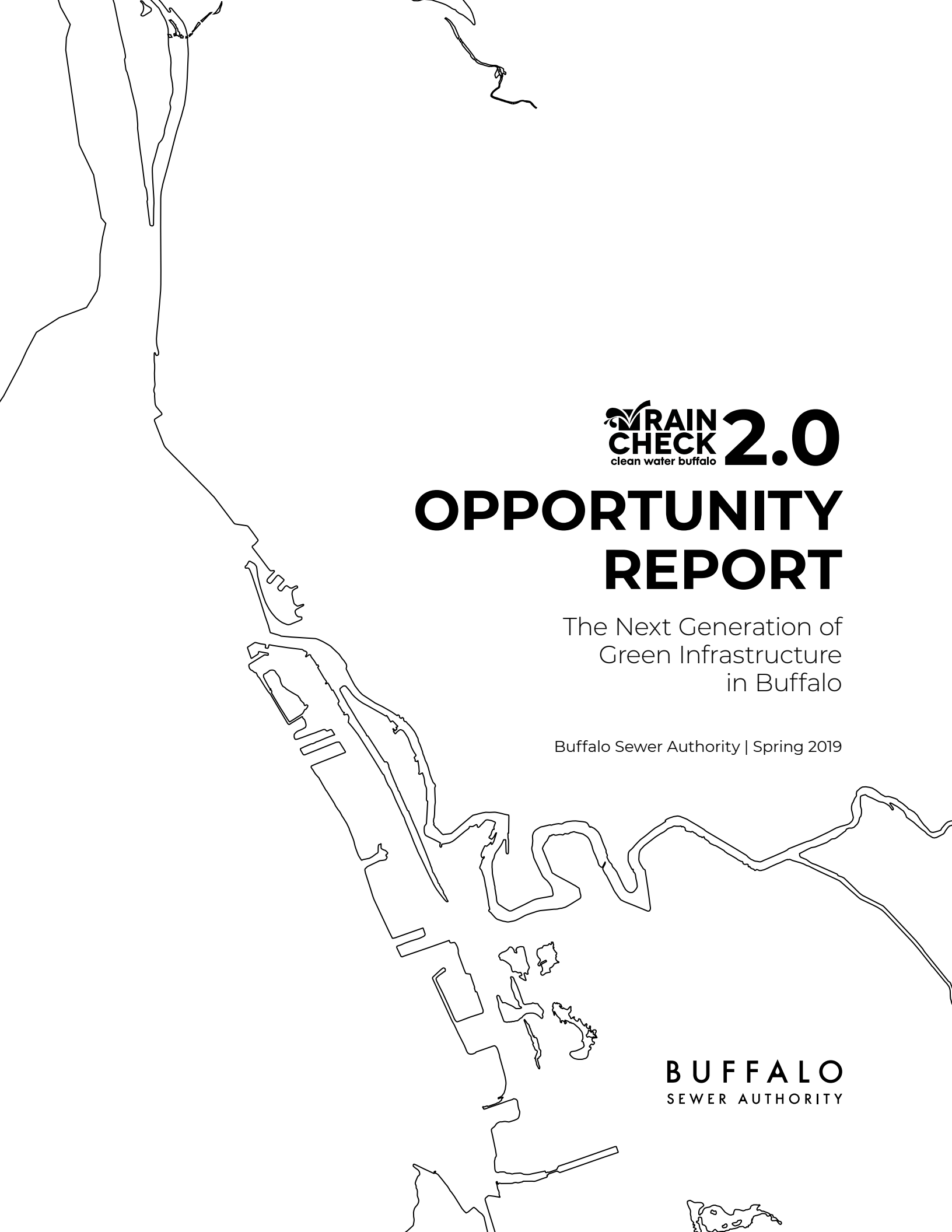
RAIN CHECK clean water buffalo 2.0

OPPORTUNITY REPORT

The Next Generation of Green Infrastructure in Buffalo

Buffalo Sewer Authority | Spring 2019

BUFFALO SEWER AUTHORITY



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This document describes the Buffalo Rain Check 2.0 Green Infrastructure efforts undertaken by the Buffalo Sewer Authority (Buffalo Sewer). As a benchmark report, the document synthesizes some of Buffalo Sewer's research and outlines future initiatives. As a tool to facilitate future investment in green infrastructure, this document provides a unified framework and strategies to support planning and decision making. As an opportunity analysis, this document identifies potential partners and community benefits to engage stakeholders and property owners in planning and funding of green infrastructure projects across the City of Buffalo.

All renderings shown in this document are intended to present the possibilities inherent in green infrastructure. They are for illustrative and discussion purposes only and are not necessarily representative of any proposed plan or anticipated action.

To learn more about Rain Check and find additional information please visit **raincheckbuffalo.org**.

CITY OF BUFFALO

MAYOR BYRON W. BROWN

Acknowledgements

The Buffalo Sewer Authority (Buffalo Sewer) extends its gratitude to the Ralph C. Wilson Jr. Foundation and the Community Foundation for Greater Buffalo for their generous support of this report and to the many partner agencies, community organizations, and customers that have contributed to the ongoing success of Rain Check. This report is the result of contributions made by:

Buffalo Sewer Authority
Oluwole A. McFoy
Kevin Meindl
Catherine Knab
Rosaleen Nogle
Scott Steinwald
Regina Harris
Tracy F. King
Allison Lack
Julie Barrett-O'Neill

Buffalo Sewer Authority Board of Directors
Herbert L. Bellamy
John D. Kennedy, Sr.
Christopher Roosevelt
Eleanor Petrucci

Local Government Agencies
City of Buffalo Mayor's Office of Strategic Planning
City of Buffalo Department of Public Works
City of Buffalo Employment and Training Center
City of Buffalo Urban Development Corporation
City of Buffalo Urban Renewal Agency

Consultant Team
Arcadis of New York
evolve :: environment architecture
University of Buffalo Regional Institute
PUSH Buffalo
Center for Watershed Protection
Core Environmental
CallisonRTKL
Watts Architecture & Engineering

ARCADIS

evolve environment :: architecture

CONTENTS

INTRODUCTION

Buffalo Sewer's core mission is protecting public health and the environment from water pollution.

Established in 1935, Buffalo Sewer continues to deliver critical services to protect public health and support the vitality of the community, environment, and economy.

Green infrastructure manages runoff, improves local waterways, increases the region's climate change resiliency, and enhances overall quality of life.

Buffalo has a stormwater challenge. When rain falls in Buffalo or when snow melts, it flows through storm drains and into the City's combined sewer system where it mixes with sanitary sewage. In dry weather, Buffalo's sewer system is able to treat all of this wastewater. However, when it rains or snow melts and more water enters the system, some of this wastewater can flow into Buffalo's rivers, streams, and the lake.

Buffalo Sewer is committed to protecting local water resources and public health through a combination of improvements to the existing gray infrastructure, such as the sewers and wastewater treatment plant, as well as innovative green strategies to reduce the amount of stormwater entering the combined sewer system.

Rain Check 2.0 builds upon the strong foundation of Rain Check 1.0, Buffalo Sewer's first generation of green infrastructure investments. This report identifies potential green infrastructure projects to reduce runoff from over 500 acres of impervious surface, fulfilling Buffalo Sewer's obligations under the Long Term Control Plan (LTCP).

Buffalo's Opportunity

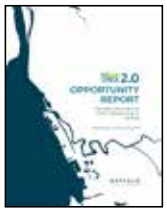
Buffalo Sewer has identified priority sewer basins for implementing green infrastructure to meet part of the LTCP goals and provide additional benefits to the community. This document summarizes the preliminary effort to identify opportunities for green infrastructure on sites within the priority combined sewer overflow (CSO) basins and includes recommendations for how green infrastructure can be deployed throughout the City.

This document describes the Buffalo Rain Check 2.0 Green Infrastructure efforts undertaken by Buffalo Sewer

Figure 0.1 Aerial View of the City. From "Erie County NYSDOP High Resolution Imagery 2017"

Our Great Lakes water is one of Buffalo's most important assets. Since 2006, my Administration, in partnership with Buffalo Sewer, has made a strong commitment to protect that water and dramatically reduce combined sewer overflows through the implementation of its Long Term Control Plan. We are proud that green infrastructure, with its demonstrated impact on economic and neighborhood revitalization, is a major component of our water protection strategy.

—Mayor Byron W. Brown



Rain Check 2.0 Goals:

Expand green infrastructure in Buffalo.

Reduce stormwater runoff and protect public health.

Conduct rigorous, **site specific analyses** of feasibility and need.

Incorporate **equity** considerations as critical elements of green infrastructure decision-making.

Maximize **economic, social and environmental benefits** in implementing green infrastructure.

Educate and **engage** stakeholders on green infrastructure benefits and implementation.

and identifies the need to create communities of action for implementation. Rain Check 2.0 includes a tool kit of green infrastructure technologies that can be deployed in Buffalo and identifies various strategies for structuring green infrastructure to maximize stormwater, environmental, equity, and economic benefits.

Successful green infrastructure requires a supportive culture in Buffalo — one that advocates for the implementation and maintenance of green infrastructure. Rain Check 2.0 also includes a robust strategy of engagement and a balancing of priorities to ensure that stormwater goals are met and that the implementation of green infrastructure is informed by consideration of equity and the broader environmental context.

The work of Rain Check 2.0 confirmed that Buffalo Sewer can meet or exceed its stormwater goals in the priority CSO basins by employing green infrastructure. Meeting the goals requires investments in green infrastructure on both publicly-owned and privately-owned properties. Ongoing planning and outreach to identify partners, engage stakeholders, and build trust and shared values is critical to success. This Opportunity Report is a first step in that larger planning effort.

How to the Use Rain Check 2.0 Opportunity Report

This document is a starting point to guide Buffalo Sewer through its next phases of planning and implementation. It is also intended to help facilitate the creation of a strong coalition of partners, including individual community members, whose collective actions can solve Buffalo's stormwater challenge. This document is organized into the following chapters:

Chapter One | Opportunity includes an overview of the stormwater challenge and Buffalo Sewer's approach. It provides the social, economic, and ecological context by examining equity, environmental systems, and the urban context for the City as a whole and in each priority CSO Basin. Each of the 6 priority CSO basins is examined in detail. This chapter provides valuable background for future decisions by Buffalo Sewer and its partners.

Chapter Two | Places details the Buffalo sewer system and identifies the green infrastructure technologies and network solutions that will work in Buffalo. It lays out the steps needed to plan and implement green infrastructure in Buffalo.

Chapter Three | People presents engagement tools and strategies that Buffalo Sewer can use to plan and implement green infrastructure in Buffalo.

Chapter Four | Methods describes the analyses conducted and the methodologies used in coming to the findings presented in Chapters One, Two and Three.

Finally a technical **Appendix** includes the technical reports and mapping completed as part of the Rain Check 2.0 process and that support the findings presented in this report.

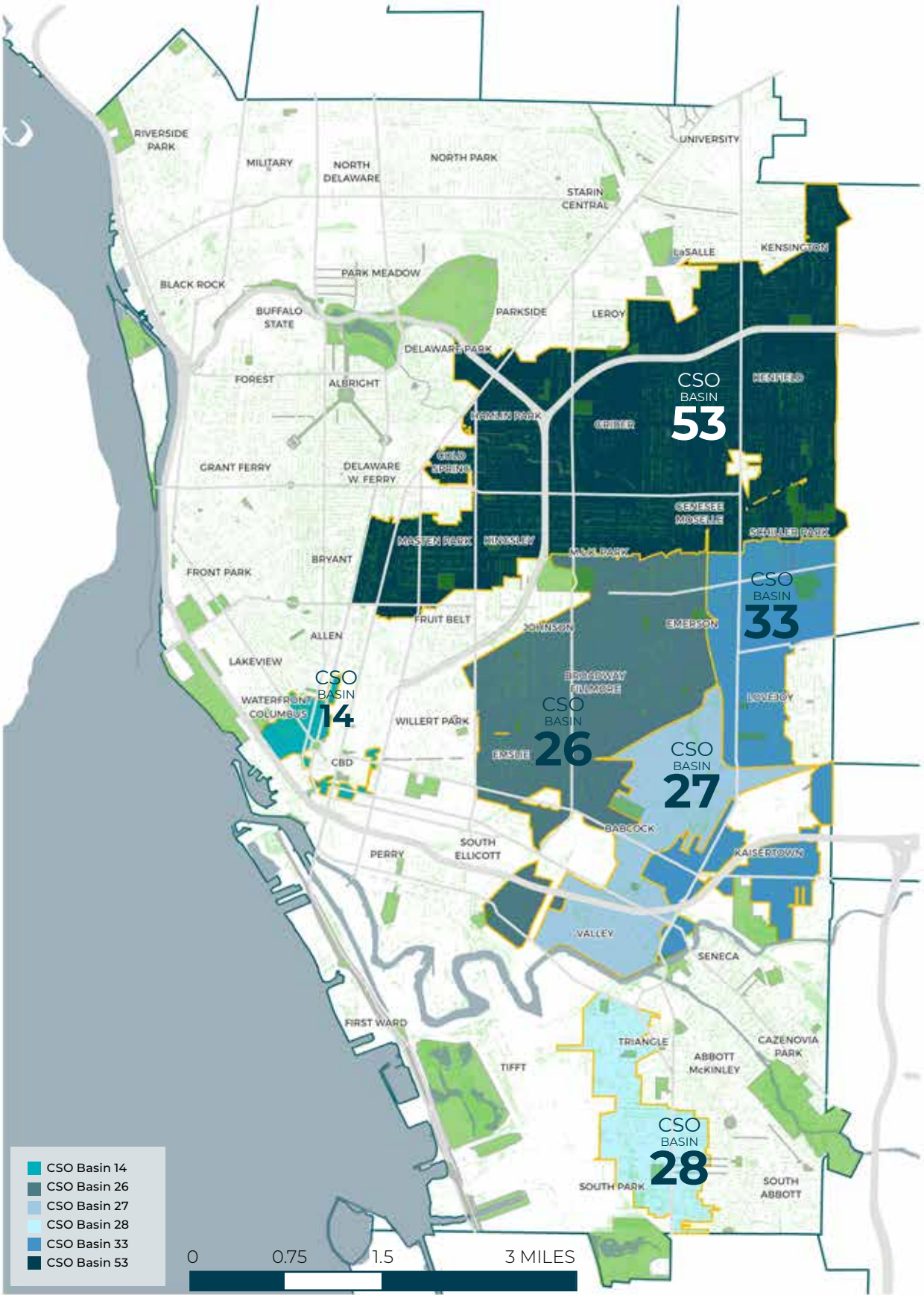


Figure 0.2: Map of Rain Check 2.0's six priority CSO Basins.

ONE
OPPORTUNITY

Green infrastructure can be a community amenity and perform key ecological services. Buffalo's neighborhoods could be transformed by connecting people to their environment with urban installations of green infrastructure. This chapter presents Buffalo's stormwater and green infrastructure goals, places these goals in the planning and regional context and details the opportunities for green infrastructure in six of Buffalo's most critical CSO Basins.

STORMWATER GOALS

Building a Green Future

Buffalo, like many older cities, has a combined sewer system. As city neighborhoods were built, the combined sewer system was engineered to carry sewage and stormwater away as quickly as possible.

The system functions similary today. Both stormwater — rainfall and snow melt — and sanitary sewage flow into the same pipe. In dry weather all sewage is conveyed to the wastewater treatment plant and treated before being released to the Niagara River. In wet weather, however, a combination of stormwater and sewage enter the sewer and the wastewater treatment plant cannot always handle all the wastewater. As a result, untreated wastewater can overflow into our creeks, rivers, and lakes, resulting in a combined sewer overflow (CSO). By diverting stormwater from the sewers, capturing it and retaining it on site, green infrastructure reduces the amoung of stormwater entering the sewers and reduces the number of CSO events, protecting public health and the environment.

Anticipating Climate Change

According to researchers at the nonprofit Climate Central, Buffalo's summers could resemble the summer weather in southern Florida by 2100. While warmer weather might not sound bad in the winter, it will threaten native habitat and cause strain on Buffalo's buildings and infrastructure. Green infrastructure projects help build a more resilient and sustainable city and Buffalo Sewer is a key partner in addressing climate change in the region. Green infrastructure mitigates climate change impacts by decreasing the urban heat island effect, preserving water resources, and mitigating extreme precipitation events. Green infrastructure helps preserve ecological communities and allows for greater adaptation to a wide range of conditions. Green infrastructure is an effective strategy and tool for sustainability planning and action.

Buffalo's Nested Stormwater Strategies

PREVENT water from entering the system with green infrastructure

MANAGE water more effectively in the existing system with smart controls

IMPROVE the existing gray system for resiliency & large events

RAIN CHECK 2.0

Buffalo Stormwater Planning

Buffalo's stormwater planning has evolved from 2004 to the present. Buffalo, like other cities with combined sewer systems, has had to demonstrate to state and federal authorities that they have a plan to comply with the federal Clean Water Act requirements for safe, healthy water. Like other cities with combined sewer systems, Buffalo has prepared a Long-Term Control Plan (LTCP) (2014) that details the specific steps Buffalo Sewer will take to ensure compliance with the Clean Water Act.

Buffalo's LTCP was developed in consultation with community stakeholders. It contains plans for improving gray infrastructure, maximizing the use of existing sewer infrastructure with "smart" solutions that use real time control sensors, and the Rain Check program to maximize green infrastructure to reduce the amount of stormwater entering the sewer system. For more detail on the LTCP goals, refer to **Chapter Two.**

The Rain Check Programs

Launched in 2015, Rain Check is Buffalo's program to protect and restore the health of Buffalo's waterways by addressing the stormwater challenge. Rain Check 1.0 described the first generation of green infrastructure in Buffalo. Rain Check 1.0 focused on tackling the parts of the built environment that create the most runoff from stormwater—streets, parking lots, and roofs. Projects included: **green streets** with planted areas to collect and infiltrate stormwater and improve pedestrian safety; **green parking lots** that collect and absorb stormwater; **demolitions** and **vacant lot restorations** that created neighborhood green spaces to absorb stormwater; and **rain barrels and downspout disconnections** that enable homeowners to keep stormwater out of the system.

Rain Check 2.0 outlines strategies to deliver the next generation of green infrastructure projects to reduce runoff to meet the LTCP goals. Since a significant percentage of Buffalo's impervious surfaces are on private property, Rain Check 2.0 proposes three areas of focus: **new developments must meet strict stormwater requirements, new investments in the public sector should consider green infrastructure, and targeted properties should be encouraged to add green infrastructure**.

Lastly, Rain Check 2.0 will apply a lens of equity considerations to both the Rain Check 1.0 and 2.0 work. Buffalo Sewer is building upon regional equity initiatives to best understand how green infrastructure strategies can be equitably implemented and benefit communities and those involved in their construction and maintenance.

Establishing a Green Culture

It takes more than well-engineered systems to meet Buffalo's stormwater challenges. Organizations and individuals across the City need to have a shared commitment to implement change, resulting in shared benefits for all. Buffalo Sewer is committed to building a culture that supports green investment and builds new knowledge across the City.

Buffalo Sewer is adapting its internal processes to identify, evaluate, and adopt effective, economical, and equitable green infrastructure solutions. This involves ongoing discussions of how to best deliver projects and serve the needs of Buffalo Sewer's customers.

Buffalo Sewer is committed to working with partners and community stakeholders to find shared benefits and to making decisions and implementing projects that promote benefits in marginalized communities. Buffalo Sewer is prioritizing engagement, establishing relationships, and building trust with communities, especially those that have been historically underserved.

GOAL

569

impervious acres managed

CSO**53** 298ac

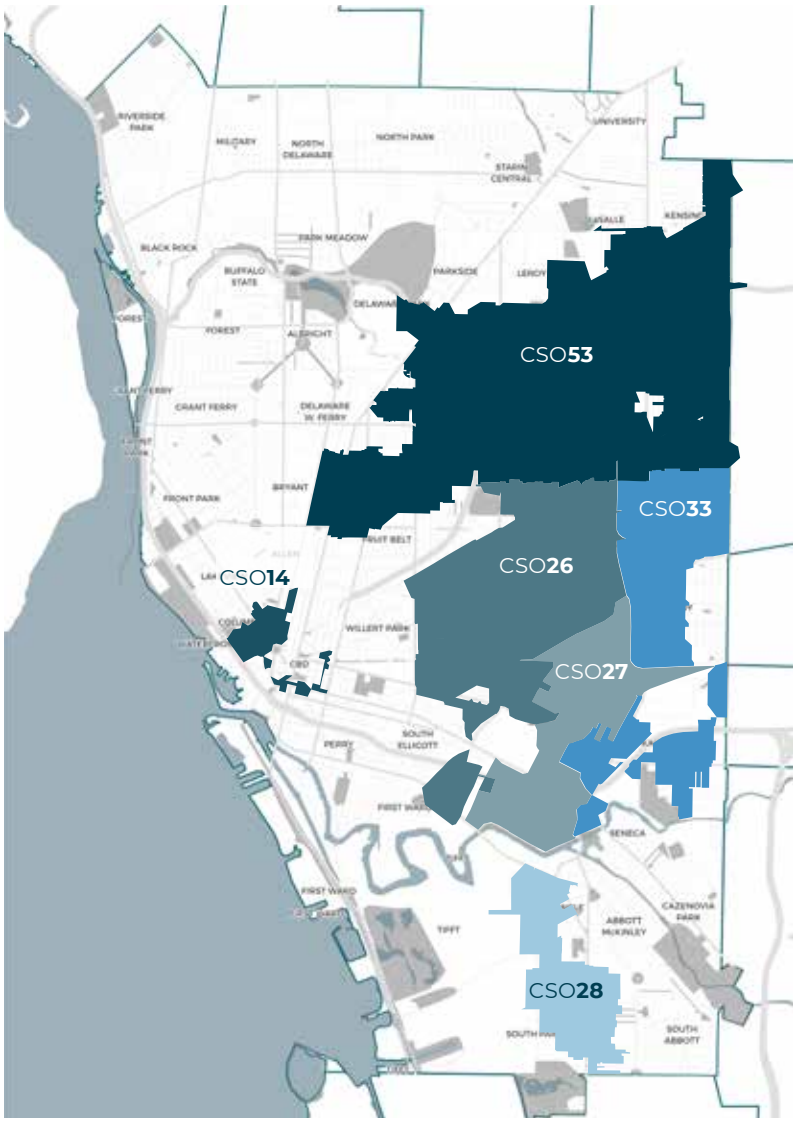
CSO**33** 94ac

CSO**28** 27ac

CSO**27** 73ac

CSO**26** 64ac

CSO**14** 13ac



2006

Buffalo Sewer tours green infrastructure in Toronto.

2010

Buffalo Sewer launches downspout disconnection pilot project.

2011

Buffalo Sewer supports a green infrastructure feasibility study. The study calls for a mix of gray and green infrastructure solutions and the creation of a citywide green infrastructure program.

2013

Buffalo Sewer prepares a **Green Infrastructure Master Plan** to accompany the Long Term Control Plan (LTCP).

The Long-Term Control Plan's goals are to dramatically reduce the number of CSO events and reduce the volume of CSO flows to local waterways.

GOAL
569
impervious acres managed by green infrastructure

By 2034, only 12 of the 52 permitted CSO discharge points are expected to activate. Forty discharge points will remain in place but not activate during a typical year.

By 2034, 11 of the permitted CSO discharge points will activate six or fewer times per typical year. Only CSO 55 will activate more often but water quality modeling shows that those activations do not prevent the attainment of Niagara River water quality objectives.

The volume of CSO flow to local waterways will be reduced by 73% and over 97% of all sanitary and stormwater flow will be captured and treated at the wastewater treatment facility.

The goal was set as a percentage of impervious area in the priority CSO basins where the number of CSOs exceeds what is permitted by the LTCP .

2014

Buffalo Sewer finalizes the LTCP and includes **first generation green infrastructure projects** with focus on green streets, green demolitions and vacant lots.

2015

Rain Check is launched.
Buffalo Sewer partners with Community Foundation for Greater Buffalo to secure a national Partners for Places grant.

2016

Buffalo Common Council adopts Buffalo Green Code, an updated city zoning ordinance that includes on-site stormwater management requirements for all new development.

2018

RAIN CHECK 1.0

Buffalo Sewer publishes Rain Check 1.0 Report. Together with the City, they partner with the Ralph C. Wilson, Jr. Foundation to explore opportunities with the private sector and start the next generation of green infrastructure in Buffalo.

2019

RAIN CHECK 2.0

Buffalo Sewer publishes Rain Check 2.0 Report and begins work on the next phase of green infrastructure in Buffalo.

STORMWATER GOALS

Buffalo's Six Priority CSO Basins

Buffalo Sewer focused on 6 priority CSO basins that span neighborhoods across Buffalo's East Side, as well as areas in downtown Buffalo and South Buffalo. These basins encompass a quarter of the City's land area and almost half of its population. The 6 priority CSO basins were chosen to have the greatest impact on water quality and public health in Buffalo, to improve basins with high numbers of CSO events, to leverage other investments, and to decrease impervious cover where its percentage is highest. For each of these basins, Buffalo Sewer conducted an equity analysis, environmental analysis, and site analysis as discussed in the next sections.

ERIE

CSO Basin 14 is in the central business district and close to waterfront access. Green infrastructure in this CSO basin can build on recent and future private development in this area to help reduce storm runoff.

BUFFALO

CSO Basin 26 is the site of many environmental improvement projects. Buffalo Sewer contributes to these projects as an important part of demonstrating environmental leadership.

CSO Basin 27 is anticipated to undergo significant investment in the near future in the East Side commercial corridors and revitalization. Buffalo Sewer wants to ensure that green infrastructure is part of these developments. This CSO basin has a very high percentage of impervious area, making work on green infrastructure here a priority.

CSO Basin 28 has the highest number of annual CSO events. This CSO basin also has a very high percentage of impervious area. Very little green infrastructure work has occurred in this CSO basin to date.

CSO Basin 33 is also anticipated to receive significant investment in the near future as part of the East Side commercial corridors and revitalization. This CSO basin also has a very high percentage of impervious area.

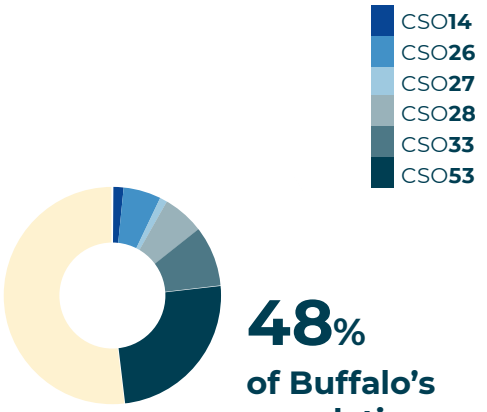
SCAJAQUADA

CSO Basin 53, where approximately one quarter of Buffalo lives, contributes to Scajaquada Creek. Recently, Scajaquada Creek has been dredged for contaminated sediment and habitat has been restored. CSO Basin 53 has a high number of annual CSO events and work in this basin can complement real time control projects that are part of Buffalo's Smart Sewer System and can augment anticipated future water quality projects by other organizations. Similar to other basins, there is anticipated investment in East Side commercial corridors and revitalization.

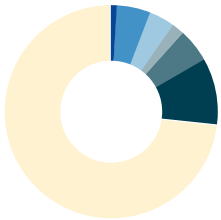
ERIE BASIN The **Erie Basin** is a popular recreation area and is part of Buffalo's iconic waterfront. CSO Basin 14 flows to the Erie Basin.

BUFFALO RIVER The **Buffalo River** is part of the industrial heart of Buffalo and is increasingly a focus of tourism and recreation. Buffalo Sewer's work in the 4 priority CSO basins contributing directly to the Buffalo River (CSO Basins 26, 27, 28, and 33) builds on work done by other agencies to improve water and habitat quality in the Buffalo River, including dredging of contaminated sediment and habitat restoration.

SCAJAQUADA CREEK
Scajaquada Creek runs both above and below grade and receives surface runoff as well as CSO drainage. CSO Basin 53 flows to Scajaquada Creek.



48%
of Buffalo's population lives in the six priority basins



26%
of Buffalo's land area is within the six priority basins

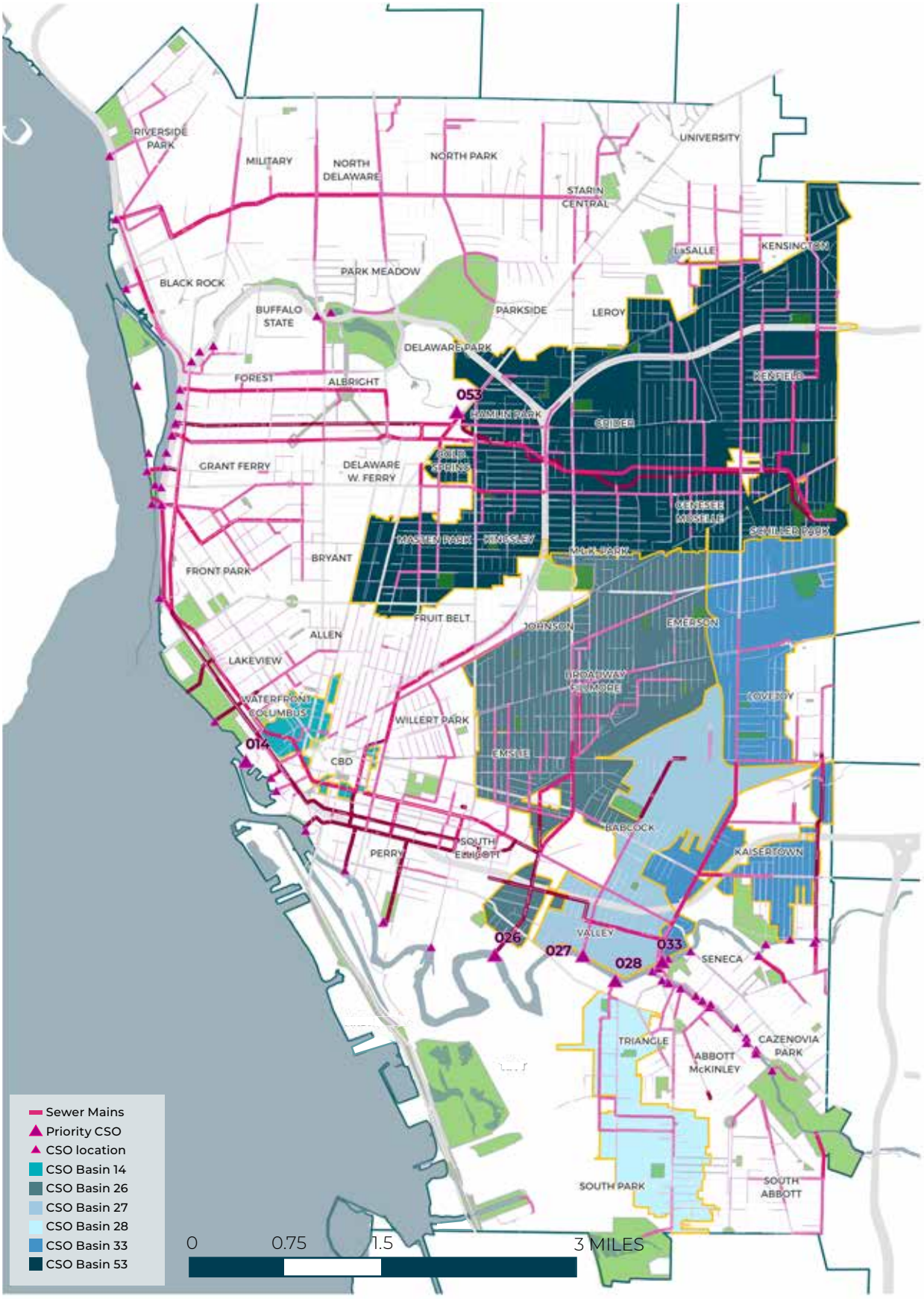


Figure 1.1: Map of Buffalo Sewer Network and Priority CSO Basins.

Green Infrastructure & Existing Initiatives

There are many signs of a more sustainable, prosperous future across Buffalo, driven by strategic planning, collaborative partnerships, and community engagement. Buffalo Sewer will help advance shared goals by working collaboratively with other agencies and aligning with existing planning efforts.

Revitalizing Buffalo's Waterfront

For years, many plans have focused on Buffalo's waterfront. These efforts strive to revitalize former industrial areas and waterfront neighborhoods, restore natural environments, and enhance waterfront access. Major efforts include the City's new development ordinance, the **Buffalo Green Code,** and the **Local Waterfront Revitalization Program (LWRP).** The Green Code integrates shoreline protection and green infrastructure into standards for commercial waterfront zones that intersect sewer basins targeted by Rain Check 2.0 along the Buffalo River.

The LWRP calls for enhancing access to waterways and improving water quality through green infrastructure. Other initiatives, like the **Ralph C. Wilson Jr. Foundation's plan to transform LaSalle Park** which lies adjacent to the downtown area targeted by Rain Check 2.0, are more geographically specific but also call for substantial improvements and better connections to key waterfront assets. Efforts to revitalize Buffalo's waterfront, whether through commercial development or natural restoration, offer high-profile opportunities to incorporate green infrastructure on both public and private lands.

Waterfront Initiatives

- Remedial Action Plan Stage 2 Addendum: Niagara River Area of Concern (2012)
- Niagara River Habitat Conservation Strategy (2014)
- Buffalo Green Code: Land Use Plan and Unified Development Ordinance (2016)
- Buffalo River Corridor: Brownfield Opportunity Area (2017)
- Imagine LaSalle: A Community Vision for Buffalo's LaSalle Park (2018)

Reinvesting in Commercial Corridors

Efforts are being made to revitalize neighborhood commercial areas across Buffalo. This is evident in City plans like the **Buffalo Green Code**, which prioritizes improving the visual character of commercial areas through form-based zoning codes to promote redevelopment. Commercial revitalization is also an economic development priority for New York State. Through the **Better Buffalo Fund** and the **East Side Corridor Economic Development Fund**, Empire State Development is partnering with the City of Buffalo to fund development and infrastructure projects along key corridors and neighborhood commercial districts. This includes a focus on Fillmore, Jefferson, Michigan, and Bailey—all of which overlap Rain Check 2.0's target areas. In downtown, public infrastructure investments are being guided by the **Public Realm Framework for Downtown Buffalo**, which promotes investment in strategic parts of downtown that also overlap Rain Check 2.0 priority areas. As these plans stimulate investment, they can create opportunities to add green infrastructure in commercial areas that tend to lack green space and are highly visible to residents.

Commercial Corridor Initiatives

- Michigan Street African American Heritage Corridor Draft Management Plan (2012)
- Buffalo Green Code: Land Use Plan and Unified Development Ordinance (2016)
- Buffalo River Corridor: Brownfield Opportunity Area (2017)
- Tonawanda Street Corridor: Brownfield Opportunity Area (2017)
- The Buffalo Billion II East Side Corridor Economic Development Fund (2018)

Existing initiatives focus on six strategic areas:

Revitalizing Buffalo's Waterfront
Reinvesting in Commercial Corridors
Enhancing the Transportation Network
Promoting Environmental Sustainability
Strengthening City Neighborhoods
Boosting the Regional Economy

Many recent plans and initiatives share common strategies with Buffalo Sewer's Rain Check program. Buffalo Sewer's investments can reinforce other plans and uplift community visions for parts of the City where relatively few plans are in place.

Figure 1.2: City of Buffalo, Buffalo Sewer and partners meet for press event during CSO Basin 60 green infrastructure pilot project.

Figure 1.3: Aligned corridor investment can support green infrastructure.

Enhancing the Transportation Network

Across the City and region, plans are underway to enhance Buffalo's transportation network by promoting alternative transportation modes. These plans call for multi-modal facilities, like bike lanes, recreational trails, and complete streets, all of which can involve green infrastructure. The **Buffalo Bicycle Master Plan** proposes specific streets for bicycle routes—such as Jefferson Avenue and Utica Street. Meanwhile, in outlining general strategies to promote multiple modes of transportation in the region, **Moving Forward 2050** envisions ways to incorporate green infrastructure on local roadways.

The **Comprehensive Transit-Oriented Development Plan for Niagara Frontier Transportation Authority** recommends green space around the City's transit stations, several of which fall within Rain Check 2.0 target investment areas, including Utica and Summer/Best. Similarly, the **Public Realm Framework for Downtown Buffalo** calls for green waterfront connections and Complete Green Streets in CSO Basin 14, including projects on Main Street, Delaware Avenue, and Erie Street. These efforts, as well as other transportation projects, provide opportunities to add green infrastructure in public rights-of-way, and potentially on private development projects spurred by public investments.

Transportation Initiatives

- Queen City Waterfront: Buffalo Waterfront Corridor Initiative: A Strategic Plan for Transportation Improvements (2007)
- Downtown Buffalo Infrastructure and Public Realm Framework (2015)
- Buffalo Bicycle Master Plan (2016)
- Niagara Street Now: A Community Vision to Guide the Streetscape Transformation (2016)
- Moving Forward 2050: A Regional Transportation Plan for Buffalo Niagara (2018)

Promoting Environmental Sustainability

Making the City and region sustainable through smart growth and environmental preservation is the objective of several recent plans. This includes regional plans, like **One Region Forward**, that share similar goals with Rain Check 2.0, namely improving water quality, preserving natural spaces, and increasing public access to waterways. Regional plans offer Buffalo Sewer an opportunity to make progress on these broader goals while helping to promote similar work across the region through collaborative networks.

Plans specific to the City of Buffalo also point to the need to add green infrastructure to improve local water quality. This includes the **Green Code**, which requires on-site stormwater management for any new development project in the City greater than 1/4 acre. The Green Code also sets vegetative buffer requirements for shoreline properties in the commercial waterfront overlay district that overlaps investment areas targeted by Rain Check 2.0 along the Buffalo River. **Plans for public parks, including for Buffalo's Olmsted Park system**, which is currently being updated, also open opportunities for enhanced green space for stormwater management in and around many public lands.

Sustainability Initiatives

- The Olmsted City: The Buffalo Olmsted Park System: Plan for the 21st Century (2007)
- Western New York Regional Sustainability Plan (2013)
- Niagara River Habitat Conservation Strategy (2014)
- One Region Forward: A New Way to Plan for Buffalo Niagara (2015)
- Buffalo River Corridor: Brownfield Opportunity Area (2017)

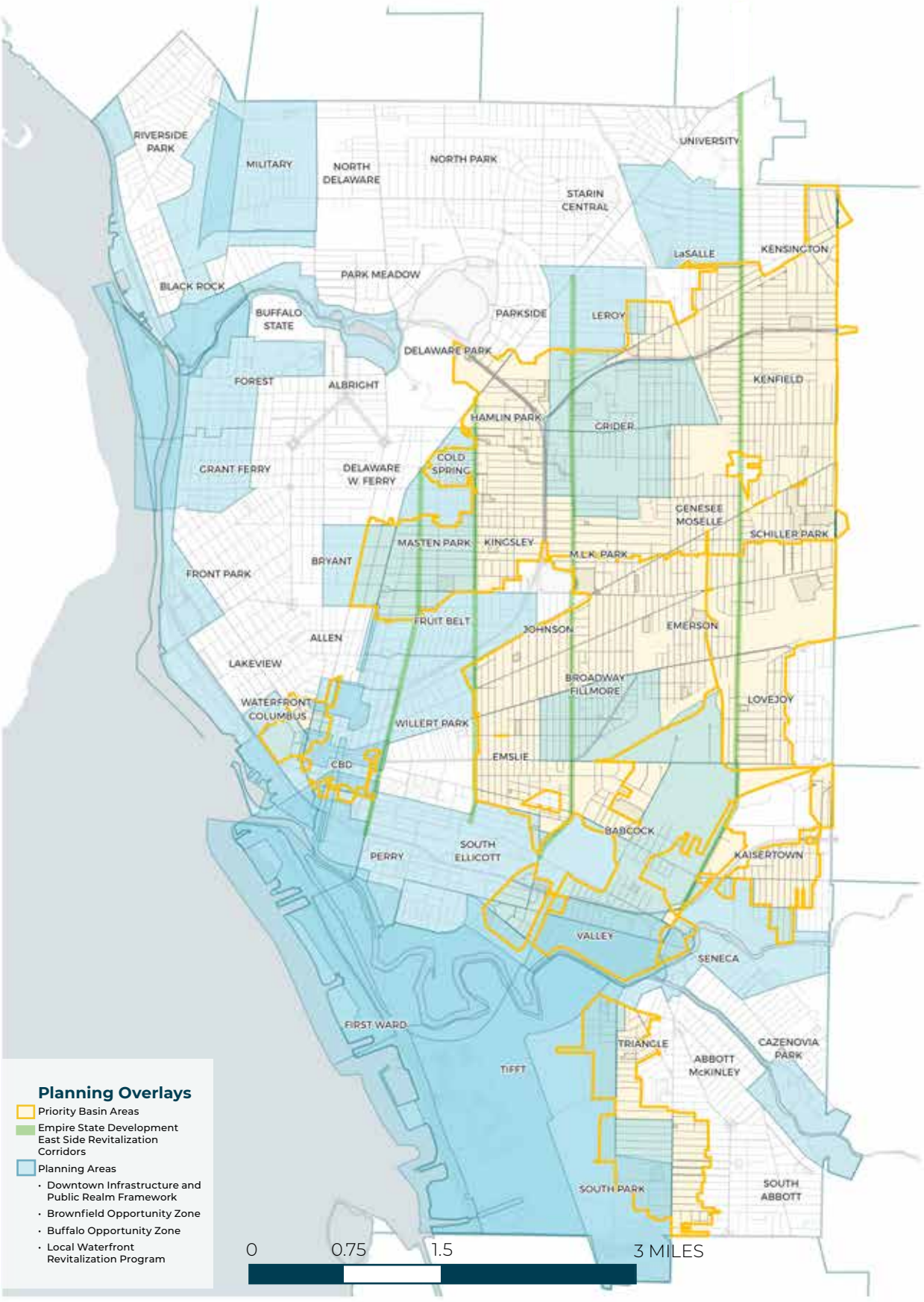


Figure 1.4: Map of Buffalo Planning Areas and Priority CSO Basins. The darker color indicates overlapping plans. More detailed planning maps for each priority basin can be found in each basin section.

Strengthening City Neighborhoods

Many plans aim to revitalize communities throughout Buffalo. These include city-wide plans, like the **Queen City Comprehensive Plan**, as well as neighborhood plans by community groups. Key examples include the **Michigan Street African American Heritage Corridor plan**, which stresses the need for green space on public and private land in its vision. Additionally, a **master plan for the Bailey-Green neighborhood** within CSO Basin 53, proposes a greenway to enhance the pedestrian experience and create community gathering spaces. Empire State Development's **East Side Corridor Economic Development Fund** is aimed at revitalizing neighborhood commercial areas within Buffalo Sewer's targeted basins.

A regional plan—**Complete Communities for a Changing Region**—highlights possibilities for using green infrastructure on vacant land to improve aesthetics and add recreational assets in distressed neighborhoods. Federal initiatives, like the recently designated Opportunity Zones, could support these local plans through tax incentives aimed to spur investment in low income communities around Rain Check's sewer basins. The City's sharpening focus on equity in community development is also clear in local plans. The **Greater Buffalo Racial Equity Roundtable** calls for analyses of racial equity impacts in decision-making, while the **City's Opportunity Pledge** urges community members to commit to a culture of inclusion and equality. All these initiatives can guide Rain Check green infrastructure investments so that they support community visions and advance equity in city neighborhoods.

Neighborhood Initiatives

- Queen City Hub: A Strategic Regional Action Plan for Downtown Buffalo (2007)
- Michigan Street African American Heritage Corridor Draft Management Plan (2012)
- PUSH Buffalo-BNSC: Building for the Future: Community Development Plan for the Massachusetts Avenue Corridor Green Development Zone (2012)
- The Racial Equity Dividend: Buffalo's Great Opportunity (2016)
- The Buffalo Billion II East Side Corridor Economic Development Fund (2018)

Boosting the Regional Economy

The **WNY Regional Economic Development Council** and its **Buffalo Billion** initiative is supporting capital investments in strategic areas that can involve green infrastructure. The recently constructed **Northland Workforce Training Center** and **Tesla's Gigafactory 2**, both signature investments of the Buffalo Billion, integrate green infrastructure. Brownfield Opportunity Areas (BOAs), another NYS initiative, promote economic growth in former industrial areas. The **South Buffalo, Buffalo Harbor, and Buffalo River BOAs** overlap with Rain Check 2.0 investment areas. Along with promoting strategic investments, these initiatives promote water quality, waterfront access, community revitalization, and infrastructure enhancements.

Economic development plans include strategies to develop the local workforce that could help promote, install and maintain green infrastructure. Community organizations, such as **PUSH Buffalo**, are also involved in training efforts for the local green workforce. As the regional economy evolves, opportunities for green infrastructure will grow, along with the ability of the workforce to install and maintain these investments.

Regional Economy Initiatives

- Queen City for the 21st Century: Buffalo's Comprehensive Plan (2006)
- WNY Regional Economic Development Strategic Plan: A Strategy for Prosperity in WNY (2011)
- Erie County Industrial Development Agency Comprehensive Economic Development Strategy (2017)
- Buffalo Billion: Buffalo Niagara's Strategic Plan for Prosperity (2017)
- WNY Regional Economic Development Council, A Strategy for Prosperity Progress Report (2018)

Figure 1.5: Enhancing the transportation network. Buffalo Niagara Medical Campus Streetscape, Design and Photo from SCAPE Studio.

Figure 1.6: Image of Buffalo's waterfront from The Racial Equity Dividend.

Figure 1.7 Niagara Street Corridor.

Equity Considerations

Beneath the headlines around waterfront revitalization and startup hubs in Buffalo lies the reality of inequities by race, ethnicity, and neighborhood in the City and region. Progress is happening on multiple fronts and Rain Check is part of the solution to creating a more equitable city.

Toward a More Equitable Future for Buffalo

Buffalo Sewer's green infrastructure initiative supports ongoing efforts to build greater equity in the region. Thousands of individuals, organizations, and businesses have signed the City of Buffalo's **Opportunity Pledge** to help build a culture of equity and inclusion across the City. The Greater Buffalo Racial Equity Roundtable, comprised of more than 30 community leaders from major public, non-profit, private, and faith institutions, has been meeting to develop innovative approaches to racial equity work that is data-driven, identifies and promotes promising practices, and promotes racial equity impact analysis. Furthermore, a range of stakeholders across Buffalo is developing more equitable and inclusive approaches to workforce training, business development, land use planning, neighborhood revitalization, and community engagement and leadership. Examples include the Northland Workforce Training Center and Beverly Gray Business Exchange Center.

Integrating Equity into Rain Check 2.0

PolicyLink, a national nonprofit research and advocacy organization, provides a useful definition of equity: "Just and fair inclusion into a society in which all can participate, prosper, and reach their full potential."

Equity is different from the formal legal equality conferred by landmark laws such as the Civil Rights Act. Equality gives everyone the right to ride on the bus, in any seat they choose. Equity ensures there are bus lines where people need them so they can get to school or the doctor or work. It means policies and investments that grow good jobs and expand entrepreneurship opportunities for low-income people and people of color. It means policies that build human capabilities by upgrading the education and skill of the nation's diverse workforce. It means policies that dismantle destructive barriers to economic inclusion and civic participation, and build healthy communities of opportunity for all.

Source: "Equity Is...," PolicyLink, October 5, 2016.

GI Equity Commitment

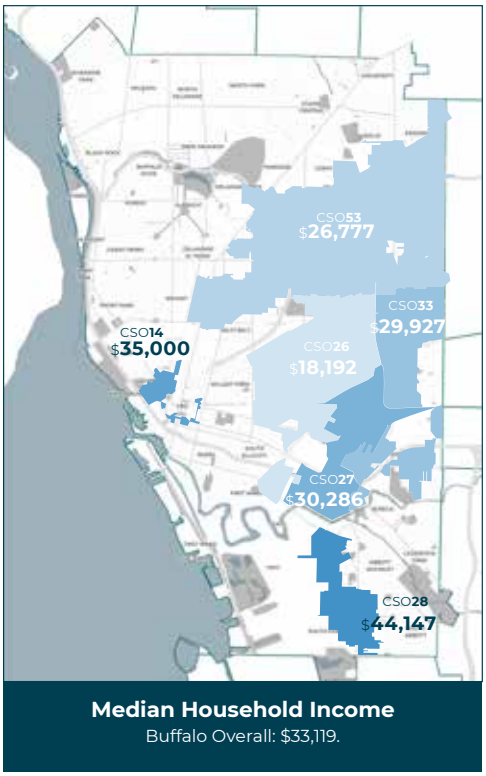
Buffalo Sewer will examine the following principles to maximize equitable investments:

- Embed equity into Rain Check mission
- Meet people where they are
- Identify and cultivate community champions
- Develop and communicate clear criteria for project selection
- Invest in social capital alongside physical capital
- Recognize that building trust takes time

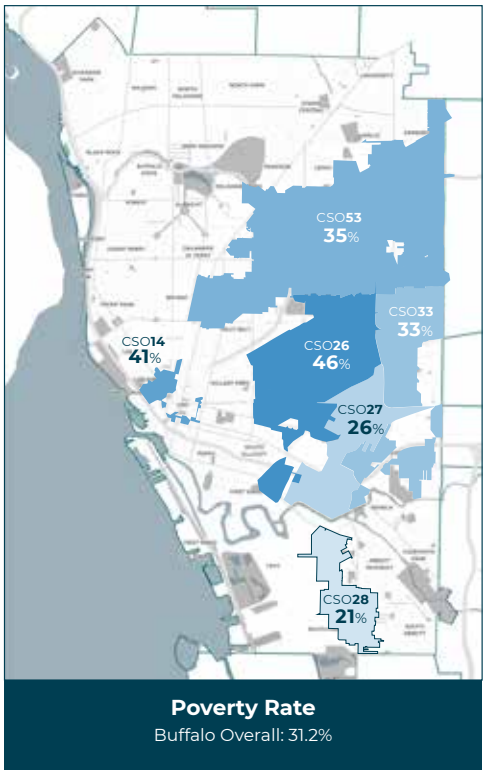
Through Rain Check, Buffalo Sewer can advance equity by creating opportunities for communities to share in the economic, social, and environmental benefits of green infrastructure and have a role in stormwater management in their communities. Many forms of green infrastructure such as rain gardens, bioswales, and planters are above-ground, vegetated practices that can be found in a wide range of urban spaces—from school playgrounds to sidewalks and rooftops. These practices may not be recognized as a form of water infrastructure by the general public, but they can help alleviate stresses to Buffalo's sewer system and improve water quality. National conversations around water challenges and equitable water management can inform local strategies around green infrastructure in Buffalo.

Green infrastructure investments can also support educational programs, local employment and career pathways, business development and contracting opportunities, and neighborhood improvements. Buffalo Sewer can maximize outcomes by partnering with educational institutions, workforce trainers, community-based organizations and other stakeholders across Buffalo.

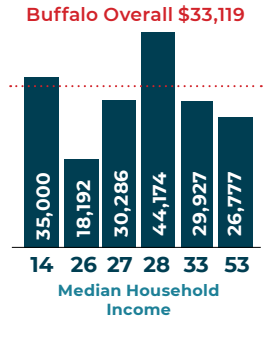
Green Infrastructure Equity Analyses and Index

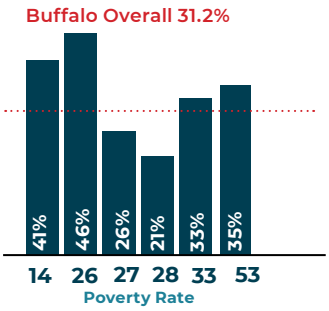


Median Household Income
Buffalo Overall: $33,119.



Poverty Rate
Buffalo Overall: 31.2%





Source for maps and graphs: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates.

Buffalo Sewer is committed to evaluating how its decisions and projects can reduce inequities across Buffalo. Site selection for green infrastructure is often driven by engineering and technical concerns. An equity analysis layers environmental, economic, and social factors onto the engineering approach when evaluating opportunities for green infrastructure. Several new planning tools use indexes and other need-based approaches to account for a wider range of potential program impacts. Buffalo Sewer has developed a Green Infrastructure Equity Index (GI Equity Index) that incorporates elements of existing green infrastructure indexes and racial equity analysis tools to conduct a preliminary analysis of various equity considerations. These in-depth analyses help form a guiding framework for Buffalo Sewer to build equity through the implementation of Rain Check 2.0 projects and the GI Equity Index allows comparison of measures of equity metrics across Buffalo. The GI Equity Index includes 17 variables related to disadvantage and vulnerability (socioeconomic factors), and environmental factors related to exposure to environmental risk and access to environmental amenities (built environment measures). To learn how the Equity Index was developed and the data sources used, reference **Appendix A** to this report.

Equity in Green Infrastructure

According to the U.S. Water Alliance, water equity "occurs when all communities have access to safe, clean, affordable drinking water and wastewater services; are resilient in the face of floods, drought, and other climate risks; have a role in decision-making processes related to water management in their communities; and share in the economic, social, and environmental benefits of water systems."

Source: U.S. Water Alliance, An Equitable Water Future: A National Briefing Paper (2017).

Equitable development considers the individuals, entities, activities and materials involved in the design, installation, and maintenance of green infrastructure projects. For example, issues of where materials are sourced, who gets contracts, and who makes up the local green infrastructure workforce could fall under equitable development considerations. Green infrastructure could create more access to opportunities for existing local, small, minority-, and women-owned businesses and workers from disadvantaged communities and provide opportunities for new businesses and workers to enter the field.

Equitable decision-making considers how the community members and government agencies make decisions and how they are engaged. Equitable decision-making considers broader community, economic, and environmental goals and tries to build partnerships and align green infrastructure development to advance shared goals. Issues of engagement are critical considerations for equitable decision-making, which aims to provide those potentially impacted by investments with opportunities to meaningfully engage throughout different phases and types of green infrastructure projects.

GI Equity Index Factors

Buffalo Sewer is examining how the following factors influence the decision-making process:

Socio-economic factors:

- Race and ethnicity
- Income
- Education attainment
- Young children
- Older adults
- Owner occupancy
- Limited English speakers
- Unemployment and labor force participation

Built environment factors:

- Traffic proximity
- Ozone levels
- Particulate matter
- Access to public open space
- Tree canopy cover
- Impervious surface cover
- Vacant land
- Residential vacancy rates
- Commercial vacancy rates

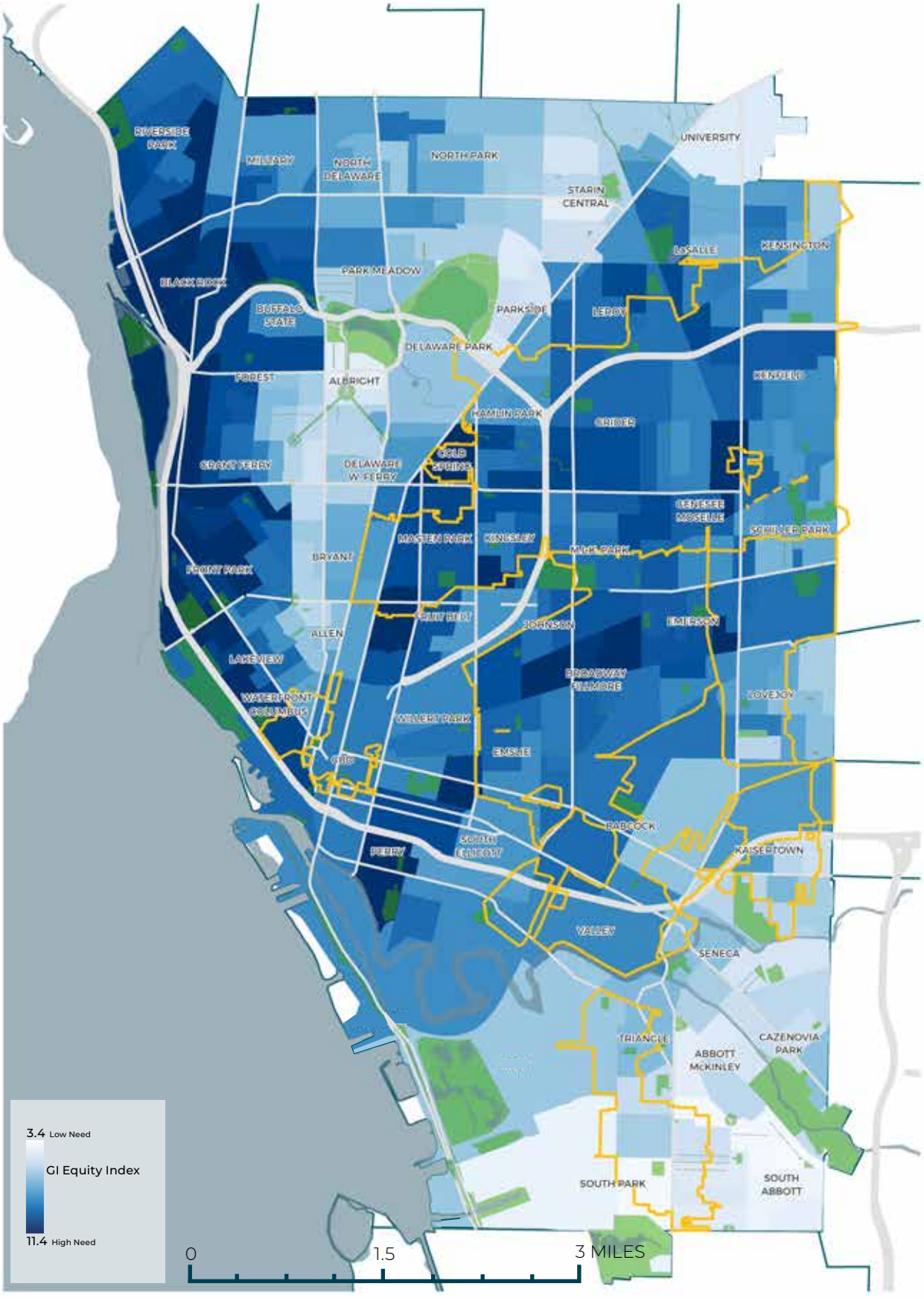
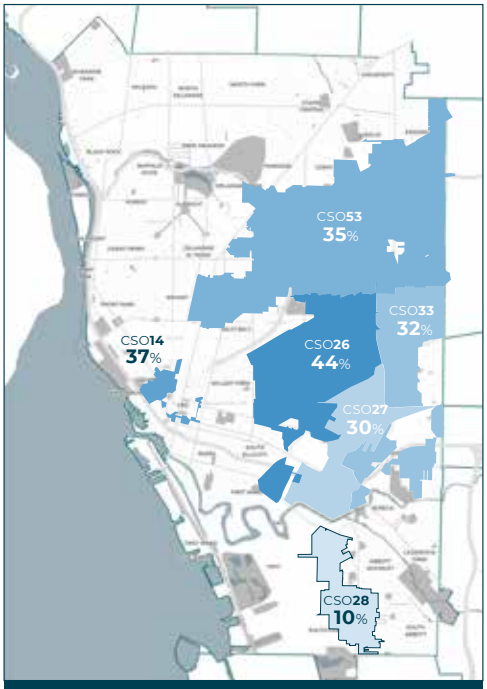


Figure 1.8: Map of Buffalo block groups with GI Equity Index Scores.

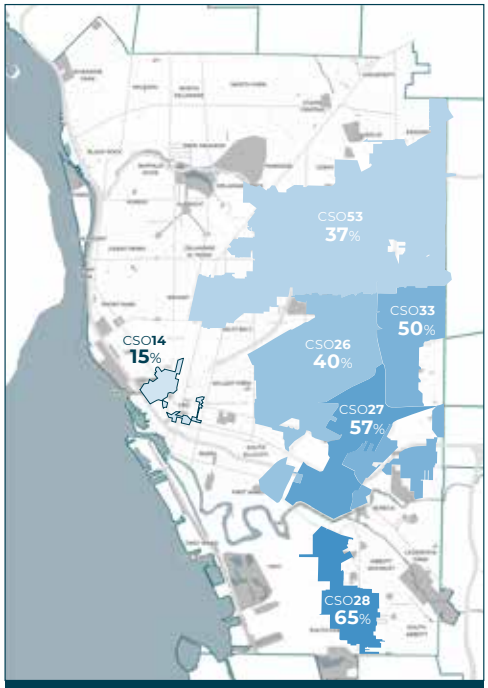
Existing Equity Challenges

In recent years, Buffalo has taken great strides to attract population, jobs, and investment to the City. However, the City still faces deeply entrenched challenges around population loss, concentrated poverty, and racial segregation. Across various indicators of economic well-being, the City of Buffalo performs worse than the Buffalo-Niagara region and the United States as a whole. Furthermore, across nearly every indicator—including income, education, employment, housing, health and environmental justice—there are significant and persistent disparities by race, ethnicity, and neighborhood.

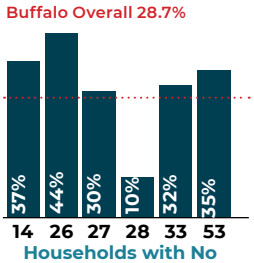
Despite overall population loss in the City, communities of color, especially immigrant communities of color, are growing. The City's population is mainly people of color (55.4%), with significant shares of Black (41.8%) and Latino residents (10.9%) and a rapidly growing Asian population (U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates). Communities of color are located throughout Buffalo, but are more concentrated in the northeastern and eastern neighborhoods of the City. Income inequality, as measured by the Gini coefficient, a summary measure of income inequality, is increasing and higher in Buffalo (0.51) than in the United

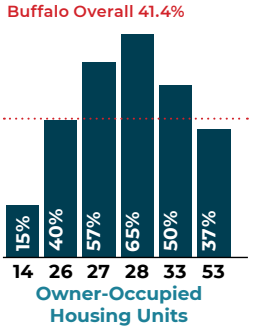


Households with No Vehicles Available
Buffalo Overall: 28.7%

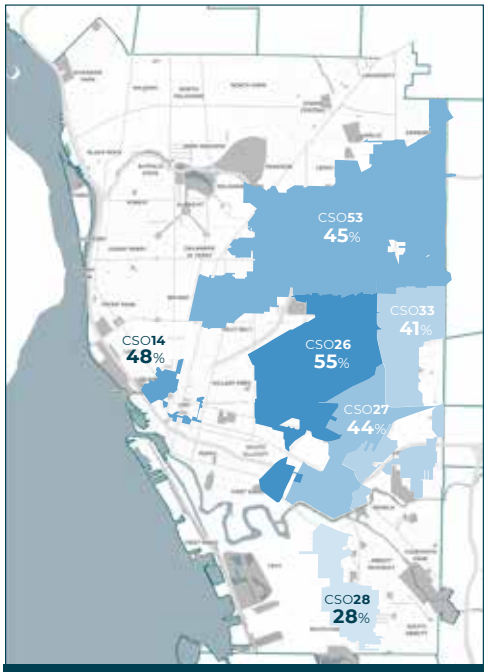


Owner-Occupied Housing Units
Buffalo Overall: 41.4%



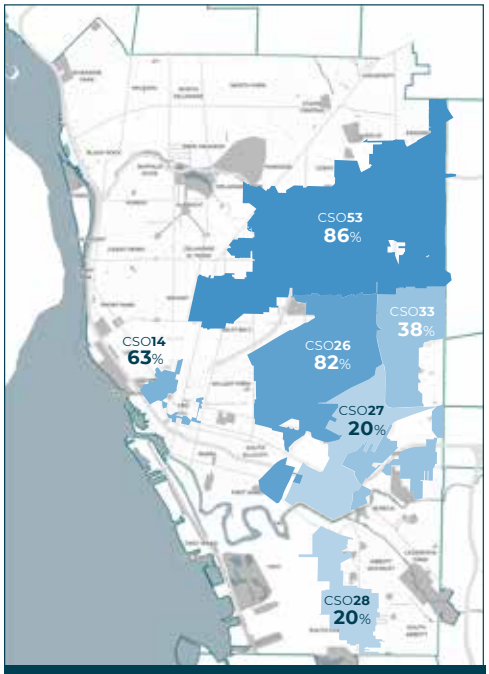


Source for maps and graphs: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates.



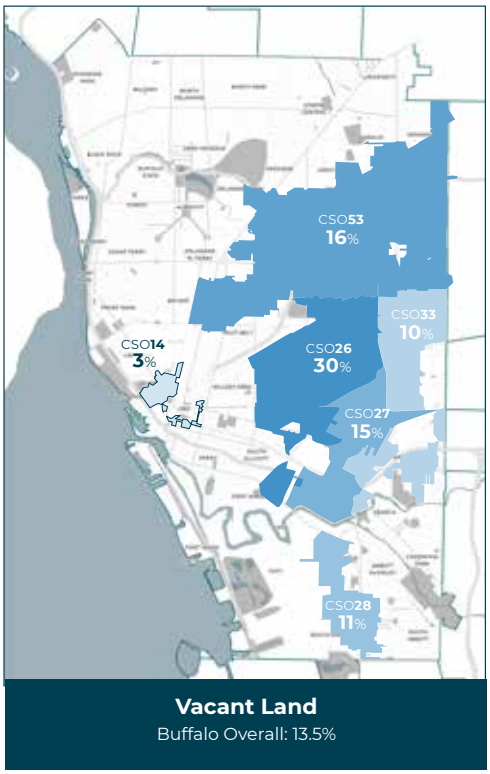
Working-age Population, Not Employed,
(16-64) including those unemployed or out of the labor force
Buffalo Overall: 40.1%

Source for map and graph: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates.



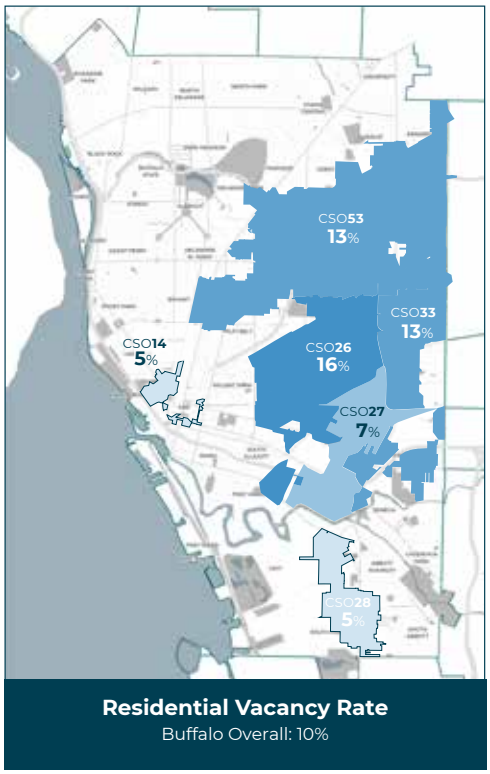
People of Color
Buffalo Overall: 55.4%

Source for map and graph: U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates.



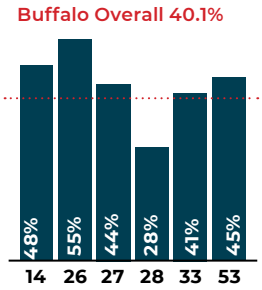
Vacant Land
Buffalo Overall: 13.5%

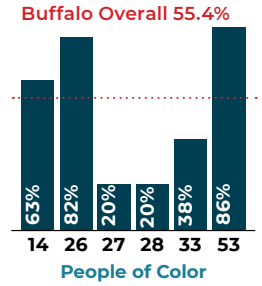
Source: UBRI analysis of parcel data from the Erie County Department of Environment and Planning, 2016.

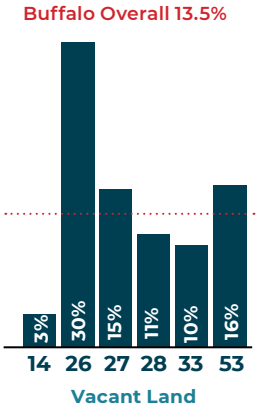


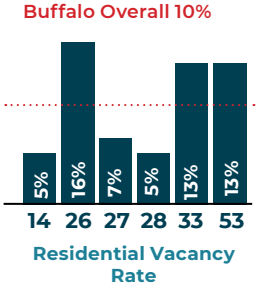
Residential Vacancy Rate
Buffalo Overall: 10%

Source: HUD-USPS data on address vacancies, June 2018.









States overall (0.48), for the period from 1979-2014. (U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates; PolicyLink and USC Program for Environmental and Regional Equity, "Advancing Health Equity and Inclusive Growth in Buffalo," (Oakland, CA: PolicyLink, 2017). Buffalo has higher rates of poverty and unemployment, and lower levels of educational attainment and car access, than the broader region and country as a whole. While rates of poverty and unemployment are relatively high overall, they vary by neighborhood and by race and ethnicity. For example, unemployment rates are higher on the east side of the City, where several neighborhoods have an unemployment rate that exceeds 21%. (PolicyLink and USC Program for Environmental and Regional Equity, "Advancing Health Equity and Inclusive Growth in Buffalo," (Oakland, CA: PolicyLink, 2017). Rates of unemployment in the City are highest for Black (15.2%) and Latino residents (12.3%). (U.S. Census Bureau, 2012-2016 American Community Survey 5-Year Estimates).

There are also challenges around work readiness, housing affordability, and car access that are unevenly distributed across the City. The education levels of the City's population are not keeping up with employers' educational demands. The non-profit organization, PolicyLink, estimates that by 2020, 51% of jobs in New York State will require at least an associate's degree. Only 24% of Black residents and 20% of Latino residents in Buffalo have that level of education today. (PolicyLink and USC Program for Environmental and Regional Equity, "Advancing Health Equity and Inclusive Growth in Buffalo," (Oakland, CA: PolicyLink, 2017). Although the share of affordable rental housing is higher in Buffalo than in the region and country overall, the majority of renter households are cost burdened (spending more than 30% of income on rent) and those on the east side of the City are particularly affected. Furthermore, Black households are more likely than White households to be cost burdened, regardless of whether they rent or own. Finally, car access is a serious issue in the City and varies significantly by neighborhood. There are several neighborhoods in the City where 43% of households or more do not have a vehicle and likely rely on public transit. (PolicyLink and USC Program for Environmental and Regional Equity, "Advancing Health Equity and Inclusive Growth in Buffalo," (Oakland, CA: PolicyLink, 2017).

Equity Considerations for Rain Check 2.0

The equity analysis prepared for Rain Check 2.0 provides context for understanding a wide range of inequities across the City overall, and in the target CSO basins. Buffalo Sewer has identified several equity considerations that it can influence through its own work or in partnership with others.

GI Equity Priorities

To leverage positive equity impacts of green infrastructure investment, Buffalo Sewer will focus on:

- Workforce Development
- Contracting and Procurement
- Neighborhood Revitalization
- Inclusive Outreach and Public Engagement

Figure 1.9: Buffalo Sewer lending a hand at Waterworx Pop-Up Park event.

WORKFORCE DEVELOPMENT

Skilled workers are needed to design, build, and maintain green infrastructure systems. By intentionally expanding opportunities for more diverse populations to enter the green infrastructure workforce, Buffalo Sewer and partners can encourage local industries to be more reflective of the communities they serve. Green infrastructure could be a unique opportunity for Buffalo Sewer, educational institutions, workforce trainers, and community-based organizations to come together to prepare the next generation of green infrastructure workers. Partnership will be critical to the success of diverse and inclusive workforce development programs.

CONTRACTING AND PROCUREMENT

Public investment in green infrastructure is an opportunity to generate economic benefits for local, small, minority-, and women-owned businesses in professional service and construction contracts. While there may be existing programs and standards for inclusion, Buffalo Sewer will likely encounter challenges that hinder successful participation in green infrastructure projects. Investments in contracting, consulting, and procurement can provide direct opportunities for local small businesses and disadvantaged firms and help expand their contacts, clients, skills, and experience. There may also be opportunities to partner on business accelerators and development programs that support the growth of new firms and build the capacity of existing firms.

NEIGHBORHOOD REVITALIZATION

Green infrastructure projects can be a tool for neighborhood transformation by creating green space, adding vegetation, and upgrading aging infrastructure. Green infrastructure can leverage public dollars to provide multiple benefits to historically disinvested neighborhoods, especially when coordinated with investments in transportation, education, clean energy, and public space. These investments can contribute to building complete communities that offer residents spaces to live, work, and move in healthier and safer ways. At the same time, by spurring new economic development or expanding green space in disinvested places, these investments have the potential to contribute to increasing rents and property taxes, as well as other neighborhood changes that may not be desirable by existing residents.

INCLUSIVE OUTREACH AND PUBLIC ENGAGEMENT

Public green infrastructure planning and projects can create venues for residents, community-based organizations, and other stakeholders to connect to and shape local decision-making processes. Robust outreach and engagement can provide mutual benefits to both Buffalo Sewer and community members by deepening understanding of community priorities; increasing legitimacy and support for public plans and projects; cultivating resident and community stewardship of projects; and improving government/community relations. Additionally, green infrastructure projects can initiate and facilitate community visioning in disinvested neighborhoods to help distribute these benefits to parts of the City that need it most.

Evaluate what is **possible**
by inventorying the opportunities and identifying partners, issues, and concerns.

Analyze what is **probable**
based on factors related to partner capacity, development momentum, need, or other criteria.

Identify what is **preferred**
by soliciting community preferences, aligning with other plans, and considering other benefits.

Environmental Systems & Regional Context

Buffalo's stormwater performance is closely linked to environmental systems including waterways and tree canopy.

Buffalo is located on the eastern shore of the Niagara River and Lake Erie, between Lake Erie and Lake Ontario – a key gateway between the United States and Canada. It is located in the Erie-Ontario Lake Plain province, with a topography typical of an abandoned lake bed – gently rolling and flat. The bedrock is Onondaga Limestone formation with a glacial till soil above this bedrock, which allows stormwater to infiltrate. High bedrock can be found just below the surface in some places and most soil types in the City are anthropogenic and the result of urban development.

Buffalo's climate is a humid continental type climate influenced by the Great Lakes. Buffalo experiences cold, snowy winters due to the lakes. The ground is typically covered with snow from December through early March. Buffalo's average annual precipitation between 2000 and 2018 was 40.3 inches. These patterns are likely to change, with an increase of snow, an extended growing season, and a temperature increase of between 3-5 degrees by mid-Century.

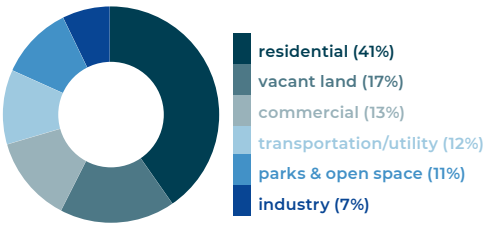
The Western New York region is characterized by hardwood forests. The most common forest communities include beech-maple forests, elm-ash forests, maple-basswood, hemlock-northern hardwood forests, oak openings and pitch pine areas. Common mammals include the cottontail rabbit, eastern chipmunk, woodchuck, raccoon, striped skunk and white-tailed deer. Characteristic birds include the American kestrel, mourning dove, downy woodpecker, red-eyed vireo, common yellow-throat, song sparrow and norther oriole. Common reptiles and amphibians include the American toad, leopard frog, painted turtle, and garter snake. Green infrastructure can support plant and animal communities by using native plants and avoiding invasive plants.

Waterways

Buffalo has a special place in the Great Lakes system. All water that drains into the western Great Lakes flows past Buffalo and into the Niagara River before flowing over Niagara Falls, into Lake Ontario, and into the Saint Lawrence River. This makes the City of Buffalo a steward for all water in the Great Lakes—about one-fifth of the world's freshwater.

The creeks and streams that run through the City of Buffalo also drain into the Great Lakes system. While the health of local waterways depends on the health of this broader system, steps taken to care for local waterways can also have big impacts on water quality throughout the Great Lakes. For example, algal blooms result from land-based runoff. The water quality in the Great Lakes can affect the environment, public health, and economy of all communities across the basin.

Buffalo's land use informed the priorities for Rain Check 1.0 and Rain Check 2.0.



Land Use Distribution Within the City of Buffalo

The priority CSO Basins discharge to the **Buffalo River** (CSO Basins 26, 27, 28 & 33), the **Erie Basin** (CSO Basin 14) and **Scajaquada Creek** (CSO Basin 53). The Buffalo River discharges into Lake Erie at the Buffalo Waterfront. All of Buffalo's stormwater eventually flows into the **Niagara River.**

The fast-flowing **Niagara River** is the distinctive waterway of the Buffalo Niagara region. The 37-mile river feeds the world famous Niagara Falls, connects Lake Erie to Lake Ontario and forms part of the border between the U.S. and Canada. Today, the Niagara River is widely used by residents and tourists for fishing, boating, sight-seeing and other recreation.

Historically, industry took root near the **Buffalo River**. It still serves that purpose today in a reduced role. The river is increasingly being used for recreation and tourism. Water quality in the Buffalo River is impaired due to a history of industrial pollution and runoff from many sources throughout the watershed, but has benefited from recent dredging and riparian restoration projects. As the Buffalo River becomes more important as a recreation and tourism amenity, cleaning up the river is a priority. Tributaries to the Buffalo River include Buffalo Creek, Cayuga Creek, and Cazenovia Creek. The river winds through South Buffalo before draining into Lake Erie at the City's Inner Harbor.

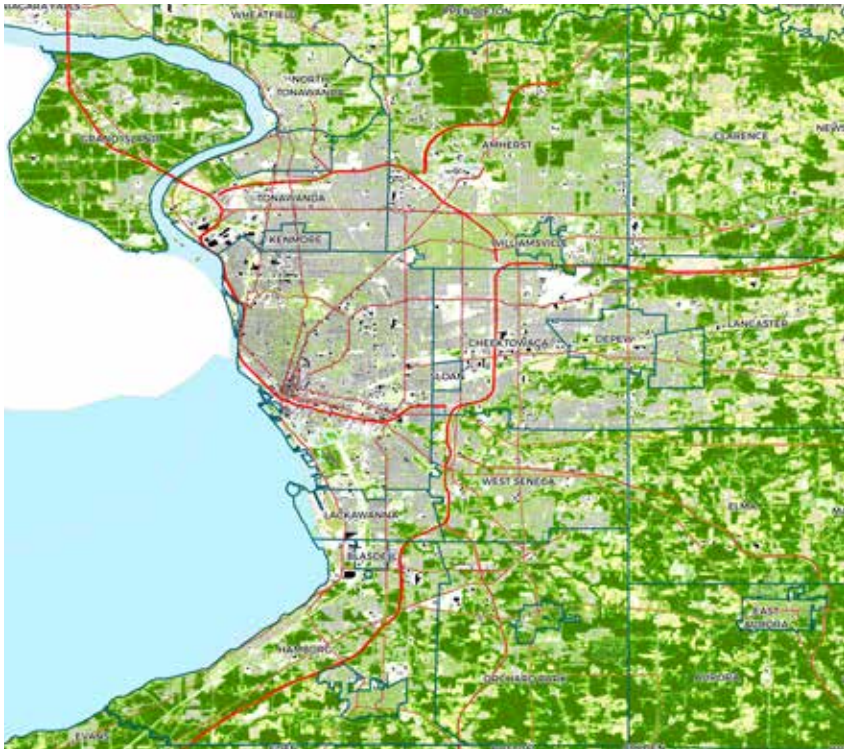


Figure 1.10 Buffalo's regional land cover from USGS national land cover dataset.

The New York Department of Environmental Conservation identified the Buffalo River as an Area of Concern in 1987. This designation resulted in restrictions on fish and wildlife consumption and dredging activities.

Lake Erie, the smallest Great Lake in terms of overall volume, links Buffalo with major shipping channels and has a substantial impact on the local climate. The Great Lakes to the west, and tributary streams south of the city, feed into Lake Erie, which is the source of all of Buffalo's water supply.

Scajaquada Creek, a tributary of the Niagara River, begins in the Town of Lancaster and flows west through Cheektowaga where it enters an underground channel before resurfacing at Forest Lawn Cemetery in Buffalo. From there, the creek travels through the cemetery and Delaware Park, feeding Hoyt Lake in the park before ultimately flowing into the **Black Rock Canal**.

The **Black Rock Canal** is formed by a break wall that reroutes the Niagara River waters between Unity Island and the City's shoreline. This channel was constructed so ships could travel from Buffalo more safely by avoiding the rapid current of the Niagara River. Today, the Black Rock Canal is a destination for boating, fishing, and for taking in waterfront scenery.

A tributary of the Buffalo River, **Cazenovia Creek** forms in southern Erie County, traveling through various towns before entering the City of Buffalo. It flows through South Buffalo neighborhoods and forms the prime water feature of Cazenovia Park, part of the City's Olmsted Park system. The creek can overflow and create flooding issues for nearby residents during significant wet weather events.

Buffalo has already taken a number of steps to address water quality concerns in the region. The **Buffalo River Ecological Restoration Master Plan** provides a framework for addressing habitat related impairments in the lower Buffalo River watershed. The **Great Lakes Legacy Act Sediment Action Plan** addresses many concerns around the Buffalo River Area of Concern. The draft **Local Waterfront Revitalization Program** proposes waterfront improvement projects, and establishes a program for managing, revitalizing and protecting resources along Lake Erie, the Niagara River, the Buffalo River, Scajaquada Creek, and Cazenovia Creek. Buffalo Sewer's Long-Term Control Plan is part of this region-wide effort to improve water quality and habitat.

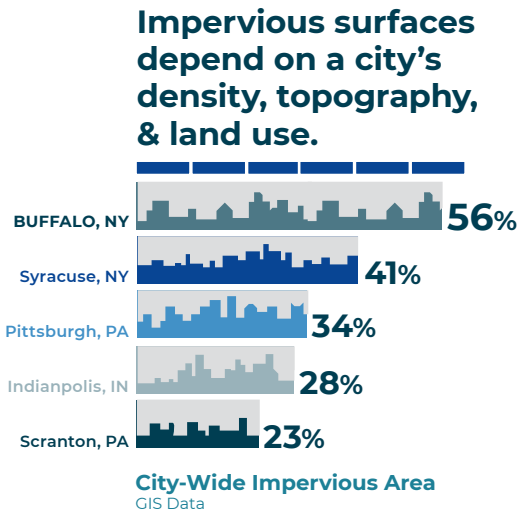
Tree Canopy Cover

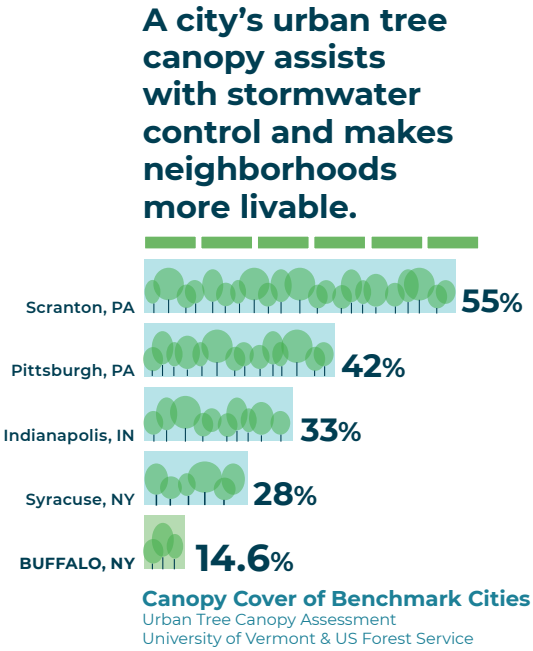
Trees intercept, absorb and filter stormwater. Increasing the tree canopy in Buffalo can help to reduce the amount of stormwater reaching the combined sewer and improve the quality of local waterways.

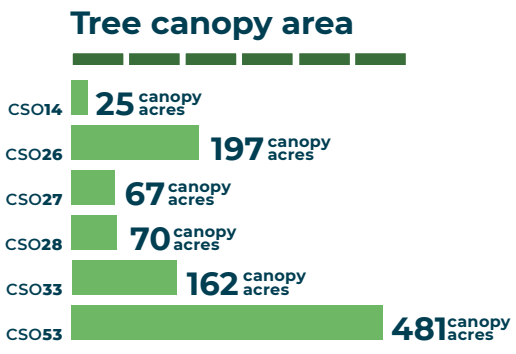
In addition to stormwater benefits, trees provide other benefits relating to equity goals and quality of life, including reducing urban heat island effect, improving walkability, increasing access to green space, and traffic calming. These many benefits of trees were also considered in the analysis of green infrastructure opportunities in Buffalo.

Buffalo's existing tree canopy in each priority CSO basin was analyzed to determine the amount of canopy within the public right of way and the amount of canopy on private land. The overall canopy cover for Buffalo is 14.6% or 3,836 acres of canopy. Most of the priority CSO basins have canopy cover on par with the city average. CSO Basins 27 & 33 are well below the city average. The city overall has more than 45,000 vacant acceptable street tree spaces. Increasing the canopy cover within the City and particularly within the priority CSO Basins would assist in meeting Buffalo Sewers stormwater goals.

To increase the tree canopy in the City, Buffalo Sewer is developing a system to account for the benefits of urban trees of different types and is examining programs to support tree planting. See Chapter Two for more information on what Buffalo Sewer is doing to understand the existing tree canopy and identify opportunities for urban forest expansion.







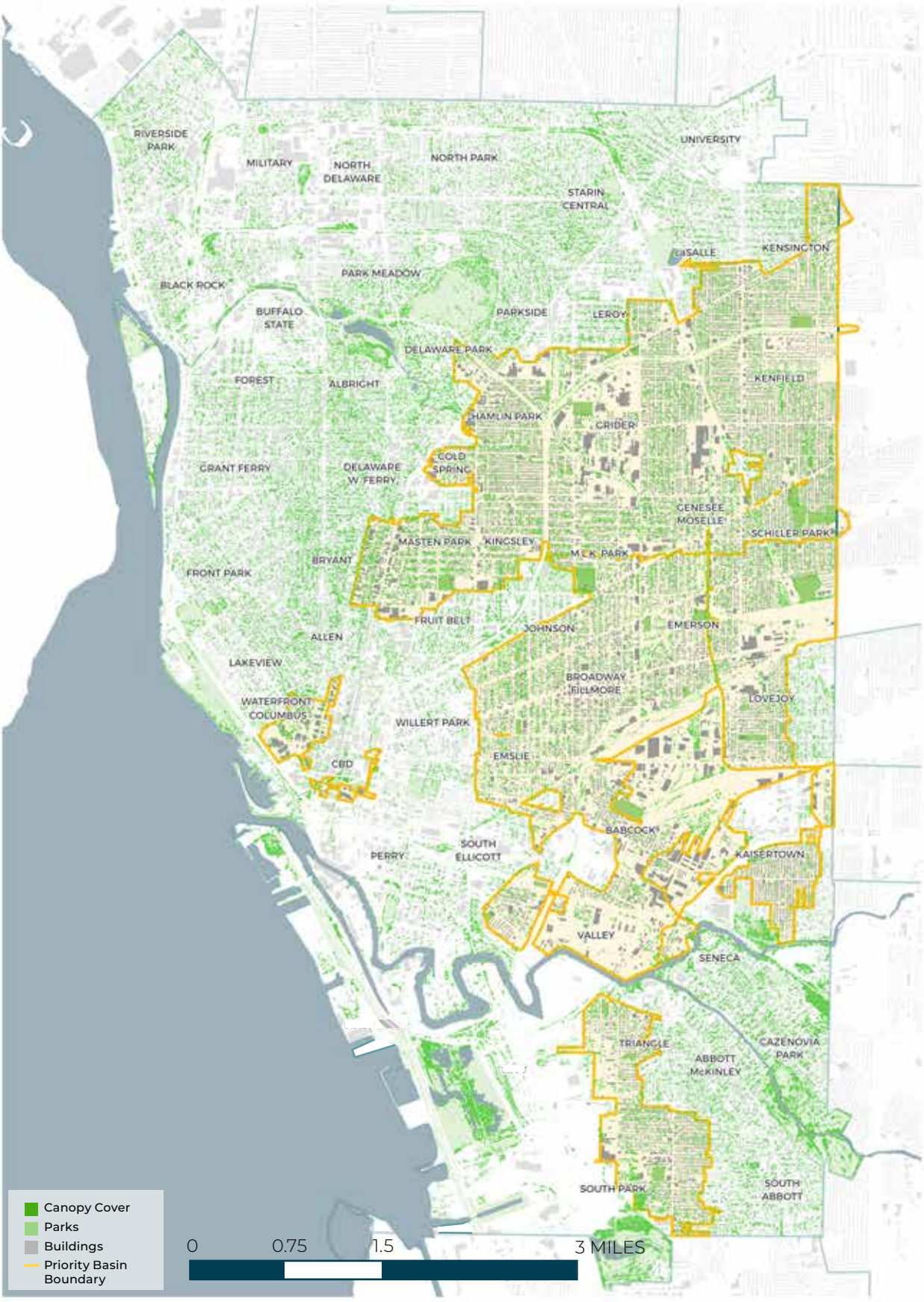


Figure 1.11: Map of Buffalo Canopy Cover and Priority CSO Basins.

OPPORTUNITY

PRIORITY CSO BASINS

PRIORITY CSO BASINS

Basin Specific Analyses

Building on the analysis completed for the Rain Check 2.0 project, Buffalo Sewer has evaluated each of the priority CSO basins through the lenses of Equity, Environmental Systems, and Site Analysis. The opportunities identified in each CSO basin later in this chapter are an effort to balance these three priorities based on the specific conditions in the basin. For example, commercial properties and parking lots comprise much of the impervious area in the priority CSO basins. They are therefore some of the largest contributors of stormwater to the combined sewer system. Retrofitting these properties with green infrastructure will be critical to effectively managing the stormwater challenge. Institutions, such as schools and churches, may be smaller contributors of stormwater, but investments in green infrastructure on those properties may better support achieving equity goals, such as workforce development and neighborhood revitalization, than developments on private property alone. Improvements to corridors, including green streets and tree planting, address high levels of impervious surfaces and provide benefits such as reducing the urban heat island effect and increasing walkability of neighborhoods.

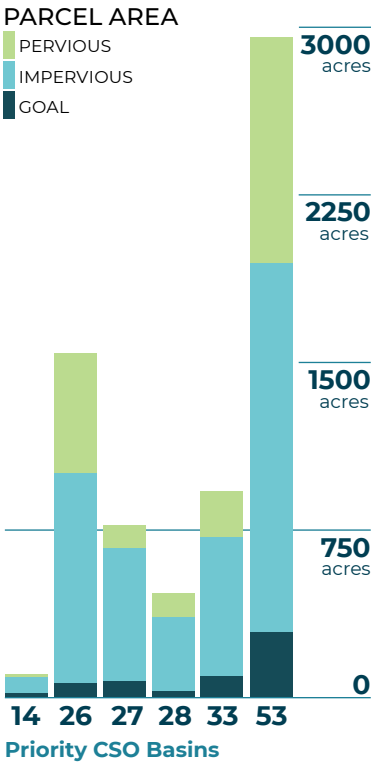
Based on this analysis, this opportunity report identifies types of green infrastructure opportunity sites. The opportunity sites are grouped by category - the key categories being corridors, commercial properties, parking lots, institutions, parks and vacant lots. These opportunity sites were identified in each CSO basin based on:

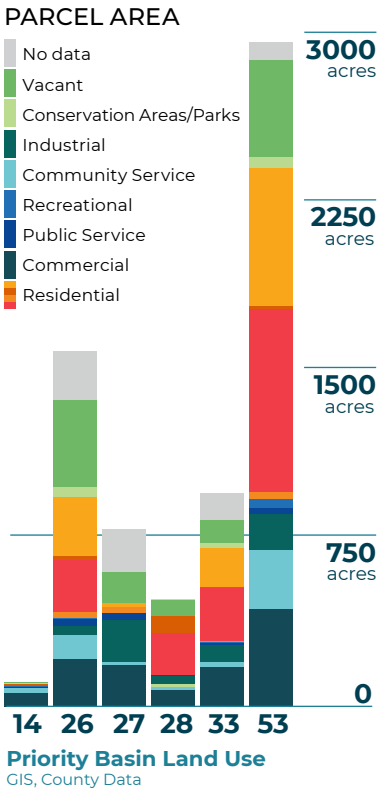
- **Equity considerations city-wide and within each CSO basin,**
- **Analysis of how green infrastructure would impact and improve environmental systems, and**
- **Site analysis to determine the best opportunities to retrofit green infrastructure based on the highest impervious area and the highest feasibility.**

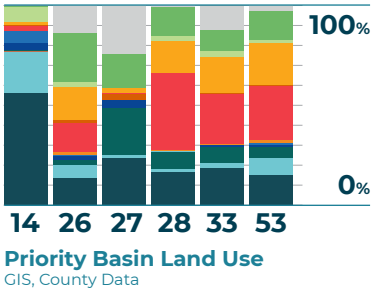
The next sections discuss each of the priority CSO basins in detail, presenting the analysis for each CSO basin. Within each CSO basin, opportunity sites are identified and an illustrative opportunity, project, or groups of projects lays out a vision of how green infrastructure can be deployed on a specific site within the CSO basin. The intent of this analysis is to begin the conversation between Buffalo Sewer, the City, property owners, and the community.

PRIORITY CSO BASINS

Basin Specific Analyses





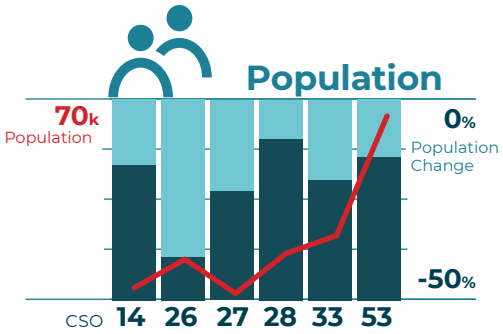


Basin Size

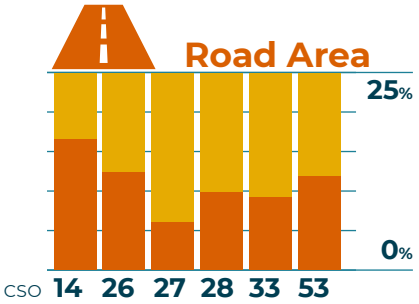
Rain Check 2.0 focused on 6 priority CSO Basins, each diverse in size, goal, and distribution of impervious surfaces. The charts above demonstrate total tax property parcel area, broken out by pervious and impervious area with the impervious reduction goal shown as a subset of impervious area.

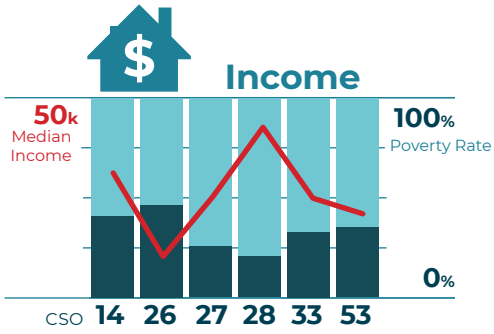
Land Use

Rain Check 2.0 emphasizes a data-driven approach to identifying areas of opportunity by evaluating city-wide data for sites likely to be strong candidates for green infrastructure. Land use is a large part of understanding the potential for green infrastructure. The graph above breaks out each CSO basin's tax parcel land area by land use.

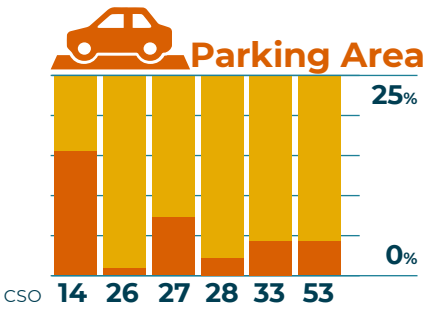


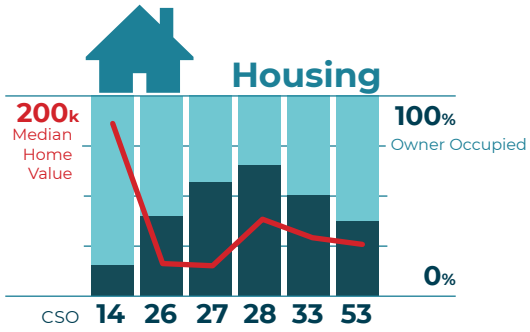
Priority Basin Trends
Population vs Population Change 2000-2016



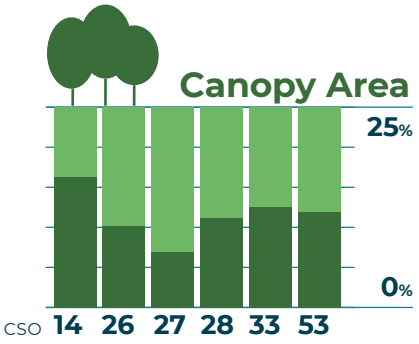


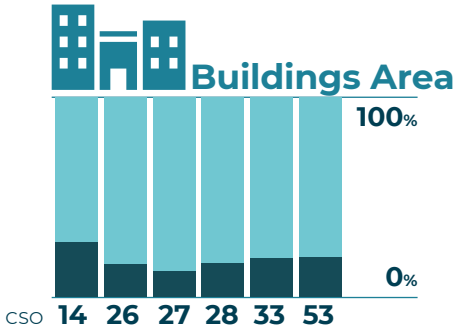
Priority Basin Trends
Rate of Poverty vs Median Income

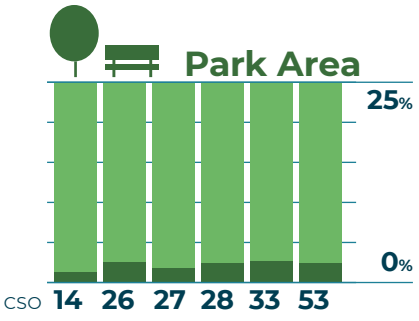




Priority Basin Trends
Rate of Owner Occupied Homes vs
Median Value of Owner Occupied Homes







PRIORITY CSO BASINS

Site Analysis

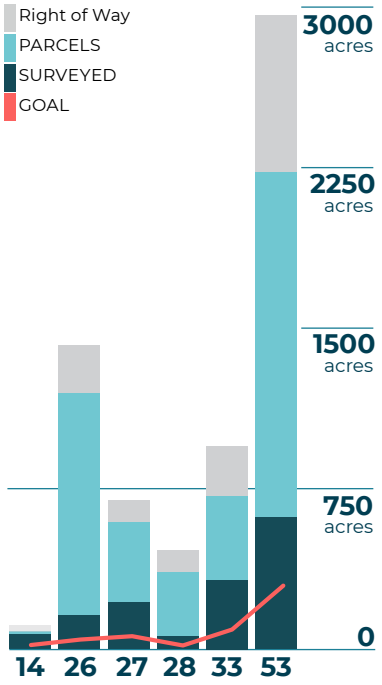
To understand the potential for managing large areas of impervious surface, detailed site analysis within the priority CSO basins were performed. This analysis involved two components: 1) a thorough desktop analysis utilizing advanced GIS and remote sensing techniques, and 2) detailed on-the-ground field surveys. A detailed discussion of the methodology can be found in Chapter Four.

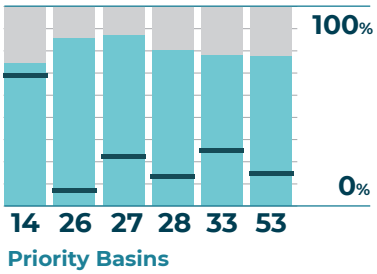
The initial desk top analysis identified potential parcels, property owners, and land use. The initial analysis also considered key community partners and property owners, including Public Schools, Parks, Buffalo Urban Renewal Agency, Buffalo Urban Development Corporation, Buffalo Municipal Housing Authority, and religious centers. These community partners can act as catalysts for engagement and implementation. The analysis concluded that a significant portion of the impervious reduction targets could be achieved working with these partners.

Buffalo Sewer then conducted field surveys of properties identified through the desktop analysis. The purpose of the field surveys was to narrow the list of potential parcels to include only those where green infrastructure retrofits were feasible, to identify the impervious surface area that could be captured on each site (the drainage area), to delineate areas within each site appropriate for green infrastructure, to propose potential green infrastructure solutions appropriate to each site, and to identify implementation challenges at each site - such as parking and utility conflicts. For each priority CSO basin, this report includes a map showing all the parcels surveyed, the drainage areas, and possible green infrastructure location. A detailed description of different green infrastructure practices can be found in Chapter Two of this report.

Since many green infrastructure practices include plants, ensuring that possible green infrastructure sites have enough sun to grow plants is an important consideration. Therefore the field surveys included as assessment of how shaded each possible green infrastructure location identified was. These finding are summarized in each CSO section. An on-site evaluation was also made regarding how visible the potential green infrastructure practice would be from the public right-of-way. Visibility is important to the community and as a way for Buffalo Sewer to visually determine if there are any issues with a green infrastructure installation.

Finally, the analysis conducted as part of this report is a preliminary assessment. When any green infrastructure practice is ready to be designed and installed, a more detailed assessment will be required to determine the suitability of the site for green infrastructure, including an evaluation of soil percolation rates and the presence of contaminated soils.





Surveyed Sites Breakdown

To better understand on the ground conditions for highly impervious parcels, site surveys where conducted in each priority CSO Basin. The above graphs show surveyed area relative to overall basin size including both tax parcels and right-of-way.

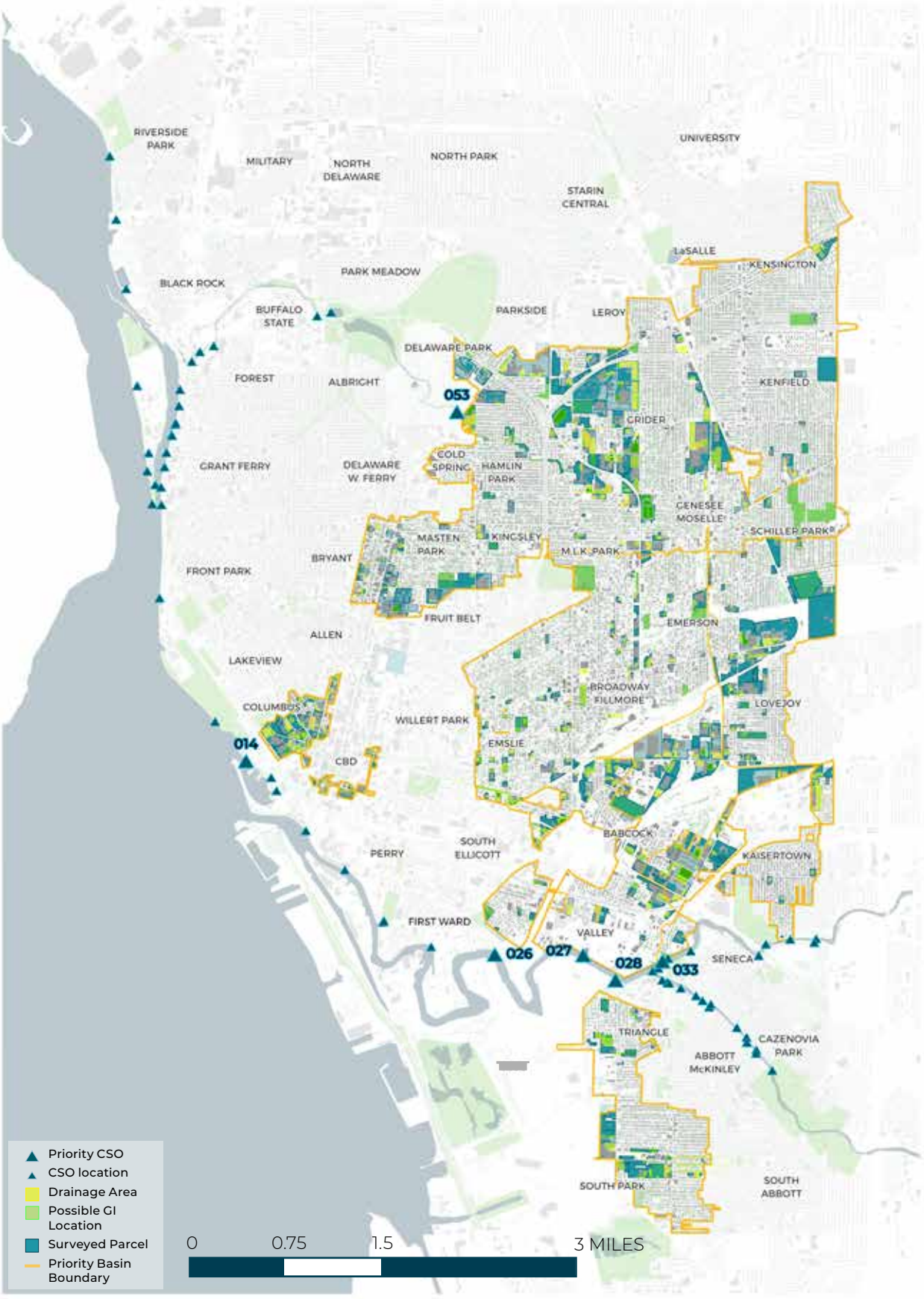


Figure 1.12: Map of Buffalo with Sites Surveyed and Priority CSO Basins.


CSO14

When a drop of water lands at the intersection of Elmwood Avenue and Niagara Street, it is joined by water from the neighborhoods of Columbus and Waterfront. During heavy wet weather the rainwater combines with sewage and overflows into the Erie Basin Marina at Combined Sewer Overflow 14 (CSO 14).

Community benefits

- Walkability
- Traffic calming
- Public Health
- Enhanced connection to the waterfront
- Expanded tree canopy
- Reduced heat island effect

CSO **Basin 14 at a glance...**

Green Infrastructure Opportunities

The goal for CSO Basin 14 is to manage stormwater from 13 acres of impervious surface. CSO Basin 14 is very small and is part of Buffalo's central business district. It is a high priority since it discharges to the Erie Basin Marina, which is used for recreation. Buffalo Sewer will coordinate with larger downtown planning efforts, such as the Buffalo Public Realm Plan, to incorporate green infrastructure. Almost the entire area has been surveyed. The CSO basin goal can easily be met through green infrastructure implementation on commercial properties and along roadways.

Urban Character

CSO Basin 14 is dominated by privately owned commercial property, including both building and surface parking lots, as well as city owned property. There are some open spaces within CSO Basin 14, although it is dominated by impervious surfaces.

Environmental Systems

This CSO basin discharges to the Erie Basin Marina and has the highest impervious surface coverage of any targeted CSO basin. It has a tree canopy cover similar to the rest of the City, but there are only a few isolated patches and no habitat corridors. Green roofs on commercial buildings could provide habitat patches within the City as well as possible amenity space for building tenants.

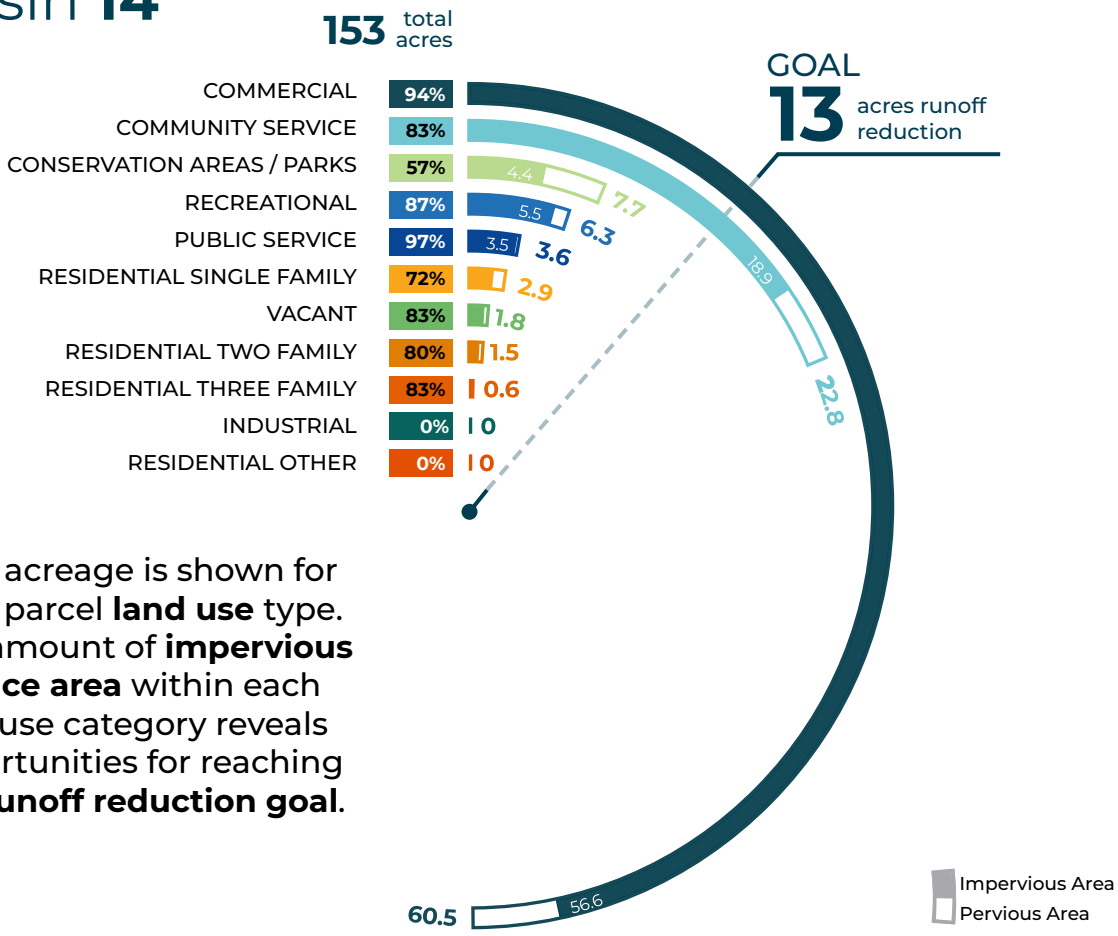
Equity Considerations

Although measures of economic vitality for CSO 14 neighborhoods, such as median household income and unemployment rate, are comparable to the City overall, there are considerable racial equity gaps. The overall unemployment rate is 7.7% among all residents, but is 15.4% among residents of color. Location and land uses indicate strategic engagement with public and private sectors is likely to be the top priority here, rather than a community-based planning process.

BY THE NUMBERS...

Land Use Opportunity and Impervious Surfaces by Area

Basin **14**



Total acreage is shown for each parcel **land use** type. The amount of **impervious surface area** within each land use category reveals opportunities for reaching the **runoff reduction goal**.

Basin Overview

153 acres
TOTAL BASIN AREA

4,375
RESIDENTS

$35,000
MEDIAN HOUSEHOLD INCOME

25 acres
OF CANOPY AREA

2 acres
OF PARK AREA

43 acres
OF RIGHT OF WAY

26 acres
OF ROAD AREA

42 acres
OF BUILDING AREA

24 acres
OF PARKING LOTS

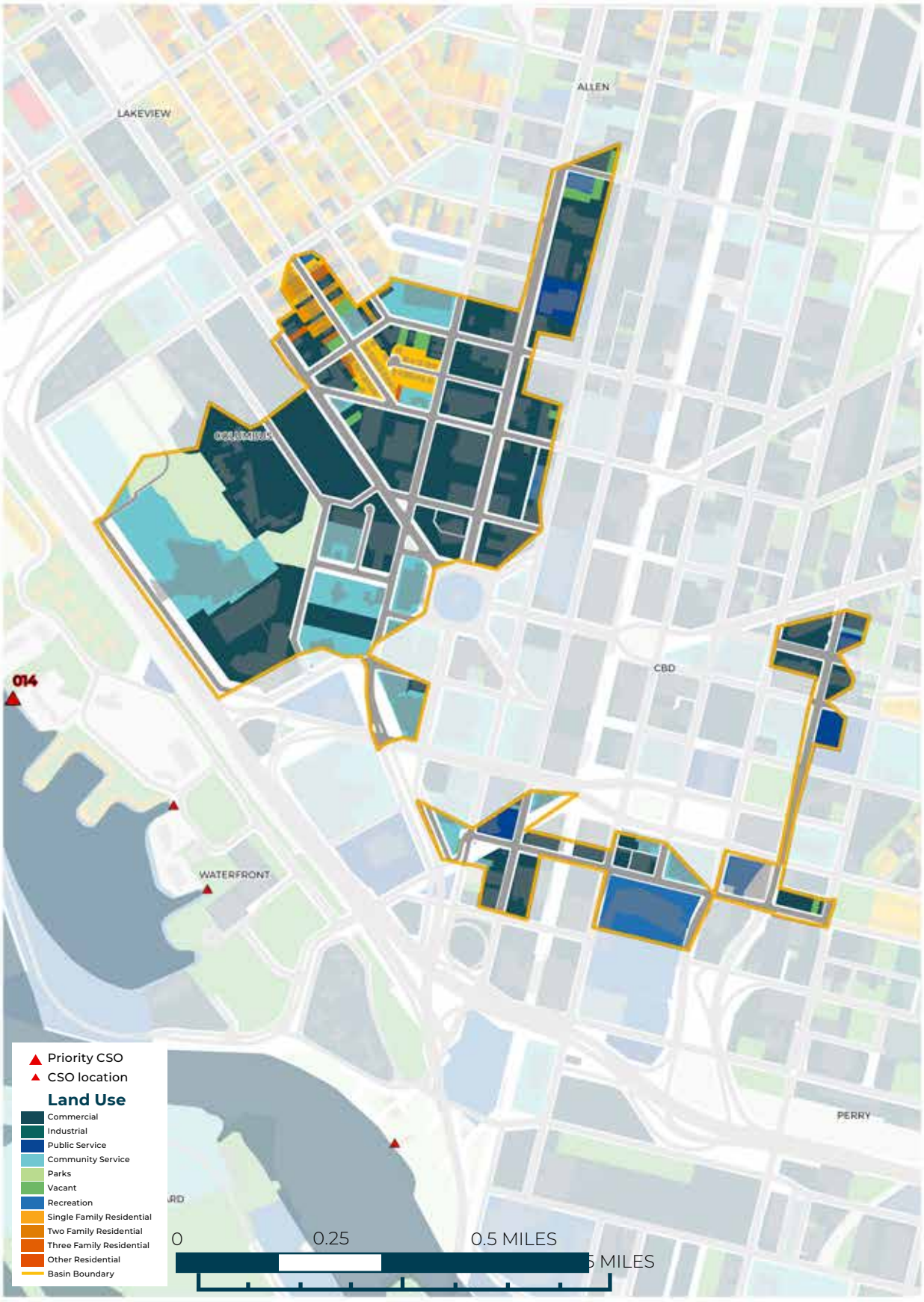


Figure 14.1: CSO Basin 14 Sites evaluated for impervious surface management through green infrastructure.

Opportunity Sites & Networks

Corridors

Because of the density in CSO Basin 14, corridors such as Elmwood Avenue, Huron, and Swan Streets present some of the largest spaces for implementing green infrastructure. These corridors also provide an opportunity for creating a green infrastructure network that connects most of the basin.

Sites

Most of the basin and many sites were found appropriate for green infrastructure retrofit. The sites naturally aggregate around the existing corridors. This analysis also indicates that a basin-wide network is possible.

Clusters and Networks

Given the small size and density of this basin, almost the entire basin could be aggregated into one or two networks, allowing for great efficiency in removal of stormwater from the system.

Key Corridors

- Elmwood Avenue
- Niagara Street
- Elm Street
- Swan Street
- Erie Street
- Huron Street

Key Institutions

1. Waterfront School,
2. Buffalo Bisons' Stadium
3. Hutchinson Central Technical High School
4. St. Anthony's of Padua RC Church

Key Commercial

5. Blue Cross/Blue Shield
6. Pine Harbor Apartments
7. Shoreline Apartments
8. Buffalo Regional Benefit Office, New Era Store.

Key Parking Lots

9. St, Anthony Parking
10. City Hall
- All Pro (various locations)

CORRIDORS are networked, physically connected systems around a road or right-of-way

OPPORTUNISTIC SITES are stand alone sites with a high opportunity for green infrastructure

CLUSTERS have an anchor institution or are groups of parcels that can implement similar strategies

NETWORKS are larger systems of capture and treatment incorporating many sites

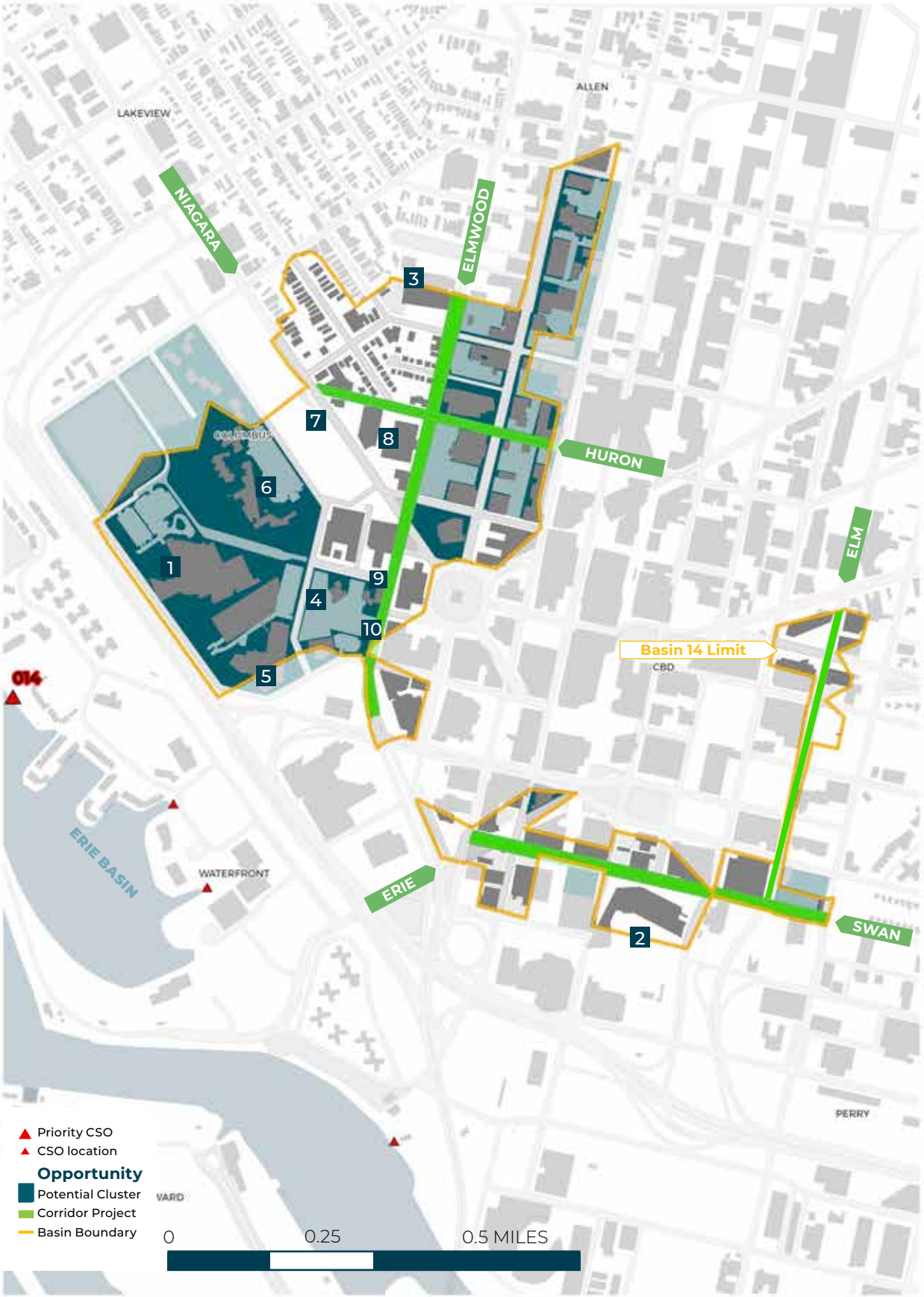


Figure 14.2: CSO Basin 14 Green Infrastructure Opportunity Sites

Green Infrastructure Opportunity
Central Business District

Many of the buildings and streets in the basin are iconic to the image of Buffalo. Green infrastructure will be important to stormwater performance and can improve neighborhood quality. These buildings and streets, in combination with the many surface parking lots present the greatest opportunity for green infrastructure. Downtown has fewer residents and more commuters than other areas of the city, resulting in an abundance of surface lots, that contribute a substantial amount of stormwater runoff. Installing bioswales around the periphery of these lots and along parking rows would result in significant runoff reduction while reducing heat island effect and increasing canopy cover. As development pressures increase, some lots are likely to be developed. Investments in open space green infrastructure here, and across the City, should be evaluated against future land use.

The surface parking lots predominantly serve commercial buildings and institutions, which represent another green infrastructure opportunity. These buildings have large footprints and maintenance budgets, making them possible candidates for green roof installations. Green roofs also help to reduce heat island effect, increase habitat, and reduce impervious runoff. Installing green roofs on rooftops visible to building occupants on upper floors can also improve the views from above. Downtown buildings are the most likely to have the extra load capacity to support green roofs.

An important time to think about green infrastructure is when properties are undergoing redevelopment. For example, the Shoreline Apartments are being redeveloped in the near future. The redevelopment will include open space that could incorporate green infrastructure that would provide amenity space for residents as well as reduce stormwater runoff.

Strategies

- **Green roof retrofits**
- **Complete streets**
- **Green parking lots**
- **Impervious surface reduction**
- **Curb bump outs**

Potential Partners

- **City Hall**
- **Department of Public Works**
- **Waterfront School**
- **Hutchinson Central Technical High school**
- **Blue Cross Blue Shield**
- **St. Anthony's**
- **Division of Parks and Recreation**

Figure 14.3: Historic Image of downtown Buffalo

Figure 14.4: Buffalo City Hall

Placemaking Opportunity with Green Infrastructure

In addition to providing stormwater benefit, green infrastructure can create beautiful and welcoming public green space for city residents. Particularly in a dense urban area the addition of street trees and green infrastructure can help to reduce urban heat island effect, calm traffic, and provide for greater walkability. Green infrastructure can also screen parking lots in the central business district, creating a strong edge and more attractive public space.

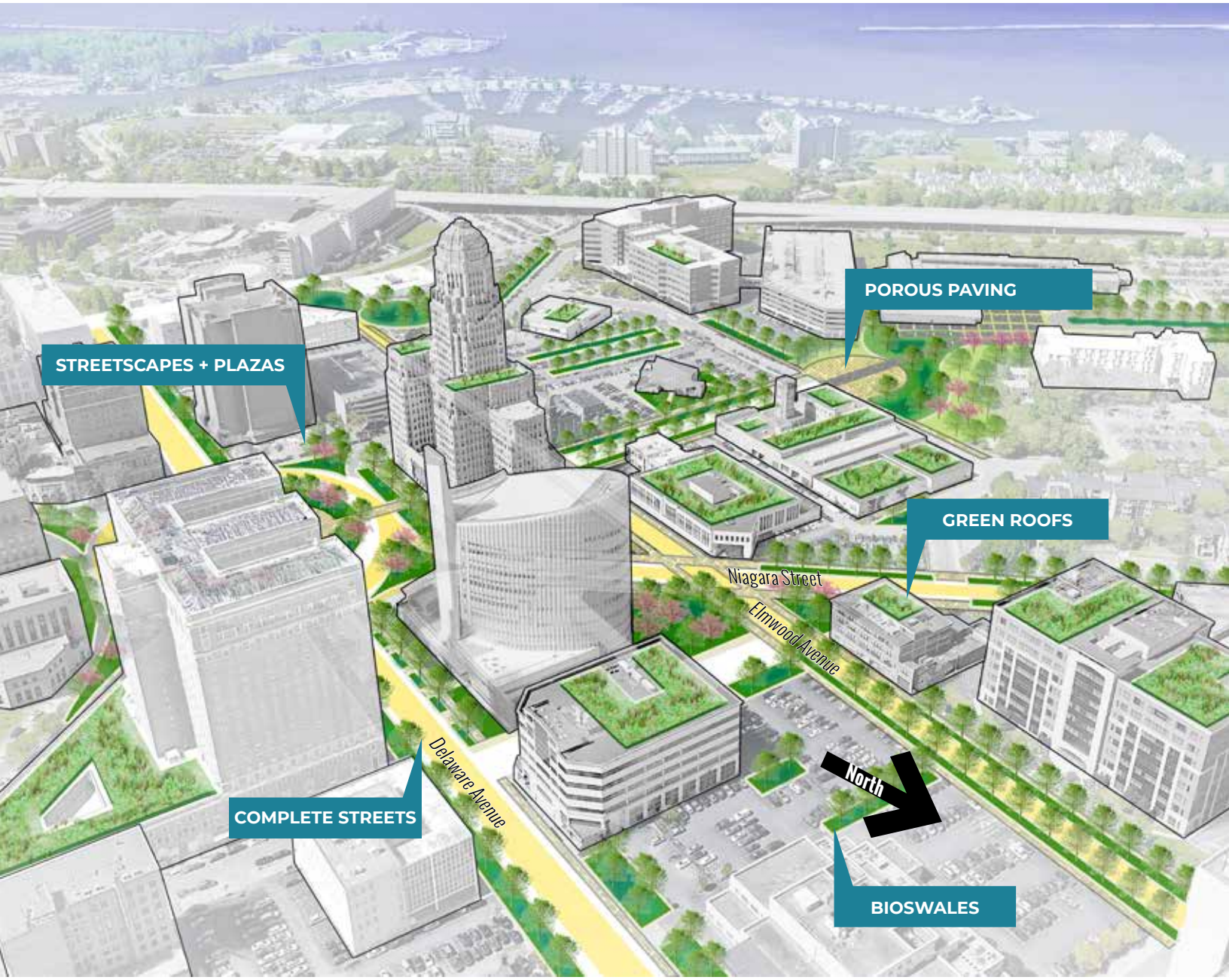


Figure 14.5: Downtown Buffalo Green Infrastructure Opportunities

ANALYSIS

Urban Character

The boundaries of CSO Basin 14 intersect with two City of Buffalo planning neighborhoods adjacent to the central business district in downtown Buffalo: Columbus and Waterfront. CSO Basin 14 also touches a number of planning areas, which green infrastructure planning and investment could support. CSO Basin 14 intersects the Local Waterfront Revitalization Program Boundary. Investment in green infrastructure in CSO 14 supports this effort to revitalize Buffalo's waterfront. Work in this basin will contribute to the Green Code's goal of improving water quality in the Erie Basin, supporting waterfront development and contributing to the momentum of Buffalo's downtown.

The urban form is characterized by large, tall office buildings, commercial uses and some large open spaces. Given the location of CSO Basin 14 neighborhoods in and around the central business district, the area is home to a mix of government offices, including Buffalo City Hall, as well as law firms and other professional services, hotels such as Embassy Suites and Westin, and numerous restaurants.

Downtown Buffalo is seeing consistently higher numbers of building permits and the heaviest commercial development per square mile compared to the other priority basins. CSO Basin 14 is experiencing the greatest overall development of all CSO basins per square mile.

Several schools are located in the area, but overall the CSO Basin 14 neighborhood area has a significantly smaller share of neighborhood groups and community institutions such as schools, religious buildings, and community centers compared to the other priority basins. This may be the only instance where it is a misnomer to characterize the priority area as a "neighborhood area." Still, the area is considered home to about 4,400 residents.

Figure 14.6: Downtown has many wide streets with many lines, Elmwood, Delaware, and Huron streets are seen here.

Figure 14.7: Downtown Buffalo has many high rise buildings and surface parking-lots leading to high levels of storm-water runoff.

Figure 14.8: Buffalo Bison's Baseball Stadium is one of many important cultural nodes downtown.

Figure 14.9: Down Town Institutions: Blue Cross Blue Shield of Western New York, City Hall

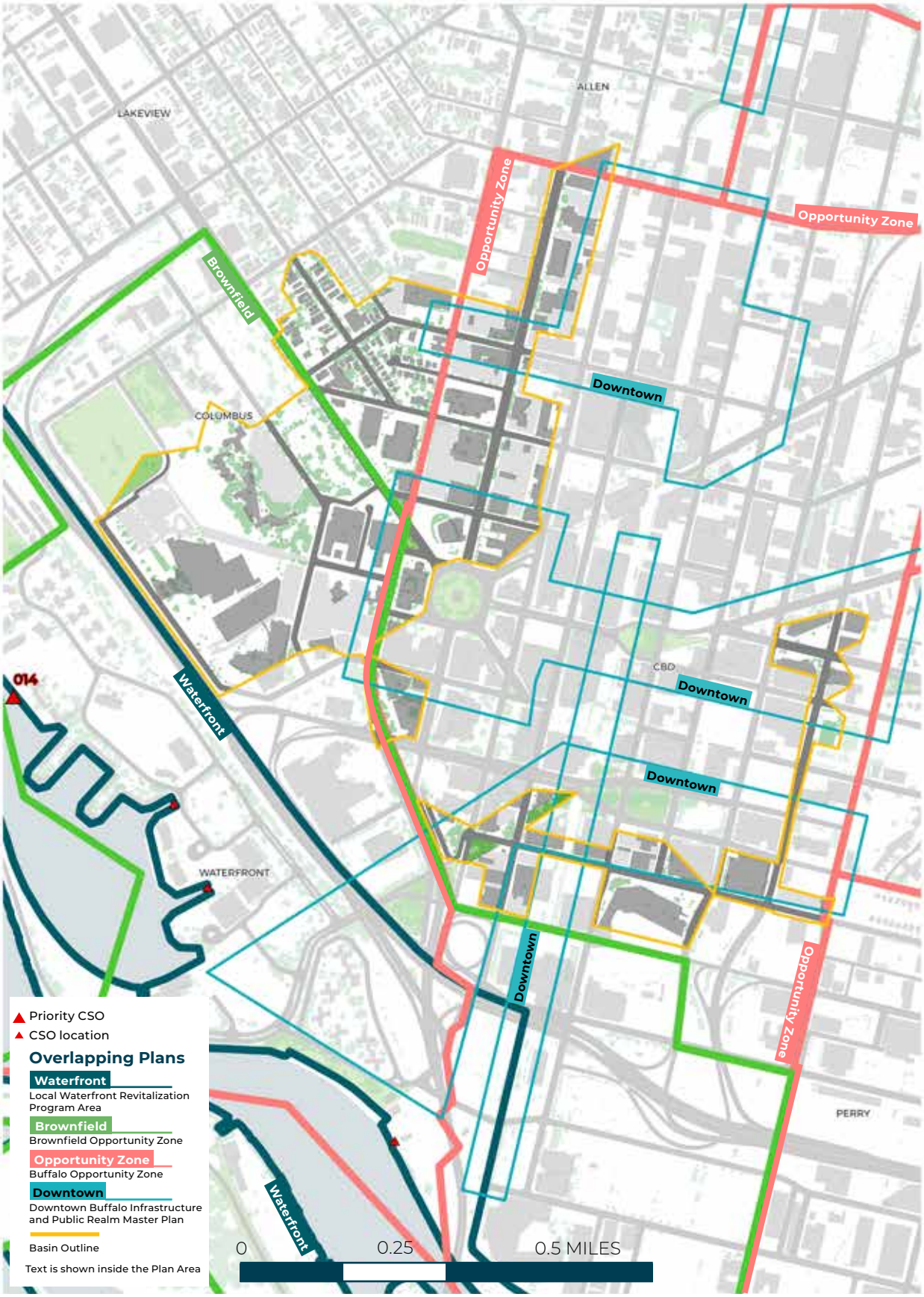


Figure 14.10: CSO Basin 14 Planning Map

ANALYSIS

Equity Analysis

Unlike some of the other priority areas where there is a predominance of one racial or ethnic group, CSO Basin 14 neighborhood areas have significant racial and ethnic diversity with relatively similar shares of White, Black, and Hispanic or Latino residents. One in five households speak Spanish, and 9.3% are limited English speaking—more than double the city rate. While overall measures of economic vitality for CSO Basin 14 neighborhoods such as median household income and unemployment rate are comparable to the City overall, there are considerable racial equity gaps. For example, the overall unemployment rate of 7.7% among residents in the area is lower than across the City, but the unemployment rate is 15.4% among residents of color.

Given the location of CSO Basin 14 adjacent to the central business district, land uses and business mix reflect that of a downtown. The basin has high impervious surface coverage, along with a small tree canopy footprint. CSO Basin 14 also has the highest traffic volumes among targeted CSO basins, due to commuter traffic and major highways nearby. Being in the active downtown area, CSO Basin 14 has the smallest share of vacant land cover and lowest vacancy rates of any targeted basin. The overwhelming majority (85%) of housing units are renter occupied, and there appear to be relatively few community-based organizations and neighborhood groups in the area.

While the need for green infrastructure is high based on the high percentage of impervious surfaces and presence of disadvantaged population groups, the feasibility of many green infrastructure investment options may be relatively limited, due to factors such as low owner-occupancy rates and a smaller amount of vacant land. Therefore, this is likely an area where engagement with public and private sectors may be the top priority or strategy, rather than a more community-based planning process.

Neighborhood Profile Snapshot

4,375
RESIDENTS

$35,000
MEDIAN HOUSEHOLD INCOME

69.4%
ATTAIN LESS THAN A BACHELOR'S DEGREE

$172,127
MEDIAN VALUE OF OWNER-OCCUPIED HOMES

37.2%
OF HOUSEHOLDS DO NOT HAVE A VEHICLE

-16.2%
2000–2016
POPULATION CHANGE

40.9%
RESIDENTS LIVING IN POVERTY

48.3%
WORKING AGE NOT EMPLOYED*

62.9%
RESIDENTS ARE PEOPLE OF COLOR

84.8%
HOUSEHOLDS ARE RENTERS

The data presented is for census tracts located within or that intersect the CSO basin boundaries, as an approximation of neighborhoods (see Appendix A for more details and methods)
*Includes those that are unemployed or out of the labor force.

Figure 14.11: CSO Basin 14 and GI Equity Index

ANALYSIS

Environmental Systems

Waterways

CSO Basin 14 is located along lake Erie and north of the Buffalo River. The CSO basin discharges to Erie Basin. Erie Basin's status as a highly active recreational area made this basin a priority for stormwater runoff reduction targets. Currently the I-90 expressway and private developments make the waterfront feel separate and less accessible. Using stormwater improvements to increase the downtown's feeling of connection with water could be one strategy to break down some of this perception of separation.

Tree Canopy Cover

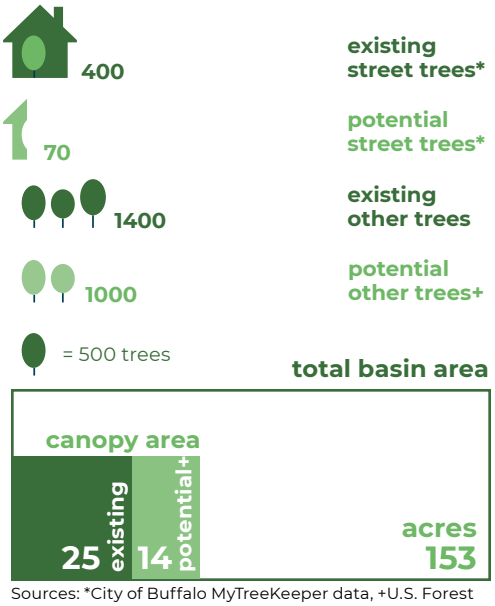
Tree canopy cover in CSO Basin 14 is slightly higher than the City average. Some planted patches exist near parks and along wide streets, but are not pervasive. There are plantable acres and street tree planting spaces available, to further expand canopy cover in the future.

Habitat Connectivity

CSO Basin 14 has a few isolated patches, but no corridors. Enhancing street tree planting in corridors is the most likely strategy to increase habitat connectivity. There are several parks or large lawns downtown that could be more heavily planted with shrubs and trees. For buildings where it is feasible, green roofs can also help to increase resting space for birds. Strategies like pollinator corridors and parking lot bioswales may also be viable techniques.

Tree Canopy Summary

NUMBER OF TREES IN BASIN



Sources: *City of Buffalo MyTreeKeeper data, +U.S. Forest Service protocol with input from the Tree Technical Advisory Committee. For detailed description of methodology, see Appendix C

Figure 14.12: There is little urban habitat downtown, but increasing the open space network along the lake edge between Times Beach Nature Preserve to La Salle Park would be a valuable addition.

Figure 14.13: CSO Basin 14: Canopy Cover and Impervious Surfaces

ANALYSIS

Site Analysis

CSO Basin 14 is the smallest drainage area of all the priority CSO Basins and is located on the edge of the downtown region of Buffalo. The street grid is tighter here than in other areas of the City and historic buildings with large footprints occupy most of the blocks in the city center. Despite the dominance of large commercial buildings and parking surfaces, space is available for green infrastructure improvements.

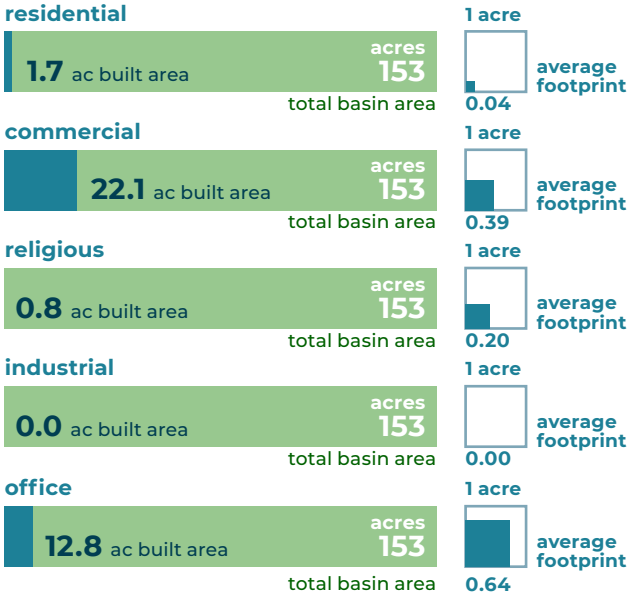
The CSO goal for impervious acres managed is also the lowest of all evaluated basins at 12.9 acres, about 8% of the total area. The greater part of the entire basin was surveyed as part of the site analysis process. Thus there is a high level of confidence that the CSO goals can be met.

Land use is mostly commercial and, to a lesser degree, city-owned land. An important advantage of city-owned land is that green infrastructure can be used to activate publicly funded public spaces. Existing public spaces include streets, sidewalks, intersections, and a larger public park to the northwest. High quality park space is limited in the downtown, so green infrastructure could benefit the existing park with additional plantings, and improved sidewalks or paved surfaces. These improvements could capture water and be welcoming for visitors representing Buffalo as a high functioning and sustainable city.

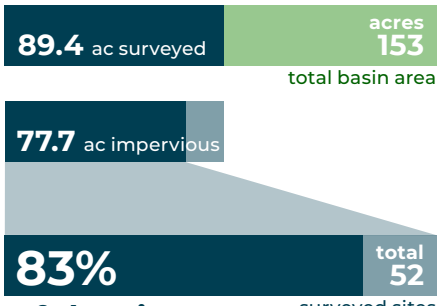
Opportunities for partnerships with top property owners could have a big impact on limiting impervious surfaces. Blue Cross/Blue Shield, Waterfront School, and the Buffalo Bisons' Stadium are top candidates for green infrastructure improvements.

Built Area by Land Use

Full Basin Area, GIS sources: Erie County data, Buffalo Sewer Authority data



The site analysis reviewed 59% of the basin and found 25.5 acres of potential drainage area.



of the sites were suitable for green infrastructure.

88% of sites are in full sun

50% of sites are highly visible

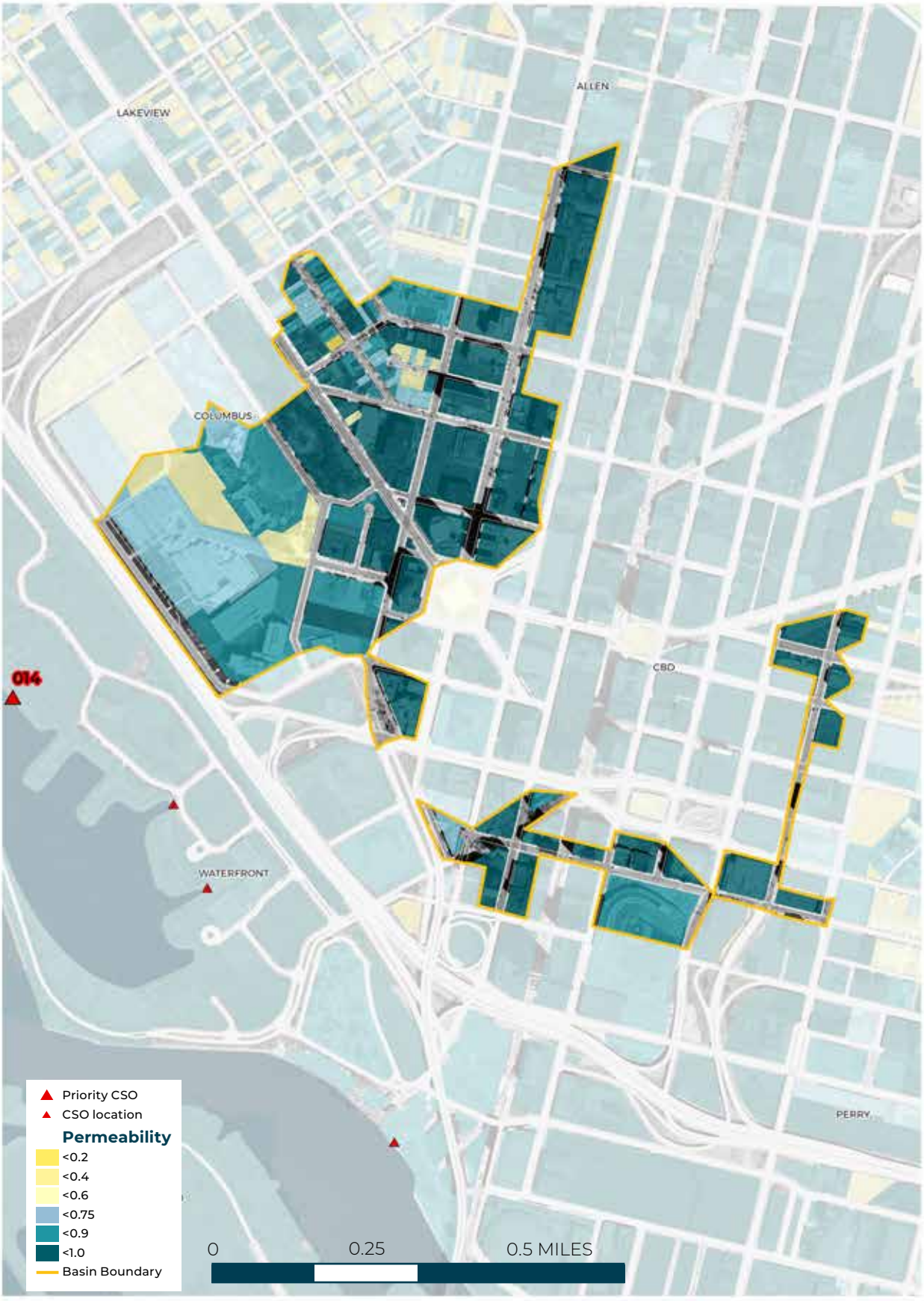


Figure 14.14: CSO Basin 14: Percent Impervious cover by Parcel

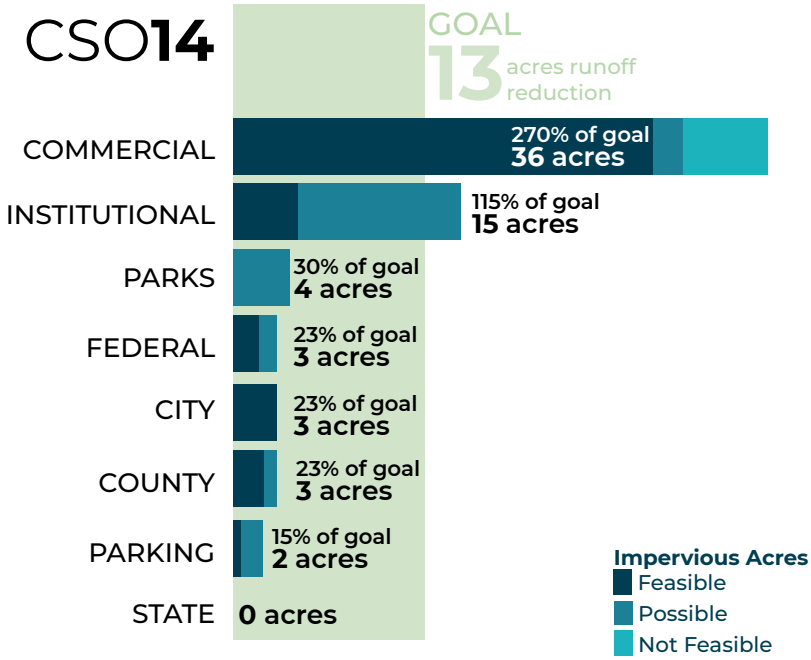
ANALYSIS

Site Analysis: Surveyed Properties

Figure 14.15: Examples of sites surveyed.

Surveyed Properties by Land Use and Ownership

GIS sources: Erie County data, Buffalo Sewer Authority data



LARGEST PROPERTY OWNERS BY LAND USE AND OWNERSHIP

COMMERCIAL

Blue Cross/Blue Shield of WNY
6.0 Imperv. acres

New Era Store
2.4 Imperv. acres

Delaware North Building
1.7 Imperv. acres

Embassy Suites by Hilton
1.6 Imperv. acres

The Benchmark Group
1.6 Imperv. acres

INSTITUTIONAL

AllPro Parking Lot (Elmwood)
1.4 Imperv. acres

St. Anthony's Parking
1.2 Imperv. acres

Lot 23 Parking
0.6 Imperv. acres

Swan Street Parking
0.5 Imperv. acres

SURVEY NOTE:

The survey team reviewed most sites intersecting the perimeter of the basin resulting in a surveyed area greater than the basin area. This is reflected in the survey summary numbers on this page.

Many different types of parking lots were surveyed in CSO Basin 14, including open lots and parking adjacent to a building.

From this, the team was able to discern if green infrastructure locations can address urban issues such as walkability and make recommendations for bioswales and tree pits to provide shade and make comfortable outdoor rooms. These recommendations are discussed on the opportunity pages.

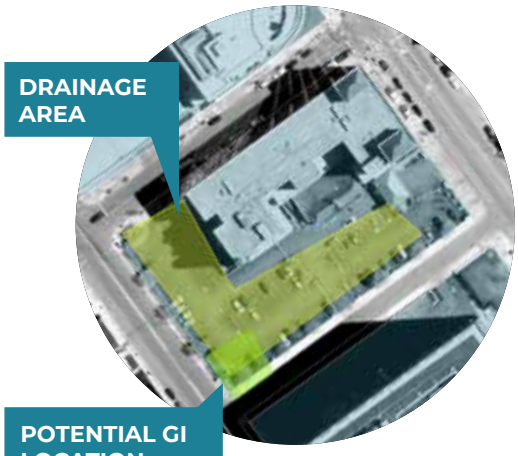


Figure 14.16: CSO Basin 14: Sites analyzed showing parcels, drainage areas and potential green infrastructure.

Figure 14.17: CSO Basin 14: Basin outline on aerial

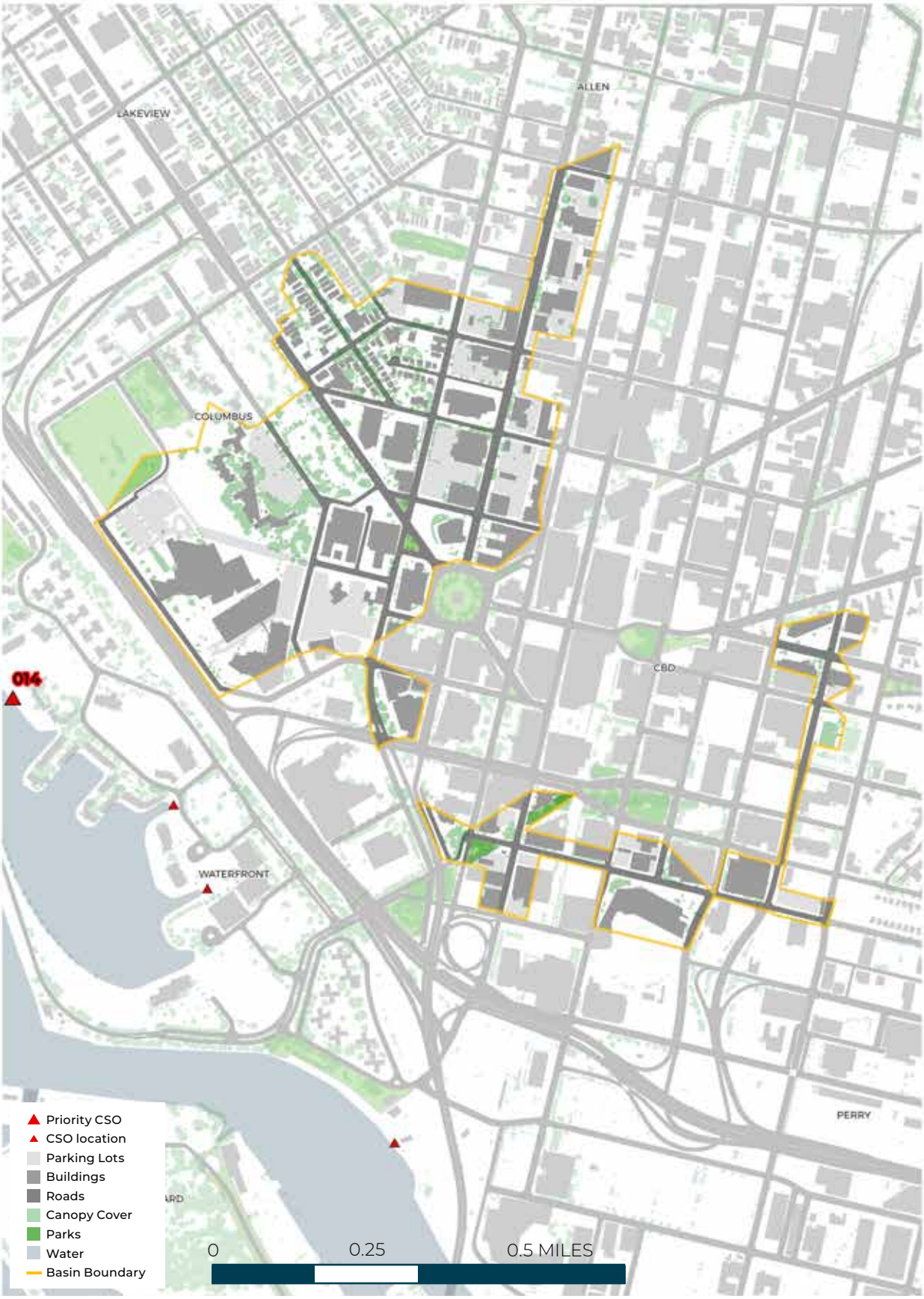


Figure 14.18: CSO Basin 14 Map of Built Environment and Tree Canopy

CSO26

When a drop of water lands at the intersection of Broadway and Fillmore Street, it is joined by water from the neighborhoods of Broadway-Fillmore, Emslie, Johnson, Emerson, Genesee Moselle, Babcock, and parts of the Old First Ward and Valley. During heavy wet weather, the rainwater combines with sewage and overflows into the Buffalo River at Combined Sewer Overflow 26 (CSO 26).

Community Benefits

- Walkability
- Active commuting (biking or walking to work)
- Improving the public realm
- Support neighborhood revitalization work
- Workforce development programs
- Green jobs
- Clean up and revitalization of vacant lots
- Increased tree canopy
- Enhanced property value
- Reduced urban heat island effect
- Traffic calming
- Access to green space

CSO **Basin 26 at a glance...**

Green Infrastructure Opportunities

The goal for CSO Basin 26 is to manage stormwater from 64 acres of impervious surface. Based on the site analysis, it will be difficult to meet the goal without incorporating public roadways and sidewalks.

Urban Character

CSO Basin 26 is characterized by low density residential neighborhoods, with high levels of vacancy, large commercial corridors with institutional and city-owned properties, and isolated industrial lots. Key corridors pass through this CSO basin and the streets are generally oversized. No single category can fulfill the required acres-managed goal and the managed acres will need to include commercial, institutional, and city property.

Environmental Systems

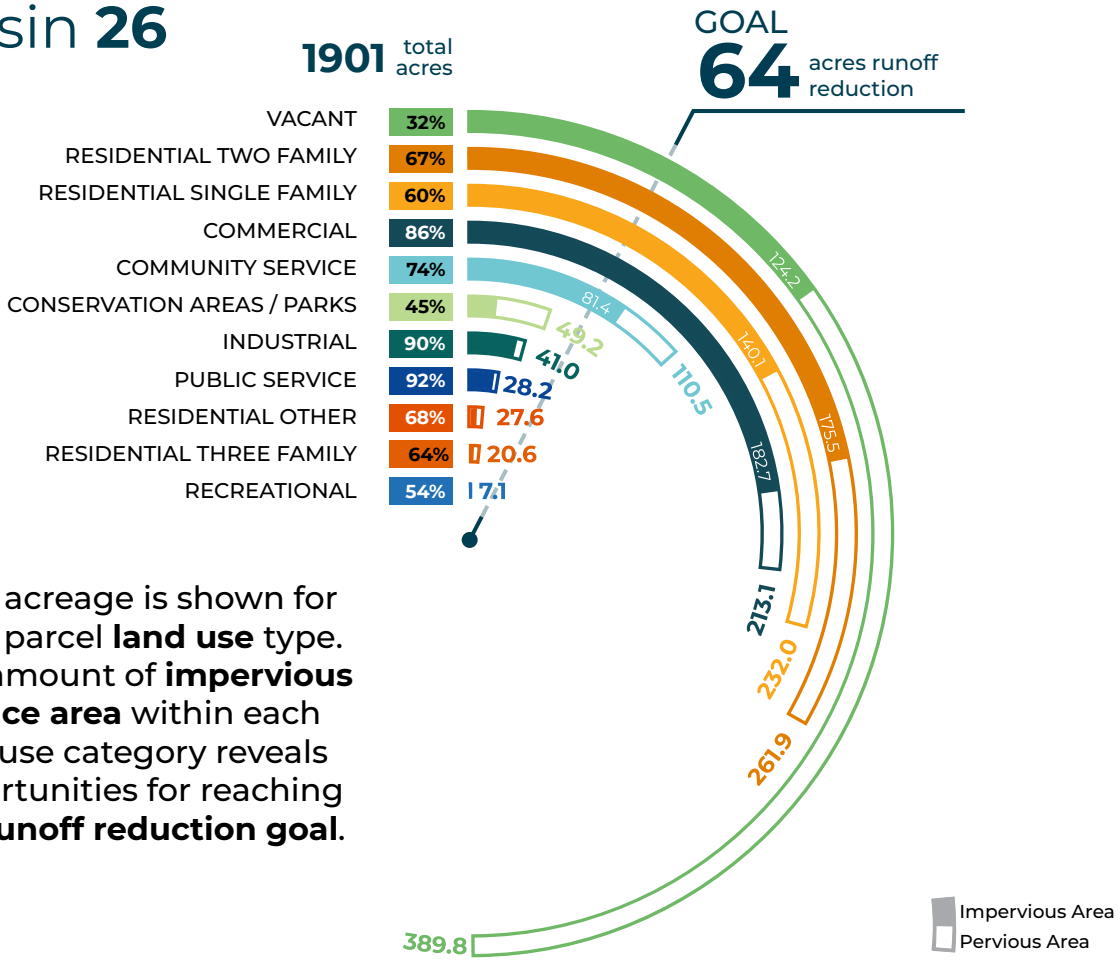
CSO Basin 26 discharges into the Buffalo River. Tree canopy is relatively low and should be augmented, particularly along major corridors. Focusing on complete streets and right of way improvements can help to grow the urban forest canopy and create habitat connectivity as well as the opportunity to network green infrastructures systems within the CSO basin.

Equity Considerations

CSO Basin 26 has the greatest need for green infrastructure investments, in terms of the average green infrastructure equity index (see Appendix A). Green infrastructure supports neighborhood revitalization efforts. By leveraging public dollars to provide benefits to historically disinvested neighborhoods, green infrastructure can contribute to building complete communities. Green infrastructure along public rights of way, at crosswalks, and transit stops could support active commuting and improve surface road conditions for the large number of residents who rely on walking and transit to commute to work and other destinations. Green infrastructure planning could tie into and activate community-driven plans and efforts by local groups. Green infrastructure projects in this area can initiate and facilitate community visioning and stewardship processes with the many active residents and other stakeholders in and around the area.

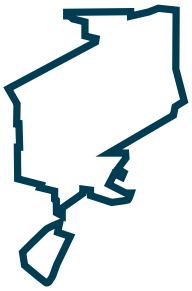
BY THE NUMBERS...

Land Use Opportunity and Impervious Surfaces by Area



Total acreage is shown for each parcel **land use** type. The amount of **impervious surface area** within each land use category reveals opportunities for reaching the **runoff reduction goal**.

Basin Overview



1901 acres
TOTAL BASIN AREA

14,349
RESIDENTS

$18,192
MEDIAN HOUSEHOLD INCOME

197 acres
OF CANOPY AREA

48 acres
OF PARK AREA

299 acres
OF RIGHT OF WAY

244 acres
OF ROAD AREA

311 acres
OF BUILDING AREA

17 acres
OF PARKING LOTS

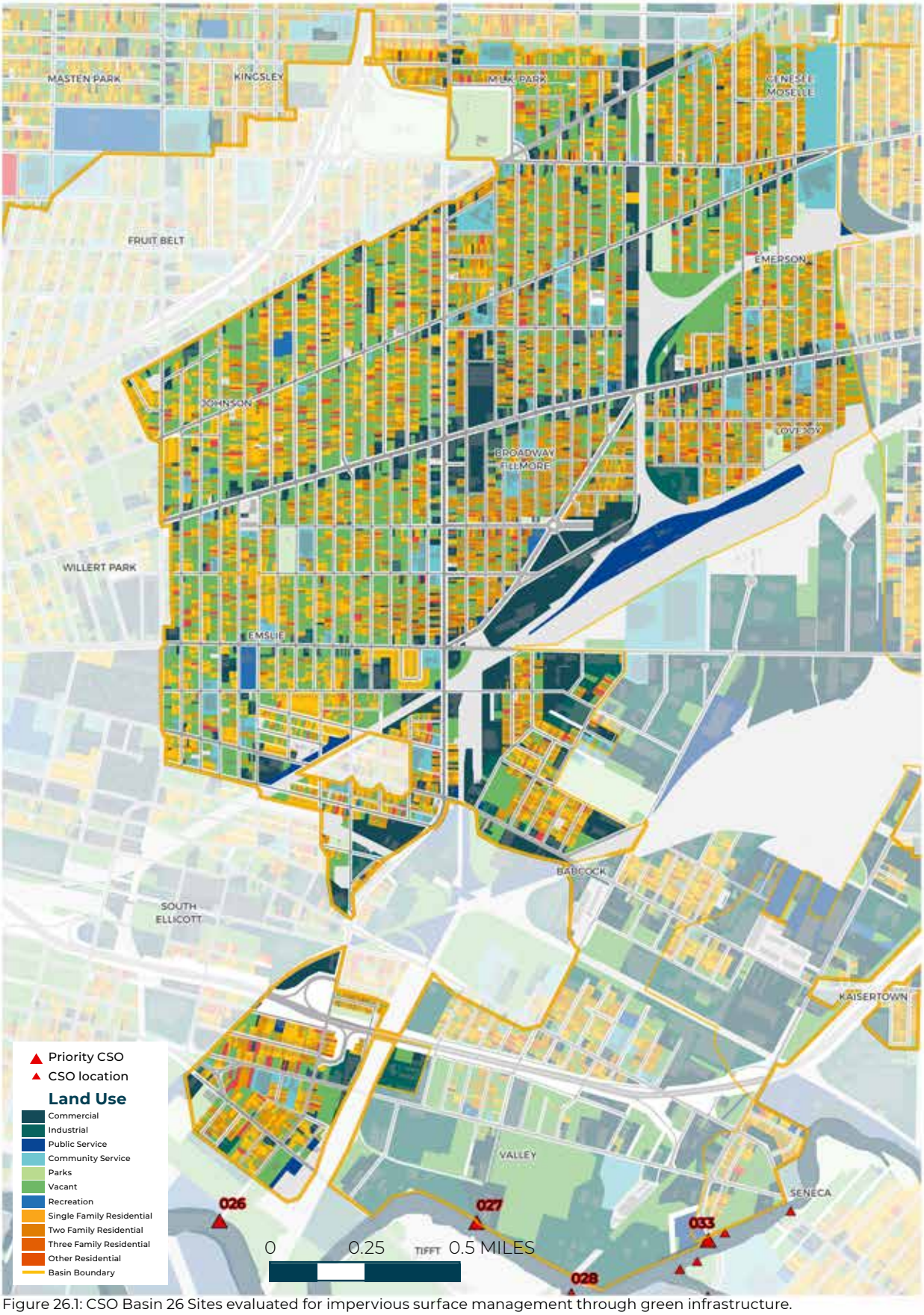


Figure 26.1: CSO Basin 26 Sites evaluated for impervious surface management through green infrastructure.

Opportunity Sites & Networks

Corridors

Corridors in CSO 26 create an armature for future networking of green infrastructure. Implementing green infrastructure would help to support revitalization of neighborhood centers. The same corridors also extend into CSO Basins 33 and 27 to the south and east. Corridor green infrastructure can support active commuting in a region where many residents rely on active commuting and public transit to get to work. The addition of green infrastructure would also help increase the tree canopy in the basin.

Sites

Many of the sites analyzed in this CSO were commercial properties. Based on the analysis conducted, these sites alone probably will not be sufficient to achieve the management goals for this basin and so including corridor green infrastructure will be critical. The high level of vacancy is both a challenge and an opportunity. There were fewer sites investigated in this CSO because of the high levels of vacancy. On the other hand vacant lots can be opportunity sites for green infrastructure, which can in turn help to revitalize these areas.

Clusters and Networks

Fewer natural clusters were identified in this basin than in others. This is in part due to the high levels of vacancy and the paucity of large institutions to anchor clusters or networks. The area at Broadway and Fillmore Avenue is such a cluster and could be a base for incubating green infrastructure in this basin. Work on a cluster of green infrastructure at this neighborhood center could be combined with workforce training programs in this and other basins to create green jobs.

Key Corridors

- Broadway
- Jefferson Avenue
- Fillmore Avenue
- William Street
- Genesee Street
- Scajaquada Parkway

Key Institutions

1. St. Luke's Mission
2. Buffalo & Erie County Workforce
3. Buffalo Central Terminal
4. Broadway Market
5. Buffalo Museum of Science

Key Parks

1. Sperry Park
2. Red Jacket River Front Park
3. Martin Luther King Jr. Park
4. Harvey Austin Elementary Playground
5. William Emslie Family YMCA

CORRIDORS are networked, physically connected systems around a road or right-of-way

OPPORTUNISTIC SITES are stand alone sites with a high opportunity for green infrastructure

CLUSTERS have an anchor institution or are groups of parcels that can implement similar strategies

NETWORKS are larger systems of capture and treatment incorporating many sites

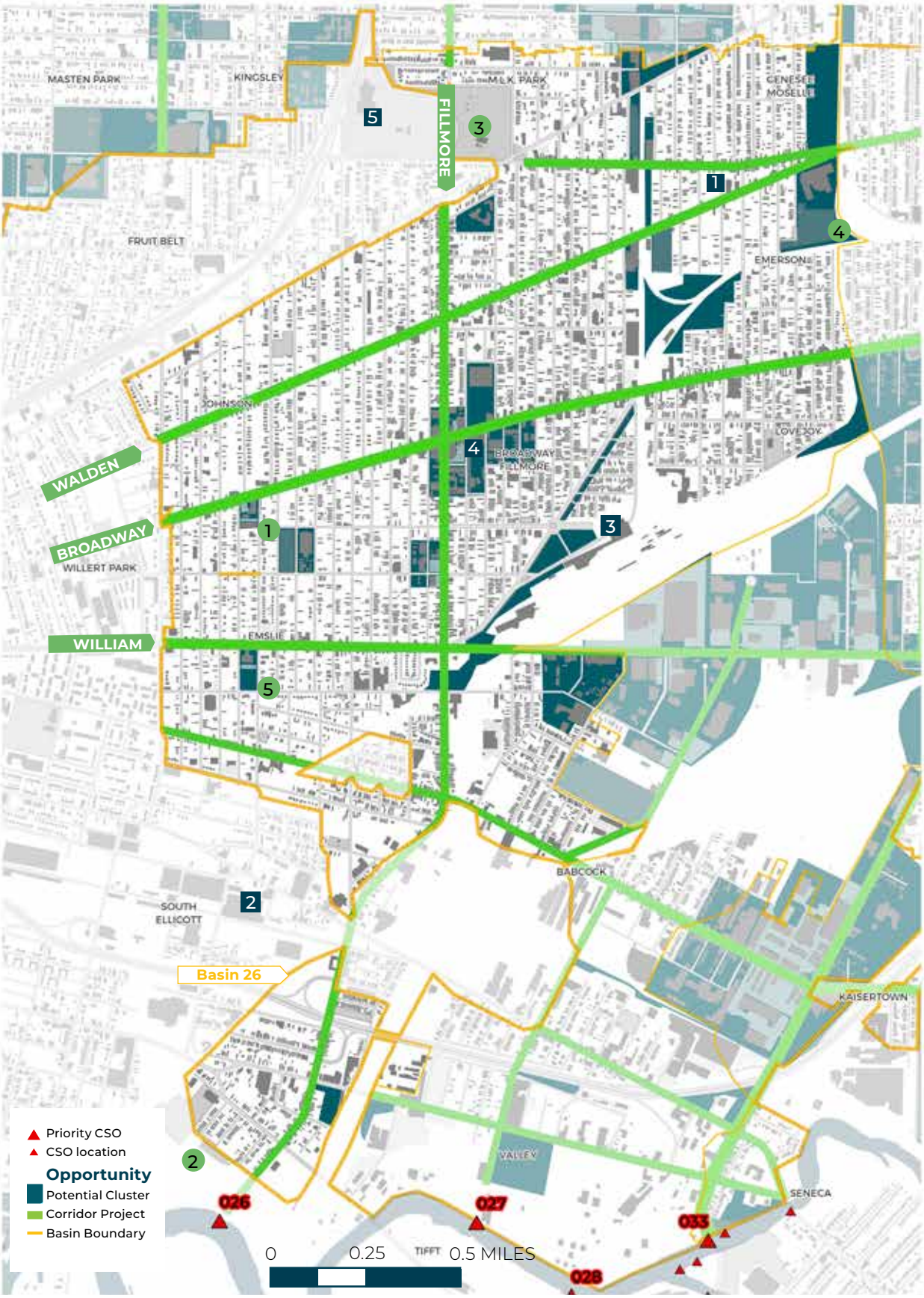


Figure 26.2: CSO Basin 26 Green Infrastructure Opportunity Sites

Green Infrastructure Opportunity
Broadway Fillmore Commercial Cluster

CSO Basin 26 is dominated by low density residential properties, with several significant cross-town commercial corridors like Broadway and Fillmore. Buffalo Sewer can cultivate green infrastructure clusters along the corridors by partnering with community-oriented or cultural institutions like the Broadway Market. These clusters can anchor economic redevelopment and promote commercial revitalization as well as beautify important streetscapes in the basin.

Broadway Market, like other places in the basin, is an unusual building and beloved by the community. The building covers the entire property, so rainwater is difficult to infiltrate on site. However, there is potential to reuse the roof of the parking structure for water capture and green roofs, as it is likely to be adequately structured for green roof loads.

Since a large percentage of residents in this CSO basin use public transit for commuting and with most transit lines running along the commercial corridors, investment in these streetscapes can also benefit the daily experience of residents. The Broadway and Fillmore Corridors, like other corridors in the basin, have the potential to become transit hubs and the streetscape and green infrastructure can be a part of the community's identity. As such, community engagement in this process would be important.

CSO Basin 26 also has a large stock of vacant land. As the neighborhood redevelops, those lots may be candidates for infill projects that will meet the stormwater capture requirements. Urban agriculture is also a good solution, but consideration should be given to investing in short-term, inexpensive vacant lot strategies or longer-term, more costly but durable right-of-way investments.

Strategies
- **Street trees**
- **Complete streets**
- **Curb bump outs**
- **Urban farming**
- **Green roofs**
- **Downspout disconnects**

Potential Partners
- **Broadway Market**
- **Wilson Street Urban Farm**
- **New York State DOT**
- **Chua Tu Hieu Buddhist Cultural Center**
- **Adam Mickiewicz Library**
- **Corpus Cristi Church**
- **Open Praise Full Gospel Baptist Church**
- **Lt. Col. Matt Urban Human Services Center WNY**
- **US Postal Service**

Figure 26.3: Historic Image near the Broadway Market.

Figure 26.4: Historic Image of Broadway Ave. (BuffaloRising.com)

Placemaking Opportunity with Green Infrastructure

Green infrastructure in CSO Basin 26 can support neighborhood revitalization in addition to managing stormwater, by making neighborhoods more inviting and putting vacant land to productive use. Green infrastructure along roadways can contribute to traffic calming, greater walkability and reduced urban heat island effect.

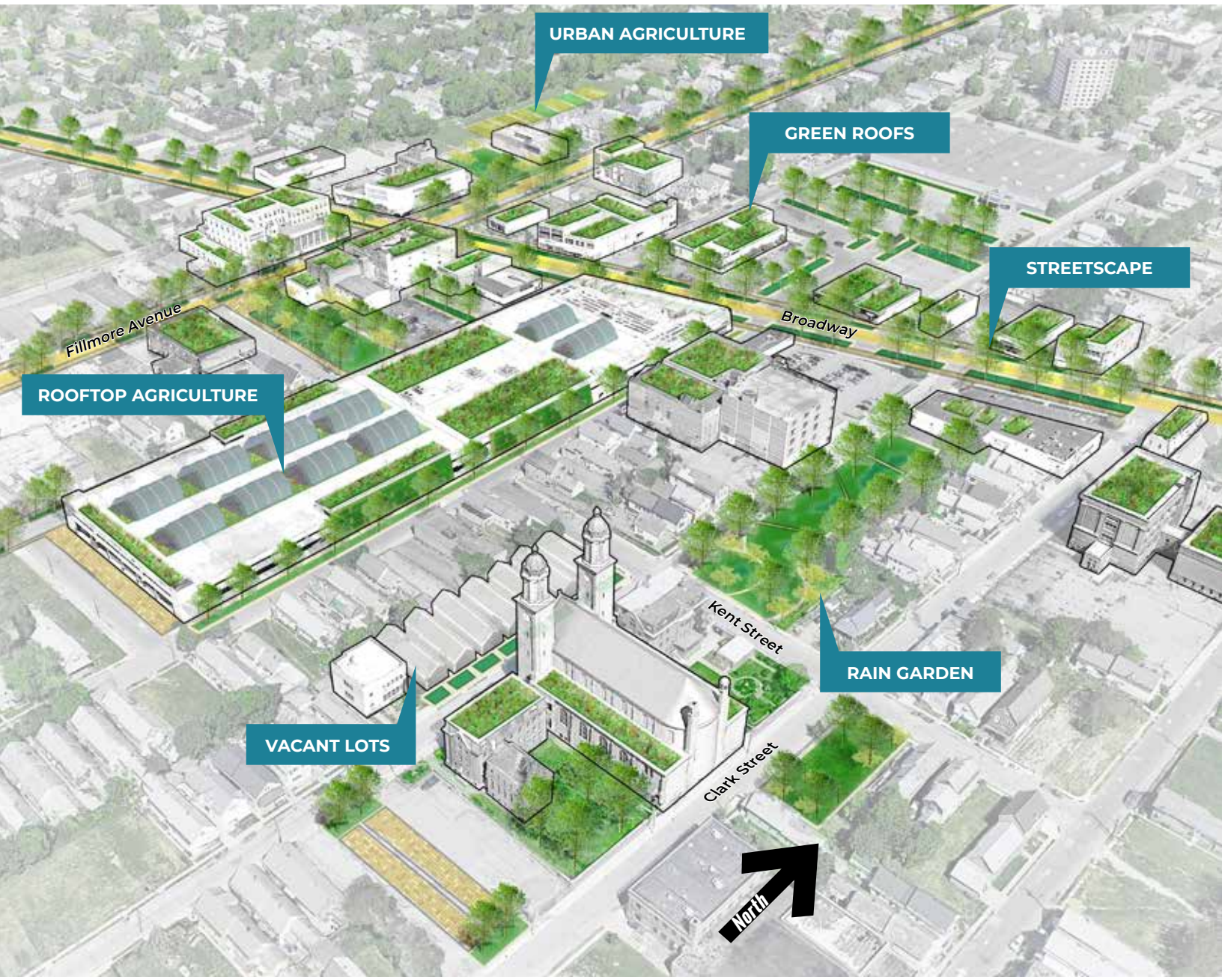


Figure 26.5 Rendering of Green Infrastructure at Fillmore and Broadway

ANALYSIS

Urban Character

CSO Basin 26 boundaries intersect several neighborhoods in East and South Buffalo centered around the Broadway-Fillmore neighborhood, including Emslie, Johnson, Emerson, Genesee, Moselle, Babcock, and parts of the Old First Ward and Valley. CSO Basin 26 has a population of over 14,000 people and is characterized by low density residential neighborhoods with many vacant lots, large commercial corridors, and isolated industrial sites.

Investment in green infrastructure in CSO Basin 26 will support a number of broader planning efforts, including the Local Waterfront Revitalization Program, which includes the Buffalo River, the Buffalo River Corridor Brownfield Opportunity Area, and the Buffalo Green Code. Important corridors such as Broadway, William Street, and Genesee Street are focuses of revitalization efforts through the Buffalo Green Code and are also opportunity sites for green infrastructure. Focusing green infrastructure along commercial corridors can also reinforce and revitalize neighborhood centers. Corridor green infrastructure can also support efforts to provide more complete streets, promote walkability, and encourage transportation choice.

Figure 26.6: The entire CSO basin has significant vacant land in the residential neighborhoods; above is an example from Peckham St. in the Emslie neighborhood.

Figure 26.7: Broadway and Fillmore commercial cluster and Broadway Market are culturally important and node for amenities.

Figure 26.8: Mixed residential and light industry along active rail corridors at Thomas Street

Figure 26.9: Openspace around rail corridors and declining light industry clusters between Broadway and Sycamore St.

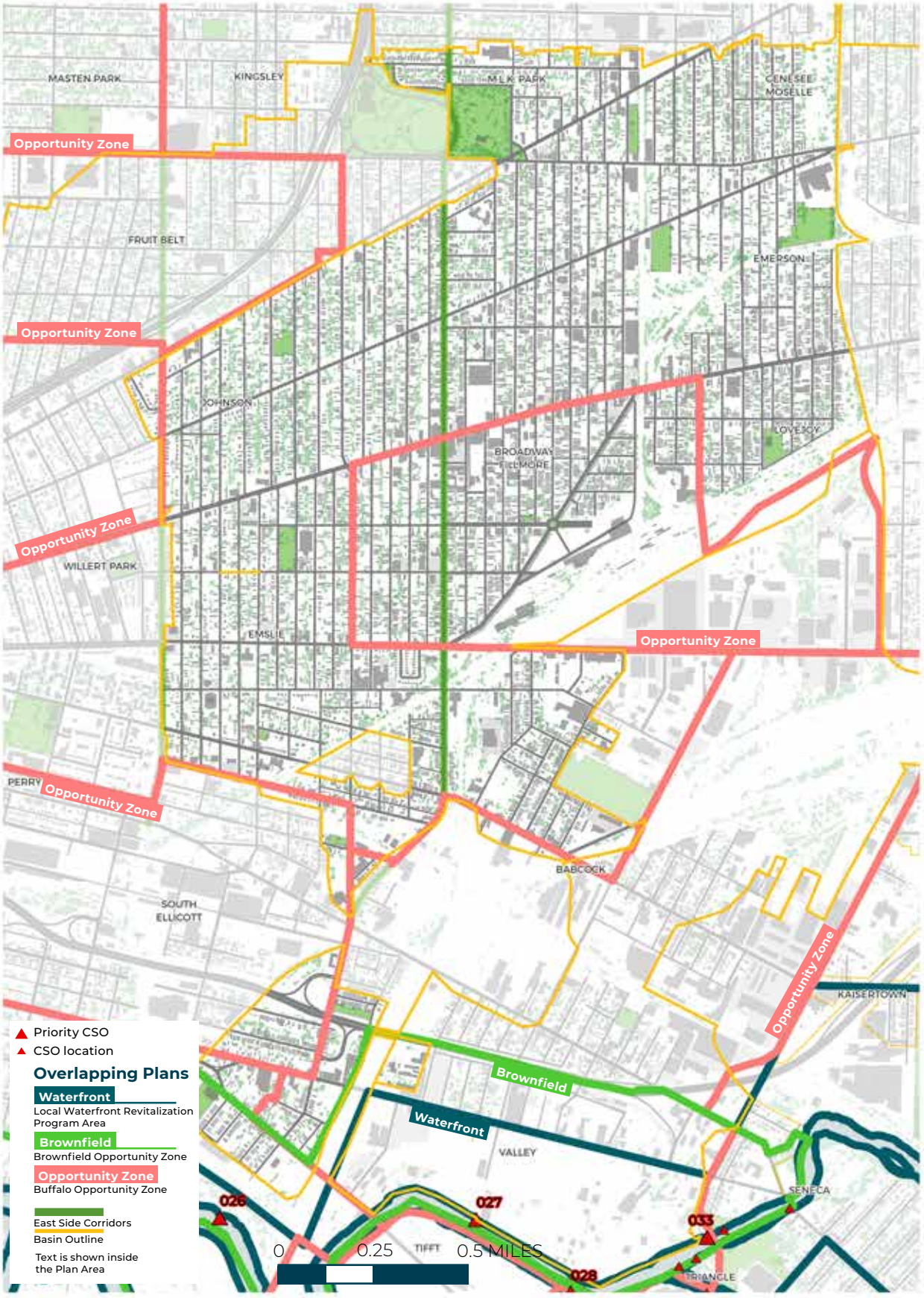


Figure 26.10: CSO Basin 26 Planning Map

ANALYSIS

Equity Analysis

The basin is home to several regional assets, most notably the Broadway Market (Buffalo's public market), Buffalo Central Terminal, Martin Luther King, Jr. (MLK) Park and the Buffalo Museum of Science. Community assets and institutions offer opportunities for green infrastructure to support and contribute to existing efforts for neighborhood revitalization, especially on main streets, commercial corridors, and around anchor institutions.

The area is home to over 14,000 residents, over 80% are people of color and over 65% are Black. The racially diverse population offers a range of potential audiences for education and engagement. Residents perform significantly worse on measures of economic vitality and connectedness compared to other priority CSO basins and the City overall. The median household income of residents living in CSO Basin 26 neighborhoods is nearly half that of the City overall. The basin has the highest share of low income households (73% have incomes less than double the poverty line), and adults without a high school diploma (25%) of any targeted area. The unemployment rate is more than double that of the City as a whole, and just over half (54.5 percent) of people age 16 and over participate in the labor force (compared to 59% for Buffalo overall). Given these considerable challenges, the creation of green jobs associated with maintenance of green infrastructure in CSO Basin 26 might be very important.

Among all targeted basins, CSO Basin 26 has the greatest need for green infrastructure investments, in terms of the average green infrastructure equity index (see Appendix A). Along with socioeconomic disadvantages, Basin 26 is also marked by environmental concerns, such as limited tree canopy coverage and vacancy. With about 30% of its land area covered by vacant lots, Basin 26 has more than double the vacant land coverage of the City overall, indicating ample opportunities for green infrastructure investments. As most households are renters and are housing cost burdened, many households may not have the capacity to maintain green infrastructure on private property. More generally, an evaluation of the community capacity for a neighborhood or specific groups and institutions to accept, plan for, promote, and maintain green infrastructure practices is critical. Given the extensive network of community assets and institutions located in the area, as well as the many residents and workers that likely rely on public transit and walking to get around, green infrastructure practices along sidewalks, at crosswalks and transit stops, and in front of major destinations could be highly visible and beautify the public realm.

Neighborhood Profile Snapshot

14,349
RESIDENTS

$18,192
MEDIAN HOUSEHOLD INCOME

89.2%
ATTAIN LESS THAN A BACHELOR'S DEGREE

$31,988
MEDIAN VALUE OF OWNER-OCCUPIED HOMES

43.6%
OF HOUSEHOLDS DO NOT HAVE A VEHICLE

-39.2%
2000–2016
POPULATION CHANGE

46.4%
RESIDENTS LIVING IN POVERTY

54.5%
WORKING AGE NOT EMPLOYED*

81.5%
RESIDENTS ARE PEOPLE OF COLOR

60%
HOUSEHOLDS ARE RENTERS

The data presented is for census tracts located within or that intersect the CSO basin boundaries, as an approximation of neighborhoods (see Appendix A for more details and methods)
*Includes those that are unemployed or out of the labor force.

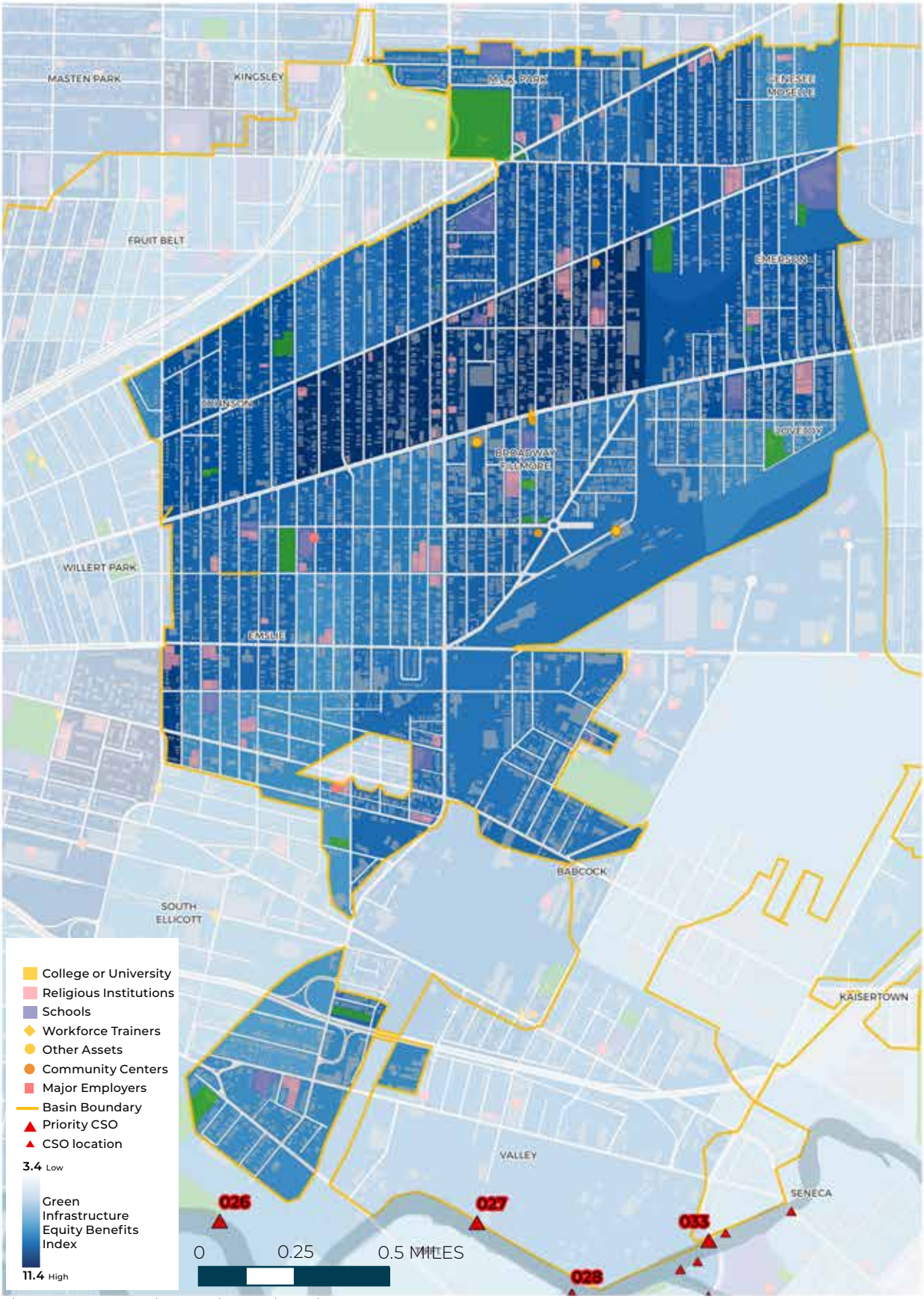


Figure 26.11: CSO Basin 26 and GI Equity Index

Waterways

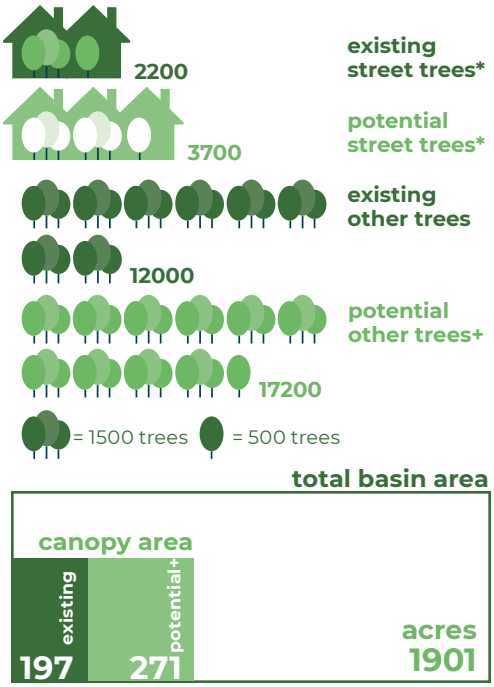
CSO Basin 26 discharges into the Buffalo River along the lower, meandering, post-industrial section of the river. The Basin does not make direct contact with the Buffalo River, stopping at Red Jacket River Front Park. This termination in the park may provide an excellent opportunity to incorporate stormwater detention or infiltration near the bottom of this CSO basin's system.

Tree Canopy Cover

The tree canopy is on a par with the City average, with many vacant tree spaces. Much of the tree canopy in CSO basin 26 is comprised of backyard trees, rather than front yard trees or street trees, which do more to reduce the amount of stormwater reaching the combined sewer system. Particularly along major corridors, canopy cover is almost completely absent.

Tree Canopy Summary

NUMBER OF TREES IN BASIN



Sources: *City of Buffalo MyTreeKeeper data, +U.S. Forest Service protocol with input from the Tree Technical Advisory Committee. For detailed description of methodology, see Appendix C

Habitat Connectivity

Major corridors with moderate canopy cover isolate patches of habitat in this basin. The dramatic vacancy rate in the basin provides a great potential to expand the urban tree canopy through strategic tree planting to create patches of urban. New street trees along corridors could link to larger regional habitat corridors along rail lines and the Buffalo River, making CSO Basin 26 a potential habitat hot-spot within the City.

Figure 26.12: Potential for Habitat Connectivity in CSO Basin 26

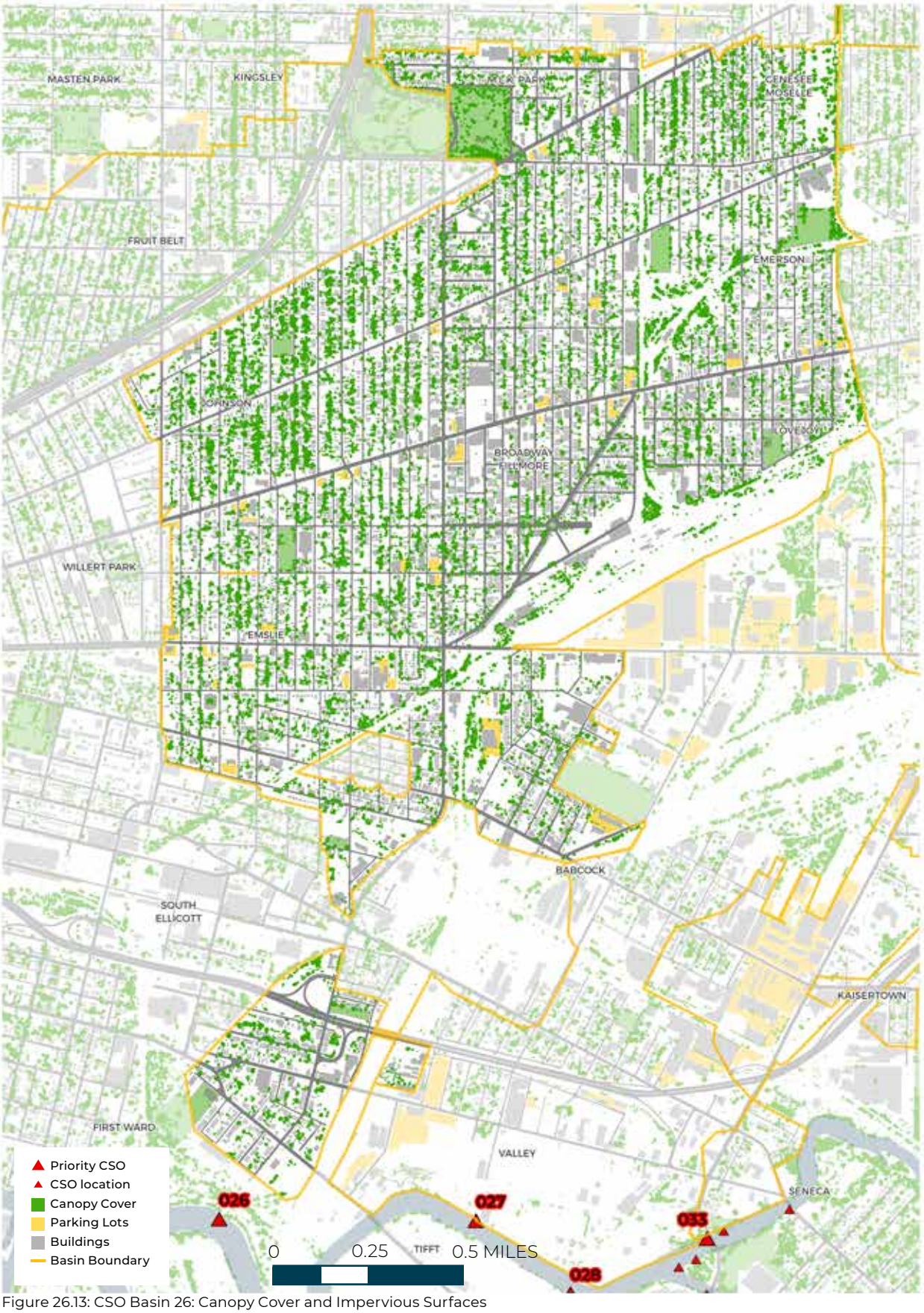


Figure 26.13: CSO Basin 26: Canopy Cover and Impervious Surfaces

ANALYSIS

Site Analysis

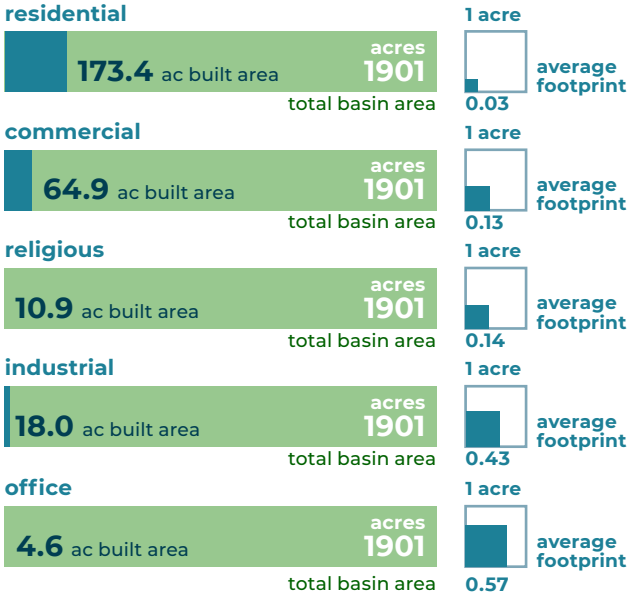
CSO Basin 26 is characterized by residential properties and commercial corridors with institutional and city-owned properties adding to the potential management area. No single category can fulfill the required acres-managed and the managed acres will need to include commercial, institutional, and city property.

The parcels that were analyzed are primarily commercial, but roads and public right of ways make up a significant portion of impervious land area. Broadway, Fillmore, and William Streets are highly visible connector roads lined with small houses and businesses. The sites inventoried are concentrated along these roads and have high green infrastructure potential, including reducing oversized parking lots, removing abandoned pavement, and improving streetscapes with new vegetation.

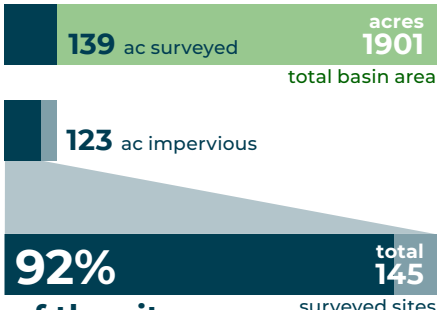
Apart from cooperation with neighbors and managing lot level run-off, there are opportunities for commercial partnerships and business owners to take advantage of the visual improvements through green infrastructure installations in this area. Green infrastructure could be incorporated into streetscape design, which, in cooperation with business improvement districts, could be a good way for the City to pool funding into green infrastructure along the commercial corridors in this area.

Built Area by Land Use

Full Basin Area, GIS sources: Erie County data, Buffalo Sewer Authority data



The site analysis reviewed 7% of the basin and found 52.6 acres of potential drainage area.



of the sites were suitable for green infrastructure.

63% of sites are in full sun

34% of sites are highly visible

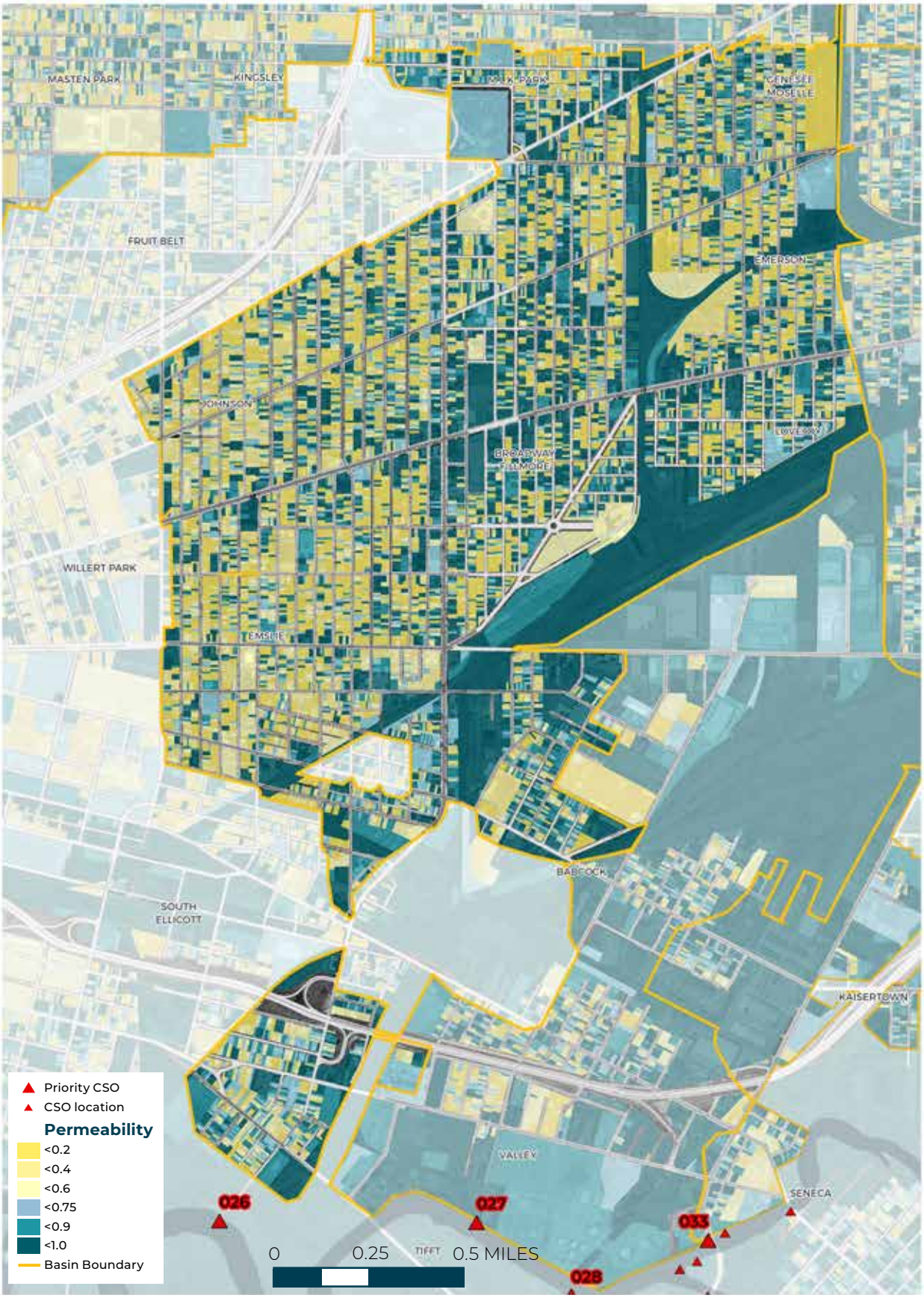


Figure 26.14: CSO Basin 26: Percent Impervious cover by Parcel

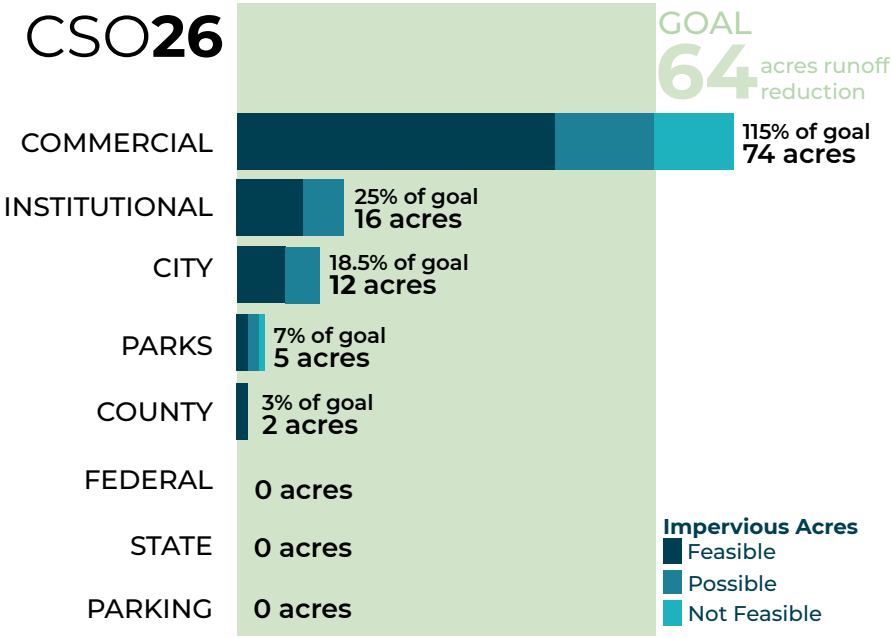
ANALYSIS

Site Analysis: Surveyed Properties

Figure 26.15: Examples of sites surveyed.

Surveyed Properties by Land Use and Ownership

GIS sources: Erie County data, Buffalo Sewer Authority data



LARGEST PROPERTY OWNERS BY LAND USE AND OWNERSHIP

COMMERCIAL

For Sale Industrial
3.7 Imperv. acres

Stetson Chemicals, Inc.
3.6 Imperv. acres

Mr. Fox Tire Co
3.5 Imperv. acres

For Sale Commercial
3.0 Imperv. acres

Carzone Auto
2.3 Imperv. acres

INSTITUTIONAL

First Cavalry Mission Baptist
1.3 Imperv. acres

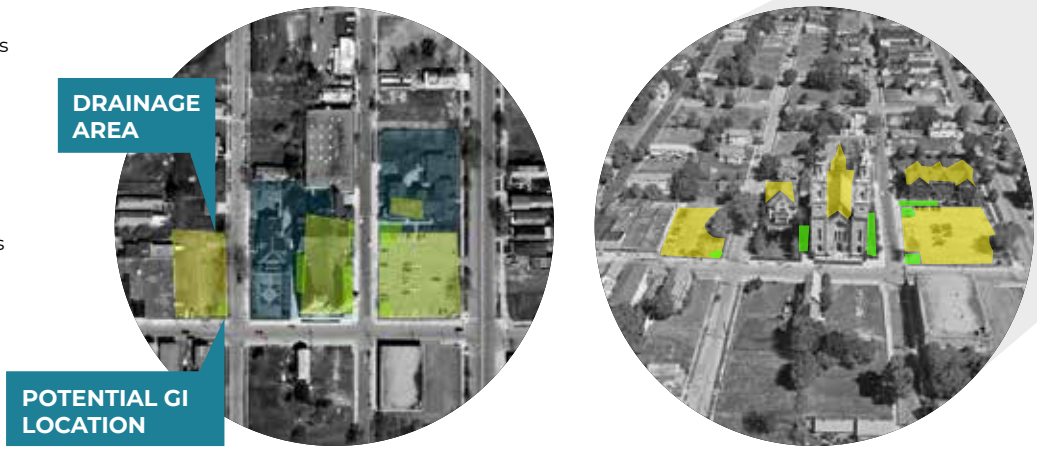
St Clare Parish
1.3 Imperv. acres

St. Stanislau RC
0.9 Imperv. acres

Grace Tabernacle Church
0.8 Imperv. acres

Churches and other sites along key corridors were surveyed in CSO Basin 26.

From these investigations, the team was able to better understand if water can be infiltrated on site or as part of a networked green infrastructure system. These recommendations are discussed on the opportunity pages.



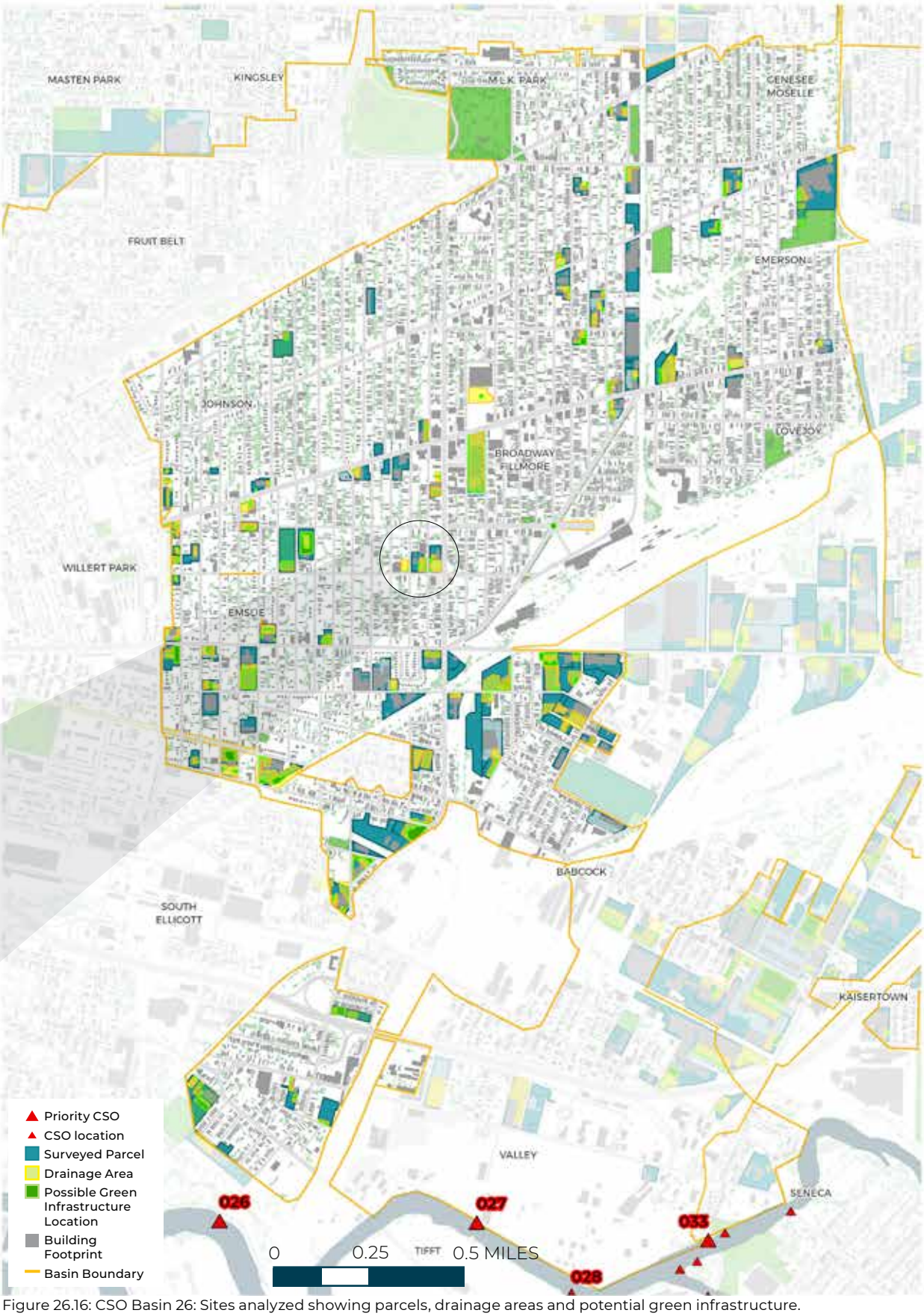


Figure 26.16: CSO Basin 26: Sites analyzed showing parcels, drainage areas and potential green infrastructure.

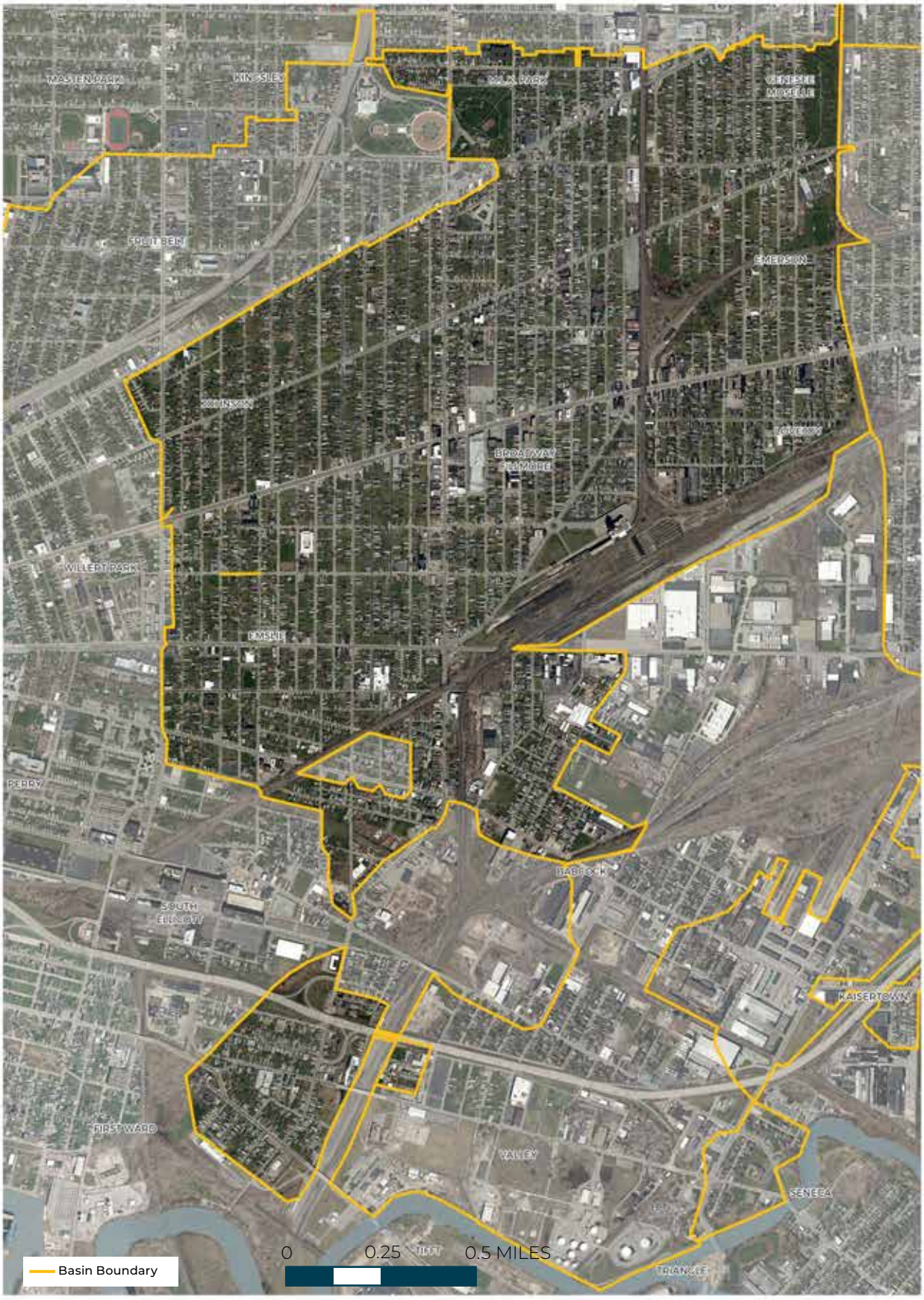


Figure 26.17: CSO Basin 26: Basin outline on Aerial.

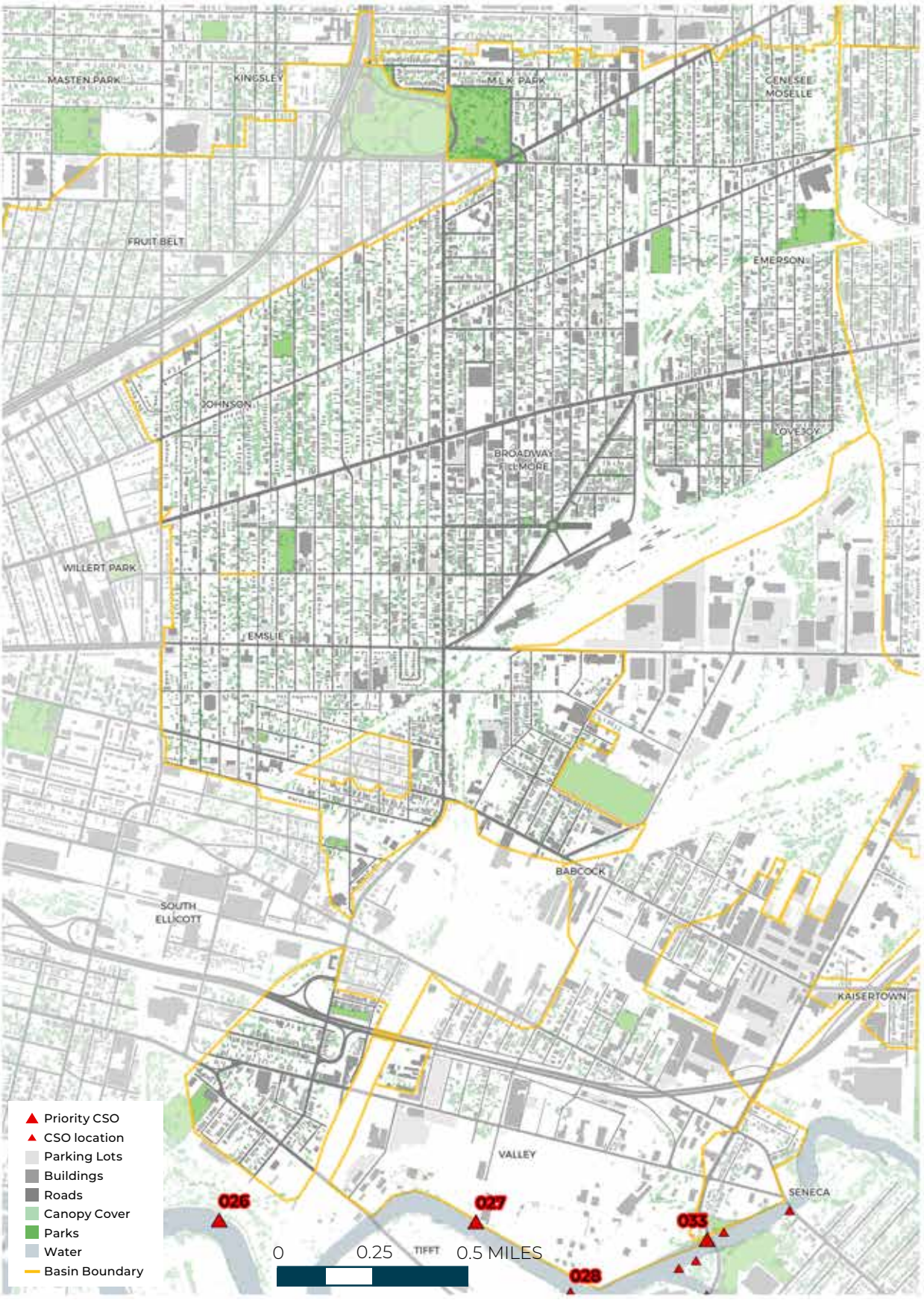


Figure 26.18: CSO Basin 26 Map of Built Environment and Tree Canopy


CSO27

When a drop of water lands at the intersection of Bailey Avenue and Clinton Street, it is joined by water from the neighborhoods of Babcock, Kaisertown, the Valley, and Broadway-Fillmore. During heavy wet weather, the rainwater combines with sewage and overflows into the Buffalo River at Combined Sewer Overflow 27 (CSO 27).

Community Benefits

- Workforce development
- Buffer between residential and industrial uses
- Tree planting programs
- Green Jobs
- Support of neighborhood revitalization efforts
- Access to the River
- Expanded canopy cover
- Clean up and revitalization of vacant land
- Traffic calming

CSO **Basin 27 at a glance...**

Green Infrastructure Opportunities

The goal for CSO Basin 27 is to manage stormwater from 73 acres of impervious surface. The majority of sites surveyed were commercial properties. The site analysis concluded that total acreage of commercial property surveyed greatly exceeds the management goal. High vacancy rates (both commercial and residential) provide the opportunity to implement distributed green infrastructure. There are also major corridors that pass through this CSO basin. In addition, many sites have significant paved areas and it may be effective to focus on impervious surface reduction in these industrial areas. Many of the commercial properties are large parcels, which may simplify implementation.

Urban Character

CSO Basin 27 is characterized by large industrial corridors, brownfield sites, and small areas of dense residential housing.

Environmental Systems

CSO Basin 27 has the lowest tree canopy cover of the six targeted CSO basins. Augmenting the tree canopy would contribute to stormwater runoff reduction and reducing urban heat island effect.

Focusing on complete streets and right of way improvements can increase the urban forest canopy, create habitat connectivity, create opportunities to network green infrastructures systems within the CSO basin, and provide a buffer between residential and industrial uses.

Equity Considerations

Neighborhoods have close proximity to high traffic corridors, so green infrastructure along corridors can provide a much-needed buffer to residential communities.

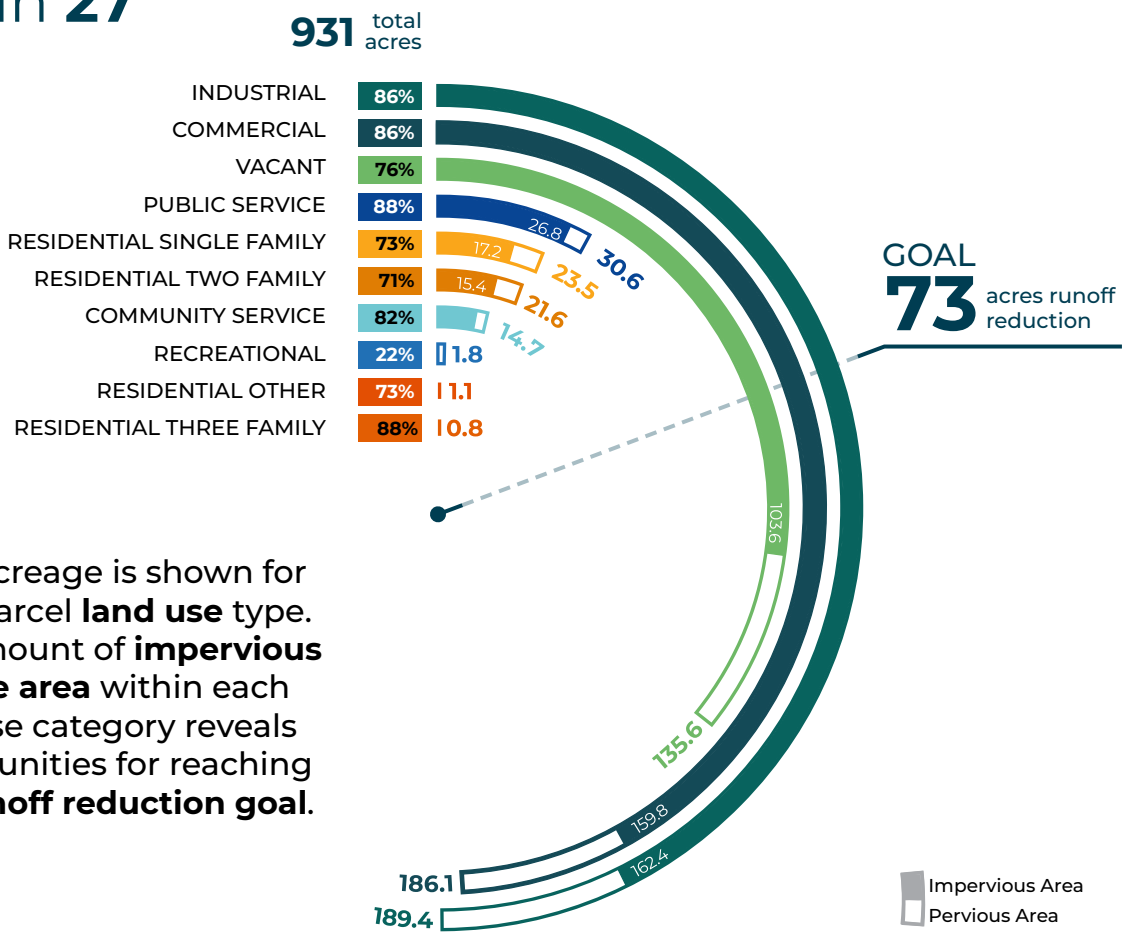
Because most properties are owner occupied there may be opportunities for residential green infrastructure or tree planting.

Unemployment in this area is higher than the City average so green infrastructure-related training and jobs would contribute to improving equity in this CSO basin.

BY THE NUMBERS...

Land Use Opportunity and Impervious Surfaces by Area

Basin **27**



Total acreage is shown for each parcel **land use** type. The amount of **impervious surface area** within each land use category reveals opportunities for reaching the **runoff reduction goal**.

Basin Overview

931 acres
TOTAL BASIN AREA

2,425
RESIDENTS

$30,286
MEDIAN HOUSEHOLD INCOME

67 acres
OF CANOPY AREA

17 acres
OF PARK AREA

132 acres
OF RIGHT OF WAY

59 acres
OF ROAD AREA

122 acres
OF BUILDING AREA

68 acres
OF PARKING LOTS

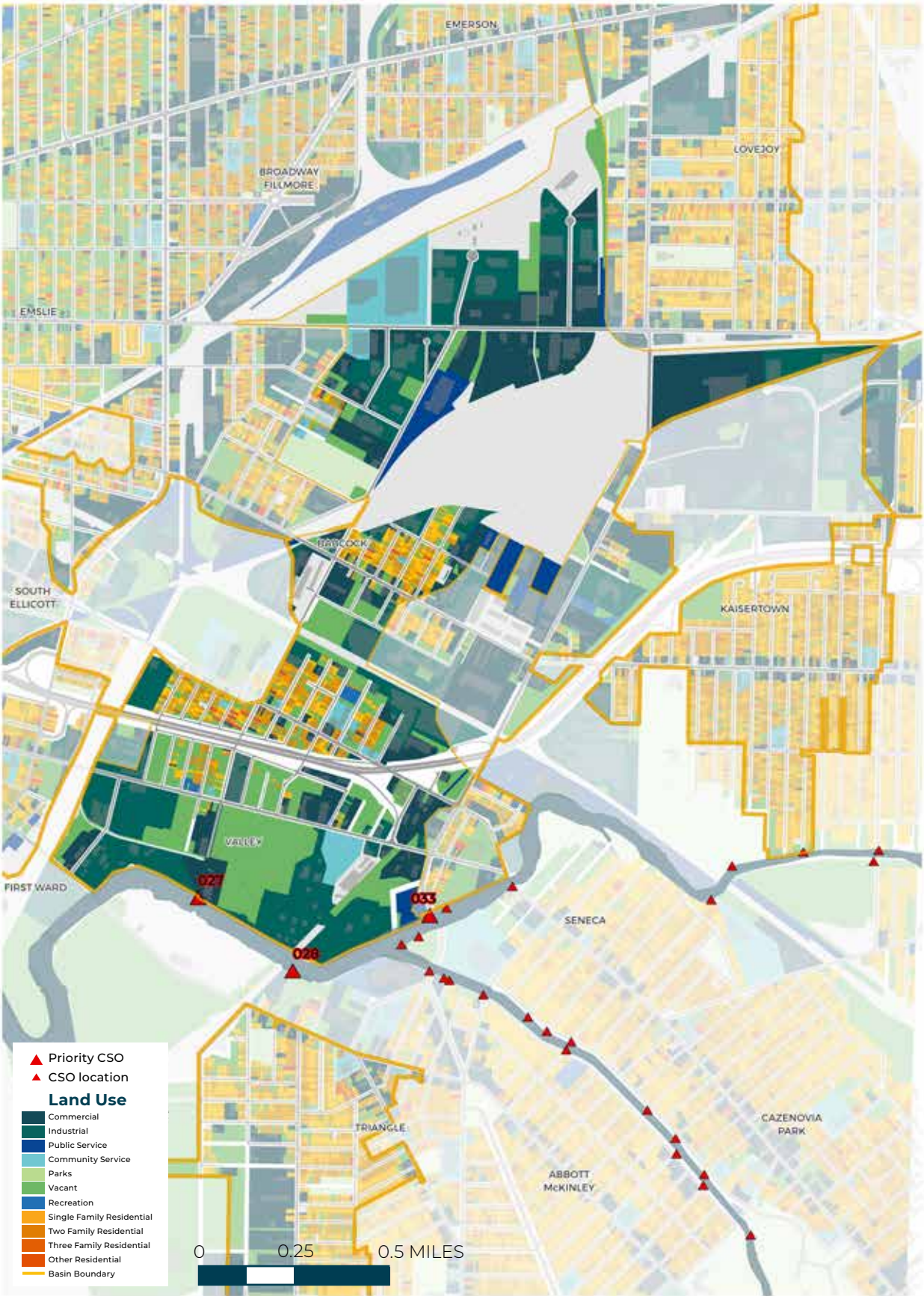


Figure 27.1: CSO Basin 17 Sites evaluated for impervious surface management through green infrastructure.

Opportunity Sites & Networks

Corridors

New Babcock, Bailey, Clinton, William, Elk, and Seneca Streets cover much of the basin, creating the armature for a green infrastructure network connecting significant sites as well as adjacent CSO basins, including Basin 33 to the east, Basin 26 to the northwest. Focusing on green infrastructure in these corridors can improve walkability and in some cases provide buffers between residential neighborhoods and industrial properties and high traffic roadways.

Sites

Important opportunity sites for green infrastructure retrofit in CSO Basin 27 are primarily large warehouse, manufacturing and distribution services that have large parking lots and impervious area. There are two large clusters of such sites along Elk and William Streets. Reducing impervious area on these properties will make a significant contribution to addressing the stormwater challenge in this basin. Also, adding green infrastructure to these sites will help address the low canopy cover and low access to green space that exists in this basin.

Clusters and Networks

Grouping these sites into clusters and networks along key corridors can improve the effectiveness of green infrastructure at reducing stormwater runoff to the sewers as well as increasing canopy cover in the basin. Since unemployment is high in this basin, the jobs created by the implementation of large-scale green infrastructure would contribute to reducing unemployment, particularly if paired with green infrastructure job training.

Key Corridors

- Elk Street
- Seneca Street
- Bailey Avenue
- William Street
- Clinton Street
- New Babcock Street

Key Parking Lots

1. US Post Office
2. American Douglas Metals
3. Food Bank of WNY
4. Niagara Frontier Transit Authority
- Industrial Locations (various)

Key Businesses

5. UPS Customer Center
6. R&R Salvage
7. Comet Flasher, Inc.
8. Robinson Home Products
- Warehouse Properties (various)

CORRIDORS are networked, physically connected systems around a road or right-of-way

OPPORTUNISTIC SITES are stand alone sites with a high opportunity for green infrastructure

CLUSTERS have an anchor institution or are groups of parcels that can implement similar strategies

NETWORKS are larger systems of capture and treatment incorporating many sites

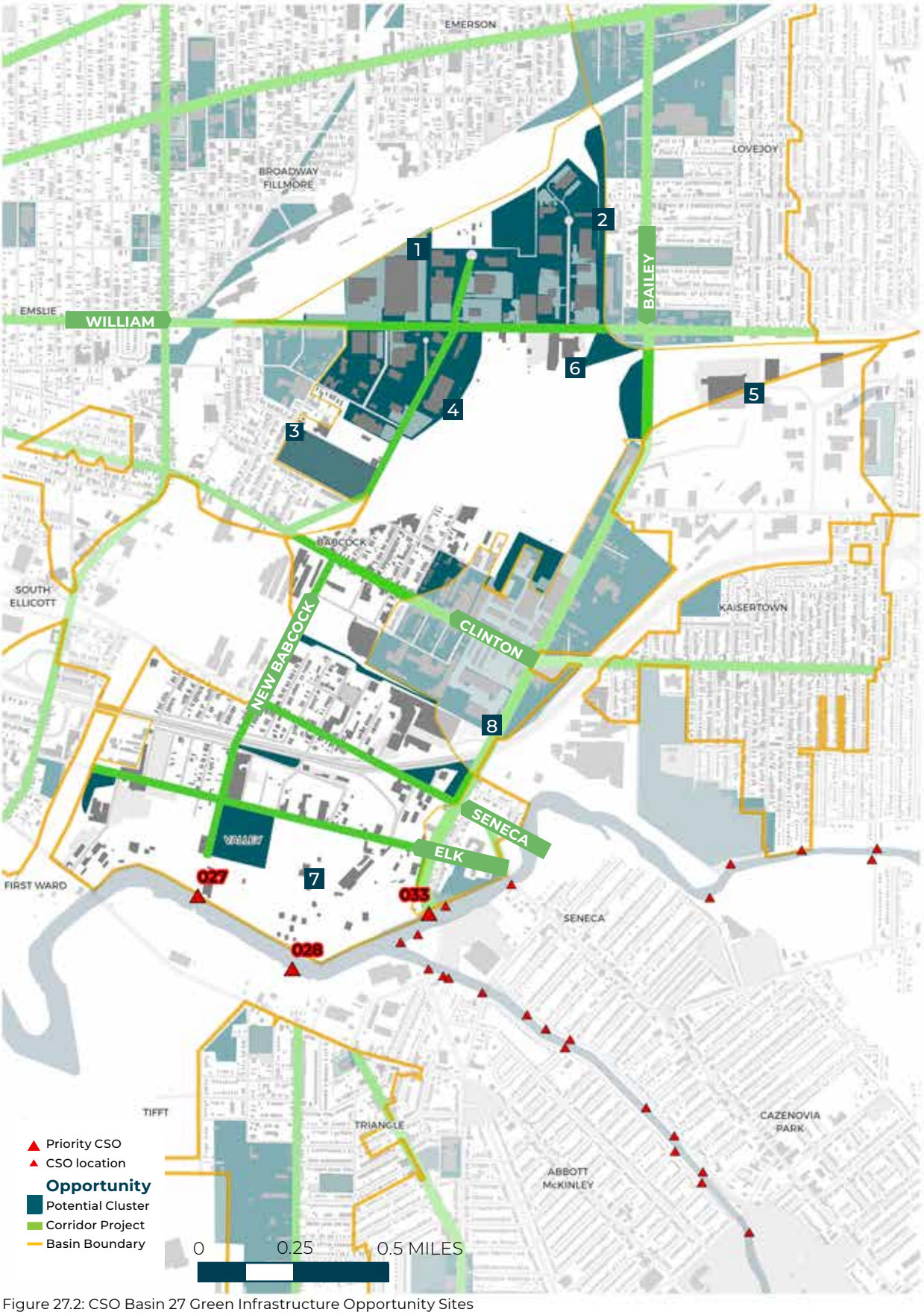


Figure 27.2: CSO Basin 27 Green Infrastructure Opportunity Sites

Green Infrastructure Opportunity
William Street Industrial Green Zone

The neighborhoods of CSO 27 have clear geographic boundaries defined by the Buffalo River, I-190 Highway and railroads. Within this bounded CSO basin the land is mostly dedicated to industrial and commercial activity, which surrounds the small neighborhoods of the Valley and Babcock. The large commercial and industrial uses provide the largest opportunity for runoff reduction while also enabling streetscape beautification and expansion of the large habitat corridors that follow the river and railways.

The William Street corridor provides a case study of this approach. Large industrial and commercial buildings with larger impervious parking lots adjacent to the railroad line could be retrofitted with green infrastructure. Porous paving could be used in parking lots, some buildings may be able to be retrofitted with green roofs, and the use of bioswales in and surrounding large surface parking lots can reduce stormwater runoff, help reduce urban heat island effect, and provide additional canopy cover. Buffalo Sewer could make use of the high rate of vacancy within CSO Basin 27 to develop networked green infrastructure that directs runoff to undeveloped parcels adjacent to key partners like that of US Postal Service and Niagara Frontier Transit Authority. Finally the use of green infrastructure along streets can also help reduce urban heat island effect, improve walkability, and calm traffic.

Strategies

- **Porous paving**
- **Green roofs**
- **Downspout Disconnections**
- **Tree planting**

Potential Partners

- **Commercial property owners**
- **Goodwill Industries**
- **US Postal Service (USPS)**
- **Niagara Frontier Transit Authority (NFTA)**
- **New York State DOT**
- **Buffalo Division of Parks and Recreation**
- **Food Bank of Western NY**

Figure27.3: Nearby neighborhood mural by artist Vinny Alejandro

Figure 27.4: Slow Roll Buffalo bikeing event. Photo by Clay Davies

Placemaking Opportunity with Green Infrastructure

The implementation of green infrastructure on existing properties along the William Street corridors could provide many neighborhood benefits in addition to stormwater runoff reduction. Green infrastructure along streets can help buffer residential communities from truck traffic. By putting vacant land to productive use and adding green space, green infrastructure can support neighborhood revitalization efforts.

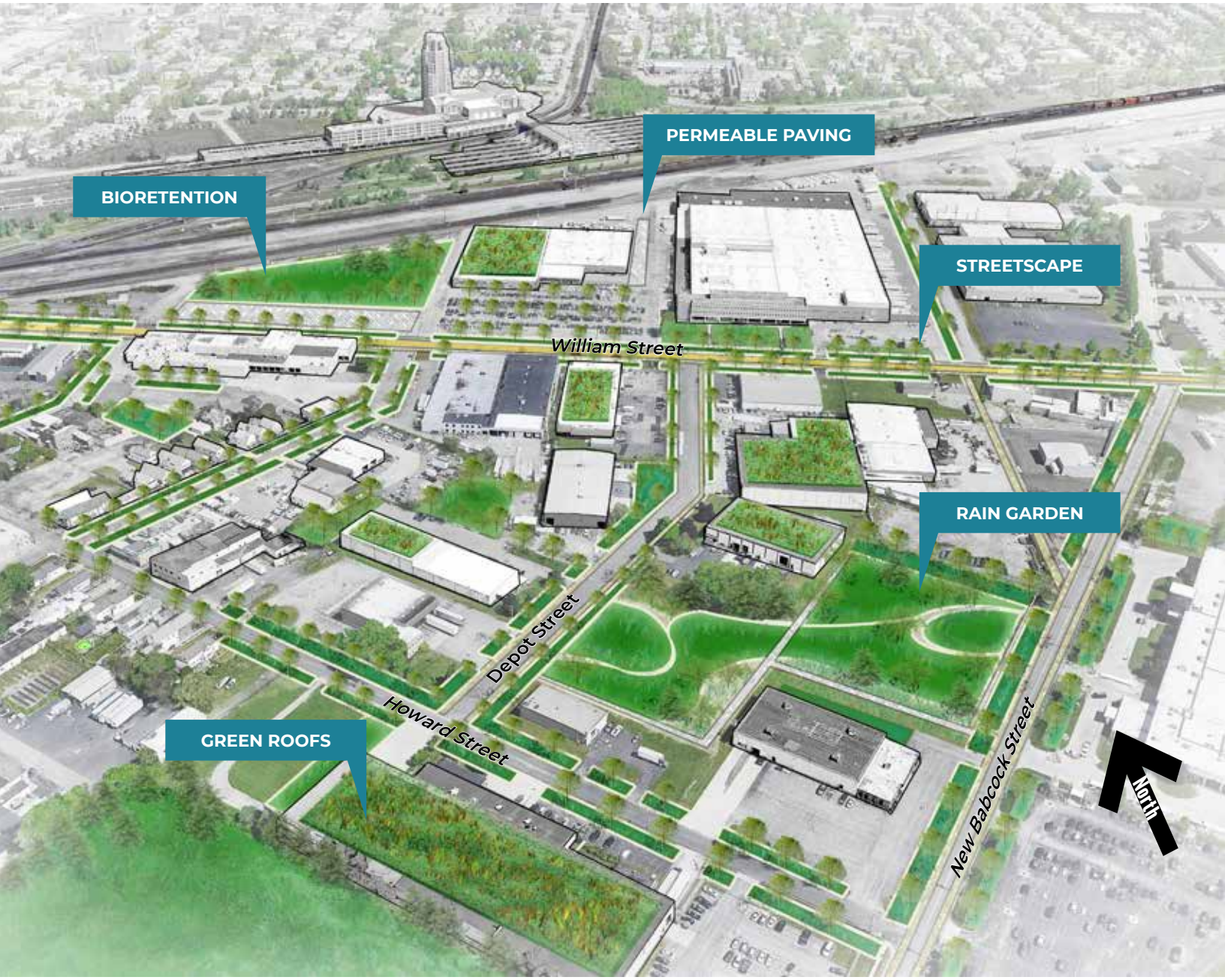


Figure 27.5: Rendering of Williams Street Corridor Cluster with Green Infrastructure

ANALYSIS

Urban Character

CSO Basin 27 intersects a small cluster of neighborhoods in Southeast Buffalo, including Babcock, Kaisertown, the Valley, and Broadway-Fillmore. CSO Basin 27 neighborhoods are dominated by large industrial land uses and truck traffic characteristic of the wholesale trade. CSO Basin 27 has a population of only about 2,400. Commercial properties dominate the sites inventoried for green infrastructure retrofit and those sites have significant paved surfaces. CSO Basin 27 includes several large industrial sites on the northern bank of the Buffalo River as well as a large rail yard area. The William Street corridor passes through CSO 27 and is dominated in that stretch by large logistical warehouses and truck traffic.

Investment in green infrastructure in CSO Basin 27 will support a number of broader planning efforts, including the Local Waterfront Revitalization Program, which includes the Buffalo River, the Buffalo River Corridor Brownfield Opportunity Area, and the Buffalo Green Code. Important corridors such as William Street, Seneca Street, and Clinton Street are focuses of revitalization efforts through the Buffalo Green Code and are also opportunity sites for green infrastructure. Clinton Street and Seneca are important neighborhood centers. Green infrastructure investment in these neighborhood centers will support implementation of the Buffalo Green Code and neighborhood revitalization efforts.

CSO Basin 27 is seeing the least amount of overall development per square mile of all the priority CSO basins, but has the highest concentration of industrial permits in the last 2 years. The Kaisertown neighborhood, which is partially located in CSO Basin 27, has one of the highest projected increases in home values according to Zillow.

Figure 27.6: Brownfield and industrial sites along Elk Street cut off the Valley neighborhood from the Buffalo River to the south.

Figure 27.7: The north end of CSO Basin 27 is characterized by large commercial and industrial sites flanking William Street with large flat roofed buildings and big parking lots.

Figure 27.8: CSO Basin 27 has several small residential blocks that are isolated by rail corridors and industrial zones. This example is in the Babcock neighborhood along Clinton Street.

Figure 27.9: CSO Large openspace around current and former rail yards.

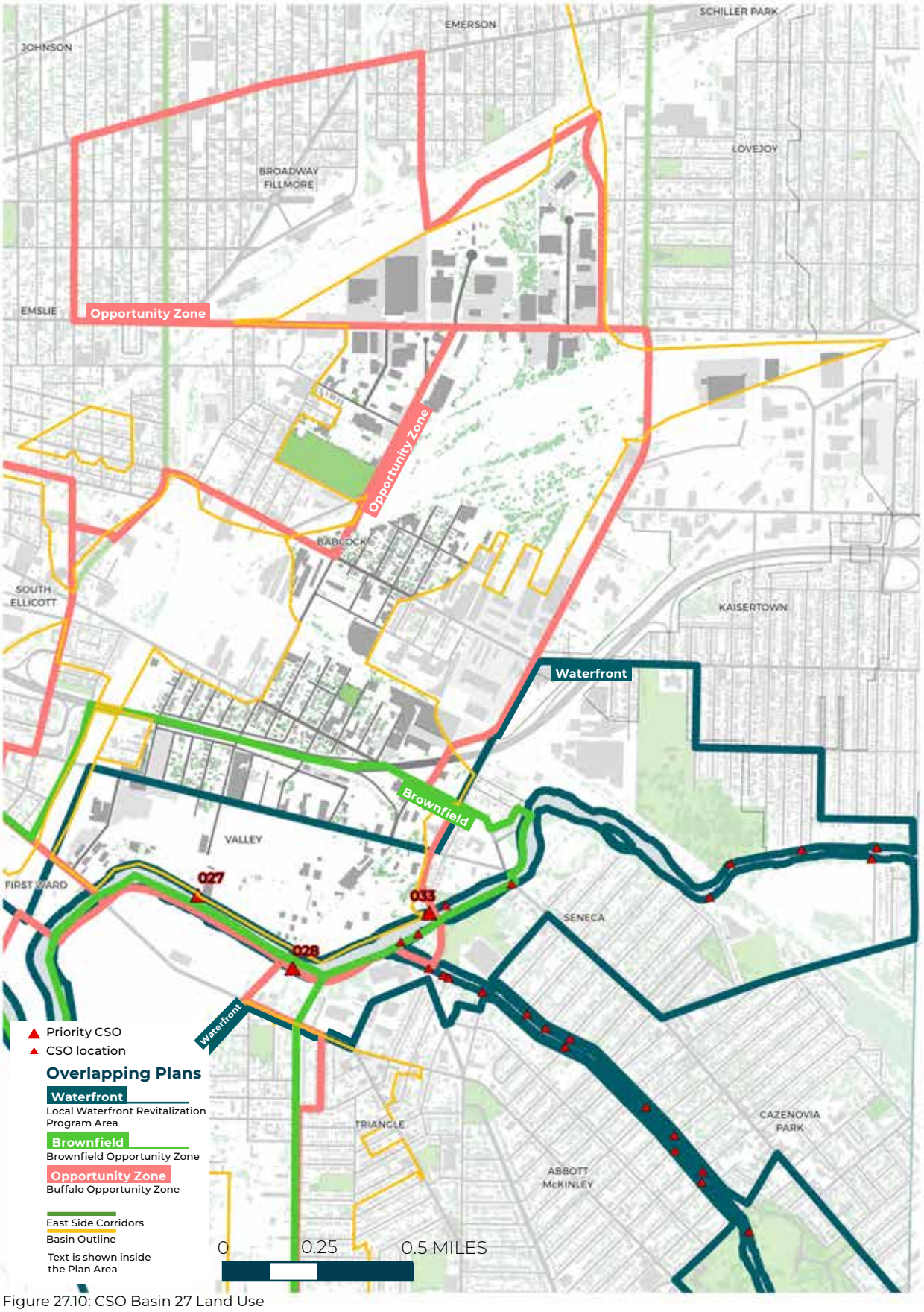


Figure 27.10: CSO Basin 27 Land Use

ANALYSIS

Equity Analysis

There is a small community of about 2,400 residents, the overwhelming majority of whom are White. Most households are owner-occupied, and median household incomes and poverty rates largely reflect the City as a whole. However, CSO Basin 27 stands out for a few environmental indicators of green infrastructure need. The basin has the highest vacancy rates, both commercial (16%) and residential (24%), of the six targeted CSO basins, along with a relatively high share of vacant land (15%). CSO Basin 27 also has the lowest tree canopy coverage of any targeted basin—7.4%, which is half that of the City as a whole. Also, as Interstate 190 runs through the basin, neighborhoods in CSO Basin 27 have a notably high proximity to heavy volumes of traffic. The highway and other barriers, including the predominant industrial land uses, railroads, and the Buffalo River, contribute to this geographic isolation, raising a number of equity considerations for the residential community.

Although the basin is one of the smallest and least diverse areas prioritized by Rain Check 2.0, green infrastructure installations could contribute to placemaking in residential areas, create attractive buffers between residences and surrounding industrial land uses, and also promote healthier environments for workers of major employers in the area. However, given the area's industrial heritage and neighborhood identities, consideration should be given to what types of green infrastructure practices can maintain or promote the neighborhood character that residents value. With the majority of households being owner-occupied, there may be potential interest in and capacity to maintain green infrastructure on private property.

Although industrial sites within the CSO basin may present the greatest opportunities to reduce stormwater runoff, residents may still benefit from installations on these properties. The proportions of residents employed in manufacturing and wholesale trade are triple the rates for the City overall, so residents employed in these industries may work at the employers located in the area. While income and poverty levels are on par with the City as a whole, the unemployment rate is nearly double the rate of the City overall. Furthermore, levels of educational attainment are relatively low, including a significant share of youth who are neither enrolled in school nor working. Job training programs could be targeted towards students, unemployed and underemployed young people living in the area, as well as workers in trade industries. There are a number of community centers in the area that could be potential partners for workforce training initiatives, as well as community outreach and engagement activities.

Neighborhood Profile Snapshot

2,425
RESIDENTS

$30,286
MEDIAN HOUSEHOLD INCOME

95.4%
ATTAIN LESS THAN A BACHELOR'S DEGREE

$29,800
MEDIAN VALUE OF OWNER-OCCUPIED HOMES

30.2%
OF HOUSEHOLDS DO NOT HAVE A VEHICLE

-22.9%
2000–2016
POPULATION CHANGE

25.9%
RESIDENTS LIVING IN POVERTY

43.8%
WORKING AGE NOT EMPLOYED*

19.9%
RESIDENTS ARE PEOPLE OF COLOR

43.3%
HOUSEHOLDS ARE RENTERS

The data presented is for census tracts located within or that intersect the CSO basin boundaries, as an approximation of neighborhoods (see Appendix A for more details and methods)
*Includes those that are unemployed or out of the labor force.

Figure 27.11: CSO Basin 27 and GI Equity Index

Environmental Systems

Waterways

CSO Basin 27 sits along the north shore of, and discharges to, the Buffalo River. The properties bordering the river are large industrial sites and there is no riparian buffer. A number of these sites are currently vacant or fallow, and prevent riverside access by residents. This area has been identified as a brownfield opportunity zone, and any future development would improve upon community resources by increasing neighborhood access to the river and restoring the riparian zone.

Tree Canopy Cover

CSO Basin 27 has the lowest canopy cover of any of the priority CSO Basins, with only half as much canopy cover as the City overall. There are many vacant tree spaces and the acreage of canopy cover is small compared to the available plantable acres.

Habitat Connectivity

The overall lack of canopy cover and the large industrial uses limit habitat connectivity. There is a large patch owned by the railroad that could have canopy increased to serve as a large habitat patch. The I-190 highway and industrial sites currently cause significant discontinuity in the network but this could be remedied by strategically developing tree canopy or habitat corridors along rail lines and vacant lots as habitat stepping stones.

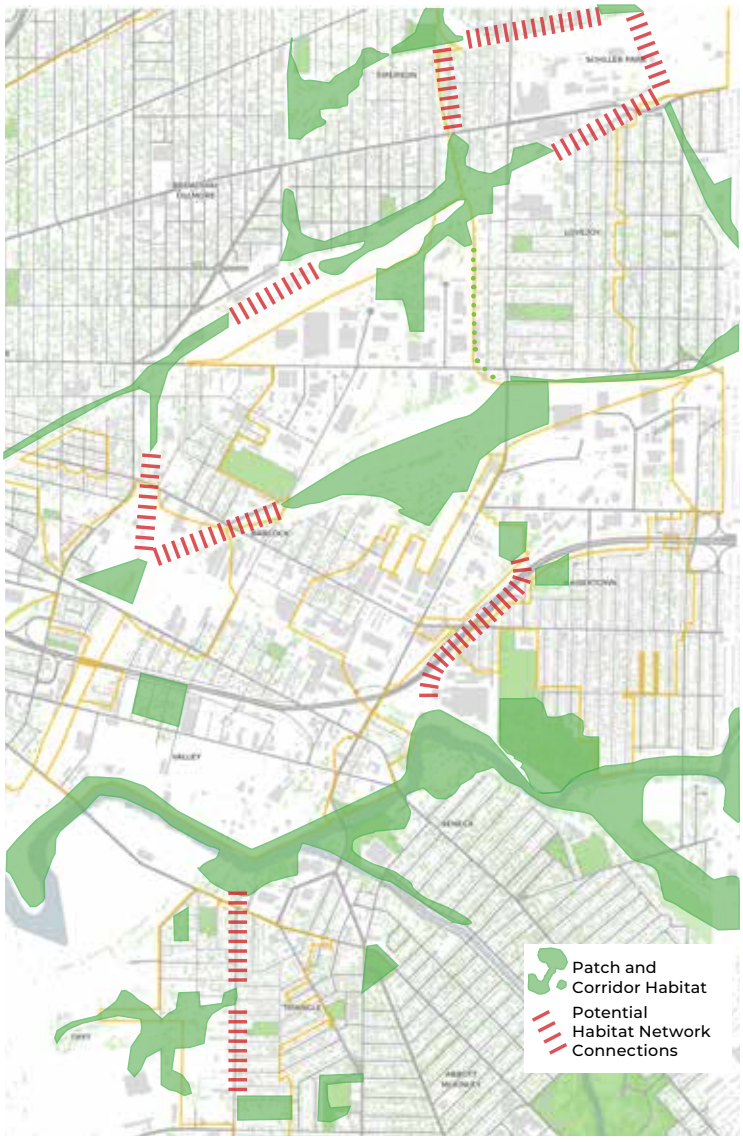
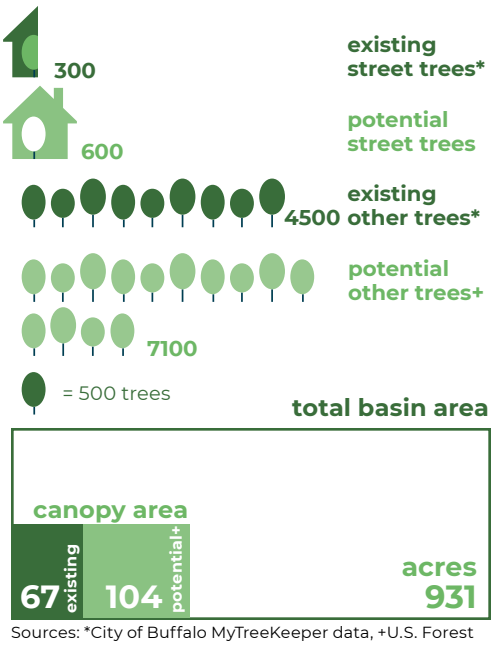


Figure 27.12: Potential for Habitat Connectivity in CSO Basin 27

Tree Canopy Summary

NUMBER OF TREES IN BASIN



Sources: *City of Buffalo MyTreeKeeper data, +U.S. Forest Service protocol with input from the Tree Technical Advisory Committee. For detailed description of methodology, see Appendix C

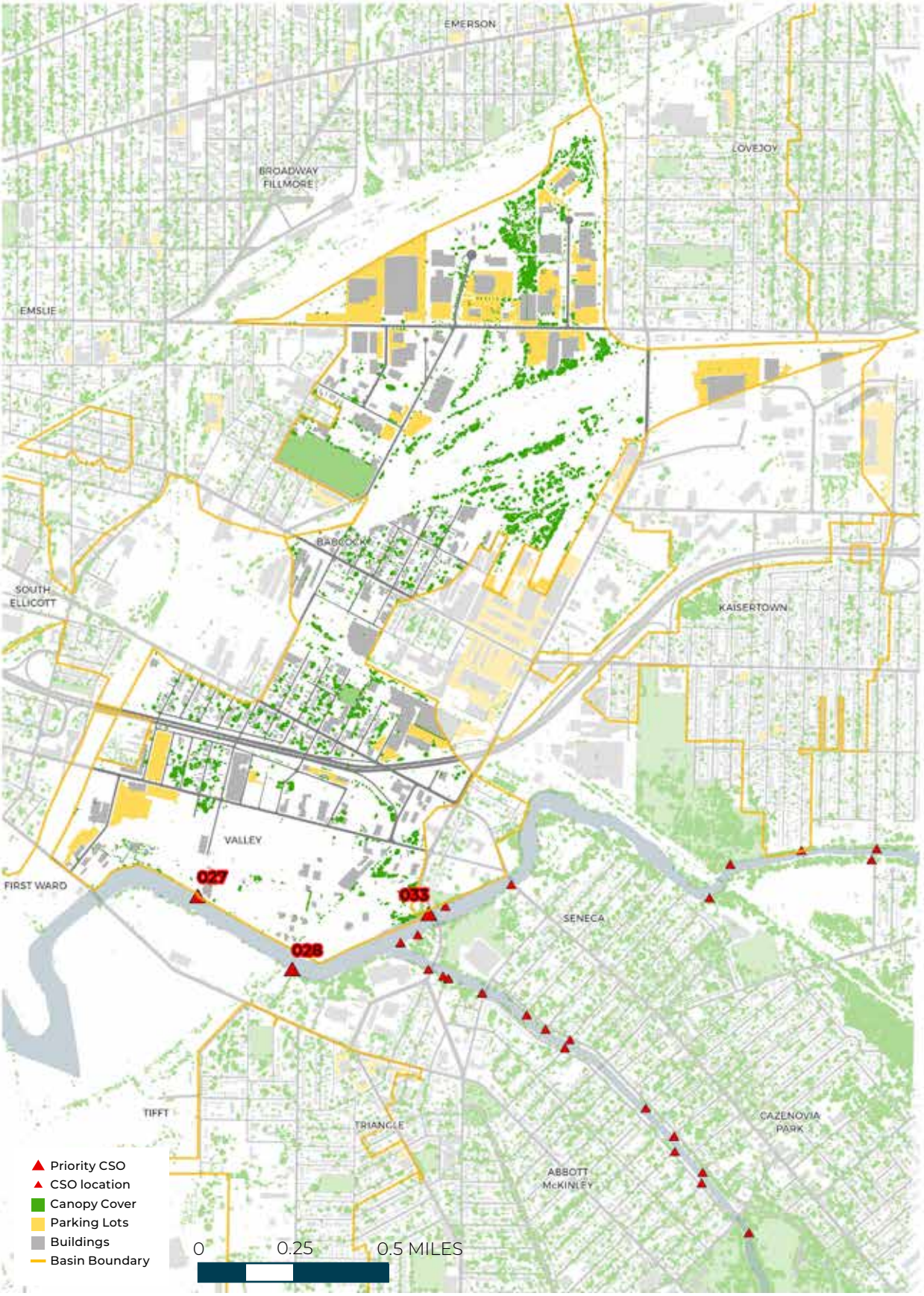


Figure 27.13: CSO Basin 27: Canopy Cover and Impervious Surfaces

ANALYSIS

Site Analysis

CSO Basin 27 is dominated by warehouses for manufacturing and distribution centers. Industrial and commercial uses to the north and south isolate residential neighborhoods. The Erie Railroad cuts through the area and comprises a large land area.

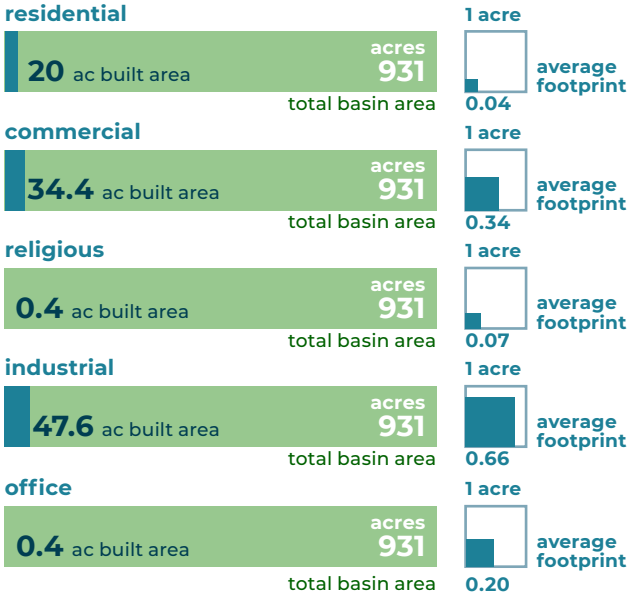
Many of the buildings have large footprints and paved areas for loading bays that, when combined with large access roads, cause this basin to have a very large percentage of impervious surfaces. The impervious surface reduction goal is 73 acres, approximately 7% of the total area. The site analysis process focused on large parcels. Because sites are so large, fewer owners would need to be engaged, possibly simplifying the implementation of green infrastructure. The sites inventoried capture about half of the total area, and are mostly concentrated along Elk Street and William Street.

The land use distribution is dominated by active commercial properties that require large driving surfaces. Porous paving may be a good option for these parcels. Along the Buffalo River there is opportunity for infiltration; however impacted soils may need remediation, and contamination may limit the feasibility of these sites for infiltration.

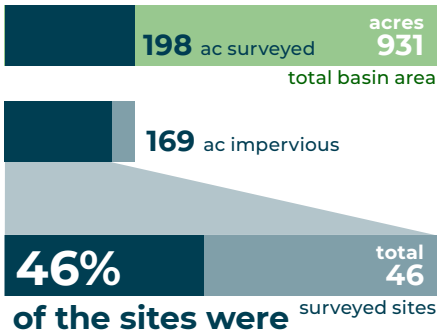
In underutilized or vacant properties along the river, there may be opportunity for green infrastructure to tie into long term redevelopment goals for the area. Green infrastructure can be designed into streetscape improvements along visible areas and improved open space should incorporate stormwater management technologies.

Built Area by Land Use

Full Basin Area, GIS sources: Erie County data, Buffalo Sewer Authority data



The site analysis reviewed 21% of the basin and found 26.5 acres of potential drainage area.



46% of the sites were suitable for green infrastructure.

87% of sites are in full sun

26% of sites are highly visible

Figure 27.14: CSO Basin 27: Percent Impervious by Parcel

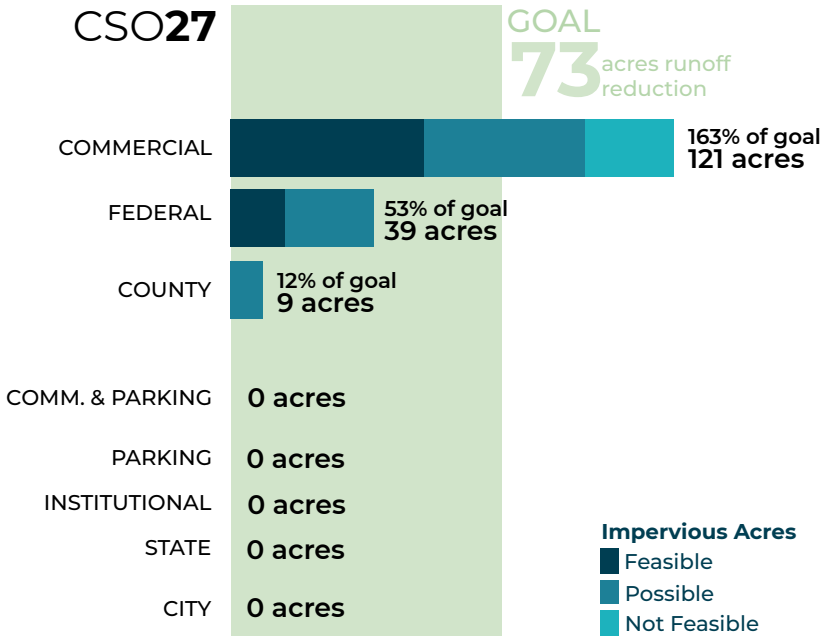
ANALYSIS

Site Analysis: Surveyed Properties

Figure 27.15: Image of sites where field work was conducted

Surveyed Properties by Land Use and Ownership

GIS sources: Erie County data, Buffalo Sewer Authority data



LARGEST PROPERTY OWNERS BY LAND USE AND OWNERSHIP

COMMERCIAL

UPS Customer Center
14.8 Imperv. acres

R&R Salvage, Inc.
11.5 Imperv. acres

Comet Flasher, Inc.
8.9 Imperv. acres

Warehouse Property
6.8 Imperv. Acres

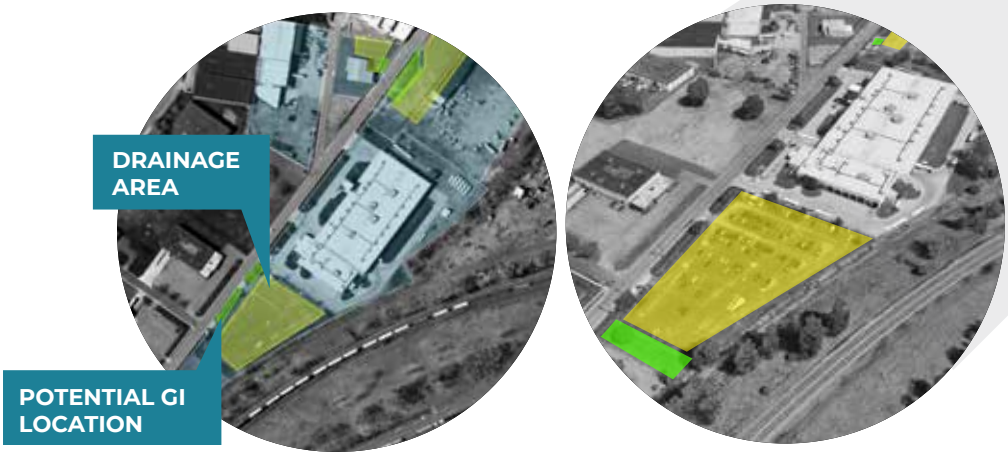
Robinson Home Products
6.4 Imperv. acres

FEDERAL

USPS William Street Site
23.8 Imperv. acres

A number of institutions and large properties were surveyed in CSO Basin 27 during this process.

This information helped the team understand that many have campuses or sizable properties that can be managed as a series of smaller green infrastructure installations or as a networked system.



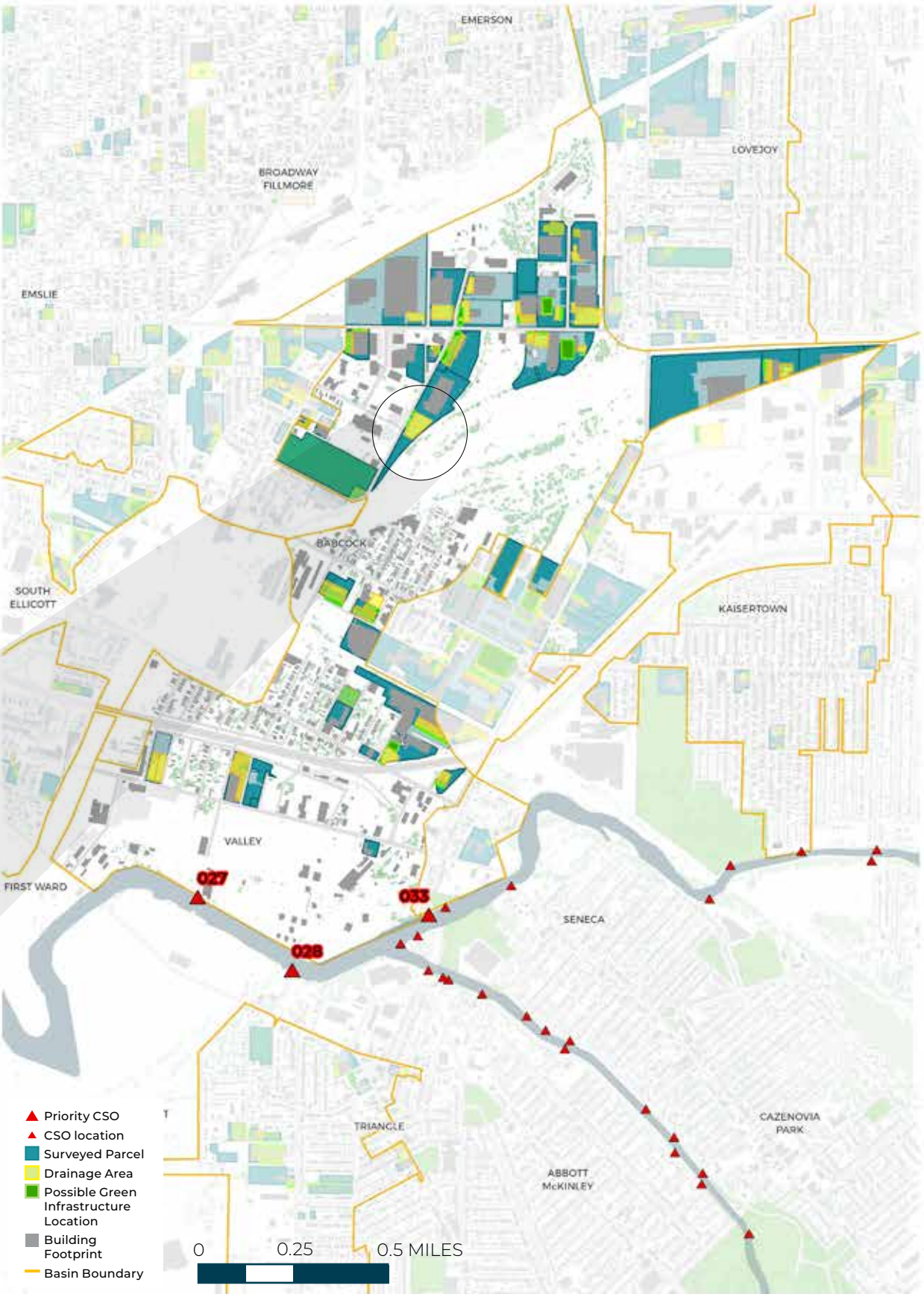


Figure 27.16: CSO Basin 27: Sites analyzed showing parcels, drainage areas and potential green infrastructure.

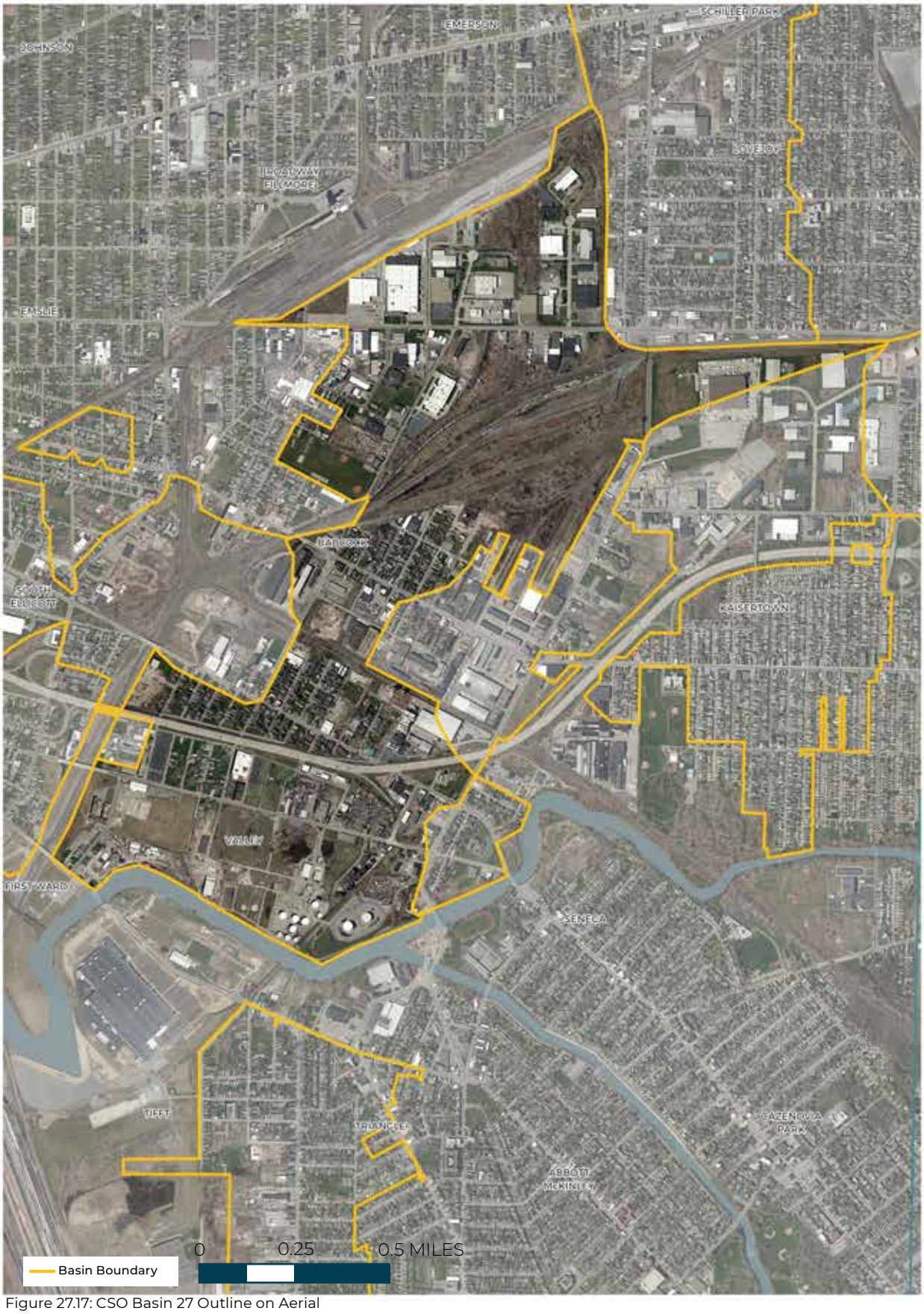


Figure 27.17: CSO Basin 27 Outline on Aerial

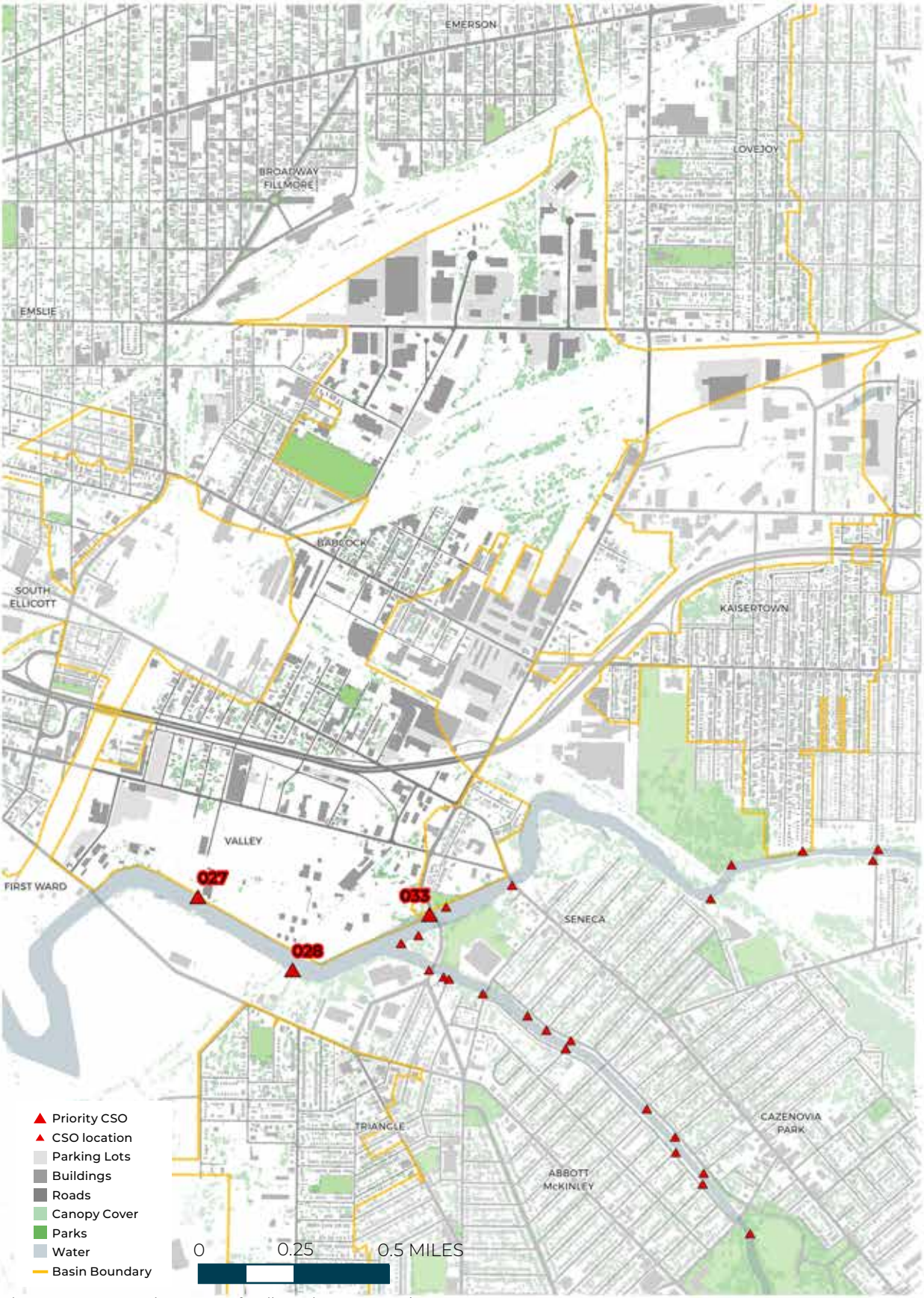


Figure 27.18 CSO Basin 27 Map of Built Environment and Tree Canopy


CSO28

When a drop of water lands at the intersection of Hopkins Street and South Park Avenue, it is joined by water from the neighborhoods of Abbott McKinley, South Abbott, South Park, Tifft, and Triangle. During heavy wet weather, the rainwater combines with sewage and overflows into the Buffalo River at Combined Sewer Overflow 28 (CSO 28).

Community benefits

- Tree planting programs
- Public parks and community amenities
- Improving the quality of the public realm
- Active commuting (biking or walking to work)
- Buffer between Industrial and residential uses.
- Walkability
- Expanded canopy cover
- Traffic calming
- Support for neighborhood revitalization efforts
- Downspout disconnection programs

CSO **Basin 28 at a glance...**

Green Infrastructure Opportunities

The goal for CSO Basin 28 is to manage stormwater from 27 acres of impervious surface. Based on the site analysis, this goal cannot be met in any one category, but will require a combination of commercial properties, parking lots and right of way improvements.

Urban Character

CSO Basin 28 is characterized by dense residential with adjacent open space and industrial uses.

Environmental Systems

The canopy cover in CSO Basin 28 is similar to the City average. Because the basin is more residential, there are more trees, many of which are street trees and older, larger trees. There are some large patches of habitat, but little connectivity. Enhancing the urban canopy, particularly along corridors, would create greater connectivity.

Equity Considerations

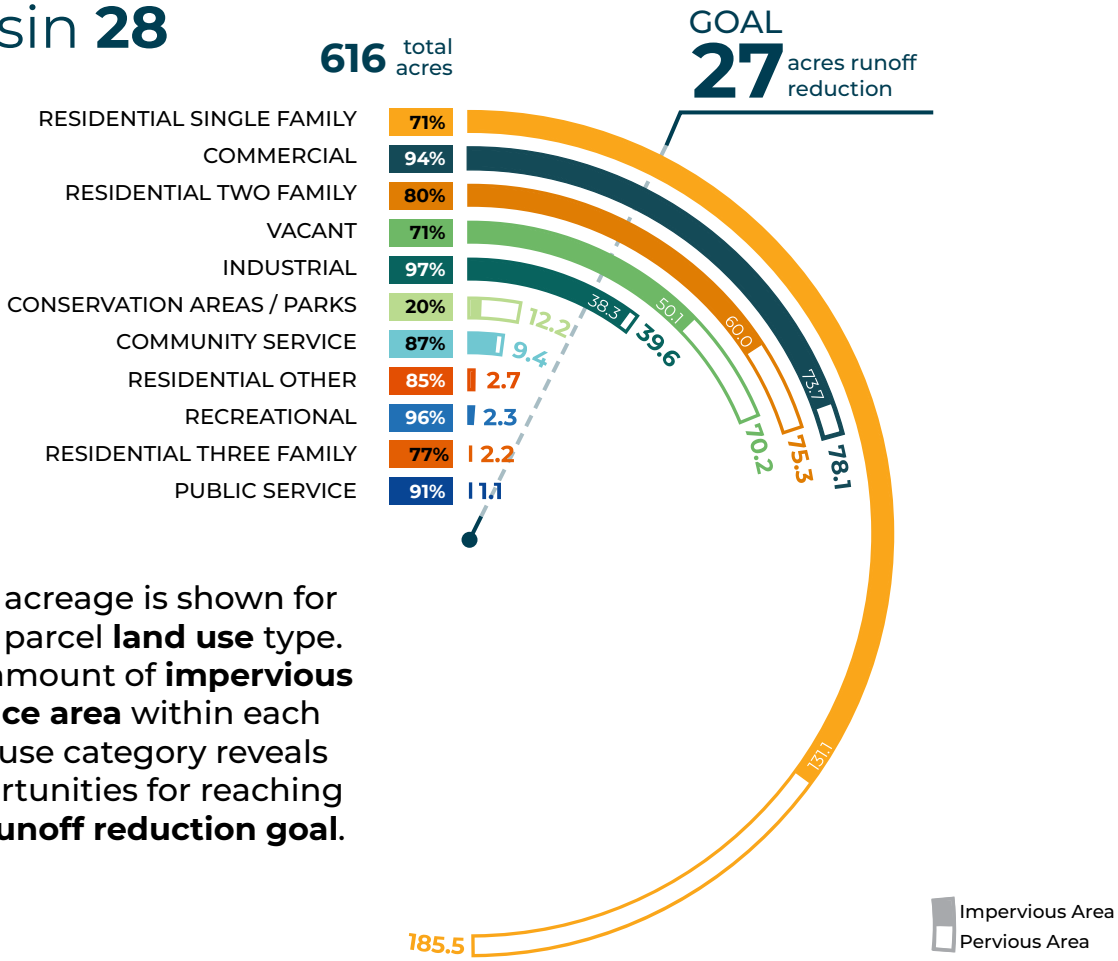
Green infrastructure improvements in the public realm—streets and sidewalks—could encourage more biking and walking by residents and provide buffers between residential and industrial zones, for example Hopkins street. Green infrastructure can be a tool for residents and other community stakeholders to connect to one another and with public officials about community priorities. Green infrastructure could enhance livability and promote physical activity of residential community surrounded by industrial uses.

Green infrastructure at public parks and community amenities could support creative placemaking at focal points and Buffalo Sewer might explore strategies and incentives to cultivate resident and community stewardship of projects.

For a number of reasons, CSO Basin 28 has the lowest overall need for green infrastructure investment as measured by the green infrastructure equity index.

BY THE NUMBERS...

Land Use Opportunity and Impervious Surfaces by Area



Total acreage is shown for each parcel **land use** type. The amount of **impervious surface area** within each land use category reveals opportunities for reaching the **runoff reduction goal**.

Basin Overview

616 acres
TOTAL BASIN AREA

16,369
RESIDENTS

$44,174
MEDIAN HOUSEHOLD INCOME

70 acres
OF CANOPY AREA

15 acres
OF PARK AREA

134 acres
OF RIGHT OF WAY

63 acres
OF ROAD AREA

106 acres
OF BUILDING AREA

13 acres
OF PARKING LOTS

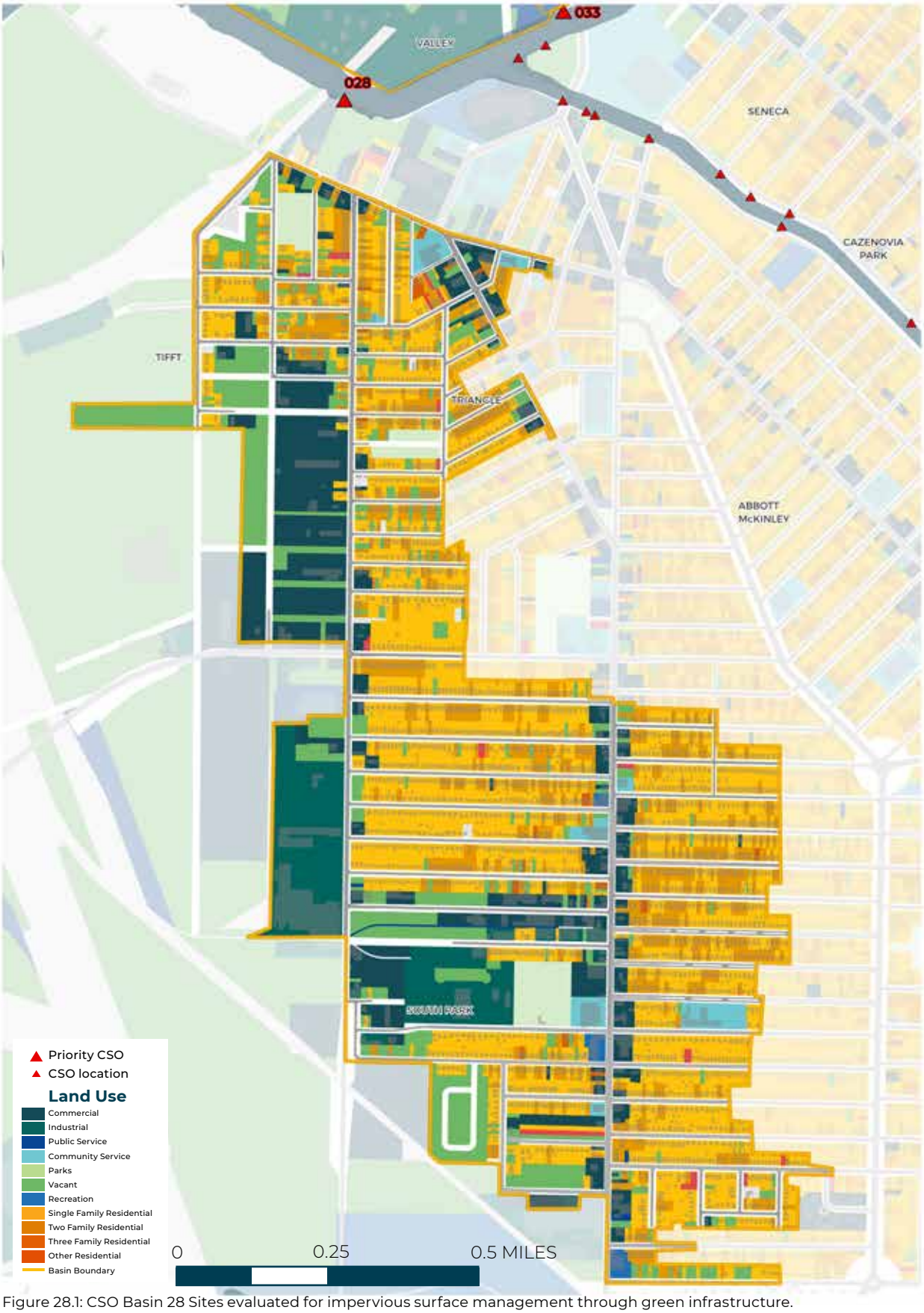
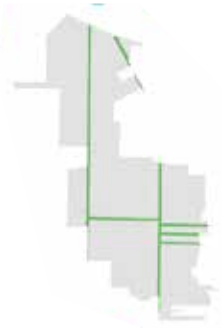


Figure 28.1: CSO Basin 28 Sites evaluated for impervious surface management through green infrastructure.

Opportunity Sites & Networks



Corridors

Hopkins Street and South Park Avenue provide the basis for a networked green infrastructure system and are also current or potential neighborhood centers. Existing medians at Harding, Culver and Ridgewood roads provide opportunities for local networks of green infrastructure that could tie in residential properties and connect to a larger neighborhood network along South Park Avenue.

Sites

The sites analyzed in CSO Basin 28 naturally organize along corridors. Small mid-block parks and open space in the basin and adjacent to it provide additional opportunities for green infrastructure both at their perimeter and below grade. Combining green infrastructure with open space and parks enhances the public realm and provides greater access to green space.

Clusters and Networks

The large cluster of primarily industrial properties surveyed can be combined with corridors into larger clusters or networks. These can be combined with institutions and parks in and adjacent to the basin. Such clusters are based on both physical proximity and programmatic synergies. Program synergies could include, for example, workforce development programs centered around schools or community centers that will assist with the implementation of green infrastructure city-wide.

Key Corridors

- Hopkins Street
- South Park Avenue
- Residential streets with existing medians (Harding, Culver, Ridgewood)

Key Institutions

1. South Park High School
2. South Buffalo Food Pantry
3. Buffalo Police Department
4. South Buffalo Irish Center
5. Holy Family Catholic Church
6. St. Ambrose Church

Industrial/Commercial

7. Niagara Fiberglass, Inc.
8. Mobile Mini
9. Price Trucking
10. Rite Aid

Key Parks

1. Boone Park
2. Heacock Park
3. Durant Street Playground
4. Mulroy Park
5. South Buffalo Charter School Playground
6. Buffalo and Erie County Botanical Gardens

CORRIDORS are networked, physically connected systems around a road or right-of-way

OPPORTUNISTIC SITES are stand alone sites with a high opportunity for green infrastructure

CLUSTERS have an anchor institution or are groups of parcels that can implement similar strategies

NETWORKS are larger systems of capture and treatment incorporating many sites

Figure 28.2: CSO Basin 28 Green Infrastructure Opportunity Sites

Green Infrastructure Opportunity
South Park Avenue Green Network

CSO Basin 28 is the second smallest of the 6 priority CSO basins and has the highest number of overflows in the system. The predominant land use is residential. Meeting the goal in this basin will require working with homeowners as well as other types of property, including the public right-of-way. South Park Avenue is an important commercial corridor with several parks and public institutions along it. South Park Avenue provides the potential armature for a networked system of the green infrastructure that could incorporate a large percentage of the basin area.

The streets of Ridgewood, Culver, Harding, and Reading and their intersection with South Park Avenue provide an opportunity to showcase green infrastructure along these wider streets with existing landscaped medians. These streets in residential areas could be the basis for connecting disconnected residential downspouts into a larger green infrastructure network. Because they intersect with South Park Avenue they can be networked into a system of green infrastructure along South Park Avenue. These projects could demonstrate to residents the benefits of implementing green infrastructure on their own properties. These streets can also contribute to beautification and pollution reduction along South Park Avenue, which has a high volume of traffic and many businesses.

There are a number of small parks and public open spaces in CSO Basin 28 that are also adjacent to South Park Avenue. These spaces could be utilized for stormwater detention and infiltration from adjacent properties and roadways and could also be connected into a larger networked system. This could also include use of porous paving for alley ways and sidewalks.

Strategies

- **Green streets**
- **Commercial building green roof**
- **Residential downspout disconnections**
- **Parking lot bioswales**
- **Convey and detain in park**

Potential Partners

- **Department of Public Works**
- **Division of Parks and Recreation**

Figure 28.3: Mulroy Park in South Buffalo

Figure 28.4:Harding Road in South Buffalo

Placemaking Opportunity with Green Infrastructure

Creating a neighborhood scale green infrastructure network not only assists in managing stormwater, but is also an opportunity to make great places within a neighborhood and support broader neighborhood revitalization goals. In CSO basin 28 this could take the form of an enhanced public realm with vacant land used for stormwater and community amenities, improvements to public streets and parks, and increased tree planting, all of which provide environmental and health benefit and increase property values.

Figure 28.5: Rendering of South Park Avenue Green Network

ANALYSIS

Urban Character

CSO Basin 28 boundaries intersect with several City of Buffalo planning neighborhoods in South Buffalo, including Abbott McKinley, South Abbott, South Park, Tifft, and Triangle. CSO Basin 28 neighborhoods are predominantly residential communities bordered by industrial land uses to the west and Cazenovia Creek and the Buffalo River to the north. The area is home to several schools and churches, and a number of public parks and open spaces including Heacock Park, Mulroy Park, and South Park.

Investment in green infrastructure in CSO Basin 28 will support a number of broader planning efforts, including the Local Waterfront Revitalization Program, which includes the Buffalo River, the Buffalo River Corridor Brownfield Opportunity Area, and the Buffalo Green Code. CSO Basin 28 borders neighborhood centers along Abbot Road and South Park Avenue and green infrastructure investment along these corridors can support the revitalization of these areas.

The Hopkins Street area is currently bordered by industrial uses on the west side, but is zoned mixed use under the green code. Investment in green infrastructure along Hopkins Street could both provide a buffer between industrial and residential uses in the short-term and support the growth of mixed use development along that corridor in the future.

Because this CSO basin is dominated by residential communities, downspout disconnection programs will likely play an important role here. The South Park area in CSO Basin 28 is seeing heavy residential development per square mile based on building permits.

Figure 28.6: Auto parts, scrap yards, and other outdoor industrial depots on the south end of Hopkins St in CSO Basin 28.

Figure 28.7: Dense single family detached housing comprises much of CSO Basin 28 seen here between Hopkins St and South Park Ave.

Figure 28.8: Industry, commercial, and brownfields line The Buffalo River along the north end of the CSO Basin.

Figure 28.9: Along Hopkins and Abby street light industry borders the residential community and creates a barrier to open space to the west.

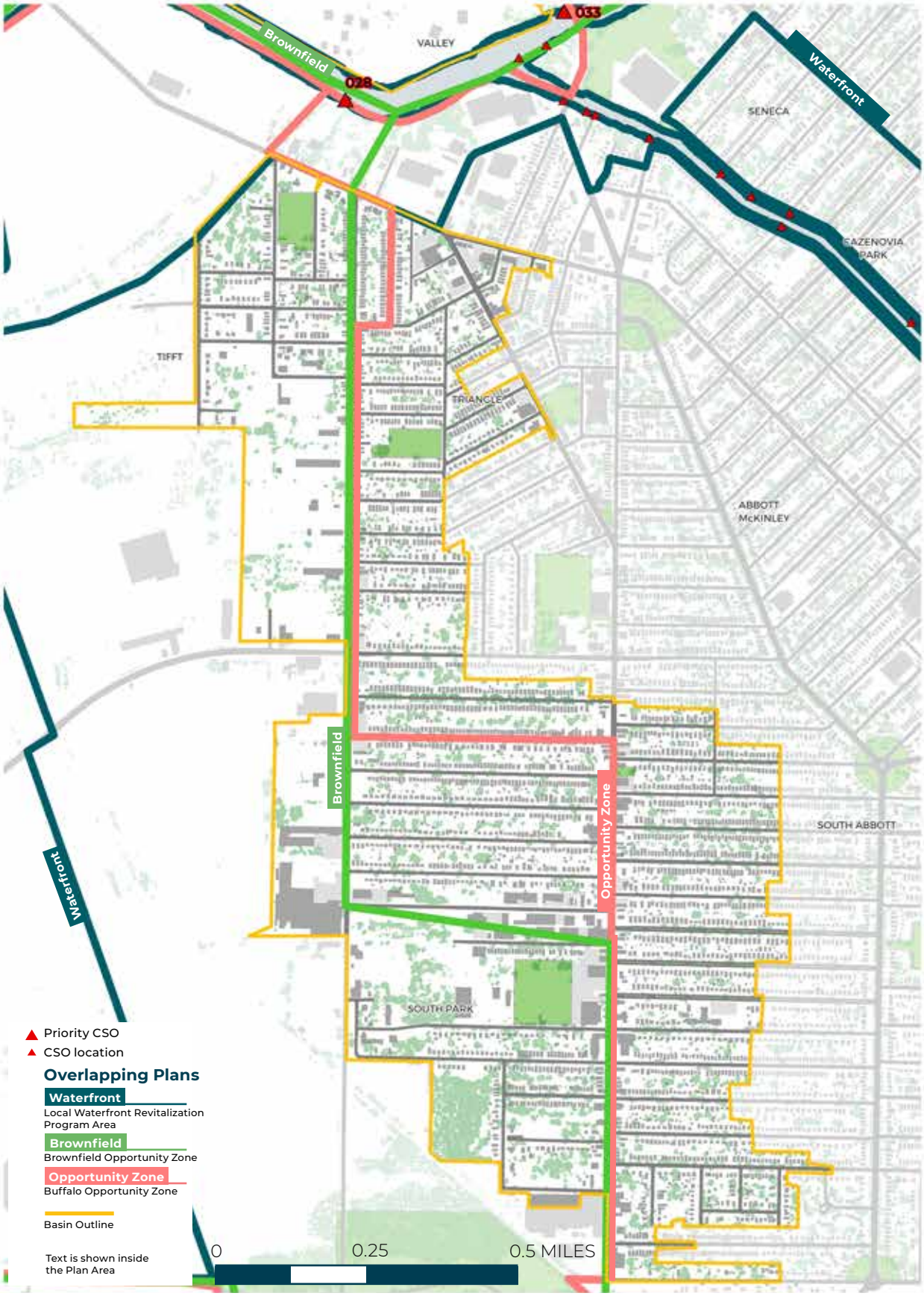


Figure 28.10: CSO Basin 28 intersecting Plans

ANALYSIS

Equity Analysis

The population of about 16,400 people is predominantly White and relatively better off than other priority areas and the City overall on measures of economic well-being and connectedness. The median household income for households in CSO Basin 28 neighborhoods is higher than the City overall, and unemployment and poverty rates for residents are lower compared to the City. CSO Basin 28 neighborhoods may offer good opportunities for targeting private property owners for engagement, installation, and maintenance of green infrastructure. Two thirds of housing units are owner occupied and only one quarter of households spend more than 30% of monthly income on housing costs.

CSO Basin 28 also ranks positively in terms of environmental concerns—it has the lowest impervious surface coverage (53%) and residential vacancy rate (5%) of all the targeted basins. It also has a relatively high tree canopy coverage (16%) and a low share of vacant land area (11%). Due to these advantages, CSO Basin 28 has the lowest overall need for green infrastructure investments as measured by the GI equity index (see Appendix A). Some opportunities for green infrastructure investments may be highly feasible in this area, such as strategies that engage residents, since neighborhoods here are well-intact with plenty of owner-occupied housing.

There may also be opportunities for green infrastructure practices to promote more active and healthy communities in CSO Basin 28 neighborhoods. Over 90% of households have access to a vehicle and 88% of workers commute via car. There could be potential for green infrastructure to improve the quality of the public realm, for example along roads and sidewalks to and from the many parks and open spaces in the area, to encourage more biking and walking among residents living in the area.

Neighborhood Profile Snapshot

16,369
RESIDENTS

$44,174
MEDIAN HOUSEHOLD INCOME

77.4%
ATTAIN LESS THAN A BACHELOR'S DEGREE

$76,369
MEDIAN VALUE OF OWNER-OCCUPIED HOMES

10%
OF HOUSEHOLDS DO NOT HAVE A VEHICLE

-9.7%
2000–2016
POPULATION CHANGE

20.6%
RESIDENTS LIVING IN POVERTY

27.9%
WORKING AGE NOT EMPLOYED*

19.5%
RESIDENTS ARE PEOPLE OF COLOR

34.8%
HOUSEHOLDS ARE RENTERS

The data presented is for census tracts located within or that intersect the CSO basin boundaries, as an approximation of neighborhoods (see Appendix A for more details and methods)
*Includes those that are unemployed or out of the labor force.

Figure 28.11: CSO Basin 28 and GI Equity Index

ANALYSIS

Environmental Systems

Waterways

CSO Basin 28 is located south of Cazenovia Creek and the Buffalo River and discharges to the river. A band of industrial properties are located on the shore of the river, but are not in the CSO basin. These industrial properties prohibit access to the Buffalo River from the neighborhood, but have helped to bolster a riverside habitat corridor where vacant industry plots have been left fallow. The community has access to Cazenovia Creek through Cazenovia Park, but downstream the connection is less pleasant due to channelization and barrier fences.

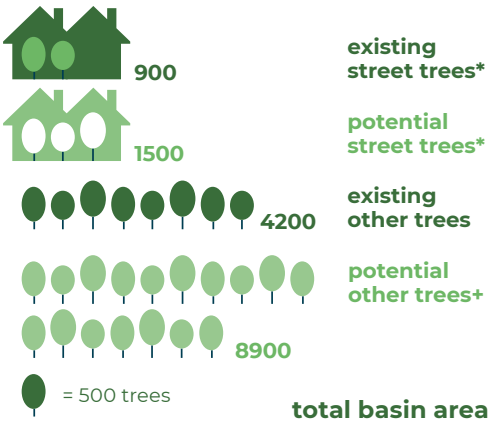
Tree Canopy Cover

The canopy cover in CSO Basin 28 is higher than the overall City. Because the basin is more residential, there are more trees, many of which are street trees and older, larger trees, which have high value for stormwater management and other environmental services.

Large planted parcel to the south could be sinks for stormwater. This CSO basin is adjacent to large open (green) spaces.

Tree Canopy Summary

NUMBER OF TREES IN BASIN



Sources: *City of Buffalo MyTreeKeeper data, +U.S. Forest Service protocol with input from the Tree Technical Advisory Committee. For detailed description of methodology, see Appendix C

Habitat Connectivity

Habitat in this CSO basin consists primarily of isolated patches with larger areas of open space to the south, and east, the Buffalo River corridor to the north, and the Tifft Nature Preserve to the east. The biggest opportunity to improve upon the habitat network in this basin would be to stitch together the isolated patches. Establishing tree canopy within the right of way could help to improve interconnectivity. Often new connections would only need to span several blocks to integrate the isolated mid-size patches into the larger network.

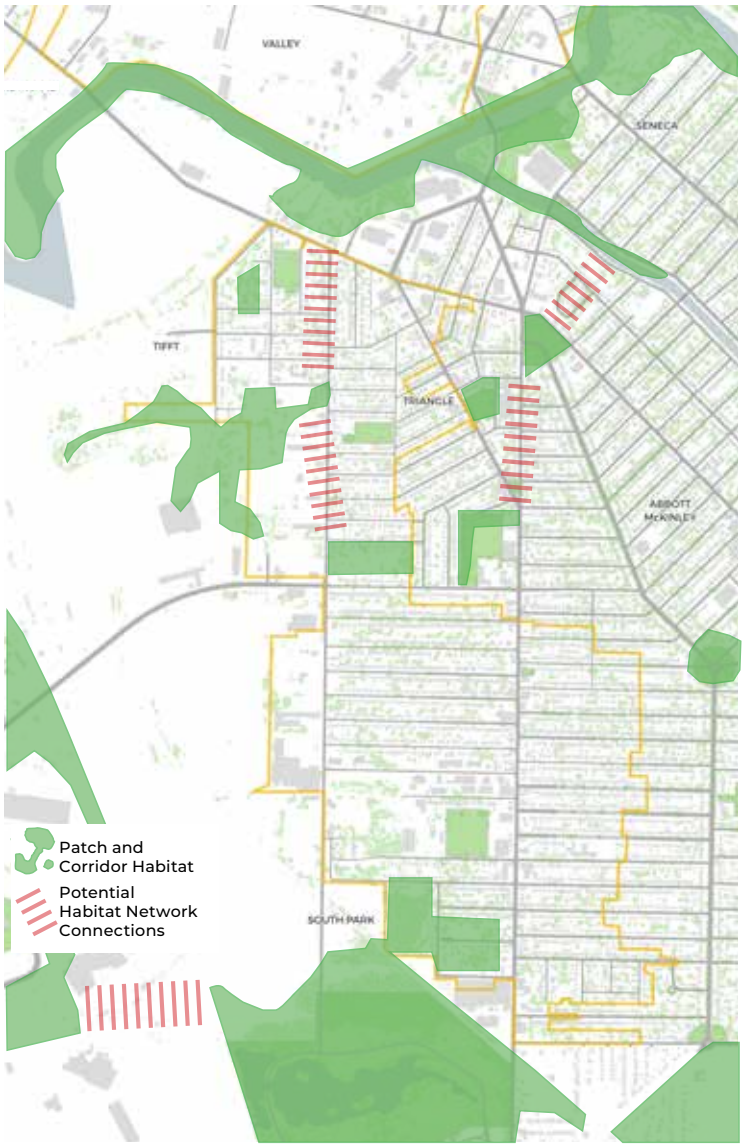


Figure 28.12: Potential for Habitat Connectivity in CSO Basin 28

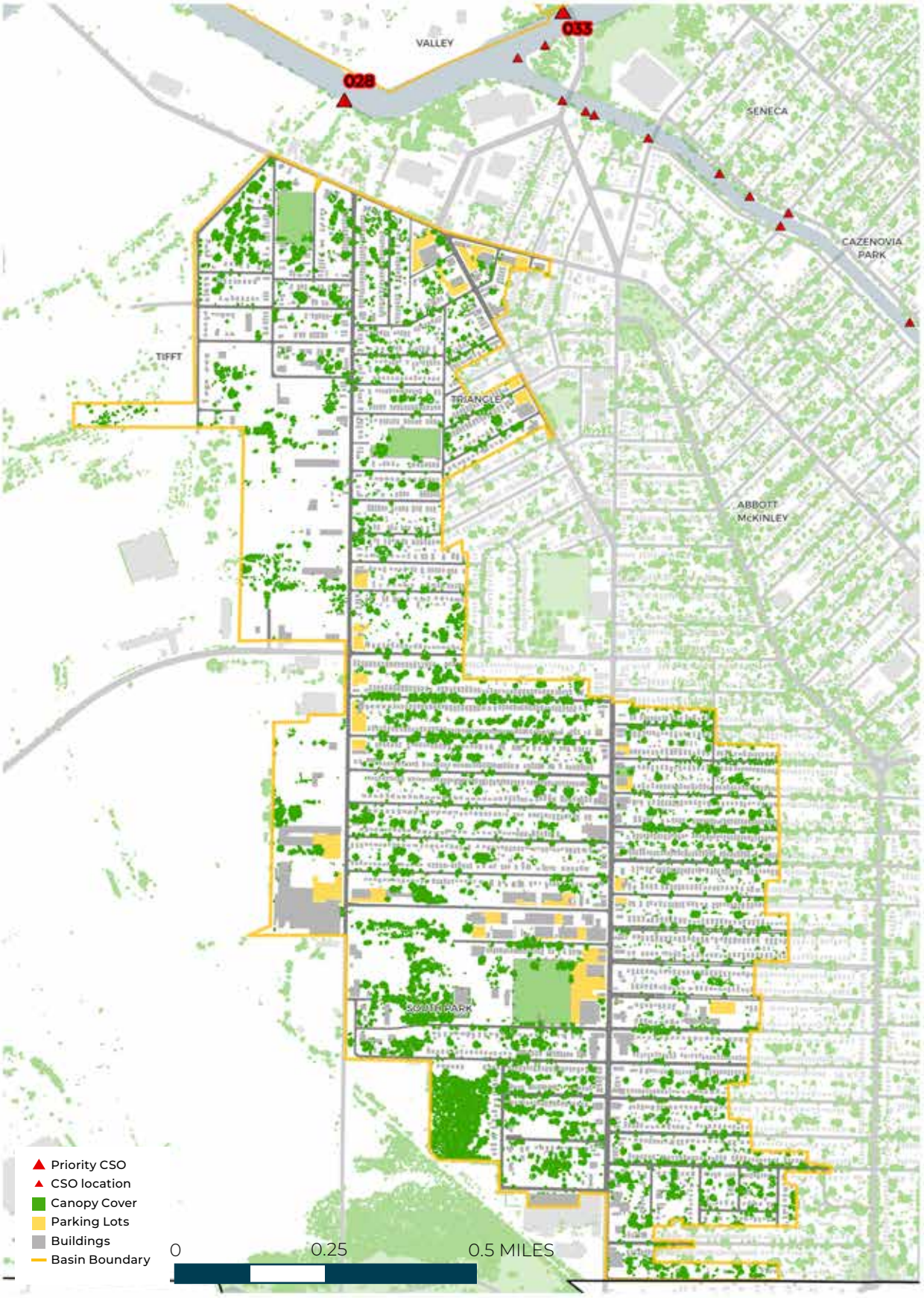


Figure 28.13: CSO Basin 28: Canopy Cover and Impervious Surfaces

ANALYSIS

Site Analysis

The CSO Basin 28 impervious surface reduction goal is 27 acres managed, which is about 4% of the CSO basin area. Because of the largely residential nature of this CSO basin, the few commercial parcels, mostly to the southeast, make up the majority of the sites selected for retrofit analysis. This analysis focused on sites that were highly impervious, such as commercial lots with large parking lots and roofs. Targeting these sites will be critical to meeting area objectives. However, these lots will also need to be combined with some residential and with green infrastructure in the right of way in order to meet the CSO basin goal.

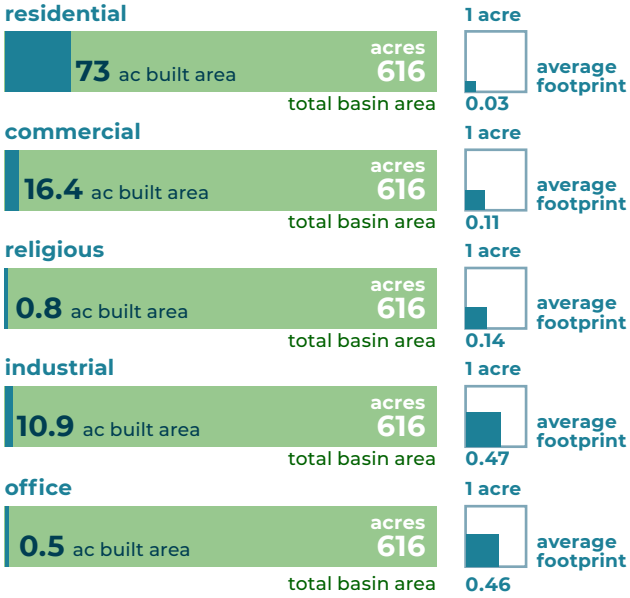
Residential properties comprise a significant area within this CSO, though none were surveyed given the uniformity of most residential parcels with regard to stormwater conditions. Conducting a mail in or online survey where residents may evaluate their own properties may be an effective way to promote residential stormwater reduction, or assess what potential green infrastructure practices are most suitable for this neighborhood.

Streets are also a significant portion of this CSO basin with 22% of land area in the right of way. Several streets were surveyed for green infrastructure opportunity, most notably the collection of Harding Rd, Culver Rd, and Ridgewood Rd, which all have potential for their green median to become stormwater retention areas.

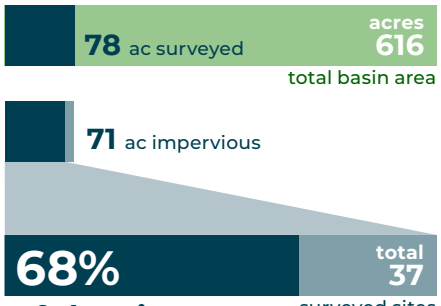
Several parks and institutions lay just outside the basin boundaries. They were not surveyed but could provide good demonstration projects and be a point of contact with the wider neighborhood in the promotion of green infrastructure.

Built Area by Land Use

Full Basin Area, GIS sources: Erie County data, Buffalo Sewer Authority data



The site analysis reviewed 13% of the basin and found 25.9 acres of potential drainage area.



of the sites were suitable for green infrastructure.

95% of sites are in full sun

35% of sites are highly visible

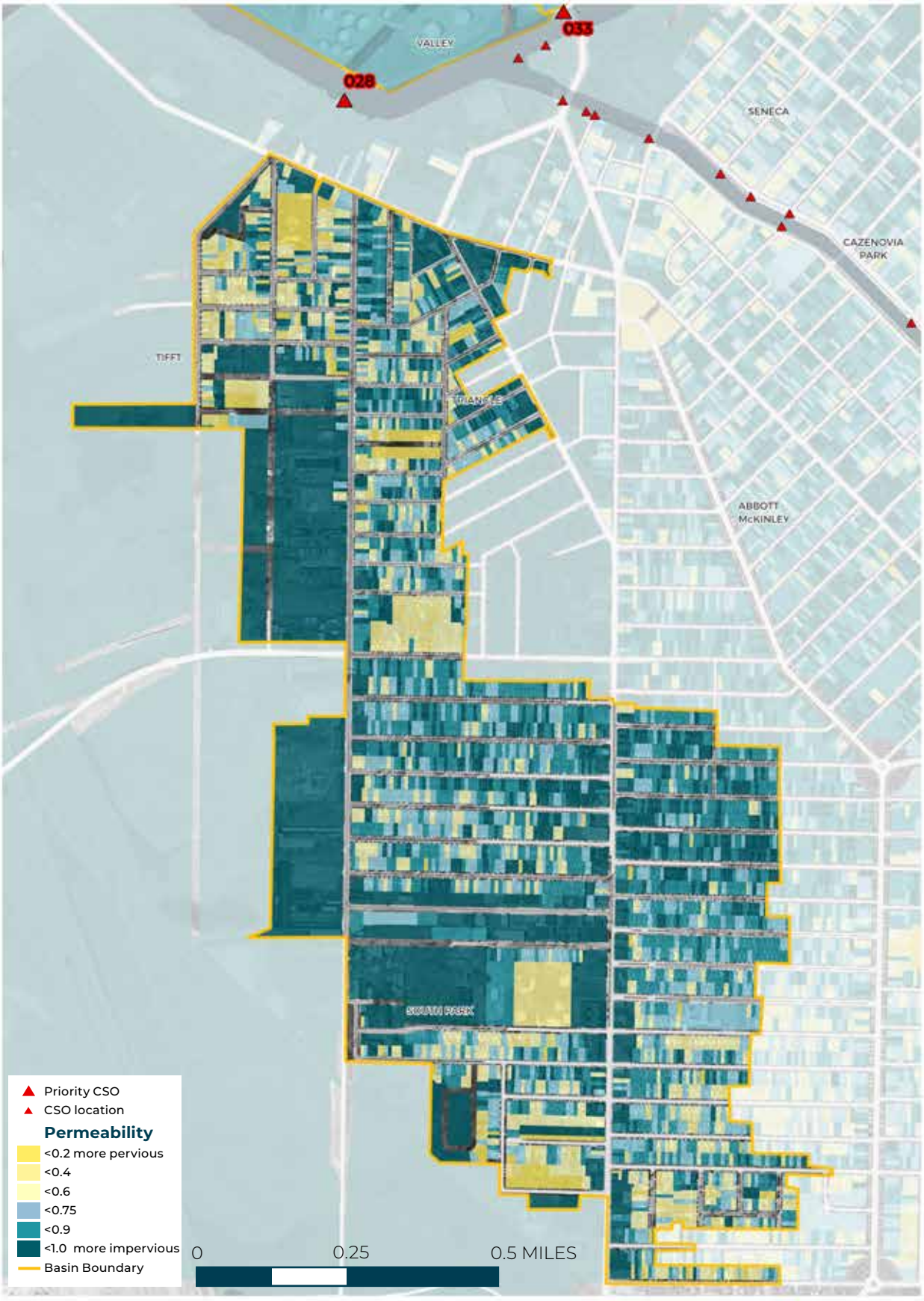


Figure 28.14: CSO Basin 28 Percent Impervious by Parcel

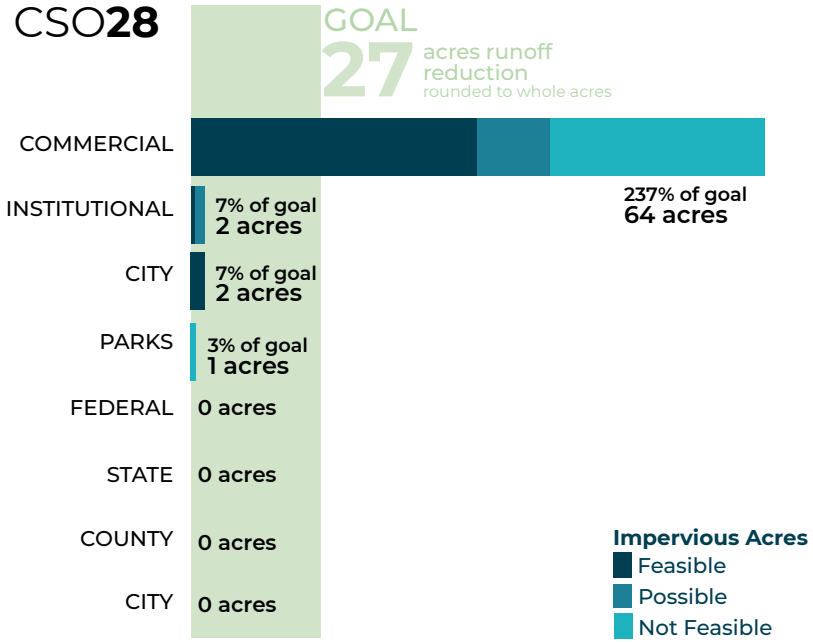
ANALYSIS

Site Analysis: Surveyed Properties

Figure 28.15: Image of sites where field work was conducted

Surveyed Properties by Land Use and Ownership

Data: Erie County GIS, Buffalo Sewer Authority GIS, field survey



LARGEST PROPERTY OWNERS BY LAND USE AND OWNERSHIP

COMMUNITY PARTNERS

Okell Park
South Park High School
St. Agatha RC Church

COMMERCIAL

Niagara Fiberglass Inc.
7.4 Imperv. acres

Mobile Mini
4.1 Imperv. acres

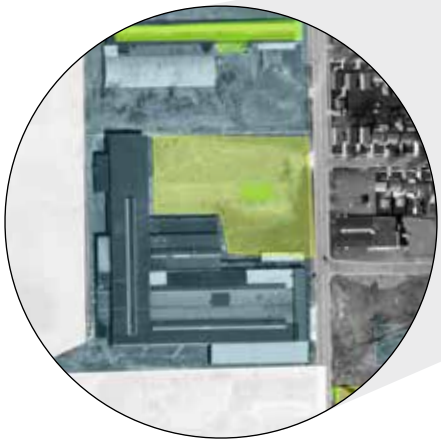
ServiceMaster Restoration
3.0 Imperv. acres

Price Trucking
2.6 Imperv. acres

Rite Aid
1.9 Imperv. acres

Commercial corridors flanked by retail and industrial properties are strong areas of opportunity in CSO Basin 28.

Most of the light industrial properties in CSO Basin 28 have large impervious areas. From the survey, the team determined that many properties slope to internal portions of the site and may have significant vehicular traffic that constrains the use of green infrastructure. Additional investigation is needed to better understand pavement requirements, traffic patterns, and possible sources of pollution.



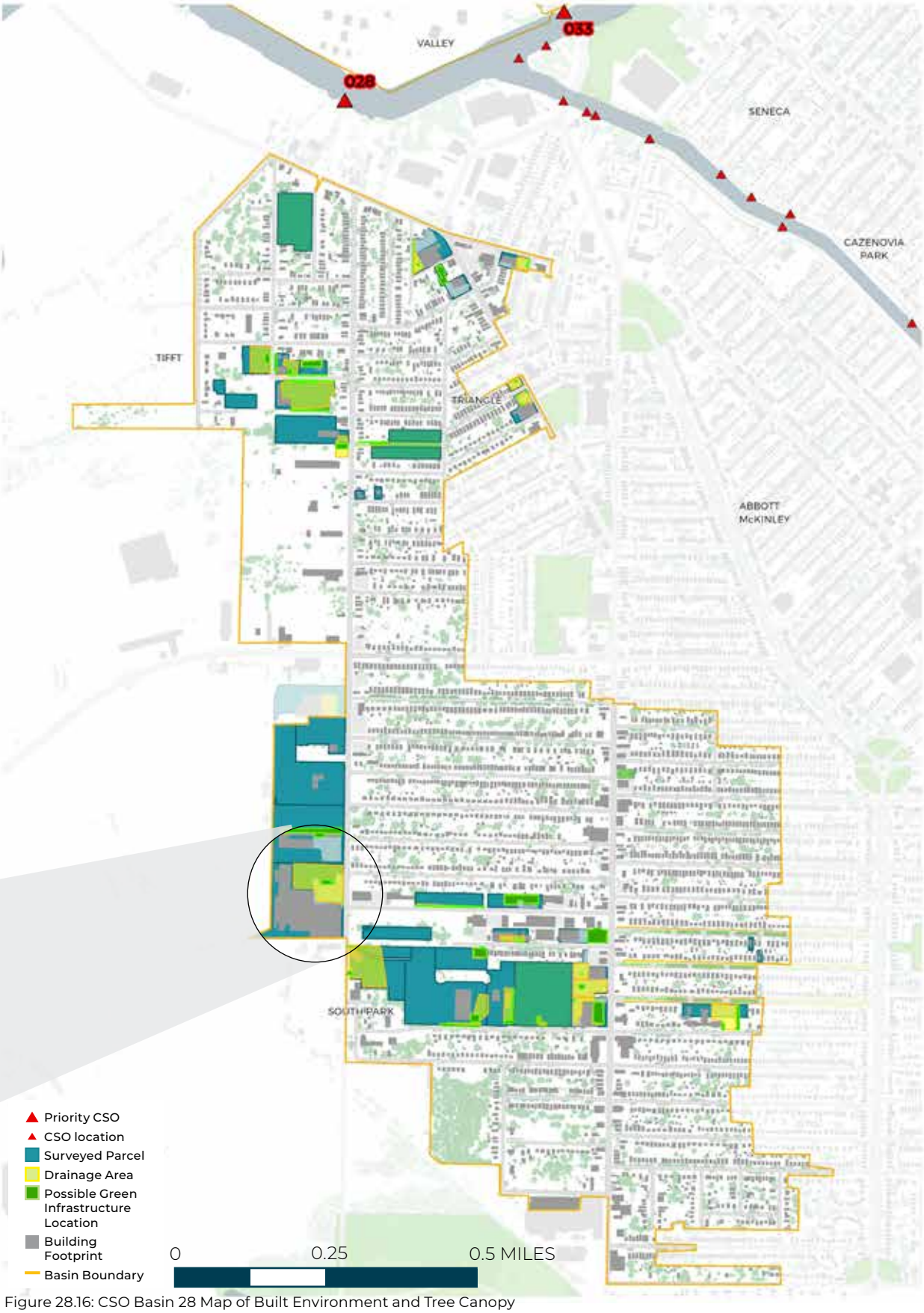


Figure 28.16: CSO Basin 28 Map of Built Environment and Tree Canopy

Figure 28.17: CSO Basin 28 Aerial Map

Figure 28.18: CSO Basin 28 Map of Built Environment and Tree Canopy


CSO33

When a drop of water lands at the intersection of Bailey Avenue and William Street, it is joined by water from the neighborhoods of Babcock, Emerson, Kaisertown, Lovejoy, Schiller Park, and Seneca. During heavy wet weather, the rainwater combines with sewage and overflows into the Buffalo River at Combined Sewer Overflow 33 (CSO 33).

Community Benefits

- Buffer zones between residential uses and industrial uses and large roadways
- Greater walkability & Pedestrian safety
- Traffic calming
- Support neighborhood revitalization
- Workforce development
- Green jobs
- Tree planting programs
- Expanded canopy cover
- Improved access to green space
- Cleanup and revitalization of vacant land

CSO **Basin 33 at a glance...**

Green Infrastructure Opportunities

The goal for this CSO basin is to reduce the number of impervious acres by 94 Acres. Based on the site analysis, the most feasible sites are located on large commercial properties and parking lots. Sidewalks and roadways also provide many feasible opportunities for green infrastructure retrofits.

Urban Character

Key corridors pass through this CSO basin and intersections on East-West corridors could be highly visible pilot locations for green infrastructure.

Environmental Systems

Urban tree canopy cover in CSO Basin 33 is lower than the City average. Large gaps in the urban canopy should be addressed. Focusing on complete streets and right of way improvements can help to grow the urban forest canopy, create habitat connectivity as well as the opportunity to network green infrastructures systems within the CSO basin.

Equity Considerations

Limited walkability and the presence of larger road corridors makes a focus on complete streets and corridor improvements a priority for improving walkability and access to parks and green space.

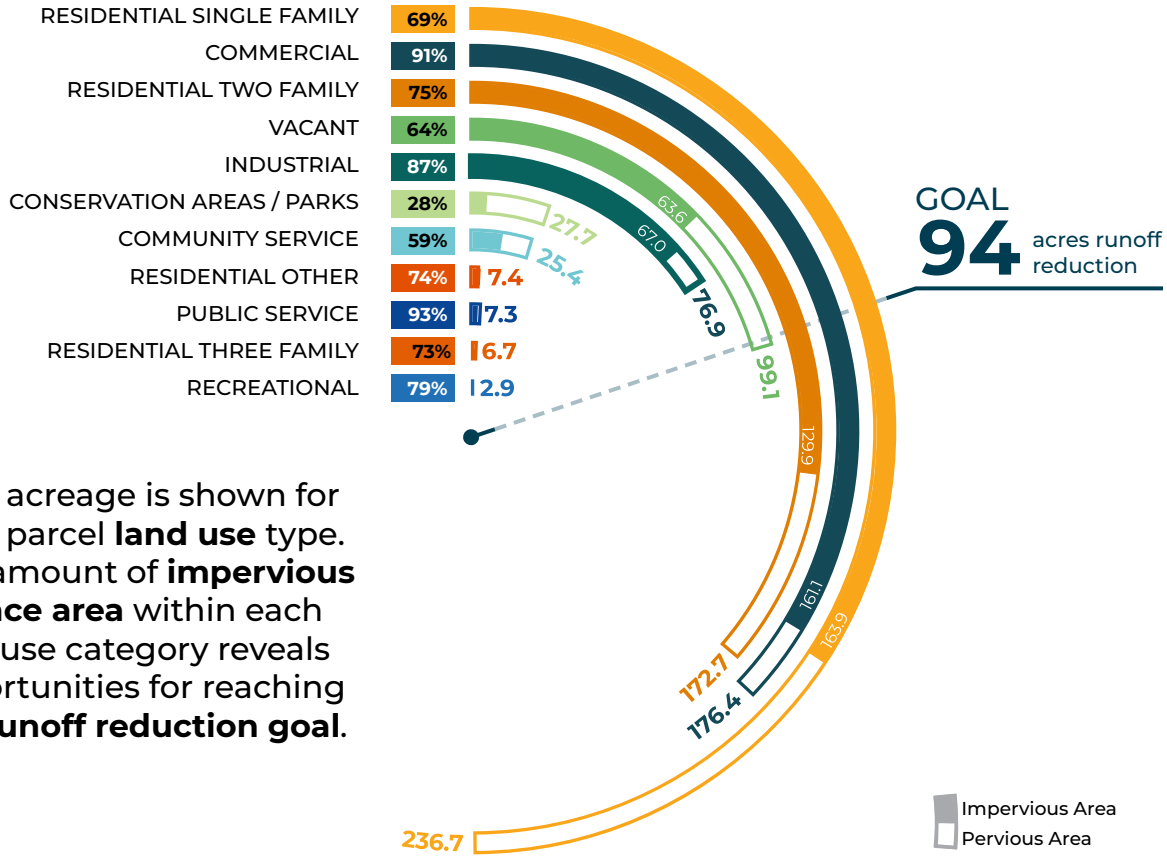
The CSO basin contains regional destinations, such as the Clinton-Bailey Farmer's Market and Niagara Frontier Food Terminal. These could be projects that highlight green infrastructure and foster economic revitalization.

BY THE NUMBERS...

Land Use Opportunity and Impervious Surfaces by Area

Basin **33**

1268 total acres



Total acreage is shown for each parcel **land use** type. The amount of **impervious surface area** within each land use category reveals opportunities for reaching the **runoff reduction goal**.

Basin Overview

1268 acres
TOTAL BASIN AREA

22,569
RESIDENTS

$29,927
MEDIAN HOUSEHOLD INCOME

162 acres
OF CANOPY AREA

31 acres
OF PARK AREA

310 acres
OF RIGHT OF WAY

121 acres
OF ROAD AREA

251 acres
OF BUILDING AREA

54 acres
OF PARKING LOTS

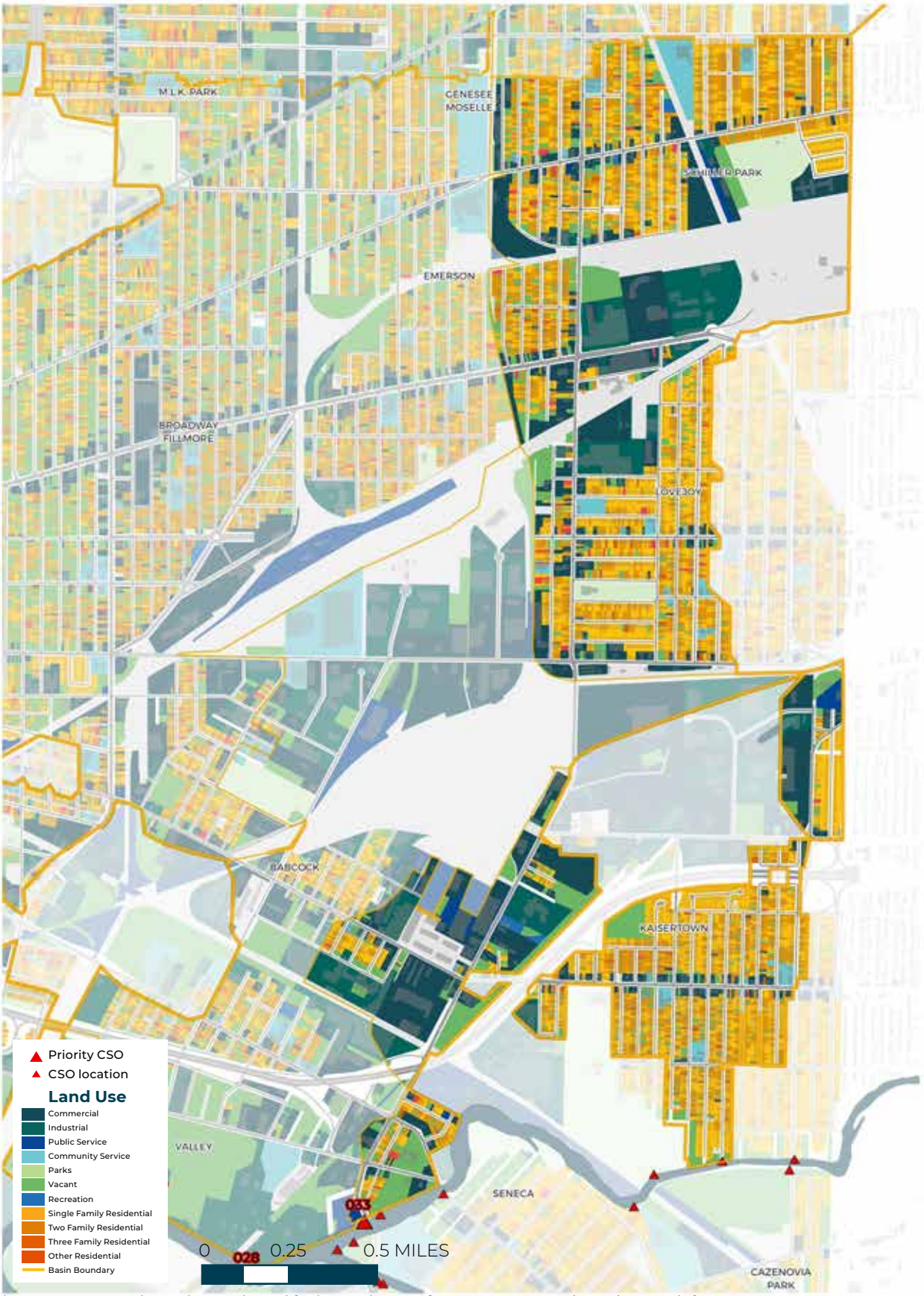


Figure 33.1: CSO Basin 33 Sites evaluated for impervious surface management through green infrastructure.

Opportunity Sites & Networks

Corridors

Bailey Avenue is the major north-south corridor running through the CSO. It's intersection with east-west corridors of Clinton, Broadway, William, and Walden form important neighborhood centers. Green infrastructure along these major corridors provides opportunities for creating networks of green infrastructure that connect adjacent properties. It would also provide greater access to green space in neighborhoods with minimal access.

Sites

Many of the sites surveyed in CSO Basin 33 were large commercial properties with large parking lots along the corridors. Retrofitting these large impervious sites with green infrastructure makes a major contribution to meeting the impervious acre management goal in this basin. Even opportunistic sites, such as Big Lots! are still good green infrastructure candidates because of their large impervious area. The key parks identified in this basin were also evaluated for the potential for green infrastructure retrofit and the possibility to bring stormwater from the street into some of the parks. Key institutions have large impervious areas that could be retrofit with green infrastructure and could be partners in workforce development.

Clusters and Networks

The large clusters of primarily commercial properties adjacent to major corridors provides the opportunity to create clusters or network of green infrastructure around neighborhood centers. Such clusters are based both on physical proximity as well as programmatic synergies, such as between Clinton-Bailey Farmers Market and Niagara Food Terminal.

Key Corridors

- Bailey Avenue
- Clinton Street
- Broadway
- William Street
- Kaisertown Central Business District

Key Parking Lots

1. Big Lots! parking lot
2. Walden Park parking lot
3. School bus and commercial vehicle

Key Institutions

4. Catholic Charities
5. Dominican Nuns
6. Kaisertown Business Community
7. Clinton-Bailey Farmers Market
8. Niagara Food Terminal

Key Parks

1. Houghton Park
2. Hennepin Park
3. Walden Park

CORRIDORS are networked, physically connected systems around a road or right-of-way

OPPORTUNISTIC SITES are stand alone sites with a high opportunity for green infrastructure

CLUSTERS have an anchor institution or are groups of parcels that can implement similar strategies

NETWORKS are larger systems of capture and treatment incorporating many sites

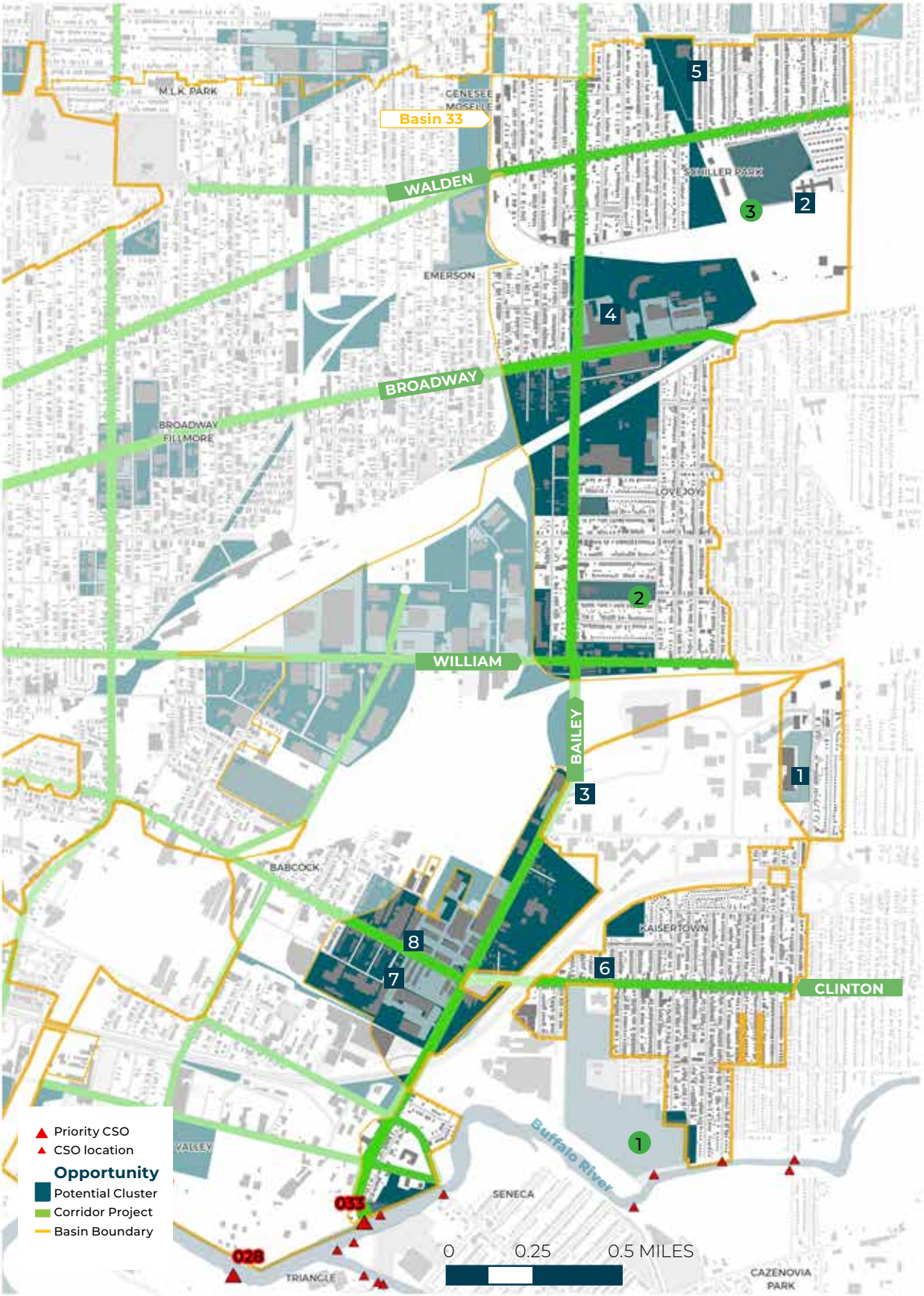


Figure 33.2: CSO Basin 33 Green Infrastructure Opportunity Sites

Green Infrastructure Opportunity
Niagara Food Terminal Green Infrastructure Node

The cluster of the Niagara Food Terminal and Clinton-Bailey Farmers' Market is an excellent candidate for green infrastructure investment because it couples historic public space and community resources with new investment and beautification. The Niagara Food Terminal is an industrial and market district on the eastern edge of CSO Basin 33 and shares many conditions similar to other urban industrial areas with heavy vehicular traffic. In addition, the terminal is a significant cultural center for Buffalo and the East Side.

This cluster has significant impervious surface area that is a major contributer to stormwater runoff to the sewer system. The Terminal is situated at the intersection of two significant corridors: Bailey and Clinton, which can also benefit from green infrastructure and traffic calming to creating a more walkable district. Tree planting and roadside bioswales would expand canopy cover and improve walkability in the neighborhood. Conducting a street tree campaign would help to connect important habitat corridors, and limit dust pollution from high traffic streets. Porous paving could be used in parking lots and market stalls, allowing stormwater to infiltrate and creating visual interest. There are many large, flat roofs in this area, which are significant contributers of stormwater runoff. Roof runoff could be addressed through the addition of green roofs, where this is feasible, or by disconnecting roof downspouts and directing them to bioretention areas or collecting the water for reuse in cisterns. Vacant land adjacent to rail lines could be retrofitted to handle stormwater from this cluster as well. Furthermore, by adding green space to this neighborhood center, access to green space for residents can be increased.

Strategies

- **Porous paving**
- **Green roofs**
- **Downspout disconnection**
- **Bioretention**

Potential Partners

- **Niagara Frontier Food Terminal**
- **Clinton-Bailey Farmers Market**
- **Cornell Cooperative Extension**
- **Babcock Boys and Girls Club**
- **Seneca Babcock Community Center**
- **NY State / Bailey Avenue Projects**

Figure 33.3: Historic image of Buffalo Food Terminal

Figure 33.4: Historic image of The Niagara Frontier Growers Co-operative Market

Placemaking Opportunity with Green Infrastructure

Creating a cluster of green infrastructure around Clinton and Bailey not only reduces stormwater runoff entering the sewers, but is also an opportunity to support the revitalization of these important community assets. The addition of street trees creates more walkable streets, contributes to traffic calming, and helps reduce the urban heat island effect, all of which provide environmental and health benefits as well as contributing to neighborhood revitalization.

Figure 33.5: Rendering of Possible green infrastructure opportunity node at Niagara Foods

ANALYSIS

Urban Character

The urban character of CSO Basin 33 is diverse and contains residential, commercial, industrial, and open spaces. This diversity will likely lead to a wide range of green infrastructure technologies being deployed in this CSO basin. The CSO basin has a population of 22,569 people. There are two dominant residential typologies present, the first is dense single family detached housing. The second type is single and multifamily detached housing in areas with medium to high parcel vacancy from block to block.

There are 583 commercial or industrial buildings in CSO Basin 33. Commercial properties are present along the important east-west City corridors of Clinton St, William Ave, and Broadway, as well as in a continuous Industrial District that cuts north-south through Emerson, Lovejoy, Babcock, Kaisertown, and the Valley. These properties are most large flat-roofed buildings with large parking lots or working yards that are paved or heavily compacted. There are significant physical divisions in this CSO basin created by multiple rail lines, train yards, and Interstate I-190.

Investment in green infrastructure in CSO Basin 33 will support a number of broader planning efforts, including the Local Waterfront Revitalization Program, which includes the Buffalo River, the Buffalo River Corridor Brownfield Opportunity Area, and the Buffalo Green Code. Bailey Avenue runs through this CSO, which has several neighborhood centers along it. Neighborhood centers along Clinton Street are also within CSO Basin 33, as well as neighborhood centers at Broadway and Bailey, Walden and Bailey, and Clinton and Bailey, including the Clinton-Bailey Farmers Market and Niagara Food Terminal.

The Kaisertown neighborhood, which is partially located in CSO Basin 33, has one of the highest projected increases in home values according to Zillow. Also the Seneca-Babcock neighborhood, which is also partially located in this CSO basin, is seeing a high level of industrial development per square mile.

Figure 33.6: CSO Basin 33 contains pockets of dense single family detached housing, seen here between Casimir St and Clinton Ave in Kaisertown.

Figure 33.7: Box store commercial lining the western edge of residential blocks along South Ogden St.

Figure 33.8: CSO Basin 33 has a number of large corridors that are flanked by larger commercial or industrial land uses and example is seen here at the intersection of Bailey Ave and Broadway

Figure 33.9: Mixed rates of vacancy between streets are visible here in the contrasting Burgard Pl with both Brinkman Ave and Goembel Ave.

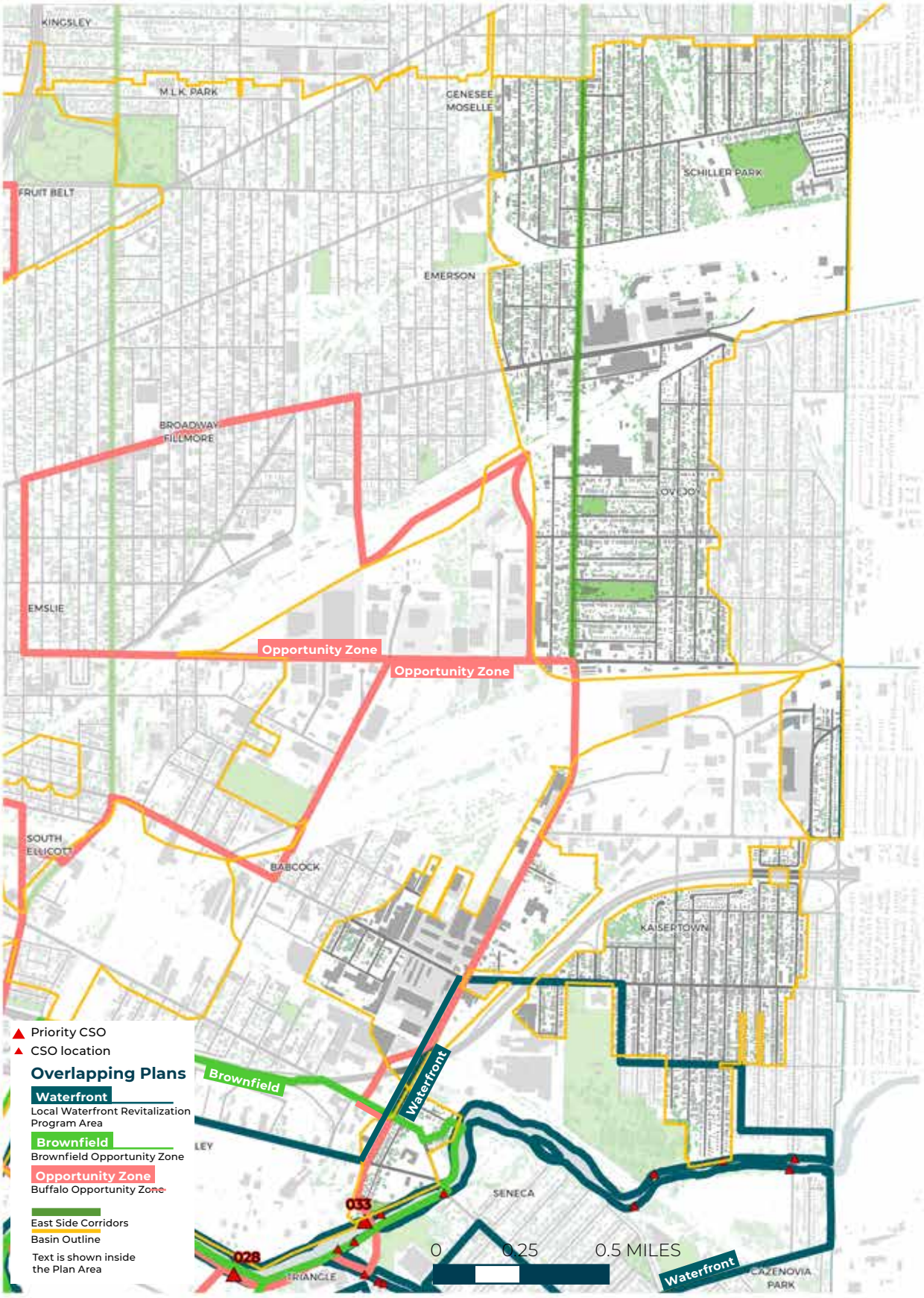


Figure 33.10: CSO Basin 33 Land Use

ANALYSIS

Equity Analysis

The boundaries of CSO Basin 33 intersect with several neighborhoods in Southeast Buffalo, including Babcock, Emerson, Kaisertown, Lovejoy, Schiller Park, and Seneca. The area is also home to several regional destinations like the Clinton-Bailey Farmers Market and the Niagara Frontier Food Terminal. The area is a mixture of residential, commercial, institutional and industrial uses, including neighborhood business districts and community amenities.

Similar to CSO Basin 27, the presence of wide roads, highways, and large lots can make the area seem somewhat geographically isolated, limit walkability, and pose safety issues for pedestrians and transit users. There could be opportunities for green infrastructure to break up large areas such as parking lots, create buffer zones between roads and sidewalks, and enhance walkability and public safety, especially around crosswalks and transit stops.

Across many demographic and economic indicators, residents in this area largely reflect the City overall. The median household income, poverty rate, and unemployment rate are mostly on par with the City overall. The majority of households are renters and cost burdened, which may limit the feasibility of green infrastructure on private property. Given this reality, neighborhood businesses and neighborhood commercial corridors might be good priorities for stakeholder engagement and investment in residential areas.

Additionally, CSO Basin 33 neighborhoods are home to a number of active community centers, service agencies, and public schools that could be good partners for community engagement and project implementation. An evaluation of the community capacity for the neighborhood area and these specific organizations to accept, plan for, promote, and maintain green infrastructure practices is critical. As CSO Basin 33's population is largely representative of the City overall, it may provide a good model for piloting new education and outreach efforts to gain insight into challenges and opportunities for Rain Check 2.0.

Neighborhood Profile Snapshot

22,569
RESIDENTS

$29,927
MEDIAN HOUSEHOLD INCOME

87.3%
ATTAIN LESS THAN A BACHELOR'S DEGREE

$57,865
MEDIAN VALUE OF OWNER-OCCUPIED HOMES

31.5%
OF HOUSEHOLDS DO NOT HAVE A VEHICLE

-20.1%
2000–2016
POPULATION CHANGE

32.8%
RESIDENTS LIVING IN POVERTY

41.3%
WORKING AGE NOT EMPLOYED*

37.7%
RESIDENTS ARE PEOPLE OF COLOR

49.8%
HOUSEHOLDS ARE RENTERS

The data presented is for census tracts located within or that intersect the CSO basin boundaries, as an approximation of neighborhoods (see Appendix A for more details and methods)
*Includes those that are unemployed or out of the labor force.

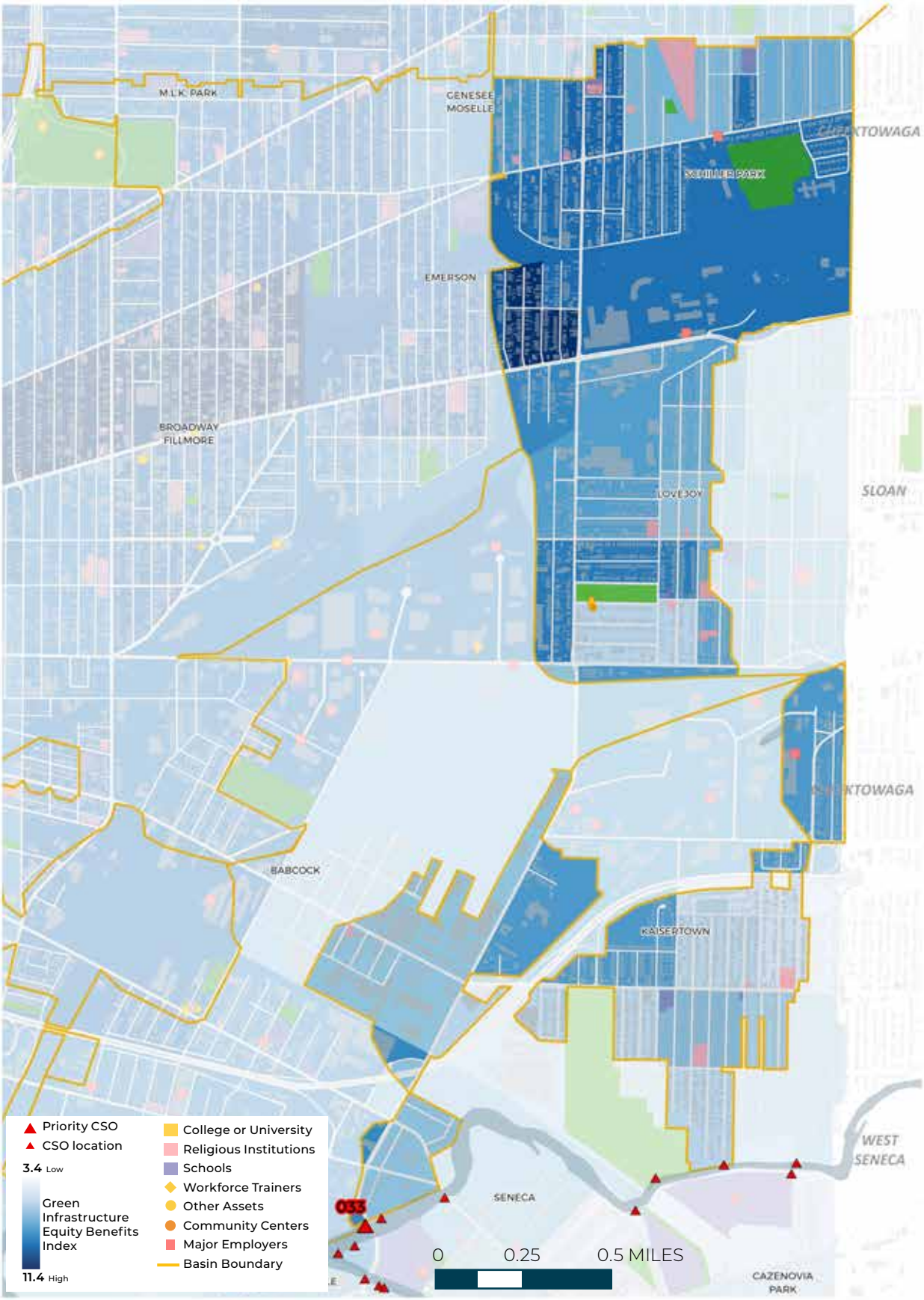


Figure 33.11 CSO Basin 33 and GI Equity Index

ANALYSIS

Environmental Systems

Waterways

CSO Basin 33 sits on the Buffalo River in a stretch that is less industrial and has wider riparian zones compared to the lower stretches where the river meanders toward the Buffalo Harbor. This basin has some of the best access to the river compared to other regions by way of Houghton Park and dead end residential roads.

Tree Canopy Cover

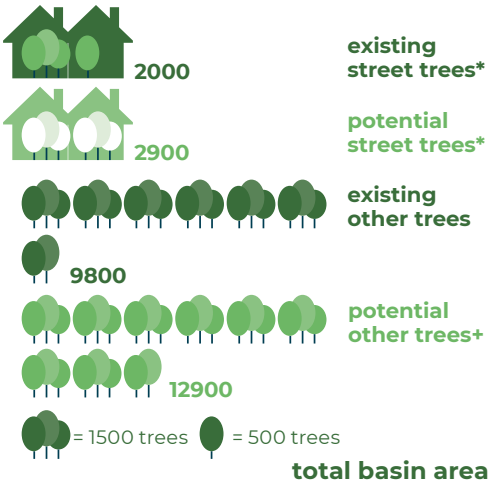
CSO Basin 33 has a deficit of canopy cover compared to the rest of the City. There are a number of densely vegetated pockets throughout or adjacent to the CSO basin along old rail corridors and the interstate, as well as along parks and cemeteries. These moments of concentrated habitat are offset by the large commercial and industrial parcels, commercial corridors, and some residential neighborhoods, which are almost completely devoid of trees. The commercial corridors in particular would benefit from increased tree planting. Expanding canopy corridors from both the Buffalo River and between rail corridors could significantly improve the habitat network in this area without needing to span large distances.

Habitat Connectivity

CSO Basin 33 is attached to and a part of several major habitat corridors and patches within the City, including the Buffalo River and the old rail network and rail yards. The latter provide significant open-space continuity within the Buffalo green space system. Future work could be done to help augment the habitat network's integrity.

Tree Canopy Summary

NUMBER OF TREES IN BASIN



Sources: *City of Buffalo MyTreeKeeper data, +U.S. Forest Service protocol with input from the Tree Technical Advisory Committee. For detailed description of methodology, see Appendix C

Figure 33.12: Potential for Habitat Connectivity in CSO Basin 33

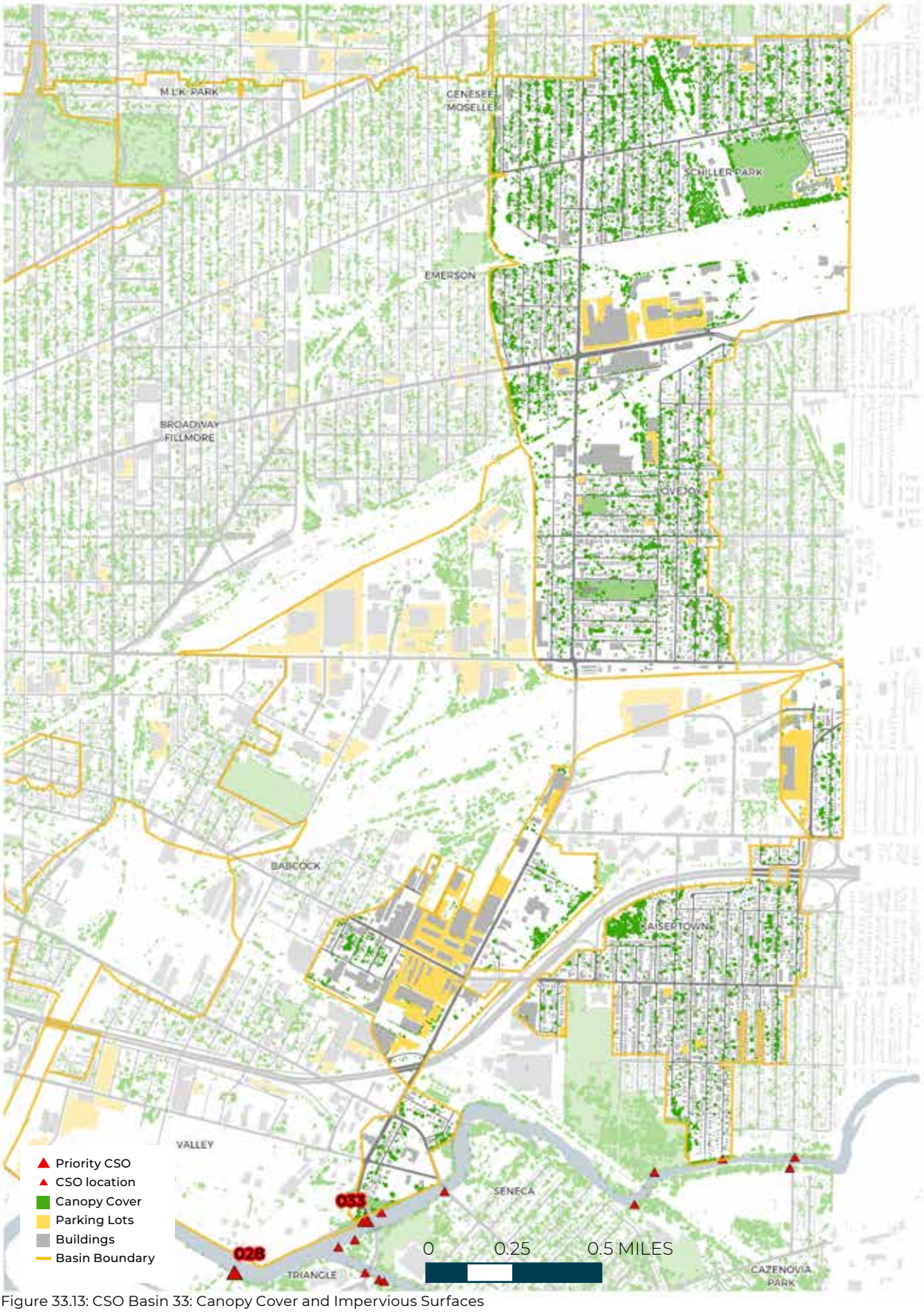


Figure 33.13: CSO Basin 33: Canopy Cover and Impervious Surfaces

ANALYSIS

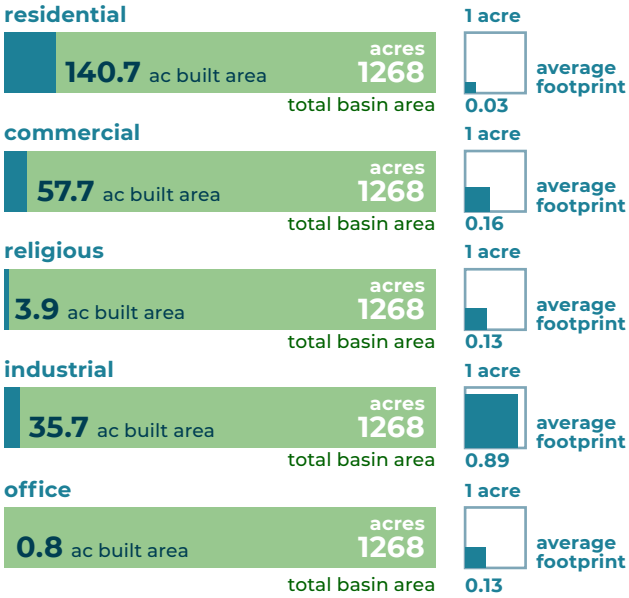
Site Analysis

Site analysis for CSO Basin 33 consisted predominantly of commercial properties. These sites included several businesses along Broadway and Bailey that shared common parking areas, often located in the front of the parcel. Drainage at these locations generally slopes toward the street and landscaping near entrances have deteriorated. These adjacent, commercial locations present opportunities to aggregate drainage capture from multiple properties with a single green infrastructure technology. Commercial properties that relied upon trucking services were often removed from consideration during site analysis in favor of more accessible locations. Frequent truck traffic presents several challenges for implementation of green infrastructure. It limits visibility of the green infrastructure and complicates construction mobilization. Existing drainage patterns are also not always ideal for green infrastructure retrofit.

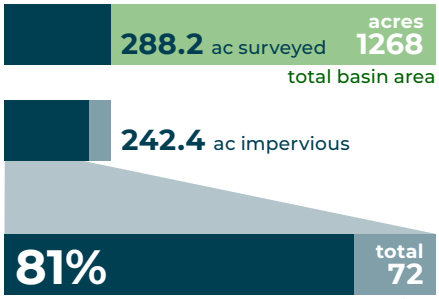
Parks and churches were also evaluated. These locations were often surrounded by residential properties and distinct from the large, commercial sites. The site analysis focused on green infrastructure retrofits that maximized drainage capture from both the parcel and adjacent street flow. Multiple retrofits were proposed on sites where drainage patterns from compacted space varied.

Built Area by Land Use

Full Basin Area, GIS sources: Erie County data, Buffalo Sewer Authority data



The site analysis reviewed 23% of the basin and found 38.2 acres of potential drainage area.



of the sites were suitable for green infrastructure.

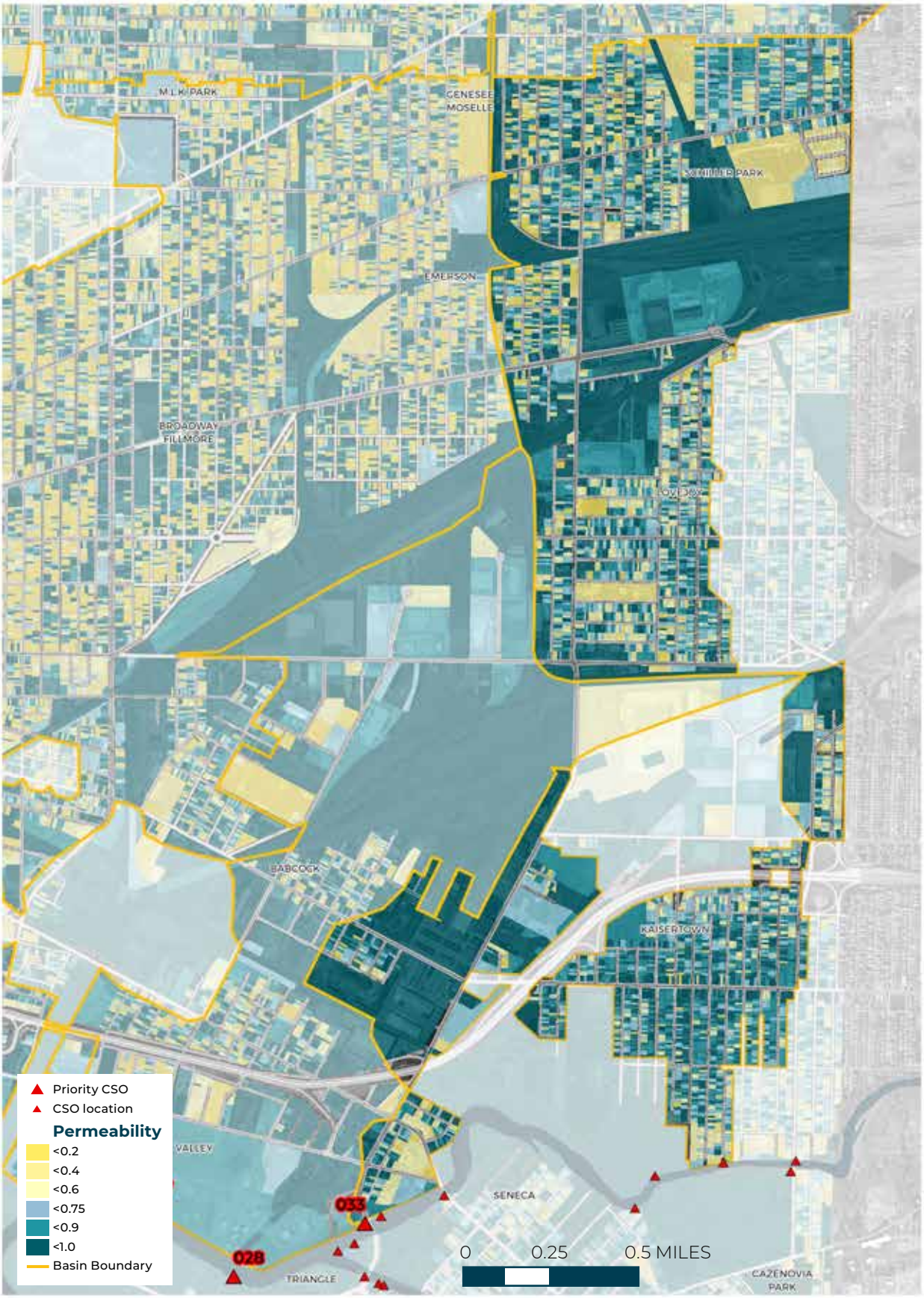


Figure 33.14: CSO Basin 33 Percent Impervious by Parcel

ANALYSIS

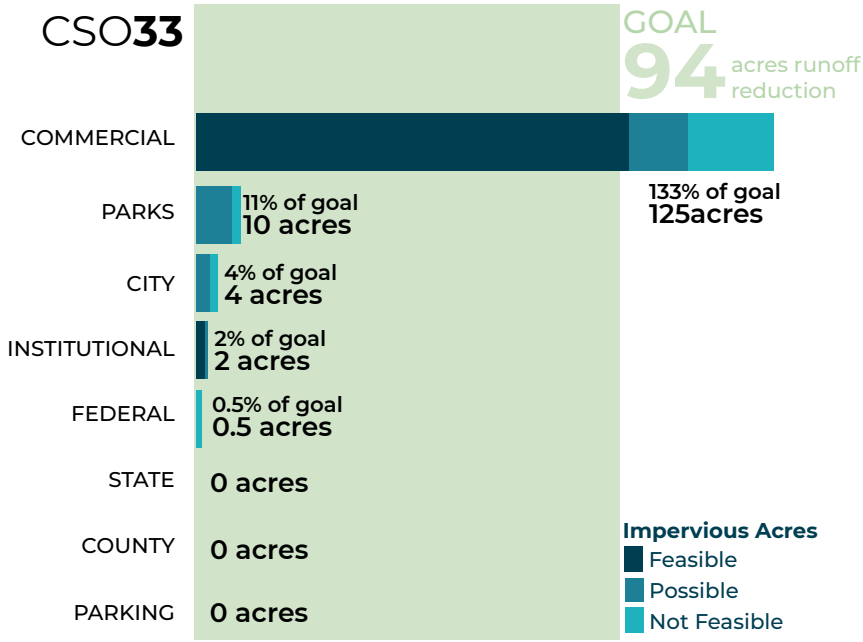
Site Analysis: Surveyed Properties

Figure 33.14: Examples of sites surveyed.

Commercial corridors flanked by commercial properties are strong areas of opportunity in CSO Basin 33.

Surveyed Properties by Land Use and Ownership

GIS sources: Erie County data, Buffalo Sewer Authority data



LARGEST PROPERTY OWNERS BY LAND USE AND OWNERSHIP

COMMERCIAL

Center One LLC
9.8 Imperv. acres

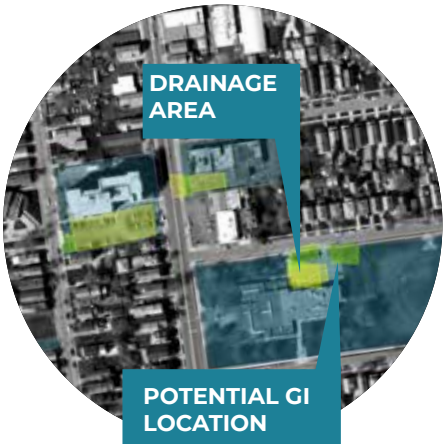
ACME Building
7.7 Imperv. acres

Aim Transportation Solutions
7.5 Imperv. acres

Clinton Bailey Farmers Market
7.4 Imperv. acres

Commercial and institutional properties along key corridors in CSO Basin 33, like Bailey Avenue, were surveyed.

From this, the team was able to determine that many of these properties can retain stormwater on site. This could become part of a perimeter buffer, or could be networked in corridor improvements to take a complete streets approach.



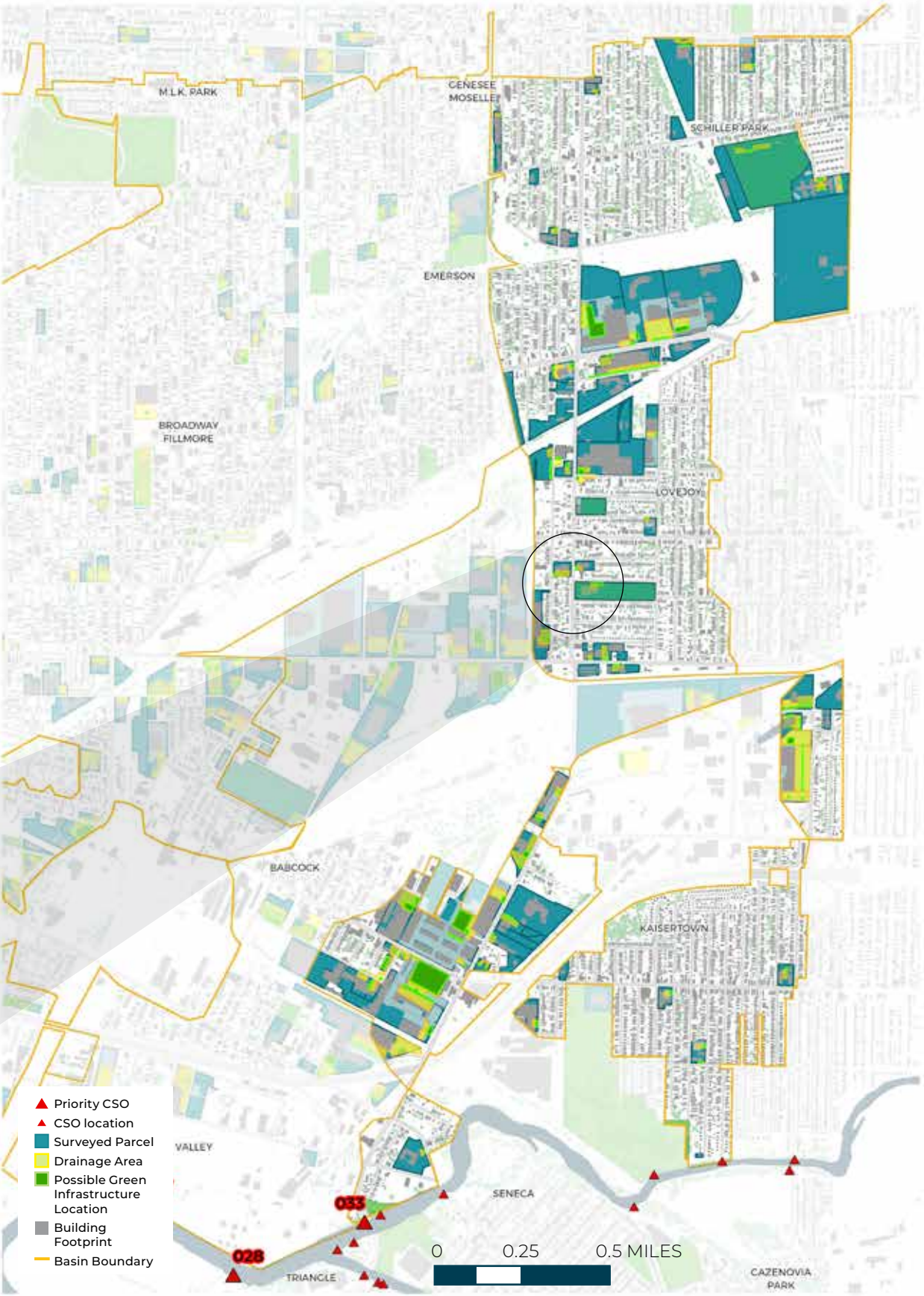


Figure 33.16: CSO Basin 33: Sites analyzed showing parcels, drainage areas and potential green infrastructure.

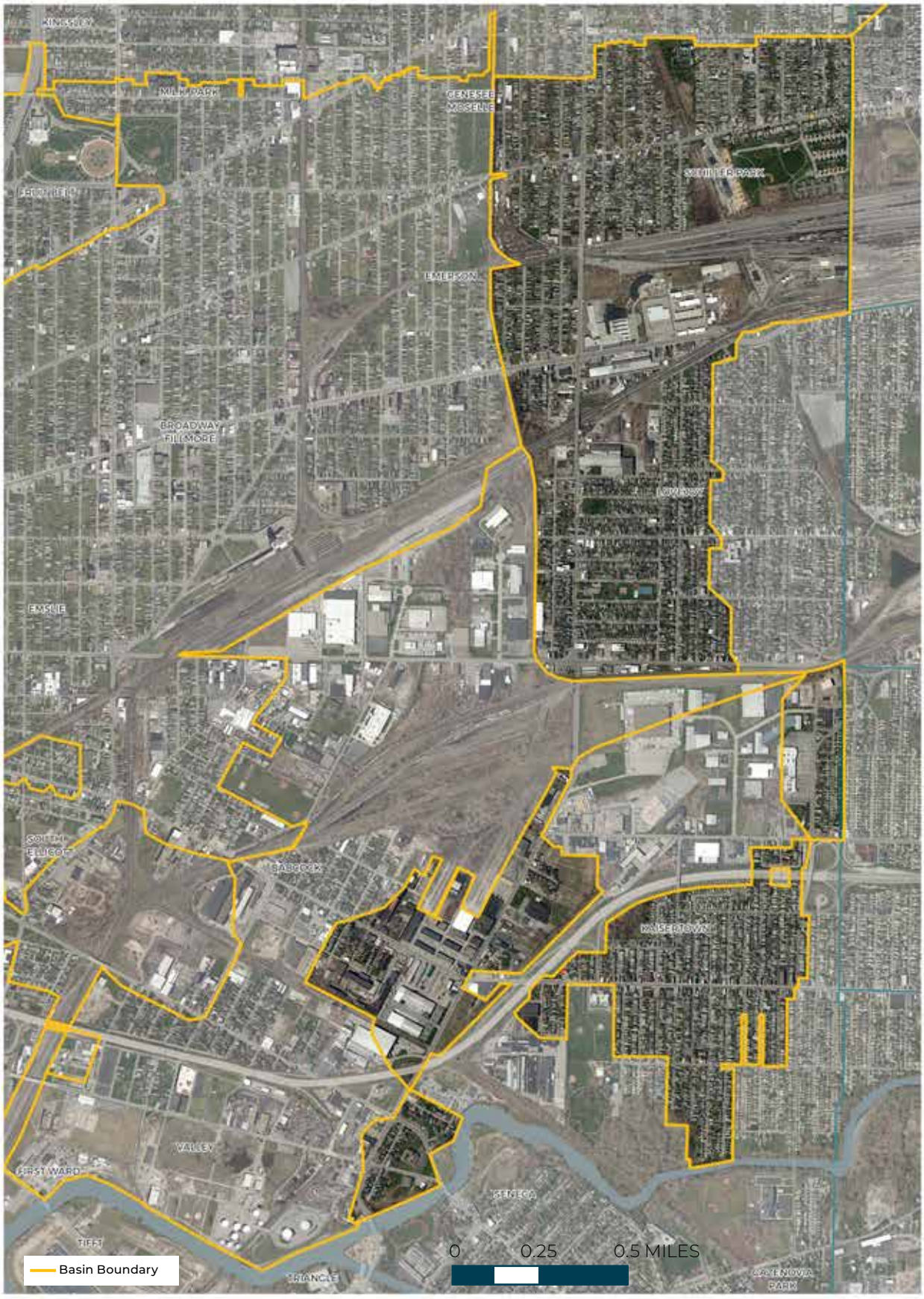


Figure 33.17: CSO Basin 33 Boundary on Aerial.

Figure 33.18: CSO Basin 33 Map of Built Environment and Tree Canopy


CSO53

When a drop of water lands at the intersection of Fillmore Avenue and Delavan Avenue, it is joined by water from the neighborhoods of Parkside, Leroy, Kensington, Kenfield, Schiller Park, Genesee Moselle, Grider, MLK Park, Hamlin Park, Cold Spring, Masten Park, Kingsley, and the Fruit Belt. During heavy wet weather, the rainwater combines with sewage and overflows into Scajaquada Creek at Combined Sewer Overflow 53 (CSO 53).

CSO **Basin 53 at a glance...**

Green Infrastructure Opportunities

CSO Basin 53 is the largest of the priority CSO Basins in terms of both area and population and it also has the largest goal at 299 impervious acres managed. Given the magnitude of the goal, it cannot be met in any one land use. Achieving the goal will require a combination of commercial, parking lots, institutional and city owned property, including the public rights-of-way.

Urban Character

Because of its size, CSO Basin 53 has a diversity of land uses, including commercial corridors, highways, large parking lots and medium density detached housing. There are both high levels of vacant land and high levels of vacancy.

Environmental Systems

Tree canopy overall for CSO Basin 53 is higher than the City average. Much of the tree canopy is located on the interior of blocks, rather than street trees. Given the size and diversity of the basin, the tree canopy is highly variable and targeted investments in increasing canopy cover, particularly street trees, may still be appropriate in this CSO basin.

Equity Considerations

Nearly a quarter of the population of Buffalo lives in the neighborhoods located within and around CSO Basin 53 and it contains the largest share of people of color of any targeted CSO basin. Based on the GI equity index (see Appendix A) this area has a high need for green infrastructure investment. This area includes anchor institutions and major employers that draw many workers and visitors, as well as residential communities. Funding support for green infrastructure, especially to community partners, will enable a range of community stakeholders to participate in the program. Schools, workforce trainers, and employers in this area are good partners for green infrastructure workforce development programs. Green infrastructure could be a unique opportunity to foster increased collaboration and partnerships among the range of educational and workforce institutions located in this area toward green economy solutions for the City's future.

Community Benefits

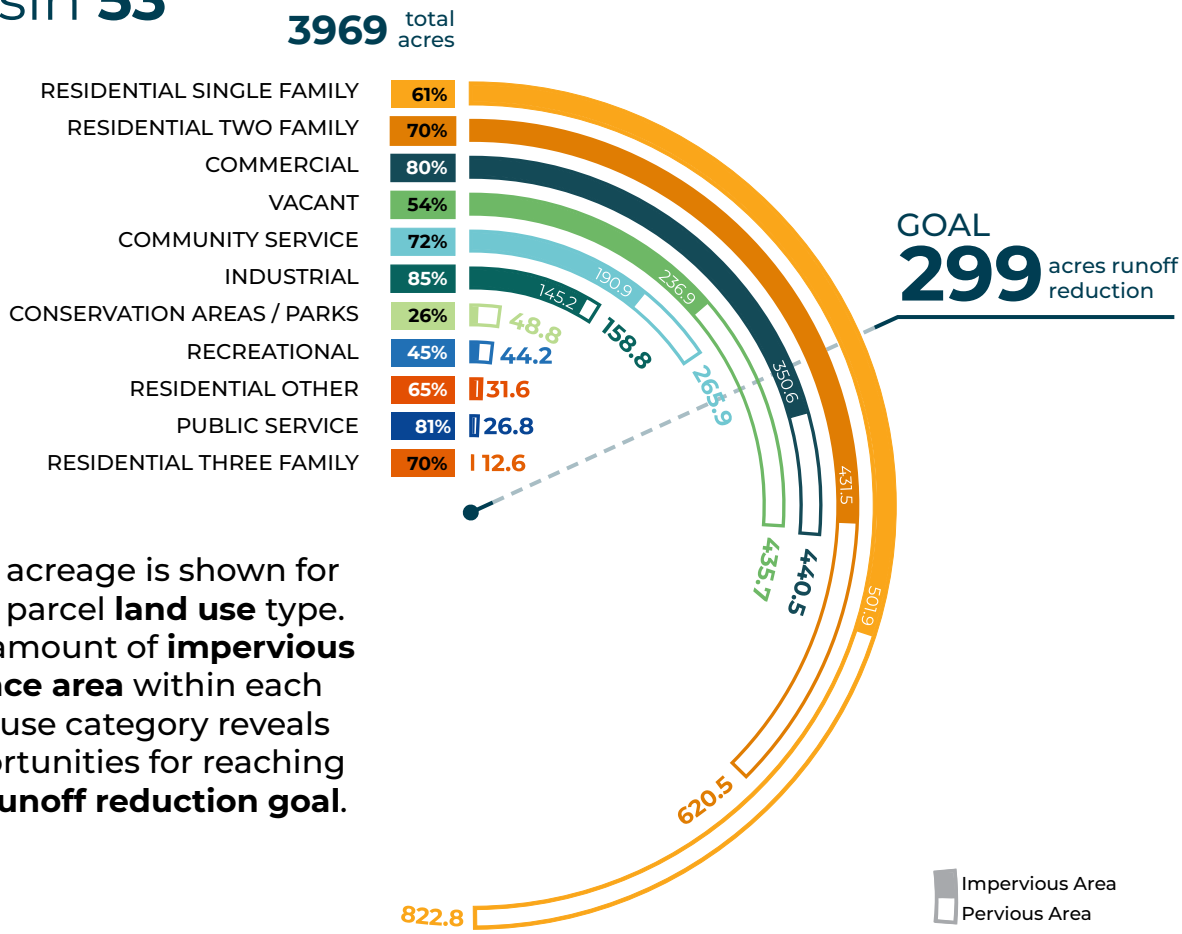
- Reconnect neighborhoods by creating a deck park over the Scajaquada expressway
- Workforce development
- Green Jobs
- Tree planting programs
- Improving the public realm
- Walkability
- Traffic Calming
- Expanded canopy cover
- Support for neighborhood revitalization efforts
- Reduced urban heat island effect
- Cleanup and revitalization of vacant land

BY THE NUMBERS...

Land Use Opportunity and Impervious Surfaces by Area

Basin **53**

3969 total acres



Total acreage is shown for each parcel **land use** type. The amount of **impervious surface area** within each land use category reveals opportunities for reaching the **runoff reduction goal**.

Basin Overview

3969 acres
TOTAL BASIN AREA

64,289
RESIDENTS

$26,777
MEDIAN HOUSEHOLD INCOME

481 acres
OF CANOPY AREA

93 acres
OF PARK AREA

980 acres
OF RIGHT OF WAY

485 acres
OF ROAD AREA

791 acres
OF BUILDING AREA

172 acres
OF PARKING LOTS

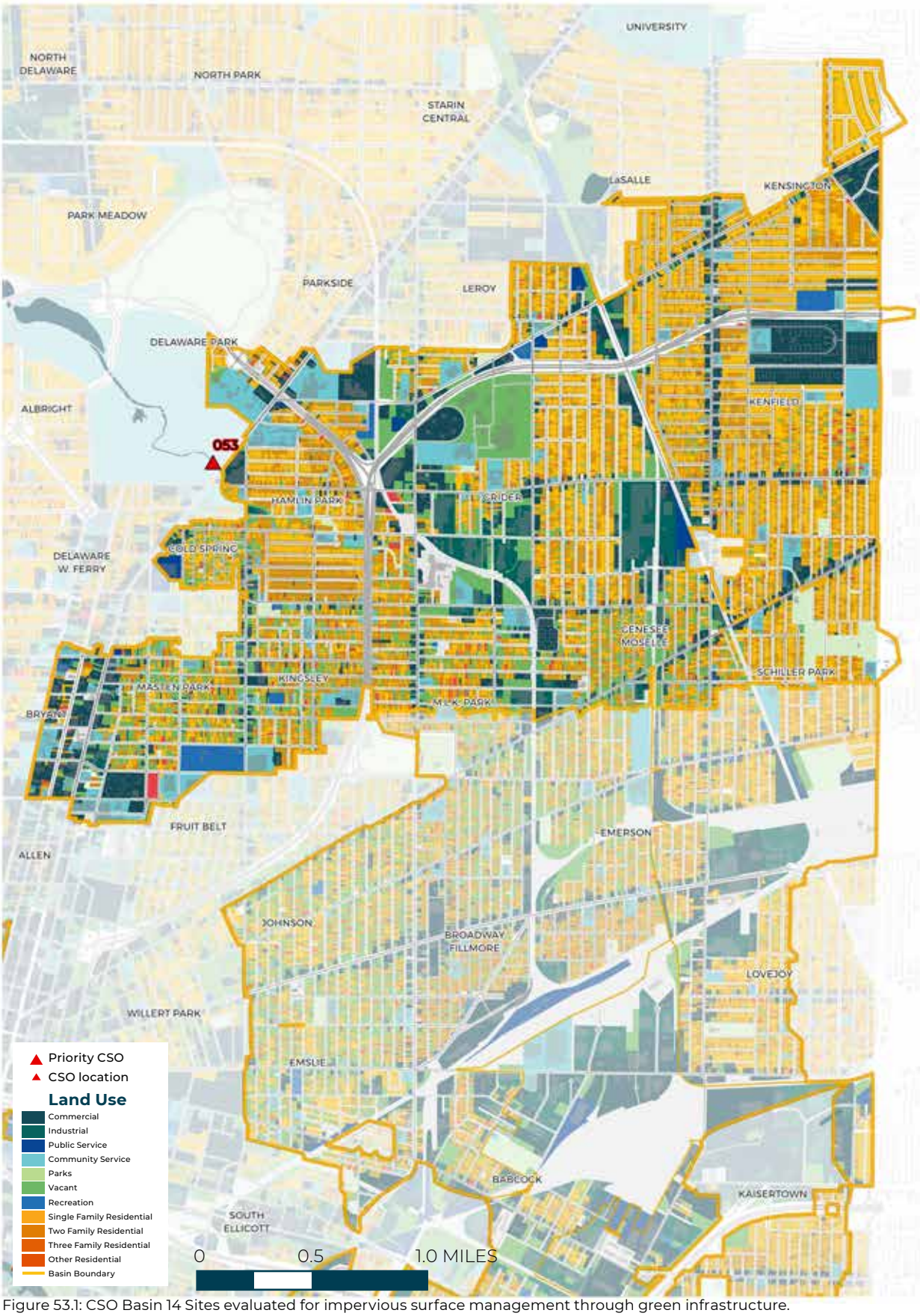


Figure 53.1: CSO Basin 14 Sites evaluated for impervious surface management through green infrastructure.

Opportunity Sites & Networks

Corridors

In CSO Basin 53, corridor green infrastructure will be critical to meeting the stormwater goal. The predominance of large corridors in this basin allows for the organization of green infrastructure into larger networked system, increasing the overall potential effectiveness of green infrastructure in the basin. The Scajaquada Creek corridor also presents the opportunity to incorporate Buffalo's water history into green infrastructure and make underground infrastructure visible. Adding a cap park to the Scajaquada expressway would provide an opportunity for both green infrastructure and neighborhood connectivity.

Sites

The sites inventoried for green infrastructure retrofit in CSO Basin 53 focused on businesses and large institutional campuses as well as community partners institutions. These sites are organized along many key corridors or grouped in industrial or commercial areas.

Clusters and Networks

Combining feasible retrofit sites, important institutional sites, and corridors reveals the existence of key clusters within CSO Basin 53. In addition to physical proximity, the presence of community institutions provides the opportunity for clusters to have a programmatic focus, such as workforce development, community health, or economic development.

Key Corridors

- Kensington Avenue
- Michigan Avenue
- Jefferson Avenue
- Northland Avenue
- Fillmore Avenue
- Genesee Street
- Main Street
- Grider Street
- Ferry Street
- Delavan Avenue
- 33 Expressway

Key Businesses

1. OSC Manufacturing and Equipment Services
2. Buflovak LLC
3. Milk-Bone Plant
4. Indigo Productions

Key Institutions

5. BUDC Redevelopment
6. Erie County Medical Center (ECMC)
7. Sisters of Charity Hospital
8. Medaille College
9. Canisius College
10. St. Stanislaus Church
11. True Bethel Baptist Church
12. City Honors School
13. Seneca Vocational High School
14. Northland Workforce Training Center

CORRIDORS are networked, physically connected systems around a road or right-of-way

OPPORTUNISTIC SITES are stand alone sites with a high opportunity for green infrastructure

CLUSTERS have an anchor institution or are groups of parcels that can implement similar strategies

NETWORKS are larger systems of capture and treatment incorporating many sites

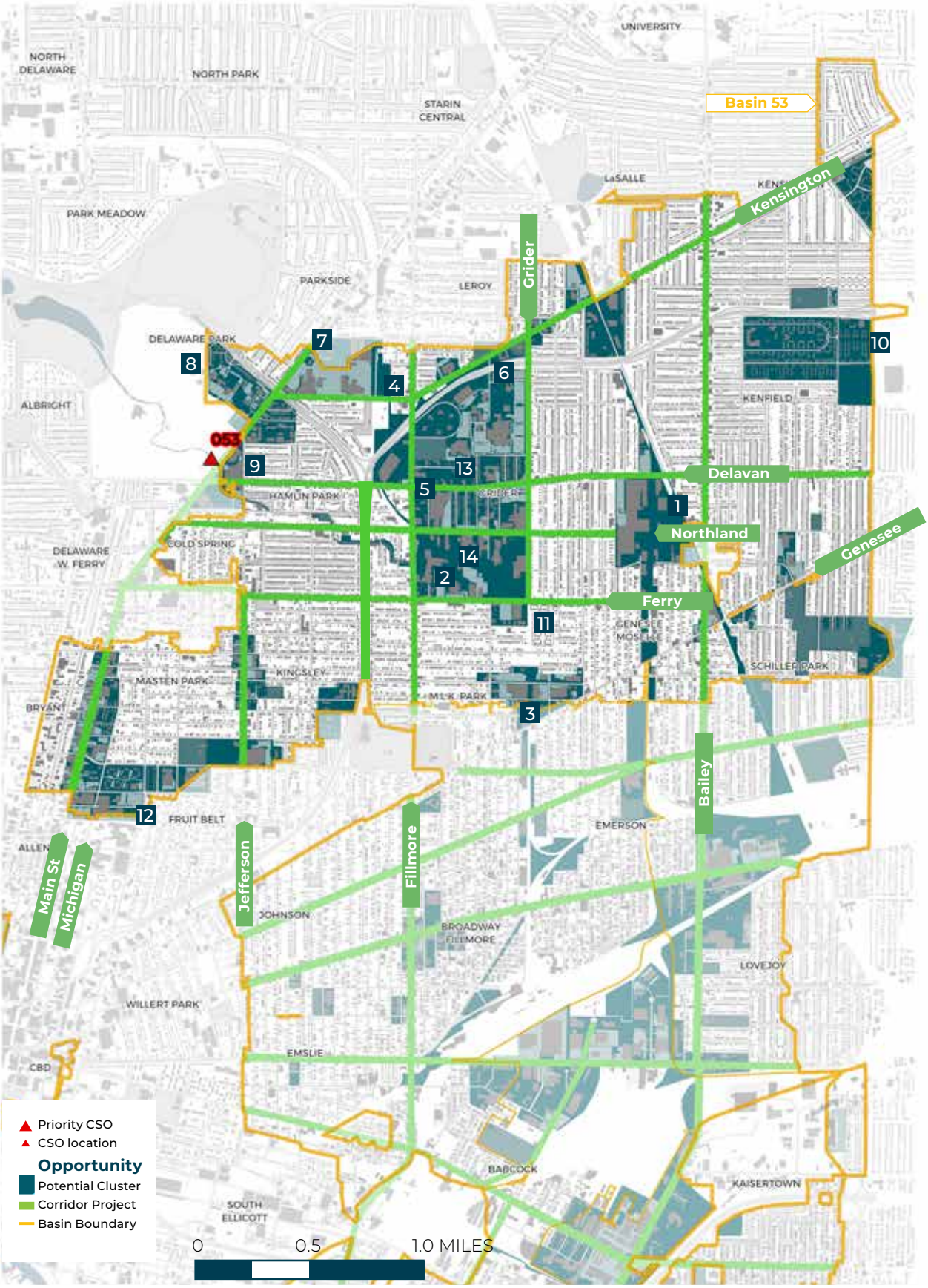


Figure 53.2: CSO Basin 53 Green Infrastructure Opportunity Sites

Green Infrastructure Opportunity
Commercial Building Clusters

Many of CSO Basin 53's large buildings are clustered together with parking lots for commuters. CSO Basin 53 presents an opportunity to showcase how green infrastructure can be integrated into the parking lots and campus areas.

Green infrastructure can help buffer the community from large parking lots and improve the appearance of commercial properties. Working with community groups can broaden the participation of stakeholders. Green infrastructure combined with complete streets can link together neighborhoods and enhance pedestrian experience and safety. Incorporating green infrastructure onto vacant land—putting it to more productive use - supports neighborhood revitalization.

The section of Northland Ave that passes between Fillmore and Grider is a good example of a green infrastructure cluster project for CSO 53. It engages community partners focused on workforce development, makes use of vacant parcels, beautifies important city corridors, and intersects with the underground course of Scajaquada Creek.

Partnerships with groups like Buffalo Urban Development Corporation (BUDC) can help showcase networked green infrastructure techniques while also adding attractive landscaping to the institution.

Strategies

- **Park improvements**
- **Detention ponds**
- **Parking lot planting**
- **Street trees**
- **Complete streets**
- **Curb bump outs**
- **Urban farming**
- **Green roofs**
- **Downspout disconnects**

Potential Partners

- **Sisters of Charity Hospital**
- **Medaille College**
- **Canisius College**
- **City Honors School**
- **Seneca Vocational High**
- **Erie County Medical Center**
- **BUDC**

Figure 53.3: "undated photograph shows the Houdaille Manufacturing Co." (BuffaloNews.com)

Figure 53.4: BUDC Redevelopment prior to demolition.

Placemaking Opportunity with Green Infrastructure

The development of green infrastructure around the cluster centered on the Northland Workforce Development Center demonstrates the many potential benefits of green infrastructure, incorporating elements of corridor improvements, urban agriculture and greening of parking lots. In addition to more effectively managing stormwater, this breadth of green infrastructure supports neighborhood development and revitalization goals, improves environmental quality and access to green space and improves public health and environmental quality as well as creates memorable neighborhood places.

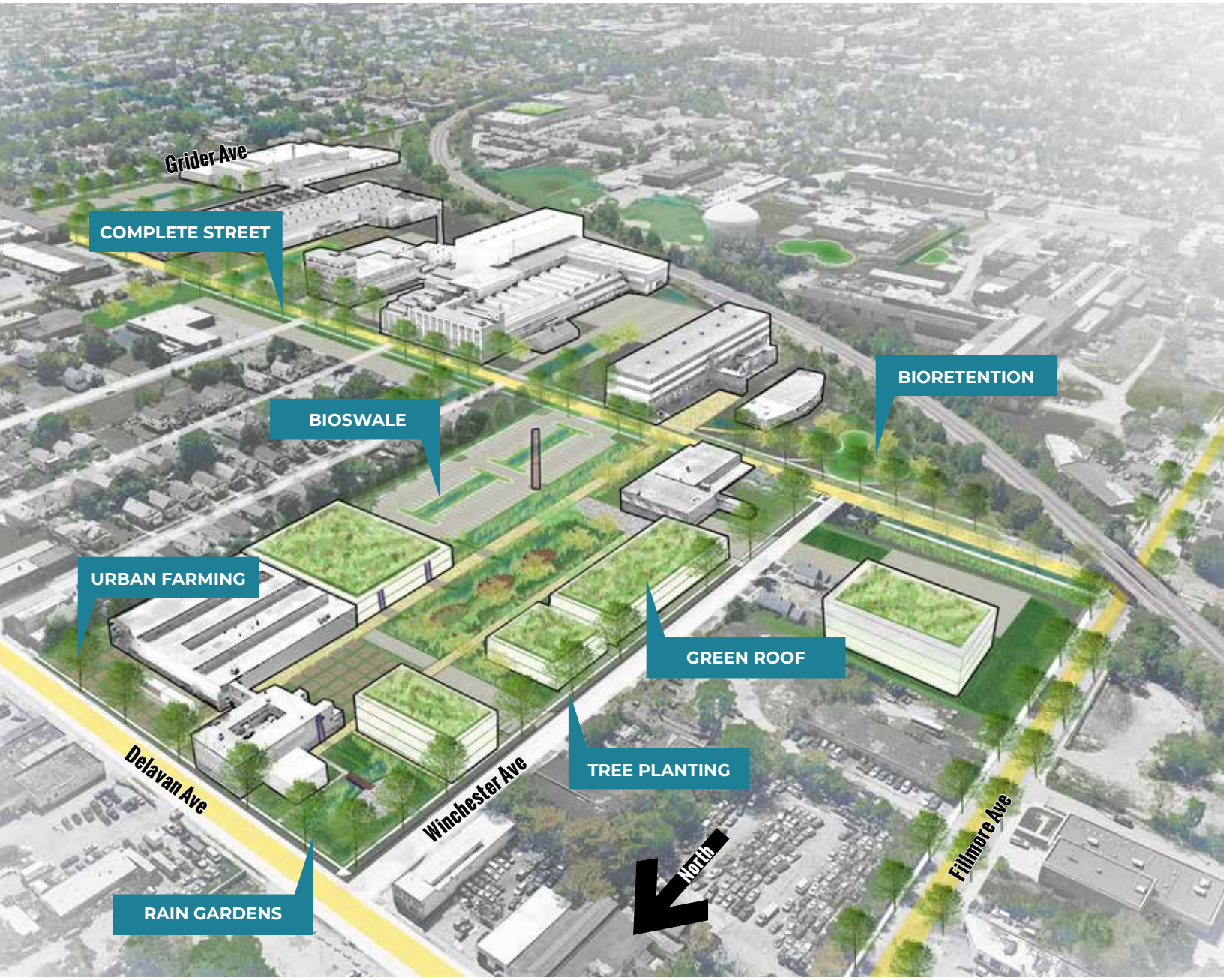


Figure 53.5: Northland Avenue new development cluster

ANALYSIS

Urban Character

Spanning the northeast section of the city, planning neighborhoods intersecting CSO Basin 53 include: Parkside, Leroy, Kensington, Kenfield, Schiller Park, Genesee Moselle, Grider, MLK Park, Hamlin Park, Cold Spring, Masten Park, Kingsley, and the Fruit Belt. CSO Basin 53 includes office buildings, ECMC, other large institutions, dense residential, less dense residential, and a few commercial corridors. There are several main clusters and corridors.

- Masten Park residential with commercial corridors. Characterized by high levels of vacancy and few street trees.
- Fillmore/Grider/East Ferry area with residential and manufacturing, which is divided by the railroad.
- Residential cluster in the north-east corner of the CSO basin and adjacent to the Buffalo Promise neighborhood.
- Residential Cluster in the south-east corner of the CSO basin.
- An institutional cluster around Canisius College, Medaille, and Sister's hospital.
- Erie County Medical Center (ECMC) Campus.
- Potential rails to trails at the edge of the CSO basin, which creates the potential to extend and create a continuity of green space.

Investment in green infrastructure in CSO Basin 53 will support a number of broader planning efforts, including the Local Waterfront Revitalization Program, which includes Scajaquada Creek, and the Buffalo Green Code. The CSO basin includes neighborhood centers along Main, Fillmore, Delavan, and Genesee. The institutional clusters around Canisius College, Medaille College, and Sisters Hospital are important anchors along Buffalo's knowledge corridor as laid out in the Green Code. Northland is also located within CSO Basin 53 and is an industrial redevelopment target in the Green Code.

Several neighborhoods partially located within CSO Basin 53 are experiencing notable residential development, including Hamlin Park, Elmwood-Bryant, and Kensington-Bailey. Elmwood-Bryant is also seeing notable levels of commercial development.

Figure 53.6: Kensington Expressway and a CSX rail line are examples of how infrastructure isolates neighborhoods and reduces walkability

Figure 53.7: ECMC between Grider St and the Kensington Expressway is an example of the large institutions that dominate parts of the CSO basin.

Figure 53.8: Dense single family detached housing comprises large pockets of CSO Basin 53 seen here in the eastern neighborhood of Kenfield.

Figure 53.9: Main St along Masten Park is an example of the strong commercial corridors that are driving growth in this basin

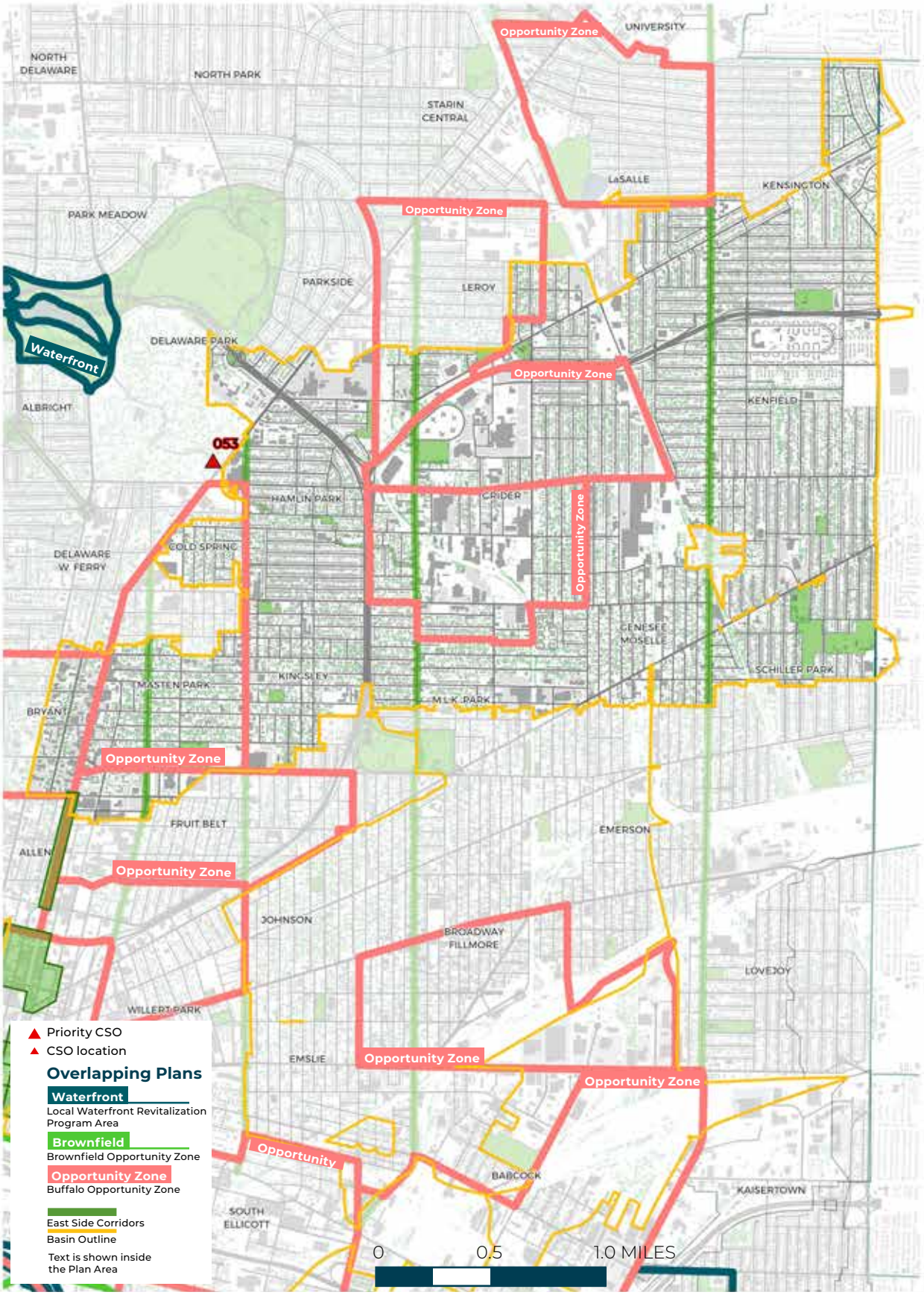


Figure 53.10: CSO Basin 33 Land Use

ANALYSIS

Equity Analysis

The most extensive basin with a population that makes up nearly a quarter of Buffalo, CSO Basin 53 has an elevated need for green infrastructure investments due to a number of interrelated factors. Covering much of the East Side, CSO Basin 53 has the largest share of people of color (86%) of any targeted investment area. The area also has lower rates of workforce participation and owner-occupancy, and higher poverty levels than the City overall. From an environmental perspective, the basin is marked by a relatively large share of vacant land (16%) and high vacancy rates, but also has the highest tree canopy coverage (16%) of any target basin.

There are a wide range of land uses represented in this basin given the broad cross-section of the City that it touches, including major institutions, employers, and recreational areas in the City of Buffalo. Major institutions and employers located in the area include Buffalo General Hospital, Sister's Hospital, Erie County Medical Center (ECMC) Hospital, Canisius College, and Harmac Medical Products. The area is also home to community amenities, including a large number of public schools, religious institutions, and neighborhood parks. The basin is also adjacent to Forest Lawn Cemetery, where a buried Scajaquada Creek that flows underneath many of these neighborhoods is uncovered and serves as a water feature in the landscape.

A wide range of typologies and strategies might be appropriate for just this one CSO basin, and the decision-making framework and approach to green infrastructure in this area could be a combination of approaches from other priority areas. In particular, it might be important to develop different strategies for major institutions located in the area and residential areas with commercial corridors, community amenities, and often high rates of vacancy. There are also many reasons to consider prioritizing workforce development in this area—it is the largest priority area and it is home to many major educational and workforce institutions including Canisius College, multiple hospitals, and the Northland Workforce Training Center. Furthermore, people living in these areas have lower rates of educational attainment and higher rates of poverty compared to the City overall, and the majority of workers are employed in service industries. Ensuring that residents and workers in these neighborhoods have opportunities to participate in the installation and maintenance of green infrastructure projects in the priority area could further equity considerations.

Neighborhood Profile Snapshot

64,289
RESIDENTS

$26,777
MEDIAN HOUSEHOLD INCOME

81.6%
ATTAIN LESS THAN A BACHELOR'S DEGREE

$51,196
MEDIAN VALUE OF OWNER-OCCUPIED HOMES

35.1%
OF HOUSEHOLDS DO NOT HAVE A VEHICLE

-14.2%
2000–2016
POPULATION CHANGE

35.4%
RESIDENTS LIVING IN POVERTY

45%
WORKING AGE NOT EMPLOYED*

85.6%
RESIDENTS ARE PEOPLE OF COLOR

62.7%
HOUSEHOLDS ARE RENTERS

The data presented is for census tracts located within or that intersect the CSO basin boundaries, as an approximation of neighborhoods (see Appendix A for more details and methods)
*Includes those that are unemployed or out of the labor force.

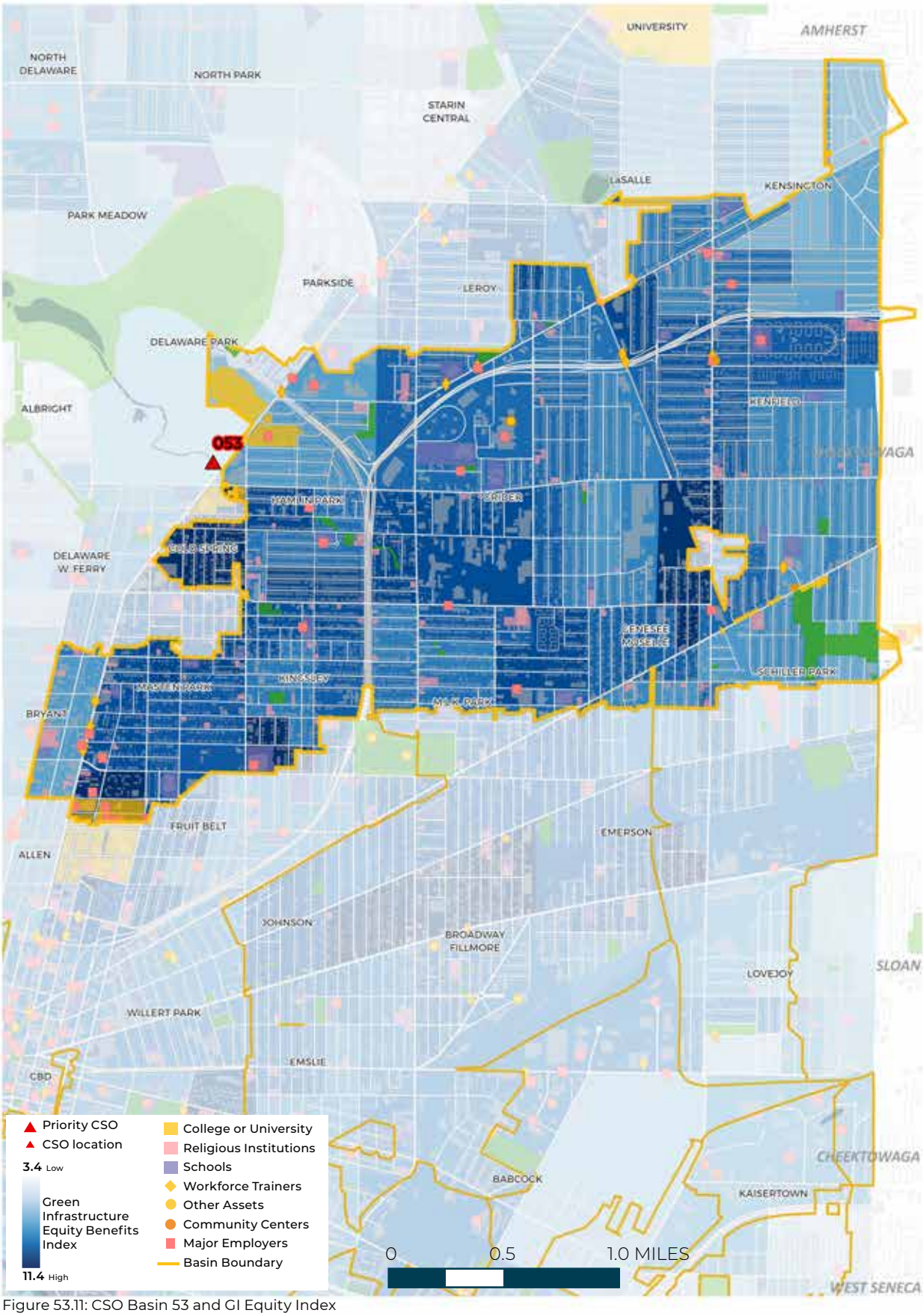


Figure 53.11: CSO Basin 53 and GI Equity Index

Environmental Systems

Waterways

CSO Basin 53 discharges to Scajaquada Creek in Delaware Park. Scajaquada Creek is below ground throughout the CSO basin. The CSO basin outfall occurs at the point where Scajaquada Creek emerges from underground. Parallel to the underground portion of Scajaquada is the primary sewer main that collects all stormwater from this basin.

Tree Canopy Cover

CSO Basin 53 has the highest canopy cover of any of the priority CSO Basins. However, the canopy cover varies considerably because of diverse land use and the large size of the basin. In some areas the canopy is higher than the average and in some areas it is absent. Also the canopy is predominantly in the interior of blocks and does not include many street trees. The CSO has available plantable acres almost equal to the amount of existing canopy acres and over 9,000 vacant tree spaces. Thus, despite its relatively high canopy cover rate, investment in canopy expansion is still appropriate in CSO Basin 53.

Habitat Connectivity

CSO Basin 53 has a number of rail corridors that provided primary habitat corridors between City and the surrounding region. These corridors are interrupted by several significant commercial corridors and expressways that reduce habitat continuity. The basin has no larger habitat patches but is adjacent significant open space, including a contiguous group of cemeteries to the east and the Grover Cleveland Golf Course to the north-east. These open spaces could be expanded or networked with new green infrastructure installations. To expand habitat, large barriers should be bridged and interior block patches integrated into networks connected to periphery patches.

Tree Canopy Summary

NUMBER OF TREES IN BASIN

Sources: *City of Buffalo MyTreeKeeper data, +U.S. Forest Service protocol with input from the Tree Technical Advisory Committee. For detailed description of methodology, see Appendix C

Figure 53.12: Potential for Habitat Connectivity in CSO Basin 53

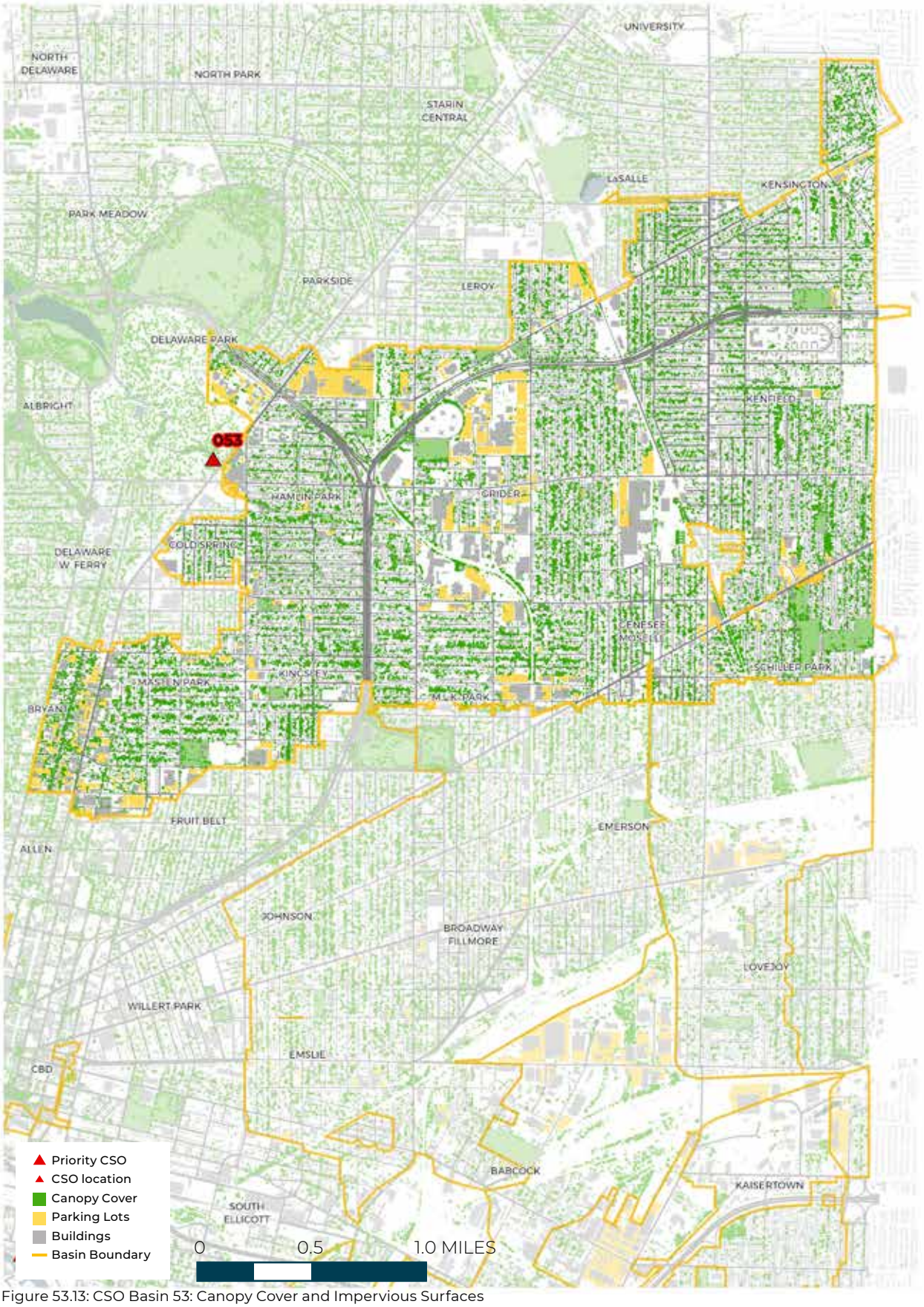


Figure 53.13: CSO Basin 53: Canopy Cover and Impervious Surfaces

ANALYSIS

Site Analysis

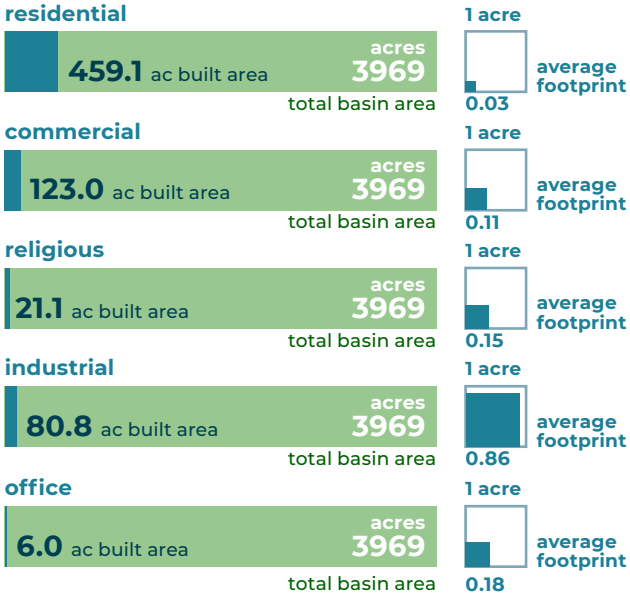
CSO Basin 53 is a very large land area spanning many neighborhoods. This is because the underground course of Scajaquada Creek, which traverses the whole of the basin, operates parallel to a large trunk line that drains this region. The management goal of 299 acres cannot be met by any one land use evaluated through the site analysis process. However, when compared to the large area of CSO Basin 53, the goal is just 10% of the total area.

Most of the land use is residential and roads, but there is a wide range of other uses, such as commercial and institutional. Public land use, including state, county, and City together, are the highest in this zone compared to the other target CSO basins, making up over 10% of the total area surveyed as part of the site analysis process. This opens up the possibility of managing all of the stormwater on public land to meet the goal. Partnerships with institutions such as hospitals may also be hugely beneficial given that the area of institutional property ownership is almost 30% of the goal.

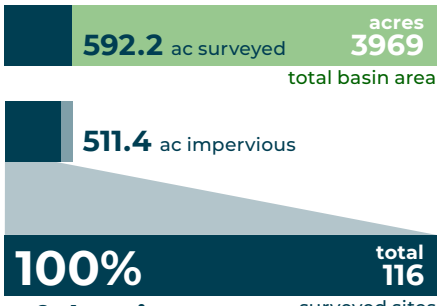
Many of the sites surveyed in this CSO basin focused on sites with large flat roofs or large parking lots because they represent the most efficient means of meeting stormwater goals. These sites also represent significant contributers to urban heat island effect and disrupt neighborhood walkability making them desirable green infrastructure improvement sites. Public rights-of-way comprise 25% of the land area in this basin. Future site analysis for green infrastructure retrofits should include streets as they provide a significant opportunity for stormwater reduction.

Built Area by Land Use

Full Basin Area, GIS sources: Erie County data, Buffalo Sewer Authority data



The site analysis reviewed 15% of the basin and found 113.6 acres of potential drainage area.



of the sites were suitable for green infrastructure.

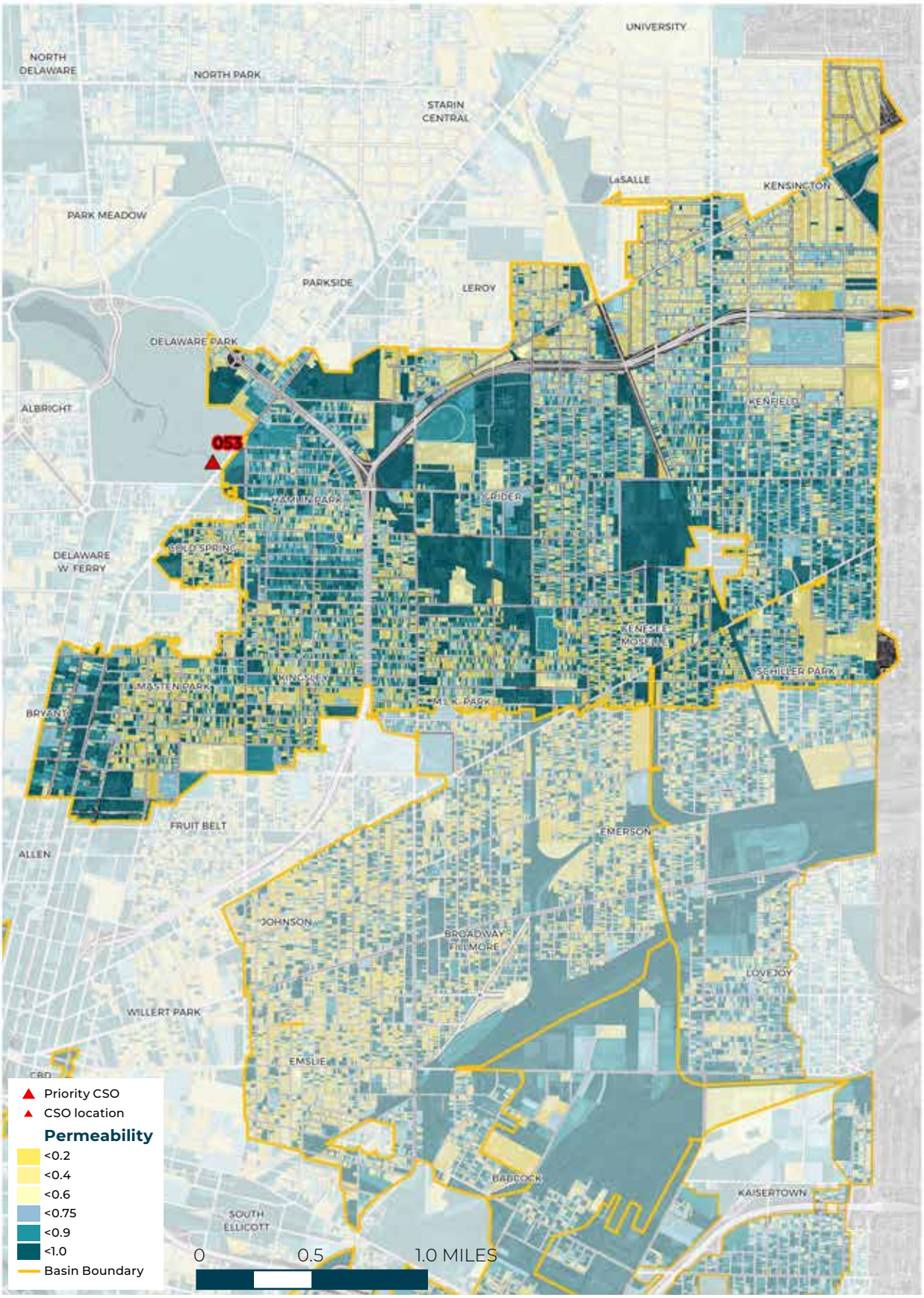


Figure 53.14: CSO Basin 53 Percent Impervious by Parcel

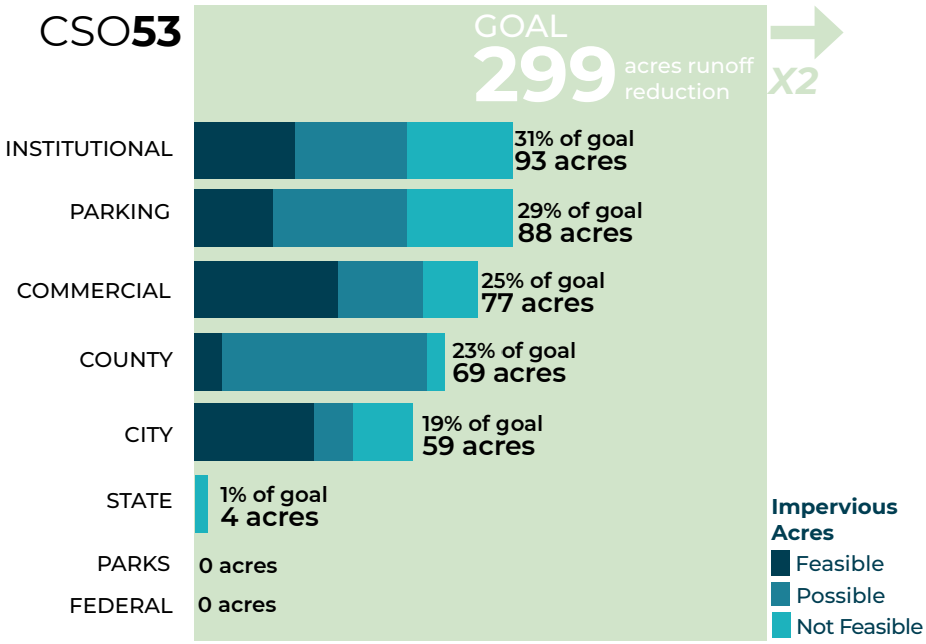
ANALYSIS

Site Analysis: Surveyed Properties

Figure 53.15: Examples of sites surveyed.

Surveyed Properties by Land Use and Ownership

GIS sources: Erie County data, Buffalo Sewer Authority data



LARGEST PROPERTY OWNERS BY LAND USE AND OWNERSHIP

INSTITUTIONAL

Sisters of Charity Hospital
15.8 Imperv. acres

Medaille College
13 Imperv. acres

Canisius College
9.7 Imperv. acres

ECMC
58.4 Imperv. acres

True Bethel Baptist Church
4.5 Imperv. acres

COMMERCIAL

National Grid
19.2 Imperv. acres

First Student
7.2 Imperv. acres

Rosalie and Healthy Chef
5.6 Imperv. acres

PARKING

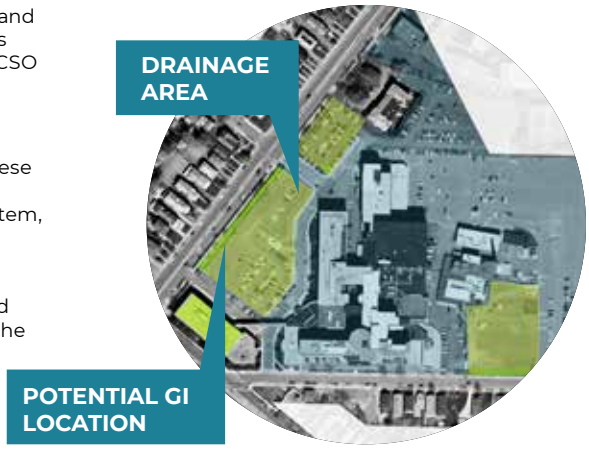
OSC
33.0 Imperv. acres

Buflovak LLC
14.7 Imperv. acres

BUDC Redevelopment
10.5 Imperv. acres

Large institutions and campus properties were surveyed in CSO Basin 53.

From this, the team was able to determine that these sites may best be managed as a system, especially if there is an institutional masterplan that guides growth and development for the site.



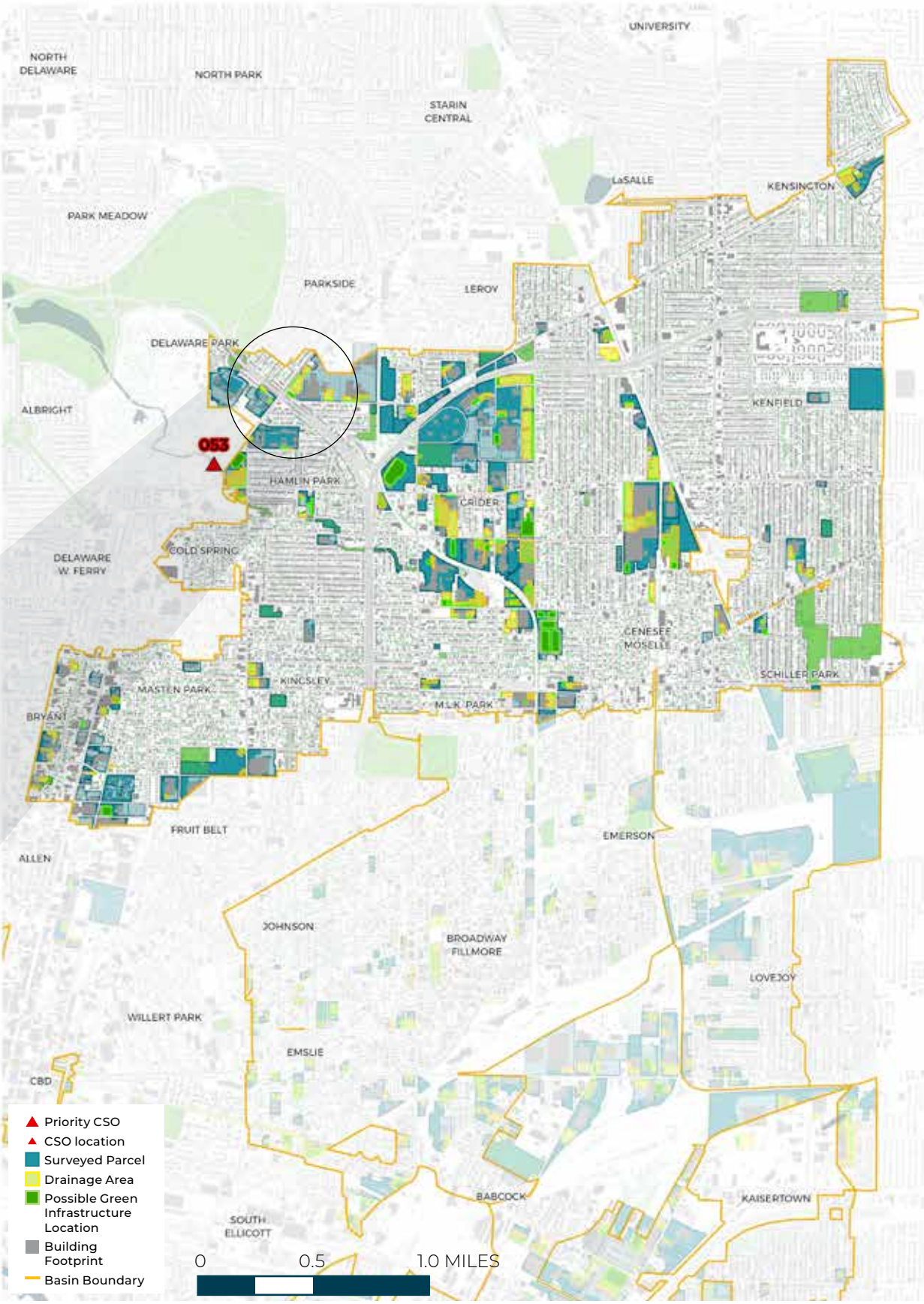


Figure 51.16: CSO Basin 53: Sites analyzed showing parcels, drainage areas and potential green infrastructure.

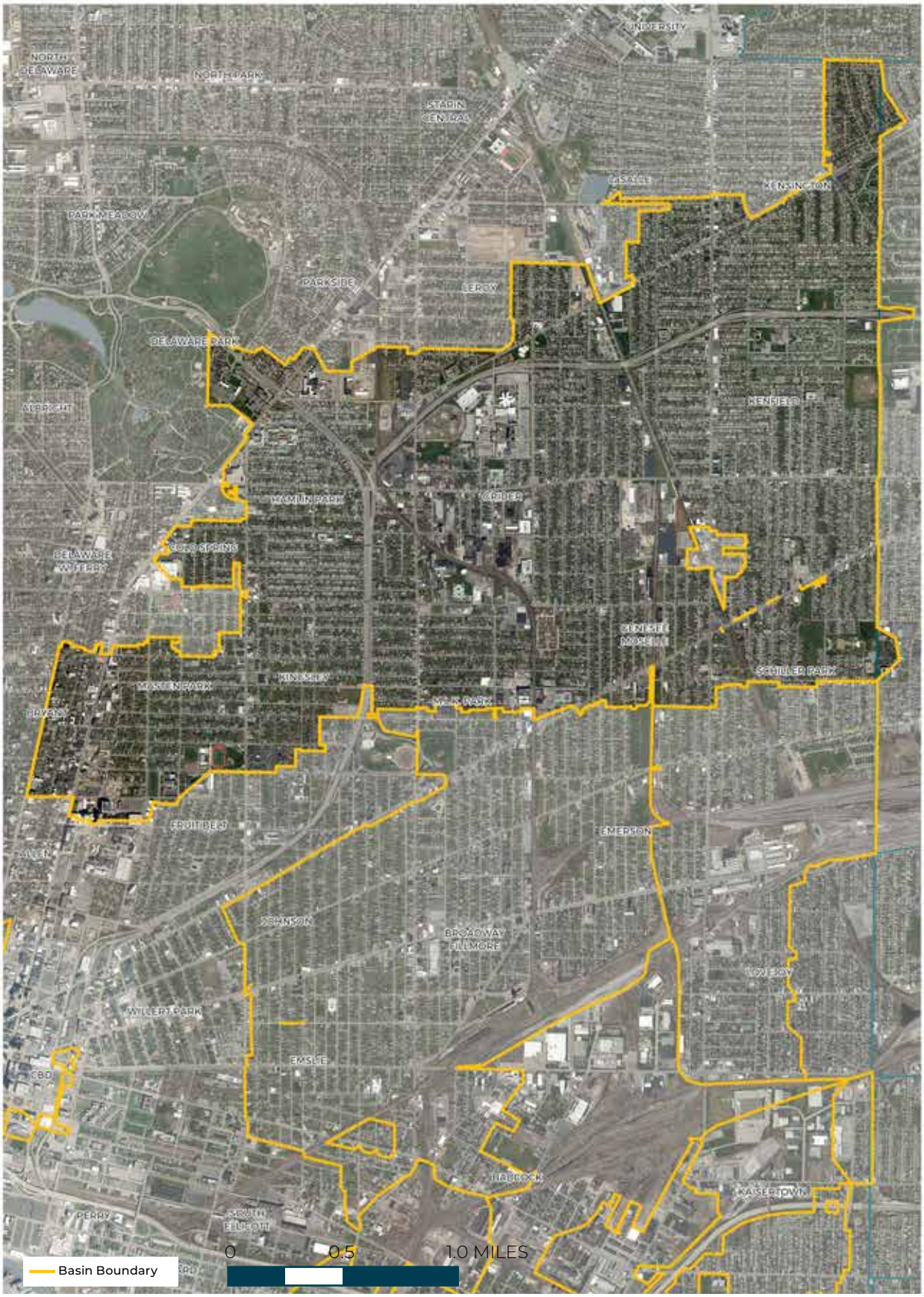


Figure 53.17 CSO Basin 53 Percent Impervious by Parcel

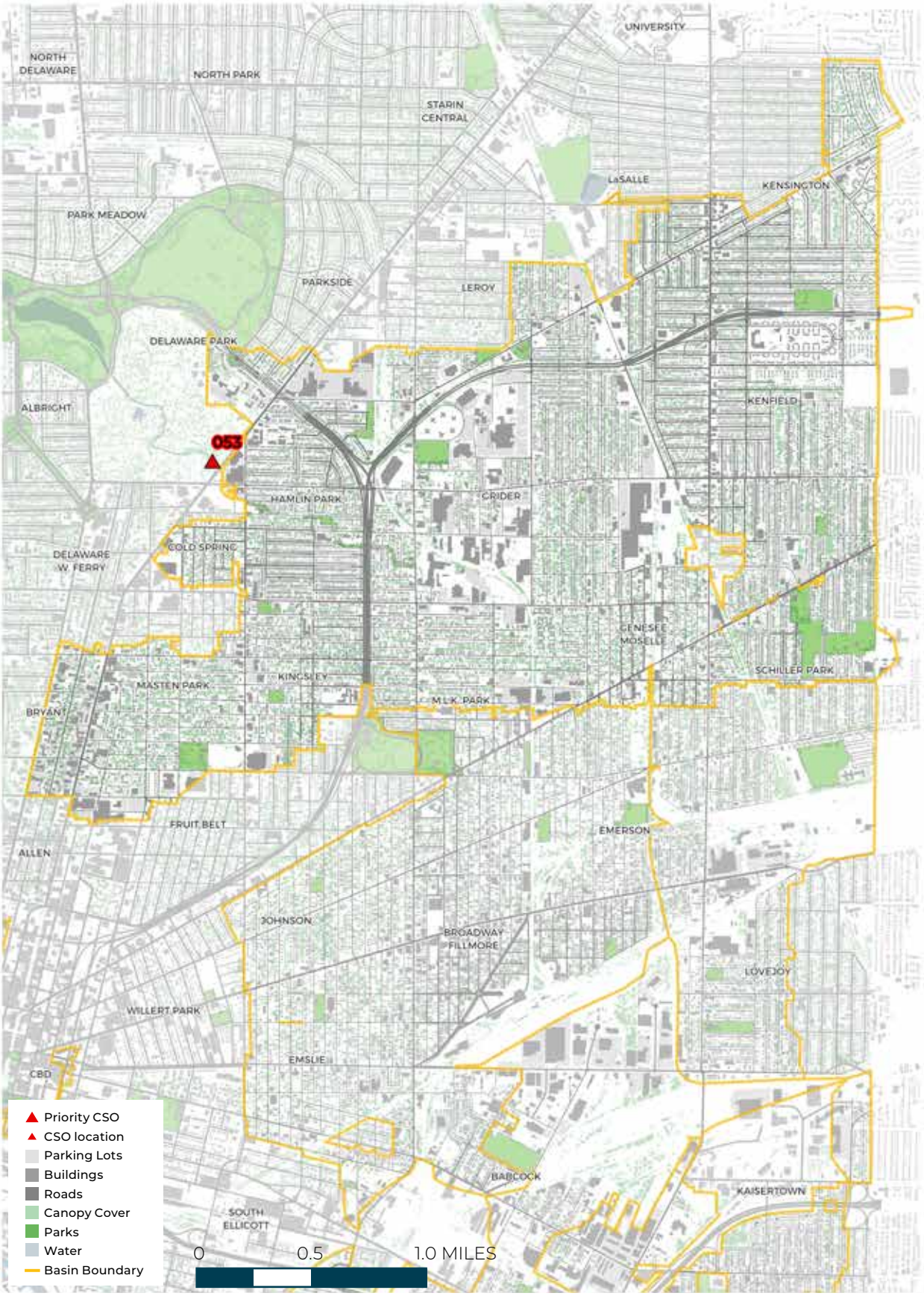


Figure 53.18: CSO Basin 53 Map of Built Environment and Tree Canopy

TWO

PLACE

Green infrastructure can solve stormwater challenges while improving public spaces, streets, and parks and create places that make Buffalo's neighborhoods unique and livable.

This chapter presents the types of green infrastructure and how they function within a green stormwater network.

The Buffalo Sewer System and Green Infrastructure

Buffalo's sewer system is a combined sewer system (CSS) — combining sanitary sewage and stormwater in the same pipe. The CSS was constructed with 65 permitted combined sewer overflow (CSOs) outfalls to relieve the system during wet weather events in order to protect downstream treatment facilities and prevent basement flooding. Buffalo Sewer has completed numerous improvement projects resulting in the reduction of CSO outfalls. Currently, the system consists of 52 permitted CSO outfalls. The United States Environmental Protection Agency (USEPA) issued a national CSO Control Policy in 1994, requiring communities with CSSs to develop Long Term Control Plans (LTCPs) that comply with the requirements of the Clean Water Act, including attainment of current or revised water quality standards to reflect wet weather in-stream conditions.

While this LTCP program focuses primarily on the collection system, the Bird Island Wastewater Treatment Plant (WWTP) is also an integral part of the CSS. Immediately after the establishment of Buffalo Sewer in 1935, a primary wastewater treatment plant, focused on disinfection and removal of solids from wastewater, was constructed and began operation on July 1, 1938. Secondary treatment facilities, which provided for additional treatment and disinfection of wastewater, were added at the plant between 1975 and 1979.

Completed and current upgrades to the facility will allow for improved treatment for up to 320 million gallons per day (MGD) of flow through the secondary treatment system and following completion of the additional future upgrades, up to 400 MGD through the secondary treatment system. All treated flows are discharged to the Niagara River via two permitted outfalls. The WWTP is also equipped with a third emergency outfall which is used to protect the WWTP in the event of extreme wet weather or equipment malfunction to prevent the plant influent flow from exceeding the plant's treatment capacity.

LTCP Development Process

Buffalo Sewer originally submitted its LTCP for CSO abatement to the New York State Department of Environmental Conservation (NYSDEC) in July 2004 (2004 LTCP). Buffalo Sewer began additional work in 2008 to update the LTCP based on comments received from NYSDEC and additional evaluations conducted at the request of NYSDEC and USEPA (the Agencies).

From 2008 through early 2012, Buffalo Sewer and the Agencies discussed revisions to the LTCP. On March 15, 2012, the USEPA ordered Buffalo Sewer to submit an updated LTCP to the Agencies no later than April 30, 2012. Following submission of the April 2012 LTCP, the Agencies provided comments. A major effort in addressing this set of comments was the development of a Green Infrastructure Master Plan (GI Master Plan). Based on the comments provided by the Agencies, the LTCP has been revised to incorporate the findings of the GI Master Plan.

In addition to developing this LTCP update, Buffalo Sewer has continued to work diligently to reduce CSO overflow volumes and frequencies. Along the way, Buffalo Sewer has invested tens of millions of dollars in capital improvements both at the WWTP and in the collection system.

Green Infrastructure Master Plan

In determining how best to address the CSO overflow challenge and respond to the Agencies' comments, Buffalo Sewer looked at implementing real time controls (RTC) to maximize the efficient use of the existing infrastructure, in conjunction with green infrastructure to reduce the amount of stormwater entering the sewer system. In response to Agencies' comments on the April 2012 LTCP, Buffalo Sewer provided additional detail on their green infrastructure program by developing a GI Master Plan.

The GI Master Plan includes further refinement of the green infrastructure impervious surface control targets presented in the April 2012 LTCP to

Figure 2.1: Buffalo's Wastewater Treatment Plant on Bird Island.

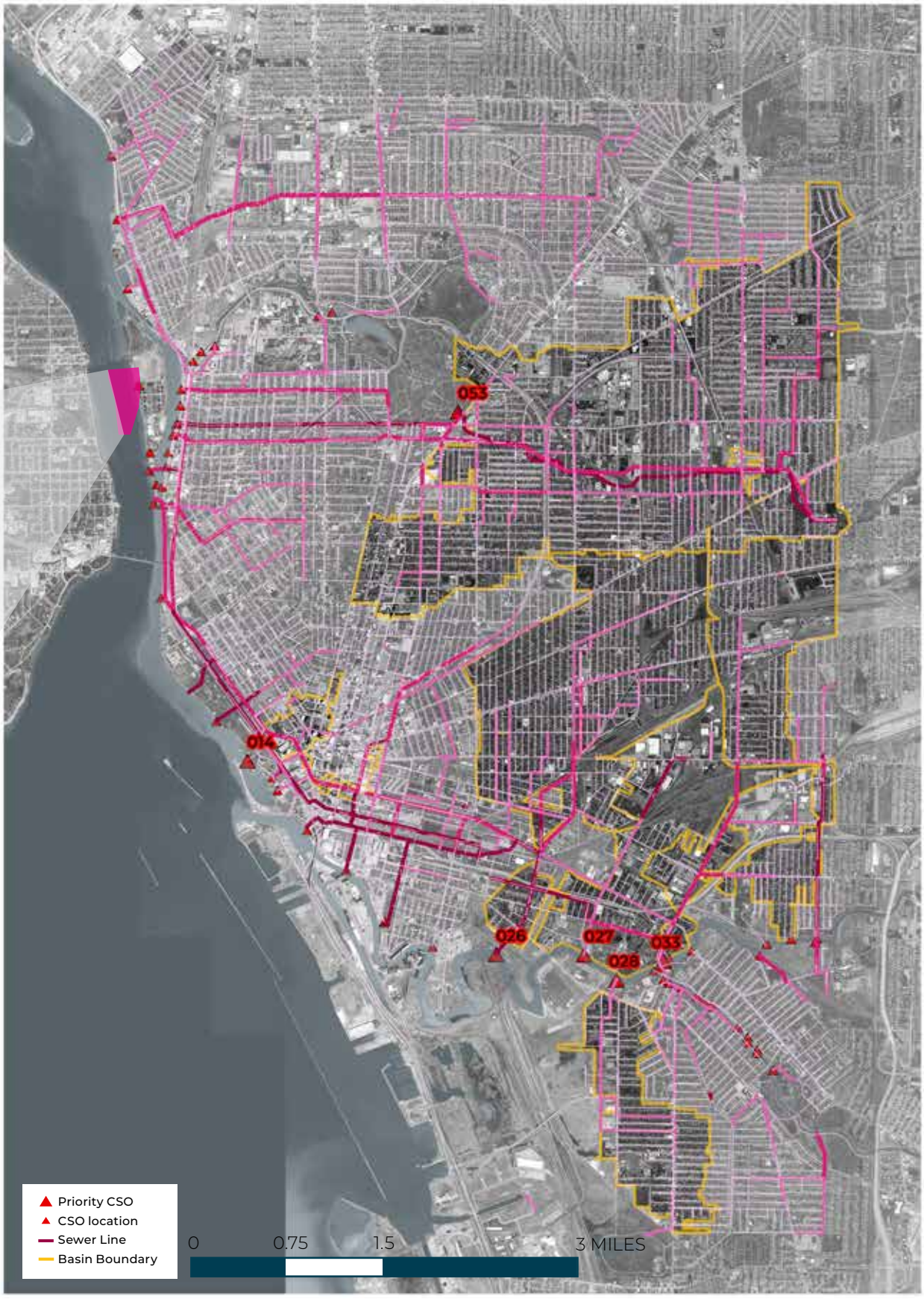


Figure 2.2: Map of Buffalo's Sewer System with the priority CSO basins outlined.

determine, on a more localized level, where the system would most benefit from green infrastructure technologies. It also provides requested detail on the Phase 1 green infrastructure projects to be implemented over the first five-year period. It does this by further dividing CSO basins into sub-basins. By focusing on the sub-basin level, the GI Master Plan could closely identify which portions of the larger CSO basins were contributing the most to the CSO challenge and where green infrastructure would provide the greatest benefit.

Refining the impervious control acreage to the sub-basin level allowed for better identification of CSO basins (and by extension CSO outfalls) that would benefit most from implementing green infrastructure technologies, and also for determining which basins would not benefit because they were already at or below the recommended level of control or do not discharge directly to receiving waters. Recommended acreages increased in the Black Rock Canal and Erie Basin, and decreased in the Cazenovia Creek, Buffalo River, Niagara River, and Scajaquada Creek Basins. Because the sub-basin-level green infrastructure allocation provides a more refined and cost-effective approach, Buffalo Sewer is working towards a 1,315-acre total green infrastructure program effort.

Buffalo Sewer remains committed to evaluating opportunities to maximize the use of cost-effective green infrastructure approaches. The target acreage above is a minimum program commitment. Additional green infrastructure acreage may go beyond this minimum and can be used in conjunction with the optimization of gray projects. This approach allows Buffalo Sewer to adaptively manage the green infrastructure program to incorporate lessons learned and take advantage of land use and infrastructure investments to deliver the maximum public benefits at the lowest cost.

Green Infrastructure Planning Efforts History

Figure 2.3: Key Buffalo stormwater planning documents. Top to bottom: Long-Term Control Plan and GI Master Plan; Buffalo Green Code and LWRP; Rain Check 1.0 Report; Rain Check 2.0 Opportunity Report.

Citywide Statistics

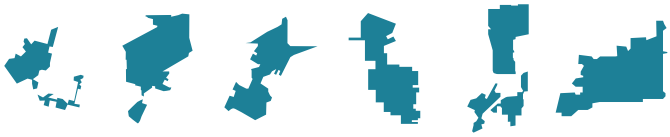
The maximum daily capacity of the WWTP is **560** million gallons, of which usually **144** million gallons are treated each day.

The length of sewer main pipes in the system is **854** miles—long enough to reach from Buffalo to NYC and back.

110 SQUARE MILES OF COLLECTION SYSTEM

92% OF BUFFALO'S SEWER SYSTEM IS COMBINED

CSO Statistics



6 TARGET CSO OUTFALLS

52 PERMITTED CSO OUTFALLS

GREEN INFRASTRUCTURE: SOLUTIONS AND NETWORKS

Practices and Technologies

Green infrastructure practices keep the stormwater challenge in check by reducing and managing the impervious surfaces of the City that produce stormwater runoff, particularly runoff from streets, buildings, and parking lots. While traditional gray infrastructure and other "smart" approaches are still needed, especially in extreme events, green infrastructure is a powerful, cost-effective way to reduce sewer overflows. This section identifies the green infrastructure practices and technologies that Buffalo Sewer has identified as the most appropriate for Buffalo and includes maintenance considerations.

As discussed in **Chapter 1 | Opportunity**, green infrastructure has the capacity to provide co-benefits in addition to reducing the amount of stormwater entering the sewer system. This section will discuss how different network configurations can contribute to increasing these co-benefits, helping to address equity and environmental goals.

Finally, planning and implementation will be key to a successful green infrastructure program, including the ability to provide larger, more networked systems. This chapter also discusses programs that create incentives for implementing green infrastructure and the planning process.

Green infrastructure captures stormwater before it goes into the combined sewer system and reduces combined sewer overflows.

Green Infrastructure Practices, Configuration, and Planning

There are many types of green infrastructure. The basic goal of all green infrastructure is to remove stormwater from the sewer system by storing, diverting, or infiltrating it on site. Green infrastructure mimics the way water moves in a natural system by allowing stormwater to be absorbed by soil and plants. Green Infrastructure is a way to let the landscape do the work of managing stormwater, rather than relying solely on the sewer system and treatment plant to do this work.

Green Infrastructure practices can be considered on one end of a sliding scale of stormwater technologies with the most 'green' consisting of vegetation and living systems and the other end being more traditional gray infrastructure technologies utilizing underground storage without living systems. Green infrastructure is also implemented in a decentralized and distributed network of stormwater management where stormwater does not travel to a central facility for treatment.

In addition to the green infrastructure itself, the way that green infrastructure is placed on the site and its relationship to other green infrastructure interventions also impact how effectively green infrastructure reduces the quantity of stormwater entering the combined sewer system. Green infrastructure practices that are networked can provide additional stormwater benefits and opportunities for shared costs and streamlined maintenance.

Figure 2.4: Rain Garden on Penn Avenue in Pittsburgh, PA.

Vegetated Practices

Vegetated practices provide many important benefits in addition to stormwater management. Stormwater planters, tree pits, rain gardens, bioswales and green roofs have the potential to increase property values, reduce urban heat island effect, and mitigate pollution.

Stormwater Planters and Tree Pits

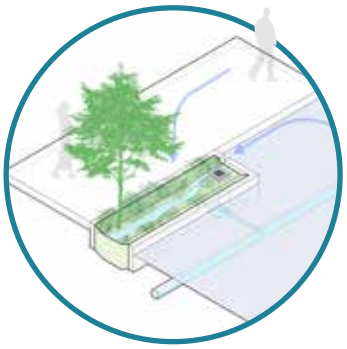
Tree pits and sidewalk planters can be used to capture stormwater in urban areas. These small landscaped installations can infiltrate or filter water and can also convey or store water if designed with the appropriate infrastructure. Stormwater planters and tree pits are usually structured and may have curbs, sidewalks, inflow, and overflow devices. According the New York State Stormwater Management Design Manual, the soil in a stormwater planter uses biogeochemical processes and soil infiltration to decrease stormwater quantity and improve water quality. Soil for urban planters and pits should be carefully selected to deal with the structural conditions and salt or contaminant inflow.

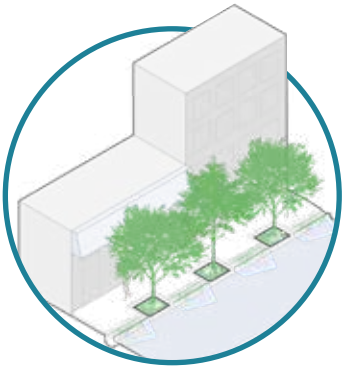
Rain Gardens

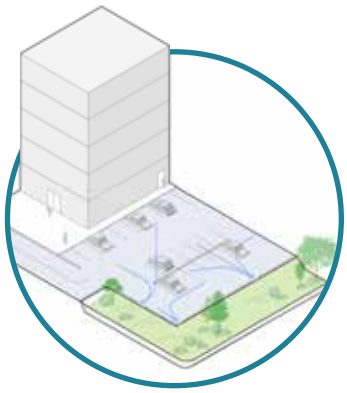
Rain gardens (sometimes called bioretention) are depressed landscape features. They contain plants that tolerate alternating wet and dry periods. They are designed to hold stormwater and allow it to infiltrate into the soil. The size of rain gardens can vary depending on how much water they will receive. A small rain garden at a private home may be able to receive water from a disconnected downspout while a rain garden that captures run off from a large parking area will be significantly larger. Rain gardens usually use a special, highly porous planting soil to promote infiltration. Rain gardens are typically sized to handle runoff from a small event and have an overflow mechanism to convey water from a large event. Depending on the porosity of the underlying soils, rain gardens may also be equipped with an underdrain.

Bioswales

Bioswales (sometimes called vegetated swales) are gently sloped and vegetated landscape features. Bioswales reduce the quantity of stormwater by promoting infiltration and help to improve water quality by slowing and filtering stormwater, allowing sediment and some pollutants to settle out. They are often used along roadways, driveways, and parking lots. They will typically use a specialized, very porous planting soil.







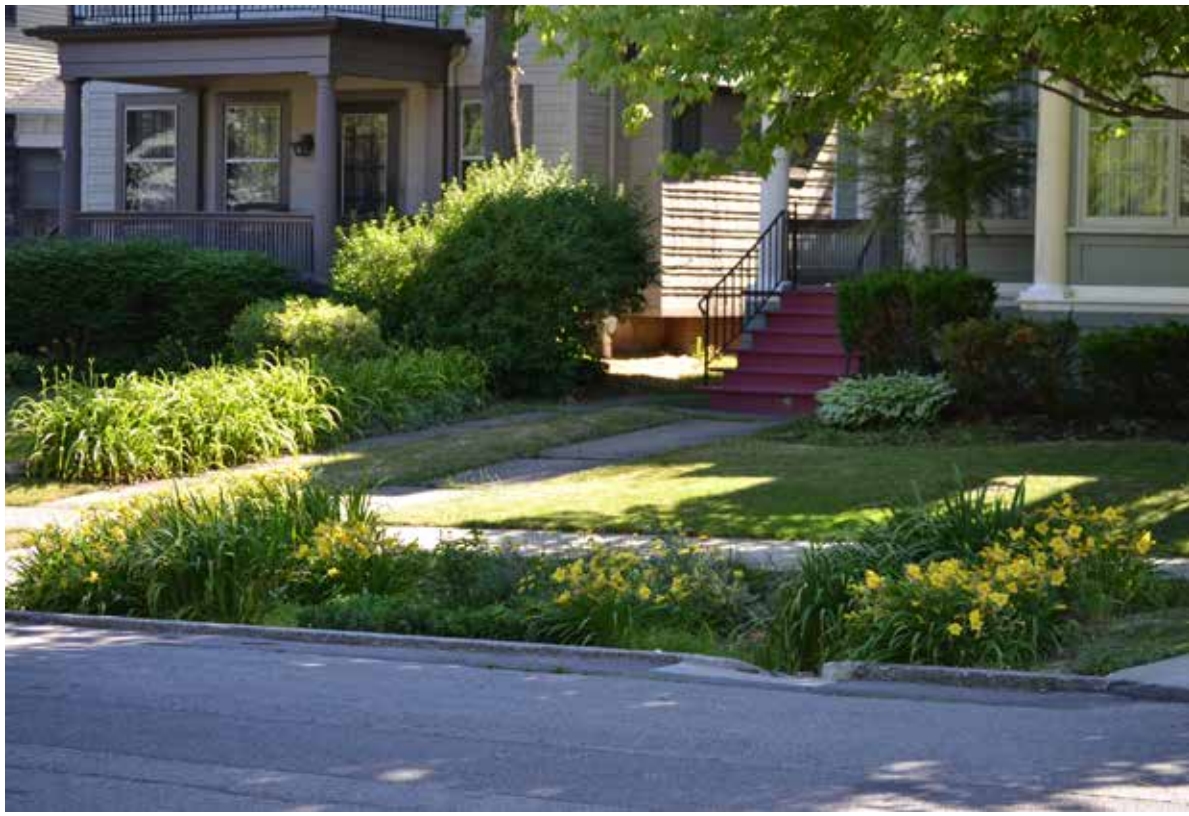


Figure 2.5: Buffalo Sewer Rain Garden on Windsor Avenue.

Considerations

For all these practices, plants should be selected for the planter or pit size, location and exposure to light, and their salt and pollutant tolerance.

- Weeding and regular maintenance will be required.
- Trash will need to be removed, especially after large events or where planters and pits are receiving water from streets or parking lots.
- Plants will need to be regularly pruned and may need to be periodically replaced.
- Soil should be selected to maximize infiltration, storage, or other site-specific and plant-specific requirements.

Pollution Mitigation Benefits

Rain gardens, bioswales, and wetlands remove pollutants from air and water. The pollution removal increases if tree area is added at a density of 5 trees per 1,000 square feet.

Benefit	No Trees	Trees
Carbon Dioxide sequestered	581 lbs/year	728 lbs/year
Ozone Removed	0.49 lbs/year	1.1 lbs/year
Particulates Removed	0.43 lbs/year	0.84 lbs/year
Nitrogen Dioxide Removed	0.39 lbs/year	0.81 lbs/year
Sulfur Dioxide Removed	0.23 lbs/year	0.46 lbs/year
Carbon Monoxide Removed	0.12 lbs/year	0.2 lbs/year

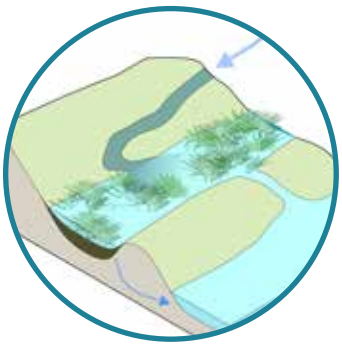
Numbers are for 1,000 s.f. installation and are based on NYC Green Infrastructure Co-Benefits Calculator.

Wetlands

Both natural and constructed wetlands provide significant stormwater quality improvement. Constructed wetlands are designed to maximize pollutant removal by settling out sediment and through uptake and filtering of pollutants by wetland vegetation. To function properly, constructed wetlands must have a sufficient drainage area and receive enough water during dry weather, in order to maintain a minimum pool level. Wetlands can also reduce urban heat island effect, increase property values, and sequester carbon dioxide.

In-stream Restoration

In addition to working inland on point source practices and prevention strategies, implementing projects within waterways addresses water quality more directly. Floating wetlands reduce nitrogen and phosphorus nutrient concentrations; root wads, pools and riffles provide habitat enhancements; and flow deflectors recreate natural stream meanders. In-stream restoration practices provide an excellent opportunity to improve water quality continuously throughout the year and not just in preventing pollution during wet weather events.



Riparian Restoration

Recreating the natural vegetated edge—or buffer—along streams and rivers assists with slowing, filtering, and infiltrating stormwater runoff before it reaches those water bodies. Combining it with a level spreader, which distributes the stormwater as sheet flow, rather than in a concentrated stream, helps to minimize erosion and increases the effectiveness of riparian buffers at filtering and infiltrating stormwater.

Tree Planting / Preservation

Trees are important allies in managing stormwater. Adding trees increases the absorption of stormwater into the soil (infiltration). Trees use stormwater (evapotranspiration), which reduces the amount of stormwater runoff. Tree canopies also intercept water, slowing stormwater flows. Trees can reduce urban heat island effect, increase property values, and sequester carbon dioxide.

Open Space Preservation

Open space—such as a park—is an important component of permeable, vegetated space, particularly in urban areas. Preserving open space and, in some cases enhancing it with the addition of planting, especially trees, reduces the amount of stormwater runoff that eventually enters the storm system. In some cases open space also provides an opportunity for incorporating other green infrastructure practices, such as riparian buffer restoration, rain gardens, tree planting, and bioswales. Open spaces can also be important nodes in a networked system of green infrastructure.

Tree Benefits

Buffalo's 3,830 acres of tree canopy provides the following benefits on an annual basis

Benefit	Buffalo Canopy
Carbon dioxide sequestered	2,523,374 lbs
Water Saved	40,882,251 gallons
Energy Saved	271 Kwh
Energy Saved	80 Therms

Based on City of Buffalo Open Data Portal

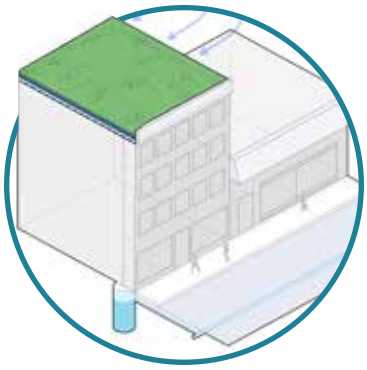
Focus on
Green Roofs

Green roofs are planted areas on building roofs that use a special lightweight planting soil and plants to store and use (evapotranspire) stormwater. Green roofs can add value to large buildings with flat roofs, such as offices and apartment buildings, by decreasing temperature swings in the buildings, extending the life of roofing, and by providing an amenity for occupants. Studies have shown that people prefer views of living habitat, and green roofs bring plants, birds, and insects into the urban environment.

Green Roofs may require significant structural support which may increase cost. Existing buildings may be difficult to retrofit. Depending on the location and height of the building, getting planting media and plants onto the roof can be a logistical challenge. Egress and access that complies with the Americans with Disabilities Act is required for occupiable green roofs.

Nearly 7,000 acres of Buffalo's impervious surface is rooftop!

Figure 2.6: Green roof at Kensington High School in Philadelphia, PA (image ROOFMEADOW).



Pollution Mitigation Benefits

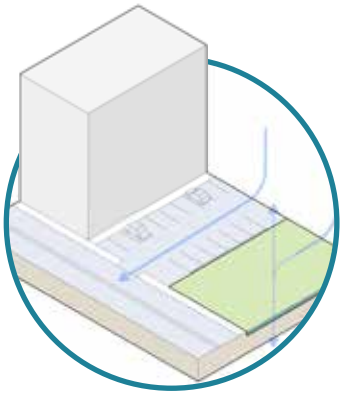
Green roofs help remove pollutants from air and water.

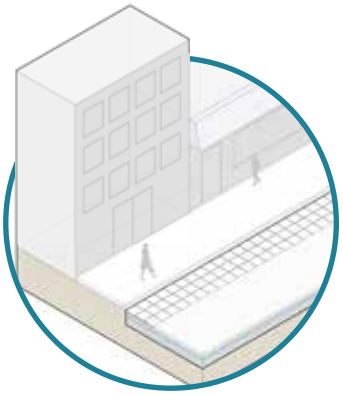
Benefit	Green Roof
Carbon Dioxide sequestered	244 lbs/year
Ozone Removed	0.55 lbs/year
Particulates Removed	0.21 lbs/year
Nitrogen Dioxide Removed	0.08 lbs/year
Sulfur Dioxide Removed	0.54 lbs/year
Carbon Monoxide Removed	0.21 lbs/year

For a 1,000 s.f. green roof with 3" of planting medium and 2" drainage layer. Based on NYC Green Infrastructure Co-Benefits Calculator

Non-Vegetated Practices

Non-vegetated practices, such as porous paving and rain barrels or cisterns, are essential in urban areas where space is constrained or where water can be captured for reuse.





Impervious Surface Reduction

Impervious surface reduction is a key strategy for managing stormwater. Impervious surfaces - such as parking lots, driveways, roadways and sidewalks - generate a much higher level of stormwater runoff than landscaped areas. Rainfall on or snowmelt from impervious surfaces runs off more quickly and carries more pollutants. By reducing the amount of impervious surface - for example using porous pavement in parking lots, incorporating landscaped areas into parking lots, putting green roofs on buildings, or simply making impervious components of the lot as small as possible - the amount of stormwater runoff is reduced.

Porous Paving

Porous or permeable pavement can include pavers with small gravel in the joints, or special concrete or asphalt with pore spaces that allow stormwater to move through the pavement into a gravel bed below, where it is held while it infiltrates into the soil. Depending on the permeability of the underlying soil, the gravel bed may be equipped with a perforated pipe to convey overflow.

The effectiveness of porous paving is reduced if the pore spaces become clogged with dirt or debris. Regular maintenance is required to vacuum out pore spaces. Consideration should be given to the type of runoff that will be reaching the porous paving. If an area receives silty runoff, for example, it may not be a suitable location for porous paving. Porous paving is appropriate for driveways, parking lanes, parking lots, sidewalks, and other low traffic applications.

Winter maintenance is important and while deicing materials such as road salt can be used, materials to reduce slipperiness, such as sand, will clog porous paving. Proper installation of the pavement is required to avoid damage from plows and porous paving should not be used in areas that require heavy duty pavement.

Sand Filtration

Sand filters are designed to remove pollutants from stormwater. Stormwater is directed to a sand bed with an underdrain. As stormwater moves through the filter, pollutants are treated by settling and absorbing into the sand bed. Sand filters are particularly effective at removing nutrients and total suspended solids, which are significant pollutants in stormwater.

Rain Barrels

Rain Barrels capture water from roofs. The water is stored and can be used by homeowners for gardening or other nonpotable uses. Rainwater should be used before the barrel overflows to ensure that the rain barrel is empty and ready to receive runoff from the next storm. Homeowners use rainwater instead of drinking water, reducing their water use and cost.

Rain barrels are low maintenance, however, they work best when owners are committed to maintaining them. Rain barrels have an overflow and need a place to divert overflow, such as a lawn or a rain garden, that is away from house foundations. Leaves and debris needs to be cleaned and rain barrels must be disconnected in winter.

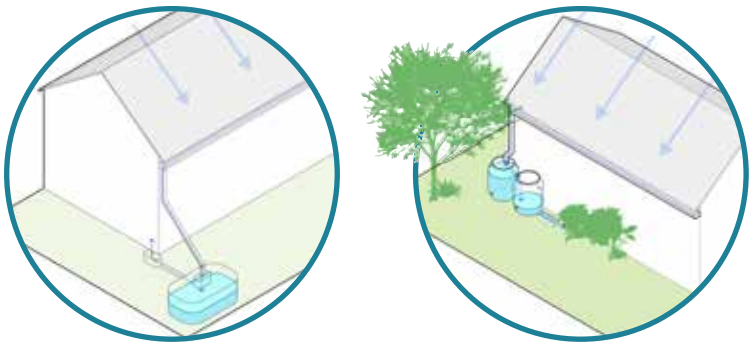
Cisterns

Rainwater cisterns are larger storage tanks for holding stormwater. These tanks can be either above or below grade. They collect stormwater from impervious surfaces, such as roofs and pavement, and store the water either for reuse for non-potable uses, such as irrigation or toilet flushing, or for slow release after wet weather has passed.

Downspout Disconnection

Roof downspouts are typically connected to the sewer system, contributing significantly to the volume of stormwater entering the system. Downspout disconnection is the process of separating roof downspouts from the sewer and redirecting roof runoff away from impervious surfaces to landscaped areas, most commonly a lawn, reducing the volume of stormwater entering the sewer system during wet weather. Directing stormwater to a vegetated area also helps to remove sediment and pollutants.

Figure 2.7: Porous paving next to bioswale along Living Place in Pittsburgh PA.



Source & Configuration

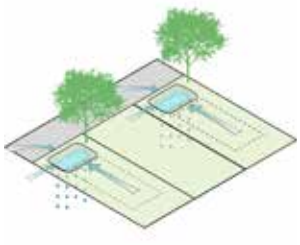
Source & Configuration describes how a system works. Planning & Decision-Making describes how it is implemented at scale.

Green infrastructure can either be stand alone or combined into systems at scale. These systems are arrayed along a continuum from the individual parcel to a network encompassing an entire CSO basin. The larger the scale of the system, the greater the quantity of stormwater that is managed, and the more effective it is at achieving green infrastructure compliance goals under the Long-Term Control Plan. Larger systems also have a greater ability to provide a broader array of benefits in addition to reducing stormwater, including equity, economic and environmental benefits, sometimes referred to as the triple bottom line. The triple bottom line benefits are discussed more later in this chapter.

Green Infrastructure Scale Continuum

PARCEL

AGGREGATED



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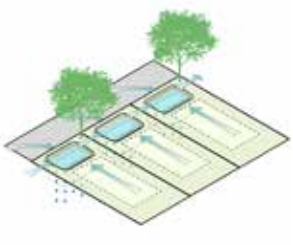


NETWORKED

Figure 2.8: Stormwater planter in Buffalo.

Figure 2.9: Rain garden along Windsor Avenue.

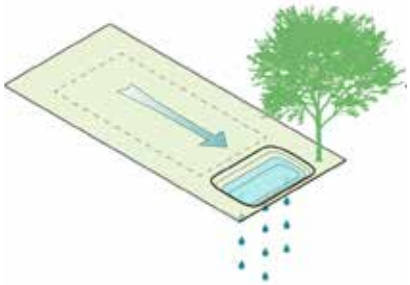
Figure 2.10: Porous paving alongside a bioswale.

Figure 2.11: Rain garden along Elmwood Avenue.

The configuration on any given parcel and how it connects into a larger green infrastructure system depends on factors such as available land, land use, and the cooperation of the property owner.

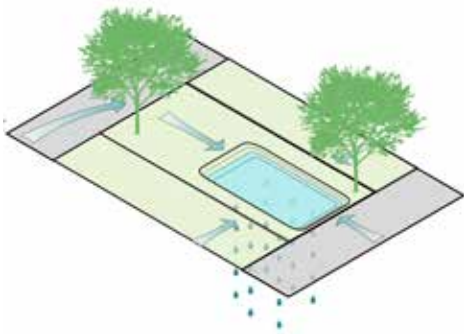
Parcel based / Single Source

The parcel level is the simplest type of configuration. In this case green infrastructure on a parcel is used to manage stormwater on that parcel. An example would be a roof downspout that flows into a rain garden. By managing water from impervious surfaces in the rain garden, a parcel-based approach helps to keep stormwater out of the sewers. The parcel is also the building block for other, more complex networks.



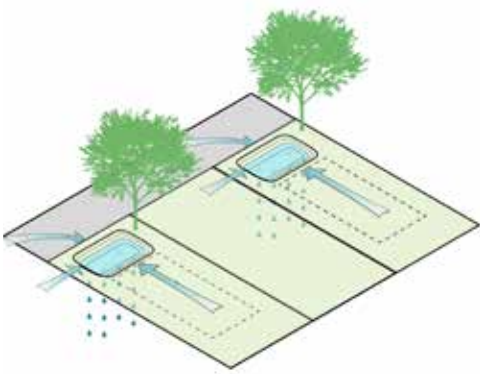
Aggregated / Multi-Source

An aggregated system uses green infrastructure to manage stormwater runoff from a variety of sources. A rain garden that manages roof and driveway runoff from multiple parcels is an example of an aggregated system. Aggregated systems may also involve a treatment train—where stormwater passes through multiple green infrastructure interventions. For example, porous pavement may be used in a driveway or parking lot to manage stormwater. If a rain garden were present on the same parcel, it would manage rainfall from larger events that is not able to be handled by the porous paving alone. By combining green infrastructure strategies, more stormwater is managed.



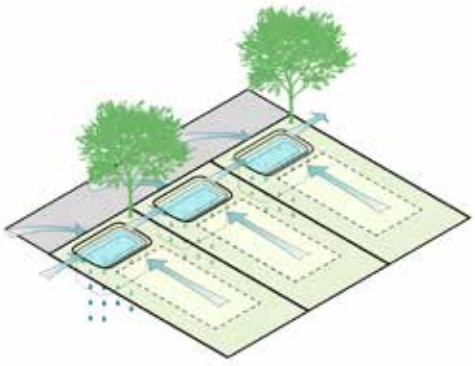
Distributed

A distributed system is where multiple aggregated systems are managing stormwater. Because there is more green infrastructure, more stormwater is being managed. While more effective than an aggregated system alone, a distributed system is smaller and less effective than a more networked system. A distributed system or systems can be a step toward a more networked system.



Networked / Multi-Part System

A networked system is the largest, most complex and ultimately the most effective network type at reducing the amount of stormwater entering the sewer system. A networked system combines distributed systems, increasing the treatment train. For example, a networked system might include a streetscape with a bioswale. The bioswale would manage stormwater from the roadway and convey it to a larger rain garden or wetland. That same bioswale could also pick up water that overflows from private parcels, or from aggregated or distributed systems, networking them together into a larger system. In addition to lengthening the treatment train and allowing more water to infiltrate into the ground or be absorbed by plants, a networked system also creates the highest amount of redundancy in the stormwater management system which allows water from larger storm events to be managed while increasing resiliency.



Planning & Decision-Making

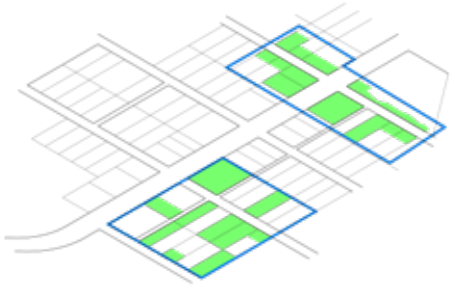
To meet the scale of implementation needed to meet compliance goals, Buffalo can bring green infrastructure to scale with different distribution typologies.

Green infrastructure can be deployed with an opportunistic approach that is typically distributed and parcel-based, responding to available opportunities. Green infrastructure can also be implemented with a strategic approach where that creates larger or more effective networks. Each typology has benefits and drawbacks.

Opportunistic sites are easier to implement and require less planning, but may come at the cost of being less effective at stormwater removal. Strategic approaches may require more time, planning, engineering, coordination among partners, and cost, but handle much larger quantities of stormwater. They also provide greater triple bottom line benefits. Strategic approaches may be based on physical proximity, or they may be more programmatic, focusing on a neighborhood or region or targeted by land use or ownership. The co-benefits of more networked approaches will be discussed in more detail later in this chapter.

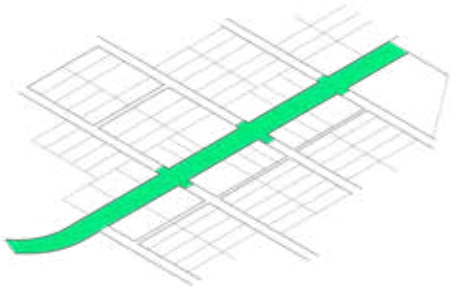
Opportunistic Sites

Green infrastructure is implemented on a parcel basis where there is an opportunity and a willing property owner. This approach is an important step in developing a larger more networked system. The approach is the simplest to implement, but has limited effectiveness in how much stormwater can be removed from the system.



Clusters

A clustered approach is where there are a number of opportunities in a common geographic location. A cluster could be a college campus, or group of institutions, an industrial park, or simply a series of green infrastructure opportunities close to one another. The power of clusters is that it allows for a more networked system, creates greater visibility for green infrastructure, and utilizes green infrastructure as a place-making opportunity.

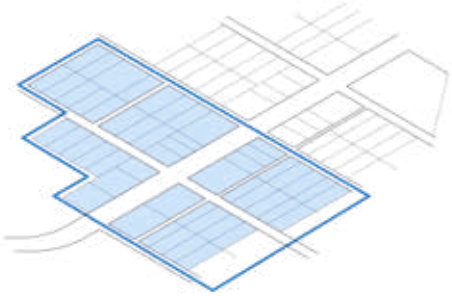


Corridors

Corridors are linearly connected systems of green infrastructure, typically within or along the public right of way. Corridor approaches can provide the armature for more networked systems. Green infrastructure in corridors also provides many other co-benefits, including traffic calming, reduction of urban heat island effect, improved walkability, and access to green space to city residents.

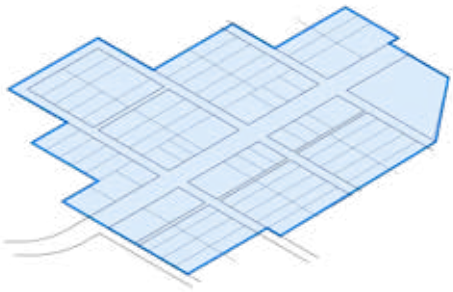
Neighborhoods

Neighborhood programs focus on systematically providing green infrastructure within a neighborhood. Neighborhood programs are most appropriate where there are strong community partners to implement the program. Neighborhood programs might include green streets and street trees along neighborhood commercial districts, working with homeowners to install rain barrels, building rain gardens, and disconnecting downspouts. Neighborhood programs can also provide other co-benefits such as workforce development and economic revitalization. Neighborhoods are also a traditional basis for planning and so planning at the neighborhood level will feel familiar to many partners.



Regional Systems

Regions are where multiple zones, neighborhoods, or clusters are aggregated and large-scale investments can be made to enable localized projects upstream. By working across larger regions, project scale can increase and greater levels of stormwater performance become possible. Regional systems could include larger planning projects or corridors. In the stormwater context, the most effective regional system will be one that encompasses the entire CSO basin and larger watershed.



Targeted Land Use or Ownership

Targeting a particular type of land use—such as parking lots—or a particular type of ownership—such as schools—can be a strategy for demonstrating green infrastructure, for building communities of action, and for providing benefits such as workforce training. Since similar land uses will have similar challenges and opportunities, targeting particular land uses can provide efficiencies and economies of scale with regard to planning and design. In addition, since land uses are often grouped together, targeting specific land uses also facilitates the creation of clusters, neighborhoods, and regional systems.

Programmatic Co-Benefits

Green infrastructure can help neighborhoods feel vibrant and livable with social, economic, and environmental benefits...while managing stormwater more effectively.

Corridors

Buffalo has very prominent avenues and streets. Green corridors and complete streets were envisioned by Olmsted in his plan for Buffalo. Green corridors can help connect neighborhoods, improve the viability of commercial districts, and create public-right-of-way systems that demonstrate green infrastructure viability to private landowners.

Corridors are an opportunity to integrate green infrastructure into complete street concepts. Complete streets integrate people and neighborhoods into the planning and design process for roadways that are safe, convenient, and comfortable for all users, including pedestrians, cyclists, and drivers. Complete streets improve walkability by creating person-scaled sidewalks. Green infrastructure's street trees, porous paving, rain gardens, and bioswales are part of the complete street design toolkit but require maintenance that the City does not have the capacity to provide. Buffalo Sewer will explore opportunities for shared maintenance responsibility with local community groups and landowners.

Commercial Property

Commercial properties have large impervious areas that contribute significant amounts of stormwater to the combined sewer system and contribute to urban heat island effect, including parking lots and rooftops. By incorporating green infrastructure technologies such as green roofs, rain gardens, porous paving and tree planting onto commercial properties, the quantity of stormwater runoff can be reduced.

Converting from traditional landscape maintenance to green infrastructure landscape maintenance requires some additional training but most commercial owners already have a maintenance regimen. Incorporating green infrastructure is essentially a modification of tasks already being performed and paid for, rather than entirely new tasks.

Parking Lots

Parking lots make up a large area of impervious pavement across Buffalo and are therefore major contributors of stormwater runoff to the combined sewer. By targeting parking lots for green infrastructure, the amount of stormwater entering the combined sewer system can be reduced. The addition of green infrastructure to parking lots can create "outdoor rooms," with trees and plants breaking up otherwise monotonous parking areas.

Green infrastructure can improve Buffalo's corridors:

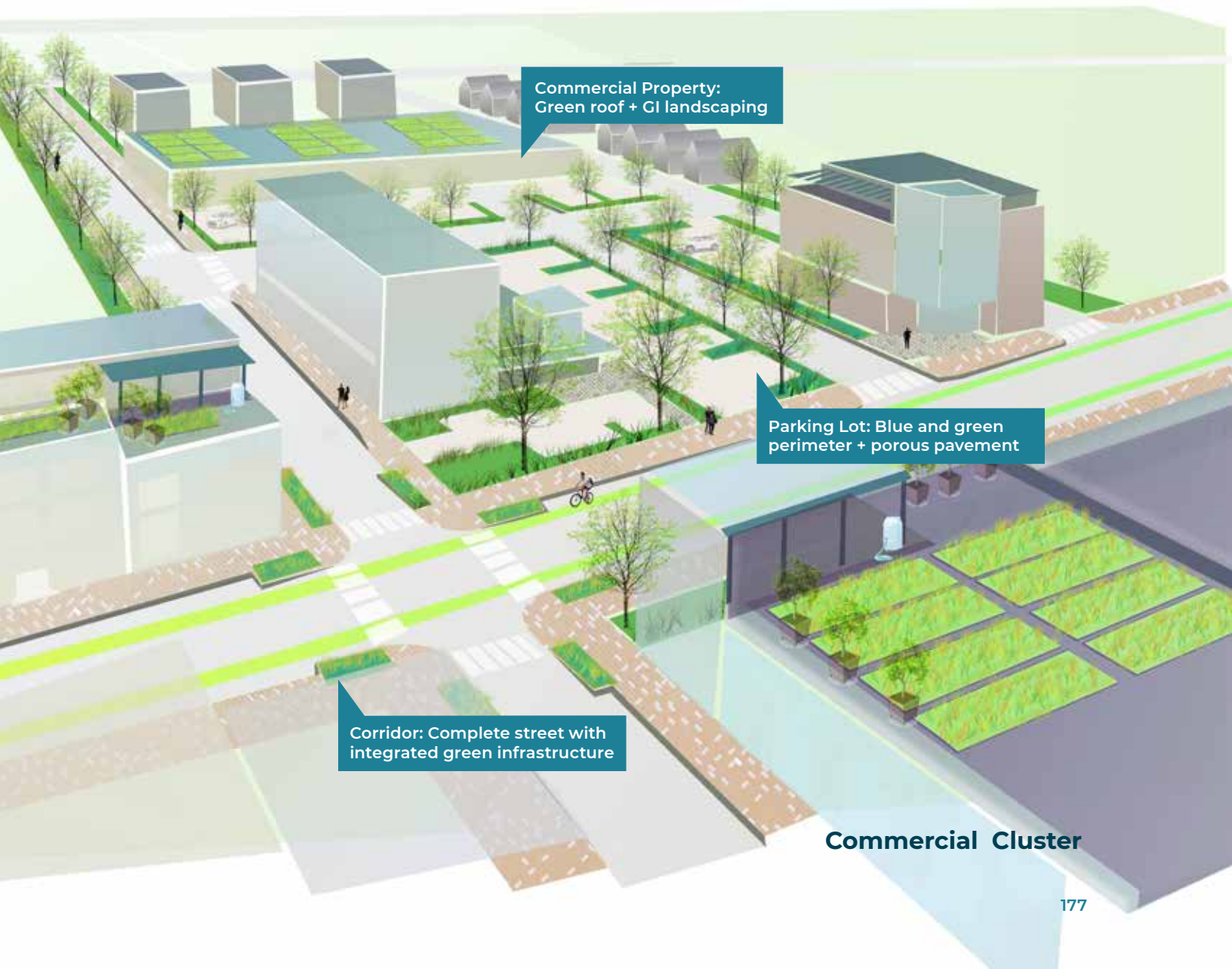
- Improves walkability, can incorporate complete street infrastructure, and can help calm traffic.
- Reduces extreme microclimate conditions due to the urban heat island effect.
- Improves habitat connectivity and usable green space.

Green infrastructure can benefit commercial properties:

- Can serve as an amenity for building occupants and increase lease values.
- Creates natural habitat that improves aesthetics and increases property values.
- Improves the public realm when visible from the public right of way.

Green infrastructure can reshape barren parking lots:

- Saves energy for adjacent buildings as it reduces the urban heat island effect.
- Serves as a visual buffer that improves the appearance of parking lots.
- Creates more walkable streets and sidewalks and provides shade for people and vehicles.



Commercial Cluster

Institutional Property

Institutions, such as schools, churches and community centers, often have large properties where green infrastructure can be implemented. Like commercial properties, institutions typically have maintenance staff that could care for green infrastructure or procure professional services. In addition, they often have a civic or charitable mission and are good partners with the community. Their implementation of green infrastructure can influence others to adopt similar practices. Institutions can implement green infrastructure, such as porous paving, street trees, and rain gardens, on campuses or across a portfolio of buildings. Implementation can range in scale from parcel based to aggregated or distributed networks.

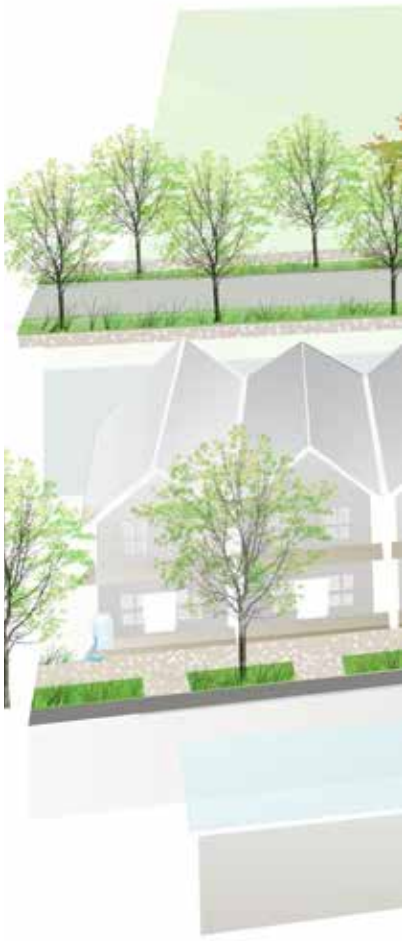
Parks & Open Space

Parks are important pieces of the urban fabric. They provide social benefits, such as access to green spaces for city residents and places for recreation and physical activity. They provide economic benefits by increasing adjacent property values. They provide environmental benefits, including habitat patches, that reduce air pollution and urban heat island effect. Parks are also highly visible and public and are often neighborhood destinations. While parks often already contain less impervious surface than other uses, their stormwater function can be enhanced through increased tree planting and the use of green infrastructure technologies, such as rain gardens and porous paving, to manage stormwater from impervious areas, such as paved playing courts, sidewalks, and parking areas. They can also be the end point for larger green infrastructure networks (for example, along corridors), providing potential sinks for stormwater.

Vacant Lots

Rain Check 1.0 addressed demolition of vacant properties and greening of vacant lots extensively. Vacant lots continue to be an important strategy as Rain Check moves into its next phase.

While vacant lots are often permeable, they can be modified to include green infrastructure and increase their effectiveness with rain gardens, tree plantings, and other practices. Green infrastructure on vacant lots needs to be protected or owned by individuals or entities who can maintain the green infrastructure. Vacant land can also be part of an aggregated stormwater network. For example, a vacant lot in a residential area could contain a rain garden that receives stormwater from disconnected downspouts from several adjacent properties. If the vacant lot is along a complete street corridor, it could be a receiving site for a larger networked public-right-of-way system.



Green infrastructure is aligned with **institutions:**

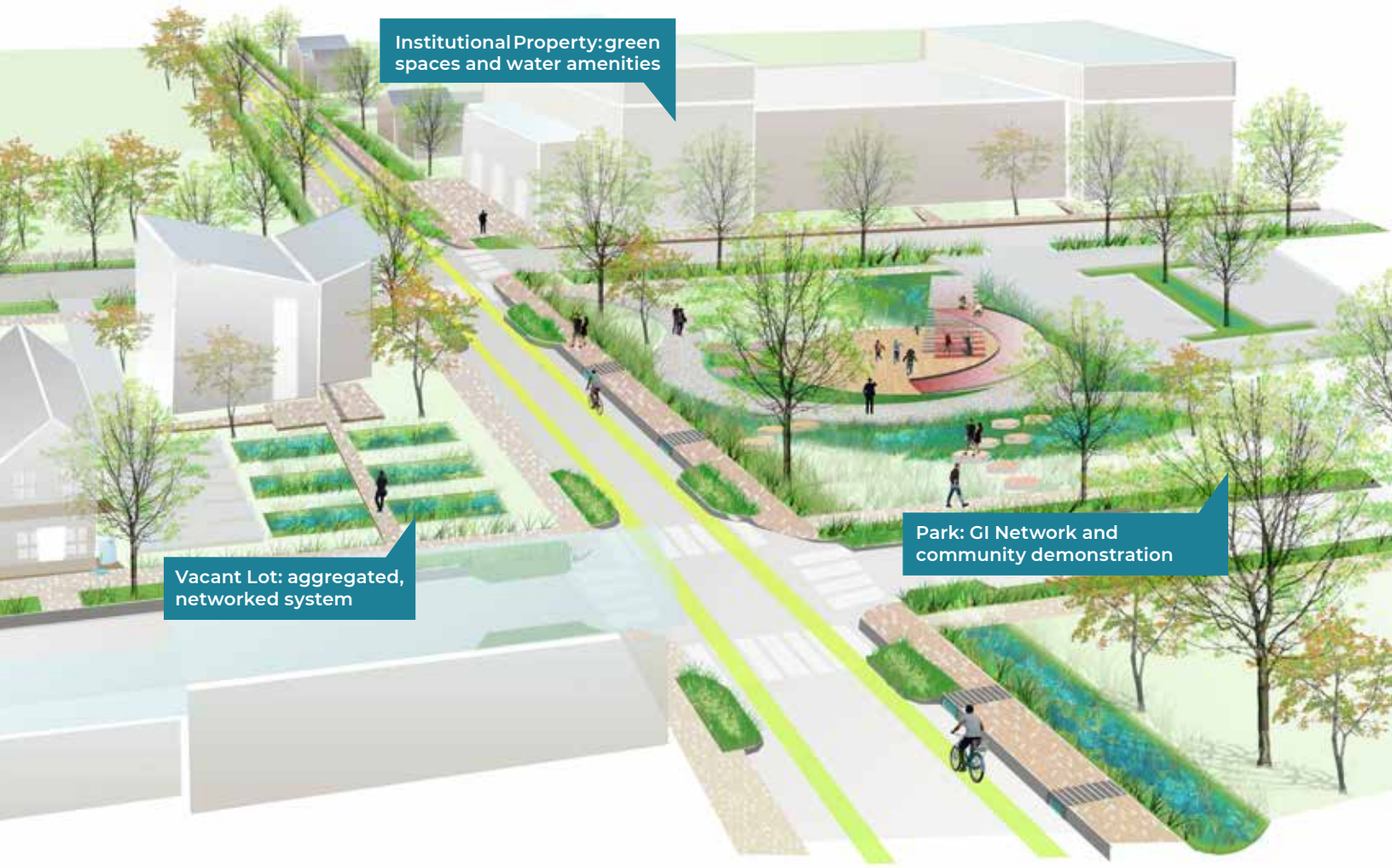
- Can provide workforce development opportunities or can align with other institutional missions.
- Can demonstrate best practices for other community members to adopt.
- Can be incorporated into existing planning, construction, and maintenance practices to ensure viability over time.

Green infrastructure can benefit **parks & open space:**

- Improves habitat, especially in highly urbanized parks.
- Can mitigate heat island effect and make more pleasant places, especially in areas of pavement such as courts and parking lots.
- Creates amenities for neighborhoods and provides opportunities for community care and participation.

Green infrastructure can reinvent Buffalo's **vacant lots by:**

- Decreasing blight.
- Functioning within a green infrastructure network.



Institutional Cluster

Review of Implementation Programs

To achieve the benefits and network efficiencies of green infrastructure, Buffalo Sewer will develop programs to support and promote implementation. Despite a recent surge in new development activity, the pace is insufficient for Buffalo Sewer to depend solely on new development stormwater regulations, such as the Green Code, for its green infrastructure compliance program.

Buffalo Sewer is required to manage runoff from 1,315 acres of impervious surfaces through green infrastructure as part of its combined sewer overflow LTCP. To date, the existing Green Infrastructure Program has focused primarily on streets, sidewalks, and other public property. Recognizing the logistical and cost challenges to meeting goals by focusing exclusively on public property, Buffalo Sewer is encouraging the installation of green infrastructure on private property. Landowners may have existing site maintenance programs that can readily incorporate green infrastructure sites and therefore implementation programs that focus on improving existing developments are key.

This section summarizes implementation programs deployed elsewhere, providing potential implementation models for Buffalo.

Typical Incentives for Green Infrastructure

Many communities, including Portland, Oregon and Howard County, Maryland, have enacted stormwater fees based on the impervious area on each property with higher fees associated with properties with larger impervious areas. Therefore, implementing green infrastructure decreases the impervious area, reducing the fee. The resulting stormwater fee discount would continue in subsequent years, if the total impervious area is retained at post-green infrastructure implementation levels. Buffalo Sewer does not currently have a stormwater fee, making this a more ambitious option.

Grant or rebate programs offer reimbursement of installation costs associated with green infrastructure implementation. Requirements for receiving the grant are dictated by the utility and may restrict funds to a certain type of project, a maximum grant amount, and require specific procedures to be followed for receipt of grant funding. Such funding may be issued in the form of a rebate once construction is finished and inspection verifies design goals are met. Examples of such programs include:

- Philadelphia's Stormwater Management Incentives and Greened Acre Retrofit Programs
- Syracuse's Green Improvement Fund, New York City's Green Infrastructure (Competitive) Grant Program
- Pittsburgh Water and Sewer Authority's Green Infrastructure Grant Program
- Allegheny County Sanitary Authority's Green Revitalization of our Waterways Program

Grant programs allow for equitable distribution and allocation of resources to those who have a demand for green infrastructure and provide a cost-effective way to meet stormwater goals.

Other incentive programs encourage developers to implement green infrastructure as they develop or redevelop projects. Such incentives can take the form of expedited permit application review processes, reduced permitting fees, zoning upgrades, and reduced stormwater requirements.

Other programs targeted towards developers also include payments in-lieu of a portion of the stormwater requirements and/or trading stormwater credits (i.e., where a project is implemented with more stormwater retention than required, the additional credit can be sold or traded to developers of more constrained sites).

Figure 2.12: Examples of green infrastructure from Pittsburgh and Buffalo.

Incentives for Implementing Green Infrastructure

Tax Credits
Some communities charge a stormwater fee as part of their sanitary sewer fees and/or property taxes based on the amount of impervious area on a given property. A credit is then extended to the property owner for the inclusion of green infrastructure technologies on the property that either captures and/or treats a given amount of flow. The amount of credit typically is determined by how much impervious area is removed or how much stormwater is captured using the green infrastructure technology.

Stormwater Permitting Fee Credits
Other incentive programs allow for a one-time reduction in stormwater fees paid during the project permitting process.

Rebates/Grants
Reimbursements may be made either during or upon completion of construction of a green infrastructure project for either the full or partial costs (design and construction). Some communities fund these programs from existing wastewater collection and/or treatment budgets, while others use the stormwater fees collected to provide such reimbursements.

New Development Incentives
Non-monetary incentives, which may include fast-track review of permit application, density and/or height bonuses, flexibility on setbacks, etc., may be offered to developers who would then apply those incentives to larger developments, such as multi-family or commercial/industrial/institutional developments.

Downspout Disconnection Program
Downspout disconnection programs encourage homeowners to have their downspouts disconnected and the standpipe to the sewer capped.

Credit Trading
When green infrastructure technologies implemented on-site do not offer sufficient incentives on their own to prove cost-effective, developers may choose to buy credits from other developers that may have excess credits from green infrastructure installations that provide more benefit than required at another site in the same watershed.

Watershed Improvement District
Watershed Improvement Districts (WID) are entities created by local government and landowners. The purpose of a WID is to address water needs, including stormwater, on a system-wide basis, in order to protect water quality and address drainage issues. The WID structures allows local government entities and property owners to collaborate on projects, generate funds needed for projects, and secure grants.

Tree Planting Program
Tree planting programs can include giving away trees, providing assistance with tree planting, or sharing long-term tree maintenance with citizens to expand the tree canopy throughout the City.

Examples of trading programs include Washington DC's stormwater retention credit (SRC) program, which allows a portion of the stormwater requirements to be met by purchasing privately traded SRC credits or paying an in-lieu of fee, and Chattanooga, Tennessee's program, which allows a portion of the stormwater requirements to be met with an in-lieu fee. In both programs, any rainfall retained on site in addition to the first inch can be sold as a credit to other developers working on sites where stormwater retention is more challenging.

Such programs can maximize green infrastructure on sites where implementation is easier and generate funds to encourage implementation by other property owners. This type of program requires significant participation from developers and land owners to be successful and Buffalo Sewer's pipe network is such that credits would need to be provided within a specific geographic area to impact CSO events associated with the particular site. This type of program would be challenging to implement in a timely manner and may not be feasible for the Buffalo market in order to meet LTCP goals.

Other programs offer non-monetary incentives in the form of recognition of the property owner, either formally or informally, in implementing "green" technologies. However, these programs are utilized less frequently than the monetary-based programs. Property owners within Buffalo Sewer's service area are not currently assessed a stormwater fee; the fee paid to Buffalo Sewer is currently based on assessed value of the property and not on impervious area. Therefore, there is no incentive under the existing fee structure to encourage green infrastructure implementation.

Grant or rebate programs seem most suitable for implementation in Buffalo. These offer direct incentives through reimbursement of installation costs associated with green infrastructure implementation. Buffalo Sewer is in the process of creating a green infrastructure grant program to encourage private partners and help realize additional co-benefits.

Programs to Encourage Tree Planting

The City of Buffalo is also researching other ways to encourage tree planting. A review of other programs nationwide highlighted some successful programs where government agencies or non-profit organizations work with citizens to encourage tree planting on private property, or better upkeep of trees planted on public lands. Some examples include giving away trees, providing assistance with tree planting, or sharing long-term tree maintenance with citizens. City of Buffalo Forestry does not currently have the capacity for a major tree planting program on streets, in parks, or within other public properties and Buffalo Sewer will explore alternative options for increasing the tree canopy throughout the City.

Programs for Residential Properties

While commercial properties typically generate larger quantities of stormwater runoff, residential properties also contain impervious surfaces that contribute runoff to the combined sewer system and programs targeted at residential properties can engage homeowners in addressing stormwater challenges.

In addition to tree planting programs that could benefit residential properties as well, downspout disconnection programs are another way to reduce stormwater runoff from residential properties. Downspout disconnection programs encourage homeowners to have their downspouts disconnected and the standpipe to the sewer capped. The disconnected downspout is directed either to a rain barrel or to a vegetated area such as a lawn, rain garden or other landscaped area. In addition to removing stormwater from the sewer system, downspout disconnection programs are a way

of making stormwater management visible and connecting residents to the environment. In addition to the stormwater benefit these programs are also important as part of larger outreach efforts. They provide the opportunity to partner with local organizations to do the work and can be part of workforce development programs as well.

Tree Canopy Crediting and Modeling

Trees provide a major benefit of reducing stormwater runoff, potentially reducing the volume and frequency of Combined Sewer Overflows. Although this benefit is widely accepted among the scientific community, the modeling that is used to estimate CSO volumes in the City of Buffalo currently does not have the granularity to consider the impact of tree planting on stormwater reduction. A panel of urban tree experts (the Tree Technical Advisory Committee), led by Buffalo Sewer, developed a system for estimating the stormwater benefit of urban trees over time. The system was developed using data about the typical trees planted in the City of Buffalo, along with a "water balance" model that accounts for the benefits of trees, including:

1. Intercepting runoff in leaves
2. Improving soil conditions to encourage soil infiltration, and
3. Increasing Evaporation and Transpiration, thus allowing more runoff to infiltrate the soil.

The resulting system equates each tree planted (or each area of tree canopy) with a volume of stormwater runoff reduction. One advantage of this system, is that it accounts for specific traits of trees, such as the age, type of tree and where it is planted.

As a next step, this system can be used to track and estimate the benefits of trees over time, with the goal of integrating trees into Buffalo Sewer's stormwater modeling in the future. Some next steps will involve determining the specific techniques to represent trees within the City's model. Some techniques might include:

1. Reflecting a tree as reducing impervious cover (using the crediting system);
2. Treating trees similar to green infrastructure practices, that reduce the volume of stormwater; or
3. Treating trees as stormwater storage throughout the landscape.

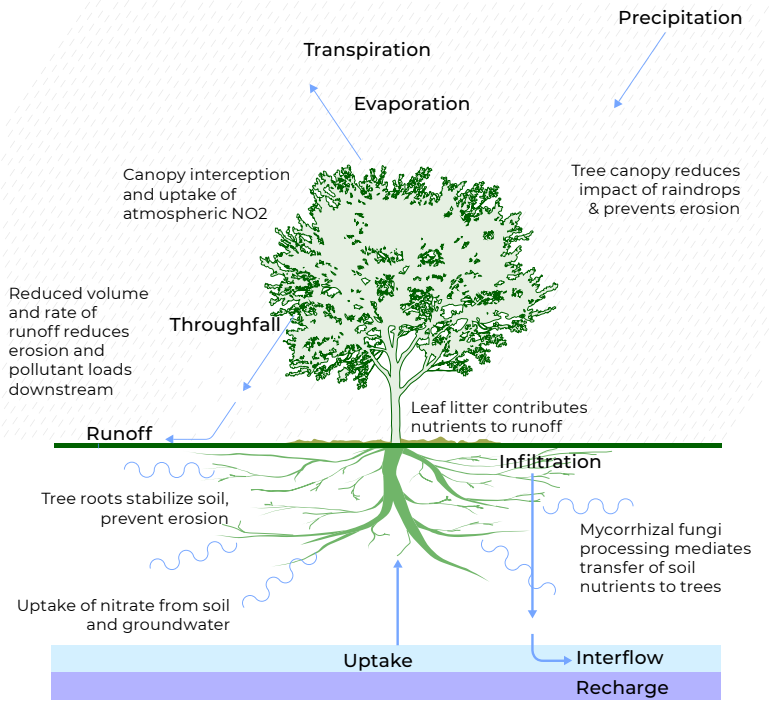


Figure 2.13: Trees reduce the volume and rate of stormwater runoff, which reduces the amount of stormwater and pollutants entering the sewer system

THREE

PEOPLE

People are central to solving Buffalo's stormwater challenge. Buffalo Sewer is creating a green culture to support, advocate for, and implement green infrastructure.

This chapter describes how community partners can help solve Buffalo's stormwater challenge.

BUILDING A GREEN CULTURE

Buffalo Sewer Learning & Leadership

Buffalo Sewer's leadership begins with strong internal expertise in green infrastructure

Buffalo Sewer continues to be a leader in green infrastructure and is committed to building a culture that supports green investment throughout the City. While green infrastructure is becoming a well established set of technologies, very few agencies have deployed green infrastructure techniques across large regions to reduce stormwater runoff.

Buffalo Sewer has taken a number of steps to build sustainable institutional knowledge, including:

- The establishment of Technical Advisory Committees.
- The design and construction of innovative green infrastructure projects.
- Collaboration with University of Buffalo researchers on a range of systems analysis projects.
- Regular discussion of best practices and lessons learned with the Green Infrastructure Leadership Exchange, an organization comprised of green infrastructure practitioners from municipalities across the country.

These initiatives are designed to build knowledge, establish best practices, and create a systemic understanding of green infrastructure so that Buffalo Sewer can implement green infrastructure to be more environmentally sensitive and equitable.

Buffalo Sewer's Technical Advisory Committee

Buffalo Sewer convened a Technical Advisory Committee (TAC) to advise on best practices and help build a community of action around green infrastructure. The TAC included technical experts from government agencies, academia, community organizations, and local practitioners. The TAC members brought with them a wide range of knowledge and experience. Through regular meetings and focused topic discussions they helped translate national practices to the Buffalo context.

The TAC had three overall goals:

- Identify and provide guidance on technical issues related to green infrastructure.
- Identify opportunities and considerations for green infrastructure

Figure 3.1: Buffalo Sewer Waterworx Pop-Up Park.

given the current state of knowledge and best practices surrounding the planning, design, construction, maintenance, and monitoring of green infrastructure.
- Provide recommendations for implementation of green infrastructure.

The primary role of TAC members was to participate in 6 monthly meetings and have discussions between meetings as part of Buffalo Sewer's green infrastructure work. Members provided input to Buffalo Sewer based on their review of technical materials.

A summary of content for each meeting follows:

- **Meeting 1:** Kickoff Meeting - Project Background, TAC overview, Scope discussion for green infrastructure site selection and site investigation work.
- **Meeting 2:** Technical Issues - Site Constraints and Stormwater Soils.
- **Meeting 3:** Technical Issues – Vegetation and Changing Climate Considerations.
- **Meeting 4:** Opportunities Outside the Public Right of Way and Delivery of Green Infrastructure Programs.
- **Meeting 5:** Community Support/ Community Awareness and Green Infrastructure Maintenance.
- **Meeting 6:** Draft Opportunity Report and Next Steps.

The outcomes of each meeting were summarized with technical issues and recommendations prepared. These recommendations have informed the findings of this report.

Innovative Projects

In addition to gathering experts and consolidating knowledge around green infrastructure, Buffalo Sewer is generating knowledge through the implementation of every project. The innovative projects Buffalo Sewer has completed so far have validated green infrastructure technologies and provided on the ground experience unique to Buffalo. For these projects, Buffalo Sewer examines the whole process including design, construction, and long-term performance. This establishes baseline knowledge and validates assumptions for larger scale planning. Buffalo Sewer has implemented a number of green infrastructure projects including:

- 9 miles of green streets in 17 different projects
- 6 green parking lots
- 224 green post-demolition sites
- Over 1,300 rain barrels

Buffalo Sewer was also the first sewer utility in the country to receive credit for demolitions within their LTCP. Building on the green infrastructure projects already completed by Buffalo Sewer, this report identifies opportunities to increase the scale and scope of green infrastructure implementation in the six priority CSO basins..

Figure 3.2: Green post-demolition for enhanced stormwater performance

Figure 3.3: Green Street Case Study at Ohio Street.

Figure 3.4: Buffalo Sewer WaterWorx Pop-Up Park.

Figure 3.5: Rain Check Opportunity Meeting.

Expert Collaboration

In addition to internal TACs, Buffalo Sewer engages external thought leaders and supports external green infrastructure knowledge building through expert collaborations. Buffalo Sewer is in regular collaboration with University of Buffalo researchers on a range of systems analysis projects and hosts the Research and Education in eNergy, Environment and Water (RENEW) fellowship program. Regular discussion of best practices and lessons learned also occur through the Green Infrastructure Leadership Exchange, an organization comprised of green infrastructure directors from municipalities across the country. Some experts that Buffalo Sewer has worked with in the past include:

- United States Geological Survey (USGS)
- University at Buffalo
- U.S. Environmental Protection Agency (EPA)
- US Army Corps of Engineers
- New York State Department of Environmental Conservation (NYSDEC)

BUILDING A GREEN CULTURE

Creating Communities of Action

Buffalo Sewer will need to build "communities of action," or groups of partners and projects that can implement green infrastructure to meet Buffalo Sewer's stormwater management goals. For example, in early green infrastructure work, Buffalo Sewer was able to work with the City of Buffalo and community groups to create green infrastructure installations on vacant land. By identifying a replicable opportunity, (green infrastructure on vacant land), a key partner (the City of Buffalo), and advocates (community members and neighborhood groups), Buffalo Sewer was able to implement green infrastructure on more than 200 sites. Getting to scale with multiple installations allows Buffalo Sewer and its partners to streamline project administration and can ultimately contribute to the longevity of the installations.

The Challenge of Incentives

Economic benefit is a major motivator for parties to implement green infrastructure. Stormwater fees are assessed in many cities to fund investment in stormwater green infrastructure and property owners may be motivated to implement green infrastructure to avoid fees. Other communities offer incentives to implement green infrastructure. Buffalo does not have a stormwater fee and has only limited incentive funds. Buffalo will need to rely on broader collective action that may be catalyzed by key investments but cannot be fully realized by Buffalo Sewer's efforts alone.

Encourage Voluntary Green Infrastructure

A variety of strategies can be employed to encourage property owners and communities to implement green infrastructure on a voluntary basis. These strategies include:

- Encourage recognition and praise for green infrastructure projects with awards and media attention.
- Establish financial incentives with a grant program.
- Create resources for designers and developers by publishing standards, guidelines, and details to make it easy to incorporate green infrastructure into projects.
- Establish design and planning competitions.
- Create scholarships or awards for green infrastructure related thesis, dissertations, or research projects.

Fostering a Green Infrastructure Knowledge Base and Skilled Workforce

The more knowledgeable the workforce is about green infrastructure implementation, maintenance, and function, the more successful green infrastructure will be. Specifically, Buffalo Sewer is committed to working on the following:

- Training Buffalo Sewer staff and seasonal workers on green infrastructure with the National Green Infrastructure Certification Program (NGICP), which provides the base-level skill set needed to properly construct, inspect, and maintain green stormwater infrastructure.

Figure 3.6: Community Visioning Walk in Buffalo.

- Creating a scholarship program for NGICP training for City of Buffalo residents.
- Incorporating green infrastructure into K-12 public school curricula and programs.
- Developing demonstration sites at schools.
- Hosting field trips for school children to green infrastructure sites.
- Regularly hosting Mayor's Summer Youth internships for high school students.
- Hosting undergraduate interns and graduate student interns.
- Supporting organizations involved in green infrastructure workforce development.
- Providing tuition assistance to Buffalo Sewer staff.
- Creating a water-based curriculum with associates degree granting institutions.
- Supporting Buffalo Sewer staff with professional development classes and training around green infrastructure and other associated skills.
- Providing a career ladder for workers so they have the potential to develop from seasonal temporary laborers to designers or engineers.
- Creating summer-long youth programs in partnership with community organizations, such as the Waterworx program that was conducted in partnership with the Community Action Organization, to expose children to green infrastructure and green-infrastructure-related career options from a young age.

Focus on Community & Economic Benefits of Green Infrastructure

Green infrastructure can also provide significant economic and workforce benefit to Buffalo. Based on economic analyses conducted as part of Rain Check 2.0, every $1 invested in green infrastructure investment in Buffalo generates $1.52 in benefit to Buffalo's economy. Also jobs in the green infrastructure sector have a higher median hourly income – $23.04 – than median hourly wage for the Buffalo metropolitan area ($17.77). The complete analysis can be found in Appendix D.

Figure 3.7: Buffalo Sewer employee and community member discussing rain barrel installation at community outreach event.

Figure 3.8: Buffalo Sewer and Community Action Organization of WNY Pop Up Park event.

Buffalo Sewer does not have stormwater fees or incentives to encourage green infrastructure on existing properties. Thus, Buffalo sewer is exploring other strategies for encouraging private property owners to implement green infrastructure. Some possible groups for joint implementation or collaborative partnership include:

Community Organizations

In some cases, Buffalo Sewer is able to "piggyback" onto existing community improvement projects spearheaded by local groups, to provide additional benefit in the form of green infrastructure. As an example, a community group may be developing new parkland areas, and Buffalo Sewer can contribute funding that would cover the incremental cost of implementing green infrastructure technologies over traditional non-stormwater-based design.

Municipal Properties

Public property owners have a portfolio of properties that are likely centrally administered, have a similar land use or physical characteristics, and may have common maintenance requirements. In addition, municipal properties provide public benefit, ensuring that the investment creates common good.

Portfolio Properties

There are many owners who have a portfolio of similar properties and who could more easily implement green infrastructure across a building type or project type. These include commercial developers, such as retail property owners, as well as institutional owners who manage campuses of medical or educational buildings. They likely have significant existing land management responsibilities where green infrastructure maintenance could be absorbed.

Figure 3.9: Educating the next generation of green infrastructure practitioners at Buffalo Sewer Waterworx event.

Proximate Properties

Studies have shown that people are more likely to take action if they see others doing similar things and that investment can inspire additional investment. In this case, being near each other allows for green infrastructure installations to be visible and become part of a community identity.

Properties that are near each other can be optimized to function as a network, or can have shared administration or maintenance. These properties might be within a geographic boundary such as a neighborhood or be part of a common resource, such as a commercial corridor.

Properties with Similar Land Use

Properties that have a similar land use, such as churches or "big box" retailers may be interested in programs, incentives, and information sharing aimed to meet their specific needs. For example, most large retailers will have similar green infrastructure opportunities such as roof and parking lot installations. They may benefit from shared educational opportunities, incentive programs, and general community cohesion.

Properties Seeking Perceived Market Advantage

Increasingly, sustainability is becoming important to market advantage in real estate. This is one of the premises behind sustainability rating systems, such as ENVISION, LEED and SITES. In certain types of industries (for example high-tech fields) a highly sustainable development is seen as conferring a market advantage. Sustainability, particularly when it is visible and attractive, can make a property more attractive to prospective tenants or buyers and command higher rents. This may also be an incentive for developers to choose to implement green infrastructure.

Figure 3.10: Buffalo Sewer and Community Action Organization of WNY Pop Up Park event.

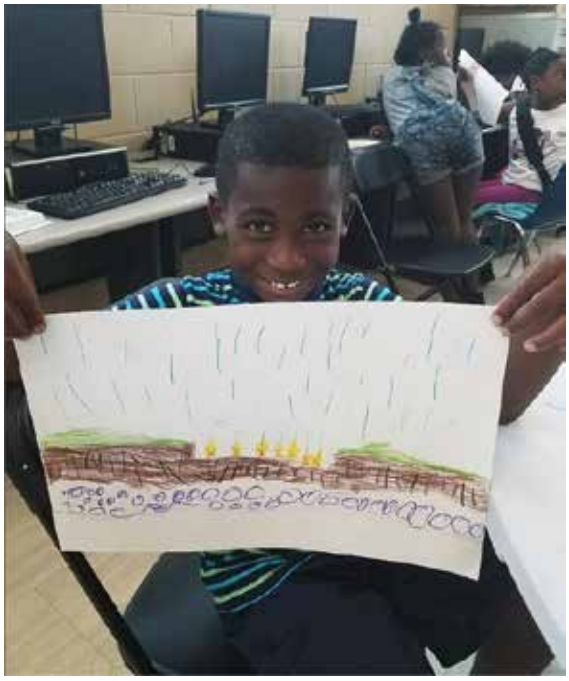


Figure 3.11: Student at Buffalo Sewer Waterworx shows off his rain garden drawing.

BUILDING A GREEN CULTURE

Workforce Development

Workforce development is an important strategy in implementing green infrastructure in Buffalo and improving opportunities for City of Buffalo residents. In order for Buffalo to successfully implement green infrastructure projects, Buffalo needs a skilled workforce to construct and maintain these systems. Buffalo Sewer is committed to creating a pool of such skilled workers who can earn a good living working on green infrastructure.

Buffalo Sewer has taken a number of steps toward achieving this goal. Buffalo Sewer has enhanced its connection to schools and summer programs for children to encourage them to think about possible green infrastructure career paths and build a broader knowledge of green infrastructure. By creating internships, fellowships, and research opportunities, Buffalo Sewer is helping to create knowledge hubs, a trained workforce, and greater opportunity for city residents.

Buffalo Sewer will be hosting training through the National Green Infrastructure Certification Program (NGICP) for Buffalo Sewer staff. NGICP training will also be available to city residents to provide skills and training to communities that may not have many opportunities for career advancement, including those with only a high school diploma/GED.

The NGICP certification training offers the green workforce an opportunity to adhere to a nationally recognized standard that promotes exceptional job knowledge, skills, and abilities to build, inspect, and maintain green infrastructure systems. NGICP certification also enables employers to ensure that they are hiring qualified workers. Having certified individuals on staff demonstrates to those looking to install green infrastructure on their properties that a contractor has the relevant experience and skills to properly install these systems.

NGICP certification offers a training pathway for workers to access skills, contractors to find the most skilled individuals to hire, and property owners to know that those installing and maintaining their systems have the necessary skills to complete the work. Training Buffalo residents for these jobs also helps ensure that the dollars spent on green infrastructure stay in the City and its economy.

The only experienced and certified NGICP professionals in New York State are located in the City of Buffalo. Buffalo is also home to 1 of 21 NGICP trainers in the entire country. Buffalo Sewer is committed to developing the most skilled and knowledgeable individuals in the field of green infrastructure and hopes to expand the number of people in the region certified and trained in green infrastructure. Buffalo Sewer will continue partnerships with organizations that conduct workforce training, such as PUSH Buffalo and Groundwork Buffalo.

Figure 3.12: Workers installing a rain garden facility at JFK community center.

Working Collaboratively

Buffalo Sewer is committed to collaborating with property owners, organizations, and individuals across the City, ranging from homeowners to large institutions. Engagement with stakeholders throughout the process will lead to better projects, open more implementation possibilities, and allow more neighborhoods to benefit.

Finding Partners

Implementing green infrastructure in Buffalo will require partnerships on many levels — local government, community organizations, national organizations, and the private sector. Through series of meetings in 2018, Buffalo Sewer focused on publicizing its green infrastructure efforts in the City, future work and collaboration, and the challenges in implementing a large scale green infrastructure program.

Buffalo Sewer can support the vision and goals of other institutions and organizations by offering technical assistance, logistical support, data sharing, potential funding, co-applications for other grant applications, and shared outreach events with individuals and organizations interested in collaborating with Buffalo Sewer on implementation of green infrastructure.

Throughout the Rain Check program Buffalo Sewer has been coordinating with local government departments and agencies. The Buffalo Green Code emphasizes that landscape, parking and street design must go hand-in-hand with stormwater management and watershed protection efforts to be effective. Collaboration with local government is a key value and approach for Buffalo Sewer and is critical to implementing the LTCP and building a green culture.

Potential partnerships with **local government agencies** include:

- Buffalo Department of Public Works
- Buffalo Employment and Training Center
- Buffalo Municipal Housing Authority
- Buffalo Public Schools
- Buffalo Urban Development Corporation
- Buffalo Urban Renewal Agency
- City of Buffalo Permits and Inspections

Figure 3.13: Buffalo Sewer Community Meeting.

- City of Buffalo Mayor's Office of Strategic Planning
- Empire State Development
- Erie County Environment and Planning
- Niagara Frontier Transportation Authority

In addition to local government, Buffalo Sewer is interested in partnering with local organizations and community groups. In addition to implementing green infrastructure projects, these partnerships can also further Buffalo Sewer's equity goals through workforce development and training programs. Potential partnerships with **local organizations** include:

- Buffalo and Erie Niagara Land Improvement Corporation
- Buffalo Green Fund
- Buffalo Niagara Waterkeeper
- City of Buffalo Block Clubs and neighborhood associations
- Clean Air Coalition
- Community Action Organization of WNY
- Community Foundation for Greater Buffalo
- Garden Walk Buffalo
- Grassroots Gardens
- GroundWork Buffalo
- GrowWNY
- Native Plants Working Group
- Olmsted Parks Conservancy
- PUSH Buffalo
- Western New York Land Conservancy
- Western New York Stormwater Coalition

Potential partnerships with **national organizations** with similar missions, include:

- Center for Neighborhood Technology
- The Nature Conservancy
- Trust for Public Land

Figure 3.14: Demonstrating porous asphalt on Clarendon.

Figure 3.15: Rain Check rain barrel being installed at a residential property..

Finally, many projects will need to be implemented by private property owners. Partners were identified in the **private sector**, including:

- Institutional or nonprofit land owners
- Design professionals
- Commercial property owners
- Developers
- Business trade groups

Property owners also play an important role in making green infrastructure a success by maintaining installations on or near their property. Meetings were held in 2018 to educate private developers on easily implementable, cost-effective green infrastructure measures that also comply with the Buffalo Green Code.

As planning and implementation progresses, Buffalo Sewer will continue to reach out to developers, businesses, organizations, institutions, and large property owners to identify more partners and expand green infrastructure opportunities. This engagement will ensure green infrastructure designs are responsive to the needs of all local partners and will foster a willingness for maintenance and support.

Buffalo Sewer can offer technical assistance, logistical support and potentially funding to individuals and organizations interested in collaborating with Buffalo Sewer to implement green infrastructure.

Figure 3.16: Team installing green infrastructure at the Crane Library.

Figure 3.17: Buffalo Sewer and Community Action Organization of WNY Pop Up Park event.

COMMUNICATION & ENGAGEMENT TOOLS

Communication Materials

Buffalo Sewer is committed to partnering with local government agencies and departments as well as collaborating with partners across the City and from many types of groups and organizations. Green infrastructure is a new part of the Buffalo landscape and it is important for Buffalo Sewer to share how green infrastructure works and how it contributes to improving the performance of the sewer system and water quality.

Buffalo Sewer has been working to develop a robust set of educational tools and knowledge sharing platforms to communicate green infrastructure benefits.

Rain Check 1.0

The Rain Check 1.0 report described the stormwater challenge, the unique role green infrastructure plays in addressing it, Buffalo Sewer's work, and Buffalo Sewer's plan to take green infrastructure to the next level. Rain Check 1.0 focused on green streets, green parking lots, green demolition and vacant lot restoration, and rain barrels and downspout disconnection. The report is a valuable tool for engaging and educating the public around the stormwater challenge.

Rain Check 2.0

Building on Rain Check 1.0, this report is an engagement tool for the next set of projects in the Rain Check program. This report communicates the descriptive characteristics and contexts of the priority areas, possible approaches to implementation, and equity implications, as well as provide locations and strategies of potential opportunities for green infrastructure.

Educational Materials

Buffalo Sewer is developing tools and techniques to deliver green infrastructure content to audiences both inside and outside Buffalo Sewer.

In seeking to expand the scale and diversity of green infrastructure planning in Buffalo, Buffalo Sewer will need to meet with many partners to spread the word on how green infrastructure is a positive investment that will benefit individuals and the community. This will mean holding additional one-on-one meetings with potential partners, having open community meetings, and providing resources for private citizens to learn on their own. In order to reach diverse audiences in many different forums the Rain Check project has prepared a series of strong, clear, and easy to understand materials that provide the core of Buffalo Sewer's educational material. These materials are briefly described here.

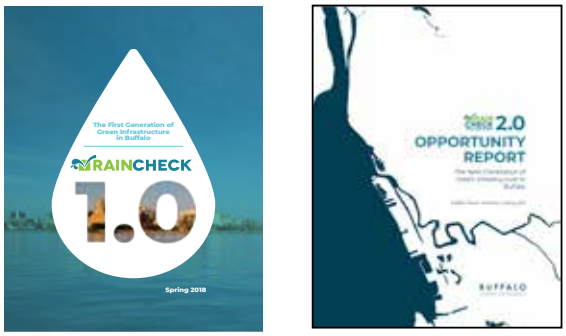


Figure 3.18: Rain Check 1.0 and Rain Check 2.0 Opportunity Report.

Figure 3.19:Rain Check Palm Card.

Figure 3.20: One Page Handouts.

Figure 3.21: Screen Shot of the Online Tour.

Figure 3.22 Buffalo Sewer Waterworx session using demonstration game

Signage will accompany Buffalo Sewer green infrastructure projects. These signs will be installed at the site of any new green infrastructure and provide descriptions of how the green infrastructure works and some of the installation's environmental benefits. These help residents to understand why these new landscape elements have been installed and their value to the environment.

Palm Card This tool can be utilized in tabling events and can be left with groups after in-person meetings. It directs people to the Rain Check website to discover green opportunities and learn more about green infrastructure.

One Page Partnership Handouts can be used in conjunction with the palm card and presentation for groups that have interest in partnering with Buffalo Sewer to take green infrastructure to the next level. The tool describes the Rain Check 2.0 project, the desire of Buffalo Sewer to partner with developers, businesses, churches, and large property owners to explore green infrastructure opportunities, and shows examples of how green infrastructure can be incorporated into different kinds of spaces. It also directs people to the Rain Check website to learn more.

Green Infrastructure Online tour offers highlights from Buffalo's first generation of Rain Check to show a number of green infrastructure projects on roadways, parking lots and vacant lots across Buffalo.

Demonstration Games can be used at in-person meetings. These kits have proved highly effective at demonstrating the stormwater challenge and how green infrastructure can be part of the solution by allowing users to play with different types of green infrastructure and see how they might manage stormwater on a city street.

Website

During the Rain Check 2.0 process a **Website** was created and raincheckbuffalo.org is home to a wide range of materials including easy-to-understand articles, interactive content, and a catalogue of Buffalo Sewer's Completed projects. These have been developed such that they can be used privately by visitors to the site and by Buffalo Sewer staff in meetings with a wide range of forums. The website includes education resources about green infrastructure and the Rain Check 2.0 program.

Green Opportunities – under this section there are three pages to introduce people to the Rain Check program and partnership opportunities with Buffalo Sewer. They also give people ideas for everyday actions that they can take to improve the local environment.

Learning – these pages provide a range of educational pieces and people interested in learning more about green infrastructure and Rain Check should be directed to these pages.

Green Infrastructure Tools – this page includes descriptions of the various green infrastructure tools available.

Our Stormwater Challenge – this page describes the stormwater challenge and why Buffalo needs to find ways to address it.

How Green Infrastructure Works – this page describes how green infrastructure works and can be part of the stormwater solution.

Benefits of Green Infrastructure – this page lays out the benefits of green infrastructure including cost savings, investment in neighborhoods, greening and beautifying neighborhoods, improving safety and public health, and creating jobs.

Green Infrastructure in Buffalo – this page describes how green infrastructure has been implemented in Buffalo, including an online tour, a link to the Rain Check 1.0 report, and a link to the Long Term Control Plan.

Figure 3.23: One of the Rain Check Website's resources pages.

Figure 3.24: Rain Check Website Splash Page.

Engagement Best Practices

Buffalo Sewer is committed to collaborating with partners across the City and across many types of groups and organizations. Public outreach by Buffalo Sewer should be a team effort in partnership with other local government agencies and departments. As Buffalo Sewer leverages these communication tools to advance implementation of Rain Check 2.0, it will be critical to build on the lessons learned through the first generation of Buffalo green infrastructure programs. In order to make decisions and install projects that can minimize harm and promote benefits to marginalized communities, Buffalo Sewer and its partners will prioritize engagement that leads to building relationships and building trust with communities, especially communities that have been historically underserved.

Figure 3.25: Community engagement on William Street.

Principles of Successful Engagement

Highlighted in the Rain Check 1.0 report, key lessons for leveraging communication tools are as follows:

Tailor engagement approaches to meet the needs of diverse communities. Buffalo is made up of many different neighborhoods shaped by diverse cultures and histories. Engagement approaches must respect this diversity and find ways to make green infrastructure concepts relatable. This includes presenting materials in several different formats and tailoring materials to reflect the specific population, languages, buildings, institutions, landscapes, and climate of the project location.

Engage individual property owners. Property owners play an important role in making green infrastructure a success, as they can act as stewards to maintain installations on or adjacent to their property. As Buffalo Sewer broadens its range of projects and the areas of the City where it is installing green infrastructure, it will need to continue to bring individual property owners into the process early, and secure their support and commitment over the long run. To the extent that Buffalo Sewer will rely on private property owners, large businesses, or major institutions to install and maintain green infrastructure, it may be challenging to promote green infrastructure in areas where residents are less likely to own their own properties, live on smaller properties with less available space for green infrastructure installation, or lack the financial resources to feel confident about long-term maintenance of the green infrastructure installations. Communities with these challenges could be targeted for additional support.

Leverage green infrastructure as a visioning tool that can help shape the future of communities. Green infrastructure can be a tool to shape the physical environment residents and stakeholders envision for their community. Implementation of Rain Check 2.0 can greatly benefit from partnering with community groups and neighborhood-level planning efforts. Communication materials can help position green infrastructure as a tool to advance neighborhood goals and aspirations.

Build "Champions" for green infrastructure in neighborhoods across the City. Neighborhood-level stakeholders play an important role

in connecting community members to public engagement processes, while opening doors to a range of audiences — property owners, tenants, customers, community institutions and their members, neighborhood or block clubs and business organizations, real estate professionals, and/or regional, issue-focused organizations. Buffalo Sewer will continue to explore opportunities to identify and empower community champions or local ambassadors for green infrastructure.

Build Trust through transparency, creation of a technical resource committee, public awareness campaign, clear, open and honest communication, and prompt, courteous, and respectful customer service. This work requires sustained investments of time, energy, and resources into building relationships and building trust with communities, interaction by interaction, meeting by meeting, project by project.

Listen First to the goals and aspirations of partners, stakeholders, and the community. Buffalo Sewer recognizes that engaging the community must be a conversation and is committed to listening first to the community vision. Only then can Buffalo Sewer understand how its green infrastructure work can support that community vision.

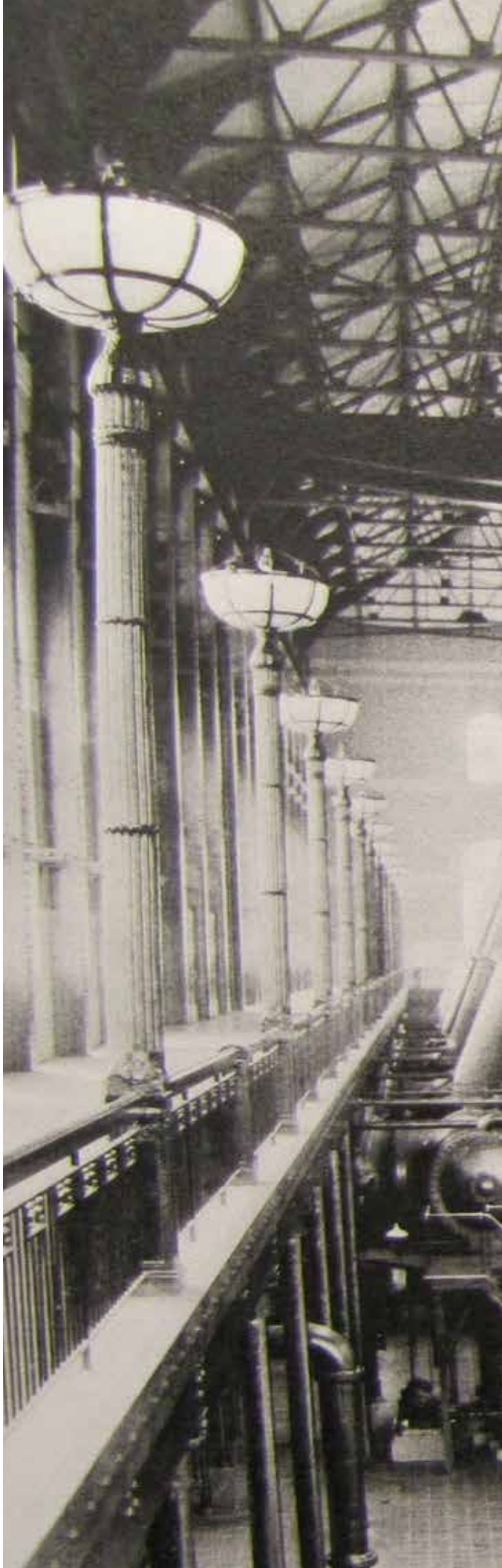
Figure 3.26: Buffalo Sewer lending a hand at a Pop Up Park event.

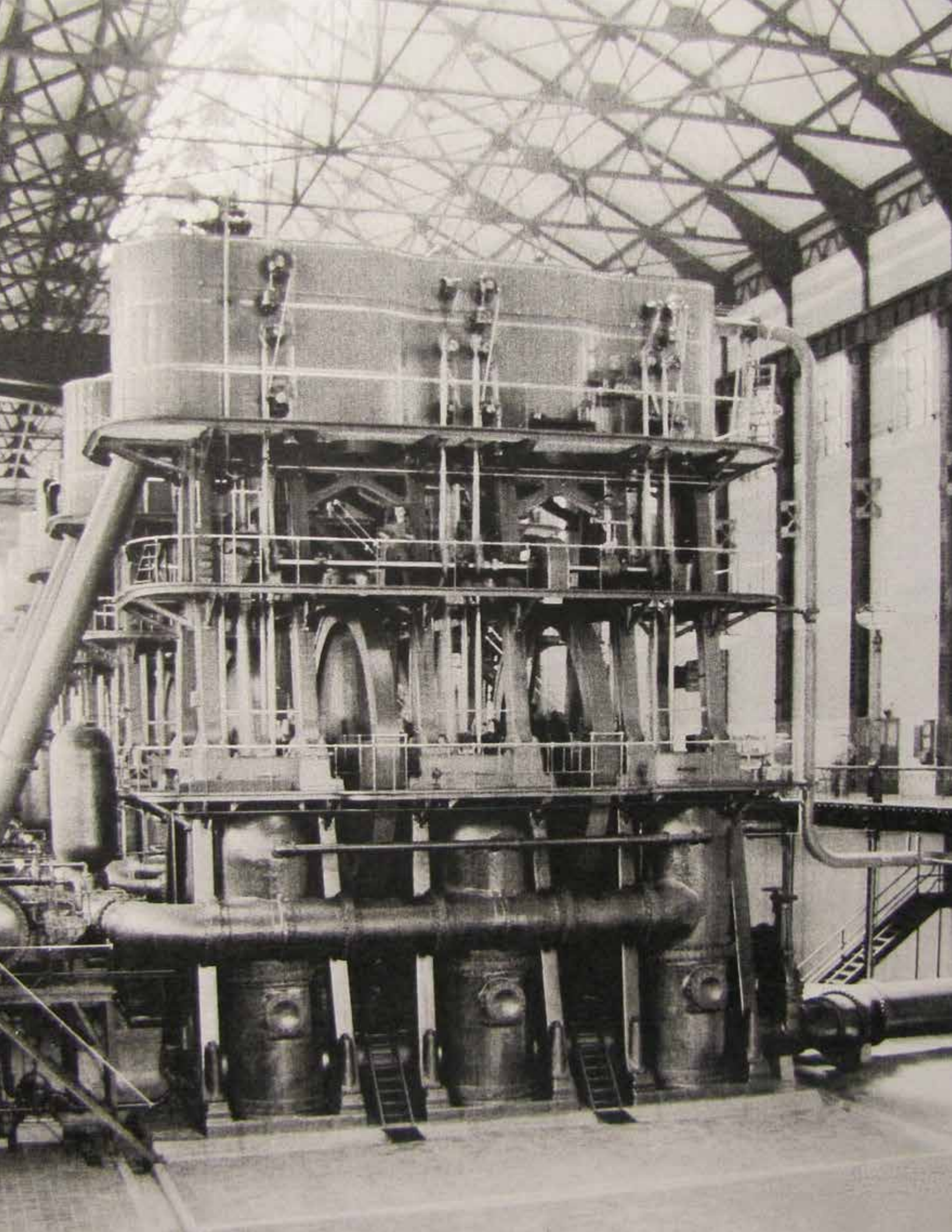
Figure 3.27: Students at Buffalo Sewer Waterworx show off their rain garden drawings.

FOUR
METHODS

Successful implementation of green infrastructure requires a deep understanding of conditions on the ground in the priority CSO basins.

This chapter describes the work Buffalo Sewer conducted and the methods used for the analyses that form the basis of this report.





CONTEXT: Rain Check 1.0 and 2.0

Rain Check 1.0 identified key solutions that could be described as "low hanging fruit," or solutions that could be quickly implemented.

Rain Check 2.0 overlaid additional concerns such as equity and building communities of action on to the achievable and technical solutions described in Rain Check 1.0. The analysis was based on a three part approach.

Defining what is **POSSIBLE**. The team gathered more data on topography, runoff, and other place-based performance data that allowed the team to determine what is needed to meet the stormwater goals and the feasibility of basin-wide capture.

Defining what is **PROBABLE**. Additional data points were gathered through simulations, GIS information, and site investigations. Using this data the team was able to find projects and places that are more likely to be strong candidates for green infrastructure.

Suggesting a method for discovering what is **PREFERRED**. Lastly, the team added metrics for evaluation such as an equity analysis, and added recommended methods for engaging a broader community in the discussion to determine what types of green infrastructure would best serve the community.

The approach resulted in some new practices, such as:

- Working with key partners and creating programs to support projects through implementation.
- Leveraging green infrastructure to support community revitalization efforts.
- Focusing on areas where projects have greatest impact.
- Creating a knowledgeable advocacy community by learning internally and from successful programs in other cities.

Work conducted as part of Rain Check 2.0 falls into two main categories. Technical, analytical, place-based work and work related to engagement and consultation with stakeholders and technical experts.

The analytical place-based work focused on quantifying the current conditions of each priority CSO as they relate to development patterns, capacity for green infrastructure installations, canopy conditions and opportunity for expansion, and the equity conditions.

Work related to communication and outreach focused on engaging people on green infrastructure. This work created tools to enhance stakeholder outreach (see **Chapter Three | People** for findings) and address technical challenges for expanding green infrastructure implementation in Buffalo (see **Chapter Two | Place** for findings). This included conversations with public, local government agencies, private property owners, developers, and green infrastructure experts.

Retrofit Reconnaissance Investigations (RRI)

The Rain Check 2.0 initiative identifies opportunities to implement green infrastructure in places where no stormwater management measures are in place. These "Stormwater Retrofits" can be built throughout the landscape, in areas where green infrastructure practices can capture stormwater and are feasible. This project built on the approach described in the "Stormwater Retrofit Handbook" (CWP, 2007), including the following steps:

- A Desktop Analysis using available mapping data to identify potential locations and
- A Field Survey to develop design concepts at each location.

The **Desktop Analysis** identified individual parcels with the greatest potential to implement green infrastructure practices. The initial screening restricted the analysis to parcels of 0.5 acres or larger, and identified potential partners based on parcel land use. Next, this initial list of parcels was refined based on other factors.

The **initial screening** resulted in a list of 945 parcels, each with an area of at least 0.5 acres. Taken together, the parcels totaled 1915 impervious acres, exceeding the total impervious cover target within every CSO basin.

The desktop analysis also considered **key community partners**, including: Public Schools, Parks, Buffalo Urban Redevelopment Authority, Buffalo Urban Development Corporation, Buffalo Municipal Housing Authority, and religious centers. Their status as a keystone for engagement, often large building footprint, and diverse representation of the community, result in a logical starting place for green infrastructure implementation. The preliminary desktop analysis indicated that 10-15% of impervious reduction targets can be achieved through these partners alone.

Figure 4.1: Image of RRI Assessment tool

Type of Information	Data Collected
Administrative Data	Person assessing Date Retrofit ID Date/Time
Property Information	Ownership Land Use Existing Practices Present
Proposed Retrofit Description	Location Purpose Practice Type / Description Practice Site / Dimensions
Retrofit Area Description	Dominant Soils (if available) Available Hydraulic Head Light Availability Visibility Adjacent Land Uses
Potential Constraints or Conflicts	Land Use Conflicts Utilities Potential other site constraints (such as contaminated soils or large trees)
Other Data Collected	Site Photos Concept Sketches Drainage Area Delineation Site and Design Notes

Table 4.1: Key Information Collected during RRI Field Visits

Field surveys of potential retrofit sites were completed using a new electronic version of the Retrofit Reconnaissance Investigation (RRI; CWP, 2007) form, adapted to suit the needs of the Rain Check 2.0 project (Table 4.1). The purpose of the field survey was to: 1) narrow the list of potential parcels to include only those sites where green infrastructure practices are feasible; 2) delineate areas within each site that could be treated by these practices; 3) propose potential solutions appropriate to each site; and 4) identify potential implementation challenges at each site, such as utilities or parking conflicts.

Parcels with Feasible Retrofits

The primary goal of the RRI field surveys was to develop a list of properties from those identified during the desktop screening, where green infrastructure is feasible given existing conditions at each site. Of the 625 sites visited, 450 were suitable for some type of green infrastructure practice. Typically, sites were removed from the list due to major conflicts, such as presence of large utilities throughout a site (for example, an electrical substation) or soil contamination issues. The site investigators used GPS to identify the specific location where they completed the assessment and each point includes data describing if the site is feasible.

Drainage Area Treated

The initial desktop screening identified the area of each parcel, as well as an estimate of the total impervious cover based on land use. At the site level, however, a practice cannot typically capture the entire site area, due to site drainage patterns. During the site visits, team members delineated the boundaries of the drainage area that could be captured by a practice. For sites that were considered feasible, the result is a map of drainage areas that are then overlaid with existing land use and impervious cover to identify the total area of impervious cover that can be captured by green infrastructure practices identified in the field. Taken together, the total impervious area captured within the drainage areas is 482.1 acres with street drainage area included when found feasible in RRI field visits.

Retrofit Concepts and Implementation Concerns

At each site where retrofits were feasible, the investigator also developed a retrofit concept, including a simple sketch of opportunities at the site scale, and a description of the types of green infrastructure practices that may be appropriate. In addition, the investigator described and noted conditions at the site that are important to implementing the practices. Some of these are opportunities, such as potential partnerships or educational opportunities. Others include data needs, such as survey data or locations of drainage features, or constraints, such as existing utilities. These data, contained in the complete database of retrofit opportunities, will be useful when opportunities arise to implement individual practices.

Tree Canopy Analysis

Trees play an important role in stormwater management. To better understand their role in Buffalo, an in-depth analysis of the tree canopy was conducted for the entire City and also for each priority CSO Basin.

Analysis of Existing Canopy

The existing tree canopy was measured using 2014 LiDAR (Light Detection and Ranging) data and GIS software. This analysis allowed the team to determine gaps in tree canopy coverage and available spaces for "street trees"" (i.e. trees located at the front of the property between the sidewalk and the street). From this evaluation, potential locations were identified for tree planting to reduce stormwater runoff.

Opportunities for Expanding the Canopy

Identification of potential sites for additional tree planting focused on several areas:

- Within the street rights-of-way. Typically located between the sidewalk and the street, acceptable planting locations currently without trees were identified through previous evaluations conducted by the City in 2014. These trees are directly managed by the City.
- Outside the public rights-of-way, on both residential and non-residential properties. These locations were identified using U.S. Forest Service protocols with input from the Rain Check 2.0 Tree Technical Advisory Committee members (Tree TAC) to identify City-specific restrictions. The potential planting sites included pervious acres not already covered by tree canopy and excluded areas within 50 feet of a railroad and any vacant city-owned parcels due to potential maintenance challenges. Trees located outside the public rights-of-way are the responsibility of the property owner.

The identified locations require further investigation to ensure that they can support long-term tree growth and survival and that appropriate tree species are selected. The City does not have the capacity or resources to take on a large-scale street tree planting campaign; therefore, partnering with property owners for the planting and maintenance of trees outside the public right-of-way will be critical for stormwater management success as significant opportunities exist on private land.

Defining the Stormwater Benefits of Trees

In addition to analyzing the opportunities for tree planting in Buffalo throughout the City and in the priority CSO basins in particular, Buffalo Sewer also established a methodology to define the benefits of tree plantings for reducing stormwater volume. The development of such a framework was needed to evaluate the volume reduction benefits of trees as compared with other green infrastructure practices. Although trees are known to improve stream quality and watershed health by decreasing the amount of stormwater runoff and pollutants that reach local waters, no single accepted methodology exists to account for these benefits in a quantitative way, particularly for single storm events.

Figure 4.2: Historic Image of Buffalo's Street Trees (source: Buffalo Rising)

Buffalo Sewer developed a method that builds on a water balance modeling framework and incorporates the expertise of a Tree TAC that was assembled for this project to develop a method that takes into account the unique needs of the City of Buffalo and the Rain Check 2.0 effort. Technical experts in forestry were brought together from government agencies and academia, along with national and local practitioners. Buffalo Sewer convened these experts as the Tree TAC to advise on this effort. Through regular meetings and focused topic discussions they helped to translate national practices and specific tree criteria to inform the method. The framework builds on work done by the Center for Watershed Protection on developing a national Stormwater Performance-Based Credit for tree planting.

The Buffalo Rain Check 2.0 Framework includes two elements to account for tree planting: 1) a per-tree credit for future planting, and 2) a canopy based credit for tracking progress over time. These credits are also supported by basic assumptions regarding tree growth rates as well as ongoing data collected as part of routine tree inventories. The credit will quantify an event-based reduction in runoff volume associated with tree planting for the City of Buffalo.

Figure 4.3: Timon St. street trees in Buffalo, NY (source: Buffalo Rising)

Equity Analysis

A detailed analysis of equity in Buffalo and how equity considerations intersect with green infrastructure was completed. Integrating equity considerations into the decision-support framework for green infrastructure is an explicit goal of Buffalo Sewer and the City of Buffalo. Part of the rationale for adopting a green infrastructure approach to reduce stormwater runoff and prevent combined sewer overflows in Buffalo is that there are social, economic, and environmental benefits to be gained as green infrastructure is installed throughout the City. These potential benefits make the equitable provision of green infrastructure an important concern.

The Equity Analysis was grounded in the understanding that CSO basins are not familiar geographies to many people; instead, these areas are neighborhoods where people are born, live, learn, work, play, worship, and age. The Equity Analysis focused on vulnerable communities that have historic or contemporary barriers to economic and social opportunities and a healthy environment as a central concern of green infrastructure planning.

The Equity Analysis consisted of two approaches: (1) a citywide equity index and (2) individual CSO equity profiles. First, a composite index of seventeen variables was developed to compare census block groups across Buffalo on measures of need, deprivation, and risk. The index included two types of variables: socioeconomic variables related to disadvantage and vulnerability, and environmental factors related to both exposure to environmental risks and access to environmental amenities. Using geographic information systems (GIS), each of the seventeen variables and index values were mapped at the block group level. The index values and accompanying set of maps provide an easy, visual way for Buffalo Sewer and stakeholders to better understand the citywide distribution of need, deprivation, and risk and to compare different neighborhoods on various measures.

Second, a series of profiles was developed for the six priority CSO basins that were identified as target areas for Rain Check 2.0. Each equity profile offered an in-depth look at demographic, economic, health, and environmental conditions for the people living in the "neighborhoods" (census tracts) located in and around the CSO basin. The profiles also highlighted community assets and institutions, including major employers, community centers, schools and religious institutions in each CSO basin. Some of the variables included in the Equity Analysis were also examined in other work, such as land use patterns and tree canopy cover. This repetition was intentional; analyzing this data alongside or in combination with socioeconomic data offered a more balanced or holistic evaluation of challenges and opportunities in each CSO basin.

The Equity Analysis focused attention upon the community and economic benefits associated with green infrastructure, the neighborhoods that are located within priority sewer basins, and the inequitable distribution of disadvantage and vulnerability by

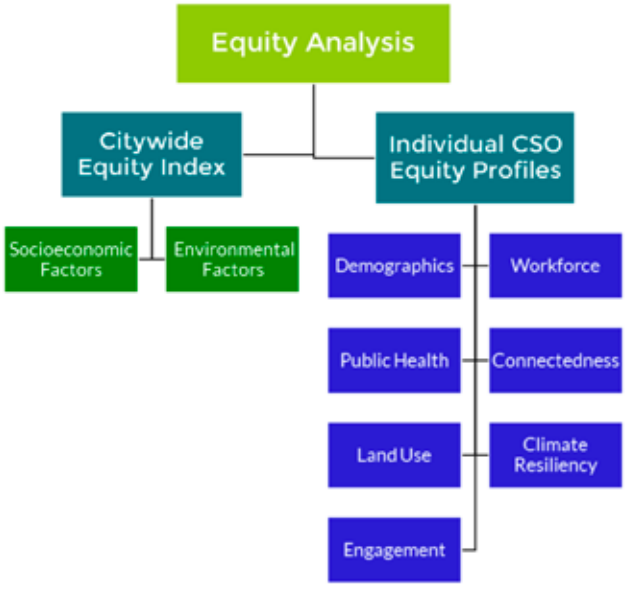


Figure 4.4: Data analyzed for City-Wide Green Infrastructure Index and Individual CSO Equity Profiles

neighborhood, race, and ethnicity across Buffalo. The equity index maps and equity profiles provided a more nuanced understanding of communities most in need of green infrastructure.

The equity index and equity profiles should not stand alone as planning tools absent community input on both the indicators and their importance. Instead, the index and profiles can be used to shape and strengthen community discussions about equity and green infrastructure. Both the index and profiles can be modified to include additional indicators.

As Buffalo Sewer targets interventions in other areas of the City, similar data can be collected and analyzed. Buffalo Sewer's methods and data were informed by engagement with the community and key stakeholders, which also set the stage for future partnerships.

More information on the Equity Index can be found in the Appendix A1.

Figure 4.5: Hoop house being installed (Source: PUSH Buffalo)

Engagement & Consultation

Private Engagement

Buffalo Sewer engaged developers, design professionals, property owners, business groups and institutional and non-profit land owners as part of the process of developing this report. Since the majority of Buffalo's land area is privately owned, engaging the private sector is key to achieving Buffalo's stormwater management goals. To engage with the private sector, Buffalo Sewer conducted one-on-one interviews with developers and private property owners, held focus group meetings, sent out email questionnaires, and researched programs used by other cities to engage the private sector in implementing green infrastructure.

Stakeholder Engagement

Buffalo Sewer engaged with the public and local government stakeholders to publicize past green infrastructure efforts in the City, discuss lessons learned, and develop approaches for local stakeholders to implement as they continue their projects. Meetings involved several one-on-one interviews as well as focus group discussions.

Technical Advisory Committees

Buffalo Sewer identified technical experts in the field of green infrastructure from government agencies, academia, community organizations, and local practitioners. Buffalo Sewer Authority convened these experts as a Technical Advisory Committee (TAC) to advise on the best possible green infrastructure network. The TAC members brought with them a wide range of knowledge and experience. Through regular meetings and focused topic discussions they helped to translate national practices to the Buffalo context.

The outcomes of each TAC meeting were summarized with recommendations prepared. The TAC meeting outcomes and recommendations were incorporated into the project process and also into this report where appropriate.

Next Steps

Buffalo Sewer's next steps are to continue the engagement and consultation process. This will include outreach to neighborhood groups and property owners in the priority CSO basins, creation of a grant program for green infrastructure implementation, green infrastructure training, and establishing partnerships.

Figure 4.6: Buffalo Sewer Waterworx educational session on soil science

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Buffalo Sewer Authority

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Rishawn Sonubi

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Tuona Bachelor
Jason Paananen

Consultant Team

Arcadis of New York, Inc
David Barnes
Rachel Smith
Mike Moscariello
John Salvagno
Angela Hintz
Erin Beyer
Colette McDonald
Hannah Rockwell
Fernando Pasquel
James Cottone

evolve enironment :: architecture
Christine Mondor
Nico Azel
Elijah Hughes
Claudia Saladin
Daniel Klein

UBRI
Bart Roberts
Enjoli Hall
Brian Conley

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Kristopher Winkler
Jessica Harms
Robert Frazer

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Ken Parker
Es Jimenez
Sarah Caputi

Center for Watershed Protection
Deb Caraco
Neely Law
Laurel Williamson
Lisa Fraley-McNeal

CORE Environmental Consultants
Shannon Hennessey
Jared Pristach

CallisonRTKL
Monica Streeper

Technical Advisory Committee

John Bidell - Buffalo Public Works
Hal Sprague – Center for Neighborhood Technologies
Marcella Bondie Keenan – Center for Neighborhood Technologies (CNT)
Anna Wolf – Center for Neighborhood Technologies (CNT)
Dawn Walker – Center for Neighborhood Technologies (CNT)
Jared Pristach – Core Environmental Consultants, Inc.
Deb Caraco – Center for Watershed Protection (CWP)
Bill Stack - Center for Watershed Protection (CWP)
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Antonina Semeti – Groundworks Buffalo WNY Environmental Alliance
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Joy Kuebler – Joy Kuebler Landscape Architect
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Ken Parker - People United for Sustainable Housing (PUSH)
Es Jimenez – People United for Sustainable Housing (PUSH) Blue
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Justin Hynicka – American Forests
Adam Berland – Ball State
Ross Hassinger – City of Buffalo Bureau of Forestry
Andy Rabb – City of Buffalo Bureau of Forestry
Deb Caraco - Center for Watershed Protection (CWP)
Neely Law – Center for Watershed Protection (CWP)
Shannon Hennessey – CORE Environmental Consultants
Lori Brockelbank – Davey Trees
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Chris Wood – Carmina, Wood, Morris, PC
Bill Paladino – Ellicott Development
Matt Roland – Hamister Group
Nick Dolpp – Iskalo Development
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Scott Rybarczyk- Wendel Companies
Dave Majewski - Sustainable Resource Group
Phil Thompson – Labella Associates

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