Green Stormwater Infrastructure **Strategic Framework**

April 2022

PHILADELPHIA WATER DEPARTMENT

Green City, Clean Waters

Land Acknowledgement

This document discusses land ownership. We respectfully acknowledge that Philadelphia is part of Lenapehoking—the ancestral home of the Lenni-Lenape people. We recognize the historic and ongoing presence of the Lenape.

Credits

Thank you to the numerous individuals who contributed to this GSI Strategic Framework document. It would not have been possible to draft this document without all of the knowledge, experience, and exceptional skills of the following people.

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A special acknowledgement to Avery Livengood, who developed a significant part of the analysis methodology for an earlier version of this strategic framework.

Contents

Definitions

Combined Sewer System (CSS): a single sewer system that carries both sewage and stormwater in one pipe, to a water pollution control plant for treatment before being released to a waterway.

Combined Sewer Overflow (CSO): during moderate to heavy rainfall events, the combined sewer system will reach capacity, overflow, and discharge a mixture of sewage and stormwater directly to our streams and rivers from the 164 permitted Combined Sewer Overflow (CSO) outfalls within the City.

Drainage Acres (DA): equivalent to an acre of impervious surface from which runoff is managed by a green stormwater infrastructure system.

Greened Acre (GA): an expression of the volume of stormwater managed by a GSI practice. Typically, a conversion of the system storage volume into acre-inches.

Green stormwater infrastructure (GSI): a variety of soil-water-plant systems that intercept stormwater, infiltrate a portion into the ground, evapotranspirate a portion into the air and, in some cases, release a portion slowly back into the sewer system to reduce stormwater pollution and combined sewer overflows. The guiding principle of GSI is to utilize rainwater as a resource where it falls, rather than a problem to be dealt with by collecting and treating it elsewhere.

Potential Acres: the range of impervious drainage acres from which stormwater runoff has the potential to be managed by green stormwater infrastructure systems.

Municipal Separate Stormwater Sewer System (MS4): collects stormwater in a storm sewer pipe and discharges it directly to a waterway, while the sanitary sewage collected from homes, businesses, and industry is collected in a sanitary sewer pipe and taken to the water pollution control plant for treatment before being released to the waterways.

PWD: Philadelphia Water Department
EPA: Environmental Protection Agency
PA DEP: Pennsylvania Department of Environmental Protection
GIS: Geographic Information Systems

Introduction

Process

Framework

Potential Acre Summary

Introduction

Over a decade has passed since Philadelphia launched *Green City, Clean Waters*. This Strategic Framework documents our current approach, identifies successes, and areas where progress needs to be made. The ambitious goals remain: We must meet regulatory requirements, and maximize social, economic, and environmental benefits to our city.

The framework provides an updated strategy for **what** stormwater runoff we need to manage with green stormwater infrastructure, along with **where** and **how** to achieve our targets. It also outlines next steps in our planning.

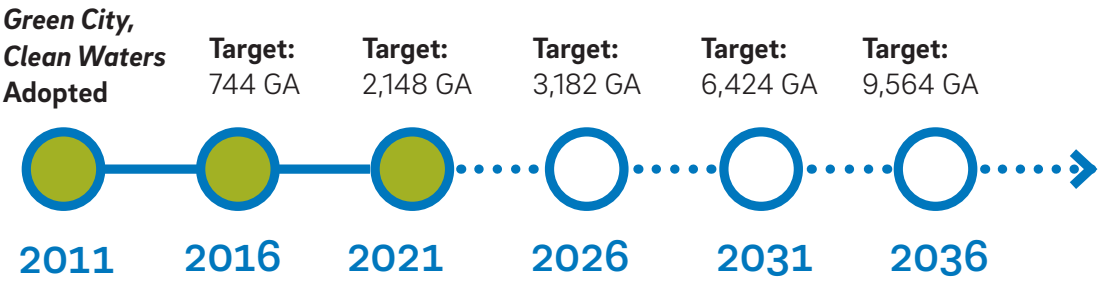
The Problem

Approximately 60% of Philadelphia is served by a combined sewer system. During wet weather, this older section of our system often overflows. As a result, billions of gallons of stormwater and diluted sewage flow into local waterways each year. State and federal regulations, including sections of the Clean Water Act, require Philadelphia to reduce at least 85 percent of this pollution—or face steep fines.

The Solution

Green City, Clean Waters uses a green-first approach, complemented by grey infrastructure, to reduce combined sewer overflow volumes. Since 2011, hundreds of GSI projects have been built across the combined sewer area.
To measure the progress, PWD and regulators set a target of delivering 9,564 greened acres by 2036. This makes our program one of the largest scale GSI programs in the country.

Green City, Clean Waters Target Milestones



Philadelphia's Green City, Clean Waters plan is divided into 5-year compliance windows. By each milestone date, specific water quality criteria must be met through a combination of green and traditional infrastructure improvements. The GA targets and corresponding milestone dates are listed above.

Why Now?

Ten years ago, Green Stormwater Infrastructure (GSI) was an emerging engineering tool. It helps communities comply with the Clean Water Act, and maximizes investments by delivering triple bottom line benefits. The time is right to build on the perspective we've gained over our first decade. Our framework provides an understanding of how to implement a large GSI program in an urban environment with extensive partner coordination. We outline existing conditions for the combined sewer system (CSS) area, potential acre ranges across programs and pipelines, as well as considerations and accompanying critical actions crucial to working with partners. We also look ahead to planning efforts that will help shape future rounds of GSI implementation.

Our Process

This report is the result of extensive analysis. We used GIS data, internal PWD databases, and detailed stormwater data from projects. We also incorporated input from focus groups familiar with policy and design challenges. Our Potential Acres projections are based on a streamlined and reproducible process that relies on structured query language (SQL). For more detailed information about our methodology, please see the Appendix.

An Updated Approach to Metrics

This document uses **drainage acres (DA)** as the primary unit of analysis. Drainage acres represent the area being managed by a GSI system. A **greened acre (GA)** represents the equivalent of the volume managed by a GSI system measured in acre-inches.

> **Most GSI installations manage approximately the first 1.5 inches of stormwater runoff, up to a maximum of 2 inches. This means one drainage acre typically results in more than one greened acre. GA = inches managed x DA**

To be conservative, and to account for the planning-level nature of this framework, all analyses, results and recommendations are reported in terms of DAs.

The term **potential acres** is used throughout this document and expressed as a range. The GSI Planning team developed this term and concept to describe the range of drainage acres that have the potential to be managed through green stormwater infrastructure. The low end of the range represents optimizing and refining PWD's current approach and policies. This includes GSI implementation primarily within the right-of-way, on City owned property, and on limited public non-City and private property. The upper end of the range represents the maximum physical potential if we gain additional access to public non-City and private property.

Framework

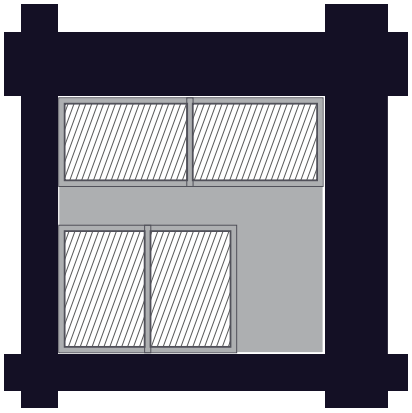
What, Where, How

The analysis, findings, and recommendations of this GSI Strategic Implementation Framework are based on **three** important planning approaches:

1. What are we trying to manage?

In Philadelphia, There are many different types of impervious surfaces, including streets, compact earth, parking lots, sidewalks, medians, driveways, and rooftops. For this strategic framework, these detailed impervious surface types were grouped into three **drainage area types**: Right-of-Way, Ground-Level, and Rooftop. They all have different characteristics influencing the potential for stormwater management. Given the large scale target of the GCCW program, to manage about 1/3 of impervious area in the CSS, **each and every source** of impervious area is important to consider as an opportunity to maximize stormwater management.

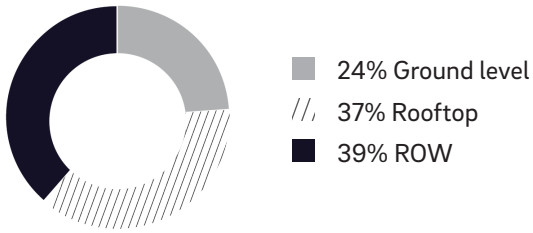
Drainage Area Types on a Hypothetical City Block



Right-of-way. The right-of-way drainage area type consists primarily of impervious surfaces like streets and sidewalks, but also includes some parking areas, travel medians and driveways that fall outside of parcel boundaries. The right-of-way is generally graded with a crown in the middle, draining to inlets on either side of the street. Another advantage of managing impervious surface from the right-of-way is that the street grid does not change frequently or easily. Therefore, the right-of-way is one of the most certain sources of impervious area for stormwater management.

Ground-level. Impervious surfaces located at-grade on parcels, such as parking lots, sport courts, private alleys and driveways, compact earth, and gravel were classified as ground-level. Accessing these impervious surfaces for stormwater management depends on their quality and slope, as well as the location of existing drainage infrastructure.

Impervious Area in the CSS by Drainage Area Type



Impervious surfaces located on parcels are subject to change based on the owners' needs, which can impact the effectiveness of GSI. Therefore, long-term credit for stormwater management of these areas requires PWD to have assurance, typically in the form of an operations and maintenance (O&M) agreement, that the impervious surface will continue to be managed.

Rooftop. Building roofs and overhangs are classified as rooftop impervious area. These are generally the most difficult impervious areas to access for stormwater management. Like ground-level impervious area, managing rooftop areas requires assurance that stormwater management will persist.

2. Where can drainage areas be managed?

Drainage areas can be managed in a variety of ways. For example, a right-of-way drainage area could be managed in a GSI system located within the right-of-way (these are known as green streets) or in a GSI system located on a parcel.

Throughout this Document, **onsite** and **off-site** drainage areas (DA) are reported separately. For example, a park drainage area managed within a park is reported as on-site DA. Right-of-way drainage areas that are managed within parks are reported as off-site DA. These metrics are reported separately to emphasize the relative importance of accessing different types of properties in order to manage impervious area from the street.

PWD's ability to manage stormwater on a site is highly dependent on the programming or land use of the site, and its ownership. Programming strongly influences the planning and design of stormwater management and its integration into the primary use of the site. Ownership dictates how stormwater can be implemented on a particular parcel site, and is further explored in the third planning approach below, *'How are GSI Projects implemented?'* The GSI Strategic Implementation Framework categorizes all land within the CSS as one of eight different **program** types. Programs are represented in the Figure 1 map, owner categories are outlined in Figure 3, and further details are found in the program section of this document.

Streets. This program is focused on impervious areas and GSI footprint availability within the public right-of-way, particularly streets and sidewalks, often including crosswalk islands and medians.

Parks. Programmed open spaces and recreational sites are categorized as parks. This includes City-owned parks, playgrounds and recreation centers, as well as state and national parks, private parks, golf courses, cemeteries, and parks owned by other public local agencies.

Commercial. This program type consists of privately-owned, non-residential parcels that are primarily in commercial, industrial, multifamily, faith-based, or transportation/parking uses.

Facilities. This program includes libraries, City-owned fire and police stations, fleet services and other facilities; as well as public non-City utility properties, museums, post offices, court houses, public housing, ports, and other civic uses.

Schools. Schools include public schools owned by the School District of Philadelphia (not by the City), as well as private, archdioceses, and charter schools.

Vacant Land. Vacant land and abandoned buildings, both City-owned and privately-owned, are characterized by a vacant property assessment status and/or vacant stormwater billing classification.

Campuses. University and healthcare campuses are characterized by large, contiguous or clustered parcels under single ownership.

Residential. Parcels with less than three residential units are categorized as residential.

Where can drainage areas be managed? (cont'd)

Although the right-of-way is the largest source of impervious area, by program, it tends to be a challenging space to manage stormwater. Where street impervious area cannot be managed within the right-of-way, parcels can serve as the location for stormwater management.

Some program types are better equipped to act as locations for stormwater management than others. Although residential land contributes a significant share of the total impervious area in the CSS, it is spread across more than 360,000 parcels. On average, each site contributes only 0.02 acres of impervious area and is limited in space for stormwater management. In contrast, the school program makes up 3% of the total impervious area in the CSS spread across 777 parcels. Each school site contributes an average of 1.2 acres of impervious area, suggesting better economies of scale for managing both on-site and off-site drainage areas. The strategic planning process evaluated land within each program type as both potential drainage areas and locations for stormwater management.

Figure 1. Parcels in the CSS by Program Type

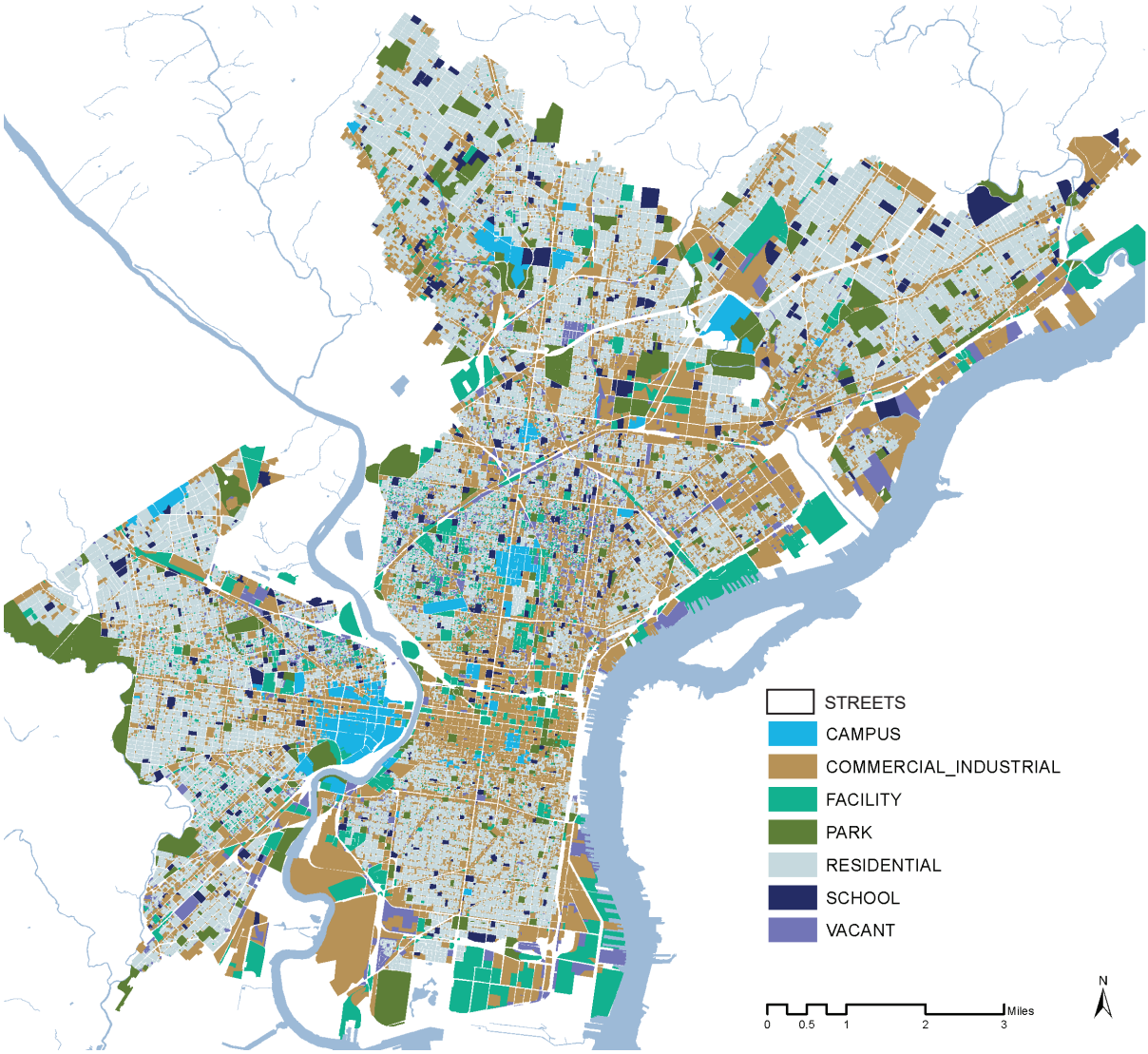


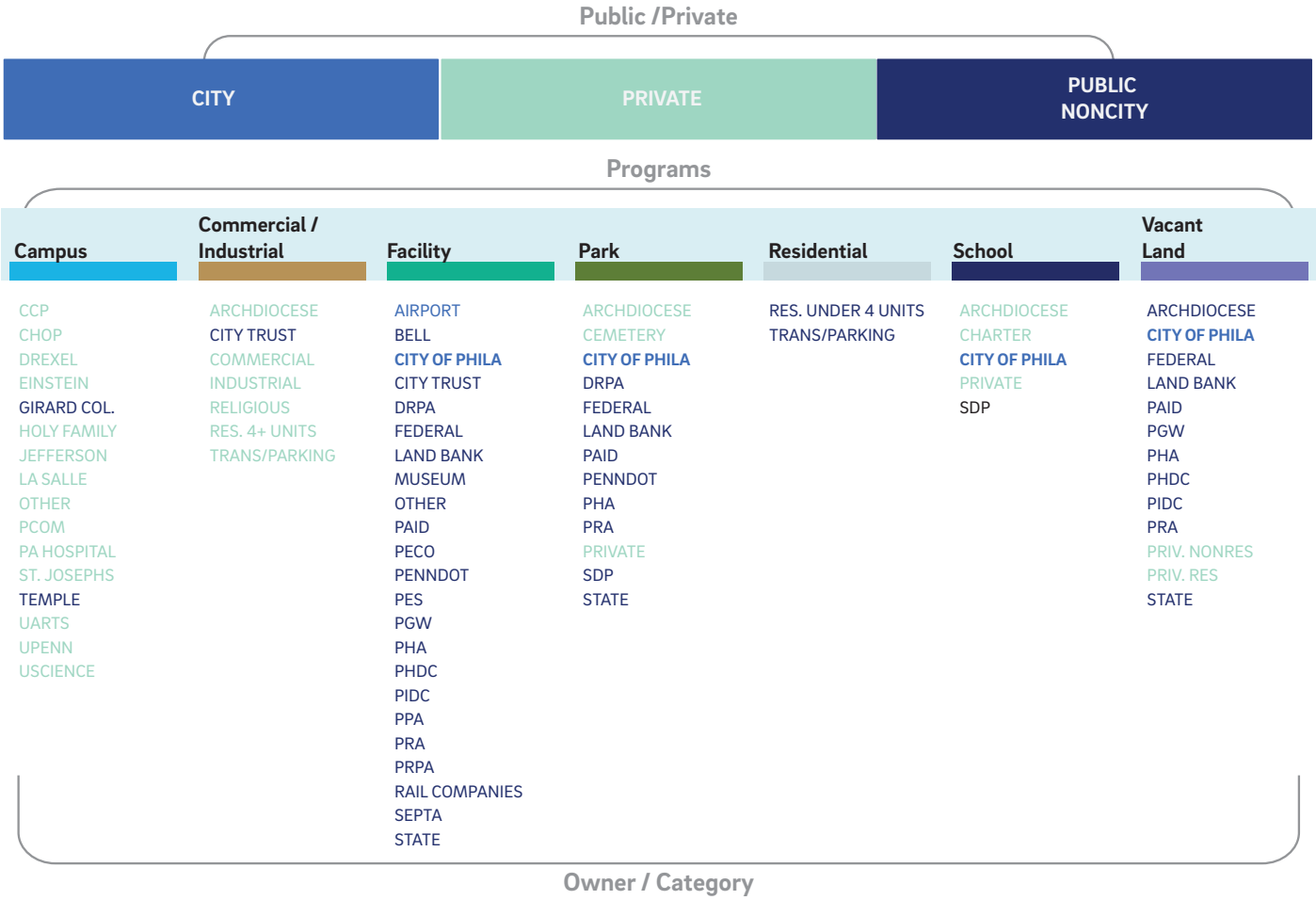
Figure 2. Existing Conditions by Program

	Total Area (acres)	Impervious Area (acres)	Number of Parcels
Streets	13,006	11,742	none
Parks	1,679	322	806
Commercial	7,330	6,059	34,549
Facilities	1,933	1,381	5,896
Schools	1,223	863	777
Vacant Land	2,011	712	37,569
Campuses	891	619	720
Residential	12,208	8,736	362,360
Total	40,281	30,434	442,677

Impervious Area in the CSS by Program

- Campuses (2%)
- Residential (29%)
- Commercial (20%)
- Schools (3%)
- Facilities (5%)
- Parks (1%)
- Vacant Land (2%)
- Right-of-way (39%)

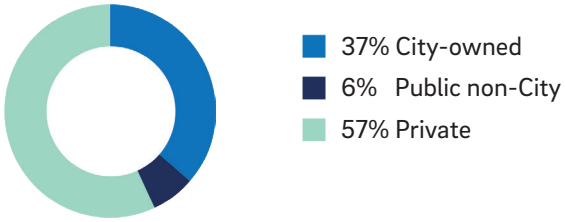
Figure 3. Parcel Program Planning Classification



3. How are GSI projects implemented?

Land ownership is the primary driver influencing how and if stormwater is managed, in addition to requirements outlined by Philadelphia's Stormwater Regulations. The GSI Strategic Framework categorizes all land within the CSS as one of three **owner categories**, City-owned, Public non-City, and Private. These categories translate to implementation approaches, or **pipelines**. For example, PWD capital funding for GSI projects is mostly limited to City-owned property, unless easements are used, and operating funds can be utilized on public non-City and private properties. Understanding the drainage areas that can be managed by each pipeline is essential for planning purposes.

Total Land Area in CSS by Ownership



Impervious Area in the CSS by Ownership

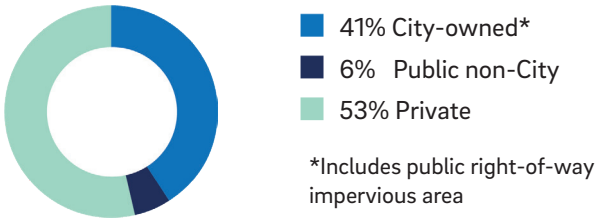


Figure 4. Parcel Existing Conditions by Ownership

	Total Area (acres)	Impervious Area (acres)	Number of Parcels
City	14,723	12,446	4,642
Public non-City	2,674	1,707	12,095
Private	22,884	16,280	425,940
Total	40,281	30,434	442,677

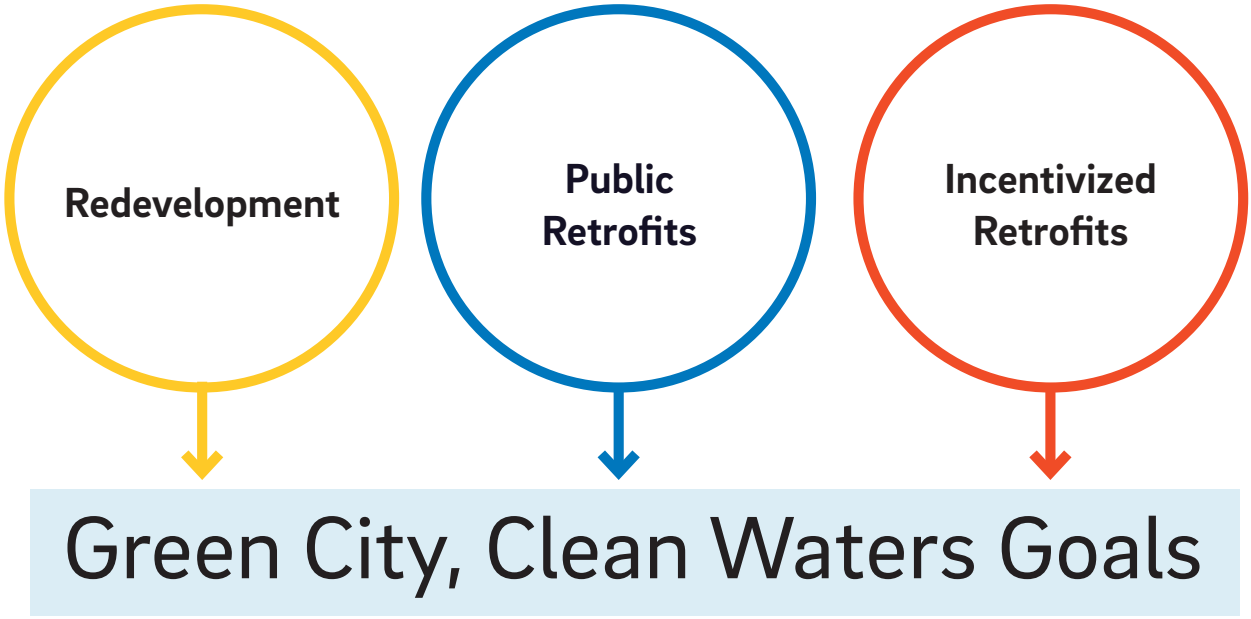
City-owned. Any land owned by the City of Philadelphia or its agencies is classified as City-owned. Although some of this land may be leased to private entities, or be encumbered by rights-of-way or other easements, the fact that it is owned by the City generally suggests that it would be eligible for public retrofits and ineligible for incentivized retrofits. For the purposes of this document, all right-of-way areas were also treated as City-owned.

Public non-City. Any land owned by public agencies or institutions, other than the City of Philadelphia, is classified as public. This includes land owned by state and federal agencies, public colleges and universities, transportation agencies, and port authorities. Local agencies that are not agencies of the City are also classified as public, including the School District of Philadelphia (SDP), the Philadelphia Housing Authority (PHA), the Philadelphia Redevelopment Agency (PRA), the LandBank and the Philadelphia Industrial Development Corporation (PIDC), among others. Land that is public but not owned by the City is generally eligible for incentivized retrofits, and may also be eligible for public retrofits in certain circumstances.

Private. Finally, land that is not owned by the City or another public agency is classified as private. Within the private land owner category there are a variety of stormwater billing classifications that dictate whether or not a property is eligible for incentivized retrofits. Generally, private non-residential property is eligible for incentivized retrofits.

This GSI Strategic Implementation Framework uses ownership information to estimate the onsite and off-site potential acres across these three pipelines:

Figure 5. Implementation Pipelines



Redevelopment. The PWD Stormwater Regulations require post-construction stormwater management on development projects that disturb more than 15,000 square feet of earth (5,000 square feet in the Darby and Cobbs Creek watershed). All land is subject to PWD Stormwater Regulations, regardless of ownership, though some may redevelop more frequently than other types. Redevelopment rates are highly dependent on market demand, and PWD has little ability to affect general redevelopment trends.

Public Retrofits. PWD's GSI Planning and Design teams identify, plan and design public retrofit projects in the public right-of-way, on City-owned land, and on land in which the Department holds a property interest. Currently, public retrofit projects are primarily implemented within the public right-of-way (these are known as green streets) and within City-owned parks. PWD has also implemented a smaller number of public retrofit projects on City-owned facilities and vacant lots. There are other program types, such as schools and non-City facilities, that could undergo public retrofit projects if PWD is able to obtain a property interest. For this framework, GSI completed in coordination with PWD water and sewer design projects (typically referred to as the renew and replace pipeline) was combined with public retrofits led by the GSI Unit.

Incentivized Retrofits. PWD incentivizes non-City property owners to manage stormwater runoff from impervious areas on their sites through a range of incentives, including the Stormwater Grants program and by offering a discount of up to 80% on the owners' stormwater bills for managed areas. The resulting GSI projects are owned and maintained by the property owner, or their designee. The vast majority of incentivized retrofit projects occur on commercial property, though private facilities, schools, and campuses are also eligible. City agencies are not eligible for grants, but long-term leasees of City property may apply.

Progress to Date & Potential Acres

The table below shows the existing conditions in the combined sewer system (CSS), the progress to date acres** by program and pipeline as of July 1, 2020, and the estimated potential acres by program and pipeline. Program optimization and refinement where PWD can currently implement GSI will ensure that the low end of potential acres remains achievable. Green text denotes acres that are only attainable with a policy or implementation change. The regulatory compliance target for the PWD's Consent Order and Agreement is 9,564 greened acres.

Potential Acres by Program	Existing Conditions in the CSS			Progress to Date Acres by Pipeline**			Progress to Date Acres	Potential Acres by Pipeline			Potential Acres	Potential Acres	% Progress Toward Potential Acres
	Total Area (acres)	Impervious Area (acres)	Number of Parcels	Redevelopment*	Public Retrofits	Incentivized Retrofits	On-Site & Off-Site	Redevelopment	Public Retrofits	Incentivized Retrofits	On-Site & Off-Site	Total	
Streets	13,005	11,742*	none	18	968		986	39	2,243 - 2,651		2,282 - 2,690	2,350 - 2,758	42% | 36%
Off-Site DA						4	4		68***		68		
Parks	1,679	322	806	27	37	7	71	63	44 - 91	7	114 - 160	736 - 1,136	32% | 21%
Off-Site DA					161	7	169		592 - 945	31	623 - 975		
Commercial	7,330	6,059	34,550	219		396	613	480		1,809 - 2,429	2,289 - 2,909	2,448 - 3,258	26% | 19%
Off-Site DA						18	18			159 - 349	159 - 349		
Facilities	1,933	1,381	5,896	81	3	86	170	180	0 - 146	39 - 280	219 - 606	223 - 909	78% | 19%
Off-Site DA					3		4		0 - 282	4 - 21	4 - 303		
Schools	1,223	863	777	64		35	98	142	0 - 281	31 - 226	173 - 453	173 - 817	60% | 13%
Off-Site DA						4	5		0 - 364	0 - 86	0 - 364		
Vacant	2,011	712	37,568	26	2	33	60	54	0 - 11		54 - 65	54 - 404	-****
Off-Site DA					18	2	20		0 - 339		0 - 339		
Campuses	891	619	720	121		16	137	269	0 - 7	0 - 143	269 - 420	269 - 495	51% | 28%
Off-Site DA									0 - 9	0 - 67	0 - 76		
Residential	12,208	8,736	362,360	31			31	66			66	66	47%
Total	**40,281**	**30,434**		**588**	**1,193**	**607**	**2,387**	**1,292**	**2,947 - 5,193**	**2,080 - 3,639**		**6,318 - 9,843**	**38% | 24%**
				Progress to Date Acres by Pipeline				**Potential Acres by Pipeline**					
Share of IA (30,434 acres)				**1.9%**	**3.9%**	**1.9%**	**7.7%**	**4.2%**	**9.7% -17%**	**6.8% - 11.9%**		**20.8%-32.3%**	

Note: Potential acres by pipeline column totals do not sum to the total range of potential acres, as some acres can be accessed through multiple pipelines.

** Streets IA existing conditions include natural areas less than 5,000 square feet reclassified from pervious to impervious.*

***Progress to Date Acres for all pipelines include complete and in-progress projects, except for the Redevelopment pipeline which only includes completed projects. The Streets Public Retrofits acres includes GSI aligned with water/sewer renew and replace projects.*

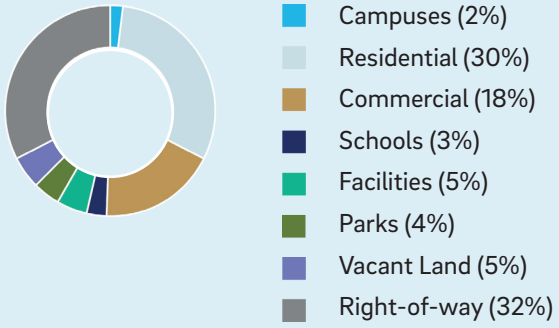
****Residential DA that is managed in right-of-way GSI and Centralized GSI Facilities is counted as off-site DA within the streets program. All other off-site DA is right-of-way DA that could be managed in GSI systems on parcels.*

***** Vacant land progress to date acres can be recategorized into another program based on site improvements or development, thus measuring progress against potential acres is not recommended.*

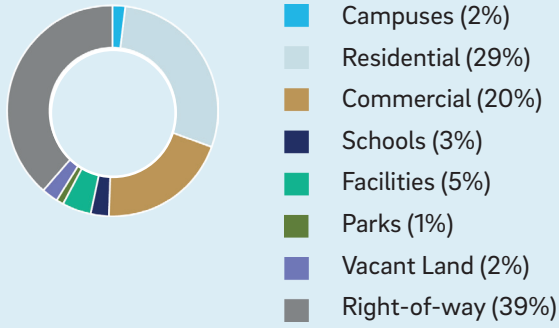
Program Summaries

This section takes a deeper dive into each of the eight different program types. For each program, more detail is provided for the following; existing conditions, progress to date figures as of July 1, 2020, success highlights and potential acre ranges.

Total Area in the CSS by Program



Impervious Area in the CSS by Program



Streets

Parks

Commercial

Facilities

Schools

Vacant Land

Campuses

Residential

Streets

Summary

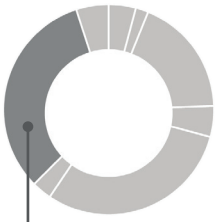
The following table summarizes the streets program existing conditions, drainage acres being managed to date, and projected potential acres.

The streets program is focused primarily on managing drainage acres in the publicly owned right-of-way, and is therefore the largest and most important program for managing acres through the public pipeline. The management potential for the streets program represents 75% of the potential acres in the public retrofit pipeline and 30% of total potential acres across all pipelines. A total of 990 drainage acres have been implemented for the streets program, comprising 42% of the low end of potential acres across all pipelines, and 36% of the high end. This includes 162 acres managed through GSI aligned with water/sewer renew and replace projects. PWD may be hitting the limits of cost-effective and straight-forward street projects with current design and cost guidance, so partnership street projects are critical for expanding potential for stormwater management and funding. This also emphasizes the significance of the parcel programs for managing right-of-way drainage area.

	Existing Conditions in the CSS			**Progress to Date Acres*** Onsite & Off-Site **				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits***	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**
Onsite DA	13,005	11,742	-	18	968	0	968	39	2,243 - 2651	4	**2,282 - 2,690**
Off-Site DA	-	-	-	0	0	4	4	0	68 - 68	0	**68 - 68**
	13,005	**11,742**	**-**	**18**	**968**	**4**	**990**	**39**	**2,311 - 2719**	**4**	**2,350 - 2,758**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.
** Onsite refers to street runoff being managed within the right-of-way, and off-site refers to large impervious areas on residential parcels (like alleyways or shared driveways) that drain into a public GSI system in the right-of-way.
* **The Public Retrofits pipeline drainage acres managed to date includes 162 acres from GSI aligned with water/sewer renew and replace projects.

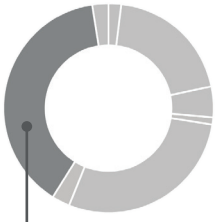
Total Area in CSS



13,005 acres

32% of total land area in the CSS

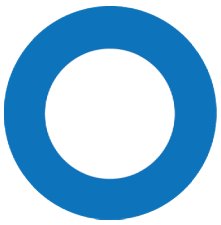
Impervious Area in CSS



11,742 acres

39% of impervious area in the CSS

Impervious Area by Owner Type



- *100% City-owned**
- *0% Public non-City*
- *0% Private*

**Includes PennDOT streets*

Existing Conditions

An estimated 13,005 acres of land within the combined sewer service area (CSS) area is located outside of parcel boundaries. Streets and sidewalks make up the majority of the impervious cover in these right-of-way areas. Other impervious right-of-way areas include public alleys, parking strips, railroad ballast, gravel and compact earth.

An estimated 11,742 acres of land within the CSS service area is considered impervious area, representing a 426 acre increase in impervious area since 2018. Some of these new acres are due to development creating new right-of-way, but most are due to a change in how impervious area was calculated. In this update, all natural ground areas in the right-of-way under 5,000 SF in area were considered impervious in order to be consistent with the GSI Planning & Design Manual.

Right-of-Way	Area (acres)
Total Area	13,005
Impervious Area	11,742
Potential Acre Impervious Area	11,143

For the right-of-way, 11,143 acres of impervious area was used for the calculation and projection of potential acres. Impervious areas in the Broad Street Line corridor on Broad St, the underground Market Frankford Line corridor on Market St, and Center City were excluded from the potential acre projection model due to their extremely low feasibility levels for public retrofits.

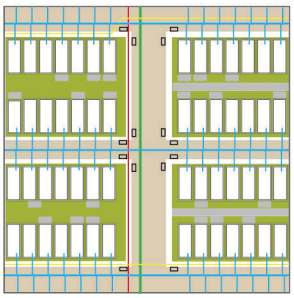
Characteristics

The street grid is one of the most permanent physical features in the City. Unlike parking lots and buildings, the street grid does not change frequently or easily. Therefore, the right-of-way is one of the most permanent or least subject to change sources of impervious area for stormwater management.

Placing stormwater management practices in streets and sidewalks is often difficult due to subsurface utility conflicts. Planning data collected across the CSS service area suggest that rights-of-way in older neighborhoods in the CSS tend to be narrower and more constrained, whereas neighborhoods in West, Southwest, Northeast and Northwest Philadelphia tend to have wider rights-of-way with fewer constraints.

Other common constraints found in the right-of-way include parallel utilities in the sidewalk and street, drainage areas that are too small to be cost-effective, shallow groundwater and bedrock, steep topography, mature street trees, active or historic trolley and rail tracks, and proximity to water transmission mains and large sewer mains.

Minimal Utility Conflict



High Utility Conflict

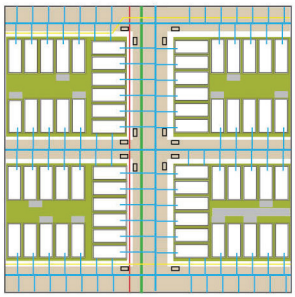
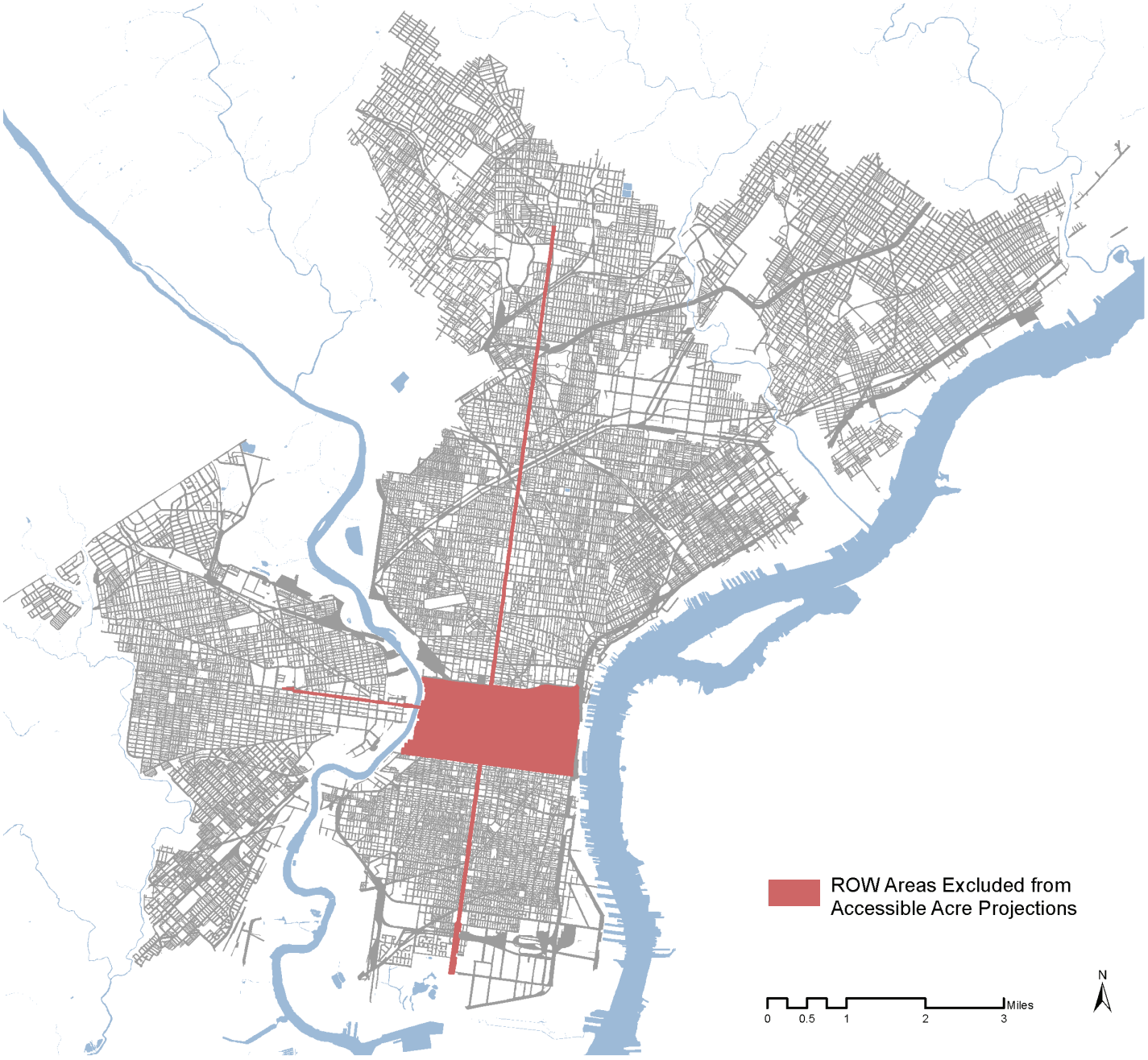


Figure 8. ROW Areas Excluded from Potential Acre Projections



Progress to Date

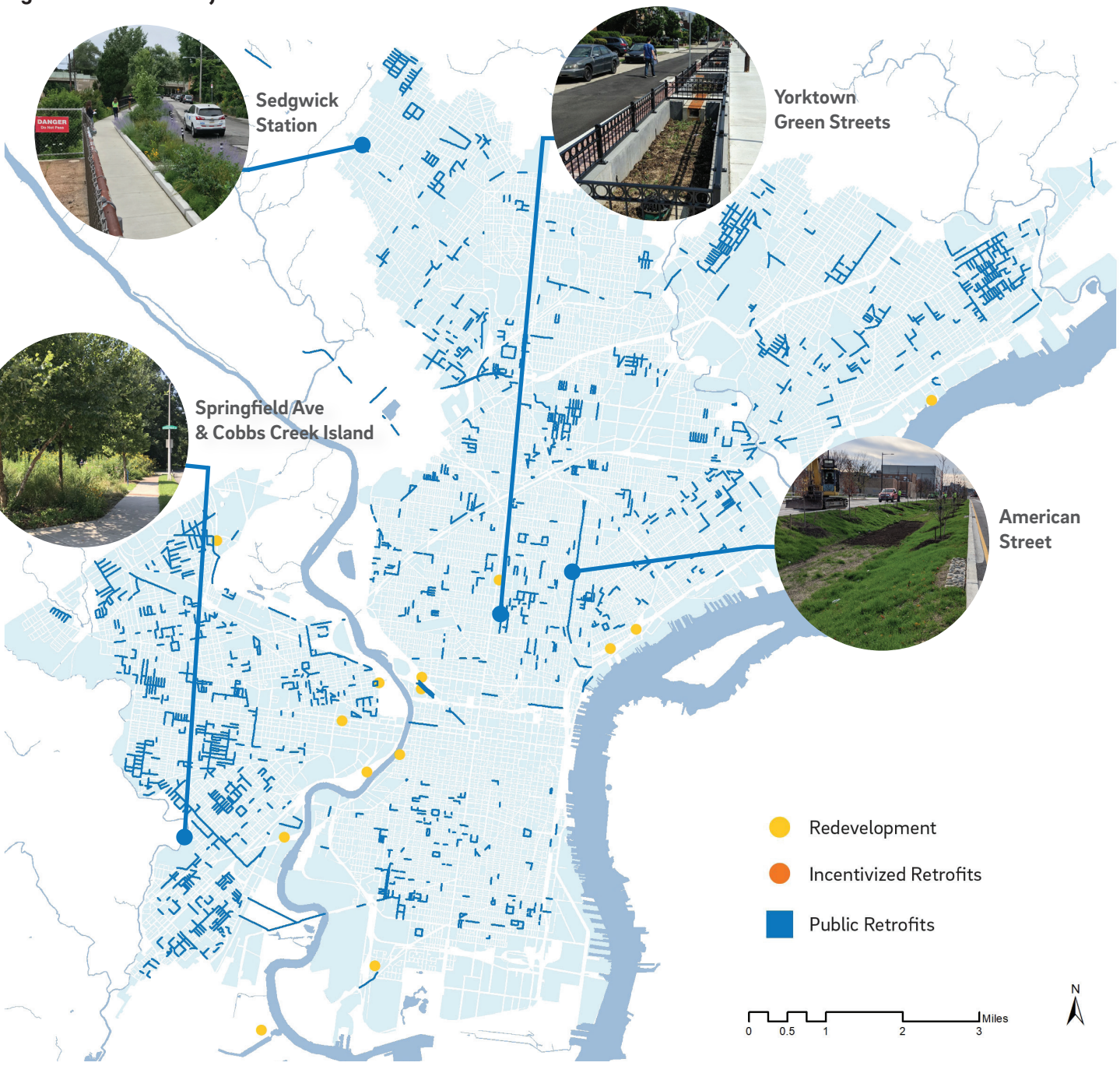
To date, the majority of drainage acres managed the streets program have been implemented through the public retrofits pipeline, which also includes GSI projects aligned with water/sewer renew and replace projects. Most street projects include multiple GSI systems. A total of 990 drainage acres have been managed through public retrofits, with 419 acres completed and 549 acres currently in progress. This success can be attributed to the ease of access to the public right-of-way, PWD staff expertise, and broad partnership and coordination with stakeholders and partners. The redevelopment pipeline has managed 18 acres to date, and the incentivized retrofit pipeline has 4 acres in progress.

Public Retrofit Highlights

185
completed projects

155
in progress projects

Figure 9. Streets Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the streets program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	Public Retrofits *		Incentivized Retrofits		Total
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	18	419	549	0	4	990
Off-Site DA	0	0	0	0	0	0
Total DA	**18**	**419**	**549**	**0**	**4**	**990**

* Includes GSI aligned with water/sewer renew and replace projects: 78 acres Complete and 84 In Progress.

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, public retrofit and incentivized retrofit projects. Potential acre totals include drainage acres that may already be managed by existing GSI projects, but all numbers were calculated as projections using a set of management assumptions.

LOW END: The low end of the range includes the acres expected to be managed through redevelopment projects and through public retrofit projects without any costly or prohibitive constraints. These public retrofit acres were calculated based on the percentage of the impervious right-of-way area in each drainage district that is expected to be high-feasibility based on current planning and design standards: 23% in the Northeast, 13% in the Southeast, and 28% in the Southwest. The low end of the range also includes acres managed from residential alley run-on into street systems.

HIGH END: The high end of the range also includes the acres expected to be managed through public retrofits that are more difficult or costly to complete due to constraints. These additional acres were calculated based on the percentage of medium-feasibility drainage acres expected to be managed in each drainage district, under the assumption that medium-feasibility drainage areas with 0-1 constraints would be managed. The percent of impervious right-of-way area assumed to be manageable with extra effort was 5% in the Northeast, 3% in the Southeast, and 3% in the Southwest.

	Streets Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total
Onsite DA	39	2,243 - 2,651	0 - 0	2,282 - 2,690
Off-site DA	0	68 - 68	0 - 0	68 - 68
TOTAL DA	**39**	**2,311 - 2,719**	**0 - 0**	**2,350 - 2,758**

Streets

Potential Acres

2,350 - 2,758

TOTAL DA

Springfield Ave & Cobbs Creek Island rain garden

Parks

Summary

The following table summarizes the parks program existing conditions, the drainage acres being managed to date, and projected potential acres.

The parks program is critical for managing right-of-way runoff and has the potential to manage over 1,100 total potential acres. A total of 240 drainage acres have already been implemented for the parks program, comprising 32% of the parks program low end of potential acres across all pipelines, and 21% of the high end. To ensure the continued success of this program, maintenance documentation and the process of aligning with Rebuild projects needs to be prioritized and refined.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**
Onsite DA	1,679	322	806	27	37	7	71	63	44 - 91	7 - 7	**114 - 160**
Off-Site DA	-	-	-	0	161	7	168	0	592 - 945	31 - 31	**623 - 975**
TOTAL DA	**1,679**	**322**	**806**	**27**	**198**	**14**	**240**	**63**	**636 - 1,035**	**38 - 38**	**736 - 1,136**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.

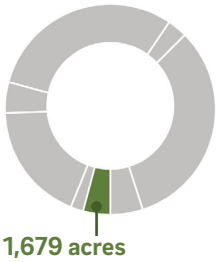
Existing Conditions

Although parks contribute only 1% to the total impervious area in the CSS service area, this program type is critical for stormwater management. Park space with vegetation and trees directly infiltrate stormwater and also provide opportunities for additional stormwater management from adjacent impervious surfaces.

There are more than 1,000 acres of City-owned parks in the CSS, and many thousands more acres of City-owned watershed parks at the edges of the CSS, providing significant open space in which to manage runoff from surrounding streets. Another 27 acres of parks are owned by other local agencies, such as PHA, PIDC, and PRA, but maintained by the City.

Cemeteries, many of which function as open green space for surrounding communities, total over 400 acres. The Commonwealth and National Park Service own and manage an additional 28 acres, and private entities own the remaining park area in the CSS.

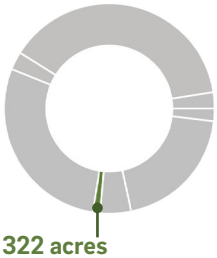
Total Area in CSS



1,679 acres

4% of total land area in the CSS

Impervious Area in CSS



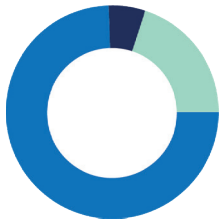
322 acres

1% of impervious area in the CSS

Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
City-owned Parks*	1,026	241	505
Local Agency Parks	27	6	111
Private Parks	157	16	99
State and Federal Parks	28	12	49
Cemeteries	441	48	42
TOTAL	1,679	322	806

*Note: the existing conditions for City-owned parks are based on parks with delineated parcels, and do not include watershed parks. The watershed park boundaries bordering the CSS total 105,738 feet.

Impervious Area by Owner Type



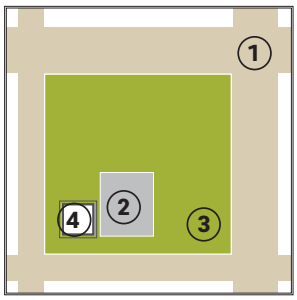
- *75% City-owned*
- *6% Public non-City*
- *20%Private*

Characterization: City-owned Parks

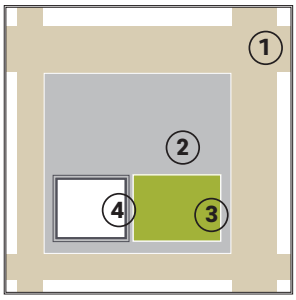
In general, City-owned parks can be categorized as either passive parks, recreation centers and playgrounds, or watershed parks. Passive parks tend to have large, open green spaces that can receive stormwater runoff, without significantly interfering with the use of the site. Watershed parks also offer open spaces for managing stormwater runoff from impervious areas, such as streets, but only along their edge where the park borders the CSS.

In contrast, recreation centers and playgrounds tend to be highly programmed with paved courts and walkways, buildings, and play equipment. Projects on these sites require close coordination with Philadelphia Parks & Recreation and their partners on the design, construction, and funding of site renovations as well as stormwater management.

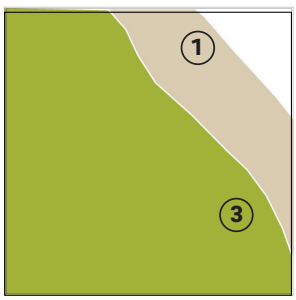
Passive Park



Recreation Center

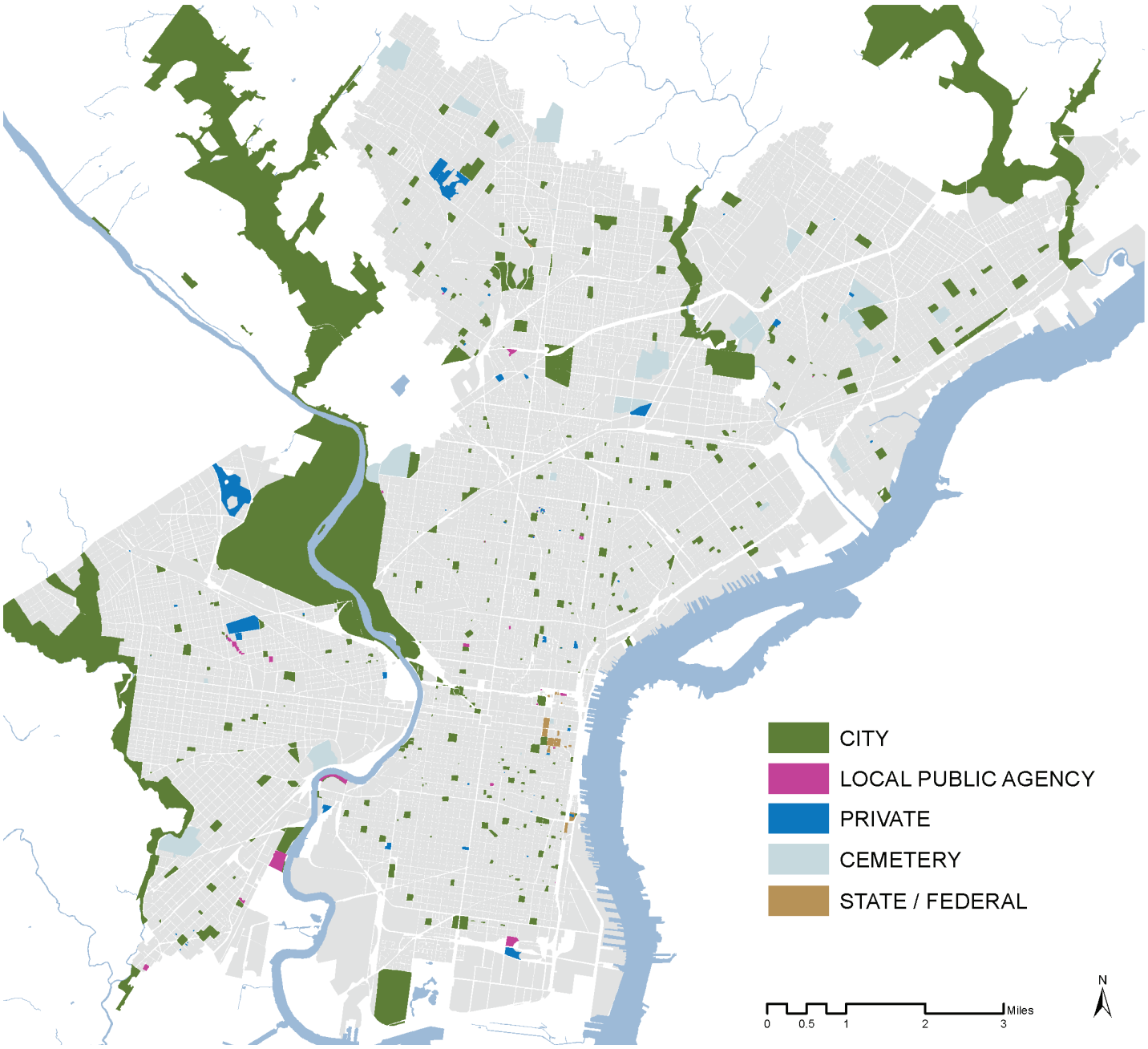


Watershed Park



1. **Street** contributing
2. **Ground Impervious Area** contributing & receiving
3. **Ground Pervious Area** receiving
4. **Rooftop Impervious** contributing

Figure 10. Park Distribution and Ownership



Although the City maintains several parks and playgrounds located on land owned by other local agencies, PWD can only pursue public retrofits on these sites if they are transferred to City ownership or if a property interest is secured. This lengthy process requires strong support from Philadelphia Parks & Recreation as well as City Council approval.

Private parks are eligible for stormwater incentives, and very large private parks, like Bala Golf Club and Awbury Arboretum, are most likely to take advantage of their open space to manage stormwater and lower their stormwater bills. To date, parks with bills of at least $1,000 per month have been motivated to undertake retrofits.

Most cemeteries are exempt from the stormwater charge, and therefore ineligible for incentives. State and federal parks are also ineligible for incentives. This analysis assumes that neither public nor incentivized retrofits will occur on these sites.

Progress to Date

To date, the majority of park projects manage stormwater through the public retrofits pipeline: 49 park projects are completed, 23 park projects are in progress. All public retrofits thus far are sited on City-owned parks. The types of park projects, however, vary in physical characteristics (passive, rec centers, watershed park) and policy mechanism (PWD-led, PWD-led Cost Share, PPR-led, Rebuild-Project User Led).

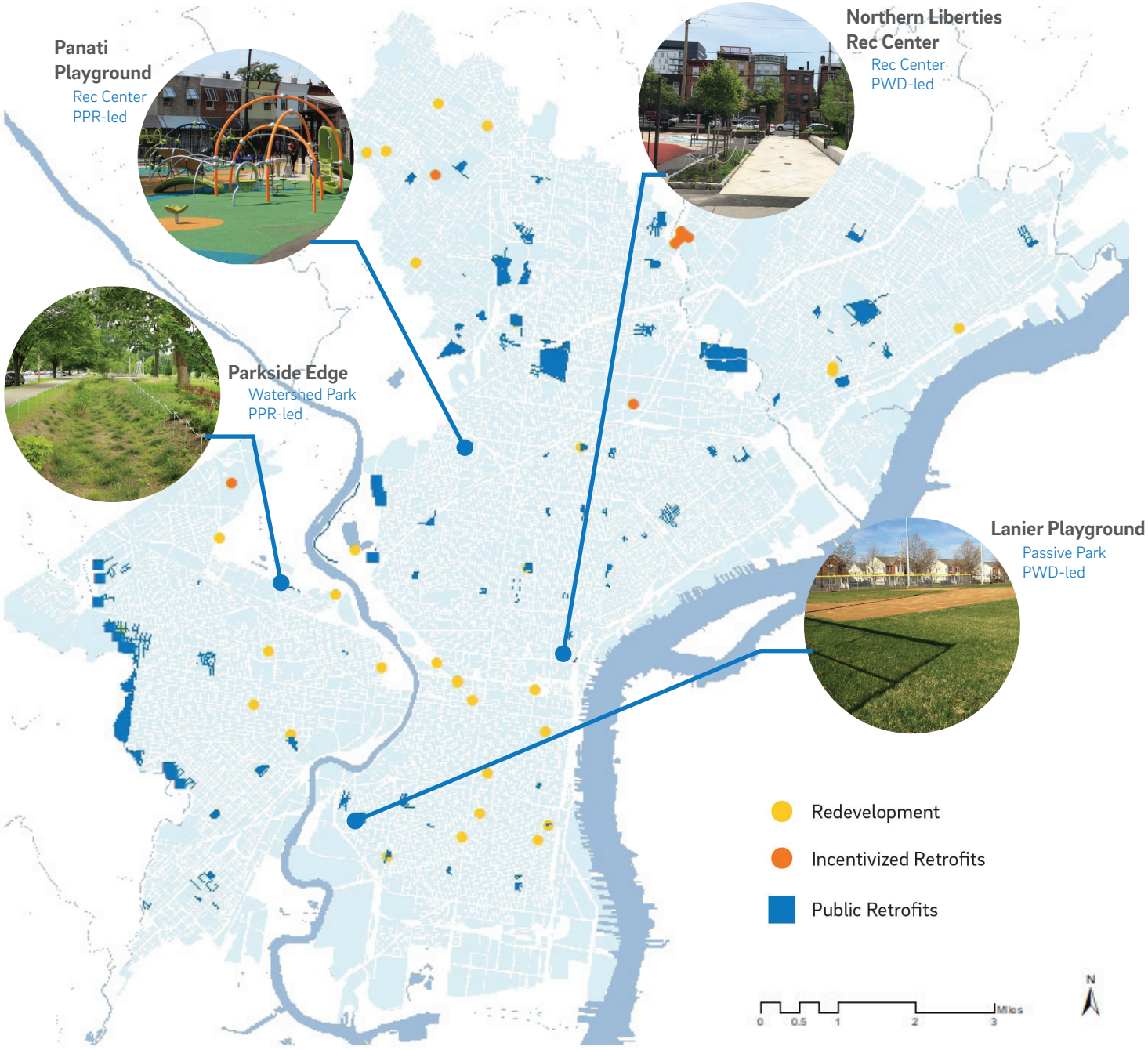
Redevelopment on park sites is not uncommon, but redevelopment projects are responsible for considerably fewer drainage acres managed than the public retrofits pipeline. Very few parks manage stormwater through the incentivized retrofits pipeline.

Public Retrofit Highlights

49
completed projects

23
in progress projects

Figure 11. Park Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the parks program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	Public Retrofits		Incentivized Retrofits		Total
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	27	32	5	6	0	71
Off-Site DA	0	91	70	6	1	168
Total DA	**27**	**123**	**75**	**13**	**1**	**240**

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, public retrofit and incentivized retrofit projects. Potential acre totals include drainage acres that are already managed by completed GSI projects and projections of future projects based on a set of management assumptions.

LOW END: The low end of the range reflects the current approach to managing stormwater on passive City-owned parks and watershed parks at the edges of the CSS. On average, public retrofits in parks manage 51% of ground-level impervious area. Only 5% of projects manage rooftop area, due to concerns about maintainability and access to plumbing. Ninety-five percent of projects manage street runoff onsite. The low end also includes the drainage area expected to be managed through redevelopment and a small number of incentivized retrofit projects on public private parks.

HIGH END: The high end of the range can be achieved by capitalizing on smaller recreation center sites and transferring local public agency land to the City. Public retrofits on recreation center sites manage 60% of ground level impervious. Consistent with the assumptions for parks, 5% of recreation center sites manage rooftop area, and 85% manage street runoff, but the area for managing street runoff tends to be more constrained on recreation center sites.

	Parks Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total
City-owned Parks	58	44 - 79	0 - 0	102 - 137
Local Agency Parks	1	0 - 12	0 - 0	1 - 12
Private Parks	4	0 - 0	7 - 7	11 - 11
State and Federal Parks	0	0 - 0	0 - 0	0 - 0
Cemeteries	0	0 - 0	0 - 0	0 - 0
Total Onsite	**63**	**44 - 91**	**7 - 7**	**114 - 160**
Off-Site DA	0	592 - 945	31 - 31	623 - 975
TOTAL	**63**	**636 - 1,035**	**38 - 38**	**736 - 1,136**

Parks

Potential Acres

736 - 1,136
TOTAL DA

Kemble Park bioinfiltration basin

Commercial & Industrial

Summary

The following table summarizes the commercial and industrial program existing conditions, drainage acres managed to date, and projected potential acres.

The commercial and industrial program comprises a significant proportion of the impervious area of the city. A combined 631 drainage acres have already been managed across all pipelines, comprising 25% of the low end of the commercial and industrial potential acres. To ensure continued access to private properties, especially smaller properties, additional incentive mechanisms should be developed. For certain large properties, a targeted approach is recommended, as well as a continued emphasis on management of street runoff.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**
Onsite DA	7,330	6,059	34,550	219	0	396	615	480	0 - 0	1,809 - 2,429	**2,289 - 2,909**
Off-Site DA	-	-	-	0	0	18	18	0	0 - 0	159 - 349	**159 - 349**
TOTAL DA	**7,330**	**6,059**	**34,550**	**219**	**0**	**414**	**633**	**480**	**0 - 0**	**1,968 - 2,778**	**2,448 - 3,258**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.

Total Area in CSS

7,330 acres

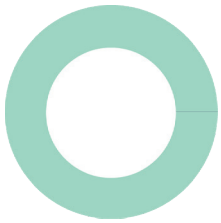
18% of total land area in the CSS

Impervious Area in CSS

6,059 acres

20% of impervious area in the CSS

Impervious Area by Owner Type



- *0% City-owned*
- *<1% Public non-City*
- *>99% Private*

Existing Conditions

The commercial program type encompasses privately-owned, non-residential land in industrial, commercial, multifamily residential, transportation and parking, or faith-based uses. The vast majority of sites are small, commercial properties. The industrial properties contribute the most impervious area to this program.

Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
Commercial	2,417	2,114	19,102
Industrial	2,811	2,398	5,131
Multifamily	1,290	938	5,813
Religious	424	288	1,466
Archdiocese	73	53	171
Transportation	309	264	2,860

Characteristics

Property owners can save up to 80% on their stormwater charge by managing runoff from onsite impervious areas. Properties with large charges are more likely to be motivated to undertake stormwater retrofits because the potential savings are more significant. To date, commercial properties with charges of at least $500 per month have implemented GSI.

The distribution of stormwater charges for commercial property is highly skewed. The median monthly stormwater charge is only $22. Thus, there are many small parcels with low charges and only a few with charges large enough to be incentivized.

Less than half of the impervious area (on 1,024 parcels), in this program type is associated with stormwater charges greater than $500 per month. More than 60% of the impervious area (on 2,752 parcels) is associated with stormwater charges greater than $200 per month.

Figure 13. Distribution of Stormwater Charges for Commercial Parcels

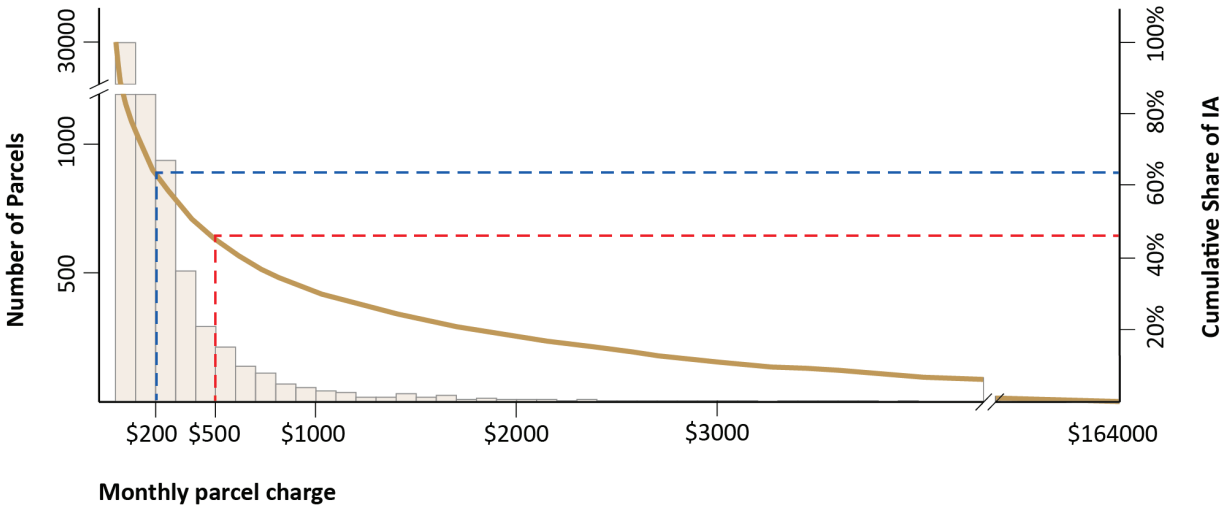
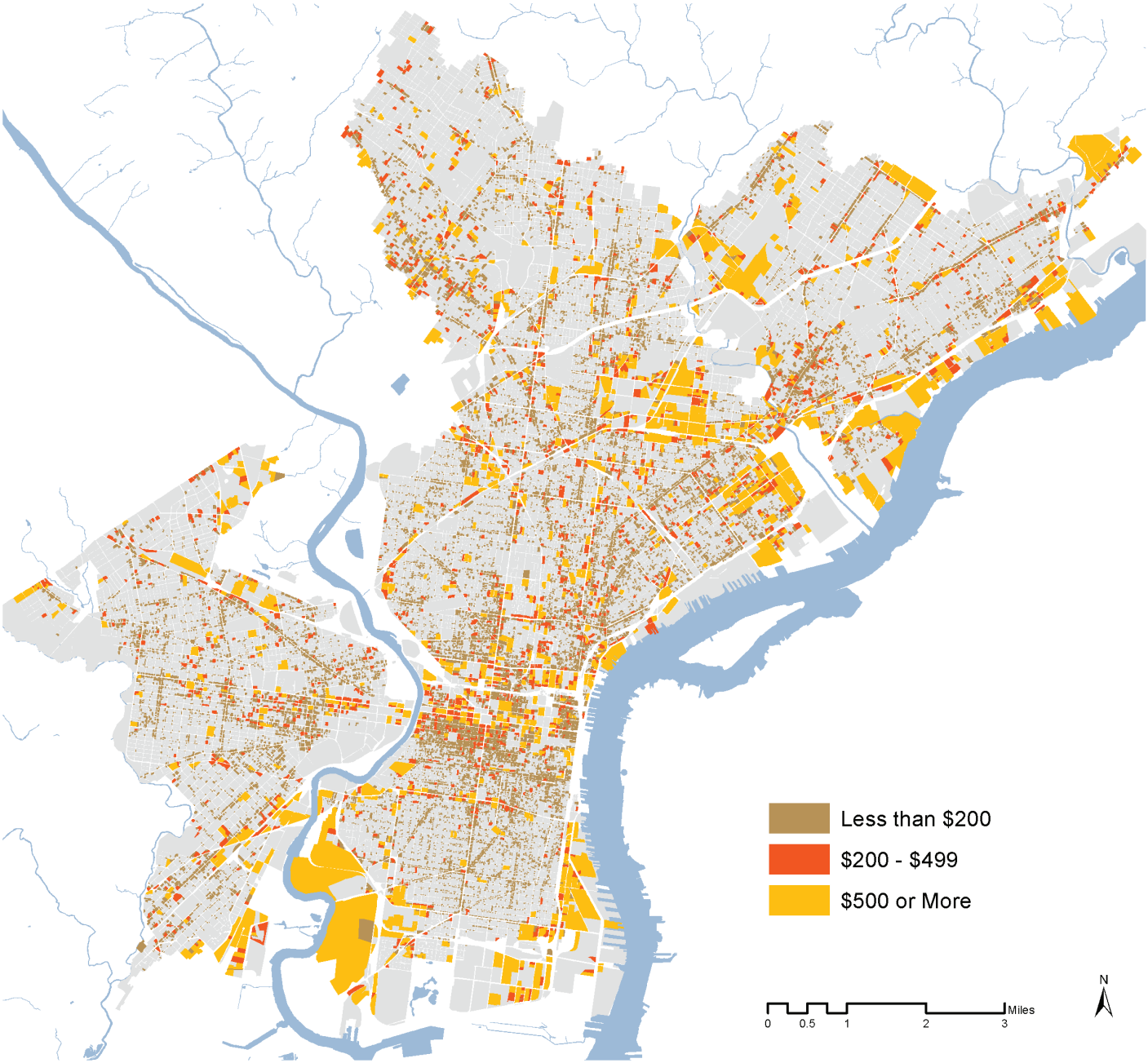


Figure 12. Commercial Property by Monthly Stormwater Charge



Progress to Date

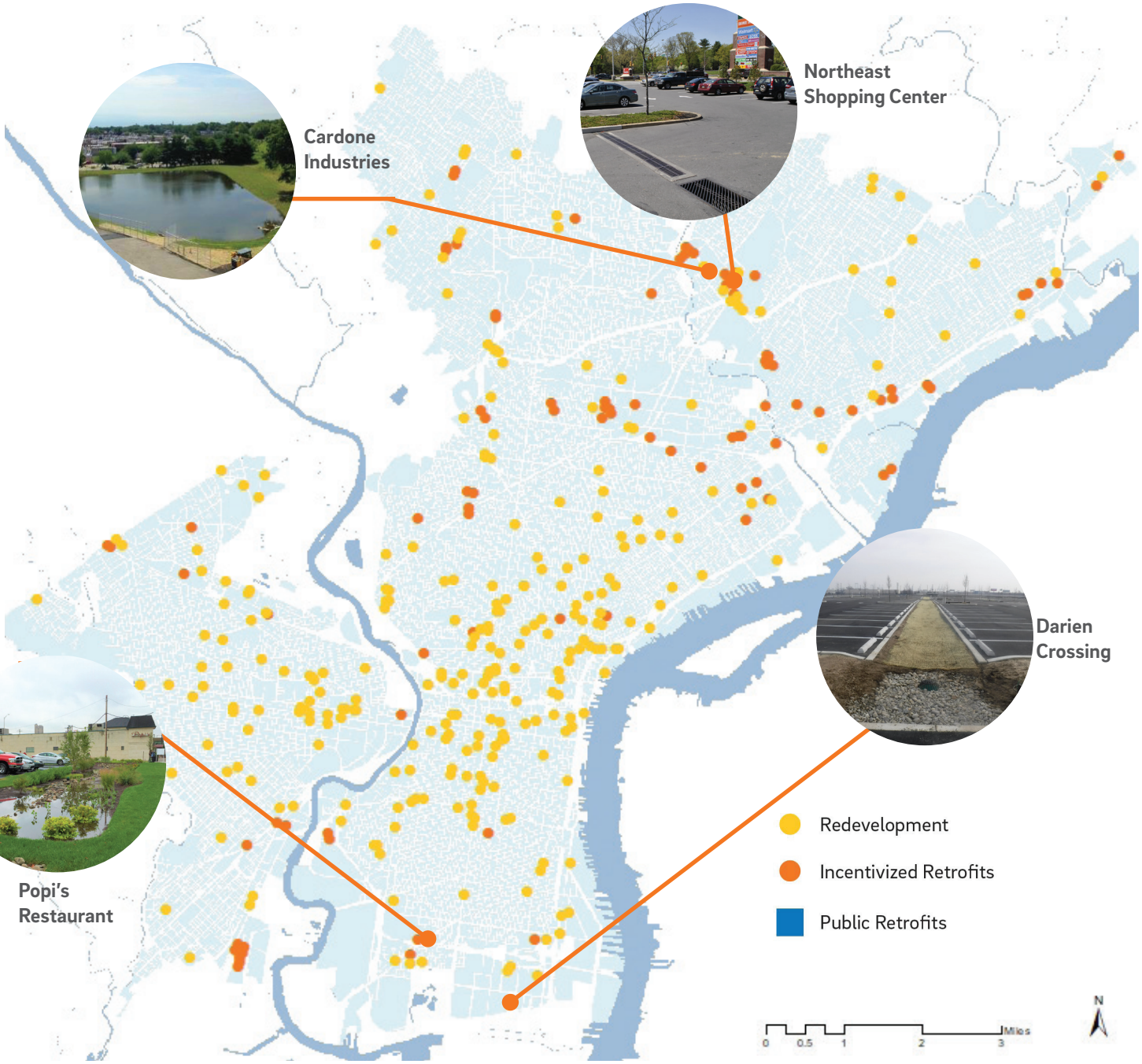
The commercial & industrial program has been a significant contributor to drainage acre totals through both the incentivized retrofit and redevelopment pipelines. There are no public retrofits for this program because all parcels are privately-owned. Redevelopment of commercial & industrial sites has resulted in the management of 219 drainage acres to date. Incentivized retrofits have been responsible for managing 412 drainage acres across over 100 completed or in progress commercial & industrial projects.

Incentivized Retrofit Highlights

79
completed projects

25
in progress projects

Figure 13. Commercial Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the parks program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	Public Retrofits		Incentivized Retrofits		Total
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	219	0	0	310	84	613
Off-Site DA	0	0	0	12	5	18
Total DA	**219**	**0**	**0**	**322**	**90**	**631**

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, public retrofit and incentivized retrofit projects. Potential acre totals include drainage acres already managed by completed GSI projects and acres projected for future projects using a set of management assumptions.

LOW END: The low end of the range includes drainage acres expected to be managed through redevelopment and through incentivized retrofits on parcels whose owners are likely to be incentivized to retrofit their sites using current stormwater incentives (i.e. roughly all parcels with stormwater bills greater than $500 per month). On average, incentivized retrofit sites manage 73% of ground-level impervious area, 47% of rooftop impervious area on commercial and multifamily sites, and 73% of rooftop impervious area on industrial and religious sites. Across all ownership categories, 44% of projects elect to manage ROW runoff.

HIGH END: The high end of the range can be achieved if smaller sites, with stormwater bills roughly between $200 and $500 per month, were also incentivized to undertake retrofits.

Note: Due to an update to the potential acres methodology, $200 and $500 are not used as exact cutoff values. Rather, those cutoffs are approximated using an associated percent savings threshold if each parcel were to manage the average amount (71%) of impervious area on their site. This update allows for the testing of any potential credit changes to understand the impact on participation in the incentivized retrofit pipeline. See the Appendix for details.

	Commercial & Industrial Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total
Commercial	157	0 - 0	528 - 687	685 - 843
Industrial	171	0 - 0	1,037 - 1,299	1,208 - 1,470
Multifamily	120	0 - 0	162 - 279	281 - 398
Religious	9	0 - 0	42 - 80	51 - 89
Archdiocese	3	0 - 0	14 - 25	17 - 28
Transportation	20	0 - 0	25 - 57	45 - 76
Total Onsite	**480**	0 - 0	**1,809 - 2,429**	**2,289 - 2,909**
Off-site DA	0	0 - 0	159 - 349	159 - 349
TOTAL	**480**	**0 - 0**	**1,968 - 2,778**	**2,448 - 3,258**

Commercial & Industrial
Potential Acres

2,448 - 3,258
TOTAL DA

Popi's Diner rain garden

Facilities

Summary

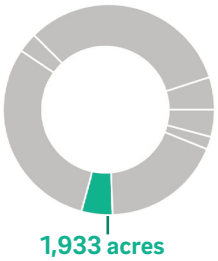
The following table summarizes the facilities program existing conditions, drainage acres managed to date, and the projected potential acres.

The facilities program presents an opportunity to implement GSI projects on a significant amount of City-owned land through public retrofits and also encourage incentivized retrofits on public non-City land. A total of 174 drainage acres have already been implemented across all pipelines, comprising 78% of the low end of the facilities potential acres and 19% of the high end. Over 700 more acres of impervious acres could be available for stormwater management with City-owned facility process refinement and development of implementation mechanisms for GSI on public non-City property.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**
Onsite DA	1,933	1,381	5,896	81	3	86	170	180	0 - 146	39 - 280	**219 - 606**
Off-Site DA	-	-	-	0	4	0	4	0	0 - 282	4 - 21	**4 - 303**
TOTAL DA	**1,933**	**1,381**	**5,896**	**81**	**7**	**86**	**174**	**180**	**0 - 428**	**43 - 301**	**223 - 909**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.

Total Area in CSS



1,933 acres

5% of total land area in the CSS

Impervious Area in CSS

1,381 acres

5% of impervious area in the CSS

Impervious Area by Owner Type

- *30% City-owned*
- *69% Public non-City*
- *1% Private*

Existing Conditions

The facilities program type includes libraries, City-owned fire and police stations, fleet services and other facilities; as well as public utility properties, museums, post offices, court houses, public housing, ports, and other civic uses. Facilities parcels comprise 5% of the total impervious area in the CSS with a concentration on large parcels and parcels owned by large public or civic landowners. The City owns the most impervious area within this program type, followed by the Philadelphia Housing Authority (PHA), the federal government, PECO, and SEPTA.

Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
City-Owned Facilities	536	417	515
PHA	402	239	4,278
PRA	30	22	196
PECO	172	135	84
PGW	30	25	9
PAID/PIDC	106	78	33
SEPTA	157	117	150
Ports (DRPA, PRPA)	112	95	54
State & PennDOT	51	35	161
Federal	195	144	40
Rail Companies	64	23	103
Other Facilities	78	51	278

Characteristics

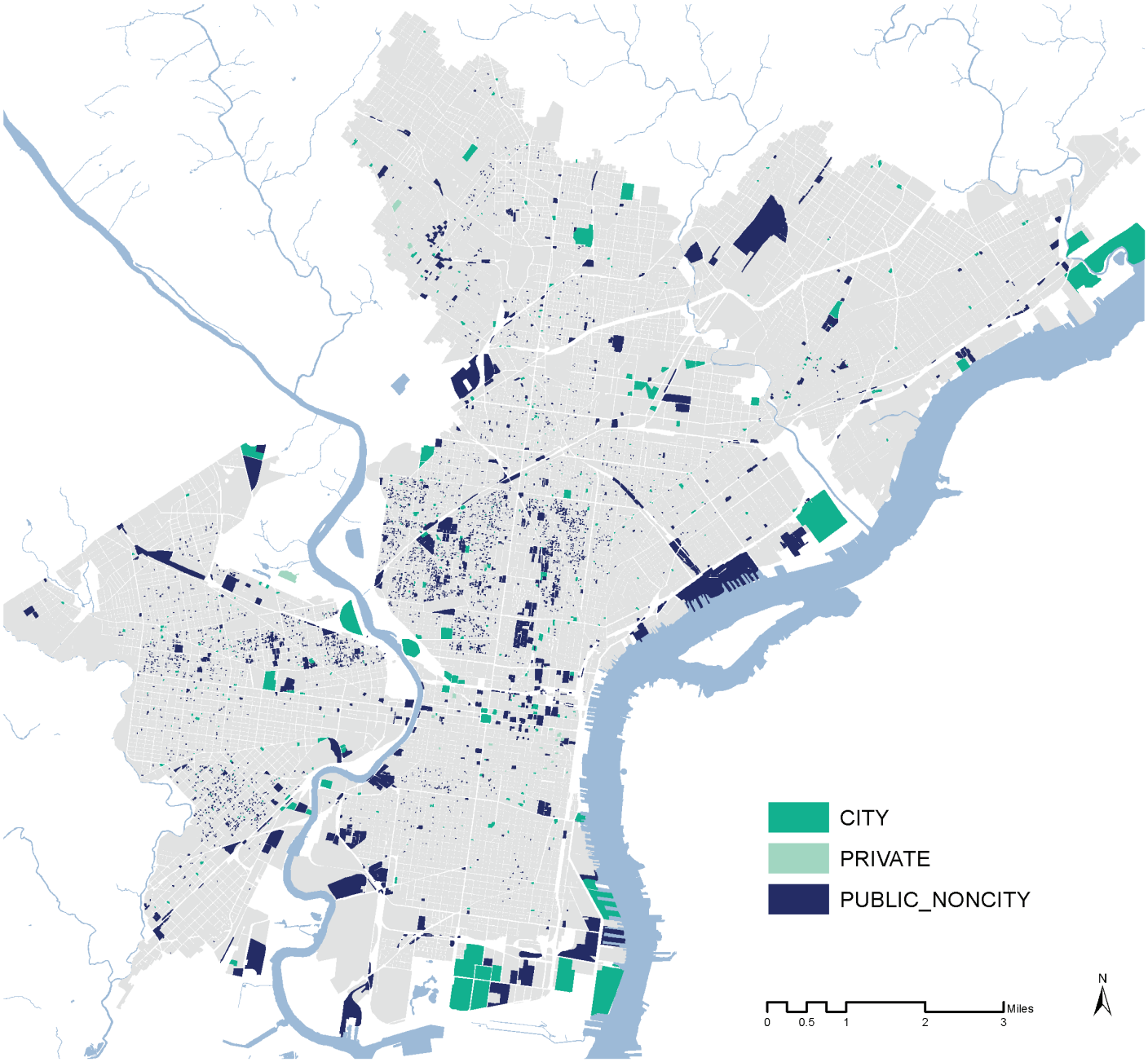
City-owned facilities vary significantly in size and cover type, ranging from small, zero lot-line sites to very large parcels used as parking or storage. However, regardless of these physical characteristics, these sites tend to be highly programmed. Pursuing GSI projects on these sites often requires coordination with the City agency that uses the site on the design, construction, funding and timing of site renovations.

Facilities that are owned by local public agencies other than the City, referred to as public non-City facilities, are eligible for stormwater grants and incentives. The property owner can save up to 80% on their stormwater charge by managing runoff from onsite impervious areas. To date, only PIDC and SEPTA have taken advantage of stormwater grant funding to retrofit their sites.

It is clear that financial incentives are insufficient to motivate these landowners. PWD is now providing technical assistance and other support for PHA, PRA, and other local public agencies to utilize stormwater grant funding to retrofit their sites. There is also potential for PWD to implement public retrofits on these sites, if PWD obtained a property interest.

Private facilities, such as museums and other civic uses, are also eligible for incentivized retrofits. As with public non-City facilities, the financial incentive of stormwater grants and a reduced stormwater charge has not proven sufficient to motivate incentivized retrofits to date. However, the small amount of impervious area located on private facilities is distributed across many different owners, making technical assistance and support less feasible.

Figure 14. Facility Distribution by Ownership



Progress to Date

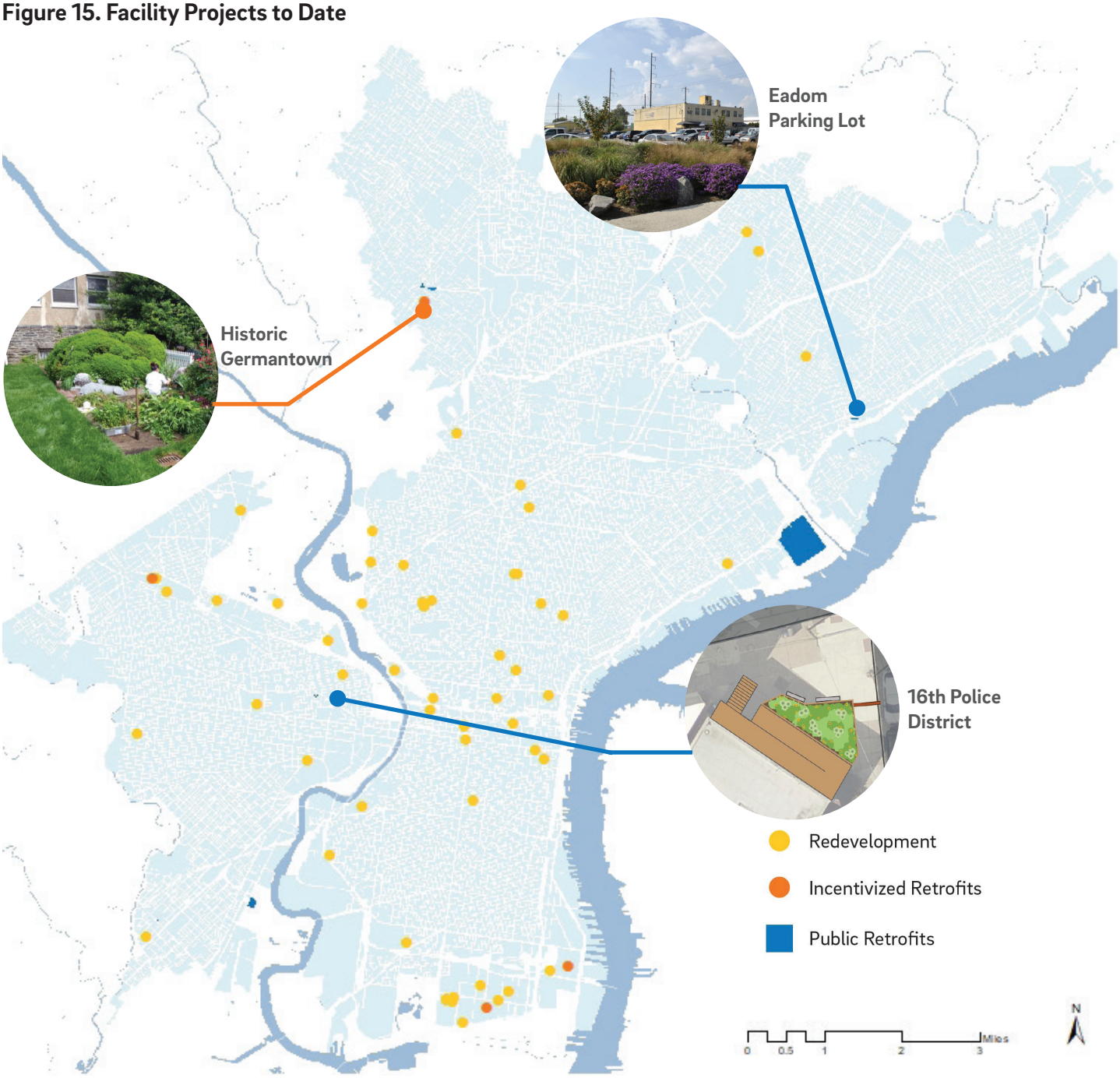
Redevelopment has been the dominant pipeline in the facilities program, contributing to the management of over 80 drainage acres to date. The public retrofits pipeline, in contrast, has been the smallest contributor to the program in terms of drainage acres, but has provided pivotal proof-of-concept opportunities for comprehensive partnership projects with other City agencies (16th Police District). The incentivized retrofit pipeline has seen just 4 facilities projects to date, but that includes 2 large sites proposing to manage over 30 acres each.

Public Retrofit Highlights

2
completed projects

3
in progress projects

Figure 15. Facility Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the parks program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	**Public Retrofits**		**Incentivized Retrofits**		**Total**
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	81	2	1	10	76	170
Off-Site DA	0	2	1	0	0	4
Total DA	**81**	**4**	**3**	**10**	**76**	**174**

Eadom Parking lot rain garden

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, public retrofit and incentivized retrofit projects. Potential acre totals include drainage acres that may already be managed by existing GSI projects, but all numbers are projections calculated using a set of management assumptions.

LOW END: The low end of the range includes the drainage areas expected to be managed through redevelopment and through incentivized retrofits only on SEPTA parcels. On average, incentivized retrofit sites manage 98% of ground-level impervious area and 12% of rooftop impervious area. It is expected that 20% of incentivized retrofits sites will manage ROW.

HIGH END: The high end of the range can be achieved by also capitalizing on public retrofit projects on City-owned sites and incentivized retrofit projects on all other public non-City and private facility parcels. Both scenarios assume that no stormwater retrofits will occur on state, federal, or railroad property. On average, public retrofits manage 61% of ground-level impervious area and 12% of rooftop impervious area. It is expected that 74% of public retrofits will manage ROW.

	Facilities Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total
City-Owned Facilities	59	0 - 146	0 - 0	59 - 205
PHA	27	0 - 0	0 - 52	27 - 79
PRA	1	0 - 0	0 - 3	1 - 4
PECO	9	0 - 0	0 - 46	9 - 55
PGW	3	0 - 0	0 - 18	3 - 20
PAID/PIDC	12	0 - 0	0 - 42	12 - 54
SEPTA	37	0 - 0	39 - 39	77 - 77
Ports (DRPA, PRPA)	18	0 - 0	0 - 68	18 - 86
State & PennDOT	6	0 - 0	0 - 0	6 - 6
Federal	0	0 - 0	0 - 0	0 - 0
Rail Companies	1	0 - 0	0 - 0	1 - 1
Other Facilities	6	0 - 0	0 - 0	6 - 19
Total Onsite	**180**	**0 - 146**	**39 - 280**	**219 - 606**
Off-Site DA	0	0 - 282	4 - 21	4 - 303
TOTAL	**180**	**0 - 428**	**43 - 301**	**223 - 909**

Facilities

Potential Acres

223 - 909

TOTAL DA

Schools

Summary

The following table summarizes the schools program, including the existing conditions within the combined sewer system area, the drainage acres being managed to date by implementation pipeline, and the potential acre available by implementation pipeline.

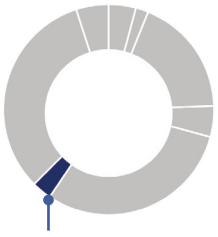
The schools program presents an opportunity to manage a significant number of drainage acres depending on implementation policy scenarios. To date, 103 acres have been implemented through the redevelopment and incentivized retrofits pipelines, comprising 60% of the low end of the school program's potential acre range. If public retrofits become possible through a property interest agreement, between 363-644 additional drainage acres would have the potential for stormwater management. While developing the public retrofits pipeline is critical, there is still a need to proactively plan with school property owners, including SDP, to optimize GSI project delivery through the incentivized retrofit and redevelopment pipelines.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total****
Onsite DA	1,210	850	766	64	0	35	99	140	0 - 281	31 - 226	**171 - 453**
Off-Site DA	-	-	-	0	0	4	4	0	0 - 364	0 - 86	**0 - 364**
TOTAL	**1,210**	**850**	**766**	**64**	**0**	**39**	**103**	**140**	**0 - 645**	**31 - 312**	**171- 817**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.

** To avoid double-counting, the maximum total potential acres for each pipeline should not be summed.

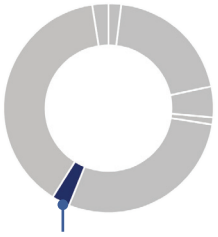
Total Area in CSS



1,223 acres

3% of total land area in the CSS

Impervious Area in CSS



863 acres

3% of impervious area in the CSS

Impervious Area by Owner Type

2% City-owned

61% Public non-City

37% Private

Existing Conditions

The school land use type represents 3% of the total impervious area in the CSS, as well as 3% of the total area in the CSS. School sites present significant opportunities to manage onsite impervious areas, given that 70% of the total land area in the schools program is impervious. Across all school owner categories, the average ground area is 1.5 acres, providing significant space to manage right-of-way runoff from nearby streets.

School property ownership was consolidated into 4 major owner categories: School District of Philadelphia (including City of Philadelphia, City of Philadelphia Charter, SDP Charter), Archdiocese (including Charter), Charter, and Private. The vast majority of impervious area is located on SDP property.

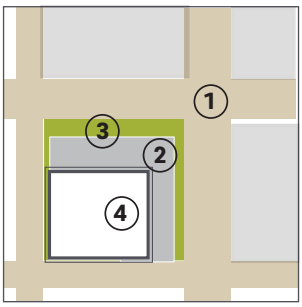
Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
School District	763	542	292
Archdiocese	106	76	103
Charter	107	83	58
Private	246	163	324

Characteristics

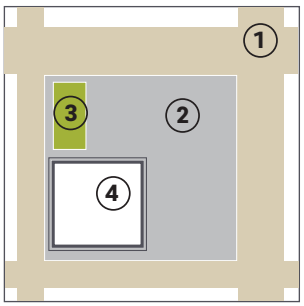
Larger schoolyards present more opportunity to manage right-of-way runoff. However, the current approach to GSI projects on schools does not take full advantage of this opportunity due to concerns about ownership, liability and maintenance primarily from SDP.

To understand the physical opportunity to manage right-of-way runoff through public retrofits on school sites, a threshold of 0.5 acres of ground area was set to categorize small and medium/large sites for analysis. Small sites were analyzed for opportunities to manage onsite drainage areas only. Medium and large sites were considered for public retrofit opportunities. To understand the maximum management potential in the incentivized retrofit pipeline, if budget and policy constraints were removed, all sites were considered eligible.

Small

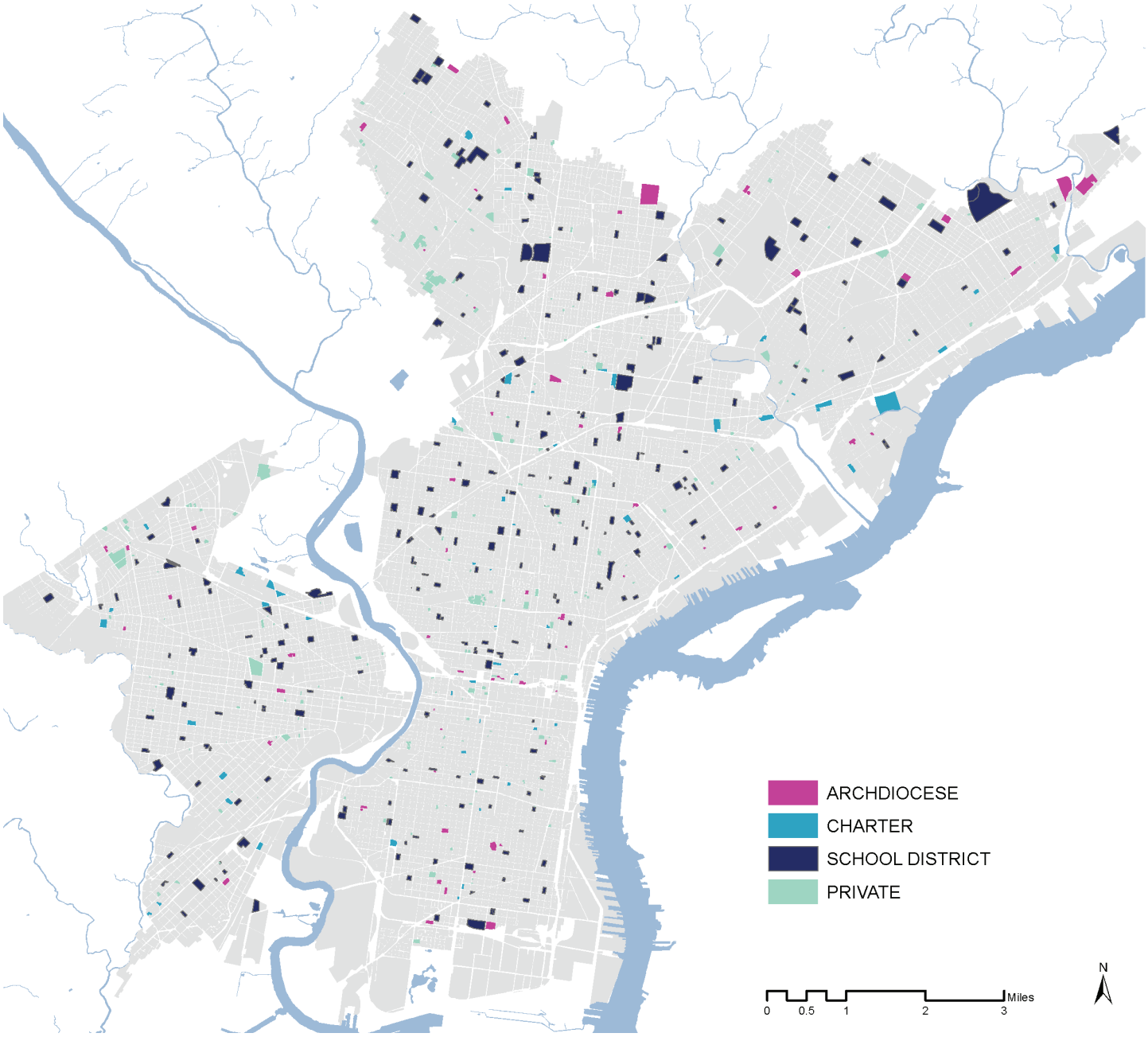


Medium/Large



1. **Street** contributing
2. **Ground Impervious Area** contributing & receiving
3. **Ground Pervious Area** receiving
4. **Rooftop Impervious** contributing

Figure 16. School Distribution by Ownership



School property ownership is relevant because the SDP owns more impervious area than all other schools combined, and controls more school parcels than all private schools combined. SDP has set a goal to retrofit 5 sites per year using stormwater grants and incentives.

Because other schools are spread across more owners, those owners may opt to retrofit their school site at anytime. To date, sites of varying sizes and ownerships have been incentivized to apply for stormwater grants to undertake stormwater retrofits.

Progress to Date

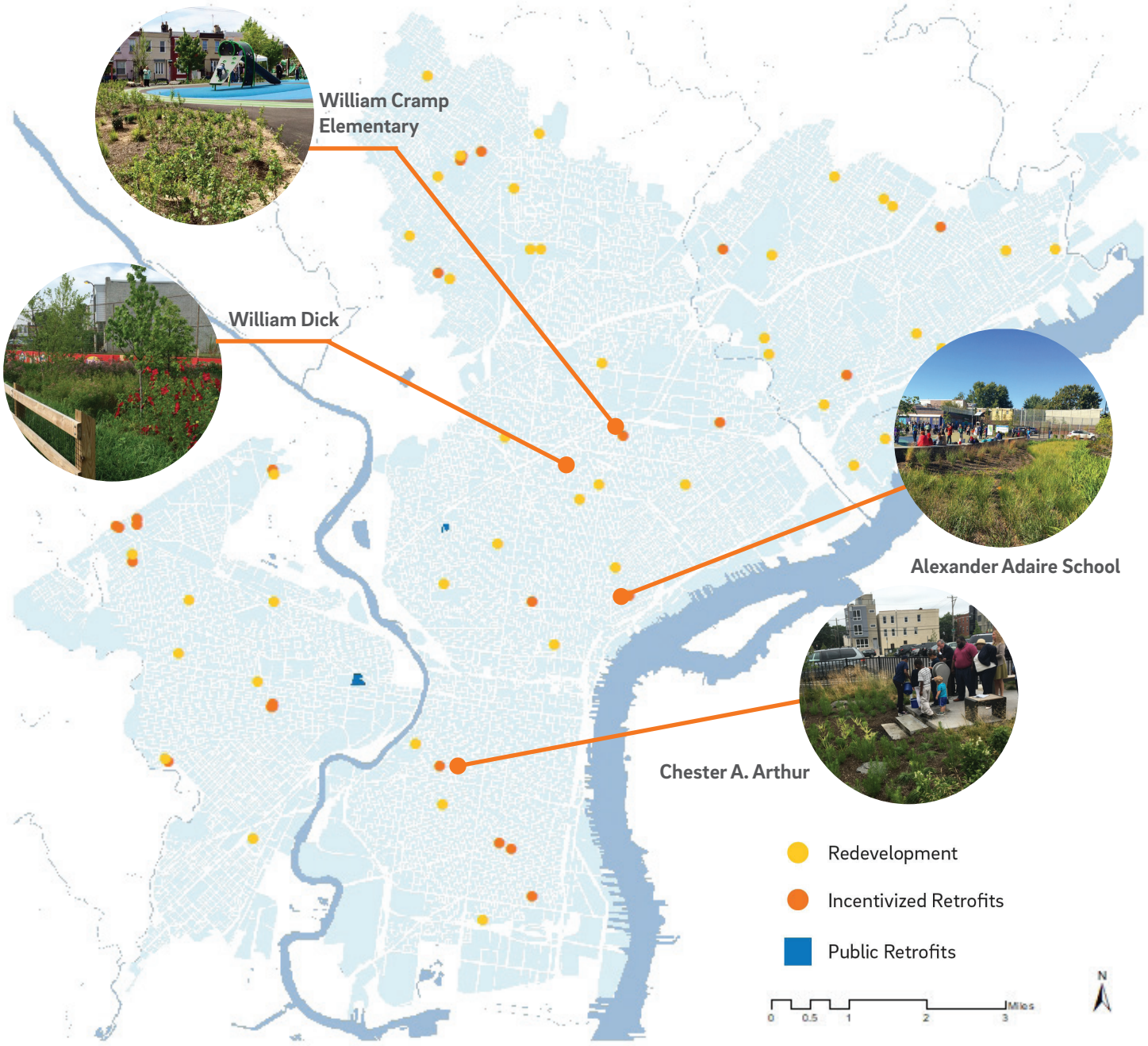
In the schools program, the most progress to date has been achieved through the incentivized retrofit pipeline where 25 grant projects are managing over 39 drainage acres. Of these, 13 are School District of Philadelphia (SDP) projects. Public retrofit projects on schools is on hold and their development is limited by the pending property interest agreement with SDP. At least 15 acres are on hold in design, across 4 PWD led GSI projects on SDP property. Many more are on hold in planning. These projects would pave the way for the public retrofits pipeline to continue to develop schoolyard projects led by PWD. Redevelopment on school properties is a consistent contributor to the drainage acre total for the schools program.

Incentivized Retrofit Highlights

18
completed projects

7
in progress projects

Figure 17. School Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the schools program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	**Public Retrofits**		**Incentivized Retrofits**		**Total**
	Complete	Complete	In Progress*	Complete	In Progress	
Onsite DA	64	0	0	29	6	99
Off-Site DA	0	0	0	4	1	4
Total DA	**64**	**0**	**0**	**33**	**6**	**103**

*15 drainage acres are not included here as they are on hold due to the pending property interest agreement between PWD and SDP

Alexander Adaire School rain garden

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, on hold public retrofit projects, and incentivized retrofit projects. Potential acre totals include drainage acres that may already be managed by existing GSI projects, but all numbers were calculated as projections using a set of management assumptions.

LOW END: The low end of the range includes redevelopment projects as well as incentivized retrofit projects on sites with less than half an acre of ground area. On average, incentivized retrofit sites manage 49% of ground-level impervious area and 21% of rooftop impervious area. Although some right-of-way runoff was managed on past projects, recent SDP projects have not managed the right-of-way due to SDP's concerns. This may change with the William Penn grant to SDP incentizing additional right-of-way runoff management, as well as PWD's Stormwater Grant's grant criteria emphasizing right-of-way capture.

HIGH END: A higher rate of onsite impervious area and ROW management can be achieved through public retrofits. This approach is dependent on an agreement with the School District of Philadelphia for a property interest to enable PWD to construct, own, and maintain GSI on SDP property. Once an agreement is obtained, it creates a model for pursuing additional agreements on SDP property, as well as other school properties.

Public retrofit sites are expected to manage 84% of ground-level impervious area and roughly 10% of rooftop impervious area. It is expected that 100% of sites pursued through public retrofit projects could manage right-of-way runoff.

The incentivized retrofit high end assumes schools of any size will participate and 72% of retrofits will manage right-of-way runoff.

	Schools Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total *
SDP	82	0 - 196	10 - 132	92 - 288
Archdiocese	7	0 - 20	6 - 22	12 - 32
Charter	19	0 - 24	3 - 24	22 - 45
Private	34	0 - 41	13 - 47	46 - 88
Total Onsite	**142**	0 - 281	**31 - 226**	**173 - 453**
Off-site DA	0	0 - 364	0 - 86	0 - 364
TOTAL	**142**	**0 - 645**	**31 - 312**	**173 - 817**

* The high end of Incentivized Retrofits is not included in the total, as it shows a scenario where public retrofits are possible. The same sites could be pursued through both pipelines; but the level of stormwater management is higher for public retrofits.

Schools
Potential Acres

173 - 817
TOTAL DA

Vacant Land

Summary

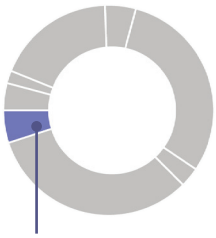
The following table summarizes the vacant land program, including existing conditions, drainage acres managed to date, and projected potential acres.

The vacant land program presents an opportunity to manage significant street runoff through the public retrofit pipeline by implementing GSI projects on City-owned and public non-City vacant lots that are unlikely to be redeveloped. A total of 80 drainage acres on vacant land have been implemented across all pipelines, comprising 20% of all potential acres. Vacant land is often re-categorized into another land use after any improvement or investment, so many of the acres shown below as managed will likely be assigned to another program upon future updates to the parcel inventory layer.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized** Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized** Retrofits	**Total**
Onsite DA	2,011	712	37,568	26	2	32	60	54	0 - 11	0	**54 - 65**
Off-Site DA	-	-	-	0	18	2	20	0	0 - 339	0	**0 - 339**
TOTAL DA	**2,011**	**712**	**37,568**	**26**	**20**	**34**	**80**	**54**	**0 - 350**	**0**	**54 - 404**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.
** The acres categorized as vacant land in the Incentivized Retrofits pipeline may be re-categorized to another program. Given this uncertainty, no Incentivized Retrofit potential

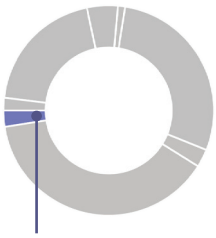
Total Area in CSS



2,011 acres

5% of total land area in the CSS

Impervious Area in CSS



712 acres

2% of impervious area in the CSS

Existing Conditions

Vacant land represents 5% of the total land area in the CSS, but only 2% of the impervious area of the CSS, as it is primarily covered by pervious surfaces. The large amount of unprogrammed ground area on vacant land provides an opportunity to manage runoff from the right-of-way.

The vast majority of vacant land area is in private ownership. Vacant land held by the City and other local public agencies totals about 425 acres. Regardless of ownership, vacant land area is spread across a very large number of parcels.

Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
City of Philadelphia	141	34	3,611
Landbank	55	13	2,318
PAID	54	10	22
PGW	2	0	5
PHA	61	16	2,024
PHDC	2	1	97
PIDC	1	1	4
PRA	112	19	1,618
Private Non-Residential	734	373	3,326
Private Residential	847	245	24,525
State	2	1	18

Impervious Area by Owner Type

5% City-owned
8% Public non-City
87% Private

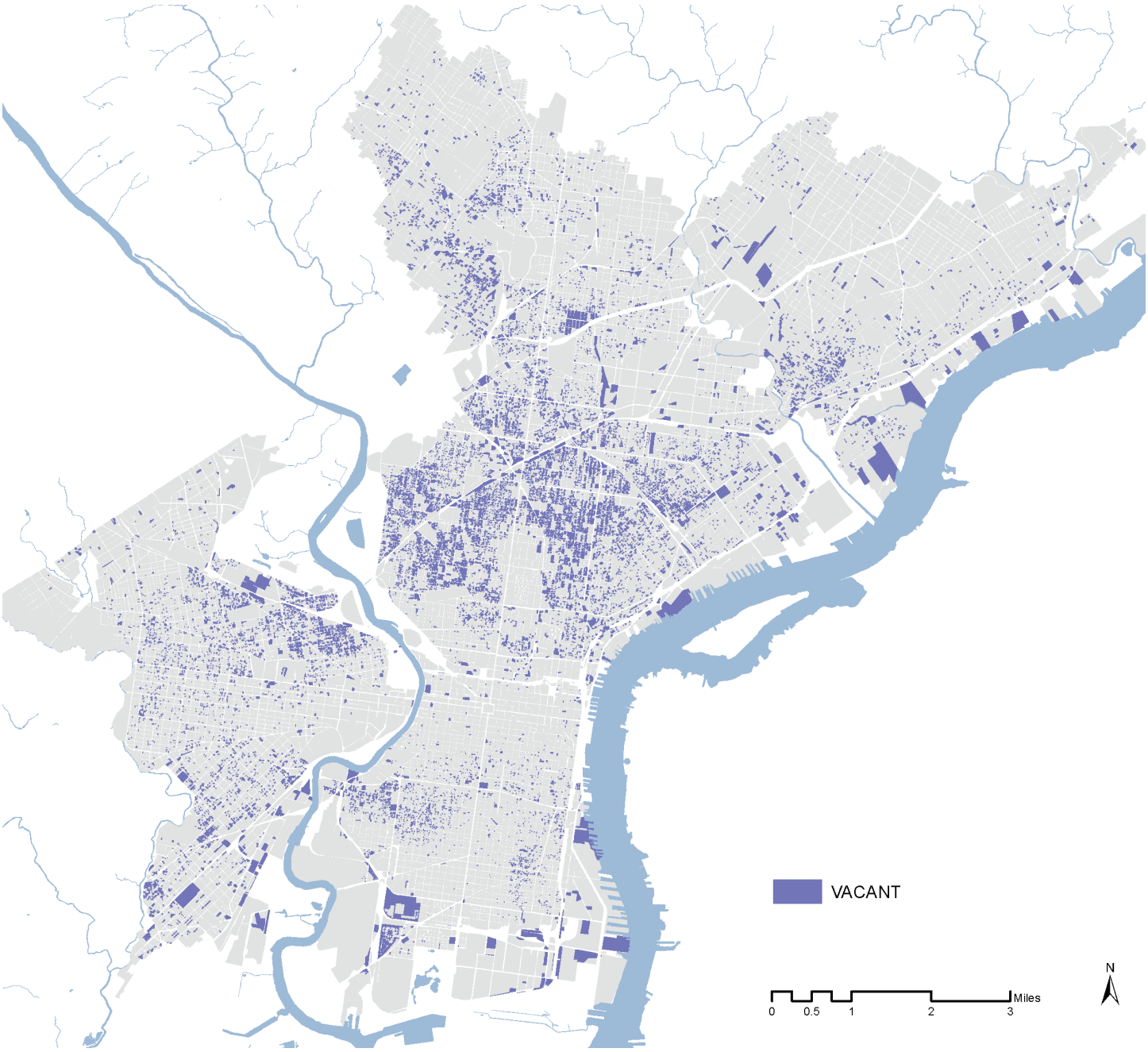
Many vacant parcels have changed ownership and/or program category since the previous strategic plan update in 2018, primarily due to the ongoing development of vacant land, the correction of previous inaccuracies in the 2018 parcel inventory layer, and the City's decision to transfer much of its vacant land to the Land Bank. In addition, a significant amount of vacant properties have shifted, into higher or lower residential real estate market value groupings, as a result of overall changes in the residential real estate market since the previous plan update. Therefore, the set of vacant parcels considered for public retrofits has shifted.

Characteristics

Vacant land is a key source of land for redevelopment, whereby it is converted to another land use and often required to meet the PWD Stormwater Regulations. Therefore, PWD-led projects on vacant land attempt to target City owned parcels that are unlikely to be redeveloped. Implementation by PWD is focused on vacant sites that meet the criteria outlined below.

- Within 15 feet of an active, PWD-owned inlet
- No buildings
- Located within one of the four lowest residential real estate market categories in Philadelphia (out of nine), with median home prices well below the city average, or sites without sufficient data to assess market value
- No parcels with Industrial/Industrial Mixed Use zoning designations
- Total ground area ≥2,000 square feet

Figure 18. Vacant Land Distribution



Progress To Date

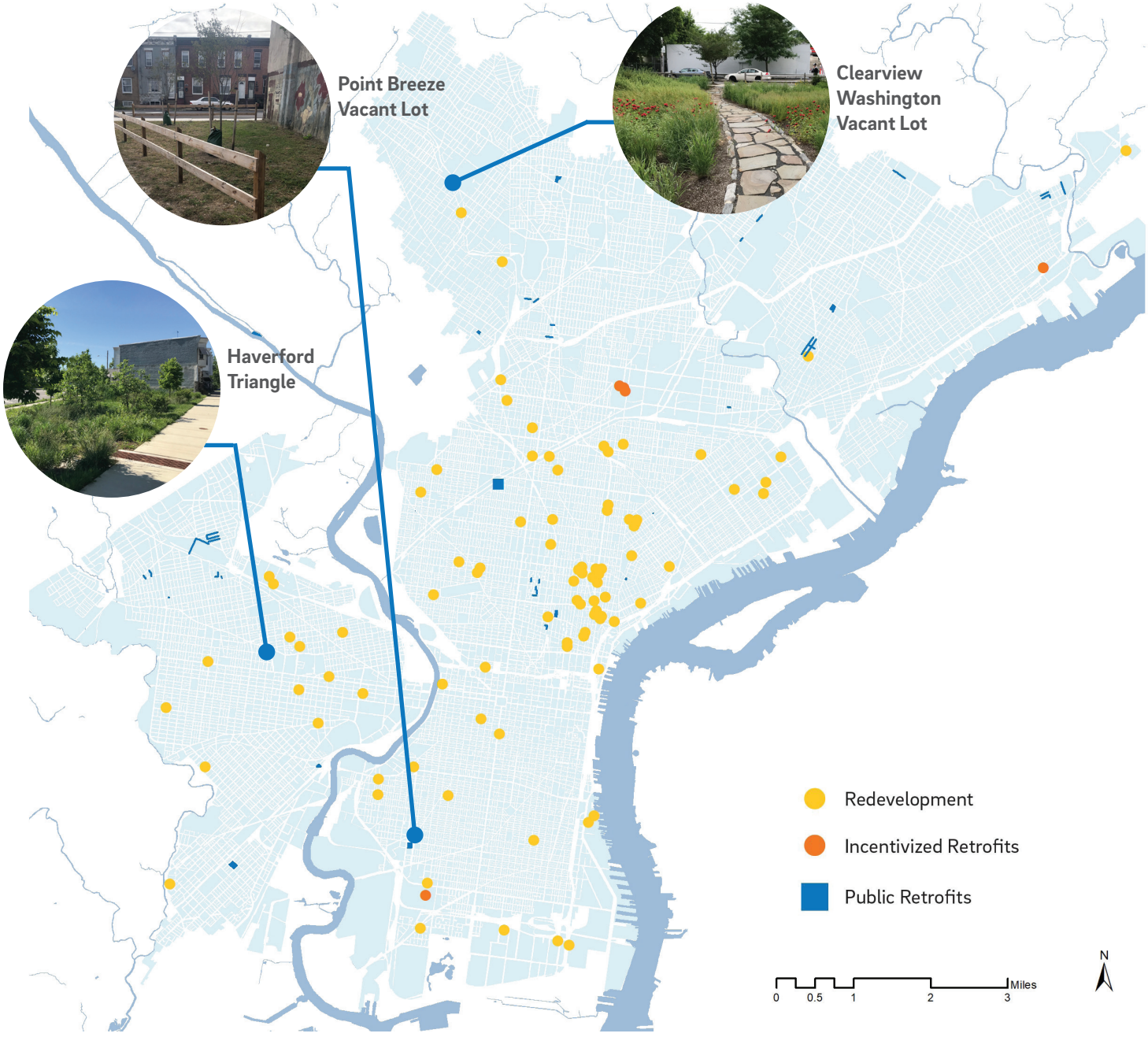
Thus far, the majority of drainage acres managed by the vacant land program have been managed through redevelopment and public retrofits. Redevelopment has managed 26 acres on vacant land. Public retrofits account for 20 drainage acres managed to date, with 5 acres completed and 15 acres currently in progress. Incentivized retrofit projections were not calculated as part of the vacant land program as the final land use may change. The Progress to Date table to the right shows 34 acres managed by the incentivized retrofit pipeline. The 34 acres displayed here represent commercial development projects that will eventually be counted as part of the commercial program. Unfortunately, there is a time lag between on-the-ground land use changes and the city databases cataloging those changes.

Public Retrofit Highlights

7
completed projects

11
in progress projects

Figure 19. Vacant Land Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the vacant program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	**Public Retrofits**		**Incentivized Retrofits**		**Total**
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	26	1	1	31	1	60
Off-Site DA	0	4	14	0	2	20
Total DA	**26**	**5**	**15**	**31**	**3**	**80**

Haverford Triangle vacant lot rain garden

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections and public retrofit projects. Potential acre totals include drainage acres that may already be managed by existing GSI projects, but all numbers were calculated as projections using a set of management assumptions.

LOW END: The low end of the range includes only the drainage acres expected to be managed through redevelopment.

HIGH END: The high end of the range also includes right-of-way acres that can be managed by public retrofit projects on City-owned, public non-City and private vacant land. On average, public and private sites both manage 90% of ground-level impervious area, while public sites utilize 66% of the remaining ground area for ROW management and private sites use only 20%.

	Vacant Land Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total
City of Philadelphia	1	0 - 2	0 - 0	1 - 3
Landbank	0	0 - 1	0 - 0	0 - 1
PAID	1	0 - 0	0 - 0	1 - 1
PGW	0	0 - 0	0 - 0	0 - 0
PHA	6	0 - 0	0 - 0	6 - 6
PHDC	0	0 - 0	0 - 0	0 - 0
PIDC	0	0 - 0	0 - 0	0 - 0
PRA	0	0 - 2	0 - 0	0 - 2
Private Non-Residential	33	0 - 5	0 - 0	33 - 38
Private Residential	12	0 - 1	0 - 0	12 - 13
State	0	0 - 0	0 - 0	0 - 0
Onsite DA	**54**	**0 - 11**	**0 - 0**	**54 - 65**
Off-site DA	0	0 - 339	0 - 0	0 - 339
TOTAL	**54**	**0 - 350**	**0 - 0**	**54 - 404**

Vacant Land

Potential Acres

54 - 404

TOTAL DA

Campus

Summary

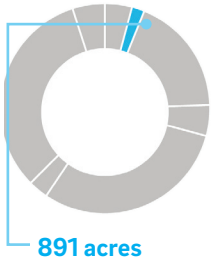
The following table summarizes the campus program, including existing conditions, the drainage acres managed to date, and the projected potential acres.

The campus program presents an opportunity to manage between 285- 495 drainage acres on properties held by large landowners, such as universities, colleges, and hospitals, through redevelopment and incentivized retrofits. A total of 137 drainage acres have been implemented across all pipelines, representing 48% of the low end of the total campus potential acres, and 27% of the high end.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**
Onsite DA	891	619	720	121	-	16	137	269	0 - 7	0 - 143	**269 - 419**
Off-Site DA	-	-	-	0	-	0	0	0	0 - 9	0 - 67	**0 - 76**
TOTAL	**891**	**619**	**720**	**121**	**-**	**16**	**137**	**269**	0 -16	**0 - 210**	**269 - 495**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.

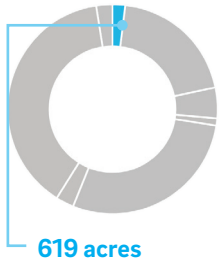
Total Area in CSS



891 acres

2% of total land area in the CSS

Impervious Area in CSS



619 acres

2% of impervious area in the CSS

Impervious Area by Owner Type

- *0% City-owned*
- *23% Public non-City*
- *77% Private*

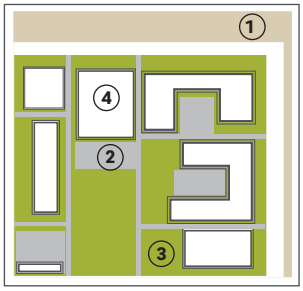
Existing Conditions

University and hospital campuses make up 2% of the total land area in the CSS, as well as 2% of the impervious area in the CSS. This land use type is 64% impervious, 50% of which is rooftop impervious area and 50% of which is ground. This impervious area is concentrated on large parcels and parcels owned by large landowners. The University of Pennsylvania owns the most impervious area, followed by Temple University, La Salle University, and Drexel University.

Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
Community College of Philadelphia	22	17	8
Children's Hospital	29	23	10
Drexel University	89	61	117
Einstein Hospital	31	22	13
Girard College	43	23	1
Jefferson University	25	22	46
La Salle University	114	60	49
Pennsylvania Hospital	7	6	10
St. Joseph's University	55	27	16
Temple University	159	119	193
University of the Arts	4	4	11
University of Pennsylvania	245	186	207
University of the Sciences	24	17	15
Other	42	32	24

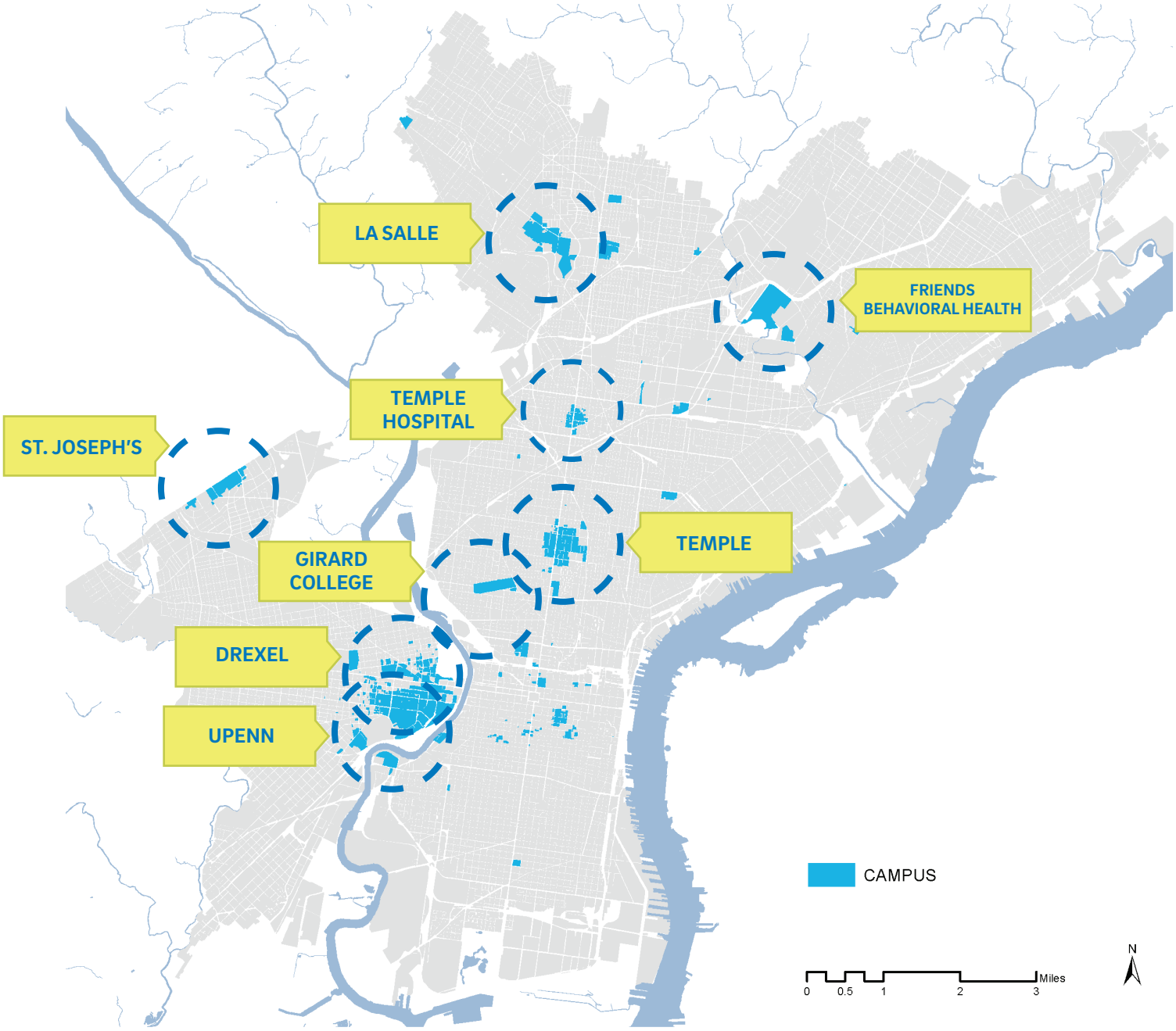
Characteristics

Campuses and hospital properties commonly have several buildings interspersed with parking lots and pervious green space that is either landscaped or used for athletic activities. Most universities and hospitals reserve properties with large open spaces for future redevelopment and are reluctant to dedicate open space for stormwater management unless required to do so by the Stormwater Regulations. For universities with significant budgets and high redevelopment rates, financial incentives may be insufficient to motivate retrofitting their sites.



1. **Street** contributing
2. **Ground Impervious Area** contributing & receiving
3. **Ground Pervious Area** receiving
4. **Rooftop Impervious** contributing

Figure 20. Campus Distribution in the CSS



Progress to Date

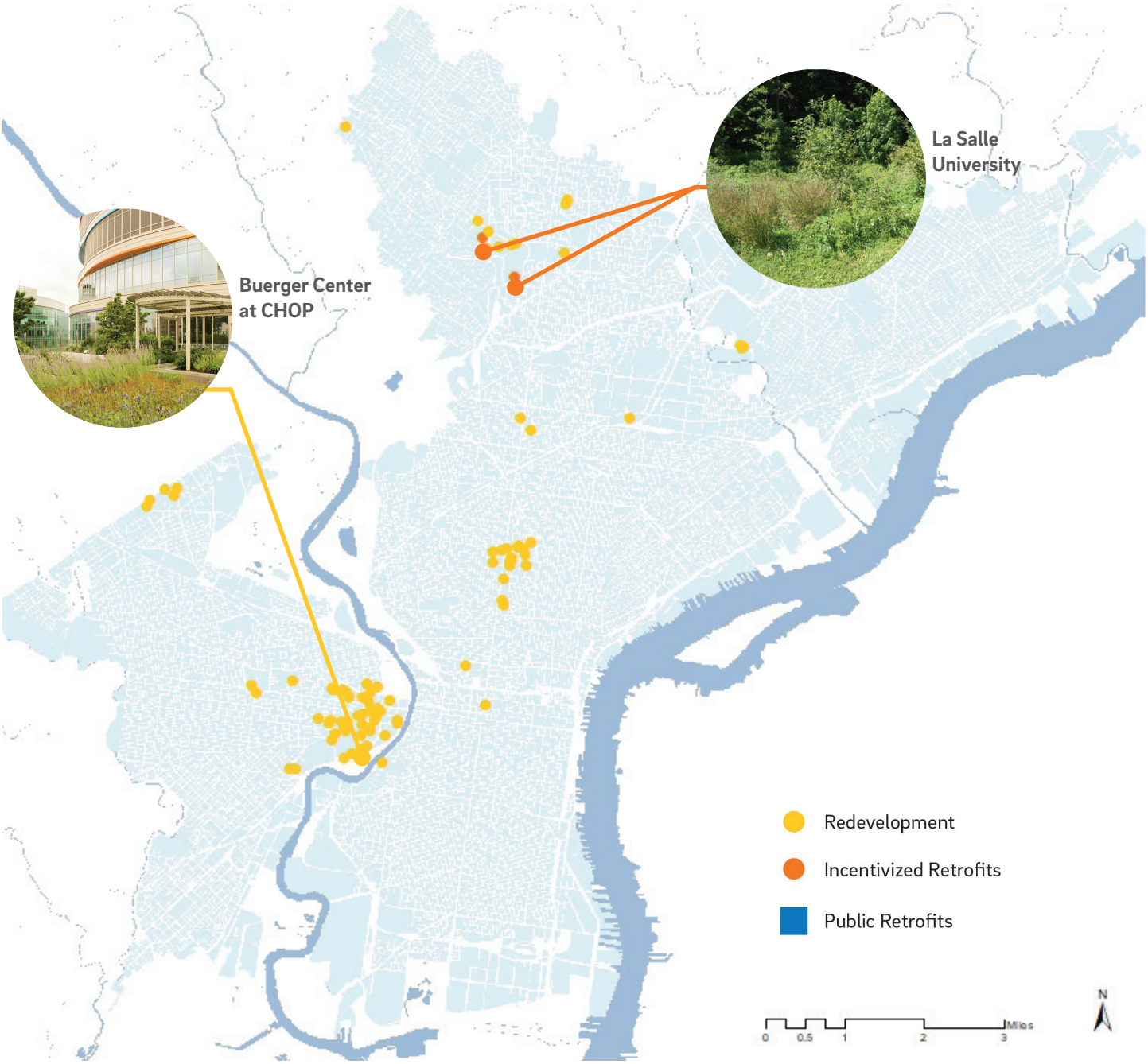
Thus far, the majority of drainage acres managed by the campus program have been through redevelopment, with 121 completed acres to date. Incentivized retrofits account for 16 managed drainage acres.

Incentivized Retrofit Highlights

3

completed projects

Figure 21. Campus Projects to Date



The table below summarizes the drainage acres managed in each pipeline of the campus program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	**Public Retrofits**		**Incentivized Retrofits**		**Total**
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	121	-	-	16	0	137
Off-Site DA	0	-	-	0	0	0
Total DA	**121**	**-**	**-**	**16**	**0**	**137**

Buerger Center at CHOP green roof

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, public retrofit and incentivized retrofit projects. Potential acre totals include drainage acres that may already be managed by existing GSI projects, but all numbers were calculated as projections using a set of management assumptions.

LOW END: The low end of the range includes primarily the drainage acres expected to be managed through redevelopment, plus potential public retrofit acres on Girard College property.

HIGH END: The high end of the range also includes acres managed by incentivized retrofits. On average, incentivized retrofit projects manage 45% of ground-level impervious area onsite, 1% of rooftop impervious area onsite, and use 1% of the remaining ground area for right-of-way management. Incentivized retrofit acres are included in the high end because campuses are not motivated by a consistent set of factors making it difficult to predict how many will participate in the incentivized retrofit pipeline.

	Campus Potential Acres			
	Redevelopment	Public Retrofits	Incentivized Retrofits	Total
Community College of Philadelphia	6	0 - 0	0 - 3	6 - 9
Children's Hospital (CHOP)	18	0 - 0	0 - 5	18 - 23
Drexel University	27	0 - 0	0 - 16	27 - 43
Einstein Hospital	7	0 - 0	0 - 6	7 - 3
Girard College	6	0 - 7	0 - 13	6 - 26
Jefferson University	5	0 - 0	0 - 3	5 - 8
La Salle	24	0 - 0	0 - 19	24 - 43
Pennsylvania Hospital	1	0 - 0	0 - 1	1 - 2
St. Joseph's University	11	0 - 0	0 - 7	11 - 18
Temple University	68	0 - 0	0 - 21	68 - 89
University of the Arts	1	0 - 0	0 - 0	1 - 1
University of Pennsylvania	74	0 - 0	0 - 39	74 - 113
University of the Sciences	6	0 - 0	0 - 4	6 - 10
Other	16	0 - 0	0 - 7	16 - 23
Total Onsite	**269**	**0 - 7**	**0 - 143**	**269 - 419**
Off-Site DA	0	0 - 9	0 - 67	0 - 76
TOTAL	**269**	**0 - 16**	**0 - 210**	**269- 495**

Campuses

Potential Acres

269 - 495

TOTAL DA

Residential

Summary

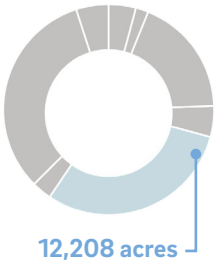
The following table summarizes the residential program existing conditions, the drainage acres managed to date, and the projected potential acres.

The residential program relies primarily on redevelopment to manage drainage acres on residential property. The redevelopment pipeline is projected to result in approximately 66 potential acres. A total of 32 drainage acres have been implemented across all pipelines, comprising 48% of the residential program potential acres.

	Existing Conditions in the CSS			**Progress to Date Acres** Onsite & Off-Site *				**Potential Acres** Onsite & Off-Site			
	Total Area (acres)	**Impervious Area** (acres)	**Number of Parcels**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**	Redevelopment	Public Retrofits	Incentivized Retrofits	**Total**
Onsite DA	12,208	8,736	362,360	31	-	-	31	66	0	0	**66**
Off-Site DA	-	-	-	0	-	-	0	0	0	0	**0**
TOTAL	**12,208**	**8,736**	**362,360**	**31**	**-**	**-**	**31**	**66**	**0**	**0**	**66**

* Includes Complete and In Progress projects. Refer to the Progress to Date section for a more detailed breakdown.

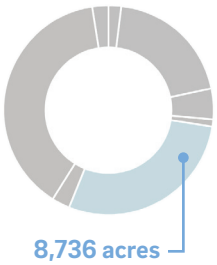
Total Area in CSS



12,208 acres

30% of total land area in the CSS

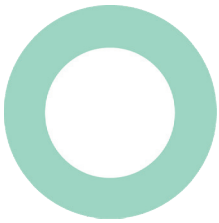
Impervious Area in CSS



8,736 acres

29% of impervious area in the CSS

Impervious Area by Owner Type



- *0% City-owned*
- *0% Public non-City*
- *100% Private*

Existing Conditions

Residential land is the predominant land use in the CSS service area, comprising 30% of total land area and 29% of impervious area. The residential program primarily consists of single-family homes, twins, rowhomes, multi-unit buildings of 3 units or less, and residential parking areas.

Some residential parcel boundaries extend into shared, private alleyways and driveways, and because these surfaces are often already sloped to convey runoff into the public right-of-way, they can be disconnected to any downstream GSI that accepts runoff from the adjacent right-of-way.

Property Type	Total Area (acres)	Impervious Area (acres)	Number of Parcels
Residential Sites*	12,199	8,729	362,260
Residential Parking	9	6	100

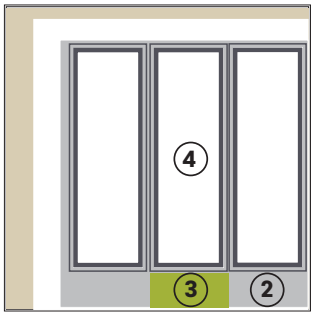
* Includes private alleyway and driveways

Characteristics

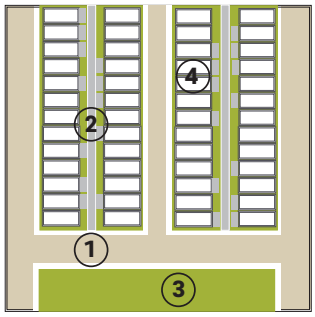
Residential sites tend to be small and highly constrained, with rooftops constituting 75% of impervious area in this program, so implementation ideas tend to focus on managing rooftop drainage areas- either onsite or off-site. The most common onsite systems are space-efficient rain barrels, which manage roof runoff. Other options include depaving and permeable pavers, which manage ground-level impervious area, downspout planters, which manage rooftop impervious area, and rain gardens, which manage both.

There are currently no incentives or mechanisms available to ensure long-term operation and maintenance of GSI on residential sites, particularly rain barrels, which must be emptied by the user. At this time, PWD cannot take compliance credit for these projects. These types of management practices were excluded from the potential acre projections for the residential program in this update of the strategic plan.

Onsite Management



Off-Site Management



1. **Street** receiving
2. **Ground Impervious Area** contributing
3. **Ground Pervious Area** receiving
4. **Rooftop Impervious** contributing

The advantage of managing residential roof runoff off-site, in public GSI systems in the right-of-way, is that PWD can ensure the long-term operation and maintenance of the GSI. Planning studies estimate that 8 to 14% of residential rooftops could be disconnected to right-of-way systems or centralized GSI facilities (LADs). However, PWD has yet to validate this planning estimate with a real-world disconnection project. Thus, rooftop disconnections were also excluded from the potential acre projections in this update.

PWD has begun to count private alleyways and driveways towards compliance credit. The potential drainage acres from the "Residential Alleyway Run-on" category is accounted for in the Streets program, as it is managed within the right-of-way.

Progress to Date

To date, redevelopment constitutes the vast majority of the residential program, with 31 drainage acres managed through redevelopment and 1 drainage acre managed through the incentivized retrofit pipeline. The table below summarizes the drainage acres managed in each pipeline of the residential program as of July 1, 2020.

	Progress to Date Acres Onsite & Off-Site					
	Redevelopment	**Public Retrofits**		**Incentivized Retrofits**		**Total**
	Complete	Complete	In Progress	Complete	In Progress	
Onsite DA	31	-	-	0	-	31
Off-Site DA	0	-	-	0	-	0
Total DA	**31**	**-**	**-**	**0**	**-**	**31**

Potential Acres

The following table shows the potential acre ranges for stormwater management based on redevelopment projections, public retrofit and incentivized retrofit projects. Potential acre totals include drainage acres that may already be managed by existing GSI projects, but all numbers were calculated as projections using a set of management assumptions.

LOW END: In this update, the entire residential program is comprised of drainage acres managed through redevelopment. Since a single number, rather than a range, of potential acres is projected for the redevelopment pipeline, there is a single number of potential acres projected for this program as a whole.

HIGH END (removed): In a previous version of this framework, the high end of the potential acre range also included acres expected to be managed through the incentivized retrofit pipeline. These acres assumed future potential to receive compliance credit for management of residential impervious area through rooftop disconnections to public systems or through smaller, owner-operated GSI on individual residential properties. Since PWD currently cannot obtain compliance credit for these types of GSI projects, and is not presently prioritizing these options, both were removed from the potential acre projections for this framework.

	Residential Potential Acres			
	Redevelopment	**Public Retrofits**	**Incentivized Retrofits**	**Total**
Residential Sites	62	0 - 0	0 - 0	62
Residential Parking	4	0 - 0	0 - 0	4
Total Onsite	**66**	0 - 0	0 - 0	**66**
Off-Site DA	0	0 - 0	0 - 0	0
TOTAL	**66**	0 - 0	0 - 0	**66**

Residential

Potential Acres

66

TOTAL DA

Potential Acre Summary

Streets	2,282 - 2,690 ONSITE DA	+	68 - 68 OFF-SITE DA	=	2,350 - 2,758 TOTAL DA
Parks	114 - 160 ONSITE DA	+	623 - 975 OFF-SITE DA	=	736 - 1,136 TOTAL DA
Commercial	2,289 - 2,909 ONSITE DA	+	159 - 349 OFF-SITE DA	=	2,448 - 3,258 TOTAL DA
Facilities	219 - 606 ONSITE DA	+	4 - 303 OFF-SITE DA	=	223 - 909 TOTAL DA
Schools	173 - 453 ONSITE DA	+	0 - 364 OFF-SITE DA	=	173 - 817 TOTAL DA
Vacant Land	54 - 65 ONSITE DA	+	0 - 339 OFF-SITE DA	=	54 - 404 TOTAL DA
Campuses	269 - 420 ONSITE DA	+	0 - 76 OFF-SITE DA	=	269 - 495 TOTAL DA
Residential	66 - 66 ONSITE DA			=	66 - 66 TOTAL DA

Total Potential Acres 6,334 - 9,843

Next Steps

This section summarizes the main program considerations facing implementation efforts and highlights critical actions needed to accomplish Green City, Clean Water goals. It also outlines future planning and coordination needs for the next 15 years and beyond.

Considerations for Streets Projects

There are various physical and policy considerations that are unique to GSI projects sited within the street. How these specific elements are addressed can greatly impact the number and type of streets projects completed for across the city. A summary of considerations that have the most impact on the streets program are categorized below.

Policy & Coordination	In 2020, the streets paving moratorium increased from 3 to 5 years. This adds complexity to siting GSI and impacts when projects can be initiated. During planning, this may result in "leftover projects" as packages have to be reshuffled or placed on hold. During design, paving coordination can affect project cost and timelines.
	Partner projects have added complexities that can extend project timelines. PWD has little influence on constraints that affect project implementation for partners, such as funding.
	High private redevelopment rates limit the siting of GSI street systems next to vacant lots, as these projects are susceptible to impacts from adjacent development/redevelopment.
	There is minimal interest in developer incentives for installing green street systems as part of redevelopment projects due to design, timing, and funding limitations.
	Differing Water/Sewer (W/S) workflow and priorities has made siting GSI on W/S projects challenging. Conflicting projects have an impact on design and construction. There are limitations to adding surface features, maximizing
Physical & Design	Physical constraints to siting GSI in the ROW include small drainage areas on dense residential blocks, steep slopes, shallow bedrock or ground water, subsidence issues, large mature trees, historic streets, active and abandoned transportation infrastructure, ROW encroachment by private property owners, and varying densities of subsurface utilities.
	Physical constraints impact GSI project costs, timelines, and complexity. In response, the GSI Unit added more design considerations and utility offsets that severely affect potential acres.
	Green street design guidance has been updated to account for transmission main and sewer offsets, reducing the number of opportunities for GSI systems and leading to planning packages that are more spread out and costly. This affects all planning districts, but has a greater impact in districts with dense neighborhoods.
Maintenance	Maintenance concerns in areas with high volumes of trash and short dumping limit opportunities for GSI with surface features.
	Maintenance cost and logistic concerns limit the placement of GSI systems within traffic and pedestrian medians.

Considerations for Projects on Parcels

There are various physical and policy considerations that are unique to GSI projects that are sited on parcels. Property ownership varies and includes City-owned, public non-City, and private properties. PWD has the ability to implement projects directly on City-owned land which also requires City department partnership; however, PWD has limited ability to influence what happens on public non-City and private properties. How these specific elements are addressed can greatly impact the number and type of GSI projects completed on parcels across the city. Considerations that have the most impact on the ability to site GSI on various parcels are highlighted below.

Policy & Coordination	For Park and City-owned facilities projects, the policy & coordination considerations include timeline and priority alignment, as well as limited partner funding.
	PWD is restricted from funding non-GSI improvements making it difficult to complete comprehensive projects.
	Easements or license agreements are needed to move forward with public retrofits on and land that is not city-owned. These types of agreements have been challenging to secure. If a streamlined process can be developed to secure property interests to broaden the use of capital funding, it would unlock opportunities on many property types.
	Stormwater management is not always maximized on GSI projects led by others for various reasons, including multiple objectives, limited funding, tight schedules, or limited scope.
	Minimal interest in incentives for managing right-of-way runoff or additional onsite runoff as part of development/redevelopment due to design, timing, and funding limitations.
	Although commercial & industrial parcels with stormwater bills over $500/month are likely to undergo a retrofit, current policies do not seem to offer enough of an incentive for properties with stormwater charges between $200-$500 to pursue a retrofit.
	Siting GSI on vacant land requires additional coordination with community groups, council, and legal teams which can extend timelines and make it difficult to align with other projects (e.g. streets and parks).
	It is complex to accurately predict where redevelopment will occur and the resulting potential for stormwater management.
	Campuses have not historically been interested in pursuing incentivized retrofits, preferring to keep most of their properties available for redevelopment, including open space, thus limiting opportunities for additional stormwater management.
	Additional policy mechanisms and design guidance need to be developed to manage residential run-off and have it count for compliance. Example: Disconnecting residential rooftops to the public right-of-way and/or into a centralized GSI facility could require specific agreements with each property owner.

Physical & Design	For park parcels, physical & design considerations of GSI projects primarily involve site use and programming, as well availability of onsite space for routing and managing adjacent right of way runoff.
	Commercial property owners have sometimes chosen subsurface systems based on site use or cost considerations, thus limiting greening and associated benefits. Some commercial & industrial parcels may have physical considerations that limit their opportunity to apply for stormwater incentives and maximize ROW capture onsite, such as an elevated site, contamination and/or high groundwater levels.
	Many facility program sites lack space for GSI due to the size of site, programming, buildings, and other onsite infrastructure, such as subsurface fuel tanks.
	For school sites, physical constraints include programming, use, and site elevation limiting the amount of ROW runoff that can be brought onsite, internal roof leaders, and historic uses, such as former industrial uses and graveyards that can limit GSI.
	For vacant parcels, physical and design considerations include vacant lot size, with larger parcels and contiguous ownership preferred, and constraints such as historic use, buried foundations and infrastructure.
	Many residential parcels are small and constrained, and a majority of the impervious area is rooftop.
Maintenance	Maintenance funding limitations for public property and parks result in a resistance to install GSI. Cost sharing for maintenance across departments is currently being explored.
	Maintenance funding is prioritized based on primary goals of partners or property owners, leaving little funding for GSI maintenance, impacting potential for GSI implementation and long term viability of installed GSI.
	Training, education, and funding for GSI maintenance, as well as community stewardship is crucial for continued GSI implementation.
	Maintenance concerns in areas with high volumes of trash and short dumping limit opportunities for GSI with surface features.
	Stormwater management practices (SMPs) constructed in residential single-family developments can stop functioning without proper maintenance by the homeowner.
	SMP maintenance challenges for residential single-family developments also arise when ownership changes from developer to owners.

Critical Actions

The critical actions summarized in this section demonstrate the continued level of effort required to sustain the delivery of GSI at the scale required to meet current regulatory compliance targets. These actions have been categorized by pipeline and include items that would present significant changes to our current implementation approaches.

Ongoing actions ensure the delivery of GSI projects to achieve the low end of the potential acre range of 6,334 acres. These actions also add flexibility to how current or future compliance targets are achieved. Short term actions are time-dependent. Implementing these actions sooner will help the City maximize stormwater management overall. Ideally these items would be in common practice before Year 15 (2026) to maximize management potential. Long term actions require continued research and exploration, but can still be effective if implemented beyond Year 20 (2031). These long term actions can be implemented later in the program because they do not require the design or construction of any new stormwater management practices; however planning for these needs to start now. Additionally, if the ongoing and short-term actions are more effective than expected, it may replace the need to implement these more challenging changes.

1. Regulate & Guide Redevelopment

Ongoing

1.1 Optimize and refine the current redevelopment pipeline approach

- Maintain the water quality requirements of the Stormwater Regulations and continue to support property owners, developers and other City agencies to meet these requirements using high-quality, green stormwater management practices. At least 1,290 acres are expected as a result.

1.2 Enforce standards to deliver high quality stormwater management projects & keep them in compliance

- Implement a funding structure for inspection services and develop active construction enforcement
- Coordinate facilitation of online/electronic fee payment and electronic recording of Operations & Maintenance agreements against property deeds

1.3 Streamline post-construction and inspection coordination with key property owners

- For example: Utilize post-construction meetings with the School District of Philadelphia to transition projects from closeout to maintenance, to prepare for inspections by discussing operations & maintenance best practices and solutions to major issues, and to inform future projects.

1.4 Facilitate and promote banking and trading process

- Promote same-owner and same-parcel banking and trading, such as on a campus. This flexibility has the potential to improve the quality of stormwater management systems. This is permitted by the Stormwater Regulations and guidance has been developed for property owners to bank and trade with each other, but is not widely utilized.
- Explore how to best support banking and trading across different property owners or partners for compliance with the Stormwater Regulations. This flexibility has the potential to improve the quality of stormwater management systems, especially for small residential sites or projects considering paying a Fee in Lieu, and contribute towards equity goals.

Short Term

1.5 Explore design guidance and policy solutions for residential single-family lot development projects

- Develop design guidance, engineering details, calculation tools, and other resources to guide the design of stormwater management for residential single-family lot development projects.
- Propose various policy solutions for residential single-family lot properties, compare and contrast the policy options using set criteria, and further develop selected solutions for possible implementation.

1.6 Promote and streamline incentives to maximize stormwater management on projects that trigger the regulations

- Continue to promote additional onsite and off-site stormwater management beyond the Stormwater Regulations through incentive mechanisms such as the Developer Right of Way incentive, purchase of assets agreements (e.g. green street projects), and zoning incentives, such as the floor-area-ratio bonus.
- Continue to identify opportunities for maximizing stormwater management in coordination with development projects that trigger stormwater regulations by working across teams and taking a comprehensive approach.

Long Term

1.7 Encourage residential rooftop management through Stormwater Regulations

- Consider revising the Stormwater Regulations to require new residential impervious areas to connect to green gutters or green sewers, when available, rather than connecting to the combined sewer system.

2. Implement Public Retrofits

Ongoing

2.1 Optimize and refine the current public retrofits pipeline approach

- Continue to work with key City agencies to implement public retrofit projects. The GSI Unit has already fostered a strong working relationship with the Streets Department and Philadelphia Parks & Recreation. Approximately 2,880 acres of the low end implementation of public retrofit projects is highly dependent on the continued support of these City agencies.

2.2 Streamline the documentation of maintenance responsibilities for all GSI built on city-owned land

- Continue to generate GSI project lists and maps to be shared in a maintenance binder, where every city owned site that has GSI, whether built through stormwater regulations or a public retrofit, will have documentation outlining maintenance responsibilities.
- Work with city agency partners to secure adequate GSI maintenance funding for GSI not owned by PWD and to develop cost shares where appropriate.

2.3 Continue linear asset planning coordination with City and utility partners

- Improve coordination between GSI and other entities both internally and externally to accomplish street projects in a more efficient manner and reduce construction impacts on neighborhoods. Examples include, proactive planning to coordinate street upgrades with paving needs in advance of paving moratoriums, coordinating work on intersections or other areas with planned improvements such as bike lanes (Cobbs Creek Pkwy, Lindbergh Blvd), and piloting collaborative investment in support of traffic signal upgrades.

2.4 Expand partnership projects through coordinated financing efforts

- Seek grants and other funding opportunities in coordination with partners to expand funding for GSI project delivery across all programs either led by PWD or partner agencies.

2.5 Maximize greening and co-benefits

- Incorporate surface greening targets and equity goals to maximize co-benefits. Example: Establish surface greening targets with PWD staff and facilitate project-by-project agreement on size of surface features. Coordinate with the Philly Tree Plan and PPR to support tree canopy goals.

Short Term

2.6 Provide assistance to other City agencies to maximize stormwater on all capital projects

Action items for parks and facilities programs dependent on City agency partnerships have been outlined in internal partner action plans, including improving capital alignment coordination with Philadelphia Parks & Recreation, and the Department of Public Property. A target of 965 acres (including 790 off-site DA) is dependent on implementing these partner action plans.

- Collaborate on projects that do not trigger the Stormwater Regulations, to add stormwater management into site improvements undertaken by other agencies and partners through cost-share and joint contracting mechanisms.
- Maximize the management of off-site drainage areas on projects that trigger the Regulations.
- Explore options for inclusion of PWD stormwater management language in standard PPR and DPP scopes for non-partner projects.

2.7 Develop design solutions for physical and maintenance challenges

- Work across PWD groups to develop solutions outlined in the consideration section and informed by ongoing learning from GSI projects.
- Modify design and cost guidance for street projects
- Explore new design parameters, flexible cost targets, and technologies in order to implement green streets in highly constrained neighborhoods.

2.8 Prioritize a dig once approach at PWD

- Continue to align GSI and Water/Sewer planning efforts to increase stormwater management in the right of way and to reduce potential conflicts with other utilities and paving.

2.9 Secure methods to implement public retrofit projects on non-City property

The ability to do public retrofit GSI projects on non-city parcels is needed to expand the acres available for stormwater management beyond the small amount of land owned by the City. More than 980 acres, of which over 690 are off-site DA, depend on these actions.

- Confirm the type of property interest and review process necessary to meet capital eligibility guidelines for GSI projects.
- Finalize a property interest agreement with the School District of Philadelphia. This agreement has the potential to serve as a model for public retrofits on other school properties, allowing the GSI Unit to manage a

higher rate of on-site impervious and additional off-site DA from the right-of-way on schools.

2.10 Continue process & policy development for GSI projects on facilities and vacant land

Management of stormwater runoff on facility and vacant land through public and incentivized retrofits is significant, accounting for up to a total of 1,079 potential acres, of which 689 acres is from the right-of-way. As mentioned previously, securing property interests is critical for these programs, as is continued development of program processes.

- Formalize a process to acquire private vacant lots. A standardized process would enable PWD to manage off-site DA on these sites.
- Maximize stormwater management opportunities on city owned facilities and vacant land through continued project planning and policy development.
- Ensure streamlined project development through planning, design, construction, and maintenance phases through continued coordination and documentation.
- Continue to identify GSI opportunities on public non-City and private land through neighborhood planning analysis.
- Engage non-profit partners and other community partners to install permanent GSI on non-City-owned vacant lots.

Long Term

2.11 Expand completed project capacity

- Explore opportunities to retrofit completed GSI projects to manage additional runoff from the ROW.

2.12 Disconnect residential rooftops

- Explore options for disconnecting residential rooftops into public GSI systems.

3. Incentivize Retrofits

Ongoing

3.1 Optimize and refine the current incentivized retrofits pipeline approach

Any changes to the potential acres in the incentivized retrofits pipeline impacts the acres needed from other pipelines, especially the public retrofit pipeline.

- To-date PWD's stormwater billing credits and stormwater grants have successfully incentivized schools, SEPTA, and many large commercial property owners to undertake retrofit projects. The baseline, or the low end of the potential acre range, 2,080 acre, associated with implementation of incentivized retrofits is therefore highly dependent on the continued availability of these incentives.
- Continue to refine stormwater grant rubric criteria and GSI project evaluation process with a focus on greening, equity and transparency.
- Explore ways for stormwater billing credits to be adjusted

3.2 Increase on-site and ROW management on incentivized retrofit projects

It is more efficient to increase the drainage area managed on sites that are already undertaking retrofits or re-

development, rather than attempting to fund more projects from scratch. Almost 300 acres are at-risk if these actions are not implemented.

- Strongly encourage ROW management on incentivized retrofits, wherever physically feasible. Continue to allocate funding to construct more ROW connections and street crossings.
- Promote various incentives to property owners, to maximize management of on-site DA.
- Continue coordination across PWD teams, including GSI Planning, Design, Stormwater Billing and Incentives, and Development Services to identify opportunities to manage additional run-off on stormwater grant projects.

3.3 Develop an approach to target large private properties that balances stormwater goals with equity, greening, and co-benefits.

3.4 Continue to explore zoning incentives for stormwater management

- Work with city agency partners such as the Planning Commission (PCPC) to explore where stormwater management incentives are appropriate to include in updates to zoning code.
- Example: The East Callowhill Overlay District allows developers to earn a height bonus for managing public stormwater runoff on private property. A similar height bonus element was developed and integrated into a recent update to the Central Delaware Overlay District as well. Both of these overlay districts have the potential to reduce the right-of-way DA that must be managed through the public retrofit pipeline.

3.5 Encourage public and incentivized retrofit projects to manage rooftops

- Rooftop impervious area represents a significant percentage of all impervious area on facilities, schools, campuses, and commercial property. Fully investigating the feasibility of managing rooftop impervious area for every incentivized and public retrofit project has the potential to roughly double potential DA on these sites.

Short Term

3.6 Develop alternative mechanism to the Greened Acre Retrofit Program (GARP) aggregator project model

3.7 Expand incentives pipeline potential by reaching smaller properties

Financial incentives are still insufficient to motivate small properties, with bills between $200 and $500/month to undertake retrofits.

- Continue to explore alternative delivery mechanisms for small commercial sites and fully understand all owner categories within the commercial program.

3.8 Expand incentives pipeline potential by streamlining GSI work on public non-City parcels

- Target partnership engagement with public non-City agencies, like the School District of Philadelphia (SDP), SEPTA, the Port Authorities, and other large public non-City land owners. Provide technical assistance to support incentivized retrofits and ensure that off-site DA is managed on these sites.
- Continue partnership coordination throughout GSI project life cycle, from pro-active planning through maintenance, to maximize stormwater management, and deliver high quality GSI projects
- Explore alternatives to the stormwater grant process for public non-City partners.

3.9 Identify options to create match funding opportunities for stormwater grants

Additional match funding is typically needed for most GSI pojects outlined in prospective stormwater grant

applications. Match funding also makes applications more competitive.

- Develop external funding opportunities. Examples include the Commercial Property-Assessed Clean Energy (C-PACE) financing structure inclusion of green stormwater infrastructure, and working with foundations on creative financing structures (e.g. William Penn Foundation).
- Revisit PWD stormwater loan program model to support match funding for stormwater grant applications

Long Term

3.10 Explore taking compliance credit for Rain Check

- Develop and test a mechanism by which PWD can access and inspect the maintenance of Rain Check GSI installations. Relate compliance credit to the share of functional Rain Check GSI installations, which may fluctuate over time. A significant amount of drainage acres could be gained from these projects, which are expected to be implemented regardless of whether PWD takes credit.

Looking Ahead

Internal strategic planning is ongoing. We'll set targets for various scenarios using the potential acre framework and considerations outlined in this report.

Although this document focuses heavily on the physical feasibility of GSI, **the department recognizes that partner priorities, community needs, racial equity, environmental justice, and climate resilience play a critical role in decision making.** All scenarios developed will include value statements addressing each of these elements. Engagement with partners has been a huge part of the success of the program to date. Ongoing partner coordination and input will be key.

Future Planning and Coordination

- **Planning for Uncertainty -** Changes to program timing, budgets, and regulatory requirements are some major examples of programmatic factors that may influence target setting. A steady but flexible approach will continue to be needed.
- **Integrated CSS/MS4 Approach -** With different planning and design goals for the MS4, additional analysis will be necessary to move forward with an integrated citywide approach. To support this effort, the Planning Parcel inventory was expanded to include all parcels in the city. Please refer to the Appendix for more detailed information about the update process, and the citywide and MS4 maps.
- **Defining Cost Effectiveness -** Full life-cycle costs, responsibility to ratepayers, and equity considerations should all be included in defining appropriate cost parameters for projects across all pipelines.
- **CSO Volume Reduction -** All GSI locations may not be equal when it comes to CSO impacts. Managing drainage from some subwatershed areas would provide more CSO volume reduction than other areas.
- **Co-benefit Value and Metrics for Surface Greening -** Most co-benefits of green stormwater infrastructure are dependent on the surface greening components of these systems, including trees and vegetation. Understanding co-benefits and their metricss will support planning and decision making for GSI implementation in relation to greening, equity, and climate resilience.

Appendix

Citywide Context

For this GSI Strategic Framework, the Planning Parcel inventory was updated to reflect property changes and combined sewer system (CSS) area boundary refinement as well as expanded to include all parcels in the City (CSS and MS4). A separate right-of-way layer was also created citywide, in addition to the CSS specific one used for this plan. Please see the Appendix for more information.

Figure 21. Parcels Citywide by Program Type

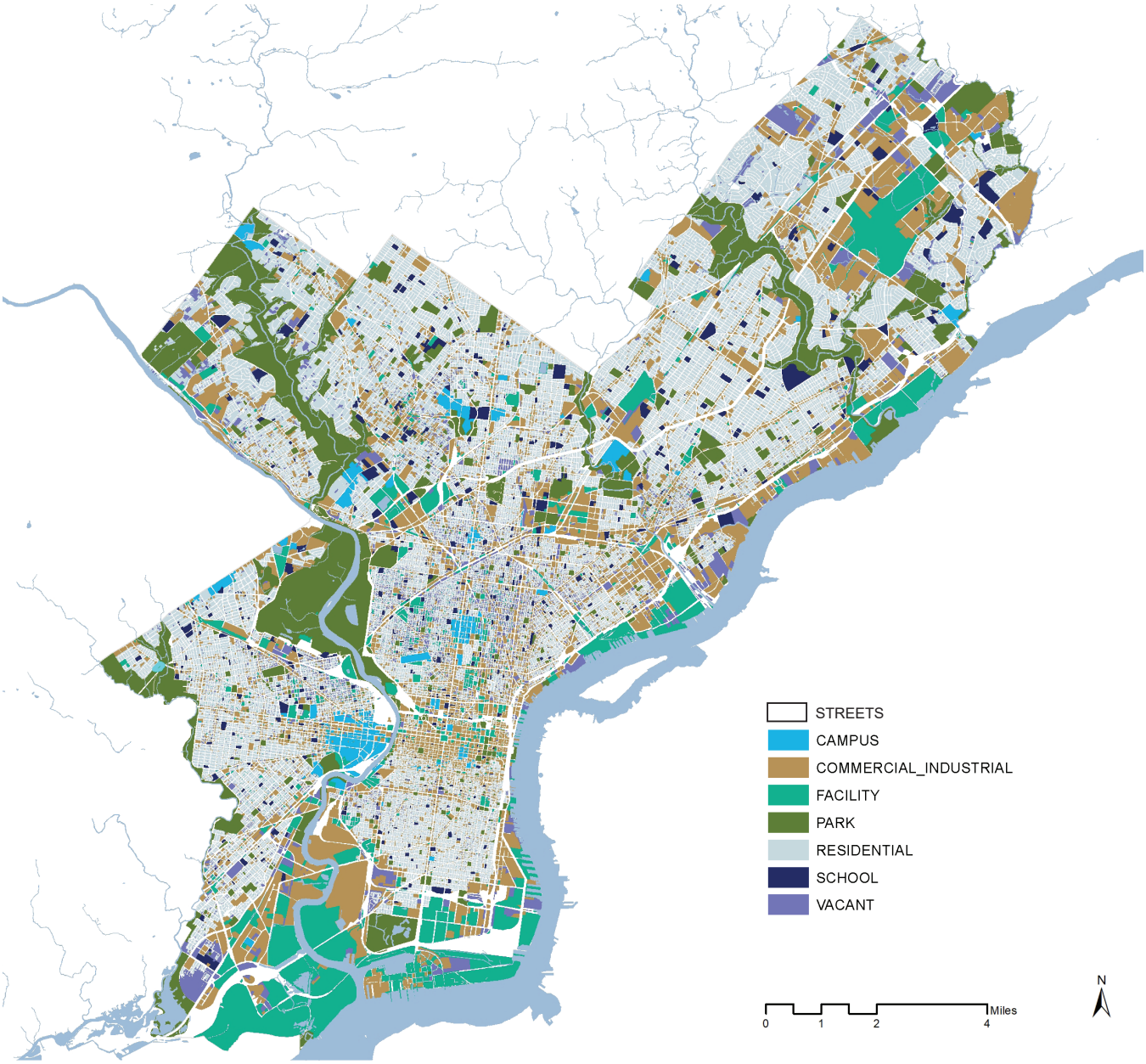
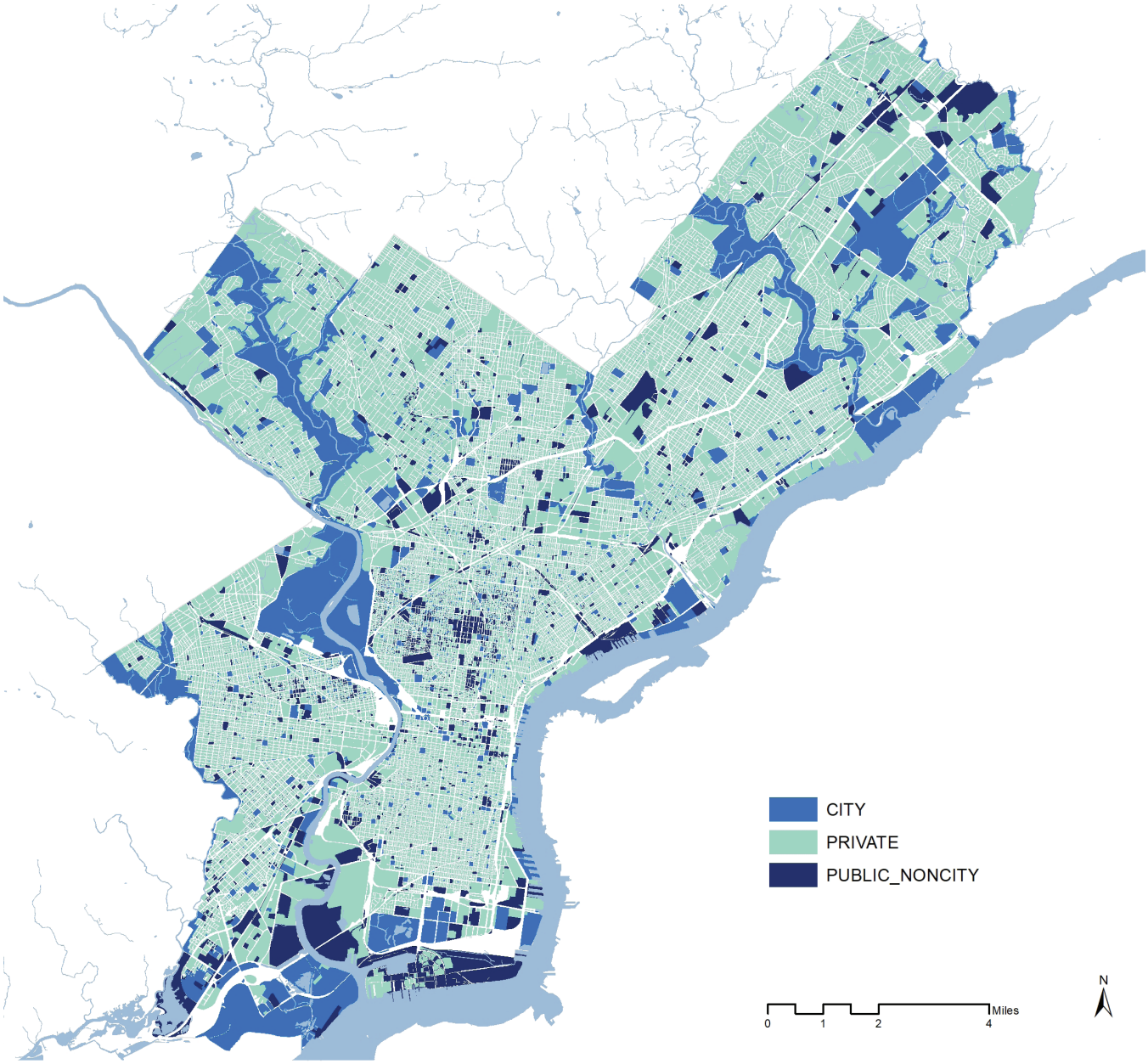


Figure 22. Parcels citywide by Ownership



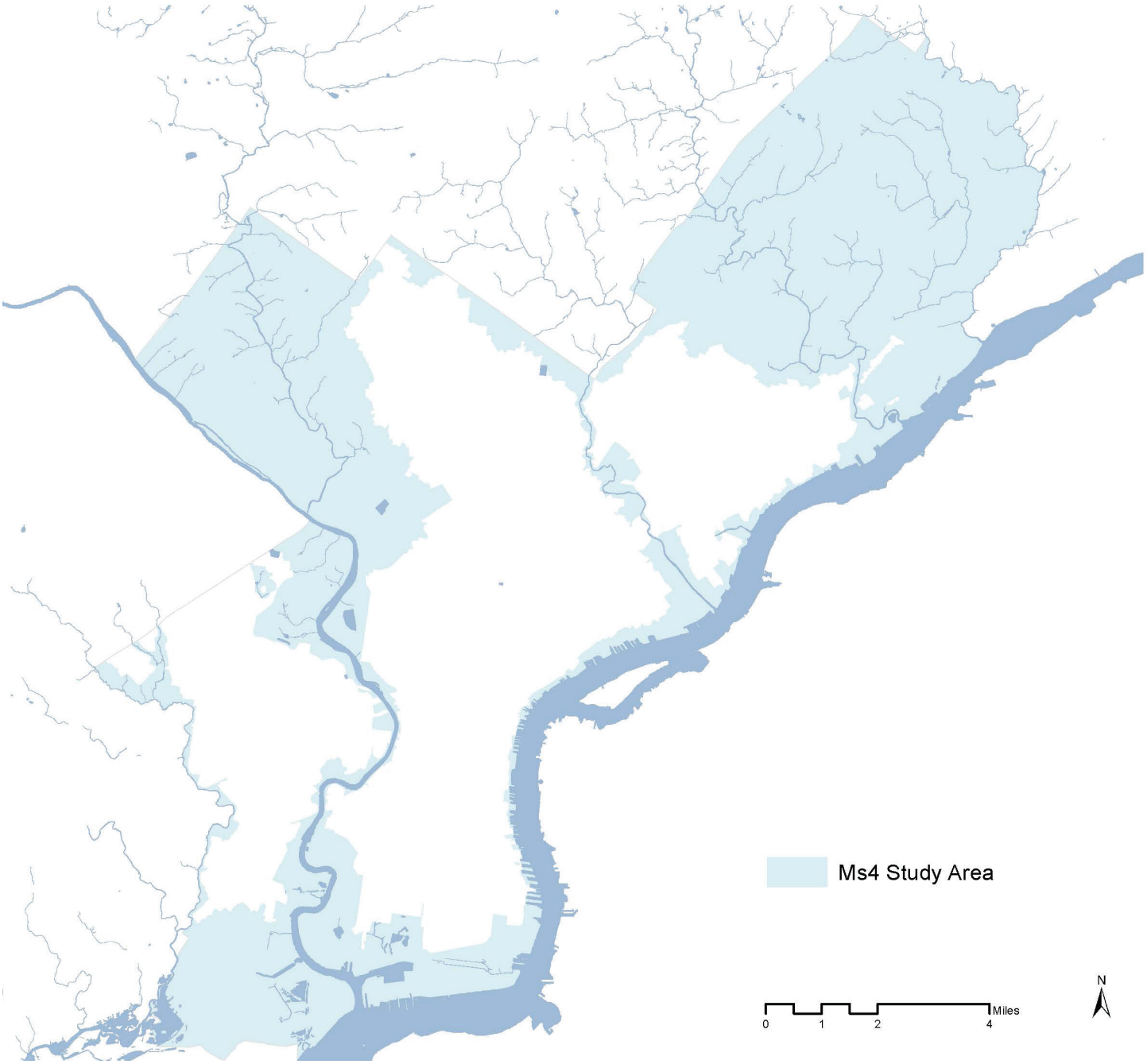
MS4 Area

Separate Sewer Storm System (MS4)

The City of Philadelphia is currently operating under the administratively extended 2005 MS4 NPDES permit. In 2017 the City of Philadelphia received a pre-draft MS4 NPDES permit from PADEP which included a Pollutant Reduction Plan (PRP) requirement. The PRP requires a municipality to reduce the sediment loading to the MS4 by 10% during the permit term. To date, a draft MS4 permit has not been publicly noticed, but the City has conducted internal planning analyses to understand the potential magnitude of implementation.

Approximately 40% of the sewered area of Philadelphia is serviced by a municipal separate storm sewer system (MS4). In these areas of the City, stormwater pipes are separate from the waste water collector system pipes, releasing stormwater directly into tributaries and rivers at stormwater outfalls without treatment. There are approximately 455 stormwater outfall points throughout the City and its watersheds. For the purposes of this report, the MS4 area is defined as all land within the City limits, not part of the combined sewer system, as shown in Figure 23. Areas considered non-contributing are included in the study area for symplicity, allowing for a generalized understanding of land use, ownership and impervious surface trends in MS4 areas.

Figure 23. MS4 Study Area



Methodology Overview

Existing Conditions

GSI Planning Parcels

For the 2018 GSI Strategic Framework, a geographic information system (GIS) layer, the Planning Parcel inventory, was created to account for all parcel surfaces in the CSS area. This layer combined attributes from the PWD parcels layer maintained by Stormwater Billing, data from the Office of Property Assessment, and other City data layers. These attributes were leveraged to streamline owner names and categories and to assign each parcel in the CSS to one of seven programs based on land use (e.g. Parks, Facilities, Campuses, etc.), one of three ownership types (City, public non-City, and private). The Planning Parcel inventory also included area metrics summarizing each parcel by surface type (impervious vs. natural ground, ground vs. roof).

For this GSI Strategic Implementation Framework update, the Planning Parcel inventory data was updated and renamed GSI Planning Parcels. The coverage area for parcel classification was expanded to include all parcels in the City (CSS and MS4) and was updated in February 2020 using an automated GIS/SQL based process. With help from Stormwater Billing, a living reference layer is planned, where the GSI Planning Parcels will be updated monthly starting in 2021 and shared to PWD central GIS servers. In addition, attribute data was added to identify the geographical areas in which parcels are located, such as PWD drainage district, GSI planning district, city council district, city planning district, and sewersheds, known as a "split junction" in this data set.

Since 2018, significant parcel changes were observed in ownership, land use and parcel boundaries. The coverage area for the CSS was updated between analyses, making the selection of parcels in the combined sewer service area slightly different in 2020. While setting up the automated update procedure, categorization errors were found in the original 2018 Parcel Inventory Data. Steps were taken to correct these errors in the updated GSI Planning Parcels data.

Right-of-Way Layers

For the 2018 GSI Strategic Framework, a right-of-way (ROW) layer was created in GIS, which accounted for all the ROW surfaces, pervious and impervious, in the CSS area. In this 2020 update, two separate ROW layers were created, one representing the total ROW area in the CSS and the other representing the total impervious area within the ROW. The method was updated slightly from 2018 in that small areas of natural ground in the ROW that were considered pervious in 2018 have been updated to be considered impervious per current GSI design guidelines.

Reproducibility through SQL Programming

New analysis methods were established for this GSI Strategic Implementation Plan update. First, a reproducible analysis process was created for the making of data inputs and analytical processes. All analyses were migrated away from a Microsoft Excel based process to a structured query language (SQL) based process, which enables accessing, querying, and relating data across GSI Unit databases, as well as ArcGIS. The SQL based process encodes all steps of each program's analysis in a script, allowing for easy replication of the calculations and data input manipulation. For future updates, inputs and assumptions can be quickly tested to understand the impact to the potential acre ranges. The analyst can scale down potential acre expectations to various geographic levels, such as GSI planning districts, PWD drainage districts, or split junction.

Focus Groups

Focus groups were convened for each program type and pipeline to revisit assumptions and modify potential acre projection methods based on participants' expertise and experience. Staff from GSI Planning, GSI Design,

Stormwater Billing and Incentives, Development Services, and Planning Analytics participated, provided feedback, and shared additional sources of data and information. Focus group participants were asked to summarize successes and considerations across programs and to outline critical actions and strategies that will continue to support GSI project delivery across pipelines.

The Office of Watersheds' Compliance and Hydrologic and Hydraulic units were consulted regarding regulatory and adaptive management considerations, including potential NPDES negotiations and future MS4 requirements, as well as how to coordinate and collaborate throughout the GSI planning process to include sewershed level considerations.

Potential Acre Calculations

General Methodology

To understand how many acres in the CSS service area have the potential to be managed with GSI, project data was collected from more than 20 planning studies, hundreds of individual site analyses, and public and private GSI projects that are in design or have been completed. For each program type, the available project data was analyzed to understand the average share of rooftop and ground-level impervious surfaces that are managed by public or incentivized retrofit projects (onsite DA). Additionally, project data was used to understand the potential to manage street runoff in GSI systems located on sites of different program types and ownership (off-site DA).

These average shares or "management assumptions" were applied to the GSI Planning Parcels layer (CSS area only) in order to create a range of potential acre projections. For each program, the parcels in that program were selected from the parcel inventory layer, filtered to a subset based on criteria affecting their level of "accessibility" (filters vary by program) and then the management averages were applied to the impervious areas in the final subset of parcels, resulting in a potential acre estimate. (The impervious ROW layer was used in the case of the streets program). The low end of the range was created using data filters and assumptions that represent maintaining PWD's current approach to building and initiating GSI projects, broadly speaking, in keeping with current policies. The high end of the range was created using filters and assumptions that represent the maximum physical potential for managing stormwater based on current guidelines.

The onsite and off-site DA that has the potential to be managed with GSI, was assigned to each of the three pipelines based on program type and land ownership. In most programs, some of the pipelines compete with each other for potential acres on the same sites, so these relationships were accounted for in the final potential acre ranges.

Methodology Updates from 2018

To account for newly available data and focus group input, the following methodology updates were implemented in this document:

Progress to Date Inclusion: To more accurately project the total amount of drainage acres expected to be managed, the acres managed to-date were incorporated for certain pipelines or programs where feasible. The redevelopment methodology was modified to include the already managed redevelopment drainage acres. The conservative projection for the redevelopment pipeline was then used to recalculate the remainder of the potential acres. Select programs with sufficient data (parks, commercial & industrial) also incorporated managed drainage acres as inputs into their methodologies. The sites with completed projects were then removed from the full set of parcels, so that potential acres were only projected on remaining sites.

Program Specific Updates: Except for the inclusion of already managed acres in select cases, the methodologies for most programs remained largely the same as the 2018 GSI Strategic Implementation Framework, and any slight modifications are noted in each individual program section. The methodology for the streets program, however, was overhauled to more accurately reflect the drainage acres expected to be managed given current design guidelines, which have been updated since the 2018 document. Please refer to the streets program section

of this report for more details.

Pipeline Alternatives: Additionally, the relationships between pipelines were re-evaluated, resulting in the decision to subtract only a portion of projected redevelopment acres from the other pipelines. This reflects the reality that often redevelopment occurs on sites where public and incentivized retrofits cannot.

Management Assumption Modifications: Original management assumptions from the 2018 GSI Strategic Implementation Framework were used as a starting point and modified where appropriate for the 2020 update. The original assumptions were based on an analysis of available project data to understand the average share of rooftop, ground-level, and right-of-way impervious surfaces managed by public or incentivized retrofit projects. This project data was collected from hundreds of individual site analyses and public and private GSI projects that are in design or have been completed. Management assumptions were modified from 2018 when recommended by focus groups and there was enough new project data to impact the old assumptions. The streets program used entirely new assumptions to fit with the new methodology that allows for continued updates to streets assumptions and their accuracy. Please refer to the streets program section of this report for more details.

Program Changes

Streets

In this update, the entire methodology for the streets program was overhauled in order to be consistent with the current GSI design guidelines, which have been updated since 2018. For a full explanation of the new methodology please see the Appendix.

Existing Conditions: In calculating the impervious area in the right-of-way, all natural ground areas under 5,000 square feet were considered to be impervious. In the 2018 document, all natural ground areas in the right-of-way were considered pervious.

Assumptions: All management assumptions were calculated using data from the GSI Planning Drainage Areas layer. Previously, Area Wide Analysis data was used to calculate management assumptions.

Methodology: Three large areas of the city were excluded from the potential acres analysis, due to the extremely low likelihood of managing right-of-way in these areas: BSL corridor on Broad St, MFL corridor on Market St (where underground), and Center City (from Vine St to South St & from the Schuylkill River to the Delaware River). Additionally, as part of all programs, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.

Parks

Changes made since the last update to the GSI Strategic Implementation Framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the parks program, this resulted in an increase in the amount of total area and impervious area across the CSS.

Assumptions: The assumptions for managing ROW runoff on City-owned parks were increased slightly to reflect the higher management percentages calculated using new project data added since the last update of the strategic framework. The rest of the assumptions remain the same.

Methodology: The parks methodology was updated to include the drainage acres already managed as part of completed public retrofit projects. Additionally, as part of all programs, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.

Commercial & Industrial

Changes made since the last update to the GSI Strategic Implementation framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the commercial & industrial program, this resulted in a slight increase in the amount of impervious area across the CSS.

Assumptions: The management percentages for commercial & industrial projects were recalculated using all data for projects completed through July 2020. The roof and ground management assumptions were updated to reflect the new percentages. The ROW management assumptions were updated to reflect the average of the old percentages and the new percentages since very few of the completed projects incorporate ROW runoff.

Methodology: The commercial & industrial methodology was modified to account for potential future changes to the credit structure for grant projects. Instead of using $500 and $200 as the exact parcel charge cutoffs to determine participation in the grants program, a calculation was created to approximate these cutoffs by assuming each site would manage the average amount of impervious area (71%) and receive a parcel charge reduction up to 80%. The methodology was also updated to include the drainage acres already managed as part of completed incentivized retrofit projects. Additionally, as part of all programs, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.

Facilities

Changes made since the last update to the GSI Strategic Implementation framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the facilities program, this resulted in a slight increase in the amount of impervious area across the CSS.

Assumptions: The assumptions for managing runoff on facilities were not changed from 2018.

Methodology: The facilities methodology was modified to fix a miscalculation that incorrectly added ~20 extra drainage acres to the public retrofits off-site drainage acre total in the 2018 version of the framework. Additionally, as part of all programs, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines, as explained in the Methodology Overview section of the Appendix.

Schools

Changes made since the last update to the GSI Strategic Implementation framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the schools program, this resulted in a slight increase in the amount of impervious area across the CSS.

Assumptions: The assumptions for managing runoff on incentivized retrofit sites were re-calculated using all data for grant projects completed through July 2020. The roof and ground management assumptions were updated to reflect the new percentages. The ROW management assumptions were updated to reflect the average of the old percentages and the new percentages since very few of the completed projects incorporate ROW runoff. The assumptions for public retrofit sites were unchanged from the 2018 framework.

Methodology: The schools methodology was modified to no longer limit the high end of the incentivized retrofit pipeline to just 5 School District projects per year in order to better reflect the physical feasibility without any policy constraints. Additionally, as part of all programs, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.

Vacant

Changes made since the last update to the GSI Strategic Implementation framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the vacant land program, this resulted in a slight decrease in total area and number of parcels, and a slight increase in the amount of impervious area across the CSS. Additionally, Policy Map created an updated Market Value Assessment (MVA) layer for 2018, which was used to assess residential real estate market values in the vacant land program. The market value of many vacant parcels has shifted significantly since the previous strategic framework update, which relied on an MVA layer for 2015.

Assumptions: The assumptions for managing runoff on vacant land were not changed from 2018.

Methodology: The vacant land methodology was not modified from 2018. As part of all programs, however, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.

Campus

Changes made since the last update to the GSI Strategic Implementation framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the campus program, this resulted in a slight increase in the amount of total and impervious area across the CSS, even while the overall number of parcels decreased.

Assumptions: The assumptions for managing runoff were not changed from 2018.

Methodology: The overall campuses methodology has not been modified since 2018. As part of all programs, however, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.

Residential

Changes made since the last update to the GSI Strategic Implementation framework in 2018 include:

Existing Conditions: The parcel inventory layer was updated to reflect changes as of 2020. For the residential program, this resulted in a slight increase in the number of parcels, amount of total area and amount of impervious area across the CSS.

Assumptions: In this update, the residential program was pared down to include only the redevelopment pipeline, therefore incentivized retrofit management assumptions from 2018 were not included.

Methodology: The methodology for the residential program was modified to only calculate potential acres from the redevelopment pipeline, excluding scenarios presented in the previous framework to manage drainage acres through incentivized retrofits. Additionally, as part of all programs, the redevelopment methodology was modified to include already managed drainage acres, and the relationship between pipelines was re-evaluated to reconsider trade-offs between pipelines as explained in the Methodology Overview section of the Appendix.