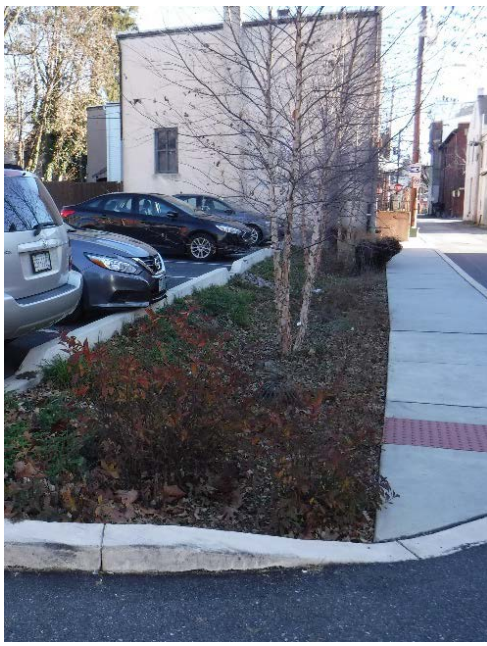


THE CITY OF LANCASTER

Green It! Lancaster

CITY OF LANCASTER
A City Authentic

This page is intentionally left blank.

Contents

Appendices

Table(s)

Figure(s)

This report was prepared in February 2019 by the City of Lancaster with support by:

JACOBS

Acronyms and Abbreviations

Ac	Acres
AQ	Air Quality
AWWTP	Advanced Wastewater Treatment Plant
City	City of Lancaster
CD	Consent Decree
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
DCNR	Pennsylvania Department of Conservation and Natural Resources
EPA	U.S. Environmental Protection Agency
Est.	Estimated
ft. or ‘	Feet
GI	Green Infrastructure
GIS	Geographic Information System
IA	Impervious Area
in. or “	Inch/Inches
LTCP	Long Term Control Plan
MG/D	Million Gallons / Million Gallons per Day
mi.	Miles
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
ORE	Overflow Reduction Efficiency
PADEP	Pennsylvania Department of Environmental Protection
PCI	Pavement Condition Index
PennDOT	Pennsylvania Department of Transportation
PMP	Pavement Management Plan
PRP	Pollutant Reduction Plan
RCRA	Resource Conservation and Recovery Act
yr	Year

This page is intentionally left blank.

1. Executive Summary

The City of Lancaster is one of about 770 cities nationwide with a combined sewer system (EPA). At the time that combined sewer systems were being built across the country 100 or more years ago, they were considered a highly efficient method of managing all forms of liquid waste from urbanized areas since they collected stormwater, sanitary sewage and industrial wastewater all in the same pipe and conveyed them to a treatment plant to be processed before discharging treated water to the nearby waterbodies. Most of the time, the City's Advanced Wastewater Treatment Plant (AWWTP) is able to manage and clean the volume of wastewater in the system. However, intense rainstorms often cause untreated wastewater to overflow into the Conestoga River, much of it runoff generated from impervious surfaces including buildings, streets, alleys, and parking lots.

With this backdrop, Lancaster City has been working proactively for many years to reduce these combined sewer overflows. Given the expense of gray infrastructure modifications (such as increasing the capacity of the City's wastewater conveyance and treatment infrastructure; adding storage or holding tanks to detain wastewater flows until treatment capacity returns; or providing some form of wastewater treatment to the overflow discharges), the City has decided to also utilize "green infrastructure" methods of stormwater management.

Green infrastructure encompasses a variety of technologies that replicate and restore the natural hydrologic cycle and reduce the volume of stormwater entering the sewer system. This, in turn, reduces overflows. Green infrastructure generally includes stormwater management methods that:

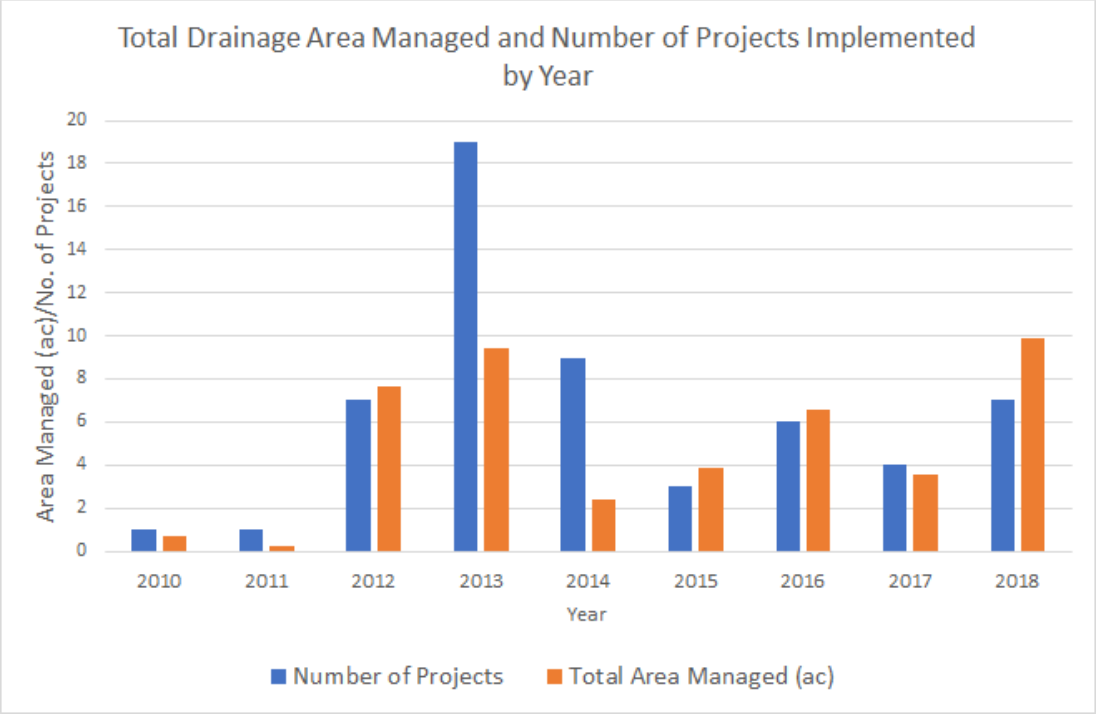
- infiltrate (porous pavements, sidewalks, and gutters; linear infiltration systems)
- evaporate, transpire and reduce energy consumption (vegetated roofs, trees, planter boxes)
- infiltrate and transpire (rain gardens and bioretention)
- capture and reuse rainfall (rain barrels, cisterns, irrigation supply systems, and gray water systems)

Green infrastructure can also offer multiple co-benefits, potentially including:

- *Environmental* – recharges ground water, provides habitat and green space, reduced energy usage, improved water quality.
- *Social* – beautifies and increases recreational opportunities, improves health through cleaner air and water, improves psychological well-being.
- *Economic* – reduces future costs of stormwater management and increases property values.

GI Implementation Since 2010

Since 2010, the City of Lancaster has been planning for and implementing green infrastructure. The City's first GI Plan, adopted in 2011, envisioned an integrated Green Infrastructure Program that incorporates green infrastructure in a cost-effective, adaptive, and systematic manner into public capital improvement projects and into select private projects. Through the City's program (not including stormwater controls required by code for redevelopment or separate voluntary implementation), green infrastructure systems have been implemented as part of 57 projects which collectively manage 44 acres of impervious area. These 57 projects encompass approximately 7 acres of new GI systems comprised of a variety of GI technologies that can be categorized into 8 project types: Green Alley, Green Street, Parking Lot, Green School, Green Park, Public Property, Green Roof, and Private Property. These completed projects are estimated to capture over 36 million gallons of stormwater during a typical year.



Vision and Goals

Green It! Lancaster clearly articulates a vision for the City:

A livable, sustainable, and safe community with clean rivers and streams.

Green It! Lancaster lays out the following goals:

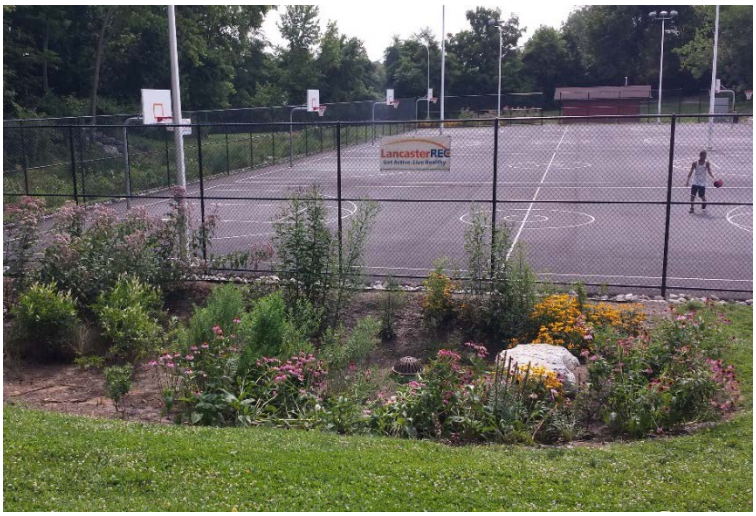
1. Improve water quality in the Conestoga River by integrating stormwater and pollution reduction into City public works and community improvement programs.
2. Reduce pollution and excessive flows from urban stormwater and combined sewer overflows.
3. Prioritize green infrastructure (GI) projects to maximize economic, clean water, health and quality of life benefits for residents.
4. Achieve cost effective Clean Water Act compliance by integrating multiple water quality drivers (e.g., consent decree, stormwater regulations, and the Chesapeake Bay Plan).
5. Reinforce Lancaster City as a national and statewide model in GI implementation.

Planning and Evaluation Strategies for Implementing GI

Green It! Lancaster presents a range of public and private strategies for implementing green infrastructure in the City of Lancaster to achieve additional stormwater capture, overflow reduction, and other benefits.

For the GI Implementation planning analysis, parcels were categorized into several project types, or GI strategies: Green Park, Green School, Green Street, Green Alley, Public Property, Green Roof, Parking Lot, and Private Property. These project types were originally presented in the 2011 GI Plan and were updated for this analysis. The project types can be organized by ownership, and at the highest level are split into public and privately-owned properties. Each project type has associated GI planning processes and implementation mechanisms.

The City has implemented significant green infrastructure in four parks to date, with the potential to implement GI at additional public parks, both at a localized scale (managing on-site runoff) and at a larger, neighborhood scale (managing both on-site runoff and runoff from adjacent streets and parcels). To date, park GI projects have managed approximately 3 times the amount of impervious area within park boundaries, indicating that they are managing a significant amount of adjacent roadway and sidewalk runoff in addition to on-site impervious.



Public schools can provide a variety of GI techniques that manage stormwater from both on-site and from adjacent impervious area such as roadways. Public schools are typically located on larger-sized parcels with significant areas of impervious play surfaces, parking, and rooftops. Green infrastructure can not only manage stormwater and improve aesthetics on school grounds but can also be incorporated into classroom curriculums. To date, green infrastructure has been implemented by the City at one school (McCaskey) with more projects scheduled for construction in the future. There are opportunities for GI implementation with facility upgrades/renovations and potential cost savings to be realized through integrated infrastructure construction. The City plans to coordinate with the School District regarding capital improvements and timing of available grant funding to determine the potential for green infrastructure implementation.

Streets are one of the principal GI project types for the City and offer a vast opportunity for GI projects, primarily because they make up the largest category of publicly owned impervious area and have potential to integrate stormwater management into planned transportation, mobility, accessibility and/or pedestrian improvements. Several city priorities shape the Streets Strategy: complete streets, active transportation (bike/pedestrian) improvements, one-to-two-way conversions, and planned reconstruction/repaving under the City's pavement management plan.

In addition to streets, alleys are prime candidates for green infrastructure implementation due to their lower volumes of traffic and potential ability to manage runoff from immediate and adjacent impervious surfaces. To date, the City of Lancaster has implemented 14 green alley projects and these projects manage on average 2.7 times the impervious area of the managed alley area. The

best potential opportunities for public green alley projects are City-owned alleys with higher overflow reduction efficiencies (OREs) in the North and Engleside basins. Additional evaluation criteria include neighborhood, drainage area potential, pavement condition, slope and the presence of utilities that would limit GI and increase costs.

Planting and maintaining city trees is an important means of expanding the City of Lancaster's urban forest. The City of Lancaster recognizes the intrinsic value and ecosystem benefits that trees provide to its citizens. Trees help to remove pollutants from the air and water, capture stormwater, shade streets and residences, increase property values, provide wildlife habitat, facilitate social and educational opportunities, improve physical and mental wellbeing, and offer aesthetic value. Prior to the development of the 2011 GI Plan, improvements to the tree canopy and the City's urban forest were primarily aesthetic. Beginning concurrent with the 2011 GI Plan, the City undertook a tree inventory and canopy assessment as well as addressing other challenges that have contributed to stresses upon the City's urban forest. The City is serious about growing and maintaining a healthy and verdant urban forest and therefore it must invest in preserving existing wooded and natural areas, and planting trees along its streets, in parks, and in other public and private open spaces. The City must also focus tree planting and preservation efforts on planting trees in back yards, parking lots and other private property.

The City recognizes that it cannot meet the stormwater reduction and clean water goals set forth in this Plan without the cooperation and collaboration of private property owners and City residents. Empowering and engaging property owners and residents in accepting and implementing GI on their properties is a key component of this GI Plan. The largest non-roadway category of impervious area (IA) is parking lots representing 27% of all IA. Results from this analysis show that approximately 10% of parcels with parking lots over 20,000 SF (0.46 acre) account for over 50% of the private parking lot impervious acreage.

If greened and reconstructed to manage stormwater, these large parking lots would contribute significantly to meeting the stormwater reduction goals of this plan. However, large parking lots are seldom reconstructed, often requiring periodic minor repair and resurfacing to keep them well-maintained. Therefore, attention should be directed toward parking lots of all sizes. Many smaller surface parking lots do not meet the current minimum parking lot design and construction standards in the City Code of Ordinances. These non-conforming parking lots were previously "grandfathered" but are now required to be brought into compliance with the City's existing zoning regulations when slated for improvement as defined in City code.

In addition to requiring compliance with City regulations, programs should be evaluated for incentivizing private property owners to green their surface parking lots. This can be done through the provision of grants, credits and rebates. The City currently has a Stormwater Management Fee credit program in addition to a residential small grant program that was created to assist homeowners in the installation of small stormwater projects. These credits and grants can help to offset the additional cost of maintaining their stormwater facilities, thus providing an incentive for implementing GI.

Potential GI Implementation Levels

In many ways, the City has made implementing green infrastructure (GI) a core part of its Public Works activities as roads, alleys, parks, and other public infrastructure are restored and improved. The City currently has budgeted $1.2 million per year for green infrastructure focused in the North and Engleside basins, with additional public implementation throughout the City supported by grants and other partnerships. Additional public GI implementation is also being investigated as part of the City's CSO Long-Term Control Plan Alternatives Evaluation process.

In addition to City-led GI, implementation of stormwater controls on private property will continue as redevelopment occurs through the City and property owners retrofit sites to reduce their stormwater fees and comply with current and future City ordinances.

This plan's analysis combines runoff capture, CSO reduction, and cost information with results of the GIS analyses to approximate what might be achieved by the City over the 20-year Consent Decree duration. For example, using the current City GI budget of $1.2M per year split between the North and Engleside basins, a sample mix of green alleys, streets, parks, and schools could potentially reduce CSOs by a combined total of approximately 80 million gallons (MG) per year in the North and Engleside basins at the end of the 20-year period. If GI is considered by the City as part of the CSO long-term control plan alternatives, then this planning approach can be scaled to estimate CSO reductions from GI over a range of implementation levels and across a full range of CSO capture objectives (i.e. frequency and volume).

Project Prioritization

As Lancaster's GI program has evolved, the City has found that most green infrastructure projects are prioritized and implemented opportunistically, rather than as part of a formal prioritization process. The City prioritizes largely based on funding availability, integration with other infrastructure improvements (e.g., street work, park renovations, water and sewer replacements, facility expansions), and coordination with other planning efforts (Active Transportation Plan, Building on Strength, etc.). The City also considers factors such as distributing projects in different neighborhoods and prioritizing locations where GI can help to address multiple needs (poor pavement condition, traffic safety concerns, lack of green space, etc.).

Potential project ideas and concepts are continually being developed through coordinated efforts by the City to integrate GI implementation with City capital improvement planning (CIP) and budgeting, and through efforts to identify new and existing funding sources which may be applied to GI projects. The City has also leveraged partnerships with other public entities such as the School District of Lancaster (SDoL), PennDOT, and various non-profit organizations to identify project and funding opportunities, as well as to integrate GI with partner-led initiatives.

While GI projects have been implemented throughout the City, project prioritization is now focused on implementing GI projects in the North and Engleside basins of the combined sewer system (CSS) since the other two CSS basins (Susquehanna and Stevens Avenue) are small with high levels of existing wet weather control in comparison to North and Engleside. Areas of the City that have separate storm sewers are covered under the City's Municipal Separate Storm Sewer System (MS4) permit with the PA Department of Environmental Protection and are implemented as part of the City's Pollutant Reduction Plan (PRP).

Plan Recommendations

1. Continue implementing green infrastructure projects in the right-of-way and on publicly-owned parcels by focusing on the project types (strategies) outlined in this Plan (Green Parks, Green Schools, Green Streets, Green Alleys, Inflow Removal).

2. Evaluate and prioritize projects per the Prioritization Considerations outlined in this Plan, such as potential impervious area capture, location, potential to address multiple needs and integrate with other infrastructure improvements, interest levels from stakeholders and community groups, and availability of funding.
3. Continue to evaluate ways to track, quantify, and communicate the co-benefits of GI in the City.
4. Evaluate private property incentive programs to encourage GI implementation outside of publicly-owned parcels, particularly for parking lots, but also for other privately-owned properties (e.g., residential downspout disconnections, rain barrels, and rain gardens).
5. Continue efforts to maintain and expand the City's tree canopy and prepare a comprehensive tree management plan to guide these efforts.
6. Continue conducting periodic reviews of the City's ordinances that relate to green infrastructure and consider enhanced ordinances such as:
    a. a stormwater ordinance that requires management of all disturbed impervious area as part of redevelopment (similar to the City of Philadelphia's ordinance),
    b. an ordinance that incentivizes or requires green roofs under certain conditions, and
    c. improved tree protection/planting requirements.
7. Coordinate with the City's climate action planning that kicked off in December 2018.
8. Continue public outreach and education efforts related to stormwater management including the use of social media as appropriate.
9. Improve the project tracking system for GI projects and consider publishing an interactive map on http://www.saveitlancaster.com.
10. Perform a cost-benefit analysis of higher stormwater capture volumes (e.g., 1.5 inches).
11. Periodically evaluate new stormwater management techniques, technologies, and products and pilot them as appropriate.
12. Review, and if necessary, update the City's Green Infrastructure Plan at least once every 5 years.

2. Introduction

2.1 Organization of Plan

This plan is organized into 7 sections and several Appendices that provide the content required for the Green Infrastructure Plan Outline contained in Appendix B of the Consent Decree.

Section 1 (Executive Summary)

Section 2 (Introduction) provides an overview of the plan, its background, and history.

Section 3 (GI Program Update) provides a summary of the GI Program's accomplishments from 2010 – 2018 including the number of projects implemented, the total amount of impervious area managed, and other significant metrics to demonstrate the impact that the GI Program has had since the first GI Plan was published in 2011.

Section 4 (Program Goals) highlights the City's goals for continued green infrastructure implementation and complementary goals of stormwater management, community development, neighborhood greening and enhancement, and ecological improvements.

Section 5 (Existing Conditions) presents an overview of changes in and new information on the City's existing conditions since the first GI Plan. For example, new mapping of the City that has affected impervious areas. A brief description of the City's socioeconomic trends is also included.

Section 6 (GI Planning and Evaluation) presents several strategies for potential GI implementation including Public Strategies for parks, schools, and right-of-way and Private Strategies for privately-owned parcels, such as parking lots that consist of significant impervious area.

Section 7 (Recommendations for Ongoing GI Implementation) presents an Analysis of Benefits of potential GI implementation over 20 years including a discussion of co-benefits. This section also discusses prioritization strategies related to GI implementation and presents lists of potential GI projects to consider for implementation.

The **Appendices** include sample GI Project Concept Plans and Green Infrastructure Project Type Fact Sheets. Also included by reference / as appendices are important documents related to this GI Plan Update, such as the City's Stormwater Ordinance Summaries, the DCNR Urban Tree Canopy Assessment, the GI Design Manual, GI Operations & Maintenance Plan, and the GI Monitoring Plan that includes a Selection of Representative Monitoring Sites.

2.2 Background

The City of Lancaster, laid out in 1730 and incorporated as a City in 1818, serves as the county seat of Lancaster County. It briefly served as the National Capital during the American Revolutionary War and for several years as the capital of Pennsylvania. Lancaster City is home to some of the largest employers in the region including Lancaster General Hospital, School District of Lancaster and Lancaster County Government. In 2010, the City's population was 59,322, with a population density of more than 8,000 persons per square mile. The City contains a land area of 7.34 square miles and includes 248 acres of publicly-owned park land and playgrounds, 140 miles of streets and alleys, 853 acres of buildings and 670 acres of parking lots, resulting in over 50% of the City covered by impervious areas. Most of the City is within the Conestoga River watershed, a tributary of the Susquehanna River watershed, with small portion within the Little Conestoga Creek and the Mill Creek watersheds. The Susquehanna River watershed is the largest tributary draining the 64,000 square mile Chesapeake Bay watershed.

In addition, the City is surrounded by some of the most productive non-irrigated farmland soil in the country. The City became a market place for the sale and purchase of various crops and livestock. This market place tradition continues today with Central Market – the oldest, continuously operating farmer's market in the country. The City has a very old housing stock containing over 23,000 housing units (as of 2007, the median year built was 1908). The City has been designated by the Pennsylvania Department of Environmental Protection (PADEP) as an environmental justice community based on both race and income. Of the sixty municipalities within Lancaster County, the City has the second lowest taxing capacity and the highest percentage of people living below the poverty level (28%, according to the 2010 census).

Lancaster is one of about 770 cities in the U.S. with a combined sewer system (CSS). The total land area served by the CSS is 2,060 acres, representing about 44% of the land area of the City. The remaining areas of the City (2,641 acres) drain into a separated storm sewer system. Most of the time, the City's Advanced Wastewater Treatment Plant (AWWTP) is able to manage and clean the volume of wastewater in the system. However, intense rainstorms often cause untreated wastewater to overflow into the Conestoga River, much of it runoff generated from impervious surfaces including buildings, streets, alleys, and parking lots.

When CSSs were being built across the country in the 19th and early 20th centuries, they were considered an efficient method of managing all forms of liquid waste from urbanized areas, because they collected stormwater, municipal wastewater, and industrial wastewater all in the same pipe and conveyed them to a facility to be processed before discharging the treated water into nearby waterways. CSSs, as originally constructed, have proven to be inadequate to address modern treatment needs and the clean water mandates the City must follow to reduce Combined Sewer Overflows (CSOs).

Efforts to clean up local waterways and the Chesapeake Bay have brought renewed federal, state and regional attention on initiatives designed to protect and restore the network of streams and rivers in the Chesapeake Bay watershed, many of which fail to meet water quality standards, including the Conestoga River. This regulatory structure includes the Pennsylvania Storm Water Management Act (Act 167), federal Clean Water Act, Pennsylvania's Chesapeake Bay Watershed Implementation Plan (WIP), and the City's Consent Decree with the EPA and PADEP, all of which are described in more detail below.

Over the past 20 years, the City has been proactive in reducing these overflows, investing over $30 million on mostly "gray infrastructure," including making it the first treatment plant in the state to meet nutrient removal requirements through a biological nutrient reduction project. Given the expense of gray infrastructure modifications, the City has instead opted for a dual strategy to reduce CSOs by increasing the efficiency and capacity of the City's existing infrastructure and, at the same time, employing "green infrastructure" methods of stormwater management that include infiltration, evaporation, transpiration, storage, and capture and reuse.

While the principles of *Green It! Lancaster* apply to the entire City, many of the analyses and metrics apply to the combined sewer system (CSS) with a focus on the North and Engleside basins since the other two CSS basins (Susquehanna and Stevens Avenue) are small with high levels of existing wet weather control in comparison to North and Engleside. The City is also planning pump station improvements and/or sewer separation work in the Susquehanna and Stevens Avenue basins that are expected to adequately reduce their combined sewer overflows (CSOs). Areas of the City that already have separated storm sewers are covered under the City's Municipal Separate Storm Sewer System (MS4) permit issued by the Pennsylvania Department of Environmental Protection (PADEP).

2.3 History of Green Infrastructure Planning and Implementation

In 2011, Lancaster became the first Third Class City in Pennsylvania to adopt a Green Infrastructure Plan. That initial GI Plan laid out a 25-year strategy to employ green infrastructure practices to manage stormwater and reduce combined sewer overflows. This 2019 *Green It! Lancaster* Plan continues and updates those efforts.

By following a green infrastructure approach, the City recognized the multiple environmental, social and economic benefits, many of which are not offered by gray infrastructure. These benefits include protecting and improving water quality, providing natural stormwater management, and reducing energy use; increasing recreational opportunities, and improving health through cleaner air and water; and, reducing future costs associated with stormwater management, as well as increasing property values.

A list of strategic recommendations was put forth to achieve the objectives and reach the goals of the 2011 GI Plan. That list included 4 implementation tasks and 27 actions. Those four tasks were 1) a comprehensive demonstration program, 2) policy action, 3) partnering and outreach, and 4) studies and technical tools. The following sections describe how these tasks and actions were implemented.

2011 Green Infrastructure Plan

Note: *This plan builds upon the City's original 2011 Green Infrastructure Plan, which continues to be available on the City's GI website: http://www.cityoflancasterpa.com/green-infrastructure*

Guided by the mission to provide more livable, sustainable neighborhoods for City residents and to reduce combined sewer overflows and nutrient loads, the 2011 GI Plan was the result of a broad collaborative effort. A Green Infrastructure Advisory Committee was convened early in the planning process, comprised of representatives from local and state government, educational and faith-based institutions, local businesses, residents, and non-governmental organizations. The 2011 Plan identified and evaluated impervious cover and potential project sites, grant funding, benefits, and the policies and actions needed to institutionalize GI in the City. The mission of reducing combined sewer overflows is necessary to fulfill the vision of being a livable, sustainable, and safe community with clean rivers and streams.

Although the original list of about 75 demonstration project sites has grown to more than 200 potential projects since 2011, some of the earlier projects were eliminated because of unforeseen conditions (e.g., shallow bedrock), owner preferences, etc.

Conceptual plans were developed for projects that would demonstrate the feasibility of GI over a range of different application types and within each major combined and separate sewer service area. Approximately $10 million in funding was secured for the demonstration projects through a variety of regional, state and federal sources including organizations and agencies such as the Chesapeake Bay Trust, PA Department of Conservation and Natural Resources, PA Infrastructure Investment Authority (PENNVEST), and National Fish and Wildlife Foundation. To-date, nearly 60 projects have been constructed, keeping over 36 million gallons of stormwater out of the City's combined and separate sewer systems.

Green infrastructure demonstration project sites included City-owned and private properties, including both residential and commercial properties. Initial GI projects included green alleys and streets, parking lots, green roofs, and City parks. Improvements incorporate a wide variety of green infrastructure

techniques including porous paving, subsurface infiltration basins, cisterns, tree trenches, and rain gardens and other forms of bioretention.

Since 2011, the City has constructed 34 green street and alley projects that manage nearly 22-million gallons of stormwater runoff annually at an average cost of $0.24/gallon. GI techniques include infiltration trenches, vegetated curb extensions, and porous asphalt or permeable paver surfaces. One green street or alley alone can manage from between 200,000 and 2,000,000 gallons of rainwater annually.

Twelve public and private parking lots were renovated using green infrastructure technologies such as permeable paving, infiltration beds, tree trenches, and rain gardens. Four City-owned parking lots alone are estimated to prevent nearly 2.3 million gallons of stormwater from entering the sewer system on an annual basis.

Five green roofs were constructed as part of the City's GI demonstration projects, on 3 buildings at the City's AWWTP, at City Hall, and on a City fire house. In addition, green roofs were independently installed on an elementary school, several Franklin & Marshall College buildings, and 7 privately-owned buildings, bringing the total area of green roofs in Lancaster to more than 100,000 square feet. In addition to eliminating approximately 2,000,000 gallons of stormwater every year, green roofs have been shown to extend the life of a roof, improve the urban heat island effect, and reduce heating and cooling expenses.

The City completed four park improvement projects that manage over 6 million gallons annually at an average cost of less than $0.30/gallon. These parks include Sixth Ward Park, Crystal Park, Rodney Park and Brandon Park, and were identified as top priority in the City's 2009 Urban Parks Recreation and Open Space Plan. The park improvements focused on park amenities like basketball courts, play equipment, improved accessibility, picnic areas, restroom facilities and water features resulting in a variety of bioretention facilities and porous surfaces including basketball courts and parking areas integrated throughout the design. In addition to the park parking areas and impervious surfaces, the GI manages runoff from surrounding streets.

Urban tree canopy is often overlooked and taken for granted as a green infrastructure technology. However, current research shows the significant contribution tree canopy makes to stormwater management. Concurrent with the 2011 GI planning process that evaluated the tree canopy cover, a tree risk assessment inventoried the street and park trees in the City. This initial effort led to enhanced tree planting and preservation efforts and the formation of a private-public tree planting partnership.

The previous GI Plan called for evaluating stormwater management opportunities with all City-financed infrastructure improvement projects. The benefits of this approach go far beyond stormwater management, with improved aesthetics, an increased urban tree canopy, and a reduction of urban heat island impacts. Taken together, these improvements promise to transform the City into a more sustainable, healthy community.

Finally, the 2011 GI Plan laid the foundation for an aggressive and comprehensive public education and outreach program.

GI Monitoring and Maintenance

The City recognizes that the success of the GI program and the quality of the green infrastructure is dependent upon ongoing and proper monitoring and maintenance. Staff from the City's Stormwater Bureau continually monitor and inspect the condition of GI. City Parks staff have been trained in the proper techniques for operating and maintaining the green infrastructure installed including porous pavement, raingardens and green roofs. A maintenance program has been developed utilizing available

asset management software for scheduling routine maintenance. The City has a year-round street sweeping program and has acquired a vacuum sweeper truck more suitable for maintaining the porous alleys and basketball courts that the current mechanical broom sweeper trucks in the fleet.

Complementary to this GI Plan are documents covering the monitoring, operations and maintenance of GI which are provided in the appendices.

Program Funding

Much of the green infrastructure work completed to date has been funded, in part, through a loan from Pennsylvania State Revolving Fund, issued by PENNVEST. This loan, totaling nearly $7 million, and other funding allowed the City to pilot the initial green stormwater infrastructure projects, build its stormwater management program, and establish a stormwater utility and fee. Additional funding for these demonstration projects has been secured through a variety of state and federal sources including grants from the PA DEP and DCNR, Pennsylvania Trees, National Fish and Wildlife Foundation, and Chesapeake Bay Trust. The City has creatively assembled these and other sources into innovative financing packages.

The City instituted a stormwater management fee in 2014 based on the total impervious area on a property. The funds collected through the stormwater management fee go into the Stormwater Fund and are dedicated to stormwater-related expenses. When the fee was established in 2014 it was approximately $31/1,000-square feet impervious area/year, one of the lowest in the region. In 2018, the fee was increased to $52/1,000 square feet IA/year, still relatively low. In 2019, the fee was again increased to $59/1,000 square feet. In support of the stormwater management fee, the City developed a credit program that allows property owners to reduce their annual fee by up to 50% if eligible stormwater management facilities are installed.

Despite the relatively low stormwater management fee in comparison to similar programs, the City has been able to sustain its efforts by integrating green stormwater infrastructure into planned capital improvement projects and through securing grants and creatively integrating funding into projects that stretch revenue dollars even farther and allow for greater cost efficiencies. Through coordinated project planning, the City has demonstrated that it can support its clean water goals cost-effectively.

Stormwater Regulation

The following state and federal statutes empower the City to regulate land use activities that affect stormwater runoff: Act of October 4, 1978, 32 P.S. P.L. 864 (Act 167), Section 680.1, et. seq., as amended, the “Storm Water Management Act”; the Pennsylvania Floodplain Management Act, and the Federal Clean Water Act (33 U.S.C.A. §1342, 40 CFR §§ 122.26 – 123.35. In addition, the City also is empowered to regulate land use activities that affect runoff by the authority of the Act of July 31, 1968, P.L. 805, No. 247, The Pennsylvania Municipalities Planning Code (MPC), as amended.

Chapter 93 of the Pennsylvania Code, Water Quality Standards, protect four stream water uses: aquatic life, fish consumption, potable water supply, and recreation. These regulations provide for protection of the aquatic life in the Conestoga River as a warm water fishery and for migratory fishes. These uses require that the river water quality supports the maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat.

Pennsylvania’s Chesapeake Bay Watershed Implementation Plan (WIP) stresses the importance of properly managing stormwater. The WIP was prepared to address the U.S. Environmental Protection Agency’s (EPA’s) expectations for the Chesapeake Bay Total Maximum Daily Load (TMDL). Although a

specific TMDL is not required for the Conestoga River through the City, the river and its watershed are included in the Chesapeake Bay TMDL.

Through the judicious administration of updated development ordinances and regulations the City has made progress toward achieving the City's clean water goals. The City has incorporated stormwater management into relevant City ordinances, taking additional steps to close loopholes, clarify requirements, and streamline permitting processes for those projects proposing regulated activities on private properties. Among the recent code amendments to incorporate green infrastructure and complementary sustainable practices are ordinances covering street trees, surface parking lots, subdivision and land development, streets and sidewalks, and sewers. The revised regulations often include supplemental materials and design specifications. In accordance with the Stormwater Management Ordinance, the City regulates and requires stormwater management for projects proposing the construction and reconstruction of impervious areas of 100 square feet and greater. More information on how these codes were amended can be found in Section 3.

Regulatory History

The City of Lancaster owns, operates, and maintains a publicly owned treatment works that includes a wastewater treatment plant known as the Advanced Wastewater Treatment Plant (AWWTP) and a collection system that collects stormwater and wastewater from residential, commercial, and industrial sources. Certain portions of the collection system are a Combined Sewer System (CSS) and other portions are a separate sanitary sewer system. Pursuant to contractual arrangements, Lancaster also treats wastewater at the AWWTP that has been collected and conveyed from neighboring municipalities and municipal sewer authorities. The Lancaster collection and treatment system includes force mains, sewer lines, and other property and appurtenances designed to collect and convey combined wastewater, including sewage and stormwater. This collection and treatment system is designed to discharge, under certain conditions specified in the City's National Pollutant Discharge Elimination System (NPDES) Permit, through Combined Sewer Overflow (CSO) Outfalls, into the Conestoga River, which ultimately flows into the Chesapeake Bay. Discharges through CSO Outfalls are a source of water pollution to these receiving waters.

Lancaster developed a Long Term CSO Control Plan in 1998 as part of complying with its NPDES permit and implemented controls outlined in that plan.

In 2008, EPA issued an Administrative Order and Information Request to the City of Lancaster. In 2009, Lancaster submitted to PADEP and EPA a revised LTCP, and in 2010, Lancaster submitted a status report on the 2009 Amended LTCP.

In 2011, Lancaster submitted to EPA a Green Infrastructure Plan (2011 GI Plan) that planned and implemented projects designed or intended to reduce CSOs. The 2011 GI Plan also evaluated approaches to adding green infrastructure throughout the City within 5-year and 25-year timeframes; estimated the water quality benefits of such green infrastructure; and articulated a series of policy, outreach, and technical recommendations for implementing green infrastructure in the City. EPA Region III reviewed Lancaster's 2011 GI Plan and provided comments.

Lancaster was selected to be a recipient of EPA's green infrastructure technical assistance program, intended to advance the adoption of GI in almost 40 communities across the country and develop knowledge and tools for a national audience. The focus of the technical assistance was to estimate the value of several co-benefits associated with Lancaster's GI Plan. The principles, methods, and projects built as a result of Lancaster's 2011 GI Plan served as the basis for the February 2014 EPA report entitled, "Economic Benefits of Green Infrastructure." This report highlights the importance of including the multiple benefits of green infrastructure in cost-benefit assessments (see Section 7 for more on co-benefits of GI).

Consent Decree

In 2018, Lancaster entered into a Consent Decree with the EPA and PADEP to ensure that Lancaster undertakes measures necessary to comply with the Clean Water Act and the Clean Streams Law. This report is intended to satisfy the following requirement in the consent decree:

> "Within twelve (12) months after the Effective Date of the Consent Decree, the City shall submit to EPA and PADEP the Green Infrastructure plans and manuals described below."

A. Green Infrastructure Plan

The City shall submit to EPA and PADEP an updated Green Infrastructure Plan ("GI Plan"). The Updated GI Plan shall include the following elements:

(a) GI Program Update. The City shall provide written documentation of its GI Program, including the following elements:

(1) summary of GI Program from 2010-2016;

(2) completed ordinance updates, and a schedule for periodic reassessments;

(3) public education efforts;

(4) public participation procedures; and

(5) project ranking/selection criteria and processes.

(b) Green Infrastructure Project Types. The GI Plan shall identify planned capital improvement projects by type (e.g., parks, roads/alleys, public schools, parking lots) and shall identify appropriate green infrastructure for each project type. These project types will be evaluated at a conceptual planning level of detail using Geographic Information System (GIS) data, pavement condition assessment data, project costs from GI constructed during the pilot phase, and planned projects determined in cooperation with City Departments, the School District of Lancaster, and other agencies as appropriate so that the City and its residents benefit from the continued integration of GI projects with other necessary Civic improvements. The GI Plan shall also identify the CSO sewersheds where the GI projects will be located.

(c) Green Infrastructure Maintenance Schedule. The City shall provide a schedule of maintenance activities for each green infrastructure type in accordance with the Green Infrastructure Operation and Maintenance Plan to be developed as required [in section II.B of Appendix A of the consent decree].

This page is intentionally left blank.

3. Green Infrastructure Program Update

3.1 Summary of GI Program (2010-2018)

Since 2010, the City of Lancaster has been implementing an integrated Green Infrastructure Program that allows it to incorporate green infrastructure in a cost-effective, adaptive, and systematic manner into public capital improvement projects and into select private projects. Through the City's program (not including stormwater controls required by code for redevelopment), green infrastructure systems have been implemented as part of 57 projects which collectively manage 44 acres of impervious area. These 57 projects encompass approximately 7 acres of new GI systems comprised of a variety of GI technologies that can be categorized into 8 project types: Green Alley, Green Street, Parking Lot, Green School, Green Park, Other Public Property, Green Roof, and Private Property.

Table 3.1 and Figure 3.1 demonstrate the level of implementation achieved through the City's GI Program between 2010 and 2018. Through implementation of a wide variety of project types, the green infrastructure projects implemented in the city have a total estimated annual runoff capture volume of over 36 million gallons per year. Most of the capture on public property was achieved through implementation of green streets, green parks, and green alleys which account for 80% of the total impervious area managed.

Table 3.1 - Completed Green Infrastructure Projects through September 2018

GI Project Type	Number of Projects	Total Area Managed (ac)	Estimated Capture Volume (gal/yr)
Green School	1	0.9	726,090
Green Park	4	7.2	6,608,000
Private Property	8	4.5	3,917,969
Green Alley	14	4.5	3,747,725
Green Street	20	24.1	18,232,239
Parking Lot	4	2.6	2,317,000
Green Roof	5	0.5	421,000
Other Public Property	1	0.1	125,000
TOTAL	**57**	**44.4**	**36,095,023**

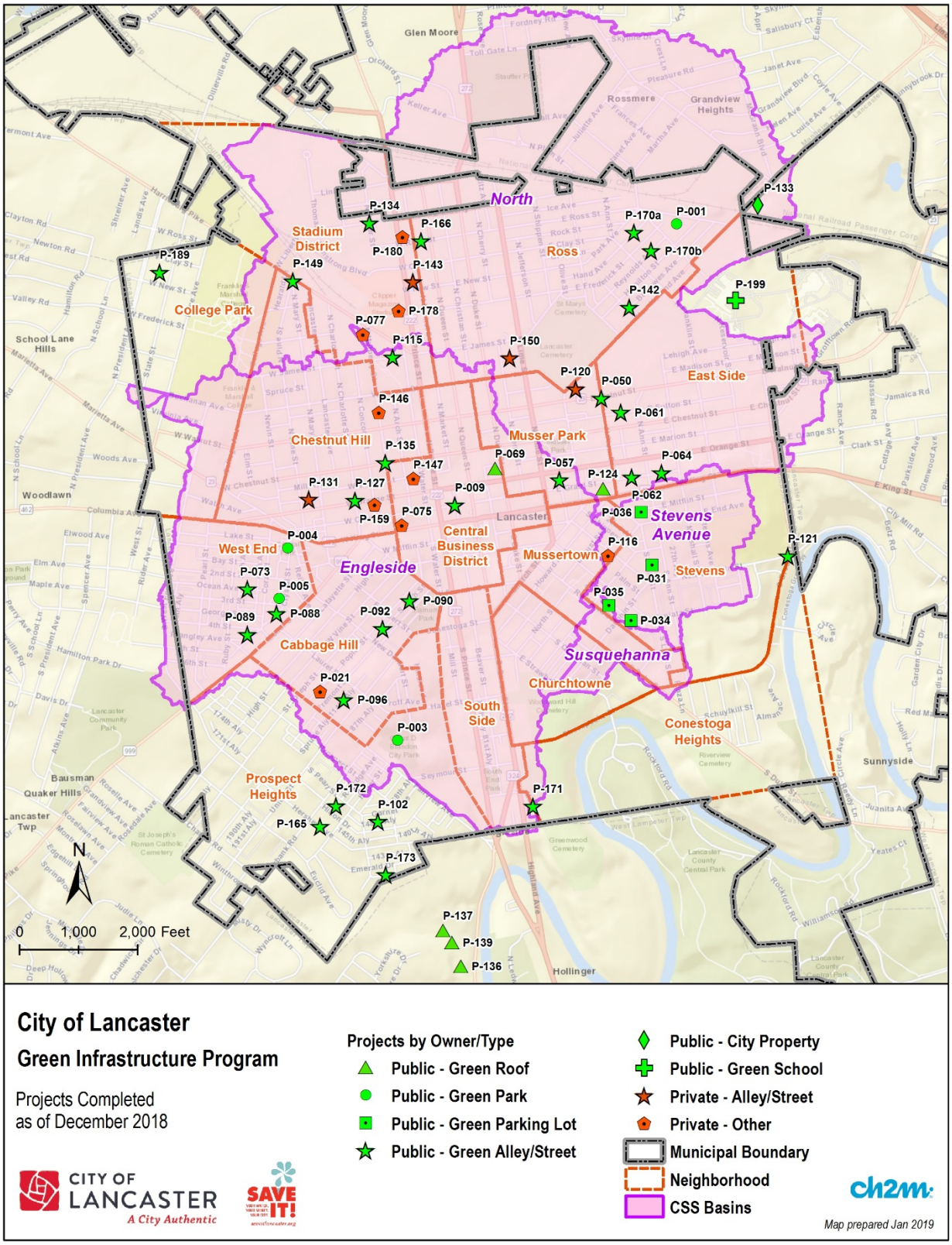


Figure 3.1 - Completed GI Projects from 2010 to 2018
Map showing locations and types of completed GI Projects from 2010 through 2018

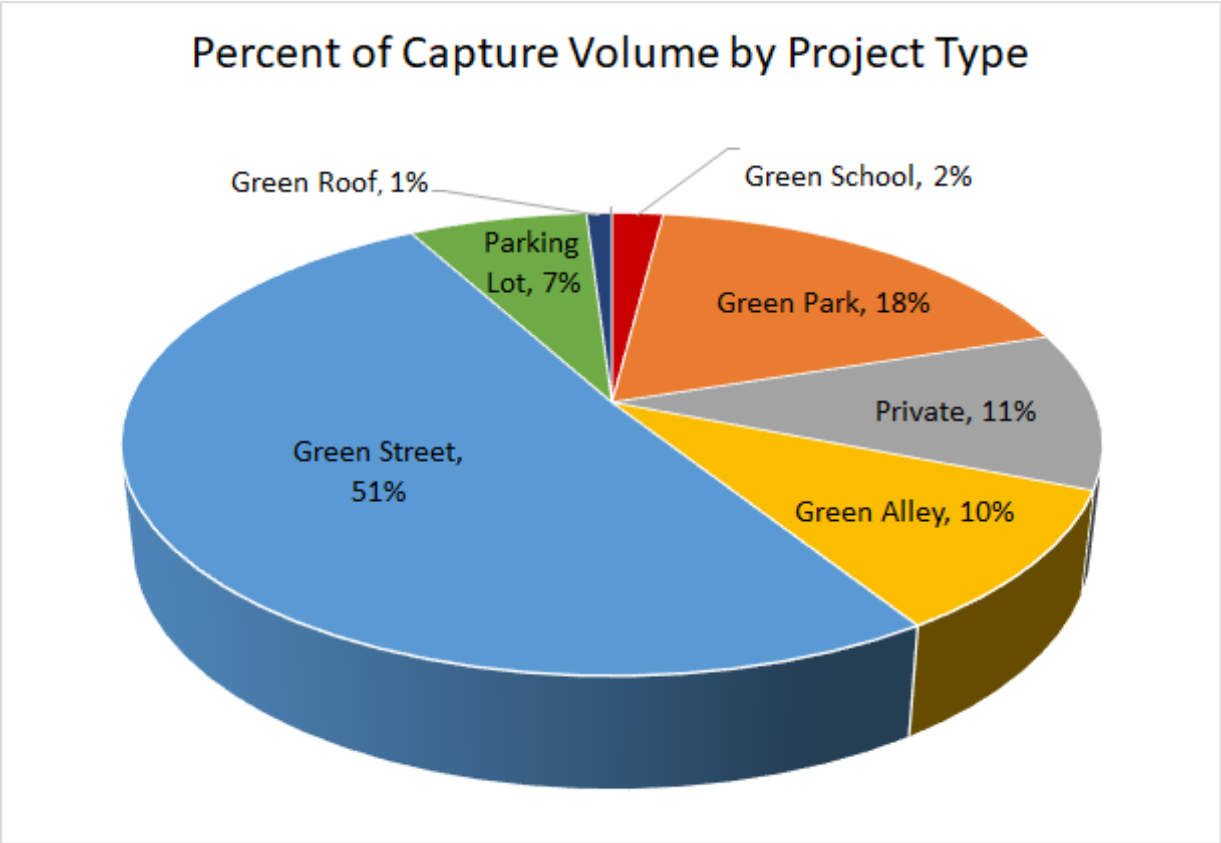


Figure 3.2 - Percent of Estimated Capture Volume (gal/yr) by Project Type

Figure 3.2 demonstrates that green streets implemented since 2010 comprise the largest percentage of annual runoff volume capture in the City at 51% of the total volume captured through green infrastructure projects. Green parks, private projects, green alleys, and parking lot projects account for the majority of the remaining capture, with green schools, green roofs, and other public properties capturing less than 4% of the total volume captured by GI projects.

Figure 3.3 shows that on average green streets and green parks provided the highest capture efficiency by capturing more impervious area per unit area of GI than other project types. Private projects and green alleys also had high efficiency with the ability to capture an average of over 4 acres of impervious area per acre of GI.

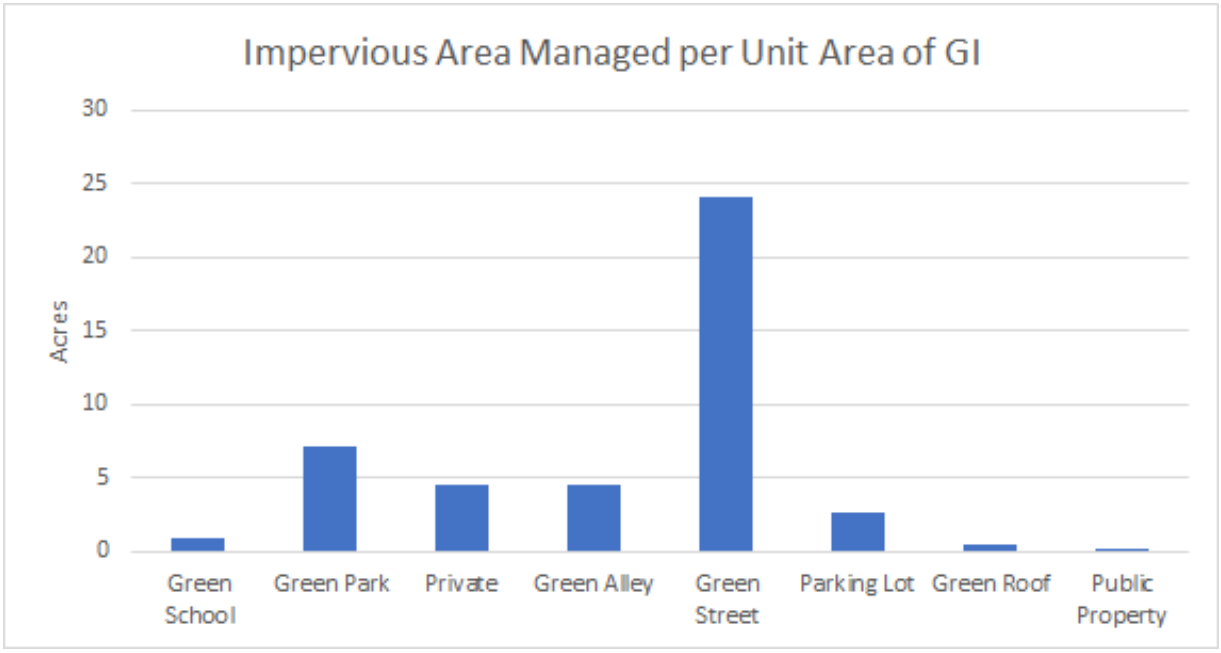


Figure 3.3 – Average Impervious Area Managed Per Unit Area Of GI

The annual distribution of green infrastructure project implementation between 2010 and 2018 varies as shown in Figure 3.4 with the highest implementation rates occurring in 2012, 2013, 2014, 2016, and 2018. It should be noted that the implementation year indicates the year of project construction and for many projects the conceptual, design, and bid phases occurred in previous months and years. The high rates of project completion in 2012, 2013, 2014, and 2018 can be correlated with available funding. In those years, the city completed projects that were funded by grants from Pennsylvania's Growing Greener program, the National Fish and Wildlife Service (NFWF), and the loan from Pennsylvania's PENNVEST program. In future years, the City will continue to seek out grants and/or loans to augment available capital improvement funds.

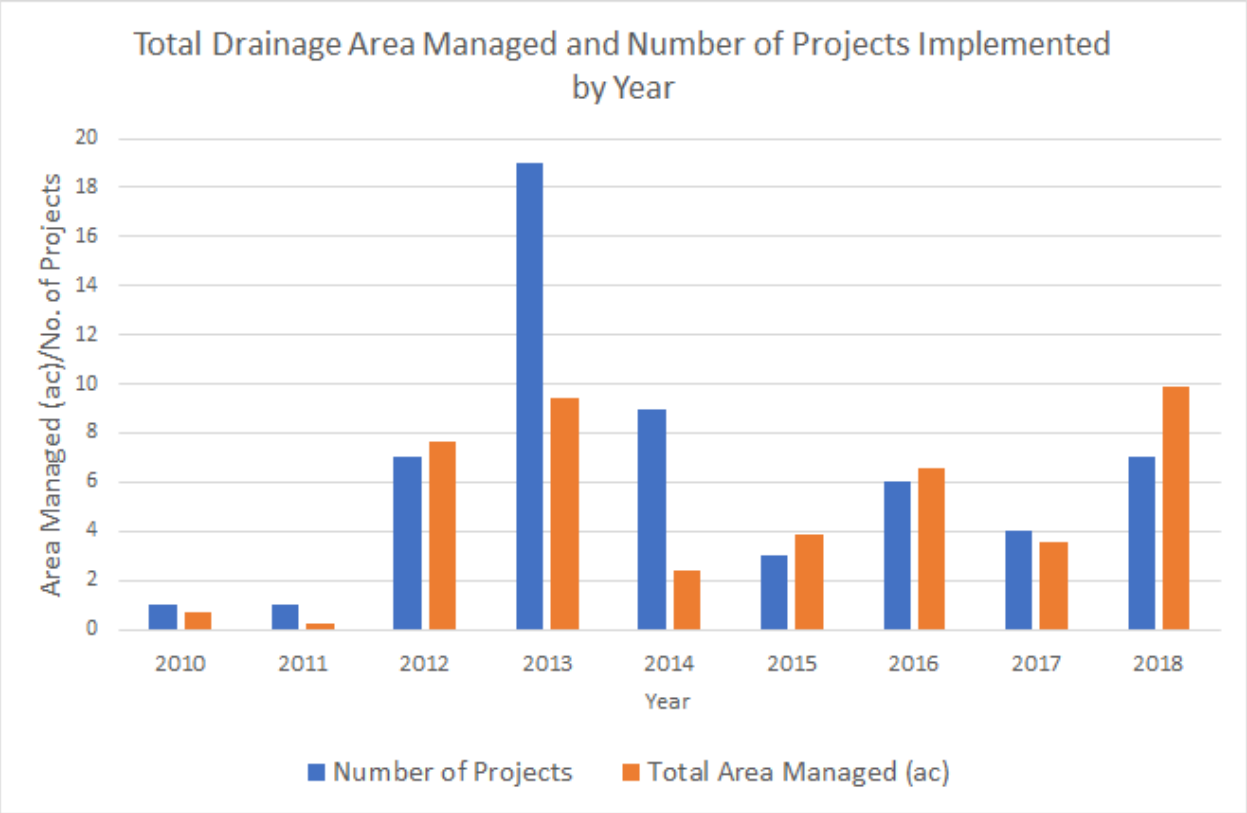


Figure 3.4 - Impervious Drainage Area Managed and Number of Projects Implemented by Year

The distribution of projects and stormwater capture benefit among the City's CSS and MS4 basins is provided in Table 3.2. Green infrastructure implementation has been primarily focused on the North and Engleside CSS basins because the City's other CSS basins, Stevens and Susquehanna, are smaller with high levels of existing wet weather controls. Nearly 75 percent of the total area managed by green infrastructure projects in the city has been implemented in the North and Engleside basins, and the estimated annual capture volume in those two basins is over 28 million gallons per year.

Table 3.2 - Project Distribution and Capture Benefit by Basin

Basin	Number of Projects	Total Area Managed (ac)	Estimated Capture Volume (gal/y)
Engleside	23	18.3	15,544,290
North	19	14.8	12,611,690
Stevens	4	2.6	2,317,000
MS4	11	8.7	5,622,043
TOTAL	**57**	**44.4**	**36,095,023**

3.2 Completed Ordinance Updates; Schedule for Periodic Reassessments

To fully institutionalize green infrastructure into the City of Lancaster's urban landscape, the 2011 GI Plan proposed a combination of policy actions, incentives for residential and commercial property owners, and innovative funding approaches to support ongoing implementation. One primary recommendation was to develop a process for reviewing and evaluating the City Code of Ordinances to

find opportunities for incorporating green infrastructure and stormwater management best practices into existing or new development regulations and design and construction standards.

At the time of this 2019 *Green It! Lancaster* Plan, nine chapters of the City of Lancaster Code of Ordinances have been amended to further the mission of the GI Plan and institutionalize green infrastructure practices. Seven of those chapters were comprehensively revised and amended to not only include GI, but to incorporate more progressive, up-to-date provisions that further the overall strategic goals of the City of Lancaster.

The following summaries of ordinance amendments are in alphabetical order. The City's codes could be standalone regulations; however, they work most effectively when utilized collectively. Whenever codes and ordinances are reviewed for revision and modification, consistency with other city codes and ordinances, as well as the regulations of adjacent municipalities should be considered. The City's codes and ordinances require periodic evaluation to keep ahead of changing standards, laws, and socioeconomic changes and trends. They must also be reviewed, and revised if necessary, to reflect changes in the overall goals and strategies put forth in the City's Comprehensive Plan.

Chapter 202 Parking Lots

The purpose of the Parking Lots ordinance is to provide minimum standards for the design and construction of new accessory and commercial surface parking lots, and the improvement, including but not limited to reconstruction and resurfacing, of existing off-street surface parking areas.

The August 2015 amendments to the Parking Lots ordinance, comprehensively revised the 2010 ordinance to better align the design and construction of off-street surface parking lots with the stormwater management vision of the City. Revisions include new minimum standards for providing adequate drainage, lighting and landscaping; procedures for permits, violations and penalties, and modifications and appeals; requirements for issuing a notice to repair, resurface or reconstruct surface parking lot; and establishing provisions for the repair of private parking lots.

Further consideration should be given to requiring non-compliant parking lots to be brought up to current code standards.

Chapter 249 Sewers Ordinance

The sewer ordinance sets forth requirements the safe and efficient operation of its waste water treatment facility and sewer conveyance system. The ordinance applies to all users of the treatment works and authorizes the issuance of permits; provides for monitoring, compliance, and enforcement activities; and establishes administrative review procedures.

In December 2017, this ordinance amended former Ch. 249 (Ord. No. 15-2007) in its entirety. Significant revisions included rewriting and organizing to be consistent with the EPA Model Ordinance; added Fats, Oil and Grease (FOG); and adding a new Article VII. Stormwater Outside the City Municipal Boundary to replace the provisions on Privy Wells and Cesspools which are already prohibited under separate sections of the ordinance.

Chapter 260 Stormwater Management Ordinance

The purpose of the Stormwater Management Ordinance is to reduce the number of Combined Sewer Overflows and minimize the negative impact of those overflows; promote stormwater management practices that emphasize infiltration, evaporation, and transpiration; manage and prevent erosion and sedimentation problems; preserve and restore the capacity of streams; and provide standards and design criteria and guidance and proper operations and maintenance of all stormwater management best management practices.

In November 2012, the City's SWM Ordinance dating from 2001 was comprehensively amended in accordance with Pennsylvania directive to make municipal stormwater ordinances consistent with the

state model ordinance. The purpose of the model ordinance was to bring municipal stormwater regulations into compliance with Act 167.

In 2015, the SWM Ordinance was again amended to correct and further modify and clarify regulations. Among the 2015 revisions is added language that defines and exempts very small projects, gardens and landscaping; added relevant definitions and cleaned up references and citations to accurately reflect state and federal legislation; organized to be consistent with recent DEP/County changes, SALDOs, zoning, and historic preservation guidance; requiring approval of Erosion and Sedimentation Control Plan prior to commencing any regulated activity; new section prohibiting connections to CSS; and cleaning up administrative provisions such as appeals and applications.

Chapter 262 Streets and Sidewalks

The purpose of Chapter 262 Streets and Sidewalks Ordinance is to promote health, safety, and welfare within the City of Lancaster by coordinating development and growth; maintaining infrastructure; and defining the type and location of streets.

The City is empowered to regulate streets and public rights-of-way, including sidewalks. The City may lay out and establish sidewalks and curbs along any street and may require property owners of land abutting any street in the City to construct, reconstruct, maintain and repair the sidewalks, curbs, driveways and planting strips abutting their property.

The Streets and Sidewalks Ordinance was comprehensively amended in 2017. The ordinance was previously amended in 1997, 2002, 2005, 2008, and 2016. The most recent changes updated how code is administered and enforced, including the issuance of permits and notices, procedures for setting fees, amendments and modifications, and providing for an appeals process. Amendments further refined the establishment of snow emergencies and snow emergency routes, nuisances and obstructions, and provisions for street excavations and the streetscape district. In addition to amending the ordinance, the Curb and Sidewalk Construction Specifications were revised with updated supplemental specifications to provide minimum standards and guidelines for the construction, repair, replacement and maintenance of new and existing curbs and sidewalks. New and revised provisions require compliance with other stormwater management regulations and a reduction in the amount of impervious sidewalk area whenever appropriate. Furthermore, porous sidewalk materials and protection and preservation of street trees are more adequately addressed in the revised ordinance and specifications.

Chapter 265 Subdivision and Land Development (SALDO)

The purpose of SALDO is to promote and ensure orderly growth and development; to protect historic resources; to implement provisions of the Comprehensive Plan; to ensure consistency with other City ordinances and regulations; and to encourage innovative and sustainable land planning and development.

The 2015 SALDO amendment replaced the previous ordinance adopted in 1997. The SALDO establishes procedures for the review and approval of subdivision and land development plans, provides for the modification of ordinance provisions, includes provisions consistent with the Pennsylvania Municipalities Planning Code addressing approval of plans and the rights of applicants following plan filing, sets forth design and improvement standards for public and private improvements, requires traffic, floodplain and other impact studies or reports for developments meeting certain thresholds, requires parks or recreational facilities for residential developments exceeding a specific threshold, requires improvement construction assurances, and provides for enforcement of violations.

Chapter 273 Trees

The City of Lancaster Tree Ordinance acknowledges the urban forest as a necessary part of the City's infrastructure and that this green infrastructure provides crucial environmental, social, and economic ecosystem services.

In November 2014, the Tree Ordinance was amended to better reflect the goals of the City's GI Plan with regard to tree canopy. The tree ordinance was comprehensively revised including the addition of a purpose and intent statement that briefly describes the ecosystem and other sustainable benefits trees provide to the community. Additional changes include provisions regarding administration and enforcement; tree planting care and protection provisions; establishing a permit application and notice of violation process; providing for payments, assessments and liens; providing for an appeals process, and establishing provisions for protected trees on private property. Additional amendments should be considered following completion of the City's first urban forest management plan in 2019.

Chapter 300 Zoning Ordinance

Lancaster's Zoning Ordinance is its primary tool for directing and encouraging development that is compatible to the form and function the City. The Zoning Ordinance was comprehensively amended in 2013, and further amended in 2017. As related to stormwater management, the 2017 revisions included increasing the interior tree planting requirement for parking lots; prohibiting the use of stone or gravel for residential parking spaces and driveways; and adding definitions for the new land use category of community garden. The City should consider exploring form-based or incentive-based zoning to further the mission of reducing the amount of impervious area through incentives, increasing unit density and building heights, and requiring greater amounts of landscaping vegetation including trees.

Other Codes and Regulations

In addition to the ordinances and design and construction standards described above, amendments to two nuisance regulations have been prepared to further address stormwater management issues. Current regulations prohibit grass and vegetation that isn't part of a vegetable garden or landscaping to exceed six inches in height. Amendments were prepared for Chapter 105, Brush Grass and Weeds, and Chapter 223, Property Maintenance, to include a provision for allowing "No Mow Zones" when associated with green stormwater infrastructure.

A "No Mow Zone" is a designated area, such as an existing lawn, detention basin or other vegetated area where the existing vegetation has been allowed to grow longer. These areas may also be planted with native grasses and/or wildflowers. The revisions clarify how these areas of naturalized vegetation support stormwater management facilities and outline the basic criteria and posting requirements for these "No Mow Zones."

3.3 Public Education & Participation

As with all public initiatives, success is dependent upon broad public participation and stakeholder involvement and support. That's why no planning effort is complete without a strategy for public involvement. Since the adoption of the first GI Plan in 2011, the City of Lancaster has been committed to informing and soliciting input from the public on its efforts to provide livable and sustainable neighborhoods and reduce combined sewer overflows. With that mission in mind, the City has implemented many of the partnering and outreach recommendations from that earlier plan.

The 2011 Plan identified specific strategies for implementing the public participation objective. The overriding strategy was to disseminate and distribute information and understanding about stormwater management and green infrastructure. This included developing a GI Portal on the City website, creating factsheets and other educational materials, and developing an outreach plan.

For the past 7 years, the website SaveItLancaster.com has been providing GI program updates and disseminating information to the public. On this independent website, you can learn about the varied GI technologies the City has been installing in streets, parks, and parking lots, and the projects home owners can do on their property.

The City set out to create a plan that has public support and can be implemented. Therefore, the City will actively engage and consult the public as it evaluates and builds GI projects. In addition to detailed factsheets on GI and stormwater best management practices, brochures, posters and signs have been produced to educate the public on all aspects of green infrastructure. Stormwater staff organize tours and activities as well as attend local and regional events and conferences to disseminate information and printed materials. Specific printed materials include an educational brochure on the City's green infrastructure program, including explaining what GI is and why it's important and a short brochure on permitting procedures for small projects. The latter explains the permitting process and describes three common BMPs acceptable for small projects.

As part of the requirements for meeting its obligations of the EPA Consent Decree, the City will prepare a comprehensive Public Participation Plan. That plan will include three broad goals to increase public understanding of the impact CSOs have on the City, County and region, and to explain the need for controlling CSOs. Furthermore, these goals guide the development of policy objectives and strategic actions the City will utilize in disseminating information to the broadest possible population and soliciting input and feedback from the public as well as special interest groups, on those objectives and alternatives.

These goals are not mutually exclusive; they overlap in purpose and will be implemented concurrently.

- Create public awareness of the problem
- Educate the public on ways we can solve the problem together
- Establish stakeholder partnerships

These goals are intended to make the public aware of the stormwater challenges and to provide accurate information about efforts to protect the environment, enhance water quality and improve quality of life in the community.

In addition, the City will further refine its educational outreach program that makes information accessible to as broad an audience as possible. The City will continue to solicit support from anyone with a stake in the continued success of Lancaster. Throughout the ongoing public participation process, consideration has been given to how information is disseminated, and input collected. In addition, the City has maintained consistent messaging throughout.

The tools and techniques described and defined here, and in more detail in the PPP, will be useful in all outreach and public involvement efforts undertaken as part of the City's broad GI initiative.

The full public participation plan will be available on the City's website.

3.4 Project Ranking/Selection Criteria and Processes (2010 – 2018)

To help guide the implementation of demonstration projects, the original 2011 GI Plan included a multi-criteria prioritization as shown in Figure 3.5. This proved helpful in guiding the early years of the City's green infrastructure program: the original top 3 scoring projects have been completed and the remaining projects shown in the figure (which were all part of the top 13 in the original prioritization) are complete or in progress. The City also considers factors such as distributing projects in different neighborhoods and locations where GI can help to address multiple needs (poor pavement condition, traffic safety concerns, etc.).

As the program continued, many projects were prioritized *opportunistically* based on funding availability, integration with other infrastructure improvements (e.g., street work, park renovations, water and sewer replacements, facility expansions), coordination with other planning efforts, etc. For example, when Pennsylvania expanded their Dirt, Gravel, and Low Volume Road program to urban areas a few years ago, alleys with low traffic volumes that were eligible for funding were prioritized and the City has successfully obtained several grants to construct green alleys.

Discussion of prioritization for future GI implementation is included in Section 7.

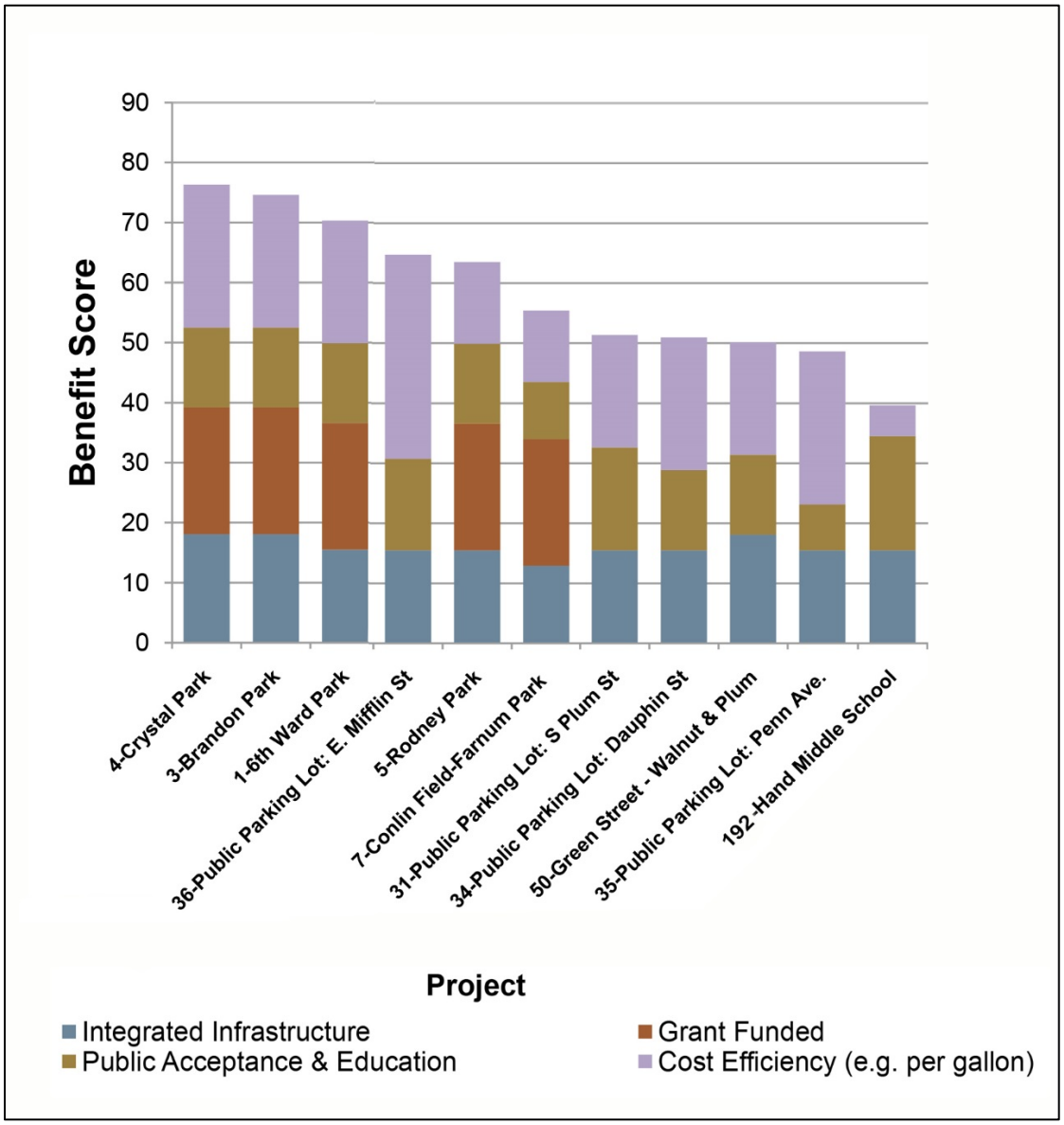


Figure 3.5 - Example of Prioritization Criteria and Benefit Scores of GI Projects
Projects shown are complete or in progress

4. Program Goals

4.1 Vision

A livable, sustainable, and safe community with clean rivers and streams.

4.2 Goals

1. Improve water quality in the Conestoga River by integrating stormwater and pollution reduction into City public works and community improvement programs.
2. Reduce pollution and excessive flows from urban stormwater and combined sewer overflows.
3. Prioritize green infrastructure (GI) projects to maximize economic, clean water, health and quality of life benefits for residents.
4. Achieve cost effective Clean Water Act compliance by integrating multiple water quality drivers (e.g., consent decree, stormwater regulations, and the Chesapeake Bay Plan).
5. Reinforce Lancaster City as a national, international, and statewide model in GI implementation.

4.3 Objectives

1. Partner with community, neighborhood, and environmental groups to implement and sustain GI projects.
2. Continue advancing the City's action and result-oriented philosophy and processes to implement green initiatives for sustainable, clean water.
3. Maintain and build capacity within Lancaster City government to effectively plan and employ GI strategies.
4. Support the efforts of residents and businesses to incorporate green strategies on their properties.
5. Enable City residents and businesses to engage in the GI program.
6. Continue the City's outreach and education efforts regarding GI.
7. Integrate GI with the recommendations of *Building on Strength*, the Lancaster Active Transportation Plan, and other relevant planning efforts in the City.
8. Advance objectives in the Lancaster County Comprehensive Plan – *Places 2040* such as reducing pollutant loads to local waters and the Chesapeake Bay. Support Lancaster County's Smart Growth achievements by providing smart urban renewal in Lancaster City.
9. Establish a technical partnership in which federal, state and local governments work together to maximize the benefits of each dollar spent on urban infrastructure.
10. Maintain and refine a comprehensive suite of GI demonstration projects on City-owned property to lead by example.
11. Incorporate GI as a significant and accepted component of the City's CSO Long Term Control Plan (LTCP) and stormwater management programs.
12. Continue to seek and obtain grant funding to implement green infrastructure projects.

This page is intentionally left blank.

5. Existing Conditions

A critical analysis of existing conditions is necessary to plan for the successful long-term implementation of green infrastructure. A Geographic Information System (GIS) was used to analyze updated base conditions, prepare summary tables and create maps depicting results for the city. As described earlier, the results of the analyses presented here focus primarily on the North and Engleside CSO Basins, which provide the greatest potential for efficient GI project implementation.

5.1 Hydrologic Systems

Watershed Setting

Lancaster City is a 7.3-square mile (mi^2) urbanized area and is the County seat of Lancaster County, in south-central Pennsylvania. The City is the urban center of one of the nation's most productive agricultural farming areas.

The City of Lancaster resides in the Conestoga River watershed, a tributary of the Susquehanna River as shown in Figure 5.1. The Susquehanna River watershed is the largest major tributary draining into the 64,000 mi^2 Chesapeake Bay watershed, shown in Figure 5.2.

The majority of the City's stormwater drainage flows toward the Conestoga River, while a portion of the City contributes storm flow to Little Conestoga Creek, which generally flows south and discharges into the Conestoga River south of the City in Manor Township. The Conestoga River drains approximately 491 mi^2 and generally flows for approximately 62 miles from near Morgantown to the southwest, through the City, and discharges into the Susquehanna River in Conestoga Township near Safe Harbor. The Susquehanna River ultimately discharges into the Chesapeake Bay. Figure 5.3 illustrates the City's watershed setting.

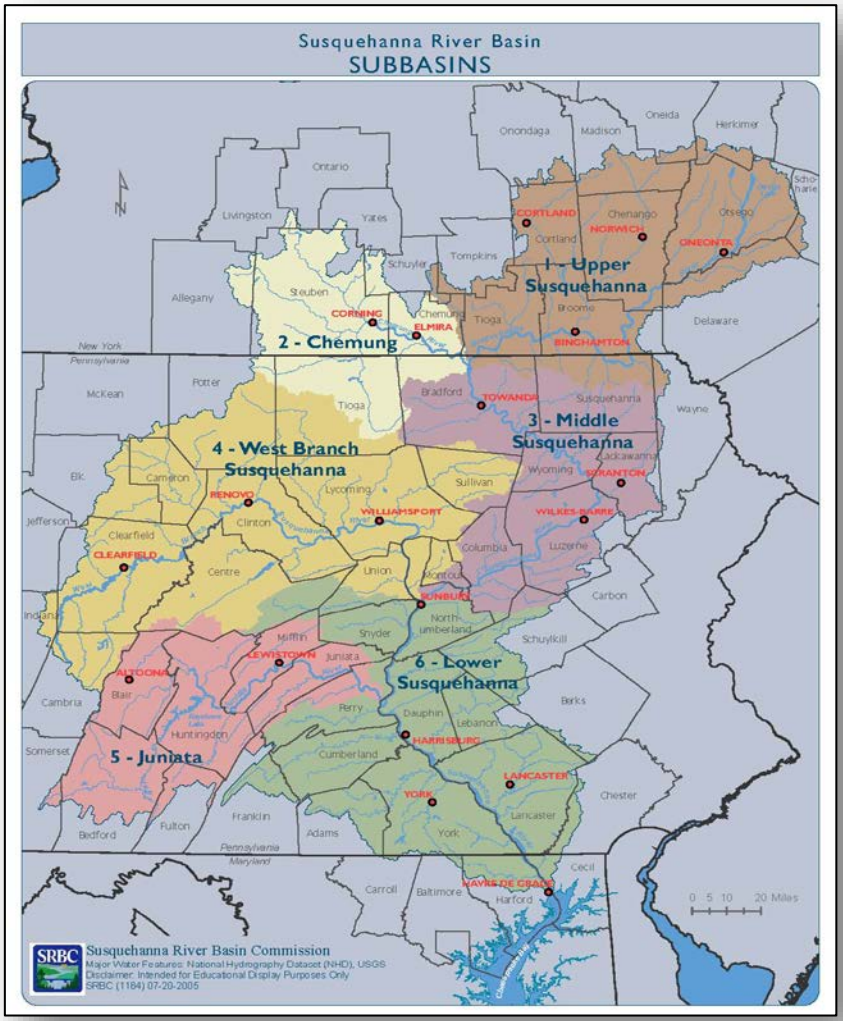


Figure 5.1 - City of Lancaster Location within the Susquehanna River Basin (Source: Susquehanna River Basin Commission)

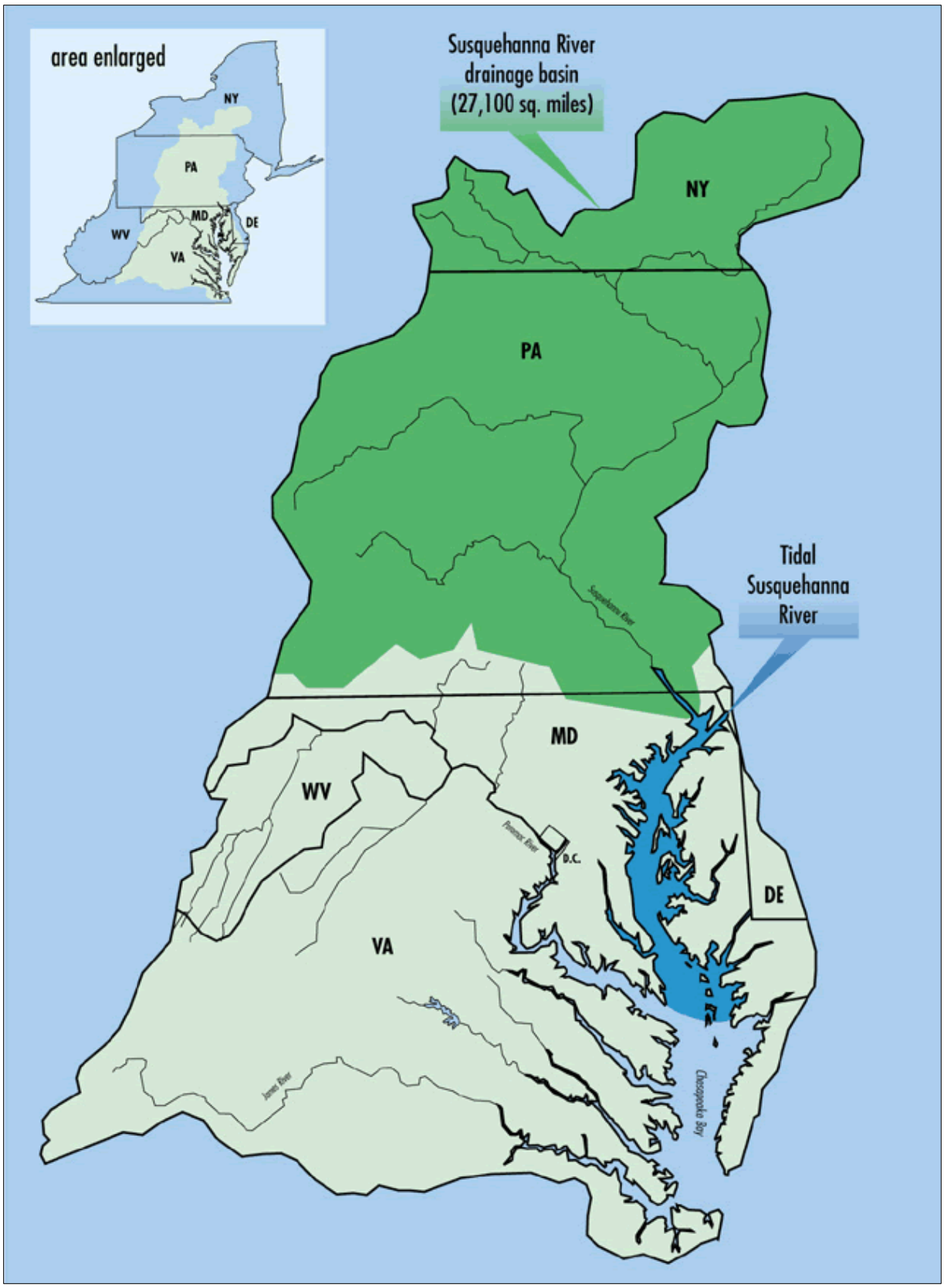


Figure 5.2 – Susquehanna Watershed Draining into the Chesapeake Bay Watershed
(Source: Chesapeake Bay Foundation)

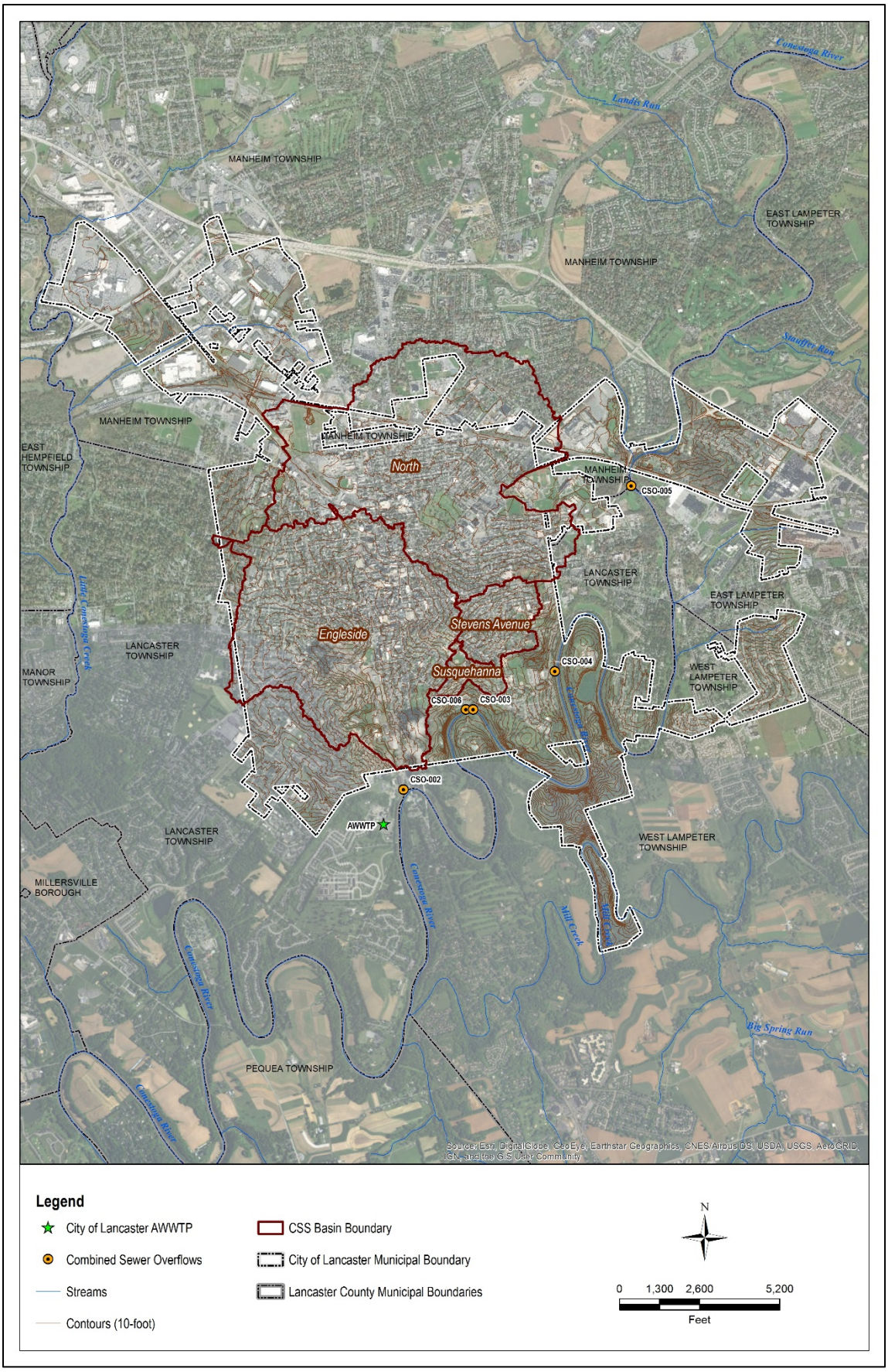


Figure 5.3 - City of Lancaster Watershed Map (Source: Jacobs)

Clean Water Act 303D/305B Listing Status

The Pennsylvania State water quality standards regulations (25 PA Code, Chapter 93) protect four stream water uses: aquatic life, fish consumption, potable water supply, and recreation. These regulations provide for protection of the aquatic life in the Conestoga River as a warm water fishery and for migratory fishes. These uses require that the river water quality supports the maintenance and propagation of fish species and additional flora and fauna which are indigenous to a warm water habitat. Migratory fish passage provides for the maintenance and propagation of anadromous and catadromous fishes and other fishes which move to or from flowing waters to complete their life cycle in other waters.

The state provides periodic reviews of waterbodies to assess the attainment of these standards as part of sections 303(d) and 305(b) of the Clean Water Act. Figure 5.4 provides a summary of the §303(d) and §305(b) listing (also called the Integrated List) status for local stream segments that have been evaluated for attainment of their designated uses. Segments determined as not attaining are considered impaired waters and a Total Maximum Daily Load (TMDL) may need to be developed for that waterbody. In the case of the Conestoga River, a specific TMDL is not required, but the river is included in the Chesapeake Bay TMDL and watershed implementation plan since the Conestoga is upstream of the Bay and contributes pollution to it.

Table 5.1 and Figure 5.4 describe the current assessed use status of the stream segments near the City. The stream attainment status is based on PADEP's 2016 Pennsylvania Integrated List Attaining and Non-attaining GIS data.

Table 5.1 - Stream Assessment Status Summary
Source: PADEP's 2016 Pennsylvania Integrated List Attaining and Non-attaining GIS data

Stream Name[a]	Assess-ment ID	Current Uses	Status	Known Problems: Source (Cause)
Conestoga River	19472	Recreational	Impaired	Agriculture (Pathogens) Urban Runoff/Storm Sewers (Pathogens)
	10227	Aquatic Life	Impaired	Agriculture (Organic Enrichment/Low DO) Small Residential Runoff (Siltation) Upstream Impoundment (Siltation)
	10230	Aquatic Life	Impaired	Channelization (Siltation) Channelization (Flow Alterations) Removal of Vegetation (Siltation)
	8503	Aquatic Life	Supporting	N/A
	8541	Aquatic Life	Impaired	Municipal Point Source (Chlorine)[b]
	9624	Aquatic Life	Supporting	N/A
	18663	Recreational	Impaired	Agriculture: (Pathogens) Urban Runoff/Storm Sewers (Pathogens)
Little Conestoga Creek	8514	Aquatic Life	Impaired	Grazing Related Agriculture (Nutrients) Grazing Related Agriculture (Siltation) Urban Runoff/Storm Sewers (Cause Unknown)
	15955	Recreational	Impaired	Source Unknown (Pathogens)

a Assessments for unnamed tributaries to the Conestoga River and Little Conestoga Creek are included.

b As shown in Figure 2-10, the Conestoga River stream segment 8541 is downstream of the City's AWWTP. It is noted that the AWWTP dechlorinates and the City's monthly discharge monitoring reports (DMRs) show minimal residual.

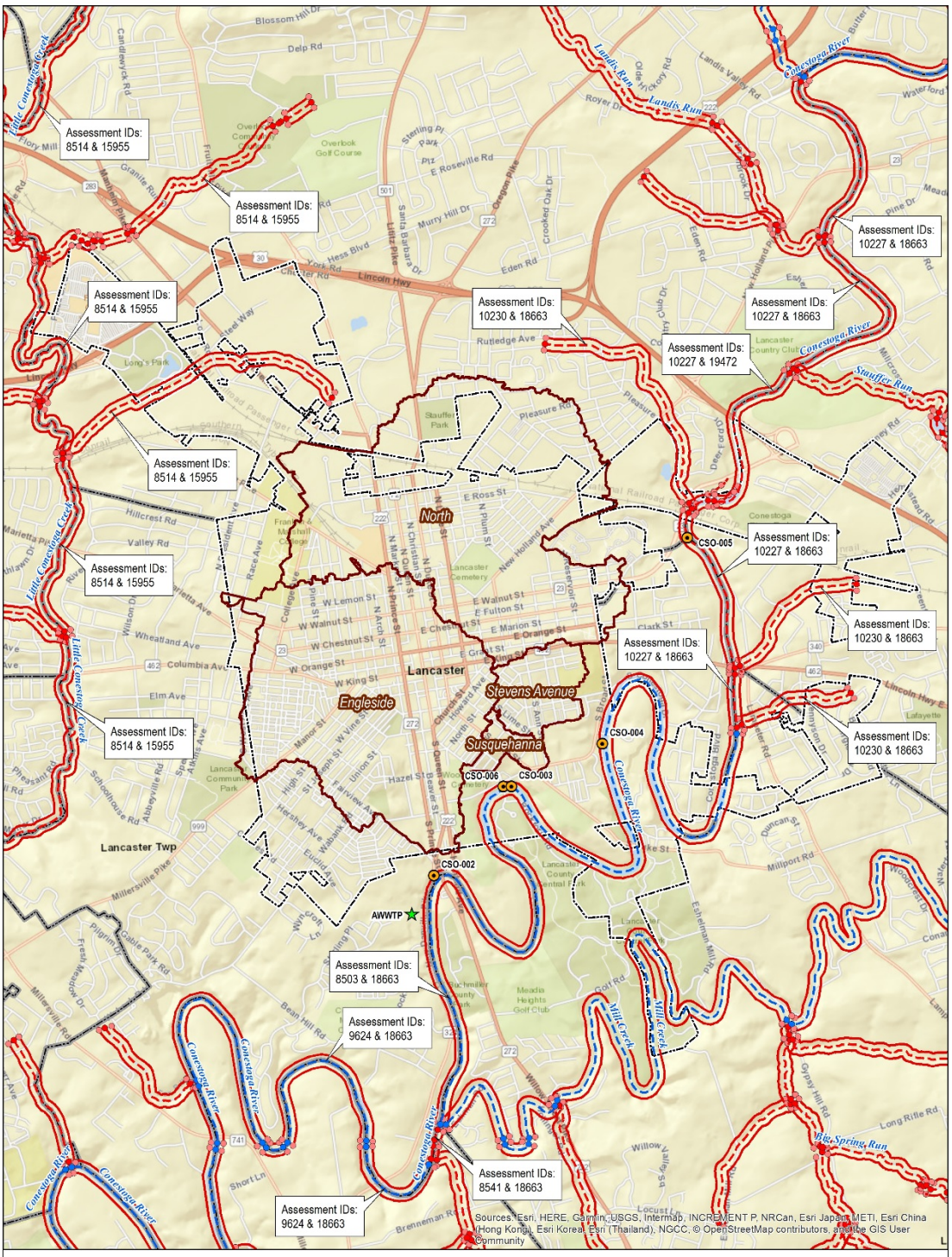


Figure 5.4 – City of Lancaster Streams Assessed Use Status (Source: PADEP and Jacobs)

Historic Hydrology

Historically, the City of Lancaster had numerous surface water features, including the historic streams shown in Figure 5.5 in addition to other streams, wetlands, and marshes. Like older cities across the nation, many of the City's surface water features were buried and replaced with combined sewers, which drained the overlying developed areas.

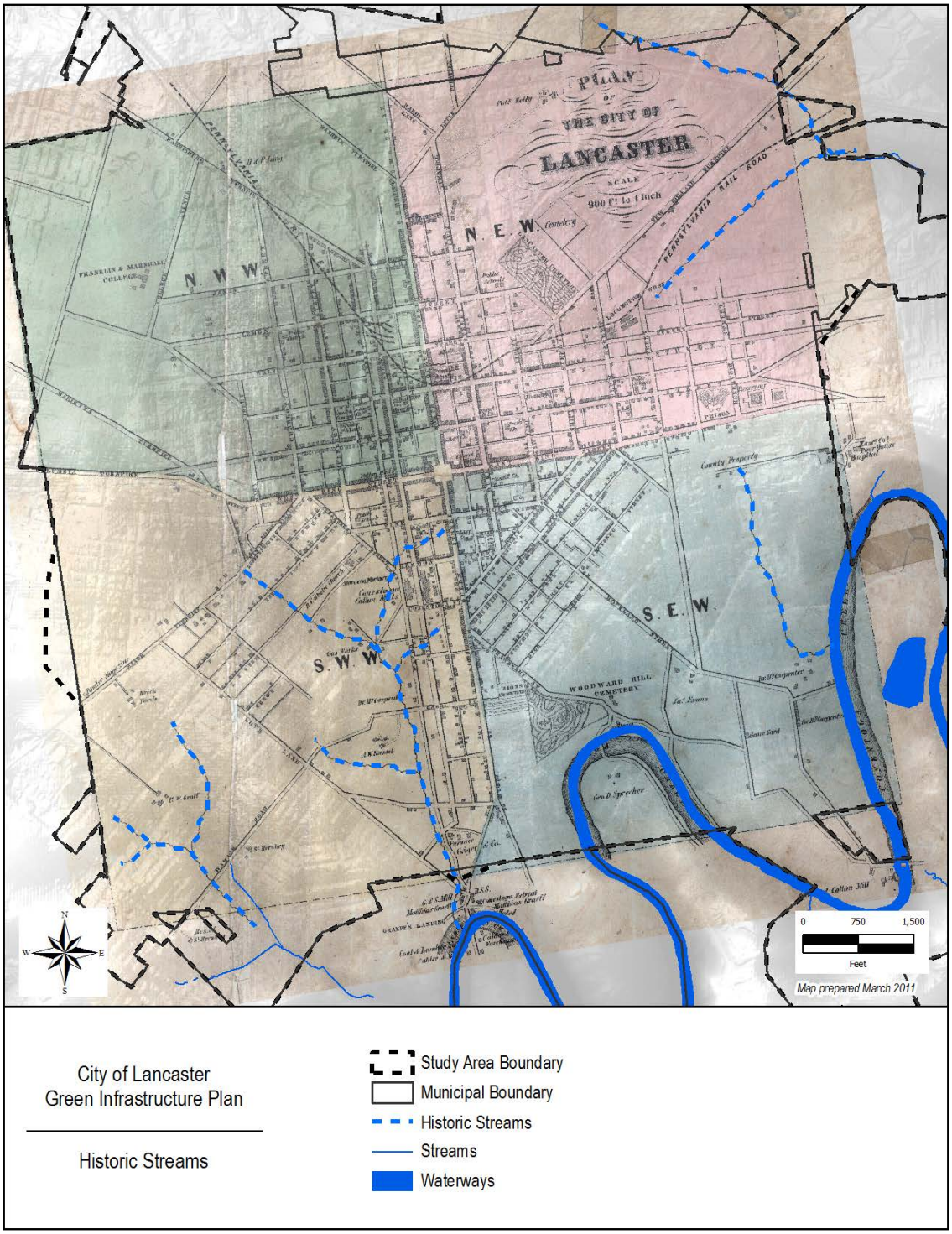


Figure 5.5 – Map of Lancaster City Showing Historic Surface Water Features (Source: Historic Map Works, Lancaster City Plan 1864)

Sewer Systems

Based on mapping updated in 2013, approximately 2,407 acres drain directly to the City's combined sewer system (CSS), which is tributary to five CSOs along the Conestoga River. Figure 5.6 shows the CSS mapping, including outfalls, conveyance and drainage areas. Parts of the City that are not directly served by the CSS are served by a municipal separate storm sewer system (MS4) that discharges storm flows to nearby streams, including the Conestoga River, unnamed tributaries to the Conestoga River, Mill Creek, and Little Conestoga Creek. The City prepared updated MS4 mapping as part of the NPDES MS4 notice of intent for the 2018 to 2023 permit period due on September 16, 2017. The updated MS4 mapping is based on a recently completed detailed survey of the MS4, and where necessary, is supplemented with information from as-built drawings. Figure 5.7 shows the updated MS4 mapping, including outfalls, conveyance, and drainage area. Table 5.2 provides a summary of the land area in the CSS and MS4 systems

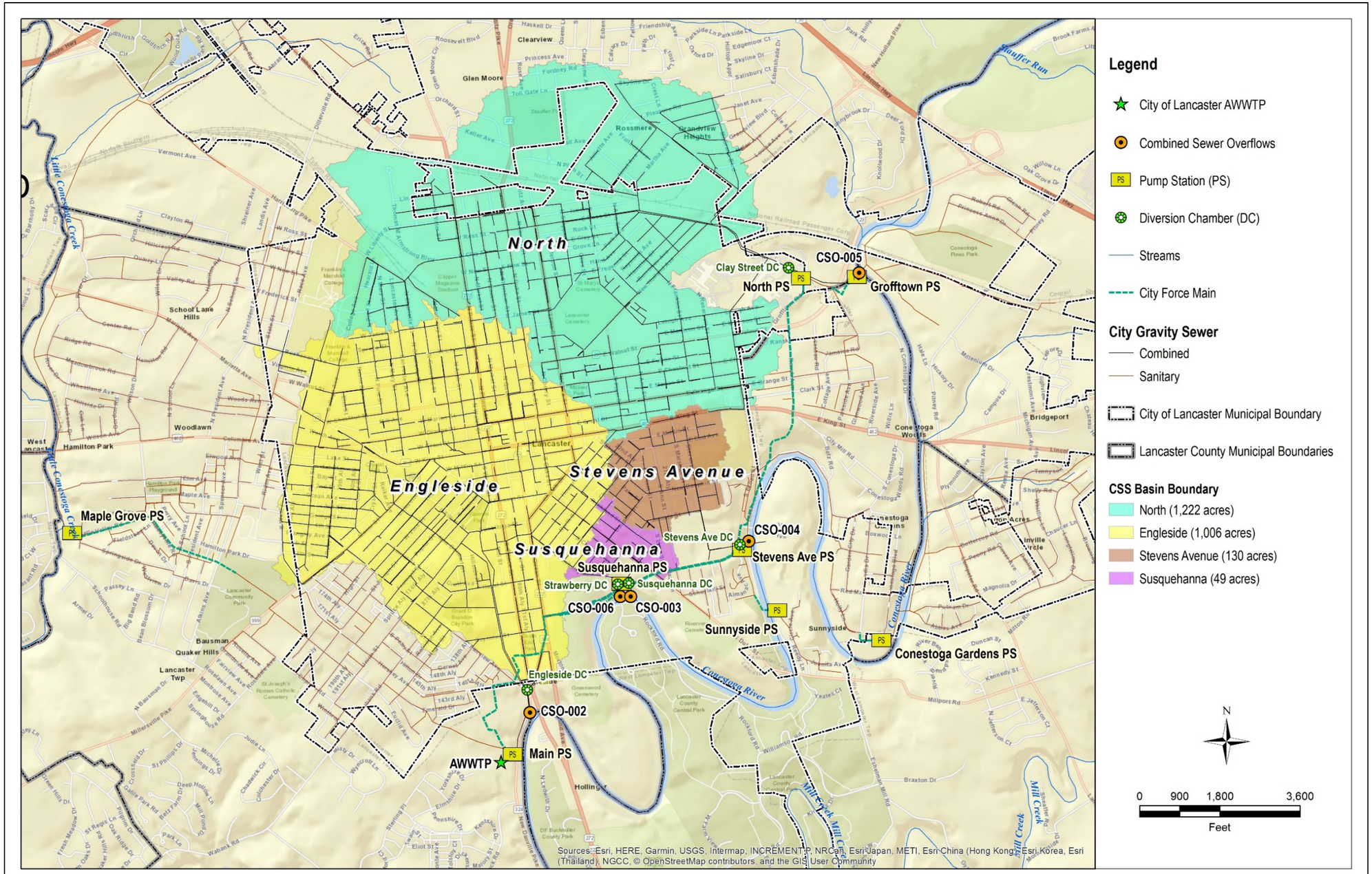


Figure 5.6 - City of Lancaster Combined Sewer System Map (Source: City of Lancaster and Jacobs)

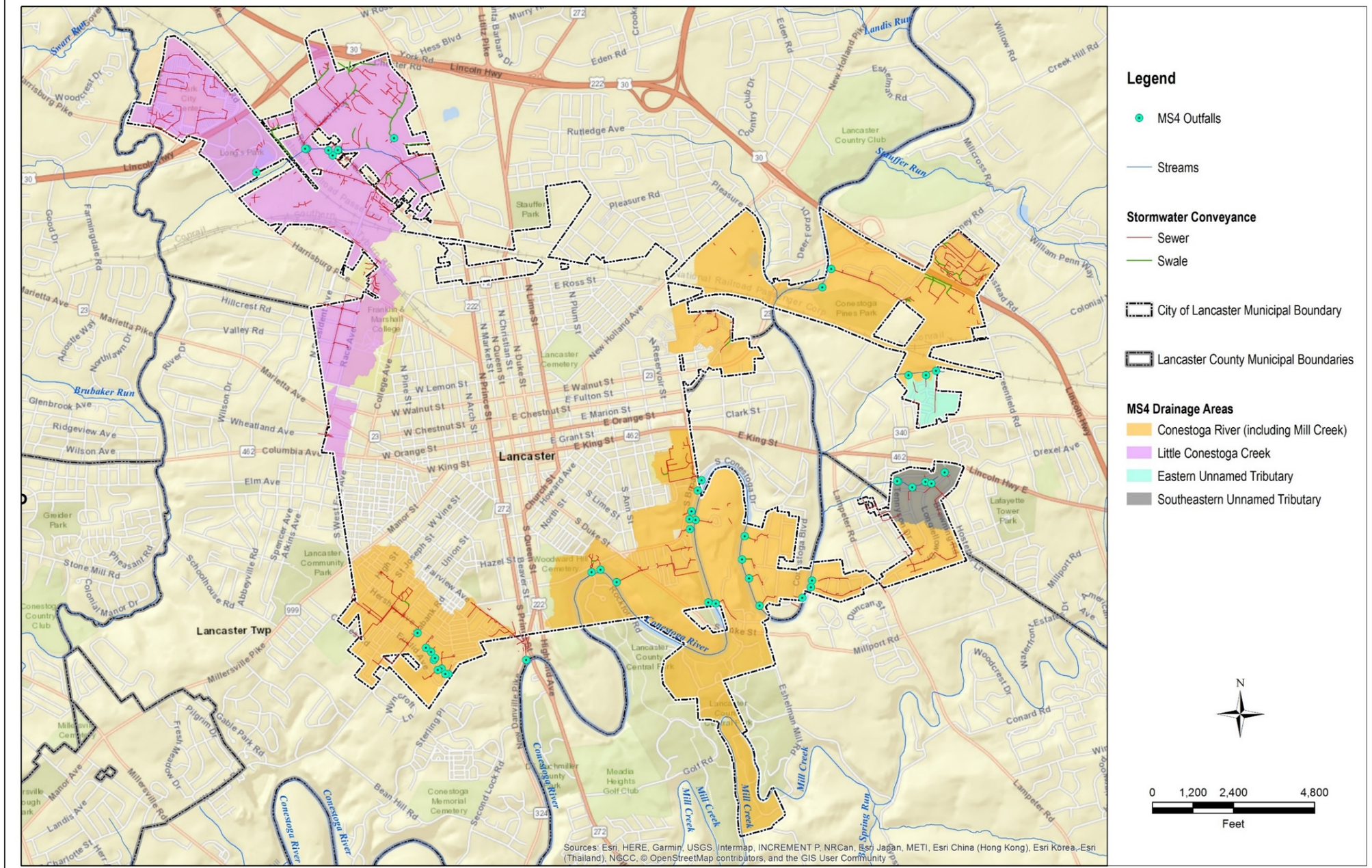


Figure 5.7 - City of Lancaster MS4 Map (Source: City of Lancaster and Jacobs)

Table 5.2 - Area (Ac) of the CSS Basins and MS4 System in the City of Lancaster

CSO Basin	City of Lancaster Area, Ac	Non-City Area, Ac	Total Area, Ac
Engleside	991	15	1,006
North	890	332	1,222
Stevens Avenue	130		130
Susquehanna	49		49
Total CSS Area	**2,060**	**347**	**2,407**
Total MS4 Area	**2,641**		**2,641**
Total Area	**4,702**		**5,049**

5.2 Surficial Geology

The majority of the City of Lancaster is situated in the Conestoga formation, found in the Piedmont lowlands. Limestone bedrock (carbonate geology) is prolific throughout the study area (Figure 5.8). Limestone is a fairly young rock that is easily eroded and is often characterized by karst topography with sinkholes, caves, subsurface depressions, and mines. All stormwater systems in karst areas should be designed and constructed to minimize the risk of subsidence with appropriate site investigations conducted to evaluate the specific geologic and soil conditions for each site. Special care should be taken not to overly concentrate stormwater in systems that can infiltrate, and vegetation should be incorporated in stormwater systems where possible to maximize evapotranspiration and help restore the natural hydrologic function to a site.

The green infrastructure technologies recommended in this plan (e.g., infiltration trenches, bioretention, and porous pavements) generally adhere to these guidelines. For more details on stormwater management in karst areas, see Chapter 7 of the Pennsylvania Stormwater Best Management Practices Manual (PADEP, 2006). The Lancaster City stormwater ordinance also has requirements related to stormwater facilities in carbonate areas. Much of the study area is also likely to have urban soil conditions that may impact the type or configuration of green infrastructure measures. Site investigations and soil testing can help identify historic cut and/or fill, soil compaction, building debris, contamination, pH, lack of plant nutrients and other issues. For example, as part of the GI program over 250 soil tests have been performed throughout the City at potential project locations. These tests reveal variable subsurface conditions that are typically conducive for some infiltration: the median in-situ measured infiltration rate was 0.45 inches per hour with 65% of tests yielding at least 0.25”/h.

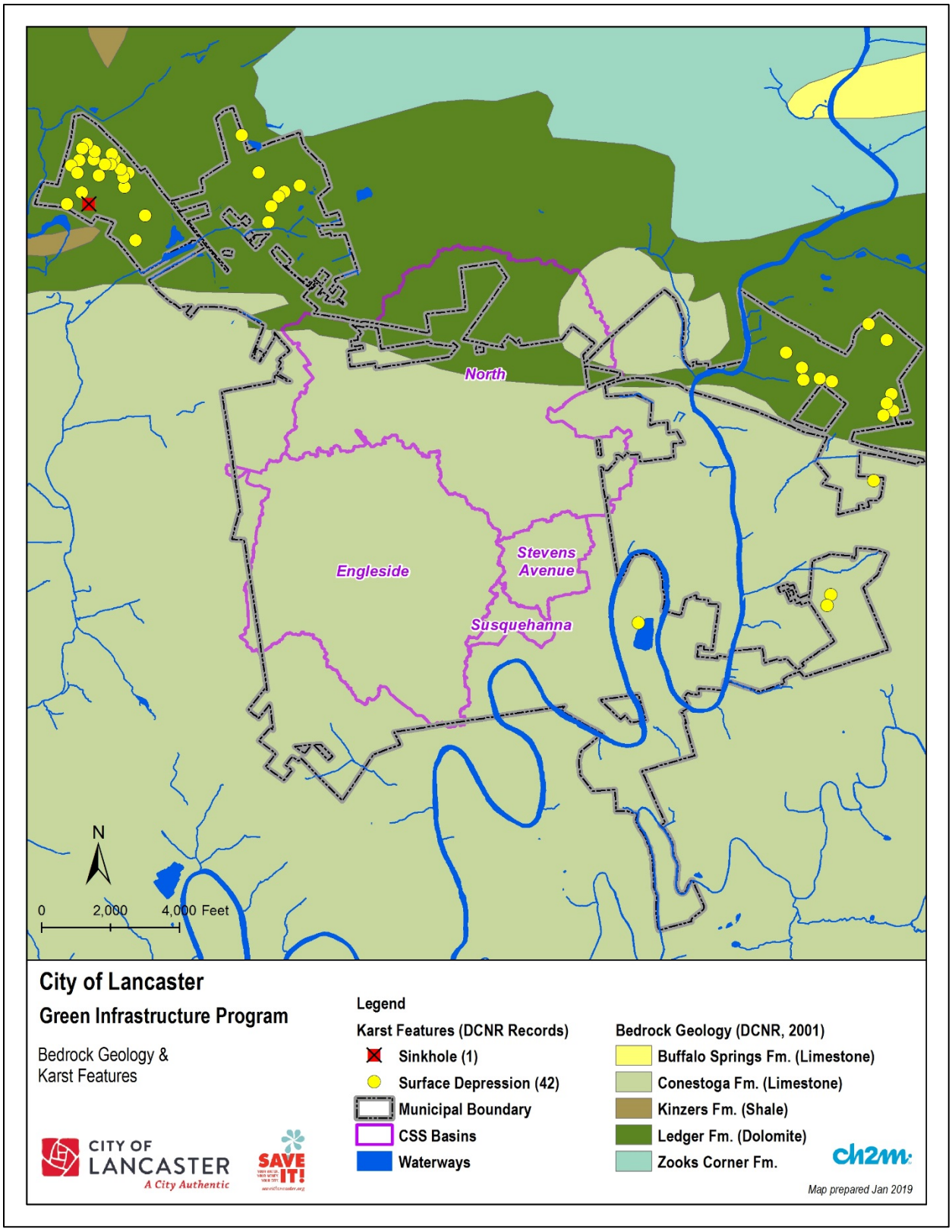


Figure 5.8 – Bedrock Geology and Karst Features within the City of Lancaster (Source: PA DCNR)

5.3 Brownfields

The City of Lancaster has properties that fall under the EPA Brownfields program and/or the EPA Resource Conservation and Recovery Act (RCRA) Corrective Action Program. According to the U.S. EPA, the term "brownfield site" refers to "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant". Treatment, storage and disposal facilities regulated under the Resource Conservation and Recovery Act (RCRA) may have releases into the environment, thereby requiring cleanup.

The EPA Nutrient Innovations Task Force estimated that 50% of the existing urban landscape will be redeveloped by 2030. Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2), which outlines clear cleanup standards based on risk and provides an end to liability when that cleanup standard has been achieved, has been applied to numerous sites throughout the City. The Land Recycling Program encourages the voluntary cleanup and reuse of contaminated commercial and industrial sites.

In some cases, "cleanup" involves the use of institutional and/or engineering controls, which could preclude the infiltration of stormwater or restrict other activities on the site. For this reason, it will be important to investigate any limitations to the use of the site when considering the incorporation of green infrastructure on a brownfield and/or cleanup site.

EPA's Brownfields Program Website (www.epa.gov/brownfields) provides information on and resources for assessing, cleaning up and redeveloping brownfields, including grant funding opportunities. A PDF fact sheet – Design Principles for Stormwater Management on Compacted, Contaminated Soils in Dense Urban Areas – describes design considerations and general principles for using green infrastructure on brownfield sites and has a page of additional resources for further consideration. It is generally more cost-effective to implement green infrastructure as part of the redevelopment process and therefore as brownfield sites are considered for redevelopment or other uses, the possible inclusion of green infrastructure can be evaluated on a case by case basis.

5.4 Land Use

Land use plays an important role in the implementation of green infrastructure and is considered along with property ownership (public versus private) and impervious area types and amounts as GI strategies are considered on a site by site basis. For example, industrial and manufacturing land uses will typically need significant more planning and analysis to determine the feasibility of green infrastructure projects. On the other hand, park and recreation land uses are excellent opportunities for GI projects, particularly when held in public ownership.

Parcel-based land use data was provided by the City of Lancaster, using data sourced from the Lancaster County IT Department, GIS Division. Land use classes were assigned to parcels using the standardized classification scheme provided by the Lancaster County Assessment Office and a summary is shown in Figure 5.9.

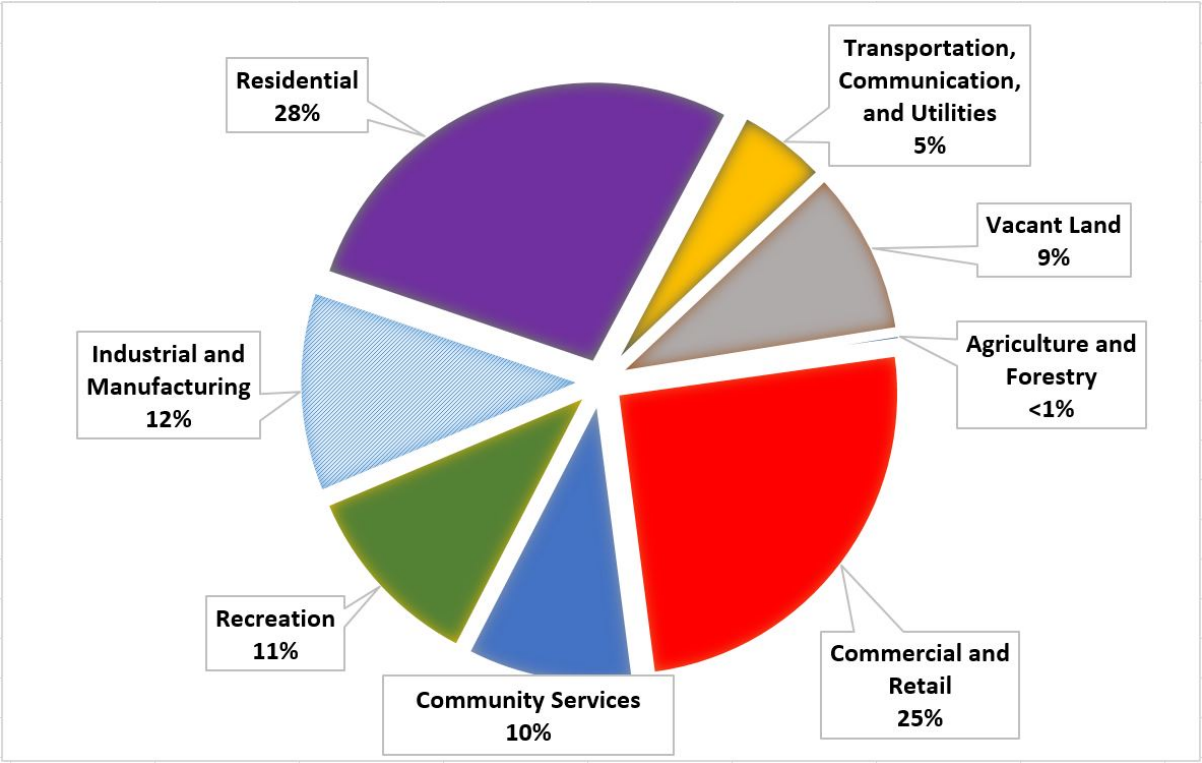


Figure 5.9 – Land Use Composition in the City of Lancaster (Source: City of Lancaster and Lancaster County, 2018)

5.5 Impervious Area Analysis

Stormwater impacts are directly linked to the amount and type of impervious land cover. This section describes the process and methodology used to analyze the impervious areas of the City.

In 2017, the City of Lancaster contracted to obtain an updated impervious area GIS database for the entire City, based on high resolution orthophotography interpretation. The resulting dataset provided a detailed update to the previous datasets from 2012 (used for the Stormwater Management Fee) and 2010 (used in the 2011 GI Plan). Features included in the impervious cover layer include building footprints, roadways, driveways, sidewalks, bridges, recreation areas (i.e. play courts) and parking lots. Figure 5.10 and Table 5.3 summarize the total impervious area by categories, across the City.

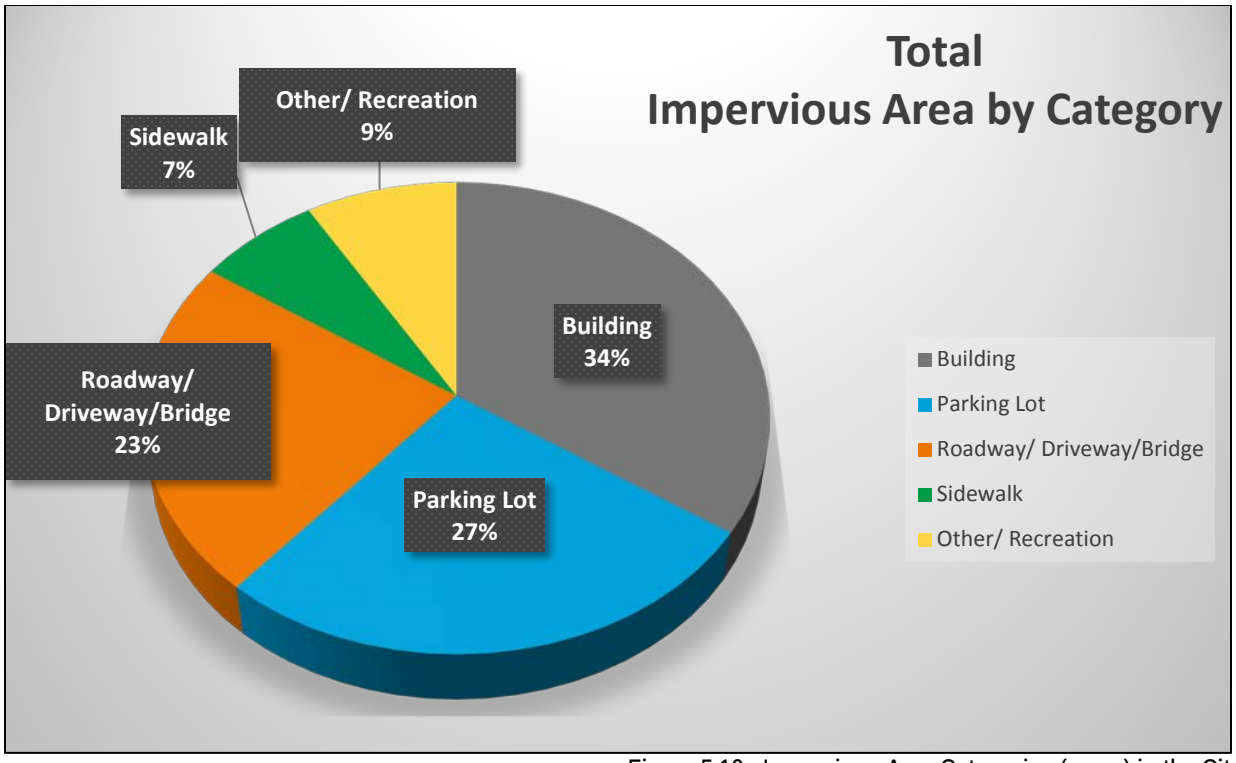


Figure 5.10 - Impervious Area Categories (acres) in the City

Table 5.3 - Composition of Impervious Area Categories in the City

Impervious Cover	Total Impervious Area, Acres	Percent of Total IA	Percent of Total City Land Area
Building	853	34%	18%
Parking Lot	670	27%	14%
Roadway/ Driveway/Bridge	574	23%	12%
Sidewalk	173	7%	4%
Other/ Recreation	213	9%	5%
TOTAL	**2,483**	**100%**	**53%**

Drilling down to analyze the distribution of impervious area across the Engleside and North CSO Basins planning area, Engleside has more buildings and right-of-way features including roads and sidewalks. North has more parking lots and "other" impervious area features (this category contains railroad tracks, patios, and decks, for example). Table 5.4 provides the distribution of impervious area categories for North and Engleside. Table 5.5 provides the total area and total impervious area.

Table 5.4 - Total Area (AC) of the Impervious Area Categories within Engleside and North Basins

CSO Sewershed	Building	Parking Lot	Road/ Driveway/ Bridge	Sidewalk	Other/ Recreation	Total Area, AC
Engleside	289	124	174	70	49	706
North	206	158	124	49	53	590
TOTAL	**494**	**282**	**298**	**119**	**102**	**1,296**

Table 5.5 - Total Area (AC) and Total Impervious Area (AC) for the Engleside and North Basins

CSO Sewershed	Total Area, Acres	Total Impervious Area, Acres	% Impervious
Engleside	1,006	706	70%
North	1,222	590	48%
TOTAL	**2,228**	**1,296**	**58%**

The coverage and extent of impervious area types is shown in Figure 5.11. Table 5.6 shows a summary of the impervious area coverage across the neighborhoods in the City. As expected, the Central Business District has the most impervious area (91%) and Conestoga Heights has the lowest impervious area (19%) followed by Prospect Heights (47%). All the neighborhoods combine to 59% impervious overall.

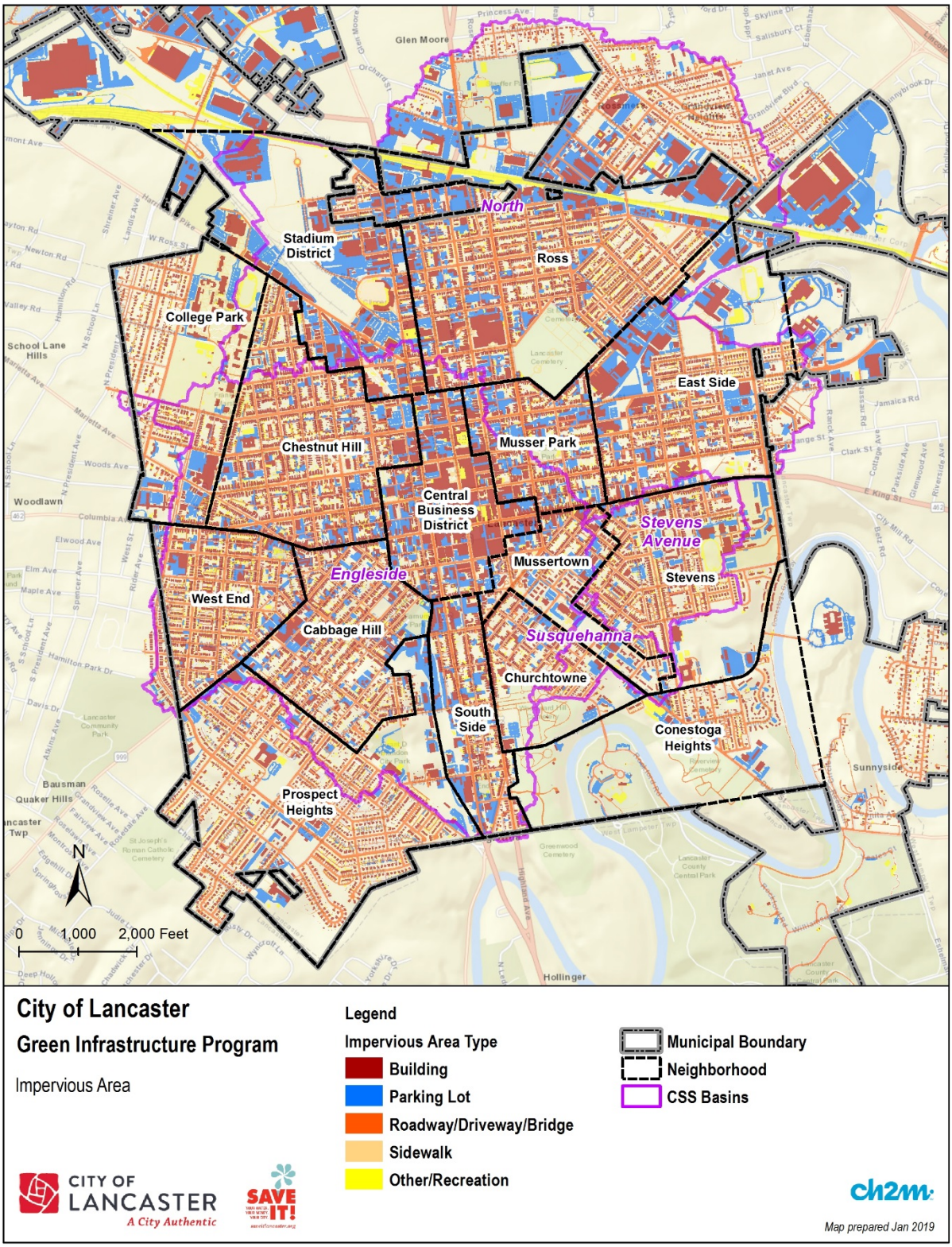


Figure 5.11 - Impervious Area in the City of Lancaster (Source: City of Lancaster and Jacobs)

Table 5.6 Total Area and Total Impervious Area (Ac) by Neighborhood

Neighborhood	Total Area, AC	Total Impervious Area, Ac	Percent Impervious
Cabbage Hill	151.9	99.3	65%
Central Business District	128.5	116.7	91%
Chestnut Hill	217.8	162.5	75%
Churchtowne	96.6	47.3	49%
College Park	196.3	93.9	48%
Conestoga Heights	237.8	45.1	19%
East Side	249.9	160.3	64%
Musser Park	96.9	77.0	79%
Mussertown	85.2	58.5	69%
Prospect Heights	361.7	169.0	47%
Ross	404.4	272.7	67%
South Side	91.9	64.6	70%
Stadium District	232.8	140.9	61%
Stevens	205.0	110.3	54%
West End	121.1	89.9	74%
Total	**2,877.8**	**1,707.8**	**59%**

5.6 Parcel-Based Analysis

For the GI Implementation planning analysis, parcels were categorized into several property types, or GI strategies. These property types were originally presented in the 2011 GI Plan and were updated for this analysis. The property types can be organized by ownership, and at the highest level are split into public and privately-owned properties. Each property type presents a defining implementation process for incorporating GI into both redevelopment or new land development processes. Table 5.7 presents a summary of the number of parcels and total impervious area within each category for Engleside and Table 5.8 presents the same information for the North Basin.

Table 5.7 - Summary of Impervious Area for Parcel-Based Property Types in Engleside Basin

Property Type	Number of Parcels	Total Impervious Area, Ac	Total Pervious Area, Ac	Total Area, Ac
City	135	23	18	40
Parks	7	5	9	13
Private	8,721	434	238	672
Public, other	7	4	0.2	4
School	6	11	4	15
ROW/non-parcel areas*	n/a	229	17	246
Total	**8,876**	**706**	**286**	**991**

* IA calculated only for City land within the CSS Basin

Table 5.8 - Summary of Impervious Area for Parcel-Based Property Types in North Basin

Property Type	Number of Parcels	Total Impervious Area, Ac	Total Pervious Area, Ac	Total Area, Ac
City	26	2	1	4
Parks	6	12	16	28
Private	4,981	407	254	661
Public, other	1	3	1	4
School	6	6	9	16
ROW/non-parcel areas	0	159	18	178
Total	**5,020**	**590**	**300**	**890**

* IA calculated only for City land within the CSS Basin

The city has successfully implemented 57 GI Projects with a total of 44 impervious acres managed that span all the property types presented here. A summary of the existing GI project implementation is presented in Section 3.

In conclusion, there are still many more opportunities for management of additional impervious area in the City for the various property types. Section 6 provides a more detailed analysis and discussion of these opportunities and suggestions for implementation strategies.

5.7 Socioeconomic Analysis

The GI projects to be constructed through this program will be targeted to benefit typical, small property owners in the City. The water quality, aesthetic, and educational benefits of the projects will strive to improve quality of life for all 60,000 people that reside in the densely populated City.

Population Demographics

A critical component of any spatial or geographic planning process is the analysis of population. While knowing the number of people living in the City is important, understanding population characteristics that describe the population is essential to planning for growth and change. This analysis of the City's population is limited to several demographic statistics that are relevant to developing strategies for the implementation of the *Green It! Lancaster* Plan goals. Typical examples of demographics used in many studies and surveys, include race, ethnicity, gender, age, education, profession, occupation, income level, and marital status though most of these are not covered here because of the relatively narrow focus of the *Green It! Lancaster* Plan. We will look at partial age, income and housing data to assist in developing strategies for implementing GI on private properties. Unless otherwise noted, the data for this analysis comes from the 2013 – 2017 American Community Survey (ACS).

The ACS population estimate for Lancaster is 59,708 persons. This is a 0.06% increase over the 2010 population. As indicated in Table 5.9, Lancaster's population has fluctuated in the past 100 years, increasing only 1.16% between 1920 and 2010. The City's current population is lower than its peak of 63,774 persons in 1950. The population decreased for the next 4 decades before beginning a trend of steady increases.

Table 5.9 –City of Lancaster Population Change 1920 - 2010

	1920	1970	1980	1990	2000	2010	1920-2010	1970-2010
Total Population	53,150	57,690	54,725	55,551	56,348	59,322		
Change		4,540	-2,965	826	797	2,987	6,172	1,632
Percent Change		0.85%	-0.53%	0.15%	0.14%	0.52%	1.16%	0.28%

Racial and ethnic composition is as follows: 59.9% White, 17.5% Black, 4.0% Asian, 0.2% American Indian, and 4.6% two or more races. In 2017, it was estimated that 38.7% of the City aligns Hispanic,

Lancaster is a relatively young City, with a median age of just 31.6 years. According to the 2010 US Census, the median age of Pennsylvanians was 40 years and the median age of all Americans was 37.2 years. Twenty-four percent, or more than 14,000, of people in Lancaster are under the age of 18, while only 9.9 % of the population is over 65 years of age. In Pennsylvania, over 15% of the population is over 65.

A further population distinction is households and families. A household is composed of one or more people who occupy a housing unit and can be family or non-family households. Family households consist of two or more individuals who are related by birth, marriage, or adoption, although they also may include other unrelated people. Nonfamily households consist of people who live alone or who share their residence with unrelated individuals. In 2017, 57% of all households were family households. The average household size was 2.56 persons and the average family size was 3.31 persons.

Population density is number of persons per square mile. The City's population density is 8,135 persons per square mile. However, if the annexed areas of the City with low population are excluded, the City's population density approaches 15,000 persons per square mile. This 4 square mile area is the original extent of the City, where most people live, and the majority of the impervious surfaces are located. It also represents all the Combined Sewer System service area.

Poverty and Income

According to the American Community Survey, 2009-2013, 29% of the City's residents live below the poverty line and the demographics are as follows:

Another tangible characteristic is household and family income. Income is money earned from all sources between any two points in time. The US Census tracks several different types of incomes including median and per capita, for all people 15 years old and over. Median family income and median household income are based on the distribution of the total number of families, including those with no income, with half the families having incomes above the median, and the other with families having incomes below the median. Household income is the sum of money income received in the calendar year by all households, including family households, people living alone, and non-family households. Per capita income is the mean money income received computed for every man, woman, and child in a geographic area, derived by dividing the total income in a geographic area by the total population in that area. Note -- income is not collected for people under 15 years old even though those people are included in the denominator of per capita income. (U.S. Census Bureau)

In 2017, the estimated median household income was $40,805 and the median family income was $44,805 with 26.5% of the City's population living below the level of poverty in 2017.

Housing

The composition of the City's housing stock is indicative of the extent to which a range of housing options are being provided for its residents. Analysis of this data can assist in developing strategies for

the equitable provision of safe, convenient and accessible housing as well as the allocation of limited resources for the implementation of GI on residential properties.

This analysis includes an inventory of existing housing, including age and occupancy characteristics of the housing stock, as well as housing costs for both owner-occupied and renter occupied housing units. The information provided is intended to assist in the decision-making process, to aid in determining unmet housing needs, and in allocation limited resources.

In 2017, the total estimated number of housing units in Lancaster was 24,010, of which over 90% were occupied. More than 85% of those housing units are in structures build more than 50 years ago. Housing occupancy looks at the housing unit's tenure, which is defined as the status of a housing unit being owned or rented by the primary occupant(s). More than 43% of the occupied housing units are owner occupied with a median value of $109,700. The 56.6% of occupied housing units that are rental had a median rent of $816 in 2017.

In 2017, the homeowner vacancy rate was 2.7% and the rental vacancy rate was 3.3%. Vacancy rates can indicate how easily someone who wants to move into Lancaster can find suitable housing. According to the U.S. Department of Housing and Urban Development, vacancy rates of at least 2% for owner occupied units and 5% for renter occupied units are considered adequate to provide sufficient choice for those looking for housing. In 2017, Lancaster clearly did not have an adequate supply of available housing for purchase or for rent.

Cost burden is that portion of a household's total gross income spent on housing costs and can be used as a measure for affordability of housing in a community. For owners, housing costs include mortgage payment, taxes, insurance, and utilities. For renters, housing costs include rent paid by the tenant plus utilities. The shortage of affordable housing can become a significant hardship for low-income households, especially senior citizens on fixed incomes, preventing them from meeting their other basic needs, such as nutrition and health care, or saving for their future and that of their families. Therefore, an adequate supply of affordable housing is vital to healthy families, communities and local economies. Affordability is measured against a household's ability pay for a mortgage or rental costs. A household is considered to be cost burdened if it is paying more than 30% of its household income for housing. The percentage of cost burdened households in Lancaster City in 2017 was 22% for owner occupied households and 53% for renter households.

The number of housing units should not be confused with the total number of single-family houses. The US Census compiles data on the number of units in a structure, such as single-family attached and detached and several categories of apartment units. According to the ACS, there were 13,509 single-family and two-family households, 4,252 units in apartments buildings with 2 – 4 units and 4,062 apartments in buildings with 5 or more units in Lancaster in 2017. These numbers are not surprising when compared to the relatively high rate of home ownership and the number of residential properties identified through the impervious area analysis completed as part of this green infrastructure program.

Refining the housing statistics further using the City's GIS, the structures noted above containing 4 or fewer households occupy 15,079 parcels containing a total area of over 46.5 million square feet of which more than 45% is impervious. This is consistent with the total impervious area for the City.

6. GI Planning and Evaluation

This section discusses a range of public and private strategies for implementing green infrastructure in the City of Lancaster to achieve additional stormwater capture, overflow reduction, and other benefits. The following potential strategies and project types are included:

- Parks
- Schools
- Streets
- Alleys
- Trees and Sidewalks
- Stormwater Ordinance
- Parking Lots
- Inflow Removal

6.1 Public GI Strategies

Parks

While many people may think of parks as already being "green," they are strong candidates for green infrastructure implementation due to their ability to manage adjacent stormwater runoff (from nearby roadways and sidewalks, for example) within the park itself. Parks typically have large available areas for siting green infrastructure, whether a surface feature such as a bioretention system, or a subsurface storage/infiltration trench that can be placed underneath existing fields or play courts without impacting park usage.

The City has implemented significant green infrastructure in four parks to date, including porous pavements and rain gardens at Brandon Park (Figure 6.1). There is the potential to implement GI at additional public parks, both at a localized scale (managing on-site runoff) and at a larger, neighborhood scale (managing both on-site runoff and runoff from adjacent streets and parcels). To date, park GI projects have managed approximately 3 times the amount of impervious area within park boundaries, indicating that they are managing a significant amount of adjacent roadway and sidewalk runoff in addition to on-site impervious. Figure 6.2 provides a visual inventory of the City's parks with respect to green infrastructure implementation.

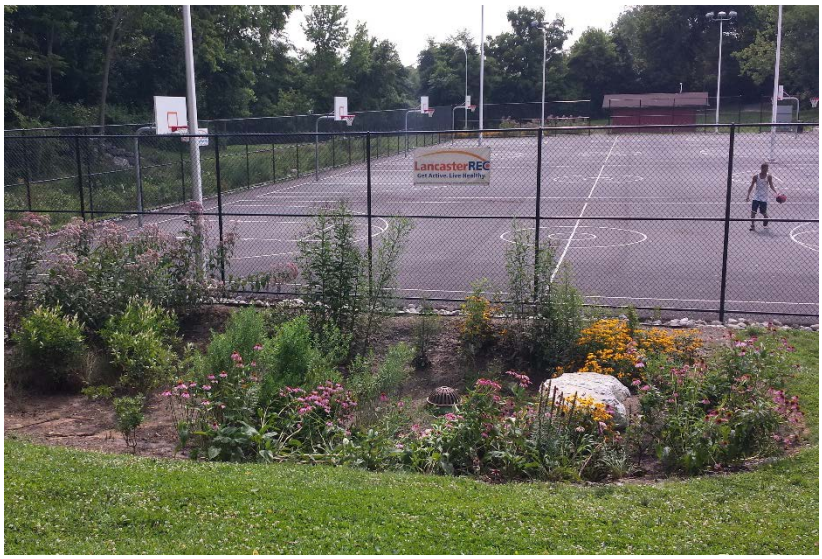


Figure 6.1 – Brandon Park features a porous pavement basketball court in addition to numerous rain gardens.

Based on input from the City, the parks were evaluated according to various criteria related to GI implementation (Table 6.1), particularly their

viability to potentially serve as neighborhood-scale GI projects. Evaluation criteria included Park Area, Impervious Area, CSO Basin, and associated Overflow Reduction Efficiency (ORE). The park project opportunity list serves as a guide for the City to consider various factors for GI project implementation as schedule, funding, and other needs arise.

The City prepared a neighborhood-scale GI implementation study for Mayor Janis Stork Linear Park (previously known as the Northwest Linear Park) in 2014, which described the potential amount of capture that could be conveyed to strategically located green infrastructure within the park if new storm sewer pipes were placed within streets adjacent to the park in order to "disconnect" that roadway runoff from the combined sewer system and direct it to green infrastructure in the park. The study ranked different combinations of pipe runs for their cost efficiency and capture volume to present recommended scenarios.

Building upon the Mayor Janis Stork Linear Park neighborhood-scale GI implementation study, high-level neighborhood-scale GI analyses for Conlin Field/Culliton (formerly Farnum) Park and South End Park were prepared. These three sites (Stork Linear, Culliton, and South End Parks) are the main candidates for neighborhood-scale GI implementation at parks due to their available open space, topography, potential capture areas, and location within the CSS.

In addition to the stormwater evaluation criteria, further assessment of neighborhood value of park improvements related to health and quality of life benefits will be considered in further prioritizing park renovation. Financial resources for providing park and open space opportunities to the residents of Lancaster must be allocated judiciously. Neighborhood need, age of existing parks, amenities, population served, maintenance and other applicable criteria will be assessed prior to the allocation of funds.

The following map and lists are not recommending or showing prioritization. These will be used in the future planning for park provision and renovation.

The GI project status of the parks listed in Table 6.1 as idea and concept are held over from the 2011 GI Plan and have no more or less potential than any other potential park project without an indicated status.

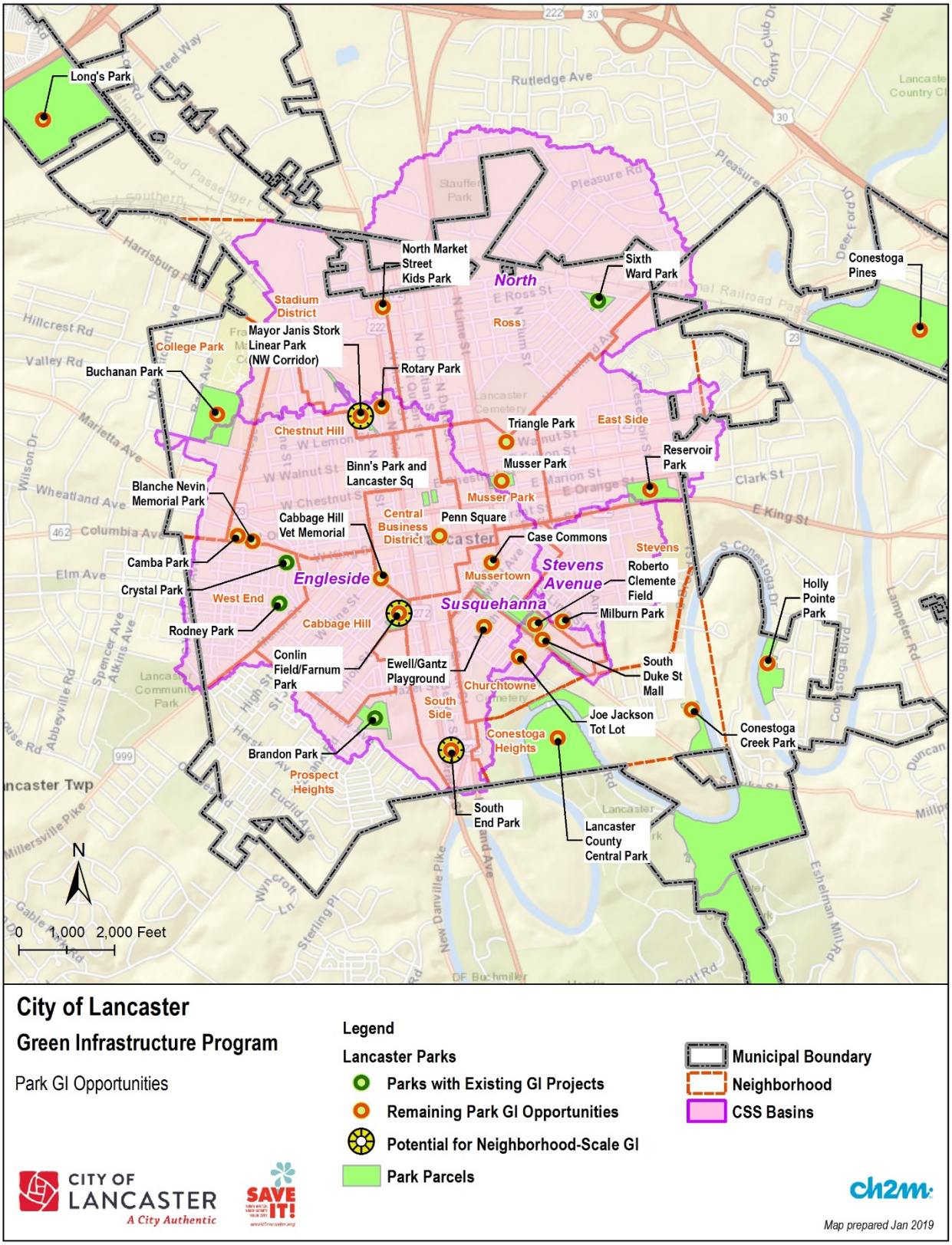


Figure 6.2 - City of Lancaster Park GI Opportunities (Source: Jacobs)
Parks with Existing GI Projects and Additional Park Sites with Opportunities for GI

This page is intentionally left blank.

Table 6.1 – Potential Park GI Project Opportunities Listed by Total Park Parcel Area

Park Name	GI Project ID and Status (if applicable)	Total Park Parcel Area (sf)	% Impervious	Parks Master Plan Park Classification	CSO Basin/ MS4	Neighborhood
Lancaster County Central Park		8,461,516	8%	N/A	MS4	Conestoga Heights
Conestoga Pines		3,105,493	12%	Community Park	MS4	n/a
Long's Park	Design (P-152)	3,031,943	16%	Community Park	MS4	n/a
Buchanan Park		930,386	9%	Neighborhood Park	MS4 (near Engleside)	College Park
Holly Pointe Park		470,564	0%	Other Open Space	MS4	n/a
Reservoir Park	Concept (P-002)	391,437	23%	Neighborhood Park	North	East Side
Brandon Park	Complete (P-003), Opportunity for Additional GI	312,101	35%	Neighborhood Park	Engleside	Prospect Heights
Roberto Clemente Field	GI Under Construction at time of writing this plan	310,148	45%	Neighborhood Park	Susquehanna	Mussertown
Conestoga Creek Park		299,617	4%	Neighborhood Park	MS4	Conestoga Heights
Conlin Field/Culliton (formerly Farnum) Park	Concept (P-007), Candidate for Neighborhood-Scale GI Project	199,414	34%	Neighborhood Park	Engleside	Cabbage Hill
South Duke Street Mall		169,539	22%	Other Open Space	Engleside / Susquehanna	Mussertown
Musser Park	Idea (P-006)	135,351	29%	Neighborhood Park	North	Musser Park
Sixth Ward Park	Complete (P-001), Opportunity for Additional GI	135,336	23%	Neighborhood Park	North	Ross
Mayor Janis Stork Linear Park (formerly NW Linear)	Concept (P-008), Candidate for Neighborhood-Scale GI Project	111,839	40%	Neighborhood Park	Engleside / North	Stadium District
Milburn Park	Slated for additional GI/enhancement of existing GI	45,405	55%	Mini Park	Stevens	Stevens
South End Park	Candidate for Neighborhood-Scale GI Project	44,633	31%	Mini Park	Engleside	South Side
Crystal Park	Complete (P-004), Opportunity for Additional GI	38,869	53%	Neighborhood Park	Engleside	West End
Rodney Park	Complete (P-005), Opportunity for Additional GI	28,565	63%	Neighborhood Park	Engleside	West End
Joe Jackson Tot Lot		13,099	94%	Mini Park	Susquehanna	Churchtowne
Penn Square (NW)		6,980	96%	Mini Park	Engleside	Central Business District
Penn Square (NE)		6,803	100%	Mini Park	Engleside	Central Business District
Rotary Park		6,786	51%	Mini Park	Engleside	Stadium District
Case Commons		5,467	35%	Mini Park	Engleside	Mussertown

Park Name	GI Project ID and Status (if applicable)	Total Park Parcel Area (sf)	% Impervious	Parks Master Plan Park Classification	CSO Basin/ MS4	Neighborhood
Camba Park		4,336	21%	Other Open Space	Engleside	Chestnut Hill
Penn Square (SE)		3,957	91%	Mini Park	Engleside	Central Business District
Penn Square (SW)		3,406	100%	Mini Park	Engleside	Central Business District
Triangle Park	Concept (P-020)	2,292	13%	Mini Park	North	Musser Park
Ewell/Gantz Playground		2,221	59%	Mini Park	Engleside	Churchtowne
North Market Street Kids Park		1,949	42%	Mini Park	North	Stadium District
Cabbage Hill Veterans Memorial		1,782	58%	Other Open Space	Engleside	Central Business District
Blanche Nevin Memorial Park		925	41%	Other Open Space	Engleside	Chestnut Hill

Schools

Public schools can provide a variety of green infrastructure techniques that manage stormwater from both on-site and from adjacent impervious area such as roadways. Public schools are typically located on larger-sized parcels with significant areas of impervious play surfaces, parking, and rooftops.

As described in the EPA Mid-Atlantic Region's recently published Storm Smart Schools, "schools provide the ability to combine environmental education with environmental service-learning opportunities," educating both children and the community in ways that can assist municipalities with regulatory requirements for public outreach and education. Green infrastructure can not only manage stormwater and improve aesthetics on school grounds but can also be incorporated into classroom curriculums. The school district also has a direct financial incentive to manage stormwater on its sites to be able to obtain credits on their Stormwater Management Fees.

This analysis focuses primarily on public schools but recognizes that there are private schools in the City as well that may offer additional potential for GI. The School District of Lancaster owns 22 school buildings in the City in addition to the Scheffey Administrative Building. This translates to 20 parcels and 175 acres of property in the City. To date, green infrastructure has been implemented by the City at one school with more projects scheduled for construction in the future (examples shown in Figures 6.3 and 6.4). Other entities (County, etc.) have implemented green infrastructure projects at three schools throughout the City. There are opportunities for GI implementation with facility upgrades/renovations and potential cost savings to be realized through integrated infrastructure construction. The City will coordinate with the School District regarding capital improvements and timing of available grant funding to determine the potential for green infrastructure implementation. Like parks, several school sites also present significant opportunity for neighborhood-scale GI implementation, managing both on-site runoff and runoff from nearby streets and parcels. Figure 6.5 provides a visual inventory of the City's schools with respect to green infrastructure implementation.

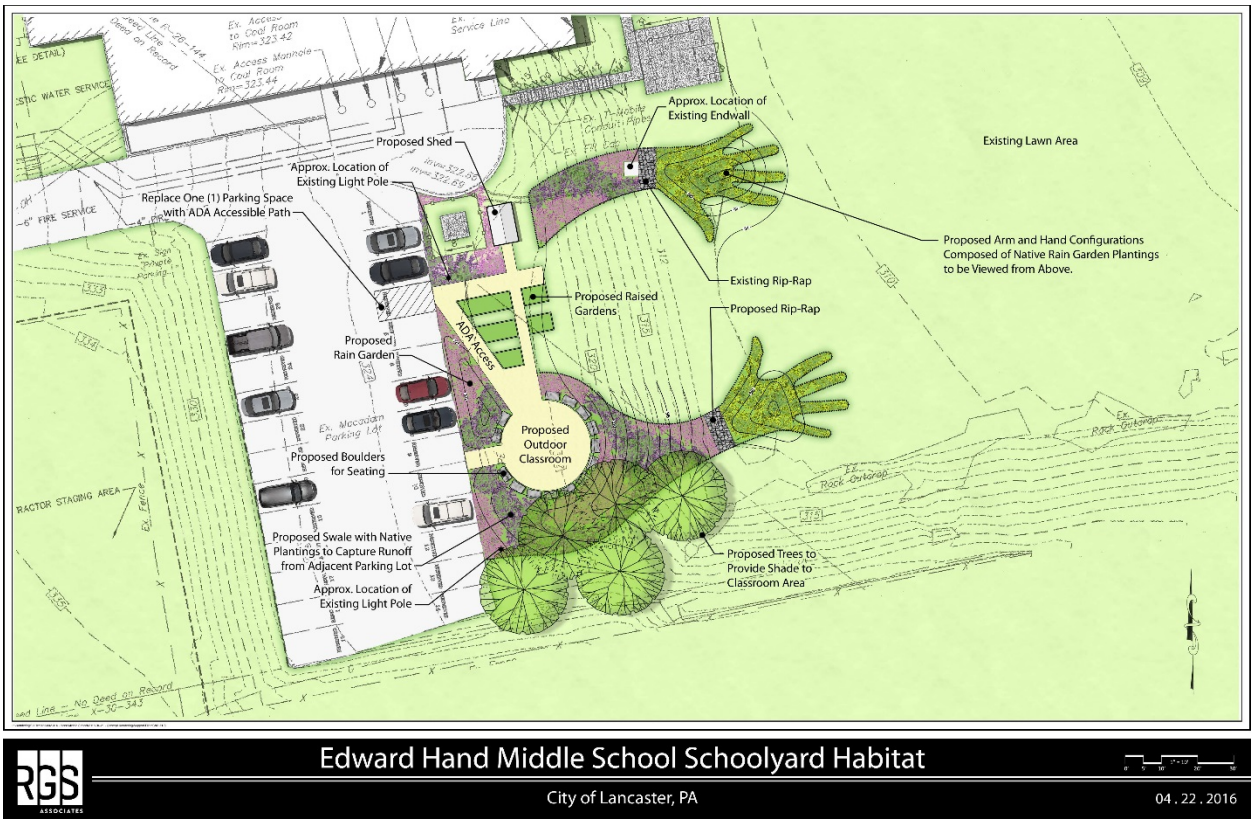
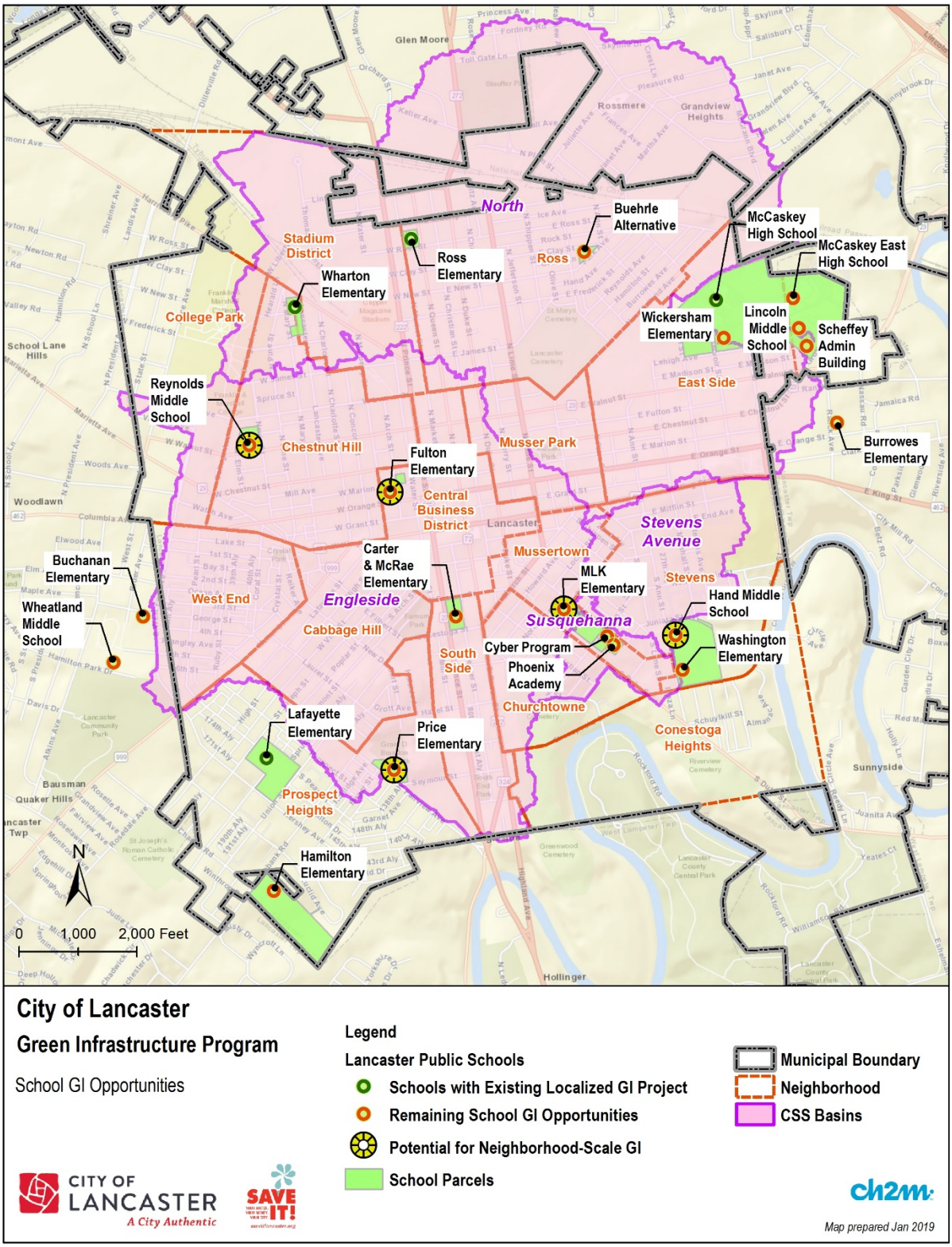


Figure 6.3 - Conceptual Green Infrastructure Plan for Hand Middle School

Figure 6.4 - Porous Pavers at McCaskey High School



City of Lancaster

Green Infrastructure Program

School GI Opportunities

Legend

Lancaster Public Schools

- Schools with Existing Localized GI Project
- Remaining School GI Opportunities
- Potential for Neighborhood-Scale GI
- School Parcels

- Municipal Boundary
- Neighborhood
- CSS Basins

CITY OF LANCASTER — A City Authentic

SAVE IT!

ch2m

Map prepared Jan 2019

Figure 6.5 - City of Lancaster School GI Opportunities (Source: Jacobs)
Schools with Existing GI Projects and Additional School Sites with Opportunities for GI

The City's public schools can be characterized into three major typologies based on their parcel size, urban context, and the availability of open space on the property. Each of these typologies lends itself to different green infrastructure strategies. **Urban Schools** (Figure 6.6 – top image) are typically the most constrained of the school sites, both in terms of physical space and opportunities for green infrastructure implementation. These schools are best suited for GI technologies that work with the existing architectural features and parking lot configurations, such as green roofs, downspout disconnection, or green parking lots that use permeable pavement and/or subsurface stormwater trenches.

Schools with Paved Play Courts (Figure 6.6 – middle image) describe schools that have paved playgrounds, parking lots, and/or paved play courts (e.g., basketball, tennis). These schools do not have significant, if any, green space for GI implementation. Schools in this category are best suited for GI technologies such as permeable pavement (pervious basketball courts, permeable parking lots), green parking lots, and/or subsurface stormwater storage systems under courts or parking lots.

Finally, **Schools with Sports Fields/Open Space** (Figure 6.6 – bottom image) describe schools that have a significant degree of open green space whether it is unprogrammed lawn or turf fields. These schools are prime candidates for bioretention, green parking lots, and subsurface stormwater storage systems under lawn or fields.

With input from the City, the schools were evaluated according to various criteria related to green infrastructure implementation, particularly their potential viability to serve as neighborhood-scale GI projects (Table 6.2). Criteria included synchronization with the School District's Capital Improvement Plan (CIP) for school properties, school typology, parcel area, % impervious, and CSO Basin and associated Overflow Reduction Efficiency.

Figure 6.6 - School Typologies (from top to bottom): Urban Schools, Schools with Paved Play Courts, and Schools with Sports Fields/Open Space

Table 6.2 – Potential School GI Project Opportunities Listed by Total School Parcel Area

School Name	GI Project ID and Status (if applicable)	Total School Parcel Area (sf)	% Impervious	School Typology	CSO Basin / MS4	Neighborhood	SDoL CIP Year (all projects on a 10-year start to finish timeline)
McCaskey High School**	Complete/ Idea (P-053, P-199)	3,080,500	43%	Open Lawn/Field	MS4	East Side	Complete (2018)
Lincoln Middle School**		3,080,500	43%	Open Lawn/Field	MS4	East Side	2019
Scheffey Admin Building**	Idea (P-045)	3,080,500	43%	Open Lawn/Field	MS4	East Side	
Wickersham Elementary**		3,080,500	43%	Open Lawn/Field	MS4	East Side	Future - TBD
Hamilton Elementary		885,100	15%	Open Lawn/Field	MS4	Prospect Heights	Future - TBD
Hand Middle School*	Design/Idea (P-192, P-193), Candidate for Neighborhood-Scale GI	810,400	27%	Open Lawn/Field	MS4	Stevens	Complete (2017)
Washington Elementary*	Idea (P-054)	810,400	27%	Open Lawn/Field	MS4	Stevens	
Wheatland Middle School		703,000	unknown	Open Lawn/Field	MS4 (near Engleside)	n/a	Complete (2017)
Lafayette Elementary	Complete (P-023)	497,000	34%	Open Lawn/Field	MS4	Prospect Heights	
MLK Elementary	Idea (P-044), Candidate for Neighborhood-Scale GI	310,100	45%	Open Lawn/Field	Engleside / Susquehanna	Mussertown	Future - TBD
Burrowes Elementary		267,000	unknown	Open Lawn/Field	MS4	n/a	Future - TBD
Price Elementary	Candidate for Neighborhood-Scale GI	153,200	56%	Open Lawn/Field	Engleside	Prospect Heights	Future - TBD
Reynolds Middle School	Candidate for Neighborhood-Scale GI	143,000	76%	Paved Courts/Parking	Engleside	Chestnut Hill	Under Construction
Carter & McRae Elementary	Concept (P-030)	132,200	83%	Paved Courts/Parking	Engleside	South Side	Future - TBD
Fulton Elementary	Idea (P-043), Candidate for Neighborhood-Scale GI	93,600	87%	Paved Courts/Parking	Engleside	Central Business District	Complete (2017)
Buchanan Elementary		73,000	unknown	Paved Courts/Parking	MS4	n/a	Complete (2017)
Ross Elementary	Complete (P-024), potential for additional GI	72,200	80%	Urban (Constrained)	North	Ross	
Wharton Elementary	Complete (P-022), potential for additional GI	60,600	93%	Urban (Constrained)	North	Chestnut Hill	
Cyber Program		58,800	79%	Paved Courts/Parking	Susquehanna	Mussertown	
Buehrle Alternative		46,500	85%	Urban (Constrained)	North	Ross	

*Hand and Washington share same parcel (same area/IA data)

**Lincoln, McCaskey, Wickersham, and Scheffey Admin Building share same parcels (same area/IA data)

This page is intentionally left blank

Right of Way

Streets Strategy

Streets are one of the principal GI project implementation strategies for the City, as evidenced by historic implementation levels described in detail in Section 2. Streets offer a vast opportunity for GI projects, primarily because they make up the largest category of publicly owned impervious area and have potential to integrate stormwater management into planned transportation, mobility, accessibility and/or pedestrian improvements (Figures 6.7 and 6.8). Several city priorities shape the Streets Strategy: complete streets, active transportation (bike/pedestrian) improvements, one-to-two-way conversions, and planned reconstruction/repaving under the City's pavement management plan.

The priorities listed above all provide opportunities to integrate GI projects into the streetscape as "green streets". For example, as shown in Figure 6.7, North Mulberry Street, between West James Street and West Vine Street, is a recent successful GI project that integrated bike facilities while converting a one-way street into a two-way street, on a street listed on the City's PMP as needing repair. The Mulberry Street GI project manages approximately 167,000 SF (3.83 acres) of impervious area and is an example of a priority for the City in selecting GI projects – integrating multiple needs and benefits (pedestrian safety, stormwater management, traffic calming, bicycle infrastructure, improved aesthetics), leveraging grant funding, and achieving stormwater capture and pollutant reduction.

Figure 6.7 – North Mulberry Street Green Street Project

Complete Streets

In 2014, the City of Lancaster adopted a "complete streets" policy to recognize that city streets should be safe and convenient for people of all ages and abilities, including pedestrians, bicyclists, transit riders and drivers. In addition, the City has adopted two ordinances that implement this policy. The *Subdivision and Land Development Ordinance* (SALDO), amended in 2015, requires sidewalks along all public streets, the planting of street trees and grass strips between the curb and sidewalk, and installation of handicapped accessible ramps at all intersections. The *Streetscape Ordinance*, amended in 2017, establishes streetscape standards for sidewalks, curbs, sidewalk ramps, traffic calming measures, crosswalks, street furnishings and amenities for pedestrians and bicyclists, lighting and plantings, and delineates a Streetscape District within the pedestrian-oriented commercial core of the City. In addition to these two ordinances, the City issued *Streetscape Design Guidelines* for the entire city in 2004, with the document serving as a "complete streets" guide for public streets serving pedestrians and bicyclists as well as motor vehicles.

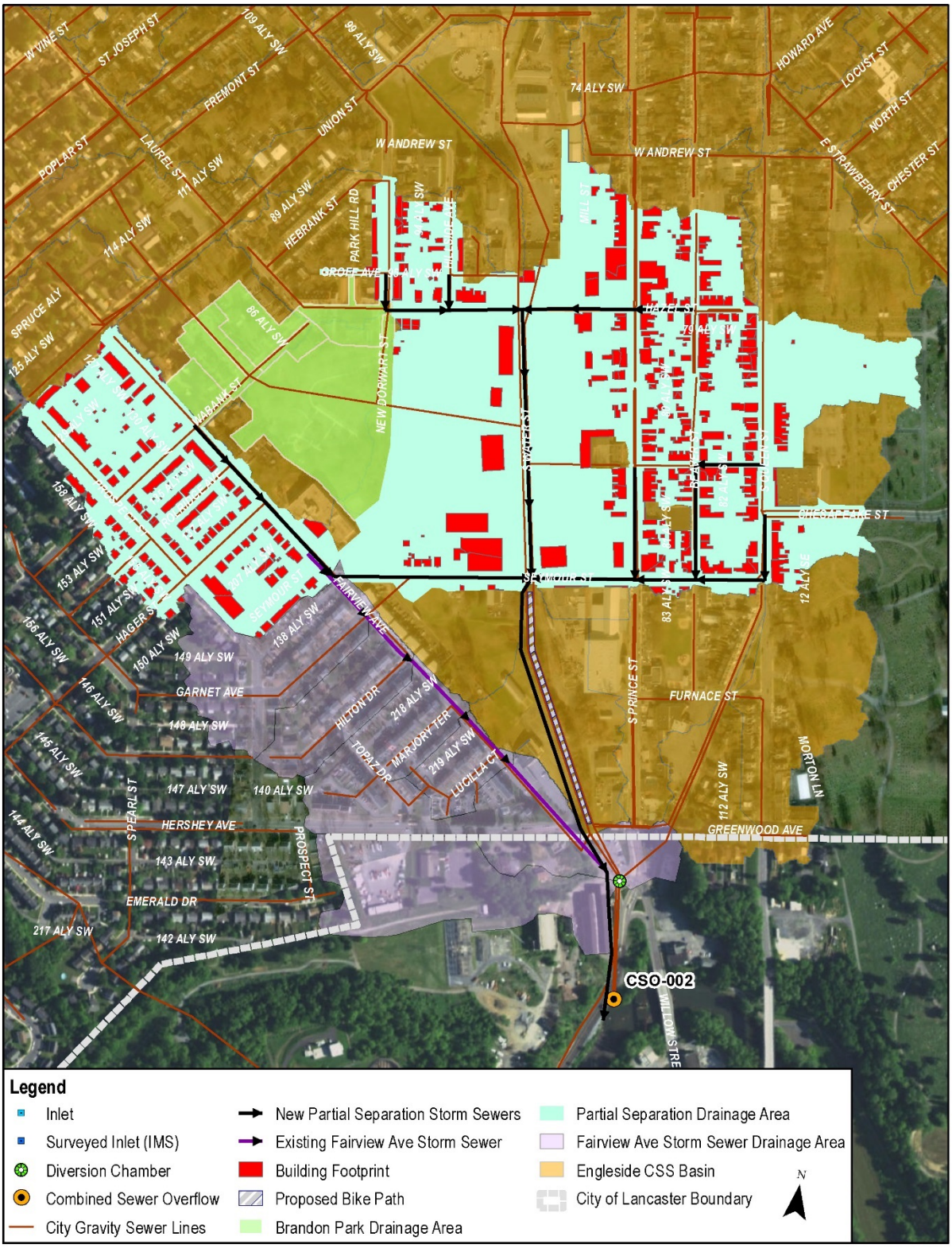


Figure 6.8 – Potential Concept for Fairview Ave Storm Sewer Separation (Source: Jacobs)
Potential separation could be coupled with bicycle and traffic improvements planned in this area

Active Transportation (Bike/Pedestrian) Plan

In 2017, the City collaborated with the County of Lancaster and the Lancaster Intermunicipal Committee to develop an Active Transportation Plan (ATP) intended to address opportunities and challenges of non-motorized transportation options. The vision statement exemplifies this present and ongoing collaboration by public and private entities across the City and County:

> "Lancaster is a vibrant, diverse, and active community where people of all ages and abilities can move safely and conveniently through an interconnected network of pedestrian, bicycle, and transit facilities that promote healthy living and economic vitality."

The City's portion of that plan focused primarily on bicycling with the intent to act as the guiding document for the development of a network of bicycle routes linking activity centers within the City, as well as to the larger regional network.

In recent years, many small and large cities across the country have seen a trend of certain segments of the population moving into the city for the amenities and convenience cities offer. Part of this trend is a reduction in driving and an increase in walking, bicycling and using public transportation. Bicycling as a transportation alternative and for recreational purposes has been increasing in the City and nationwide in recent years. With the increase in bicycling there is a greater need to reduce and eliminate bicycle-motor vehicle conflict. The ATP has identified methods for building a bike network through the use of different types of infrastructure to encourage more people to cycle and improve safety. On-street improvements include a variety of bicycle only lanes, as well as shared lane streets where bikes share the street with cars. There are also opportunities in the City for an off-street system of trails and paths. Providing a smooth transition for bicyclists between an off-street system and the street network, as well as between different modes is a vital component of any bicycle network.

Accessible and convenient bicycling infrastructure, from on-street pavement markings to bike share programs have been shown to enhance existing transportation choices, serve as a catalyst for economic development and redevelopment, and increase enthusiasm for bicycling. The ATP will serve as an important reference document ensuring that bicycle facilities are considered during road maintenance and reconstruction, as well as when important land use decisions are made.

Supplemental to the ATP is a Design Guide for the design and construction of all types of bicycling facilities. Included in the design guide is a recommendation to include stormwater management facilities where applicable. In addition, a GIS data layer was developed by the City to catalog the Plan's recommendations, including whether the street has an existing or proposed bike facility, and to show the type of bike facilities recommended. Concurrent to drafting the Active Transportation Plan, the City started allocating funds for the development of critical bike facilities as part of roadway projects. For example, two off-street trail segments are being designed to provide a north-south route through the City.

The vision and goals of the ATP set the stage for improving access & connectivity, promoting equity, enhancing health and economic vitality, protecting the environment, and increasing safety for current and future users.

One-Way to Two-Way Conversions

Currently, the City of Lancaster has multiple pairs of north/south and east/west one-way corridors, expediting traffic through the City but creating inefficient circulation patterns within the City. This network of one-way streets does not represent the historic traffic patterns; they were established following a study conducted in the 1970's to more rapidly move vehicles through the City. As part of the City's ongoing efforts to integrate green infrastructure and complete streets concepts into major capital projects, two streets in the northwest area have been converted from one-way to two-way traffic. In 2016, the northbound North Mulberry Street was converted to two-way traffic and in 2019, its southbound

counterpart North Charlotte Street was converted. These initial one-way to two-way conversion green street projects manage a total of 8 acres of impervious area, indicating that these types of projects manage adjacent runoff from driveways, sidewalks, alleys, parking lots, etc.

Table 6.3 shows several major streets that are potential candidates for conversion. Prior to any one-way to two-way conversion beyond the two completed, the City will undertake a more detailed feasibility analysis of these streets to further evaluate which ones can be realistically converted to two-way traffic. This evaluation would be undertaken as part of the Downtown Mobility Study recommendation in the Active Transportation Plan or a future City-wide comprehensive planning effort.

Table 6.3 - List of Major Streets with Potential for Conversion from One-Way to Two-Way

Street Name	From Street	To Street	Total Length (ft)
Church St	Queen	Shippen	1,648
E Orange St	Broad	Queen	5,200
W Orange St	Queen	Ruby	3,975
N Duke St	Liberty	King	5,217
S Duke St	King	Church	1,174
N Lime St	Liberty	King	5,214
S Lime St	King	Church	594
TOTAL			23,021 ft (4.36 mi)

2016 Pavement Management Plan (PMP)

In 2016, the City undertook a comprehensive pavement condition assessment of the City's roadways resulting in a scoring system for each segment (Pavement Condition Index, PCI) and developed a pavement information management system to assist in developing a long-term pavement rehabilitation program. Through this planning process, the City identified streets that are in need of full depth reconstruction due to low PCI scores. These streets are defined as "Backlog" streets (PCI of 25 or less) or "Borderline" streets (PCI between 26 and 35). The City has committed to prioritizing GI implementation on these streets, as budget and schedule permit, and has developed a street restoration schedule for 2019 and 2020. Table 6.4 summarizes the backlog and borderline street segments in the Engleside and North basins and Figure 6.9 shows the location of the streets across the City.

Table 6.4 - Summary of Street Length (Miles) of PMP 2016 Backlog and Borderline Streets in Engleside and North Basins with PCI scores below 35.

CSO Subbasin	Backlog (PCI < 25)	Borderline (PCI 26-35)	Total Length (mi)
Engleside	2.66	4.87	7.53
North	1.06	2.97	4.03
TOTAL	3.72	7.84	11.55

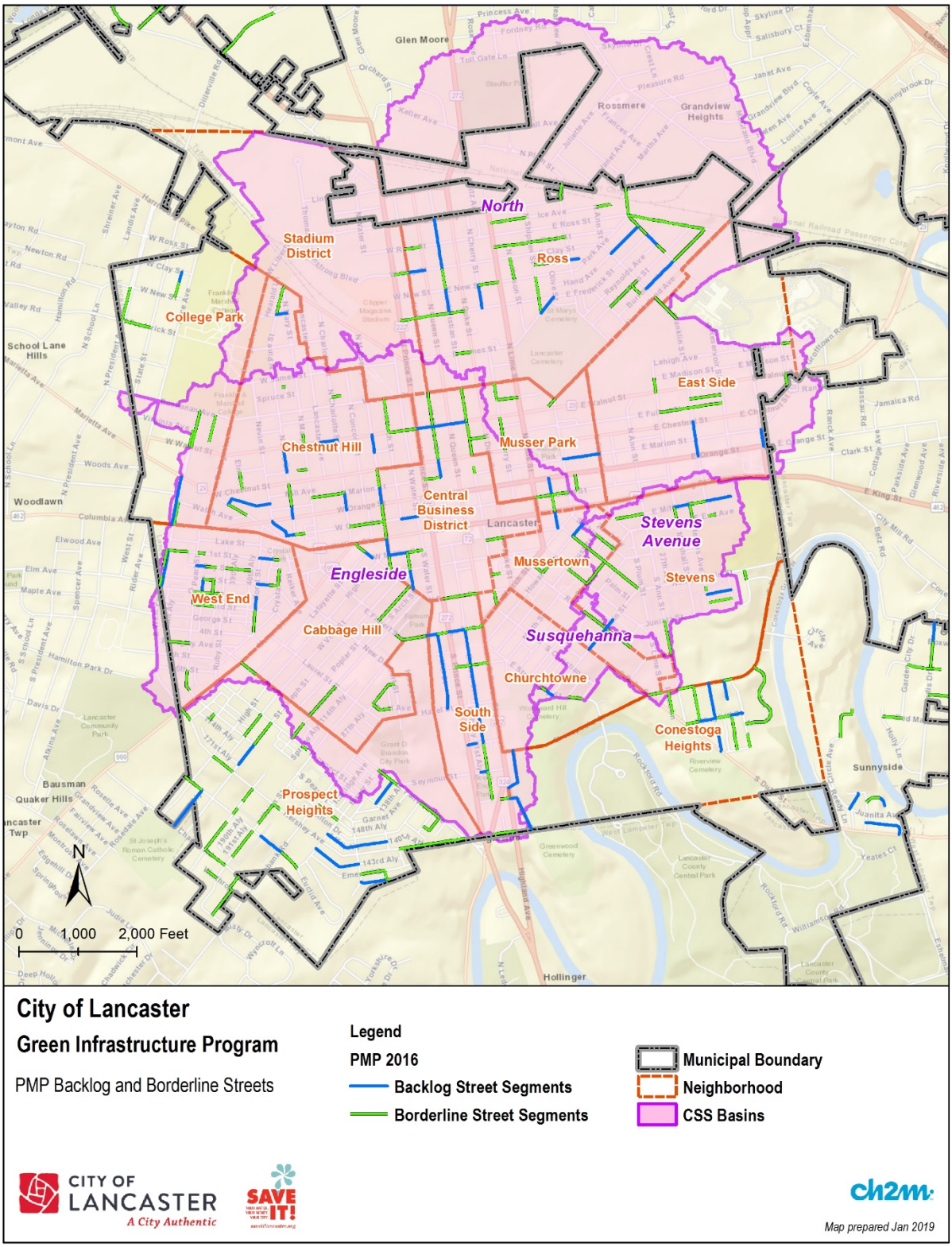


Figure 6.9 - PMP 2016 Backlog and Borderline Streets in the City (Data source: City)

Potential Green Street Project Opportunities from the 2019 and 2020 PMP

To develop a partial list of potential green street projects, an overlay and prioritization analysis was performed using the 2016 PMP list. All backlog and borderline streets scheduled for restoration in 2019 and 2020 (the end of the current PMP schedule) were filtered from the full list of PMP streets. Determining their potential for a GI project is a valuable exercise that may help the city's decision-making process. The analysis can be replicated and refined in the future to develop a list of streets with the most potential as green streets, in conjunction with the City's annual review of their PMP and street repaving program. The PMP is reviewed annually in coordination with utilities, PennDOT, and the City's budget.

Street segments planned for reconstruction in the PMP should be overlaid with other capital projects such as green infrastructure, bike facility recommendations and potential one-to-two-way conversion locations, as well as public and private utility work. Streets listed on the PMP that are recommended for other capital improvements should be prioritized over streets with no planned integrated capital projects. Table 6.5 provides a summary of the first-level results used to develop this PMP-based potential green street project list. Figure 6.10 provides a map of these PMP-based potential green street projects in North and Engleside basins.

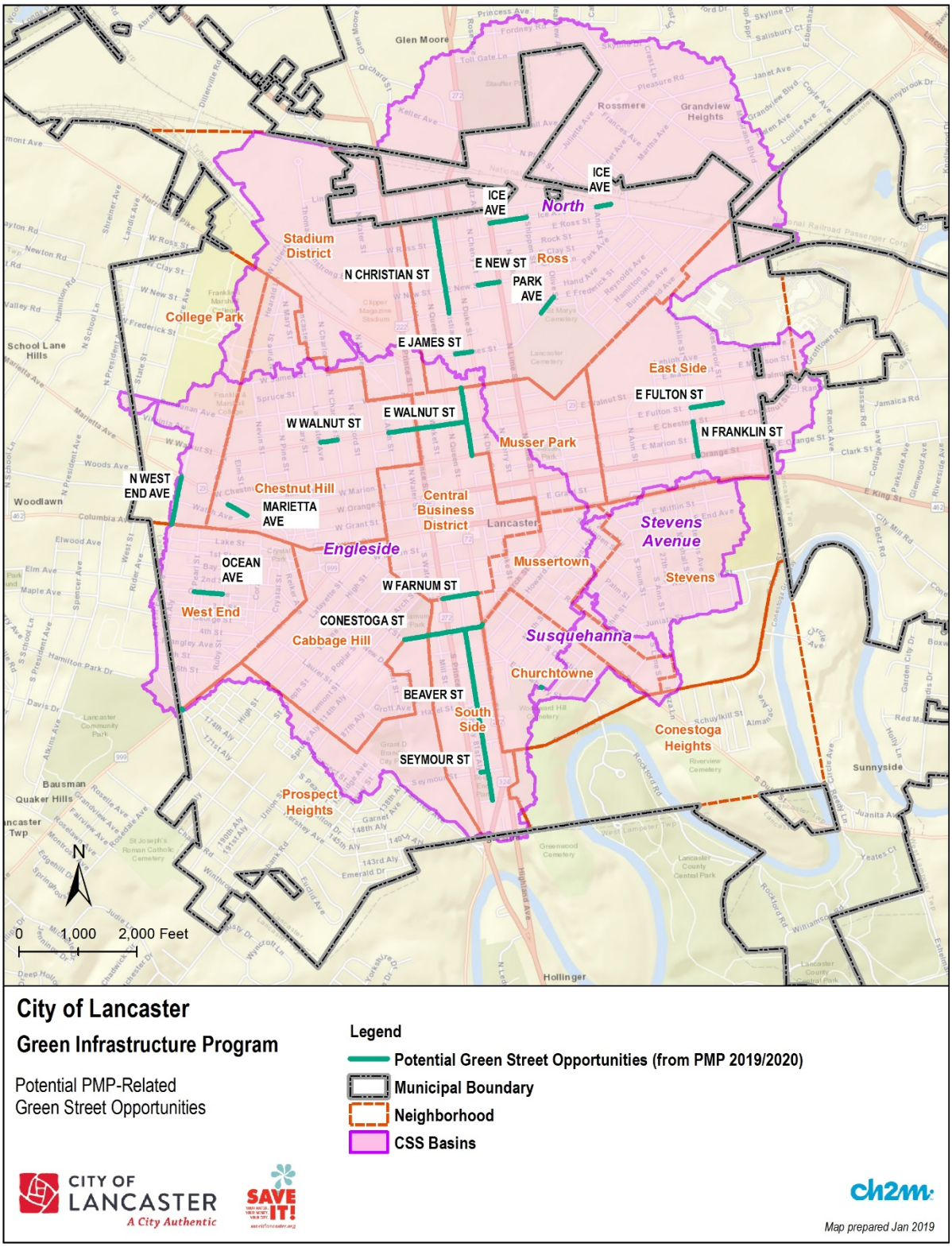


Figure 6.10 - Potential Green Street Projects from the 2019/ 2020 PMP in Engleside and North Basins (Source: Jacobs)

This page is intentionally left blank.

Table 6.5 - Potential Green Street Projects in Engleside and North Basins from 2019 and 2020 PMP

PREFIX	STREET NAME	FROM STREET	TO STREET	PCI Score	Year	CSO Basin	Neighborhood
	BEAVER ST	CONESTOGA ST	FURNACE ST	18 - 32	2019	Engleside	South Side
N	CHRISTIAN ST	E CHESTNUT ST	E LIBERTY ST	21 - 33	2019	Engleside	Central Business District
	CONESTOGA ST	S QUEEN ST	FILBERT ST	18 - 30	2019	Engleside	South Side
W	FARNUM ST	S Queen St	S PRINCE ST	27 - 32	2020	Engleside	Central Business District
N	FRANKLIN ST	E ORANGE ST	E CHESTNUT ST	22 - 25	2020	North	East Side
E	FULTON ST	N FRANKLIN ST	N RESERVOIR ST	27	2019	North	East Side
	HERSHEY AVE	Manor St	176 ALY	33	2019	Engleside	Prospect Heights & West End
	ICE AVE	N ANN ST	Dead end	31	2020	North	Ross
	ICE AVE	N LIME ST	N SHIPPEN ST	32	2020	North	Ross
E	JAMES ST	N CHRISTIAN ST	N DUKE ST	30	2020	North	Ross
	MARIETTA AVE	HAGER ALY	W MARION ST	32	2019	Engleside	Chestnut Hill
E	NEW ST	N CHERRY ST	N LIME ST	30	2020	North	Ross
	OCEAN AVE	RUBY ST	PEARL ST	28/29	2019	Engleside	West End
	PARK AVE	N SHIPPEN ST	E FREDERICK ST	24/25	2019	North	Ross
	SEYMOUR ST	BEAVER ST	81 ALY	23	2019	Engleside	South Side
E	STRAWBERRY ST	WOODWARD ST	WHITE OWL ALY	29	2020	Engleside	Churchtowne
W	WALNUT ST	N CHARLOTTE ST	LANCASTER AVE	25	2019	Engleside	Chestnut Hill
E & W	WALNUT ST	N CHRISTIAN ST	N WATER ST	20 -34	2019	Engleside	Chestnut Hill & CBD
N	WEST END AVE	Columbia Ave	MARIETTA AVE	17 - 25	2019	Engleside	College Park & West End

This page is intentionally left blank

Alley Strategy

Alleys are prime candidates for green infrastructure implementation due to their low-volumes of traffic and potential ability to manage runoff from immediate and adjacent impervious surfaces. To date, the City of Lancaster has implemented 14 green alley projects (many of which span multiple alley segments) and these projects manage on average 2.7 times the impervious area of the managed alley area. See Section 3 for a detailed breakdown of impervious area managed by Green Alley projects. As shown in Figure 6.11, Alley 8NW is an example of a green alley project that features porous pavement on top of a stone infiltration trench, capturing stormwater while improving alley aesthetics.

Figure 6.11 – Green Alley Project at Alley 8NW

The City has prioritized greening publicly owned alleys. The City's GIS data shows a total of 659 alley segments which consist of 147 public alley segments and 512 private alley segments. Of the 147 public alley segments, 15% are currently managed through 11 existing GI projects, with the remaining 85% as potential public green alleys. These should be further evaluated for feasibility of green infrastructure implementation based on objective criteria including ownership and alley length and width characteristics was performed. The best potential opportunities for public green alley projects are City-owned alleys with higher overflow reduction efficiencies (OREs) in the North and Engleside basins. Additional evaluation criteria should include neighborhood, drainage area potential, pavement condition, slope and the presence of utilities that would limit GI and increase costs. As funding becomes available, the City will use the above criteria in addition to other factors to prioritize a potential public alley GI project for implementation.

Urban Forest Strategy

The City of Lancaster recognizes the intrinsic value and ecosystem benefits that trees provide to its citizens. Trees help to remove pollutants from the air and water, capture stormwater, shade streets and residences, increase property values, provide wildlife habitat, facilitate social and educational opportunities, improve physical and mental wellbeing, and offer aesthetic value. These benefits are realized at many levels, from individual homes to entire neighborhoods to the City and beyond. Therefore, this Plan recommends making trees and their many benefits accessible to all Lancaster's residents, workers and visitors to enjoy. In addition, trees along the City's streets and in its parks and back yards are helping to reduce combined sewer overflows (CSOs), which has been a driving force in many advances in "green" and sustainable practices the City has made in recent years.

Planting and maintaining city trees is an important means of expanding this urban forest. Prior to the development of the 2011 GI Plan, improvements to the tree canopy and the City's urban forest were primarily aesthetic. Beginning concurrent with the 2011 GI Plan, the City undertook a tree inventory and canopy assessment as well as addressing other challenges that have contributed to stresses upon the City's urban forest. An accurate street tree inventory provides the foundation for which annual work plans and budgets are based. Knowledge of the community forest species composition, condition, and age helps to create a prioritized maintenance plan for annual tree pruning, removal, and planting.

An inventory of Lancaster's public street trees was conducted in 2011 and 2012 by the Pennsylvania State University School of Forest Resources and Millersville University. The purpose of the inventory was to assess the health and structure of street trees in the City; identify potentially hazardous trees; indicate trees that may require removal or are in need of maintenance, such as pruning; and identify possible tree

planting sites. Approximately 9,000 trees were inventoried, with an additional 1,200 potential planting sites identified. Although individual trees and some tree masses were identified, not all areas of the City were covered and gaps in the data are still being filled. These inventories should be maintained and updated on a regular basis, at intervals of between 5 and 10 years. Along with the inventories, specific recommendations should be made for planting, protecting and maintaining the City's urban forest.

In addition to the tree inventories, an Urban Tree Canopy (UTC) analysis was conducted in 2010 in collaboration with the PA Department of Conservation and Natural Resources Bureau of Forestry, Lancaster County, the University of Vermont, and the U.S. Department of Agricultural Northern Research Station. The UTC was based on land cover data derived from high-resolution aerial imagery and LiDAR (Light Detection and Ranging). The analysis showed that 1,299 acres of the City are covered by tree canopy, representing 28% of all land in the city. The UTC analysis included areas that could theoretically accommodate tree canopy: under-vegetated areas and unused or underutilized impervious areas**.**

The Canopy Analysis concluded that Lancaster's urban tree canopy is a vital city asset that reduces stormwater runoff, improves air quality, reduces the city's carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as habitat for wildlife. Although the assessment indicated that 45% of the land in Lancaster could theoretically support tree canopy, planting new trees on much of this land may not be socially desirable or financially feasible. Therefore, setting realistic goals requires a more detailed evaluation at the parcel level. The report recommended that the City focus on parcels that have large, contiguous impervious surfaces such as parking lots that contribute high amounts of stormwater runoff. Establishing tree canopy on these parcels will help reduce runoff.

A further conclusion was that the majority of the City's tree canopy is on private property furthering the importance of developing programs to educate residents and property owners on tree stewardship as well as providing incentives for tree planting. In addition, tree planting and preservation efforts need to be targeted in different parts of the city on both private and public land where the analysis identified opportunities. For example, the City's rights-of-way contain 24% of the existing tree canopy which has the potential to be increased by another 24%.

The data obtained through the inventories and canopy analysis was entered into the City's Geographic Information System (GIS) for analysis and management. GIS is a useful tool for organizing tree planting efforts in different neighborhoods and managing all the information in one place. With the assistance of professional staff and interns, the data is continually refined, analyzed and updated as needed. It is important that this practice continues as new data and methodologies come on line. Department of Public Works continues to fill data gaps through surveying targeted sections of the City and in-depth analysis using tools such as iTrees®.

In 2016, Pictometry International collected leaf-on aerial imagery that was processed by the Vermont Spatial Analysis Labs. That newer analysis showed that between 2010-2016 there was no net change in the UTC in the City. Although this doesn't sound positive, the trend that many communities in the US are experiencing is a loss of tree canopy.

Between 2010 and 2016, some areas in Lancaster experienced gains in tree canopy while other areas lost tree canopy. In 2015, nearly 200 ash trees were removed due to the invasion of the Emerald Ash Borer insect. Tree canopy loss from pests and construction is nearly instantaneous and dramatic. Although more trees are being planted each year, more formerly vacant land is being developed resulting in no net change. Tree canopy increases resulting from new plantings, as well as natural regeneration and growth, are slow processes that take time. Maintaining Lancaster's tree canopy in the future will require investments in efforts that preserve existing tree canopy in addition to new tree plantings.

The City is serious about growing and maintaining a healthy and verdant urban forest, it must invest in preserving existing wooded and natural areas, and planting trees along its streets, in parks, and in other public and private open spaces. The City must also focus tree planting and preservation efforts on planting trees in back yards, parking lots and other private property. Additionally, the City must also

continually refine, analyze and update the tree inventory and canopy analysis as new data and methodology comes on line.

Furthermore, to increase support for and understanding of the urban forest, the City must implement a coordinated and comprehensive outreach and education program that emphasizes neighborhood-based initiatives and solutions.

The results of strategies such as these can be seen in recently completed green streets projects such as the Mulberry Street and Charlotte Street Two-way Conversions. Between those two projects more than 200 street trees have been preserved or planted. Other projects that planted new trees and preserved existing trees include North Marshall Street, Walnut Street, Pine & Harrisburg and Crystal Park.

6.2 Private GI Strategies

The City recognizes that it cannot meet the stormwater reduction and clean water goals set forth in this Plan without the cooperation and collaboration of private property owners and City residents. Empowering and engaging property owners and residents in accepting and implementing GI on their properties is a key component of this GI Plan. The largest non-roadway category of impervious area is parking lots representing 27% of all IA. More than 50% of the building impervious area shown in Section 4 is residential buildings, which is nearly 20% of all the IA in the City, and the second largest non-roadway category. Rounding out the top three non-road IA categories are non-residential buildings. Although both buildings and parking lots could be owned by public entities such as federal, state and local governments and educational and faith-based institutions, only City of Lancaster facilities are considered public for the purposes of this Plan. The strategies discussed in this section apply to the remaining private buildings and parcels, including single and two-family dwellings, public and privately owned multi-family apartment buildings, commercial and industrial buildings, and surface parking lots.

Private Parking Lot Strategy

Parking lots are a significant source of the City's impervious area (27% of the total impervious area) and generate substantial amounts of stormwater runoff to the sewer system. The City has implemented green infrastructure in several publicly-owned surface lots and, as presented in Section 3, this project type category has managed 2.6 acres of impervious drainage area to date.

The City has also performed an analysis of privately-owned parking lots to assess their ability for future GI projects. To date, the City assisted 8 property owners in greening their parking lots, managing 4.5 acres of impervious drainage area.

A GIS and spreadsheet-based analysis was undertaken to further assess the distribution of privately-owned parking lots across North and Engleside basins. Small parking areas (less than 1,200 SF) were excluded from the analysis since GI for those would likely be less cost-effective and they are also exempt from the City's parking lot ordinance.

The GIS analysis examined surface parking lots based on size, grouping the lots into tiers as shown in Table 6.6. Results from this analysis show that approximately 10% of parcels with parking lots over 20,000 SF (0.46 acre) account for over 50% of the private parking lot impervious acreage. Figure 6.11 shows the location of these parcels in North and Engleside basins.

Figure 5.14 – Green Parking Lot at Community Mennonite Church

Table 6.6 – Parking Lot Area on Private Parcels in North and Engleside Basins

Tier / Parking Lot Area (SF)	Total Number of Parcels	Percent of Total Number of Parcels	Total Parking Lot Area, AC	Percent of Total Area
Tier 1: 1,200 - 5,000	500	53%	31	13%
Tier 2: 5,001 - 10,000	213	23%	35	15%
Tier 3: 10,000 - 20,000	121	13%	40	17%
Tier 4: 20,000 - 43,560	68	7%	44	19%
Tier 5: > 43,560	36	4%	81	35%
TOTAL	**938**	**100%**	**231**	**100%**

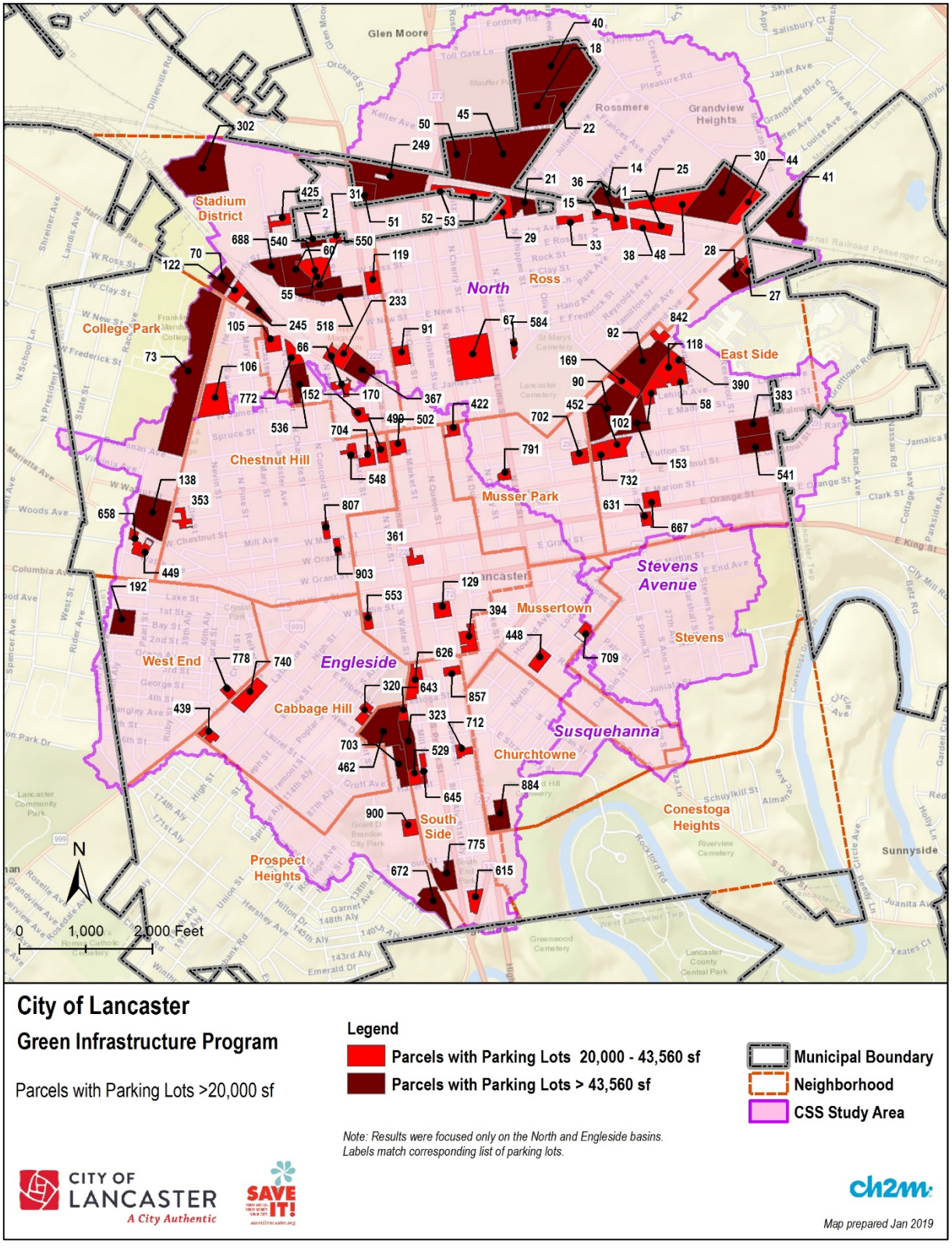


Figure 6.11 - Private Parking Lots with > 20,000 sf of Impervious Area (Source: Jacobs)

If greened and reconstructed to manage stormwater, these large parking lots would contribute significantly to meeting the stormwater reduction goals of this plan. However, large parking lots are seldom reconstructed, often requiring periodic minor repair and resurfacing to keep them well-maintained. Therefore, attention should be directed toward parking lots of all sizes. Many smaller surface parking lots do not meet the current minimum parking lot design and construction standards in the City Code of Ordinances. These non-conforming parking lots were previously "grandfathered" but are now required to be brought into compliance with the City's existing zoning regulations when slated for improvement as defined in City code.

In 2014, the City updated its parking lot standards, separate from its zoning ordinance, to require all new or reconstructed surface lots to manage runoff through a combination of GI techniques including porous paving materials, bioretention, trees and landscaping. To adequately address the run-off problems associated with these noncompliant parking lots, the City should increase its enforcement of current regulations. All unpaved parking lots should be identified and required to come into compliance. A more thorough analysis and evaluation of all surface parking lots should be completed.

In addition to requiring compliance with City regulations, programs should be developed for incentivizing private property owners to green their surface parking lots. This can be done through the provision of grants, credits and rebates. The City currently has a stormwater management fee credit program described in the next section. Furthermore, in collaboration with the Lancaster County Conservancy, a residential small grant program was created to assist homeowners in the installation of small stormwater projects. This program is described below.

Stormwater Management Fee, Credit, and Rebate Incentives

Following completion of the 2011 GI Plan, the City convened the Green Infrastructure Advisory Committee (GIAC) in 2012. The GIAC presented a report to the City on "Impervious Area Fee Policy Options and Recommendations," which summarized the City's stormwater program needs and policy options for funding those program needs. The primary recommendation was the creation of an impervious area (IA) based fee that would be paid by all City properties in direct proportion to the amount of impervious area that is on their property. This Stormwater Management Fee is the result of a review and analysis of the real costs associated with the management and maintenance of the City's stormwater management system.

The City utilizes a tiered approach that is based on the amount of impervious area, grouping properties within a range of IA based on the average for the first 3 tiers and for parcels over 3,000 square feet, an actual calculation is made from the impervious area. Using a rate structure based on these four tiers was preferred over using actual IA or lumping all properties by type because it represents the most reasonable and equitable method.

The Stormwater Management Fee is based on a percentage of the Base Rate, which is currently $59.00 per 1000 square feet of impervious area. As noted, Tiers 1 – 3 are a flat rate percentage of the base rate – Tier 1 is 50%, Tier 2 is 150% and Tier 3 is 250%.

In addition to the SWMF, the GIAC recommended that the City establish a system of credits to incentivize property owners to build and maintain stormwater management systems on their property. The credits are available to all properties with stormwater BMPs constructed after 2006 and not constructed to meet the minimum stormwater ordinance requirements.

The credit amount that a property can receive varies based on the specific qualifying conditions that significantly mitigate the effects of increased stormwater runoff and pollution from a property. The criteria for determining the credit level is based on the type of facility and percent of IA treated. The maximum credit available to a property 50%.

A property owner using City grants to help pay for GI improvements is eligible to receive credits, which are valid for a maximum of two (2) years. In addition to stormwater BMP credits, Education Credits are available to all public and private schools that implement a program that educates and informs students

on the importance of preserving and restoring the source and integrity of water resources (stormwater, ground water and/or surface waters).

Improved data management of all projects that install BMPs will help staff in the review of SWMF credits applications and expand the scope of our understanding of the full impact this GI program is having toward the elimination of CSOs.

Residential Grants

In collaboration with the Lancaster County Conservancy, the City developed a residential small grant program intended to stimulate small scale green infrastructure projects on private properties. Lancaster City residential property owners or contractors working with City residential property owners are eligible for funding paid directly to contractors once project is approved by City staff.

Eligible projects include rain gardens, permeable pavers, and dry wells not otherwise part of a permit or ordinance requirement.

The current grant request cannot exceed $2,500, with a minimum of $500 and a match of 50% of the project cost. The match can consist of cash or in-kind design or labor services approved by the City.

Ordinance Administration and Enforcement

The City has been following two approaches to institutionalize stormwater management using green infrastructure. The SWMF Credit and Residential Grants described in the previous sections are examples of incentives. The amendment of regulations described in Chapter 2 shows how the City is working to mandate the installation of green infrastructure and other stormwater management practices during construction and reconstruction.

The ordinances discussed in Chapter 2 are administered by the Department of Economic Development and Neighborhood Revitalization (Zoning, SALDO, Property Maintenance) and the Department of Public Works (Stormwater Management, Parking Lots, Sewers, Streets and Sidewalks). For these regulations to be administered equitably and effectively, open communication and collaboration must be maintained between City departments.

The City of Lancaster has the responsibility to protect the public health, safety, and general welfare through the provision of construction, property maintenance and fire codes. In Pennsylvania, the power to regulate construction and property maintenance lies exclusively with local governments. These powers are granted to the City through the authority of the Act of November 24, 2015 P.L.242, No.67, the Third Class City Code (11 Pa.C.S. § 101), as amended; the Optional Third Class City Charter Law Act of Jul. 15, 1957, P.L. 901, No. 399, as amended; and the Act of July 31, 1968, P.L. 805, No. 247, The Pennsylvania Municipalities Planning Code (MPC), as amended.

Any person violating any of the provisions of any City code or ordinance or failing to comply with an order from any City Board or Commission will be subject to penalties set forth in the code being violated. Penalties imposed for noncompliance of City regulations currently include fines, permit denial, revocation of an issued permit, and stop work orders.

As noted, codes are administered and enforced by City staff in multiple departments and bureaus. As codes are updated and the provisions for violations and penalties are reviewed and amended for consistency and applicability, the enforcement capacity of staff should be evaluated. Continued interdepartmental cooperation should be maintained to administer City codes and regulations most effectively and efficiently.

6.3 Inflow Removal

Over time, the City has identified several sources of groundwater or separated storm inflow to the combined system (Table 6.7 and Figure 6.12). Known sources of significant groundwater inflow to the combined sewer system total 0.115 million (115,000) gallons per day (MGD). The City tries to work

with property owners to find ways to remove inflow from the system. For example, Amtrak removed a significant portion of their groundwater inflow by installing a groundwater injection well in 2016 and monitoring showed that over 21 million gallons was injected in the first 13.5 months of operation (with an estimated annual removal of 18.67 MG/yr). In addition, the City has developed a concept for removing the flow from McCaskey High School and has applied for a grant to implement that project.

Table 6.7 - Identified Sources of Groundwater Inflow

Groundwater Infiltration Source	Estimated Flow (MGD)[1]
Amtrak (remaining inflow after 2016 project)	0.0432
JP McCaskey	0.0216
ACM	0.0076
EDC Finance	0.0205
Convention Center	0.0102
Hamilton Clock Tower Apartments	0.0123

[1] Estimated flows based on evaluations from City data including monitoring data, Chapter 94 reports, field observations, etc.

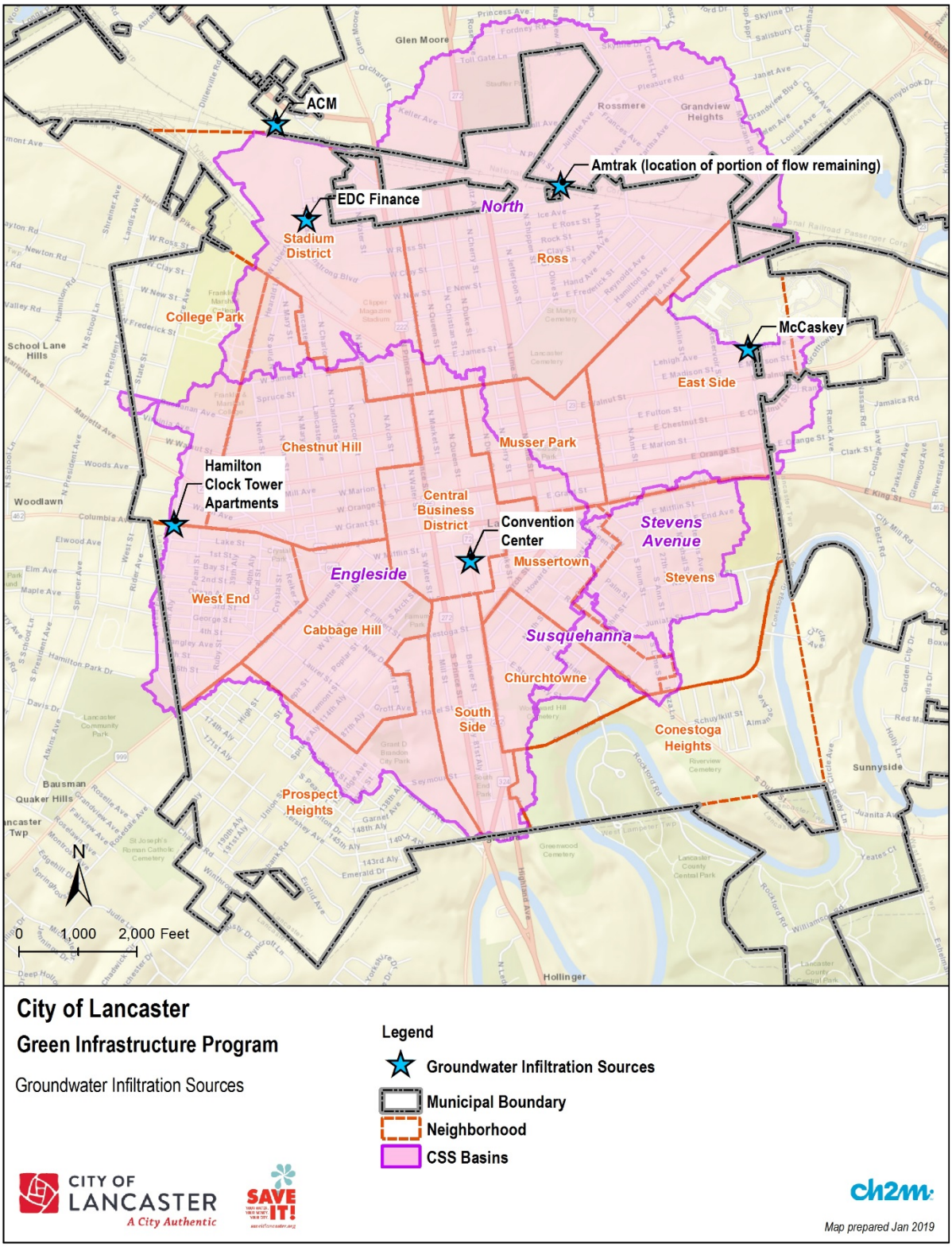


Figure 6.12 - Locations of Identified Groundwater Infiltration Sources (Source: Jacobs)

This page is intentionally left blank.

7. Recommendations for Ongoing GI Implementation

Lancaster is performing an Alternatives Evaluation and developing a Long-Term Control Plan for Combined Sewer Overflows (CSOs) as part of its consent decree with the U.S. Department of Justice. The following section provides a conceptual overview of green infrastructure benefits for potential use in the Alternative Analysis phase of the long-term control plan development.

7.1 Analysis of Benefits

Basis of Cost Estimating

Representative unit costs from projects already bid and/or constructed were used to predict costs for the continuation of the program. A summary of these costs by project type (escalated to 2018 dollars) is included in Table 7.1. Green parks and green streets have the lowest unit costs on average, likely due to some economy of scale (larger projects on average) and being integrated with other enhancements (e.g., park renovations and traffic improvements). The parking lot projects were more expensive on average than other ground-based GI project types because they involved extensive parking lot improvements as part of the GI projects. Green roofs tend to be the most expensive on a per acre basis because they typically only manage the rainfall that directly falls on the roof.

Table 7.1 - Summary of Costs by Project Type

GI Project Type	# of Projects Included in Cost Analysis	Total Impervious Area Managed (ac)	Total Construction Cost*	Cost / Impervious Acre ($/ac)*
Green Park	4	7.2	$1,522,000	$211,000
Private (Pennvest Program)	8	3.6	$892,000	$250,000
Green Alley	12	3.8	$1,047,000	$274,000
Green Street	24	30.5	$6,619,000	$217,000
Parking Lot	4	2.1	$785,000	$376,000
Green Roof	5	0.4	$760,000	$1,799,000
TOTAL	**57**	**47.6**	**$11,625,000**	
AVERAGE				**$230,000**

*2018 dollars, total cost/acre calculated for ground-based projects (excluding green roofs)

Implementation Levels

Public

In many ways, the City has made implementing green infrastructure (GI) a core part of its Public Works activities as roads, alleys, parks, and other public infrastructure are restored and improved. The City currently has budgeted $1.2 million per year for green infrastructure focused in the North and Engleside basins, with additional public implementation throughout the City supported by grants and other partnerships. Additional public GI implementation is also being investigated as part of the City's CSO Long-Term Control Plan Alternatives Evaluation process.

Private

In addition to City-led GI, implementation of stormwater controls on private property will continue as redevelopment occurs through the City and property owners retrofit sites to reduce their stormwater fees and comply with current and future City ordinances.

Runoff Reduction and Capture

As part of the City's 2011 Green Infrastructure Plan, an analysis of long-term daily precipitation data was performed to develop a relationship between the capture depth provided by GI and the percent of total precipitation captured. For example, capturing 1 inch from all storms in the 1926 to 2000 record would result in the overall capture of approximately 86.4% of the total precipitation (Figure 7.1). The other 14% would be expected to overflow or bypass a system sized to store 1 inch, during storms greater than that. As shown on Figure 7.1, this relationship is closely represented (R^2 of 0.9993) by a regression equation which can be used to estimate the percent of total precipitation captured for any capture depth up to 2 inches:

Fraction of Total Precipitation = -0.195depth^4 + 1.0588depth^3 - 2.1835depth^2 + 2.1692depth + 0.0106.

This analysis both supports the calculation methodology for estimating the benefit of GI and informs the City's GI sizing goals (for example, the City has typically targeted 1 to 1.25 inches of storage capacity for GI since the incremental annual capture tails off after approximately an inch).

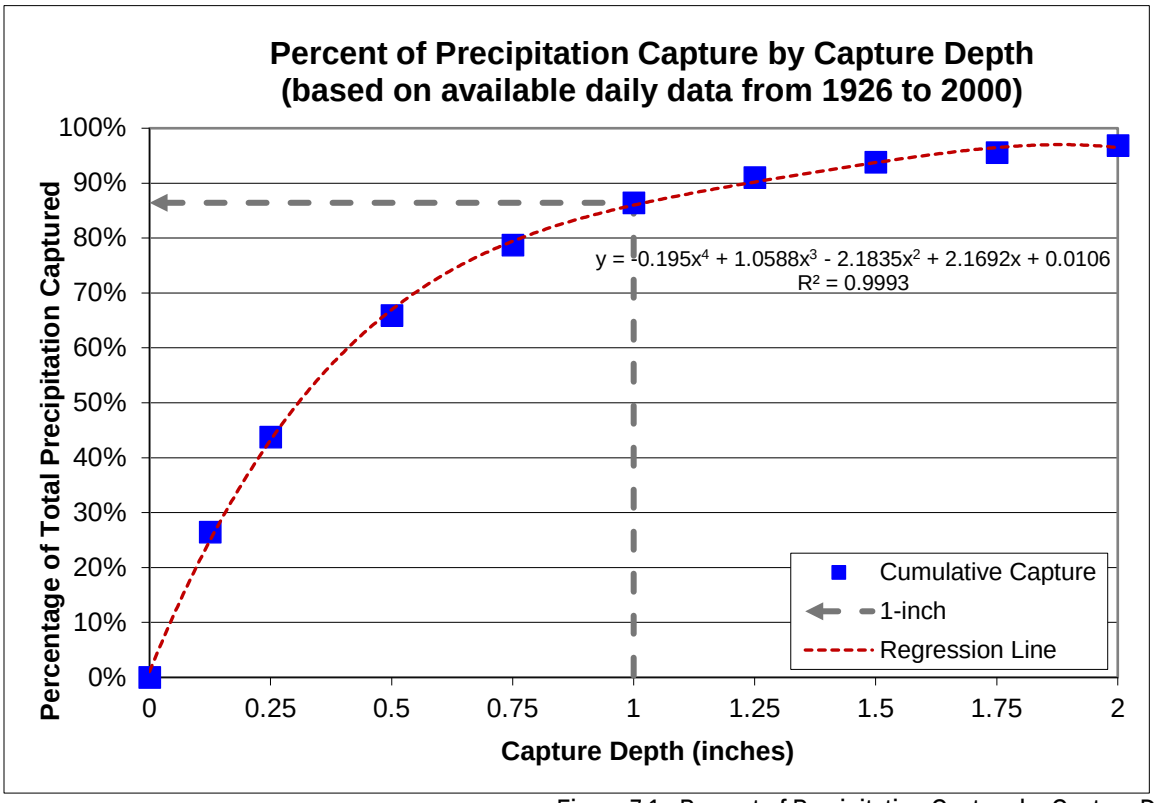


Figure 7.1 - Percent of Precipitation Capture by Capture Depth

The methodology for estimating runoff capture is also consistent with the 2011 GI Plan. In summary, the average annual stormwater runoff associated with an impervious area is the area multiplied by the average precipitation (42.04 inches or 3.503 feet), multiplied by an average long-term runoff coefficient for impervious surfaces (assumed to be 85% for typical impervious areas based on hydrologic modeling). For example, 1 acre of impervious area would be estimated to generate an annual runoff volume of: *129,702 cubic feet = 43,560 SF/acre * 3.503 feet precipitation * 85% runoff coefficient.* This is equal to 970,236 gallons annually (1 cubic foot = 7.4805 gallons). As discussed in the previous paragraph, GI

sized to capture 1 inch of runoff from that impervious acre would be estimated to capture an average of 86.4% of that runoff or 838,284 gallons per year (970,236 * 86.4%).

Combined Sewer Overflow Reduction Efficiency (ORE)

The use of CSO reduction efficiency estimates for each CSO subarea provides an efficient approach for estimating CSO reductions occurring from runoff reducing GI measures. CSO reduction associated with green infrastructure has been analyzed using the City's EPA-approved, calibrated hydrologic and hydraulic model of the sanitary and combined sewer system (see *City of Lancaster Hydrologic & Hydraulic Model 2016 Calibration & Validation Report* [January 27, 2017] for a detailed description of the City's model). Using EPA's Storm Water Management Model (SWMM) engine, green infrastructure in the combined sewer system (CSS) was simulated using the Low Impact Development (LID) Module and the resulting CSO reduction was tabulated. Green infrastructure managing 20% of the existing impervious area was added to the model sub-areas representing the CSS. For this specific analysis, GI was added only to one sub-area at a time so that the impact of GI in that specific area could be analyzed. The stormwater runoff reduction from the GI in the model was then compared to the resulting combined sewer overflow reduction to develop an overflow reduction efficiency:

overflow reduction efficiency (ORE) = overflow reduction ÷ runoff reduction

The ORE quantifies the relative overflow reduction benefit of GI in a specific location which is heavily influenced by the existing collection and conveyance system. An ORE of 75% indicates that if 100,000 gallons of stormwater is captured, CSOs would be reduced 75,000 gallons as a result (75% of 100,000). Therefore, the estimated CSO reduction for GI can be calculated by multiplying the runoff capture volume by the ORE for that area. Using the previous example of GI capturing an inch from an impervious acre in the Engleside Basin (with an average ORE of 82%), the 838,284 gal/yr of runoff capture would result in an estimated CSO reduction of 687,393 gal/yr (82% of 838,284).

In the City of Lancaster:

- An average of 1.14 million gallons of precipitation falls on an acre of land each year
- A typical impervious acre produces an estimated 970,000 gallons of runoff per year
- Managing 1 inch of runoff from an impervious acre yields approximately 838,000 gallons of captured runoff per year
  - In Engleside Basin, this reduces CSOs by an estimated 687,000 gallons/year

The OREs for the subareas within the North and Engleside CSO basins were generally consistent and relatively high. The one exception was the subarea in North that includes a large stormwater basin on the former Armstrong site which dampens the overflow reduction benefit of green infrastructure in that subarea. The Stevens Avenue and Susquehanna basins had low OREs as expected given their relatively high level of existing CSO control. The average (area weighted) OREs for the four CSO basins is shown in Table 7.2.

Table 7.2 – Average Overflow Reduction Efficiency per Basin

Basin	Average Overflow Reduction Efficiency (%)
North*	83%
Engleside	82%
Stevens Avenue	28%
Susquehanna	28%

*Not including the sub-area that includes the large stormwater basin on the former Armstrong site

Green Infrastructure Conceptual Build-Out Matrix

The GI Build-out Matrix provides a conceptual overview of how various GI project types can be implemented over time to reduce runoff to the combined sewer system and reduce overflows. The analysis combines the runoff capture, CSO reduction, and cost information with results of the GIS analyses to approximate what might be achieved by the City over the 20-year Consent Decree duration. For example, using the current City budget of $1.2M/yr split between the North and Engleside basins, a sample mix of green alleys, streets, parks, and schools could potentially reduce CSOs by a combined total of approximately 79 million gallons (MG) per year in the North and Engleside basins (Tables 7.3 and 7.4). This planning approach can be scaled to estimate CSO reductions from GI over a range of implementation levels and across a full range of CSO capture objectives (frequency and volume) for use in the Alternatives Analysis should GI be considered by the City as part of its long-term control plan alternatives.

Table 7.3 – Example Public GI Project Type (Strategy) Matrix for North Basin for 2019-2039
Note that this strategy matrix is based on conceptual GI opportunities which would require further study and engineering analysis to determine project feasibility

Implementation Mechanism / Project Type	Impervious Area, IA (ac)	Impervious Drainage Area (ac)	Example # of Typical-Sized Projects	Est. Additional Area Captured (ac)	Est. Construction Cost Per Acre Managed ($/ac)[a]	Est. Construction Cost ($M)[a]	Estimated Annual Stormwater Capture (MG)	Est. Annual CSO Reduction (MG)
Green Alleys - Public[b]	2.5	6.7	10	3.2	$274,000	$0.87	2.8	2.3
Green Streets[c]	107	202	31	39.8	$217,000	$8.63	34.8	28.8
Parks[d]	11.8	36.4	5	9.0	$211,000	$1.90	7.9	6.5
Schools[e]	6.1	18.9	2	2.8	$211,000	$0.60	2.5	2.1
TOTAL	**127**	**264**	**48**	**54.8**	**$219,000**	**$12.0**	**48.0**	**39.6**
Subtotal per year[f]				***2.7***		***$0.60***	***2.4***	***2.0***

Table 7.4 – Example Public GI Project Type (Strategy) Matrix for Engleside Basin for 2019-2039
Note that this strategy matrix is based on conceptual GI opportunities which would require further study and engineering analysis to determine project feasibility

Implementation Mechanism / Project Type	Impervious Area, IA (ac)	Impervious Drainage Area (ac)	Example # of Typical-Sized Projects	Est. Additional Area Captured (ac)	Est. Construction Cost Per Acre Managed ($/ac)[a]	Est. Construction Cost ($M)[a]	Estimated Annual Stormwater Capture (MG)	Est. Annual CSO Reduction (MG)
Green Alleys - Public[b]	5.1	13.8	15	4.8	$274,000	$1.31	4.2	3.4
Green Streets[c]	149	283	31	39.4	$217,000	$8.55	34.5	28.3
Parks[d]	4.9	15.0	3	5.4	$211,000	$1.14	4.7	3.9
Schools[e]	10.9	33.4	3	4.8	$211,000	$1.01	4.2	3.4
TOTAL	**170**	**345**	**52**	**54.3**	**$221,000**	**$12.00**	**47.6**	**39.0**
Subtotal per year[f]				***2.7***		***$0.60***	***2.4***	***1.9***

[a] Costs in 2018 dollars based on average program costs to date by project type
[b] Green alleys have managed 0.32 acres on average, including 2.7 times the impervious area of the alley itself
[c] Green streets have managed 1.29 acres on average, including 1.9 times the impervious area of the street itself
[d] Park projects have averaged 1.8 acres, including 3.1 times the impervious area in the park itself
[e] Assume schools can manage 3.1 times their site impervious area similar to parks
[f] Implementation rates calibrated to City's total GI budget of $1.2M/yr, split evenly between North and Engleside basins

This page is intentionally left blank

Evaluation of the Co-Benefits of GI

Green infrastructure can provide a wide array of co-benefits (also known as triple bottom line benefits) related to reduced wastewater pumping and treatment costs, energy savings for heating and cooling, air quality improvements, and reduced carbon dioxide emissions. In 2014, these co-benefits related to the City's 2011 GI Plan were estimated in *The Economic Benefits of Green Infrastructure: A Case Study of Lancaster, PA* (EPA Report 800-R-14-007) and are summarized in Table 7.5. The total annual co-benefits per acre managed were estimated to be $4,082 in 2014 ($4,655 in 2018 dollars). For the 44.4 acres managed by the City to date, this represents co-benefits of nearly $207,000 per year. It should be noted that while the reduced wastewater treatment costs of $780/ac/yr ($889 in 2018 dollars) accrue directly to the City, most of the other benefits accrue to the community as a whole. Other potential co-benefits of GI such as reduced crime, improved quality of life, and higher property values have also been reported in the literature and are important to the City but are more difficult to monetize. For example, Kondo et al. (2015) found in Philadelphia that arrests for possession of narcotics were between 18% and 27% lower near GI sites than at matched control sites. Figure 7.2 displays an array of potential benefits of GI and as part of its GI program, the City will continue to evaluate ways to track and quantify the co-benefits of GI in the City.

Table 7.5 - Estimated Annual Co-Benefits of GI Per Acre in Lancaster

Related Co-Benefit	Per Acre Benefit (2014 dollars)*	Per Acre Benefit (2018 dollars)**
Total Energy Cost Savings ($/ac)	$1,872	$2,135
Total Value of Air Quality Benefits ($/ac)	$809	$922
Total Value of Reduced CO_2 ($/ac)	$621	$709
Annual Pumping/Treatment Cost Savings ($/ac)	**$780**	**$889**
Total Co-Benefits in CSS ($/acre managed)	**$4,082**	**$4,655**

*Unitized to per acre benefits from the total benefits in *The Economic Benefits of Green Infrastructure: A Case Study of Lancaster, PA* (EPA Report 800-R-14-007), assumed to be in 2014 dollars (ENRCCI = 9806)

** Using 20-City Engineering News Record Construction Cost Index (ENRCCI) of 11183 for September 2018

Figure 7.2 - Environmental, Social, Economic, and Public Health Benefits of Green Infrastructure (Source: EPA, 2017)

7.2 Green Infrastructure Project Prioritization Methodology

As Lancaster's GI program has evolved, the City has found that most green infrastructure projects are prioritized and implemented opportunistically, rather than as part of a formal prioritization process. The City prioritizes largely based on funding availability, integration with other infrastructure improvements (e.g., street work, park renovations, water and sewer replacements, facility expansions), and coordination with other planning efforts (Active Transportation Plan, Building on Strength, etc.). The City also considers factors such as distributing projects in different neighborhoods and prioritizing locations where GI can help to address multiple needs (poor pavement condition, traffic safety concerns, lack of green space, etc.).

Potential project ideas and concepts are continually being developed through coordinated efforts by the City to integrate GI implementation with City capital improvement planning (CIP) and budgeting, and through efforts to identify new and existing funding sources which may be applied to GI projects. The City has also leveraged partnerships with other public entities such as the School District of Lancaster (SDoL), PennDOT, and various non-profit organizations to identify project and funding opportunities, as well as to integrate GI with partner led initiatives.

While GI projects have been implemented throughout the City, project prioritization is now focused on implementing GI projects in the North and Engleside basins of the combined sewer system (CSS) since the other two CSS basins (Susquehanna and Stevens Avenue) are small with high levels of existing wet weather control in comparison to North and Engleside. Areas of the City that have separate storm sewers are covered under the City's Municipal Separate Storm Sewer System (MS4) permit with the PA Department of Environmental Protection and are implemented as part of the City's Pollutant Reduction Plan (PRP).

As described in Section 6, the City has performed planning level analyses on parks, schools, streets, alleys, and parking lots to identify potential opportunity areas that may be targeted for GI implementation efforts. Ultimately, implementation of a project will be prioritized depending on the technical feasibility and impact of the project and the mechanism by which the project can be realized. For example, potential green alley projects may be evaluated and prioritized as part of grant applications, or potential green park projects may be prioritized because of the ability to integrate GI with another funded capital improvement project. Although there is overlap, different GI project types or strategies often lend themselves to specific implementation mechanisms, and therefore, prioritization considerations may vary as described below. For all potential GI projects, the City considers the project's location both in regard to its neighborhood and the CSO Basin and associated Overflow Reduction Efficiency (ORE).

Additional GI Strategy Prioritization Considerations by Project Type

Green Parks & Green Schools:

- Evaluation and prioritization criteria include park and school area and typology, percent impervious cover and availability of open green space, and potential impervious area capture.
- Priority is placed on parks and schools that have the potential to manage runoff as part of an area-wide stormwater disconnection project (those projects that can manage significant runoff from areas outside the site itself, for example from adjacent streets).
- Opportunities for GI implementation are prioritized when they can be integrated with facility upgrades/renovations or infrastructure reconstruction as part of the City's or SDoL's CIP.
- Interest from school stakeholders, community groups, etc. is also factored into potential park and school projects.

Green Streets:

- Opportunities for Green Street implementation are prioritized when they can be integrated with other City initiatives, such as:
  - Complete Streets implementation and pedestrian/bike planning,
  - One-way to two-way street conversions to enhance traffic safety and flow,
  - Planned reconstruction and repaving under the City's pavement management plan, and
  - Integration with other infrastructure upgrades and reconstruction.

Green Alleys:

- Evaluation and prioritization criteria include drainage area potential, physical constraints such as alley width and slope, pavement condition, potential for utility conflicts, and ownership classification.
- GI implementation opportunities are prioritized in public alleys where other capital improvements are being proposed or where funding can be supplemented by grants received through Lancaster County Conservation District's Low Volume Road Program.

Green Parking Lots (Private):

- The City has developed a list of potential private properties to target for a GI parking lot retrofit program. Prioritization of these retrofit opportunities will be largely influenced by property owner cooperation and interest, the potential for future site development or the need for parking lot modifications, pavement condition and the need for pavement repair or replacement, and enforcement of the City's existing parking lot ordinance.

7.2 Green Infrastructure Potential Project Lists

The City's goal is to implement green infrastructure projects to maximize economic, public and environmental health, and social/community benefits for residents and businesses while achieving regulatory compliance related to stormwater, wastewater, and CSO discharges. Based on various planning analyses and project finding tools for the GI strategies described throughout this plan, the City has identified a variety of potential project opportunities (Figure 7.3 and Tables 7.6 and 7.7) throughout the City which are tracked according to their current planning stage (e.g., idea, concept, design). Some of these project opportunities have already moved out of the planning stage and are under design, while most are project ideas or concepts that have been documented for potential future implementation. A detailed potential project list is provided in Appendix A along with concept plans for a selection of projects.

Table 7.6 - Summary of Potential Project Opportunities by Planning Stage

GI Project Opportunity Status	Number of Potential Projects
Concept	18
Design	7
Idea	45
Potential	257
Total	**327**

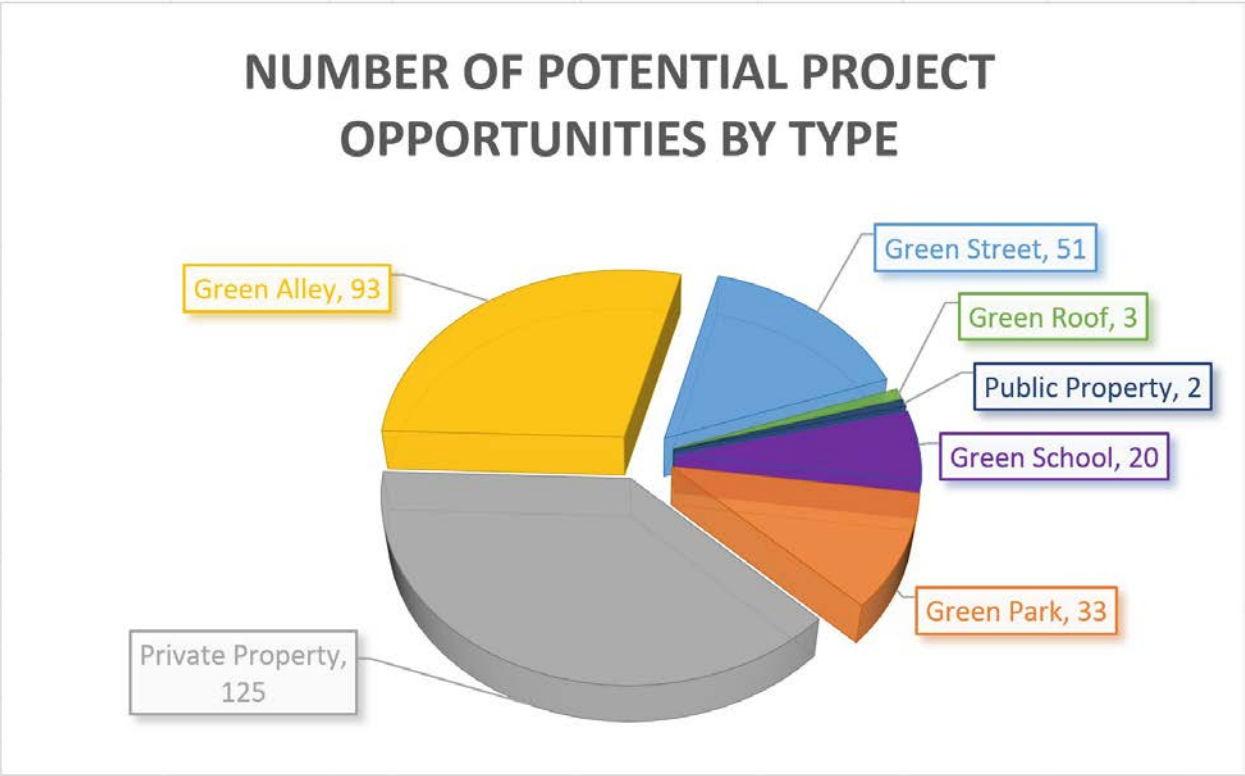


Figure 7.3 - Summary of Potential Project Opportunities by Type

Table 7.7 - Summary of Potential Project Opportunities by Type

GI Potential Project Type	Number of Potential Projects
Green School	20
Green Park	33
Private Property	125
Green Alley	93
Green Street	51
Green Roof	3
Other Public Property	2
TOTAL	327

The City's Project Opportunity List is continually evolving and being updated as current project ideas and concepts are advanced and new potential projects and ideas are added to the list. New ideas and concepts are identified through the city's efforts to incorporate green infrastructure into both city and partner CIPs and planning efforts, as well as through city-wide planning analyses as described in Section 6, which help to target specific opportunity areas where future GI can be strategically implemented.

7.3 Summary of Plan Recommendations

1. Continue implementing green infrastructure projects in the right-of-way and on publicly-owned parcels by focusing on the project types (strategies) outlined in this Plan (Green Parks, Green Schools, Green Streets, Green Alleys, Inflow Removal).
2. Evaluate and prioritize projects per the Prioritization Considerations outlined in this Plan, such as potential impervious area capture, location, potential to address multiple needs and integrate with other infrastructure improvements, interest levels from stakeholders and community groups, and availability of funding.
3. Continue to evaluate ways to track, quantify, and communicate the co-benefits of GI in the City.
4. Evaluate private property incentive programs to encourage GI implementation outside of publicly-owned parcels, particularly for parking lots, but also for other privately-owned properties (e.g., residential downspout disconnections, rain barrels, and rain gardens).
5. Continue efforts to maintain and expand the City's tree canopy and prepare a comprehensive tree management plan to guide these efforts.
6. Continue conducting periodic reviews of the City's ordinances that relate to green infrastructure and consider enhanced ordinances such as:
    a. a stormwater ordinance that requires management of all disturbed impervious area as part of redevelopment (similar to the City of Philadelphia's ordinance),
    b. an ordinance that incentivizes or requires green roofs under certain conditions, and
    c. improved tree protection/planting requirements.
7. Coordinate with the City's climate action planning that kicked off in December 2018.
8. Continue public outreach and education efforts related to stormwater management including the use of social media as appropriate.
9. Improve the project tracking system for GI projects and consider publishing an interactive map on http://www.saveitlancaster.com.
10. Perform a cost-benefit analysis of higher stormwater capture volumes (e.g., 1.5 inches).
11. Periodically evaluate new stormwater management techniques, technologies, and products and pilot them as appropriate.
12. Review, and if necessary, update the City's Green Infrastructure Plan at least once every 5 years.

CITY OF
LANCASTER
A City Authentic

APPENDIX A – GI CONCEPT PLANS AND POTENTIAL PROJECT LIST

Table A.1 - Potential GI Project List

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
P-001	Sixth Ward Park	Green Park	Potential	City	North	Potential Park GI Project Opportunities	E Ross St & Hamilton St		Opportunities for additional GI and/or GI expansion			
P-002	Reservoir Park	Green Park	Concept	City	North	Potential Park GI Project Opportunities	E King St & N Franklin St		Porous Play Courts, Sidewalks, Pavements, Cisterns			
P-003	Brandon Park	Green Park	Potential	City	Engleside	Potential Park GI Project	Wabank St & Hazel St		Opportunities for additional GI and/or GI expansion			
P-004	Crystal Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities	1st St & Reiker Ave		Opportunities for additional GI and/or GI expansion			
P-005	Rodney Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities	W 4th St & N Rodney St		Opportunities for additional GI and/or GI expansion			
P-006	Musser Park	Green Park	Idea	City	North	Potential Park GI Project Opportunities	N Shippen St & E Marion St		Bioretention, Porous play surfaces and walkways			
P-007	Conlin Field/Farnum Park	Green Park	Concept	City	Engleside	Potential Park GI Project Opportunities	South Water St and E Filbert St					
P-008a	Mayor Janis Stork Linear Park (Engleside Basin)	Green Park	Concept	City	Engleside	Potential Park GI Project Opportunities	W. Lemon St & Harrisburg Ave					
P-008b	Mayor Janis Stork Linear Park Park (North basin)	Green Park	Concept	City	Engleside	Potential Park GI Project Opportunities	W. Lemon St & Harrisburg Ave					
P-013	Beaver Street Redevelopment	Green Street	Idea	ROW	Engleside		100 block Beaver Street		Green Street			
P-014	West Grant Street Improvement District	Green Street	Concept	ROW	Engleside		200 block W Grant Street		Tree Trench, Curb Extension Planter			
P-018b	Church Street Towers (Site)	Private Property	Concept	Other Public	Engleside		333 Church Street					
P-022	Wharton Elementary	Green School	Potential	SDL	North	Potential School GI Project Opportunities	705 N Mary St					
P-023	Lafayette Elementary	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities	1000 St Joseph St					
P-024	Ross Elementary	Green School	Potential	SDL	North	Potential School GI Project Opportunities	840 N Queen St					
P-032	Public Parking Lot: Rockland St	Public Property	Idea	City	Susquehanna		700 block Rockland Street		Infiltration Tree Planters / Porous			
P-041	Ice Ave	Green Street	Idea	ROW	North		300 Block Ice Ave		Green Street			
P-043	Fulton Elementary	Green School	Idea	SDL	Engleside	Potential School GI Project Opportunities	225 West Orange Street		potential green roof / other TBD			
P-044	MLK Elementary	Green School	Idea	SDL	Engleside	Potential School GI Project Opportunities	466 Rockland Street		TBD pending future capital project			
P-045	Scheffey Administrative Building	Green School	Idea	SDL	North	Potential School GI Project	1020 Lehigh Avenue		TBD pending future capital project/Phase 2			
P-046	Prince St	Green Street	Concept	ROW	North		400 and 500 blocks N Prince St		tree trench			
P-048	Duke Street Mall Streetscape	Green Street	Concept	ROW	Susquehanna		500-800 blocks S Duke St		tree trenches; curb extension			
P-052	Euclid Ave	Green Street	Idea	Other Public	MS4		500 block Euclid Ave		Green street/Residential			
P-053	McCaskey High School	Green School	Idea	SDL	MS4	Potential School GI Project Opportunities	1020 Lehigh Street (McCaskey High school)		Bioretention and Cistern; (GW Inflow Removal to Capture and Re-use of 50,000 GPD from elevator)			
P-054	Washington Elementary School	Green School	Idea	SDL	MS4	Potential School GI Project Opportunities	545 South Ann St		TBD pending future capital project			
P-056	East Marion	Green Street	Idea	ROW	North		N. Plum to N. Shippen		Green street			
P-058	Lehigh Avenue	Green Street	Idea	ROW	North		N. Franklin to N. Marshall		Green street			
P-059	Burrowes Avenue	Green Street	Idea	ROW	North		N. Franklin to N. Reservoir		Green street			
P-060	Marshall Avenue	Green Street	Idea	ROW	North		Lititz Pike to Stadium		Green street			
P-063	Lehigh Avenue	Green Street	Idea	ROW	North		Franklin to N. Reservoir		Green street			
P-065	First Street	Green Street	Idea	ROW	Engleside		Coral to Old Dorwart		Green street			
P-067	Proposed Garage at Market Street	Private Property	Idea	Private	Engleside		N Prince St & Lemon St		Parking Garage			
P-068	Fulton Bank	Private Property	Idea	Private	Engleside		E King St & N Christian		Private Redevelopment			
P-070	Parking Authority project	Private Property	Idea	Private	North		N Cherry		repaving			
P-071	Champion Forge	Private Property	Concept	Private	North		398 Harrisburg Ave					
P-072	George Street	Green Street	Idea	ROW	Engleside		Pearl to Coral		Green street			
P-074	South West End Avenue	Green Street	Idea	ROW	Engleside		Columbia to First		Green street			
P-085	James St Mennonite Church (includes P-079b shared rear parking lot)	Private Property	Design	Private	North		323 W James St					
P-086	Green Alley: SE17	Green Alley	Concept	ROW	Stevens		17 Alley bw S Plum and 18 Alley		Green alley			
P-091	Green Alley: SE9	Green Alley	Concept	ROW	Susquehanna		White Owl Alley bw E Strawberry and S Christian		Green Alley			
P-093	600 block N Charlotte St	Green Street	Design	ROW	North		Charlotte St bw Harrisburg and Frederick		Landscape Planting (Street Trees)			
P-095	Charlotte Place, LP	Private Property	Idea	Private	North		500 block N Charlotte St					
P-101	Green Alley: 174 Alley	Green Alley	Idea	ROW	MS4		174 Alley between High Street and 175 Alley		Infiltration Trench in Alley			
P-109	Alley 55	Green Alley	Idea	ROW	Stevens		Between New Green and New Dauphin		green street			
P-110	Alley 17	Green Alley	Idea	ROW	Engleside		Near 6th and Pearl St		green street			
P-111	Ace Rents/Constuction Company	Private Property	Idea	Private	MS4		1103 Ranck Mile Road					
P-118b	Penn Stone - SITE	Private Property	Design	Private	North		190 West Ross St					
P-119	Garage Queen Street	Private Property	Idea	Private	Engleside		Queen Street					
P-125	Cherry Street	Green Street	Concept	ROW	Engleside		behind Library		green street			

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
P-128	Groundwater Inflow Removal at Lancaster Co. Convention Center	Private Property	Idea		Engleside		W Vine St and Queen St					
P-130	Alley 30 (NW)	Green Alley	Concept	ROW	Engleside		Between W Walnut and Buchanan		Green Alley to manage runoff from adjacent properties			
P-138	Community First Fund	Green Roof	Idea	Private	Engleside		30 W Orange St		Green Roof			
P-140	Model Building #2	Green Roof	Idea	Private			TBD		Green Roof			
P-141	Model Building #3	Green Roof	Idea	Private			TBD		Green Roof			
P-145	248 E Liberty Street	Green Street	Idea	ROW	North		248 E Liberty Street		Green Street			
P-151	Lancaster Operations Center	Public Property	Idea		MS4		Riverside Ave north of Ranck Mill Rd					
P-152	Long's Park	Green Park	Concept	City	MS4	Potential Park GI Project Opportunities	1441 Harrisburg Pike		Stormwater wetland			
P-155	217 Harrisburg Ave	Private Property	Idea	Private	Engleside		217 Harrisburg Ave		Green Roof			
P-158	Unitarian Universalist Church	Private Property	Idea	Private	Engleside		538 West Chestnut St		redesign parking and play area; downspout disconnection			
P-160	Hillrise Housing Assoc	Private Property	Design	Private	Engleside		241 Locust St		Possible permeable paving, infiltration trenches, rain gardens, and dry wells			
P-161	512 N Market St	Private Property	Idea	Private	North		512 N Market St		Potential project - porous parking, porous alley			
P-163	Clay Street	Green Street	Idea	ROW	North		Queen to Prince		Green Street			
P-164	Strawberry Street	Green Street	Idea	ROW	Engleside		W. King to W. Mifflin		Green Street			
P-175	Faith United Church of Christ	Private Property	Idea	Private	MS4		1204 Wabank St		Infiltration trench and/or Rain Garden			
P-182	216 - 224 N. Lime Street	Private Property	Idea	Private	North		216 N. Lime Street		Porous Pavement and Bioretention			
P-183	241 W. Lemon Street	Private Property	Idea	Private	Engleside		241 W. Lemon Street		Porous Pavement and Bioretention			
P-184	324 N. Lime Street	Private Property	Idea	Private	North		324 N. Lime Street		Porous Pavement and Bioretention			
P-185	502-506 W. Walnut St Green Roof	Private Property	Idea	Private	Engleside		502 - 506 W. Walnut Street		Green Roof			
P-186	Fairview Ave Green Street	Green Street	Concept	ROW	Engleside		Fairview Ave btw Seymour St and Wabank St		Curb Extensions, Separation			
P-188	Grace Lutheran Church	Private Property	Idea	Private	North		517 N Queen St		Potential project - Green Roof, Permeable Paving, Rain Gardens, Cisterns			
P-190	Prince Street Turning Lane Removal	Green Street	Design	ROW	Engleside		N Prince St at W Walnut St		Green Street - bioretention			
P-191	West Ross Street	Green Street	Concept	ROW	North		W Ross St btw Market St and Prince St		Green Street - Tree trench, curb extensions, bioretention, infiltration trenches			
P-192	Hand Middle School*	Green School	Concept	SDL	MS4	Potential School GI Project Opportunities	431 South Ann Street		Rain Garden	Complete (2017)		
P-193	Hand Middle School Stormwater Disconnection	Green School	Design	SDL	MS4	Potential School GI Project Opportunities	431 South Ann Street		GI TBD - potential stormwater disconnection			
P-197	St Joseph St	Green Street	Design	ROW	MS4		St Joseph St from Fairview to Hershey		Green Street			
P-200	N Christian Street	Green Street	Concept	ROW	Engleside		between E. Chestnut Street to E. Liberty Street					
P-XXX	Landis Drive	Green Street	Idea	ROW			Landis Drive					
	South End Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Binn's Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Camba Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Case Commons	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Ewell/Gantz Playground	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Lancaster Square	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	North Market Street Kids Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Penn Square (NE)	Green Park	Potential	City	North	Potential Park GI Project Opportunities						
	Penn Square (NW)	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Penn Square (SE)	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Penn Square (SW)	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Rotary Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	South Duke Street Mall	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Cabbage Hill Veterans Memorial	Green Park	Potential	City	Engleside/Susquehanna	Potential Park GI Project Opportunities						
	Blanche Nevin Memorial Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	Buchanan Park	Green Park	Potential	City	Engleside	Potential Park GI Project Opportunities						
	Joe Jackson Tot Lot	Green Park	Potential	City	MS4	Potential Park GI Project Opportunities						
	Roberto Clemente Field	Green Park	Potential	City	Susquehanna	Potential Park GI Project Opportunities						
	Milburn Park	Green Park	Potential	City	Stevens	Potential Park GI Project Opportunities						
	Conestoga Creek Park	Green Park	Potential	City	Susquehanna	Potential Park GI Project Opportunities						
	Conestoga Pines	Green Park	Potential	City	MS4	Potential Park GI Project Opportunities						
	Holly Pointe Park	Green Park	Potential	City	MS4	Potential Park GI Project Opportunities						
	Lancaster County Central Park	Green Park	Potential	City	MS4	Potential Park GI Project Opportunities						
	Price Elementary	Green School	Potential	SDL	Engleside	Potential School GI Project Opportunities				Future - TBD		
	Reynolds Middle School	Green School	Potential	SDL	Engleside	Potential School GI Project Opportunities				Complete (2017)		
	Buehrle Alternative	Green School	Potential	SDL	North	Potential School GI Project Opportunities						
	Cyber Program	Green School	Potential	SDL	Susquehanna	Potential School GI Project Opportunities						
	Wheatland Middle School	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities				Complete (2017)		
	Buchanan Elementary	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities				Complete (2017)		
	Burrowes Elementary	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities				Future - TBD		
	Hamilton Elementary	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities				Future - TBD		
	Lincoln Middle School	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities				Future - TBD		
	Wickersham Elementary	Green School	Potential	SDL	MS4	Potential School GI Project Opportunities				Future - TBD		
	Church St from Queen to Shippen	Green Street	Potential	ROW	Engleside	Streets identified as Potential for Conversion to Two-way						
	E Orange St from Broad to Queen	Green Street	Potential	ROW	North	Streets identified as Potential for Conversion to Two-way						
	W Orange St from Queen to Ruby	Green Street	Potential	ROW	Engleside	Streets identified as Potential for Conversion to Two-way						
	N Duke St from Liberty to King	Green Street	Potential	ROW	North	Streets identified as Potential for Conversion to Two-way						
	S Duke St from King to Church	Green Street	Potential	ROW	Engleside	Streets identified as Potential for Conversion to Two-way						
	N Lime St from Liberty to King	Green Street	Potential	ROW	North	Streets identified as Potential for Conversion to Two-way						
	S Lime St from King to Church	Green Street	Potential	ROW	Engleside	Streets identified as Potential for Conversion to Two-way						
	BEAVER ST from Conestoga to Furnace	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					18 - 32	2019
	N CHRISTIAN ST from E Chestnut to E Liberty	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					21 - 33	2019
	CONESTOGA ST from S Queen to Filbert	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					18 - 30	2019
	W FARNUM ST from S Queen to S Prince	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					27 - 32	2020
	N FRANKLIN ST from E Orange St to E Chestnut St	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					22 - 25	2020
	E FULTON ST from N Franklin St to N Reservoir St	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					27	2019
	HERSHEY AVE from Manor St to 176 ALY	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					33	2019

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	ICE AVE from N Ann to dead end	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					31	2020
	ICE AVE from N Lime to N Shippen	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					32	2020
	E JAMES ST from N Christian to N Duke	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					30	2020
	MARIETTA AVE from Hager Aly to W Marion	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					32	2019
	E NEW ST from N Cherry St to N Lime St	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					30	2020
	OCEAN AVE from Ruby to Pearl	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-					28/29	2019
	PARK AVE from N Shippen to E Frederick	Green Street	Potential	ROW	North	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					24/25	2019
	SEYMOUR ST from Beaver St to 81 Aly	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					23	2019
	E STRAWBERRY ST from Woodward to White Owl Aly	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					29	2020
	W WALNUT ST from N Charlotte to Lancaster Ave	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					25	2019
	E & W WALNUT ST from N Christian to N Water	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					20 -34	2019
	N WEST END AVE from Columbia to Marietta	Green Street	Potential	ROW	Engleside	Potential Green Street Projects in Engleside/North Basins from 2019-2020 PMP					17 - 25	2019
	100 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	100 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	101 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	101 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	102 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	102 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	103 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	109 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	119 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	119 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	12 Aly SE	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	120 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	122 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	123 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	126 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	129 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	129 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	146 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	147 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	15 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	27 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	28 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	28 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	3 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	3 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	30 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	30 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	33 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	33 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	34 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	4 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	40 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	60 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	74 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	75 Aly SW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	83 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	83 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	83 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	83 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	85 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	89 Aly NE	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	98 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	99 Aly NW	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Ash Ln	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Burrowes Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Campbell Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Campbell Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Campbell Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Canary Ln	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Canary Ln	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Chambers St	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Fulton St	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Fulton St	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	Fulton St	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Grove Ln	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Grove Ln	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Grove Ln	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Grove Ln	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Hager Aly	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Hager Aly	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Hand Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Hand Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Hensel Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Jefferson St	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Jefferson St	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Maple Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Maple Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Marion St	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Mill Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Reiker Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Reiker Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Reo Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Rolridge Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Rolridge Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Rolridge Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Rolridge Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	School House Aly	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	School House Aly	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	School House Aly	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	Tobacco Ave	Green Alley	Potential	ROW	North	Ch 5 - Public Alleys in North and Engleside Basins						
	W. Fulton Street	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	W. Madison Aly	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	W. Marion Street	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Watch Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Watch Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	Watch Ave	Green Alley	Potential	ROW	Engleside	Ch 5 - Public Alleys in North and Engleside Basins						
	1067 Dillerville Rd	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		AFI INTERMEDIATE CO				

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	655 Stadium Rd	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LEECH REV GEORGE L				
	480 New Holland Ave	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		URBAN PLACE LP				
	1211 Marshall Ave	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		JA JR & TJ SCHWARTZ PARTNERSHI				
	715 Fountain Ave	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		ECORE INTERNATIONAL				
	53 McGovern Ave	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		AMTRACK TAX & INS DEPT				
	320 W Liberty St	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LIBERTY PROPERTY HOLDINGS LP				
	1300 Marshall Ave	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		BROOK FARMS DEVELOPMENT II LLC				
	262 Rear Conestoga St	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		ACCOUNTS PAYABLE				
	303 N Plum St	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		JL CLARK INC				
	262 Conestoga St	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		ACCOUNTS PAYABLE				
	190 W Ross St	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		MCGGROUP INC				
	210 COLLEGE AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		PINNACLE HEALTH LANCASTER REGI				
	790 NEW HOLLAND AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		GRANDVIEW PLAZA LANCASTER LP				
	1205 MARSHALL AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		STUMPF KATHLEEN M				
	825 E CHESTNUT ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		SATTAZAHN A BRUCE				
	351 W JAMES ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		CHAMPION FORGE LLC				
	501 E WALNUT ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		JL CLARK INC				
	1000 NEW HOLLAND AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		BURLE BUSINESS PARK LP				
	235 N RESERVOIR ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		GIANT FOOD STORES LLC				
	217 HARRISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		HEART GRP LG HEALTH				
	350 W LIBERTY ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		FRANKLIN & MARSHALL COLLEGE				
	1009 N PRINCE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LLM REALTY PARTNERS				
	812 N PRINCE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		SECOND STRONG & DETWEILER LLC				
	1147 LITITZ PIKE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		STOCK YARD INN INC				
	201 W LIBERTY ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LIBERTY PROPERTY HOLDINGS LP				
	601 S QUEEN ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		COMMUNITY ACTION PROGRAM OF				
	715 FAIRVIEW AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		AMVETS POST 19 HOME ASSN				
	601 HARRISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		FRANKLIN & MARSHALL COLLEGE				
	600 COLLEGE AVE	Private Property	Potential	Private	North/Engleside	Potential Private GI parking lots > 20,000 SF		FRANKLIN & MARSHALL COLLEGE				
	415 HARRISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		FRANKLIN & MARSHALL COLLEGE				
	533 JANET AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		RISEN STAR PROPERTIES LP				
	702 S PRINCE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		B&D VENTURES INC				
	115 S WEST END AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		SOUTH WEST END INC				
	301 E LIBERTY ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		DEMARCO LAWRENCE J				
	209 HAZEL ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		MMAG DEVELOPERS LP				

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	1055 LITITZ AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		PENNSYLVANIA LINES LLC				
	625 FOUNTAIN AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		DODGE REGUPOL INC				
	525 N DUKE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LANCASTER GENERAL HOSPITAL				
	800 S QUEEN ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		QUEEN ST DEVELOPMENT PARTNERS				
	330 N PRINCE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		330 ASSOCIATES LLC				
	620 N CHARLOTTE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		FRANKLIN & MARSHALL COLLEGE				
	811 N PRINCE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		CYGNET PARTNERS LP				
	304 N WATER ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		SOUTHEAST LANCASTER HEALTH SER				
	NEFF J GARY N WEST END AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		NEFF J GARY				
	217 COLLEGE AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		PINNACLE HEALTH LANCASTER REGI				
	555 W JAMES ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LANC THEOLOGICAL SEMINARY OF U				
	619 E ROSS ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		MARTIN CAROLYN W				
	131 S QUEEN ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		SALVATION ARMY				
	550 N QUEEN ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LANCASTER GENERAL HOSPITAL				
	265 HARRISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LANCASTER FAMILY YMCA				
	42 W ORANGE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		HAGER PARKING PROPERTIES LP				
	260 S PRINCE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		WATER STREET MISSION				
	701 MARTHA AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		GRAHAM CAPITOL CO				
	275 E LIBERTY ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		STILLMAR PARTNERSHIP				
	322 N ARCH ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		TA NGUYEN LLC				
	850 N WATER ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LANC LEAF TOB CO OF PENNA INC				
	115 W LIBERTY ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LIBERTY PROPERTY HOLDINGS LP				
	454 NEW HOLLAND AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		454 NEW HOLLAND AVENUE PARTNER				
	342 N MARSHALL ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		GISH JOHN H				
	226 N ANN ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		AMERECTOR HOLD 2 INC				
	17 FAIRVIEW AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		MANORVIEW LLC				
	241 N PLUM ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		EGAN FAMILY TRUST LP				
	521 E ROSS ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		MARTIN EARL K				
	503 E ORANGE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		ST ANTHONY ROMAN CATHOLIC				
	341 E FULTON ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		TOBACCO AVENUE LLC				
	669 E ROSS ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		RICHLAND PARTNERS LLC				
	560 NEW HOLLAND AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		DO MOC VAN				
	504 E ORANGE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LEECH MOST REV GEORGE L DD				
	301 HARRISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		SIEGEL-ANSEL BAG & BURLAP CO				
	398 HARISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		CHAMPION FORGE LLC				

Project Reference ID (if applicable)	Project Name	GI Prototype Project Type	Status	Owner	CSO Basin	Green It! Lancaster - Planning and Evaluation Analysis	Address	Owner Name (Parking Lots)	Proposed GI Technology (if determined)	School District CIP Year (if applicable)	PCI Score (if applicable)	PMP Year (if applicable)
	1060 N CHARLOTTE ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LSC PROPERTIES LP				
	230 HARRISBURG AVE	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		230 MEDICAL CENTRE ASSN				
	205 HAZEL ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		LAPEX LLC				
	652 MANOR ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		KUNZLER & COMPANY INC				
	201 HAZEL ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		COHEN ALLEN M				
	335 N PRINCE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		THOMPSON REUTERS INC				
	796 B NEW HOLLAND AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		GRANDVIEW PLAZA LANCASTER LP				
	216 N LIME ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		EAST MARION PROPERTIES LP				
	570 S WATER ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		JAMES DIAMANTONI				
	47 S MULBERRY ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		ST JOSEPHS PAROCHIAL SCHOOL				
	430 N FRANKLIN ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		HAINES JAMES S				
	422 N WATER ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		SNAVELY & DOSCH INC				
	Map Label 449	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF						
	315 W ORANGE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		COVENANT UNITED METH CHURCH				
	420 S QUEEN ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		LIGHT OF HOPE COMMUNITY				
	Map Label 709	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF						
	214 CONESTOGA ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		CONESTOGA STREET DEVELOPMENT L				
	245 PARK AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LANC GENERAL HOSP				
	425 S DUKE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		DALEY JOSEPH T				
	501 HARRISBURG AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		FRANKLIN & MARSHALL COLLEGE				
	945 N PLUM ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		SGRO GESINO G				
	17 W VINE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		SREG VINE LLC				
	330 W CHESTNUT ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		ECKLIN DEVELOPMENT				
	342 N DUKE ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		FIRST UNITED METHODIST CHURCH				
	675 MANOR ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		LANC LABOR FOUNDATION INC				
	515 ICE AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		MDS REAL ESTATE LLC				
	222 S QUEEN ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		222 SOUTH QUEEN STREET LLC				
	801 FOUNTAIN AVE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		INTERNATIONAL PAPER				
	830 N WATER ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		LSC PROPERTIES LP				
	1102 LITITZ PIKE	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		BRUBAKER LEASING INC				
	444 N FRANKLIN ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		C&K INVESTMENT PROPERTIES LLC				
	420 N FRANKLIN ST	Private Property	Potential	Private	North	Potential Private GI parking lots > 20,000 SF		PRECISE PROPERTIES LLC				
	531 UNION ST	Private Property	Potential	Private	Engleside	Potential Private GI parking lots > 20,000 SF		KIRCHNER VONDA L				

City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 02: Reservoir Park

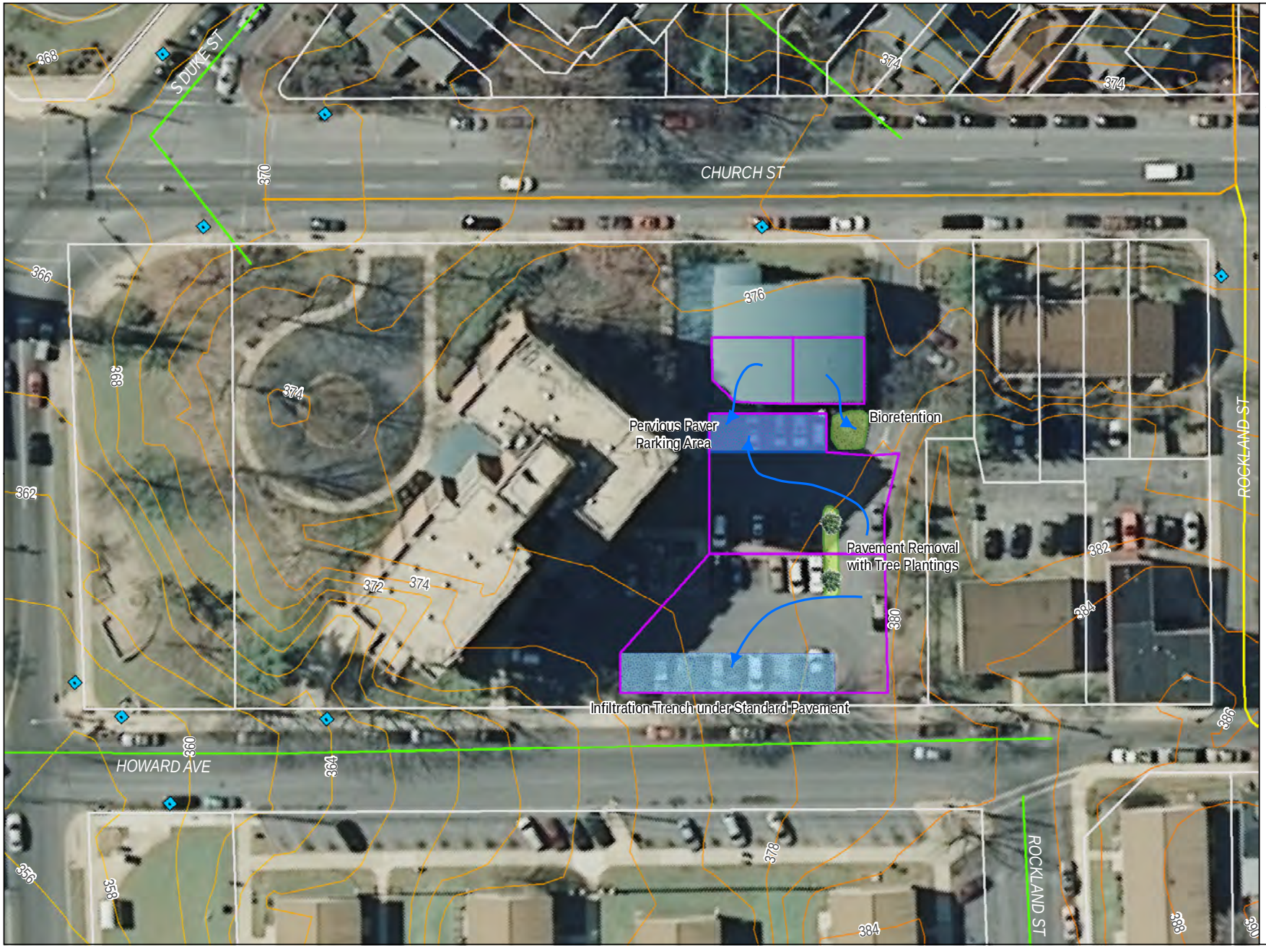
GI Demonstration Project
Manhole
Inlets
Parcel Boundary
Drainage Area to GI

Gravity Sewer Lines
4" - 15" diam.
15" - 30" diam.
30" - 60" diam.
60" - 120" diam.

Proposed GI Technology
Cistern/Rain Barrel
Green Roof
Infiltration Bed
Pervious Pvmt Parking Lot
Pervious Pvmt Play Court

CH2MHILL

Map prepared October 2010



City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 18b:
Church Street Towers (SITE)

PROPOSED CONCEPT PLAN

Legend

- Storm Inlets
- Manholes

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.

- Parcel Boundary
- Drainage Areas
- Bioretention
- Pavement Removal
- Por. Pavement Parking Lot
- Infiltration Trench
- Existing Tree Canopy
- Proposed Trees (2)

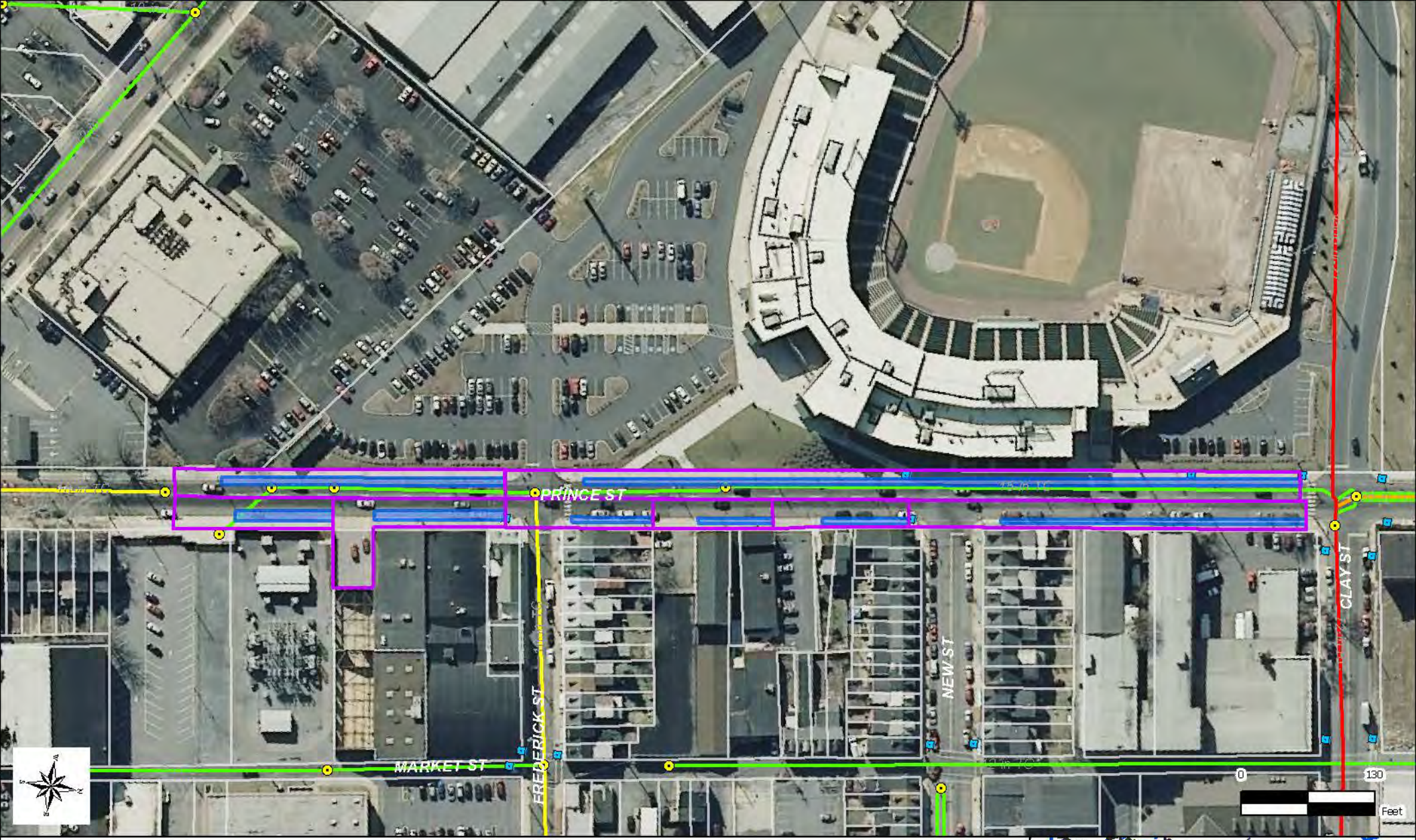
0 40 80
Feet

the city of Lancaster
a city authentic

Live Green

CH2MHILL

Map prepared Mar 2012



City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 46: Commercial
Green Street @ Prince St

GI Demonstration Project
CSO Outfall Loc.
Inlets
Manhole
Parcel Boundary

Gravity Sewer Lines
4" - 15" diam.
15" - 30" diam.
30" - 60" diam.
60" - 120" diam.

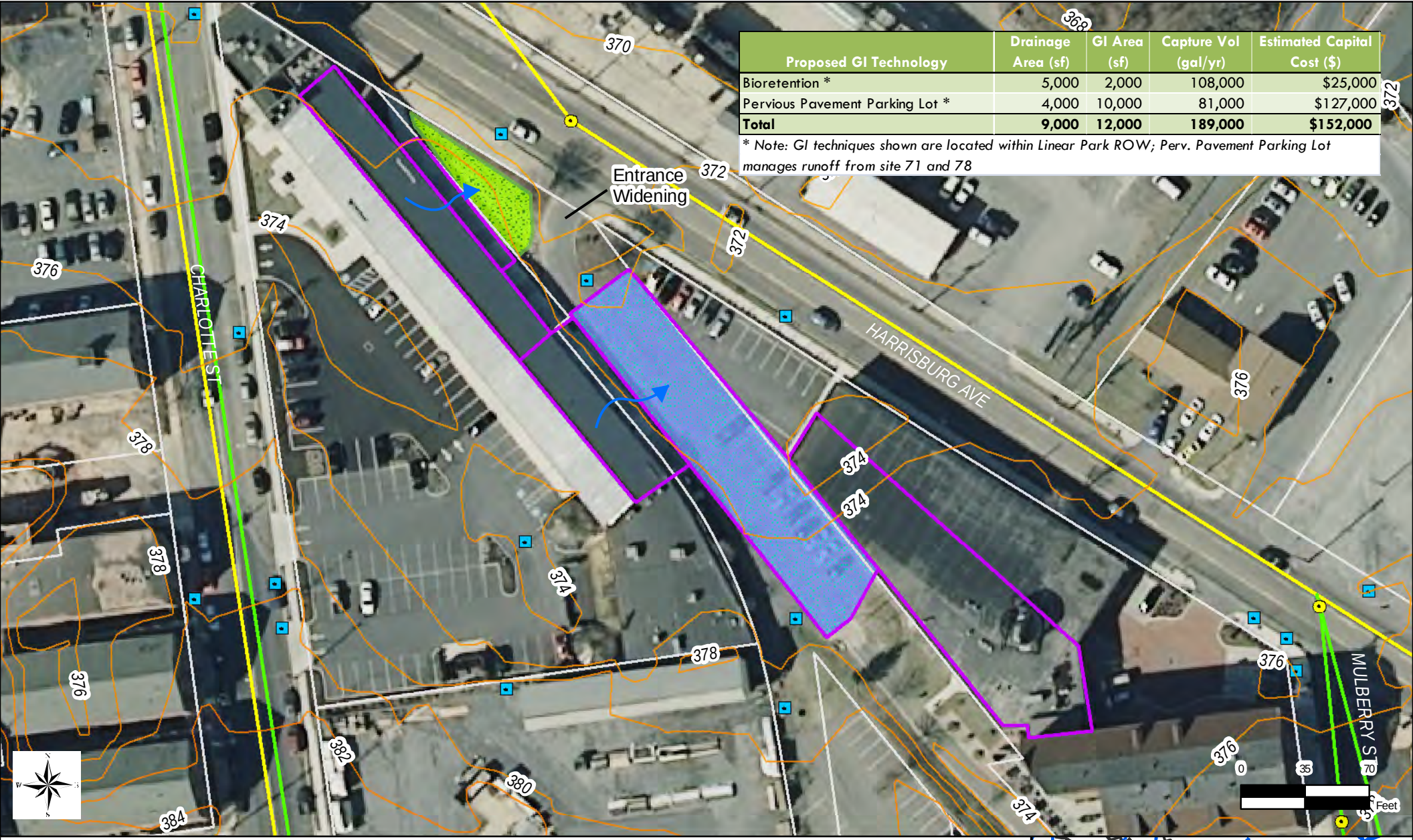
Drainage Area to GI

Proposed GI Technology

Tree Trench

CH2MHILL

Map prepared Oct. 2010



Proposed GI Technology	Drainage Area (sf)	GI Area (sf)	Capture Vol (gal/yr)	Estimated Capital Cost ($)
Bioretention *	5,000	2,000	108,000	$25,000
Pervious Pavement Parking Lot *	4,000	10,000	81,000	$127,000
Total	**9,000**	**12,000**	**189,000**	**$152,000**

** Note: GI techniques shown are located within Linear Park ROW; Perv. Pavement Parking Lot manages runoff from site 71 and 78*

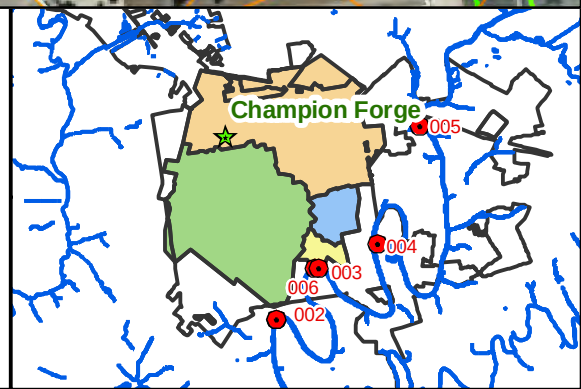
City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 71:
Champion Forge

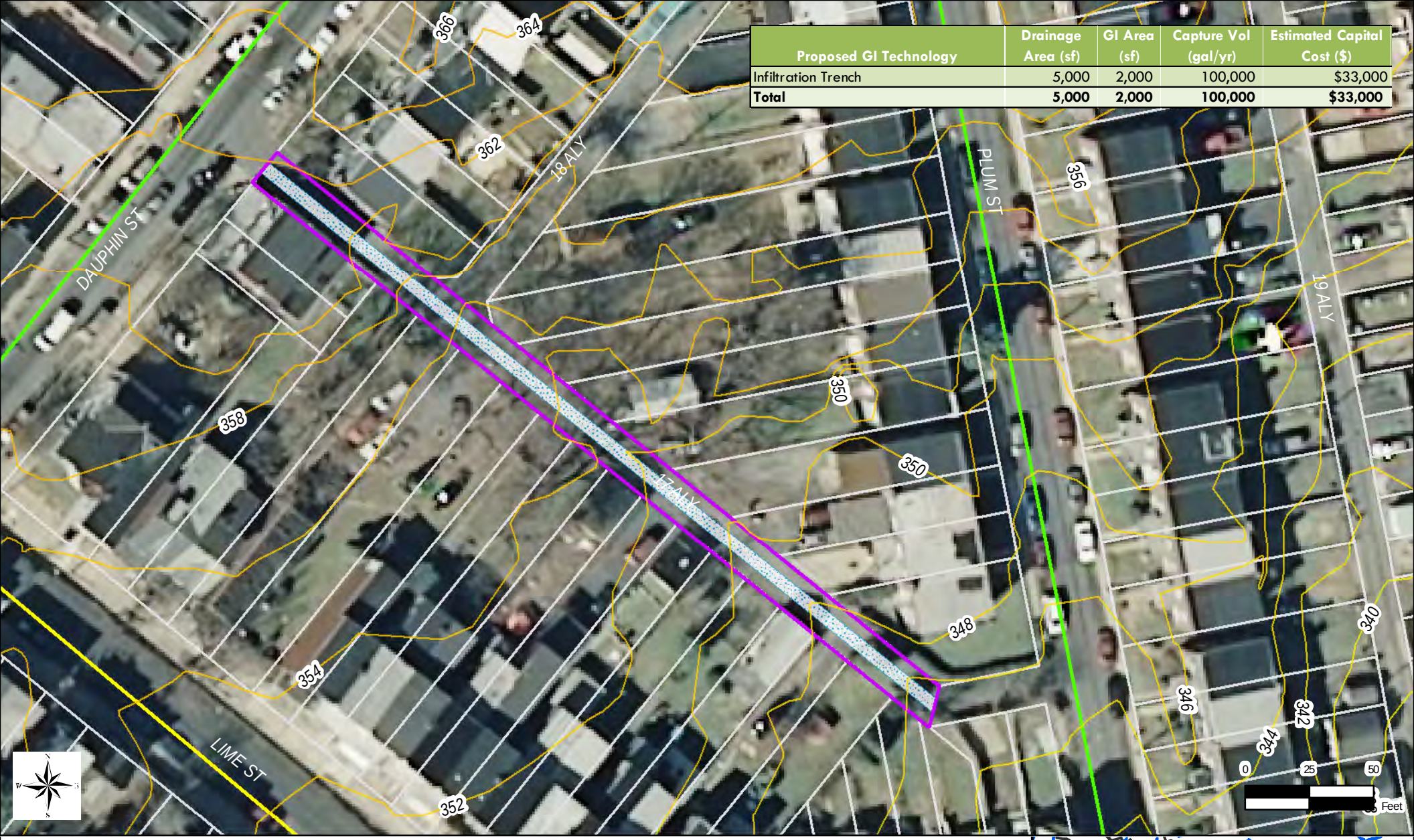
- GI Project Location
- CSO Outfall Loc.
- Manholes
- Storm Inlets

Gravity Sewer Lines
- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.

- Parcel Boundary
- Drainage Area
- Bioretention
- Pervious Pvmt Lot



Map prepared February 2011 in support of PennVest Application



Proposed GI Technology	Drainage Area (sf)	GI Area (sf)	Capture Vol (gal/yr)	Estimated Capital Cost ($)
Infiltration Trench	5,000	2,000	100,000	$33,000
Total	**5,000**	**2,000**	**100,000**	**$33,000**

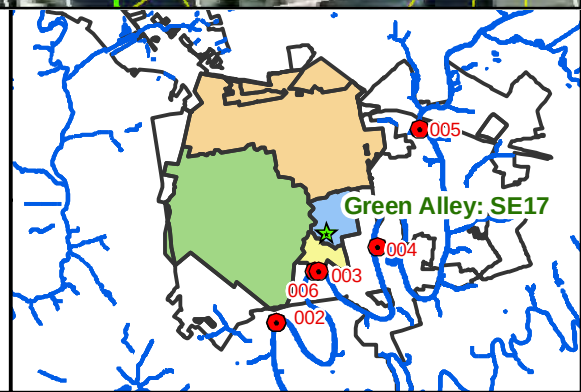
City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 86:
Green Alley SE17

- GI Project Location
- CSO Outfall Loc.
- Manholes
- Storm Inlets

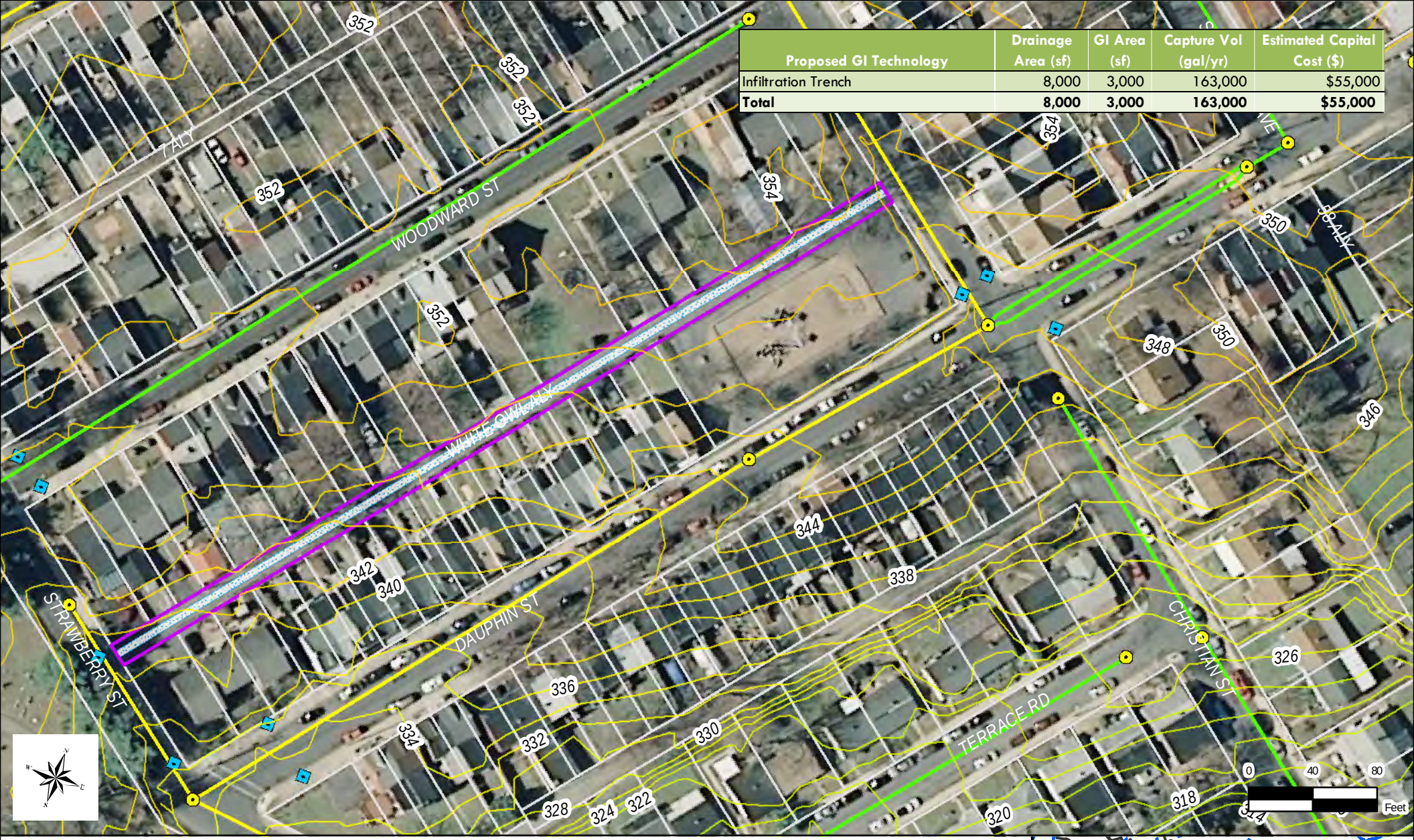
Gravity Sewer Lines
- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.

- Parcel Boundary
- Drainage Area
- Infiltration Trench



Map prepared February 2011 in support of PennVest Application

Proposed GI Technology	Drainage Area (sf)	GI Area (sf)	Capture Vol (gal/yr)	Estimated Capital Cost ($)
Infiltration Trench	8,000	3,000	163,000	$55,000
Total	**8,000**	**3,000**	**163,000**	**$55,000**



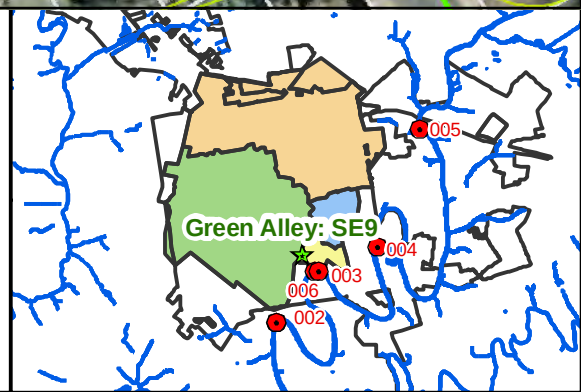
City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 91:
Green Alley SE9

- GI Project Location
- CSO Outfall Loc.
- Manholes
- Storm Inlets

Gravity Sewer Lines
- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.

- Parcel Boundary
- Drainage Area
- Infiltration Trench



Map prepared February 2011 in support of PennVest Application

City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 125:
Green Alley: Cherry Street

PROPOSED CONCEPT PLAN

Legend

- Hydrants
- Storm Inlets
- Manholes

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.

- Parcel Boundary
- Drainage Areas
- Green Street
- Tree Trench
- Existing Tree Canopy
- Proposed Trees (2)

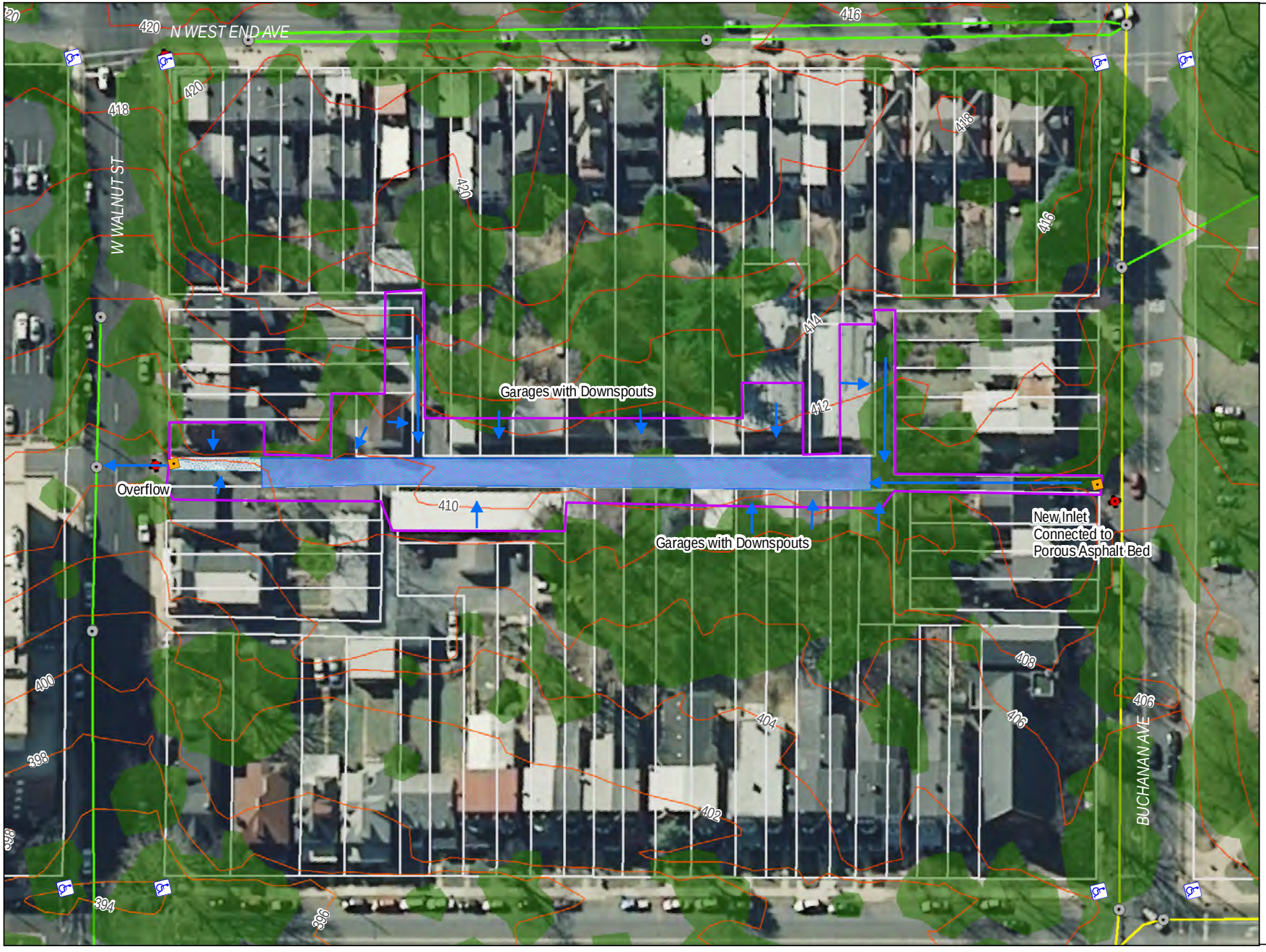
0 37.5 75
Feet

the city of Lancaster
a city authentic

LIVE Green

CH2MHILL

Map prepared Mar 2012



City of Lancaster

Green Infrastructure Program

Growing Greener Concept

Site 130: Alley 130

PROPOSED CONCEPT PLAN

Legend

- Hydrants
- Existing Inlets
- Manholes
- Proposed Inlets
- ADA Ramps

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.
- Parcel Boundary
- Drainage Areas
- Existing Tree Canopy
- Infiltration Trench
- Porous Pavement

0 50 100

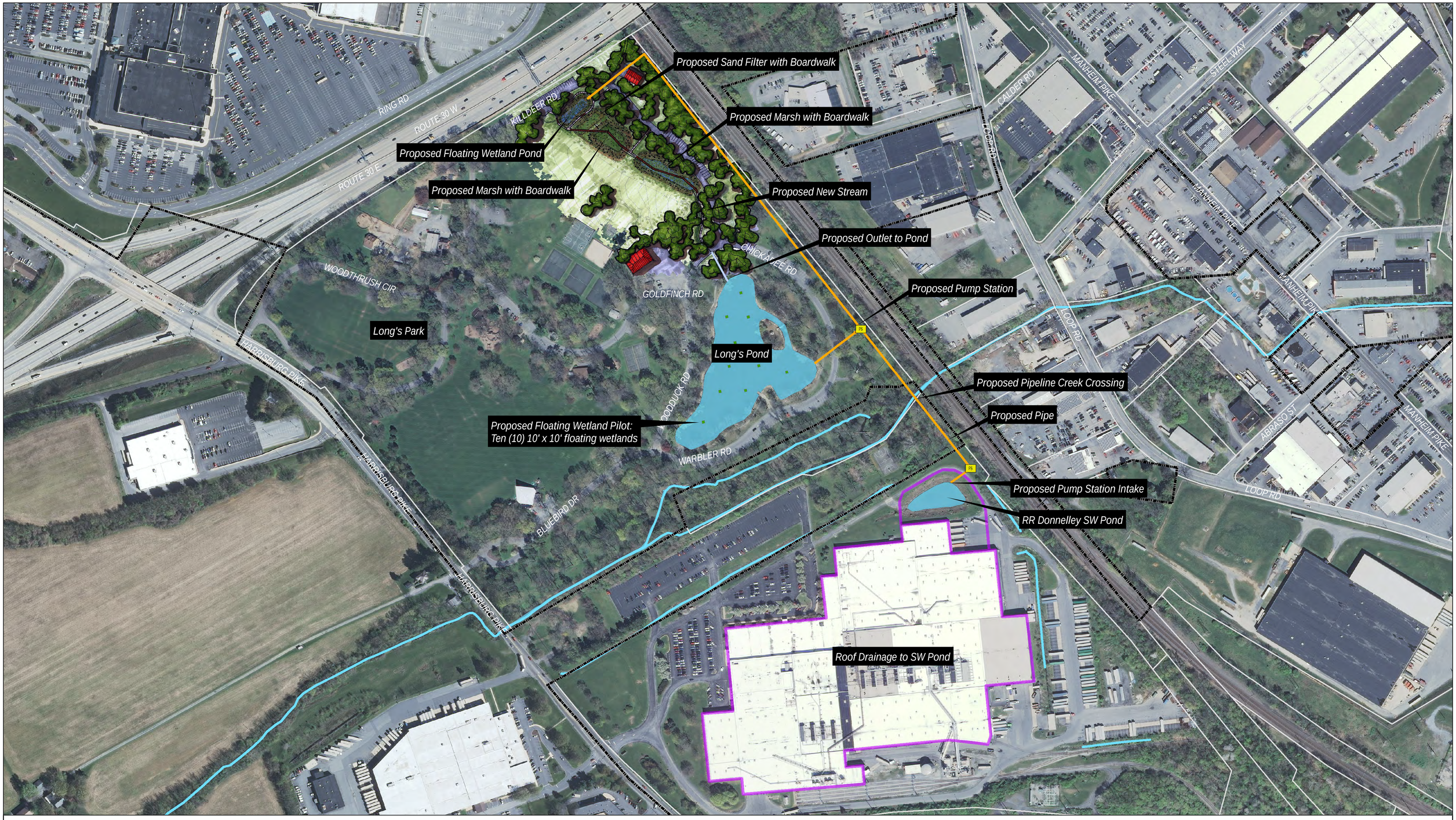
Feet

the city of Lancaster
a city authentic

LIVE Green

CH2MHILL

Map prepared Aug 2012



CITY OF LANCASTER: LONG'S PARK WETLAND CONCEPT - REVISED JAN. 2019

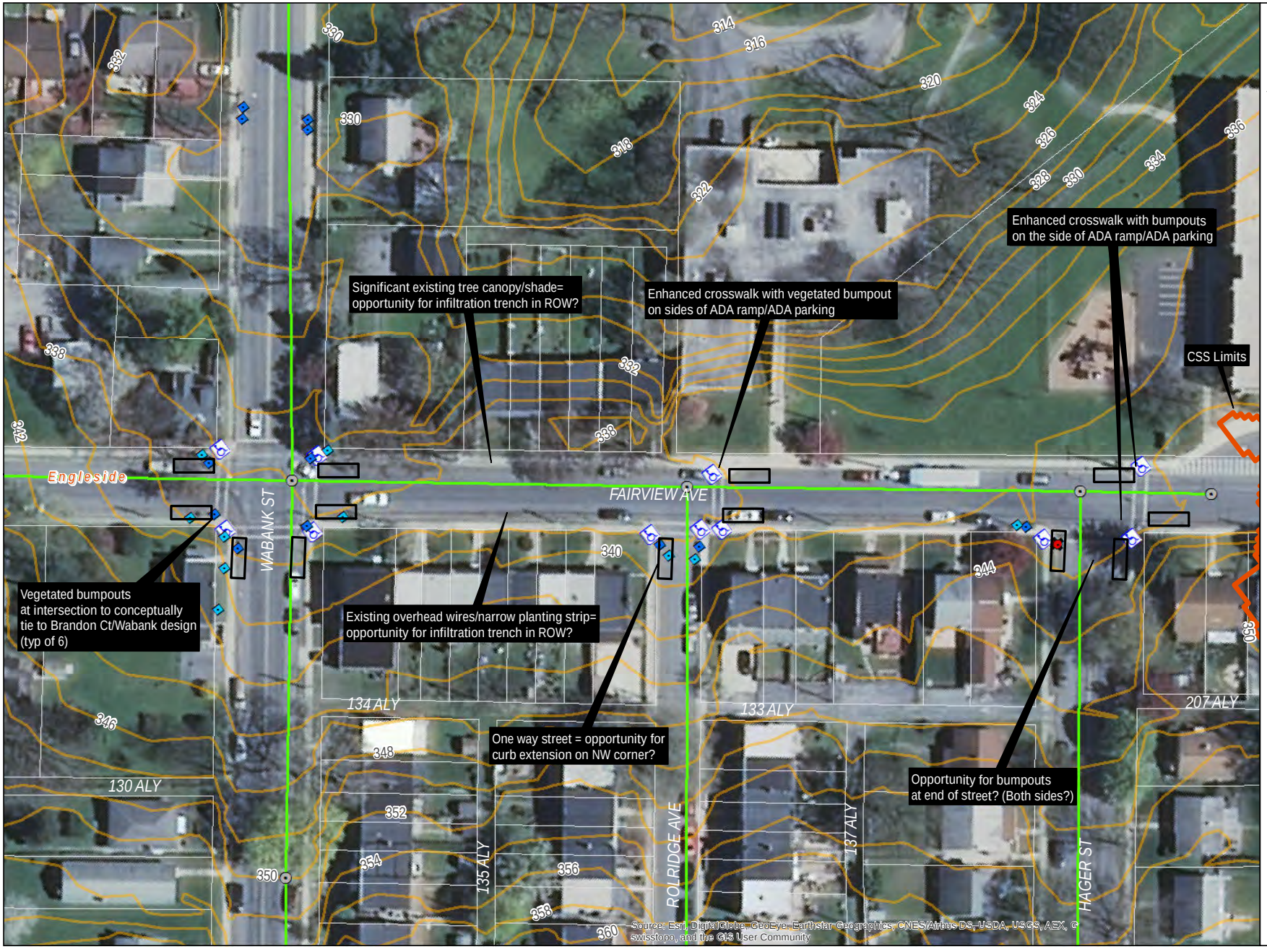
- Proposed Pump Station
- Proposed Pipe
- Lancaster County Stream
- Parcel Boundary
- RR Donnelley Drainage Area (19 ac rooftop + 1 ac around pond)
- Municipal Boundary

0 100 200
Feet

the city of Lancaster
a city authentic

ch2m

Map prepared Jan 2019



City of Lancaster

Green Infrastructure Program

Site 186:
Fairview Avenue
Green Street

PRELIMINARY GI IDEAS

Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- Manholes
- ADA Ramps

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.
- Parcel Boundary
- 2014 CSS Basins

N

0 25 50

Feet

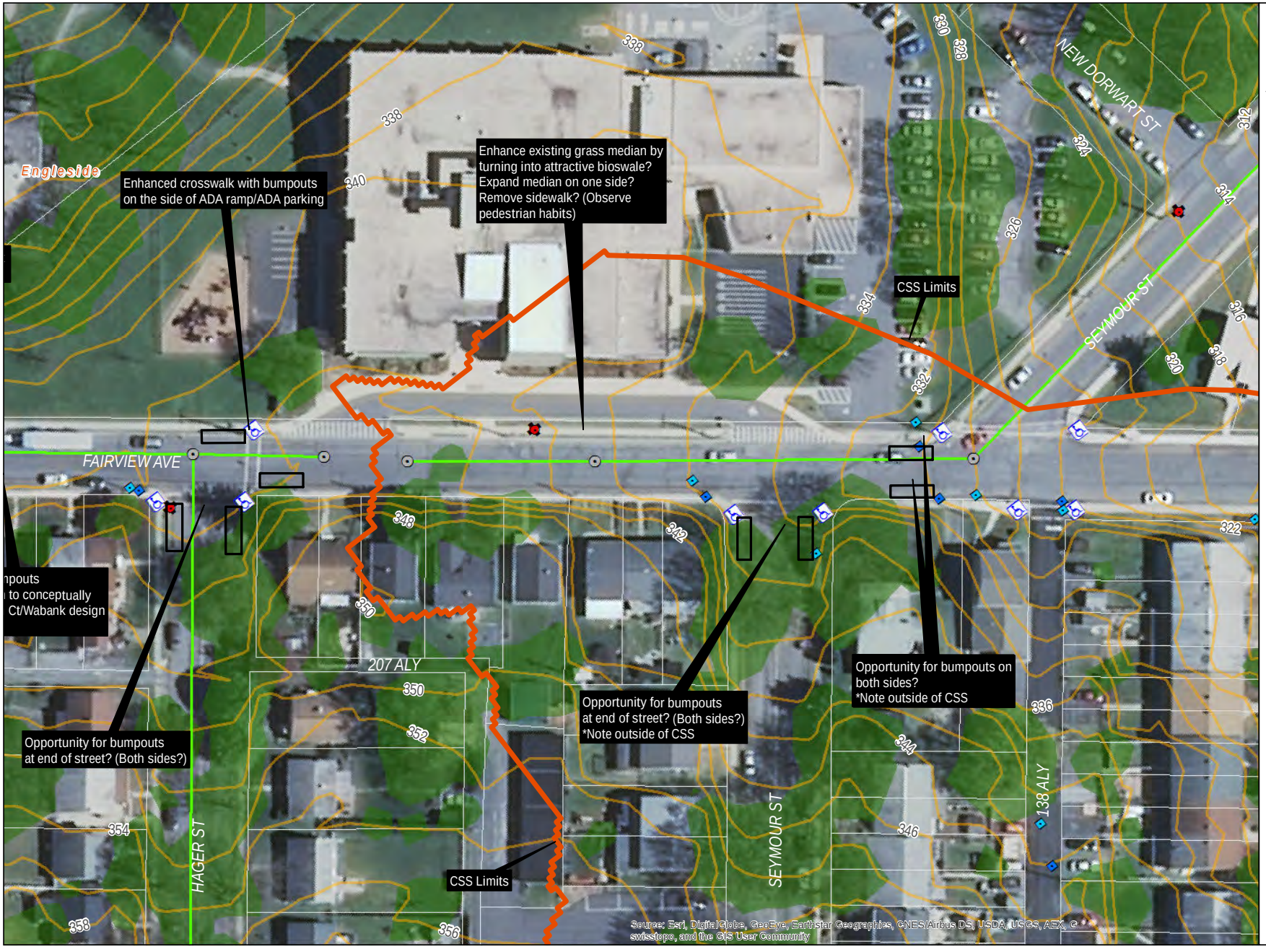
1 inch = 50 feet

the city of Lancaster
a city authentic

SAVE IT!

ch2m

Map prepared June 2015



City of Lancaster

Green Infrastructure Program

Site 186:
Fairview Avenue
Green Street

PRELIMINARY GI IDEAS

Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- Manholes
- ADA Ramps

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.
- Parcel Boundary
- Existing Tree Canopy
- 2014 CSS Basins

N

0 25 50

Feet

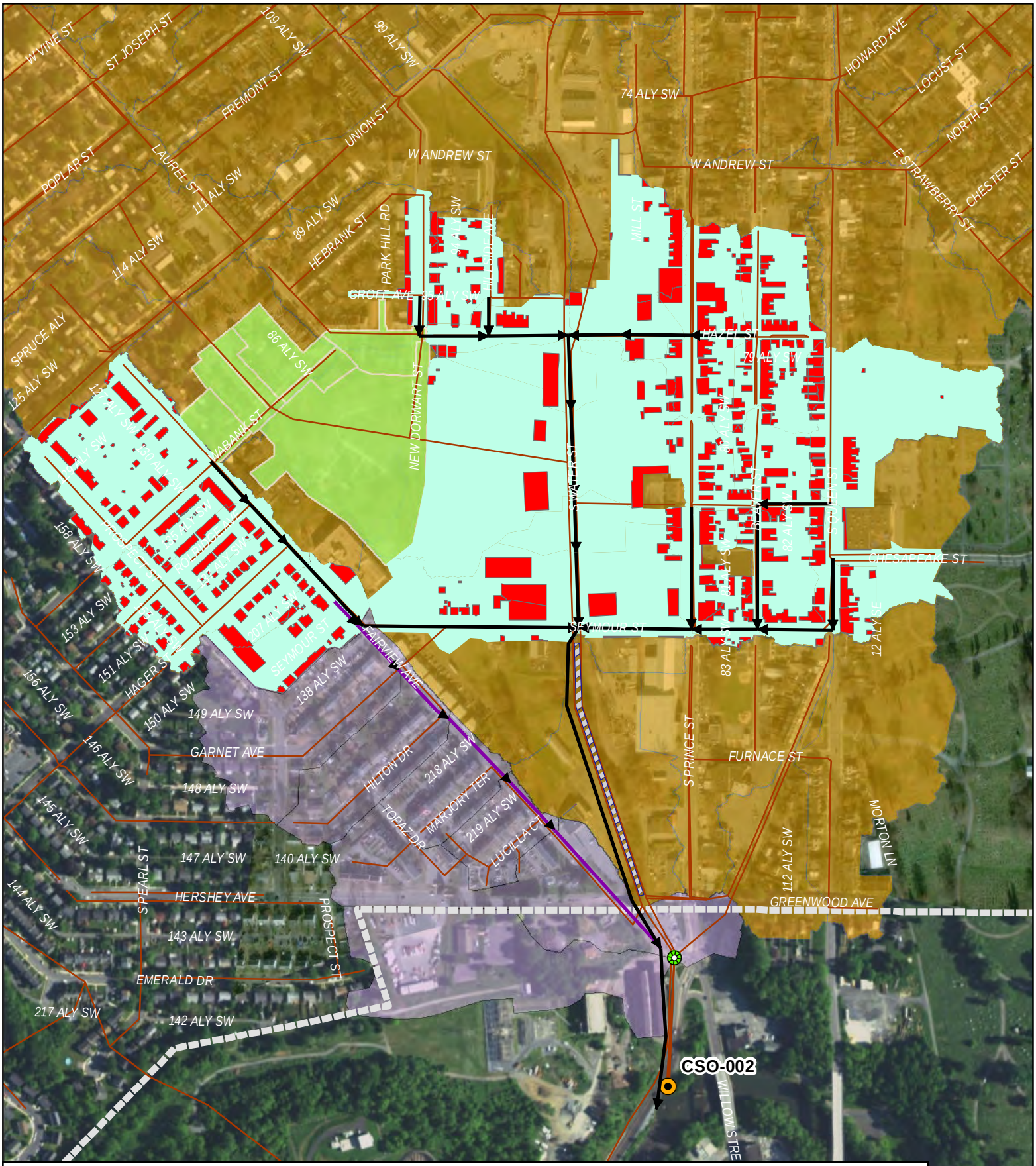
1 inch = 50 feet

the city of Lancaster
a city authentic

SAVE IT!

ch2m

Map prepared June 2015

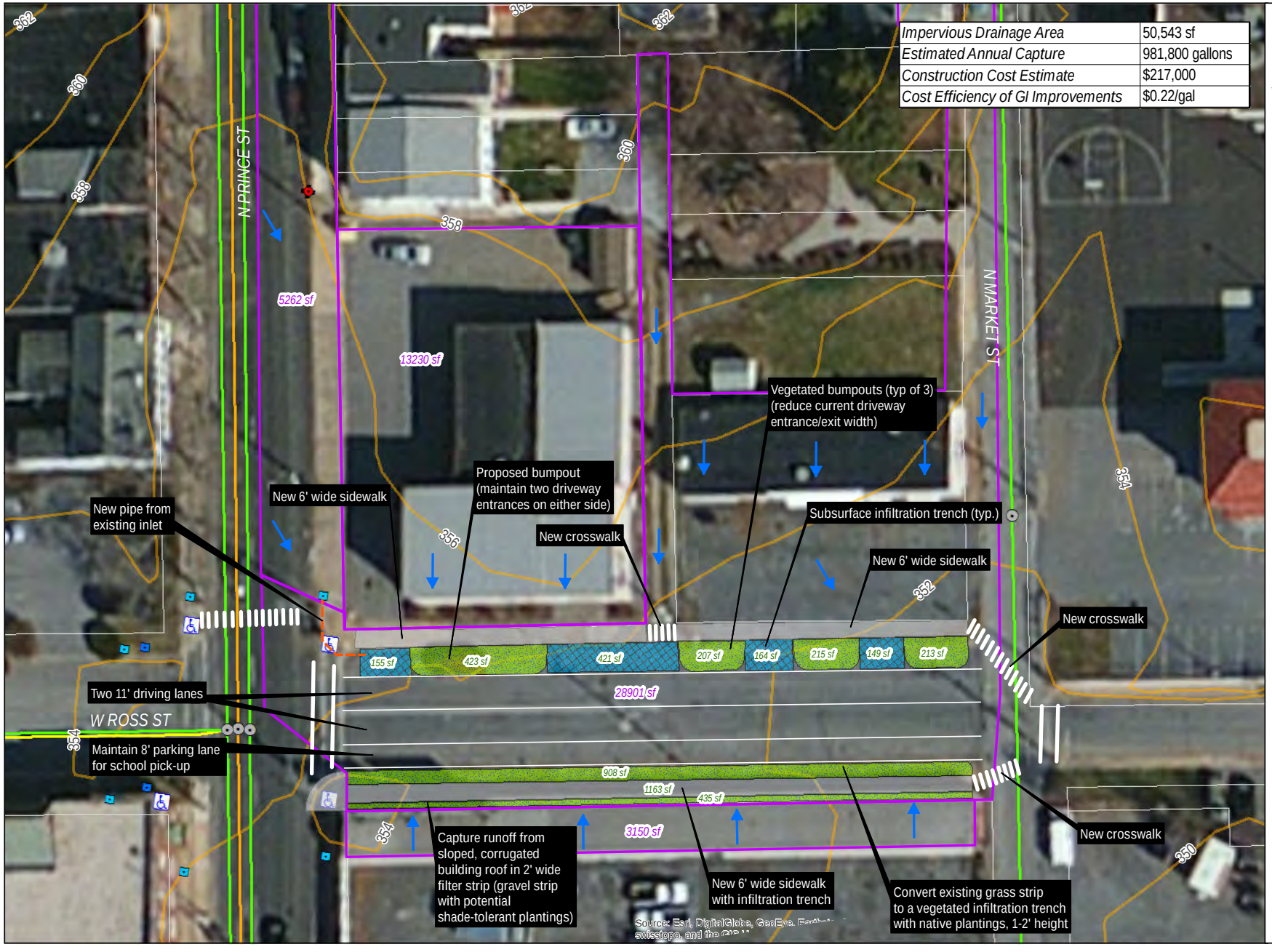


Legend

FAIRVIEW AVE - SEWER SEPARATION (DISCONNECTION) CONCEPT

- Inlet
- Surveyed Inlet (IMS)
- Diversion Chamber
- Combined Sewer Overflow
- City Gravity Sewer Lines
- New Partial Separation Storm Sewers
- Existing Fairview Ave Storm Sewer
- Building Footprint
- Proposed Bike Path
- Brandon Park Drainage Area
- Partial Separation Drainage Area
- Fairview Ave Storm Sewer Drainage Area
- Engleside CSS Basin
- City of Lancaster Boundary

N



City of Lancaster

Green Infrastructure Program

Site 191:
West Ross Street

CONCEPT PLAN

Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- Manholes
- ADA Ramps

Gravity Sewer Lines

- 4" - 15" diam.
- 15" - 30" diam.
- 30" - 60" diam.
- 60" - 120" diam.
- Parcel Boundary

N

0 15 30

Feet

1 inch = 30 feet

the city of Lancaster
a city authentic

SAVE IT!

ch2m

Map prepared Feb 2016

Approx. Location of Existing Endwall

Existing Lawn Area

Proposed Shed

Approx. Location of Existing Light Pole

Replace One (1) Parking Space with ADA Accessible Path

Proposed Arm and Hand Configurations Composed of Native Rain Garden Plantings to be Viewed from Above.

Existing Rip-Rap

Proposed Raised Gardens

Proposed Rip-Rap

Proposed Rain Garden

Proposed Outdoor Classroom

Proposed Boulders for Seating

Proposed Swale with Native Plantings to Capture Runoff from Adjacent Parking Lot

Approx. Location of Existing Light Pole

Proposed Trees to Provide Shade to Classroom Area

P:\Renderings\2016\2016992-014 - Hand Middle School\2016-04-21 - Concept Rendering\Support Files\CAD-EPS

Edward Hand Middle School Schoolyard Habitat

1" = 10'

0' 5' 10' 20' 30'

RGS ASSOCIATES

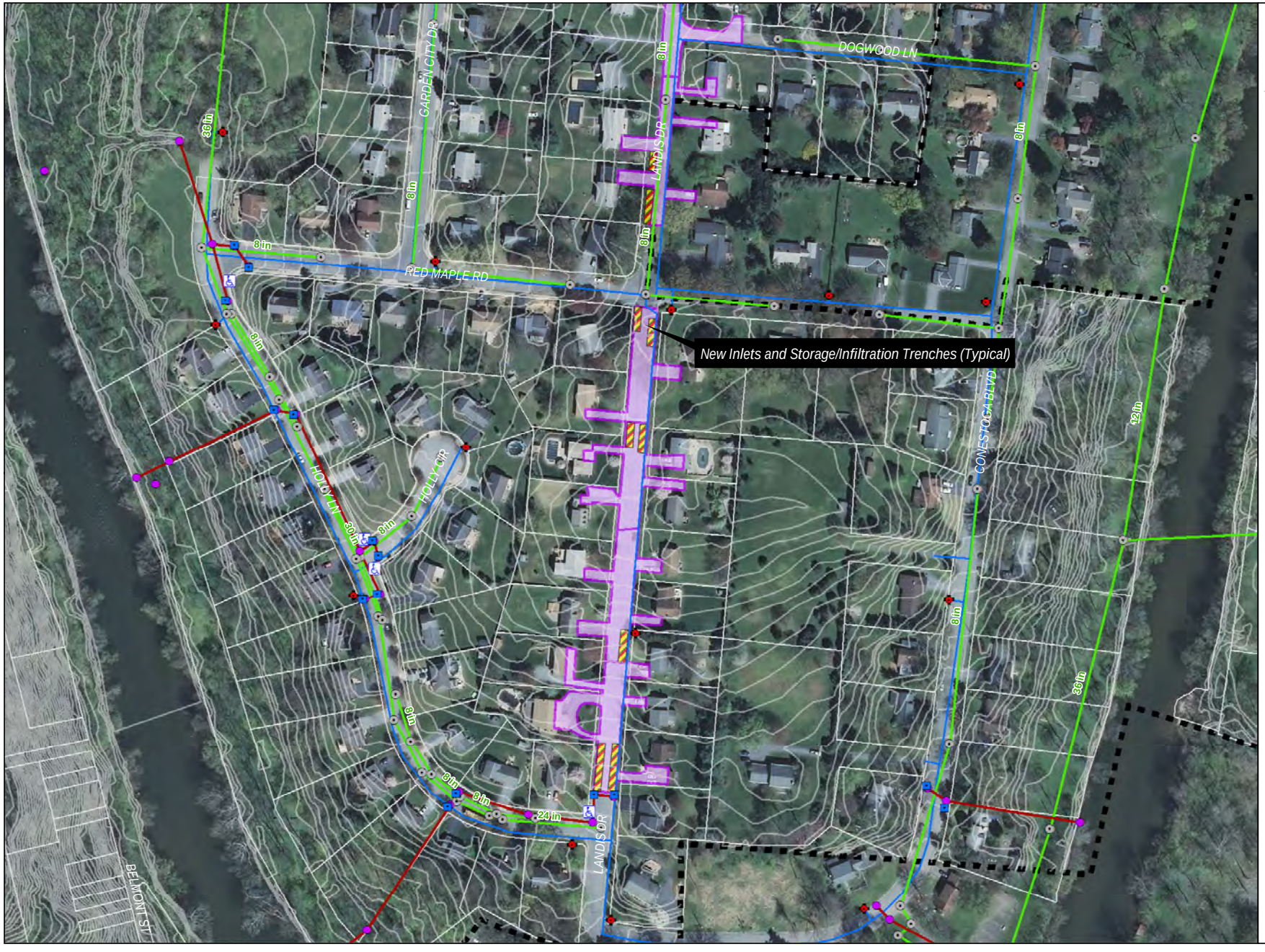
City of Lancaster, PA

04 . 22 . 2016

LANCASTER SQUARE

Concept D

Note: Project being coordinated with the City and other private development partners



City of Lancaster

Green Infrastructure Program

Landis Drive

CONCEPT PLAN

Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- MS4 Structures (USACE)
- Manholes
- ADA Ramps
- Water Mains
- MS4 Sewer Lines (USACE)
- Gravity Sewer Lines
- 2-ft Contours (LIDAR)
- Parcel Boundary
- Impervious Drainage Areas
- GI Footprints
- City Boundary

N

0 75 150

Feet

1 inch = 150 feet

the city of Lancaster
a city authentic

SAVE IT!

ch2m

Map prepared Aug 2018

City of Lancaster

Green Infrastructure Program

Landis Drive

CONCEPT PLAN

Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- MS4 Structures (USACE)
- Manholes
- ADA Ramps
- Water Mains
- MS4 Sewer Lines (USACE)
- Gravity Sewer Lines
- 2-ft Contours (LIDAR)
- Parcel Boundary
- Impervious Drainage Areas
- GI Footprints
- City Boundary

N

0 75 150

Feet

1 inch = 150 feet

the city of Lancaster
a city authentic

SAVE IT!

ch2m

Map prepared Aug 2018

APPENDIX B –
GI TECHNOLOGY FACT SHEETS

Green Streets and Green Alleys

Green streets and alleys incorporate a wide variety of green infrastructure (GI) elements including street trees, curb extensions, porous pavements, bioretention, water quality devices, planter boxes and swales. Although the design and appearance of green streets will vary, the functional goals are the same: provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, restore predevelopment hydrology to the extent possible, and provide environmentally enhanced roads. Additional potential benefits include aesthetics, safety, walkability, and heat island reduction. Green street projects often incorporate bicycle infrastructure and traffic improvements.

GI can be applied to residential, commercial and arterial streets as well as to alleys. The range of GI techniques that can be incorporated into a Green Street/Alley allow for customization of the stormwater management strategy for site-specific conditions. Since much of the impervious area in the City is found in the right-of-way, Green Streets are a critical project type.

Green Streets and Alleys may include a combination of the following practices:

- Porous pavements such as porous asphalt or porous pavers (street/alley and/or sidewalk)
- Vegetated curb extensions and other traffic calming strategies
- Stormwater planters
- Storage/infiltration trenches
- Enhanced tree plantings
- Water quality inlets
- GI may be integrated with bicycle, ADA, and pedestrian safety improvements

W. Liberty Street features vegetated curb extensions with attractive plantings, new crosswalks, new ADA ramps, and restriped bike lanes.

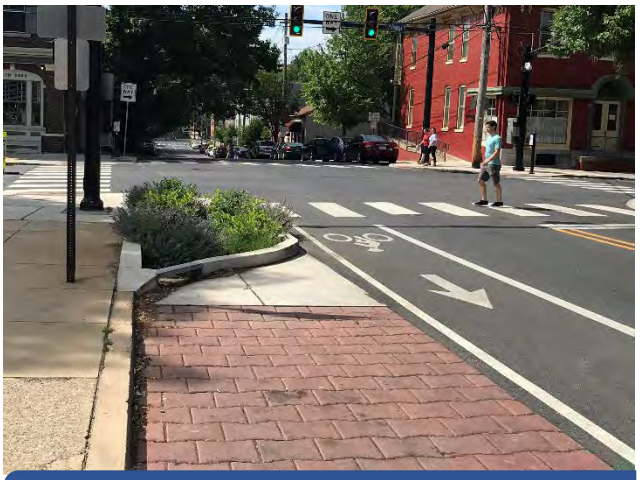
BENEFITS OF GREEN STREETS & GREEN ALLEYS

- Balance space for vehicles with green space
- Improved traffic safety
- Increased tree canopy and improved aesthetics
- Provide alternative transportation options, increased pedestrian safety/walkability
- Other applicable co-benefits of GI (energy savings, air quality improvements, urban heat island reduction, etc.)

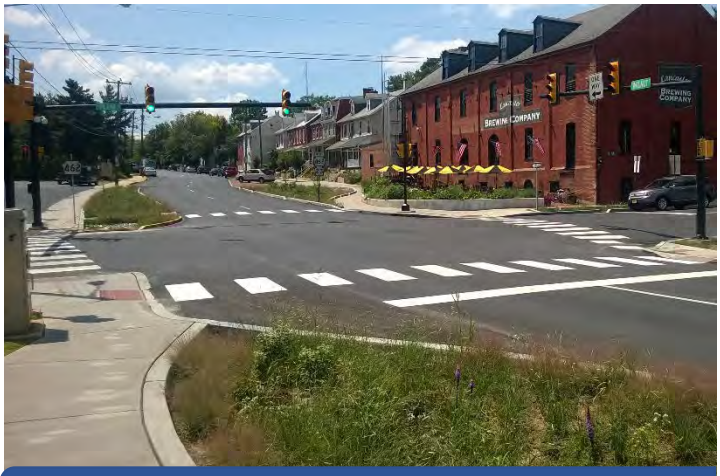
Mulberry Street is an example of a green street project that featured a one-way to two-way traffic conversion and the creation of a dedicated bike lane.

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic



Porous paver parking lanes at Mulberry Street



The GI project at Plum and Walnut Streets focused on traffic safety improvements in addition to stormwater capture.

MAINTENANCE AND COST

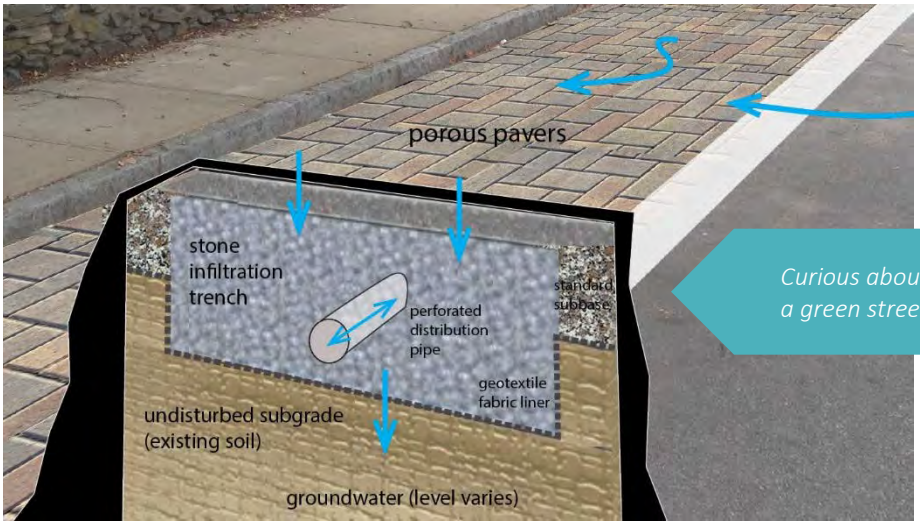
Construction of Green Streets and Alleys in the City has averaged $223,000 per impervious acre managed. Maintenance requirements and costs vary depending on the types of GI practices used. Typical GI maintenance includes:

- Porous pavement – vacuuming monthly
- Vegetated curb extensions – weeding, pruning, and trash removal monthly
- Pretreatment devices like Inlet filters – cleaning monthly

POTENTIAL LIMITATIONS

- Steep slopes, unfavorable soil/bedrock conditions
- Space constraints due to utility conflicts and the width of the right-of-way
- Conflicts with/impacts to structures and other infrastructure (e.g., adjacent building basements)

Alley 148 was redesigned to feature porous pavers atop an aggregate (gravel) infiltration trench.



Curious about what happens below the surface in a green street? Take a look.

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

Green Parks

Parks can be strong candidates for green infrastructure implementation due to their ability to manage adjacent stormwater runoff (from nearby streets, for example) within the park itself. Parks typically have large available areas for siting green infrastructure, whether a surface feature such as a bioretention system (rain garden), or a subsurface storage/infiltration trench that can be placed underneath existing fields or play courts without negatively impacting park usage.

Green Parks can incorporate a wide variety of green infrastructure (GI) elements including bioretention, porous pavements, swales, curb extensions (on adjacent streets). Although the design and appearance of green parks will vary, the functional goals are the same: provide source control of stormwater, limit its transport and pollutant conveyance to the collection system, restore predevelopment hydrology to the extent possible, and provide environmentally enhanced public spaces. Additional potential benefits include improved aesthetics, increased biodiversity, and improved pedestrian safety/walkability.

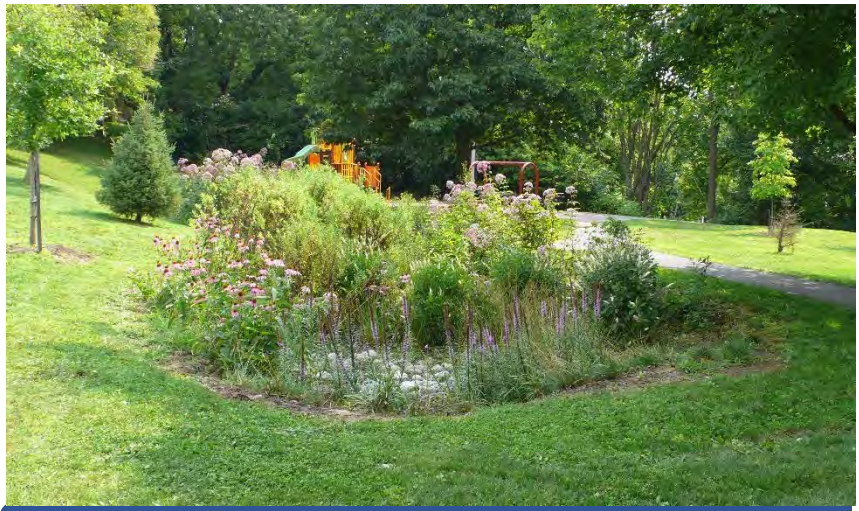
Green Parks may include a combination of the following practices:

- Porous pavements such as porous asphalt, porous pavers, or porous play surfaces
- Bioretention (rain gardens)
- Storage/Infiltration beds/trenches
- Enhanced tree plantings
- Vegetated curb extensions (bump-outs) on adjacent streets and other traffic calming strategies
- GI may be integrated with bicycle, ADA, and pedestrian safety improvements

Crystal Park features a porous pavement basketball court, porous paver plaza, and vegetated curb extensions for pedestrian safety among other park improvements.

BENEFITS OF GREEN PARKS

- Potential to manage significant quantities of runoff from both on-site and off-site
- GI features can co-exist with or enhance park programming and activities
- Increased tree canopy and biodiversity
- Improved pedestrian safety and aesthetics
- Other applicable co-benefits of GI (energy savings, air quality improvements, urban heat island reduction, etc.)



Bioretention areas such as this rain garden at Brandon Park serve to enhance biodiversity and attract pollinators in addition to managing stormwater.

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

Parks are prime candidates for multiple green infrastructure features due to the large amount of space that may be available.

Curb extensions help promote a safer pedestrian journey to the park entrance

MAINTENANCE AND COST

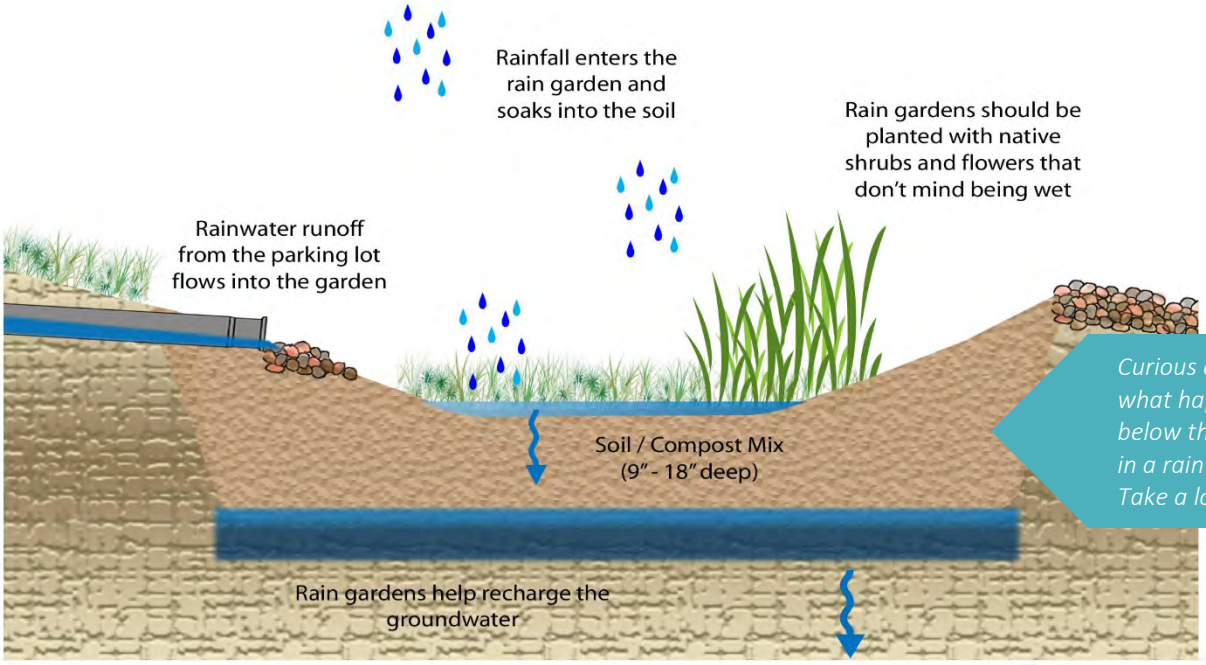
Construction of GI in parks in the City has averaged $211,000 per impervious acre managed.

Maintenance requirements and costs vary depending on the types of GI practices used. Typical GI maintenance includes:

- Porous pavement – vacuuming monthly
- Vegetated curb extensions – weeding, pruning, and trash removal monthly
- Pretreatment devices like Inlet filters – cleaning monthly

POTENTIAL LIMITATIONS

- Steep slopes, unfavorable soil/bedrock conditions
- Conflicts with existing park programming/uses and need to preserve open space
- Avoid damage to existing mature trees on site
- Conflicts with utilities, structures and other infrastructure (i.e., building foundations)



Curious about what happens below the surface in a rain garden? Take a look.

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

Green Schools

Schools are candidates for a variety of green infrastructure (GI) techniques that manage stormwater from not only buildings and parking lots on site but also potentially from adjacent impervious areas such as roadways. Many schools are located on larger-sized parcels with significant areas of impervious play surfaces, sidewalks, parking, and rooftops.

Schools are uniquely positioned to combine hands-on learning opportunities with GI implementation. Green infrastructure can not only manage stormwater and improve aesthetics on school grounds but can also be incorporated into classroom curriculums. Students can take ownership of rain garden maintenance and learn not only about managing stormwater but also about biodiversity, native plants, pollinators, and sustainability.

Green Schools may include a combination of the following practices:

- Porous pavements such as porous asphalt, porous pavers, or porous play surfaces (parking spaces, roads, basketball courts, playgrounds)
- Bioretention (rain gardens)
- Storage/infiltration beds and trenches (e.g., under natural or artificial turf)
- Enhanced tree plantings
- GI may be integrated with bicycle, ADA, and pedestrian safety improvements to promote safe routes to school and encourage alternative ways of commuting
- Vegetated curb extensions (bump-outs) on adjacent streets and other traffic calming strategies
- Green roofs

Similar to Crystal Park shown here, Green Schools can feature porous pavement basketball courts and porous pavement play areas.

BENEFITS OF GREEN SCHOOLS

- Enhance classroom curriculum related to environmental education and provide service-learning opportunities for students
- Reduce stormwater management fees
- Increased pedestrian safety/improved walkability
- Improved aesthetics, tree canopy, and enhanced biodiversity
- Other applicable co-benefits of GI (energy savings, air quality improvements, urban heat island reduction, etc.)

Porous pavement parking spaces, such as these at McCaskey High School, manage school parking lot runoff while improving aesthetics.

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

The green infrastructure concept for Hand Middle School incorporates a rain garden as a "schoolyard habitat". Rain gardens offer significant environmental education opportunities for students.

MAINTENANCE AND COST

Until more GI is installed at schools in Lancaster, it is assumed that the costs will be similar to GI in parks (averaging $211,000 per impervious acre managed).

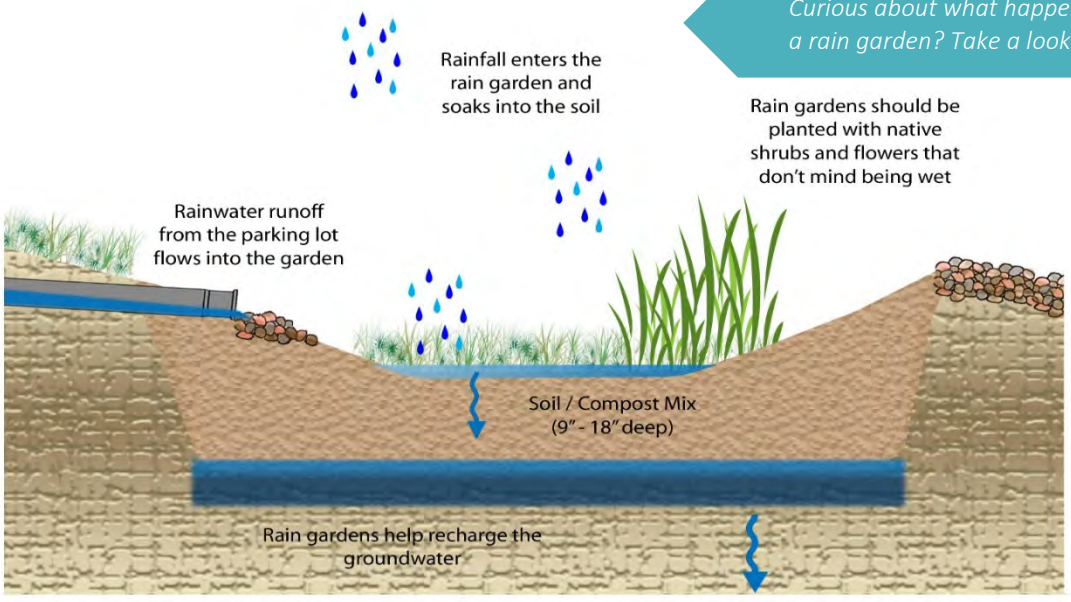
Maintenance requirements and costs vary depending on the types of GI practices used. Typical GI maintenance includes:

- Porous pavement – vacuuming monthly
- Vegetated curb extensions – weeding, pruning, and trash removal monthly
- Pretreatment devices like Inlet filters – cleaning monthly

POTENTIAL LIMITATIONS

- Steep slopes, unfavorable soil/bedrock conditions
- Need to preserve space for existing schoolyard usage and activities
- Safety considerations associated with schools
- Utility conflicts
- Conflicts with structures and other infrastructure (e.g., building foundations)

Curious about what happens below the surface in a rain garden? Take a look.



SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

Green Parking Lots

Parking lots are a significant source of the City's impervious area (27% of the total impervious area) and generate substantial amounts of stormwater runoff to the combined sewer system. Green infrastructure has been successfully implemented in both privately-owned and publicly-owned surface parking lots.

The cost of implementing green infrastructure in parking lots can be significantly reduced if projects are coordinated to take place when the pavement needs to be replaced or the parking lot requires reconfiguration for other reasons.

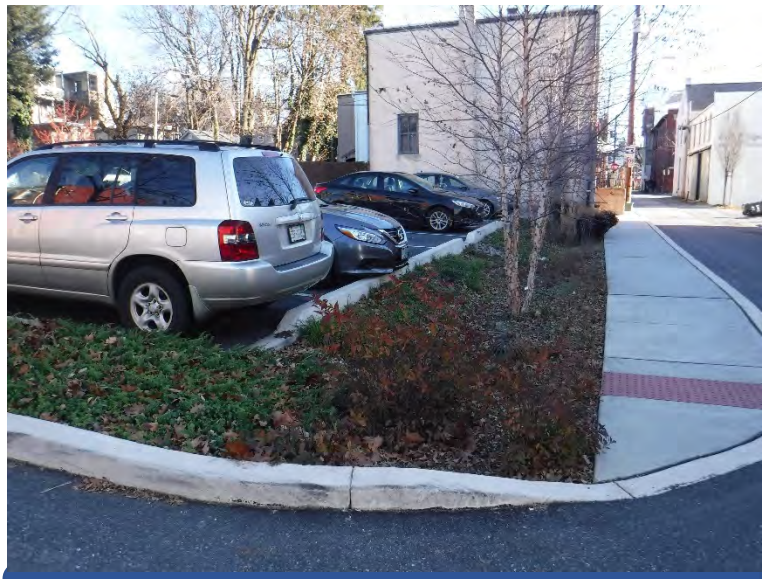
The range of GI techniques that can be incorporated into a parking lot allow for customization of the stormwater management strategy for site-specific conditions.

Green Parking Lots may include a combination of the following practices:

- Porous pavements such as porous asphalt or porous pavers (often specified in the parking spaces rather than the drive lanes)
- Bioretention/rain gardens in islands or along the perimeter
- Storage/infiltration trenches
- Enhanced tree plantings
- Water quality inlets

BENEFITS OF GREEN PARKING LOTS

- Balance parking spaces with green space
- Increased tree canopy and improved aesthetics
- Improved layout/traffic flow
- Other applicable co-benefits of GI (energy savings, air quality improvements, urban heat island reduction, etc.)



The GI project installed at the parking lot of the Community Mennonite Church features porous asphalt, attractive plantings, and new trees.

The public parking lot on Mifflin Street features a large bioretention area in the island with native plantings and new trees. The design also featured reconfiguration and restriping of the parking spaces.

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

MAINTENANCE AND COST

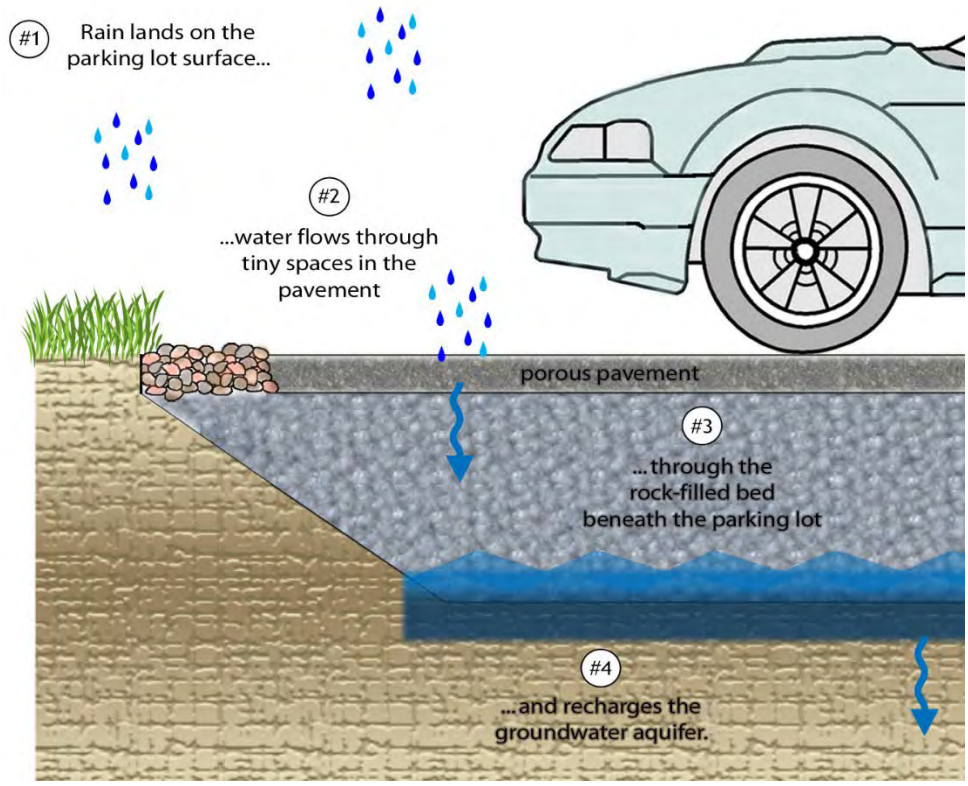
Construction of privately-owned Green Parking Lots in the City has averaged $258,000 per impervious acre managed.

Maintenance requirements and costs vary depending on the types of GI practices used. Typical GI maintenance includes:

- Porous pavement – vacuuming monthly
- Vegetated curb extensions – weeding, pruning, and trash removal monthly
- Pretreatment devices like Inlet filters – cleaning monthly

This parking area along North Jefferson Street was reconfigured to include a rain garden. A colorful mural was painted behind the rain garden to add to the overall improvement of the site.

Curious about what happens below the surface with porous pavement? Take a look.



POTENTIAL LIMITATIONS

- Unfavorable soil/bedrock conditions
- Inability to reduce parking spaces and/or reconfigure the lot
- Utility conflicts
- Conflicts with structures and other infrastructure (e.g., building basements)

SAVE IT! YOUR WATER. YOUR MONEY. YOUR CITY. savelancaster.org

CITY OF LANCASTER A City Authentic

APPENDIX C – LANCASTER CITY STORMWATER ORDINANCE

The full Chapter 260 Stormwater Management ordinance is available at:
https://ecode360.com/8119841

The full Chapter 202 Parking Lots ordinance is available at:
https://ecode360.com/8118669

APPENDIX D – DCNR URBAN TREE CANOPY ASSESSMENT

A Report on the City of Lancaster's Existing and Possible Tree Canopy

Why is Tree Canopy Important?

Tree canopy (TC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above. Tree canopy provides many benefits to communities, improving water quality, saving energy, lowering city temperatures, reducing air pollution, enhancing property values, providing wildlife habitat, facilitating social and educational opportunities, and providing aesthetic benefits. Establishing a tree canopy goal is crucial for communities seeking to improve their green infrastructure. A tree canopy assessment is the first step in this goal-setting process, providing estimates for the amount of tree canopy currently present in a city as well as the amount of tree canopy that could theoretically be established.

How Much Tree Canopy Does Lancaster Have?

An analysis of the City of Lancaster's tree canopy based on land cover data derived from high-resolution aerial imagery and LiDAR (Figure 1) found that 1,299 acres of the city were covered by tree canopy (termed Existing TC), representing 28% of all land in the city. An additional 45% (2,063 acres) of the city could theoretically be modified (termed Possible TC) to accommodate tree canopy (Figure 2). In the Possible TC category, 19% (863 acres) of the city was classified as Impervious Possible TC and another 26% was Vegetated Possible TC (1,200 acres). Vegetated Possible TC, or grass and shrubs, is more conducive to establishing new tree canopy, but establishing tree canopy on areas classified as Impervious Possible TC will have a greater impact on water quality and summer temperatures.

Figure 1: Land cover derived from high-resolution aerial imagery for the City of Lancaster.

Project Background

The goal of the project was to apply the USDA Forest Service's TC assessment protocols to the City of Lancaster. The analysis was conducted based on year 2010 data. This analysis of the City of Lancaster's tree canopy (TC) was conducted in collaboration with the PA Department of Conservation and Natural Resources Bureau of Forestry, City of Lancaster, Lancaster County, the University of Vermont, and the Northern Research Station. The Spatial Analysis Laboratory (SAL) at the University of Vermont's Rubenstein School of the Environment and Natural Resources conducted the assessment.

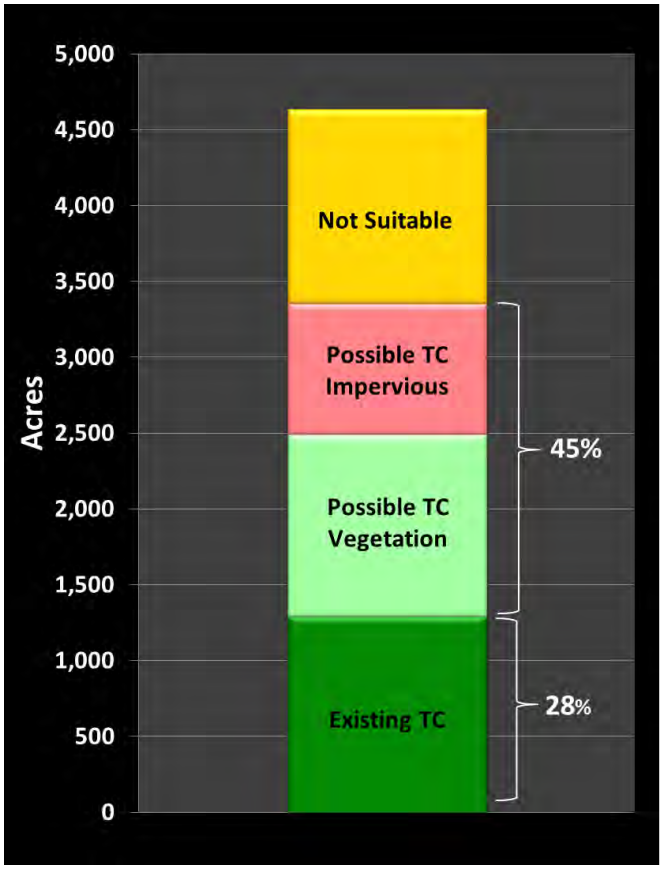


Figure 2: TC metrics for the City of Lancaster based on % of land area covered by each TC type.

Key Terms

TC: Tree canopy (TC) is the layer of leaves, branches, and stems of trees that cover the ground when viewed from above.
Land Cover: Physical features on the earth mapped from aerial or satellite imagery, such as trees, grass, water, and impervious surfaces.
Existing TC: The amount of urban tree canopy present when viewed from above using aerial or satellite imagery.
Impervious Possible TC: Asphalt or concrete surfaces, excluding roads and buildings, that are theoretically available for the establishment of tree canopy.
Vegetated Possible TC: Grass or shrub area that is theoretically available for the establishment of tree canopy.

Mapping the City of Lancaster's Trees

Prior to this study, the only comprehensive remotely sensed estimates of tree canopy for the City of Lancaster was from the 2001 National Land Cover Database (NLCD 2001). While NLCD 2001 is valuable for analyzing land cover at the regional level, it is derived from relatively coarse, 30-meter resolution satellite imagery (Figure 3a). Using high-resolution aerial imagery acquired in 2010 (Figure 3b), in combination with LiDAR and advanced automated processing techniques, land cover for the city was mapped with such detail that trees as short as 6ft tall were detected (Figure 3c). NLCD 2001 estimated a mean percent tree canopy of 10% for the City of Lancaster largely because it failed to capture many isolated trees.

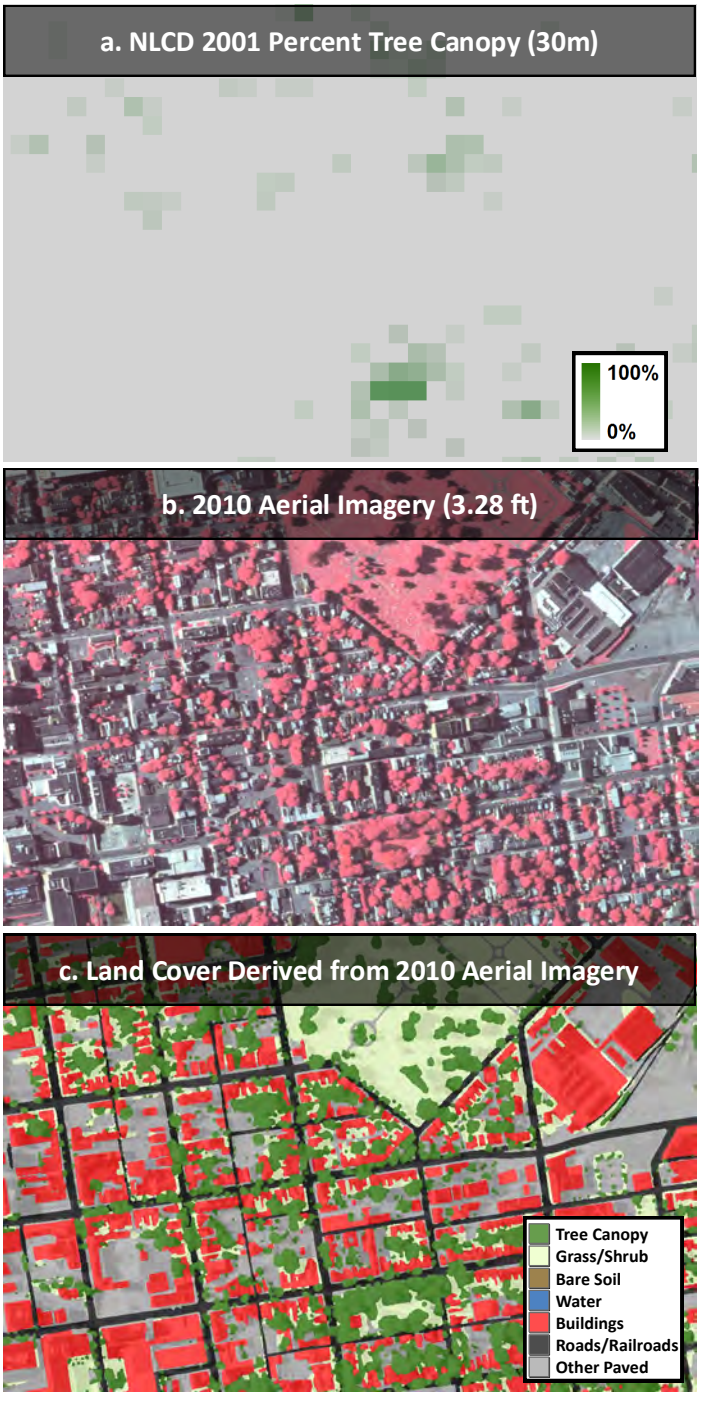


Figure 3a, 3b, 3c: Comparison of NLCD 2001 to high-resolution land cover.

Parcel Summary

After land cover was mapped city-wide, Tree Canopy (TC) metrics were summarized for each property in the city's parcel database (Figure 4). Existing TC and Possible TC metrics were calculated for each parcel, both in terms of total area and as a percentage of the land area within each parcel (TC area ÷ land area of the parcel).

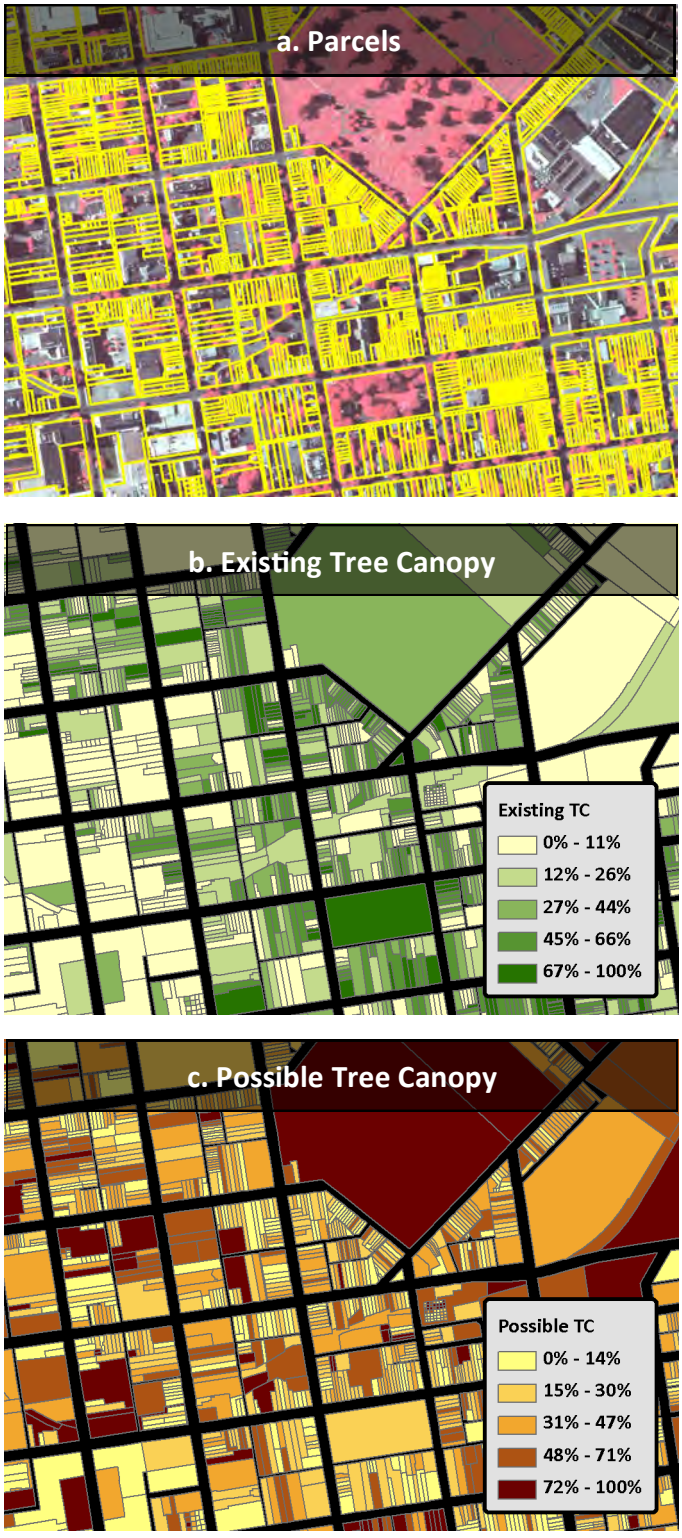


Figure 4a, 4b, 4c: Parcel-based TC metrics. TC metrics are generated at the parcel level, allowing each property to be evaluated according to its Existing TC and Possible TC.

Land Use

Lancaster County maintains a comprehensive land use layer for the County which includes Lancaster City. For the this study the land use data were aggregated into thirteen general categories. Existing and Possible tree canopy was summarized for the thirteen aggregated land use classes (Figure 5, Table 1). For each land use category, Tree Canopy (TC) metrics were calculated as a percentage of all land in the city (% Land), as a percentage of land area in the specified land use category (% Category), and as a percentage of the area for TC type (% TC Type). Residential land use had the largest amount of tree canopy of any land use category with 31% of all tree canopy. Residential land use also had the largest percentage of land area covered by tree canopy (9%). Residential land use had most of the Possible Vegetated TC available to support tree plantings (32%) while Commercial and Retail Trade had the most Impervious Possible TC (36%) available for planting trees of all land use categories. Vacant Lands also had a high percentage of Existing TC (39%), Possible Vegetated TC (33%), and Possible Impervious TC (18%).

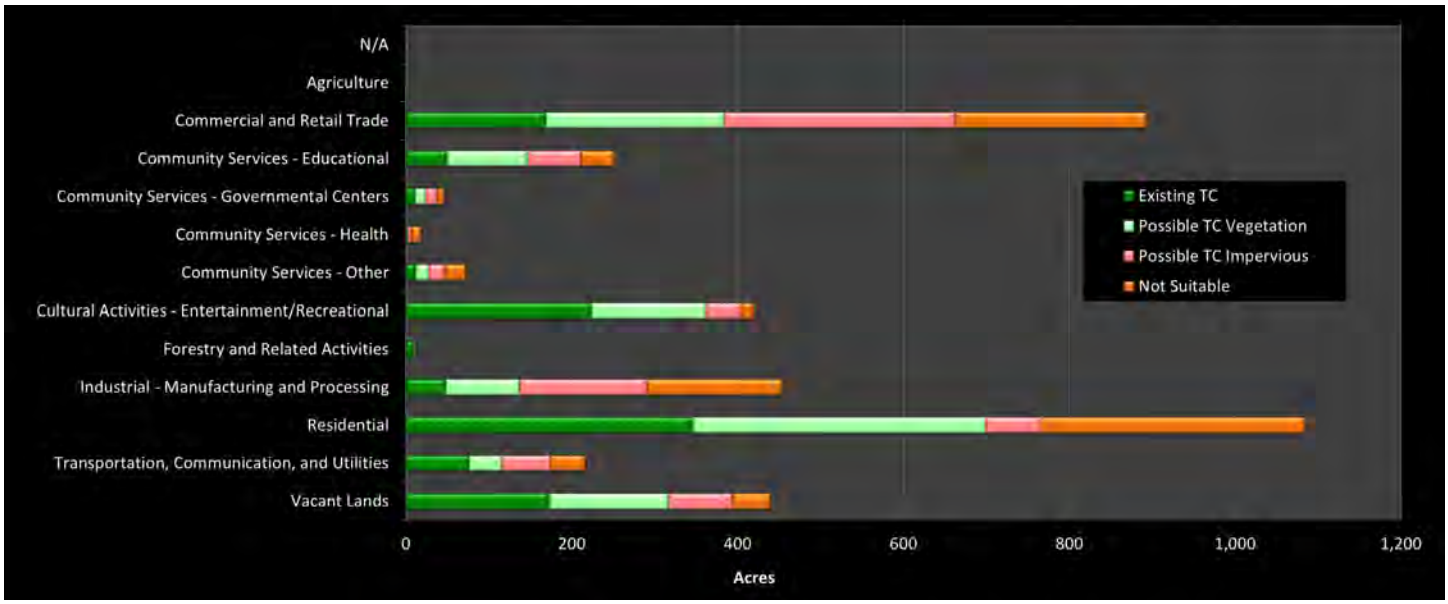


Figure 5: Tree Canopy (TC) metrics summarized by land use category.

Land Use	Existing TC			Possible TC Vegetation			Possible TC Impervious		
	% Land	% Category	% TC Type	% Land	% Category	% TC Type	% Land	% Category	% TC Type
N/A	0%	19%	0%	0%	9%	0%	0%	48%	0%
Agriculture	0%	65%	0%	0%	21%	0%	0%	14%	0%
Commercial and Retail Trade	4%	19%	15%	5%	24%	19%	7%	31%	36%
Community Services - Educational	1%	20%	4%	2%	39%	9%	2%	25%	8%
Community Services - Governmental Centers	0%	22%	1%	0%	30%	1%	0%	28%	2%
Community Services - Health	0%	6%	0%	0%	5%	0%	0%	26%	1%
Community Services - Other	0%	17%	1%	0%	21%	1%	1%	28%	3%
Industrial - Manufacturing and Processing	1%	11%	4%	2%	20%	8%	4%	34%	20%
Residential	9%	32%	31%	9%	32%	32%	2%	6%	9%
Transportation, Communication, and Utilities	2%	35%	7%	1%	18%	4%	2%	27%	8%
Vacant Lands	4%	39%	15%	4%	33%	13%	2%	18%	10%

$$\text{\% Land} = \frac{\text{Area of TC type for land use category}}{\text{Area of all land}}$$

The % Land Area value of 9% indicates that 9% of Lancaster's land area is covered by tree canopy in the Residential land use class.

$$\text{\% Category} = \frac{\text{Area of TC type for land use category}}{\text{Area of all land for specified land use}}$$

The % Land value of 32% indicates that 32% of land in the Residential land use category is covered by tree canopy.

$$\text{\% TC Type} = \frac{\text{Area of TC type for land use category}}{\text{Area of all TC type}}$$

The % TC Type value of 31% indicates that 31% of all tree canopy is in the Residential land use category.

Table 1: Tree Canopy (TC)metrics were summarized by land use category. For each land use category, TC metrics were computed as a percentage of all land in the city (% Land), as a percentage of land in the specified land use category (% Category), and as a percentage of the area for TC type (% TC Type).

Zoning Analysis

Existing and Possible Tree Canopy (TC) was analyzed by Zoning category for Lancaster (Figure 6). Land zoned as Residential and Conservation/ Park/Open Space account for 56% and 29% of the Existing TC by land area, respectively. Manufacturing/Central City and Residential Medium Density categories had the most acreage available for Possible TC with 437 acres and 301 acres representing 21% and 15% of the Possible TC by zoning category.

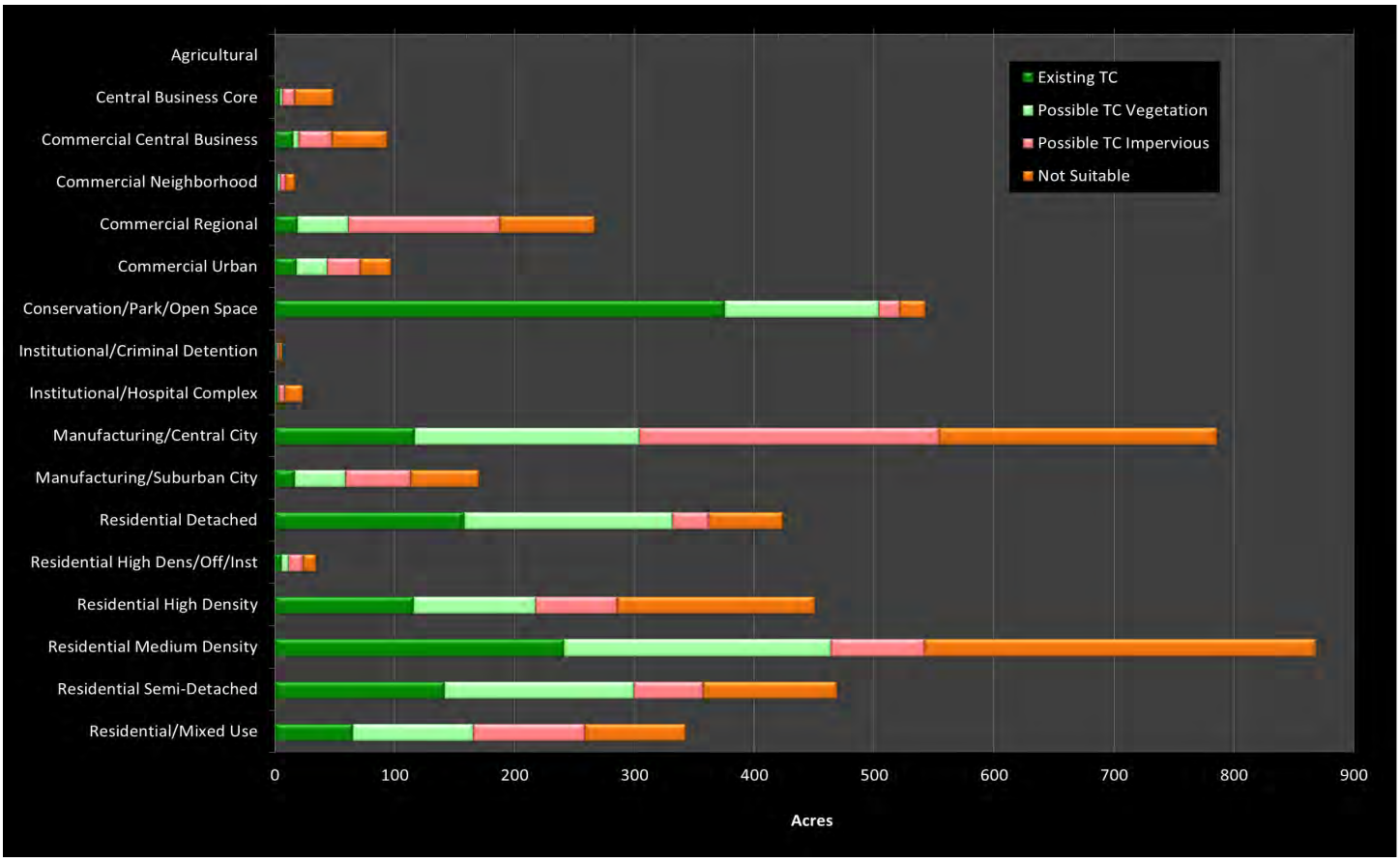
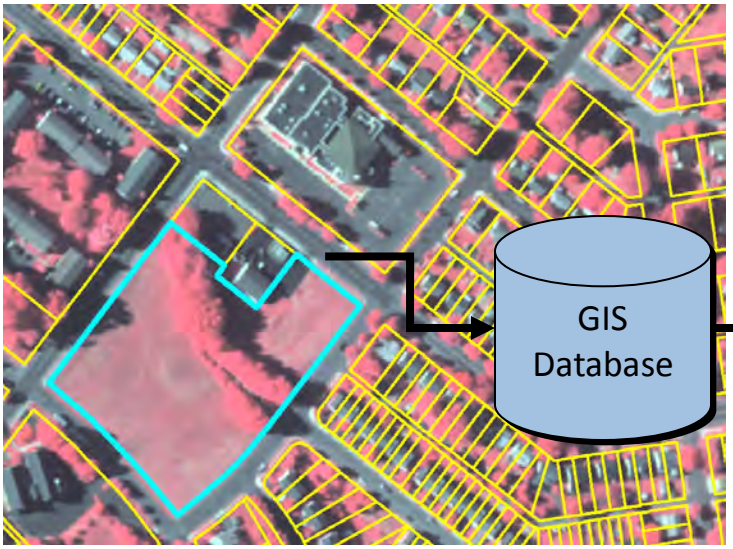


Figure 6: Tree Canopy (TC) metrics summarized by zoning category.

Decision Support



Parcel-based Tree Canopy (TC) metrics were integrated into the city's existing GIS database (Figure 7). Decision makers can use GIS to query specific TC and land cover metrics for a parcel or set of parcels. For example, this information can be used to estimate the amount of tree loss in a planned development or set TC improvement goals for an individual property.

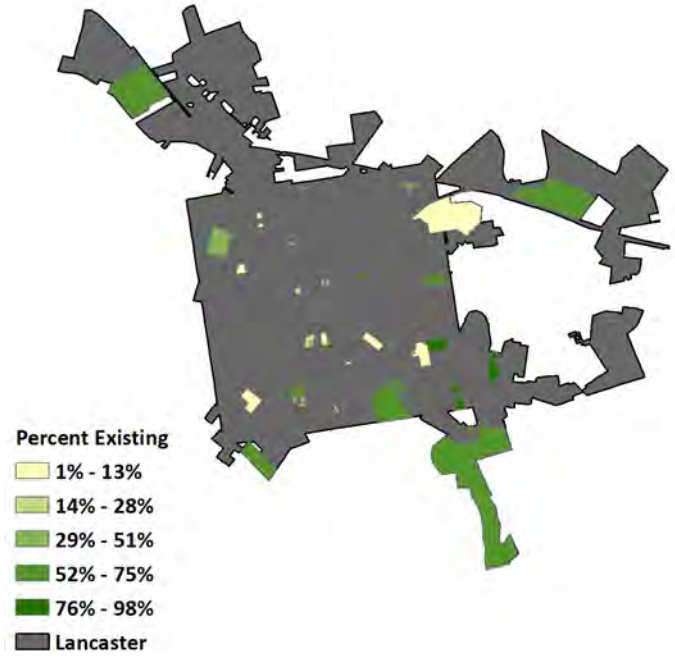
Attribute	Value
Land Use	Vacant Land
Parcel ID	141605
Address	64 Springhouse Road
Existing TC	19%
Possible TC	82%
Possible TC—Vegetation	79%
Possible TC—Impervious	3%

Figure 7: GIS-based analysis of parcel-based TC metrics for decision support. In this example, GIS is used to select an individual parcel. The attributes for that parcel, including the parcel-based TC and land cover metrics, are displayed in tabular form providing instant access to relevant information.

Parks Analysis

Cabbage Hill Veterans Memorial, Hand W.O.O.D.S., Holly Pointe Conservation Area, and Triangle Park have the highest Existing Tree Canopy (> 95%). Nine parks had 8% or less tree canopy. Edward Hand Jr. High and Washington Elementary, Ewel/Ganz Playground, George Ross Elementary, and Wharton Elementary School each had relatively high amounts of Possible TC (> 93%).

Existing Tree Canopy



Possible Tree Canopy

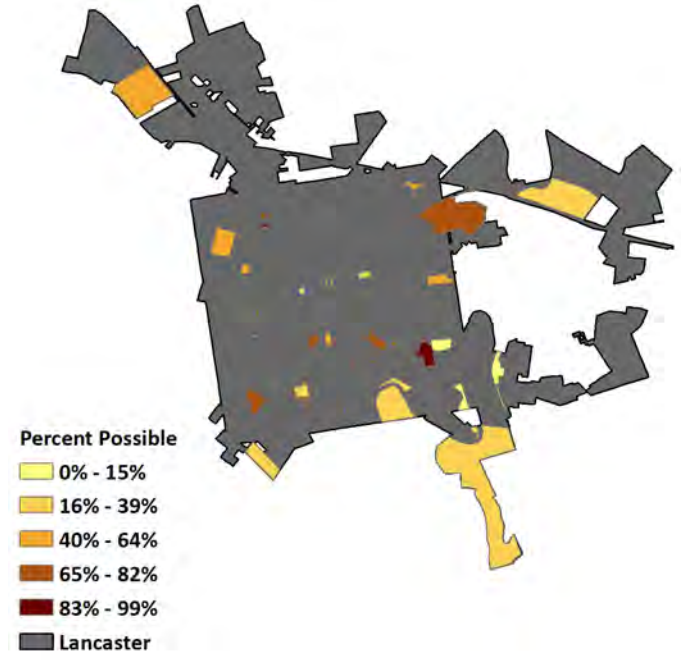
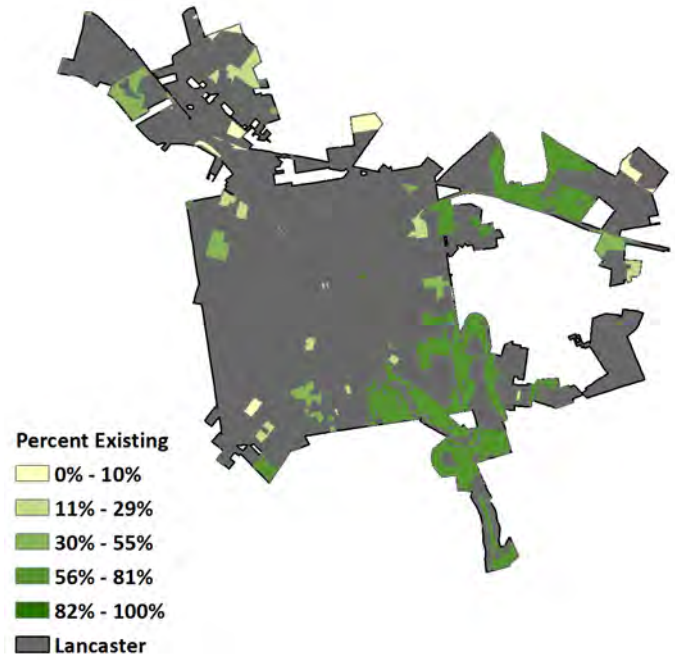


Figure 8: Existing TC (left) and Possible TC (right) as a percentage by Park.

Priority Habitat Restoration Area Analysis

The Priority Habitat Restoration Area layer was used to summarize Existing and Possible TC within Lancaster. Twenty-four of the restoration areas (27%) had Existing TC exceeding 93%. Over 35% of the restoration areas had greater than 50% Possible TC.

Existing Tree Canopy



Possible Tree Canopy

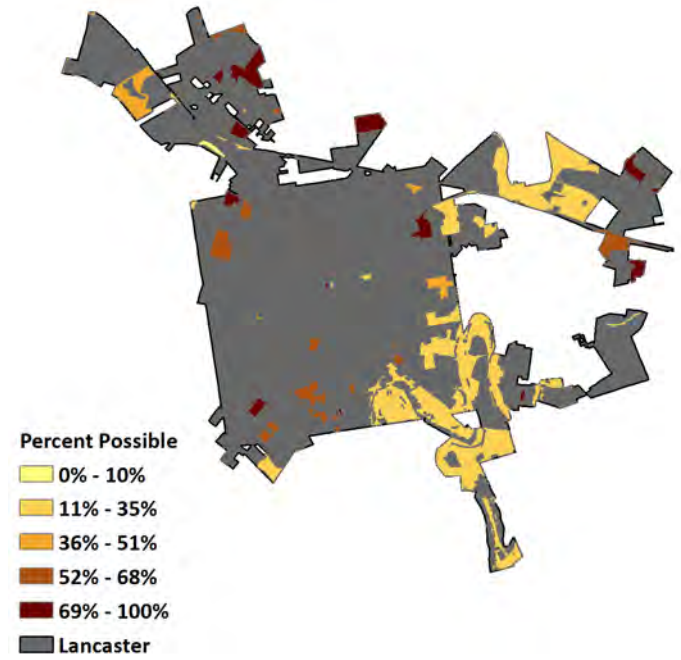
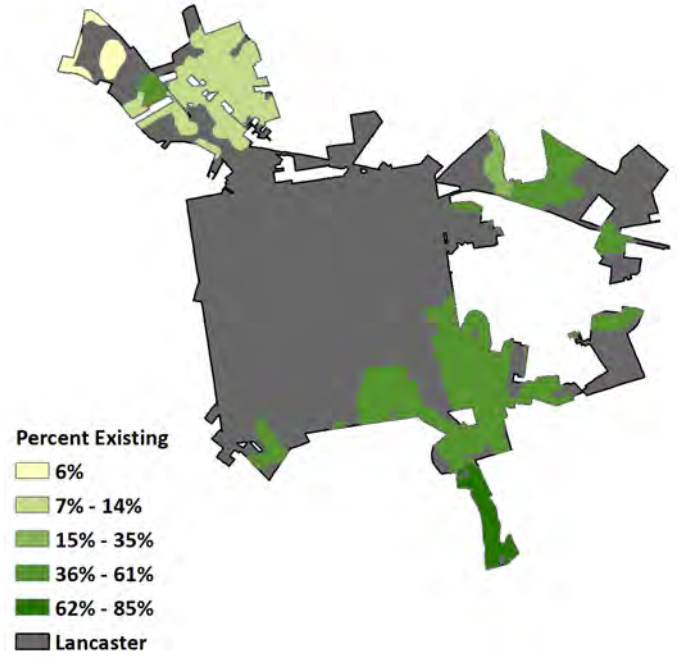


Figure 9: Existing TC (left) and Possible TC (right) as a percentage by Priority Restoration Habitat Area.

Riparian Buffer Analysis

Tree canopy metrics were calculated for riparian buffers within Lancaster. Higher amounts of Existing Tree Canopy are clustered in both the southern and eastern parts of the city along Conestoga and Mill Creek. Riparian buffers located in the northern portions of the city along Little Conestoga Creek had the highest amounts of Possible TC.

Existing Tree Canopy



Possible Tree Canopy

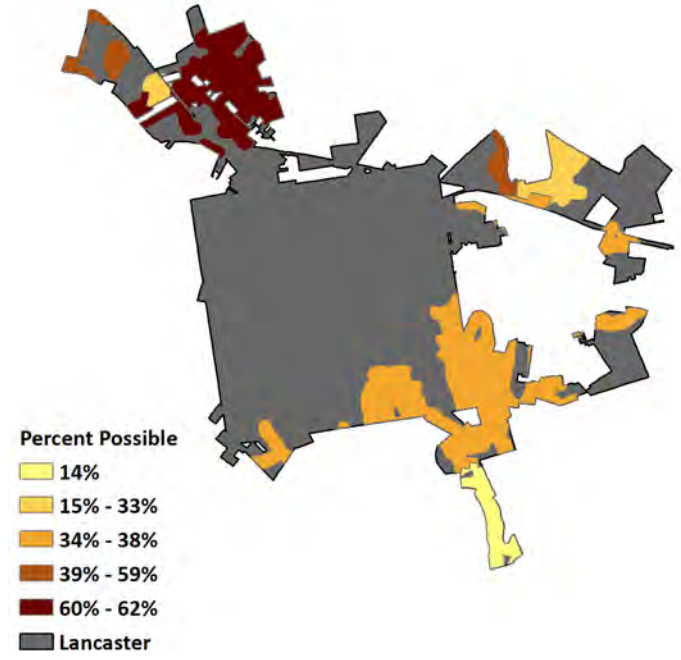


Figure 10. Existing TC (left) and Possible TC (right) as a percentage by riparian buffer.

Roads and Rights-of-Ways Analysis

Tree Canopy (TC) metrics were summarized by roads and rights-of-ways (ROW) as a surrogate analysis of street trees in Lancaster. Tree canopy overhanging roads accounts for 96 acres of tree canopy or 20% of all road areas while 24% of ROW are covered by tree canopy (24%). Within ROW, 24% of the land was mapped as Possible TC suggesting there are opportunities for adding street trees in the city.

Figure 11: Tree Canopy metrics summarized for all roads.

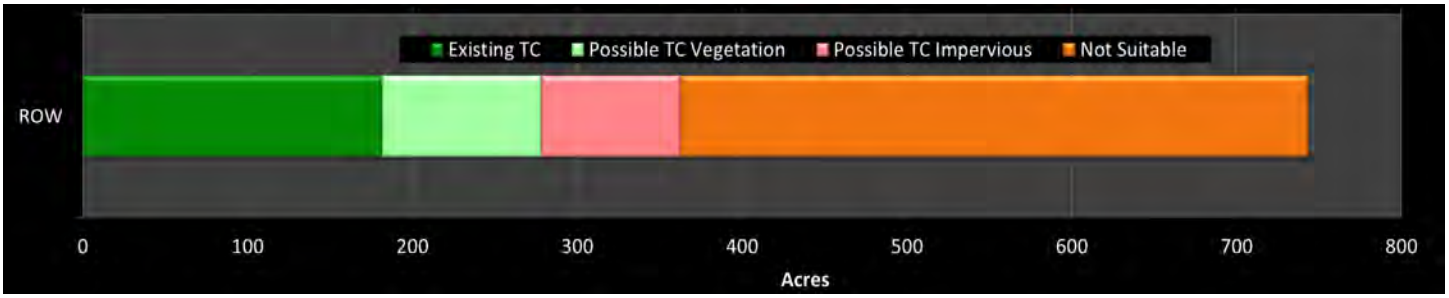


Figure 12: Tree Canopy metrics summarized for all rights-of-ways.

Conclusions

- City of Lancaster's urban tree canopy is a vital city asset that reduces stormwater runoff, improves air quality, reduces the city's carbon footprint, enhances quality of life, contributes to savings on energy bills, and serves as habitat for wildlife.
- Although this assessment indicates that 45% of the land in Lancaster could theoretically support tree canopy, planting new trees on much of this land may not be social desirable (e.g. recreation fields) or financially feasible (e.g. parking lots). Setting a realistic goal requires a detailed feasibility assessment using the geospatial datasets generated as part of this assessment.
- With Existing and Possible TC summarized at the parcel level and integrated into the city's GIS database, individual parcels and subdivisions can be examined and targeted for TC improvement. Of particular focus for TC improvement should be parcels in the city that have large, contiguous impervious surfaces. These parcels contribute high amounts of runoff, which degrades water quality. The establishment of tree canopy on these parcels will help reduce runoff during periods of peak overland flow.
- Lancaster's residents control the majority of the City's tree canopy and have most of the land to plant tees. Programs that educate residents on tree stewardship and provide incentives for tree planting are crucial if City of Lancaster is going to sustain its tree canopy in the long term.
- Commercial and Retail Trade land use has high amounts of Possible TC therefore incentive programs could be used to encourage business owners to maintain or plant additional tree canopy on their property.
- Park and Priority Habitat Restoration Area summaries can be used for targeting tree planting and preservation efforts in different parts of the city.
- With TC metrics summarized by riparian buffers, individual streams can be examined and targeted for TC improvement and establishing or maintaining tree canopy along streams for reducing surface runoff, controlling streambank erosion, and providing wildlife habitat.
- The city's rights-of-way (ROW) contain 24% Existing TC and 24% Possible TC, suggesting that opportunities exist for increasing the number of street trees.

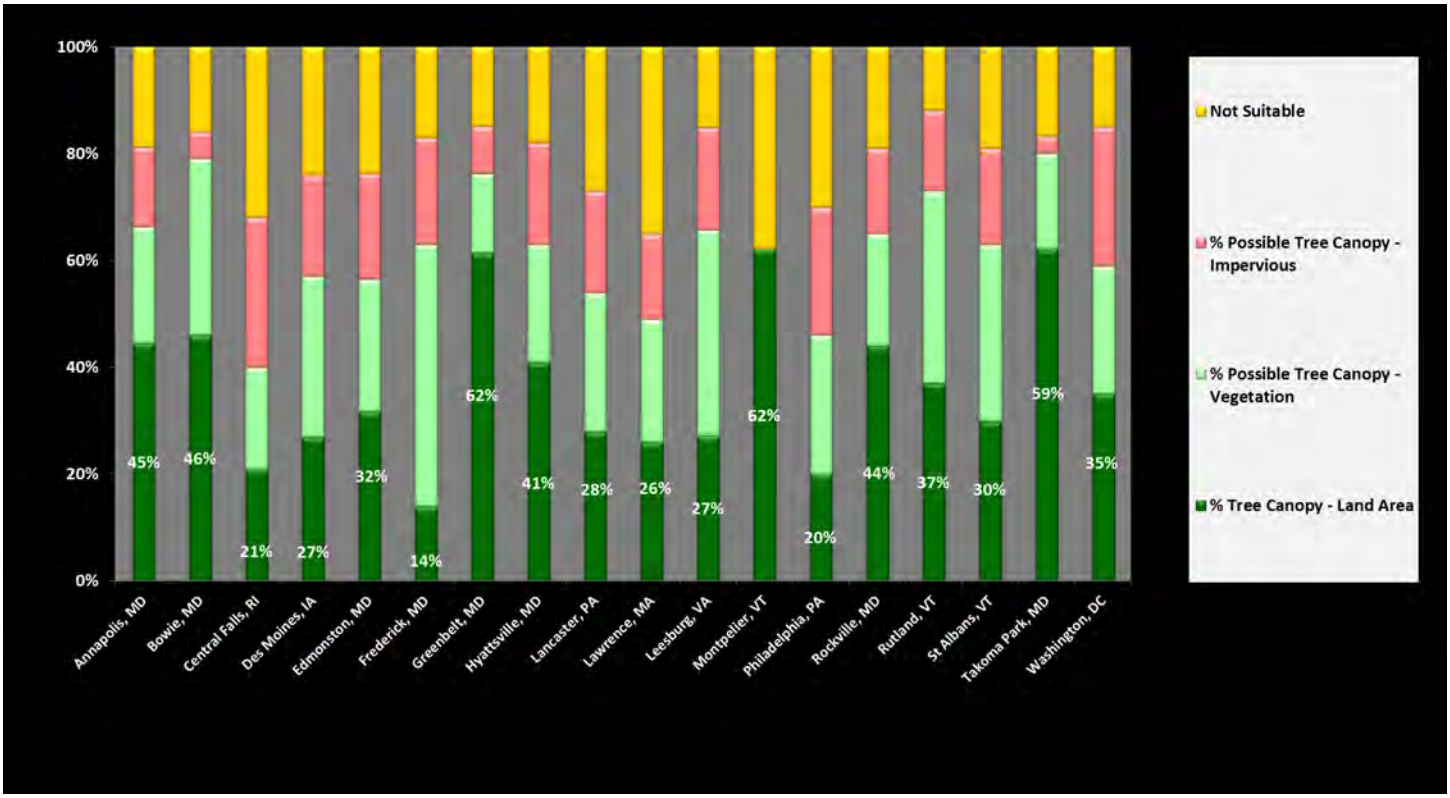


Figure 13: Comparison of Existing and Possible Tree Canopy with other selected cities that have completed Tree Canopy Assessments.

Prepared by:

Keith Pelletier
Jarlath O'Neil-Dunne
University of Vermont
Spatial Analysis Laboratory
kpelletti@uvm.edu
joneildu@uvm.edu
802.656.3324

Additional Information

Funding for the project was provided by PA Department of Conservation and Natural Resources Bureau of Forestry. More information on the TC assessment project can be found at the following web site: **http://nrs.fs.fed.us/urban/utc/**

Spatial Analysis Lab Tree Canopy Assessment Team: Brian Beck, Ray Gomez, Claire Greene, Dan Koopman, Sean MacFaden, Jarlath O'Neil-Dunne, Keith Pelletier, Eleanor Regan, Anna Royar, Bobby Sudekum, and Emily West

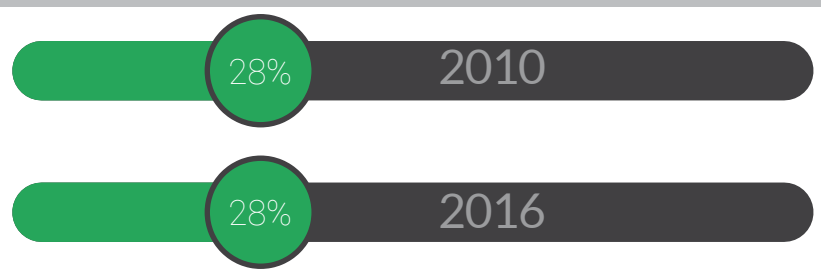
University of Vermont Spatial Analysis Lab

Tree Canopy Change in the City of Lancaster

2010
2016

No net change

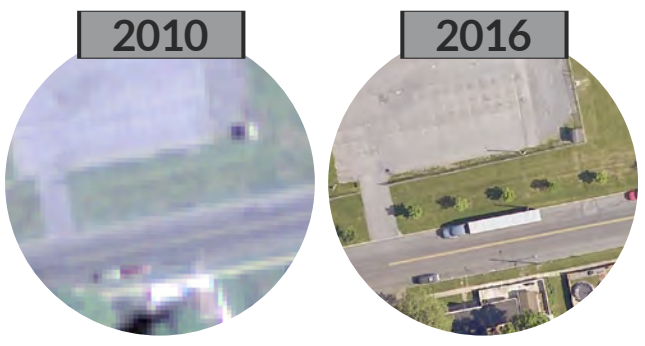
Over the *2010 to 2016 time period the* City of Lancaster experienced no net change in the amount of tree canopy. This bucks the trend that many communities in the United States are experiencing, which is a loss of tree canopy.



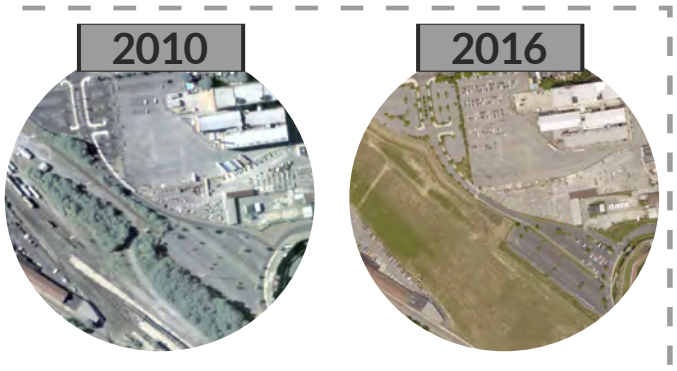
The tree canopy change detection was carried out using high-resolution aerial imagery. The imagery acquired in 2010 and 2016 were from different sensors and do not perfectly align, adding to the challenge of distinguishing false from true change. The estimated error for the mapping is +/- 1%.

A mix of loss and gains

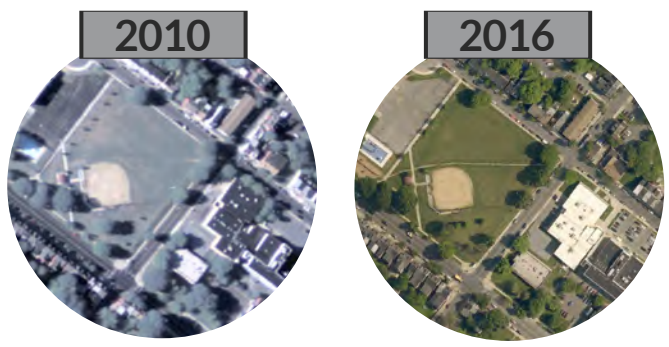
The actual story of tree canopy change in Lancaster is more nuanced than simply stating that tree canopy did not change. Over the six-year *time period*, areas throughout Lancaster experienced localized gains and losses. These changes have both positive (e.g., reduced peak summer temperatures) and negative (e.g., loss of wildlife habitat) effects. Tree canopy loss, whether due to human activities, such as construction, or natural events, such as pest outbreaks, can be near instantaneous and dramatic. Tree canopy increases resulting from new plantings, natural regeneration, and growth, are slow processes that take time and commitment. Maintaining Lancaster's tree canopy in the future will require investments in efforts that preserve existing tree canopy in addition to tree plantings.



Near the intersection of New Dauphin Street and S. Reservoir St, newly planted trees have contributed additional tree canopy to the City.



An area of substantial tree canopy loss near Clipper Magazie Stadium. This type of extensive forest loss harms numerous ecosystem services and will take decades to replace.



There is almost no place within the city that does not show signs of loss and gain. This area near the interection of Duke and Dauphin Strees shows evidence of both loss and gain.

Jarlath O'Neil-Dunne University of Vermont joneildu@uvm.edu 802.*656.3324* *May 2*, 2018

APPENDIX E –
GI DESIGN MANUAL

The final version of the GI Design Manual will be available through SaveIt! and the City's website:

http://www.saveitlancaster.com

APPENDIX F – GI OPERATIONS AND MAINTENANCE MANUAL

The final version of the GI Operations and Maintenance Manual will be available through SaveIt! and the City's website:

http://www.saveitlancaster.com

APPENDIX G–
GI MONITORING PLAN

The final version of the GI Monitoring Plan will be available through SaveIt! and the City's website:

http://www.saveitlancaster.com