brook

Meadow Brook: example of historic construction.



Leggett's Creek

- 18.46 mi.2 watershed
- Confluence with Lackawanna River RM 14.5
- 3rd Order Tributary

Summary

Leggett's Creek is a larger third order tributary that rises outside the Lackawanna Valley to the northwest of Scranton. It flows through the suburban communities of Clarks Summit, Clarks Green and South Abington along the busy Northern Boulevard commercial arterial and through "The Notch", also known as Leggett's Gap, a prominent Water Gap that cuts through the West Mountain Range where it enters the City of Scranton near the North Scranton "Traffic Circle". Both water quality and aquatic habitat quality are heavily impacted by MS-4 from the Northern Boulevard commercial corridor, the Interstate 81/PA Turnpike interchange and the Abington Regional Wastewater Authority treatment plant discharge just upstream of the Notch.

Upon entering Scranton, Leggett's Creek flows through a steeply incised course northeast of Market Street. There are numerous properties acquired as part of Hazard Mitigation Buy-outs after flooding in the 1940's and 1950'sthat are owned by the City of Scranton along the flood plain of the creek upstream of Mary Street. There are extensive recreation lands downstream of Leggett Street / Brick Avenue and along Parker Street adjacent to McLane Park near Rockwell Avenue and the Dutch Gap Little League Field at Welles Street. A Greenway and Recreational Trail project has been suggested for this area. Invasive plant species are a concern along the stream corridor through North Scranton. The primary invasive plants are Japanese knot weed, Ailanthus or Tree of Heaven and Norway Maple.

Leggett's Creek is a trout stocked cold water fishery and supports a variety of non-game species as well. According to the Lackawanna River Watershed conservation Plan of 2001, Leggett's Creek aquatic habitat is suppressed by fine sediment embededness of the benthic horizon and the prevalence of dumping of litter and debris and construction demolition wastes, utility trench cut waste and sediment loading from un-vegetated abandoned mine land sites and street grit from MS4 sheet flow across both impervious and erodible surfaces. These conditions and impacts are still noticeably present and there are apparently no practices in place to mitigate them.

Leggett's Creek

The City of Scranton owned Rockwell Avenue Bridge is a severely deteriorated stone arch structure over 120 years old. It has recently been condemned and is now closed and awaiting replacement.

The confluence of Leggett's Creek with the Lackawanna River adjacent to North Main Avenue and Welles Street is an important water quality sampling station that will be predictive of long term trends in water quality and aquatic habitat quality related to the Long Term Control Plan for Combined Sewer Overflow by the

Scranton Sewer Authority. LRCA and others have collected biological habitat and water chemistry data at this location both in the river and the creek since 1991.

Leach Creek

- 2.55 mi.2 watershed
- Confluence with Leggett's Creek RM 1
- 2nd Order Tributary

Summary

Leach Creek rises from springs and wetlands situated along the PA Turnpike and PA Route 307, aka the Morgan Highway. It flows steeply down the mountain parallel to the Morgan Highway. It receives storm waters from the Morgan Manor Apartments and the Allied Services Campus medical facilities prior to flowing under the Morgan Highway / Keyser Avenue / North Scranton Expressway intersections. After passing under the Expressway it flows for 300 feet in an open channel and then through an approximate 150 foot long stone arch culvert under a large fill slope of coal mine overburden that once carried rail road service tracks to the Cayuga Breaker. Following that, it flows along City of Scranton owned land through a storm water / flood control basin adjacent to Bloom Avenue. This site is an illegal dumping ground.

Leach Creek

The stream channel from the basin through Oak Street to Market Street and the confluence with Leggett's Creek exhibits extreme impacts of sedimentation and embededness. The remnant riparian understory is dominated by Japanese knot weed, the canopy by Ailanthus and Norway maple.

Leach Creek loses its entire flow to the underground mine pool complex through extensive fissures in the bedrock strata below the cobble of the streambed. The flow loss begins upstream near the Allied Services Campus and extends to the confluence. On most days, the creek exhibits a dry stream bed. Perennial flow form the mountain side source springs is lost along the lower reaches of the Morgan Highway. When storm water flows exceed the rate of infiltration to the subterranean mine voids, Leach Creek will carry water for several days or during extremely wet periods for several days or weeks at a time.

Leggett's Creek and the other tributaries reported in this assessment are also affected to some degree by flow loss to the underground mine voids. The rate of infiltration exceeds the flow volumes of Leach Creek, Keyser Creek, Lindy Creek, Lucky Run, Carter Creek and Meadow Brook. (We note that the previously unnamed tributaries discussed elsewhere in this report like Wal-Mart Run along Colan Court at the Scranton /Taylor Boundary and Philo Creek in North Scranton demonstrate similar morphological dysfunctions and are in need of reclamation and restoration work.) The Scarlift report on Mine Drainage in the Lackawanna River Basin published by the PA DER in 1978 estimates that dry weather flows are reduced by approximately 20 to 30% in Leggett's Creek, Roaring Brook, Stafford Meadow Brook and the Lackawanna River. The rates of infiltration do not cause these larger streams to loose flow to the extent that aquatic habitat is lost. The smaller streams like Leach Creek completely lose their flow and aquatic habitat and are unlikely to have these functions restored without an extensive mine reclamation stream flow restoration program.

Clover Hill Creek

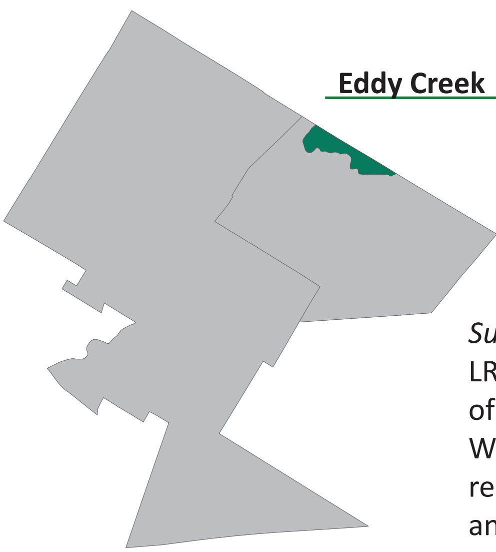
- 2 Mi.2 watershed
- Confluence with Leggett's Creek at RM 2
- 1st Order Tributary

Summary

Clover Hill Run is a first order tributary to Leggett's Creek. It rises from springs along the ridge line of Bell Mountain in Dickson City. It flows through a steeply pitched course on the forested mountain side with many rock ledge falls and splash pools. There are minor influences of local roads in the low density Bell Mountain residential neighborhood. It flows under the Scranton Carbondale Highway and through the entrance way to the Viewmont Mall, crosses into the City of Scranton and through the Interstate 81 interchange with the Scranton Carbondale Highway. In its final 3000 foot long reach, it flows along and through the highway interchange riparian habitat, which is dominated by the roadway system. The stream is severely channelized to its confluence.

Clover Hill Creek

Clover Hill Creek



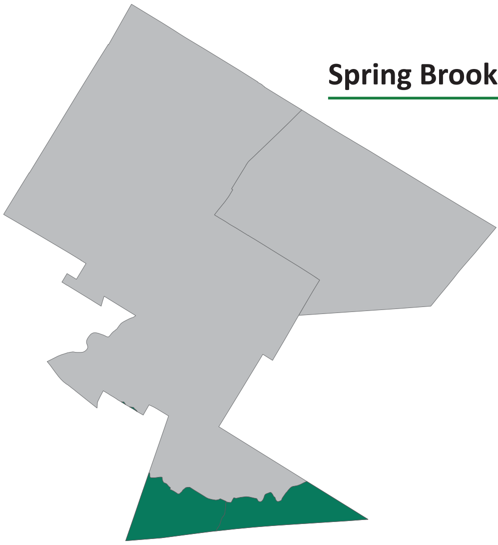
Eddy Creek

- 2 Mi.2 watershed
- Confluence with Leggett's Creek at RM 2
- 1st Order Tributary

Summary

LRCA did not conduct a stream walk of Eddy Creek as part of this survey. We did conduct a site location reconnaissance to obtain GPS and photographic data of the KSL Stormwater system outfall and the former railroad stone arch culvert. Eddy Creek loses its flow to the mine pool one mile upstream, east of the KSL outfall. The stream channel is not evident over several reaches due to strip mining impacts.

Eddy Creek



Spring Brook

- 54 Mi.2 watershed
- Confluence with Lackawanna River at RM 3.8
- 3 rd Order Tributary

Summary

Spring Brook and its tributary Green Run drain an area within the corporate boundary of Scranton in the vicinity of Montage Mountain. This area in not developed it contains steeply to very steeply pitched topography and it is heavily forested in native successional forest. This area does not contain any development and was not walked by the survey teams. Examination of satellite imagery was used to ascertain that no significant development is present in the area. Small portions of Glen Maura National Golf Course that lie partially in Scranton also drain into Spring Brook.

Green Run

- 2 Mi.2 watershed
- Confluence with Spring Brook at RM 2
- 1st Order Tributary

Watershed and Stream Recommendations

Lackawanna River Corridor

I-81 Swale
The jurisdiction for permitting on the I-81 Swale lies with the Pennsylvania Department of Transportation. We include it in the planning for the Scranton Dunmore MS4 system due to the size, location and nature of the storm water flows from the interstate highways that will discharge at the head of the watercourse of the Lackawanna River just as it enters the jurisdiction of the Scranton Dunmore MS4 service area.

It is recommended that PENNDOT consider the retrofitting of portions of the catch basin collection system with green infrastructure installations as may be appropriate during periodic upgrades and replacement work. The proposed expansion of the interstate corridor to a six lane carriageway will provide opportunities for an extensive upgrade of this system.

Regular maintenance work should include assessments of the fine particulate and grit sediment transported by the swale relative to its constituent potential for metal and organic toxicity and nutrient transport, as well as its degrading potential to increase substrate embeddedness in the receiving water.

The gravel maintenance roadway that follows the Swale from the river up to the Marywood Campus Athletic fields has the strong potential to serve as a link to the Lackawanna River Heritage Trail and Greenway. The feasibility for establishment of a native riparian canopy along this swale should be investigated.

Minooka Run
Minooka Run has the potential to serve as an MS4 conduit for a number of developments and neighborhoods in Minooka. Due to the damages to the Run that can be attributable to pre 1977 coal mining, the PA DEP BAMR and or BCR should be requested to conduct an analysis to determine whether Mine Reclamation funds can be used to rebuild and reclaim at least the lower portion of the Run below Colliery Avenue to the River. Developers who seek to develop additional properties between Colliery Avenue and McCarthy Street should be required by the City Planning Commission to restore that portion of the stream channel that currently exists as a brush and weed filled swale. Existing new developments should be involved in retrofitting portions of the swales on their parcel boundaries that were the likely location of the original watercourse. Credits towards possible stormwater fees should be available in exchange for easements that allow public agencies to conduct and maintain this work.

In the event that the recommended work is not able to qualify for Mine Reclamation funding the Sewer Authority and City should consider funding this work as part of the green infrastructure program of the CSO LTCP and seek funding from other available state and federal sources in collaboration with the LRCA and LVC.

The potential to collect and direct storm water flows from the Penn-wood Neighborhood into a restored Minooka Run through wooded areas along Kane Street and the Polish National Cemetery should be examined as part of a comprehensive restoration plan for Minooka Run. The retrofitting of other MS4 basins along Stafford Avenue Business Park should also be included in this planning work.

Mount Pleasant Run
The stormwater swale and the basin developed as part of the expressway project can serve as an outlet to the river for the Mount Pleasant Business park and other future development in that immediate vicinity. This plan

recommends the use and extension of this swale system be considered to serve the stormwater needs of a wider catchment area. Retrofitting additional green infrastructure into the Scranton High School Campus and nearby KOZ commercial areas and directing the flows to this swale rather than into the combined system are also recommended where feasible.

Carter Creek

Carter Creek has very good potential for restoration work and provides an opportunity to use green infrastructure techniques and practices on a neighborhood / tributary watershed basis. The redevelopment of abandoned mine lands by Marywood University and through the KOZ site at the former Marvin Colliery can provide opportunities to use storm water management facilities to help restore perennial flows and aquatic habitat to Carter Creek. The day-lighting of the creek from Olyphant Avenue to the river can provide additional opportunities to divert neighborhood stormwater flows out of the CSO system. Note that the existing remnant open channel and a restored day-lighted channel along the Parker Street Corridor would all likely require an impervious channel liner due to surface fractures and communication to the underground mine pool complex. Development of a consensus is recommended among the City, the Sewer Authority, Marywood University and commercial property owners to determine the feasibility of day lighting Carter Creek and retrofitting it and local stormwater management facilities to aid in reestablishing water and habitat quality values to Carter Creek.

Greenbush Run

It would be useful to determine the condition, extent and functionality of the stone arch culvert. If it extends upgrade along the Reese Street / Greenbush Street alignment, then it could possibly function as an outlet right of way for green infrastructure improvements and retrofits to serve the neighborhood. There are numerous unimproved lots scattered along existing city streets that were associated with abandoned mine property acquisitions from federal bankruptcy court in the 1990's that are posted for sale. These lots are being sold and are being developed for single family homes. These building lots are available, are being developed by individuals and do not require the planning approval process required of contemporary subdivision ordinances. In several instances homes have been built on low lying lots and are now subject to stormwater flows that are not adequately handled by the local street curb and storm water inlet system.

A comprehensive green infrastructure system is recommended for this drainage area. Entire lots and portions of lots that are not buildable should be designated and acquired through the green infrastructure program and serve as a neighborhood storm water management system. This could facilitate the redevelopment of some larger parcels higher up in the neighborhood that presently cannot be developed due in part to a lack of adequate stormwater options.

Philo Creek

Historic stream corridors such as Philo Creek may offer opportunities for the reestablishment of natural water courses and hydrological regimes at least in part of their original drainage areas by combining proposed and potential new stormwater basins in open basins and channels flowing into day lighted and restored portions of the original channel. The installation of culvertized outlets to nearby streams or the river using existing roadways or the creation of open channels in newly acquired rights of way should be investigated as a way to encourage the redevelopment of otherwise developable in-fill sites in Scranton and Dunmore.

For the immediate term, the ownership and management responsibilities for the Tripp's Park storm system needs to be identified. The remnant of the original channel at Pierce Street needs to be restored and the impacts associated with erosion of coal waste need to be addressed. The ownership of abandoned mine land adjacent to the remnant channel also needs to be clarified.

Pine Brook
It does not appear that there are any practical or feasible ways to daylight Pine Brook and install a separated sewer conduit. There may be some opportunities to string together a number of privately developed MS4 facilities with a publicly developed MS4 conveyance system that could contain open portions. However, extensive closed reaches would be necessary due to the high density of the existing build out in this watershed. For instance if a new MS4 corridor could be developed along Phelps Street, it could be routed to the river on city owned land in the area of the Pine Brook Recreation Field. Ash Street or Poplar Street may offer other routes that could provide outlets for a collection of private MS4 basins, such as the wetland basin at the PPL facility at Washington Ave and Poplar St, the Forensic Center facility at Monroe Ave and Larch St, and the TCMC facility at Washington Ave and Myrtle St. The feasibility of these suggestions is severely constrained due to the need to acquire right of way and work in busy public streets already crowded with utilities. If such projects could be considered, it may be in conjunction with some of the CSO / LTCP cistern projects. This survey suggests that consideration be given to integrating these opportunities where possible.

Scranton/Dickson City Basins
The detention basins along the commerce Boulevard corridor are large open vegetated basins. They upper basins do hold some water. The basins cover over 20 acres of detention area and are bounded by several acres of open space buffer. The basins appear to be functioning adequately. The upper basins seem to need some maintenance with the outlet structure and an erosion slump along the berm between the two basins.

An assessment is needed to determine the discharge courses of these basins and the condition and ownership of the outlet conveyances to the Lackawanna River.

Wal-Mart Tributary
The colocation of two CSOs and their discharge into this otherwise dry stream channel in close proximity to a residential neighborhood is problematic. The steep slopes along adjacent property on the Scranton side of the stream are compromised with a large amount of thoughtlessly deposited construction waste and debris. A significant amount of this material is eroding into the channel during high flows and is contributing to the blockage of the culvert under the railroad.

A conference with the adjacent property owners and the PA DEP BAMR is recommended to determine the interest and feasibility of an abandoned mine reclamation project to address dysfunctions in this tributary stream and restore its outlet to the river and potentially use existing and future stormwater flows to restore some more natural flow regime. Any potential for flow separation during the CSO LTCP work on the Scranton System that could contribute separate storm flows to a restored stream channel should be considered.

Keyser Creek Subwatershed

Keyser Creek exhibits significant dysfunctions associated with Abandoned Mining impacts. These include flow loss, habitat loss, sediment transport, and bank instability; domination of remnant riparian areas by invasive plants, urban litter and dumping. A comprehensive greenway, stream channel and habitat restoration program is recommended.

Keyser Creek may be a candidate for a Hydrologic Unit Plan or similar program through the PA DEP Bureau of Abandoned Mine Reclamation or Bureau of Conservation and Restoration (BAMR and BCR). Such a designation would enable the use of federal mine land reclamation trust funds through the Office of Surface Mines (OSM) to develop and construct a restoration of Keyser Creek.

An outreach program is suggested for industrial and commercial property owners along the riparian corridor to develop collaborations that would facilitate a restoration program for Keyser Creek. Presently the watercourse and riparian corridor along Keyser Creek are severely restricted by adjacent property development in several reaches. With the longer term potential that a storm water fee will be established, credits towards this fee could be granted in exchange for an expanded riparian corridor easement program. Other credits could be generated as property owners voluntarily retrofit green infrastructure aspects to on-site storm water management of facilities built prior to 1990.

There may be several opportunities for incorporating green infrastructure and associated work related to the CSO LTCP in later phases of that program during the 5 to 15 year horizon with an overall Keyser Creek restoration effort. The restoration of Keyser Creek will require a multi objective and a multi-agency approach. Long term management of storm water flows from the Scranton MS4 system in and through Keyser Creek can contribute to a restoration of perennial flow and habitat. Leadership of this effort by the Scranton Sewer Authority combined with a forward leaning collaboration with PA DEP agencies along with active involvement by business and property owners is suggested as the model that brings all stakeholders to the table with a common purpose.

The further protection of this work with an expanded, protected and well managed riparian corridor can also involve the integration of a greenway and trail component to better manage the corridor and further involve residents and adjacent businesses proactively with the Keyser Creek as a recognized community asset.

Lindy Creek

The one mile reach of Lindy Creek upstream of the flood control works at Frink Street exhibits some moderate impacts from coal mining and features the presence of several abandoned water works. This reach may hold some potential for a channel stabilization project similar to that developed on Lucky Run in McDade Park. The involvement of PA DEP BAMR and BCR is recommended along this reach of Lindy Creek.

Longer term, there may be future residential subdivision developments up stream in the Mt. Dewey neighborhood of Ransom Township. An outreach to Ransom Township to discuss the potential use of the stormwater facilities in future subdivision development to compliment the suggested restoration work on downstream portions of Lindy Creek is recommended.

Outreach to the PA Turnpike Commission is also recommended to explore collaborations for better stormwater management along reaches of the Turnpike in the Lindy Creek/Keyser Creek watershed.

Lucky Run

The lower reach of Lucky Run below McDade Park should be assessed for flow loss and the PA DEP Bureau of Conservation and Reclamation should be requested to design and construct additional channel restoration work if deemed appropriate. The operation and management of adjacent storm water facilities at Park Edge and Keyser Terrace are resources that can play a role in water quality and flow management BMPs.

Outreach is recommended to The PA Turnpike Commission to suggest improving stormwater BMPs with the next capital improvement project along the sections of turnpike that contribute to the entire Keyser Creek watershed. Additional retrofits of MS4 BMPs should be considered through McDade Park as park improvements are made going forward.

Briggs Street Drainage

As this report was being written, outreach to neighbors in the Keyser Valley Neighborhood brought a new drainage issue to the attention of the LRCA. An abandoned water impoundment structure at Briggs Street and Horatio Avenue contributes to a separate storm line following Briggs Street and Field Court.

The ownership and status of this impoundment are unknown and there are conflicting ownership claims. This drainage area has good potential or retrofit that could assist in solving persistent flooding problems in the neighborhood. It is recommended that an assessment of this drainage area be completed and that restoration plans include realignment of an outlet to Keyser Creek. The relationship of this drainage area and the area served by the Merrifield Street pumping station need assessment to determine the most feasible way to manage the storm water flows in these neighborhoods. Additional flows from current and future improvements to Keyser Avenue are directed through these drainage systems.

Stafford Meadow Brook Subwatershed

The LTCP for the Scranton Sewer System proposes several CSO storage cistern systems for the drainage area of Stafford Meadow Brook (SMB) with a goal of reducing CSO events to three or four per year on tributary streams. The CSO LTCP also proposes incorporation of green technologies to divert storm flows from the combined system and manage those flows to maximize water quality values. The following projects are suggested for SMB:

- LRCA suggests that the feasibility of an enhanced separate storm drainage system should be examined from the recreation fields near Alder St and Meadow Ave following the combined line over to SMB near Stafford Ave and the trolley tunnel.
- Opportunities to detain and infiltrate separate storm flows from East Mountain Rd, Mountain Lake Run and Route 81should be investigated in the context of the Route 81 widening project proposed over the next 15 to 20 years.
- A green infrastructure feasibility study is recommended to investigate retrofitting The McNichols Plaza School campus to correct the adverse impact of the culvertization and placement of impervious surface on SMB.
- Other CSO/LTCP green infrastructure projects should be incorporated to separate and manage catch basin flows in the immediate proximity of SMB where real estate and topographic opportunities may be present.
- An outreach program to property owners with open channel portions of SMB should be organized with the objective of debris removal, invasive species control and bank stabilization.
- The “debris basin” at Cedar Ave and Maple St should be re-evaluated and retrofitted for better water quality values. The retrofits at this basin should be green technology based and include a diversity if riparian plantings as may be appropriately managed.

Mountain Lake Run

Despite some moderate impacts from Coal Mining the upper watershed of Mountain Lake Run carries a perennial flow and most of its watershed is forested with native mixed hardwoods. The lower watershed is culvertized from Wintermantle Avenue down through the I-81 median. It may not be cost effective to daylight this system, however this potential should be examined in the context of an I-81 widening project. Stormwater quality BMP’s should be incorporated into the highway improvement works.

The as yet undeveloped upper watershed of Mountain Lake Run should be protected with conservation easements or acquisitions. Sub-division developments proposed or revised in this area should have significant open space protection and require open storm water management facilities with enhanced groundwater recharge where feasible.

Roaring Brook Subwatershed

Stormwater from Abandoned Mine Land (AML) and Abandoned Mine Drainage (AMD) flows along the De Naples Auto Parts Yard. There are stream bank stabilization and storm water management controls being installed there as part of a re-formatting of the yard operations. Discussion is recommended on the feasibility of installing green technology-based water quality retrofits as part of this work.

Nay Aug Park has the potential to be used as a demonstration site for various storm water BMP's. Rain gardens, soakage trenches, and other bio-filtration systems should be developed to manage storm flows from park roadways and parking lots. The park will present some particular challenges due to the prevalence of bedrock strata and extremely shallow soils at a number of locations throughout the park.

The University of Scranton and other institutional campuses represent opportunities to re-establish separate storm water flows into RB. Presently, new state of the art storm water management systems at these campuses flow into the CSO system. Due to the proximity of RB to the University of Scranton, and the Geisinger – Community Medical Center, the City of Scranton and the SSA should examine the feasibility of collaboration to direct these campus flows out of the CSO system and into RB via new MS4 outlets. This recommendation may apply to the Cedar Avenue /Iron District Corridor; the Meadow Avenue commercial area and inputs into East Mountain Run as well.

Little Roaring Brook

In order to better manage municipal storm water, the undeveloped portions of Little Roaring Brook watershed need to be maintained as Open Space with watershed conservation and recreation as the primary uses. Due to shallow to non-existent soils and steep slopes, development would accelerate high rates of run off. Detention and water quality enhancements and the related costs to the Municipality present challenges that need to be considered by the planning and zoning boards and Borough Council.

Below Dunmore No. 1 Reservoir, there are limited opportunities for stream corridor facilities that can offer water quality BMP enhancements and flow management. The area along the RR corridor between Drinker Street and the Interstate should be considered for acquisition by a municipal agency to provide a storm water management site. The SSA green infrastructure program may be applicable at this site, providing a neighborhood storm water facility that could help reduce flows into the combined system.

Below Drinker Street to the confluence, an outreach program is suggested to involve property owners with better stream corridor stewardship practices. Due to challenging physical access and steep slopes, clean-up work along the falls of Little Roaring Brook needs to be carefully considered. The involvement of property owners with a clean-up is essential and is recommended. Outreach to property owners to discuss scenic and protective easements to the falls area is also recommended.

East Mountain Run

This small steeply pitched tributary to Roaring Brook carries a large volume of stormwater from East Mountain Road, Moosic Street and Interstate 81. The undeveloped area upgrade of I-81 through Moosic Street to East Mountain Road and Lynnwood Avenue is an important open space that can serve to compliment the green infrastructure program of the CSO LTCP. Development on these parcels is already constrained by steep slopes, rock ledges and limited access to utilities. The acquisition of land along this stream corridor for open space preservation should be considered.

An enhanced green infrastructure detention facility along the Interstate -81/Central Scranton Expressway interchange is suggested long term in conjunction with roadway improvements or lane expansion.

Meadow Brook Subwatershed

Meadow Brook offers many opportunities for restoration and retrofitting associated with progressive MS4 BMPs. Several sources of CSO were identified and removed during the past 20 years. The lower portion of the culvert between the confluence and Penn Avenue was re-built with a six million dollar project funded by the Commonwealth of Pennsylvania in 2004. The open reach between the Forest Hill Cemetery and Marywood University presents feasible opportunities for habitat restoration using green infrastructure practices and techniques tied into retrofitting MS4 facilities on the adjacent Marywood University campus and in the commercial area around the Blakely Street –Interstate 81 Interchange. The creative use of MS4 detention facilities, and water quality BMP's could assist with the restoration of a more natural flow regime and related habitat restoration for a tributary stream that has been dysfunctional as a natural water body for the past 120 years.

Outreach is recommended with Marywood University, the Cemetery Associations, and appropriate property and business owners to develop collaborations that will restore the water quality, hydrology and habitat values and functions of the open reach of Meadow Brook and lessen the adverse impacts associated with the remaining culvertized portions. The involvement and leadership of the SSA LTCP CSO green infrastructure program with this work is essential.

The involvement of the Lackawanna Valley Conservancy in collaborations to devise stormwater based conservation easements is also recommended. Dunmore Borough is encouraged to prioritize a program to replace the Jefferson Avenue Bridge. The City of Scranton and the SSA are encouraged to discuss long term needs to repair, replace or day light sections of the culvert works between Electric Street and Penn Avenue. The upstream extent and main invert to the culvert system near Blakely Street and I -81 needs to be determined.

Leggett's Creek Subwatershed

There are several reaches of Leggett's Creek that would benefit from in-stream and riparian flood-plain rehabilitation and habitat restoration work. These sites are coincidentally parcels owned by the City, upstream of the Mary Street bridge to Hollow Avenue; adjacent to the confluence of Leach Creek off Market Street, upstream and downstream of the Rockwell Avenue Bridge and The Leggett's Creek Greenway adjacent to the Leggett's Street, Brick Avenue, Parker Street area between McLane Park and the Dutch Gap Little League.

LRCA has consulted with US Fish and Wildlife Service regarding a potential habitat mitigation project to be developed by PA DEP and GSA at the Leggett's Creek Greenway site. This project would install both in-stream and riparian habitat improvements as mitigation for a loss and destruction of aquatic and riparian habitat along a reach of Rush Brook in the Borough of Jermyn resulting from a flood control project. This may become a viable project by 2016. LRCA will continue to advocate for this project and requests the City and Sewer Authority prioritize a response should this project advance further.

The Rockwell Avenue bridge replacement project will offer additional opportunities for a green infrastructure response that can address habitat and water quality needs of Leggett's Creek in the proximity of the new bridge site.

The LRCA and the Sewer Authority can collaborate to mobilize neighborhood and community volunteer projects to conduct a major trash and litter removal campaign from the upstream reaches from the Leach Creek confluence to upper Leggett Street and Loop Avenue through Mary Street to Hollow Avenue. Property owners suspected of allowing the dumping of utility trench waste and other "fill" materials that violate the PA Clean Streams Law and federal flood plain and stream encroachment regulations protective of the "waters of the United States", should be advised that the deposition of additional materials is a violation of city ordinances as well as state and federal statutes.

There are several undeveloped parcels of abandoned mine lands in the Leggett's Creek area in North Scranton that may be developed in the next 10 to 15 years. There are other already developed sites that may undergo redevelopment. The City and SSA should anticipate that these developments may present opportunities for collaboration with the developers through the green infrastructure initiative of the CSO LTCP. Assistance in locating and securing appropriate MS4 conveyance rights of way to divert new MS4 flows out of the CSO system and convey as separate flows to Leggett's and Leach Creeks should be a priority and outreach for this purpose should be incorporated into the Planning and Permit approval process.

The development of a Greenway and Trail system in and along City owned properties and along adjacent streets should be advanced with a properly managed MS4 system program for the Leggett's Creek watershed.

Leach Creek

The aquatic habitat values and functions of Leach Creek can only be restored through a comprehensive stream restoration project. This assessment report recommends that the PA DEP Bureau of Abandoned Mine Reclamation (PA DEP BAMR) and or the Bureau of Conservation and Restoration (PA DEP BCR) be requested to initiate such a program for Leach Creek and the other tributary streams identified in this report or in the Scar Lift report or the Lackawanna River Watershed Conservation Plan report as having flow loss that eliminated aquatic habitat functions.

The storm water / flood control basin at Bloom Avenue and the city owned property surrounding it, including the Cayuga Culvert have potential to host a regional green infrastructure MS4 facility that could assist in management of storm water for water quality and flood control purposes and augment a program for aquatic habitat and stream flow restoration for Leach Creek.

The green infrastructure program for the SSA CSO LTCP should consider the Bloom Avenue basin as a significant resource. As a first step, LRCA, SSA and the City can collaborate with community organizations and commercial businesses to conduct a major illegal dump-site clean-up in and along Leach Creek through the Bloom Avenue site.

The planning approval and building permit process should be used to outreach and encourage stormwater retrofits and "green" system upgrades, green infrastructure designs and conveyance rights of way collaborations in the vicinity of Leach Creek to divert storm flows from the CSO system and utilize the se storm flows as part of the habitat and flow restoration program for Leach Creek and Leggett's Creek in the Keyser-Oak and Market Street Corridors.

Clover Hill Creek

The PA Department of Transportation should examine the inlets and swales that direct stormwater from the roadways into Clover Hill Creek and install bio filtration and similar installations where possible. Scouring in the deeply incised channel upstream of Hollow Avenue and the erosion of shale from the slopes of the fill along the Scranton Carbondale Highway roadway berm should be investigated and appropriate bank stabilization should be designed and installed.

Spring Brook Subwatershed

Recommendations for the areas of Scranton in the Spring Brook and Green Run Watershed include prioritizing funding to acquire these steeply pitched, forested mountainsides as public open space, conservation and recreation lands. This area is prioritized for conservation in the Lackawanna Luzerne Bi - County Open Space plan of 2004.

Eddy Creek Subwatershed

The PA DEP BAMR is considering the restoration of two miles of the middle reach of Eddy Creek from the point of flow loss downstream through the Marshwood Road and Underwood road areas to join with the previously restored reach from South Valley Avenue to the point of confluence with the river. LRCA recommends that BAMR consult with KSL on long term opportunities to use green infrastructure throughout the landfill to help restore natural hydrologic capacity with the landfills storm water collection and detention system to contribute to reestablishing perennial flow and aquatic habitat to Eddy Creek.

CHAPTER 4: GREEN INFRASTRUCTURE INVENTORY & ANALYSIS

Green Infrastructure Basics

What is Green Infrastructure?

The American Planning Association defines green infrastructure as the interconnected network of open spaces and natural areas — greenways, wetlands, parks, forest preserves, and native plant vegetation — that naturally manages stormwater, reduces the risk of floods, captures pollution, and improves water quality. This network of green infrastructure is further expanded, especially within urban areas, to include rain gardens, green roofs, street trees, permeable pavement, and other landscape-based drainage features, that also help restore, protect, and mimic natural hydrologic functions within the built environment.[21] It is apparent that green infrastructure can be defined at a broad, encompassing scale, as well as, a more specific and smaller scale.

According to the U.S. EPA, green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier environments across multiple scales. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provides habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or parcel, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing stormwater.

For the purposes of this report, the impact of green infrastructure on stormwater management is the primary concern. Green infrastructure (GI) will refer to the use of techniques that facilitate and integrate natural processes, like infiltration, within the built environment. Green infrastructure is the fabric, when woven into an impervious environment that can provide multiple stormwater/environmental benefits and support sustainable communities. GI slows water and provides opportunities for ground water recharge. Conversely, grey infrastructure, such as pipes, convey water runoff that often accumulates from its source to the final destination point - either a watercourse or a wastewater treatment plant. Taking a green approach to storm water will help reduce the amount of water entering the sewage system, lessen the number of CSO occurrences and help restore a more natural hydrologic cycle.

Use of green infrastructure across the United States has been steadily increasing, from Prince George's County in Maryland to Portland, Oregon and within municipalities both large and small in between. The popularity of Green Infrastructure across Pennsylvania has been steadily increasing, as well. Philadelphia has gained national notoriety for their large scale implementation and the use of green infrastructure to not only handle storm water but improve neighborhoods. Other communities, such as Pittsburgh and Lancaster, are making strides to incorporate these natural processes into their built environments while positively effecting stormwater runoff.

As skepticism recedes, the use of green infrastructure spreads throughout municipalities across the United States.

Green Infrastructure Techniques

On the following pages are descriptions of several green infrastructure techniques and methods. Most of these technologies already have documented success across the United States, Pennsylvania, and even Scranton. In ideal situations, these strategies are utilized in combination to provide even more cumulative benefits. Both the strategies and the construction costs associated with each strategy are dependent upon the site conditions (soils, topography, access, etc.), the scale of the project, the project materials (rock, mulch, paver types) and the specific project scope and vision.

Specific to this report, the following headings and corresponding logos, were developed as a way to group and organize the green infrastructure techniques described in this document. The headings may vary slightly from other regions or from other planning documents, however, the functionality and design of the technique is similar. The logos are used throughout this chapter, as well as, on the demonstration project sheets, the CSO catchment area case study and the associated green infrastructure mapping.

Pervious Pavement

Bio-Retention

Street Greening

Building Greening

Water Harvesting

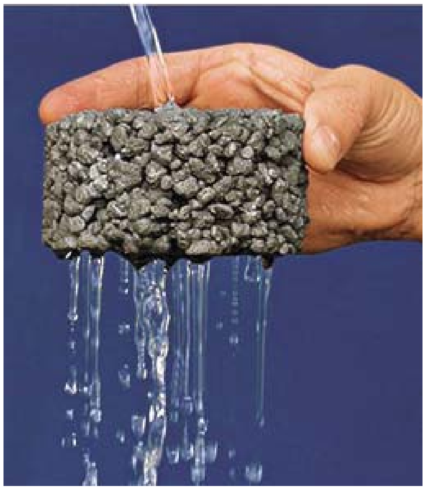
Infiltration Bed

Natural Habitat

Combined Techniques

Pervious Pavement

Pervious pavements are an alternative to typical asphalt and concrete surfaces and hardscapes. Structurally they are still strong enough to allow vehicles to drive over them while also allowing water to infiltrate into the ground. There are several types ranging from brick pavers and porous concrete/asphalt to multiple grid systems that allow vegetation to grow through them. They can be used to replace areas of impervious surfaces, however, it is important to have well drained soils under the pavers to ensure water can infiltrate.



www.vilksoutdoorservices.com

Porous Pavement: allows water to pass through, into a gravel bed.

http://www.islandblockmfg.com/

Permeable Pavers: The voids in between the stones allow water to infiltrate through them.

http://www.coregravel.ca

Grid System: A plastic grid can be filled with plant material, such as grass, or gravel to create a permeable surface.

Porous Pavement

This type of paving resembles traditional cement or asphalt, paving. However, when manufacturing this product the fine materials are left out and replaced with void space. This enables water runoff to move through the openings in the pavement into a gravel reservoir space where it can percolate into the subsoil. It is still structurally strong enough to handle vehicular traffic.

Grid Systems

A grid system is an interlocking web of small pockets that can be used for ground stabilization, grass reinforcement, and gravel retention. These systems can be made of plastic or concrete and filled with either soil and vegetation (lawn) or gravel. Commonly the plastic systems are completely hidden under the fill material, whereas others can create a pattern on the surface. With this system water has the opportunity to move through the cells, into an underground reservoir where it can percolate into the ground. Grid systems that are filled with vegetation can also evaporate and filter water.

Hillside Farms in Shavertown, PA used a grid system filled with grass for an overflow parking area instead of traditional asphalt. The grass fits in with the farm atmosphere. (Picture above is 1st year of growth.)

Permeable Pavers

Permeable pavers usually consist of traditional paver stones that have void spaces in between them, which are commonly filled with gravel or sand, that allows water to move vertically from the surface and infiltrate into the ground.

Bio Retention

Rain garden

A rain garden is a strategically placed depression in the ground that collects water runoff from impervious surfaces and increases the opportunity for infiltration. Most rain gardens are heavily vegetated which facilitates evapotranspiration and infiltration via plant roots. The plants also help filter out pollutants and enhance water quality. Rain gardens vary in shape, depth and size as dictated by the size of the drainage, soil conditions (clay versus sandy), space available and topography. Native vegetation is ideal to use because they normally do not require fertilizer and they are accustomed to the climate. Rain gardens also create habitat for native pollinators. Rain gardens, if sized/designed properly, should capture and treat a 1” storm event from the contributing watershed.

http://images.hayneedle.com

The plant roots within a rain garden help infiltrate water into the ground.

http://blog.vermontwildflowerfarm.com

A rain garden implemented in a front yard, next to a roadway can help filter road runoff.

Vegetated Swale / Bioswale

A swale is a long narrow depression within the landscape that conveys water. A vegetative swale or bioswale further incorporates and utilizes plants that help decrease the speed of water and increase infiltration into the ground. A pipe quickly carries water away from the site, whereas, a swale increases time of concentration. A long swale, with spaced depressions or check dams, is an ideal design because it gives water the most opportunity for infiltration into the ground. Narrow spaces adjacent to roadways and along parking lots are ideal locations for bioswales. Additionally, these swales can help move water away from buildings and other structures.

http://www.werf.org

Vegetated swale adjacent to a parking lot.

http://farm7.staticflickr.com

Vegetated swale adjacent to a street.

Constructed Wetland
According to the Army Corps of Engineers, a “wetland” is “those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.”

Constructed wetlands are engineered systems that strive to simulate the water quality improvement functions found in natural wetlands. Constructed wetlands are effective in removing a range of pollutants created by urban runoff and they decrease quantity and velocity of runoff entering water bodies during a storm. Throughout the wetland are surfaces that host micro-organisms which are effective at removing pollutants from water. This process is important in the removal of oxygen demanding substances and in the removal of nitrogen through nitrification/denitrification. The size of the wetland and amount of plants effects the amount of micro-organisms present and the amount of water that can be filtered. Additionally, plants within the wetland can be an important source of pollutant removal through storage.


www.waterandcarbon.com

An example of a constructed wetland that filters runoff from an adjacent street.

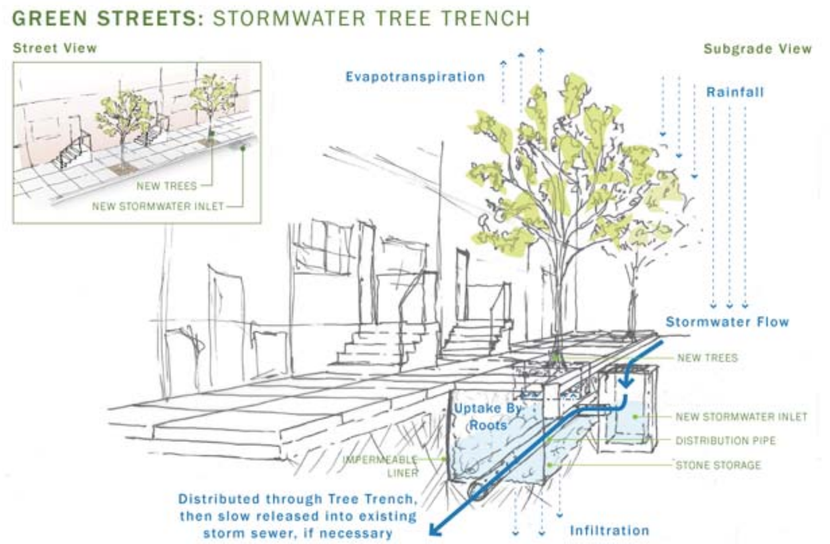
Street Greening

Stormwater Planter
A stormwater planter is a vegetated area installed within a sidewalk to manage both street and sidewalk runoff. The planter is lined with a permeable fabric then filled with gravel or stone. The top layers consist of soil, plants and sometimes trees. The planter is commonly surrounded by a concrete curbing and is lower than the adjacent sidewalk, allowing water to enter through a curb cut. The planters provide opportunity for storage, infiltration, and evapotranspiration. Any excess water is then diverted back onto the street or into an overflow pipe that connects to the stormwater system.


http://water.epa.gov/

Tree Trench

A Tree Trench runs underneath the side walk, parallel to the curb and at surface view it appears similar to a series of standard street trees. However, these tree pits are connected by an underground infiltration structure made of structural soils, gravel and/or modular structural cells to form a continuous trench. The runoff is stored in the empty spaces between the stones (void space) and helps water the trees prior to infiltrating through the bottom. Stormwater from the street is diverted to the trench through curb-cuts while sidewalk runoff can be diverted through permeable pavers between tree wells. If capacity is reached, excess runoff can be diverted into an existing storm drainage system.



http://www.phillywatersheds.org

http://www.dot.ca.gov/

Bumpout

A bumpout is an extension of the curb that protrudes into the street creating extra space for pedestrians and/or landscaping. When used for green infrastructure, they are normally comprised of a stone base that is topped with soil and plants. A curb-cut brings water from the street into the vegetated area where it can be stored, infiltrated, and taken up by plants. Any excess water can exit the bumpout and continue down the road to another bumpout or existing stormdrain. Bumpouts are often located near intersections in the spaces already dedicated as “no parking here to corner” areas. Thus, they help create larger and safer intersections for cars and pedestrians, and they often do not relocate on-street parking. Any vegetation planted in the bumpout would be shorter to ensure the line of sight for traffic is not blocked.

http://www.landscapeonline.com

An example of a vegetated bumpout at an intersection.

http://www.asla.org/

Water flowing through a curb cut into a bumpout.

Green Roof

A green roof implies a building has a roof that is partially or completely covered in vegetation. Instead of rain water flowing directly into drains and down to the sewage system it has the opportunity to be absorbed by soil and plant material. If there is too much water for the vegetation to absorb and evapotranspirate, it moves to a downspout after being slowed and filtered by the plants. A green roof has many other benefits including insulation of the building, aesthetics, creating habitat and reduction of the heat island effect when in an urban setting. A properly functioning green roof also protects the underlying roof and prolongs its lifespan.

A green roof is generally made up of a waterproof membrane, planting material, and vegetation. There are two types of green roofs: intensive and extensive. Extensive green roofs are light weight with herbaceous vegetation and normally 3 to 5 inches of soil or planting medium. They are commonly made of a light weight material with minimal organic mater. Therefore, the plants suitable to these types of roofs are hardy, shallow-rooting varieties that can survive in poor, dry conditions. Common varieties used are sedum and delosperma because they are succulents and retain water during dry spells. Plants used on these roof are often low maintenance if the roof is in a location that is difficult to reach.


http//desantislandscapes.com

View of an extensive green roof made of low growing vegetation.

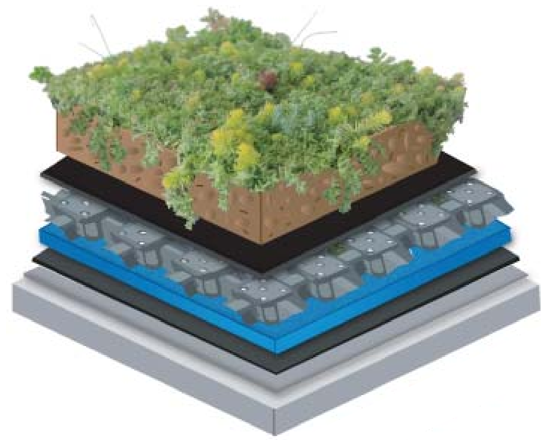

www.vegetalid.usfaq

Diagram of an extensive roof with layers consisting of vegetation, growing media, filter fabric, drainage layer, root barrier and waterproofing membrane at the base.

Intensive green roofs have a minimum of 5 inches of soil and can support a variety of larger plants. Due to the increased soil depth, additional structural support must be included in the design to hold the extra weight. Often, it is more cost effective to install a green roof on new construction rather than as a retrofit. These roofs are commonly transformed into gardens that can be occupied and enjoyed by people. An example of an effective intensive green roof is the one on top of Chicago's City Hall that is used for functional purposes like absorbing rainfall and protecting the roof, as well as, creating a peaceful, elevated green space.


http://www.asla.org/

Data collected from Chicago's City Hall's green roof indicate that the roof not only reduces stormwater runoff by 50 percent, but significantly reduces energy use and saves the City approximately $5,500 annually on heating and cooling expenses.[22]

Downspout Disconnect

In many urban areas, rainwater hits a buildings roof, enters a downspout and is sent directly into the storm or combined sewer system. Instead of allowing the water to directly enter the system the downspouts can be disconnected, which gives stormwater the opportunity to sheet flow and infiltrate into the ground. For disconnection to be possible there must be sufficient room available and adequate slope to direct the water away from the building or any neighboring buildings. To have the largest impact this solution can be combined with other green infrastructure techniques such as a rain garden or rain barrel.

When considering the amount of impervious surfaces that are created by buildings, the impact that downspout disconnect can have on an urban area would be large if implemented on a city wide scale. It is easiest to implement on buildings that have gutters on the exterior of the building and this can become a relatively inexpensive way to increase the time of concentration of runoff.

www.regionalwaterproofing.com

Example of a downspout that is disconnected and directing water away from the building into a lawn area.

Bernie McGurl, LRCA, completes a downspout disconnect demonstration project.

Downspout Planter

A downspout planter is a decorative planter that is irrigated by the runoff from a building. The container itself is filled with gravel, soil and vegetation and it has an overflow that allows excess water to flow back into the storm water system. In areas where downspout disconnect is not possible, due to space available or other site factors, a planter can be used to absorb some of the water runoff while increasing the time of concentration. These can be a variety of shapes and sizes and made from various materials like metal, plastic or wood. These planters are built with their own irrigation system and can be used to improve the aesthetics of a yard or building.

http://water.epa.gov/

A downspout planter can be located next to a building.

http://rocknrollproblems.files.wordpress.com

Incorporating the planter into the downspout is another option when room is limited.

Rain Water Harvesting

Rainwater harvesting is simply the capture and reuse of rainwater. The scale and goals of the project, residential application versus commercial, determines the size of the holding tank. This type of green infrastructure provides supplemental water supply while reducing potable water needs and stormwater discharges.

http://images.hayneedle.com

A rain barrel attached to downspout.

Rain Barrel

A rain barrel can be connected to a down spout and take water runoff from a building to hold in a container for use at a later point. Commonly the barrels have a 55-gallon holding capacity and are used on smaller buildings/houses and used for gardening or lawn irrigation. Even though the term is refers to a barrel the container used to store water can be a variety of shapes, sizes and materials. In order for a rain barrel to be effective at reducing stormwater runoff the water captured should be used and the barrel empty by the next rain event. Rainbarrels can be purchased at local hardware stores or easily constructed by homeowners. Recycled food shipping containers, like those used for olives are an ideal size.

http://tufftechbags.com

Water harvesting bag

Bag

A flexible rain barrel can also be used to collect water. This is basically a water storage unit that can be filled with water and will collapse when emptied. This can be hidden in places such as under a porch and put away when not in use.

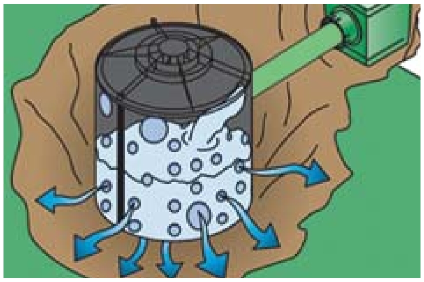
www.corgaltanks.com

Above ground cistern.

Cistern

A cistern is a larger water volume holding container that is attached to a building and is commonly located underground. They collect a larger amount of stormwater runoff that can be used for gray water purposes throughout the building such as toilet flushing. The typical size for a cistern ranges between 5,000 and 10,000 gallons making them ideal for larger structures. Capturing this water helps slow the time it takes to reach the sewage system and reduces the buildings reliance on potable water.

Infiltration Bed



http://www.earthcontactproducts.com

Dry Well

A dry well is an underground storage system that takes water runoff from impervious surfaces, provides storage room and facilitates infiltration. It is commonly filled with gravel to ensure plenty of void space and is located in permeable soils. The size will change depending of the surface area being treated. When the well is filled the overflow will be directed into the existing stormwater system to prevent any flooding. This is not ideal for treatment of sediment laden water.

http://fortikur.com

A french drain before it is covered with dirt.

French Drain

A french drain is a trench filled with gravel that has a perforated pipe running through it. The drain takes water away from an impervious surface moves it through the pipe, into the gravel and provides the opportunity for the water to move into the void space and infiltration into the ground.

This large category refers to the creation, preservation, management, conservation and restoration of natural habitats.

Riparian Areas/Floodplains

Riparian Buffers
Riparian vegetation is a critical component of a healthy stream system. Riparian areas maintain aquatic food webs, provide habitat for flora and fauna, assist with reducing chemical and thermal water pollution, and increase bank stability and flood control. Maintaining natural vegetation is the most effective and inexpensive form of erosion prevention control and water quality treatment and is especially important in sensitive areas like stream corridors.[23] Thus, the main priorities for the City and their MS4 system obligations are to conserve existing width and to increase buffer zone width, wherever possible. Techniques to accomplish this may include conservation easements, avoidance, restoration, land acquisition and enhancement plantings.

Stream Bank Stabilization
Bioengineering can be utilized as a component within the riparian buffer to help establish vegetative cover, as well as, assist with bank stabilization. Despite its name, bioengineering is more horticultural rather than engineering.[24] Soil bioengineering is an applied science that combines engineering design principals with biological and ecological concepts to naturally control erosion, sediment and flooding using healthy, living plant communities. [25] Another definition of Bioengineering as described by Bentrup and Hoag (1998)[26] is the integration of living woody and herbaceous materials with organic and inorganic materials to increase the strength and structure of soil. Whereas, engineered approaches are strongest the day they are built, bioengineered projects are usually the weakest when built and gain in strength each day thereafter. Bioengineered projects also have less maintenance costs over time because of their self-sustaining nature and resiliency. Bentrup and Hoag (1998)[26] present a report by Parson that equated a fully developed stand of densely stemmed purple-osier willow (*Silax purpurea*) to a blanket of 6-inch angular rip-rap. Although, vegetative protection may be adequate where streamflow velocities do not exceed 8 feet per second, structural and bioengineering techniques should be considered with velocities greater than 8 ft/sec.[27] Types of bioengineering that may be applicable within the LMT Greenway include brush mattresses,[28] live stakes and joint plantings.

Floodplains
Strive to limit disturbance and development in flood prone areas. The city should even attempt to convert developed areas back into natural habitats or limit disturbance to recreation and park land.

Natural Habitats
In an urban context there are small pockets of habitat scattered through out a city that can be found in spaces like empty lots and along roadways. These can range from woodlands, which can be defined as an area of land with a high density of trees, to meadows, or a field that is mostly covered with grass and other non-woody plants. These habitat pockets are important to keeping natural systems functioning and habitat available for wildlife. Additionally, they produce little if any stormwater run off and many times help absorb excess runoff from adjacent impervious surfaces all while improving air quality. Heavily

vegetated areas are commonly used to stabilize steep slopes and prevent erosion during heavy rain periods as well. Preserving and creating habitat are important components to incorporating natural systems into the built environment.

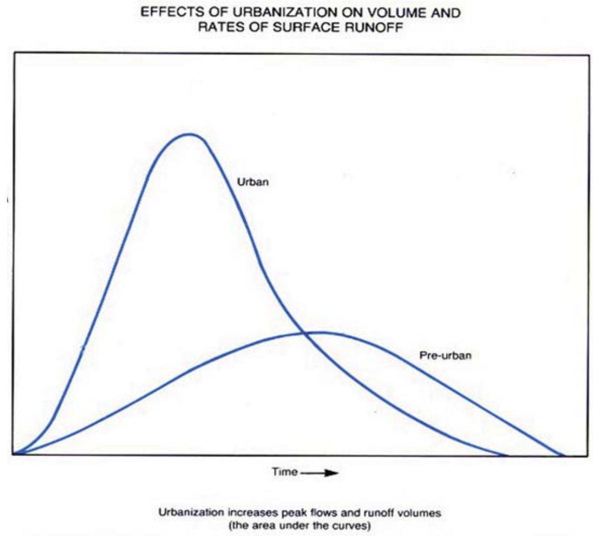
Woodland Areas
A woodland would be considered an area of land with a high density of trees that is made up of an upper and under story. Woodlands provide habitat and improve air quality, while the high density of vegetation encourages water absorption and filtration. Within an urban context there is commonly small pockets or fragments of a woodland which are important to conserve. Unlike pervious surfaces, these pockets would have little if any stormwater runoff and can be used in steep areas that may be dealing with erosion.

Meadow/Open Field Areas
A meadow can be defined as a field that is mostly cover with grass and other non-woody plants. They have high ecological importance because they provide food and shelter for a variety of organisms.

Recreation/Parks Areas
Parkland and trails are important within the context of a large scale green infrastructure network. These systems are often comprised of the natural habitats described above. These areas also have potential in urban environments to capture and treat stormwater. Greenways and Corridors along the Lackawanna River and tributary streams are important recreation connectors and possible locations for stormwater management.

Sustainable trail through the Moosic Mountain Nature Preserve. Shows incorporation of sustainable recreation, with preservation of woodland and open field areas.

Why Use Green Infrastructure?



Adapted from Drainage Manual, Roads and Transportation Association of Canada, 1982.

Urban development increases the amount of impervious surfaces, such as asphalt roads, roofs and concrete sidewalks. These surfaces concentrate stormwater runoff, increase water pollution and reduce natural infiltration potential.

The common gray infrastructure approach to stormwater management, tends to disrupt the natural hydrologic cycle because water hitting impervious surfaces either runs into a stormwater system or a combined sewer system. These systems increase the quantity and flow of runoff into watercourses or remove water from its natural watershed, respectively.

Increases in stormwater runoff, causes more CSO outfalls to occur and jeopardizes the health of the receiving waters and ecosystems. Even the separated storm water system is negatively affected by the extra runoff. Instead of having time to absorb into the ground as it moves toward a water source, water enters a pipe and it is sent to the river with no chance for absorption or filtration of pollutants and the increased velocities exacerbate erosion.

One study found that in general, green infrastructure is just as effective at removing pollutants from stormwater, reducing peak flows, and mitigating flooding and sedimentation as gray infrastructure, but on average costs 5-30% less to construct and is approximately 25% less costly to maintain over the life cycle of a project

Gray infrastructure will always be needed, however, there is a need to evaluate the incorporation of green infrastructure into a stormwater system, as a means to address cost savings, improve water quality and attain permit requirements.

Environment

Green infrastructure has the ability to deal with many of the issues created by the traditional gray water infrastructure implemented in many cities. By dealing with water on site, instead of carrying it away, there is opportunity for it to absorb into the ground and filter out excess pollutants. Along with this, slowing the speed that water reaches a river or stream reduces the chances of flooding. By using green methods to capture water we can reduce our use of municipal water or recharge groundwater, an important water source in the United States. While filtering and infiltrating water, the vegetation used in some of the green infrastructure would also attract and create habitat for small wildlife such as butterflies and birds.

Economically

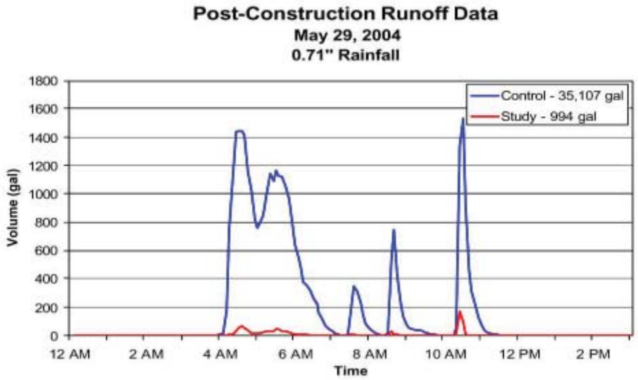
Green infrastructure is also capable of benefiting a city economically. Often, when comparing a green infrastructure plan with a gray one, the green solutions are less costly. The reason for this difference is gray infrastructure often needs more grading and built materials such as piping and detention facilities. Spending less money on green infrastructure and still meeting the goals of the SSA Long Term Control Plan is an option the SSA wants to consider.

Community

Additionally, the dual purposes of green infrastructure can benefit the surrounding community. When green infrastructure is implemented it has the potential to convert an unused area into an enjoyable green space, while still dealing with storm water runoff. The addition of plant life, whether to a sidewalk or small park, makes a space more enjoyable to be in.

Green infrastructure has the ability to benefit the city environmentally, socially, and economically. Having a green approach would move toward improving surface and ground waters; eventually producing a healthier water way for animals and aquatic life, and have positive effects down to the Chesapeake Bay.

There have been other cities and municipalities that have successfully implemented green infrastructure techniques:



Burnsville, MN

A study was conducted to determine the effectiveness of rain gardens on stormwater management. The study involved monitoring two similar residential areas. One was considered the study's control site while the other was fitted with 17 new rain gardens within 5.3-acre neighborhood. The rain gardens were sized to accept the first .9 inches of rainfall runoff from the impervious surfaces in the subwatershed for each storm event. Runoff rates and volumes were collected using area-velocity flow meters in the storm sewer pipe at the outlet of each watershed. Automatic samplers were also set up to collect water quality samples at each of the watershed monitoring locations. In the end the conclusion of the study was that the rain gardens held reduce runoff volumes by approximately 90 percent. [30]

Chicago, IL

Since 1989 Chicago has been developing into a greener city with the start of the Green Streets program that was put in place to improve quality of life, stormwater management, and the urban heat island effect. Since then several other projects have been taken under by the city such as the Green Roof Program, Green Alley Program and Sustainable Streetscapes Programs. Through these projects the city was able to plant nearly 600,000 trees and more than 4 million square feet of green roofs had been added. As more projects have been implemented in the city developers and associated design, construction and manufacturing industries have become more familiar with the materials and practices which has increased the cost competitiveness within the development community.[31]

Kansas City, MO

The Kansas City Water Services Department has launched a pilot project to demonstrate how stormwater improvements can enhance neighborhoods while effectively handling stormwater runoff. Out of the 744-acre combined sewer area, 100 acres was taken as a pilot or sample project. Hydraulic modeling conducted for the project indicates the system of BMPs constructed for this project area will reduce the peak runoff flow rate for a 1.4-inch storm event by approximately 80%. Approximately 150 BMPs, providing 370,000 gallons of storage volume, were completed in July 2012 and are currently being monitored.[32]

Washington DC

The district of Columbia is focusing on getting home owners involved in stormwater management and implementing green infrastructure. In order to do this an online, interactive tool GreenUp DC lets one explore local green infrastructure while helping property owners design and plan green projects on their property. the effort stated after a MS4 permit was issued and the district recognized that retrofits on public property alone would not meet the reductions required. Additionally, the effort included a stormwater fee based on impervious area that can be reduced with the implementation of green infrastructure.[31]

Current State of Green Infrastructure

Completed Projects

There are a variety of projects throughout Scranton and Dunmore where green infrastructure has been successfully implemented. An analysis of how effective these projects handle stormwater can be useful when designing future green infrastructure projects and determining the cost-effectiveness of green infrastructure over time, when compared to gray infrastructure.

The projects range from small rain gardens, bioswales and dry wells, to green roofs to large cisterns and constructed wetlands. Many projects are obvious and are for the public, however, several can not be seen because of their location underground. The parties involved also range from businesses to institutions.

Additionally, the SSA has started to embrace green infrastructure techniques as well. They installed a green roof at their treatment plant and they are currently constructing tree pits.

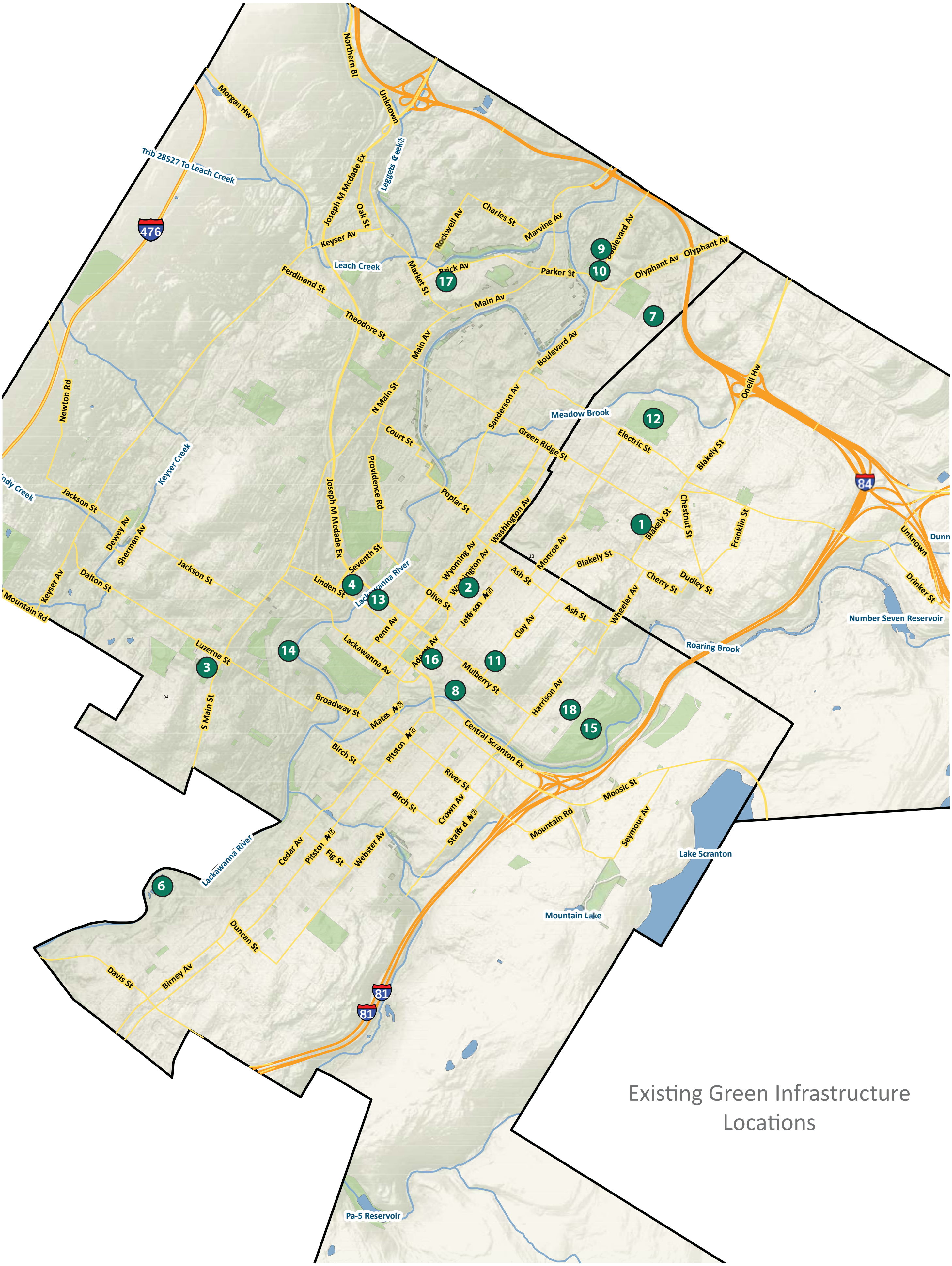
Without a formal green infrastructure program or plan and without any incentives for green infrastructure currently available, the number of green infrastructure projects in the greater Scranton area is respectable. They also show the interest and eagerness the city has to incorporate green practices into the built environment. However, there is obviously room for growth and installation of improved methods.

There are 30 city-owned parks, several parks in the Borough of Dunmore, the county-owned McDade park that are found within the project area. There is a portion of the forty-mile Lackawanna River Heritage Trail that links communities within the Lackawanna Valley. There is also protected watershed land, Lake Scranton, wetlands, woodland and vacant lots undergoing various levels of succession. Collectively, all these features represent the green infrastructure network of the project area. However, as explained previously, the narrowed focus of this report inventory in specific to the green infrastructure techniques used to address stormwater. Stormwater basins and underground pipes built as permit requirements are not included.

Existing Green Infrastructure Projects

NO.	NAME	LOCATION	WATERSHED/ CSO CATCHMENT	GREEN INFRASTRUCTURE	
1.	Saint Joseph's Center (2010)	Blakely St., Dunmore	Meadow Brook	Bioswale	
2.	The Commonwealth Medical College (2009)	Pine Street, Scranton	Lackawanna Corridor	Cistern; Rain Garden	
3.	Fellow's Park (2010)	Main Ave., West Scranton	Lackawanna Corridor	Dry Well	
4.	Mt. Pleasant Business Park (2008)	Providence Rd. Scranton	Lackawanna Corridor	Constructed Wetland	
5.	Street Tree Pits, SSA (2013)	Multiple	Multiple Drainage Areas	Tree Trenches	
6.	SSA Green Roof (2010)	Breck Street	Lackawanna Corridor	Green Roof	
7.	Marywood University	Upper Green Ridge, Scranton	Lackawanna Corridor	Subsurface Infiltration Beds; Green Roof;	
8.	University of Scranton	Hill Section, Scranton	Roaring Brook	Several LEED buildings; Rain gardens; Subsurface Infiltration Beds; Bioswales; Green Roof (under construction)	
9.	Green Ridge Health Care Center (2012)	Boulevard Avenue, Scranton	Lackawanna Corridor (Carter Creek)	2,485 sf Infiltration Basin; 2,480 sf Infiltration Trench	
10.	Green Ridge Personal Care Home (2012)	Boulevard Avenue, Scranton	Lackawanna Corridor (Carter Creek)	2,700 sf Rain garden; 5,580 sf Infiltration Trench	
11.	Jewish Home	Vine Street, Scranton	Roaring Brook	Subsurface infiltration beds	
12.	Dunmore High School	Dunmore Street	Meadow Brook	Subsurface infiltration beds	
13.	Dunkin Donuts (2009)	Mulberry & Mifflin Avenue, Scranton	Lackawanna Corridor	Rain garden	
14.	Lackawanna River Heritage Trail (2012)	Along Lackawanna River, Scranton	Lackawanna Corridor	Rain gardens	
15.	Nay Aug Park, City of Scranton (2013)	Hill Section, Scranton	Roaring Brook	Rain gardens	
16.	Elm Park United Methodist Church (2013)	Jefferson & Madison Scranton	Roaring Brook	Rain garden	
17.	Holy Rosary Church (2011)	North Scranton Street	Leggett's Creek	Infiltration Bed	
18.	Geisinger CMC (2014)	Mulberry Street, Scranton	Roaring Brook	Pervious Pavers, (under construction)	

This chart and supplemental map can be removed and used as a tour of existing green infrastructure within Scranton/Dunmore.



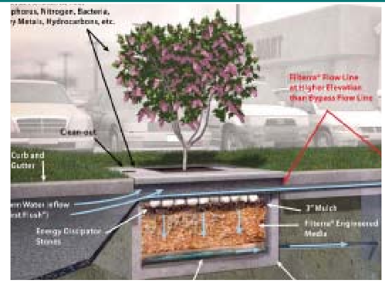
Existing Green Infrastructure Locations

Highlighted Existing Projects

SSA Tree Pit Project

The SSA is installing several tree pits through out Scranton to help store and infiltrate runoff. These pits are small but cumulative impacts from multiple installations will have benefits to the CSO and MS4 systems.

- Cedar Avenue & Ripple Street
- Locust Street & Remington Avenue
- Theodore Street & Church Avenue
- Cedar Avenue & Breck Street
- Locust Street near Schimpff Court
- Spring Street & Hollister Avenue



http://www.filterra.com

The University of Scranton

Has several LEED-certified buildings, rain gardens and subsurface infiltration beds throughout their campus. Rain gardens and bioswales are located along the pedestrian portion of Clay Avenue and in association with the new Science Center.

The Scranton Lackawanna Industrial Building Corporation

SLIBCO installed a constructed wetland to capture overflow runoff from one of their building pads. It also captures runoff from the Scranton Expressway. The wetland has plants, like cattails and soft rush, for nutrient/pollution removal and slow-moving open water, which promotes settling of suspended solids.

Marywood University

Marywood installed a green roof atop their School of Architecture building. This gives not only provides benefits for stormwater management but also helps protect the roof, insulate the building, and provide educational opportunities for students.

Elm Park United Methodist Church

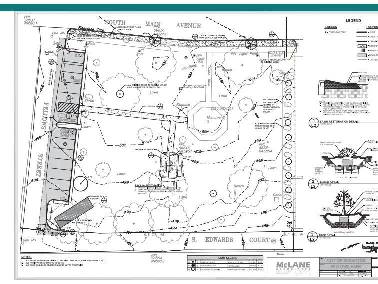
The church is working on completion of a master site plan for the entire grounds. Currently, they installed a simple grass depression that captures runoff from the adjacent parsonage building. This area will be further enhanced with plantings and permeable hardscaping for increased functionality as a gathering space.

Dunkin Donuts

Installed a rain garden in 2009. It appears the original plants have been removed and the rain garden is currently just mulched. This highlights the fact that rain gardens do need some form of ongoing maintenance. The system most-likely promotes infiltration, and mulch does help remove pollutants; however, it now lacks a biological filtration component that plants provide.

Fellows Park

During park renovations, a sub-surface infiltration bed was installed to capture runoff from a newly renovated and paved parking lot. This reduces the amount of surface runoff down the adjacent alley to the CSO system.



Commonwealth Medical College

During a storm, water is directed from the roof to a cistern that can hold up to 10,000 gallons. This gray water is reused to flush toilets and for irrigation. Once the cistern is filled, excess water is diverted into a rain garden in front of the building. All other gutters empty into custom concrete dissipater boxes and into the large rain garden. Provides a unique entranceway to this LEED-certified building.

Scranton Sewer Authority

The SSA installed a green roof during renovations to an existing building. This site serves as a demonstration project and an educational tool for the community. The roof has recently been installed and is still growing.

St. Joseph's Center

This project is best described as a retrofit of an old parking lot with green infrastructure. Bioswales planted with River Birch and Red Chokeberry were sawcut into the existing asphalt to remove impervious area and capture runoff. Helps remove water from the CSO system in Dunmore.

Lackawanna River Heritage Trail

This is a good example of handling stormwater runoff on-site and within a recreational parcel. Rain gardens and gravel swales were installed to filter and slow stormwater runoff from the new asphalt trail. Helps the MS4 system.

Green Ridge Health Care Center

A rain garden is under construction at the main entrance of the facility and helps remove storm water from the CSO system.

Vision for Green Infrastructure

Green infrastructure has potential to become a integral part of how Scranton and Dunmore treats stormwater. Green infrastructure projects can be catalysts to help transform streetscapes and run-down areas into safer, healthier, and more-aesthetically pleasing centers and corridors. Not only will green infrastructure improve water quality but it can also improve quality of life in these urban areas. At the broad scale, it can enhance the overall network of green spaces from parks and riparian areas to the crucial links and corridors through green streetscapes and trails.

The financial issues facing Scranton and Dunmore are large and as they continue to plan for the future we envision new leaders with thinking and actions that shift from reactive to proactive. Green infrastructure represents this shift. We envision green infrastructure is used with each new project and renovation project.

We envision an urban environment with renovated streetscapes that are aesthetically pleasing and pedestrian-friendly, well-maintained and numerous park lands providing passive and active recreation opportunities, vibrant and clean urban center thriving with businesses and an underlying network of green infrastructure that helps dually achieves these goals and manage stormwater.

We envision a true community effort, where green infrastructure is implemented on many levels from municipals to residential for a common good.

http://farm3.staticflickr.com/ http://www.greatcity.org

Connecting the built and natural environment.

Opportunities for Green Infrastructure

Green infrastructure offers a range of benefits from water infiltration to storage/reuse of rainwater, to the control of stormwater runoff. Green infrastructure can be utilized within varying locations and at many different scales, from small residential lots to large city parks and open space. The flexibility of green infrastructure within several settings and areas is briefly discussed below.

When determining the location of opportunities, the first focus should be on city owned parcels because they should be the easiest to implement green infrastructure. Next, public land and the street right-of-way should be considered because community enhancement can be an added benefit integrated with stormwater management. Additionally, these areas should be a focus because of the amount of runoff created by them. When analyzing stormwater issues in the city of Philadelphia it was estimated that 40% of stormwater was created by the right of ways. The next opportunities are within commercial buildings or institutions that occupy large impervious surfaces like roof tops and parking lots. Lastly residential properties should be considered, unless they show interest in green infrastructure (this refers more to individual projects, rather than large programs like downspout disconnect.

Park Land

Park lands, within urban settings, often represent the largest pockets of open space. There are several parks throughout Scranton that can be used to infiltrate, slow and filter stormwater runoff. Many of the parks have green space that is under utilized and can be converted into a rain garden or vegetated swale to take the street runoff and give it the opportunity to be absorbed. Installing these gardens would also add value to the parks. Over all the goal should be to look for opportunities to redirect water off of the streets into parkland or at minimum keep stormwater runoff from parks out of the storm drains.

City of Scranton owned:

Allen Park	Cayuga Field and Playground	Chic Feldman Field
Clover Field	Connell Park	Connors Park
Duffy Park	Fellows Park	Grace St. Playground
Jackson Terrace Park	James P. Connors Park	Jim Crowley Park
The Lookout	Billy Barrett Park	Nay Aug Park
Paul Ross Field	Powderly Park	Rockwell Park
Sturgis Park	Theodore St.	Tripp Park
Weston Field	Weston Park	Robinson Park
Oakmont Park	Woodlawn Islands	Sunset Islands
North Scranton Mini Park	Novembrino Park	Penn Ridge Swim Complex

Borough of Dunmore owned:

Tank Memorial	Monroe Park & Dunmore Community Center

Lackawanna County Owned:

McDade Park

Vacant Lots

Throughout the city are plenty of opportunities to convert unused vacant lots into pocket parks that handle stormwater from surrounding structures and impervious surfaces. Often, these lots border roadways and are cut off from street runoff by a curb or sidewalk. By giving water the opportunity to enter the site, utilize green infrastructure, and over flow back to the street when filled, a large portion of water is stored or infiltrated and removed from the system or is greatly slowed. Simply sending water through a vegetated swale would make a large difference in the time it takes to enter the MS4 or CSO system. Other methods such as rain gardens or infiltration trenches can be utilized along with pervious pavers when paths or hardscape is needed. Several of the parcels are owned by the city, however many are privately owned. Incentives or partnerships can be used to find common ground that will benefit both parties. By including paths and spaces for people, some parks can be enhanced and provide a more enjoyable space for those in the neighborhood. The ability of green infrastructure to serve dual purposes of stormwater management and community enhancement make it an option that should be considered for all public space. Additionally, the spaces can be used as educational devices to increase awareness of green infrastructure techniques and involve the community in stormwater management. Where possible, agreements with neighborhood groups or homeowners can be used to assure maintenance.

http://watershedmg.org

A curb cut that allows water to enter a site. The painted pavement makes the use of the curb cut more obvious to the public.

Streetscaping

Green infrastructure elements can be applied throughout a streetscape to store, infiltrate and evapotranspire stormwater. Extra or unused space along roadways provide opportunities to filter and infiltrate stormwater. Often a portion of a large side walk can be converted into a vegetated strip or garden that will slow and filter runoff. These areas will not only help with water but will also improve sidewalk atmosphere and life, creating a barrier between pedestrians and traffic. Curb extensions into the road when there is extra room or unused parking can also become vegetated areas. These will not only improve sidewalk life but can also be used to narrow a roadway if traffic speed is an issue. Tree infiltration pits are viable as well.

http://water.epa.gov/

Example of curb extensions incorporated into a street intersection.

http://hpigreen.files.wordpress.com

Unused area on sidewalk converted into vegetated swale.

Several streets in Scranton are prime candidates for street greening because several once has an active trolly line. These streets, like S. Washington Ave., are wide, leaving room for a redesign with green infrastructure and improved biking/pedestrian lanes.

Alleyways

A green alley program can benefit the city of Scranton and Dunmore especially in the downtown district. Often alleys are paved and left without a purpose, however, with planning they can be converted into a space that benefits the surrounding neighborhood and community. Instead of having an asphalt drive, a small vegetated pocket park or pedestrian path can be implemented that can serve the purpose of connecting businesses and other green infrastructure while handling stormwater runoff. In high traffic areas, permeable pavers can be used in the place of traditional pavement.

The impact of the Center Street Improvement Project in Downtown Scranton is positive and financially beneficial. This alley has new businesses and it has an urban vibe during First Friday events. It is a gateway to the Hilton Hotel and is a multi-use event space, as well as, a corridor for both vehicles and pedestrians. The only benefit not provided by this alley is stormwater reduction. Had pervious pavers been utilized rather than stamped concrete this alley could provide an added benefit to the City and SSA. Another missed opportunity is at Oakford Court Alley, which was recently paved with no stormwater controls or pedestrian/aesthetic improvements.

http://www.modeldmedia.com

Example of a green alley using permeable pavers and vegetation.

Parking Lots

Often the functional requirements of a parking lot, to maximize parking and vehicular circulation, is the only goal for a lot design. When this happens, pedestrian circulation, adequate landscape areas and green infrastructure to handle stormwater is often overlooked. However, many times there is opportunity to implement green infrastructure, such as vegetated swales and rain gardens to better handle the runoff, and to create a more enjoyable space without compromising function. An example of a parking lot implementing green infrastructure is the Saint Joseph's Campus on Blakely street. What was once concrete parking dividers were converted into vegetated strips that filter storm water from the asphalt. Another approach is changing the material used to build the parking lot. Using permeable pavers or porous pavement, even if only in the parking spots, can make a large difference in the amount of water running off the surface. Municipal ordinances can even be adjusted to force minimally used, overflow lots to be constructed with pervious surfaces.

http://www.uni-groupusa.org

Pervious pavers replace the parking spaces.

http://www.chesapeakebay.net

Raingarden located next to a parking lot. The overflow is sent into the catchbasin.

Commercial/Institutional Buildings

Commonly, commercial and institutional buildings have larger square footage and are surrounded by a high percentage of impervious surfaces. There are many opportunities to handle the stormwater created by the roof top. On many buildings, especially newly constructed, it is possible to fit the building with a green roof. This will allow water to be filtered and absorbed before entering a downspout. Excess roof runoff can then be directed into bio-retention areas to infiltrate. Another approach the building can utilize is a large cistern that reuses the water for gray water throughout the building. Additionally, the impervious surfaces surrounding the building can be directed toward bio-retention which will help infiltrate water while filtering out pollutants. When space is not available for bio-retention the use of pervious pavement and underground infiltration beds can be used to handle storm water. The potential to handle runoff from the parking lots associated with this facilities was previously discussed.

Residential Lots

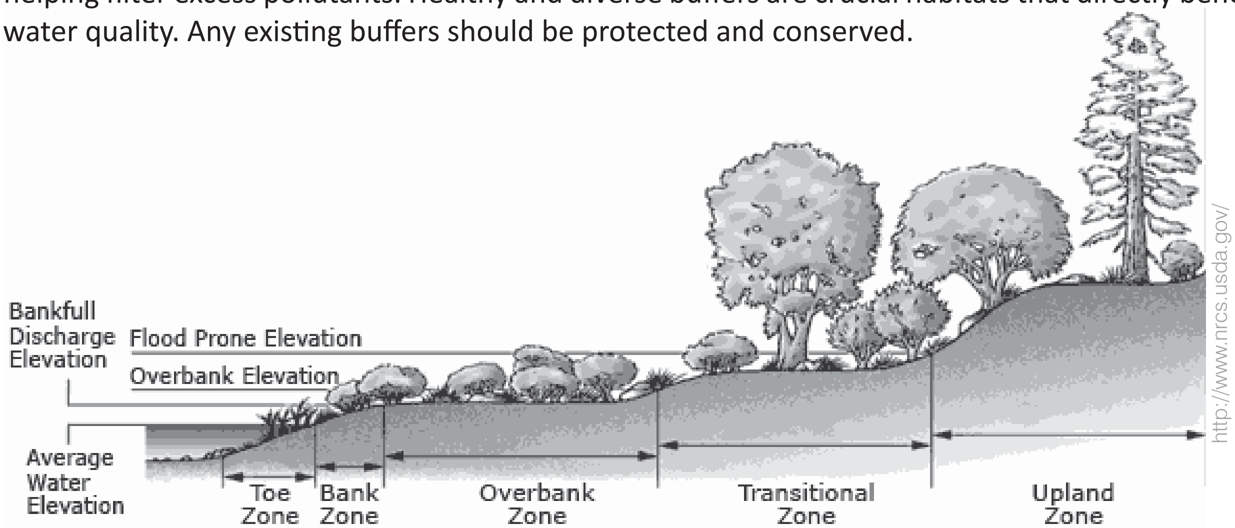
A downspout being directed into a rainbarrel.

Small steps can be taken within individual lots to decrease or slow the amount of stormwater runoff. With a large amount of residential parcels in Scranton and Dunmore, residents have the potential to impact stormwater both positively and negatively. The green infrastructure that a homeowner can use will vary from site to site but there are plenty of options. The first steps would be determining how much runoff is created by the building or impervious surfaces and where this excess water flows too. From there the amount of room available and other constraints on the site, such as adjacent buildings, should be considered.

If room is available working landscapes, such as rain gardens or vegetated swales, can be used to encourage water infiltration. When possible this can be combined with downspout disconnect however on several of the residential lots this may not be possible because of steep slopes and proximity of adjacent structures. Downspouts should not be disconnected if they will discharge back toward the building or have potential to cause water damage on an adjacent parcel. If space is limited an easy but still effective approach is the use of a rainbarrel to collect stormwater that can be used later to water a lawn or garden. If water from a rainbarrel would not be used regularly a down spout planter can be utilized to filter and absorb some water while creating a planter with a built in irrigation system. Another option available, especially when constructing a new parcel, is to reduce the amount of impervious surfaces. An example would be to replace a small drive with permeable pavement. These surfaces can resemble asphalt or concrete and appear like a regular drive, or can be made of a reenforced grid system filled with vegetation or gravel. Simply reducing the amount of impervious surfaces would have cumulative benefits when used in several locations and on many parcels.

Riparian Buffer Lands and Flood Plains

The lands located next to creeks and the Lackawanna River in Scranton commonly consist of levees and flood control techniques. While many green infrastructure techniques, such as pervious pavement aren't optimal because of risk of flooding and filling of void spaces, the best opportunities for riparian lands are habitat conservation, restoration of woodlands, meadows and constructed wetlands. Many parcels can be transformed into more natural stream banks that create habitat while still managing flooding. Instead of just utilizing a berm to hold back water the banks can be sloped more gently and planted to allow more room for water and utilize vegetation to slow and filter water. Tiers of land can be created and converted into wetlands to handle excess water while helping filter excess pollutants. Healthy and diverse buffers are crucial habitats that directly benefit wildlife and water quality. Any existing buffers should be protected and conserved.



The section above illustrates a more natural river banks that has different flood zones, levels and vegetation.

Proposed Recommendations and Strategies

Recommendations

The success of green infrastructure within municipalities across the country and within Pennsylvania provides validation for the positive benefits of green infrastructure use within a stormwater management system. Green infrastructure may not be able to control and manage stormwater completely, however, it should be utilized in conjunction with gray infrastructure. The potential for green infrastructure within Scranton/Dunmore and the specific benefits to the SSA should be explored.

There is potential that green infrastructure can supplement and compliment the existing and proposed gray infrastructure and save money in the long term. The phasing strategies by the SSA provide the opportunity to pursue less expensive and more beneficial green infrastructure approaches. The SSA is already proposing to invest a minimum of 5 million dollars over the next 10 years on green infrastructure. The SSA is interested in using this money for demonstration projects to determine the real benefits to Scranton's CSS. This document identifies 15 demonstration projects that highlight several green infrastructure techniques.

Although construction is often viewed as the final step for most projects, monitoring is the paramount phase for these demonstration projects. Without monitoring the SSA cannot fully document the complete benefits that green infrastructure has on stormwater management, specifically the amount of stormwater being retained. Once monitoring quantifies the impact of green infrastructure on stormwater reduction, then the amount of proposed gray infrastructure, such as culverts for storage, can then be adjusted. Reducing gray infrastructure and increasing green infrastructure has potential to save the SSA and ratepayers money while still attaining permit requirements.

In order for green infrastructure to have the largest impact it should become an integral part of all new construction projects, as well as, any renovation and enhancement projects. Taking the initiative to handle stormwater on site can have cumulative positive impacts on the CSS/MS4. For example, as sidewalks and streets need improvements, green infrastructure in the form of infiltration beds, bio-swales, and pervious pavers should become an important component of the design. As mentioned in 'our vision' encouraging the integration of green infrastructure in development would facilitate a proactive way of thinking by the City.

The implementation of green infrastructure and restoration projects by public agencies on public lands or within right-of-ways will have an impact on stormwater management. However, participation from private, non-profit and commercial residents is still required. Otherwise, the SSA and the City will be forced to rely on traditional gray infrastructure to meet EPA mandates. This means the costs outlined in the SSA Long-term Control Plan will be realized. Additionally, these costs are related solely to the CSS and not the MS4, which would also need costly upgrades. To reach the full benefit of green infrastructure we recommend a partnership program to encourage a more encompassing network of green infrastructure at all levels.

Green Infrastructure Partnership Program
A new program can be initiated, that promotes collaboration between the SSA and the City with developers and residents for the implementation of green infrastructure techniques. Within this mutually beneficial program, members may have access to direct funding, grants, incentives or in kind services to take their green infrastructure ideas from concept to construction. Interested participants must apply to the SSA/City for review and consideration. The top projects will be awarded based on cost, the benefits to the CSS/MS4,

partnership stability, maintenance plans, and project support. To Involve the community further, yearly awards can be given that highlight exemplary projects and their benefits.

Following is a list of community members that have already shown interest in being part of the solution and they are willing to learn how they can work with the City and the SSA to reduce their stormwater footprint.

The Scranton Memorial Library
The University of Scranton
The Immaculate Heart of Mary
The Elm Park United Methodist Church

Demonstration Projects

There are many opportunities for municipalities, residents and businesses to deal with stormwater on site, before letting it flow into the stormwater system. Several demonstration projects have been highlighted to showcase potential use of green infrastructure techniques at a variety of locations within both CSS and MS4 areas. These projects by themselves cannot prevent a CSO overflow event, however, the most beneficial green infrastructure system consists of many small projects that cumulatively have positive effects on stormwater.

Methodology
Several key components were utilized when prioritizing potential green infrastructure projects and ultimately deciding upon demonstration projects.

The project team considered and assessed the following:

- Is the project located within a CSO catchment area?
- Is the project within a CSO catchment area that is listed as Phase B and/or Phase C as determined by the SSA long-term control plan?
- Is the project located on city-owned land or on public land?
- Is the project cost effective and functional?
- Does project have a dual function of stormwater management and community enhancement?
- Is the project in a visible location that increases its educational potential?

All properties owned by the City of Scranton and the Borough of Dunmore were visited to identify any potential opportunities for green infrastructure. Opportunities ranging from preservation of existing conditions to the installation of rain gardens were documented for both CSS and MS4 areas. The inventory sheets along with a map of the parcels are included in Appendix C.

Public property became an important first focus because green infrastructure can be implemented without the need to acquire land. Additionally, the properties range in size and type giving opportunity to demonstrate techniques that can be implemented on a variety of locations. Private property was also considered for demonstration projects if the owner had expressed interest and the parcel could be beneficial to the city. Taking these factors into consideration a rudimentary analysis of the associated opportunities for each parcel was completed to determine the most beneficial projects based on tangible results versus cost. Providing examples of a range of green infrastructure techniques also became a priority so the most beneficial techniques can be determined. Fifteen of the top priority Green Infrastructure projects identified through this process are explained and described in detail on subsequent pages.

Overall, ten (10) demonstration projects are located within a CSO catchment area; five (5) are located within the MS4 system, and one is located within both systems.

The projects were rated based on the following:

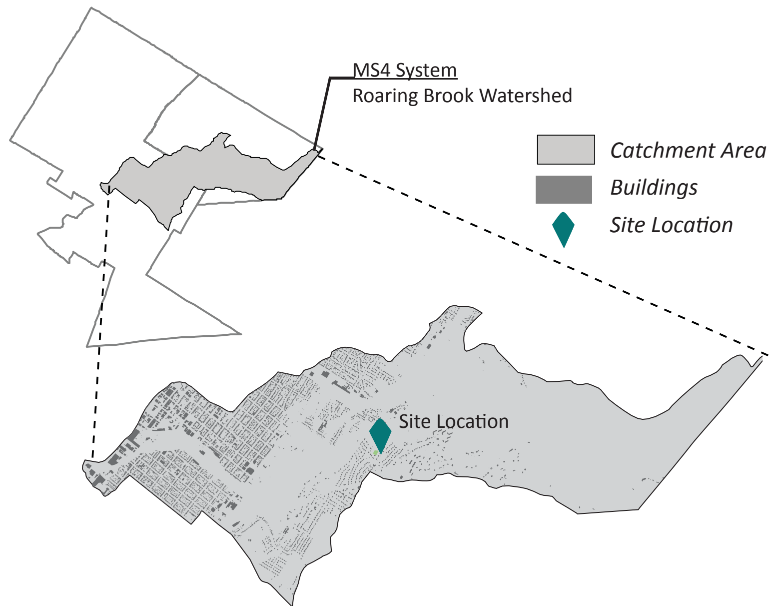
- Visual/aesthetics;
- Community enhancement potential
- Treatment of what percentage of impervious CSO catchment area
- Potential to increase Time of Concentration
- Location in priority CSO area. Currently CSO areas are more important because it provides opportunity to show cost savings.
- Education potential
- Storage Potential
- Water Quality/Habitat Improvements

When deciding which projects should be implemented all the factors that were considered and listed above are important, however, the largest consideration should be the comparison of gallons captured or slowed versus the cost. Using this as the main deciding factor, the projects implemented will give the largest benefit to the CSS/MS4 for the smallest price.

Subwatershed Opportunities

Multiple opportunities exist within the MS4 system. There are unlimited potential projects along the stream banks and riparian areas of the Lackawanna River and Tributary Streams. As explained in Chapter 3, the LRCA also completed stream walks of all the tributary streams. They identified recommendations for each subwatershed that would directly benefit the MS4. A few stream restoration projects are also described in more detail as demonstration projects (Carter Creek and Sweeny Beach).

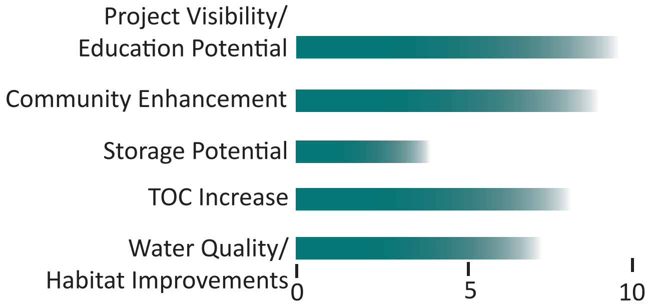
OAKMONT PARK ENHANCEMENT PROJECT



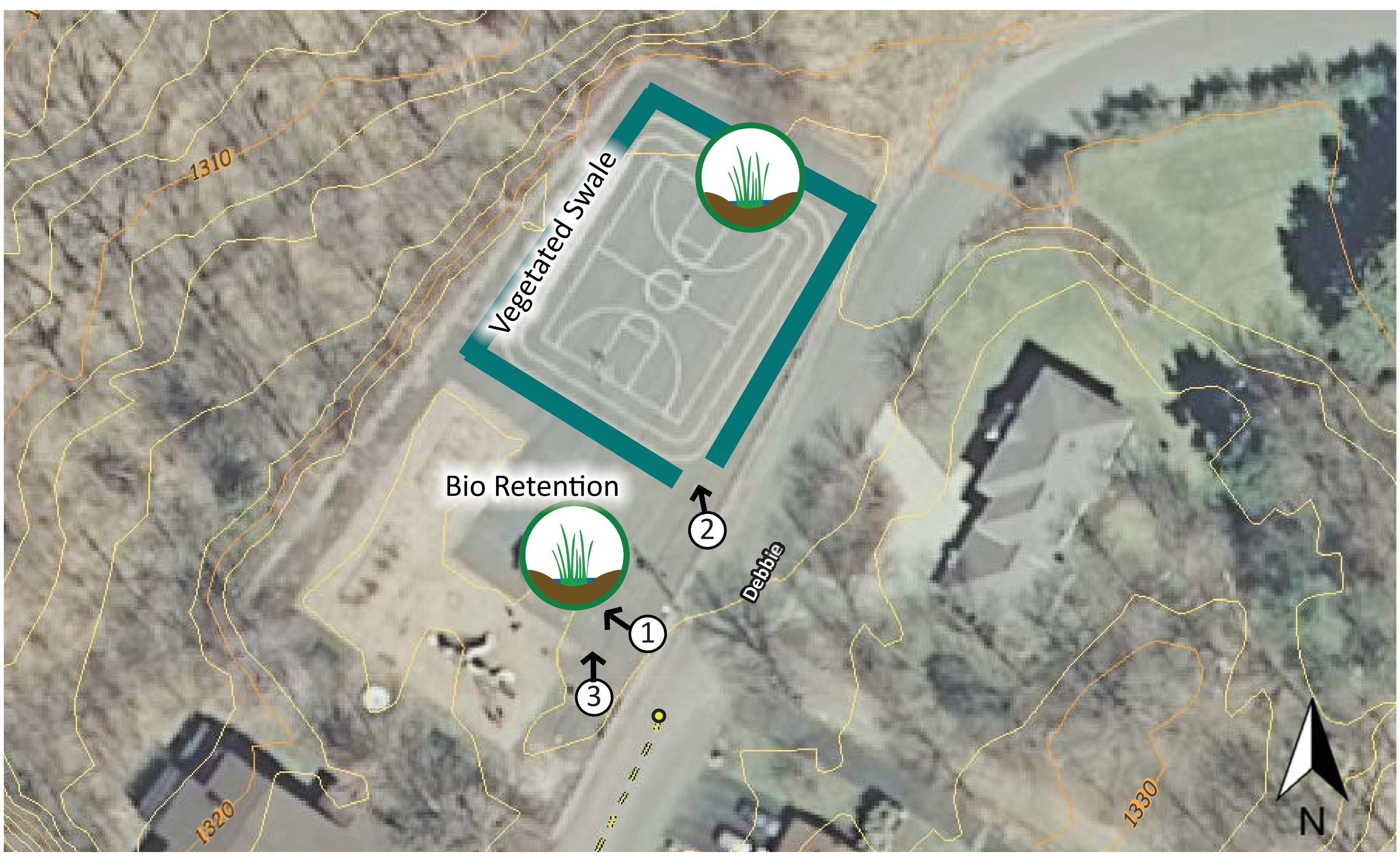
Location
Sub-Watershed Area: Roaring Brook
CSO Catchment Area: #73F (Drains to MS4)
Neighborhood: Oakmont
Address: Debbie Drive

Green Infrastructure Opportunities
Current Use: City Park
Stormwater Source: Expansive Asphalt
GI Options: Asphalt removal, bio-swales, rain gardens, permeable pavers, trees

Project Justification



Oakmont Park is an under-utilized park that is dominated by a large sea of asphalt. The site (city parcel # 312) is located within the Roaring Brook Sub-watershed and CSO Catchment Area 73F. Much of the site sheet flows to the back right (north) corner of the site and towards a house that is under construction.



A large portion of the existing asphalt can be removed along the perimeter fence as well as around the existing gazebo. The asphalt can be replaced with bio-swales, vegetation and permeable pavers to capture runoff and improve aesthetics. Additionally the vegetation can provide habitat and decrease the temperature of the park during summer months.

This park would benefit from a master site plan with a green focus. The enhancement of this park can be used as an example for public owned spaces that are primarily comprised of impervious asphalt of potential enhancement options. The City or the neighborhood association should apply for grant funding.

Asphalt surrounding the gazebo can become a vegetated planting bed that captures stormwater.

Asphalt surrounding the basketball courts can be converted into a vegetated swale that collects runoff and reduces overall impervious area. (approx. 6' wide)

Existing conditions of Oakmont Park. The majority of the site is covered by asphalt, which increases stormwater runoff.

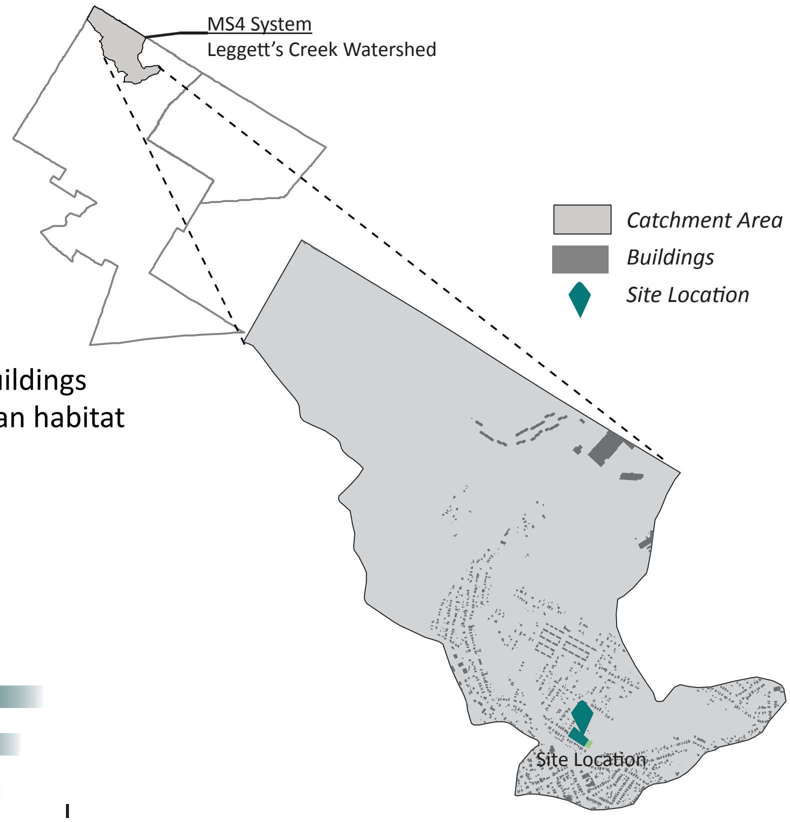
Drainage Area: 14,500 SF

Impervious Area Treated: 14,500 SF

Potential Costs:

BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	1,050 SF	$ 16,000	6,700
Vegetated Swale (300' x 6')	2160 SF	$ 28,000	13,750
Asphalt Removal	3210 SF	$ 11,250	n/a
Design/Engineering		$ 5,000	
Total		**$ 60,250**	**20,450**

LEGGETT STREET PROJECT



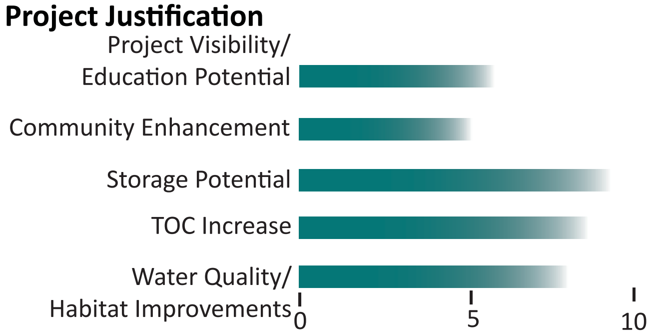
Location

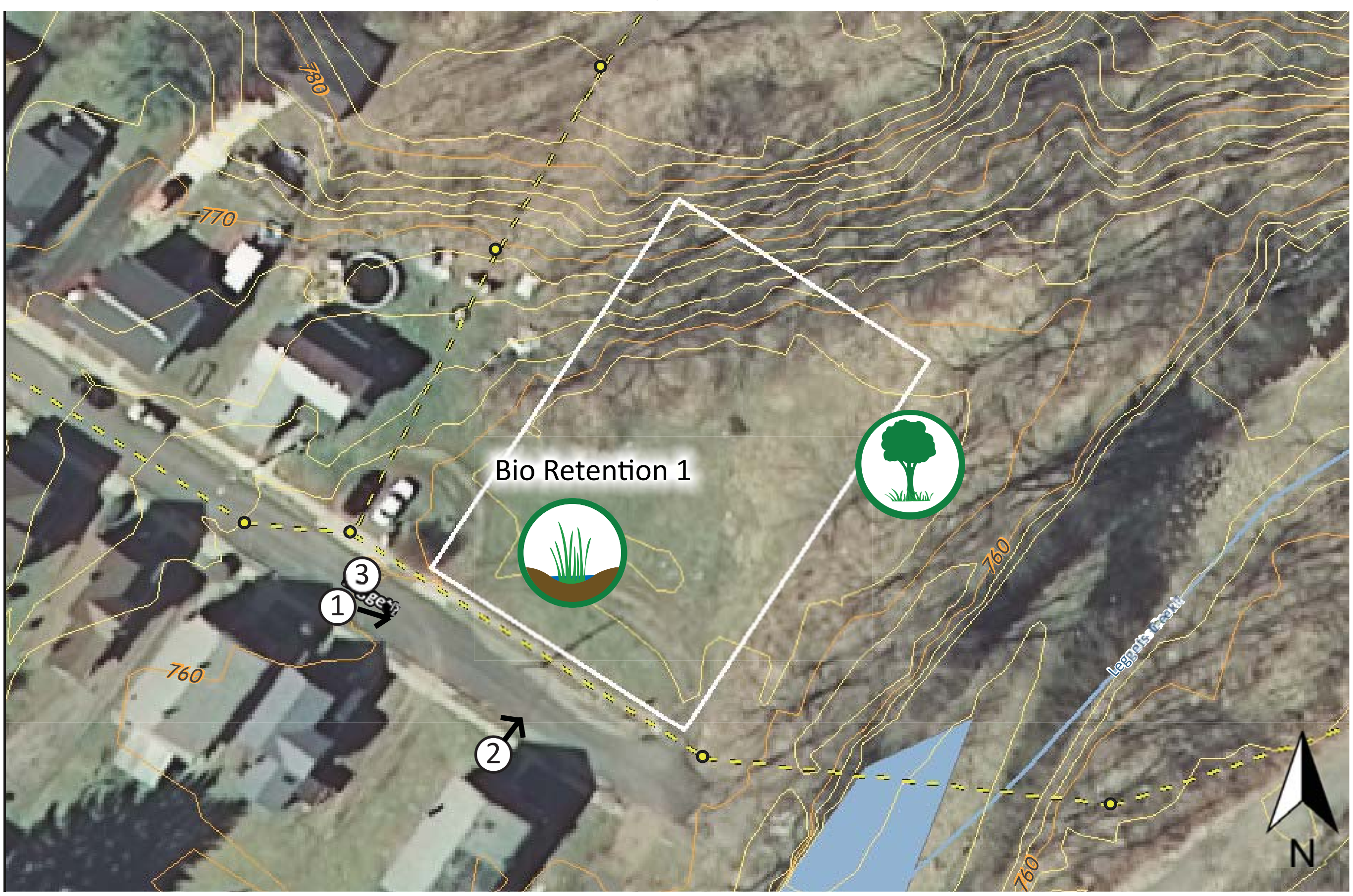
Sub-Watershed Area: Leggetts Creek
CSO Catchment Area: #04E (Drains to MS4)
Neighborhood: North Scranton
Address: 394 Leggett Street

Green Infrastructure Opportunities

Current Use: Vacant Lot
Stormwater Source: Roadways, Adjacent Buildings
GI Options: Bio-swales, raingardens, Riparian habitat enhancement

Project Justification





Leggett Street is a small residential street that slopes down toward Leggett's Creek in North Scranton. The site is located within the Leggett's Creek Sub-Watershed and CSO Catchment Area 04E. At the end of this road there are two catch basins that capture and convey stormwater from the road directly into the creek. There is a mowed, city-owned parcel (city parcel # 28/86) that is not being utilized and was most-likely the site of a razed property. This space can be used for a green infrastructure installation to filter pollutants from stormwater runoff prior to entry into the creek. A pipe extending under the sidewalk, or a trench drain can be installed in the sidewalk to direct water from the road into a rain garden. Any excess water would flow from the rain garden into Leggett's Creek, however, this venture will slow, filter and store runoff prior to overflow.

Water currently runs along the existing curb and into Leggett's Creek at the end of the road. In this picture, the transported and deposited sediment is visible.

A large portion of the parcel is mowed lawn that is bordered by a wooded edge and Leggett's Creek.

The existing curb can be cut with a pipe or trench drain extending under the sidewalk to allow water to enter the space.

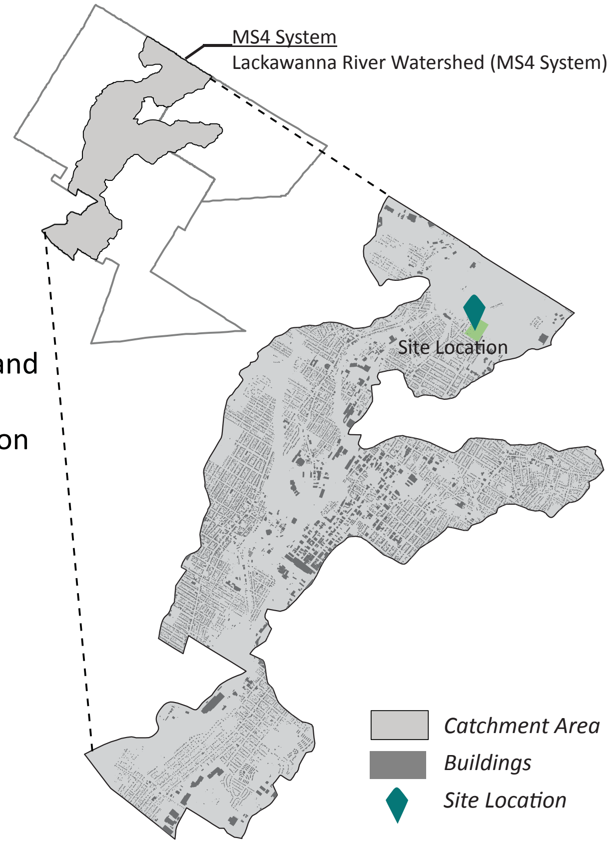
Drainage Area: 6,350 SF

Impervious Area Treated: 5,120 SF

Potential Costs:

BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	3,000 SF	$ 45,000	19,000
Vegatated Swale (60' x 6')	360 SF	$ 4,700	2,300
Curb Cut/Infrastructure		$ 2,500	n/a
Riparian Habitat Enhancement		$ 5,000	600
Design/Engineering		$ 5,000	
Total		**$ 62,200**	**21,900**

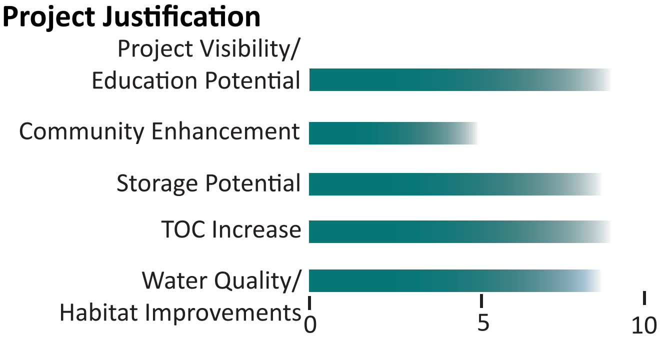
CARTER CREEK RESTORATION PROJECT

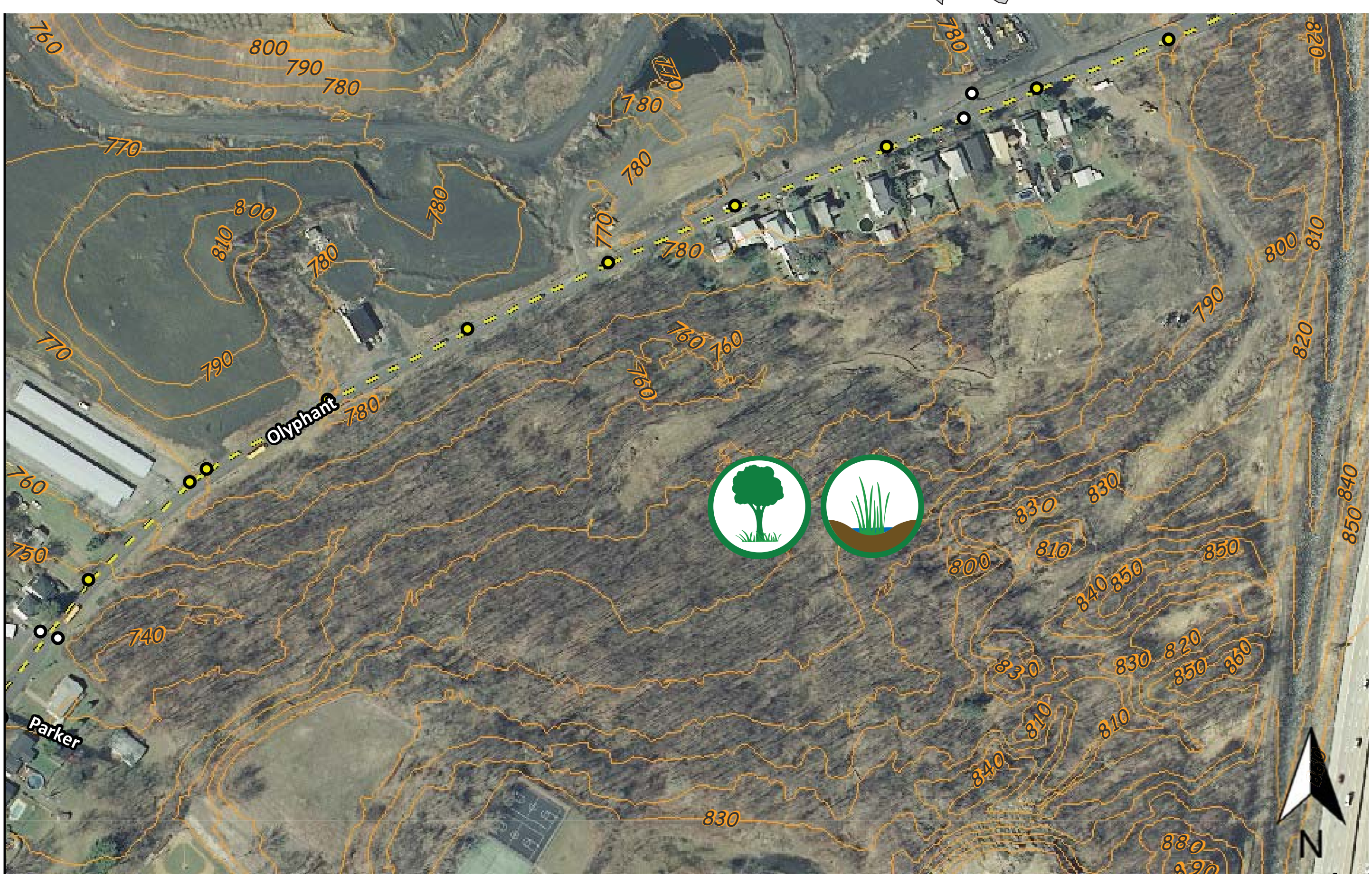


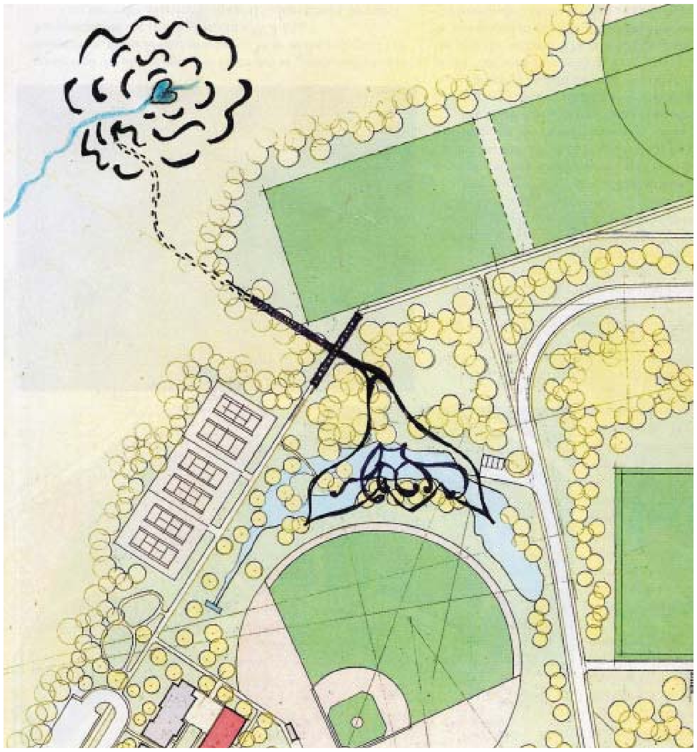
Location
Sub-Watershed Area: Lackawanna River Corridor
CSO Catchment Area: #34A (Drains to MS4)
Neighborhood: Green Ridge
Address: Olyphant Ave & E. Parker St.

Green Infrastructure Opportunities
Current Use: Stream Remnant Channel, Abandoned Mine Land
Stormwater Source: Stream Water
GI Options: Riparian Buffer Restoration, Wetland Construction

Project Justification

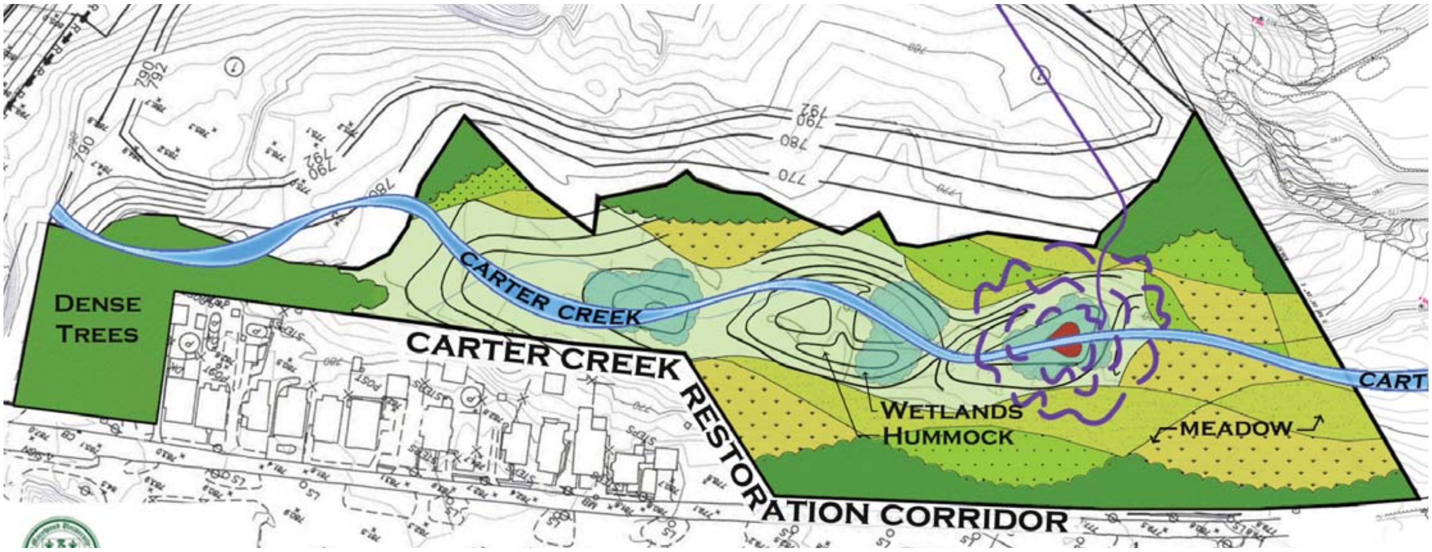






The design by Patricia Johnson incorporates paths to bring a park space to the restored stream bank.

This project is a creative, environmental restoration, conservation and education project on an 8+/- acre tract of campus land, adjacent to City parcel 318 (Green Ridge Little League). Specifically, the Project will utilize and implement an artistic, restoration design for the only remaining segment of Carter Creek. Carter Creek is a severely impaired sub-watershed within the Lackawanna River Watershed and located within CSO area 34B. The restoration activities will enable Marywood University and the City of Scranton to showcase a large scale, aesthetic and functional environmental art exhibit that helps clean and protect the Carter Creek watershed, restore riparian habitat, and facilitate surface water cleansing within the Lackawanna River. The Project incorporates two separate, yet intertwined components – Carter Creek Riparian Restoration using buffer enhancements and wetland construction and Mary's Garden Environmental Art Design by Patricia Johanson, an environmental artist.



The Stream bank would have many layers and different plant communities.

Potential **Costs:**

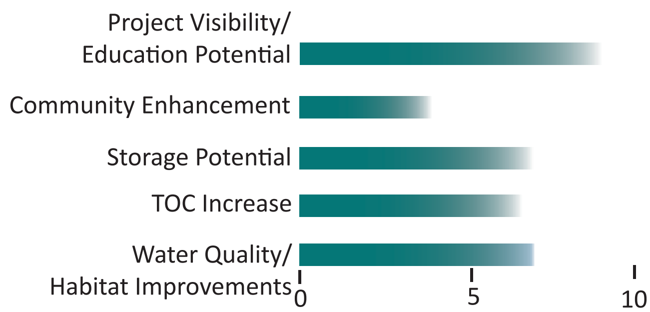
BMP Type	*BMP Size*	*Estimated Cost*
Stream/Wetland Construction	8 acres	$ 175,000
Design/Engineering	n/a	$ 50,000
Total		**$ 225,000**

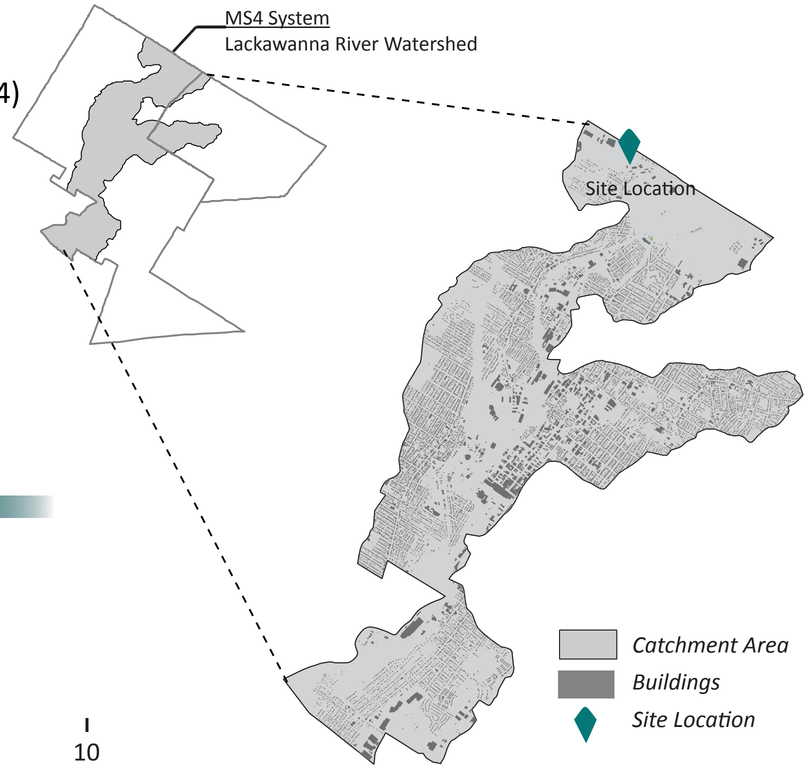
PARKER ST. & BOULEVARD AVE. PROJECT

Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #030 (Drains to MS4)
Neighborhood: Green Ridge/ Plot
Address: 10 E. Parker St.

Green Infrastructure Opportunities
Current Use: Vacant Lot
Stormwater Source: Adjacent Roadway
GI Options: Bio-retention

Project Justification





The parcels (44/11/39), at the intersection of Parker Street and Boulevard Avenue, are located within the Lackawanna River Corridor and CSO Catchment Area 34B/03O. They are classified as an MS4 area due to the presence of separate stormlines and catch basins. The site is a city-owned, abandoned and over grown lot. The southeast perimeter of the space is slightly elevated where an old sidewalk once existed and this keeps water from entering the parcel. Currently water flows along the road, past the site and into an existing catch basin to the Lackawanna River.

With excavation, the parcel has potential for use as a rain garden or soakaway pit to filter and infiltrate stormwater from the abutting roadway. Any excess water that cannot be managed will be directed back to the already existing catchbasins. This green feature can help with the first flush of pollutants and help improve water quality.

Existing conditions of over grown lot.

Portions of an old sidewalk are left at the front of the space.

Stormwater currently runs along the site and passes by the space.

Drainage Area: 13,030 SF

Impervious Treated: 10,800 SF

Potential Costs:

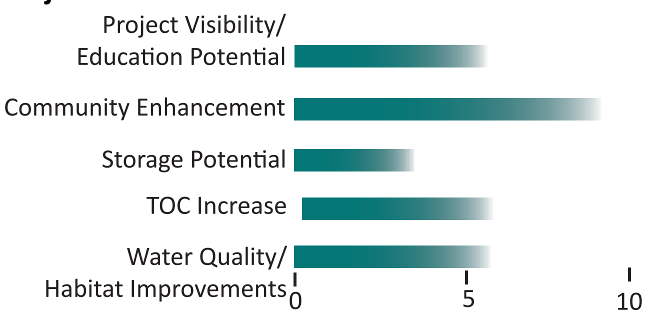
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	6,000 SF	$ 90,000	38,000
Curb Cuts/Site Demo	n/a	$ 10,000	n/a
Design/Engineering		$ 8,000	
Total		**$108,000**	**38,000**

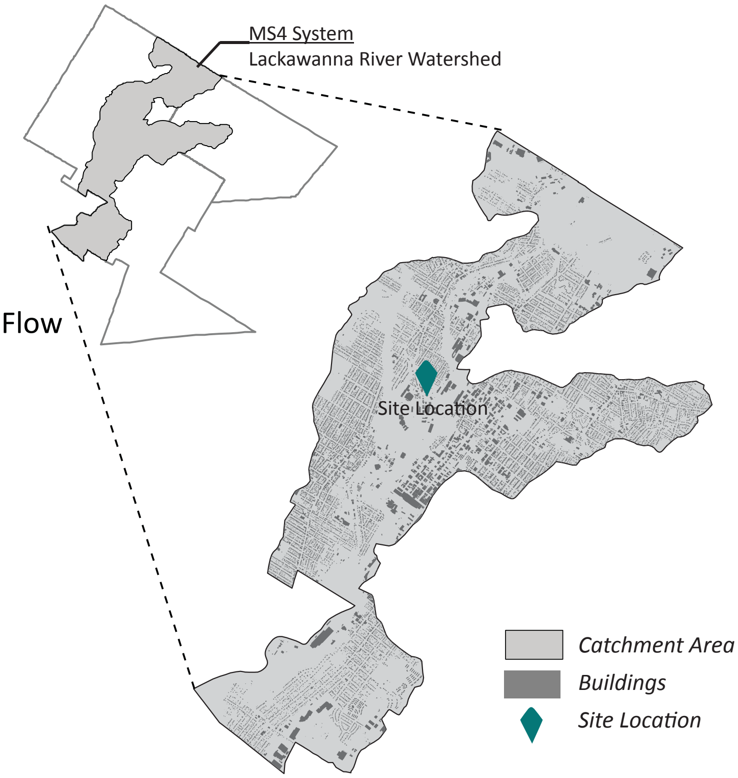
SWEENEY BEACH ENHANCEMENT PROJECT

Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: n/a (River Edge)
Neighborhood: Pine Brook
Address: Between W Poplar Ave & W Olive St.

Green Infrastructure Opportunities
Current Use: River Edge
Stormwater Source: River Water, Up-slope Sheet Flow
GI Options: Riparian Buffer Restoration/ Conservation

Project Justification

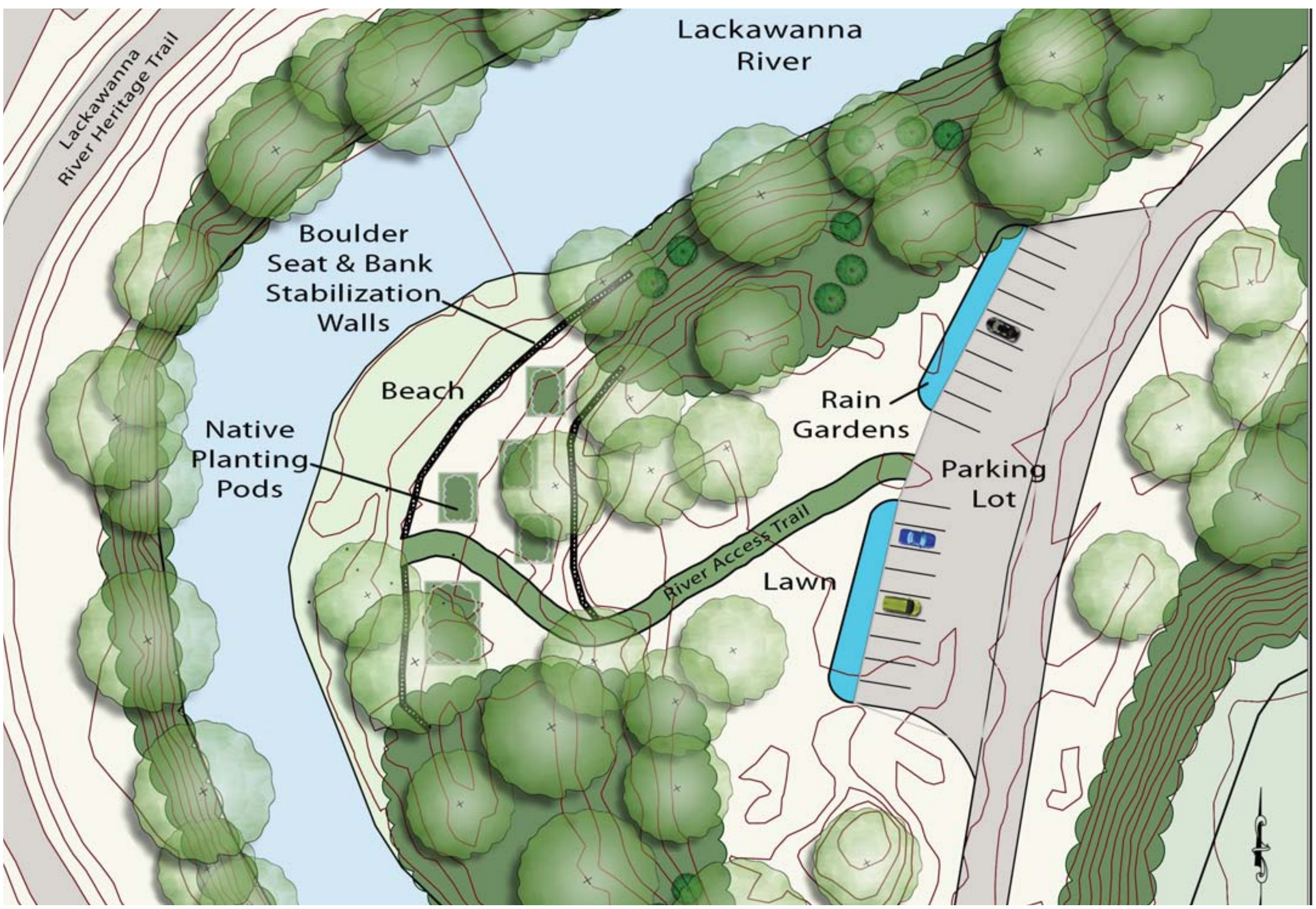




The site is located along the east bank of the Lackawanna River between Olive Street and Poplar Street adjacent to Chick Feldman Field (city parcel #299). It is within CSO area 77A, however, would be classified as an MS4 area. The project goals span from water quality benefits and habitat restoration to recreational and educational opportunities. Specifically, the project will: provide safe access to the River for fishing and boating; increase bank stability and reduce erosion and sediment loading; establish and maintain a native plant nursery for future riparian planting and restoration projects; and research potential solutions to control Japanese Knotweed (shade, lawn, native competition, soil replacement). Additionally, riparian buffer expansion through plantings and increased microtopography using berms and rain garden depressions are proposed to slow runoff and promote infiltration.

This demonstration project highlights the importance of riparian bufferland. Boulders will double as seatwalls and bank stabilization. Rain garden will handle runoff from the parking lot and road.

Project will promote education and will provide a venue for increased awareness of the Lackawanna River as a community resource and important habitat for fish. The area is in the center of the largest urban area in Northeastern Pennsylvania and in close proximity to the Scranton High School, the Lackawanna River Heritage Trail, the Scranton Farmers Market and other recreation opportunities. It is also a site utilized by the Lackawanna River Corridor Association for their annual celebration of the River – Riverfest.



Potential **Costs:**

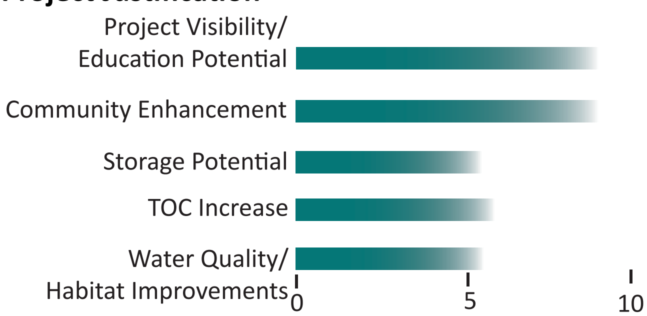
BMP Type	*Estimated Cost*
Design/Permits	$ 10,000
Materials (Stone/Plants)	$ 6,200
Excavation (6 inches)	$ 40,000
Total	**$ 56,200**

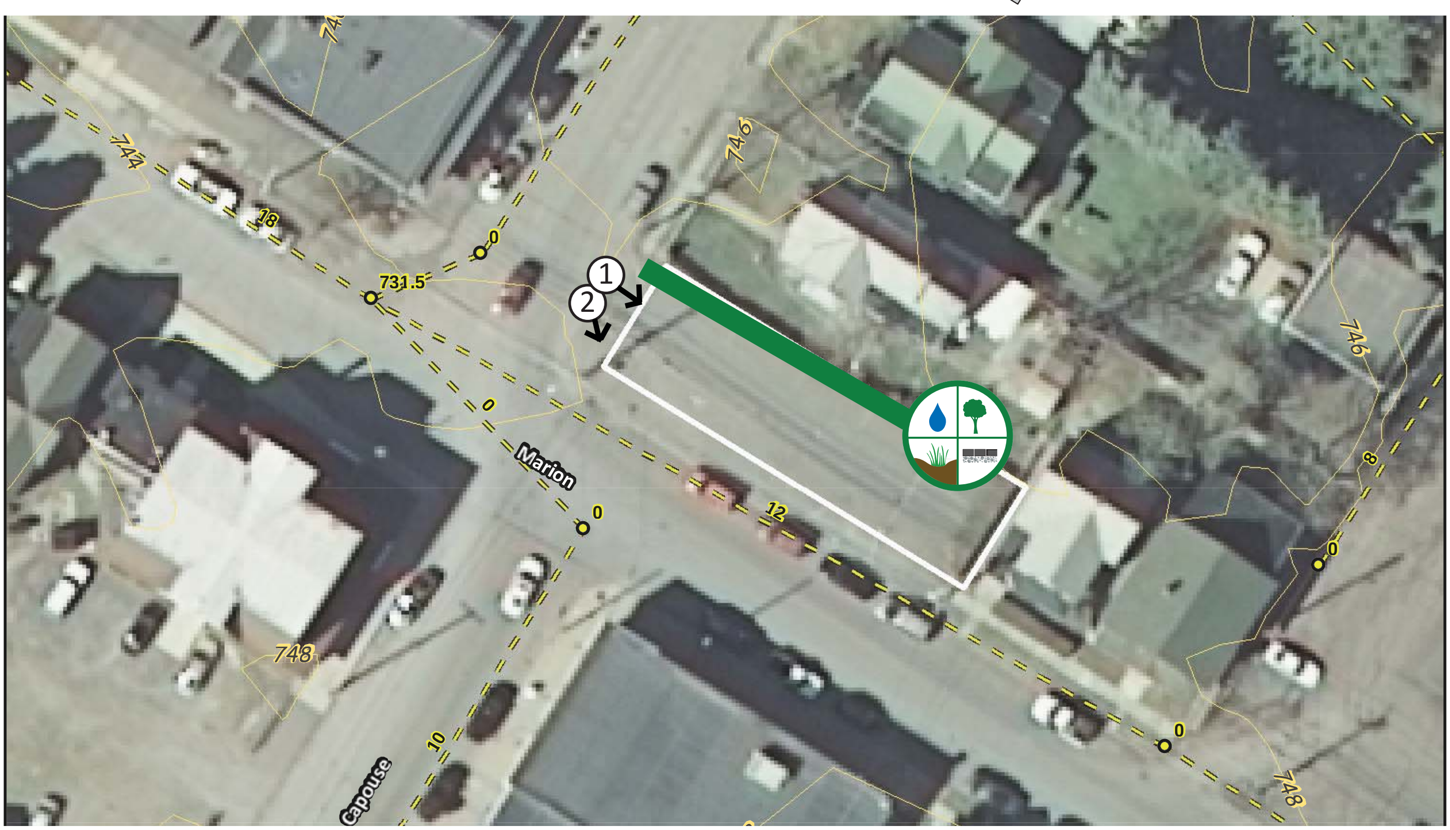
CAPOUSE & MARION STREET PROJECT

Location
Sub-Watershed Area: Meadow Brook
CSO Catchment Area: #74
Neighborhood: Green Ridge
Address: Capouse Ave. & Marion St.

Green Infrastructure Opportunities
Current Use: Asphalt Lot
Stormwater Source: Adjacent Roadway, Existing asphalt
GI Options: permeable pavers, Bio-swale,
tree trench

Project Justification



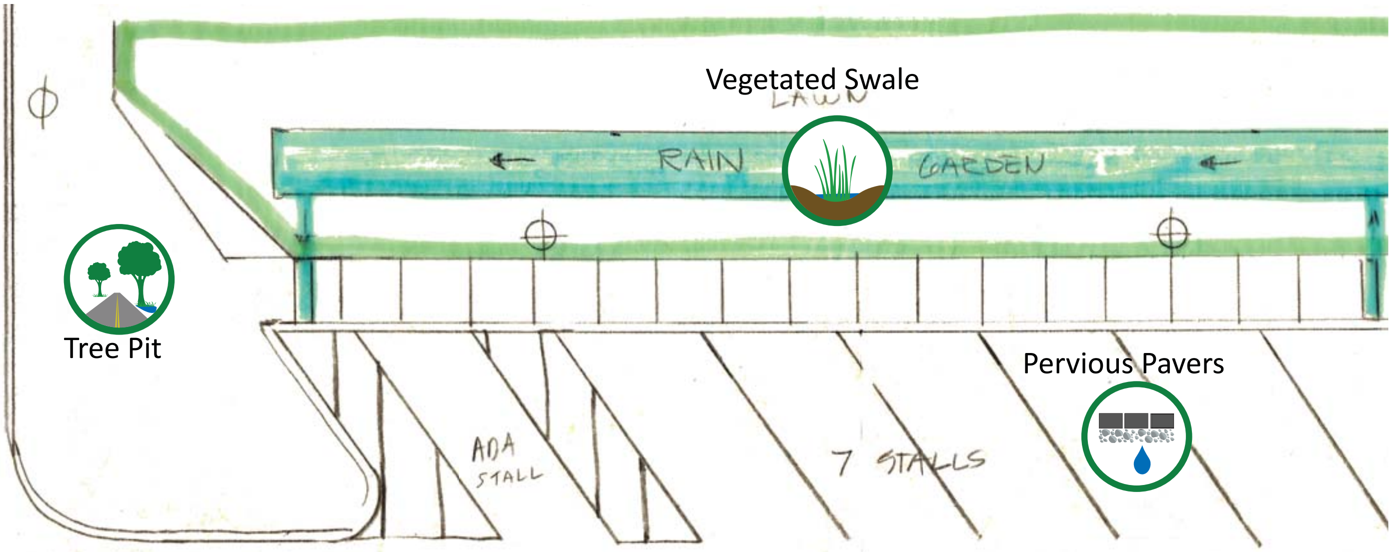


The City of Scranton just acquired this corner lot via donation from a private developer. It is located within the Meadow Brook Sub-watershed and CSO Catchment Area 74A. The site will be developed through Scranton OECD and the project entails new green space and angled parking stalls. In partnership with the SSA, this project will be further elevated to a demonstration project that highlights green infrastructure techniques. The site may use a rain garden, bioswale, soakaway garden, curb cuts, tree pits and permeable pavers to handle site and street stormwater.

Due to the large drainage area (12% of CSO area) coming to the proposed bio retention areas, under drain systems will be installed to empty the systems when full capacity is reached. Despite not retaining all stormwater, the time it takes for stormwater to reach the CSO system will be greatly lengthened by these techniques.

Currently the space is completely covered in asphalt.

The new design for the space will provide angled parking for the public.



A lawn area and rain garden with underground retentin/detention will deal with stormwater runoff fromt he road.

Drainage Area: 170,000 SF

Impervious Treated: 165,000 SF

Potential Costs:

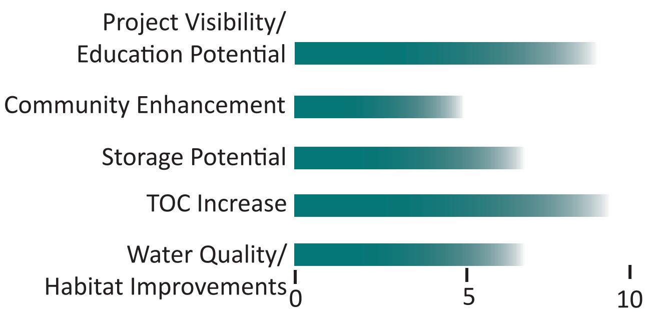
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio-retention	90 LF	$ 6,500	3,400
Permeable Pavers/Walks	1350 SF	$ 19,000	3,500
Design/Engineering		$ 6,500	
Excavation/Demo		$ 12,000	
Stalls/curbs/lights		$ 20,000	
Lawn/Vegetation/Tree		$ 8,000	
Total		**$71,000**	**6,900**

WESTON FIELD ENHANCEMENT PROJECT

Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #77
Neighborhood: Weston/Bulls Head
Address: 982 Providence Road

Green Infrastructure Opportunities
Current Use: Mowed Lawn
Stormwater Source: Parking lot, walk way
GI Options: Vegetated Swale, Bio-retention

Project Justification



Weston Field (parcel #177) is a large city-owned park complex with indoor and outdoor pools, office space, a gym, playgrounds, fields, courts, parking lots, and trails. The site is located within the Lackawanna River Corridor and CSO Catchment Area 77C.

There is potential to add a series of soakaway pockets along Providence Road, between the sidewalk and the metal perimeter fence. Currently any runoff from the sidewalk sheet flows along the curb, into the road and into the CSO system.

A rain garden can also be installed adjacent to the storage shed to treat runoff from a large portion of the parking lot, which pitches away from Providence Road. We recommend removing the parking lot catch basins, which are undersized anyway. A portion of asphalt must be removed near the shed to assure proper pitch and to direct surface water into the rain garden. Overflow from the rain garden will be directed toward Meade Street and an existing catch basin.

Currently water hits the curb of the sidewalk and runs down it until entering the street.

Curb cuts can be made to allow water to enter a series of connected rain gardens.

Mowed space next to the parking area can be converted into a rain garden to help filter runoff.

Drainage Area: 31,500 SF

Impervious Treated: 24,500 SF

Potential Costs:

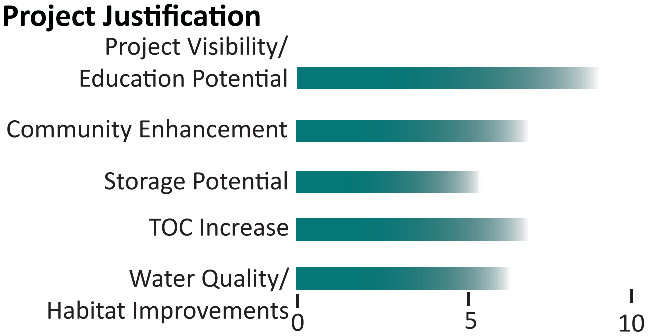
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	875 SF	$ 13,000	3,300
Vegetated Swale	220 LF	$ 3,000	2,300
Design/Engineering		$ 1,500	
Total		**$ 16,000**	**5,600**

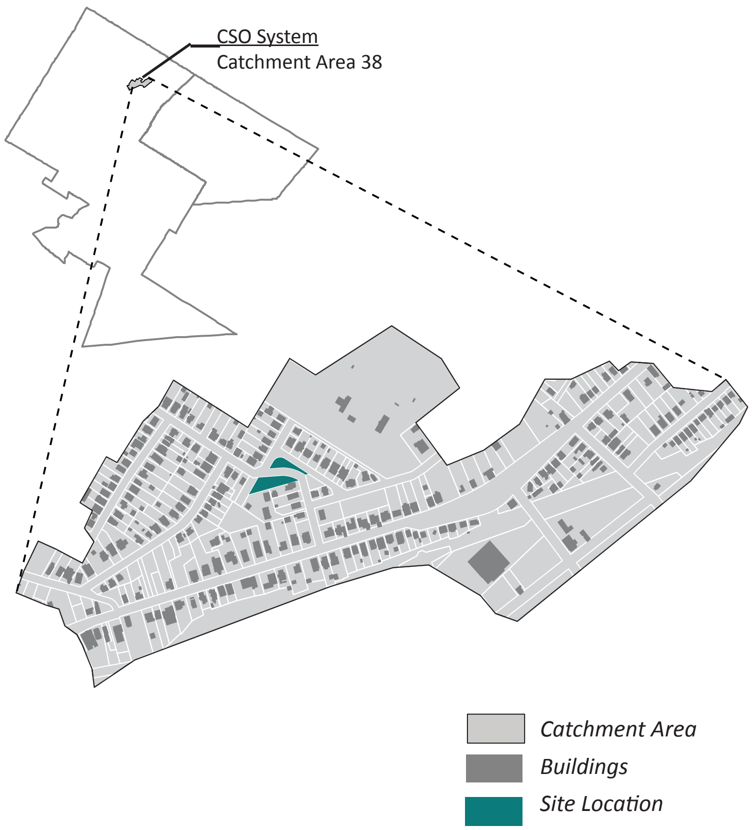
SPRING & BELMONT LOT PROJECT

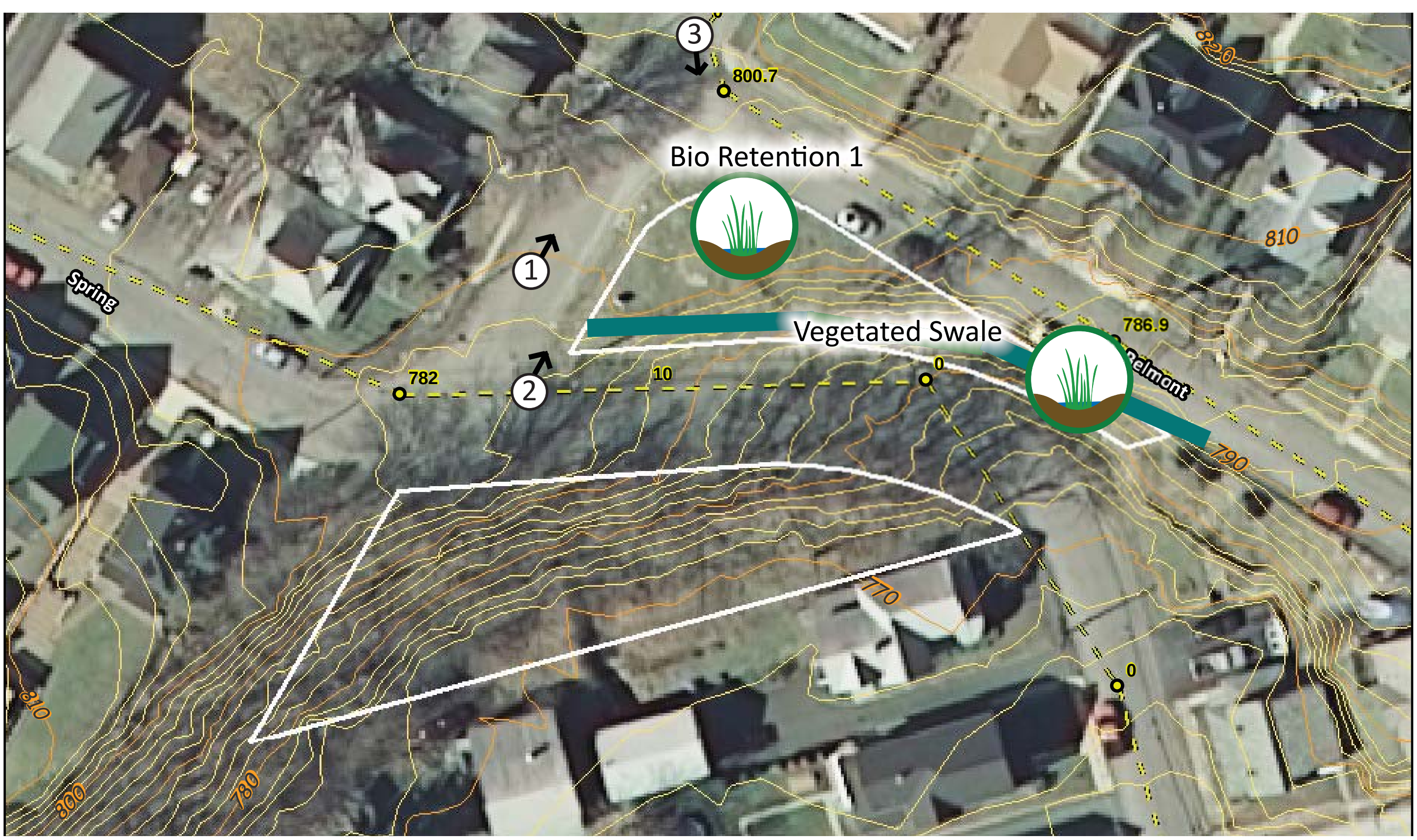
Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #38
Neighborhood: North Scranton
Address: 127 Spring Street

Green Infrastructure Opportunities
Current Use: Vacant lot, overgrown
Stormwater Source: Adjacent roadway and buildings
GI Options: vegetated swale, bio-retention

Project Justification





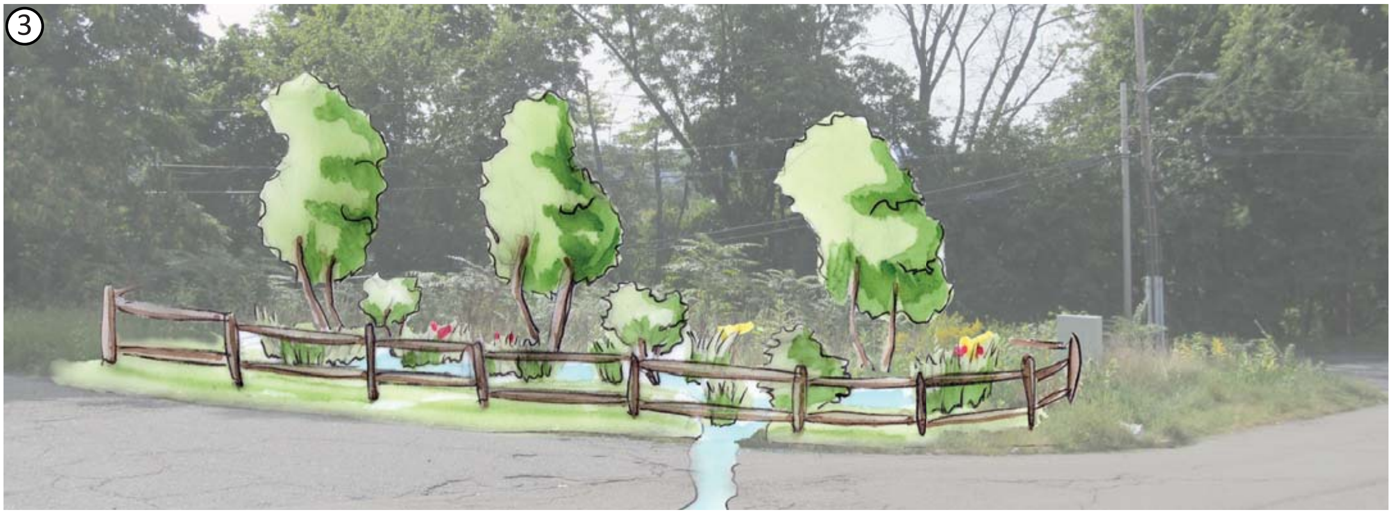


The Spring Street and Belmont Avenue corner lot (parcel #48) is a triangular shaped, over-grown lot that has no apparent use. The site is located within the Lackawanna River Corridor and CSO Catchment Area 38A. The top of lot is generally flat with a steeper slope that extends down toward Spring Street. The parcel continues across Spring Street where it becomes wooded and steeply sloped.

The upper portion of the parcel can be converted into a rain garden and used to infiltrate and filter stormwater runoff from Belmont Street. Any excess overflow would be directed into the existing catch basin. The steep portion can be maintained with lawn or a ground cover and a bio-swale will be installed at the base of the slope along Spring Street. The very bottom of the parcel, across Spring Street, should be conserved as wooded. The proposed features will improve the neighborhood aesthetics and increase time of concentration and infiltration of runoff.

Currently water runs down Belmont street (shown above) passes by the existing site and into a catch basin.

The lot is a triangular shaped parcal that is over grown and not being used.



Instead of allowing the water to run directly into the catch basin, it can first be given an opportunity to infiltrate within a rain garden located at the top of the site.

Drainage Area: 6,100 SF

Impervious Treated: 5,800 SF

Potential Costs:

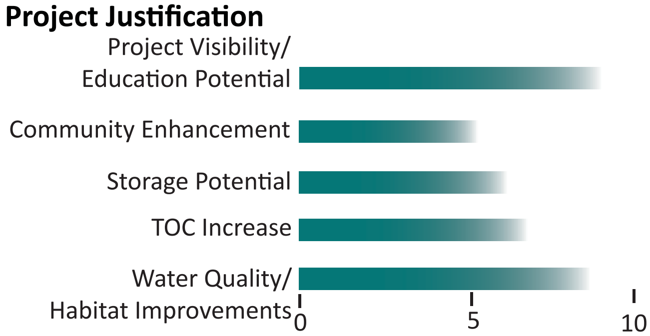
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	1,400 SF	$ 21,000	15,700
Vegetated Swale	160 SF	$ 2,100	1,600
Split Rail Fence	90 LF	$ 2,000	n/a
Design/ Engineering		$ 2,500	
Total		**$ 27,600**	**16,300**

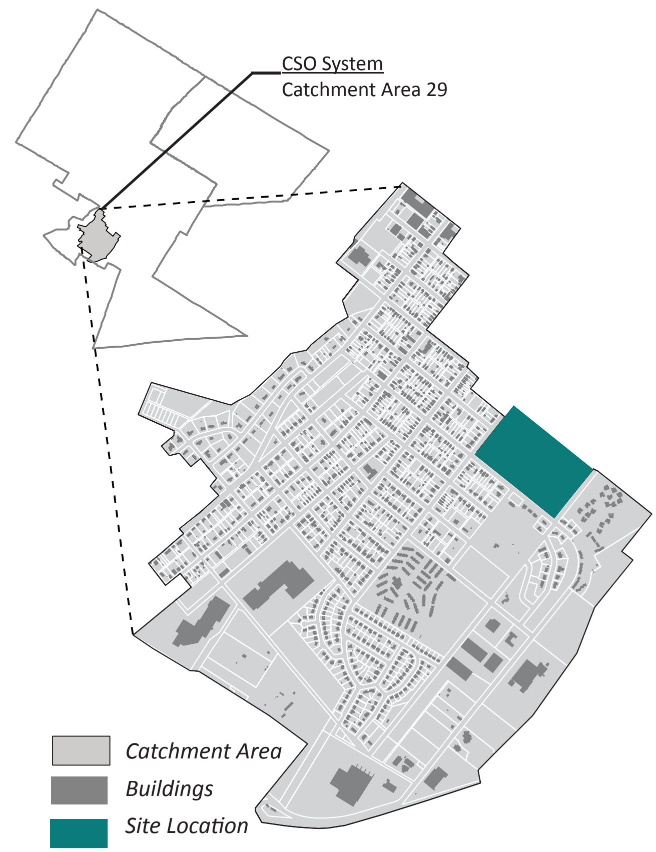
CONNELL PARK ENHANCEMENT PROJECT

Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #29
Neighborhood: South Scranton
Address: Gibbons St. & Webster Ave.

Green Infrastructure Opportunities
Current Use: Multi-use Park
Stormwater Source: Adjacent roadway and parking lot
GI Options: vegetated swale, bio-retention

Project Justification





Connell Park (Parcel #273) is a large park with a play area, dog park, parking lot, football field, and pool complex. The site is located within the Lackawanna River Corridor and CSO Catchment Area 29E. The hills and slopes within and adjacent to the park increases both quantity and velocity of stormwater runoff, which causes erosion and floods the CSO system.

The open space at the bottom of the park near Webster Avenue can be converted into a vegetated swale that intercepts water from the park and from Gibbons Street. The swale can wind through the park like a dry creek bed and help slow and filter stormwater. The swale would take a generally unused space and give it a function as green infrastructure that can be used for aesthetics and education. Due to its proximity near the top of the drainage area, this project could also have positive impacts within the lower portions of the drainage area.

Currently the park has a curb surrounding in allowing no excess water to run in the park.

An inlet can be installed under a section of the walk toward the bottom of the park to allow street runoff to enter a vegetated swale within the park.

The swale would bring the water through the base of the park and allow any excess water to exit onto Webster Street.

Drainage Area: 12,500 SF

Impervious Treated: 3,500 SF

Potential Costs:

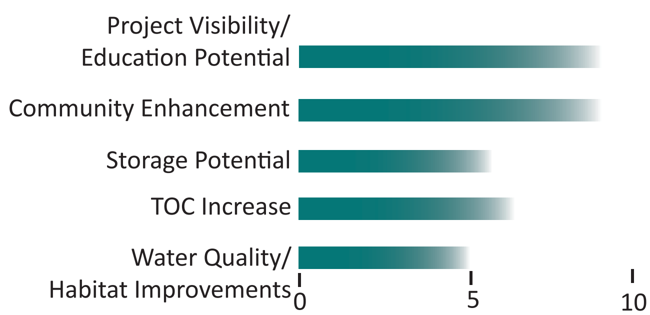
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Vegetated Swale	520 LF	$ 8,000	2,000
Curb Cuts/Trench Grates	n/a	$ 6,000	n/a
Design/Engineering		$ 1,500	
Total		**$ 15,500**	**$2,000**

TANK MEMORIAL ENHANCEMENT PROJECT

Location
Sub-Watershed Area: Meadow Brook
CSO Catchment Area: #14
Neighborhood: Dunmore
Address: Blakely Street & Cherry Street

Green Infrastructure Opportunities
Current Use: Borough Memorial
Stormwater Source: Adjacent roadway
GI Options: Asphalt removal, raingardens, permeable pavers

Project Justification



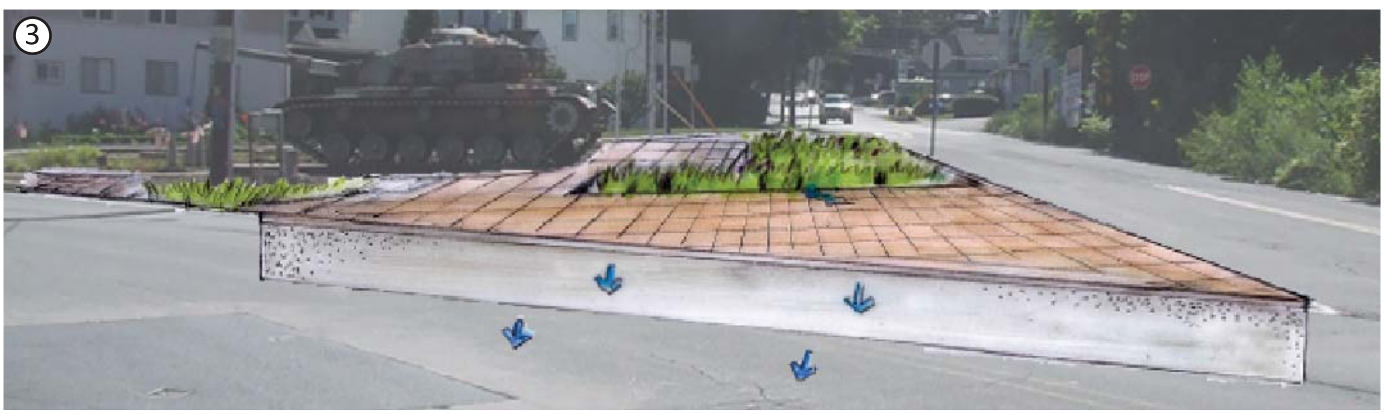
The Tank Memorial (parcel #220) in Dunmore is located in the center of the busy intersection of Blakely and Cherry Street. It has a triangular shape, with a gravel base, a few landscape beds, flag poles and a memorial tank in the center. The site is located within a remnant stream called Pine Brook, within the Lackawanna River Corridor and CSO Catchment Area 14X.

This is a highly visible memorial that has potential to become a highly visible platform for green infrastructure, as well. The area along Cherry and Blakely Street can be converted into a series of small tiered rain gardens that flow into each other during storm events. The landscape areas can be re-defined with low-growing plants and permeable pavers can be used for the walkways. The expansive asphalt abutting the memorial can be saw cut and replaced by permeable pavers in non-traffic areas. Stormwater would be retained in underground gravel beds.

To the northwest of the memorial, a small vacant parcel (#219) next to LaCucina is owned by the Borough. This has potential to handle runoff, via a sub surface infiltration tank, from the surrounding road way and any of excess runoff from the Tank Memorial. Above ground the parcel can be turned into a seating area or pocket park. Once full the infitration tank would empty back into an existing catch basin.

Existing conditions of south side of the memorial consists of gravel and stones.

Proposed terraced rain gardens that filter water runoff from adjacent roads



Existing asphalt triangle next to memorial will be converted to permeable paves with an infiltration pit under it to deal with excess water from rain gardens.

Drainage Area: 19,500 SF

Impervious Treated: 18,000 SF

Potential Costs:

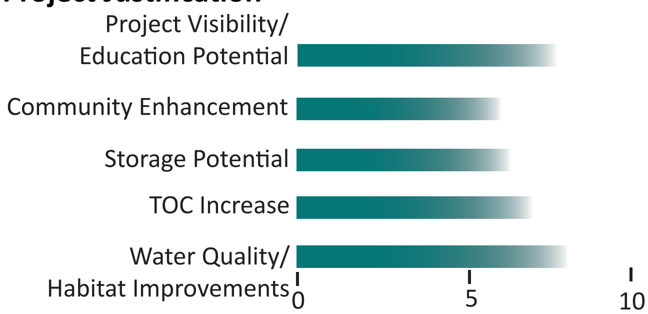
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Pervious Pavers	SF	$ 44,000	8,000
Bio Retention	2,500 SF	$ 32,000	14,000
Asphalt Removal	SF	$ 8,000	n/a
Type M Inlet/Curb Cuts	n/a	$ 9,000	n/a
Design/ Engineering		$ 10,000	
Total		**$ 100,500**	**22,000**

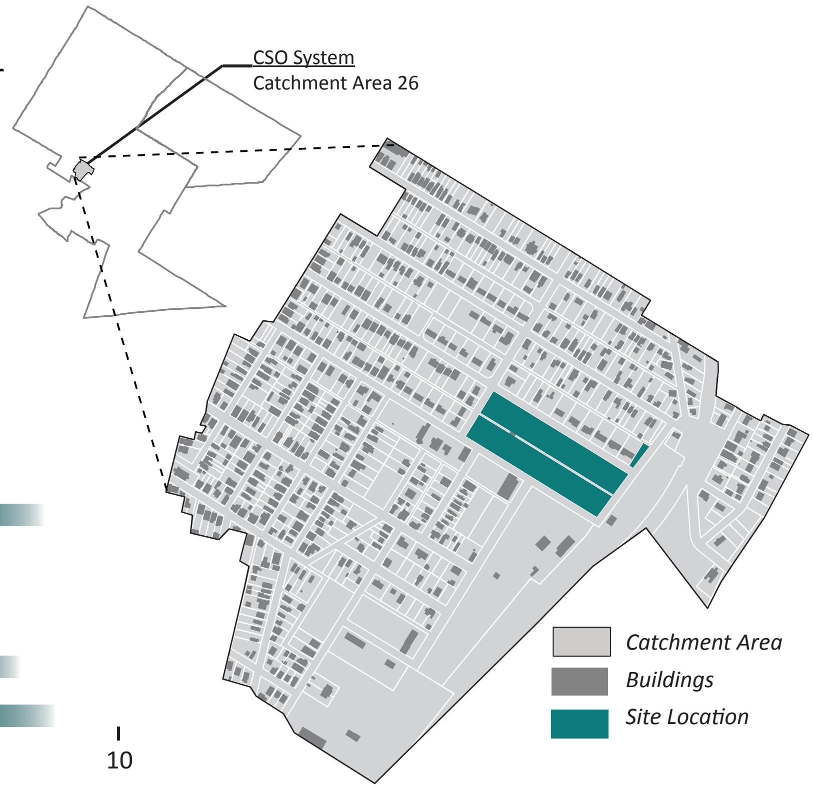
CLOVER FIELD ENHANCEMENT PROJECT

Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #26
Neighborhood: South Scranton
Address: Meridian Ave. & W Elm St.

Green Infrastructure Opportunities
Current Use: Public Park
Stormwater Source: Adjacent roadway
GI Options: bio-swale, bio-retention

Project Justification





Clover Field is a city-owned park located at 900 Acker Ave. in West Scranton. It contains a football field, a small maintenance building, and an undersized, non-descript parking lot. The site (city parcel # 252/253) is located within the Lackawanna River Corridor and CSO Catchment Area 26A.

Two bio-retention areas and a long vegetated channel along Elm Street have been proposed to assist in the management of stormwater runoff within this CSO area. These benefits will coincide with a redesign of the parking lot, as well. Due to the large drainage area coming to the proposed bio retention areas; under drain systems will be needed to empty the systems when full capacity is reached. Even though all water will not be retained, this green infrastructure will lengthen the time it takes for stormwater to reach the CSO system. In fact, with the construction of this small project, stormwater from 12 % of the watershed will be conveyed through a green infrastructure feature.

①

Approximately twelve feet of area between the edge of pave along Elm Street and the fence line create an ideal location to take water from the existing street gutter and direct it down a vegetated channel.

A large maintained open space with existing berms provides ample opportunities for a sizeable bio retention area.

A smaller bio-retention area positioned in the corner of the existing earthen parking lot will alleviate sediment and erosion problems before entering the combined system.

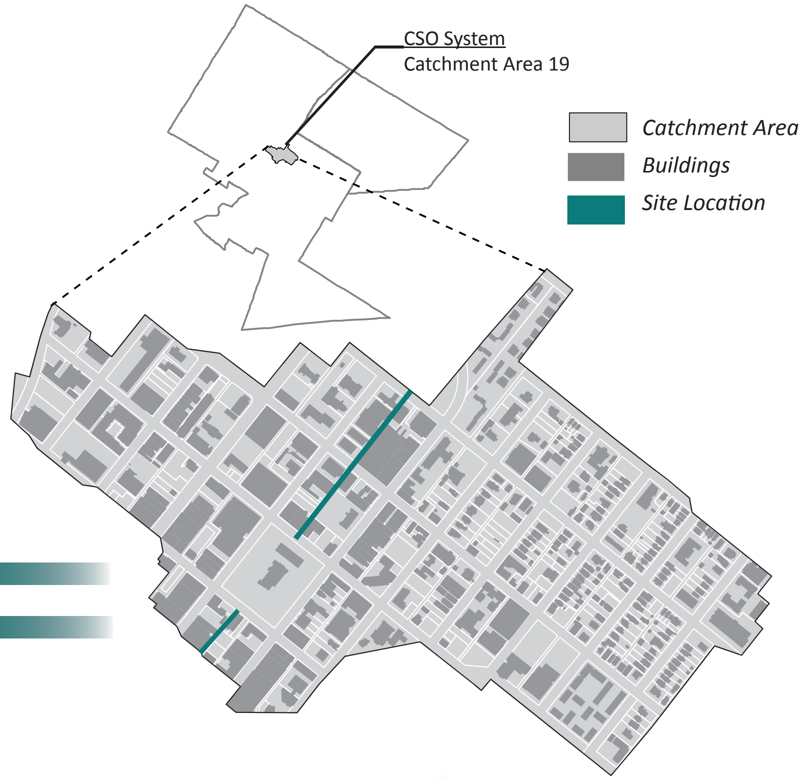
Drainage Area: 174,000 SF

Impervious Treated: 68,000 SF

Potential Costs:

BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention 1	9,100 SF	$133,000	58,000
Vegetated Swale 1	750 LF	$ 12,000	29,000
Type M Inlet	n/a	$ 3,500	n/a
Design/Engineering		$ 14,000	
Total		**$162,500**	**87,000**

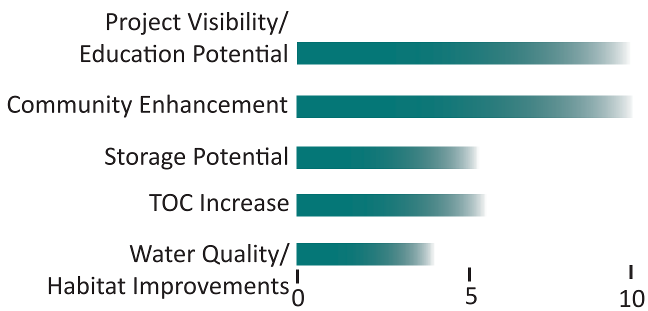
DOWNTOWN GREEN ALLEY/STREET PROJECT



Location
Sub-Watershed Area: Roaring Brook
CSO Catchment Area: #19
Neighborhood: Downtown
Address: Dix Court

Green Infrastructure Opportunities
Current Use: Paved Alley
Stormwater Source: pavement surface
GI Options: permeable pavers, infiltration bed, bio-retention

Project Justification



Several alleyways in Scranton have potential to become more than just a repository for garbage cans. Like Center Street near the Hilton, these spaces with proper enhancements can become viable pedestrian and entertainment corridors. The use of green infrastructure is one solution that should be considered to improve both the aesthetics and functionality of alleyway like Dix Court. This alley is located within the Roaring Brook Sub-watershed and CSO Catchment Areas 20B/19A.

Proposed green alley that utilizes permeable pavers and underground storage to infiltrate water.

Dix Court is currently a paved, uninviting place that increases stormwater loading to the CSO system. However, this corridor has connections to businesses on Lackawanna Avenue, the Courthouse, City Hall, the Cultural Center, the Library and Lackawanna College. By creating a green alley the space will encourage pedestrian connections in the city stretching from Lackawanna Avenue up to Vine Street. Large portions of the alley can be replaced with permeable pavers that feed into underground infiltrations containers. Additionally, portions of the alley that are wide enough can utilize planting beds to deal with excess runoff while improving street atmosphere.

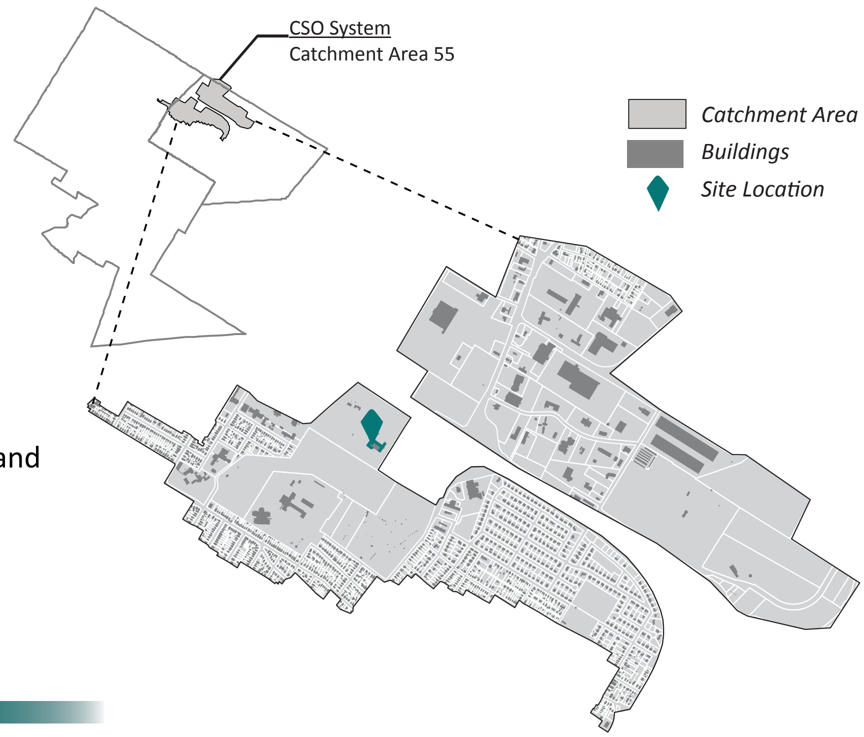
Another green street option is Cedar Avenue between Downtown Scranton and South Scranton within the proposed Iron District and adjacent to the historic Iron Furnaces (CSO area 031). Bumpouts, stormwater planters, tree trenches, permeable hardscapes and signage can be used to create a pedestrian friendly corridor that also captures stormwater.

The green alley would continue up Dix Court and connect with Vine Street.

Proposed Costs:

BMP Type	*BMP Size*	*Estimated Cost*
Varies based on length of alleyway renovated		
Center St. to Lackawanna Ave.		$265,000
Design/Engineering		$ 30,000
Total		**$295,000**

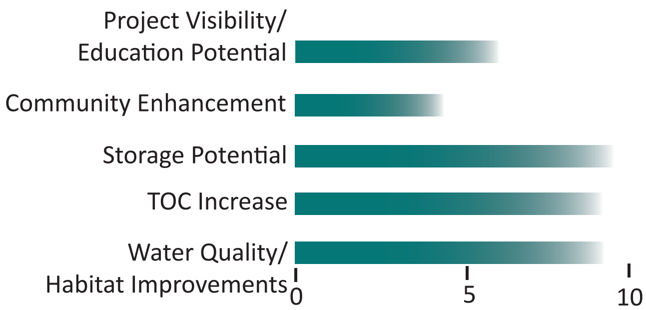
IMMACULATE HEART OF MARY CENTER



Location
Sub-Watershed Area: Meadow Brook
CSO Catchment Area: #55
Neighborhood: Dunmore
Address: 2300 Adams Avenue

Green Infrastructure Opportunities
Current Use: Institutional building
Stormwater Source: Building roof
GI Options: Downspout disconnect,
bio-retention, constructed wetland

Project Justification



The Immaculate Heart of Mary Center is located within the Meadow Brook Sub-watershed and CSO Catchment Area 63C. Currently runoff from the expansive roof is sent directly into the CSO system.

This project proposes to disconnect the downspouts and redirect the water into raingardens or a constructed wetland. First, a large open lawn behind the building will be converted into the bio-retention area to better handle stormwater. If a rain event is too large for the garden or wetland, the excess runoff would then be directed into Meadow Brook, which runs directly behind the building, and eventually into the Lackawanna River. With this project there is potential to remove approximately 34,000 Square feet of impervious surface runoff that enters directly into the CSS. Additionally, runoff from an existing drive is currently being directed into Meadow Brook. The installation of the bio-retention will help filter the runoff and keep pollutants out of the river.

The site has a large open space to the south of the building that can be used to filter and infiltrate storm water that would normally pass through the building into the sewer system.

Water from the drive is piped to the open space, runs into Meadow Brook and eventually to Lackawanna River.

A constructed wetland can be used to handle excess stormwater runoff.

Drainage Area: 33,700 SF

Impervious Treated: 33,700 SF

Proposed Costs:

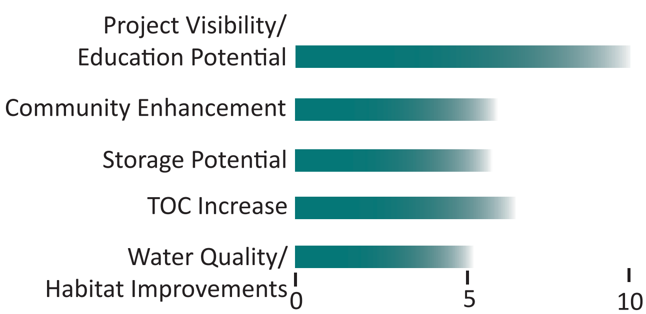
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	8,000 SF	$100,000	50,000
Downspout Disconnect		$ 12,000	
Design/Engineering		$ 10,000	
Total		**$122,000**	**50,000**

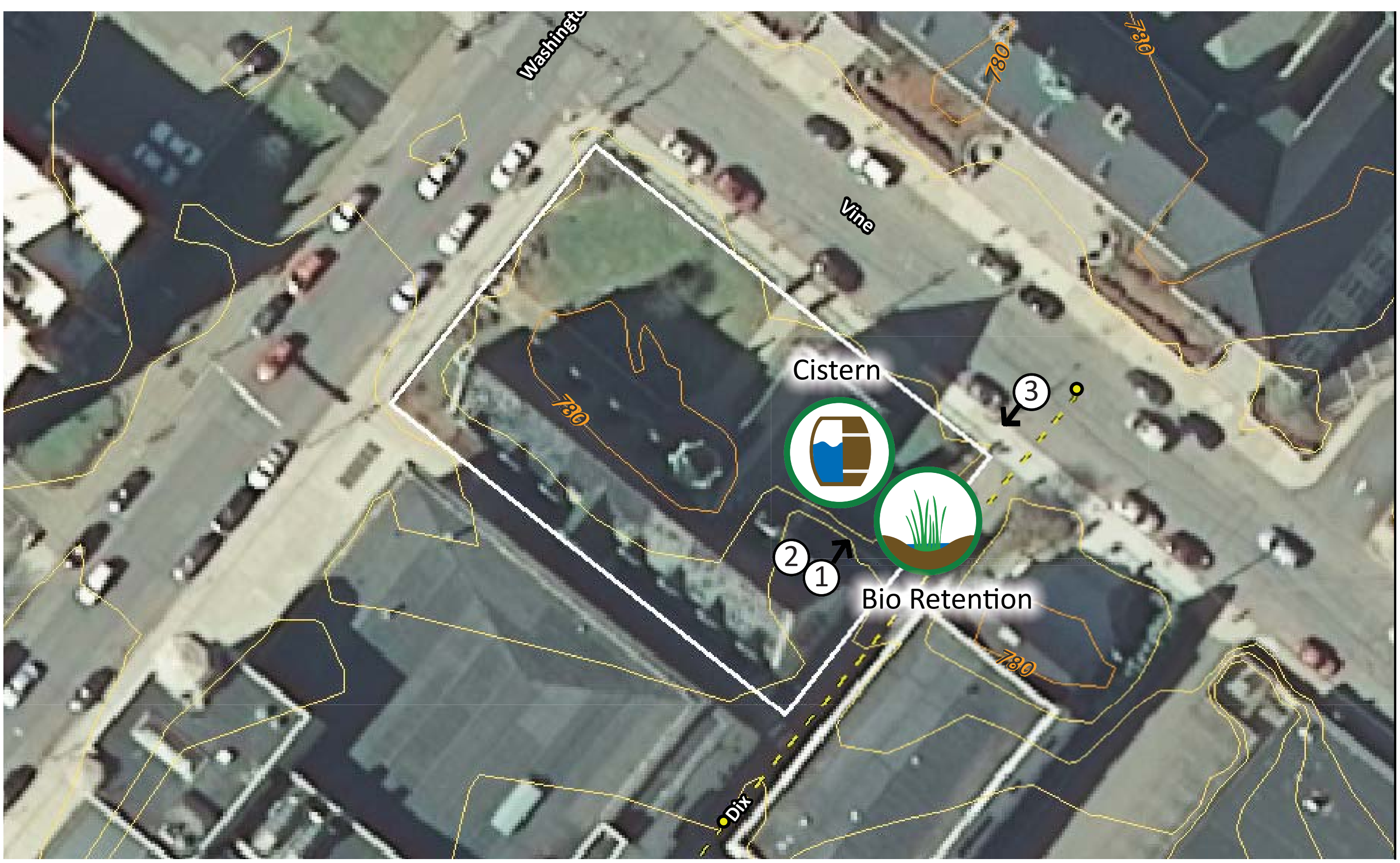
ALBRIGHT MEMORIAL LIBRARY

Location
Sub-Watershed Area: Roaring Brook
CSO Catchment Area: #19
Neighborhood: Downtown
Address: 500 Vine Street

Green Infrastructure Opportunities
Current Use: Public Library
Stormwater Source: Building roof
GI Options: Downspout disconnect, cistern, bio-retention,

Project Justification





The Albright Memorial Library currently has its downspouts connected to the sewer system. Despite a lack of open space, the Library still has interest in minimizing their stormwater contributions to the CSO. The site is located within the Roaring Brook Sub-watershed and CSO Catchment Area 19A.

The most feasible option is to disconnect the downspouts on the southeast side of the building and convert an unused, mowed area into a rain garden with an underground 5,000 gallon cistern. This will give the water opportunity to be absorbed and will provide plenty of storage area under the surface. Having this garden connected to the library will also give opportunity for environmental education and will also make use of a space that is not being utilized. The cistern can provide water for irrigation or gray water for interior building usage.

Existing conditions of the back courtyard.

Existing conditions of the back courtyard and potential rain garden location.

The mowed space behind the Albright Library will be retrofit with green infrastructure - artful downspout disconnect, educational signage, san underground cistern that over flows into a rain garden.

Drainage Area: 1,200 SF

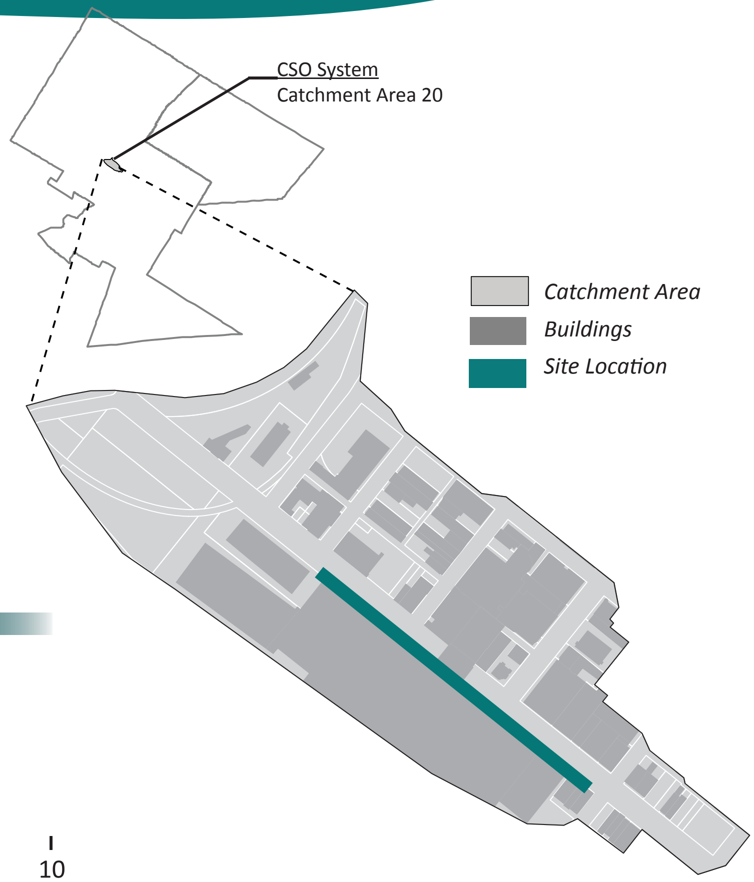
Impervious Treated: 1,200 SF

Proposed Costs:

BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Bio Retention	250 SF	$ 3,000	1,600
Cistern	5,000 GAL.	$ 10,000	5,000
Gutters		$ 6,000	n/a
Design/Engineering		$ 2,000	n/a
Total		**$ 21,000**	**6,600**

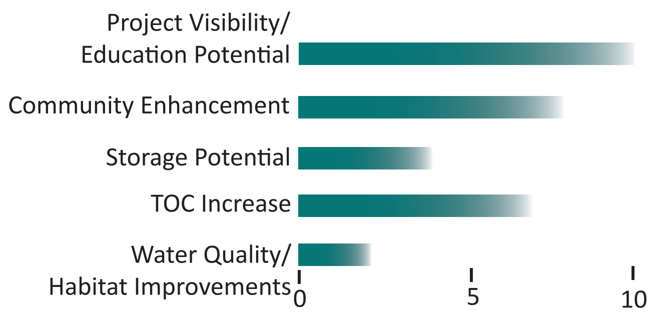
STEAMTOWN MALL / LACKAWANNA AVENUE

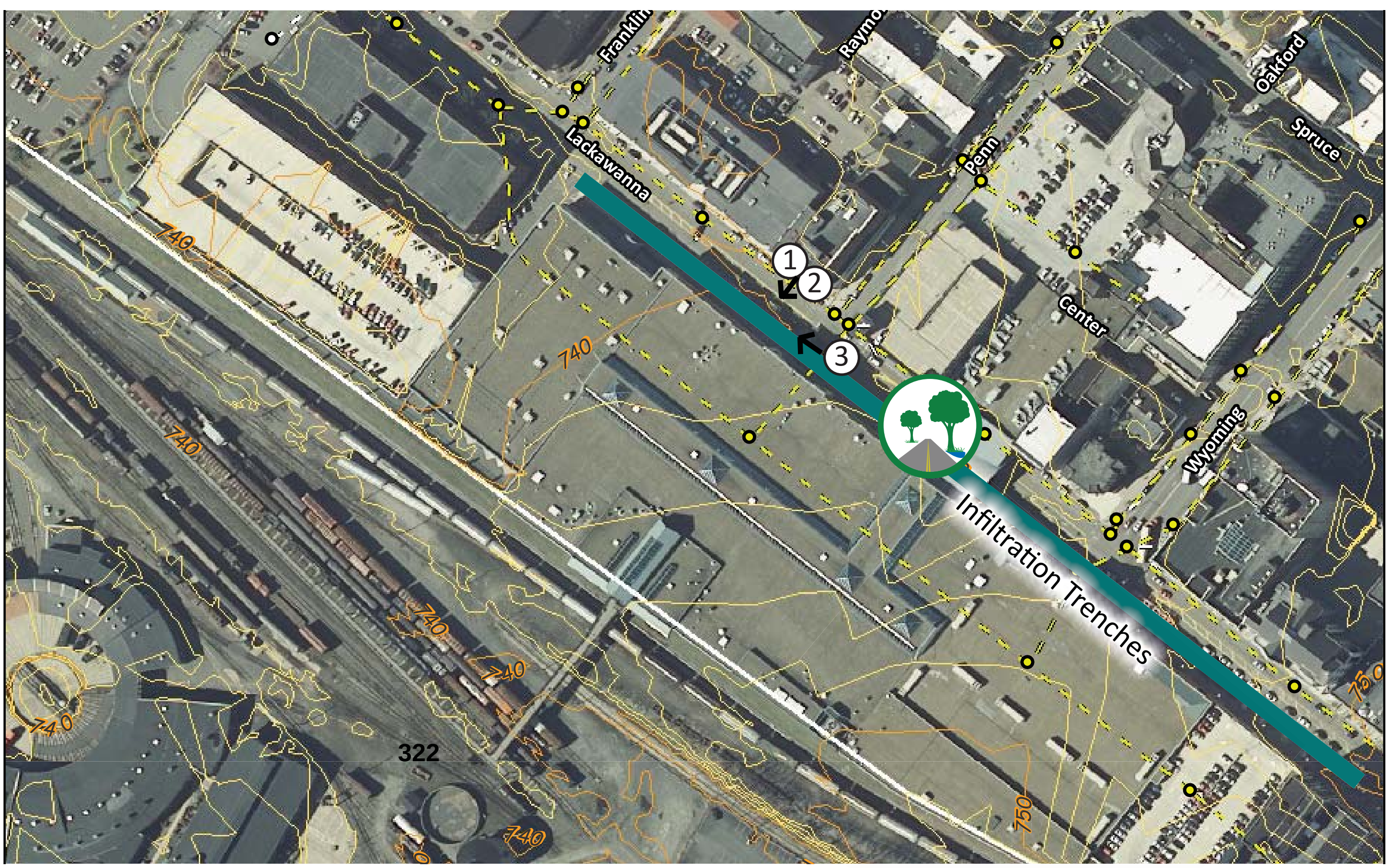
Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #20
Neighborhood: Downtown
Address: 300 Lackawanna Ave.



Green Infrastructure Opportunities
Current Use: Sidewalk
Stormwater Source: Building roof/Sidewalk
GI Options: tree trench, infiltration bed, downspout disconnect

Project Justification





A wide concrete sidewalk passes in front of the Steamtown Mall and partially beneath a series of awnings extending from the mall façade. Currently, any rain water that hits the walk is directed into a catchbasin, while the rainwater that hits the overhangs is directed into gutters and sent through the building into the sewer system. The site is located within the Lackawanna River Corridor and CSO area 20B.

In order to better handle stormwater, a 3-5' strip of sidewalk abutting the curbline can be removed and converted into an infiltration trench that is topped with permeable pavers. The gutters can also be extended over the walk to direct water into artistic seatwall/catchment urns within the permeable paver strip that connect to the underground storage space. If extending the gutters is not an option, they can be run under the sidewalk and connect to the infiltration trench underground. From there water will have the opportunity to infiltrate into the ground. If the trenches were to over fill water would be directed into an existing catch basin. Utilizing underground storage will encourage infiltration without minimizing sidewalk space. The location of the space on a busy street also gives plenty of opportunity for education.

Stretching along Lackawanna Avenue are a series of overhangs that direct stormwater into the building through gutters.

The water can be brought into catchment containers and given the opportunity to infiltrate through underground storage.

Even though storage units will be underground, the surface will be made of pervious pavers that do not take away from sidewalk space.

Drainage Area: 1,200 SF

Impervious Treated: 1,200 SF

Proposed Costs:

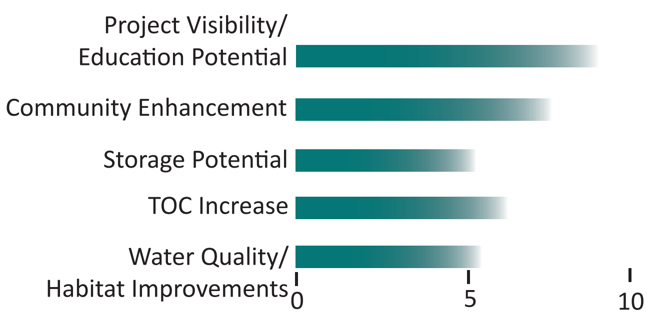
BMP Type	*BMP Size*	*Estimated Cost*	*Potential Gallons Captured*
Permeable Pavers	2500 SF	$ 35,000	n/a
Tree Pits/Infiltration Beds	12	$ 40,000	37,500
Gutters/Splash Box		$ 6,000	n/a
Design/Engineering		$ 10,000	
Total		**$ 91,000**	**37,500**

NAY AUG PARK ENHANCEMENT PROJECT

Location
Sub-Watershed Area: Roaring Brook
CSO Catchment Area: #30
Neighborhood: Hill Section/ E. Scranton
Address: Nay Aug Park

Green Infrastructure Opportunities
Current Use: Public Park
Stormwater Source: Entire Site
GI Options: tree trench, infiltration beds, downspout disconnect, bio-retention

Project Justification



Nay Aug Park (parcels # 243/245/313/302) is located within the Roaring Brook Sub-watershed and CSO Catchment Area 30C - it actually contributes to both the MS4 and CSO areas. The areas closest to the pool complex, the Everhart Museum, and the associated parking lots and access roads drain to Arthur Avenue and into the CSO system. The areas near Hanlon's Grove, the Greenhouse, Memorial Area, the Davis Trail and the CMC parking lot drain directly to Roaring Brook.

There are several options to capture and redirect surface water from the CSO system and improve water quality within the MS4 system. First and foremost, the wooded land within parcels #245/313/302 should remain conserved and undeveloped. Rain gardens and bioswales are potential methods to utilize within parcel 243. Green infrastructure is needed within the expansive asphalt parking lots; however, depth to bedrock does limit infiltration in places. Rain gardens can handle runoff from the Myrtle Street parking lot, additional tree planters can be added to the pool parking lot, greening is needed within the CMC parking lot, a rain garden is needed near the bandshell to slow or stop water flow directed at the greenhouse/memorial. Some green infrastructure techniques have been installed at Nay Aug Park with volunteers. For example, an earthen berm and rock dissipater strip was installed within an existing tree pit to retain stormwater runoff from the pool parking lot.

A small rain garden has been installed in an existing gab in the parking lot.

The parking lot on the north side of the park can be redesigned and implement a long rain garden to catch stormwater.

Some green infrastructure techniques have been installed at Nay Aug park with volunteers. For example, an arched earthen berm was added to the existing tree pit on the downslope end to retain stormwater runoff from the parking lot. A small rock dissipater strip slows runoff. Remnant asphalt was also removed to promote infiltration. Techniques like this were very low cost and have potential for cumulative positive impacts, if install throughout the parking lot.

Drainage Area: 1,200 SF
Impervious Treated: 1,200 SF
Proposed Costs:

Scale of project is not yet defined. There is potential to spend $1,000 or $50,000

CSO Catchment Area Case Study

As shown through the demonstration projects an option for green infrastructure is to identify parcels throughout the city that can benefit the CSS/MS4, however, implementation of many projects within a small area could have larger impacts and a better chance of preventing a CSO overflow events.

The goal of the demonstration CSO catchment area case study is to show that implementing green infrastructure can be a cost-effective approach to treating stormwater and reducing CSO overflows. However, to completely understand the positive effects green infrastructure may have, requires implementation, as well as monitoring. After green infrastructure is implemented, monitoring helps identify actual volume quantities being removed by green infrastructure. Without monitoring all stormwater reductions are assumed. Once installed, stormwater models would be run multiple times to determine the effects on gray infrastructure. If green infrastructure can be installed at a lower price for the same benefit, it may reduce the need for or the size of a gray infrastructure approach. This ultimately saves the SSA and rate payers money.

When selecting which catchment area to use as the demonstration more consideration was given to those within Phase B or C of the SSA LTCP. These phases were considered because construction would take place between 5 and 14 years, giving time for green infrastructure to be implemented and monitored. We did not focus on areas receiving phase A improvements, because this money is definitely being spent within these catchment areas. Additionally, there was consideration given to catchment areas with a presence of city owned parcels or institutions. A variety of parcels would make it possible to have a range of projects through out the area. Preference was also given to neighborhoods that could benefit from improvements and enhancements within public spaces, it was considered a more valuable area because of the close relationship between green infrastructure and community enhancement. A highly visible area would also be ideal because there would be more opportunities for education and public awareness.

The following catchment areas were considered for the case study:

#12 Grove Street	#21 W Scranton Street	#33 W Parker Street
#78 Shawnee Ave PS	#25 Willow Street	#49 River Street
#40 W Market Street		

Catchment Area #40

CSO Catchment Area 40 was selected for the green infrastructure case study. This area has been improved over the last decade, however more work is still needed. Providence Square is a visible section of the City that receives a high traffic volume, and is primed for a renaissance that can be facilitated by new infrastructure -both gray and green. This CSO area has a few city -owed parcel, multiple vacant lots, churches, parking lots and both business and residential areas. The variety of land uses gives opportunity to implement a range of green infrastructure techniques while utilizing available space and making partnerships with parcel owners. Additionally, the majority of public space is considered the public right of way along the street. This gives opportunity to demonstrate projects that can be implemented when space is restricted.

Existing conditions of a sidewalk in Providence Square. This technique can be utilized throughout the neighborhood to tie it together but utilize infiltration bed and permeable pavers.

On average CSO 40 has 14 overflow events a year, releasing an estimates 810,000 gallons. Currently, the LTCP is purposing to spend $870,000 on this area to handle 17,000 gallons of water per rain event to prevent over flows. Implementing green infrastructure through out the catchment area has potential to reduce the amount of water entering the sewer system, slow the time it takes for water to reach it and reduce the amount of gallons need to be stored to prevent overflows.

Design Methodology

When looking at existing conditions the overall drainage area was broken down into 15 smaller areas, each running to an individual catch basin. Additionally, several buildings are still connected, sending water from the roof directly into the sewer system. After using this to understand where rainfall was flowing, possible green infrastructure was considered. First city owned and public property, such as park land and right-of-ways, were analyzed for opportunities. Followed by identifying businesses and institutions, specifically those with large roof and parking areas that greatly contribute to runoff and can benefit from aesthetic enhancements via green infrastructure. Finally residential parcels were considered.

City Owned/ Public Property

For the city owned and public property the biggest suggestion is to utilize the right-of-way along W Market Street and Wayne Avenue. This would involve the installment of bumpouts and vegetated swales along the street on alternating sides, extending into parking areas. W Market Street, having a 50' right-of-way would consist of 6 foot sidewalks on either side, a 24 foot two way drive lane, a 7 foot parking sections and a 7 foot bumpout of vegetated swale that would collect and slow runoff from the adjacent impervious surfaces. Wayne Ave and other 40 foot right-of-way streets that utilize bump outs would consist of 4 1/2 foot walkways, a 24 foot drive isle and a 7 foot vegetated swale. The location of the bumpouts were selected for areas that have a large amount of stormwater runoff running past them, and if the walkway could use improvements. If a walk was recently redone it would not be cost effective to replace it.

Businesses/ Institutions

For businesses and institutions the focus was on handling parking lot run off and down spout disconnect. The Howard Gardener School and the Puritan Congregation Church are two larger roofs within the catchment areas that are still connected directly to the sewer system. Disconnecting downspouts and handling as much of the water on site as possible would slow the time of concentration and remove a large amount of stormwater that contributes to overflows. Additionally, parking areas for the Holy Rosary School and Casa Bella can be fitted with pervious pavers and an infiltration strip.

Residential/Privately Owned

Residential Parcels would require either purchasing of land by the state, partnerships with owners or incentives to get residents involved in managing storm water on site. For this catchment area we looked at vacant parcels that have potential for collecting water off the roadways. Two lots along W Market Street and one along Wayne Avenue are currently not being used and are capable of storing and infiltrating stormwater while allowing excess to over flow run back into the street.

All of the projects proposed for the catchment area can be found on a map attached at the end of this report. The amount of projects shown on the attached map are able to be lessened or increased. The projects shown are meant to have a balance between the amount of parking taken away and green infrastructure implemented.

CSO CATCHMENT AREA #40

Location
Sub-Watershed Area: Lackawanna River
CSO Catchment Area: #40
Neighborhood: Providence
Address: Market Street & Main Ave.

Catchment Area 40
West Market Street Subcatchment Area
NPDES Outfall # 40
Outlets to the Upper Lackawanna River
Impervious surfaces: 530,000 Square Feet
LTCP Proposed Investment: $870,000
LTCP Estimated Storage 17,000 Gallons
Estimate Annual Overflow: 810,000 Gallons

Green Infrastructure Opportunities
City-Owned Parcels
Fire Station: Rain garden
Parking Lot: Bio Infiltration Area

Public-Owned Land Including R.O.W.s
School Street: Pervious Paver Band
West Market Street: Bumpouts, bio-swale
Wayne Ave Street: Bumpouts, bio-swale
William Street: Bumpouts, bio-swale

Civic Parcels
Howard Gardener School:
Downspout Disconnect, Rain gardens
Shilo Baptist Church: Rain garden
Puritan Congregational Church: Roof Disconnect
Holy Rosary: Rain Garden, Impervious Pavers
Casa Bella: Infiltration Strip

Residential Parcels
Downspout disconnect
Bio-retention

Example of a bumpout being added to W. Market Street

Attached at the end of the document is a map highlighting the selected green infrastructure methods within the catchment area.

The catchment area can be broken down into 15 separate drainage areas being directed into separate catch basins. The map below indicates the individual drainage areas.

Drainage Area	Size (SF)	Total Impervious	% Impervious
1	13,400	13,400	100%
2	66,500	56,525	85%
3	8,700	8,265	95%
4	14,400	12,960	90%
5	3,200	3,200	100%
6	158,600	111,020	70%
7	19,400	13,580	70%
8	77,900	50,635	65%
9	40,300	40,300	100%
10	27,700	18,005	65%
11	39,700	23,820	60%
12	113,300	67,980	60%
13	79,000	51,350	65%
14	23,500	17,625	75%
15	52,000	41,600	80%
Totals	**737,600**	**530,265**	**79%**

Building Roof Tops that tie directly into Sanitary Sewer System

Catchbasin Location

Proposed Costs

	Estimated Cost	Impervious Treated
City Owned Parcels		
Fire Station Raingarden	20,000	2,500 SF
Parking Lot Bio Infiltration Area	25,000	6,000 SF
Public Owned Land Including R.O.W.s		
School Street Pervious Paver Band	$40,000	22,000 SF
West Market Streetscape	$235,000	55,000 SF
Wayne Ave Streetscape	$135,000	38,000 SF
Remaining Improvements along School and William Street	$85,000	18,000 SF
Civic Parcels		
Howard Gardener School Roof Disconnect and Raingardens	$15,000	6,500 SF
Shilo Baptist Church Raingarden	$25,000	11,000 SF
Puritan Congregational Church Roof Disconnect	$10,000	4,000 SF
Holy Rosary Rain Garden	$5,000	4,500 SF
Casa Bella Infiltration Strip	$10,000	6,500 SF
Holy Rosary Impervious Pavers	$15,000	7,000 SF
Residential Parcels		
Deed Book 0968 Pg 0214 Purchase and Raingarden Installation	$35,000	6,500 SF
Deed Book 0834 Pg 0194 Purchase and Raingarden Installation	$35,000	18,000 SF
Deed Book 1382 Pg 0212 Purchase and Raingarden Installation	$35,000	17,000 SF

When considering projects a range of different levels of green infrastructure were considered to find a balance between stormwater management and public needs and amenities, such as parking. The level to which a neighborhood takes green infrastructure can become as large or as small as a neighborhood will allow. In this case study example the public right-of-way can support green infrastructure at four different levels. The following levels of gray/green infrastructure improvements were explored:

- Level 0: Follow SSA Long-term control plan and install only gray infrastructure improvements.
- Level 1: New sidewalks with tree pits and underground gravel bed storage.
- Level 2: Remove 1/3 of the on-street parking along Market Street, add bumpouts and stormwater planters.
- Level 3 : Remove parking on both sides and add full length stormwater planters.

To balance public need and stormwater management level 2 was selected as the most optimal design for this catchment area. These street amenities and other green infrastructure techniques are meant to treat approximately 42% of all impervious surfaces, with excess overflow designed to enter back into existing catch basins. A map highlighting the proposed projects can be found at the back of this report.

The goal of this case study was to depict how green infrastructure can be incorporated throughout the fabric of a community from public to private lands. It further illustrates how community needs and enhancements can be accomplished in parallel with stormwater controls. This case study did not try to provide exact and valid quantities related to stormwater retention or infiltration. Detailed designs, construction and monitoring is the only way to obtain data that is useful in future SSA design making processes regarding amount of green versus gray infrastructure required to meet federal mandates.

Maintaining Green Infrastructure

Similar to gray infrastructure, the long-term success of green infrastructure is dependent on maintenance. The first step to maintaining any type of green infrastructure is to establish written plans and procedures to assure long-term maintenance. This includes determining who will conduct maintenance, their responsibilities, and what amount of maintenance will be needed. This will change from project to project depending on its location. For instance, if a raingarden is on private land an agreement can be made with property owners or neighborhood associations to care for it. Also, if a green technique is located directly off a parking lot it will require more attention, with sediment and litter removal, than one connected to a downspout. When designing it is important to keep in mind the amount of maintenance a green technique will receive.

For a rain garden the typical maintenance will include sediment removal, keeping stormwater entry and exit points clear of debris, and removing litter. Like most things, a rain garden would need more attention the first years of installation with the main activities being weeding by non-chemical means and summer irrigation when needed. By having a regular maintenance program during the establishment period a rain garden is given the best opportunity to thrive in the long run.

Often, municipalities with more experience with green infrastructure have a stormwater utility that collects fees dedicated to the maintenance of green infrastructure systems. This fee is discussed in greater detail in Chapter 2.

According to *The Importance of Operation and Maintenance for the Long-Term Success of Green Infrastructure* report produced by the EPA there are a few strategies that helped the long-term success of green infrastructure. One of the strategies was having a tracking system in place to identify gaps in current maintenance practices. Having this system makes it easier to adjust to more preventative and effective maintenance controls. Another step toward long-term success is involvement from the community and volunteers. This approach encourages those of the neighborhood to have an invested interest in their community while tying in with environmental education and awareness of water quality and the positive effects of green infrastructure. Additionally, having some type of authority to assure compliance with maintenance or legal agreements can ensure the proper maintenance activities are performed regularly.

PROGRAMS

The LRCA Rescue Plant Nursery

The LRCA initiated a native plant nursery project. The project takes advantage of already established rain gardens that need to be thinned out and uses the plants for new rain gardens. Dogwoods, and Willows taken from these gardens can be used for stream bank stabilization projects.

CHAPTER 5:
ENVIRONMENTAL EDUCATION PROGRAM

Environmental Education Program

A successful environmental education program should address current priorities, teach the public in a manner which is easy to understand, and address the issue of stormwater management from a variety of approaches. People learn in different and various ways. They come from varied cultural backgrounds, with differing educational levels and understanding of the subject. The LRCA has addressed the issue with this in mind, realizing that it will take a long term, diverse, and creative educational plan to reach the majority of citizens in the community.

Permit Requirements & Environmental Education

The previous chapters have done a thorough job of explaining current regulations by providing an overview of the Federal Clean Water Act and the Pennsylvania Clean Streams Laws. Municipalities must comply with provisions of these two in order to discharge stormwater into rivers or streams. They must implement a storm water management program which reduces the amount of pollutants and improve the quality of storm water from MS4s, which carry storm water from roads, roofs, drive ways, parking lots, and any other impervious surfaces. Federal regulations require that municipalities in urbanized areas apply for a NPDES permit to discharge storm water.

To assist in this application process, the PA DEP has issued a general permit for MS4 communities. In addition, PA DEP has developed a protocol which describes an approved storm water management program. This includes best management practices, and requires measurable goals to comply with the six EPA mandated MCMs. The first two of these MCMs are “Public Education and Outreach” and “Public Participation and Involvement” which this chapter will address. The intention going forward for Stormwater Management is that green infrastructure projects will help address water quality issues and save money for the community, handling the problem in an environmentally sensitive manner.

Green Infrastructure consists of site- specific, de -centralized stormwater management techniques and options, using natural hydrologic features to manage water on site. Green infrastructure can result in additional positive environmental and social benefits such as cleaner air from vegetation, community beautification, and flood mitigation. Some examples of green infrastructure include rain gardens, rain barrels, downspout disconnection, vegetated roofs, vegetated swales and tree trenches, green streets and alleys, and porous paving.   These options are more cost effective and environmentally sustainable than centralized, gray infrastructure systems which carry stormwater through expensive conveyances to a final location for treatment

Environmental Education program at the Scranton Iron Furnaces.

Minimum Control Measure #1 – Public Education and Outreach –

Why are Public Education and Outreach Necessary?

As stated by the EPA, “an informed and knowledgeable community is crucial to the success of a stormwater management program.” This helps ensure that there is greater support for the program, as the public gains an understanding of the issues involved, including the benefits for them, and the negative effects of inaction. In addition, an informed public can provide volunteers for projects, and help to counter any opposition. An informed and involved public can bring about greater compliance. The public needs to know that their actions and compliance are a necessary component of the process. Public involvement will help to improve water quality and enhance their quality of life. The public needs to know that their actions matter and need to know that informed public involvement is welcome and appreciated by the municipality and storm utility agency.

What is required by EPA to satisfy this MCM?
To satisfy this measure, EPA requires the operator to distribute educational materials to the community, or conduct outreach activities about the impacts of stormwater discharges on local waters, and the steps that can be taken to reduce pollution. Three main action areas are important to address.

These include:

- Forming Partnerships
- Using Educational Materials and Strategies
- Reaching Diverse Audiences

Setting Appropriate Measurable Goals
It is important to follow up on whether the programs have met these goals. Measurable goals are necessary to gauge permit compliance and program effectiveness. They should be specific to the needs and characteristics of the operator and address issues that are important to the local area. They should also allow improvements to the program and allow evaluation throughout a five year period. If the goals are not being met, the evaluation process should be flexible enough to allow a change in the educational program or outreach strategy.

Minimum Control Measure #2 – Public Participation and Involvement
Why Is Public Participation and Involvement Necessary?
EPA believes that the public can and should provide valuable input and assistance. They should have an active role in the storm water management program, both in development and implementation of the program. Not only is this required by EPA, but it is genuinely important that the public be involved and crucial to the program's success. If the public does not have an understanding and a role in the process, it will be difficult to implement. "Buy In" at an early stage, produces greater success later in the process because it allows for:

- Broader Public Support. As the EPA states in its final rule document, those who participate in decision making are partially responsible and more likely to take an active role in implementation. They are more likely to forego any legal challenges since they have some authorship in the proposed course of action.

- Shorter Implementation Schedules. There are less challenges and obstacles when the public is informed from the beginning. Citizen volunteers also help the process move quicker since they provide needed resources for implementation.

- A Conduit to Other Programs. Those involved with the program share a sense of "buy-in" and can provide relationships with other organizations and programs. They can help sell and implement the program, and serve as a link to other watershed groups. They also help to promote the program and can help educate others in the community.

What is required to satisfy this MCM?

- Comply with all applicable public notice requirements. The public should be informed about meetings, educational programs, and volunteer opportunities through the best sources of communication for the local region. The municipality or operator should keep the public informed of all new regulations and activities by reaching out to all economic, public interest, and ethnic groups. The LRCA has been involved in local conservation and watershed issues since its founding in 1986, and knows the local community well. The organization works well with both government agencies, municipalities, and other community groups. They have a long history of successfully involving the public in watershed related issues, and will work to inform and involve all interested parties. The partnership between SSA and LRCA is a creative means to accomplish this MCM.

- Determine the appropriate BMPs and measurable goals. The LRCA has been active in a wide variety of best management practices since its inception. Some of these will be continued since they have been very successful and the LRCA/SSA will incorporate additional new BMPs as the process unfolds.

Benefits and Needs

In order to measurably reduce pollution from stormwater, it is necessary that the general public, along with businesses, institutions, and municipal staff, understand the problem and understand the role that everyday decision making plays in positive and negative ways on the opportunities to reduce the generation of pollutants that impact on stormwater. Education is a key – and sometimes overlooked – component of a sound pollution reduction strategy. Therefore, one can easily see why the first two EPA protocols address education. It is often the least expensive, and easiest to implement protocol. Education is both a first step and a necessary continuing program, needed for continual reinforcement of the idea that the community can reduce pollution and storm water related flood events through the implementation of various strategies.

There are a host of pollutants that threaten our waterways. These range from grease and oil from cars, trucks, and roadways, to sediment from construction sites and any earth moving activities. Often earth moving activities include the clearing of trees from the site. This, along with improper sediment control, causes significant run off and water pollution.

Constructing a bioretention area at Nay Aug Park with University of Scranton volunteers.

Litter is also a problem. It's one with an easy and inexpensive fix, with public involvement. Cigarette butts, paper and plastic wrappers, plastic bottles, and a host of other offenders litter streets, catch basins and waterways. Better education can help reduce the problem but a community also needs to provide proper upkeep, maintenance and good housekeeping measures.

Animal waste from pets is a problem. People need to pick up after pets and dispose of the waste in the proper trash container. Pet waste is unsightly, adds to the litter problem, and increases the nitrogen load in waterways.

Fertilizers, pesticides and herbicides are often overused and incorrectly applied. Natural, organic alternatives are available, and can be substituted for many chemical products. They should be applied only when necessary, and by following all application directions. More is not always better when it relates to fertilizers/pesticides/herbicides.

Tree and vegetation planting offer a number of benefits that help to combat pollutants. By planting trees, and other appropriate vegetation, along with installing rain barrels, vegetative buffers, rain gardens, and other natural means of storm water control, storm water based pollution can be reduced at lower costs in an environmentally responsive manner.

Current /Continuing Educational Initiatives

For over 25 years the LRCA staff and volunteers have conducted public outreach and educational programs. The organization has an extensive network of contacts with community organizations, business interests, non-profit organizations, institutions, and local governments. The following Public Education and Outreach Strategies have been implemented successfully, and many of these will continue in the future.

MCM 1: Public Education and Outreach

The SSA permit requirements for this MCM include:

Develop, implement and maintain a written Public Education and Outreach Program

- List of target audiences (residences, businesses, developers, schools etc.)
- Distribute storm water educational materials and/or information to the target audiences. Publish MS4 and related water quality information in a newsletter and flyers for specific events/audiences.
- Utilize electronic and social media such as web sites and face book to disseminate environmental information and promote specific events/activities/

Community Outreach

The LRCA has provided educational materials to the local community since its founding over 25 years ago, and has maintained and expanded this role during the last year through a cooperative agreement with the Scranton Sewer Authority. Under the outreach program “Lackawanna River Clean,” begun several years ago, they have consistently distributed educational materials which address stormwater and the sources of water pollution. Under a grant from the National Fish and Wildlife Foundation the outreach program and educational programs have been expanded and now include:

Booths and Outreach activities at the following locations:

- Scranton Courthouse Square downtown Scranton during the August Jazz Festival
- First Fridays. Booth located on Courthouse Square
- Various Farmer’s Markets throughout Scranton
- Lackawanna River fest picnic, canoe race, and duck derby
- Lackawanna Heritage Explorers Bike Tour
- Nay Aug Park, Scranton
- Dunmore Council meeting

- Scranton Iron Furnace Arts Alive festival
- Steamtown Mall
- Viewmont Mall

The handouts distributed during these events include:

- A Guide to Downspout Disconnection
- Rain Garden Construction
- Rain Barrels
- Vegetated Swales
- Helpful Hints to Minimize Water Pollution
- Lackawanna Watershed Citizens Handbook

Websites and Newsletters

- The SSA and LRCA both maintain extensive educational resources on their websites, and encourage visitors to link to other organizations to learn more. Both organizations encourage citizens to contact them to report illicit discharges and sources of pollution.
- The SSA also includes educational materials in billing statements at various intervals throughout the year to all its customers.
- The LRCA provides information through various lectures and presentations to groups such as community garden volunteers, scout troops, school groups and civic organizations. They work with the local Trout Unlimited Chapter, and other conservation organizations, to maintain the river and its tributaries, and provide educational information to libraries and schools.
- Storm Drain Stenciling. The LRCA has worked over the past decade to stencil storm drains throughout the busy downtown Scranton area. This program will continue throughout the City and Dunmore Borough with one event per year minimum.

MCM 2: Public Participation and Involvement

The SSA permit requirements for this MCM include:

- Develop, implement and maintain a written public involvement and participation program that describes various types of participation activities and methods of encouraging the public's involvement and soliciting input.
- Regularly solicit public involvement and participation from target audience groups. This includes the reporting of suspected illicit discharges and dry weather discharges.

Downspout disconnect with rainbarrel.

The LRCA works extensively throughout the community, sponsoring many public involvement and participation programs. Some of these include:

- Stakeholders Group - The LRCA and SSA formed a stakeholders group 4 years ago comprised of business and civic leaders and neighborhood residents. The group has met several times a year to review and provide input on a long term control plan (LTCP) for the CSO system. The organizations will recruit stakeholder's group members on an ongoing basis. The group will continue to meet and be consulted for input in the future on both CSO and MS4 matters.

- The LRCA and SSA are working with the Public Works Departments of the City of Scranton and the Borough of Dunmore to develop a more comprehensive LTCP which includes more frequent good housekeeping measures such as street sweeping and catch basin cleaning.
- Good housekeeping programs and practices for urban water quality parameters for private property owners, commercial and institutional campus managers are being promoted.
- "River Watch" Water Monitoring – Since its inception in 1991, River Watch has been – and continues to be - one of the LRCA's most successful public participation programs. Teams of volunteers from Lackawanna Valley communities, including senior volunteers, high schools and universities, collect and test water samples at various locations throughout the year. Labs at the University of Scranton provide the site for water sample analysis. The volunteers also record the presence of macro invertebrates (stoneflies, damselflies, caddisflies, hellgrammites, dragonflies) along the river at four locations in fall and spring. This provides especially useful information in assessing water quality since different species live and thrive in response to various levels of pollution.
- The LRCA works regularly with the Biology Department of the University of Scranton which now includes water quality testing and analysis along the Lackawanna River in its curriculum. This partnership has provided invaluable, high quality data about the river's overall health. It provides hands-on, practical experience to future leaders in the environmental science field.
- The LRCA works in close partnership with the Lackawanna Valley Chapter Trout Unlimited (TU) on water monitoring programs, and the organization helps to train volunteers to assist with educational programs about water quality, and the effects of pollution. TU can provide future volunteers for educational outreach programs, storm drain stenciling, water testing and other programs. Because of their interest in the river, they also provide information on illegal discharges and pollution events.
- Storm Drain Stenciling – This program will continue and expand to other sections of the City and Dunmore Borough. The LRCA plans one storm drain stenciling event each year.

Macroinvertebrate sampling along the Lackawanna River.

Fly fishing along the Lackawanna River.

Volunteers pulling a tire out of the river.

- The LRCA holds public meetings throughout the Lackawanna Valley on issues on local and regional importance. They work closely with municipal officials to educate them about issues such as proper planning and zoning, good housekeeping issues, open space development, conservation easements, and water quality issues.
- The LRCA has sponsored the Lackawanna Riverfest, including its popular Canoe – a – thon, for over twenty five years. More than 120 canoes and kayaks run a section of the river between either Archbald or Blakely Boroughs and the City of Scranton, enjoying firsthand the beauty and challenges which the river provides. A celebration at the finish line in Scranton provides a fitting end to the race. Staffed with food vendors, musicians, and educational tables, Riverfest is a day to celebrate the Lackawanna River and its watershed,

Volunteers help clean up the levee along the Lackawanna River.

- The LRCA, along with its sister organization the Lackawanna Valley Conservancy (LVC), has worked to conserve land, and encourage landowners through direct purchase or easements, to protect valuable property along the Lackawanna River, its tributaries and in its watershed.
- The LRCA holds frequent clean – ups along the river and its tributaries. Local organizations, schools, businesses and civic minded individuals have cleaned hundreds of tons of trash, including tires and other debris, for more than 25 years. For the past several years LRCA cleanups have been supported by the SSA with equipment and staff assistance and funding for landfill disposal.
- The LRCA has partnered with local artists and art galleries to host events along the river and in local galleries. The organization distributed educational materials at these events, and a portion of the sales were donated to the LRCA.

Future Strategies

- Focus Groups - The LRCA is planning two focus groups to elicit the local perspective on stormwater issues. These will be held at the Scranton Chamber of Commerce and the Dunmore Community Center. One group will include government officials, real estate and housing, contractors, engineers, and business leaders. Another group will hold religious leaders, educators, environmental and civic representatives. The groups will provide input on strategies for future success. The LRCA will provide a short questionnaire to be returned after the meeting if participants have more ideas.

Macroinvertebrate kick-net sampling along a riffle in the Lackawanna River.

- Storm drain stenciling will continue and expand to other areas of Scranton City and Dunmore Borough.
- The LRCA will continue its clean-ups along the river and at sites identified by this survey along tributary streams.

- Meetings with local government officials, Chamber of Commerce and other business leaders, contractors, and engineers will continue at various locations. The LRCA is now planning a public meeting in conjunction with Penn Future on stormwater management.
- The LRCA will continue to provide speakers and outreach at various public events and venues.
- Public reporting will continue with semiannual reports provided on storm water issues, and future strategies. It will include: What has worked; What has not worked well, and a reassessment for future programing.
- Continue RiverWatch and water testing programs in conjunction with the University of Scranton.
- Enlist help from Penn State Extension and the Master Gardener Program to provide education and demonstrations on rain gardens, rain barrels, downspout disconnect, tree planting, and similar topics.
- Meet with local chocolate companies, and other manufacturers, to publicize the LRCA and its environmental stewardship efforts on their candy wrapper or container. A portion of the sales of these products could be donated to the LRCA.
- Expand outreach to commercial and institutional stakeholders; develop general business and site specific programs and projects.
- "Adopt a Storm Drain" program – This future outreach effort will work through cooperation with schools, religious leaders, colleges and universities, businesses and neighborhood organizations. They will work to clean litter and report problems to responsible agencies.
- Contact the Everhart Museum (Nay Aug Park Scranton), and the Anthracite Museum (McDade Park Scranton), to host presentations on stormwater and water quality issues in conjunction with coordinating exhibits.
- Work with the local public access television station, Electric City TV, and with WVIA Public Television, to air educational presentations on proper stormwater management, including panel discussions, focus groups, and a public forum on storm water to be held in conjunction with Penn Future and other organizations.
- Encourage businesses and institutions to adopt and help provide maintenance to "green infrastructure" areas such as rain gardens and vegetated swales.
- Include educational materials in bulletins of religious congregations such as churches and synagogues.
- Work with the Scranton Chamber of Commerce, the City of Scranton, Dunmore Borough, and Lackawanna County Planning to develop a "land bank" of properties suitable for green infrastructure installation.

Participants at the annual Lackawanna Riverfest

CHAPTER 6: CONCLUSION

Conclusion

The recommendations contained in this report provide the City of Scranton and SSA a path toward developing a more comprehensive stormwater program. This report presents the City and SSA with a managerial and financial framework to integrate activities required by both entities to adequately meet the MS4 Permit, LTCP, and additional requirements. Simultaneously, as the City and SSA begin to shift responsibilities to enable a more efficient and streamlined program, all local partners should continue collaborating to implement the programmatic recommendations contained in this report, specifically the stream and watershed recommendations, green infrastructure recommendations, and environmental education strategies.

While the local partners have been working to improve water quality in the Lackawanna River Corridor for many years, this Phase 1 effort will position the City and SSA to more adequately meet their water quality goals by improving the efficiency and incorporating cost-saving strategies, as well as better educating the community to generate the buy-in that will be necessary for the stormwater program to sustain itself in the long-term. Once the Phase 1 recommendations are implemented, the local partners can leverage their existing and future efforts to continue to enhance local stormwater management.

One of the major challenges impeding the City's ability to invest in stormwater is the competing priorities in the community, all vying for limited resources. In addition, the upcoming City elections may alter the makeup of elected officials substantially. While it is anticipated that political changes may shift priorities within the City, the Chesapeake Bay restoration plan will require stringent local policies and procedures to mitigate the negative impacts of stormwater. It is therefore essential that the local partners involved in these efforts work closely with elected officials and the public to educate them on the importance of managing stormwater so that a more comprehensive stormwater program will be implemented into the future.

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32. Stormwater the Journal for Surface Water Quality Professionals

ACRONYMS

AMD - Abandoned Mine Drainage

BAMR - Bureau of Abandoned Mine Reclamation

BCR - Bureau of Restoration and Conservation

BMP – Best Management Practices

CBPRP – Chesapeake Bay Pollutant Reduction Plan

CIP – Capital Improvement Plan

CSO - Combined Sewer Overflow

CSS - Combined Sewer System

CWA – Clean Water Act

CWF - Cold Water Fisheries

DCNR - Department of Conservation and Natural Resources

DPW – Department of Public Works

E&S – Erosion & Sedimentation Control Plans

EFC - Environmental Finance Center at the University of Maryland

EPA - Environmental Protection Agency

EPCAMR - Eastern Pennsylvania Coalition for Abandoned Mine Reclamation

ERU – Equivalent Residential Unit

GI - Green Infrastructure

GIS – Geographic Information System

HOAs – Home Owners Associations

IDD&E – Illicit Discharge Detection & Elimination

KOZ – Keystone Opportunity Zone

LCCD – Lackawanna County Conservation District

LGCBI – Local Government Capacity Building Initiative

LHVA- Lackawanna Heritage Valley Authority

LID – Low Impact Development

LLVSA – Lower Lackawanna Valley Sewer Authority

LRBSA – Lackawanna river Basin Sewer Authority

LRCA - Lackawanna River Corridor Association

LTCP – Long Term Control Plan

LVC - Lackawanna Valley Conservancy

MCM - Minimum Control Measures

MDE – Maryland Department of the Environment

MoU – Memorandum of Understanding

MS4 - Municipal Sanitary Storm Sewer System

MSMP – Metropolitan Scranton Mine Pool

NFWF - The National Fish and Wildlife Foundation

NPDES - National Pollution Discharge Elimination System

O&M – Operations & Maintenance

OSM - Office of Surface Mines

PA DEP – Pennsylvania Department of Environmental Protection

PAWC - Pennsylvania American Water Company

PENNDOT – Pennsylvania Department of transportation

PCSM – Post Construction Stormwater Management

PMAA – Pennsylvania Municipal Authorities Association

PUC- Pennsylvania Utility Commission

RM – River Mile

RTC NEPA – Rail Trail Council of Northeast Pennsylvania

SLIBCO - Scranton –Lackawanna Industrial Building Company

SMB - Stafford Meadow Brook

SML - Abandoned Mine Land

SOP - Standard Operating Procedure

SRBC – Susquehanna River Basin Commision

SSA - Scranton Sewer Authority

TMDL – Total Maximum Daily Load

TOC – Time of Concentration

TSF - Trout Stocked Fisheries

USGS – United States Geological Survey

WIP – Watershed Implementation Plans

WWTP – Wastewater Treatment Plant

APPENDIX A: EFC FACT SHEET & STORMWATER PROGRAM BUDGET

STORMWATER IN THE CITY OF SCRANTON

What is stormwater runoff?

Stormwater runoff is generated when precipitation from rain and snowmelt events flows over land or impervious surfaces and does not percolate into the ground. As runoff flows over the land or impervious surfaces (paved streets, parking lots, and building rooftops), it accumulates debris, chemicals, sediment or other pollutants.

Why does stormwater matter?

Because rivers and streams matter.

- ✓ The City of Scranton is located within the Lackawanna River watershed, where all stormwater drains. Poorly managed stormwater pollutes the Lackawanna River, causing erosion and flooding and damaging property and habitats.
- ✓ The Lackawanna River is the largest tributary to the North Branch of the Susquehanna River in Northeastern Pennsylvania. Any pollution that occurs locally affects not only the local rivers and streams, but ultimately the Susquehanna River and Chesapeake Bay.

Stormwater systems require long-term management and maintenance.

- ✓ The City's aging infrastructure is in need of repair to mitigate heavy rainfall, manage runoff, and meet regulatory requirements.

Stormwater systems are overlooked.

- ✓ Neglecting stormwater systems can cost the City millions in damages and repairs if an emergency strikes or fines if regulations are not met.
- ✓ Stormwater in Scranton can create public health, safety, and economic concerns.

What's happening in the City to address stormwater?

Working with local and regional partners.

- ✓ Funded by the National Fish & Wildlife Foundation (NFWF), the City currently receives technical assistance from Lackawanna River Corridor Association (LRCA) to inventory the City's Storm Sewer System, Hatala Associates to conduct public outreach and education, McLane Associates to identify opportunities to better manage stormwater at a lower cost by incorporating "green" practices, and the Environmental Finance Center (EFC) at the University of Maryland to provide long-term financing recommendations to managing stormwater.

These partners are working closely with the City and the Scranton Sewer Authority (SSA) to determine the most sustainable, accountable, comprehensive, and fairest approach to managing stormwater.

Want to learn more or share your thoughts on stormwater in the City of Scranton?

CONTACT:

Lackawanna River Corridor Association, 570-347-6311

Sponsored by: In partnership with:

Initial Stormwater Program Budget, Year 1

NOTE: This budget represents activities identified by the EFC Project Team that are needed to meet the City's existing regulations, which are being implemented across many partners. In the near term, the City and SSA will need to determine which entity is responsible for which activity. In the long term, the MS4 permit holder will need to incorporate personnel, capital improvement, and O&M costs associated with existing activities *in addition* to those identified in the initial budget below for a final program budget.

Activity	Year 1 Costs	Estimated # units	One-time/annual cost	Comments	Recommended Financing Source
Contractual services:					
Lackawanna River Corridor Association (LRCA)					
Outreach and engagement	$63,880	[redacted]	Annual	Conduct all public outreach and engagement activities (MCMs 1 & 2)	Stormwater user fee
Mapping, inventory, and prioritize projects	$32,000	[redacted]	Years 1-3	Help finish system map, inventory, and develop prioritized list of water quality improvement projects	Stormwater user fee
City of Scranton					
Engineer/Inspector		[redacted]	Annual	Construction inspections (in tandem with LCCD) & tracking all construction projects	General funds
Public Works		[redacted]	Annual	DPW staff (basin crew) to develop O&M schedule for BMPs and continue maintaining all publically-owned PCSM BMPs	General funds
McLane Associates					
GI projects	*Insert from report*	[redacted]	Will vary from year to year	Contract with McLane Associates to implement GI projects identified in study	Stormwater user fee/potential bond financing or grants
Personnel costs:					
Stormwater coordinator		1	Annual	Coordinate all components of MS4 permit + additional SW-related regulations; track all components, maintain plans	Stormwater user fee
Technical staff		2	Annual	SSA hire additional staff to fully handle all its LTCP and MS4 permit activities -- adding marginal work since already being done for LTCP; will at least need two street sweepers, unsure how many additional staff needed	Stormwater user fee
Administrative staff		1	Annual	These two hires are for SSA to consider - need to determine if they already have this capacity in-house	Stormwater user fee
GIS staff		1	Annual		Stormwater user fee

Activity	Year 1 Costs	Estimated # units	One-time/annual cost	Comments	Recommended Financing Source
Capital improvement costs:					
Outfall location identifiers		Need to determine	One-time	Purchase outfall location identifiers once all outfalls are identified to begin inspecting and tracking on schedule	Stormwater user fee
Water quality improvement projects		[redacted]	Will vary from year to year	Contract with local firm(s) to implement prioritized water quality improvement projects identified by project partners	Stormwater user fee/potential bond financing or grants
GI projects		[redacted]	Will vary from year to year	Contract with local firm(s) to design, construct, and maintain additional GI projects not identified in study/leverage exisitng projects through LTCP	Stormwater user fee/potential bond financing or grants
Street sweeping equipment		Need to determine	Annual reserve or every 20 years	Can purchase City's two old sweepers or new equipment	Stormwater user fee
Additional equipment		Need to determine	Annual reserve or every 20 years	Determine what additional equipment is needed and when it needs purchased; can purchase up front or set aside reserves each year and purchase in future	Stormwater user fee
Operations & maintenance costs:					
Management software		0.37	Annual	SSA has existing software to utilize - should pay for 37% of total cost for MS4 permit activities	Stormwater user fee
IDD&E testing materials		[redacted]	Annual or one-time?	Determine if additional materials are needed or if SSA already has in-house	Stormwater user fee
GIS software	$18,500	0.37	Annual	ArcMap License to map system (total cost is $50,000) - should pay for 37% of total cost for MS4 permit activities	Stormwater user fee
Conveyance system mapping		[redacted]	Until complete	SSA's costs to finish mapping system (likely personnel costs)	Stormwater user fee
Equipment maintenance		Need to determine	Annual	SSA must determine the existing equipment that it will utilize for MS4, and if additional new equipment will be purchased	Stormwater user fee

EFC’s Recommended Budget to Contract with the LRCA

LRCA Costs of Annual Administrative Tasks

Task	Explanation	Cost
Written Public Education & Outreach Plan (PEOP)	2 hours @ $80 per hour (annual maintenance)	$160
Target Audience list	10 hours @ $80 per hour	$800
Material distribution	410 hours @ $80 per hour	$32,800
	Printing costs	$5,000
Written Public Involvement & Participation Plan (PIPP)	24 hours @ $80 per hour (annual maintenance)	$1,920
Promote/sponsor events (stream clean up, tree planting, etc.)	$3600 per event	$3,600
	Event costs	$1,000
Hold annual public meeting	Staff time to prep for event	$3,600
Solicit public feedback	100 hours @ $80 per hour	$8,000
Track attendees, meetings, events	80 to 100 hours per year	$7,000
	Total costs for administrative tasks:	**$63,880**

LRCA Costs of Annual Technical Tasks

Task	Explanation	Cost
System mapping	Finish system mapping and inventory	$16,000
Water quality improvement project prioritization	200 additional hours @ $80 per hour (years 1-3)	$16,000
	Total costs for technical tasks:	**$32,000**

APPENDIX B:
LRCA STREAMWALK DATASHEETS

Draft

The purpose of this Standard Operating Procedure (SOP) is to explain how to operate and navigate through the SSA's Trimble Juno 3B data collectors and use them effectively in the field to collect outfall information, identify different types of stormwater structures (i.e., pipes or swales), note catch basins in close proximity to the receiving waterway, and appropriately enter the required information into the data collectors for use in the Municipal Separate Storm Sewer System (MS-4) program, being carried out by the LRCA, SSA, and McLane & Associates.

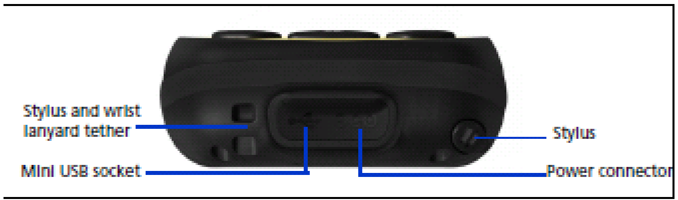
Equipment Overview

The SSA is currently implementing Trimble Juno 3B handheld data collectors for the use of collecting map grade latitude, longitude and information on all stormwater receiving structures and basins within the Scranton and Dunmore area.

Below is an overview of the Juno 3B basic controls.

Front View

Bottom View



Operation

1.→ Power on Juno 3B

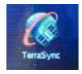
a.→ Hold the green power button at the top of the screen until the display lights up.

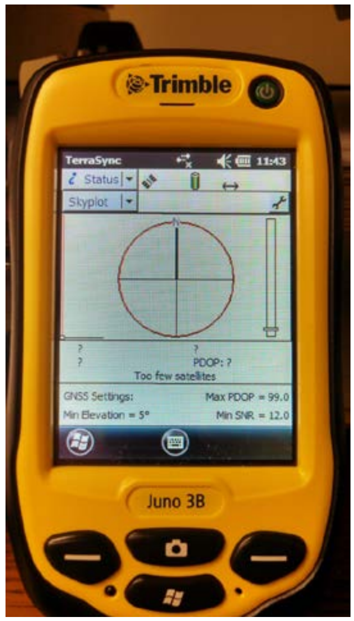
i.→ The screen will dim after a period of inactivity. If this happens simply push and immediately release the power button to turn the display back on.

- Once the unit is powered on the Windows Mobile ***home screen*** will be displayed, see image below.

2.→ Click the ***Start button***  to navigate to the ***Start screen***, see image above.

3.→ Remove the tethered stylus (*looks like a pen*) from the bottom of the Juno and gently press it against the screen while dragging it up the screen until you see the TerraSync icon.

4.→ Click the TerraSync icon  with the stylus. It may take a few moments for TerraSync to open. Once the program is open you will see the screen below.

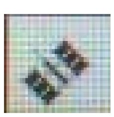


On this screen you should notice a few of the basic controls.

1. The Status drop down menu on the upper left corner of the screen

2. The green battery indicator at located at the upper middle of the screen

3. The satellite indicator located directly to the left of the battery indicator



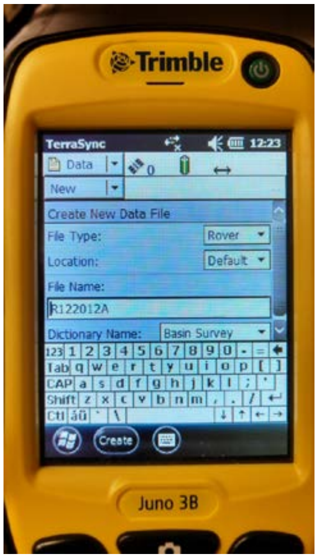
4. The digital keyboard control located at the lower center of the screen

All controls can be activated through the use of the stylus.

Operating the TerraSync software for creating a new job

1.→ Using the stylus click the **Status** dropdown button. After clicking it you should see the screen below.

2.→ From the Status dropdown menu click on **Data** with the Stylus. Once Data is clicked you should see the screen below and be in the Create New Data File screen.



Take notice that the digital keyboard appeared, the file name was automatically created and there is now a Create button at the bottom of the screen.

3.→ From the Create New Data File screen using the stylus click the **Create** button at the bottom of the screen. After clicking Create you should see the screen below and be in the Confirm Antenna Height screen.

4.→ From the Confirm Antenna Height Screen, using the stylus click **ok**. After clicking ok you should see the Data Collection screen below.

Collecting field data

The focus of this project is to identify all outfall structures flowing into receiving waterways within the Scranton / Dunmore area. To help identify these structures, they have been broken down into six categories:

1.→ Outfall Pipe
2.→ Swale
3.→ Creek Bed
4.→ Basin
5.→ Unknown
6.→ Manhole

1. Selecting the MS4 Point button

1.→ Make sure Terrasync is open and you are in the Data Collection screen.

2.→ Stand approximately 1'-2' back from the structure.

3.→ Using the stylus click the MS4 Point button on the data collection screen

- *Once the MS4 Point is clicked you must remain as still as possible. Once selected the data collector is recording data. Excess movement can shift the point.*
- *You should always try to take the points/pictures looking upstream.*

2. Crew Information

1.→ Click on the Crew Information dropdown menu
2.→ Select your given crew name

3. Picture

1.→ Click on the button that looks like a camera on the screen. The camera screen may take a few moments to appear.

- *If possible, take the picture looking upstream*

2.→ From the camera screen make sure that the entire structure is visible.

- *Excessive movement will shift the points*

3.→ Once the entire structure is visible in the screen, **firmly** press the camera button located below the screen 

4.→ When the picture has been taken the program will automatically return to the MS4 Point screen.

- *Notice that the picture field has been populated with a filename and time.*

4. Type of Asset

1. → Click on the Type of Asset dropdown menu.
2. → Select the type:
    a. Outfall Pipe
    b. Swale
    c. Creek Bed
    d. Basin
    e. Unknown
    f. Manhole

5. Receiving Waterway

1. → Click on the Receiving Waterway dropdown menu.
2. → Select the waterway:
    a. GRE (Green Run)
    b. KEY (Keyser Creek)
    c. LAC (Lackawanna River)
    d. LEA (Leach Creek)
    e. LEG (Leggetts Creek)
    f. LIN (Linde Creek)
    g. LUC (Lucky Run)
    h. MEA (Meadow Brook)
    i. ROA (Roaring Brook)
    j. SPR (Spring Brook)
    k. STA (Stafford-Meadow Brook)

6. Pipe Moisture

1. → Click on the Pipe dropdown menu.
2. → Select Wet or Dry

7. Pipe Size

1. → Using the stylus click the digital keyboard key located at the bottom of the screen.

2. → Record the diameter of the inside of the pipe in inches.

8. Pipe Material
1. → Click on the Pipe Material dropdown menu.
2. → Select Pipe Material:
    a. BR (brick)
    b. CAS (cast iron)
    c. CMP (corrugated metal)
    d. CP (non-reinforced concrete)

e. CSB (concrete segments)
f. DIP (ductile iron)
g. PVC (polyvinyl chloride)
h. VCP (vitrified clay)
i. WD (wood)
j. XXX (not known)
k. ZZZ (other – state in comments)

9. Comments
- Using the stylus click the digital keyboard key located at the bottom of the screen. 
  - Record anything unique about the structure, such as:
    a. Side of the stream the structure is on
    b. Maintenance that needs to be done (if pipe is caved in or needs to be cleaned out)
    c. Degree of erosion, if any
    d. Water characteristics (i.e., cloudy/clear, color, smell)
    e. Right of way issues (i.e., gates, fences, dogs)
    f. Possibility of a BMP

10. Using the stylus, click done at the bottom of the screen. Move to the next structure and repeat the process. When it returns to the Data Collection screen the observation is complete and you are ready to go to the next basin.

Types of Basins

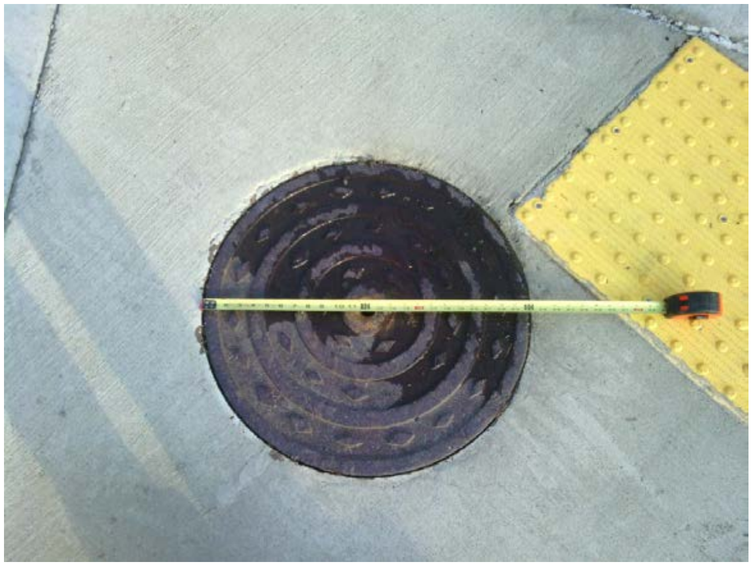
Combination Inlet – Grate in the street along with an opening at the curb. Commonly has a manhole on the sidewalk.

Curb Opening – Open pipe at the curb and commonly has a manhole on the sidewalk.

Highway Grate – Grate in street. Either contributes to a basin or directly to the combined or separated system. May have a manhole on the sidewalk.

Curb Inlet – Opening in curb and commonly has a manhole on sidewalk.

Basin – Manhole structure that receives flow from several of the above structures.



I-81 SWALE

General Notes	Watershed Area	4 Mi.^{2}
	Confluence	Lackawanna River at RM 15
	Order	1st Order Tributary
	Date	21-Aug-13
	Survey Staff	Sean McCauley, Bernie McGurl, Bridgette Robinson
	Weather	
Field Walk Observations	Starting Point	· Confluence with Lackawanna River at I-81 Bridge at exit 190. The confluence and lower open channel are accessible on gravel maintenance road adjacent to Boulevard Avenue near the Lackawanna County Recycling Center.
	Stream Bed & Banks	· Dry stream bed · A trapezoidal swale consists of rip-rap boulders on impervious geo-textile liner in stream bed near the confluence up through Boulevard Avenue and Olyphant Avenue to a point near the Marywood University athletic fields. From this point up to the I-81 junction, the watercourse consists of a large network of catch basins and culverts. · Heavy sediment load · Metals likely in sediment · Shallow banks
	Riparian Area	· Knotweed; goldenrod · Black locust
	Adjacent Neighborhoods	· Marywood University · O'Neil Highway/Blakely Street Commercial Corridor · Swinick residential subdivision · Keystone Industrial Park · Keystone Sanitary Landfill (KSL)
	Roads & Bridges	· Reeves Street · O'Neil Highway/Blakely Street · I-81
	Impervious Surface	· ~ 90% · Low Density Residential
	Estimated # of Storm Water Detention Facilities	· N/A
	#/Size of Pipes	· N/A
	Debris	· Measurable sediment load
	Trash	· N/A
	Infrastructure	· N/A
	Note:	· This is under Penn DOT permit responsibility.

MINOOKA RUN

General Notes	Watershed Area	2 Mi.^{2}
	Confluence	Lackawanna River at RM 7.4
	Order	1st Order Tributary
	Date	October 2 & 3, 2013
	Survey Staff	10/2 – Kelsey Biondo, Sean McCauley, Bernie McGurl, Bridgette Robinson; 10/3 – Kelsey Biondo, Sean McCauley, Bridgette Robinson
	Weather	60° F, Sunny
Field Walk Observations	Starting Point	· Confluence along east bank of Lackawanna River along Pennsylvania Northeast Railroad Authority's Lackawanna Valley Line; about one half mile north of Davis Street Bridge.
	Stream Bed & Banks	· Original stream channel through stone arch bridge under railway to the Lackawanna River is evident. Channel upgrade of railway has been blocked and diverted by mining and development activities (possibly circa 1930s). There is a 10 inch corrugated metal culvert, of unknown ownership and origin, emanating from fill-debris in channel blockage that needs to be identified. · The blocked stream channel seems to have been rerouted to a point in the cliffside topography above the railroad about 800 ft up river from the original blocked channel location near the dead end of McCarthy Street.
	Riparian Area	· Grassy swale (along residential properties and small park)
	Adjacent Neighborhoods	· Residential (along Colliery Avenue, Cedar Avenue, Birney Avenue, and Pittston Avenue) · Neighborhood commercial (at Davis Street, Birney Avenue, and Pittston Avenue)
	Roads & Bridges	· Stone arch culvert bridge under railway circa 1890 · Unknown culvert at Colliery Avenue · Concrete culvert bridge at Cedar Avenue · Unknown culverts at Pittston Avenue and Hamm Court · Unknown culverts at Burke Street and Cemetery Avenue
	Impervious Surface	· ~ 40% · Low Density Residential · Neighborhood Commercial · Industrial
	Estimated # of Storm Water Detention Facilities	· 7 Facilities (Zero Watershed) o Scranton Health Care Center o McCarthy Street Townhouses o Laurel Woods o CVS Pharmacy o Canton Properties o Waffle House o Montage Motors Car Lot Expansion
	#/Size of Pipes	· 1 pipe · Size: 18 inches
	Debris	· N/A
	Trash	· Litter and yard waste
	Infrastructure	· McCarthy Street trunk line to sewer plant is affected by washout of nearby channel diversion

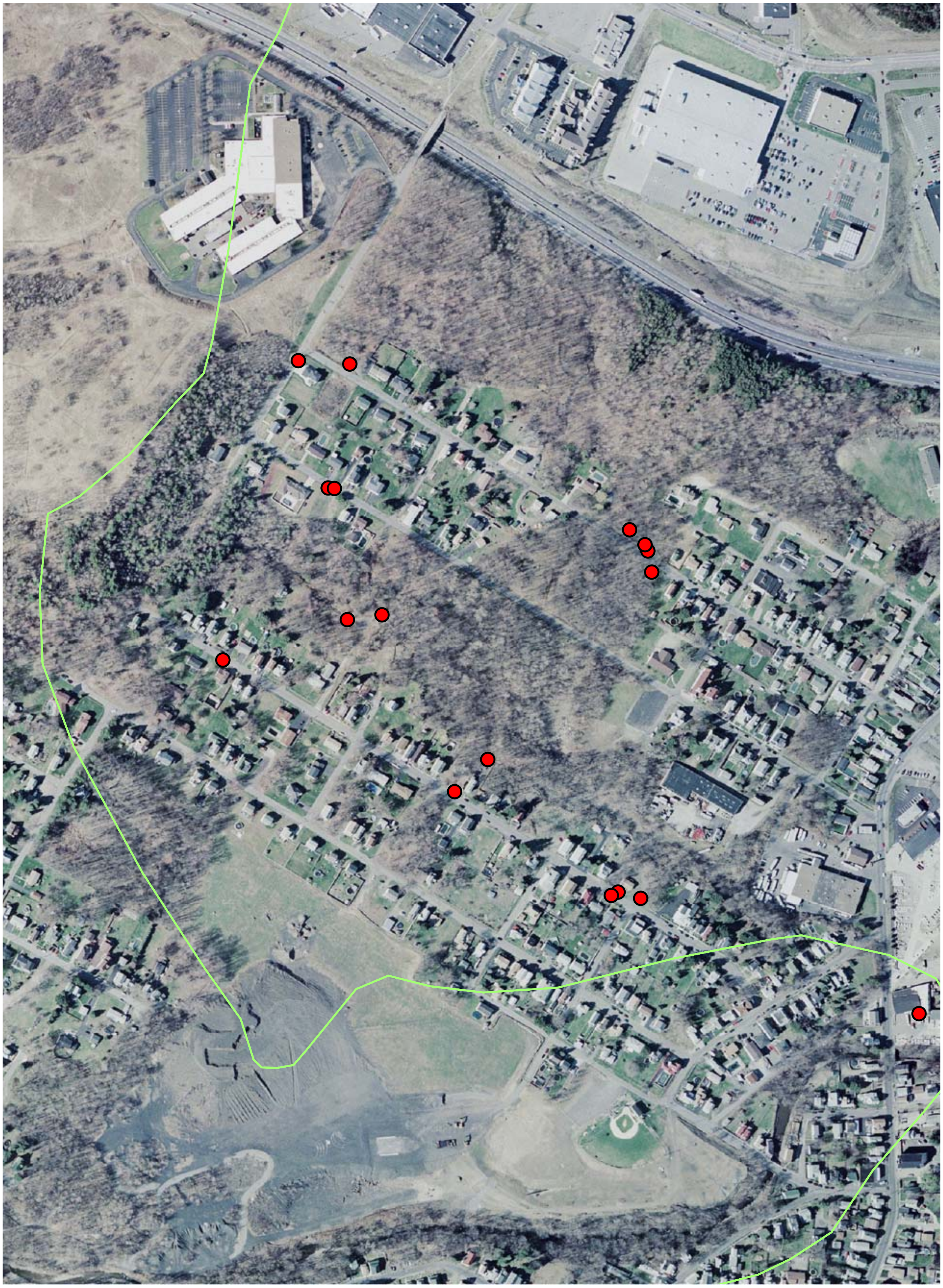
MOUNT PLEASANT RUN

General Notes	Watershed	1 Mi.^{2}
	Confluence	Lackawanna River at RM 11
	Order	1st Order Tributary
	Date	NA
	Survey Staff	NA
	Weather	NA
Field Walk Observations	Starting Point	· Confluence with Lackawanna River at Mulberry Street/North Scranton Expressway Bridge and Lackawanna River
	Stream Bed & Banks	· Confluence with the Lackawanna River through a flap-gate in flood control works adjacent to CSO #18 · Channel is rip-rapped swale · Adjacent storm water detention basin developed as part of the Expressway Bridge relocation covers ~ 2 acres
	Riparian Area	· Original stream channel and riparian area were eliminated by mining and urban development activities
	Adjacent Neighborhoods	· Mount Pleasant Business Park · The Shops at Linden Place · Scranton High School
	Roads & Bridges	· North Scranton Expressway · Seventh Avenue · Linden Street
	Impervious Surface	· ~ 50% · Neighborhood Commercial · Institutional Campus
	Estimated # of Storm Water Detention Facilities	· N/A
	#/Size of Pipes	· N/A
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· N/A
	Note:	· No field work was conducted on this tributary; feasible to look into in the future.

CARTER CREEK		
General Notes	Watershed Area	1.5 $Mi.^2$
	Confluence	Lackawanna River at RM 14.1
	Order	1^{st} Order Tributary
	Date	5-Apr-13
	Survey Staff	Kelsey Biondo, Kayleigh Cornell
	Weather	55° F, Sunny
Field Walk Observations	Starting Point	· Confluence with Lackawanna River behind Advanced Textile Composites Warehouse · Presently a stone culvert and CSO system; discharges into Lackawanna River through Raines St. CSO
	Stream Bed & Bank	· Dry stream bed · Shallow banks · Underground until headwall at Olyphant Avenue
	Riparian Area	· Wooded · Grassland
	Adjacent Neighborhoods	· Green Ridge Little League on Olyphant Avenue
	Roads & Bridges	· Follows East Parker Street to Olyphant Avenue · Ends at I-81
	Impervious Surface	· ~ 50% · Low Density Residential · Open Space
	Estimated # of Storm Water Detention Facilities	· 4 Facilities (Green Ridge Health Care Centers, Marywood University, Armed Forces Training Center, Stor-way Self Storage Facility)
	#/Size of Pipes	· 1 pipe, size = 3 inches
	Debris	· Headwaters blocked with debris
	Trash	· Residential litter and tires (Olyphant Avenue to I-81)
	Infrastructure	· Sheet flow to basements of residential areas (from Green Ridge Little League Field)

GREEN BUSH RUN

General Notes	Watershed Area	1 Mi.^{2}
	Confluence	Lackawanna River at RM 14.6
	Order	1st Order Tributary
	Date	4-Apr-13
	Survey Staff	Kelsey Biondo, Kayleigh Cornell, Sean McCauley, Bernie McGurl
	Weather	
Field Walk Observations	Starting Point	· Behind Johnny's Car Wash on Main Avenue
	Stream Bed & Banks	· Underground · Culverts
	Riparian Area	· Wooded
	Adjacent Neighborhoods	· Career Technology Center (Vo Tech)
	Roads & Bridges	· N. Main Avenue · Opens at Green Bush Street uphill from Mulley Avenue
	Impervious Surface	· ~ 30% · Low Density Residential o Wilbur Street resident's yard affected by new development runoff from across the street · Commercial
	Estimated # of Storm Water Detention Facilities	· 2 Facilities (Zero Watershed) o Johnson College Health Sciences o Toyota Scion of Scranton
	#/Size of Pipes	· 5 pipes · Sizes range from 6-36 inches
	Debris	· N/A
	Trash	· Residential trash in wooded area (behind Wilbur Street and Reese Street)
	Infrastructure	· Inlet clogged (Greenbush Street) · Grate is missing over basin (Greenbush Street) · Curb needs to be fixed (Greenbush Street) · Lack of storm water infrastructure (Wilbur Street after new construction)

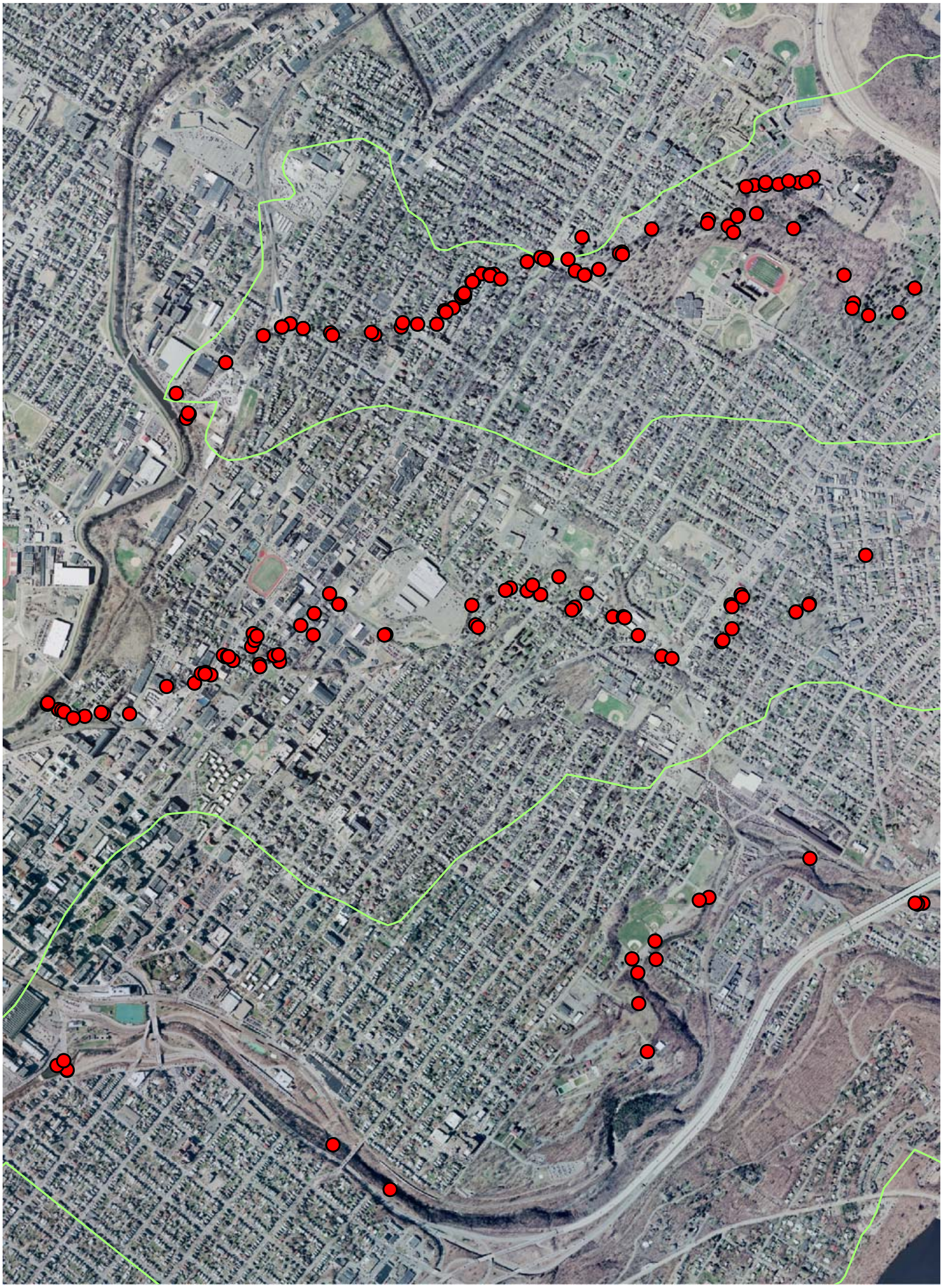


PHILO CREEK

General Notes	Watershed Area	2 $Mi.^2$
	Confluence	Lackawanna River at CSO #7 Philo Street Regulator
	Order	1st Order Stream
	Date	4-Sep-13
	Survey Staff	Kelsey Biondo, Bernie McGurl, Bridgette Robinson
	Weather	78° F, Sunny
Field Walk Observations	Starting Point	· Tripp Park storm water basin at Court Street and Euclid Avenue
	Stream Bed & Banks	· Starts out as swales in Tripp Park residential development · Drains through subdivision storm water basin to culvert and catch basins at Court Street under the Expressway Bridge · Flows through culvert into open channel · Opens up into severely degraded remnant of its original stream bed 400 ft upstream of Pierce Street dead end; channel flows through coal mine waste to invert at Peirce Street · Steep banks ~ 6 ft · During rain storm events, must have heavy flow from development, due to deep splash pool, which potentially leaches into mine pool · Flows into catch basin of CSO system at dead end of Pierce Street · From CSO, flows into Lackawanna River through Philo Street Regulator
	Riparian Area	· Grassland · Wooded
	Adjacent Neighborhoods	· Bull's Head · Tripp Park
	Roads & Bridges	· Court Street · Pierce · Scranton Expressway Overpass · Canadian Pacific Railway Overpass
	Impervious Surface	· ~ 70% [Strip mining remnants, High density residential]
	Estimated # of Storm Water Detention Facilities	· 1 facility (Zero Watershed) o 1 open basin for Tripp Park neighborhood (Court Street & Euclid Avenue)
	#/Size of Pipes	· N/A
	Debris	· Strip mining remnants (wooded area off Pierce Street)
	Trash	· Tires, electronics, etc (wooded area off Pierce Street)
	Infrastructure	· Inverts at Court Street catch basins · 48 inch culvert from Court Street to open channel · CSO line to Philo Street Regulator

PINE BROOK

General Notes	Watershed Area	2.6 Mi.^{2}
	Confluence	Lackawanna River at RM 11.2
	Order	1st Order Tributary
	Date	April 25 & 26, 2013
	Survey Staff	4/25 – Kelsey Biondo, Sean McCauley, Bernie McGurl; 4/26 – Kelsey Biondo, Bernie McGurl
	Weather	4/25 - 59° F; 4/26 - 60° F
Field Walk Observations	Starting Point	· Confluence with Lackawanna River off of railroad tracks near Olive Street Bridge
	Stream Bed & Banks	· All underground
	Riparian Area	· Non-existent
	Adjacent Neighborhoods	· Hill Section
	Roads & Bridges	· W. Olive Street · Wyoming Avenue · N. Washington Avenue · Second Street · E. Gibson Street · New Street · Poplar Street · Monroe Avenue · Clay Avenue · S. Blakely Street · Quincy Avenue · N. Webster Avenue · Green Street
	Impervious Surface	· ~ 95% · High Density Residential · Neighborhood Commercial
	Estimated # of Storm Water Detention Facilities	· 9 Facilities (Zero Watershed) o Overlook at Clay o Scranton Prep Arts and Sciences Center o Shiloh Baptist Church (TCMC Parking Lot) o Commonwealth Medical College o Normandy Holdings Mid-Rise Apartments o Tobyhanna Federal Credit Union o Penn's Furniture Parking and Sidewalk Improvements o COLTS Intermodal Facility o Dunkin' Donuts
	#/Size of Pipes	· N/A
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· Needs street sweeping throughout; many catch basin inlets are clogged with street litter and debris



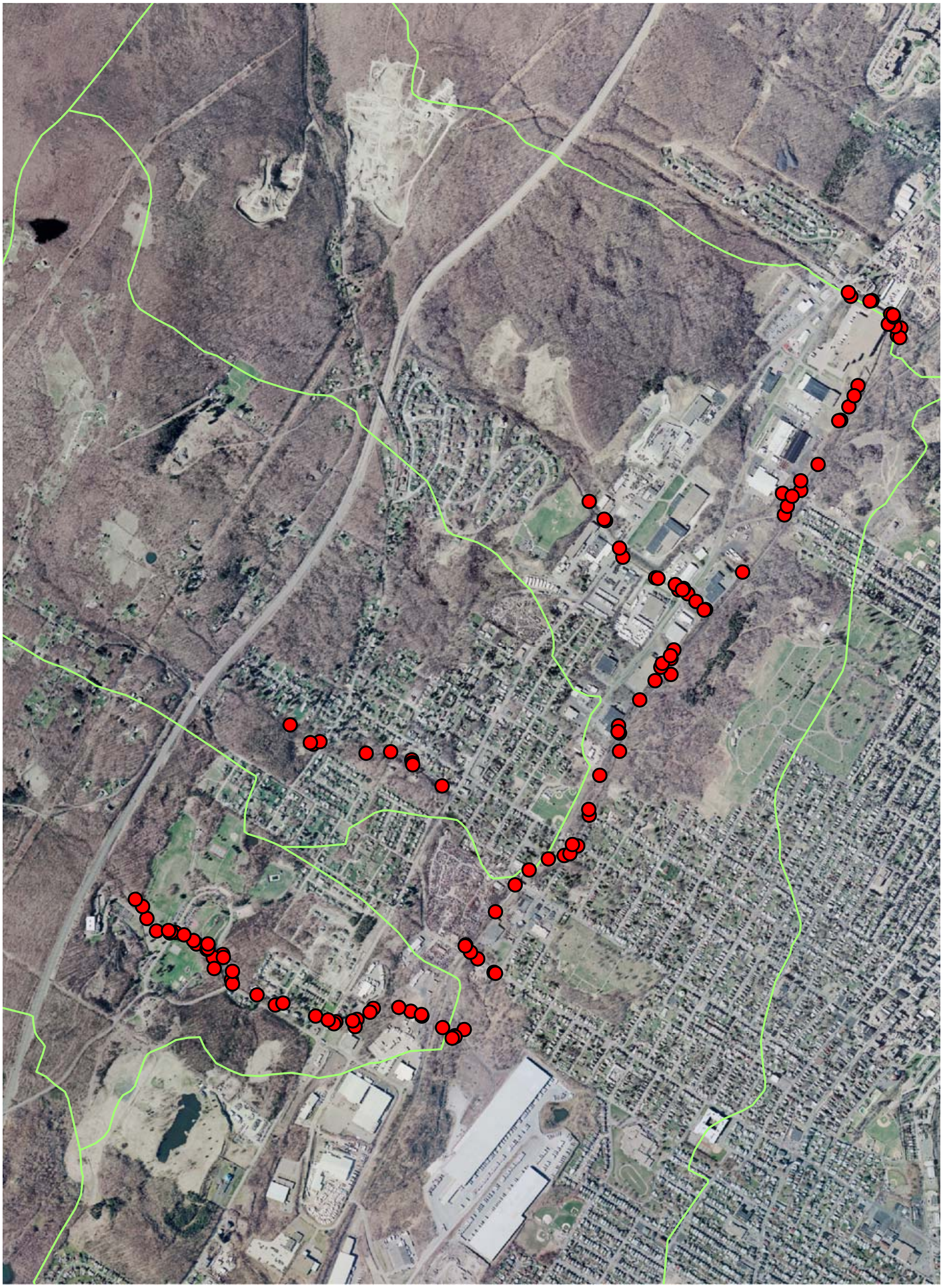
SCRANTON DICKSON CITY BASINS		
General Notes	Watershed	1 $Mi.^2$
	Confluence	Lackawanna River
	Date	22-Aug-13
	Survey Staff	Sean McCauley, Bernie McGurl, Bridgette Robinson
	Weather	80° F, Rainy
Field Walk Observations	Starting Point	· Confluence with Lackawanna River downstream side of west bank pier footer of I-81 overpass
	Stream Bed & Banks	· N/A
	Riparian Area	· Grassland · Cattails
	Adjacent Neighborhoods	· Viewmont Mall · Various “Big Box” stores
	Roads & Bridges	· Commerce Boulevard · I-81
	Impervious Surface	· ~ 95% · Commercial
	Estimated # of Storm Water Detention Facilities	· N/A
	#/Size of Pipes	· 4 pipes · Sizes range from 12-36 inches
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· N/A

WALMART TRIBUTARY

General Notes	Watershed Area	1 $Mi.^2$
	Confluence	No confluence with Lackawanna River
	Order	1^{st} Order Tributary
	Date	28-Aug-13
	Survey Staff	Kelsey Biondo, Bernie McGurl, Bridgette Robinson
	Weather	82° F, Cloudy
Field Walk Observations	Starting Point	· Colan Court
	Stream Bed & Bank	· Dry stream bed · Steep banks · Portion of bank composed of red ash
	Riparian Area	· Covered in knotweed · Densely wooded
	Adjacent Neighborhoods	· Taylor · Wal-Mart
	Roads & Bridges	· Colan Court · Main Avenue
	Impervious Surface	· ~ 60% · Neighborhood Commercial · Industrial · Open Space
	Estimated # of Storm Water Detention Facilities	· 1 new open basin under construction on Wal-Mart site at the time of survey
	#/Size of Pipes	· 2 pipes · Sizes range from 24-36 inches
	Debris	· Heavy tree debris in multiple locations · Red ash boulders eroding stream bed
	Trash	· Tires (along Colan Court) · Culligan tank (entrance of wooded area) · Residential garbage (along Colan Court)
	Infrastructure	· Culvert running under railroad 85% blocked · Undercut berm on left bank near construction site

KEYSER CREEK

General Notes	Watershed Area	8.58 $Mi.^2$
	Confluence	Lackawanna River at RM 7.3
	Order	2nd Order Tributary
	Date	May 9 & 16, 2013
	Survey Staff	Kelsey Biondo, Sean McCauley, Bridgette Robinson
	Weather	
Field Walk Observations	Starting Point	· Kane Trucking facility near Scranton/Taylor boundary (Stauffer Industrial Park)
	Stream Bed & Banks	· Rain the day before made active flow; otherwise dry streambed · Natural cobblestone downstream · Bank becomes steep near Luzerne Street · Channeled where splits with Lindy Creek · Natural downstream with shallow banks
	Riparian Area	· Wooded downstream with Silver maple, River birch, and Red maple · Understory covered in knotweed
	Adjacent Neighborhoods	· Fawnwood residential area ·Stauffer & Hampton Industrial Parks ·Keyser Ave – residential, commercial, industrial
	Roads & Bridges	· Keyser Avenue · Luzerne Street · N. South Road · Simplex Drive · Washburn Street · Sherman Avenue
	Impervious Surfaces	· ~ 75% · Industrial · Neighborhood Commercial
	Estimated # of Storm Water Detention Facilities	· 4 Facilities o Kane Properties o Isaac Tripp Elementary School o Colts o Compression Polymers (new owners)
	#/Size of Pipes	· 21 pipes · Sizes range from 3-36 inches
	Debris	· Sediment in concrete channel (near Washburn Street Bridge) · Debris in concrete channel (near S. Sherman Ave) · Dam, possibly animal-made (behind W Side Falcon Football Field) · Debris covering pipes (near Simplex Dr) · Sediment in concrete channel (where Keyser Creek runs under Keyser Avenue, near Master Halco Fence Company)
	Trash	· Downstream side of Washburn Street Bridge · Behind warehouses between railroad tracks · End of Philo Street & Keyser Avenue · Tarp inside pipe (near building next to Erie Materials) · Rusty water coming from Master Halco warehouse (NPDES Industrial Discharge Permit holder)
	Infrastructure	· Pipe partially buried (S. Sherman Street) · Pipe backflows, flooding parking lot of Erie Materials; pipe severely damaged · Pipe buried under pavement rubble, in need of bank stabilization (corner of Simplex Drive & N. South Road) · Point source pollution from Master Halco warehouse
	Tributaries	· Lindy Creek flows into Keyser Creek [RM 2.5, < 10 mi.2 watershed] · Lucky Run flows into Keyser Creek [RM 2.0, < 10 mi.2 watershed]



LINDY CREEK

General Notes	Watershed Area	<10 Mi.^{2}
	Confluence	Keyser Creek at RM 2.5
	Order	1st Order Tributary
	Date	9-May-13
	Survey Staff	Kelsey Biondo, Sean McCauley, Bridgette Robinson
	Weather	68° F, Cloudy
Field Walk Observations	Starting Point	· Confluence of Keyser Creek near Washburn Street Bridge
	Stream Bed & Banks	· Downstream channeled · Natural at Frink Street · Steep banks ~ 8 ft · Erosion at Frink Street
	Riparian Area	· Wooded
	Adjacent Neighborhoods	· Keyser Valley
	Roads & Bridges	· S. Keyser Avenue · S. Dewey Avenue Bridge · Frink Street
	Impervious Surface	· ~ 30% · Low Density Residential
	Estimated # of Storm Water	· N/A
	#/Size of Pipes	· 3 pipes · Sizes range from 3-12 inches
	Debris	· N/A
	Trash	· Residential trash on sediment in concrete channel
	Infrastructure	· Breached dam structures: remnants of abandoned water works circa 1890

LUCKY RUN

General Notes	Watershed Area	<10 $Mi.^2$
	Confluence	Keyser Creek at RM 2
	Order	1^{st} Order Tributary
	Date	3-May-13
	Survey Staff	Kelsey Biondo, Sean McCauley
	Weather	72° F, Partly Cloudy
Field Walk Observations	Starting Point	· Confluence with Keyser Creek at Stauffer Industrial Park
	Stream Bed & Banks	· Shallow banks · Covered in knotweed · Scattered tree cover · Stream bank restoration using concrete and stone
	Riparian Area	· Grassland · Wooded
	Adjacent Neighborhoods	· Park Edge Development · Keyser Terrace · McDade Park
	Roads & Bridges	· Keyser Avenue · Park Edge Lane
	Impervious Surface	· ~ 45% · Open Space · Industrial
	Estimated # of Storm Water Detention Facilities	· 1 Facility o Estes Express Lines
	#/Size of Pipes	· 10 pipes · Sizes range from 3-36 inches
	Debris	· Heavy tree debris rerouting stream, eroding right bank (behind Estes Express Lines)
	Trash	· N/A
	Infrastructure	· Culvert under Keyser Avenue undergoing replacement during 2013-14

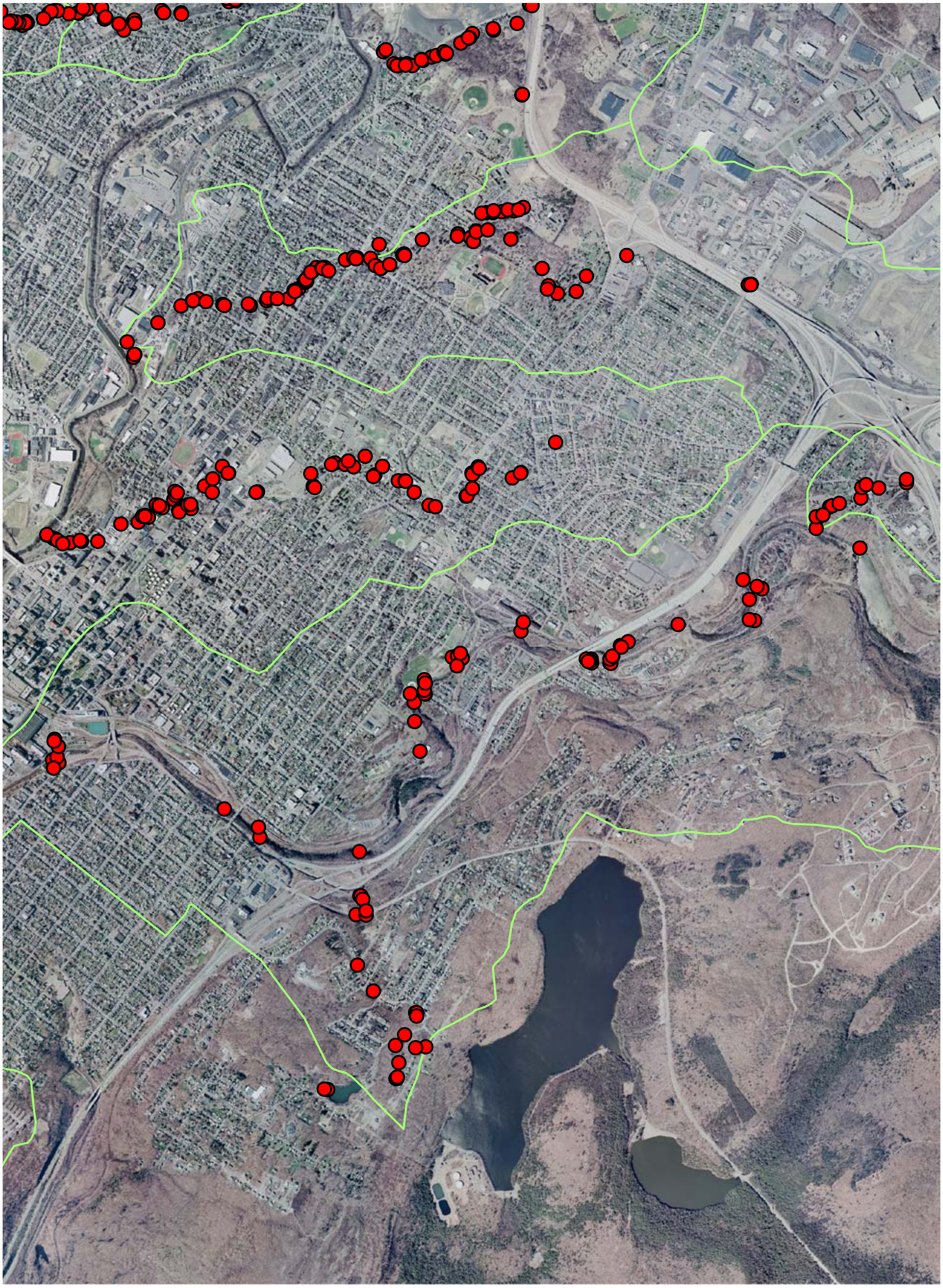
STAFFORD-MEADOW BROOK		
General Notes	Watershed Area	14.11 $Mi.^2$
	Confluence	Lackawanna River at RM 9.2
	Order	2^{nd} Order Tributary
	Date	24-Jul-13
	Survey Staff	Kelsey Biondo, Sean McCauley, Bernie McGurl, Bridgette Robinson
	Weather	74° F, Cloudy
Field Walk Observations	Starting Point	· Confluence with Lackawanna River at S. Washington Avenue Bridge
	Stream Bed & Banks	· Open concrete channel · Underground by Pittston Avenue
	Riparian Area	· N/A
	Adjacent Neighborhoods	· Meanders underground through high density residential area · Edges St. Mary's Cemetery
	Roads & Bridges	· Pittston Avenue · I-81
	Impervious Surface	· ~ 90% · Industrial · High Density Residential
	Estimated # of Storm Water Detention Facilities	· 4 Facilities o Autism Center at Friendship House o Friendship House o Mountain Lake Estates subdivision o Proposed 9-Hole USGA Golf Course
	#/Size of Pipes	· 1 pipe · Size: 24 inches
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· N/A

MOUNTAIN LAKE RUN

General Notes	Watershed Area	2 $Mi.^2$
	Confluence	Stafford-Meadow Brook
	Order	1st Order Tributary
	Date	September 4 & 5, 2013
	Survey Staff	9/4 – Kelsey Biondo, Bernie McGurl, Bridgette Robinson; 9/5 – Kelsey Biondo, Sean McCauley, Bridgette Robinson
	Weather	9/4 - 78° F, Sunny; 9/5 - 72° F, Sunny
Field Walk Observations	Starting Point	· Mattes Community Center & Marine Corps League Museum on Wintermantle Avenue
	Stream Bed & Banks	· Natural 2 to 3 ft channel width · Shallow banks ~ 2 ft · Many rock ledges and splash pools
	Riparian Area	· Native plants (Red oak, Witch hazel, Mountain laurel) · Small meadow patches with Little bluestem and other native grasses/herbaceous plants
	Adjacent Neighborhoods	· Mountain Lake Estates · Robinson Park · Bolus subdivision
	Roads & Bridges	· Stream drops into a culvert system below Wintermantle Avenue
	Impervious Surface	· ~ 30% · Low Density Residential · Open Space
	Estimated # of Storm Water Detention Facilities	· 4 Facilities (Stafford-Meadow Brook Subwatershed) o Mountain Lake Estates subdivision o Proposed 9-Hole USGA Golf Course o Friendship House o Autism Center at Friendship House
	#/Size of Pipes	· N/A
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· Impoundment structure at Mountain Lake · Historic WPA stone masonry walls and culverts at Mattes Community Center: Hopkins Falls circa 1938 · Culvert system under Wintermantle Avenue, Moltke Avenue, Erie & Wyoming Valley Railroad Corridor, and I-81 · Confluence with Stafford-Meadow Brook via culvert along I-81 median to cemetery bridges

ROARING BROOK

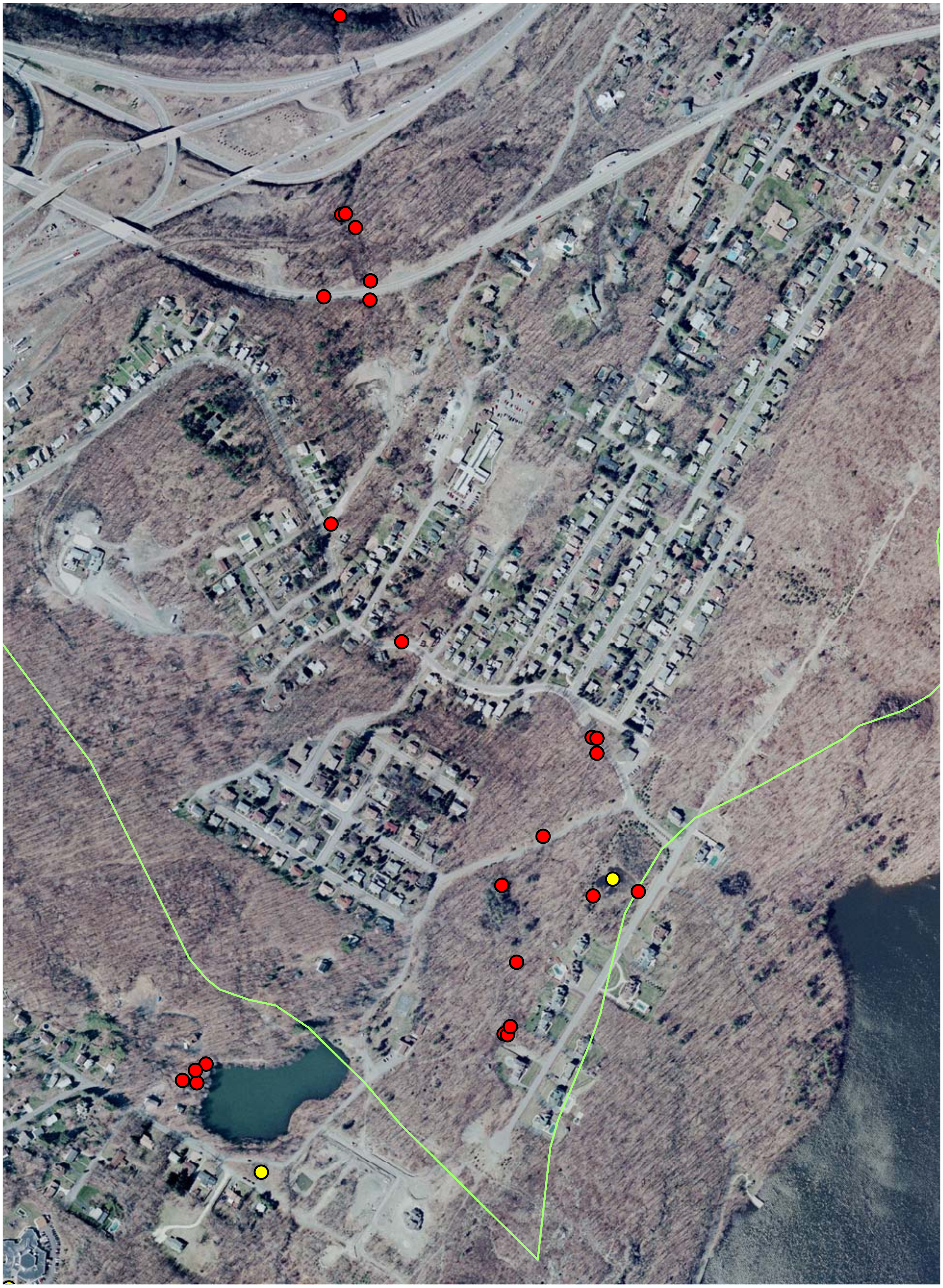
General Notes	Watershed Area	53.68 Mi.^{2}
	Confluence	Lackawanna River at RM 9.7
	Order	3rd Order Tributary
	Date	May 2,10, & 22, 2013
	Survey Staff	5/2 – Kelsey Biondo, Sean McCauley, Bernie McGurl, Bridgette Robinson; 5/10 – Sean McCauley, Bernie McGurl, Bridgette Robinson; 5/22 – Kelsey Biondo, Sean McCauley, Bridgette Robinson
	Weather	5/2 - 76° F, Sunny; 5/10 - 74° F, Cloudy; 5/22 - 89° F, Cloudy
Field Walk Observations	Starting Point	· Confluence with Lackawanna River near S. Washington Avenue & Birch Street Bridge
	Stream Bed & Bank	· Open concrete channel · Opens at University of Scranton/Ridge Row · Steep banks both natural & concrete channel · ~ 10 ft
	Riparian Area	· Upstream of Ridge Row wooded with rock outcrops · Nay Aug Gorge & Falls: National Geologic Landmark Registry · Upstream of Nay Aug: predominantly natural channel; 40-60 ft in width; mostly intact riparian canopy; some steep slopes and rock ledges; some influence of railroad embankments; abandoned mine land and outside auto salvage yard storage drainage impacts
	Adjacent Neighborhoods	· Central City Scranton · Hill Section · South Scranton/Nativity · University of Scranton · Oakmont · Dunmore · Bunker Hill · Denaples Auto & Salvage
	Roads & Bridges	· I-81 · Moosic Street/Stafford Ave · Central Scranton Expressway · Harrison Avenue Bridge · Cedar Ave · S. Washington Ave · 6 railroad bridges
	Impervious Surface	· ~ 60% · Downtown Commercial · High Density Residential · Abandoned Mine Land
	Estimated # of Storm Water Detention Facilities	· 12 facilities o Medallion Parking Garage o Brennan Hall/Kania School of Management o University of Scranton New Residence Hall o University of Scranton Parking Lot o University of Scranton Residence Hall (Condron Hall) o Wheeler Green o John G. Whittier Elementary School o CMC Parking Garage o Medical Suites o CVS Pharmacy o L.A. Bank (Wells Fargo) o Mountain Lake Estates
	#/Size of Pipes	· 30 pipes · Sizes range from 6-48 inches
	Debris	· Wide gravel & sand bar (under Cedar Avenue Bridge)
	Trash	· Dumped garbage (along railroad near step falls)
	Infrastructure	· Corroding pipe (near Harrison Avenue Bridge) · Corroding pipe (near Ash Street Bridge) · Sheet flow runoff (from parking lot of E Scranton Little League Field) · Dilapidated pipe (near Mill Street) · Potential pipe underneath concrete slab (near E Scranton Little League Field) · AMD (off of Park S on bank of Roaring Brook) · Inlet pipe needs to be cleaned (near Mill Street by railroad tracks)
	Tributaries	· East Mountain Run o 4 mi.^{2} watershed o RM 2 · Little Roaring Brook o < 10 mi^2 watershed o RM 4.5



LITTLE ROARING BROOK		
General Notes	Watershed Area	8 Mi.^{2}
	Confluence	Roaring Brook at RM 4
	Order	2nd Order Tributary
	Date	22-May-13
	Survey Staff	Kelsey Biondo, Sean McCauley, Bridgette Robinson
	Weather	89° F, Cloudy
Field Walk Observations	Starting Point	· Dunmore Reservoir No. 1
	Stream Bed & Bank	· Open concrete channel · Shallow banks o Natural o Bank repair
	Riparian Area	· Wooded
	Adjacent Neighborhoods	· Sport Hill: Low Density Residential · Drinker Street & Tigue Street
	Roads & Bridges	· I-84 · I-380 · I-81 · US-6
	Impervious Surface	· ~ 40% · Neighborhood Commercial
	Estimated # of Storm Water Detention Facilities	· 1 Facility (Roaring Brook Subwatershed) o PennDOT basin adjacent to Tigue Street exit & railroad corridor
	#/Size of Pipes	· 8 pipes · Sizes range from 6-24 inches
	Debris	· Heavy sediment load throughout
	Trash	· Some trash & debris along waterfalls between Lackawanna Railroad & Drinker Street
	Infrastructure	· N/A
	Tributaries	· 3 unnamed

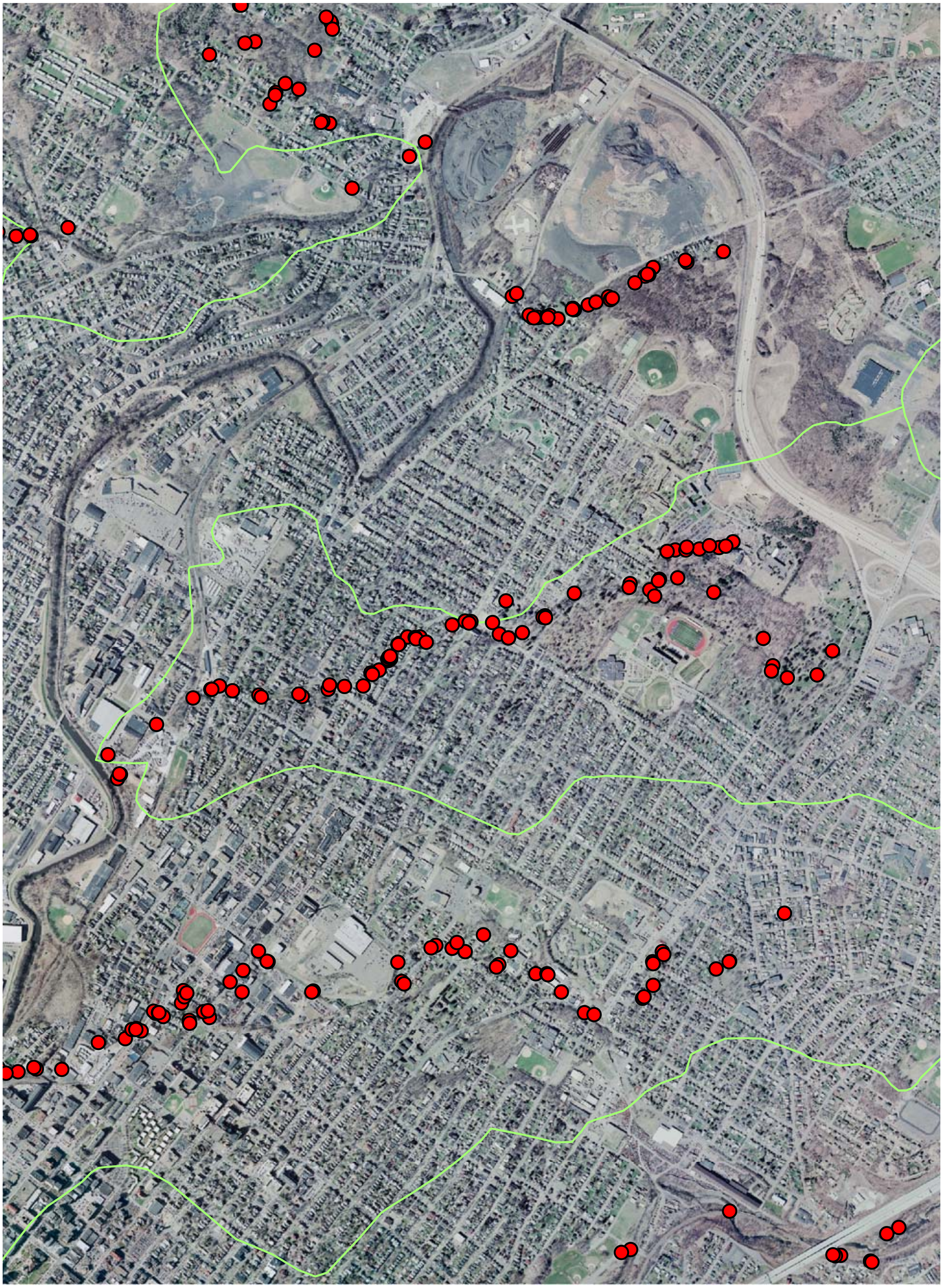
EAST MOUNTAIN RUN

General Notes	Watershed Area	4 $Mi.^2$
	Confluence	Roaring Brook at RM 2
	Order	1^{st} Order Tributary
	Date	May 23 & July 24, 2013
	Survey Staff	5/23 - Kelsey Biondo, Sean McCauley, Bernie McGurl; 7/24 – Sean McCauley
	Weather	76° F, Cloudy
Field Walk Observations	Starting Point	· Confluence with Roaring Brook
	Stream Bed & Banks	· Natural · Steep banks · Rock wall channel (Lilac Lane & East Mountain Road) · Detention pond within Mountain Lake Estates
	Riparian Area	· Heavily wooded
	Adjacent Neighborhoods	· East Mountain Road residential · Robinson Park · Mountain Lake Estates
	Roads & Bridges	· PA Route 307 · East Mountain Road · Decommissioned railroad bridges (Erie & Wyoming Valley/Pocono Northeast Railroad) · I-81 culverts
	Impervious Surface	· ~ 35% · Low Density Residential · Open Space
	Estimated # of Storm Water Detention Facilities	· 1 Facility (Roaring Brook Subwatershed) o Mountain Lake Estates subdivision
	#/Size of Pipes	· 2 pipes · Sizes: 24, 36 inches
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· N/A



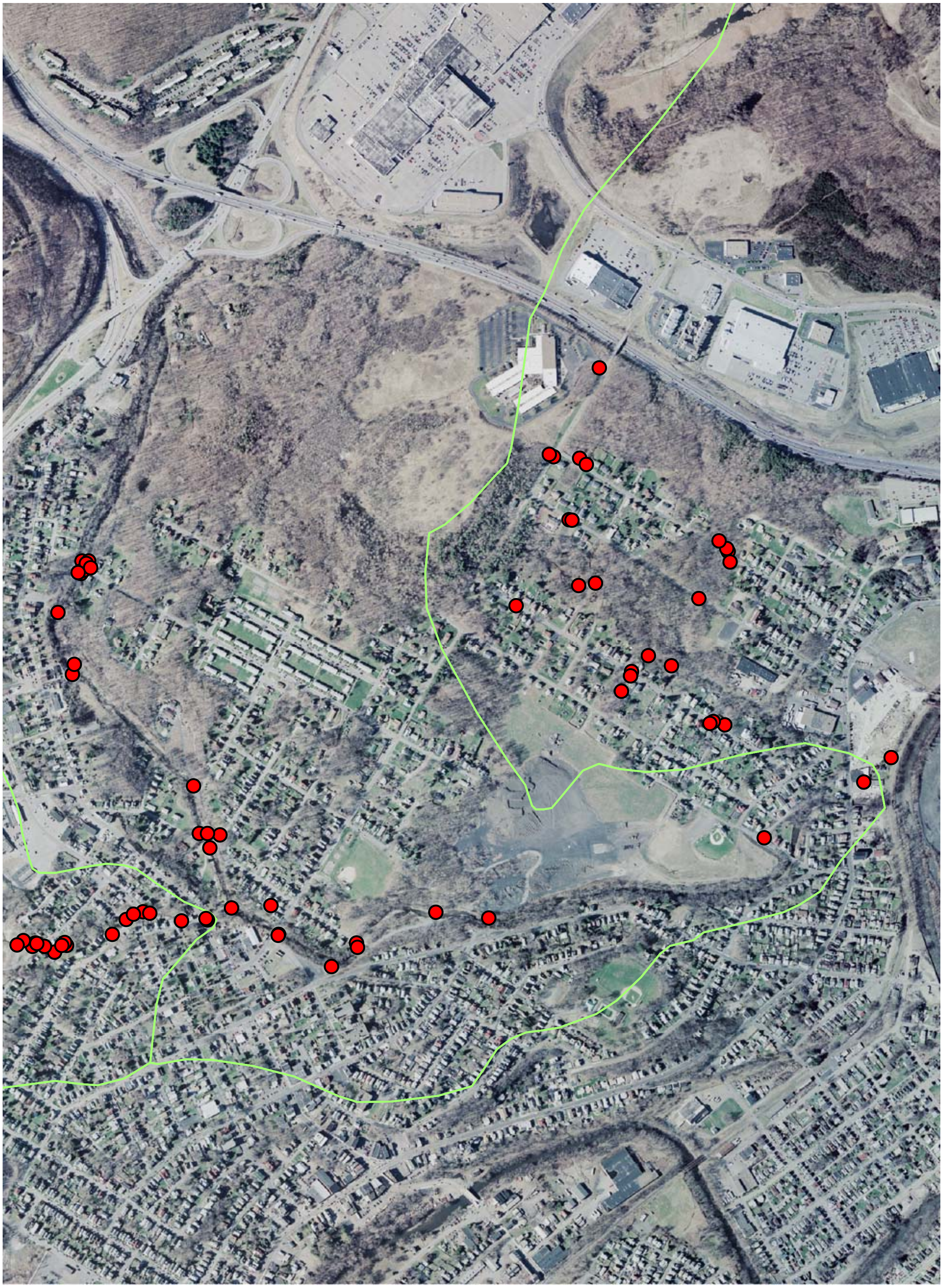
MEADOW BROOK

General Notes	Watershed Area	2.45 Mi.^{2}
	Confluence	Lackawanna River at RM 12
	Order	1st Order Tributary
	Date	April 11 & 18, 2013
	Survey Staff	4/11 - Kelsey Biondo, Sean McCauley, Bernie McGurl; 4/18 – Kelsey Biondo, Sean McCauley
	Weather	4/11 - 54° F; 4/18 - 59° F
Field Walk Observations	Starting Point	· Confluence with Lackawanna River near Glenn Street
	Stream Bed & Banks	· Mostly underground in culverts · Surfaces as open concrete channel · Becomes natural in south campus on Marywood University until Dunmore Cemetery · Dry stream bed
	Riparian Area	· Wooded · Mountain laurel
	Adjacent Neighborhoods	· Hollywood & Green Ridge · Marywood University · Forest Hill Cemetery · Dunmore Cemetery
	Roads & Bridges	· Culvert under roadway in Dunmore Cemetery to Blakely Street · Madison Avenue · Stone arch bridges in Forest Hill Cemetery · Jefferson Avenue Bridge · Extensive culvert system from Electric Street through Washington Avenue, Sturges Park, Wyoming Avenue, Delaware Street, Penn Avenue, Green Ridge Street, Capouse Avenue, Monsey Avenue, Marion Street, Sanderson Avenue, Glenn Street to confluence with Lackawanna River
	Impervious Surface	· ~ 70% · Industrial · High Density Residential · Open Space
	Estimated # Storm Water Detention Facilities	· 1 Facility o Swift Fence Company
	#/Size of Pipes	· 7 pipes · Sizes range from 3-24 inches
	Debris	· Tree debris (top of Woodlawn Street & Madison Avenue) · Deposition of floral waste and landscape waste (Forest Hill Cemetery) · Tree & large woody debris in creek bed (between Forest Hill Cemetery & Dunmore Cemetery)
	Trash	· Creek bed full of debris (behind former Scranton School for the Deaf) · Debris-filled stream bed (behind Marywood Science Building)
	Infrastructure	· Bank stabilization (behind abandoned home near Green Ridge Club) · Sheet flow runoff (from Madison Avenue) · Culvertized creek caving (metal plate cover near Ryerson Ave) · Large sediment deposits (near Jefferson Ave) · Jefferson Avenue Bridge at risk of collapsing; creek full of rubble · Pipe crushed & clogged (near Jefferson Avenue Bridge) · Clogged vitrified clay pipe (near Jefferson Ave) · Collapsed deck of bridge (near Jefferson Avenue Bridge)



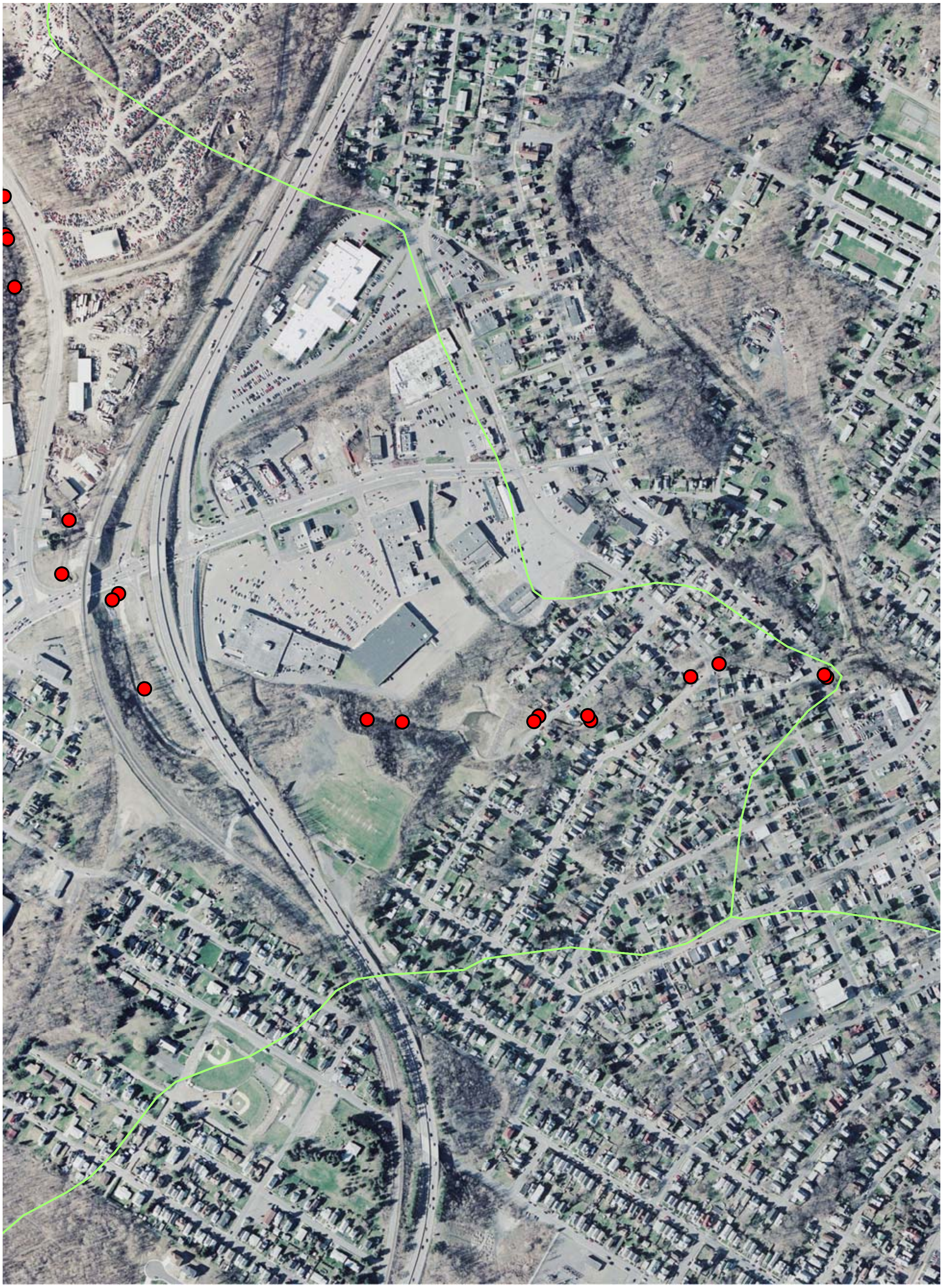
LEGGETTS CREEK

General Notes	Watershed Area	18.46 Mi.^{2}
	Confluence	Lackawanna River at RM 14.5
	Order	3rd Order Tributary
	Date	7-Mar-13
	Survey Staff	Kelsey Biondo, Sean McCauley
	Weather	42° F, Windy
Field Walk Observations	Starting Point	· Confluence with Lackawanna River at N. Main Avenue
	Stream Bed & Banks	· Gradual slopes · Natural creek bed
	Riparian Area	· Grassland · Wooded
	Adjacent Neighborhoods	· Historic residential neighborhoods dating from 1870s through 1920 · Reclaimed coal mine lands (Leggett's Creek Estates proposed residential subdivision)
	Roads & Bridges	· NEPA Rail Authority steel girder bridge at confluence · I-81 & regional arterial roadways · N. Main Avenue stone arch bridge · Wells Street concrete box culvert bridge · Scranton/Carbondale Highway concrete arch culvert · Northern Boulevard concrete box culvert · Rockwell Avenue stone arch bridge (due for removal & replacement) · Mary Street/Neary Place steel beam grinder with concrete deck
	Impervious Surfaces	· ~ 50% · Open Space · Neighborhood Commercial · High Density Residential
	Estimated # of Storm Water Detention Facilities	· 1 Facility o Leggett's Creek Estates (400 ft upstream of Welles Street)
	#/Size of Pipes	· 51 pipes · Sizes range from 3-36 inches
	Debris	· Tree debris on left bank (adjacent to Neary Place)
	Trash	· Extensive trash, tires, and litter dumping adjacent to Leggett Street off of Brick Avenue along City of Scranton-owned · Extensive dumping along City of Scranton-owned property upstream of Mary Street Bridge · Construction signs in creek (Rockwell Avenue Bridge)
	Infrastructure	· Basin obstructed (Mary Street Bridge) · Pipe obstructed (end of Leggett's Street)
	Tributaries	· Leach Creek flows into Leggett's Creek o 2.55 mi.^{2} watershed o RM 1



LEACH CREEK

General Notes	Watershed Area	2.55 $Mi.^2$
	Confluence	Leggett's Creek at RM 1
	Order	2nd Order Tributary
	Date	March 14 & April 4, 2013
	Survey Staff	3/14 – Kayleigh Cornell, Sean McCauley; 4/4 – Kelsey Biondo, Kayleigh Cornell, Sean McCauley
	Weather	3/14 - 38° F, Windy; 4/4 - 54° F
Field Walk Observations	Starting Point	· Market Street & Yard Avenue
	Stream Bed & Banks	· Steep banks near confluence · Urbanized stream; a building straddles the stream at Yard Avenue and W. Market Street · Evidence of channelization along many reaches between the Morgan Highway and the confluence
	Riparian Area	· Single line of trees · Very little green space near confluence
	Adjacent Neighborhoods	· Morgan Manor · Allied Services · Keyser Oak Plaza
	Roads & Bridges	· Market Street · Morgan Manor Drive · Moffat Drive · Yard Avenue · Morgan Highway · Keyser Avenue · Bloom Avenue · North Scranton Expressway · McDonough Avenue
	Impervious Surface	· ~ 60% · Low Density Residential · Industrial · Commercial
	Estimated # of Storm Water Detention Facilities	· 2 Facilities: Oakwood Estates, Morgan Manor Apartments
	#/Size of Pipes	· 49 pipes · Sizes range from 3-60 inches
	Debris	· Right bank – sediment fill half-blocking pipe (near ramp onto Expressway from Keyser Avenue toward downtown Scranton)
	Trash	· Base of Morgan Highway · Behind Keyser Oak Plaza (needs major clean-up)
	Infrastructure	· There is a 3 to 4 acre flood control basin and detention structure located adjacent to Bloom Avenue and to the rear of the · There is an 8 ft wide x 16 ft high x 150 ft long stone arch culvert that carries Leach Creek under the North Scranton Vikings Junior Football Field, adjacent to the Keyser Oak Plaza. This site is a former AML, the Cayuga Colliery of the Glen Alden Coal Company. The stone arch culvert carried the service rail road trackage to the coal pockets at the Cayuga Breaker once located on the Keyser Oak Plaza site. · Right bank – pipe obstructed with debris (Morgan Manor Drive) · 1 pipe failing, 1 pipe obstructed (100 ft from the above pipe) · Pipe submerged and dispensing rust-colored residue (across from Rock Church Worship Center)



CLOVER HILL CREEK

General Notes	Watershed Area	2 Mi.^{2}
	Confluence	Leggett's Creek at RM 2
	Order	1st Order Tributary
	Date	4-Sep-13
	Survey Staff	Kelsey Biondo, Bernie McGurl, Bridgette Robinson
	Weather	
Field Walk Observations	Starting Point	· Confluence with Leggett's Creek, near the Hollow Avenue Bridge off of W. Market Street, adjacent to the Scranton/Carbondale Highway
	Stream Bed & Banks	· Begins as open natural stream from Bell Mountain in Dickson City · Channeled into culvert when crossing beneath the Scranton/Carbondale Highway at the Viewmont Mall entrance · Becomes rip-rap channel on the Viewmont Mall side of the Scranton/Carbondale Highway heading toward the I-81 interchange with Business Route 6, Scranton/Carbondale Highway o At time of survey, the stream was undergoing re-channelization and the culverts through the I-81 interchange were being relined and grouted
	Riparian Area	· Headwaters (outside of Scranton) are found in forested and low density residential · From Viewmont Mall to I-81 interchange to confluence, herbaceous vegetation and meadow grasses in the interchange cloverleaf
	Adjacent Neighborhoods	· Viewmont Mall
	Roads & Bridges	· Entrance to Viewmont Mall · I-81 · Scranton/Carbondale Highway
	Impervious Surface	· ~ 70% · Highway Commercial
	Estimated # of Storm Water Detention Facilities	· N/A
	#/Size of Pipes	· 2 pipes · Size: 12 inches
	Debris	· N/A
	Trash	· N/A
	Infrastructure	· N/A

EDDY CREEK

General Notes	Watershed Area	7.5 Mi.^{2}
	Confluence	Lackawanna River at RM 16.75
	Order	2nd Order Tributary
	Date	3-Oct-13
	Survey Staff	Kelsey Biondo, Bernie McGurl, Bridgette Robinson
	Weather	68° F, Partly Cloudy
Field Walk Observations	Starting Point	· No Stream walk was conducted; only a site visit to the outfall of the Keystone Sanitary Landfill (KSL) storm water discharge site along the remnant channel of Eddy Creek, adjacent to a stone arch that carried the Winton Branch of the Erie and Wyoming Valley Railroad over Eddy Creek, approximately 800 ft northeast of the former railroad grade crossing on Marshwood Road
	Stream Bed & Banks	· Dry stream bed: Stream loses flow approximately one mile east near the Marshwood Road intersection with US Route 6 · Steep banks with rip-rap and concrete headwalls of outfall structure · Stream channel has been destroyed by mining activity and only short portions of the natural channel are evident
	Riparian Area	· Covered in woody herbaceous vegetation · Strip mine overburden piles with forest cover
	Adjacent Neighborhoods	· Keystone Industrial Park and KSL · LaCapra Stone & Supply
	Roads & Bridges	· Marshwood Road · Stone arch railroad culvert
	Impervious Surface	· ~ 20% · Industrial · Open Space
	Estimated # of Storm Water Detention Facilities	· 1 Facility · KSL
	#/Size of Pipes	· 1 pipe · Size: 84 inches
	Debris	· N/A
	Trash	· Empty industrial paint canister in stream bed near outfall
	Infrastructure	· Culvert, running under railroad, half-filled with concrete and sediment

Document Name	Date	Address	Project Area (sq ft)	Type of Dentention	Discharge
Erosion and Sedimentation Control Plan and Storm Drainage for L.A. Bank (Wells-Fargo)	4/1/1998	330 Meadow Avenue			
Soil Erosion and Sedimentation Control Narrative and Calculations and Stormwater Management Narrative and Calculations for Scranton Housing Authority - Garage Addition	12/1/1998	107 S Ninth Avenue	3,905	closed	
Stormwater Management Report Scranton Retail	12/10/1998	3 West Olive Street		closed	
Soil Erosion and Sediment Control Plan and Drainage Report for Brennan Hall/Kania School of Management	3/25/1999	320 Madison Avenue	67,340	closed; 6 on-site catch basins	Into storm sanitary sewer system
Roadway Drainage Report Scranton Retail	4/12/1999	3 West Olive Street	75,851	closed	
Engineering Report for the T6 Warehouse for Kane Properties	5/6/1999	Stauffer Industrial Park (Meridian Avenue)	360,400	closed	Keyser Creek
The Executive Golf and Country Club at Mountain Laurel Summit Stormwater Calculations for Proposed 9 Hole USGA Golf Course	6/1/1999	Between East Elm Street & Birch Street	2,178,000	open	
Srtormwater Management Calculations for Mountain Lake Estates Subdivision of Lands of Grambo Reality INC.	8/1/1999	Lakeview Drive	215,622	open; outflow structure	Lackawanna River
Engineering Report for a Warehouse for P.J.L.	8/17/1999	572 Seventh Avenue	12,000		
Stormwater Management Narrative for Proposed Rite Aid Pharmacy Minooka Site (CVS)	8/20/1999	509 Davis Street	11,180	closed	
Engineering Report for Lackawanna County Performing Arts Amphitheater for Lackawanna County Performing Arts Authority	9/23/1999	Montage Mountain	116,500	closed	
Stormwater Narrative for Proposed Development CVS Pharmacy	7/20/2000	1101 Moosic Street	63,597	closed	Directly into existing inlet
Soil Erosion and Sedimentation Control Plan and Drainage Report for Community Medical Center Parking Garage and Auxiliary Parking Lot	5/23/2001	324 Colfax Avenue	21,780	closed; catch basin	Combined stormwater system
Soil Erosion and Sedimentation Control Plan and Drainage Report for University of Scranton New Residence Hall	7/17/2002	387 Madison Avenue	23,086	closed	Combined stormwater system
Mountain Lake Estates Stormwater Management Calculations for Proposed Subdivision	10/1/2002	Lakeview Drive	415,126,000	open	
Stormwater Calculations for Proposed Ice Rink	12/4/2002	3 West Olive Street	91,600		Directly into Lackawanna River; large area discharges to city storm system
Wetlands Presence/Absence Determination and Waterways Evaluation for Estes Trucking Site	5/1/2003	777 South Keyser Avenue	+/- 34,840	open; 2 storm swales	Lucky Run
Stormwater Management and Erosion and Sediment Pollution Control Report For Estes Express Lines	5/1/2003	777 South Keyser Avenue	196,020	closed	Lucky Run
Erosion and Sedimentation Control Plan Narrative and Storm Drainage Designs for Moosic Street Medical Suites	7/3/2003	21 Meadow Avenue		closed	Roaring Brook

Stormwater Management and Drainage Report for CVS Pharmacy	7/22/2003	Pittson Avenue	11,970	closed	
Erosion and Sediment Control Plan Narrative and Storm Drainage Designs for University of Scranton Proposed Parking Lot	8/1/2003	Mulberry Street & Monroe Avenue			
Erosion and Sedimentation Control Plan Narrative and Storm Drainage Designs for Green Ridge Tract	9/12/2003	111 Green Ridge Street		closed	Lackawanna River
Erosion and Sediment Pollution Control Plan Narrative and Storm Drainage Designs for Friendship House Proposed Building Addition	2/1/2004	1615 East Elm Street		closed	system ?
Post Construction Stormwater management PLan Scranton Heath Care Center	3/26/2004	2933 McCarthy Sreet	23,000	closed	
Erosion and Sediment Pollution Control Plan Narrative and Storm Drainage Designs for Proposed Scranton Preparatory Arts and Sciences Addition	4/1/2004	1000 Wyoming Avenue		closed	combined sewer system
City of Scranton Police Headquarters Stormwater Narritive	4/21/2004	340 North Washington Avenue		closed	combined
Erosion and Sedimentation Pollution Control and Stormwater Drainage Report for O.S.C. Company Professional Office Building	4/23/2004	Olive Street and Love Road	2,000	closed	
City of Scranton Police Headquarters Stormwater Narrative	6/10/2004	340 North Washington Avenue		closed	separate stormwater collection; and combined flow
Soil and Erosion and Sedimentation Control Plan and Drainage Report for Scranton Parking Authority Medallion Parking Facility	9/8/2004	140 Adams Avenue	7,768	closed	combined
Stormwater Management Plan for Green Ridge Health Care Center, LLC	11/4/2004	2741 Boulevard Avenue	93,654		existing drainage swale; Lackawanna River
Post Construction Stormwater Management Plan for Green Ridge Health Care Center, LLC	11/4/2004	2741 Boulevard Avenue	93,654		existing drainage swale; Lackawanna River
Stormwater Management Narrative and Calculations for EOTC Building Renovation	2/1/2005	431 North Seventh Avenue		closed	
Erosion and Sedimentation Control Plan Narrative and Storm Drainage Designs for Swift Fence Storage Facility	6/16/2005	1646 Penn Avenue		closed	
Stormwater Narrative and Calculations for Waffle House	6/16/2005	708 Davis Street	56,628	stormwater easement & basin	
Amended Stormwater and Engineering Report for Warehouse No. 7 and Warehouse No. 6 South Addition Kane Properties-1, LP	10/1/2005	Stauffer Industrial Park (Meridian Park)	324,000		
Stormwater Management Report for the Shiloh Baptist Church (TCMC Parking Lot)	10/1/2005	915 North Washington Avenue	17,000	closed	combined sewer system
Stormwater Management Report for Shiloh Baptist Church	10/1/2005	915 North Washington Avenue	17,000	closed	combined sewer system
Sanitary Sewer Calculations for Shiloh Baptist Church	11/26/2005	915 North Washington Avenue			

Erosion and Sedimentation Control Stormwater Management Narrative Colts Intermodal Facility	2/1/2006	Corner of Lackawanna Avenue & South Bridge Avenue	163,350	closed	combined
Erosion and Sediment Pollution Control Plan Narrative and Storm Drainage Designs for Holecko Self Storage Facility (Stor-way)	6/1/2006	2735 Olyphant Avenue		closed	stormwater system
Stormwater Management Report for Overlook at Clay	6/27/2006	Corner of Clay Avenue & Poplar Street	23,958	closed	combined
Post Consruction Stormwater Management Narrative for Saginaw Street Residential Development	7/10/2006	600 Block Saginaw Street	202,554	closed	combined
Post Construction Stormwater Management Report for Mount Pleasant Corporate Center	8/15/2006	521 Mount Pleasant Drive	1,023,660	closed	adjacent to PENNDot drainage system
Advance Auto Parts Stormwater Management Control Plan and Narrative	8/19/2006	780 Luzerne Street	37,461	closed	
Project Narrative for Mount Pleasant Corporate Center	9/1/2006	521 Mount Pleasant Drive	1,023,660	closed; open from runoff wetland from Scranton Expressway	adjacent PENNDot drainage system
Stormwater Management Control Plan and Narrative for Wheeler Green	9/8/2006	Rear 1207 Wheeler Avenue	32,670	closed	combined
Keyser Village Center Stormwater Report	10/26/2006	1739 North Keyser Avenue	132,858	closed	combined
Keyser Village Center Post Construction Stormwater Report	11/1/2006	1739 North Keyser Avenue	132,858	closed	combined
Post Construction Stormwater Management Report Mount Pleasant Corporate Center	11/13/2006	521 Mount Pleasant Drive	1,023,660	closed	adjacent PENNDot drainage system
Soil Erosion and Sediment Control Plan and Drainage Report for Toyota Scion of Scranton	3/1/2007	3400 North Main Avenue	53,074	open	Lackawanna River
Post Construction Stormwater Management Narrative for Toyota Scion of Scranton	3/1/2007	3400 North Main Avenue	53,074	open	Lackawanna River
Stormwater Management Analysis and Erosion and Sedimentation Pollution Control Narrative for McCarthy Street Townhouses	4/1/2007	2944 McCarthy Street	30,492	closed	combined
Soil Erosion and Sedimentation Control Plan and Drainage Report for University of Scranton Residence Hall	5/29/2007	1129 Linden Street	17,547	closed	combined
Erosion and Sediment Pollution Control Plan Narrative and Storm Drainage Designs for Morgan Manor Apartments Proposed Apartments Land Development	6/1/2007	117 Mountain View Way	17,017	closed	
Post Construction Stormwater Management Plan for Compression Polymers	8/1/2007	North South Road	1,350,360	open	evaporation or infiltration
Stormwater Management Narrative and Calculations for John G. Whittier Elementary School Scranton School District	9/1/2007	700 Orchard Street		closed	combined
Stormwater Management Narrative and Calculations Isaac Tripp Elementary School Scranton School District	11/1/2007	James Robeson Way		open; closed	combined

Soil Erosion and Sediment Control Plan and Drainage Report for Scranton Parking Authority Parking Facility	11/7/2007	140 Adams Avenue	3,700	closed	sanitary & stormwater system
Soil Erosion and Sedimentation Control Plan and Drainage Report for Normandy Holdings, LLC Mid-Rise Apartements	1/2/2008	346 Oakford Court	7,300	closed	combined
Dunkin Donuts Commercial Development Stormwater Management and Erosion Control Report	6/9/2008	100 Mulberry Street	23,958		
HydroLogic and Hydraulic Study for the Keyser Creek Watershed	7/1/2008	800 North South Raod	239,193,240		Keyser Creek
Stormwater Management Narrative and Calculations for John G. Whittier Elementary School Scranton School District	8/1/2008	700 Orchard Street	41,382	closed	combined sewer
Drainage Control Report 25 Year Design Storm Storage Building Addition	9/1/2008	405 Gilligan Street	7,000	open; lawn area	
Soil Erosion and Sedimentation Control Narrative and Calculations for the Commonwealth Medical Education Corporation Proposed Medical College	11/1/2008	525 Pine Street	51,000	closed	combined
Post Constrution Stormwater Management Narrative and Calculations for The Commonwealth Medical Education Corporation proposed Medical College	11/1/2008	525 Pine Street	51,000	closed	combined
Roadway Drainage Report For the Proposed Roadway Improvements Associated with Mount Pleasant Corporate Center	12/1/2008	521 Mount Pleasant Drive		closed	stormwater system
Autism Center at the Friendship House Stormwater Management Report	3/1/2009	1509 Maple Street			
Final Drainager Report for The Montage Car Lot Expansion	9/18/2009	2649 Pittston Avenue	27,007	closed	combined sewer system
Final Drainage Report for the Montage Motors Car Lot Expansion	10/26/2009	2649 Pittston Avenue	27,007	closed	combined sewer system
Erosion and Sediment Pollution Control Plan Narrative and Storm Drainage Designs for Oakwood Estates Phase 2	12/1/2009	2 Oakwood Drive	44,866	closed	combined
Erosion and Sediment Control Report Stormwater Managent Report Tobyhanna Army Depot Federal Credit Union	2/1/2010	315 Franklin Avenue			
Soil Erosion and Sedimentation Control and Stormwater Management Narritative and Calculations for EH Real Estate Self Storage	3/1/2010	Across from 2741 Boulevard Avenue	76,230	closed	city storm system
Erosion and Sediment Pollution Control Plan Narrative and Storm Drainage Designs for Oakwood Estates Phase II	4/1/2010	2 Oakwood Drive	368,953	closed	existing swale
Stormwater Management Narrative and Calculations for Penn Furniture Parking Lot and Sidewalk Improvements	5/1/2010	97-99 Lackawanna Avenue		closed	
Kanton Property Erosin and Sediment Pollution Control/ Stormwater Management Narrative	6/1/2010	618 Davis Street	1,500	closed	
Stormwater Management Report and Erosion and Sediment Control Plan Integrated Marketing Solutions Proposed Sonic Resturant	10/1/2010	4 West Olive Street	1,818	closed	combined

Stormwater Narrative and Calculations for Turkey Hill	1/10/2011	Providence Road	91,600	none	Lackawanna River
Stormwater Management Narritve and Calculations Marywood University Nazareth Hall Loading Docks	3/1/2011	Coner of Adams Avenue & University Avenue		closed	combined
Post Construction Stormwater Management Report for Johnson College Health Sciences Technology Center Land Development	4/1/2011	3427 North Main Avenue	208,216	closed	stormwater system
Proposed Constrution Stormwater Managemnet Report for Johnson College Heath Sciences Technology Center	4/1/2011	3427 North Main Avenue	208,216	closed	stormwater system
Post Construction Stormwater Management Plan for Green Ridge Health Care Center 31 Bed Addition	9/7/2011	2741 Boulevard Avenue	11,748	closed	
Post Construction Stormwater Management Plan for Green Ridge Health Care Center 31 Bed Addition	10/10/2011	2741 Boulevard Avenue	11,748	closed	
Post Construction Stormwater Management Plan Laurel Woods	2/3/2012	205 Davis Street			
Stormwater Management Plan and Narrative for Rossi Rooter Development	3/1/2012	2015 Cedar Avenue			
Erosion and Sediment Pollution Control/ Stormwater management Narrative for EOTC Site Improvements	7/1/2012	431 North Seventh Avenue		closed	combined system
Post Consruction Stormwater Management Narrative for Learning and Memorial Commons	9/1/2012	2300 Adams Avenue	21,868	closed; vegetated roof	combined system
Geisinger Heathcare: Scranton Medical Office Land Development and Stormwater Management Report	10/1/2012	521 Mount Pleasant Drive	556,000		

APPENDIX C:
GREEN INFRASTRUCTURE INVENTORY

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
22	Woodland	N I-476	Keyser	Natural woodland adjacent to I-476	Preserve Woodland
41	Vacant Lot	Perry Ave. & Laurel St.	Keyser	Vacant mowed lot	Bio-retention, Raingarden
156	Wooded Lot	Hudson Ave.	Keyser	Overgrown lot adjacent to commercial properties	Bio-retention
163	Wooded Lot	Swetland St.	Keyser	Woodland	Conservation
173	Gravel Lot	Hudson Ave.	Keyser	Gravel lot	Bioswale
176	Woodland	Byron Ln.	Keyser	Woodland	Conservation
188	Open Space	N. Keyser Ave.	Keyser	Slightly depressed mowed area next to car sales lot	Bioswale
190	Wooded Lot	Price St.	Keyser	Overgrown buffer between two residential lots on a slope	Conservation, Bio-retention
195	Woodland	Byron Ln.	Keyser	Woodland	Conservation
196	Recreation Space	S. Dewey Ave & Robinson Ave.	Keyser	Baseball / Football fields adjacent to railroad, Steep slope with rock along Price St.	Bio-retention, Raingarden
208	Open Space	20th Ave. & Oliver Pl.	Keyser	Mowed areas with gravel parking on Fire Dept. building	Bioswale, Raingarden
217	Streambank	N. Sherman Ave.	Keyser	Wooded slope from Sherman Ave. down to creek	Streambank Stabilization, Riparian Buffer
218	Streambank	Robinson St.	Keyser	Wooded slope down to creek	Streambank Stabilization, Riparian Buffer
237	Open Space	13th Ave. & Hampton St.	Keyser	Steep mowed slope from Hampton St. plateaus at top at 13th Ave.	Bioswale, Bio-retention
179-224	Channel Creek	N. Keyser Ave. & Frink St.	Keyser	Follows creek, Open space amongst residential properties	Conservation, Bio-retention, Infiltration
215/216	Jackson Terrace	N. Keyser Ave. & Jackson St.	Keyser	Steep wooded slope from Jackson St., Dirt drive behind building, Woodland surrounding building	Conservation, Raingarden, Pervious Pavers, Downspout Planters, Rain Barrels
142	Dunmore High School	W. Warren St. & N. Webster Ave.	Meadow Brook	School property, Open space, Sports fields, Paved parking lots	Raingardens, Bioswales, Pervious Pavers, Downspout Planters, Open Space, Rain Barrels
180	Wooded Lot	Monsey Ave.	Meadow Brook	Overgrown lot adjacent to railroad with gravel parking lot and steep slope up to residential property	Bio-retention
189	Wooded Berm	Glen St.	Meadow Brook	Bermed area over creek through Keystone Building Block	Bioswale, Infiltration
185/186/198	Casey Athletic Complex	Capouse Ave.	Meadow Brook	Public pool with little open space and wooded buffers and old asphalt parking lot	Pervious Pavers, Infiltration, Downspout Planters, Rain Barrels

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
7	Streambank	McDonough Ave. & Block St.	Leggetts	Wooded growth next to creek	Streambank Stabilization, Riparian Buffer
8	Woodland	Rockwell Ave. & Kirkland St.	Leggetts	Steeply sloped woodland	Conservation
9	Wooded Lot	Wales St. & Durkin Ave.	Leggetts	Wooded lot with sale sign	Conservation
10	Woodland	Rockwell Ave. & Kirkland St.	Leggetts	Steeply sloped woodland	Conservation
18	Weston Park	Stanley Pl. & Belmont Terrace	Leggetts	Heavily used park with community room, Outdoor pool, Playground and nice views	Bioswale, Raingarden, Infiltration
25	Streambank	McDonough Ave.	Leggetts	Steeply wooded slope to creek	Streambank Stabilization, Riparian Buffer
28	Vacant Lot	Leggett St.	Leggetts	Vacant lot adjacent to creek	Bio-retention, Riparian Buffer
30	Streambank	McDonough Ave. & Oak St.	Leggetts	Steeply wooded slope to creek	Streambank Stabilization, Riparian Buffer
31	Meadow / Woodland	Cayuga St. & Bloom Ave.	Leggetts	Meadow-like open space leading to uphill sloping woodland on culm banks	Conservation, Bio-retention
54	Wooded Lot	W. Market St. & Leggett St.	Leggetts	Wooded slope	Conservation, Bio-retention
87	Dutch Martin	Wells St.	Leggetts	Steeply sloped scrubland with dirt trails along creek	Riparian Buffer, Bioswale
297	Streambank	Mary St.	Leggetts	Densely overgrown riparian buffer	Streambank Stabilization, Riparian Buffer
12-15	Streambank	Mary St.	Leggetts	Steep wooded slope	Preserve Woodland
16/17	Weston Park	Loop Ave.	Leggetts	Heavily used park with community room, outdoor pool, playground, and nice views	Bioswale, Raingarden, Infiltration, Pervious Pavers
20/86	McClain Park	W. Parker St.	Leggetts	Small park with baseball field, open space, and basketball courts	Open Space, Bioswale, Raingarden
264	Vacant Lot	Morgan Ct. & E. Elm St.	Stafford Meadow	Slope adjacent to school grounds	Conservation, Bio-retention
265	Marine Corps Museum	Blucher Ave. & Willow St.	Stafford Meadow	Open space surrounded by woodland	Raingarden, Conservation, Bio-retention, Rain Barrels, Downspout Planters
271	Wooded Lot	Wintermantle Ave. & E. Elm St.	Stafford Meadow	Natural woodland	Conservation
274	Wooded Lot	McGuiness Ct. & Healy Pl.	Stafford Meadow	Wooded lot	Conservation
276	Wooded Lot	Stafford Ave. & Palm St.	Stafford Meadow	Wooded lot with well-used informal trails	Conservation
277	Lake	Mountain Lake Rd. & Birch St.	Stafford Meadow	Mountain Lake, Wooded buffer	Conserve Lake Buffer Zones
328	Vacant Lot	Donnelly Ct. & E. Elm St.	Stafford Meadow	Steeply sloped overgrown vacant lot	Bio-retention
269/270 275/279	Wooded Lots	McGuiness Ct. & Fig St.	Stafford Meadow	Wooded lots	Conservation

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
232	Vacant Lot	Union Ave. & William St.	Roaring Brook	Mowed lot near homes, downspouts appear to be disconnected	Bioswale
242	Streambank	Myrtle St.	Roaring Brook	Wooded streambank	Streambank Stabilization, Riparian Buffer
243	Nay Aug	Arthur Ave. & Roselynn St.	Roaring Brook	Open space, Swimming pools, Trails, Paved parking lots	Raingarden, Conservation, Pervious Pavers, Bioswales, Rain Barrels, Downspout Planters
245	Woodland	Matthew Ave.	Roaring Brook	Woodland	Conservation
254	Connor's Park	Orchard St. & Hamm Ct.	Roaring Brook	Park with open space, Community garden, Playground	Curb Cut Outs, Raingarden, Bio-retention
258	Wooded Lot	Moosic St. & Roosevelt St.	Roaring Brook	Wooded slope, Defined channel that carries run off	Conservation
262	Wooded Lot	Moosic St. & Lynnwood Ave.	Roaring Brook	Wooded lot	Conservation
263	Stormwater Basin	Lynnwood Ave.	Roaring Brook	Stormwater basin that handles runoff along utility row	Conservation, Bio-retention
267	Woodland	Cobb Ave. & Grand Ave.	Roaring Brook	Woodland	Conservation
268	Stormwater Basin	Lakeview Dr. & E. Mountain Rd.	Roaring Brook	Stormwater basin	Conservation, Bio-retention
312	Oakmont Playground	Debbie Dr.	Roaring Brook	Under-utilized park with large amount of asphalt	Bioswales, Pervious Pavers, Raingarden
313	Woodland	Lynnwood Ave. & Silkman Ave.	Roaring Brook	Harold Watres parcel to Nay Aug Park, Natural woodland	Conservation
317	Robinson Park	Mountain Lake Rd. & Yesu Dr.	Roaring Brook	Natural woodland	Conservation
239/295	Wooded Lots	Olive St. & Kelum Ct.	Roaring Brook	Wooded lots	Conservation, Maintenance
256/257	Duffy Park	Moosic Street	Roaring Brook	Open space, Small woodland	Raingarden, Bioswales
259/266	Wooded Lot	Florida Ave. & Snook St.	Roaring Brook	Wooded slope, Rip rap swale to pipe	Infiltration Berms, Step Pools
260/261	Scranton Lookout	Moosic St. & Lynnwood Ave.	Roaring Brook	Historic pull off area, Overlooks city of Scranton	Raingarden, Pervious Pavers, French Drain

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
2	Street	Nay Aug Ave.	Lackawanna	Mowed sidewalk with curbing	Stormwater planter
3-89	Vacant Lots	E. Parker St.	Lackawanna	3/5/27/32/33/34/35/37/89 Overgrown vacant lots	Bio-retention, Conservation
6	Vacant Lot	Grace St.	Lackawanna	Mowed vacant lot	Bio-retention, Open Space
11	Vacant Lot	E. Parker St. & Boulevard Ave	Lackawanna	Vacant lot adjacent to culm bank	Bio-retention
19-335	River Buffer	E. Parker St. to Sanderson Ave.	Lackawanna	19/36/38/40/43/47/50/51/53 55/59/60/62/63/64/65/66/67 68/69/70/71/76/79/97/103 104/105/106/118/120/122 123/125/127/136/137/138 139/283/284/288/300/308 316/335 Lackawanna River Corridor	Streambank Stabilization, Riparian Buffer, Floodplain
29	River Buffer	Throop St.	Lackawanna	Mowed bank adjacent to railroad	Streambank Stabilization, Riparian Buffer, Floodplain
39	Vacant Lot	E. Parker St. & Boulevard Ave	Lackawanna	Vacant lot adjacent to culm bank	Bio-retention
42	Wooded Bank	Hollister Ave.	Lackawanna	Wooded bank	Bio-retention
44	Vacant Lot	E. Parker St.	Lackawanna	Overgrown vacant lot with abandoned house	Bio-retention
45	Park	Grace St.	Lackawanna	Small park with pavement	Raingarden
46	Woodland	Lemon St.	Lackawanna	Woodland	Conservation
48	Overground Lot	Spring St. & Belmont Terrace	Lackawanna	Overground parcel with good visibility, Lower lot is wooded and steep	Infiltration
49	Vacant Lot	Alden Pl.	Lackawanna	Mowed vacant lot	Bio-retention, Open Space
56	Powderly Park	N. Main Ave. & School St.	Lackawanna	Very steep, narrow area alongside road	Raingarden
57	Gravel Lot	W. Market St.	Lackawanna	Gravel lot abutting restaurant	Infiltration, Dry Well, Cistern
61	River Bank	E. Market St. & Nay Aug Ave.	Lackawanna	Mowed river bank	Streambank Stabilization, Riparian Buffer, Floodplain
72	Parking Lot	Bundy St.	Lackawanna	Paved parking lot	Pervious Pavers
77	Open Space	Nay Aug Ave.	Lackawanna	Small open space between buildings	Rain Barrels, Downspout Planters / Disconnect
82	Open Space	E. Market St. & Nay Aug St.	Lackawanna	Moderately sized mowed open space	Raingarden, Street Trees, Bioswale, Curb Cut Outs
88	Vacant Lot	Hollister Ave. & E. Parker	Lackawanna	Grass growing on gravel lot	Bio-retention, Open Space
95	Vacant Lot	Electric St.	Lackawanna	Mowed vacant lot	Bio-retention
96	Vacant Lot	Ross Ave. & Electric St.	Lackawanna	Narrow mowed strip between commercial property fence and residential property	Bio-retention
99	Wooded Buffer	Clearview St.	Lackawanna	Wooded buffer separating neighborhood from railroad	Conservation, Bio-retention
107	Vacant Lot	Whitetail Dr. & Deerfield Rd.	Lackawanna	Wooded vacant lot	Bio-retention
119	North Scranton Mini Park	Wayne Ave. & Jabez Pl.	Lackawanna	Open space adjacent to Fire Station, Needs maintenance	Raingarden, Soakaway Garden, Bioswale

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
126	Wooded Buffer	E. Market St.	Lackawanna	Wooded buffer along river with dirt road access	Bio-retention, Conservation, Riparian Buffer
132	Open Space	Nay Aug Ave.	Lackawanna	Mowed open space	Raingarden, Street Trees, Bioswale, Curb Cut Outs
140	Reddington Field	Silver Ave. & Wood St.	Lackawanna	Baseball field with gravel parking lot and woodland	Open Space, Recreation, Pervious Pavers, Raingarden, Conservation
152	Tripp Park	N. Filmore Ave. & Dorothy St.	Lackawanna	Playground with paved parking lot, basketball / tennis courts	Pervious Pavers, Raingarden, Curb Cut Outs, Bio-retention
158	Fellow's Park	N. Main Ave.	Lackawanna	Fire Dept. building	Rain Barrels, Downspout Disconnect / Planters, Pervious Pavers
166	River Bank	Albright Ave. & Court St.	Lackawanna	Mowed bank with rip rap material	Streambank Stabilization, Riparian Buffer
177	Weston Field	Foster St. & Meade Ave.	Lackawanna	Large park complex, Indoor / Outdoor pools, Offices, Gym, Playground, Fields	Raingarden, Soakaway Garden, Open Space, Recreation, Bio-retention
178	Utility ROW	Foster St.	Lackawanna	Overgrown slope on utility ROW	Stormwater Planter
181	Public Works	7th Ave. & W. Poplar St.	Lackawanna	Public Works parcel with mowed lawn and paved parking adjacent to River	Rain Barrels, Downspout Planters / Disconnects, Bioswales, Pervious Pavers
183	Public Works	7th Ave. & Grove St.	Lackawanna	Road Works salt storage lot with mowed strips, asphalt lot	Bioswale
184	Open Space	7th Ave. & Grove St.	Lackawanna	Sidewalk with mowed grass	Pervious Pavers, Curb Cut Outs, Bump Outs
193	River Buffer	7th Ave. & Middle St.	Lackawanna	Small flat open area with dirt and gravel base adjacent to River and trucking facility	Riparian Buffer
194	Vacant Lot	Calvin St.	Lackawanna	Vacant lot with Free Masons building	Raingarden, Rain Barrel, Downspout Planters
200	Utility ROW	Webster Dr.	Lackawanna	Mowed strip of land, Catch basin present	Raingarden, Cistern, Dry Well
203	Vacant Lot	Mears Pl.	Lackawanna	Mowed vacant lot with historical sign	Bioswale, Raingarden
210	Dunmore Fire Station	W. Pine St. & Legion Dr.	Lackawanna	Houses Borough building and fire / police departments	Raingarden, Rain Barrel, Downspout Planters
219	Vacant Lot	S. Blakely St.	Lackawanna	Vacant lot adjacent to La Cucina	Cistern, Dry Well
220	Tank Memorial	Cherry St. & N. Blakely St.	Lackawanna	Highly visible, Gravel base	Soakaway Garden, Raingarden
222	Commercial Lot	Providence Rd. & Gilligan St.	Lackawanna	Commercial property with trucking depot, Gravel/dirt base, adjacent to River	Infiltration, Bio-retention
225	Park	N. Bromley Ave & Robinson St.	Lackawanna	Elevated park with asphalt courts, Container gardens	Pervious Pavers, Bioswale, Curb Cut Outs
229	Planting Strip	N. Washington Ave. & Lackawanna Ave.	Lackawanna	Small planting strip between Dix Ct. and parking lot	Curb Cut Outs, Bio-retention

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
230	Parking Lot	N. St. Francis Cabrini Ave.	Lackawanna	Paved parking lot with street trees	Curb Cut Outs, Bio-retention, Pervious Pavers
231	Sidewalk	Mifflin Ave.	Lackawanna	Small strip between Mifflin Ave. and railroad with grass and benches	Curb Cut Outs, Bioswale
233	Crawley Field	Meridian Ave. & Oxford St.	Lackawanna	Baseball fields	Bioswale, Raingarden, Bio-retention
234	Bellvue Center	Coar Pl.	Lackawanna	Mowed lawn in front with playground on side and asphalt parking in back	Raingarden, Curb Cut Outs, Pervious Pavers
235	Westside Senior Center	N. St. Francis Cabrini Ave. & Robinson St.	Lackawanna	Brick building with downspout planter and street parking	Rain Barrel
241	Park	S. Edward's Ct. & Fellows St.	Lackawanna	Moderately sized park with open space, Street trees, Mowed lawn, Small paved parking lot	Raingarden, Curb Cut Outs, Pervious Pavers
244	Gas House	S. Washington Ave. & River St.	Lackawanna	Former Gas House adjacent to railroad trestle	Rain Barrels, Downspout Planters
246	Vacant Lot	W. Elm St.	Lackawanna	Overgrown lot	Pocket Park, Bio-retention
248	Vacant Lot	8th Ave. & Oxford St.	Lackawanna	Mowed vacant lot	Bioswale
249	Baseball Field	8th Ave. & Oxford St.	Lackawanna	Baseball field with gravel parking	Bioswale, Bio-retention
250	Wooded Lot	Rogan Pl.	Lackawanna	Steep wooded slope	Conservation
251	Wooded Buffer	S. Wyoming Ave. & Mechanic St.	Lackawanna	Wooded buffer between railroad and Steamtown	Conservation
255	Clover Field	Landis St. & Archbald St.	Lackawanna	Wooded steep slope	Conservation
272	Engine Company No. 2	Pittston Ave. & Gibbons St.	Lackawanna	Fire station with mowed lawn	Rain Barrels, Downspout Planters, Bioswale
273	Connell Park	S. Webster Ave. & Gibbons St.	Lackawanna	Park built on side of hill with dog park, Playground, Fields, and Pool	Raingarden, Bioswales, Infiltration
278	Kennedy Elementary School	Prospect Ave., Saginaw St. to Ohara St.	Lackawanna	School yard	Raingarden, Rain Barrels, Downspout Planters
280	Wooded Lot	Donnelly Ct. to Herz Ct. & Ripple St.	Lackawanna	Un-maintained vegetation covers sidewalk	Conservation, Infiltration
281	Vacant Lot	Pittston Ave. & McDonough St.	Lackawanna	Overgrown lot at the top of a hill	Raingarden, Infiltration
282	Minooka Park / Billy Barrett Playground	Colliery Ave. & McDonough St.	Lackawanna	Small park with tennis courts and playground	Bioswale, Raingarden
289	Municipal Lot	Nay Aug Ave.	Lackawanna	Gravel lot	Bio-retention
290	Municipal Lot	Nay Aug Ave.	Lackawanna	Municipal building	Rain Barrel, Downspout Planter / Disconnect, Bioswale

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
298	Utility Lot	8th Ave. & Middle St.	Lackawanna	Utility lot adjacent to River	Streambank Stabilization, Riparian Buffer
299	Park	Green Pl.	Lackawanna	Park with baseball field, basketball court, play area	Open Space, Pervious Pavers
302	Nay Aug	Arthur Ave. & Roselynn St.	Lackawanna	Streambank	Conservation
307	Tripp Park	N. Filmore Ave. & Dorothy St.	Lackawanna	Baseball fields, Paved parking lot, Woodland	Conservation, Raingarden, Pervious Pavers
314	Wooded Slope	Terrace St.	Lackawanna	Steep wooded slope	Conservation
315	Open Space	Bridge St. & Lackawanna Ave.	Lackawanna	Sloped, mowed area in front of Steamtown Historic sign	Raingarden, Bioswale
318	Recreation Space	Olyphant Ave.	Lackawanna	Large park with baseball fields, basketball courts, woodland	Conservation, Raingarden, Bio-retention
319	Dunmore Historical Society	Barton St. & Tripp St.	Lackawanna	Former church	Rain Barrels, Downspout Planters
321	River Levi	S. Washington Ave. & W. Elm St.	Lackawanna	River bank	Streambank Stabilization, Riparian Buffer
322	Steamtown	N. Washington Ave. & Mechanic St.	Lackawanna	Large amount of brownfield space	Soil Restoration, Bio-retention, Rain Barrels, Downspout Planters
329	Industrial Lot	Providence Rd. & Gilligan St.	Lackawanna	Brownfield industrial/commercial lot	Soil Restoration, Bio-retention, Rain Barrels, Downspout Planters
330	River Bank	Love Rd. & W. Olive St.	Lackawanna	Mowed river bank	Streambank Stabilization, Riparian Buffer
331	Wooded Lot	Mineral Ave. & Mica St.	Lackawanna	Wooded lot	Conservation
332	River Bank	Love Rd. & Providence Rd.	Lackawanna	River bank with detention basin, Outlet flows into River, Riverwalk	Streambank Stabilization, Riparian Buffer
337	Theodore Park	W. Pass Ave. & Theodore St.	Lackawanna	Steep wooded slope	Parking Lot Improvements, Raingarden
340	River Levi	S. Washington Ave. & Cherry St.	Lackawanna	River bank	Streambank Stabilization, Riparian Buffer
345	River Bank	Love Rd. & Providence Rd.	Lackawanna	Vegetated slope leading away from Riverwalk	Bio-retention
108-303	River Bank	Green Ridge St. to Albright Ave.	Lackawanna	108/109/111/113/114/115/116 117/141/143/144/145/147/148 149/150/151/153/154/155/157 159/160/162/165/167/169/170 171/172/175/286/287/292/303 River Bank	Streambank Stabilization, Riparian Buffer
128-323	River Bank	Albright Ave. to W. Poplar St.	Lackawanna	128/129/168/174/182/294/296 305/323 River Bank	Streambank Stabilization, Riparian Buffer
191/192	Holy Cross High School	Harper St. & Truman Ave.	Lackawanna	Mowed open space, Paved parking,	Raingarden, Rain Barrels, Downspout Planters / Disconnects, Bioswales
197/201	Monroe Park / Dunmore Community Center	Monroe Ave.	Lackawanna	Large complex, Playground, Fields, Parking, Community center, Community garden	Raingardens, Rain Barrels, Downspout Planters / Disconnects, Bioswales

Parcel #	Parcel Name & Type	Location	Sub-Watershed	Notes	Opportunities for Green Infrastructure
21-339	River Bank	I-81 to E. Parker St.	Lackawanna	21/24/26/310/338/339 Wooded river bank down to Throop St. then turns into mowed bank, Culm bank refuse	Streambank Stabilization, Riparian Buffer, Bio-retention, Reforestation
221	West Scranton Memorial	S. Main Ave. & Price St.	Lackawanna	Small memorial space with mowed lawn, gazebo	Pervious Pavers, Raingarden
226/227 228/238	Parking Lot	S. Main Ave. & Price St.	Lackawanna	Moderately sized paved parking lot	Bio-retention, Pervious Pavers
236/240	Park Garden	Dix Ct. & Mulberry St.	Lackawanna	Tiered planting beds in front of Municipal building, Fire Dept. HQ	Rain Barrels, Downspout Planters
252/253	Football Fields	S. 6th Ave. & W. Locust St.	Lackawanna	Small gravel parking, Mowed grass, Seating area, Football fields	Remove Berm, Bioswale
4-304	River Bank	E. Market St. to Green Ridge St.	Lackawanna	4/66/73/74/78/80/81/84/90/91 94/98/101/102/110/130/134 291/293/304 Mowed bank on one side, Wooded on the other	Streambank Stabilization, Riparian Buffer
58-344	River Bank	Sanderson Ave. to E. Market St.	Lackawanna	58/75/85/92/93/100/121/285 306/320/324/325/326/327/336 341/342/343/344 Mostly wooded bank	Streambank Stabilization, Riparian Buffer
83/131	Vacant Lot	E. Market St. & Ross Ave	Lackawanna	Mowed vacant lot with pervious paver parking lot	Raingarden

APPENDIX D: ENVIRONMENTAL EDUCATION MATERIALS

Additional educational materials are available at www.lrca.org.

Lackawanna River Watershed Conservation Plan

prepared by The Lackawanna River Corridor Association

November 2001

This project is funded with support from the Chesapeake Bay Program Small Watershed Grants Program administered by the National Fish and Wildlife Foundation, the Scranton Area Foundation, the Rivers Conservation Program of the Commonwealth of Pennsylvania, Department of Conservation and Natural Resources

and

The membership and community support funding received through contributions to the Lackawanna River Corridor Association.

This document has been prepared by:

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Arthur Popp, Project Manager
Deilsie Heath Kulesa, Administrative Assistant
Gail Puente, Education and Outreach Coordinator

For the: LRCA Lackawanna River Corridor Association

Lackawanna River Citizens

Water Quality Handbook

LRCA Lackawanna River Corridor Association

The Lackawanna River Guide

A publication of the
Lackawanna River Corridor Association

Second Edition

This Guide is dedicated to
the membership
of
The Lackawanna River Corridor Association
whose support and commitment are helping to create
a revitalized Lackawanna River.

This book is published by the Lackawanna River Corridor Association, 2006 North Main Avenue, Scranton, Pennsylvania 18508. This document was originally published with assistance provided by the Scranton Area Foundation in 1994.

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Jack McDonough, Editorial Assistance
Pamela Lomax, Proofreading
Deilsie Heath Kulesa, Typesetting

Lackawanna River Clean

Easy Tips to Help Reduce Flooding and Stormwater Pollution

- Lawns add to the problem! Use natural or organic lawn chemicals, fertilizers, and pesticides. Reduce the amount you use.
- Plant trees, shrubs and ground cover to reduce the amount of water run- off from your property.
- Leave a buffer of vegetation along the road to reduce water run-off.
- Pick up after your dog. Pet waste adds to water pollution.
- Don’t pour oil or hazardous chemicals down storm drains. They all lead to the river.
- Mulch grass clippings. Use compost and mulch to reduce the amount of chemical fertilizers needed.
- Use a rain barrel to catch water run- off from your property. This can be used later to water lawns and plants.
- Reduce the amount of impervious (paved) surface on your property. Plant grass, shrubs and ground cover instead.
- Don’t litter. Put trash where it belongs.
  Recycle everything you can.

We’re all part of the solution.
Each home owner, business, or school can help
to reduce flooding and water pollution.

"Thinking Globally and Acting Locally"

Lackawanna River Clean

www.scrantonpa.gov/
Municipal Separate Storm System.html

347-6311

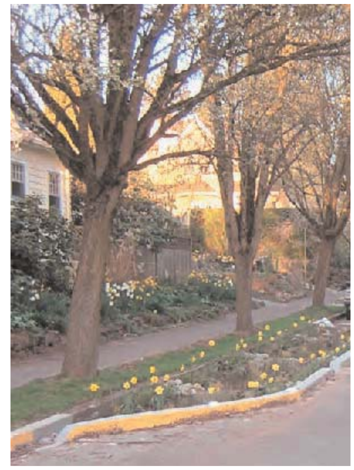
348-5330

LACKAWANNA RIVER CLEAN

Vegetated Swales

(bioswales, grassy swales)

Swales have many options in design and planting



Swales are gently sloping depressions planted with dense vegetation or grass that treat stormwater runoff from rooftops, streets, and parking lots. As the runoff flows along the length of the swale, the vegetation slows and filters it and allows it to infiltrate into the ground. Where soils do not drain well, swales are typically lined and convey runoff to a drywell or soakage trench. Swales can include check dams to help slow and detain the flow. A swale can look like a typical landscaped area.

Benefits

The plants in a swale filter and slow stormwater runoff while sediments and other pollutants settle out. Swales are cost effective, attractive and can provide wildlife habitat and visual enhancements. Single or multiple swale systems can treat and dispose of stormwater runoff from an entire site. Swales can reduce the number and cost of storm drains and piping required when developing a site.

Vegetation

Swales can be planted with a variety of trees, shrubs, grasses, and ground covers. Plants that can tolerate both wet and dry soil conditions are best. Plant grassy swales with native broadleaf, dense-rooted grass varieties. Avoid trees in areas that require enhanced structural stability, such as bermed side slopes. Summer irrigation and weed pulling may be required in the first one to three years.

Maintenance

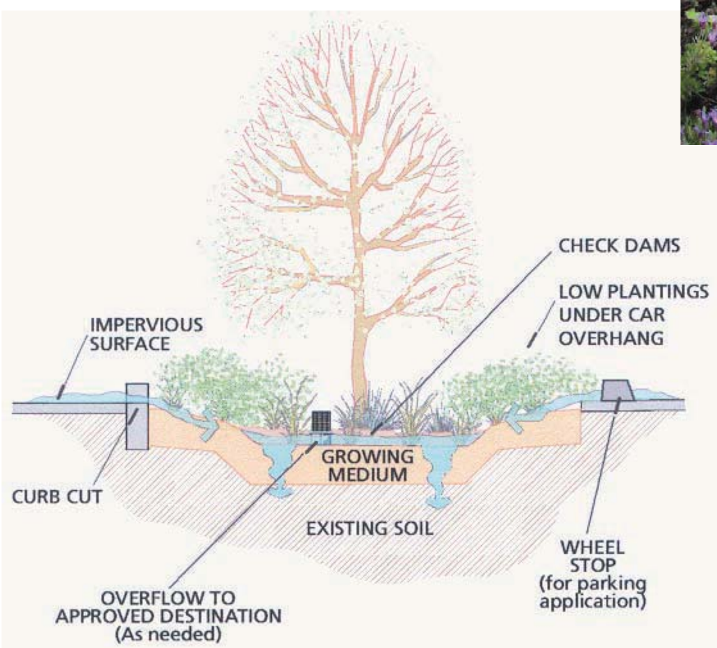
Inspect swales periodically, especially after major storm events. Remove sediment and trash, clean and repair inlets, curb cuts, check dams, and outlets as needed. Maintain side slopes to prevent erosion and ensure proper drainage. With proper construction and maintenance, swales can last indefinitely.

Cost

Costs vary but swales typically cost less than a standard piped drainage system.

Safety and Siting Requirements

- Swales should not be located closer than 10 feet from building foundations.
- Locate swales at least 5 feet from any property line.
- Grade the site so that water drains to the swale, or provide some form of conveyance such as a trench or berm to direct the runoff into the swale if site grading is impractical.
- Many parking lot planting islands can be excavated and retrofitted into swale systems with curb cuts.
- Refer to Pennsylvania’s Stormwater Management Manual for detailed information on sizing, placement, and design.



Call the
Sewer Authority at 348-5330
or visit www scrantonsewer.org.

Call the
Lackawanna River Corridor Association
at 347-3611 or visit www.lrca.org.

LACKAWANNA RIVER CLEAN

This pamphlet is made available through a cooperative agreement between the Scranton Sewer Authority and the Lackawanna River Corridor Association.

Lackawanna River Clean

Rain Barrels

Rain barrels are containers that capture the roof runoff flowing out of a downspout.

Rain barrels placed at the end of roof downspouts capture and store roof runoff for non-potable water use, like irrigation. Rain barrels come in a wide variety of materials, designs, and colors. Common sizes for residential use are 55 gallons and 90 gallons. They are usually installed on the ground next to buildings.

Commercial or industrial properties are more likely to use cisterns because of their larger capacity and durability.

Benefits

Using rain barrels to temporarily store and reuse rainwater slows and reduces stormwater runoff from the site. They conserve non-potable water and may reduce water use charges. Rain barrels are inexpensive, easy to install and maintain, and readily available.

Cost

Do-it-yourself rain barrels can be constructed for under $30. Ready-made 55 gallon to 90 gallon rain barrels generally cost from $50 to $300 uninstalled. All rain barrels must be mosquito proof, have approved overflow points and meet city standards.

Maintenance

Inspect periodically for leaks, especially spigots and other connection points. Make sure debris does not clog the system. Screen all vents to prevent mosquito breeding.
For maximum stormwater benefits, empty the barrel between rain events in the wet season. Clean the rain barrel interior annually by brushing or disinfecting with vinegar or other non-toxic cleaners. The washout can be disposed of onsite to vegetated areas if disinfecting agents are adequately diluted so they do not harm plants. A rain barrel and its system components have a lifespan of about 20 years.

Safety and Siting Requirements

• A typical residential rain barrel design includes an opening in the sealed lid to accept downspout flow, an overflow pipe for when the barrel is full, and a spigot at or near the bottom to attach a hose or faucet. A screen at the opening controls mosquitoes and other insects. Several rain barrels can be connected to store more rainwater.

• Locate rain barrels on a flat surface next to or near roof downspouts.

• In areas with soils that drain well, you can direct overflow from the rain barrels onto the yard or landscape areas. The area must meet the safety requirements listed under downspout disconnect.

• Only collect roof water for reuse. Do not reuse water from parking or pedestrian areas, surface water runoff, or bodies of standing water.

• Refer to Lackawanna River Clean's *A better way to manage stormwater - Rain Gardens* brochure for detailed sizing, placement, and design information.

Permits

• Rain barrels attached to a downspout that do not connect back into the building's water system do not require permits.

Call the
Sewer Authority at 348-5330
or visit www.scrantonsewer.org.

Call the
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LACKAWANNA RIVER CLEAN

LRCA
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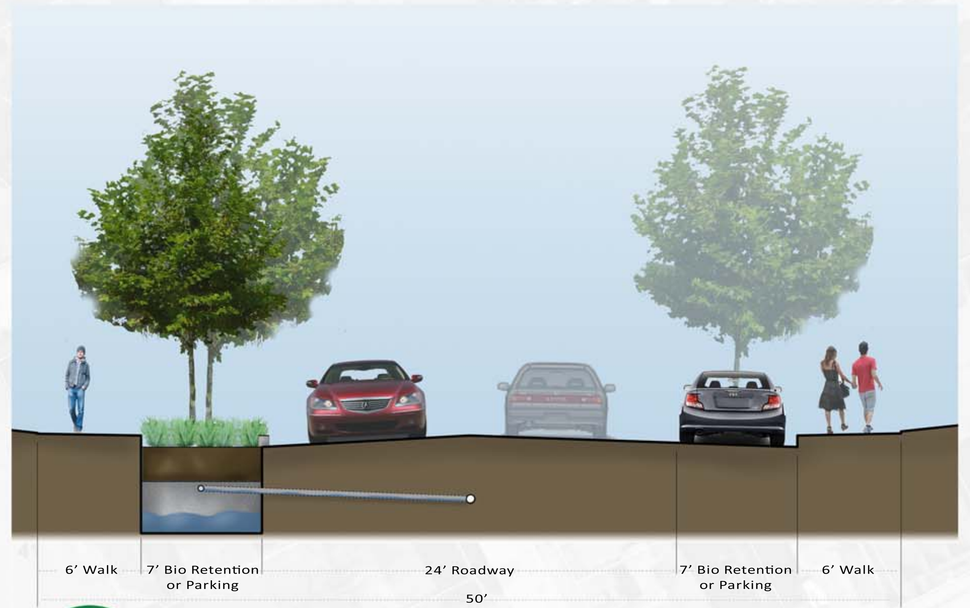
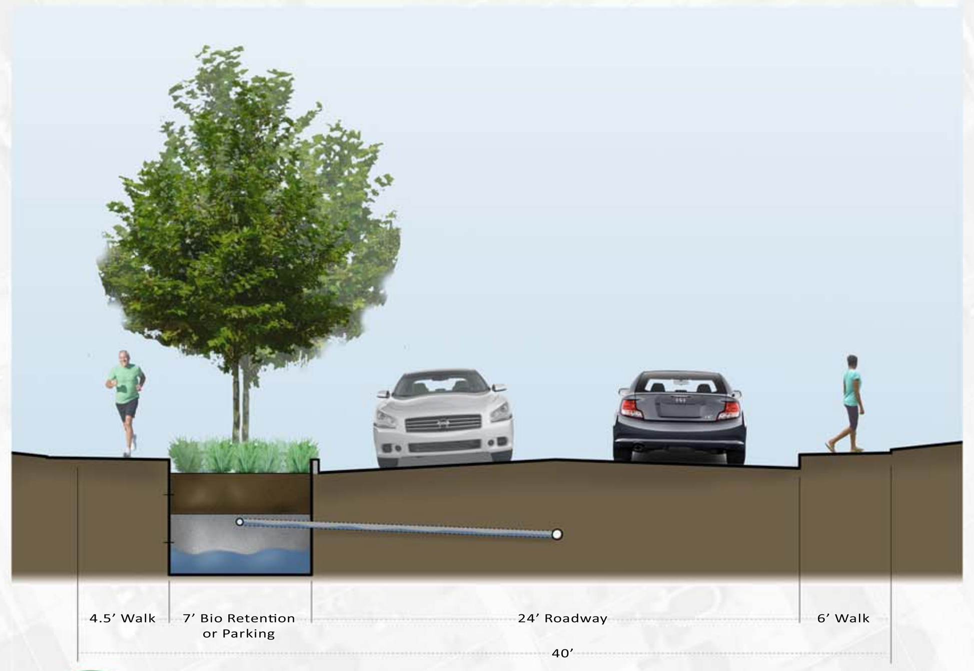
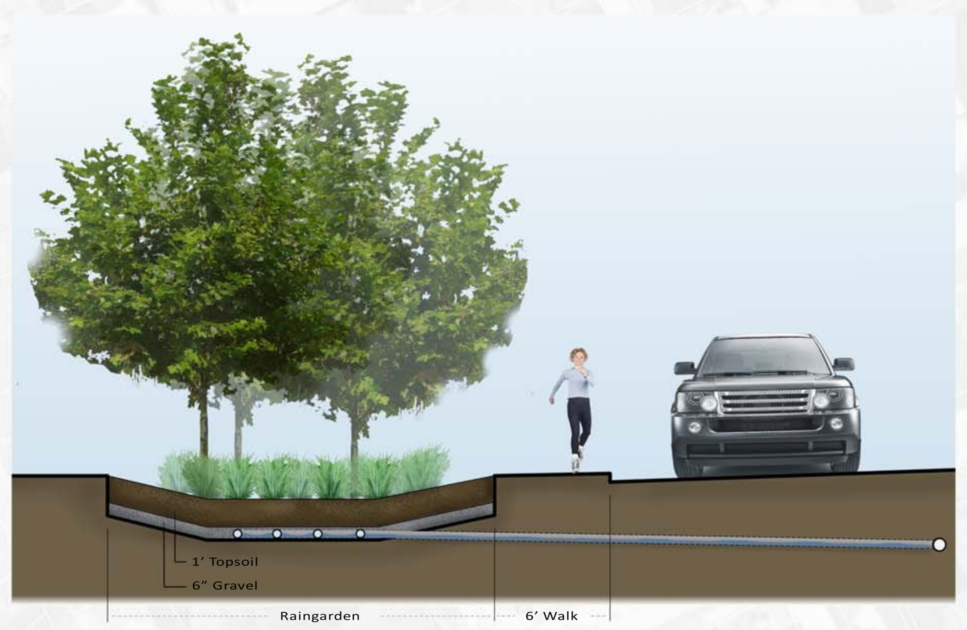


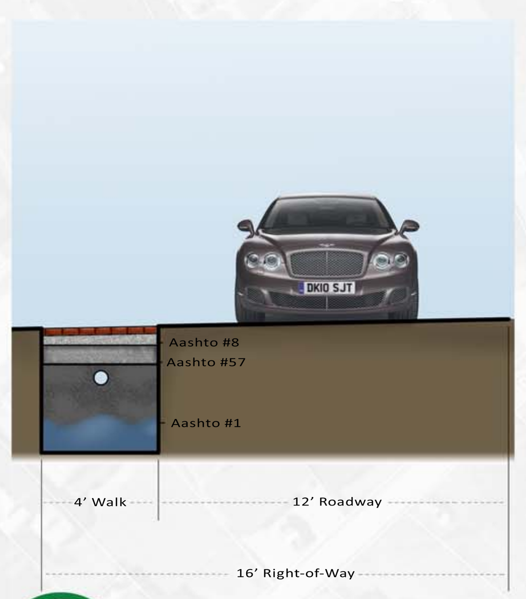
50' Right-Of-Way Street Scape



40' Right-Of-Way Street Scape



Raingarden With Underdrains



Pervious Pavers

Project By Locations

		Estimated Cost	CSO Imperviouse Treated
	City Owned Parcels		
A1	Fire Station Raingarden	$20,000	2,500 SF
A2	Parking Lot Bio Infiltration Area	$25,000	6,000 SF
	Public Owned Land Including R.O.W.s		
B1	School Street Pervious Paver Band	$40,000	22,000 SF
B2	West Market Street Scape	$235,000	55,000 SF
B3	Wayne Ave Street Scape	$135,000	38,000 SF
B4	Remaining Improvements along School and William Street	85,000	18,000 SF
	Civic Parcels		
C1	Howard Gardener School Roof Disconnect and Raingardens	$15,000	6,500 SF
C2	Shilo Baptist Church Raingarden	$25,000	11,000 SF
C3	Puritan Congregational Church Roof Disconnect	$10,000	4,000 SF
C4	Holy Rosary Rain Garden	$5,000	4,500 SF
C5	Casa Bella Infiltration Strip	$10,000	6,500 SF
C6	Holy Rosary Impervious Pavers	15,000	7,000 SF
	Residential Parcels		
D1	Deed Book 0968 Pg 0214 Purchase and Raingarden Installation	$35,000	6,500 SF
D2	Deed Book 0834 Pg 0194 Purchase and Raingarden Installation	$35,000	18,000 SF
D3	Deed Book 1382 Pg 0212 Purchase and Raingarden Installation	$35,000	17,000 SF
		$725,000	**222,500SF***

***42% Of All Impervious Surfaces Will Pass Through a Minimum of One Green Infrastructure Technology Before Emptying Into the Combined Sewer**

PROJECT PARTNERS:

McLane Associates Landscape Architects; Chesapeake Bay Program – A Watershed Partnership; Scranton, The Electric City, Pennsylvania; ssa; National Fish and Wildlife Foundation NFWF; Lackawanna River Corridor Association; EFC Environmental Finance Center

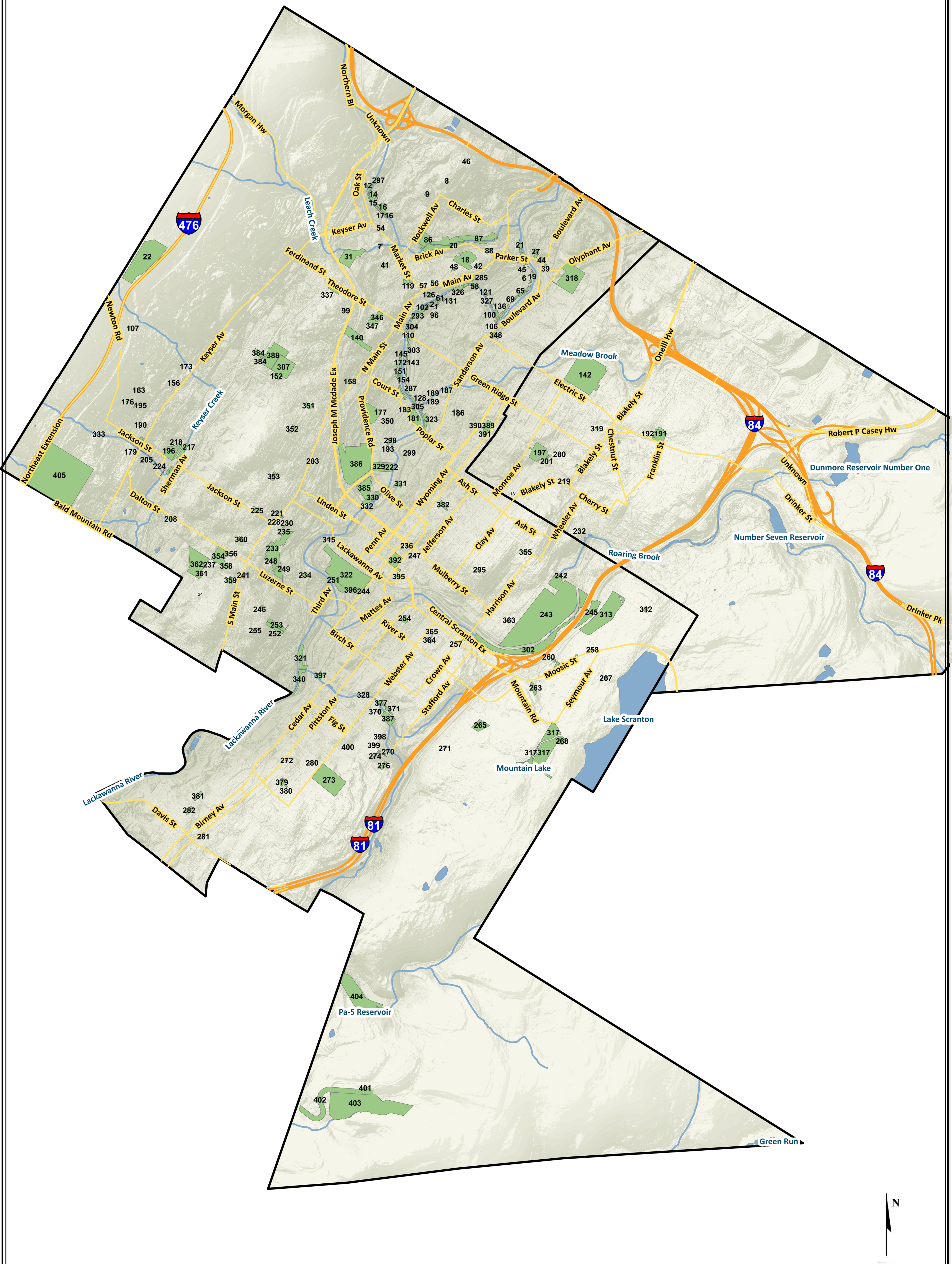
- Catchment Area 40 Boundary
- Sanitary Sewer Lines, Manholes, & Invert Elevations
- Stormwater Lines, Manholes, & Invert Elevations
- Stormwater Catchbasins that tie into Sanitary Network
- Street Tree
- Street Greening
- Pervious Pavers
- Bio Retention
- Building Greening

SUBCATCHMENT DESCRIPTION

- West Market Street Subcatchment Area
- NPDES Outfall#40
- Outlets to the Upper Lackawanna River
- 530,000 Square Feet of Impervious Surfaces
- $870,000 LTCP Proposed Investetment
- 17,000 Gallons LTCP Estimated Storage
- 810,000 Gallons of Estimated Annual Overflow

Subcatchment Area Case Study

Comprehensive Plan



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Scranton & Dunmore

Public Parcels

Key:

City Owned Parcels	Major Roads
Water Body	Minor Roads