United States Environmental Protection Agency

Greening the Iron Arts District

Green Infrastructure Interventions for Reducing Combined Sewer Overflow (CSO) in the City of Scranton, PA.

January 2017
EPA 833-R-16-013

ABOUT THE GREEN INFRASTRUCTURE TECHNICAL ASSISTANCE PROGRAM

Stormwater runoff is a major cause of water pollution in urban areas. When rain falls in undeveloped areas, soil and plants absorb and filter the water. When rain falls on our roofs, streets, and parking lots, however, the water cannot soak into the ground. In most urban areas, stormwater is drained through engineered collection systems and discharged into nearby water bodies. The stormwater carries trash, bacteria, heavy metals, and other pollutants from the urban landscape, polluting the receiving waters. Higher flows also can cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

Green infrastructure uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provide habitat, flood protection, cleaner air, and cleaner water. At the scale of a neighborhood or site, green infrastructure refers to stormwater management systems that mimic nature by soaking up and storing water. Green infrastructure can be a cost-effective approach for improving water quality and helping communities stretch their infrastructure investments further by providing multiple environmental, economic, and community benefits. This multi-benefit approach creates sustainable and resilient water infrastructure that supports and revitalizes urban communities.

The U.S. Environmental Protection Agency (EPA) encourages communities to use green infrastructure to help manage stormwater runoff, reduce sewer overflows, and improve water quality. EPA recognizes the value of working collaboratively with communities to support broader adoption of green infrastructure approaches. Technical assistance is a key component to accelerating the implementation of green infrastructure across the nation and aligns with EPA's commitment to provide community focused outreach and support in the President's *Priority Agenda Enhancing the Climate Resilience of America's Natural Resources*. Creating more resilient systems will become increasingly important in the face of climate change. As more intense weather events or dwindling water supplies stress the performance of the nation's water infrastructure, green infrastructure offers an approach to increase resiliency and adaptability.

For more information, visit http://www.epa.gov/greeninfrastructure

ACKNOWLEDGMENTS

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Photo: Scranton, PA

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1. EXECUTIVE SUMMARY

The Federal Clean Water Act (CWA) requires municipalities in urban areas to develop and implement programs to control stormwater runoff in order to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Under the authority of the CWA, Pennsylvania's Department of Environmental Protection (DEP) established requirements for communities served by a combined sewer system (CSS) to reduce or eliminate combined sewer overflows (CSOs). In Scranton, this effort led to a development of the CSO Long Term Control Plan (CSO-LTCP). The LTCP — adopted by the Scranton Sewer Authority (SSA) in 2012 — outlines a phased approach to reducing CSOs that includes the use of green infrastructure as one of multiple recommended strategies.

The SSA has been conducting a public education, outreach, and involvement program to educate the community, improve water quality, and enhance the overall network of green spaces in Scranton.

Moreover, the SSA has requested technical assistance from the EPA to incorporate green infrastructure projects into a comprehensive master plan for the newly developing Iron Arts District in South Scranton. The purpose of this EPA technical assistance is to identify potential green infrastructure projects that can be incorporated into a comprehensive master plan for the Iron Arts District.

The LID Center, subcontractor to Tetra Tech, coordinated with the task force to identify green infrastructure strategies that are appropriate for the site and provide concept designs for potential pilot green infrastructure demonstration projects. The task force is comprised of representatives from the SSA, City of Scranton, Lackawanna River Corridor Association (LRCA), United Neighborhood Centers of Northeastern Pennsylvania (UNC), Lackawanna Heritage Valley Authority, Iron Arts District Master Plan Team, and Lackawanna County.

The concept designs described in this report are examples of how green infrastructure can be used to reduce the impact of stormwater runoff and catalyze additional green infrastructure projects throughout Scranton. Implementation of this project within the Iron Arts District will provide valuable data for the SSA to measure and assess impacts of green infrastructure on a neighborhood-wide scale that can also be applied to expand green infrastructure across the City of Scranton.

2. INTRODUCTION

The City of Scranton, the state's sixth-largest city, is in Lackawanna County, Pennsylvania (Figure 1). It covers 25.4 square miles and has a population of 76,089 (2010 Census). The majority of Scranton's urbanized areas, including the Iron Arts District, lie in the Roaring Brook watershed – the largest tributary to the 350 square mile Lackawanna River watershed. The Lackawanna River begins northeast of Scranton and joins the Susquehanna River about 8 miles south of Scranton (Gannett Fleming 2012).

WATER QUALITY ISSUES/GOALS

Many urban cities such as Scranton were developed without modern stormwater quality controls. The City's sewer system was originally designed in the late 1800s to convey both storm-water and municipal sewage to wastewater treatment facilities in a single pipe (combined sewer). Today, an estimated sixty-three percent (63%) of this network remains and thirty-seven percent (37%) has been converted to a municipal separate storm sewer system (MS4) (Gannett Fleming 2012). During wet weather, the volume of stormwater runoff and raw sewage frequently exceeds the capacity of downstream treatment facilities, resulting in the discharge of untreated wastewater into local tributaries.

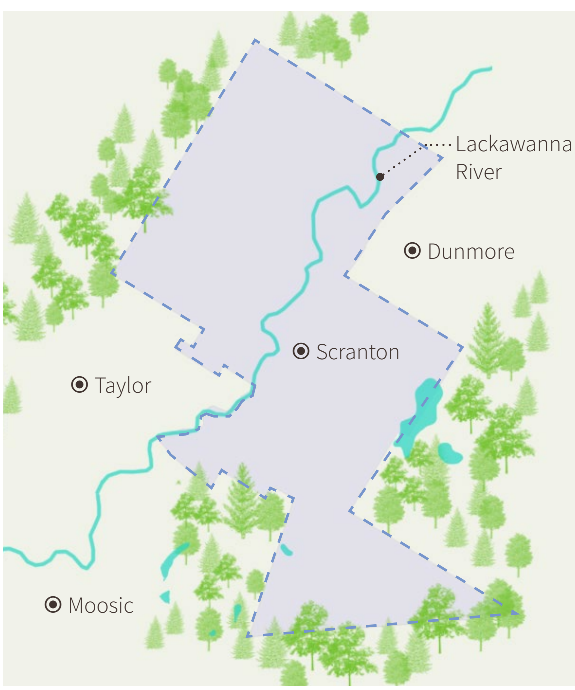

Figure 1. Regional Context

To comply with the Clean Water Act, the SSA is obligated to implement the LTCP over a twenty-five year period. Presently, sewer rates are increasing to fund major upgrades of infrastructure and stormwater management but the resources required to implement the control measures would require sewer rates greater than two percent (2%) of the community's median household income (Gannett Fleming 2012). The per capita income of Scranton is well below the State's average income, as over nineteen percent (19%) of residents are below the poverty level. The Iron Arts District has even lower income levels.

The implementation of green infrastructure practices has the potential to reduce the cost of implementing the LTCP by reducing the storage volume required for gray infrastructure. A pilot green infrastructure demonstration project is an opportunity to observe and record the performance of green infrastructure and potentially reduce the sizing in the final gray infrastructure design.

PROJECT OVERVIEW & PURPOSE

The City of Scranton is in the process of developing the “Iron Arts District” inspired by the historic Scranton Iron Furnaces located on Cedar Avenue. The Iron Furnaces and the Iron Arts District serve as a gateway between Downtown and South Side neighborhoods of Scranton. The integration of a pilot green infrastructure demonstration project with ongoing development efforts throughout the Iron Arts District can positively impact both the environment and local economic revitalization. The goals of this EPA technical assistance are to identify potential pilot green infrastructure demonstration projects that:

- Are highly visible;
- Can produce measurable results; and
- Can be integrated with ongoing capital improvement projects.

PROJECT BENEFITS

This project offers exciting opportunities to engage the community with effective watershed stewardship practices and may leverage additional green infrastructure funding to continue revitalization initiatives in the Iron Arts District and surrounding neighborhoods.

The concepts in this study have the potential to:

- Improve the water quality of Roaring Brook;
- Reduce the annual number of CSO events;
- Educate the community about the benefits of green infrastructure;
- Enhance aesthetics and livability of the neighborhood;
- Establish a “green” identity for the Iron Arts District; and
- Serve as a model for the expansion of “going green” throughout Scranton.

3. PROJECT SITE: THE IRON ARTS DISTRICT

The Iron Arts District designation is intended as a branding tool that focuses attention on the connection of South Scranton to Downtown Scranton and the historic furnaces. The furnaces were the site of the first mass production of iron T-rails for railroads in the United States and are a cultural and historical community landmark (Lockwood 2012). The Iron Arts District connects Downtown Scranton and South Scranton via Cedar Avenue. The area is bounded by the Iron Furnaces to the north, Birch Street to the south, Cedar Avenue to the east, and Roaring Brook to the west (Figure 2).

The Iron Arts District has the potential to introduce arts, culture, and economic viability to local residents. Numerous revitalization projects are progressing in South Scranton with the goals of developing new homeownership and rental housing for community residents; providing opportunities for small business start-ups along the Cedar Avenue commercial corridor: and removing and restoring blighted properties (United Neighborhood Center 2014). A steering committee with representation from cultural, environmental, and social service organizations is currently preparing an Iron Arts District Master Plan (IADMP) to define goals and plan future action to benefit the community. The IADMP will identify strategies to improve pedestrian facilities; connect existing trails and bikeways; create public spaces; and improve the overall aesthetics of the neighborhood. The goal of this project is to support these initiatives with green infrastructure concepts that can be integrated with the comprehensive master plan.

Figure 2. Iron Arts District Boundary

EXISTING SITE CONDITIONS

TOPOGRAPHY

The study area slopes from the east to west towards the Roaring Brook. The streets and alleys running from north to south, including Cedar Avenue, are relatively flat. The slope of the cross streets within the study area have slopes up to eight percent (8%). Due to the topography, there are many views of Downtown Scranton but the Roaring Brook is obscured within its channel.

DRAINAGE AREA

The study area drains to a combined sewer system with overflows identified as CSO #25, #49, and #50 (Figure 3). These outfalls discharge into the channelized portion of Roaring Brook and must overflow no more than nine times annually (Gannett Fleming 2012).

CEDAR AVENUE

Cedar Avenue, a state-owned highway, is the main access into the District from South Scranton and the Scranton Expressway and links the District to the Iron Furnaces and Downtown Scranton. There is one 12-foot vehicle travel lane in each direction and on-street parking on both sides of the roadway. Commercial, residential, and mixed-use buildings line the street. Sidewalk widths vary and in certain locations are as wide as 12 feet. Catch basins are located along the curb and gutter. Cedar Avenue was the primary focus for evaluation due to these attributes in addition to topography and the potential to treat stormwater.

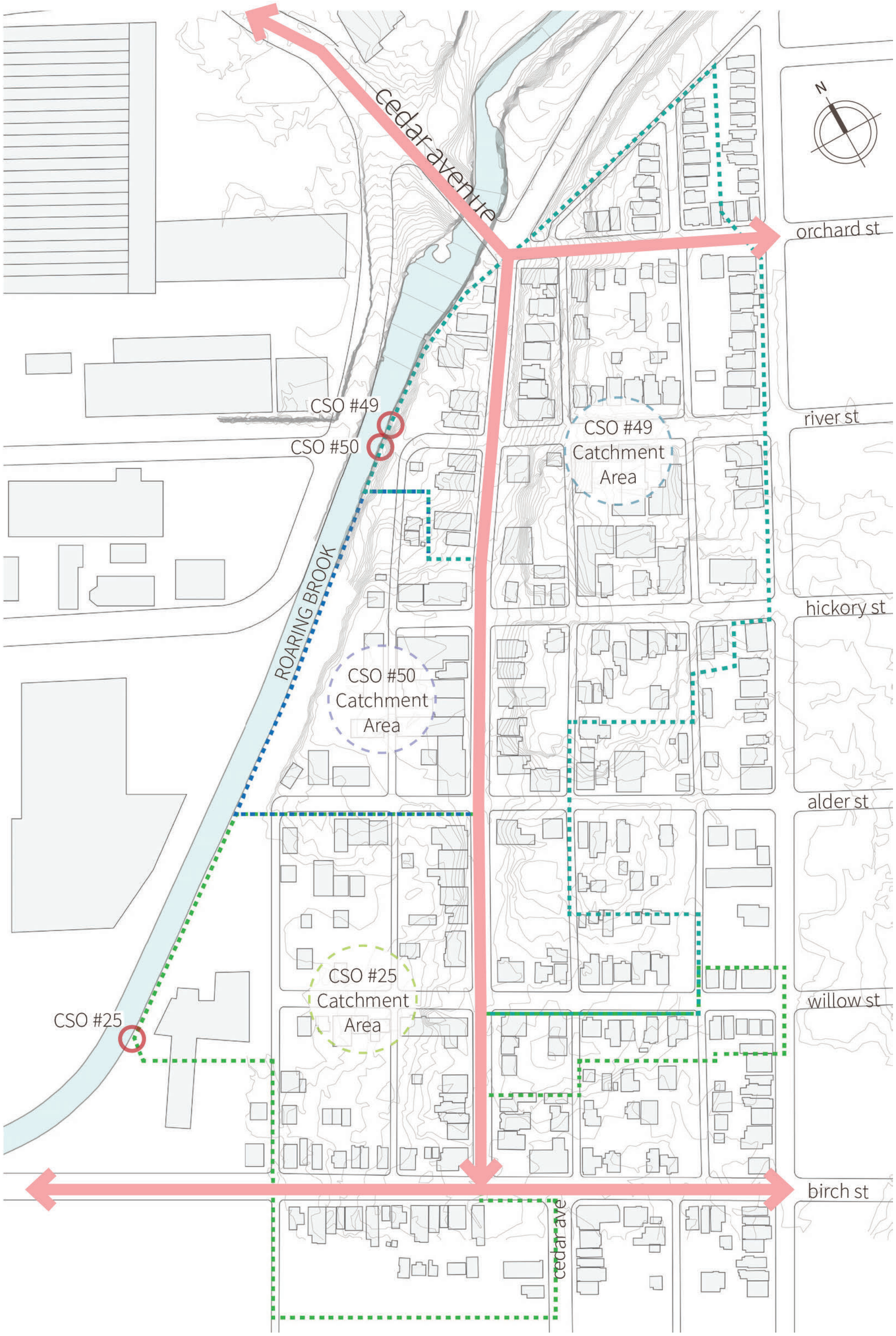

Figure 3. CSO Catchment Areas

4. GREEN INFRASTRUCTURE CONCEPTUAL PLAN

Figure 4. Sub-Catchment Areas

DESIGN APPROACH

The planning process for identifying potential green infrastructure projects was influenced by multiple factors including the potential to:

1. Reduce the annual number of CSO events;
2. Assess water quality improvements; and
3. Catalyze community reinvestment.

STORMWATER PRIORITY SITES

To determine priorities for treating stormwater, five sub-catchment areas were defined by analyzing the existing topography and catch basin locations (Figure 4). The objective was to treat stormwater to the maximum extent practicable to reduce occurrences of CSO events.

Sub-catchment areas A, B, C, and D are within CSO #49 and catchment area E is within CSO #50. Under the LTCP, CSO #50 will be plugged and the two catchment areas will be combined. Priority sites for green infrastructure retrofits were chosen to treat runoff within these sub-catchment areas.

For the purpose of this study, the year 1982 was selected as the typical year to prepare the hydrologic analysis and design, as identified by the LTCP. There were approximately eight rainfall events over 1.3 inches during that time period. The recurrence interval for that peak volume and intensity is in the range of three to six months (Gannett Fleming 2012).

The concept designs are based on capturing a volume of runoff from the demonstration site that is generated by the 1.3 inch event with best management practices (BMPs). The captured runoff volume can then be detained until the peak intensity of the storm has passed and/or retained through the process of infiltration or evapotranspiration. Planning level stormwater runoff and BMP sizing tools were used for the analysis.

It is recognized that there may be localized conditions that will require detailed and accurate design and engineering analysis. The result may be that additional storage and potential combinations of gray and green infrastructure will be required to achieve the CSO reduction goals in the LTCP. The runoff volume was determined using Equation A (below) and the results are shown in Table 1.

Equation A: Runoff Volume Required

$$Svr = [P \times [(Rvi \times \%I) + (Rvc \times \%C)] \times SA] \times 7.48/12$$

Where:

Svr = Volume Required (cu. ft)

P = Runoff Event (in.)

Rvi = Runoff Coefficient for Impervious/BMP Cover

I = Percent of Site in Impervious/BMP Cover

Rvc = Runoff Coefficient for Compacted Cover

C = Percent of Site in Compacted Cover

SA = Site Surface Area (sq. ft)

TABLE 1. SUB-CATCHMENT AREAS				
Sub-Catchment Area	**Drainage Area (sq. ft)**	**Impervious Area Treated (sq. ft)**	**Volume Required (cu. ft)**	**Green Infrastructure Practice**
A	20,000	20,000	1,000	Stormwater Curb Extension
B	23,500	23,500	1,200	Stormwater Planter Box
C	18,730	11,000	500	Rain Garden
D	42,250	28,750	1,000	Rain Garden
E	50,530	33,500	1,250	Rain Garden

The preliminary analysis and sizing for BMPs used different combinations and configurations of bioretention technology that provide surface and subsurface storage in the media for stormwater runoff. For the purpose of this study, Equation B (below) was used to determine the treatment capacity of the proposed green infrastructure practices. In addition, a bioretention section was designed to meet the requirements of each site (Table 2).

Equation B: BMP Storage Provided

$$Svp = SAb \times [(dm \times \eta m) + (dg \times \eta g)] + (SAa \times Dpond)$$

Where:

Svp = Volume Provided (cu. ft)

Sab = Bottom Surface Area (sq. ft)

Dm = Depth of Media (ft)

ηm = Porosity of Media

dg = Depth of Gravel (ft)

ηg = Porosity of Gravel

SAa = Average Surface Area (sq. ft)

Dpond = Ponding Depth (ft)

TABLE 2. PRACTICE DESCRIPTIONS

Sub-Catchment Area	Green Infrastructure Practice	Bioretention Section
A	Stormwater Curb Extension	Bioretention: 3′ Media, 1′ Gravel Storage, 0.5′ Ponding
B	Stormwater Planter Box	Bioretention: 3’ Media, 1′ Gravel Storage, 0.5′ Ponding
C	Rain Garden	Bioretention: 3’ Media, 1.5′ Gravel Storage, 1′ Ponding
D	Rain Garden	Bioretention: 3’ Media, 1.5′ Gravel Storage, 1′ Ponding
E	Rain Garden	Bioretention: 3’ Media, 1.5′ Gravel Storage, 1′ Ponding

Based on the project goals and space limitations, curbside bioretention was selected as the preferred BMP within the Cedar Avenue right-of-way (ROW). Bioretention practices which include stormwater curb extensions, planter boxes, and rain gardens are described in the stormwater toolbox in the following section.

Strategic locations along Cedar Avenue were selected for pilot demonstration projects to determine how bioretention facilities can intercept stormwater runoff from the roadway, increase the time of concentration, and slowly release it into the storm drain system. Recommendations for additional bioretention locations have been identified in a vacant lot adjacent to Schimpff Court and the Roaring Brook. This location can provide added stormwater treatment and has the potential to increase community awareness of water quality issues due to its proximity to the river.

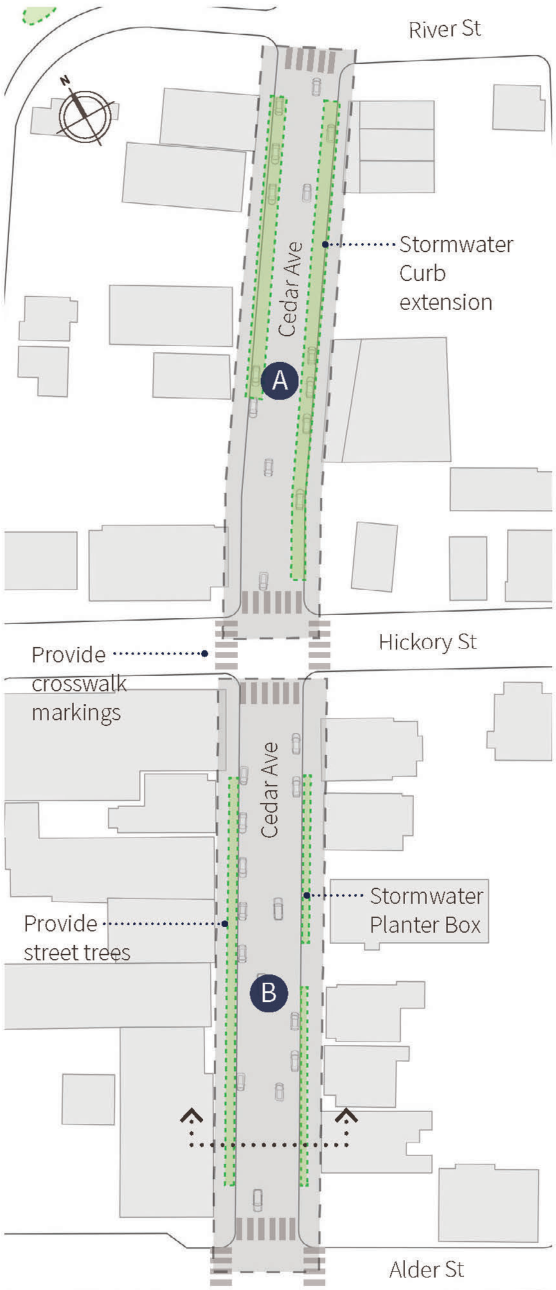

Figure 5. Green Street Concept Plan

CEDAR AVENUE PILOT GREEN STREET

The optimal location for the Cedar Avenue Green Street is the two-block segment between River Street and Alder Street. Factors that were used to prioritize this segment include: existing building uses, sidewalk widths, lack of tree canopy, and potential for redevelopment are factors that were used to prioritize this segment. The existing 12-ft to 14-ft sidewalk of Cedar Avenue between Hickory Street and Alder Street provides an opportunity for integrating stormwater planter boxes to intercept runoff from the roadway. Stormwater curb extensions are better suited between River Street and Hickory Street due to inadequate existing sidewalk width. Approximately three parking spaces on each side of the roadway may be compromised for the installation of curb extensions.

STORMWATER RECOMMENDATIONS:

Catchment Area A – Provide 650 sq. ft. of stormwater curb extensions on both sides of the roadway.

Catchment Area B – Provide 750 sq. ft. of stormwater planters on both sides of the roadway.

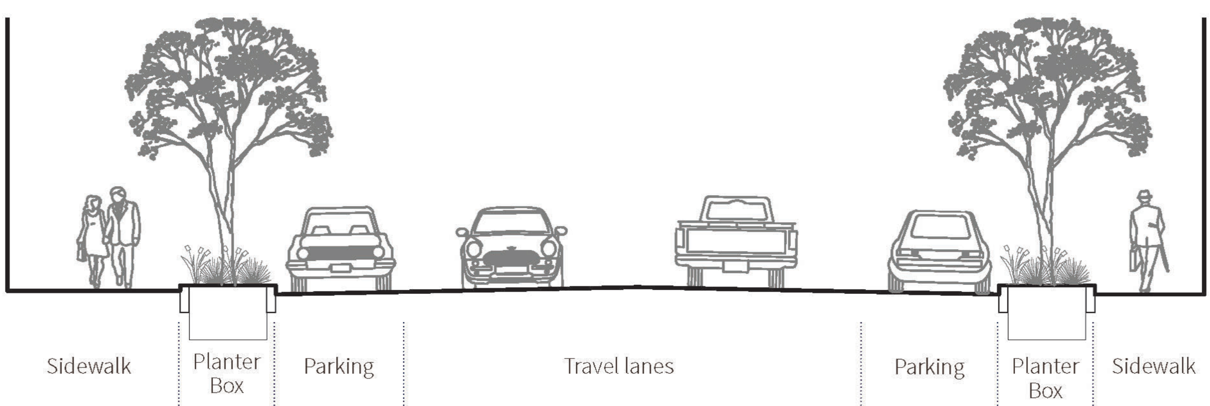

Figure 6. Green Street Section

Figure 7. Green Street Perspective

Figure 8. Schimpff Court Concept Plan

SCHIMPFF COURT RAIN GARDEN PILOT PROJECT

In addition to the Cedar Avenue Green Street pilot project, the vacant areas and right-of-way of Schimpff Court present an opportunity to treat a significant amount of stormwater within the same catchment area. Multiple bioretention facilities (rain gardens) could potentially treat the impervious area within the catchment areas shown in Figure 8. Incorporation of signage could be implemented to educate the public on the benefits of stormwater management through green infrastructure practices. Moreover, a pedestrian and/or bicycle connection to the Cedar Avenue Bridge would strengthen the physical and visual connection to the Iron Furnaces. This option has the potential to bypass the CSO if the bioretention facilities are designed to overflow directly into the adjacent channelized tributary.

STORMWATER RECOMMENDATIONS:

Catchment Area C – Provide 600 sq. ft. of rain garden.

Catchment Area D – Provide 1,250 sq. ft. of rain garden.

Catchment Area E – Provide 1,650 sq. ft. of rain garden.

Figure 9. Schimpff Court Perspective

5. STORMWATER TOOLBOX

A key factor for achieving significant CSO reduction in the Roaring Brook is through strategic placement of green infrastructure practices that can reduce the speed of water conveyance into treatment facilities. Over time, these practices may reduce the need to increase storm drain capacity.

BIORETENTION

Bioretention treats stormwater by ponding water on the surface and allowing contaminants and sediments to filter and settle at the mulch layer, prior to entering the soil media for infiltration and pollutant removal. Bioretention uses native vegetation such as grasses, shrubs, and trees to remove a variety of pollutants including suspended solids, nutrients, metals, and bacteria from stormwater runoff.

Photo Source: LID Center

STORMWATER CURB EXTENSIONS

Stormwater curb extensions are a type of bioretention designed to handle stormwater runoff from the roadway. Stormwater flowing down the street is directed to the bioretention facility through inlets or curb cuts. There, the runoff temporarily ponds above the surface and then filters through the bed. Where urban spaces permit, stormwater curb extensions can be designed to fully infiltrate down to the soils below. In most cases, the filtered runoff is collected in an underdrain and returned to the sewer system. Because public rights-of-way are primarily impervious and bioretention facilities work best with smaller drainage areas, the contributing drainage area for a single facility is generally limited to 1/4 to 1/2 acre.

Photo Source: LID Center

STORMWATER PLANTER BOXES

Stormwater planters — commonly referred to as foundation planters — are an on-site retrofit option for treating rooftop runoff in ultra-urban areas. These flexible practices can be placed either above the ground or at grade in landscaping areas between buildings and roadways, and can be designed to allow water to fully seep into the ground (i.e., infiltration planters) or designed as flow-through planters. Similar to stormwater curb extensions, the allowable drainage area is typically limited to 1/4 acre or less.

Photo Source: LID Center

STREET TREES

In addition to bioretention practices described above, trees are one of the most economical and green stormwater management practices with the potential to be introduced into urban communities. When it rains, water is intercepted by the leaves, bark, and roots of trees — allowing water to evaporate, evapotranspirate, or absorb into the ground. Additionally, trees help to reduce the urban heat island effect, improve the urban aesthetic, and improve air quality. Healthy trees should be protected and enhanced when implementing green street retrofit projects, and new trees should be incorporated wherever possible. In either situation, care should be taken to ensure adequate root space, improved soil conditions, and sufficient soil volumes and depths. Doing so will help street trees reach maturity and enable generations to come to enjoy their benefits.

Photo Source: ACTrees

6. SUMMARY OF RECOMMENDATIONS

There are multiple opportunities to incorporate green infrastructure into ongoing revitalization projects in the Iron Arts District. The table below provides additional recommendations for incorporating green infrastructure practices to supplement the pilot projects previously discussed in this report.

TABLE 3. SUMMARY OF OPPORTUNITIES

		Location	Opportunities	Considerations
1		Cedar Ave. - between River St. & Alder St. (Pilot - see page 18)	Install planter boxes and curb extensions to establish the Cedar Avenue Green Street.	Engage commercial property owners.
2		Vacant lots - 314, 404, 414 Cedar Ave. (Pilot - see page 20)	Provide a public stormwater demonstration park to serve as a community destination.	Verify excavation limit behind concrete channel.
3		Cedar Ave. - between Alder St. & Birch St.	Add planter boxes and curb extensions to strengthen the Cedar Avenue Green Street.	Engage residential property owners.
4		Roaring Brook Buffer - Hickory St.	Install a rain garden and outlet directly into Roaring Brook to bypass the CSO.	This area has lower visibility and tree loss is likely.
5		Vacant lot - 409 Cedar Ave.	Convert vacant lot into a pocket park that encourages local art installation/projects.	Steep slope can be a challenge for a high-activity park.
6		Hickory St. - between Schimpff Ct. & Rosen Ct.	Add bioretention facilities and improve sidewalks.	Verify ROW width and avoid utilities.
7		Alder St. - between Schimpff Ct. & Rosen Ct.	Provide street trees and curbside bioretention facilities.	Verify ROW width and avoid utilities.
8		Vacant lot - 307 & 311 Willow St.	Convert vacant lot into a pocket park with bioretention facilities.	Encourage community input from planning to design.
9		Willow St. - between Schimpff Ct. and Rosen Ct.	Provide street trees and curbside bioretention facilities.	Verify ROW width and avoid utilities.
10		Vacant lot - 715 Cedar Ave.	Convert vacant lot into a pocket park with bioretention facilities.	Encourage community input from planning to design.
11		Birch Ave. - between S Washington Ave. & Cedar Ave.	Provide street trees and curbside bioretention facilities.	Verify ROW width and avoid utilities.

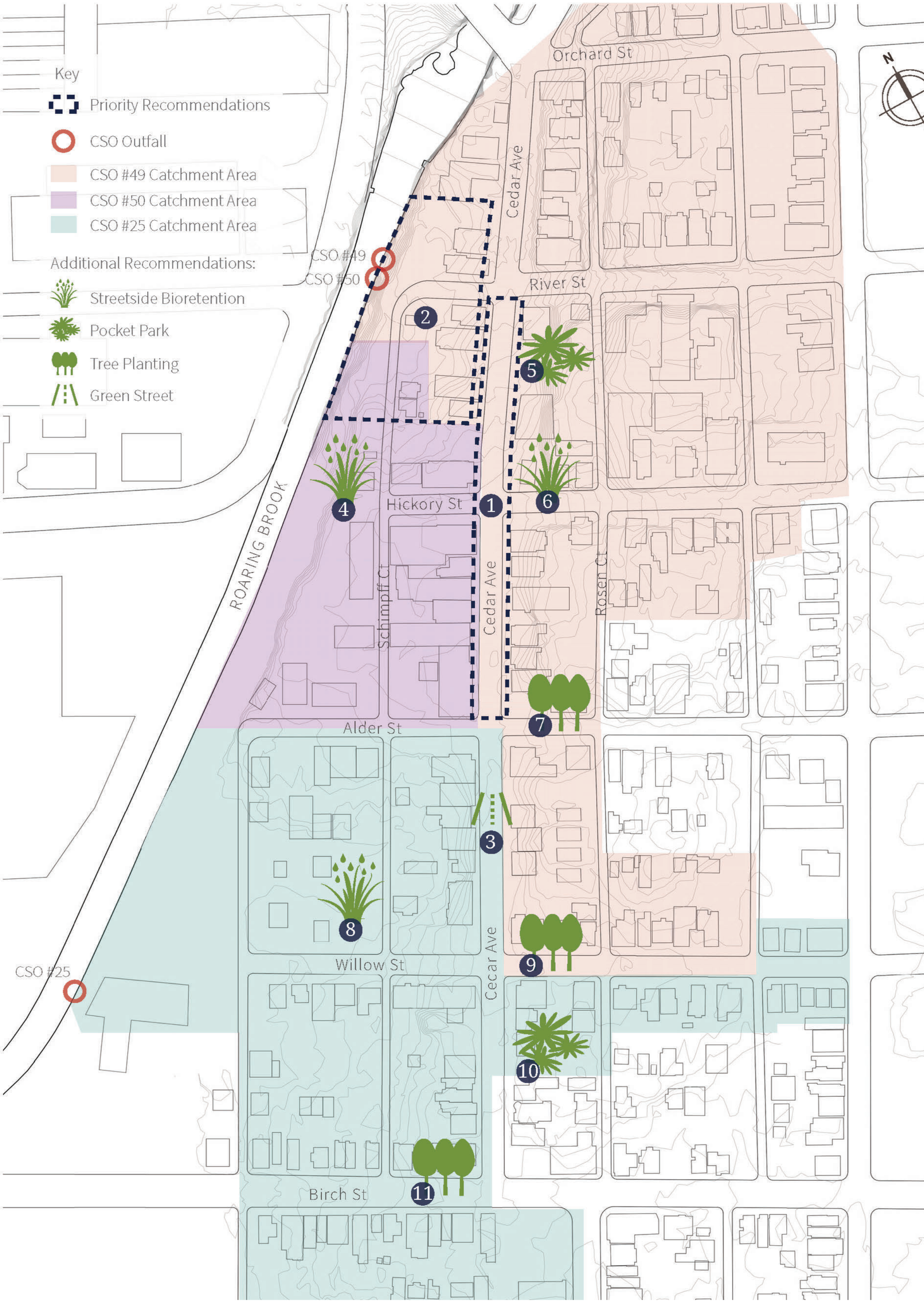

Figure 10. Summary of Recommendations

FOR FURTHER INVESTIGATION

This report represents a preliminary assessment initiated to identify opportunities and constraints for incorporating green infrastructure in the Iron Arts District. The following are key design elements that will require further studies as part of the future design development phase.

SOIL SUITABILITY

The task force identified potential limitations to stormwater infiltration due to hardpan soils and potential complications from previous mining operations. For that reason, stormwater calculations assumed little to no infiltration and pipes would tie into the existing sewer system. Soil borings are necessary to determine if infiltration is possible; if conditions are favorable, greater volumes of stormwater runoff could be treated.

PERMEABLE PAVEMENT

Due to potential limitations to stormwater infiltration (see above), permeable paving was not recommended as part of the concept design. Without infiltration, the use of permeable pavement in pedestrian areas would not be a cost-effective practice. If soil borings determine that infiltration is possible, permeable pavement should be considered to increase the volume of treatment during larger storm events.

STREET PARKING

The concept design includes the removal of some on-street parking. Further analysis and community input should be collected to determine the final configuration of on-street parking to best accommodate all stakeholders.

EXISTING UTILITIES

The presence of overhead utilities is problematic for street trees. The City should investigate the possibility of burying or relocating utilities as part of any capital streetscape improvement plans. If relocation is not feasible, care should be taken in the final design stage to avoid utilities where possible and substitute smaller trees where necessary.

PENNDOT

Cedar Avenue (Route 11) is a state highway and PennDot should be considered a primary stakeholder in any development of proposals along the Avenue. PennDot has existing policies for incorporating green infrastructure within the right-of-way that have been reviewed as part of the preliminary analysis.

ROARING BROOK CHANNEL / ARMY CORPS OF ENGINEERS

The channelized portion of Roaring Brook is under the Army Corps of Engineers' authority. The Corps should be involved early in any design development of concepts that include daylighting into the channel to determine any limitations or restrictions.

ADDITIONAL OPPORTUNITIES

There are many opportunities to implement green infrastructure practices at the University of Scranton and the Iron Furnaces. Large impervious areas such as parking lots should be considered for integrating stormwater retrofits as part of the future design process.

7. GREEN INFRASTRUCTURE PRACTICE COST ESTIMATES

The preliminary cost estimates for constructing the green infrastructure practices at each of the sites are found in the tables below. Cost information was derived from price history data published by various public agencies (PennDOT, Ohio DOT, PG County DPW&T) and compared against projects constructed in the northeast Pennsylvania area. All cost estimates assume green infrastructure retrofit practices and are based on the sizing denoted in Table 2. A thirty percent (30%) contingency has been added to all costs.

TABLE 4. CEDAR AVENUE GREEN STREET COST ESTIMATE

Item Description	Unit	Qty	Unit Cost	Total
Adjust Curb Boxes	Ea	4	$150.00	$600.00
Adjust Fire Hydrant	Ea	4	$1,350.00	$5,400.00
Adjust Sewer Manhole	Ea	8	$450.00	$3,600.00
Relocate Utility Pole	Ea	4	$15,000.00	$60,000.00
6 inch Storm Sewer Tap	Ea	4	$400.00	$1,600.00
6 Inch PVC Pipe (underdrain)	Lf	1,400	$18.00	$25,200.00
Boring and Jacking up to 15 Inch Pipe	Lf	20	$500.00	$10,000.00
Mobilization (for Construction $100k – $500k)	Ls	1	$10,000.00	$10,000.00
Geotechnical testing	Ls	1	$10,000.00	$10,000.00
Remove Curb and Gutter	Lf	1,400	$4.00	$5,600.00
Remove Inlet or Manhole	Ea	8	$924.00	$7,392.00
Remove Pavement	Sy	900	$4.00	$3,600.00
Saw Cut Existing Paving	Lf	1,400	$2.00	$2,800.00
Earth Excavation	Cy	520	$40.00	$20,800.00
Graded aggregate	Cy	160	$40.00	$6,400.00
Concrete Curb Gutter	Lf	1,400	$15.00	$21,000.00
Jersey Barrier for Maintenance of Traffic	Lf	1,000	$25.00	$25,000.00

TABLE 4. CEDAR AVENUE GREEN STREET COST ESTIMATE				
Item Description	**Unit**	**Qty**	**Unit Cost**	**Total**
DPW&T Street Tree	Ea	20	$250.00	$5,000.00
Inlet Protection Device	Ea	4	$250.00	$1,000.00
Soil Media	Cy	300	$40.00	$12,000.00
Plantings	Sf	2,800	$6.00	$16,800.00
Shredded Mulch 3" Deep	Cy	30	$40.00	$1,200.00
			Sub-total	$254,992.00
			30% contingency	$76,497.60
			Total	**$331,489.60**

TABLE 5. SCHIMPFF COURT RAIN GARDENS COST ESTIMATE				
Item Description	**Unit**	**Qty**	**Unit Cost**	**Total**
6 inch Storm Sewer Tap	Ea	3	$400.00	$1,200.00
6 Inch PVC Pipe (underdrain)	Lf	200	$18.00	$3,600.00
Mobilization (for Construction $100k – $500k)	Ls	1	$10,000.00	$10,000.00
Geotechnical testing	Ls	1	$10,000.00	$10,000.00
Earth Excavation	Cy	650	$40.00	$26,000.00
Graded aggregate	Cy	195	$40.00	$7,800.00
DPW&T Street Tree	Ea	10	$250.00	$2,500.00
Inlet Protection Device	Ea	2	$250.00	$500.00
Silt Fence	Lf	350	$4.00	$1,400.00
Stabilized Construction Entrance	Ea	1	$1,250.00	$1,250.00
Soil Media	Cy	390	$40.00	$15,600.00
Plantings	Sf	3,500	$6.00	$21,000.00
Shredded Mulch 3" Deep	Cy	32	$40.00	$1,280.00
			Sub-total	$102,130.00
			30% contingency	$30,639.00
			Total	**$132,769.00**

8. CONCLUSION

The concept designs developed for the pilot projects demonstrate how green infrastructure can be retrofitted into the Iron Arts District to reduce the impact of stormwater runoff, mitigate combined sewer system overflows, and improve neighborhood aesthetics. Implementation of this project within the District will provide valuable data for the SSA to measure and assess impacts of green infrastructure on a neighborhood-wide scale. Green infrastructure initiatives can be modified by results from the Iron Arts District Pilot and emulated in other communities within the City of Scranton and in nearby municipalities across the region.

The integration of a pilot green infrastructure demonstration project with the ongoing development efforts throughout the Iron Arts District can positively impact both the environment and local economic revitalization. This project offers opportunities to engage the community at all levels with more effective watershed stewardship practices and may leverage additional green infrastructure funding to continue revitalization initiatives in the neighborhood.

REFERENCES

Gannett Fleming. 2012. “Combined Sewer Overflow Long Term Control Plan.” Scranton Sewer Authority. 23Oct. 2012. Accessed via web on Aug. 15, 2014. <http://www.scrantonsewer.org/docs/submittedltcp.pdf>

Gelb, Natalie. 2014. “The Scranton Iron Furnaces: Forging ahead.” Northeast Pennsylvania Business Journal. 2 April 2014. Accessed via web on July 29, 2014. <http://biz570.com/op-ed/management/the-scranton-iron-furnaces-forging-ahead-1.1657662>

Lockwood, Jim. 2012. “Historic Scranton Furnaces Eyed as Heart of New Iron District.” The Scranton Times-Tribune. 13 Nov. 2012. Accessed via web on Dec. 4, 2014.

McGurl, Bernie, Robert E. Hughes, and Michael Hewitt. 2012. “Lower Lackawanna River Watershed Restoration and Assessment Plan Report (LLRWRAPR).” Lackawanna River Corridor Association. Lackawanna River Corridor Association, 31 Dec. 2012. Accessed via web on Aug. 4, 2014. <http://www.lrca.org/LRCA/pdf/LLWRAP_Final.pdf>.

United Neighborhood Centers of Northeastern Pennsylvania. 2014. “Cedar Point Apartments & Townhouses.” United Neighborhood Centers of Northeastern Pennsylvania. 1 Jan. 2014. Accessed via web on Aug. 4, 2014. <http://www.uncnepa.org/cedar-avenue>.

University of Maryland Environmental Finance Center, Lackawanna River Corridor Association, McLane Associates et al. 2013. “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.” Accessed via web on Aug. 4, 2014. <http://efc.umd.edu/assets/2013_scranton_nfwf_report_final.pdf>

Wallace Roberts & Todd, LLC. 2008. South Side Revitalization Plan Scranton, Pennsylvania; Elm Street Plan.

United Neighborhood Centers of Northeastern Pennsylvania. December 2008.