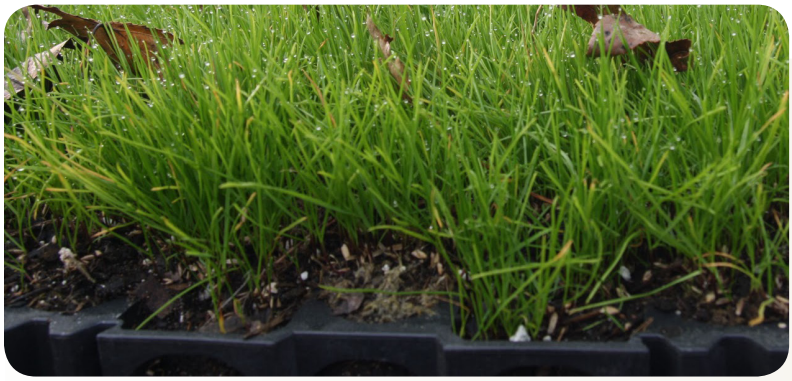


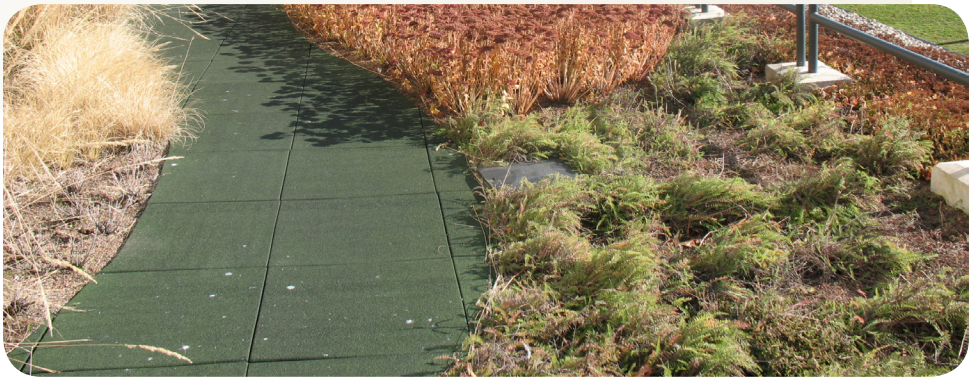
PROJECT CLEAN LAKE

GREAT LAKE • GREAT FUTURE

Northeast Ohio Regional Sewer District

Green Infrastructure Plan

April 23, 2012



Contents

APPENDIXES

TABLES

FIGURES

Acronyms

CIP	Capital Improvement Plan
CSO	Combined Sewer Overflow
CSS	Combined Sewer System
CY	Cubic Yard
DCIA	Directly Connected Impervious Area
District	Northeast Ohio Regional Sewer District
EAP	Early Action Project
GI	Green Infrastructure
GIPCM	Green Infrastructure Post-Construction Monitoring
GIS	Geographic Information System
H&H	Hydrologic and Hydraulic
LF	Linear Foot
LS	Lump Sum
MG	Million Gallons
NEORSD	Northeast Ohio Regional Sewer District
Ohio EPA	Ohio Environmental Protection Agency
O&M	Operation and Maintenance
RFQ	Request for Qualifications
ROW	Right-of-Way
SF	Square Foot
SY	Square Yard
USEPA	United States Environmental Protection Agency

1 Introduction and Background

On July 7, 2011, a Consent Decree was filed between the U.S. Environmental Protection Agency (USEPA), the State of Ohio and the Northeast Ohio Regional Sewer District (District). The document describes the specific combined sewer overflow (CSO) control measures, reduction quantities, performance goals and construction and monitoring measures the District will be required to perform over the next 25 years. A key component of the Consent Decree is Appendix 3, which requires the District to develop a Green Infrastructure Plan (GI Plan). This GI Plan shall detail how the District will control an additional 44 million gallons (MG) of wet weather CSO volume above the gray infrastructure control measures required by the Consent Decree through green infrastructure (GI) and spend at least $42 million dollars to build GI projects. GI is defined in the Consent Decree as "a range of stormwater control measures that use plant/soil systems, permeable pavement, or stormwater harvest and reuse, to store, infiltrate, or evapotranspirate stormwater and reduce flows to the combined sewer system (CSS). Green infrastructure may include, but is not limited to, bioretention and extended detention wetland areas as well as green roofs and cisterns." According to the requirements of the Consent Decree, the GI projects necessary to meet the 44-MG capture and $42 million expenditure requirements must be completed within 8 years of the date of entry (July 7, 2011).

This GI Plan identifies the process for locating, designing, constructing, operating and evaluating the performance of a set of GI control measures and outlines the implementation plan for the GI control measures to meet Appendix 3 requirements.

Chapter 2 of the GI Plan identifies the components of the GI Plan required per Appendix 3 of the Consent Decree and provides information on how the requirements were met. Subsequent Chapters 3, 4, and 5 detail development of candidate GI projects and how the District intends to implement the candidate projects over the next 8 years. Appendices A through G provide additional information on candidate GI projects and GI control measures as well as modeling and template agreements to ensure permanent access and sufficient control of GI projects.

1.1 Background

One of the predominant focuses of the Consent Decree negotiations revolved around the level of control (LOC). The District's original CSO control plan would reduce overflows to four or less in a typical year and capture 97% of the total volume of wet weather flow in the combined sewer system. Due to the proximity of CSO discharges to Lake Erie and the State of Ohio's designation of Lake Erie as a "sensitive receiving water," the District's original CSO control plan did not meet the Agencies' overall goals for CSO capture.

As an alternative to upsizing the gray infrastructure, a more cost-effective combination of upsized gray infrastructure and the use of green infrastructure to achieve the higher LOC and capture an additional 63 million gallons of CSO was proposed. The green infrastructure component of this enhanced LOC provides an additional 44 MG of CSO capture at a prescribed minimum expenditure of $42 million. This proposal was accepted by the USEPA and Ohio EPA and the green requirements of the proposal memorialized in Appendix 3 of the Consent Decree.

Appendix 3 of the Consent Decree requires the development and submittal of a GI Plan to USEPA and Ohio EPA by December 31, 2011 for the required additional 44 MG of CSO capture to be achieved through green infrastructure. To meet the requirements of Appendix 3 and count towards the 44 MG of additional capture, the CSO reduction provided by the green infrastructure must occur during events in which CSO activations still occur following construction of the gray infrastructure control measures required under the Consent Decree.

2 Program Requirements per Consent Decree

The District has developed a GI Plan to implement candidate GI projects. GI projects are composed of site-specific GI control measures that capture stormwater runoff and will result in an additional 44-MG reduction of CSO volume systemwide. The 44-MG capture is in addition to the capture per typical year that would be achieved by all of the planned gray infrastructure control measures. Per the requirements of the Consent Decree, the District must expend at least $42 million on the construction and installation of GI control measures. Per Section 3 of Appendix 3, the GI Plan addresses the following:

- *Geographic Coverage*: The GI Plan will guide the District in locating and prioritizing GI control measures within the District's combined sewer areas that meet Consent Decree performance requirements, accommodate permanent GI control measures, and improve socioeconomic conditions.
- *Preservation of Practices, Ownership, and Access*: The GI Plan will demonstrate how the District will retain permanent access and sufficient control over the land devoted to GI control measures set forth in the GI Plan by showing how it will acquire ownership of land parcels or obtain legally binding agreements with Cuyahoga County, pertinent governing authorities, or landowners.
- *Public Participation*: The District will develop a public participation process that actively involves the affected public in the decision making for the selection of the GI projects and GI control measure types and locations including participation and representation from areas that have low household incomes or concentrated minority populations.
- *Implementation Schedule*: The GI Plan will include a detailed implementation schedule for the GI control measures planned to meet the 44-MG capture requirement within 8 years of the Date of Entry of the Consent Decree.
- *Methods for Measuring Achievement of Performance Standard*: The GI Plan will describe how the District will adjust the hydrologic model parameters directly related to the GI control measures (prior to and during model recalibration as set forth in Appendix 2 of the Consent Decree) to accommodate changes in model parameterization caused by shifts in runoff hydrology from the GI control measures to demonstrate CSO control with and without the proposed GI control measures for the purpose of gauging compliance.
- *Environmental Justice Considerations*: The District will identify its methods to prioritize environmental justice considerations in its site selection process and will evaluate environmental justice considerations as a co-benefit of candidate GI projects.
- *Operation and Maintenance (O&M)*: The GI Plan will identify a suite of possible GI control measures that could be implemented to achieve the performance criteria and describe the O&M activities including schedules and information management necessary for each.

Further description of these components of the GI Plan, including how the GI Plan meets each of the requirements discussed above, is provided in the following subsections of this Chapter.

2.1 Geographic Coverage

The District services 62 communities and more than 1 million people in an approximately 350-square-mile tributary area. It is responsible for wastewater treatment facilities and interceptor sewers in the greater Cleveland metropolitan area. In 2010, the District began the implementation phase of a regional stormwater management program; this effort will expand the District's responsibilities and services to regional stormwater issues. The District will address flooding, erosion, and water quality problems across the region, assist communities to minimize new problems and protect roads, bridges, and other infrastructure, and protect and restore waterways as regional economic resources.

The District owns and operates three wastewater treatment plants — Easterly, Southerly, and Westerly — and is responsible for maintaining more than 200 miles of large interceptor sewers designed to convey wastewater from locally-owned sewers to the treatment plants. The District's service area includes 80 square miles of combined sewer area, including 126 permitted CSO outfalls. This combined sewer service area falls mostly within the City of Cleveland, with the remaining area in portions of the surrounding inner-ring suburbs.

In accordance with Appendix 3 of the Consent Decree, GI control measures are to be located within the District's combined sewer area and are to control an additional 44-MG of wet weather CSO after execution of the planned gray infrastructure control measures. Because this performance criterion focuses on remaining CSO volume, the geographic area available to the District for GI implementation is limited to areas where CSOs will occur after execution of the planned gray infrastructure. Based on the Consent Decree, there are 24 CSOs with 1-MG or more of overflow remaining after the implementation of the planned gray infrastructure. Those CSOs and their locations within the Southerly, Big Creek, Westerly, or Easterly interceptors of the District's CSS are listed in Table 1 and presented in Figure 1. To meet Appendix 3 of the Consent Decree, the District's GI Plan is limited to implementation of GI projects within CSO areas with remaining overflow volume in a typical year.

In addition to focusing on areas with high remaining overflow volumes, the District gave priority to geographic areas where:

1. Land ownership will readily accommodate permanent GI control measures, such as areas where parcels can be acquired from the City of Cleveland's Landbank Program, the Cuyahoga County Land Reutilization Corporation, and the City of Cleveland's Industrial-Commercial Land Bank.
2. GI projects can improve socioeconomic conditions in the District's service area, including in neighborhoods that are comprised predominantly of households that have low household incomes or concentrated minority populations. Environmental justice considerations will be explored further in Section 2.6.

Chapter 3 provides a detailed discussion of how GI control measures and potential GI project locations were selected, developed, and prioritized for the list of candidate GI projects to be advanced. The general geographical location of each candidate GI project is provided in Chapter 4 and the projects are listed in Table 10.

Table 1. CSO Catchments with 1-MG or More of CSO after the Implementation of the Planned Gray Infrastructure

Drainage System	CSO #	Drainage System	CSO #
Southerly Interceptor	033	**Easterly Interceptor**	001
	035		206
	036		210
	039		211
	040		230
Big Creek Interceptor	045		242
	051		201
	057		202
	058		204
Westerly Interceptor	002		073
	065		222
	075		
	080		

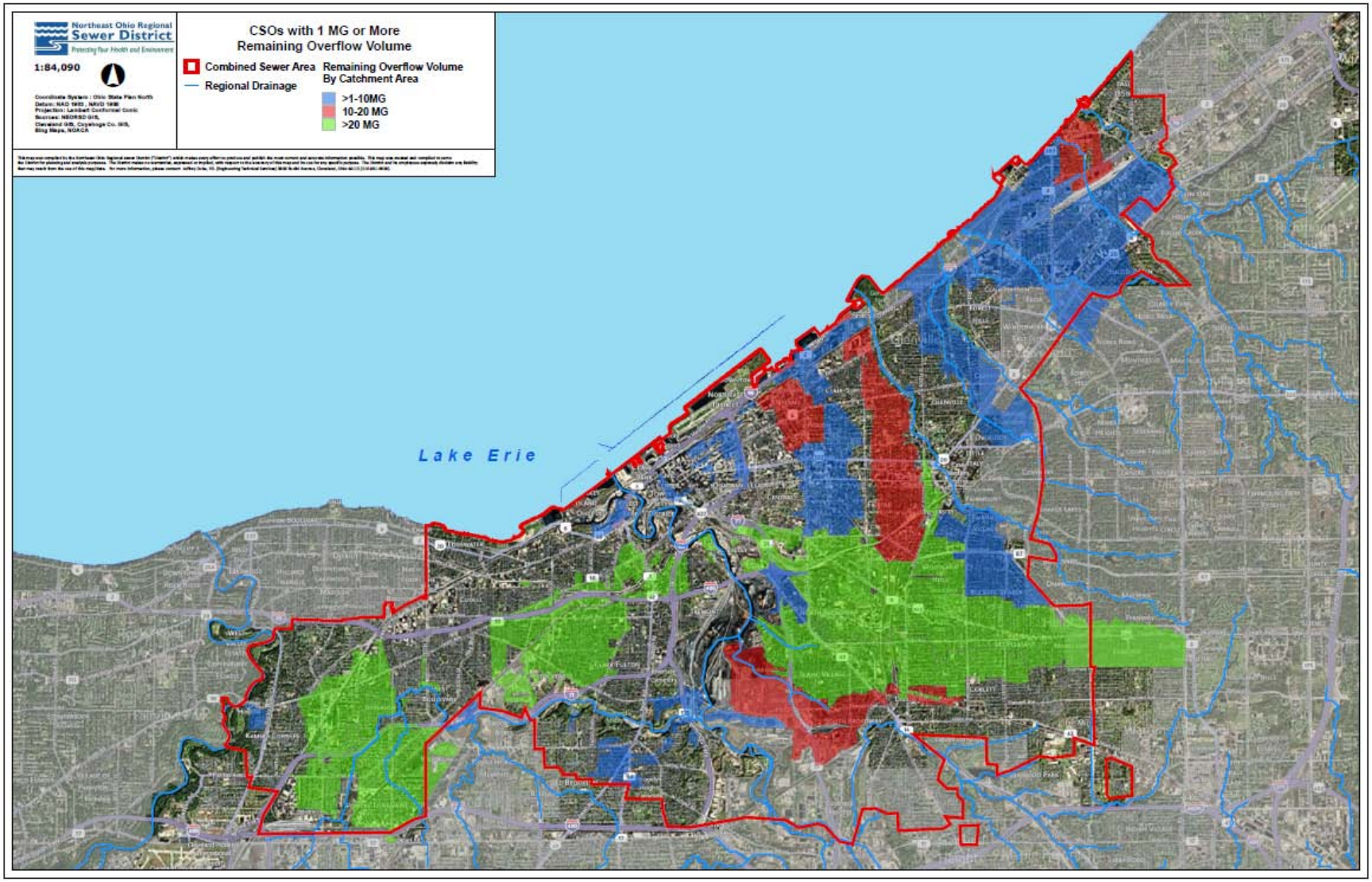


Figure 1. CSO Catchments with 1-MG or More of CSO after the Implementation of the Planned Gray Infrastructure

2.2 Preservation of Practices, Ownership, and Access

The District is required to retain permanent access and sufficient control over the land devoted to GI control measures implemented through the GI Plan. The District will enter into cooperative and service agreements with Cuyahoga County, City of Cleveland, and other public and private entities to aggregate potential parcels of land on which GI control measures will be constructed. In addition, the District will enter into appropriate agreements with landowners on a project-by-project basis using templates that meet the requirements of Appendix 3 of the Consent Decree. The District will either own the land used for GI control measures or enter into appropriate agreements for the implementation of GI control measures on land owned by a separate party. For project areas where the District is not the property owner, the District will obtain all necessary easements and related access agreements to ensure permanent access and sufficient control of GI control measures after construction in order to allow for the inspection, operation, and maintenance of GI control measures in perpetuity.

The District outlined anticipated land ownership and easement requirements for each candidate GI project. Two potential options for land ownership were identified:

1. **District ownership:** The District owns the property and the GI control measures that collectively form the GI project. The District is responsible for all inspection, operation, and maintenance activities in perpetuity.
2. **Second party ownership:** A private and/or nonprofit commercial, institutional, or industrial entity owns the property and may or may not retain control of the GI control measures that collectively form the GI project. The District retains permanent responsibility of the GI control measures as follows:
    a. The District retains access and control through a permanent easement on the land devoted to the GI control measures and will remain responsible for O&M in perpetuity.
    b. The District has a permanent easement for the GI control measures; however, the property owner maintains responsibility for O&M of the GI control measures through an appropriate agreement between the property owner and the District.

To ensure Consent Decree Appendix 3 requirements are met with second party GI projects, each agreement will include provisions that address the following:

- The terms and conditions of the agreement will ensure the GI project continues to function in accordance with its defined purpose. For example the agreement will ensure the GI project will capture the required amount of wet weather flow on an annual basis that would otherwise discharge into the District's CSS. The agreement will also permit the District sufficient access to and control of the property to ensure proper O&M of the GI control measures.
- If the agreement calls for the second party to construct the GI control measures, the District will retain the right to review design plans and drawings describing the materials and methods for installation of the GI project. The District will also provide construction supervision and inspection oversight of the construction of the GI control measures in compliance with contract provisions.

- The agreement will provide the District with legal and financial remedies if the second party should fail to perform its duties under the terms and conditions of the agreement.
- The agreement will provide for the transfer of O&M responsibilities to the District if the second party fails in the performance of its duties.

Appendix A includes a template Cooperative Agreement and Easement for Permanent Access Agreement applicable to a Consent Decree Appendix 3 GI control measure. Appendix B includes a template O&M Agreement when second party owners are involved in maintenance. The anticipated required agreement types for each of the candidate GI projects are presented in Table 10. The non-negotiable elements of these agreements include:

- The right of the District to inspect and approve/disapprove any work;
- The right for design and plan review by the District;
- The right of inspection and monitoring by the EPA;
- The right of approval for any relocation/redesign by the District;
- Easement and Maintenance agreements are perpetual and run with the land;
- Relocation of any GI measure must occur within the same sewershed; and
- The conveyance and transfer procedures from one property owner to another.

2.3 Public Participation

The District has developed and followed a public involvement and collaborative decision-making process to actively include the affected public in development and selection of candidate GI projects. This will continue as the District refines GI projects and control measure types and locations. Figure 2 summarizes the District's public participation process followed in GI Plan development and anticipated during GI Plan implementation.

With the majority of CSOs located within the City of Cleveland, including 20 of the 24 outfalls with 1MG or more of remaining overflow volume, it is critical to the success of the GI Plan that the City of Cleveland and organizations within the City be actively involved in development and implementation of GI. The District supports the City's ongoing efforts to address vacancy and to promote economic development to the extent feasible with the GI Plan, while ensuring compliance with Appendix 3 of the Consent Decree. Throughout development of the GI Plan, the District engaged the City of Cleveland department staff, community development corporations, nonprofits, and institutions such as Case Western Reserve University.

To further facilitate cooperation and successful implementation, three committees were established over the course of the GI Plan development, and they are discussed in Sections 2.3.1 and 2.3.2. Additional details regarding public participation during the development of the GI Plan are included in Chapter 3.

Figure 2. Summary of Public Participation Process

2.3.1 Cleveland Green Stormwater Management Team and City/NEORSD Green Infrastructure Steering Committee

The City of Cleveland supported the District throughout 2010 and 2011 to ensure the GI Plan aligned to the greatest extent possible with the City's economic development and planning priorities. The "Cleveland Green Stormwater Management Team" was established to assist the District in developing the GI Plan and consisted of staff representing both the City of Cleveland and the District. See Appendix C for a participant list. In March 2011, the first meeting of the Cleveland

Green Stormwater Management Team was held. This team met four times from March to August 2011 to review and provide comment on GI Plan development.

In September 2011 the City of Cleveland and District staff modified the team to create the "City/Northeast Ohio Regional Sewer District (NEORSD) Green Infrastructure Steering Committee." The Steering Committee was engaged during development of the candidate GI projects and will continue to be involved during GI project implementation and GI control measure selection. The purpose of transitioning from the Team to the Steering Committee was to add certain essential City personnel and to ensure a regular process whereby coordination and feedback issues can be addressed in a timely manner to keep GI projects on track. See Appendix C for a participant list. The Steering Committee also includes three nonprofit organizations: ParkWorks, Neighborhood Progress, Inc., and Cleveland Urban Design Collaborative of Kent State University. These organizations work to enhance the economic and community development and quality of life of the Cleveland community.

2.3.2 Vacant Land Use Steering Committee Meeting

Under the leadership of ParkWorks, Neighborhood Progress and the Cleveland Urban Design Collaborative of Kent State University a group of planners, elected officials, City and County employees, community development corporations, and nonprofit leaders have been participating in "Re-Imagining Greater Cleveland" (see Appendix C for a participant list). The object of the planning effort is to find productive end uses for the range of vacant properties in Cleveland and Cuyahoga County. The Vacant Land Use Steering Committee is one of the Re-Imagining standing committees. On March 18, 2011, the Steering Committee met at the District and agreed to serve as a Green Infrastructure Advisory Committee to the District over the course of District's GI efforts.

The District plans to convene the GI Advisory Committee with biannual yearly meetings starting in 2012. The purpose of the larger community GI Advisory Committee is to provide a conduit whereby the District can update local leaders and ensure District efforts build on and support larger community goals and objectives.

2.3.3 GI Plan Implementation

As the District begins to implement the GI Plan, public participation will continue to be incorporated into the process. The District will continue to work closely with the City of Cleveland steering committees and staff, community development corporations, and other interested parties. As candidate GI projects are advanced, the District will work with community development corporations to engage residents and commercial and industrial businesses in project areas. Each candidate GI project will be reviewed with applicable neighborhoods to ensure residents and businesses have input on the location, design, and maintenance of GI control measures. This is further discussed in Chapter 5.

2.4 Implementation Schedule

Within 8 years of the Date of Entry of the Consent Decree, all GI projects required to meet the 44-MG capture requirement must be completed, and within 10 years of entry of the Decree, the District must demonstrate the effectiveness of the GI projects.

The plan and schedule for achieving these implementation requirements is outlined in Chapter 5.

2.5 Methods for Measuring Achievement of Performance Standard

As part of the GI Plan, the District is required to adjust and use the District's systemwide CSS models to gauge compliance with the requirement that GI control measures mitigate a minimum additional CSO volume of 44-MG per typical year. Section 3.2 of Chapter 3 describes how the models were used to evaluate the effectiveness of GI projects and their associated GI control measures. Hydrologic models were modified to calculate the reduction of stormwater runoff rate and volume resulting from GI control measure tributary areas and to produce revised stormwater runoff discharge hydrographs. The revised stormwater runoff discharge hydrographs were then routed through the District's systemwide Consent Decree hydraulic models to determine the resulting reduction of CSO volume for GI control measures per GI project.

As required, the hydrologic and hydraulic (H&H) models will be used in two forms under GI Plan implementation to simulate the controlled systems' typical year performance. The first form of the model will encompass all CSO control measures including the candidate GI control measures. The second form of the model will be identical to the first, but without the candidate GI control measures. The difference in performance between the two simulations will be used to gauge compliance with the required 44-MG of additional CSO reduction per typical year. Chapter 5 outlines how the models will be further refined and employed during design activities to evaluate GI control measure performance.

2.6 Environmental Justice Considerations

Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Environmental justice communities include low income or minority communities who have suffered a disproportionate burden from air, water or land pollution. Green infrastructure can improve socio-economic conditions where the need is greatest, by improving conditions in areas impacted by environmental justice concerns. The use of GI offers the possibility of transforming vacant brownfields located in minority and low income residential areas into valuable community assets. The District's GI Plan will capitalize on the potential to use legal and financial mechanisms such as the Cleveland and Cuyahoga County landbanks to transform the area's numerous vacant or abandoned properties to productive use, helping to revitalize disadvantaged communities and resulting in cleaner air and green space.

Per Appendix 3 of the Consent Decree, the GI Plan describes the efforts the District will make to prioritize environmental justice considerations into its site selection process, to provide for an evaluation of environmental justice considerations as a co-benefit of the GI projects, and to consider collaborative decision making with community groups whenever possible in developing and implementing the GI Plan.

Consent Decree Appendix 3 identifies environmental justice areas as neighborhoods with households that have low household incomes or concentrated minority populations. The District's CSS area is located within the City of Cleveland and within identified environmental justice areas (Figure 3). In Northeast Ohio, environmental justice areas are defined as those comprising 25-percent or greater non-white population, a 10.6-percent or greater number of impoverished households, or a combination of both, per the 2000 Census (Northeast Ohio

Areawide Coordinating Agency. *Transportation Improvement Program (SFYs 2008-2011): Highway, Bikeway and Transit Element*. 2007). As discussed in Chapter 3, the majority of the District's identified GI priority areas are located in environmental justice areas.

To meet the requirements of Appendix 3 of the Consent Decree, the GI Plan targets the areas of the CSS area that will have remaining CSO volumes after full implementation of the District's gray infrastructure program. As shown in Figure 3, the majority of these areas with remaining CSO volume are located in environmental justice areas, and as a result, the GI Plan will directly benefit environmental justice areas by providing additional CSO reduction. Chapter 4 (Table 10) indicates those candidate GI projects that are in environmental justice areas. Of the 20 candidate GI projects listed in Table 10, 14 are within designated environmental justice areas.

In addition to the increased CSO control in environmental justice areas, GI benefits environmental justice communities by enhancing socioeconomic or quality of life co-benefits such as improved access to safe and maintained green spaces and recreational opportunities and increased property values due to additional neighborhood amenities. The District considered the co-benefits as well throughout GI Plan development and in identifying the GI priority areas and developing and prioritizing candidate GI projects. As a result, the following factors were collectively considered under environmental justice considerations in Chapter 4 (Table 10).

- **Located in Environmental Justice Area:** The District identified candidate GI projects located within designated environmental justice areas.
- **Vacant Land Reuse:** The District looked at the repurposing and reuse of vacant land for green space, or commercial/industrial uses that would add value to neighborhoods and provide socioeconomic co-benefits.
- **Community Redevelopment:** The District considered candidate GI projects that incorporated redevelopment projects within neighborhoods, including projects for street rehabilitation or incorporation of landscaping into street redevelopment projects.

The GI Plan demonstrates alignment between candidate GI projects and identified environmental justice areas of the CSS as required by Appendix 3. Chapter 3 further outlines the candidate GI project development, evaluation, and prioritization process.

The District also acknowledges USEPA's goal that environmental justice be more than the location of GI projects and includes the involvement and equal access of all people to the decision making process. This aspect of environmental justice is addressed through the District's approach to public participation under the GI Plan. Section 2.3 summarizes the District's public participation process to date in development of this GI Plan. Section 5.5 details how the District will expand involvement of all people in an impacted neighborhood once the general area of a GI project has been selected based on ability to reduce remaining overflow and before final design of the GI project begins. This public participation process will rely on the District's existing well developed and skilled education and outreach staff to target environmental justice areas taking into considerations USEPA environmental justice goal.

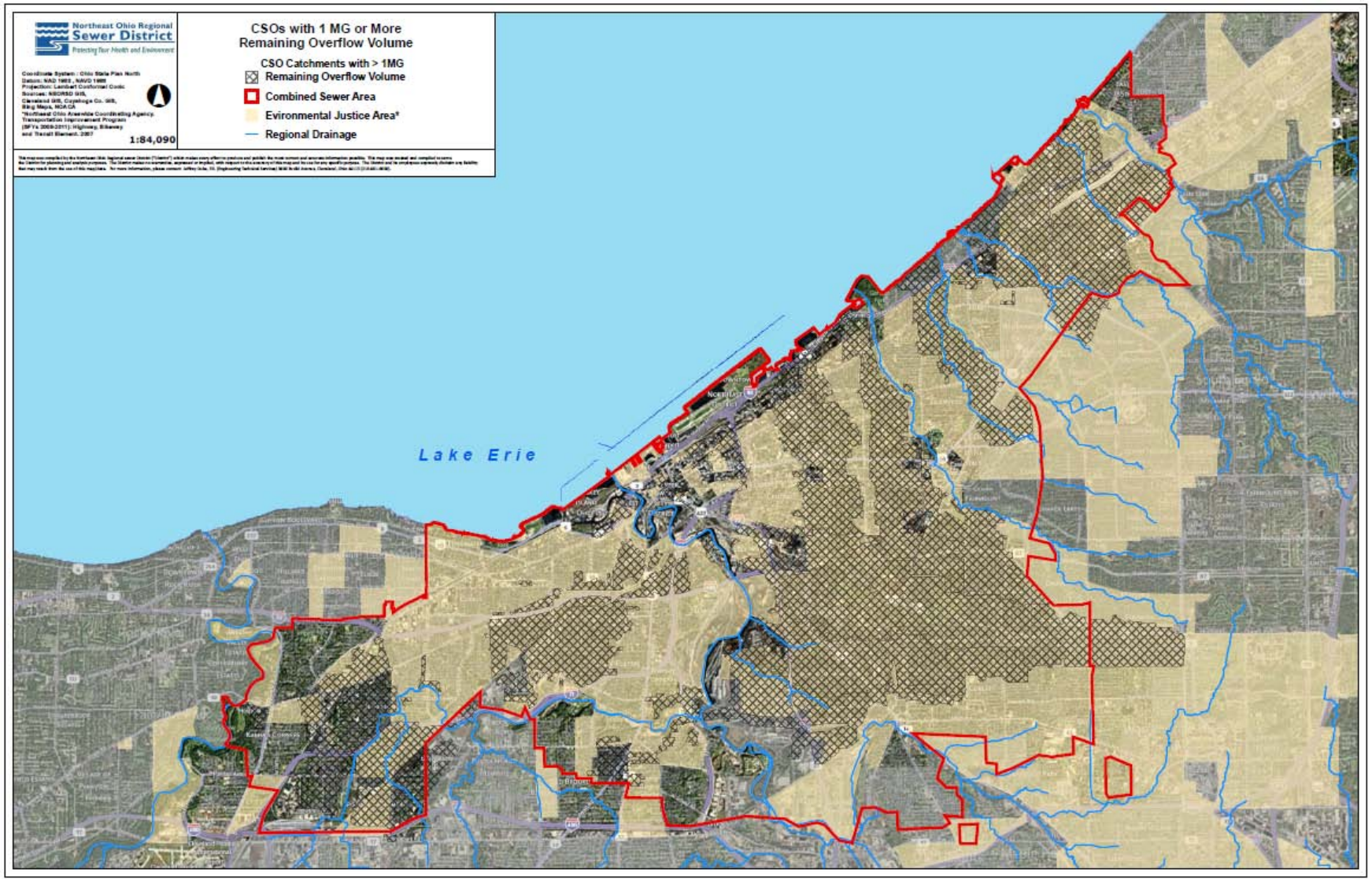


Figure 3. Environmental Justice Area within the District CSS Area

2.7 Operation and Maintenance

Appendix 3 of the Consent Decree required the District to describe the associated O&M activities planned for identified GI control measures including schedules and information management procedures. In developing the GI Plan, the District evaluated a suite of GI control measures for potential implementation within candidate GI projects (Section 3.2). Included was the identification of anticipated required O&M activities for GI control measures. As part of the prioritization of candidate GI projects, the O&M requirements of the identified control measures were also generally considered.

O&M activities will be established for each implemented GI project and associated control measures through the development of O&M plans as part of GI Plan implementation (Chapter 5). As discussed in Section 2.2, O&M agreements will be established for GI control measures on property owned by a second party. At a minimum, all O&M documents will include the following information:

- Routine and non-routine maintenance requirements,
- Inspection schedules and checklists, and
- Maintenance schedules.

3 Green Infrastructure Plan Development

The GI Plan was developed in the following 3 steps:

1. **Development of the GI Index and GI Priority Area Identification:** The District performed geographic screening of areas within the District's CSS through a GI Index to identify locations most suitable for GI projects and most likely to result in meeting the performance criteria of 44-MG of additional reduction in CSO volume after the implementation of the gray infrastructure.
2. **GI Project Development, Evaluation, and Prioritization:** The District developed GI projects and evaluated them for performance and cost in each GI priority area.
3. **Public Participation in GI Project Development, Evaluation, and Prioritization:** The District engaged with the City of Cleveland, community development corporations, the Cuyahoga County Land Reutilization Corporation, and others during the development, evaluation, and prioritization of GI projects.

The District will further evaluate the feasibility and effectiveness of the potential candidate GI projects included within this GI Plan as a part of future design efforts. It is anticipated that the GI projects identified within this GI Plan will be modified as a result of these future, more detailed evaluations. Chapter 3 describes the process followed to develop potential candidate GI projects.

3.1 Development of the Green Infrastructure Index & Green Infrastructure Priority Area Identification

GI priority areas were identified through the development of a GI Index. The GI Index was a process for scoring areas within the District's CSS based on the potential for these areas to support and to benefit from the implementation of GI projects and the ability of the areas to contribute to meeting the 44-MG CSO control requirement. Areas with high GI Index scores were identified as priority areas for focus in the development of GI projects and finally the candidate GI projects.

The GI Index has two separate and equally-considered components. The first component, referred to as the Baseline Index, provides a numeric score that characterizes opportunity, space, and potential effectiveness of GI projects. The second component is specific to the 44-MG of additional CSO control and provides a numeric score that characterizes the collection system and CSO volume reduction response to the implementation of GI projects. The GI Index is a sum of the numeric scores.

3.1.1 Data for Green Infrastructure Index

Existing geographic information system (GIS) databases and systemwide model results were used to develop the GI Index. GI Index numeric scores were developed for each sub-catchment area included within the District's CSS-wide H&H models. The sub-catchment areas are

typically between 1.5 and 50 acres and represent primarily topographic-based drainage patterns tributary to CSSs.

The Doan Valley combined sewer drainage area was not included in the area for which the GI Index was developed. The area was separately evaluated for GI projects as part of a targeted study of the Doan Valley. Although GI Index scores were not developed for sub-catchments in the Doan Valley, one of the GI projects included in Chapter 4 is based on recommendations from the separate Doan Valley drainage area evaluation. This Doan Valley project is included as a candidate GI project because it shows potential to meet a portion of the 44-MG of additional CSO control requirement.

3.1.2 Baseline Index

The Baseline Index was developed using modified versions of available GIS databases. The GIS data were collected, compiled, and reviewed for completeness and suitability to support development of GI Index variables. These baseline variables are summarized in Table 2.

Table 2. GIS Variables for the Baseline Index

Variable	Summary
Available Land	The City of Cleveland's Landbank Program retains a large number of parcels within the CSS area. Available landbank parcels provide a potential opportunity for GI projects.
Development Opportunities	Planned development and redevelopment activities provide potential GI opportunities. Development can be public, such as road reconstruction projects, or private. Examples of development opportunity data sets evaluated as a part of the GI Index include the planned Opportunity Corridor project, targeted development zones in the Cleveland Citywide Plan, and updates on development plans from community development corporations.
Greenways	Similar to parks, public lands used as greenways provide opportunities for GI projects in existing open space.
Imperviousness	Areas with large amounts of impervious surfaces will generate larger amounts of runoff and thus the incorporation of GI control measures into these areas are expected to have a greater potential to reduce overflow volume. GIS data layers were assembled to represent the locations of pavement and roofs within each sub-catchment area.
Parks > 3 Acres	Public parks provide potential opportunity spaces for GI projects. GI projects can be incorporated into park areas to address overflow volumes while enhancing the recreation and wildlife habitat benefits the public spaces provide to the community. Data on parks larger than 3 acres was used to ensure space would be available for GI projects while maintaining recreation and wildlife habitat benefits.
Partnership Opportunities	Owners of large properties in the CSS area can potentially partner on GI projects through the retrofit of GI control measures into their properties. To capture the potential partnership opportunities, the GIS database contains large private property parcels, public lands that are not represented in other variable data layers, and the campuses of hospitals and universities.
Soil Drainage: Well-Drained Soils	GI control measures will have greater infiltration potential in well-drained native soils. Soil drainage characteristics, obtained from SSURGO data published by the Natural Resources Conservation Service, were mapped relative to catchments in the District's CSS area.
Environmental Justice	This database contained those areas of the CSS area that contain 25-percent or greater non-white population, a 10.6-percent or greater number of impoverished households, or a combination of both, per the 2000 Census (Northeast Ohio Areawide Coordinating Agency. Transportation Improvement Program (SFYs 2008-2011): Highway, Bikeway and Transit Element. 2007)

The Baseline Index evaluated the CSS area for opportunity sites and potential effectiveness, providing a screening tool that looked at existing conditions on the ground without consideration of collection system performance. Baseline scores were developed for each sub-catchment by scoring each variable numerically.

The following two main considerations went into the scoring process:

- **Simplicity:** Keeping the Baseline Index numerically simple provides transparency and facilitates communication across a range of involved parties and stakeholders. Some indices involve relatively complex numerical transformations to go from quantified variables to a final score. With this in mind, the decision was made to use a simple 10-point scale. The Baseline Index variables were scored so that the highest score possible was 10.
- **Scoring:** Baseline Index variables were not all considered equally important to the placement of GI projects. Therefore certain variables were given higher score potential within the Baseline Index.

With the abovementioned considerations, the Baseline Index was developed and tested. The process was iterative, with some adjustments made to refine the process and calibrate results to engineering judgment. Table 3 shows each variable, its value breaks, and potential score.

Table 3. Baseline Index Scoring System

Variable*	Value	Potential Score
Available Land	<1% 1% to 5% 5% to 20% >20%	0 0.5 1 1.5
Development Opportunities	Not containing or adjacent Containing or adjacent	0 1
Greenways	Not containing or adjacent Containing or adjacent	0 1
Imperviousness	<1% 1% to 20% 20% to 50% >50%	0 1 1.5 2
Parks >3 Acres	Not containing or adjacent Containing or adjacent	0 1.5
Partnering opportunities	Contains none/not adjacent to any Contains none/adjacent to one >0%, <25% 25% to <50% >50%	0 0.5 1 1.5 2
Soil Drainage: Well-Drained Soils	0% >0%, <50% >50%	0 0.5 1

* Environmental Justice was equally considered throughout the District's CSS area.

For some of the variables, the scoring was a semi-quantitative process in which the distributions of variable values were examined to find natural breaks where the variables could be spatially differentiated and scores assigned. For example, the impervious area percentage value of each catchment was calculated in GIS and then sorted from highest value to lowest value to provide an ordered distribution as show in Figure 4. The ranked distribution of percent impervious area by model catchment shows an inflection point in the curve in the vicinity of 20 to 30-percent imperviousness, where the slope of the distribution changes from a relatively even angle slope, to a steep downward slope. The break, or knee of the curve, suggests that a possible break might be chosen at that level. The median value of 50-percent imperviousness occurs at approximately the middle of the distribution and offers another potential break. Above 50-percent, the curve is relatively smooth, with no strong inflections. Although a third break could be selected above 50-percent using judgment, without a strong inflection in the distribution, this would have been done only if there were a need to further subdivide the variable to discern opportunity. In the case of imperviousness, it was not necessary.

In the case of other variables, breaks were identified more subjectively. For example, the parks larger than 3 acres variable did not lend itself to the distribution approach because the objective was to assign value to a catchment if it contained park land or was immediately adjacent to park land. In such cases the variable could be assigned an "either/or" score. Once the value thresholds for variable breaks were selected, numeric scores were assigned to the variables.

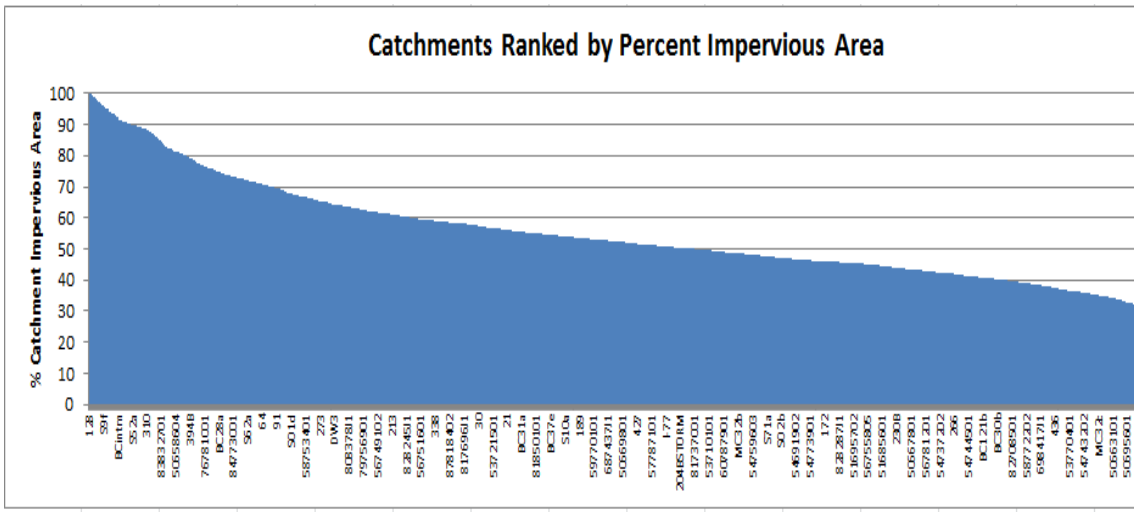


Figure 4. Example of Variable Distribution Used to Identify Breaks for Variable Scoring

Figure 5 depicts the maximum potential scores of the Baseline Index variables. After the scoring system was developed so that it appeared to yield a desirable number and spatial distribution of potential GI priority areas, the locations were further evaluated using aerial photography and other data to ground-truth the Baseline Index results. The results of the Baseline Index are depicted in Figure 6.

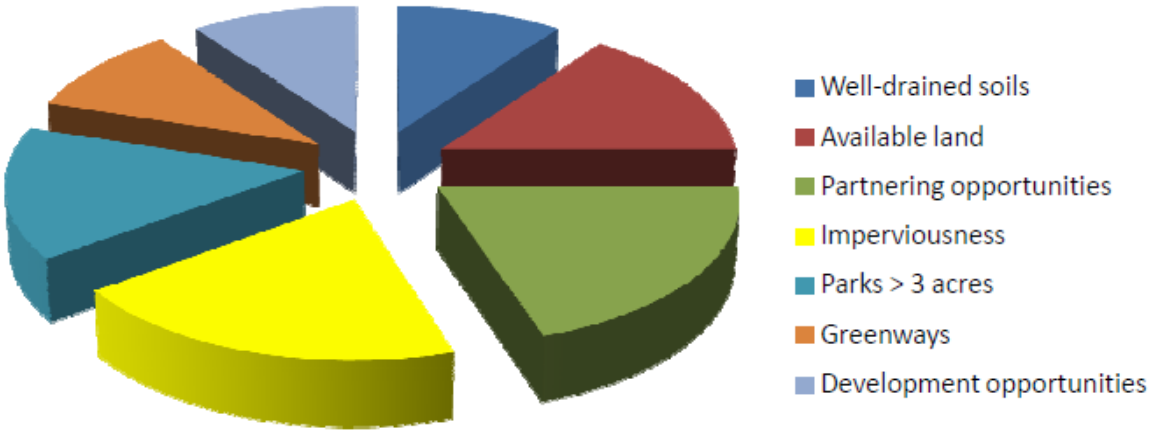


Figure 5. Baseline Index Variables by Maximum Potential Score

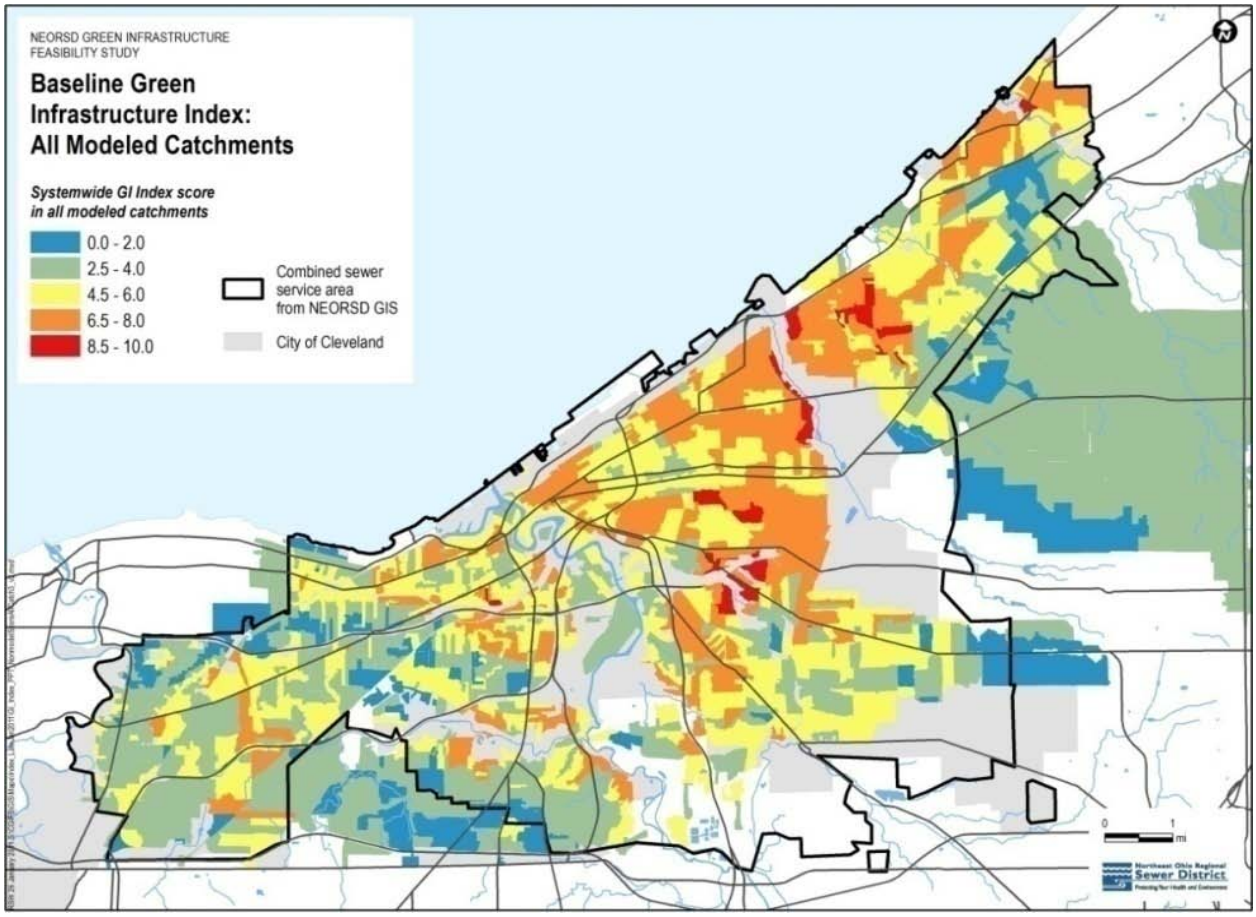


Figure 6. Baseline Index

3.1.3 44-MG Targeted Index

In order to adequately consider the potential of GI priority areas to contribute to the 44-MG of CSO reduction Consent Decree requirement, a second index was developed. The second index was referred to as the 44-MG Targeted Index. The 44-MG Targeted Index characterized the collection system and CSO volume reduction response to the implementation of GI projects using the following variables:

- Residual Combined Sewer Overflow Collection System Response
- Overflow Reduction Potential

3.1.3.1 Residual Combined Sewer Overflow Collection System Response

The purpose of the GI Plan is to identify candidate GI projects that can provide an additional 44-MG reduction in annual CSO volume after the implementation of the planned gray infrastructure. GI projects implemented in drainage areas tributary to CSOs with high residual overflow volume have greater potential to contribute to meeting the 44-MG Consent Decree requirement. The 44-MG Targeted Index considers the magnitude of remaining annual CSO volume after the implementation of the planned gray infrastructure control measures. Through its modeling of the CSS the District has identified the CSOs with high residual overflow volumes.

3.1.3.2 Overflow Reduction Potential

The ability to reduce CSO volume through GI projects varies throughout the District's CSS area as a result of differing system hydraulic characteristics. Directly connected impervious area (DCIA) was chosen to represent this differing anticipated contribution of GI projects to CSO volume reduction. The reduction of DCIA is a common planning-level approach to represent the effects of GI projects within a systemwide H&H model. To characterize the hydraulic variability in the CSS and evaluate whether GI projects would have an impact on reducing remaining CSO volume, the District's systemwide collection system models were used to evaluate the two largest storm events in the District's CSO Phase II Facilities Plan defined "typical year". These 2 events generate CSO after the implementation of the planned gray infrastructure. Figure 7 is a graphical representation of storm events by depth of rainfall for the District's "typical year" as recorded in Appendix 2 of the Consent Decree. For each of the storms, DCIA in each model sub-catchment was reduced by 30-percent in the District's systemwide collection system models. The resulting overflow reduction was categorized into the following breakdown: 0-percent, 0 to 50-percent, and greater than 50-percent.

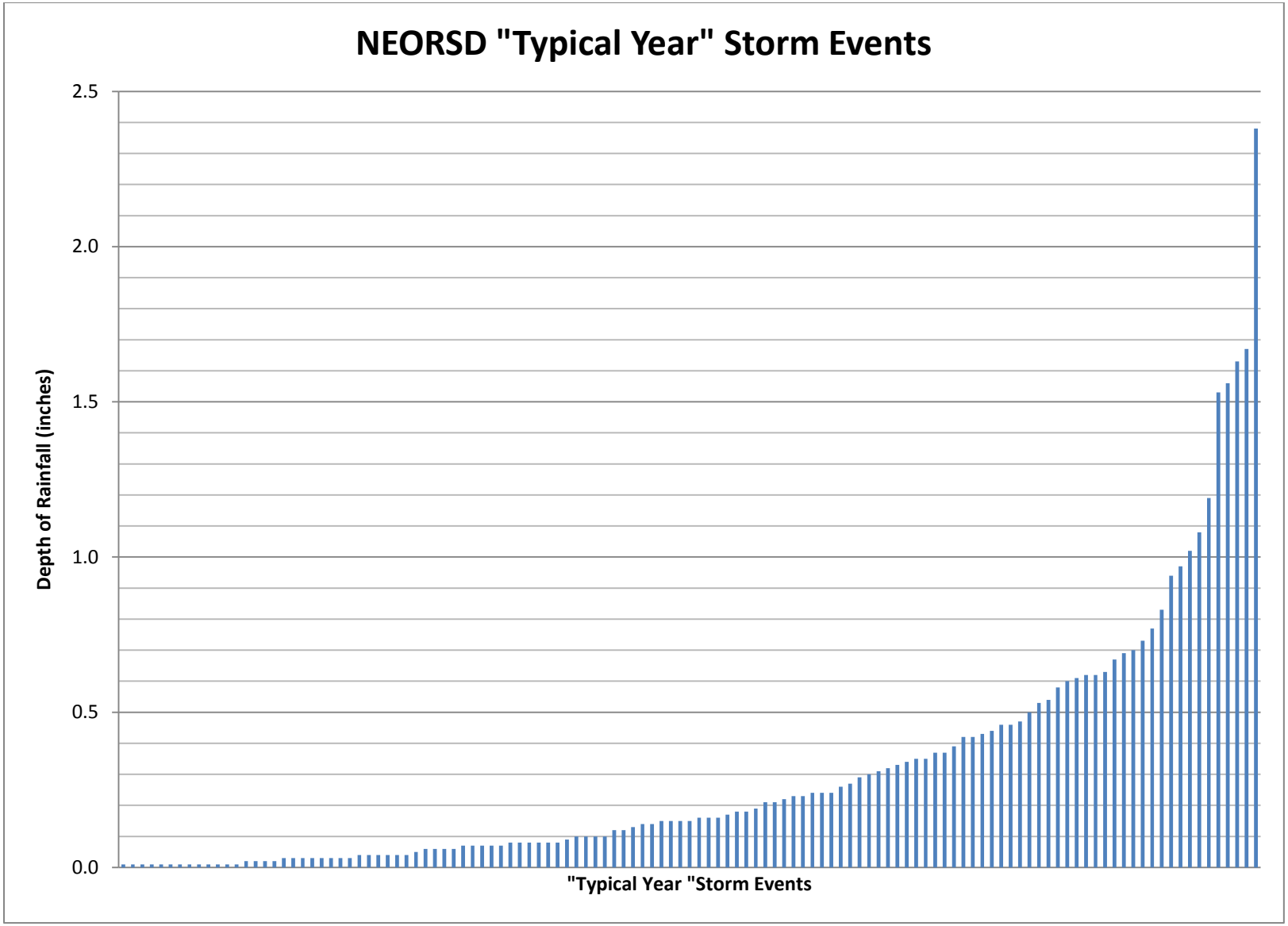


Figure 7. District "Typical Year" Strom Events

3.1.3.3 Variable Scoring

The two 44-MG Targeted Index variables were calculated using a 10-point maximum score similar to the Baseline Index. Their distributions were examined to develop scoring breaks and values (Table 4). The relative importance of each variable was also assessed (Figure 8). One significant observation from the distributions was the importance of independently considering these variables. There are catchments with high residual overflow volumes but low hydraulic responsiveness, just as there are catchments with high hydraulic responsiveness but low residual volume. To be successful, the 44-MG Targeted Index identified catchments with both high residual CSO volume and high hydraulic responsiveness.

Table 4. Scoring for Overflow Variables in the 44-MG Targeted Index

Variable	Value	Potential Score
Residual Overflow (typical year, MG)	0 to 0.01 00.1 to 0.1 0.1 to 1 1 to 20 > 20	0 1 2 4 7
Overflow Reduction Potential	0% 0% to 50% >50%	0 1.5 3

It is important to note in Figure 7 that the District assigned a higher potential individual score to the residual combined sewer overflow variable in the 44-MG Targeted Index. This was done because residual CSO volume is a modeled result based on the District's overall CSO control program. Overflow reduction potential, by contrast, is based on changes in DCIA as a proxy for the impact of GI projects.

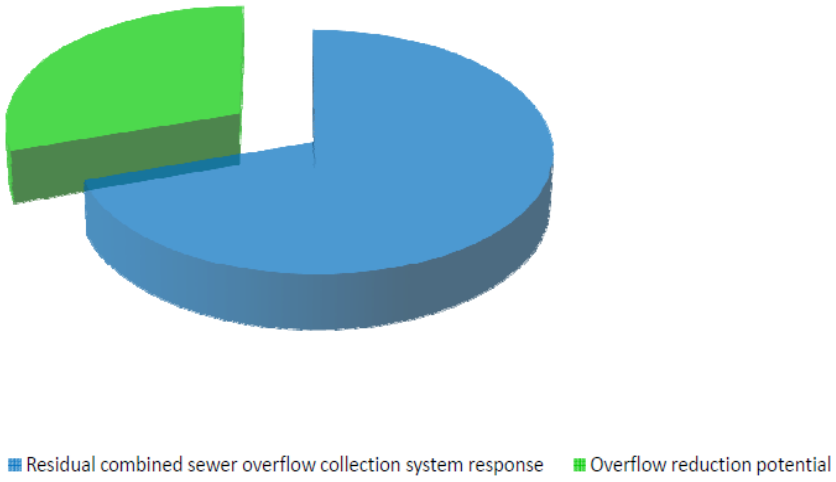


Figure 8. 44-MG Targeted Index Variables by Maximum Potential Score

The result of the 44-MG Targeted Index provided data to support prioritization of areas that are responsive to GI control measure application and have high CSO volume reduction potential (Figure 9).

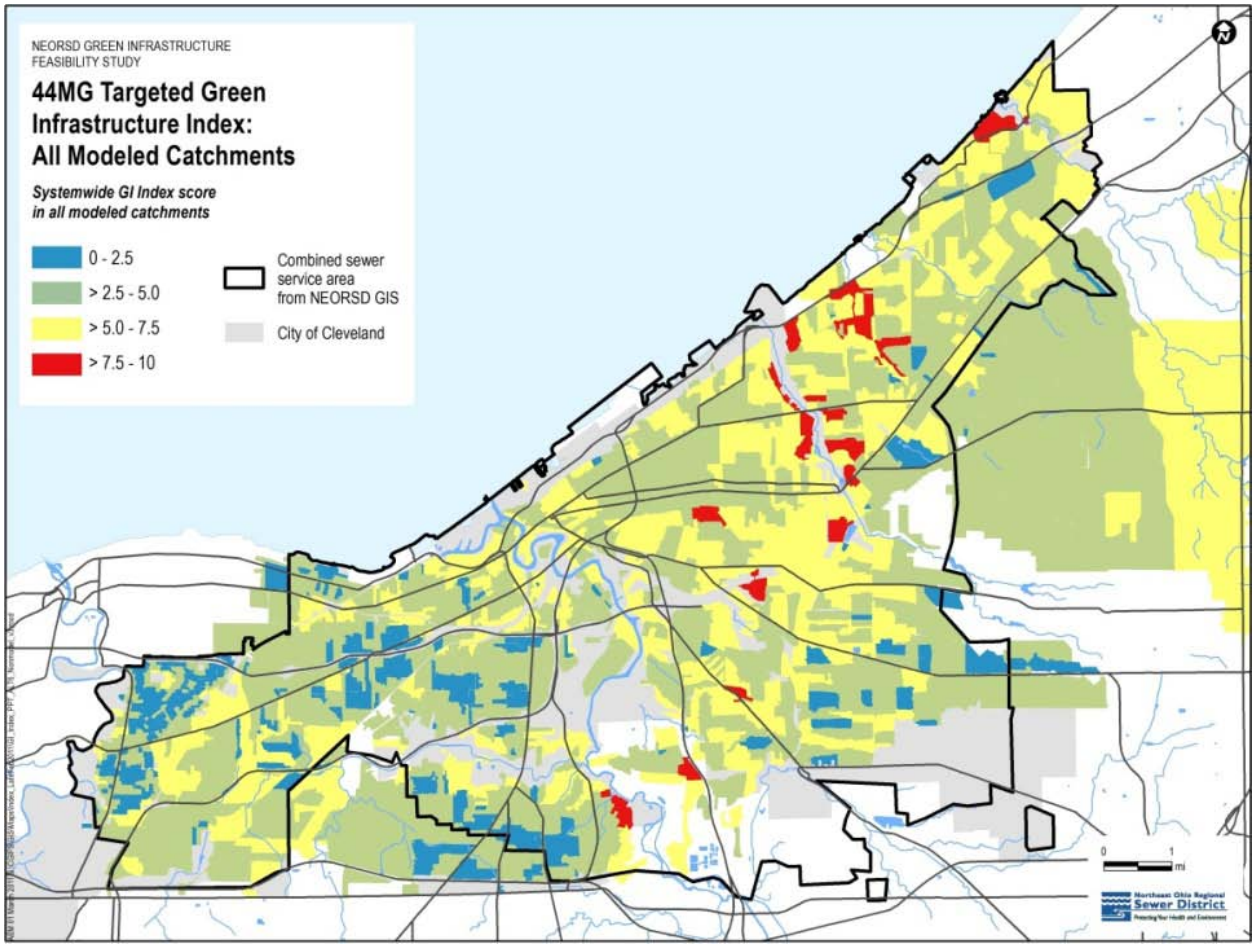


Figure 9. 44-MG Targeted Index

3.1.4 Green Infrastructure Index

The GI Index equally considered the numeric scores of the Baseline Index and 44-MG Targeted Index (Figure 10). The sum of the Baseline Index and the 44-MG Targeted Index scores form the GI Index and were used to identify GI priority areas. The result of adding these two 10-point scale indices was the final 20-point scale GI Index reflected in Figure 11.

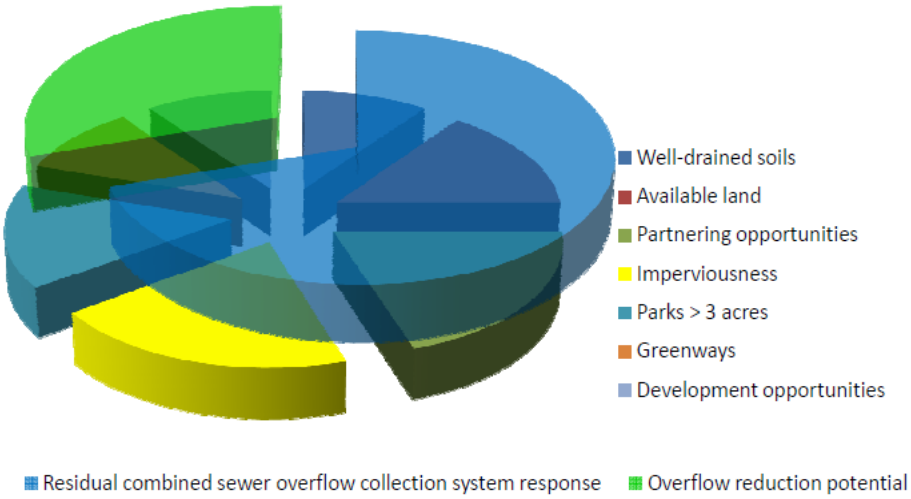


Figure 10. Green Infrastructure Index Variables

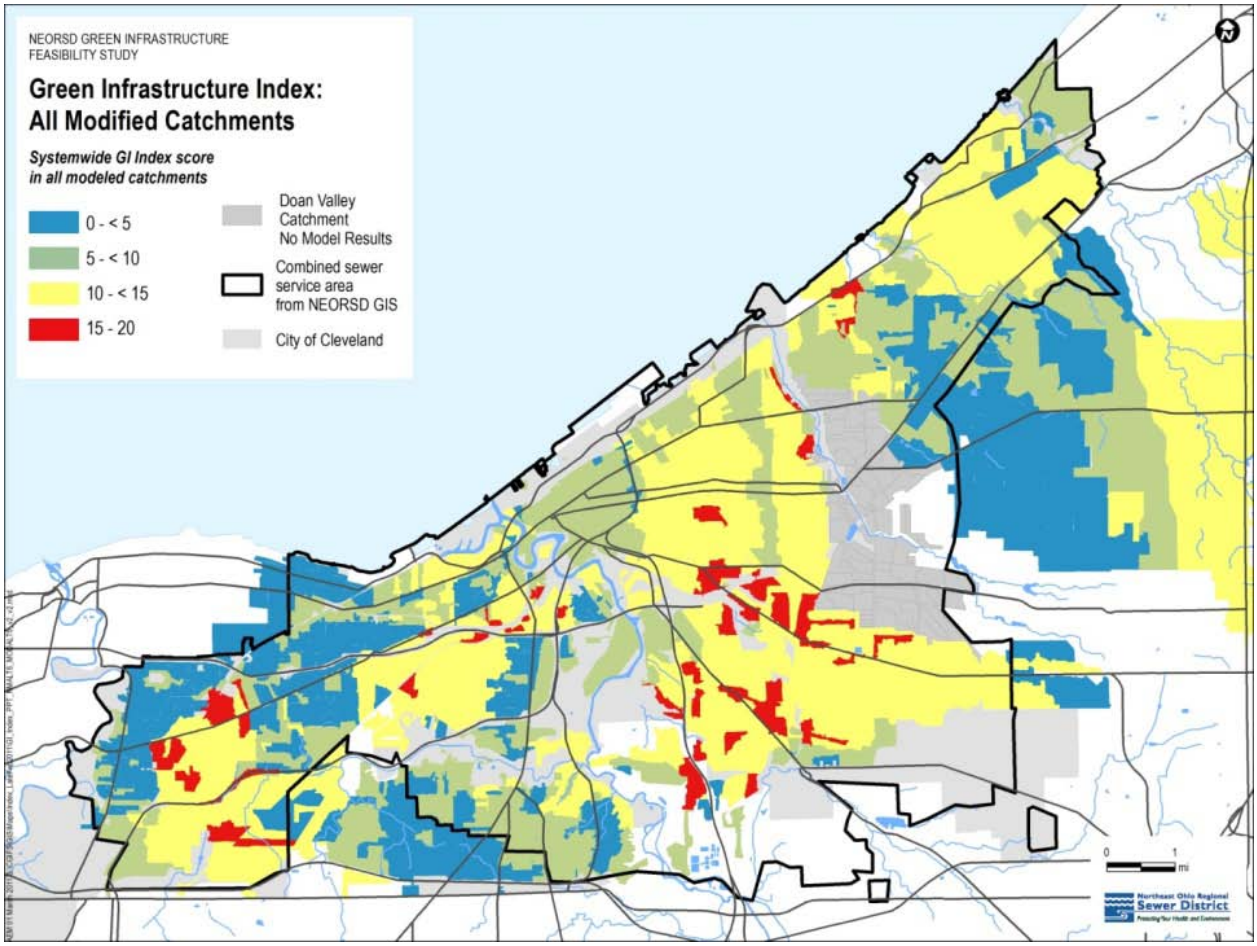


Figure 11. Green Infrastructure Index

3.1.5 Green Infrastructure Priority Areas

The GI Index scoring identified 67 sub-catchments with scores greater than 14.5 that were reviewed using aerial photography and other GIS data. A GI Index high score of 14.5 was selected to ensure the District did not miss potential opportunities. Selected catchments were modified to reflect comments and in many cases merged with nearby high scoring areas. The result was the list of 38 GI priority areas. The graphical depiction of GI priority areas was shown in the District's final GI priority area map to generalize the locations (Figure 12). This GI priority area map was used to support discussions with potential project partners and stakeholders. Final development of candidate GI projects considered sub-catchment areas in order to plan for placement of GI projects that contribute to meeting the 44-MG CSO control Consent Decree requirement.

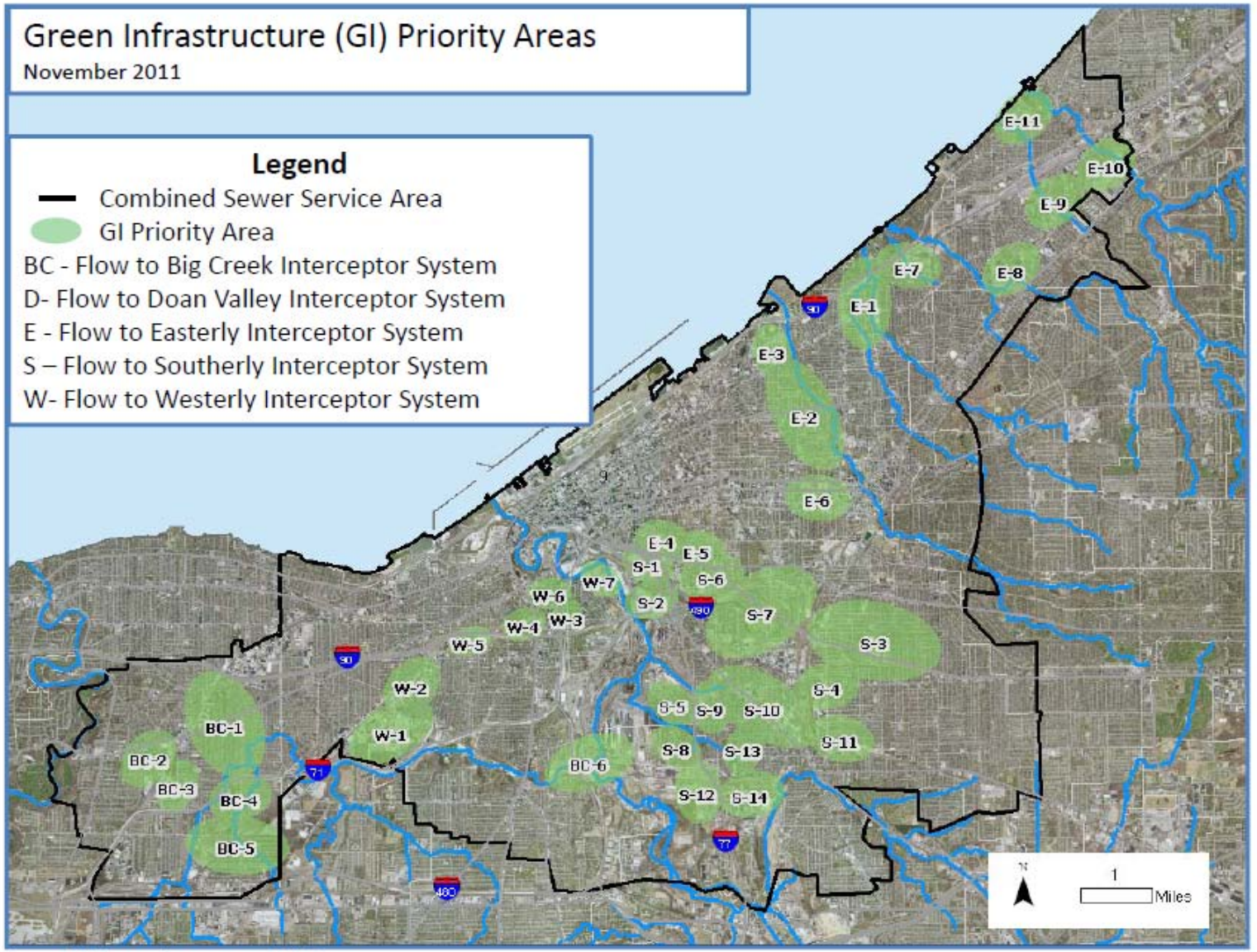


Figure 12. Green Infrastructure Priority Areas

3.2 Green Infrastructure Project Development, Evaluation, and Prioritization

With the identification of 38 GI priority areas best suited to meet the requirements of Appendix 3 of the Consent Decree, the District next developed, evaluated, and prioritized GI projects in each GI priority area. A GI project is composed of GI control measures such as bioswales, green streets, and other site controls. Performance for each GI project was evaluated using planning metrics developed through H&H modeling. General cost information on GI control measures was developed to enable the estimation of costs for GI projects. Cost estimates included engineering and construction costs based on available local and national unit cost data. GI projects were prioritized to identify those most suitable for additional design and possible implementation. Several criteria related to performance and feasibility were developed to score and prioritize GI projects.

The GI projects delineated GI control measures that collectively had the potential to reduce CSO volume within a specific catchment. The GI projects considered the site specific information presented in the GI Index for each GI priority area. The development of GI projects was based on the following guiding principles:

1. Seek infiltration opportunities and other options to permanently remove stormwater from the CSS area and to offload this stormwater to soil for infiltration or surface water after being appropriately treated through a stormwater control measure, where possible. Throughout the GI Plan, this is referred to as "offloading."
2. Incorporate community and transformational benefits.
3. Repurpose vacant land.
4. Support viable partners.

The following subsections detail each step of the development, evaluation, and prioritization of GI projects.

3.2.1 Green Infrastructure Project Development

A GI project was developed for each of the 38 priority areas. The planning-level evaluation of the 38 priority areas resulted in the identification of locations of potential GI projects and general sizes, stormwater capture potential, probable CSO reduction, and estimated cost of GI projects. The following information was used to develop each GI project, most of which was gathered for the GI Index.

- **Aerial Information:** US Department of Agriculture, 2011. Cuyahoga County, Google Street-side images and Bing images.
- **Local Knowledge:** District staff gathered information from the City of Cleveland Planning Commission staff as well as community development corporations and other stakeholders.
- **Surface Drainage Characteristics:** 2006 Cuyahoga County topography from Cuyahoga County Engineer and City of Cleveland GIS information on manhole locations.
- **Existing Sewer Information and CSO Long-term Control Plan Facilities Plans and Advanced Facilities Plan:** City of Cleveland and the District.

- **Potentially-Available Parcels:** City of Cleveland and Cuyahoga County landbank properties, vacant lands as defined by Cuyahoga County Auditor, potentially-vacant lands as described by community development corporations and the City of Cleveland's Planning Commission staff, and City of Cleveland tax delinquent properties as identified by the Cuyahoga County Auditor.
- **Redevelopment Coordination Opportunities:** City of Cleveland Capital Improvement Plan (March 30, 2010), Ohio Department of Transportation improvement locations, City of Cleveland Municipal School District improvements and closures data, City of Cleveland Greenspace Plan, the Re-Imagining Greater Cleveland project, community and neighborhood farm locations from the Urban Design Collaborative, and the City of Cleveland's 2020 Plan.
- **Rights-of-Way (ROW):** Roadway ROW from Cuyahoga County Engineer and easement data from the District.
- **Soil Characteristics:** Soils data from the Re-Imagining Greater Cleveland project, District soil boring information, and Ohio EPA water well soil boring logs.
- **Potential Partnerships:** City of Cleveland and Cleveland Metroparks data, and Cuyahoga County Auditor ownership data.
- **Brownfield/Environmental Issues:** USEPA and local knowledge of brownfield sites from the City of Cleveland and community development corporations.

Each GI project was evaluated based on an estimation of the CSO volume reduction potential (Table 6) and cost (Table 7). Conceptual design and construction costs were calculated based on the potential GI control measures possible within each GI project concept. The evaluation is discussed below.

3.2.2 Green Infrastructure Project Performance Evaluation

A simplified approach was developed to measure the effectiveness of GI projects in contributing to meeting the District's 44-MG Consent Decree requirement. The approach first included determining a volume of stormwater runoff generated during a typical year for several landuse categories within the District (Table 5). The volume of stormwater runoff generated during a typical year was then converted to CSO volume reduction during a typical year. This was based on conversion ratios developed through hydraulic modeling for each interceptor system within the District. The result of this process was an estimated CSO volume reduction based on tributary area, landuse category and interceptor system.

3.2.2.1 Hydrologic Approximation of Stormwater Runoff Volume

Hydrologic models included within the District's systemwide models were used to develop a typical volume of stormwater runoff generated during a typical year for several landuse categories within the District (Table 5). Three representative landuse catchments from the Easterly, Southerly, and Big Creek Interceptor models were averaged to develop typical stormwater runoff volumes per acre of tributary area. The values were then averaged to determine typical ranges within each landuse category.

Table 5. Typical Year (Annual) Stormwater Runoff

Land Use/Site Type	Stormwater MG/Acre (typical year)	Stormwater Acres per MG
Typical Residential	~0.25 to 0.5 MG/Acres	2 to 4 Acres/MG
Large Impervious Area (Commercial/Industrial)	~0.3 to 1.0 MG/Acres	1 to 3 Acres/MG
Open Space/Vacant Land	~0.2 to 0.3 MG/Acres	3 to 6 Acres/MG
100% Impervious Surface	~1.02 MG/Acres	1 Acre/1 MG

3.2.2.2 CSO Reduction

The potential effectiveness of distributed stormwater runoff controls in reducing CSO volume varies throughout the District's system. This variation is primarily attributed to the system-specific hydraulics throughout the District's CSS area. In order to estimate CSO reduction for GI projects, a ratio of stormwater capture to CSO reduction was developed for each major CSS area (Table 6). Individual conversion ratios were developed for the Westerly, Southerly, Easterly, and Big Creek Interceptor systems.

Table 6. Stormwater Runoff - CSO Reduction Ratio

Sewershed	Ratio of CSO Reduction to Stormwater Capture	Stormwater Capture to 1 MG of CSO Reduction
Westerly Interceptor	10%	9.6 MG/MG CSO
Big Creek Interceptor	14%	6.9 MG/MG CSO
Southerly Interceptor	13%	7.6 MG/MG CSO
Easterly Interceptor	10%	10.5 MG/MG CSO

Similar to the modeling evaluations performed to create the GI Index, hydrologic inputs were modified to simulate the effects of GI project implementation and determine the resulting estimated CSO reduction. The ratios were used to estimate potential CSO reduction volumes for each GI project. This process is represented in Figure 13. See Appendix D for additional discussion on CSO reduction ratio derivation.

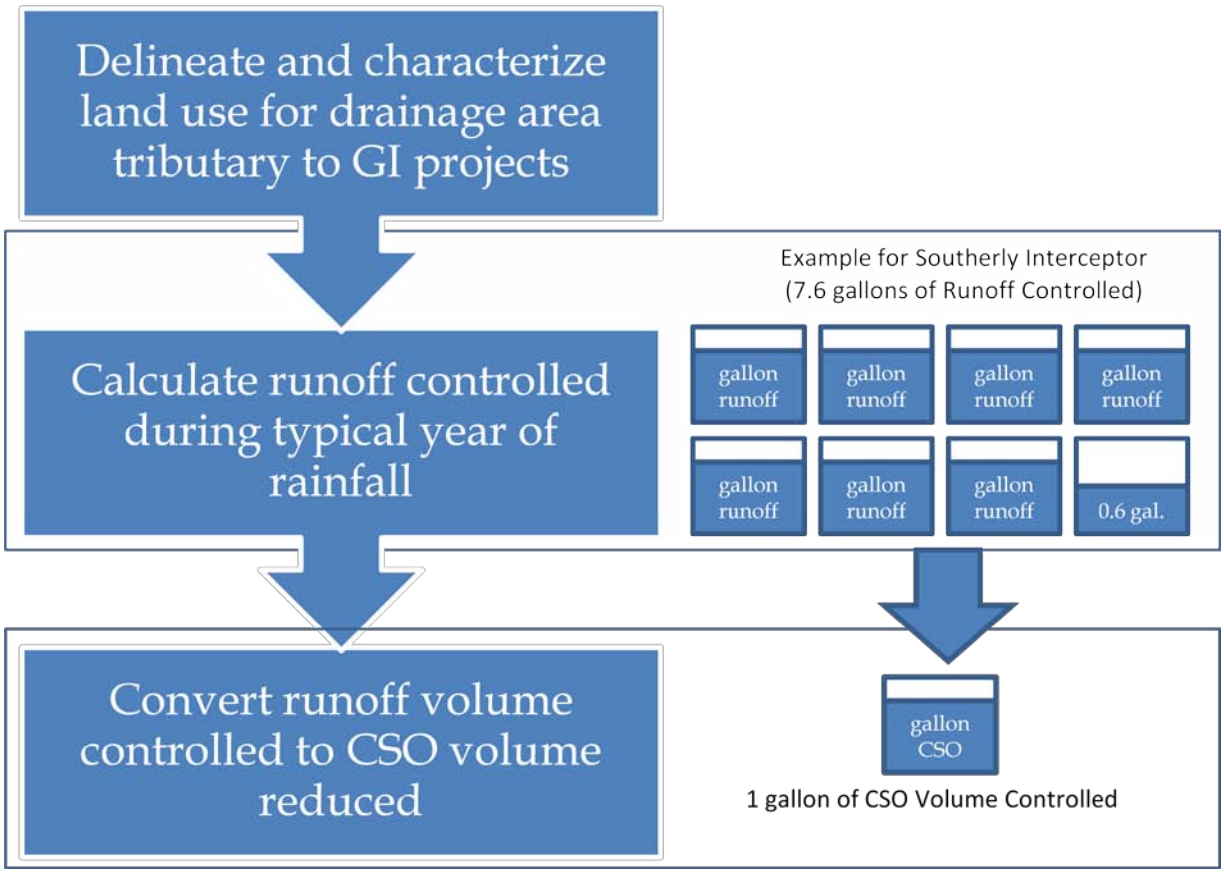


Figure 13. Process to Calculate CSO Volume Reduction Potential for Each GI Project

3.2.2.3 GI Control Measure Cost Evaluation

Planning level project cost estimates were developed to evaluate each proposed GI project along with conceptual design criteria (Table 7). Project costs included planning, design, construction, and construction administration services. They did not include O&M costs, which will be evaluated in subsequent detailed design of candidate GI projects. Project costs included a 55-percent markup for construction contingency and design and construction administration related services. Unit cost data were established using *RS Means* cost data, Ohio Department of Transportation Bid Tabulation Results, and other local project bid tabulation results. See Appendixes E and F for additional information on GI control measures and costs.

Table 7. Green Infrastructure Control Measure Costs and Sizing Criteria

GI Control Measure Group	GI Control Measure	Sizing Criteria GI Control Measure Surface Area to Drainage Area Ratio	Project Cost[a] (SF or LF)
Storage/Treatment	Dry Extended Detention	1:15 to 1:20	$3.90/SF ($168,000/acre)
	Wet Extended Detention	1:15 to 1:20	$6.45/SF ($281,000/acre)
	Wetland Extended Detention	1:15 to 1:20	$6.40/SF (80,000/acre)
	Irrigation Pond	1:15 to 1:20	$8.70/SF ($380,000/acre)
Stormwater Storage/Infiltration and Treatment	Infiltration Basin	1:5 to 1:50	$6.80/SF
	Bio-Retention Cell/Swale	1:5 to 1:10	$25.00/SF
	Green Street[b]		$47.00/LF
	Low[c]	see note b	$227.00/LF
	Medium[d]	see note b	$460.00/LF
	High[e]	see note b	$6.80/SF
	Porous Pavement	NA	$14/SF
Stormwater Source Reduction	Vacant Land Repurposing[f]	NA	
	Low Level	NA	$0.70/SF ($30,000/acre)
	High Level	NA	$0.85/SF ($37,000/acre)
	Green Roof	NA	$28.70/SF
	Impervious Surface Removal and Reforestation	NA	$1.15/SF ($44,000/acre)
Stormwater Conveyance/Separation	Storm Sewer	NA	$280/LF
	Open Channel/Swale	NA	$30/LF
	Overland Flow	NA	$17/LF

[a] Project cost includes raw construction cost plus a 55-percent markup for construction contingency, and engineering design and construction administration related services. Construction costs are based on local pricing and do not include costs associated with land acquisition and demolition.

[b] Green street costs assume District participation in funding a portion of a planned City of Cleveland Street Rehabilitation Project. Green streets low, medium and high implementation categories are based on the potential drainage area controlled by GI control measures incorporated into a green street project.

[c] Costs for low level green streets include addition of bump-ins or bump outs.

[d] Medium level green street cost includes continuous bio-retention swale on both sides of the street.

[e] High level green street costs include continuous bio-retention swales on both sides of the street in addition to new storm sewer construction.

[f] Assume large scale (30+ acres) lot repurposing. Cost includes demolition but excludes land acquisition. High level cost includes plantings.

LF = linear foot

SF = square feet

Project costs were expressed as cost per square foot (SF) or linear foot (LF), but are based on more detailed unit cost development described in Appendix F. For example, a 1-acre surface area wet-extended detention basin was used in GI project development to control drainage from a 15 to 20-acre drainage area depending on landuse and associated imperviousness of the tributary drainage area. The $6.45/ SF costs for wet-extended detention basins shown in Table 7 are based on costs to construct a 6-foot-deep basin with a 3-foot-deep permanent pool (Table 8).

Table 8. Example Planning Cost Estimate Development for Wet Extended Detention Basin

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation and Disposal	9,680	CY	$17	$164,600
2	Outlet Structure	1	EA	$3,000	$3,000
3	Storm Sewer Outlet	100	LF	$50	$5,000
4	Seeding	1000	SY	$0.30	$300
5	Topsoil	400	CY	$20	$8,000
	Subtotal Construction Costs				$180,900
	55% contingency (includes engineering and construction administration services)	1	LS	$99,480	$99,480
				Total	**$ 281,000**
				$/SF	**$6.45**

CY = cubic yard
EA = each
LF = linear foot
SF = square feet
SY = square yard

During GI project development green streets were planned in areas where the City of Cleveland's Capital Improvement Plan would be leading roadway rehabilitation projects. The costs were derived by calculating the additional District funding necessary to add the green street concept components described below to existing typical Cleveland roadway rehabilitation projects. Planning-level green street costs are typically 20 to 40-percent of the overall roadway rehabilitation project budget. This allowed the District to use green streets as a GI control measure and only contribute the costs needed to upgrade the roadway rehabilitation.

Green street GI projects were classified as low, medium, or high based on the extent of stormwater management features incorporated into the roadway rehabilitation project. The following is a general summary of each green street classification used for the development of GI projects.

- **High-level Green Street:** Controls stormwater runoff from most of the areas within the ROW and areas adjacent to the green street. Planning-level costs include continuous bioretention swales on both sides of the street, and new storm sewer construction to provide conveyance of stormwater to or from stormwater control measures incorporated in the GI project.
- **Medium-level Green Street:** Controls stormwater runoff from a significant percentage of areas within the ROW, but limited additional areas adjacent to the green street. Planning-level costs include continuous bioretention swales on both sides of the street.

- **Low-level Green Street:** Controls stormwater runoff within the street cross section, but only a small percentage of the entire ROW. Planning-level costs include stormwater control measures that bump-in or bump-out into the street cross section. The bump-in or bump-out areas collect stormwater and provide storage and treatment prior to discharge.

See Appendix E for typical sections that illustrate the high-, medium-, and low-level green street concepts and Appendix F for additional details on the development of planning-level costs.

3.2.3 Green Infrastructure Project Prioritization

With potential GI projects developed for each of the 38 priority areas, the District reviewed and rated each project for both performance and feasibility to establish a prioritized list of candidate GI projects. Each GI project was rated by the following criteria:

- Performance Criteria:
  - Cost-benefit (Project costs/CSO gallons removed)
  - CSO reduction magnitude (volume)
- Feasibility Criteria
  - Land requirements: Availability of land for GI control measures in GI project area, such as vacant or landbank owned properties, or the need to purchase or partner with private land owners in the area.
  - Partnership opportunities: Potential to partner with local organizations such as community development corporations or financial partners such as City of Cleveland or private industry to facilitate new development or redevelopment in a neighborhood.
  - Public acceptance: Potential for negative impacts of construction and project to a neighborhood, such as reducing the size of usable park land for recreation; and potential co-benefits to a neighborhood, such as adding green space, streetscaping or the reuse of vacant land.
  - Flexibility in the use of GI control measures within the GI project area: Opportunity to adjust GI control measures in the GI project area based on property, topographic, time constraints, or opportunities.
  - O&M administration: Assess the O&M needs based on the number of GI control measures needed for a GI project. GI projects composed of fewer GI control measures will generally have lower O&M costs.
  - Performance reliability: Ability of the GI control measures within the GI project to perform and ensure CSO control including control during back-to-back storm events and other antecedent conditions that may impact the performance of GI control measures.
  - Overall feasibility of GI within the priority area: Overall feasibility of the GI project including opportunities or constraints not captured in previous criteria.

Each GI project was scored for the established criteria. Table 9 includes these criteria and their scoring and weighting.

Table 9. Green Infrastructure Project Ranking Criteria

Criterion	Value	Score	Weight
Project Cost/ CSO Gallons Removed	≤$0.83/MG CSO >0.84/MG - ≤$2.00/MG CSO >$2.00/MG CSO	3 2 1	25%
CSO Reduction Magnitude	≥ 4.00 MG < 4.00MG - ≥1.99MG <1.99MG	3 2 1	25%
Land Requirements (GI Control Measures)	High vacancy and landbank properties and/or low land acquisition requirements including limited to no private property required acquisition Low to medium vacancy and landbank properties and/or low to medium land acquisition requirements including limited private property required acquisition Low vacancy and landbank properties and/or high land acquisition requirements including private property required acquisition	3 2 1	50%
Partnership Opportunity	Cooperative and financially viable partners Cooperative partners and/or limited required partnerships Non-viable partners and/or many required partnerships	3 2 1	
Public Acceptance (of project/GI Control Measure)	No negative impacts and/or significant co-benefits Minimal negative impacts and some co-benefits Significant negative impacts	3 2 1	
Flexibility (to change GI control measure)	Alternative concepts Alternatives within project No alternatives	3 2 1	
O&M Admin	Low distribution/low maintenance Medium distribution/medium maintenance High distribution/high maintenance	3 2 1	
Performance Reliability	Offload to stream system Infiltration Other	3 2 1	
Feasibility	Feasible - all aspects Feasible - most aspects Feasible - few aspects	3 2 1	

The result was a prioritized list of candidate GI projects of which the top 20 GI projects representing approximately 95-MG of additional CSO reduction will be advanced for further evaluation. A more detailed description and list of these top 20 candidate GI projects including estimated costs, CSO volume reduction, preservation/ownership/access requirements, environmental justice considerations, and anticipated public participation involvement is provided in Chapter 4 (Table 10). GI projects not advanced for further evaluation may be reconsidered if new opportunities arise during GI Plan implementation.

3.3 Public Participation

The District engaged with the staff from the City of Cleveland, community development corporations, the Cuyahoga County Land Reutilization Corporation, and others (Figure 2. Summary of Public Participation Process) at the following three stages during the development of candidate GI projects:

- GI Priority Area Identification
- GI Project Development and Evaluation
- Candidate GI Project Prioritization

As described under Section 2.3, the District engaged with City of Cleveland staff in Planning and Capital Projects, the Cleveland Green Stormwater Management Team, community development corporations, and the Cuyahoga County Land Reutilization Corporation to assist in identifying and reviewing GI priority areas (Section 3.1) and to gather information about potential development projects in these areas that could offer partnership opportunities. The Cleveland Green Stormwater Management Team and City/NEORSD Green Infrastructure Steering Committee were specifically formed to provide input on GI projects. The District also presented the GI priority areas to the City of Cleveland Council at their regular caucus meeting and met with individual council people at their request.

At the same time the District presented to and conducted field visits with Burten, Bell, Carr Development, Inc.; Slavic Village Development, Inc.; Stockyard, Clark-Fulton & Brooklyn Centre Community Development; and University Circle Inc., to gain their input on the GI priority areas and learn about future partnership opportunities. The information gathered during these meeting influenced the GI project development and evaluation and highlighted opportunities to partner in redevelopment projects. Examples include the District's early action GI project to install pervious pavement and a StormTech chamber system at the Courtyard by Marriot in University Circle in partnership with University Circle, Inc.

The District worked with the City of Cleveland Planning Commission staff and the City/NEORSD GI Steering Committee during the GI project development, evaluation, and prioritization (Section 3.2) to review each GI project. The District used the information gathered during the project evaluation to adjust projects and understand Cleveland development priorities and the City of Cleveland Capital Improvement Plan (CIP). The Cleveland CIP is focused on major road projects and provides opportunities for inclusion of GI control measures such as green streets. In total, the information provided from these public participation and partner interactions established a framework for collaboration and information sharing on GI projects and will shape the implementation phase of the GI Plan (Chapter 5).

4 Candidate Green Infrastructure Projects

Per Appendix 3 of the Consent Decree, the GI Plan shall propose a process for the design, construction, and operation of candidate GI projects to capture a minimum of 44-MG of additional CSO volume in a typical year. Table 10 lists candidate GI projects identified as a result of the evaluation process outlined in Chapter 3. The GI projects do not include any field surveys or testing, detailed engineering design calculations or externally focused investigations of property acquisition requirements. The issues will be fully investigated as a part of engineering design, which will be conducted subsequent to this GI Plan. See Appendix G for a map and details on each candidate GI project.

Due to the aggressive implementation schedule required under Appendix 3 of the Consent Decree, and the uncertainties associated with the acquisition of property and ability to secure the necessary agreements for each project in a timely fashion, some projects may not be feasible within the 8-year schedule. Consequently, the District has identified candidate GI projects that exceed the target 44-MG CSO reduction requirement. The aggregate CSO reduction potential of the candidate GI projects represents approximately 95-MG (Table 10). The District intends to refine the list of projects, and possibly add new prospective projects, as the GI design concepts are advanced. The goal is to identify projects that will support the GI implementation and monitoring timeline prescribed in Appendix 3 of the Consent Decree and provide the best opportunity for CSO reduction. The District will only advance candidate projects with the greatest opportunity for implementation to final design.

Table 10 summarizes the information on each candidate GI project. The table columns are explained below and provide the information required under Appendix 3 of the Consent Decree as explained in Chapter 2 of the GI Plan.

- GI Project ID: A District-assigned identification number that indicates the catchment and project number. The catchments include Big Creek (BC), Easterly (E), Southerly (S), Doan (D), and Westerly (W).
- Project Location: The general geographic location of the project by major roads.
- CSOs: The CSO to which the candidate GI project is tributary.
- CSO Volume Reduction Potential (MG): The anticipated CSO reduction potential from the project.
- Project Cost (millions): The estimated capital cost of the project.
- Preservation/Ownership/Access requirements: The specific type of ownership and O&M agreement anticipated for the project from the detailed discussion in Chapter 2.
- Environmental Justice Considerations: The environmental justice considerations, as explained in Chapter 2, that the candidate GI project addresses. For example, most projects are within a designated environmental justice area and also provide opportunities for vacant land reuse and community redevelopment.

- Public Participation: The primary partners necessary to ensure a candidate GI project proceeds, including the City of Cleveland, a local community development corporation, and/or a private development partner.

Table 10. Candidate GI Projects

GI Project ID	Project Location	CSOs	CSO Volume Reduction Potential[a] (MG)	Project Cost[b] (Millions)	Preservation/Ownership/Access Requirements			Environmental Justice Considerations			Public Participation		
					District Ownership/O&M	Second Party Ownership, District O&M	Second Party Ownership/O&M	EJ Area	Vacant Land Reuse	Community Redevelopment	City Partnership	Private Partnership (commercial/industrial)	Community Development Cooperation
E-8	Euclid Ave, Ivanhoe Rd, St Clair between E140th to E152nd St	001, 211, 242	13.7	$15,431,000	X			X	X	X	X		X
D-1	Giddings Brook - Buckeye, Woodhill, and Fairhill to Baldwin	073, 222	8.5	$10,439,000	X	X	X	X	X	X	X	X	X
S-6	Woodland Ave to CSX Rail; Includes E55th and Kinsman	040	8.1	$9,115,000	X			X	X	X	X		X
S-7	Agricultural Innovation Zone Neighborhood; Bessemer Ave and E65th; RTA Red line and Crowell Ave (Opportunity Corridor)	040	7.2	$9,034,000	X	X		X	X	X	X	X	X
E-1	E104th - Parkwood Dr and St Clair and Rt 2/I-90; Forest Hill Park	001, 230, 205, 231	7.1	$6,615,000	X			X	X	X	X		X
S-3	E92nd to Woodhill Rd; Manor Ave to Lamontier Ave; Luke Easter Park Area	040	6.3	$7,282,000	X			X	X	X	X		X
S-9	Fleet Ave between E49th and E 57th St and up to Dalton Ave	036	5.6	$8,282,000	X			X	X	X	X		X
S-10	Morgana Run Trail; Broadway Ave and Aetna Rd	036	5.1	$3,547,000	X	X	X	X	X	X	X	X	X
E-7	Eddy Rd to E133rd St from Taft Ave to Rte 2/I-90	001, 211, 231, 232	4.6	$4,556,000	X	X	X	X		X	X	X	X
S-4	Union Avenue between E88th and MLK	036	4.4	$4,881,000	X	X		X	X	X	X	X	X
E-6	Cedar Rd at E89th to Fairhill Rd; Chester to Hough Ave from E90th to E105th St.	204, 236, 222	4.0	$4,799,000	X	X		X	X	X	X	X	X

GI Project ID	Project Location	CSOs	CSO Volume Reduction Potential[a] (MG)	Project Cost[b] (Millions)	Preservation/Ownership/Access Requirements			Environmental Justice Considerations			Public Participation		
					District Ownership/O&M	Second Party Ownership, District O&M	Second Party Ownership/O&M	EJ Area	Vacant Land Reuse	Community Redevelopment	City Partnership	Private Partnership (commercial/industrial)	Community Development Cooperation
S-8	Harvard Avenue and E42nd St between RTA and CWD properties	035	3.8	$3,332,000	X	X	X	X			X	X	
BC-5	W130th from Lena Ave to Giles Rd	057	3.2	$2,923,000	X					X	X		
W-2	Denison and W65th St up to Camden Rd and E71st St	080	3.1	$2,713,000	X			X	X	X	X		X
BC-2	Lorain Avenue at West 150th St and Warren Road	058, 067	2.4	$2,395,000	X	X	X			X	X	X	
BC-1	Lorain Avenue to West Ave between W140th and W192nd St	058, 056	2.4	$1,539,000	X					X	X		
BC-3	Emery Avenue W150th W143rd St	058	2.3	$1,056,000	X	X	X			X	X	X	
E-11	Lake Shore Blvd from E156th to 169th St	206	1.3	$1,489,000	X						X		X
E-3	St Clair Avenue to CSX Rail; Industrial Park and CMSD Bus Storage	204	1.2	$1,518,000	X	X	X	X	X	X	X	X	X
BC-6	Valley Rd and W20th St	045	0.9	$735,000	X	X	X			X	X	X	
Total			**95.1**	**$101,681,000**									

[a] Estimated potential additional annual CSO reduction during remaining overflow events in a typical year.

[b] Estimated present value project costs (55-percent markup for construction contingency, and engineering design and construction administration related services).

5 Implementation Plan and Schedule

Future phases of the District's GI program subsequent to this GI Plan will include the design, construction, operation, and evaluation of GI projects to capture a minimum of 44-MG of additional overflow. Figure 14 details the implementation schedule for the District's GI Plan going forward.

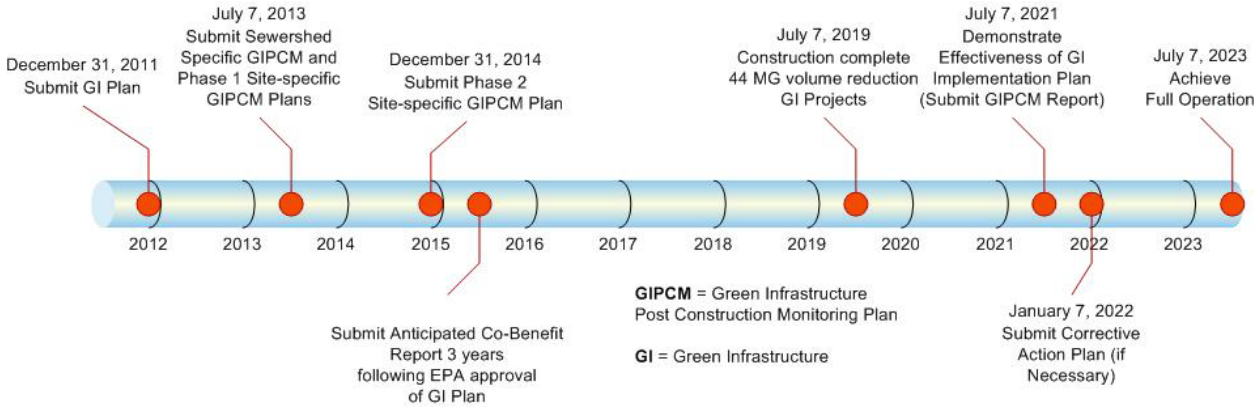


Figure 14. Implementation Schedule for Appendix 3 of the Consent Decree

Design of GI projects is planned to initiate in 2012 with construction completion within 8 years of entry of the Consent Decree and the demonstration of effectiveness within 10 years. Chapter 5 outlines the process that will be used to implement the GI Plan to comply with the Consent Decree. This is also detailed in Figure 15. The GI implementation process includes the following 5 components:

1. Design Option Evaluation of Candidate GI Projects
2. Preliminary and Final Design, including Early Action Projects
3. Construction and O&M
4. Post-Construction Monitoring
5. Public Participation
6. Anticipated Co-benefits Report

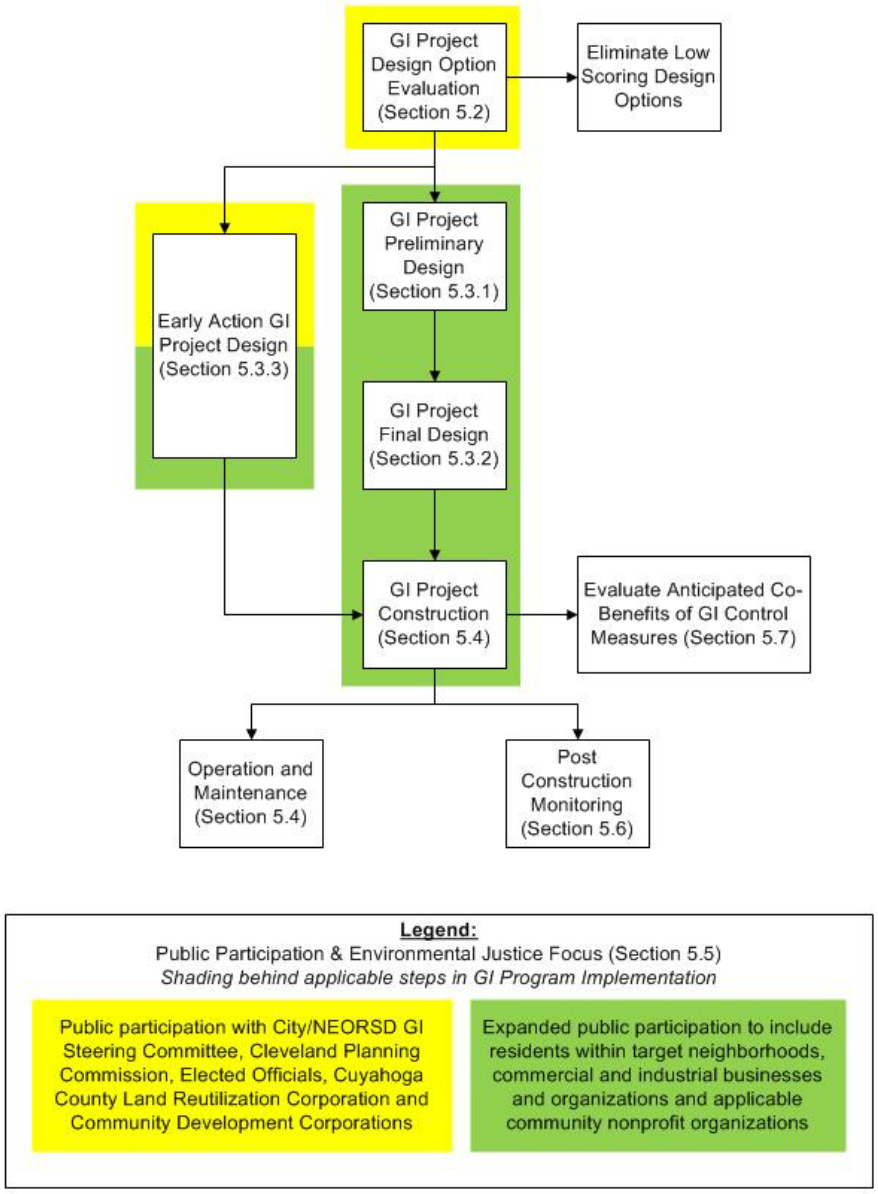


Figure 15. Green Infrastructure Plan Implementation Process

A Request for Qualifications (RFQ) for GI Design Services was released by the District on October 28, 2011. The scope of work identified in this RFQ includes the following:

- Design option evaluation and preliminary design of GI projects to meet the 44-MG Consent Decree requirement. Candidate GI projects included in Chapter 4 of this GI Plan will be further evaluated as a part of the design option evaluation (Section 5.2) conducted prior to preliminary design (Section 5.3).
- Optional final design of Early Action Projects. Early Action Projects are candidate GI projects that may be advanced because of crucial development opportunities with viable partners willing to incorporate GI into site design and contribute to meeting the District's GI Consent Decree requirements.

H&H models will be used throughout most components of the GI Plan implementation including the design option evaluation, preliminary and final design, and post-construction monitoring to evaluate the effectiveness of GI projects as summarized below.

- **Design Option Evaluation:** H&H models will be used to evaluate GI projects and support recommendations on projects further evaluated as a part of preliminary design. A detailed design option evaluation will be conducted prior to beginning preliminary design.
- **Preliminary Design:** H&H models will be refined to support design and confirm the effectiveness of GI projects in reducing CSO volume.
- **Final Design:** H&H models will be refined to represent the final design and confirm the effectiveness of GI projects in reducing CSO volume.
- **Post-Construction Monitoring:** H&H models will be updated as necessary as a result of post-construction monitoring and re-evaluated to confirm the effectiveness of GI projects in reducing CSO volume.

Section 5.1 provides additional detail on the H&H modeling to be used during GI Plan implementation.

5.1 Hydrologic and Hydraulic Modeling

H&H model data will be developed and evaluated within the District's existing systemwide models for each GI project considered as a part of the design option evaluation, preliminary, and final design, and post-construction monitoring. Model results will be used to define design criteria and evaluate systemwide performance of GI projects in reducing CSO volume. Design criteria established for each GI project through H&H modeling will include storage volume and conveyance system capacity requirements. Systemwide performance of GI projects will be evaluated using the various CSO models that were prepared during the development of the District's Long-term Control Plan. The models have been updated as necessary to reflect the increased level of control negotiated under the Consent Decree, as well as other subsequent changes in the collection system. For purposes of evaluating the systemwide performance of the GI projects, the H&H systemwide models will be updated with specific project area modifications representing the impact of GI projects.

Table 11 summarizes the H&H modeling approach that will be generally applied to evaluate GI projects. The setup of GI project-specific models will vary slightly depending on the CSS. The variation is necessary because the District uses multiple systemwide modeling applications, including USEPA SWMM, MIKE Urban, and InfoWorks. All GI projects implemented will be evaluated using the full systemwide model and a simulation of the entire typical year of rainfall through the H&H models.

Table 11. Summary of H&H Modeling Approach for Green Infrastructure Project Evaluation

GI Control Measure Group	Project Area Hydrologic Modeling Approach	Project Area Hydraulic Modeling Approach	Systemwide Modeling Approach
Stormwater Storage and Treatment	If storage is provided by proposed GI control measures for runoff from a tributary drainage area without overflow to the CSS, tributary drainage area to storage facility will be removed from hydrologic model as appropriate.	If storage is provided by the proposed GI control measure for only the control storm runoff with an overflow to the CSS, create and route runoff through storage node. Represent evaporation, evapotranspiration, irrigation and/or infiltration losses utilizing options within hydraulic modeling application. If no suitable options exist within hydraulic modeling application, appropriate methods utilizing hydrologic modeling application will be considered.	Run full systemwide H&H model utilizing model with project area modifications.
Infiltration and Treatment[a]	If proposed GI control measures result in a reduction of imperviousness and/or increased infiltration, changes in land conditions will be represented through modifications to impervious area and soil infiltration characteristics in hydrologic model.	If infiltration or exfiltration occurs while runoff is conveyed or stored through the proposed GI control measure, infiltration or exfiltration will be represented utilizing options within hydraulic modeling application. If no suitable options exist within hydraulic modeling application, appropriate methods utilizing hydrologic modeling application will be considered.	
Stormwater Source Reduction[a]	If proposed GI control measures result in a reduction of imperviousness and/or increased soil infiltration, changes in land conditions will be represented through modifications to impervious area and soil infiltration characteristics in hydrologic model. If a proposed GI control measure diverts all runoff from a tributary drainage area without overflow to the CSS, remove tributary area from hydrologic model.	No changes to hydraulic model setup other than reference new hydrologic model results that remove drainage area.	
Stormwater Capture and Conveyance	If GI control measure conveys or stores runoff from areas with existing separate sewer systems that do not overflow to the CSS, these areas will be represented through hydrologic modeling of their tributary area to allow for hydraulic modeling through proposed GI control measures.	If storm sewers, open channel/swales, or street drainage slippage will be constructed as a part of GI control measures, a capture and conveyance system will be represented utilizing options within the hydraulic modeling application.	

[a] As applicable, modeling of these green infrastructure practices will include considerations of rainfall-derived inflow and infiltration

5.2 Design Option Evaluation

The design option evaluation of candidate GI projects will include further consideration of candidate GI projects to evaluate and determine which projects move forward to preliminary design. At a minimum, the evaluation will include the following project elements:

- GI performance in reducing CSO volume: Ability to contribute to meeting the District's 44-MG Consent Decree requirement.
- Cost of design and construction: Updated design and construction cost estimate developed consistently for all design options.
- Ability to offload to the environment: Ability to completely remove drainage areas from the District's CSS through the discharge of stormwater runoff to soil for infiltration or surface water through appropriate stormwater control measures.
- Land availability and ownership: Availability of land to acquire for permanent ownership or easements to ensure permanent and sufficient access and operation of GI projects constructed.
- Scope and cost of O&M: Anticipated scope and cost to operate and maintain GI projects.
- Integration with community goals and landscapes: Ability to integrate GI projects into other community development goals, activities and community landscapes.
- Short- and long-term community impacts: Economic, public health, and other short- and long-term community impacts of GI project.
- Regulatory barriers to implementation: Ability to meet all regulatory requirements for construction of GI projects.
- Readiness to proceed: Ability to implement GI project without any major barriers and within the Consent Decree schedule requirement.
- Site suitability for implementation of GI control measures: Ability of site to support construction of the GI project.

GI projects will be developed to a schematic design, or 10-percent design level for the design option evaluation. The design option evaluation will result in a recommendation of GI projects that best meet the 44-MG Consent Decree requirement and should be advanced to a 30-percent design level.

5.3 Preliminary and Final Design

GI projects will be designed in two steps, preliminary and final design where considerations that ensure accurate estimation and required performance of the GI control measures will be made including but not limited to considerations for rainfall-derived inflow and infiltration for projects employing infiltration. Preliminary design will be used to develop the final design scope of GI projects. The outcome of preliminary design will be reports and drawings that can be used to initiate the final design and construction of GI projects. The schedule for final design of GI projects is anticipated to be phased for several Early Action Projects that are tied to development activities of potential project partners, but is anticipated to be complete by July 7, 2019.

5.3.1 Preliminary Design

Preparation of preliminary design reports and drawings will begin with the completion of the design option evaluation. A 25-percent CSO volume removal contingency will be built into the design option evaluation process in case some GI projects are found to be infeasible during final

design. This design contingency will produce preliminary design for GI projects that will provide approximately 11-MG of additional CSO volume reduction potential, which is 25-percent of the 44-MG Consent Decree requirement. At a minimum, preliminary design will include the following:

- Detailed preliminary engineering design reports,
- Updated preliminary engineering-level cost estimates, and
- Operational and maintenance plan costs and discussion.

5.3.2 Final Design

Final design will initiate subsequent to the completion of preliminary design and phased throughout the 8-year Consent Decree schedule as necessary to leverage partnership opportunities. Final design will be completed for projects recommended to achieve the 44-MG Consent Decree requirement.

5.3.3 Early Action Green Infrastructure Projects

The District's October 28, 2011 RFQ for GI Design Services included scope of work for the identification and possible full design and construction administration related services for Early Action Projects (EAPs). EAPs are generally defined as high-potential projects that can be readily implemented early in the GI Program. Candidate EAPs will be evaluated against other candidate GI projects to determine whether they should be selected for implementation. If selected for implementation, the GI Design Services contract will include scope for all design and construction administration related services necessary for their implementation.

As an example of an EAP the District established a partnership with University Circle Inc. (local community development corporation) on an ongoing hotel development in November 2011. The District's partnership included funding for the design and construction of specific project elements included within a new 153 room Courtyard by Marriott Hotel. The property is currently owned by University East LLC and University Hospitals on Cornell Road, near Euclid Avenue. The District worked with University Circle Inc. to improve the design to take advantage of the naturally sandy soil conditions on site, which are optimal for stormwater infiltration. The design includes a permeable paver system that eliminates stormwater discharges from this site into the District's CSS for events up to a 100-year-design storm. This equates to approximately 1-MG of stormwater infiltration in a typical year.

5.4 Construction, Operation and Maintenance

Construction will be completed within the 8-year Appendix 3 Consent Decree schedule and GI projects will be maintained upon completion of construction. The District will develop a GI project-specific O&M plan as a part of project design. The project-specific O&M plan will consider at a minimum the general GI control measure O&M recommendations documented in Appendix E and any other relevant site specific issues. It will include a schedule for maintenance that will be carried out by the District or contracted O&M personnel. O&M activities will be documented in a centralized District database. The database will be used to manage O&M activities and support semiannual reporting required under Paragraph 46 of the Consent Decree.

5.5 Public Participation and Environmental Justice Considerations

Chapters 2 and 3 summarized the public participation process the District followed during development of the GI Plan. The District's public participation efforts to date have focused on communications with groups representing the public, and not directly with residents. The organizations the District worked with in 2011 are listed in Figure 3 and include the City of Cleveland Planning Commission, City Council, Office of Capital Projects, and Economic Development as well as community development corporations and nonprofit organizations. The District will continue to work with these organizations to expand public participation during the GI Plan implementation. As represented in Figure 15, the District will continue its work with the entities described above, and will expand involvement to include the following groups when candidate GI projects are selected to move forward to preliminary design or an EAP:

- Residents within targeted neighborhoods,
- Commercial and industrial businesses, and
- Organizations and applicable community nonprofit organizations.

Once a candidate GI project is selected to move forward to preliminary design or as an EAP the District intends to develop a public participation plan for each selected GI project. These public participation plans will be tailored to the unique needs and concerns of the neighborhood and stakeholders affected by the GI project. The District will focus this outreach to target low income and minority populations in these neighborhoods. While public participation plans will be distinct to each GI project, the District's future public participation efforts are anticipated to include the elements listed below. Collectively, the District's goal is to move beyond traditional methods of public participation, such as evening meetings and presentations, and into more innovative approaches that reach as many interested residents as possible.

- **Early and Active Involvement:** Early and active involvement of the impacted neighborhood and public in project design. Where appropriate this will include newsletters and mailings regarding the District's overall GI program and its manifestation in their neighborhood, and hosting of public meetings to gather community input on project location within the relevant sub-catchment as well as specific project design elements. This input will feed into the District's design option evaluation and be furthered during the preliminary design of the GI project.
- **On-Line Efforts:** In addition to our primary websites, the District also uses social media, particularly Twitter and Facebook, as avenues for community input. The District will make these available for GI project input as well. Each GI project will have its own location on the District's website to ensure easy and direct access for interested residents via the internet and the District will make every effort to respond directly to comments and questions received on-line and through social media.
- **Support Existing Public Participation Efforts of GI Partners:** The District will build on the existing community involvement/public participation work of its GI partners including the City of Cleveland, as well as ParkWorks, Neighborhood Progress Inc., and the Cleveland Urban Design Collaborative through Re-Imagining Greater Cleveland project, as well as

Environmental Health Watch's neighborhood organizational efforts and individual community development corporations.

5.6 Post-Construction Monitoring Program

As part of the 2012 contracted GI Design Services efforts, the District will commence GI post-construction monitoring (GIPCM) plan development. This includes the development of proposals for site-specific and sewershed specific programs to evaluate the performance and effectiveness of the GI control measures. The plans will detail the model-based approach to assessing compliance. In accordance with the requirements of Appendix 3 of the Consent Decree, the District will submit for USEPA and Ohio EPA review and approval the following proposals.

- Site Specific Phase 1: Submit proposal by July 7, 2013 to address projects to be implemented from 2012 through 2015.
- Site Specific Phase 2: Submit a proposal by December 31, 2014 for a representative selection of the remaining site-specific projects.
- Sewershed-specific: Submit proposal by July 7, 2013.

Once approved by USEPA and Ohio EPA, the District will implement the GIPCM programs in accordance with the approved GIPCM plan. GI post-construction monitoring reports providing the results of the GIPCM programs including detailed information on the modeling efforts used in evaluating the performance and effectiveness of the green infrastructure, and the documentation of the actual design and construction costs for GI project implementation will be submitted for approval to USEPA and Ohio EPA in accordance with the GIPCM plan. At a minimum, this will include the submission of the results of each site-specific GIPCM as a part of the next semi-annual report submitted to USEPA and Ohio EPA pursuant to reporting requirements of Paragraph 46 of the Consent Decree.

5.7 Analyzing the Co-benefits of Green Infrastructure Projects & Control Measures

Within three years following USEPA approval of this GI Plan, the District will submit a Report on Anticipated Co-Benefits to USEPA and Ohio EPA quantifying the expected co-benefits of the District's GI projects and control measures. The direct benefit of the District's GI program is the mitigation of wet weather flows. Green infrastructure has the potential for a range of other benefits to the community in addition to controlling CSOs. Referred to as co-benefits for the purposes of the District's GI Plan, these include neighborhood green space amenities, energy savings, increased property values, and other positive outcomes of GI in the District's CSS area. In the Report on Anticipated Co-benefits, the District will describe the methods used to identify and analyze these and other co-benefits. The co-benefits that will be evaluated and quantified include, at a minimum, the following:

- Life-cycle costs for GI as compared to gray infrastructure.
- Ecological benefits and ecosystem services including habitat improvements and the flood and erosion control benefits of GI.

- Socioeconomic and/or quality of life benefits to low-income or minority populations including improved access to safe and maintained green spaces and recreational opportunities and increased property values due to additional neighborhood amenities.
- Provision of recreational benefits, such as bicycle lanes and walking trails, within underserved communities of the District's CSS area.
- Climate change-related effects, including change in carbon footprint and reduction in the overall carbon impact of the District's implementation of gray infrastructure per the Consent Decree.
- Energy savings as a result of increased GI implementation.
- Air quality benefits of additional green space, trees, and plantings within neighborhoods.
- Aesthetics and improvements in the look and feel of neighborhoods as a result of GI implementation.
- Jobs resulting from the deployment of site-based GI control measures and the growth of local expertise related to GI.
- Property values increases as a result of the collective impact of GI projects within a neighborhood.

To complete the Report on Anticipated Co-Benefits, the District plans to enter into an agreement with an external entity with relevant co-benefit evaluation experience. Work on this report is anticipated to begin at approximately the same time as construction of GI projects.

6 Glossary

Combined Sewer Overflow (CSO): Any discharge from the District's CSS at a CSO Outfall designated in the District's NPDES CSO Permit.

Combined Sewer System (CSS): The portion of the District's collection system designed to convey only municipal sewage (domestic, commercial, and industrial wastewaters) and stormwater to any of the District's three Waste Water Treatment Plants (WWTPs) or to a CSO.

Consent Decree: United States and State of Ohio versus Northeast Ohio Regional Sewer District filed on July 7, 2011, all appendixes hereto, and all plans, schedules, reports, memoranda, or other submittals approved by USEPA and/or Ohio EPA, as applicable, pursuant to the requirements of the Decree or any appendix.

Green Infrastructure (GI) Control Measures: The range of stormwater control measures that use plant/soil systems, permeable pavement, or stormwater harvest and reuse, to store, infiltrate, or evapotranspirate stormwater and reduce flows to the CSS. GI control measures may include, but are not limited to, bioretention and extended detention wetland areas as well as green roofs and cisterns.

GI Plan: The document identifying the process for locating, designing, constructing, operating, and evaluating the performance of a set of GI control measures and outlining the implementation plan for the GI control measures to meet Consent Decree requirements set in Appendix 3.

GI Priority Areas: Locations within the District's combined sewer area identified through the GI index as best suited for GI projects.

GI Project: Composed of site-specific GI control measures that capture stormwater runoff and will result in an additional 44-MG reduction of CSO volume systemwide.

Green Infrastructure Post-Construction Monitoring (GIPCM): The Post-Construction Monitoring Program for Green Infrastructure set forth in Appendix 2 and 3 of the Consent Decree.

Offloading to the Environment: The discharge of stormwater to soil for infiltration or surface water after being appropriately treated through a stormwater control measure, where possible.

Operation and Maintenance (O&M): The inspection of GI projects and GI control measures and the activities necessary to ensure perpetual function of the green infrastructure to meet Consent Decree Appendix 3 requirements.

Appendix A: Cooperative Agreement and Easement and Permanent Access Agreement Template

COOPERATIVE AGREEMENT BY AND BETWEEN
THE NORTHEAST OHIO REGIONAL SEWER DISTRICT
AND
[redacted]

PROJECT NAME: [redacted] Pervious Pavement Project
NEORSD Project No. 1290

This Cooperative Agreement ("Agreement") is entered into as of this _____ day of _____, 2011 by and between the Northeast Ohio Regional Sewer District ("NEORSD") a regional sewer district organized and existing as a political subdivision under Chapter 6119 of the Ohio Revised Code, acting pursuant to Resolution No. [redacted], adopted by the Board of Trustees of NEORSD on [redacted] (copy attached as Exhibit A), and [redacted] an Ohio not-for-profit corporation, acting pursuant to Resolution No. _____ adopted by its Board of Trustees on [redacted] (copy attached as Exhibit B).

RECITALS

1. NEORSD is developing a Green Infrastructure Plan pursuant to Appendix 3 to the Consent Decree in *United States and State of Ohio v. Northeast Ohio Regional Sewer District* 1:10-CV-02895 (N.D. Ohio) to determine the nature and extent of Green Infrastructure control measure opportunities for its service area to capture wet weather flow that would otherwise be discharged by NEORSD's combined sewer system.

2. [redacted]

3. [redacted], intends to make improvements on land that it will continue to own for its surface parking lot and drive isle located on its property adjacent to the proposed [redacted].

4. NEORSD is exploring opportunities to capture stormwater volume in the Doan watershed and across its combined sewer area to potentially minimize the need for traditional "gray infrastructure" solutions to the region's combined sewer overflow problem, including the implementation of a range of stormwater control measures, referred to as "green infrastructure", using plant and soil systems, permeable pavement, or stormwater harvest and reuse, to store, infiltrate, or evapotranspirate stormwater and reduce flows to the combined sewer system. The project is known as the [redacted] Pervious Pavement Project, NEORSD Project No. 1290, and involves the construction of a pervious pavement surface parking facility with an underlying StormTech system, and is further described in Exhibit D attached hereto (the "Project"). The purpose of the Project is to provide for the capture by NEORSD of at least one

(1) million gallons of stormwater that would otherwise be discharged into NEORSD's combined sewer system.

5. NEORSD has worked with [redacted] to improve the design of the parking lot to take advantage of the naturally sandy soil conditions on site which are optimal for stormwater infiltration, and the design includes a permeable paver and StormTech system for the site that is intended to provide that stormwater runoff from the site, including the [redacted] roof, will be infiltrated within the site footprint and will not discharge to the combined sewer system.

6. NEORSD has agreed to make available certain funds for the design and construction of the Project.

7. [redacted] has entered into a Construction Agreement with [redacted] dated _____, which agreement is attached hereto as Exhibit C (the "Construction Agreement"), for the construction of the Project.

8. The Project is estimated to result in the following benefits: divert over an estimated one (1) million gallons of stormwater annually from the combined sewer system; reduce the burden of the current combined sewer system and the likelihood of overflow of the combined sewer system and potential of sanitary sewage contaminating Cleveland's watersheds; reduce the probability of repairs or expansion to the existing storm sewer system, thereby creating cost savings for the NEORSD; and become a public model for sustainable design and implementation of stormwater management.

NOW, THEREFORE, in consideration of the foregoing and the agreements set forth herein, the parties agree as follows:

Section 1. Construction of the Project. [redacted], in conjunction with the construction of the [redacted] Project, will construct the Project.

Section 2. NEORSD Funds. NEORSD agrees that it will make available funds not to exceed $285,000.00 (with the breakdown of $192,375 for base contract plus contingency, and $92,625 for contaminated soils allowance) (the "Funds"), for the Pervious Pavement Project, designated Project #1290, solely for the design and construction of the Project according to the plans and specifications previously submitted to and approved by NEORSD and attached hereto as Exhibit E-1 and the cost calculations attached hereto as Exhibit E-2.

Section 3. NEORSD Approvals. NEORSD and UCE agree that with respect to the Project, NEORSD shall have the right to: (i) inspect and approve or disapprove any and all work to determine whether it complies in all material respects with the plans and specifications listed in Exhibit E-1; (ii) approve or disapprove changes to the work; and (iii) resolve any and all disputes and claims related to the work. Subject to the foregoing and to the reasonable approval of UCE, NEORSD shall have the right to expend any additional funds it makes available to the Project, and NEORSD's approval of any changes to the work or resolution of any dispute or claim shall also constitute NEORSD's agreement to pay for such changes to the work or such dispute or claim. NEORSD and [redacted] acknowledge and agree that the plans and

specifications listed in Exhibit E-1 are approved for the construction of the Project and, subject to the other terms of this Agreement, the Funds shall be used exclusively to pay for work completed in accordance with such plans and specifications .

Section 4. Design and Plan Review. UCE shall cause the submittal to NEORSD, at appropriate intervals as determined by NEORSD and UCE, sufficient to allow NEORSD to review detailed shop drawings describing the materials and methods of installation for the Project. UCE understands that it must allow sufficient time for NEORSD to allow multiple rounds of review and comment as necessary and for the review by NEORSD of the construction schedule so that staffing can be determined and coordinated with other NEORSD activities. Attached hereto as Exhibit F is the schedule for the Project (including the dates for NEORSD's review of submittals) and UCE and NEORSD shall abide by such schedule and shall review all submittals promptly so as not to delay construction of the Project. NEORSD may supply a construction supervisor and such other personnel as may be deemed by NEORSD appropriate to monitor and oversee installation of the facilities and compliance with the contract documents. All pay applications or requests for disbursements shall be documented to NEORSD's reasonable satisfaction based on the previously approved schedule of values and shall be submitted in a form sufficient to allow NEORSD to review and inspect and approve quantities installed as part of the Project. Payment of pay applications or requests for disbursements shall be made within 25 days after receipt by NEORSD.

Section 5. Inspection and Warranty. [redacted] shall warrant the proper installation of the Project improvements for a period of one year from the date of completion of the installation of the Project.

Section 6. Change Order Requests and Contract Claims. Notwithstanding any provisions of the Construction Agreement or any other agreement between [redacted] and [redacted] to the contrary, [redacted] shall process change order requests and contract claims using NEORSD's change order pricing standards and processes pursuant to NEORSD's General Conditions Article 12, Work Orders, Change Orders and Construction Change Directive, a copy of which is attached hereto as Exhibit G. Specifically, [redacted] shall use NEORSD's pricing requirements and labor and material standards set forth in Article 12 for determining the cost for extra work, including but not limited to, cost reimbursements, material and supplies, equipment, deducted work, and approved expenditures from contingency allowances, if applicable, as set forth in the cost calculations spreadsheet attached hereto as Exhibit E-2. Change Order Requests shall require the signatures of [redacted], and NEORSD. In addition to NEORSD's field representatives, the signature of the Executive Director of NEORSD shall be required on Change Order Requests prior to processing a request for funds relating to any approved Change Orders. [redacted] shall modify any terms and conditions of its agreement with [redacted] to comply with the provisions of this Section.

Section 7. Dispute Resolution.

7.1 The Parties shall continue the performance of their obligations under this Agreement notwithstanding the existence of a dispute.

7.2 The Parties shall first try to resolve the dispute at the level of the designated representatives in Exhibit H. If the Parties are unable to resolve the dispute at that level within 10 working days, the Parties shall escalate the issue to the next higher level within their respective organizations to resolve the dispute.

7.3 The Parties shall select a mediator, who is experienced in engineering design and construction administration services. The mediator shall review all documents and written statements, in order to accurately and effectively resolve the dispute. The mediator shall call a meeting between the Parties within 10 working days after mediator appointment, which meeting shall be attended by at least the respective representatives in Exhibit H. The Parties shall attempt in good faith to resolve the dispute. The Parties agree to follow the Uniform Mediation Act, Chapter 2710 of the Ohio Revised Code. The Parties shall share the cost of the mediator equally.

7.4 Such mediation shall be non-binding between the Parties and shall be kept confidential. If the dispute is resolved and settled through the mediation process, the decision will be implemented by a written agreement signed by both Parties. If the dispute is unable to be resolved through mediation, the Parties agree to submit the dispute to the appropriate jurisdiction as per Section 8 Remedies below.

Section 8. Remedies. The parties agree that all claims, counter-claims, disputes and other matters in question between the District and [redacted] arising out of or relating to this Agreement, or the breach thereof, will be decided at law. This Agreement shall be governed by and interpreted according to the law of the State of Ohio.

Section 9. Perpetual Easement Agreement. Simultaneously with execution of this Agreement, the parties will execute a perpetual easement agreement in the form attached hereto as Exhibit I.

Section 10. Counterpart Signatures. This Cooperative Agreement may be executed in counterparts, each of which shall be deemed to be an original, but which counterparts when taken together shall constitute one Agreement.

Section 11. Governing Law. The terms and provisions of this Agreement shall be construed under and governed by the laws of Ohio (to which all parties hereto consent to venue and jurisdiction).

Section 12. Indemnification. [redacted] agrees to indemnify and save NEORSD harmless from and against any and all claims, demands, actions, causes of action, or injury to or death of persons and/or loss of or damage to property or to NEORSD and any of NEORSD's agents, employees, invitees or licensees of NEORSD caused by or resulting from the use or exercise of the rights and privileges retained by [redacted] and not specifically granted to NEORSD.

Section 13. Disclaimer of Joint Venture. This Agreement is not intended to create a joint venture, partnership or agency relationship between [redacted] and NEORSD, and such joint venture, partnership, or agency relationship is specifically hereby disclaimed.

Section 14. Authority to Execute. Each person executing this Agreement represents and warrants that it is duly authorized to execute this Agreement by the party on whose behalf it is so executing.

[signatures to follow]

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Cooperative Agreement as of the date first above written.

NORTHEAST OHIO REGIONAL SEWER DISTRICT

By: _____
Julius Ciaccia, Jr.
Executive Director

and: _____
Darnell Brown
President, Board of Trustees

[redacted],
by its sole member
[redacted].

By: _____
Print Name: _____
Its: _____

The legal form of this instrument is approved.

Date: _____, 20____.

_____
Marlene Sundheimer
Director of Law
Northeast Ohio Regional Sewer District

NORTHEAST OHIO REGIONAL SEWER DISTRICT

EASEMENT FOR THE CONSTRUCTION, OPERATION, INSPECTION, AND MAINTENANCE OF A STORMWATER MANAGEMENT SYSTEM

This Easement Agreement ("Easement Agreement") is made as of the _____ day of _____, 2011 ("Effective Date"), by [redacted] ("Grantor"), whose address is [redacted], and the Northeast Ohio Regional Sewer District ("Grantee"), organized and existing as a political subdivision under Chapter 6119 of the Ohio Revised Code, acting pursuant to Resolution No. [redacted], adopted by its Board of Trustees on [redacted].

RECITALS

Grantor is the owner of that certain parcel of real property located in the City of Cleveland and State of Ohio, identified as [redacted] Parcel 3 on the Plat attached hereto as Exhibit B (the "Easement Property").

Grantor is implementing a Green Infrastructure (GI) Plan pursuant to Appendix 3 to the Consent Decree in United States and State of Ohio v. Northeast Ohio Regional Sewer District, Case No. 1:10-CV-02895 (N.D. Ohio). Grantor and Grantee have entered into a Cooperative Agreement (the "Cooperative Agreement") dated _____, 2011, providing for construction by Grantor of certain capital improvements consisting of a pervious pavement surface parking facility with underlying stormtech system to be partially paid for by Grantee (the "GI Control Measure"). The Easement is executed into in order to comply with the requirements of a Consent Decree entered into by the Northeast Ohio Regional Sewer District ("District") and the U.S. Environmental Protection Agency through the implementation of the District's Green Infrastructure program. The purpose of this Easement is to provide for the capture by Grantor of all rainfall falling over Grantor's one- (1-) acre site for up to a 100-year design storm event (the "Easement Purpose"). Stormwater runoff generated from this rainfall would otherwise be discharged into Grantee's combined sewer system.

1. Grantee desires a perpetual non-exclusive right-of-way and easement over the Easement Property for access, construction, inspection and investigation, maintenance, operation and such other activities deemed by Grantee to be necessary or appropriate in relation to the GI Control Measure and its appurtenances (the "Easement Activity").

2. Grantor is willing to grant Grantee such perpetual Easement for the Easement Purpose to be achieved through the Easement Activity on the terms and conditions set forth herein.

GRANT OF EASEMENT

NOW THEREFORE, for and in consideration of the sum of One Dollar ($1.00) and other good and valuable consideration, the receipt, adequacy and sufficiency of which are hereby confessed and acknowledged, Grantor and Grantee agree as follows:

1. Perpetual Easement for the Easement Activity.

A. Pursuant to the Cooperative Agreement, Grantor is obligated to construct a stormwater management project, known as the GI Control Measure, on, under, over and across the Easement Property. Grantor does hereby declare, establish and create for the benefit of

Grantee a perpetual non-exclusive right-of-way and easement (the "Easement") on, under, over, and across the Easement Property as described in Exhibit A and shown on the plat on Exhibit B attached hereto and incorporated herein by reference, solely for the Easement Purpose through the Easement Activity. Grantor hereby conveys to Grantee all necessary rights to construct, operate, maintain, inspect and protect, redesign and reconstruct the GI Control Measure within the Easement and clean, clear, remove, and/or otherwise control, at Grantee's option and sole expense, any obstructions, of whatever size or nature, that in Grantee's reasonable judgment endangers or will endanger the safety of, or function of, or interfere with or encroach upon the use of its GI Control Measure within the Easement. Within the Easement area, Grantor agrees that it shall not: place any buildings or structures, hinder or interfere with the structural integrity of the GI Control Measure, interfere with support, store any materials or equipment or stockpile materials, including, but not limited to, salt, sand, mulch, earth or fill, construct any obstruction, permit or cause any excavation, except for other utilities, provided such utilities rights do not conflict with this Easement, or allow any construction that would be inconsistent with the purposes of the Easement Activity. This Easement also conveys to Grantee the right of ingress and egress in and over those portions of the Easement Property immediately adjacent to the Easement solely to the extent necessary to access the Easement for purposes of inspection, cleaning, monitoring the function of, maintaining of, or repairing the GI Control Measure.

B. Prior to performing any maintenance, repair, replacement, or reconstruction permitted under this Easement, or any Easement Activity, Grantee shall give Grantor reasonable prior notice of the work to be undertaken and shall schedule its work in a commercially reasonable manner. Grantor shall have the right to approve the schedule and the general manner in which such work shall be sequenced, which approval shall not be unreasonably withheld or delayed. Grantee shall restore any damage to the Easement Property or adjacent areas to a condition that is substantially the same or better than that which existed immediately prior to such maintenance, repair or replacement (including, without limitation, restoration of all paving or landscaping disturbed).

C. Grantor hereby reserves the right to use the entire Easement Property, including those portions encumbered by the Easement, for any and all purposes not inconsistent with this Easement. Grantor acknowledges certain GI Control Measures will be constructed or installed within the Easement.

2. Covenants of Grantee. Grantee shall assume responsibility for maintenance, repair, and reconstruction of the GI Control Measure as may be required to ensure its maximum effective function for the Easement Purpose. The Easement Activities shall not extend to any area outside the described Easement area. Grantee shall have no responsibilities of ownership, maintenance, rehabilitation or construction over any facility or appurtenance adjacent to or providing flows to the GI Control Measure, including, but not limited to, the roof drainage system and adjacent trench drains. In exercising the rights granted hereunder, using the Easement, performing the Easement Activity, and otherwise accessing the Easement Property, Grantee agrees to each of the following covenants:

A. All Easement Activity shall be performed at Grantee's sole cost and expense.

B. In all actions undertaken on the Easement Property by Grantee, its employees, agents, contractors, subcontractors, assigns, lessees, licenses and agents, all work shall be

completed in a prompt, safe, good and workmanlike manner, free of all liens (including mechanic's liens) and encumbrances.

3. Covenants of Grantor. Grantor, its successors and assigns, covenants and agrees to the perpetual nature of the GI Control Measure. Grantor may not replace, reconstruct, redesign or undertake any negligent acts or omissions that impair the proper function of said GI Control Measure without the express, written consent of Grantee.

A. In the event that Grantee determines in a commercially reasonable fashion and supported by data confirmed by industry standards that Grantor has not lived up to its obligations under this paragraph, Grantee may undertake such repair or reconstruction as may be necessary in Grantee's sole discretion and may invoice and collect the costs of such work from Grantor.

B. Grantor shall permit the U.S. Environmental Protection Agency and the Ohio Environmental Protection Agency, their employees and representatives, as is necessary per their regulatory responsibility, to enter upon the site, with reasonable notice, solely for purposes of the inspection of the GI Control Measure and for physical monitoring of the GI Control Measure in order to determine District compliance to its Consent Decree and the Clean Water Act.

4. Compliance with Laws. Grantor and Grantee shall comply with all applicable federal, state and local laws, rules and ordinances in connection with their respective use of the Easement Property and Easement and shall obtain all permits and approvals required by applicable governmental or quasi-governmental entities in connection with their respective use of the Easement Property and Easement as permitted hereunder.

5. Indemnification. Grantor agrees to indemnify and save Grantee harmless from and against any and all claims, demands, actions, causes of action, or injury to or death of persons and/or loss of or damage to property or to Grantee and any of Grantee's agents, employees, invitees or licensees of Grantee caused by or resulting from the use or exercise of the rights and privileges retained by Grantor and not specifically granted to Grantee.

6. Relocation and/or Redesign. Grantor reserves the right to relocate the Easement and/or to redesign the GI Control Measure subject to maintaining the Easement Purpose, and subject to the following terms and conditions: (a) such relocation and/or redesign requires the express written consent of Grantee, which shall not be unreasonably withheld; (b) such relocation and/or redesign shall only be considered possible so long as the GI Control Measure retains a location within its original sewer shed and that it maintains the same or better performance standards as originally conceived; (c) such relocation and/or redesign shall be at the sole cost and expense of Grantor; (d) Grantor shall notify Grantee of its intent to relocate the Easement and/or redesign the GI Control Measure, which notice shall be given at least 180 days prior to commencement of such relocation and/or redesign and shall contain the anticipated date for commencement and completion of the work, state the reason for such work, and shall be accompanied by drawings and specifications showing the proposed new location of the Easement and/or the work encompassing the redesign of the GI Control Measure; (e) Grantee shall have the right to approve the drawings and specifications showing the proposed new location of the Easement and/or the work encompassing the redesign of the GI Control Measure; which approval shall not be unreasonably withheld (f) such relocation and/or

redesign shall not affect the Easement Purpose and shall not materially increase the cost of maintaining, decrease the efficiency of, or diminish the capacity of the GI Control Measure; and (g) concurrently with or after fulfillment of the foregoing clauses, Grantor and Grantee each covenants and agrees, for itself and its successors and assignees, that it will, upon request of the other, execute recordable evidence of the termination of the original Easement and the execution of a new Easement document for the relocated easement area containing precisely the same provisions as the original and differing only in Exhibits A and B which will portray the relocated easement area.

7. Covenant. This Easement shall be a covenant that runs with the land and shall inure to the benefit of and shall be binding upon the parties hereto, their respective successors and assigns, and all subsequent owners of the property.

Each instrument hereafter conveying any interest in or responsibility for the GI Control Measure shall contain a notice of the activity and use limitations set forth in this Easement, and provide the recorded location of this Easement. The notice shall be substantially in the following form:

> "THE INTEREST CONVEYED HEREBY IS SUBJECT TO AN EASEMENT DATED _____, RECORDED IN THE DEED OR OFFICIAL RECORDS OF THE _____COUNTY RECORDER ON _____, 20__, IN DOCUMENT _____ OR VOLUME _____, PAGE _____. THE EASEMENT CONTAINS THE FOLLOWING ACTIVITY AND USE LIMITATIONS:"

The Owner shall supply the District with a copy of any document of transfer, executed by both parties within thirty days of recordation.

8. Recordation. Upon execution of this Easement, it shall be recorded in the Recorder's Office of _____ County, Ohio, at the District's expense.

9. Miscellaneous.

A. Counterparts. This Easement Agreement may be executed in several counterparts, and each counterpart shall constitute one Easement Agreement binding on all parties hereto, notwithstanding that all of the parties are not signatory to an original or same counterpart.

B. Successors and Assigns. This Easement Agreement shall be binding on Grantor's, and Grantee's respective successors and assigns.

C. Representations. Grantor, also binding successors and assigns, covenants with Grantee, and its successors and assigns, that Grantor is well seized of the Easement Property as a good and indefeasible estate in fee simple, has good right to bargain and grant in the same manner and form as above written, and will warrant and defend said premises with appurtenances thereunto belonging to Grantee, its successors and assigns, against all lawful claims and demands whatsoever for the purposes herein described, excepting, however, all matters of record.

D. Section Headings. The Section headings herein are inserted only for convenience and reference and shall in no way define, limit, or prescribe the scope or intent of any provisions of this Easement Agreement.

E. Entire Agreement. This Easement Agreement, together with the exhibits attached hereto, contains the entire agreement of the parties hereto with respect to the subject matter hereof and no prior written or oral agreement shall have any force or effect or be binding upon the parties hereto.

F. No Rights in Public. Nothing contained herein is intended to dedicate, grant, or reserve to the general public or the public at large or for any public purpose whatsoever, or to permit any member of the general public to acquire any right, by adverse possession, prescription, grant, dedication or otherwise, to possess, use or occupy the Easement Property, or any portion thereof, said grant, dedication, reservation, or prescriptive rights being expressly denied.

G. Severability. If any portion of this Easement Agreement is declared by any court of competent jurisdiction to be void or unenforceable, such decision shall not affect the validity of any remaining portion of this Easement Agreement, which shall remain in full force and effect. In addition, in lieu of such void or unenforceable provision, there shall automatically be added as part of this Easement Agreement a provision similar in terms to such illegal, invalid or unenforceable provision so that the resulting reformed provision is legal, valid and enforceable. In the event that such provision cannot be so reformed, Grantor may terminate this Easement Agreement in its sole discretion.

H. Governing Law. The terms and provisions of this Easement Agreement shall be construed under and governed by the laws of Ohio (to which all parties hereto consent to venue and jurisdiction). If any action or proceeding is brought concerning this Easement Agreement, it shall be brought in, and the sole and exclusive venue of any such action shall be, a court of competent jurisdiction sitting in the location of the Easement Property. If any action or proceeding shall be brought in any forum in any other location, then it shall, to the fullest extent permitted by law, be stayed upon initiation of any action or proceeding concerning this Easement Agreement in the foregoing forum.

I. Amendment. This Easement Agreement may not be amended or terminated except by a written instrument signed by the then-fee-owner of the Easement Property and the Grantee; provided, however, that no indemnity or reimbursement obligation contained in this Easement Agreement or limitation of liability with respect to any beneficiary may be modified or eliminated without the prior written consent of such beneficiary of such indemnities and reimbursement obligations or limitation of liability, regardless of whether such beneficiary continues to own an interest in the Easement Property.

J. Default. If any party hereto breaches any provision of this Easement Agreement and fails to cure such breach within 30 days after written notice thereof, the non-breaching party shall be entitled to any and all remedies, legal or equitable, which may be available including, without limitation, specific performance. All such remedies, including those set forth in this Easement Agreement, shall be cumulative.

K. Attorney Fees. The substantially prevailing party in any action or arbitration brought to enforce or interpret this Easement Agreement shall be awarded its costs and reasonable attorney's fees (including those of in-house counsel), including for any appellate review.

L. Usage of Terms. When the context in which words are used herein indicates that such is the intent, words in the singular number shall include the plural and vice versa. All pronouns and any variations thereof shall be deemed to refer to all genders.

M. Authority to Execute. Each person executing this Easement Agreement represents and warrants that it is duly authorized to execute this Easement Agreement by the party on whose behalf it is so executing. Grantee acknowledges that Grantor may execute this Easement Agreement by authorized representative.

N. Disclaimer of Joint Venture. This Easement Agreement is not intended to create a joint venture, partnership or agency relationship between Grantor, and Grantee, and such joint venture, partnership, or agency relationship is specifically hereby disclaimed.

O. Limitation or Liability. Grantee agrees that, notwithstanding any provision of this Easement Agreement to the contrary, neither Grantor nor any other Indemnitee shall be personally liable for any breach of or other action related to this Easement Agreement, but rather Grantee shall look solely to Grantor's interest in the Easement Property. Notwithstanding the foregoing, Grantee acknowledges and agrees that this Section does not grant Grantee any lien or similar rights with respect to the Easement Property or other assets of Grantor.

P. Survival. All terms, covenants, releases, and indemnities which are intended to survive termination or expiration of this Easement Agreement shall survive such termination or expiration. Under no circumstances, however, shall any of the easements granted to Grantee pursuant to this Easement Agreement survive any such termination or expiration.

Q. Construction. The parties hereto have participated jointly in the negotiation and drafting of this Easement Agreement. In the event an ambiguity or question of intent or interpretation arises, this Easement Agreement shall be construed as if drafted jointly by the parties and no presumption or burden of proof shall arise favoring or disfavoring any party by virtue of the authorship of any of the provisions of this Easement Agreement.

GRANTOR:
[redacted]

By: _____

Name:_____

Title:_____

STATE OF OHIO)

) ss.

COUNTY OF CUYAHOGA)

On _____, 2011 before me, _____ Notary Public, personally appeared _____ who proved to me on the basis of satisfactory evidence to be the person whose name is subscribed to the within instrument and acknowledged to me that he executed the same in his/her authorized capacity, and that by his signature on the instrument the person, or the entity upon behalf of which the person acted, executed the instrument.

I certify under penalty of perjury under the laws of the State of Ohio that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

My commission expires: _____

_____

Notary Public

GRANTEE:

NORTHEAST OHIO REGIONAL SEWER DISTRICT

By: _____

Julius Ciaccia, Jr.

Executive Director

and: _____

Darnell Brown

President, Board of Trustees

STATE OF OHIO)

) ss.

COUNTY OF CUYAHOGA)

The foregoing Easement Agreement was acknowledged before me this _____ day of _____, 2011, by Julius Ciaccia, Jr., Executive Director, Northeast Ohio Regional Sewer District.

Witness my hand and official seal.

My commission expires: _____

_____

Notary Public

STATE OF OHIO)

) ss.

COUNTY OF CUYAHOGA)

The foregoing Easement Agreement was acknowledged before me this _____ day of _____, 2011, by Darnell Brown, President, Board of Trustees, Northeast Ohio Regional Sewer District.

Witness my hand and official seal.

My commission expires: _____

_____

Notary Public

This instrument prepared by:

_____

[redacted]

The legal form of this instrument is approved.

Date: _____, 20____.

_____

Marlene Sundheimer

Director of Law

Northeast Ohio Regional Sewer District

Appendix B: Operation and Maintenance Agreement Template

NORTHEAST OHIO REGIONAL SEWER DISTRICT

OPERATION AND MAINTENANCE AGREEMENT TEMPLATE

[This template is designed for those projects where the District does not own the green infrastructure control measures and the owner of the green infrastructure control measures is responsible for operation and maintenance]

This Operation and Maintenance Agreement, made this _____ day of _____ 20__, by and between the Northeast Ohio Regional Sewer District (District), a regional sewer district organized and existing as a political subdivision under Chapter 6119 of the Ohio Revised Code, acting pursuant to Resolution No._____, adopted by the Board of Trustees of the District on _____, 2011 (copy attached as Exhibit A), and, the *[party responsible for the green infrastructure control measure]* (Owner) and provides as follows:

RECITALS

The District is implementing a Green Infrastructure (GI) Plan pursuant to Appendix 3 to the Consent Decree in *United States and State of Ohio v. Northeast Ohio Regional Sewer District* 1:10-CV-02895 (N.D. Ohio) to capture wet weather flow that would otherwise be discharged by the District's combined sewer system.

The Owner is responsible for certain real estate described as *(property description, parcel number, etc.)*; and, the Owner is providing operation and maintenance for a GI project consisting of the following GI control measures *(list all components of the stormwater management system)* as shown and described on the attached Stormwater Management Plan *(attach copy of the District Plan)* (Exhibit B); and,

The District has developed a site specific Operation and Maintenance Plan to ensure the function of the GI control measures described in Recital 2 *[attach copy of the District O&M Plan]* (Exhibit C).

The Owner has agreed to maintain the GI control measures in accordance with the terms and conditions hereinafter set forth.

NOW, THEREFORE, for and in consideration of the mutual covenants and undertaking of the parties, the parties hereby agree as follows:

Operation and Maintenance Plan for the GI Control Measures. The Owner agrees to operate and maintain in perpetuity the GI control measures in accordance with the approved Operation and Maintenance Plan and in a manner that will permit the GI control measures to perform for the purposes and in accordance with the standards by which they were designed and constructed, all as shown and described in the approved Stormwater Management Plan. This includes all conveyance systems built to convey stormwater runoff to the GI control measures, as well as the GI control measures. It also includes site management measures to minimize pollutants harmful to the proper operation of GI control measures. The Operations and Maintenance Plan will include specific discussion of site management practices required to maintain proper operation of GI control measures.

The Owner shall perform all maintenance in accordance with the District's approved Operation and Maintenance Plan and shall complete all repairs identified through regular inspections, and any additional repairs as requested in writing by the District.

The Owner shall maintain, update, and store the maintenance records and as-built drawings for the GI control measures. These records will be provided to the District.

Payment and Term. The Owner is responsible for the financial costs of operation and maintenance of the GI control measure for a *[insert details on term of Agreement]*. Upon completion of this Term the District shall assume the responsibility of all financial costs of operation and maintenance of the GI control measure.

Relocation and/or Redesign. Owner reserves the right to relocate and/or to redesign the GI control measure subject to the following terms and conditions: (a) such relocation and/or redesign requires the express written consent of the District, which shall not be unreasonably withheld; (b) such relocation and/or redesign shall only be considered possible so long as the GI control measure retains a location within its original sewer shed and that it maintains the same or better performance standards as originally conceived; (c) such relocation and/or redesign shall be at the sole cost and expense of Owner; (d) Owner shall notify District of its intent to relocate and/or redesign the GI control measure, which notice shall be given at least 180 days prior to commencement of such relocation and/or redesign and shall contain the anticipated date for commencement and completion of the work, state the reason for such work, and shall be accompanied by drawings and specifications showing the proposed new location and/or the work encompassing the redesign of the GI control measure; (e) District shall have the right to approve the drawings and specifications showing the proposed new location and/or the work encompassing the redesign of the GI control measure which approval shall not be unreasonably withheld; (f) such relocation and/or redesign shall not materially increase the cost of maintaining, decrease the efficiency of, or diminish the capacity of the GI control measure; and (g) concurrently with or after fulfillment of the foregoing clauses, Owner and District each covenants and agrees, for itself and its successors and assignees, that it will, upon request of the other, execute recordable evidence of the termination of the original Operation and Maintenance Agreement and the execution of a new Operation and Maintenance Agreement document for the relocated GI control measure area containing precisely the same provisions as the original and differing only in Exhibits B and C which will portray the relocated GI control measure area.

Owner's Responsibilities for Inspection and Repairs of GI Control Measures. The Owner shall inspect all GI control measures identified in the District approved Operation and Maintenance Plans, at a minimum, every three (3) months and within 24 hours after all storm event greater than one-half (0.5) inch of rain for the first year of operation. The Operation and Maintenance Plan may include additional inspection requirements for specific GI control measures.

The Owner shall inspect all GI control measures identified in the District approved Operation and Maintenance Plans at least once every year thereafter. The Operation and Maintenance Plan may include additional inspection requirements for specific GI control measures.

The Owner shall submit Inspection Reports in writing to the District engineer within 7 business days after each inspection using the Inspection Form attached to the District approved Operation and Maintenance Plan.

The Owner grants permission to the District to enter the Property and to inspect all aspects of the GI project and related drainage whenever the District deems necessary in accordance with the perpetual Easement for Construction, Operation, Inspection and Maintenance of a Stormwater Management System Agreement executed by the parties in form attached as Exhibit D. The District shall provide the Owner copies of the inspection findings and a directive to commence with the repairs if necessary.

The Owner grants permission to the U.S. Environmental Protection Agency and the Ohio Environmental Protection Agency, their employees and representatives, with reasonable notice to enter the Property and to inspect all aspects of the GI project and to conduct physical monitoring of the GI project in order to determine District compliance with its Consent Decree and the Clean Water Act.

The Owner shall make all repairs within ten (10) days of their discovery through Owner inspections or through a request from the District. If repairs will not occur within this ten (10) day period, the Owner must receive written approval from the District for a repair schedule.

Default. In the event of any default or failure by the Owner in the performance of any of the covenants and warranties pertaining to the maintenance of the GI control measures, or the Owner fails to maintain the GI control measures in accordance with the approved design standards and Operation and Maintenance Plan, or, in the event of an emergency as determine by the District, the District shall have the right, in its sole discretion after providing reasonable notice to the Owner, to enter the property and take whatever steps necessary to correct deficiencies and to charge the cost of such repairs to the Owner. The Owner shall reimburse the District upon demand, within thirty (30) days of receipt thereof for all actual cost incurred by the District.

Dispute Resolution. In the event of a dispute between the Parties for obligations under this Agreement, either Party may request the following dispute resolution process. The Parties shall continue the performance of their obligations under this Agreement notwithstanding the existence of a dispute.

The Parties are committed to working with each other to resolve disputes and agree to communicate regularly so as to avoid or minimize disputes. The Parties shall first try to resolve the dispute at the level of the designated representatives in Exhibit D. If the Parties are unable to resolve the dispute at that level within 10 working days, the Parties shall escalate the issue to the next higher level within their respective organizations to resolve the dispute.

If the Parties are unable to resolve the dispute through the above meetings, then on the written notice of either party requesting the matter may be taken to mediation, the Parties shall begin the mediation process within 20 days of such notice. The Parties shall select a mediator, who is experienced in engineering design and construction administration services. The mediator shall review all documents and written statements, in order to accurately and effectively resolve the dispute. The mediator shall call a meeting between the Parties within 10 working days after mediator appointment, which meeting shall be attended by at least the respective representatives in Exhibit D. The Parties shall attempt in good faith to resolve the dispute. The Parties agree to follow the Uniform Mediation Act, Chapter 2710 of the Ohio Revised Code. The Parties shall share the cost of the mediator equally.

If the dispute is resolved and settled through the mediation process, the decision will be implemented by a written agreement signed by both Parties. If the dispute is unable to be resolved through mediation, the Parties agree to submit the dispute to the appropriate jurisdiction as per Section Remedies below.

Indemnification. The Owner hereby agrees that it shall save, hold harmless, and indemnify the District and its employees and officers from and against all liability, losses, claims, demands, costs and expenses arising from, or out of, default or failure by the Owner to operate and maintain the GI control measures, in accordance with the terms and conditions set forth herein, or from acts of the Owner arising from, or out of, the construction, operation, repair or maintenance of the GI control measures.

Remedies. The parties agree that all claims, counter-claims, disputes and other matters in question between the District and Owner arising out of or relating to this Agreement, or the breach thereof, will be decided at law. This Agreement shall be governed by and interpreted according to the law of the State of Ohio.

Perpetual Easement Agreement. Simultaneously with execution of this Agreement, the parties will execute a perpetual Easement for Construction, Operation, Inspection and Maintenance of a Stormwater Management System Agreement in the form attached hereto as Exhibit D.

Counterpart Signatures. This Agreement may be executed in counterparts, each of which shall be deemed to be an original, but which counterparts when taken together shall constitute one Agreement.

Governing Law. The terms and provisions of this Agreement shall be construed under and governed by the laws of Ohio (to which all parties hereto consent to venue and jurisdiction).

Disclaimer of Joint Venture. This Agreement is not intended to create a joint venture, partnership or agency relationship between Owner and the District, and such joint venture, partnership, or agency relationship is specifically hereby disclaimed.

Authority to Execute. Each person executing this Agreement represents and warrants that it is duly authorized to execute this Agreement by the party on whose behalf it is so executing.

Covenant. This Operation and Maintenance Agreement shall be a covenant that runs with the land and shall inure to the benefit of and shall be binding upon the parties hereto, their respective successors and assigns, and all subsequent owners of the property.

Each instrument hereafter conveying any interest in or responsibility for the GI control measures shall contain a notice of the activity and use limitations set forth in this Agreement, and provide the recorded location of this Agreement. The notice shall be substantially in the following form:

> "THE INTEREST CONVEYED HEREBY IS SUBJECT TO AN AGREEMENT DATED _____, RECORDED IN THE DEED OR OFFICIAL RECORDS OF THE _____COUNTY RECORDER ON _____, 20__, IN DOCUMENT _____ OR VOLUME _____, PAGE _____. THE AGREEMENT CONTAINS THE FOLLOWING ACTIVITY AND USE LIMITATIONS:"

The Owner shall supply the District with a copy of any document of transfer, executed by both parties within thirty days of recordation.

Recordation. Upon execution of this Operation and Maintenance Agreement, it shall be recorded in the Recorder's Office of _____ County, Ohio, at the District's expense.

Exhibits. The following Exhibits attached hereto are hereby incorporated with and made a part of this Agreement:
Exhibit A – District Resolution No.
Exhibit B – District Stormwater Management Plan
Exhibit C – District Operation and Maintenance Plan
Exhibit D - Easement for Construction, Operation, Inspection, and Maintenance of Stormwater Management System
Exhibit E – Designated Representatives

IN WITNESS WHEREOF, the parties hereto have executed and delivered this Agreement as of the date first above written.

Northeast Ohio Regional Sewer District

by: _____

Julius Ciaccia, Jr.

Executive Director

and: _____

Darnell Brown

President, Board of Trustees

[Owner]

By: _____

Print Name: _____

Its: _____

The legal form of this instrument is approved.

_____

Marlene Sundheimer

Director of Law

Northeast Ohio Regional Sewer District

Date: _____, 20__

Appendix C: Public Participation Information

Table C1. Cleveland Green Stormwater Management Team members

Name	City of Cleveland Department/Division	Title
Robert Brown	City Planning Commission	Director
Chris Garland	Community Development - Division of Neighborhood Development	Commissioner
Tracey Nichols	Economic Development	Director
Chris Warren	Mayor's Office	Chief of Development
Andrew Watterson	Mayor's Office	Chief of Sustainability
Jomarie Wasik	Office of Capital Projects	Director
Kyle Dreyfuss-Wells	Northeast Ohio Regional Sewer District (NEORSD)	Manager of Watershed Programs
Kellie Rotunno	NEORSD	Director of Engineering and Construction
Denis Zaharija	NEORSD	Project Manager
Tim Coleman	CH2M Hill (Representing NEORSD)	Principal Technologist

Table C2. City/NEORSD Green Infrastructure Steering Committee Members

Name	Organization	Title
Darnell Brown	City of Cleveland: Mayor's Office	Chief of Operations
Chris Warren	City of Cleveland: Mayor's Office	Chief of Development
Andrew Watterson	City of Cleveland: Mayor's Office	Chief of Sustainability
Chris Garland	City of Cleveland: Community Development - Division of Neighborhood Development	Commissioner
Tracey Nichols	City of Cleveland: Economic Development	Director
Jomarie Wasik	City of Cleveland: Office of Capital Projects	Director
Richard Switalski	City of Cleveland: Office of Capital Projects – Division of Engineering & Construction	Administration Bureau Manager
Robert Brown	City of Cleveland: Planning Commission	Director
Jim Danek	City of Cleveland: Planning Commission	Asst. Director
Rob Mavec	City of Cleveland: Public Works-Division of Bridges & Streets	Commissioner
Rachid Zoghaib	City of Cleveland: Public Utilities-Water Pollution Control	Commissioner
Terry Schwarz	Kent State - Urban Design Collaborative	Director

Bobbie Reichtell	Neighborhood Progress Inc.	Sr. Vice-President for Programs
Ann Zoller	ParkWorks	Executive Director
Kyle Dreyfuss-Wells	Northeast Ohio Regional Sewer District (NEORSD)	Manager of Watershed Programs
Kellie Rotunno	NEORSD	Director of Engineering and Construction
Rachel Webb	NEORSD	Watershed Team Leader
Denis Zaharija	NEORSD	Project Manager
Tim Coleman	CH2M Hill (Representing NEORSD)	Principal Technologist

Table C3. Reimagining A More Sustainable Cleveland – Vacant Land Steering Committee

Name	Organization
Paul Alsenas	Cuyahoga County Planning Commission
David Beach	GreenCityBlueLake Institute
Pamela Brackett	City of Cleveland Department of Public Health
Evelyn Burnett	Living Cities
Karen Butler	City of Cleveland Department of Public Health
Bill Carroll	The Trust for Public Land
Richard Cochran	Western Reserve Land Conservancy
Elaine Borawski	Case Western Reserve University
Michael Bosak	City of Cleveland Planning Commission
Robert Brown	City of Cleveland Planning Commission
Marty Cader	City of Cleveland Planning Commission
Fred Collier	City of Cleveland Planning Commission
Michael Cox	City of Cleveland – Parks, Recreation and Properties
Jim Danek	City of Cleveland Planning Commission
James Downing	City of Cleveland – Department of Community Development
Mark Duluk	Duluk Strategic Sustainable Solutions
Jeff Epstein	The Coral Company
Maribeth Feke	Greater Cleveland Regional Transit Authority
Brooke Furio	US Environmental Protection Agency – Cleveland Office
Terri Hamilton Brown	Opportunity Corridor
Martha Halko	Cuyahoga County Board of Health

Marvin Hayes	Office of Governor Ted Strickland
Trevor Hunt	City of Cleveland Planning Commission
Sonia Jakse	City of Cleveland Planning Commission
Marie Kittredge	Slavic Village Development
Noreen Kuban	City of Garfield Heights
Lillian Kuri	The Cleveland Foundation
Jennifer Kuzma	First Suburbs Consortium
Kamla Lewis	Shaker Heights
Dave Lincheck	West Creek Preservation Committee
Michael Lyons	Mayors + Manager Association
John Mack	Cleveland Metroparks
Howard Maier	Northeast Ohio Areawide Coordinating Agency
Sally Martin	City of South Euclid – Housing Manager
Randy McShepherd	City of Cleveland Department of Public Health
Dan Meaney	Cuyahoga County Planning Commission
Tori Mills	Doan Brook Watershed Partners
John Mitterholzer	The George Gund Foundation
Gary Norton, Jr.	Mayor of East Cleveland
Paul Oyaski	Cuyahoga County Department of Development
Elaine Price	Cuyahoga County Planning Commission
Jon Ratner	Forest City Enterprises
Bobbi Reichtell	Neighborhood Progress Inc.
Dennis Roberts	Cuyahoga County Land Reutilization
Edward Rybka	City of Cleveland Department of Building and Housing
Jan Rybka	Cuyahoga Soil and Water Conservation District
Derek Schaffer	West Creek Preservation Committee
Terry Schwarz	Kent State - Urban Design Collaborative
Jennifer Scofield	Health Impact Consulting, Inc.
Drew Siley	City of Lakewood
Patty Stevens	Cleveland Metroparks
Martin Sweeney	City of Cleveland Council
Morgan Taggart	The Ohio State University Extension – Cuyahoga County

Carol Thaler	Cuyahoga County Planning Commission
Arlene Watson	Mobius Grey LLC
Andrew Watterson	City of Cleveland Office of Sustainability
Kyle Dreyfuss-Wells	NEORSD
Kellie Rotunno	NEORSD
Rachel Webb	NEORSD
Ann Zoller	ParkWorks

Appendix D: Green Infrastructure Plan Modeling Documentation

This appendix provides supporting documentation to the H&H modeling done as part of the GI Plan development. The GI Plan recommends candidate GI projects that conceptually achieve CSO reduction above the 44-MG CSO control Consent Decree requirement. H&H systemwide models developed for each of the District's major service areas were used to evaluate GI projects and determine their CSO reduction potential. These include separate H&H systemwide models for the Big Creek, Easterly, Southerly and Westerly interceptor systems and are summarized in Table A1. These models were initially developed as a part of CSO facility planning projects and updated recently to include the District's implementation of the planned gray infrastructure summarized in Appendix 1 of the Consent Decree.

Table A1: Hydraulic and Hydrologic Models

Service Area	Hydraulic Model	Hydrologic Model
Big Creek Interceptor (BCI)	MIKE URBAN 2009	SWMM 4.4
Doan Valley Interceptor (DVI)	InfoWorks 10.5	InfoWorks 10.5
Easterly Interceptor (EI)	MIKE URBAN 2009	SWMM 4.4
Southerly Interceptor (SOI)	MIKE URBAN 2009	SWMM 4.4
Westerly Interceptor (WI)	InfoWorks 10.5	InfoWorks 10.5

The Doan Valley Interceptor system was not evaluated as a part of the GI Plan. The Doan Valley Interceptor system was evaluated under a separate study to identify GI projects that could provide an alternative to tunnel systems planned to be constructed early in the District's CSO program implementation schedule. Recommendations from the separate Doan Valley Interceptor system evaluation were evaluated to identify any candidate GI projects that contribute to 44-MG CSO control Consent Decree requirement and are listed in Chapter 4.

H&H model evaluations were broken into two stages:

1. Comparison of directly connected impervious area (DCIA) to CSO reduction: Evaluation of the CSO volume reduction resulting from a simulation of a range of DCIA values in tributary drainage areas.
2. Development of relationship between stormwater runoff volume and CSO volume reduction for each interceptor system: Changes to hydrologic model DCIA values in a range of tributary drainage areas were simulated to determine resulting CSO volume reduction.

A.1 Relationship between DCIA Reduction and CSO Volume Reduction for GI Index

The GI Index includes factors that represent an areas ability to contribute to meeting the 44-MG CSO control Consent Decree requirement. A series of model evaluations were conducted throughout the District's CSS to develop GI Index scores for CSO reduction effectiveness. Model evaluations included modifications to DCIA and evaluation of resulting CSO reduction during typical year storms with remaining CSO volume after the implementation of planned gray infrastructure.

Model evaluations were first performed to develop a relationship between DCIA and CSO volume. This was done through a series of hydrologic model runs with modifications to the DCIA. Hydrologic model results showed a direct relationship between the DCIA and the volume of stormwater runoff generated for any given model catchment area. Existing condition DCIA values were reduced by 5, 10, 15, 20, 25 and 30-percent to develop a relationship between DCIA reduction and CSO volume reduction for representative catchments.

Model evaluations were then performed using systemwide hydraulic model with results from the modified DCIA hydrologic models. Only typical year storms with remaining CSO volume, post planned gray infrastructure, were evaluated. These storms were designated storms 054 and 086. CSO volumes from these hydraulic model runs were then used to create a ratio of DCIA and associated CSO volume.

The results of these modeling evaluations were used to characterize the potential CSO volume reduction potential resulting from a change in DCIA. Results were incorporated into the GI Index score for catchments throughout the District's CSS area.

A.2 Development of Runoff to CSO Reduction Ratio for Evaluation of GI Projects

The potential effectiveness of distributed stormwater runoff controls in reducing CSO volume varies throughout the District's system. This variation is primarily attributed to the system specific hydraulics for each major interceptor system. In order to estimate the CSO reduction for GI control measures, a stormwater capture to CSO reduction ratio was developed for each major CSS as shown in Table A2.

Table A2: Stormwater Runoff to CSO Reduction Ratios

Interceptor System	Runoff to CSO Reduction Ration (Stormwater Volume Controlled / CSO Volume Reduction)
Westerly	9.6
Big Creek	6.9
Southerly	7.6
Easterly	10.5

This CSO reduction ratio was developed through an evaluation of 3 areas and averaging these results within each of the Easterly, Big Creek, Southerly and Westerly interceptor systems. Figure A1 shows the process followed for the development of CSO reduction ratios.

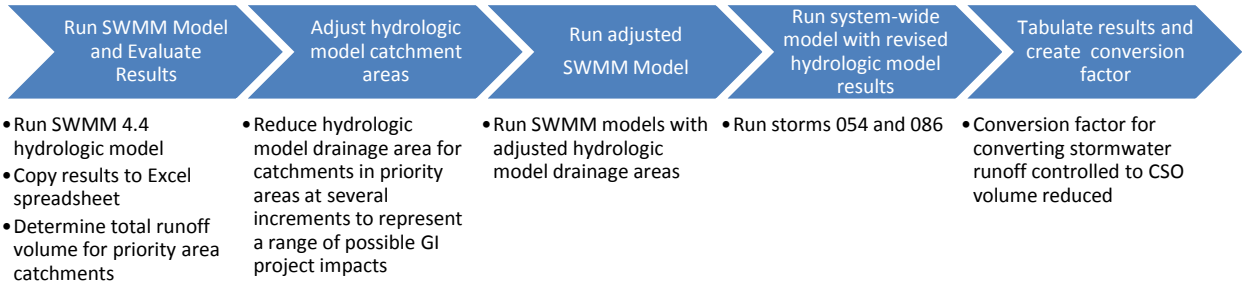


Figure A1. CSO Reduction Ratio Development

The stormwater capture to CSO reduction ratio was developed based upon the process shown in Figure A1 and several test model runs within each interceptor system. The test model runs were focused on select GI priority areas. A cursory GI implementation scenario for each area was assumed, which was represented in a reduction in drainage area simulated. The resulting modeled percent reduction in runoff, typical year stormwater runoff and CSO reduction values were tabulated to develop a ratio between the stormwater capture and CSO reduction. To target remaining overflow volume after implementation of the required gray infrastructure, only the two largest storms in the CSO Phase II Facilities Plan defined "typical year" were evaluated. For the areas modeled to create the stormwater capture to CSO reduction ratio, no other typical year storms produce CSO volume after implementation of the required gray infrastructure.

The following details the specific procedures used in developing the stormwater capture to CSO reduction ratios.

a) To obtain the runoff for the Phase I Long Term Control Plan (Consent Decree) model, the SWMM input file was run in SWMM 4.4h and the output was pasted into Excel.

b) The Depth of Runoff for the typical year at each flow loading point is part of the SWMM output file, so the depth was multiplied by the area and the total volume of runoff for the typical year was tabulated for each of the catchments in the priority areas

c) Develop a percent area reduction for each of the catchments within the priority areas modeled based upon drainage capture area potential.

d) The SWMM input file was then adjusted to reflect the percent area reduction at each of the priority catchments. For example if the area was to be reduced by thirty percent a line was added to the SWMM file that would multiply that catchment area by 0.7 causing SWMM to use 70 percent of the original area, a reduction of 30 percent.

e) Then the SWMM input file was run in SWMM4.4h and the runoff volume for the priority catchments was tabulated in the same manner as the Consent Decree model.

f) The Consent Decree hydraulic model overflow volumes were tabulated previously and those values were used as the "baseline condition" results.

g) The GI priority area hydraulic models were run for the 2 largest typical year storms that were determined to still have remaining overflow volume for all of the collection system

models after the Consent Decree has been implemented. The hydraulic models used the results from the modified SWMM files for the hydrology.

h) The GI priority area overflow volumes were tabulated using the spreadsheets and post processing procedures developed by the District.

i) Based on the ratio of runoff reduction to CSO overflow volume reduction a single value was developed for each of the collection system areas these are provided in Table A2.

A.3 Validation of Planning

The runoff to CSO reduction ratios were validated through several GI project specific model evaluations performed subsequent to their development. GI project specific evaluations were completed for several GI projects with partner opportunities that created the need for a higher level of evaluation during the GI Plan development. These evaluations and the runoff to CSO reduction ratio validation are summarized in Table A3.

Table A3. Runoff to CSO Reduction Ratio Validation and Evaluation

GI Project	Project Area	Interceptor System	Runoff to CSO Reduction Ratio – CSO Volume Reduction (MG)[1]	Model Validation Results – CSO Volume Reduction (MG)[2]
Urban Ag Zone (S-6)	57 acres	Southerly	2.1	2.1
Lakeshore Relief Sewer (E-11)	42 acres	Easterly	1.3	1.5
Woodland Ave. Street Improvement	48 acres	Southerly	1.8	2.6
Upper Chester Street Improvement	37 acres	Easterly	1.5	1.2

1. This is the CSO volume reduction calculated using the runoff to CSO reduction ratios applied to all potential GI projects evaluated as a part of the GI Plan.
2. This is the GI project specific model evaluation results.

Appendix E: Green Infrastructure Control Measures

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Dry Extended Detention (Dry Basin)	Storage and treatment	An impoundment for the short term detention of stormwater, with a controlled slow release from the outlet structure at a pre-developed or desired flow rate. Engineered to detain water during wet weather flows and drain during dry periods. Typically grassed basins that are mowed and can be used for open areas when not holding water. Most effective when sized to manage drainage areas over 2 acres. Limited aesthetic value but can be enhanced with plantings.	Annually inspect embankment and outlet structure for damage and to ensure proper flow. Monitor sediment accumulation and remove sediment every 3-7 years as needed. Regularly mow embankments and clean trash and debris from outlet structure, address any accumulation of oil and grease, remove woody vegetation, and fix any eroding areas.	

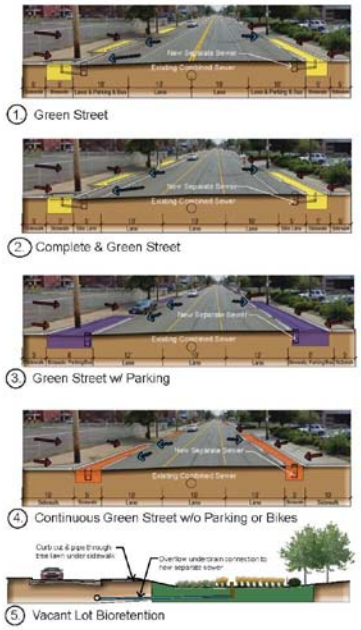
GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Wet Extended Detention (Wet Pond)	Storage and treatment	A permanent pool of water typically a minimum of 3 feet where runoff from each rain event is detained and slowly released from the outlet structure at a pre-developed or desired flow rate. Prior to the water entering the pond, sediment removal is handled in a forebay. A higher level of stormwater quality control can be achieved in wet extended detention than with dry extended detention. Shallow ledges can be used to establish aquatic plants and provide additional habitat along the pond's edge. Wet ponds typically sized for larger drainage areas in excess of 10 to 25 acres.	Annually inspect embankment and outlet structure for damage and to ensure proper flow. Monitor sediment accumulation and remove sediment every 3-7 years as needed. Inspect for invasive plants and remove as needed. Regularly mow embankments and clean trash and debris from outlet structure, address any accumulation of oil and grease, remove woody vegetation, and fix any eroding areas.	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Constructed Wetland (Wetland Extended Detention)	Storage and treatment	Treatment is enhanced through the wetland plants that promote infiltration and evapotranspiration. The water depth limited to less than 1 foot to promote wetland plant growth. During heavy rains there can be standing water and over extended periods of dry weather a stormwater wetland can become dry. However, these areas are designed with plants and soils that are suited to wet and dry conditions. Constructed wetlands can be incorporated into parks and can provide recreational opportunities when trails are built on their retaining structures (berms). Important to consider hydrology when determining to use constructed wetlands	Annually inspect embankment and outlet structure for damage and to ensure proper flow. Monitor sediment accumulation and remove sediment every 3-7 years as needed. Inspect for invasive plants and remove as needed. Regularly mow embankments and clean trash and debris from outlet structure, address any accumulation of oil and grease, remove woody vegetation, and fix any eroding areas.	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
		to ensure a consistent source stormwater flow.		
Irrigation Pond (Rainwater Harvesting)	Storage and treatment	An impoundment designed to retain stormwater to be used to irrigate fields or gardens between rain events. Runoff is detained in a permanent pool with the ability to pump water for surrounding irrigation areas such as golf courses, sports fields, farming, and parks. Reusing stormwater for irrigation allows the water to infiltrate into the ground, be absorbed by vegetation, but effectiveness is compromised during winter months. Irrigation ponds are typically sized for larger drainage areas in excess of 10 acres and should only be placed where an irrigation demand is available.	Maintenance is similar to a wet pond but includes additional inspections and maintenance for irrigation system.	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Infiltration Basin	Storage/ Infiltration and treatment	A shallow impoundment designed to infiltrate stormwater into the soil. Gravel media and sediment collectors allow for filtration of stormwater prior to entering the ground water system. A forebay must be included in the design and construction to reduce clogging due to sediment. Have high pollutant removal efficiency and can recharge groundwater sources. Drainage area of infiltration basins typically limited to 25 acres. Generally only consider this GI control measure for areas with sandy soils.	Inspect pretreatment devices and diversion structures for sediment build-up and structural damage. Remove sediment and oil/grease from pretreatment devices as well as overflow structure. Replace gravel layer as needed.	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Bioretention Swale or Cell	Storage/ Infiltration and treatment	Intercept runoff from impervious surfaces to slow and filter stormwater through engineered soil substrate and selected plant material. Stormwater is retained for no more than 24 to 48 hours and only to a 6” - 9” ponding depth. Can be retrofitted into existing impervious surfaces such as parking lots. Sizing is limited between 2 to 5 acres of drainage.	Water plants as necessary during first growing season. Prune and weed plants for appearance as needed. Inspect and replace poorly suited or diseased plants as needed. Check for erosion or deposition in pretreatment areas. Clean out and repair damaged areas. Inspect and repair or remove for salt damage, litter and debris. Check planting soil and filter layer for clogging, and replace portions necessary.	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Green Streets	Storage/ Infiltration and treatment	Use the area of a street's right of way to collect and convey stormwater through linked GI control measures. Include landscape bumpouts (bioretention), bioswales, pervious pavements, pervious parking stalls, and/or permeable pavement bike lanes. Can provide more economic benefits than a typical streetscape project and can reduce the cost of grey infrastructure used on the street. Low Level Implementation – bumpouts along the road that allow for bioinfiltration with overflow connection to combined sewers. Medium Level Implementation – long bioswales along road with overflow	See bioretention swale/cell and pervious pavement for maintenance considerations.	 High Green Street Concept 

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
		connection to combined sewer. High Level Implementation – bioswales and/or pervious pavements with a separation of stormwater into a new storm pipe to an offload point not connected to the combined sewer.		
Pervious/ Porous Pavements	Stormwater Storage/ Infiltration and Treatment	Allows stormwater to filter through a drivable or walkable surface and be either infiltrated into ground or piped slowly back to the sewer system. Can provide runoff retention, infiltration, and/or treatment. Reduces the amount of roadway salt required and has lower heat retention during the summer - reducing the heat island effect. Can be used to replace existing impervious surfaces and is ADA accessible.	Ensure that the porous paver surface is free of sediment. Inspect to make sure that the system dewaters between storms. Ensure that contributing area and porous paver surface are clear of debris. Ensure that the contributing and adjacent area is stabilized. As needed, vacuum porous	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
			paver surface to remove sediment. Inspect the surface for deterioration and clogging. Rehabilitate the porous paver system, including the top and base course, as needed.	
Vacant Lot Repurposing with the inclusion of GI Control Measures	Stormwater Source Reduction	Impervious surface reductions over a large area of vacant land. May include razing existing structures and re-grading areas to minimize site runoff. Low Level Implementation includes detention or depression areas that capture water from surrounding areas, less than 2 acres. High Level Implementation includes areas for redevelopment and/or reforestation to capture surrounding stormwater from roads	GI control measures incorporated into vacant land must be permanently maintained through ownership or easement.	Picture not available.

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
		and other impervious surfaces.		
Green Roof	Stormwater Source Reduction	Green roofs are mainly flat roof areas of a building that are partially or completely covered with vegetation and a growing medium that is planted over a waterproofing membrane. Green roofs absorb rainwater, provide insulation, create habitat for wildlife, help to lower air temperatures and combat the heat island effect in urban areas. Green roofs can be depths from 4” to 6’” thick.	Plant material should be maintained to provide 90% cover. Weeding should be manual with no herbicides or pesticides used. Growing medium should be inspected for evidence of erosion from wind or water and corrections made as necessary. Inspect drain inlet pipe and containment system and make corrections as necessary.	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
Impervious Surface Removal and Reforestation	Stormwater Source Reduction	Remove/reduce unneeded impervious surfaces and plant trees or other appropriate vegetation.	Maintain reforested areas.	
Storm Sewer	Stormwater Conveyance	Underground conveyance of stormwater.	Standard maintenance to ensure sewers are functioning as intended.	Picture not available.
Open Channel/Swale	Stormwater Conveyance	At-grade conveyance of stormwater transported by gravity.	Protect the channel from damage by equipment and traffic. Inspect swales regularly. Repair damage to channels and	

GI Control Measures	GI Control Measure Function	Description	Maintenance Considerations	Picture
			subsurface drains as needed. Remove sediment deposits, trash or debris as needed.	
Overland Flow	Stormwater Conveyance	At grade conveyance. Reduces inflow to existing catch basins on streets with more than a 2% slope to move runoff down the street to be collected by a GI control measure such as a bioswale, or green street.	Sediment and debris removal.	Picture not available.

Appendix F: Green Infrastructure Control Measure Cost Technical Memorandum

Date: December 02, 2011

To: Rachel Webb
Northeast Ohio Regional Sewer District

From: URS, Joe Ferenczy

cc. Tom Denbow, Katherine Holmok, Biljana Sverko, Roni Depaulo

Subject: *GI Control Measures Cost Technical Memorandum*

Numerous Green Infrastructure (GI) control measures were considered and analyzed for suitability for the study goals and primarily focused on larger or more regional GI control measures for long term maintenance and monitoring objectives. The final selected GI control measures, shown below, were then analyzed for sizing requirements and planning level costs for GI implementation protocols used in assessing the GI priority areas. The following are the final GI control measures for this study organized by GI control measure function.

- Stormwater Storage and Treatment
  - Dry Extended Detention (Dry Basin)
  - Wet Extended Detention (Wet Pond)
  - Constructed Wetland (Wetland Extended Detention)
  - Irrigation Pond (Rainwater Harvesting)

- Stormwater Infiltration and Treatment
  - Infiltration Basin
  - Infiltration Trench
  - Bioretention Swale or Cell
  - Green Streets

- Stormwater Source Reduction
  - Vacant Lot Repurposing
  - Impervious Area Removal
  - Green Roof
  - Pervious/Porous Pavements

- Stormwater Capture and Conveyance
  - Storm Sewer
  - Open Channel/Swale
  - Overland Flow

Costs were estimated using typical construction practices; RS Means cost data; Ohio Department of Transportation (ODOT) Bid Tabulation Results; and local projects. Added to the raw construction cost, is a 55% markup for construction contingency and design and construction administration related services. The applied construction contingency (30%) is well within the Association for the Advancement of Cost Engineering (AACE) accepted range for a Class 4/5

planning level construction estimate. Excluded from costs are expenses associated with land acquisition. Material haul-off/disposal costs include estimated disposal expenses.

Each GI control measure description, size and layout and individual cost summary are listed below.

Dry Extended Detention (Dry Basin)

Used for short term detention of stormwater runoff, with a controlled slow release from the outlet structure at minimal flow rates, a one (1) acre, three (3) foot deep wet weather storage capacity Dry Extended Detention basin can control stormwater from an area roughly 15 to 20 acres. Table 1 includes estimated quantities based upon a 1 acre footprint area as a targeted minimum basin size and corresponding estimated unit prices. The total cost was converted from a one (1) acre footprint to a square foot cost.

Table 1. Dry Extended Detention cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	4840	CY	$7	$33,880
2	Material Haul-off/Disposal	4840	CY	$10	$48,400
3	Outlet Structure	1	EA	$3,000	$3,000
4	Storm Sewer Outlet	100	LF	$50	$5,000
5	Seeding	4840	SY	$0.30	$1,452
6	Topsoil	807	CY	$20	$16,140
				Subtotal	$107,872
				55% contingency	$59,330
				Total	**$168,000**
				$/SF	**$3.90**

Wet Extended Detention (Wet Pond)

Wet ponds are stormwater control structures providing both retention and treatment of stormwater runoff. The pond consists of a permanent pool of deep water and shallow ledges for aquatic plants to provide additional habitat along the pond's edge. A one (1) acre, three (3) feet deep wet weather storage capacity with a three (3) foot deep permanent pool controls drainage from an area roughly 15 to 20 acres in size. Table 2 includes estimated quantities based upon a one (1) acre footprint area as a targeted minimum basin size and corresponding estimated unit prices. The total cost was converted from a one (1) acre footprint to a square foot cost.

Table 2. Wet Extended Detention (Wet Pond) cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	9680	CY	$7	$67,760
2	Material Haul-off/Disposal	9680	CY	$10	$96,800
3	Outlet Structure	1	EA	$3,000	$3,000
4	Storm Sewer Outlet	100	LF	$50	$5,000
5	Seeding	1000	SY	$0.30	$300
6	Topsoil	400	CY	$20	$8,000
				Subtotal	180860
				55% contingency	$99,480
				Total	**$281,000**
				$/SF	**$6.45**

Constructed Wetland (Wetland Extended Detention)

During heavy rain events in the spring and fall, a constructed wetland can have an average of three (3) feet of permanent water pools yet during extended dry periods, it can become dry. These areas are designed with plants and soils suited to wet and dry times and allow water to flow slowly through the pools. A one (1) acre, three (3) feet deep wet weather storage capacity with an average one and a half (1.5) foot deep permanent pool controls drainage from an area roughly 15 to 20 acres in size. Table 3 includes estimated quantities based upon a one (1) acre footprint area as a targeted minimum basin size and corresponding estimated unit prices. The total cost was converted from a one (1) acre footprint to a square foot cost.

Table 3. Constructed Wetland (Wetland Extended Detention) cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	7260	CY	$7	$50,820
2	Material Haul-off/Disposal	7260	CY	$10	$72,600
3	Outlet Structure	1	EA	$3,000	$3,000
4	Storm Sewer Outlet	100	LF	$50	$5,000
5	Seeding	1000	SY	$0.30	$300
6	Plantings	43560	SF	$1	$32,670
7	Topsoil	807	CY	$20	$16,140
				Subtotal	$180,620
				55% contingency	$99,300
				Total	**$280,000**
				$/SF	**$6.40**

Irrigation Pond (Rainwater Harvesting)

Similar to a wet pond, runoff is detained in a permanent pool with the ability to pump water for surrounding heavy irrigation areas such as golf courses, sports fields, farming, and urban parks.

Reusing stormwater for irrigation allows the water to infiltrate into the ground and be absorbed by vegetation. Irrigation pump costs include typical irrigation line expenses for a functioning system. A one (1) acre, three (3) feet deep wet weather storage depth with a three and a half (3-1/2) foot deep permanent pool and irrigation equipment can control stormwater from an area roughly 15 to 20 acres in size. Table 4 includes estimated quantities based upon a one (1) acre footprint area as a targeted minimum basin size and corresponding estimated unit prices. The total cost was converted from a one (1) acre footprint to a square foot cost.

Table 4. Irrigation Pond cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	10500	CY	$7	$73,500
2	Material Haul-off/Disposal	10500	CY	$10	$105,000
3	Outlet Structure	1	EA	$3,000	$3,000
4	Storm Sewer Outlet	100	LF	$50	$5,000
5	Seeding	1000	SY	$0.30	$300
6	Irrigation Pump	1	LS	$50,000	$50,000
7	Topsoil	400	CY	$20	$8,000
				Subtotal	$244,800
				55% contingency	$134,640
				Total	**$380,000**
				$/SF	**$8.70**

Infiltration Basin

An infiltration basin is a shallow impoundment designed to infiltrate stormwater into existing sandy sub soils and should include gravel media layer and a forebay for easy sediment removal. A one (1) acre infiltration basin with a minimum of one (1) foot gravel media and three (3) foot deep water storage capacity can control stormwater from an area roughly 5 to 50 acres in size depending upon drainage area landuse and requires in-situ soils with high infiltration rate (predominantly sandy soils). Additionally, a 1 foot layer of stone was assumed to filter the urban stormwater runoff. Table 5 includes estimated quantities based upon a one (1) acre footprint area as a targeted minimum basin size and corresponding estimated unit prices. The total cost was converted from a one (1) acre footprint to a square foot cost.

Table 5. Infiltration Basin cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	5000	CY	$7	$35,000
2	Material Haul-off/Disposal	5000	CY	$10	$50,000
3	Outlet Structure	1	EA	$3,000	$3,000
4	Storm Sewer Outlet	100	LF	$50	$5,000
5	Seeding	5000	SY	$0.30	$1,500
6	Stone Backfill	1700	CY	$50	$85,000
7	Topsoil	600	CY	$20	$12,000
				Subtotal	$146,500
				55% contingency	$105,330
				Total	**$297,000**
				$/SF	**$6.80**

Infiltration Trench

Similar to an infiltration basin, an infiltration trench, allows stormwater to infiltrate into existing sandy sub soils. Its dimensions are long and narrow, collecting sheet flow stormwater from multiple areas and includes a gravel media layer. A 100 foot long by 10 foot wide infiltration trench with a gravel media four (4) feet deep controls drainage from an area roughly one tenth to one quarter (0.1 to 0.25) acres in size depending upon drainage area landuse and existing sandy sub soil porosity. Table 6 includes estimated quantities based upon a 1,000 square foot footprint area as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a square foot cost.

Table 6. Infiltration Trench cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	140	CY	$7	$980
2	Material Haul-off/Disposal	140	CY	$10	$1,400
3	Outlet Structure	1	EA	$3,000	$3,000
4	Storm Sewer Outlet	25	LF	$50	$1,250
5	Filter Fabric	100	SY	$3	$300
6	Stone Backfill	140	CY	$50	$7,000
				Subtotal	$13,930
				55% contingency	$7,670
				Total	**$22,000**
				$/SF	**$22.00**

Bioretention Swale or Cell

Bioretention swales intercept runoff to slow and filter stormwater through engineered soil substrate and selected plant material. The stormwater is generally retained for 24 to 48 hours and only for a 6" - 9" ponding depth. A 100 foot long by 10 foot wide area with a minimum of four (4) foot deep bioswale soil media and nine (9) inch deep water storage controls stormwater from an area roughly one tenth to one quarter (0.1 to 0.25) acres in size depending upon drainage area landuse and existing sub soil porosity. Table 7 includes estimated quantities based upon a 1,000 square foot footprint area as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a square foot cost.

Table7. Bioretention Swale or Cell cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	140	CY	$7	$980
2	Material Haul-off/Disposal	140	CY	$10	$1,400
3	Outlet Structure	1	EA	$1,500	$1,500
4	Storm Sewer Outlet	25	LF	$50	$1,250
5	Filter Fabric	100	SY	$3	$300
6	Soil Media	105	CY	$40	$4,200
6	Misc.	1	LS	$320	$320
6	Plantings	1000	SF	$3	$3,000
7	Mulch	1000	SF	$1	$1,000
8	Stone 1' Deep	35	CY	$50	$1,750
				Subtotal	$15,700
				55% contingency	$8,640
				Total	**$25,000**
				$/SF	**$25.00**

Green Streets

Green streets use the area of a street's right of way to collect and convey stormwater through linked GI control measure features. Some examples include landscape bumpouts (bioretention), bioswales, pervious pavements, pervious parking stalls, and/or permeable pavement bike lanes. Green streets costs were derived by calculating additional contribution necessary to add the high, medium or low green street concept components to existing typical City of Cleveland roadway rehabilitation projects as listed in the Capital Improvement Plan (CIP). Based on the CIP, green street components estimated costs are typically 20% to 40% of the overall project budget. Green street costs were subdivided into three categories to further refine low, medium and high implementation scenarios. These are described below.

Low Level Green Street

Low level green streets costs include bump-ins/bump outs within the street right-of-way and have an estimated stormwater capture rate of 30 to 50% of the drainage area (i.e. street, tree lawn and sidewalk). A 24 foot wide street, 300 foot long would include approximately two (2), 20 foot long by six (6) foot wide, bio-retention areas. Table 8 includes estimated quantities based upon a

300 foot length as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a linear foot cost.

Table 7. Low Level Green Street Cost Estimate Worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Bump-in 20'x6' Demo	120	SF	$2	$240
1A	Bioretention	120	SF	$15	$1,800
1B	Catch Basin Modification	1	EA	$1,000	$1,000
2	Bump-out 20'x6' Demo	120	SF	$2	$240
2A	Bioretention	120	SF	$15	$1,800
2B	Catch Basin Modification	1	EA	$1,000	$1,000
3	Maintenance of Traffic	1	day	$1,000	$1,000
4	Curbing	40	LF	$25	$1,000
5	Asphalt Repavement	300	SF	$2	$600
				Subtotal	$5,640
				55% contingency	$4,780
				Total	**$14,000**
				$/LF	**$47.00**

Medium Level Green Street

Medium level green streets costs include a continuous narrow bioretention swale on both sides of the street within the tree lawn and two (2) bump-ins and/or bump outs. This GI measure has an estimated stormwater capture rate of 50-75% of the drainage area (i.e. street, tree lawn, sidewalk and front lawn). A 24 foot wide street, 300 foot long would include approximately two (2), 20 foot long by six (6) foot wide bioretention cells and two three (3) foot wide by 300 foot long bioretention swale . Table 9 includes estimated quantities based upon a 300 foot length as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a linear foot cost.

Table 8. Medium Level Green Street Cost Estimate Worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Bump-in 20'x6' Demo	120	SF	$2	$240
1A	Bioretention	120	SF	$15	$1,800
1B	Catch Basin Modification	1	EA	$2,225	$2,225
2	Bump-out 20'x6' Demo	120	SF	$2	$240
2A	Bioretention	120	SF	$15	$1,800
2B	Catch Basin Modification	1	EA	$2,225	$2,225
3	Treelawn Demo	4800	SF	$2	$7,200
4	Bio-Retention Swale 3' wide on both sides	1800	SF	$15	$27,000
5	Maintenance of Traffic	1	day	$1,000	$1,000
				Subtotal	$43,730
				55% contingency	$24,060
				Total	**$68,000**
				$/LF	**$227.00**

High Level Green Street

In addition to a continuous narrow bioretention swale on both sides of the street within the tree lawn and two (2) bump-ins and/or bump outs, high level green streets also include new storm sewer construction. This GI measure has a general stormwater capture rate of 50-90% of commercial landuse (some large roof areas are excluded) and 100% of residential landuse within the drainage area. A 24 foot wide street, 300 foot long would include approximately two (2) 20 foot long by six (6) foot wide bioretention cells and two three (3) foot wide by 300 foot long bioretention swales as well as 300 linear feet of new 24" storm sewer pipe. Table 10 includes estimated quantities based upon a 300 foot length as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a linear foot cost.

Table 9. High Level Green Street Cost Estimate Worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Bump-in 20'x6' Demo	120	SF	$2	$240
1A	Bioretention	120	SF	$15	$1,800
1B	Catch Basin Modification	1	EA	$2,225	$2,225
2	Bump-out 20'x6' Demo	120	SF	$2	$240
2A	Bioretention	120	SF	$15	$1,800
2B	Catch Basin Modification	1	EA	$2,225	$2,225
3	Treelawn Demo	4800	SF	$2	$7,200
4	Bio-Retention Swale 3' wide on both sides	1800	SF	$15	$27,000
5	Storm Sewer	300	LF	$150	$45,000
6	Maintenance of Traffic	1	day	$1,000	$1,000
				Subtotal	$88,730
				55% contingency	$48,670
				Total	**$138,000**
				$/LF	**$460.00**

Pervious/Porous Pavements

Porous paving allows stormwater to filter through a drivable or walkable surface and be either infiltrated into existing sandy sub soil or piped slowly back to the existing sewer system. For estimating purposed, a one-half (1/2) acre lot retrofit of porous concrete or permeable concrete paver (most commonly used in Northeast Ohio), with an 18" gravel drainage layer and a 4" underdrain pipe was used to develop an estimated square foot cost for Pervious/Porous Pavements. Table 10 includes estimated quantities based upon a 22,000 square foot area as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a square foot cost.

Table 10. Pervious/Porous Pavements cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	1600	CY	$7	$11,200
2	Material Haul-off/Disposal	1600	CY	$10	$16,000
3	Pervious Concrete/Permeable Pavers	21800	SF	$4.5	$98,100
4	18" Stone drainage base	1200	CY	$40	$48,000
5	Filter Fabric	2500	SY	$2	$5,000
6	6" Concrete Curbing &/or wheel stops (edging)	600	LF	$30	$1,800
7	Striping	1	LS	$12,000	$2,000
8	6" under drainage perforated pipe	600	LF	$8	$4,800
9	Clean out	4	EA	$500	$2,000
10	Storm Sewer Outlet	100	LF	$50	$5,000
11	ADA Sign & pole	4	EA	$400	$1,600
12	Seeding	800	SY	$0.30	$240
13	Topsoil	10	CY	$20	$200
				Subtotal	$195,940
				55% contingency	$107,800
				Total	**$303,800**
				$/SF	**$14.00**

Vacant Lot Repurposing

Vacant land repurposing is the removal of impervious surfaces from the drainage area through the razing of existing structures, re-grading and revegetating areas to minimize site runoff. Represented costs include some pavement/street demolition, utility abandonment, house/structure demolition, minor grading and revegetation. Costs do not include land acquisition.

Low Level Implementation – Vacant Lot Repurposing

Low Level Implementation is selective demolition of vacant residential area on a large scale (larger than 30 acres) and subsequent conversion to a grassed area. Costs include one (1) house demolition per acre (including removal of structure off site), removal of driveway and other pavement estimated at 24' wide by 200' long, regrading to create detention/depression areas capturing water from surrounding impervious areas, utility demo/abandonment and vegetation with ODOT typical lawn seed. For estimating purposes, a one (1) acre of area was used to develop per square foot cost shown in Table 11.

Table 11. Low Level Implementation – Vacant Lot Repurposing cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	House Demo	1	EA	$2,000	$2,000
2	Pavement Demolition	4800	SF	$1	$3,600
3	Utility Demo/Abandonment	200	LF	$3	$600
4	Seeding	4800	SY	$0.20	$960
5	Topsoil	533	CY	$20	$10,660
6	Grading	4,800	SY	$0.25	$1,200
				Subtotal	$19,020
				55% contingency	$10,470
				Total	**$30,000**
				$/SF	**$0.70**

High Level Implementation – Vacant Lot Repurposing

Just like Low Level Implementation, High Level Implementation of Vacant Lot Repurposing includes selective demolition of vacant residential area on a large scale (larger than 30 acres) and subsequent conversion to a grassed area. Also included in the High Level are plantings that are not included in the Low Level Implementation. Costs include two (2) house demolitions (including removal of structure off site), removal of driveway and other pavement estimated at 24' wide by 250' long, regrading to create detention/depression areas capturing water from surrounding impervious areas, utility demo/abandonment and vegetation with Ohio ODOT typical lawn seed and tree liner plantings (whips). For estimating purposed, a one (1) acre area was used to develop an estimated per square foot cost shown in Table 12

Table 12. High Level Implementation – Vacant Lot Repurposing cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	House Demo	2	EA	$2,000	$4,000
2	Pavement Demolition	6000	SF	$1	$4,500
3	Utility Demo/Abandonment	250	LF	$3	$750
4	Seeding & Planting	4800	SY	$0.50	$2,400
5	Topsoil	533	CY	$20	$10,660
6	Grading	4800	SY	$0.25	$1,200
				Subtotal	$23,510
				55% contingency	$12,940
				Total	**$37,000**
				$/SF	**$0.85**

Impervious Area Removal

Removal of large areas of impervious area can be a cost effective way to reduce stormwater. Estimates for this GI measure were based upon ODOT pavement removal data. For estimating

purposed, a one (1) acre area was used to develop an estimated per square foot cost shown in Table 13.

Table 13. Impervious Area Removal cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Pavement removal	43560	SF	$0.75	$32,670
2	55% contingency	1	LS	$17,970	$17,970
				Total	**$50,640**
				$/SF	**$1.16**

Green Roof

Green roofs are mainly flat roof areas of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. Green roofs absorb rainwater, provide insulation, create a habitat for wildlife, help to lower urban air temperatures and combat the heat island effect. Construction costs were developed based upon local costs for 4" to 6" green roof media and do not include full roof replacement costs. For estimating purposed, a one (1) acre area was used to develop an estimated per square foot cost shown in Table 14.

Table 14. Green Roof cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Green Roof media	43560	SF	$18.50	$805,860
2	55% contingency	1	LS	$443,230	$443,230
				Total	**$1,249,090**
				$/SF	**$28.70**

Stormwater Capture and Conveyance

Traditional capture and conveyance of stormwater methods are included below. Costs associated with these measures were derived by calculating the infrastructure necessary to collect and convey the stormwater to the various GI measures without coordination with other redevelopment.

Storm Sewer

In commercial corridors, underground conveyance of stormwater through sewer separation within the street right-of-way is a cost effective solution to convey stormwater to a central GI control measure. A 300 foot long street separation would include 300 linear feet of 36" sewer buried at an average depth of seven (7) feet, backfilled with existing material, pavement removed and repaired with approximately 2 catch basins replaced. Table 15 includes estimated quantities based upon a 300 foot length as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a linear foot cost.

Table 15. Storm Sewer Conveyance cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	300	CY	$17	$5,100
2	Pavement Demolition	1500	SF	$1	$1,125
3	Asphalt Repavement	1500	SF	$2	$3,000
4	Maintenance of Traffic	1	day	$1,000	$1,000
5	Storm Sewer including backfill	300	LF	$135	$40,500
6	Storm Catch Basin	2	EA	$1,500	$3,000
				Subtotal	$53,725
				55% contingency	$29,600
				Total	**$84,000**
				$/LF	**$280**

Open Channel/Swale

Open Channels are the most cost effective means of drainage conveyance and provide added habitat and water quality benefits although a larger corridor width is required. A 300 foot long three (3) foot deep swale would include grading, seeding and material disposal. Table 16 includes estimated quantities based upon a 300 foot length as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a linear foot cost.

Table 16. Open Channel/Swale Conveyance cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Excavation	320	CY	$7	$2,240
2	Material Haul-off/Disposal	140	CY	$10	$1,400
3	Topsoil	40	CY	$20	$800
4	Grading	4800	SY	$0.25	$1,200
5	Seeding	340	SY	$0.10	$34
				Subtotal	$5,674
				55% contingency	$3,130
				Total	**$9,000**
				$/LF	**$30**

Overland Flow

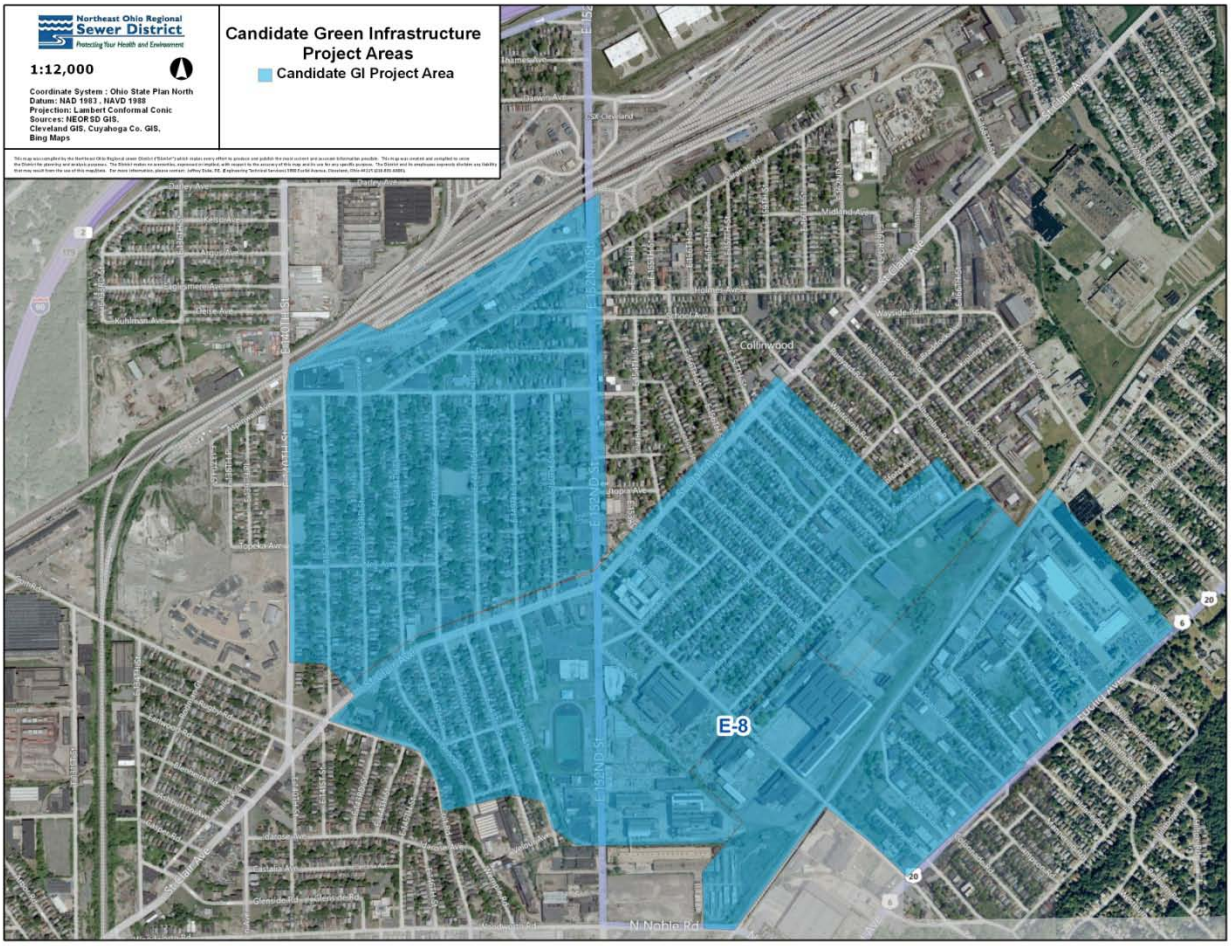
On residential streets that have greater than 2% downhill slope, overland flow or slippage allows for the closing of two (2) catch basins within 300 linear feet of street allowing stormwater to continue flowing to the end of the street to be collected by another GI control measure. Table 17 includes estimated quantities based upon a 300 foot length as a targeted minimum control measure size and corresponding estimated unit prices. The total cost was converted to a linear foot cost.

Table 17. Overland Flow Conveyance cost estimate worksheet

Item No.	Description	Est. Quantity	Unit	Unit Price	Total
1	Catch Basin Modification	2	EA	$1,600	$3,200
2	55% contingency	1	LS	$1,760	$1,760
				Total	**$5,000**
				$/LF	**$17**

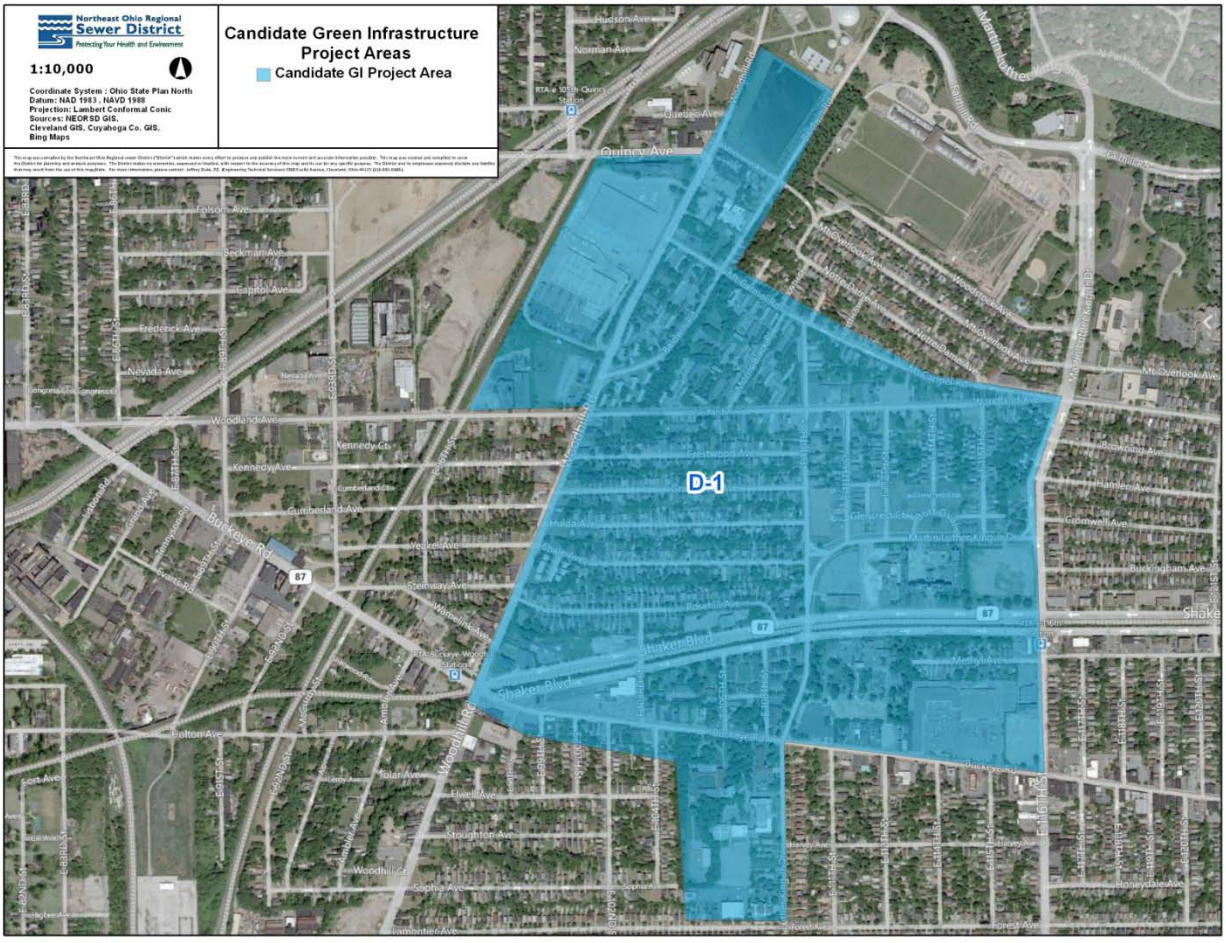
Appendix G: Candidate Green Infrastructure Project Maps

Candidate GI Project E-8
(Euclid Ave, Ivanhoe Rd, St Clair between East 140th to East 152nd St)



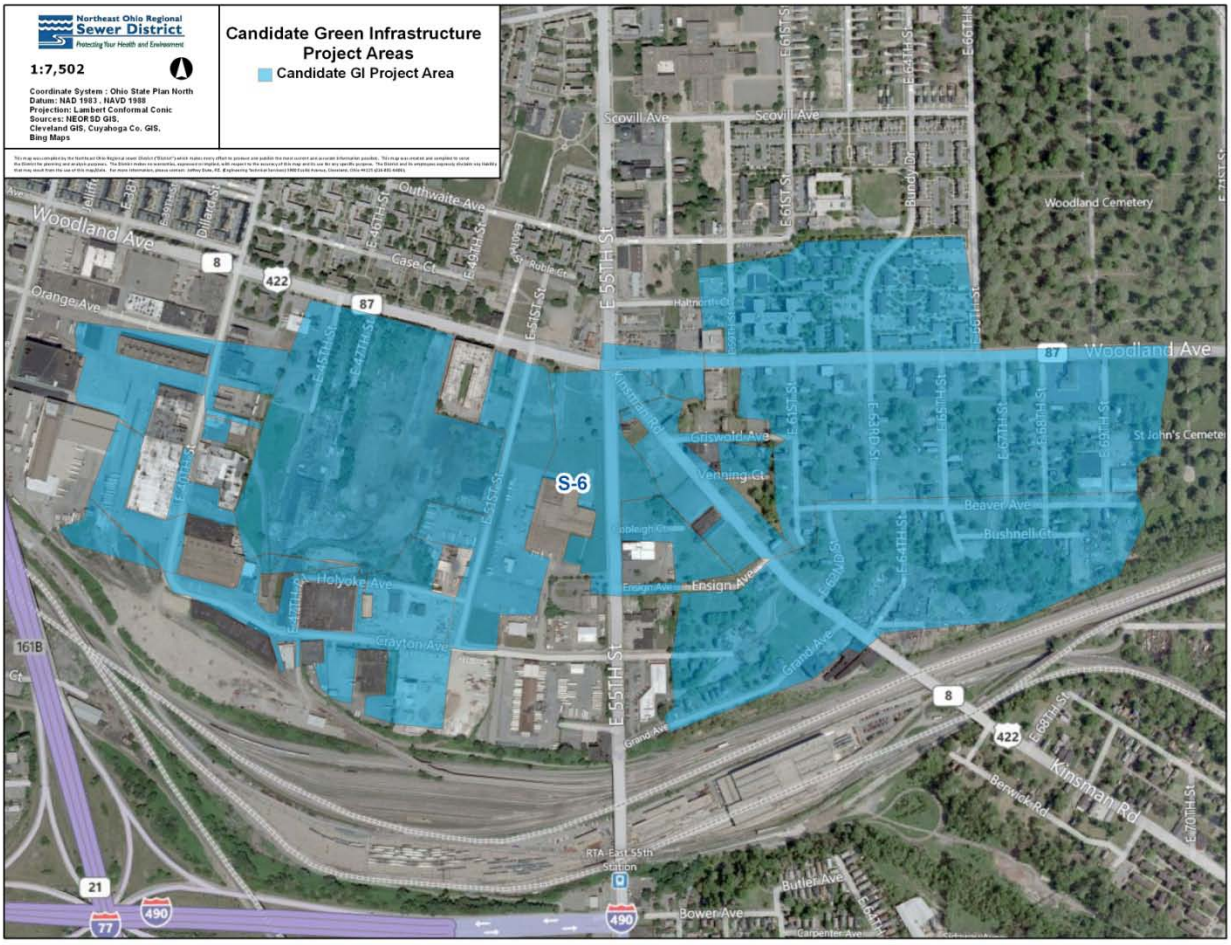
CSO Volume Reduction Potential	13.7 MG
Opportunities	**1.** Potential existing separated storm sewers from East 146th to East 152nd St **2.** Vacant land: up to 80% in some area
Potential GI Control Measures	Offload to Nine Mile Creek and store and return to CSS using: Detention Green streets Overland Flow Storm sewer separation Vacant land repurposing

Candidate GI Project D-1
(Giddings Brook – Buckeye, Woodhill, and Fairhill to Baldwin)



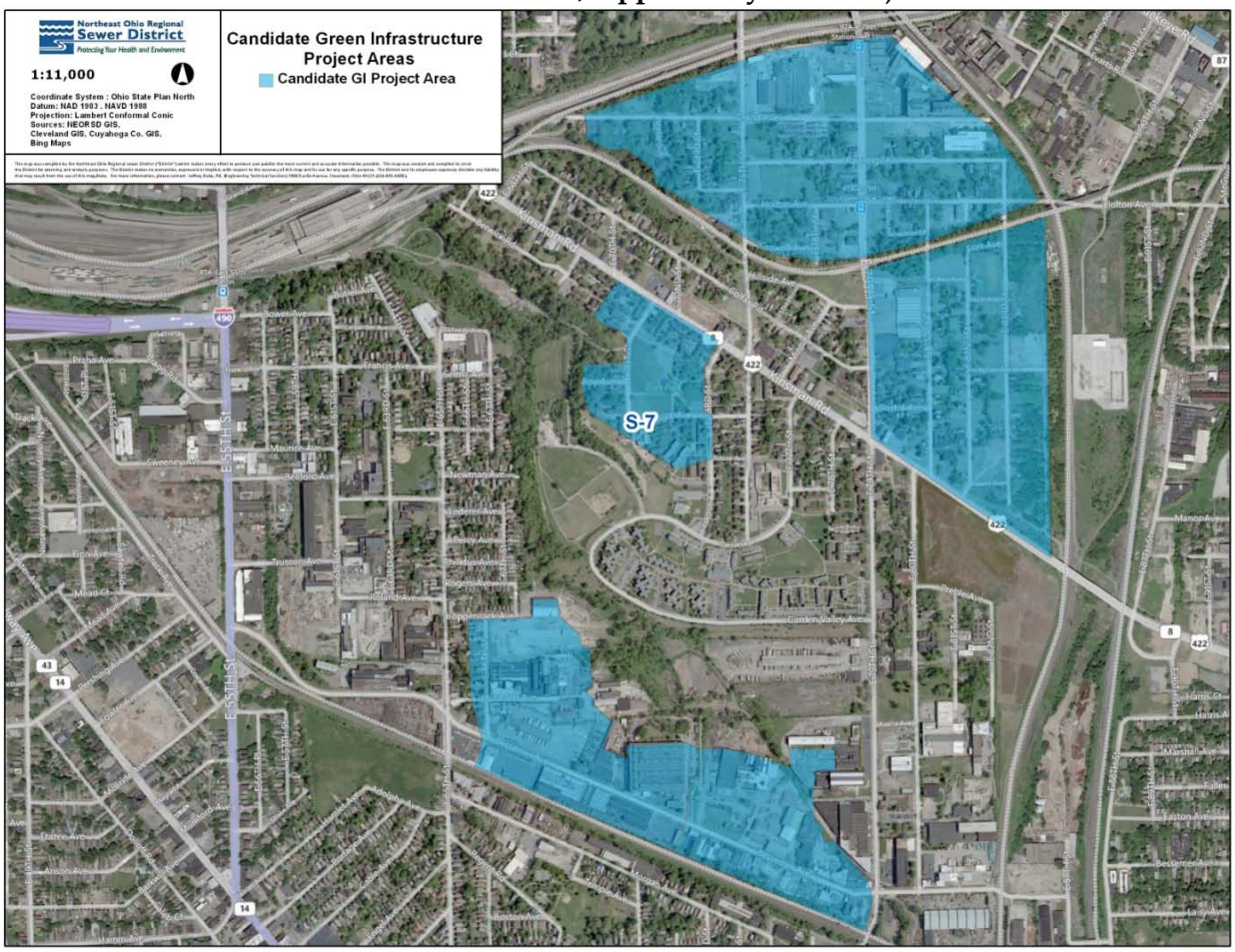
CSO Volume Reduction Potential	8.5 MG
Opportunities	1. Partnership opportunities: • Community development cooperation: Buckeye Area Development Cooperation • Great Cleveland Regional Transit Authority - Woodhill Garage 2. Impervious area disconnection: Industrial area along Woodhill Rd 3. Vacant land: up to 80% in some area 4. Redevelopment around former St. Luke's hospital property
Potential GI Control Measures	Offload to Doan Brook using: Detention Green streets Storm sewer separation Vacant land repurposing

Candidate GI Project S-6
(Woodland Ave to CSX Rail; Includes East 55th St and Kinsman)



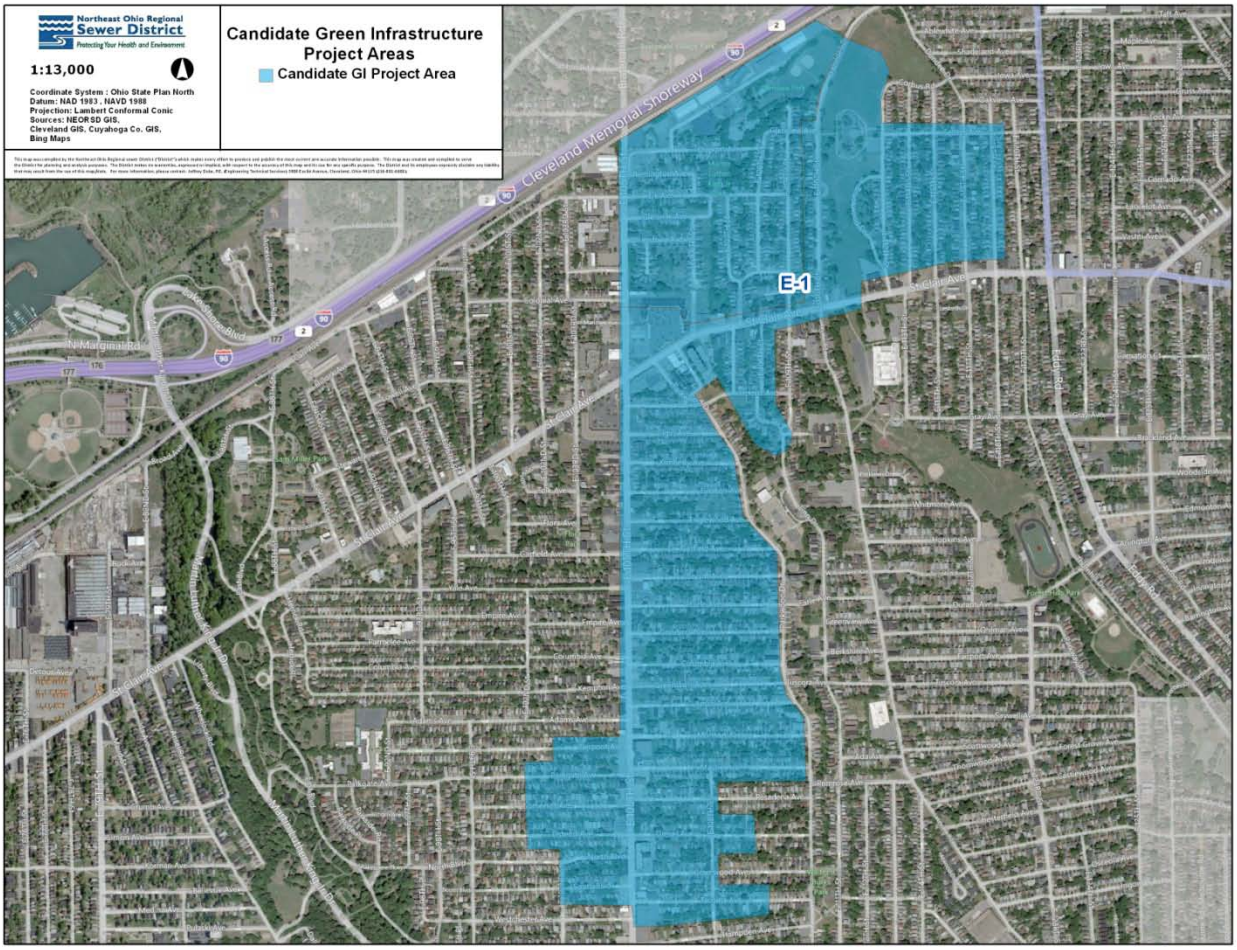
CSO Volume Reduction Potential	8.1 MG
Opportunities	1. Partnership opportunities: • City of Cleveland CIP: Woodland Ave **2.** Vacant land availability: up to 90%
Potential GI Control Measures	Offload to Kingsbury Run and store and return to CSS using: Detention Green streets Storm sewer separation Vacant land repurposing

Candidate GI Project S-7
(Agricultural Innovation Zone Neighborhood; Bessemer Ave and East 65th St; RTA Red line and Crowell Ave; Opportunity Corridor)



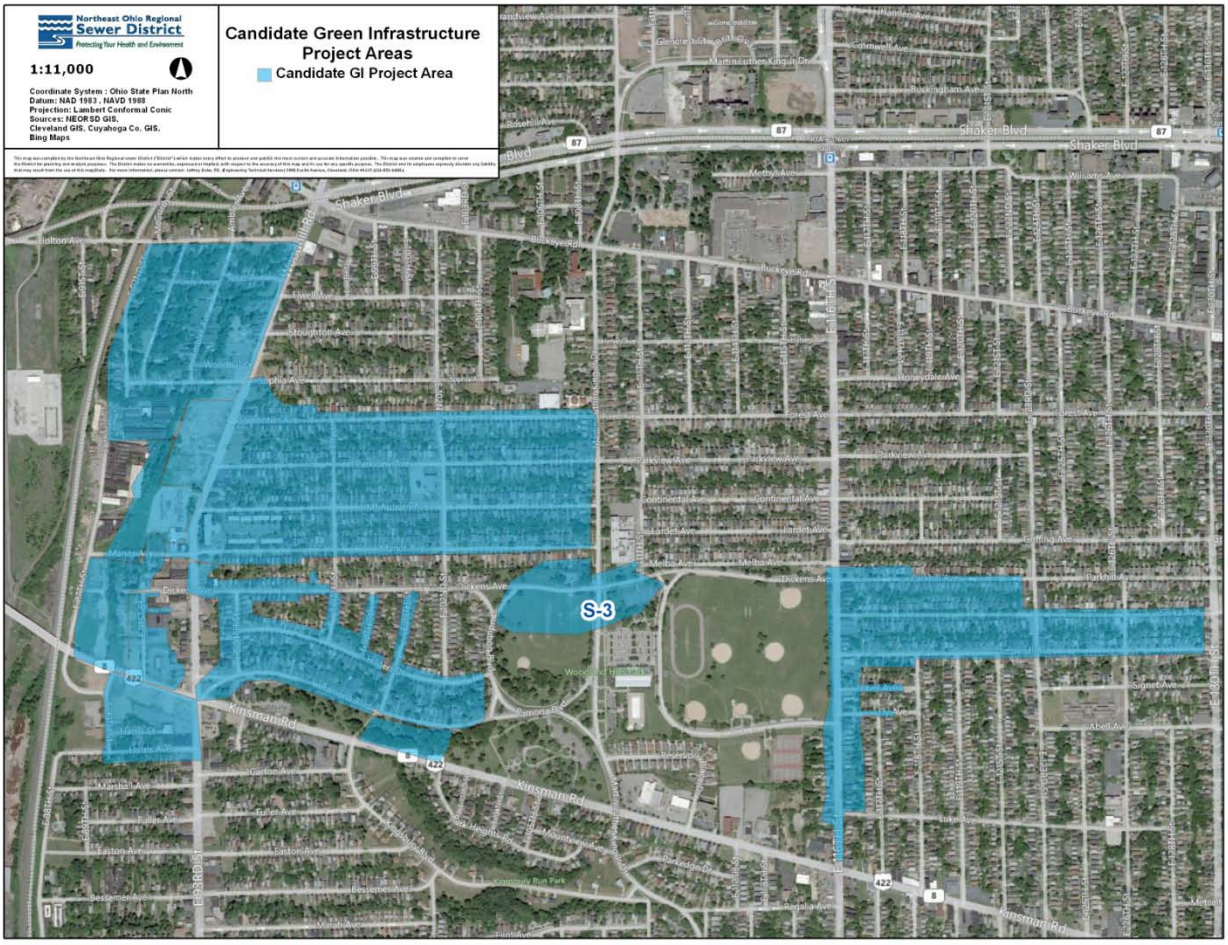
CSO Volume Reduction Potential	7.2 MG
Opportunities	1. Partnership opportunities: • City of Cleveland: Opportunity Corridor • Community development corporation: Burton, Bell, Carr • Urban Agriculture Innovation Zone 2. Vacant land availability: up to 80% in some areas 3. Potential existing separated storm sewers at Heritage View - Cleveland Municipal Housing Authority
Potential GI Control Measures	Offload runoff to Kingsbury Run and store and return to CSS using: Detention Green streets Storm sewer separation

Candidate GI Project E-1
(East 104th St - Parkwood Dr and St Clair and Rte 2/I-90; Forest Hill Park)



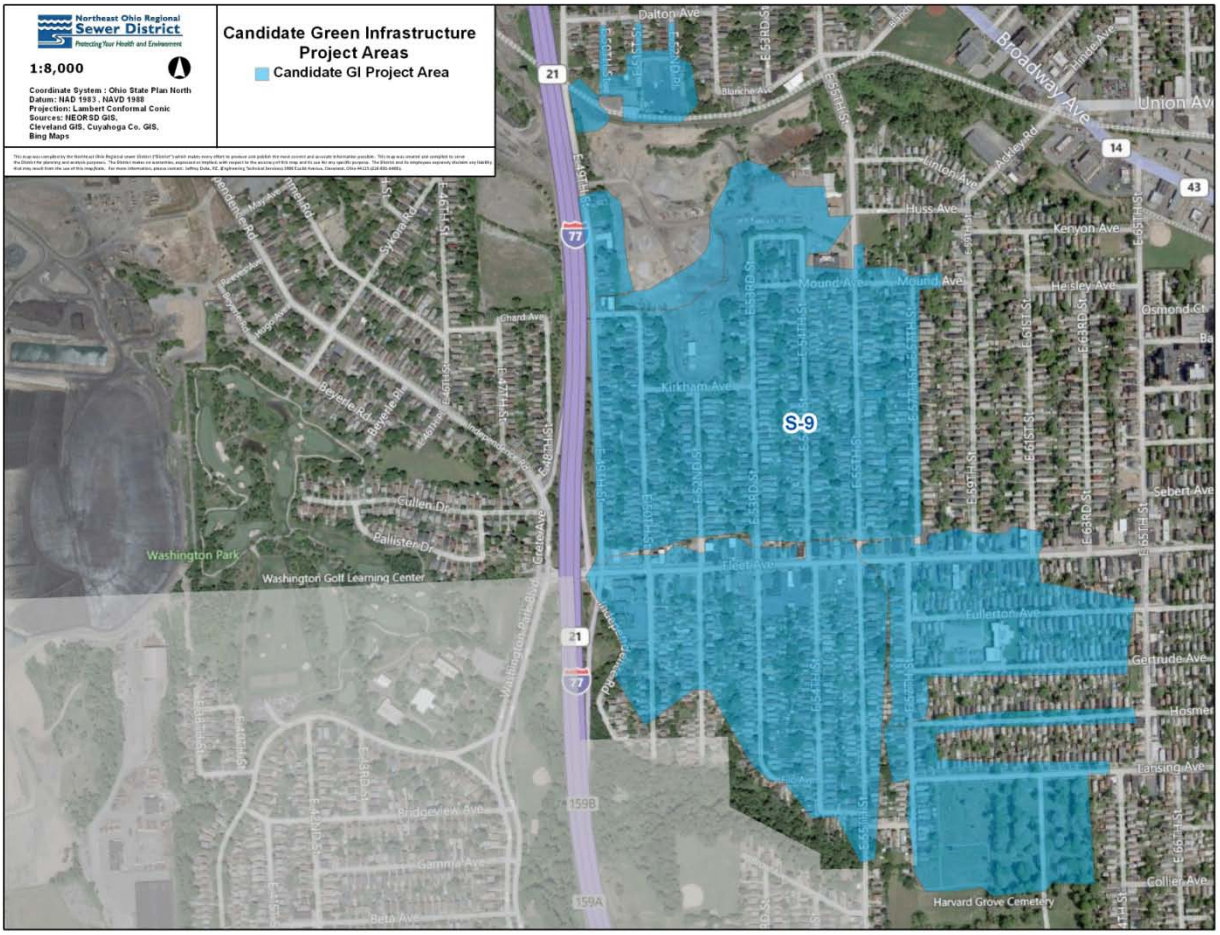
CSO Volume Reduction Potential	7.1 MG
Opportunities	1. Partnership opportunities: • City of Cleveland – Forest Hills Park 2. Potential existing separated storm sewers on streets east of East 105th St from Elgin Ave to Columbia Ave
Potential GI Control Measures	Offload to Dugway Brook using: Detention Green streets Overland flow Storm sewer separation

Candidate GI Project S-3
(East 92nd St to Woodhill Rd; Manor Ave to Lamontier Ave; Luke Easter Park Area)



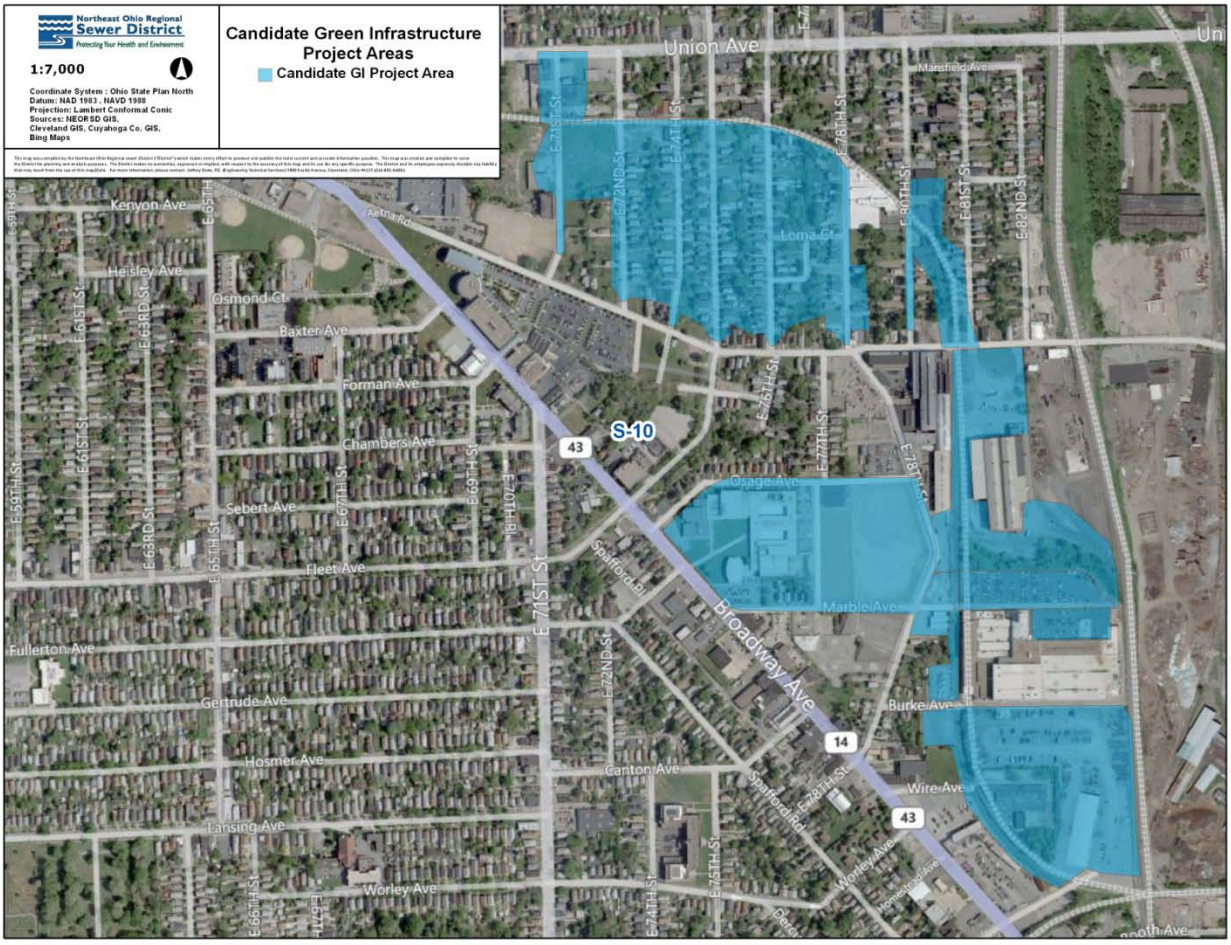
CSO Volume Reduction Potential	6.3 MG
Opportunities	1. Partnership opportunities: • City of Cleveland: Luke Easter Park, new City Service Garage 2. Vacant land: up to 90% in some area
Potential GI Control Measures	Offload to Kingsbury Run Culvert and store and return to CSS using: Detention Green streets Storm sewer separation Vacant land repurposing

Candidate GI Project S-9
(Fleet Ave between East 49th and East 57th St and up to Dalton Ave)



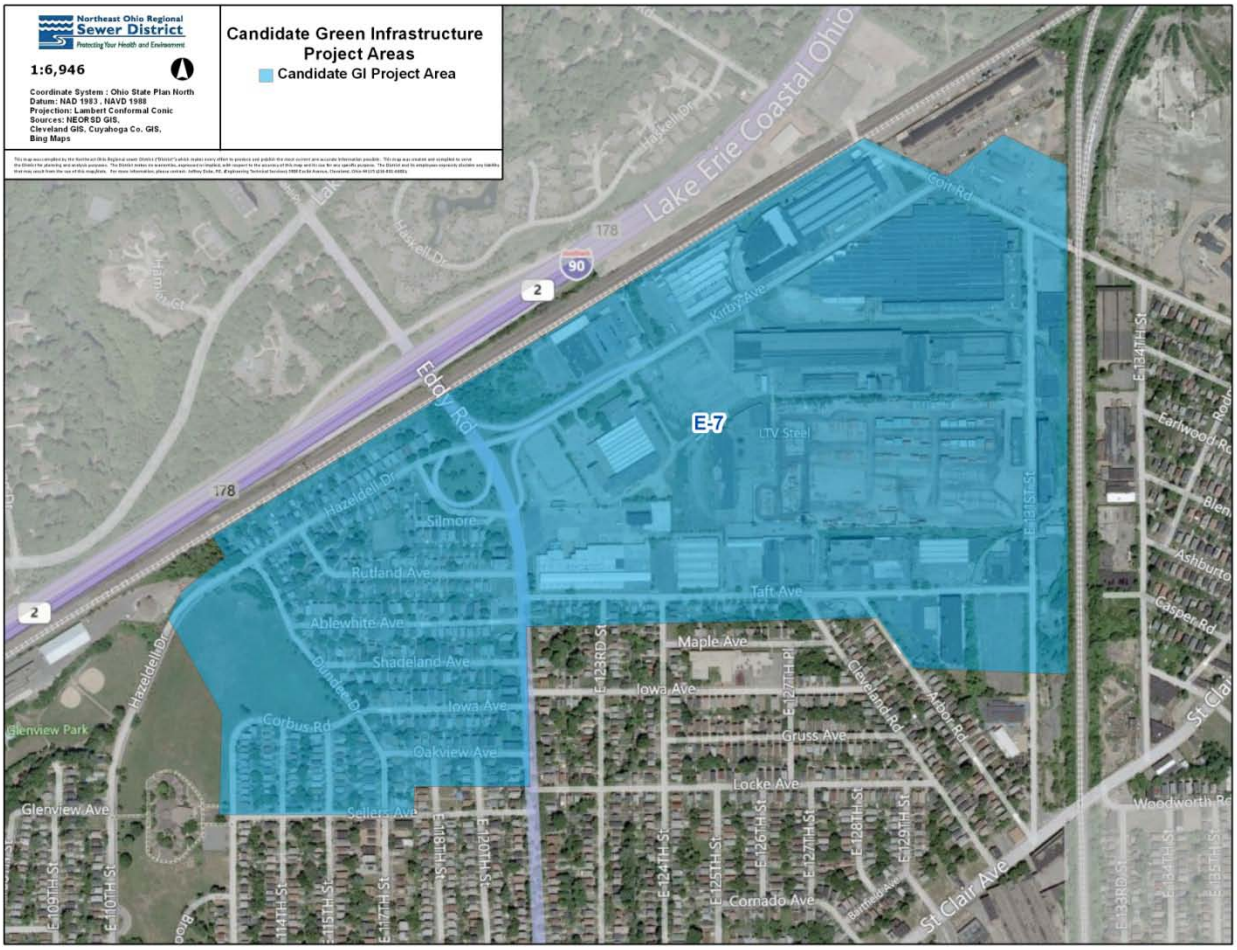
CSO Volume Reduction Potential	5.6 MG
Opportunities	1. Partnership opportunities: • City of Cleveland CIP: Fleet Ave • Community development cooperation: Slavic Village Development 2. Vacant land: up to 50%
Potential GI Control Measures	Offload to Burke Brook and store and return to CSS using: Detention Green streets Storm sewer separation Vacant land repurposing

Candidate GI Project S-10
(Morgan Run Trail; Broadway Ave and Aetna Rd)



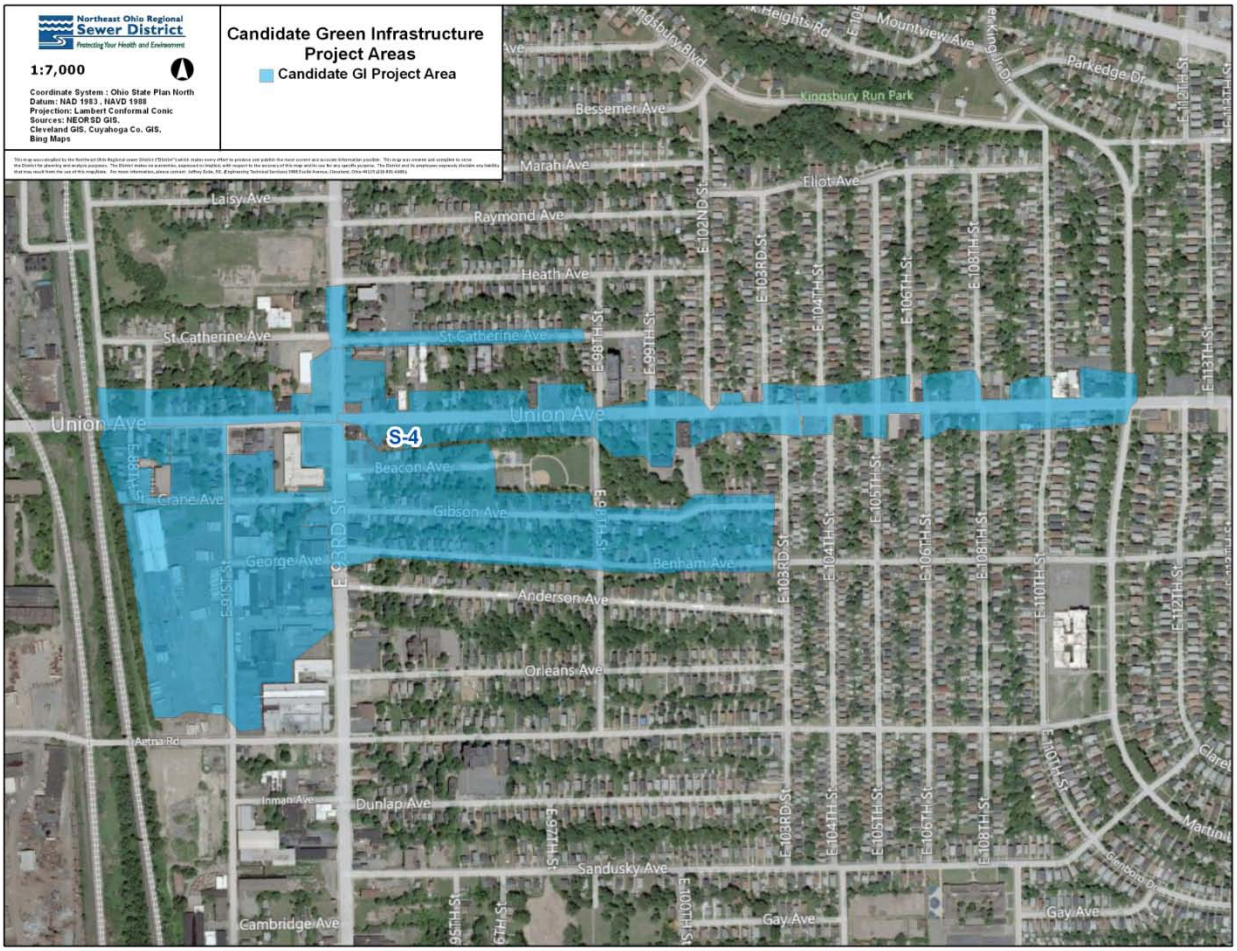
CSO Volume Reduction Potential	5.1 MG
Opportunities	1. Partnership opportunities: • Community development cooperation: Slavic Village Development • City of Cleveland: Neighborhood Connector with Morgana Run Trail 2. Impervious area disconnection: Industrial area along East 78th St 3. Vacant land: up to 90% in some area 4. Industrial expansion
Potential GI Control Measures	Store and return to CSS using: Detention Green streets Storm sewer separation Vacant land repurposing

Candidate GI Project E-7
(Eddy Rd to East 133rd St from Taft Ave to Rte 2/I-90)



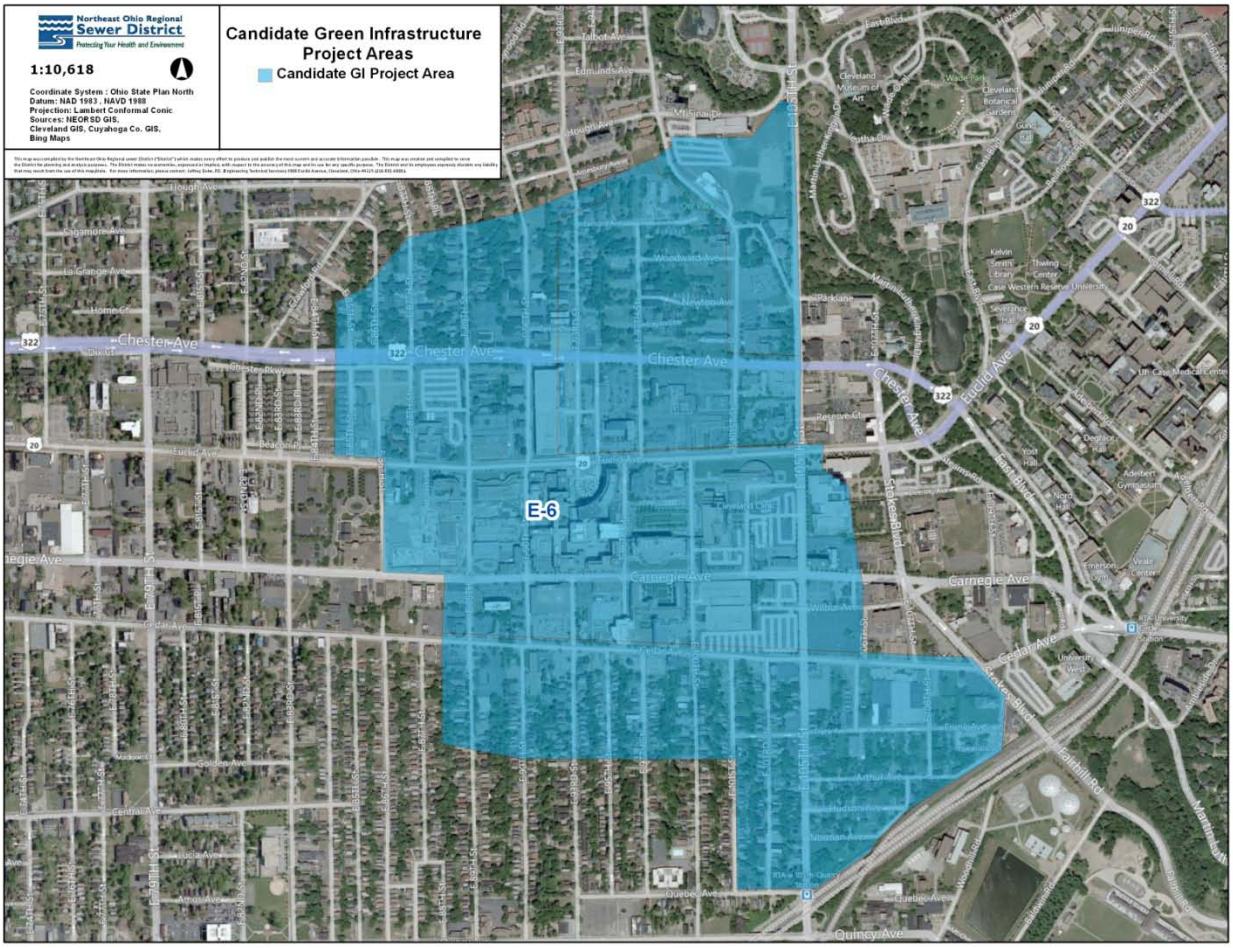
CSO Volume Reduction Potential	4.6 MG
Opportunities	1. Impervious area disconnection: Industrial area along Kirby and Taft Ave
Potential GI Control Measures	Offload to Dugway Brook using: Detention Green streets Storm sewer separation

Candidate GI Project S-4
(Union Ave between East 88th St and Martin Luther King Blvd)



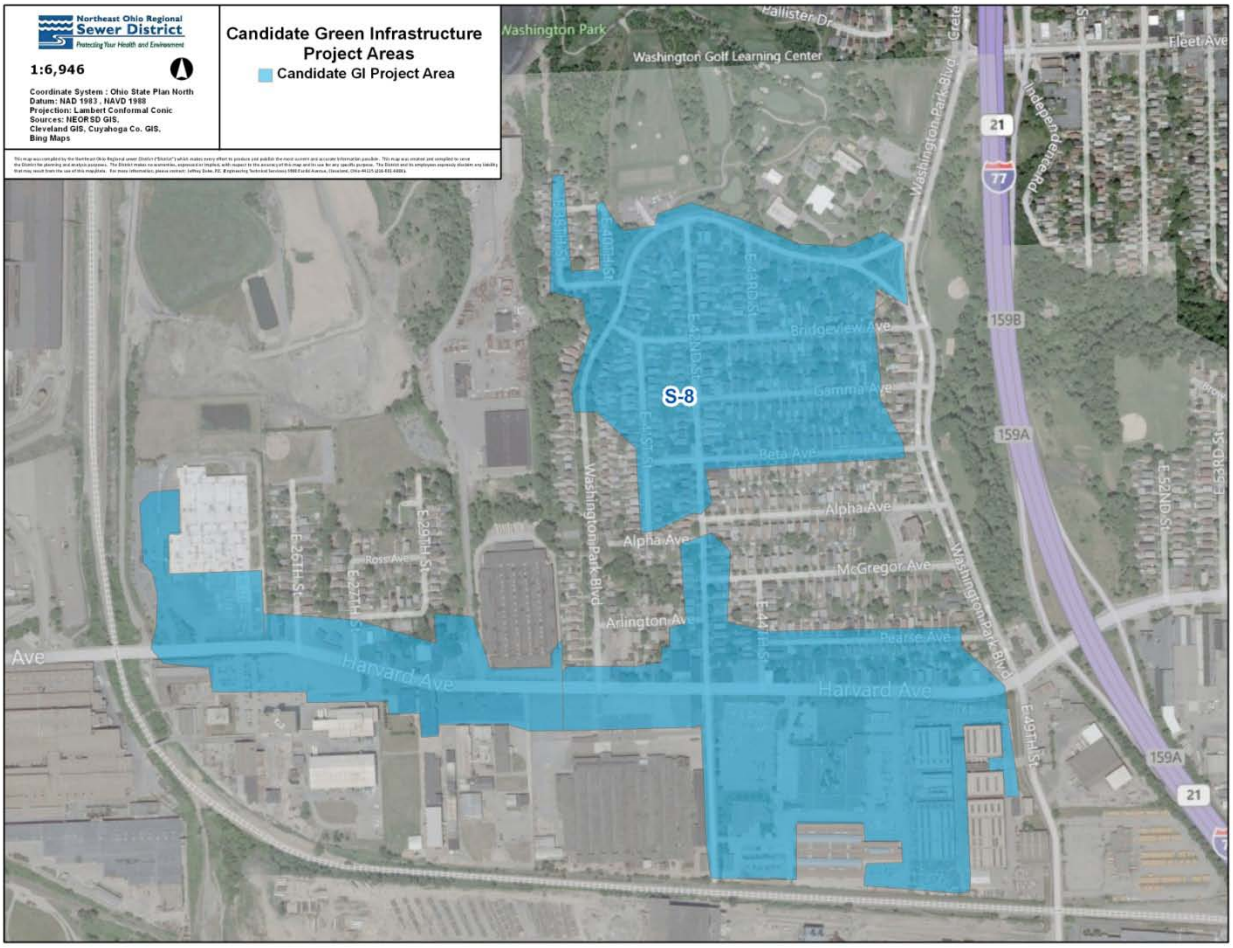
CSO Volume Reduction Potential	4.4 MG
Opportunities	1. Partnership opportunities: • City of Cleveland: Residential park reuse 2. Vacant land availability: up to 60%
Potential GI Control Measures	Store and return to CSS using: Detention Green streets Storm sewer separation Vacant land repurposing

Candidate GI Project E-6
(Cedar Rd at East 89th St to Fairhill Rd; Chester to Hough Ave from East 90th to East 105th St)



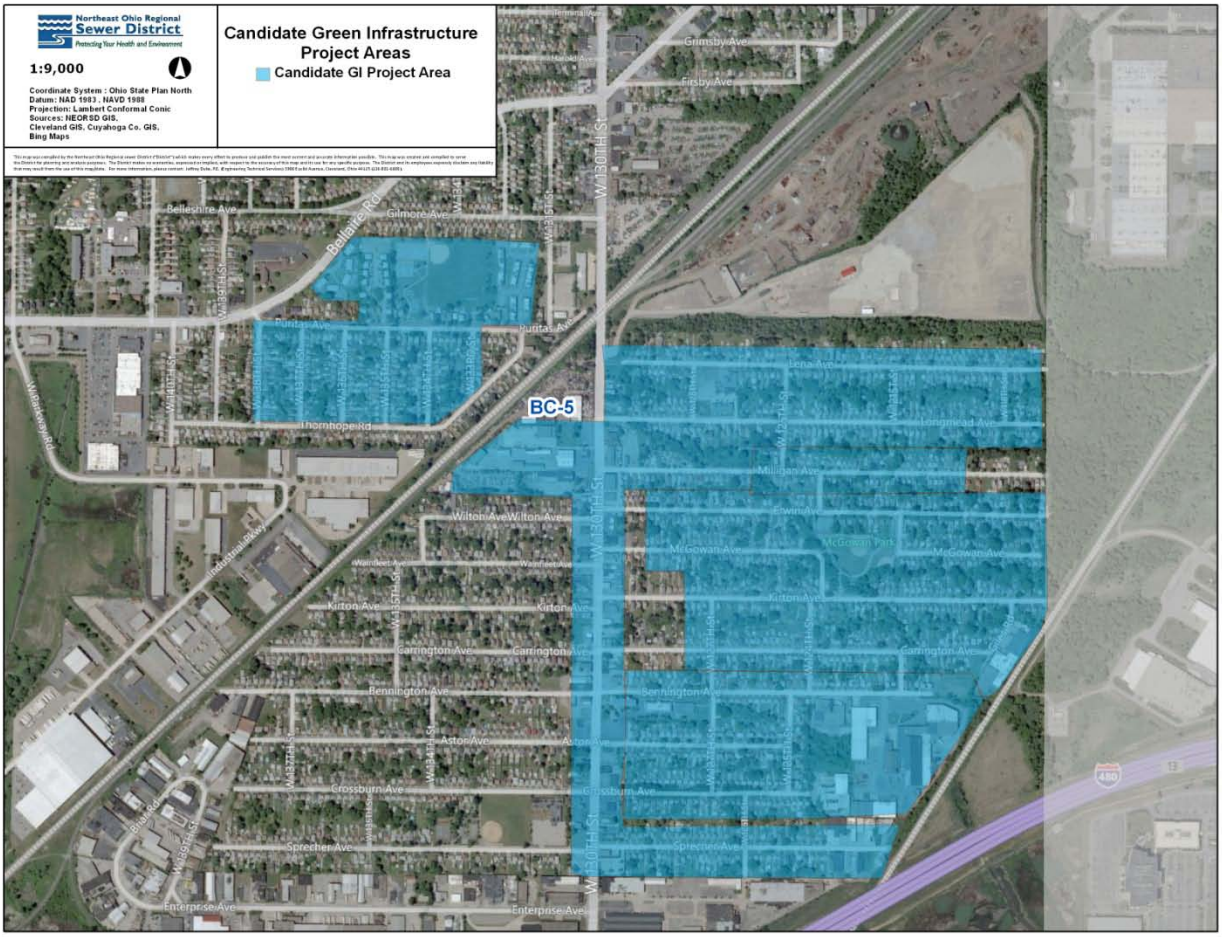
CSO Volume Reduction Potential	4.0 MG
Opportunities	1. Partnership opportunities: • City of Cleveland – Upper Chester redevelopment, Cedar Ave CIP, Opportunity Corridor • Case Western Reserve University • Community development cooperation: University Circle Inc. and Fairfax Renaissance Development Cooperation 2. Vacant land: up to 80% in some area
Potential GI Control Measures	Offload to Doan Brook and store and return to combined sewer system using: Detention Green streets Overland flow Storm sewer separation Vacant land re-purposing

Candidate GI Project S-8
(Harvard Ave and East 42nd St between RTA and City of Cleveland properties)



CSO Volume Reduction Potential	3.8 MG
Opportunities	1. Partnership opportunities: • City of Cleveland: Harvard Yards facility • Great Cleveland Regional Transit Authority: Harvard facility 2. Impervious area disconnect: Industrial area along Harvard Ave
Potential GI Control Measures	Offload runoff to Burke Brook and store and return to CSS using: Detention Green streets Storm sewer separation

Candidate GI Project BC-5
(West 130th St from Lena Ave to Giles Rd)



CSO Volume Reduction Potential	3.2 MG
Opportunities	1. Vacancy at 20-30% 2. Partnership opportunities: • City of Cleveland: Work together to manage flooding concerns • Bellaire-Puritas Development Corporation is active with stormwater management improvements
Potential GI Control Measures	Offload to Chevy Branch of Big Creek using: Detention Green streets Overland Flow Storm sewer separation

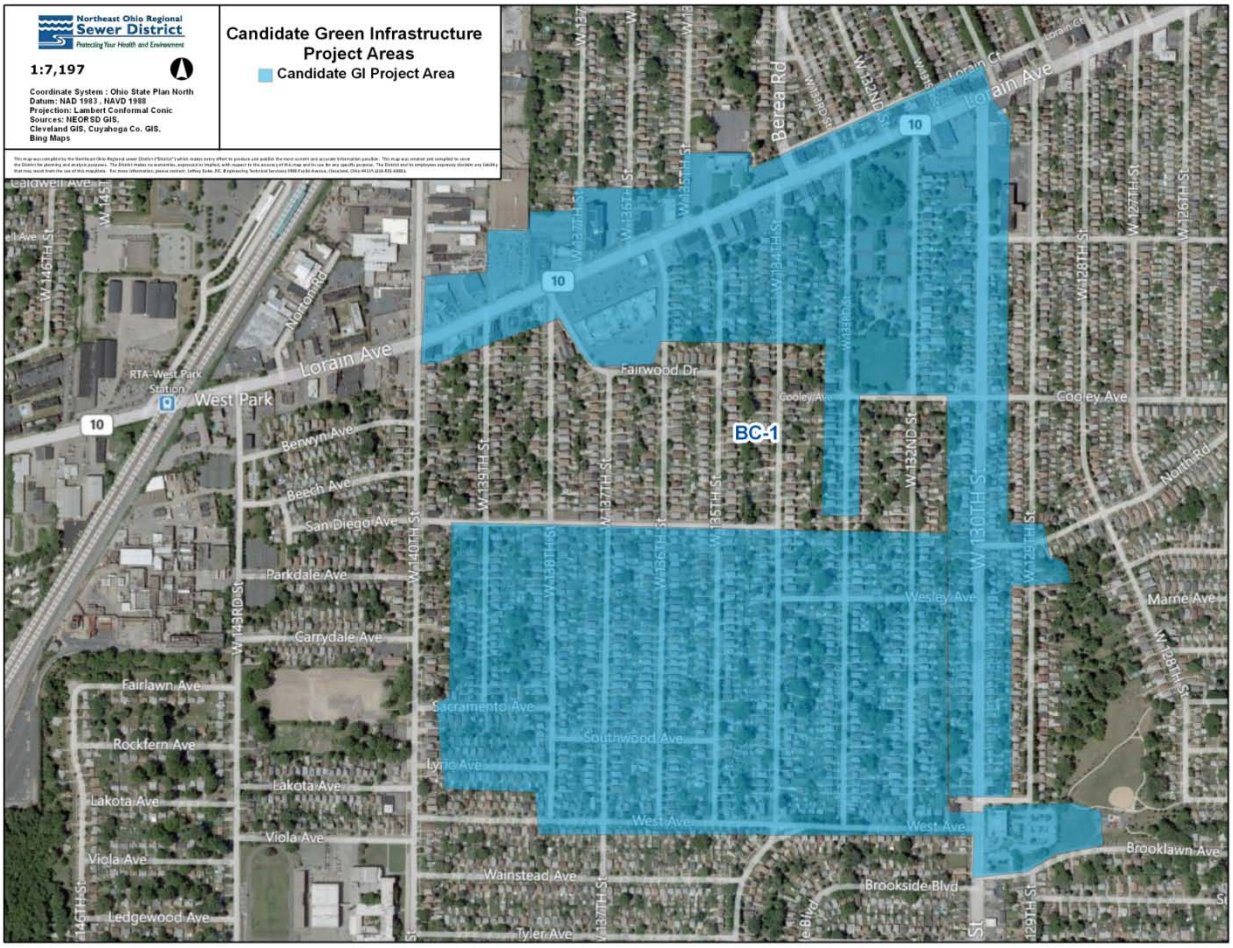
Candidate GI Project W-2
(Denison Ave and West 65th St to Camden Rd and East 71st St)

CSO Volume Reduction Potential	3.1 MG
Opportunities	1. Partnership opportunities: • Community development cooperation: Stockyard, Clark-Fulton & Brooklyn Centre Community Development 2. Impervious area disconnection: Commercial area between Denison Ave and West 65th St
Potential GI Control Measures	Store and return to CSS using: Detention Green streets Storm sewer separation

Candidate GI Project BC-2
(Lorain Ave at West 150th St and Warren Rd)

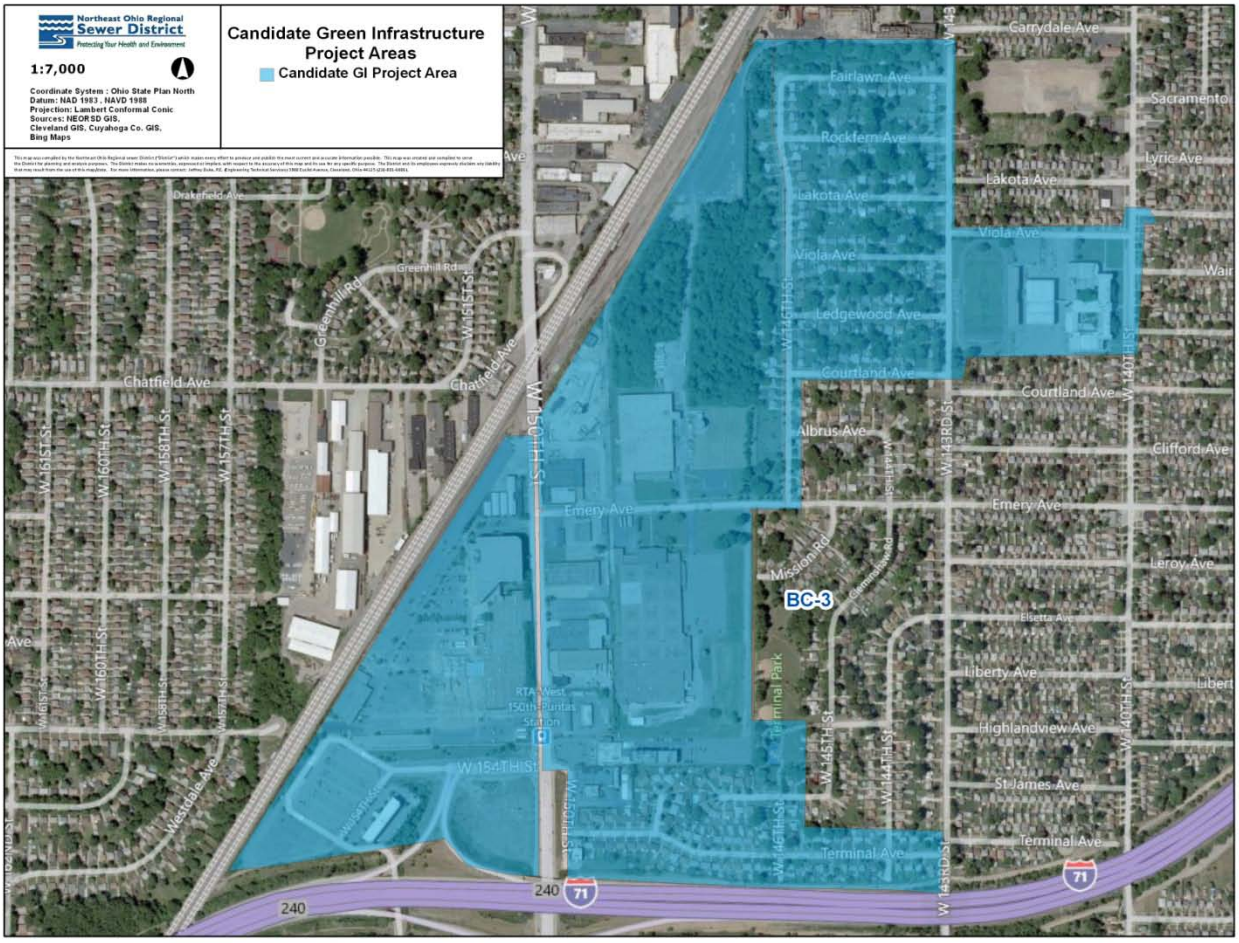
CSO Volume Reduction Potential	2.4 MG
Opportunities	1. Partnership opportunities: • City of Cleveland CIP: Lorain Ave between West 150th St and West 117th St 2. Impervious area disconnection: Commercial area on W 150th St and Lorain Ave
Potential GI Control Measures	Store and return to CSS using: Detention Green streets Storm sewer separation

Candidate GI Project BC-1
(Lorain Ave to West Ave between West 140th St and West 192nd St)



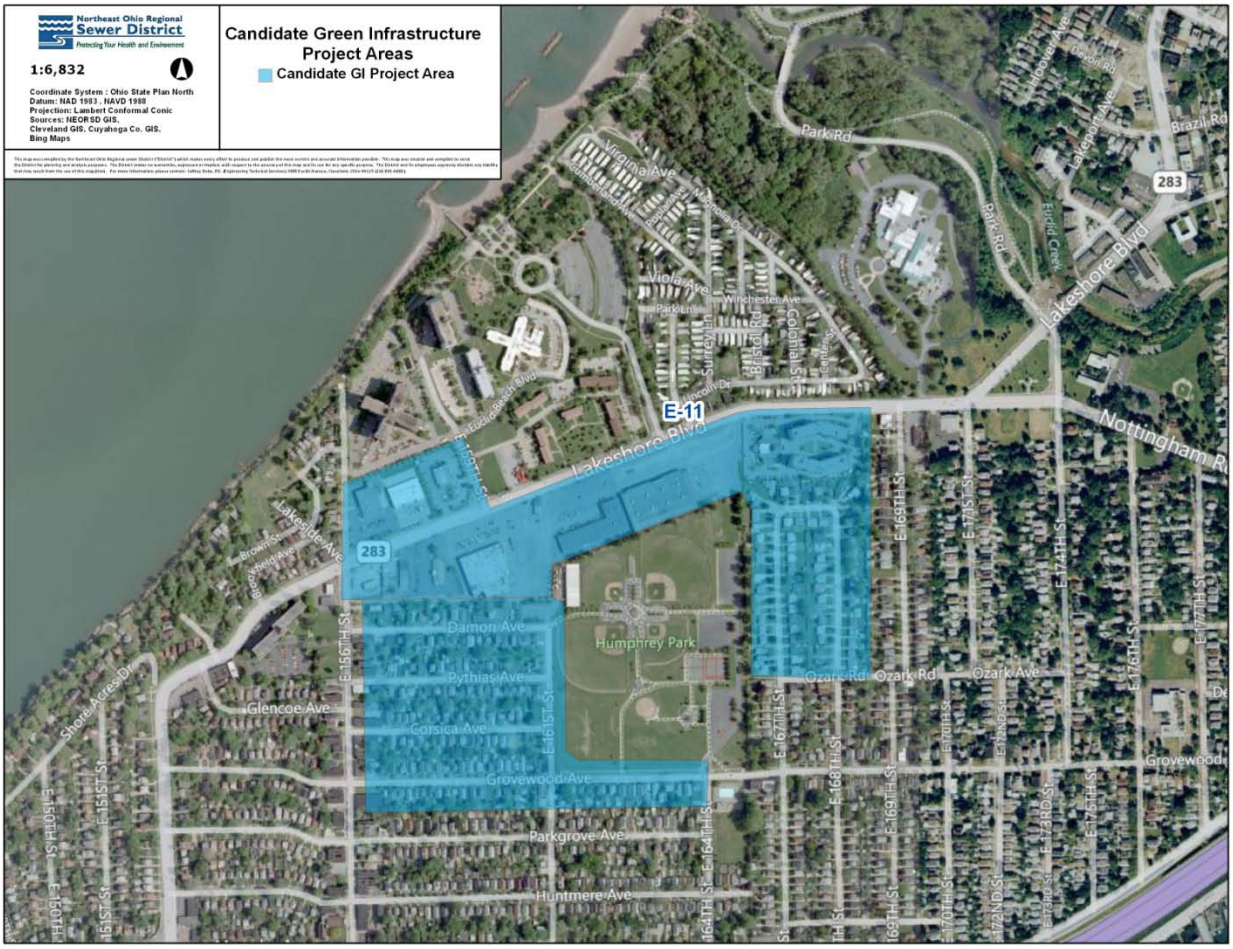
CSO Volume Reduction Potential	2.4 MG
Opportunities	1. Partnership opportunities: • City of Cleveland Capital Improvement Plan (CIP): Lorain Ave and West 130th St 2. Potential existing separate storm sewers east of West 140th St to West 134th St
Potential GI Control Measures	Offload runoff to Big Creek using: Detention Green streets Overland Flow Storm sewer separation

Candidate GI Project BC-3
(Emery Ave between West 150th and West 143rd St)



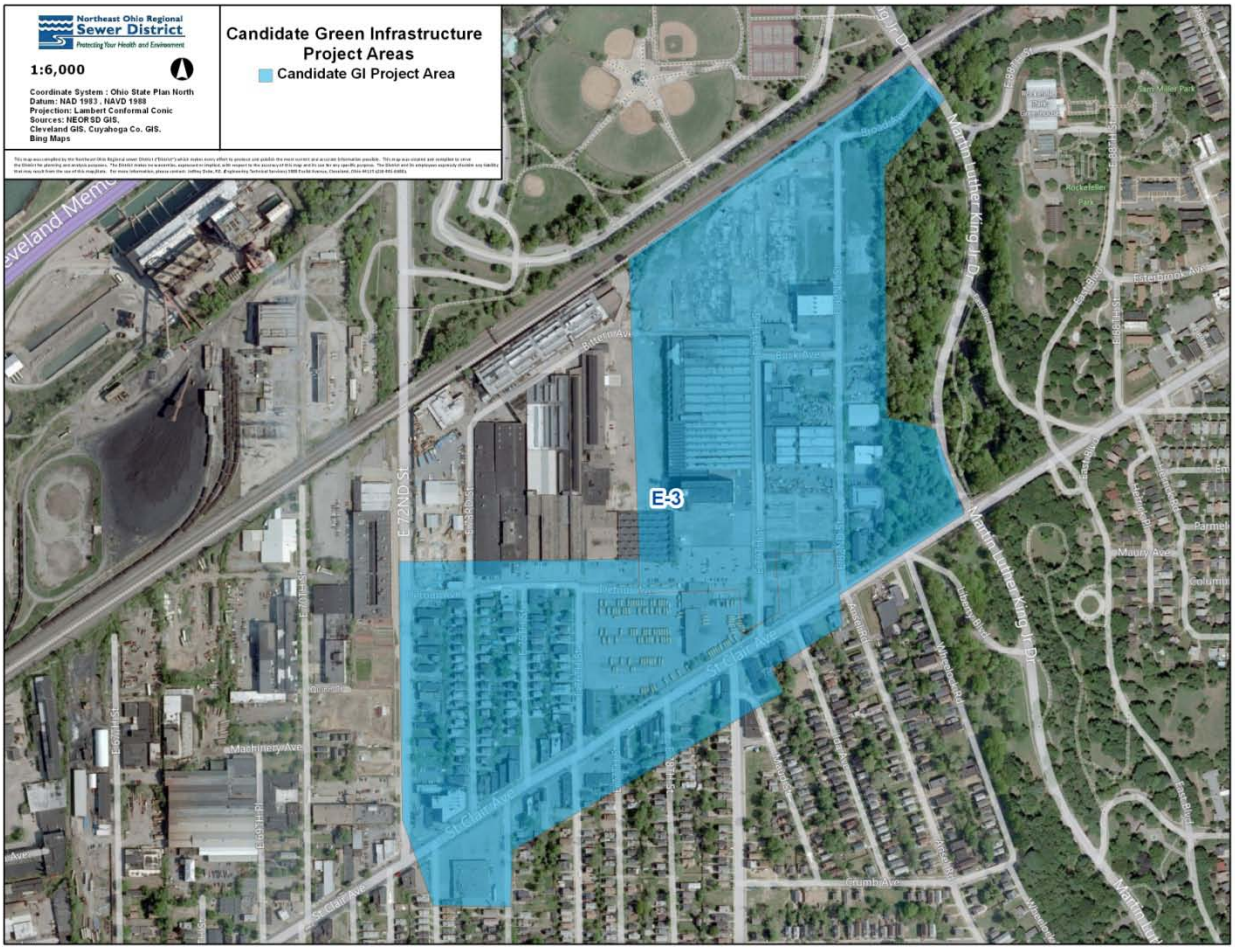
CSO Volume Reduction Potential	2.3 MG
Opportunities	1. Partnership opportunities: • Ohio Department of Transportation: Use open area near on/off ramp for Interstate-71 2. Impervious area disconnection: Commercial area along W 150th St
Potential GI Control Measures	Offload to separate storm sewers using: Detention Green streets Overland Flow Pervious Pavement Storm sewer separation

Candidate GI Project E-11
(Lake Shore Blvd from East 156th to East 169th St)



CSO Volume Reduction Potential	1.3 MG
Opportunities	1. Partnership opportunities: • City of Cleveland – Lakeshore Blvd repaving 2. Potential existing separated storm sewers on East 167th St and East 168th St and south of Lakeshore Blvd.
Potential GI Control Measures	Offload to Green Creek culvert using: Detention Green street Storm sewer separation

Candidate GI Project E-3
(St Clair Ave to CSX Rail; Industrial Park and CMSD Bus Storage)



CSO Volume Reduction Potential	1.2 MG
Opportunities	1. Partnership opportunities: • City of Cleveland – Industrial park redevelopment 2. Impervious area disconnection: Industrial area along St Clair Ave
Potential GI Control Measures	Offload to Doan Brook using: Detention Green streets Storm sewer separation

Candidate GI Project BC-6
(Valley Rd and West 20th St)

CSO Volume Reduction Potential	0.9 MG
Opportunities	1. Potential existing separated storm on West 20th St 2. Impervious area disconnection: Industrial area along Valley Rd
Potential GI Control Measures	Offload to Big Creek using: Detention Storm sewer separation

Appendix H: Table of Responses by NEORSD to USEPA Comments, January 30, 2012

I. Section Specific Comments				
Chapter-Page	**#**	**Comment**	**Response**	**GI Plan Updated Section**
2-2	1	3rd paragraph - The discussion may imply grey infrastructure planning/design comes first, with green infrastructure to be fitted in post facto. In some situations grey infrastructure may be the initiator of the planning/design and green infrastructure planning follows that, but in many cases green planning should precede or be intertwined with grey infrastructure planning. EPA recommends that NEORSD highlight that the green planning here is unique because the District is looking for green CSO reduction on top of (beyond) the grey infrastructure features and performance. Different approaches for green planning could be appropriate in other situations.	Text has been added to the Introduction and Background - Chapter 1.	1-1
2-5	2	Last bullet - Is there any potential conflict with the county engineer here?	There is no anticipated conflict with the County Engineer. The District will ensure construction projects are reviewed by the appropriate agency or city to ensure compliance with local, federal and state regulations.	N/A
5-5	3	3rd bullet - Define "environment" (in context of offloading SW volume to the environment.)	"Environment" is defined as soil for infiltration or surface water after being appropriately treated through a stormwater control measure.	5.2
2-9	4	Section 2.5 - There is no mention of any physical monitoring of either flow or pollutants from the GI measures. This should be planned for and covered in the Green Infrastructure Post-Construction Monitoring Plans.	Section 2.5 of the GI Plan is specific to the methods for gauging performance of green infrastructure control measures for purposes of GI Plan development. Physical monitoring of the green infrastructure control measures ultimately constructed will be performed as part of the performance compliance post-construction monitoring activities. The proposed physical monitoring activities will be outlined in the GIPCM Plans required to be submitted for EPA approval as discussed in Chapter 5 of the GI Plan.	N/A
3-2	5	This section needs more clarity. Additional detail is needed on the methods and qualitative judgments applied in the ranking process that is nominally illustrated in Figure 4.	Additional language was added to Section 3.1.2 to provide more clarity on the Baseline Index scoring process.	3.1.2
3-6	6	Section 3.1.2 - It would be appropriate to show in a graph the distribution of rainfall for the stated average year. *(Think they are referring to Section 3.1.3.2)*	The table of storm events for the District's "typical year" was recorded in Appendix 2 of the Consent Decree. A graphical representation of the table has been added to in Section 3.1.3.2 of the GI Plan.	3.1.3.2
3-1	7	(in discussion of 3 steps) states that "The district developed GI projects and evaluated them…" The plan does not so much identify "projects" as it does identify areas where there are opportunities for green infrastructure implementation that would likely contribute toward significant CSO reductions and toward meeting the 44 MG commitment. The District stated that it will plan specific projects in the opportunity areas as NEORSD proceeds with plan implementation.	Agreed.	N/A
3-6	8a	Section 3.1.3.2 - A 30-percent reduction was used in the model. How did NEORSD arrive at this percent reduction?	The District modeled the effect of 0, 5%, 10%, 15%, 20%, 25%, and 30% area reductions to simulate the effects of GI implementation. The modeling effort was used to gage the reactivity of the system and 30% reduction was deemed the maximum that could reasonably be achieved on a CSO-catchment scale, based on professional judgment. In developing the index we chose to work with 30% because we wanted a single metric and 30% seemed to offer the greatest differentiation between CSOs.	N/A

Chapter-Page	#	Comment	Response	GI Plan Updated Section
3-13	9	"Soil Characteristics"- another source available to the District is the USDA's Web Soil Survey for soils information. Yet, this data does not have sufficient spatial resolution to help with this GI design project. ORD is willing to provide interpretive assistance to NEORSD with regard to the detailed soil information collected 2010, 2011, which will be particularly helpful for the Aetna-area project.	The comment has been noted and will be considered in future phases of program design.	N/A
3-17	10	Table 8- Normally a wet extended detention basin should have a permanent pool greater than 3 feet deep. At that shallow depth, the water temperature in warm weather will rise and lower oxygen levels and may not provide good habitat for aquatic species. Second, the shallow depth allows sunlight to penetrate to the bottom encouraging undesirable plant/algae growth. The shallow depth may also impede pollutant removal. (Safety may be a consideration with any depth of pool)	The comment has been noted and will be taken into consideration during design.	N/A
3-15	11	Figure 12 seems to be based upon the modeling methods presented in Appendix pgs. D1-D3. Figure A1 reads as incomplete – an example of missing information or insufficient specificity is that some of the labels are missing type of area (e.g., DCIA), which needs to be more specific to be clear and understandable.	Figure 12 illustrates the process followed to calculate the CSO volume reduction potential for GI Projects evaluated during the development of the GI Plan. This process used a ratio of stormwater control to CSO volume reduced that was based on modeling evaluations of representative areas within each major interceptor system. Figure A1, Appendix D, summarizes the process for modeling evaluations conducted within each major interceptor system to develop the ratio of stormwater control to CSO volume reduction. Figure A1 in Appendix D was revised to better define the use of the term area (page D-3).	Appendix D
3-16	12	Table 7 and related text - vacant lot reclamation may use existing soils for some proportion of the soil volume required for renovation. This would reduce the volume of topsoil that would need to be purchased.	Agreed. More detailed cost estimates will be developed in subsequent phases of design when the District has a better understanding of site specific conditions.	N/A
3-17	13	Paragraph below Table 8- More information should be provided on how NEORSD will control or ensure proper maintenance on green street projects (especially when interacting with homeowners). Will "shrinkage" due to theft be an issue, or perhaps the 55% markup will account for this.	As green street GI control measures are developed during the final design phase the District will consider and develop design, operation and maintenance standards that align with the City of Cleveland maintenance capabilities. The 55% markup is for construction contingency, and engineering design and construction administration related services and does not included issues related to theft.	N/A
5-4	14	Table 11, first row- The table indicates that storage is provided for "all runoff from a tributary drainage area" and that this area can be removed from the model. In some cases, a revised drainage configuration may remove all stormwater in a particular catchment, but if storage is provided within a catchment, the amount of control will be limited to the amount of storage provided. If there is a storm size that would not be fully captured and stored, the drainage area cannot be removed from the model.	Agreed. Hydrologic and hydraulic models will be modified as necessary to simulate a full range of storm events for the proposed GI projects. Drainage area will only be removed from the system-wide model if GI projects result in a completely new drainage path with no possibility of inflow or infiltration into the combined sewer system. Table 11 has been revised to reflect this clarification (page 5-4).	5.2
5-5	15	Similar to comment from Pg.3-12- In the third bullet, "offloading" to the environment is mentioned. This can only be done if there is appropriate treatment for flow detention/ reduction and pollutant treatment. Otherwise, EPA would not consider it a green infrastructure alternative.	See Comment #8b	N/A
5-8	16	For the third and fourth bullets- if parkland is going to be used- will there be space for these items after the GI structure is installed?	Yes.	N/A
A-7	17	There's no mention of the purpose of the Easement (i.e., in conjunction with a GI program and a CD) and are being tracked to comply with a Decree.	Appendix A has been revised to address comment (page A-7)	Appendix A

Chapter-Page	#	Comment	Response	GI Plan Updated Section
A-8	18	Possible inspection by EPA of a site shall be included under (2).Pg B- There's no mention of the purpose of the Easement (i.e., in conjunction with a GI program and a CD) and are being tracked to comply with a Decree.	Appendix A has been revised to address the comments (page A-9).	Appendix A
B-2	19	USEPA/Ohio EPA shall have access and authority to do inspections of the GI (1) to determine compliance with the Consent Decree and the CWA and (2) to be able to do physical monitoring (as is now currently available in industrial user situations.)The easement agreements should alert landowners that EPA has this regulatory responsibility.	The Easement and Permanent Access and the Operation and Maintenance Agreement templates have been revised to allow for access, inspection, and monitoring.	Appendix A/B
B-1/2	20	the agreement states- "Owner agrees to operate and maintain in perpetuity the GI control measures in accordance with the approved operation and maintenance plan."	Appendix B, page B-2 includes a section entitled "Default" which places the burden of maintenance on the District in the event the Owner fails in its performance. No update/revision was necessary.	N/A
B-2	21	under Payment and Term, the appendix states, "The Owner is responsible for the financial costs of operation and maintenance of the GI control measures for a [*insert details on term of the agreement*]." What happens after the term of the agreement? What is the mechanism to ensure the GI is maintained in perpetuity?	Appendix B under "Payment and Term" has been revised to transfer responsibility to the District for O&M upon completion of the term (page B-2).	Appendix B
B-2	22	As-Built drawings should be part of the records maintained, not just by any external partner to of NEORSD, but also by NEORSD itself, to make any repairs.	NEORSD will maintain records of As-Built drawings for all GI projects (page B-2).	Appendix B
B-2	23	Inspections should follow the practices outlined in Ohio EPA's construction site permit for post construction practices or more often as will be required to properly ensure the operation and maturity (for plants) of the GI method. This may mean on a case-by-case basis the agreement will have to be written to address the particular requirements of the GI method installed. The maintenance plan may be a place to house some of this information.	As specified in Section 5.4 of the Plan, the District will develop a site and project specific O&M Plan that provides for adequate long term performance of constructed facilities.	N/A
B-4	24	In the fourth paragraph the statement should be revised to add "and as often as is necessary to maintain this agreement in perpetuity…"	Appendix B has been revised with language concerning notice to future owners of the perpetual nature of the GI control measure (page B-4).	Appendix B

II. General Comments associated with Appendix A and B				
Chapter-Page	**#**	**Comment**	**Response**	**GI Plan Updated Section**
Appendix A/B	25	What elements in these documents are non-negotiable? In other words, each of the individual GI projects on private property will be negotiated separately and will be unique projects with unique characteristics. Therefore not every one of those private owners/businesses/organizations will agree to these exact terms. NEORSD has stated these agreements will serve as the models or templates. What terms/elements found in these model documents would be considered non-negotiable and be contained in all future transactions?	Non-negotiable elements include: District's right to inspect and approve/disapprove any work; District's right for design and plan review; the Easement and Maintenance Agreement are perpetual and will run with the land; EPAs' rights of inspection and monitoring; conveyance and transfer procedures; District's right of approval for any relocation/redesign; any relocation must occur within the same sewershed.	N/A
Appendix A/B	26	Language about the transfer of the easement to another owner if the property was to change hands via a sale, gift, foreclosure, is not included, An easement should be a permanent encumbrance on the property that would be discovered in any due diligence (e.g. title search) conducted as a part of a real estate transaction. However some easements have different rules (length, disclosure.) The agreements should more openly address how the terms of the easement transfer to the future property owners and should be disclosed. No formal or informal expiration date for these agreements regardless of the number of property owners (1 or more).	See the District's response to Comment #24.	Appendix B
Appendix A/B	27	In (If?) the GI infrastructure has to be moved or relocated that the performance standards (gallons, acres, flow…) are maintained in the same location (sewer shed), language should be included to address this. The language in the document should make clear that the easement and associated GI has to stay on the same property. *See* Section 6 Page 3 and Section I Page 5.	Additional language has been added to both the Easement and Permanent Access template (page A-9 section 6) and the Operation and Maintenance Agreement template in the section relating to redesign/relocation (page B-2).	Appendix A/B
Appendix A/B	28	The records referred to at the top of Page 2 - "NORTHEAST OHIO REGIONAL SEWER DISTRICT OPERATION AND MAINTENANCE AGREEMENT TEMPLATE" shall be available to EPA/OEPA.	The District will make the records available to USEPA/OEPA upon request.	N/A
Appendix A/B	29	NEORSD shall retain the right to take whatever steps necessary to correct any deficiency in the GI, if the owner defaults or there is a failure in the technology, or there is an emergency (or for other compliance reasons). The agreements to should be sufficiently robust to ensure NEORSD legally has that authority. See Page 2 "Default" - NORTHEAST OHIO REGIONAL SEWER DISTRICT OPERATION AND MAINTENANCE AGREEMENT TEMPLATE.	The agreements ensure that the District has the legal authority to act upon the owner's default.	N/A

III. Additional Overall Comments				
Chapter-Page	**#**	**Comment**	**Response**	**GI Plan Updated Section**
	30	With regard to Table 10, and on page F-2, and in other places, EPA shall verify and document what costs can be counted toward the $42 million commitment incurred by NEORSD. Construction and installation costs are allowed under the Decree. For example, it is clear that design costs, construction costs and construction oversight costs are included. Soft costs, such as costs for consultation, etc, are not associated with construction and installation	As required under Item #6 of Appendix 3 of the Consent Decree, the District shall submit green infrastructure post-construction monitoring reports providing the results of the GIPCM programs for approval to EPA and Ohio EPA in accordance with the EPA approved GIPCM plan. These post construction reports will include documentation of cost information for purposes of EPA review and approval towards the required $42M expenditure. Section 5.6 of the GI Plan which discusses the post-construction monitoring program has been updated to include the documentation and submittal of cost information for EPA approval as part of the GIPCM reports.	5.6
	31	In general, the effort by NEORSD to model the runoff, hydraulics and CSO discharges is not described in sufficient detail. EPA/OEPA need more information to understand the modeling effort by NEORSD. As EPA/OEPA begin to evaluate the projects for the 42/44 projects or possible substitutions under Appendix 4 of the CD, NEORSD will be well served by a modeling program that is clear, easily understood by EPA/OEPA and other sewer districts (who are looking to NEORSD for guidance and standards of practice) and forward looking is crucial to the success of the GI program. NEORSD must examine this issue closely. The District currently uses three models to simulate runoff, hydraulics, and CSO discharges – an older version of SWMM, Mike Urban and Infoworks (the last two are commercialized versions of SWMM). This leads to the possibility that the system performance, much less the effects of the GI will not be consistently characterized across all the areas. Also, there is a LID Usage Editor in the newer version of SWMM, among other commercialized versions of SWMM (we are just using SWMM as an example here that we are more familiar with than the commercial versions). Hydrologic modeling for system performance with and without GI would be simpler and more consistent across the service areas if the District were to use the versions of hydraulic-hydrologic modeling software (e.g., SWMM5 LID) across all the service areas. Each of the modeling programs in the different interceptor systems (SWMM, InfoWorks, and MIKE Urban) employs its own way of modeling LID controls.	Table 11, in the GI Plan, provides a general overview of the approach to H&H modeling anticipated for the simulation of GI projects. The approach provided in the table was developed to allow the District to utilize the most advanced tools available for the simulation of GI projects, without creating software limitations that might reduce the quality and cost effectiveness of design, and resulting effectiveness of GI projects. The District is aware of the potential issues identified by the EPA and continues to consider model and modeling enhancements, including but not limited to a standard software platform, which improve the District's ability to design gray and green CSO projects that achieve the required levels of control and allow for accurate evaluation of project performance. As required by Item #6 of Appendix 3, the GIPCM plans that will be developed and submitted for EPA review and approval will set forth the steps/methods to evaluate the performance and effectiveness of GI measures.	N/A

Chapter-Page	#	Comment	Response	GI Plan Updated Section
	32	Unless they NEORSD commits to a single modeling platform, how will the District be able to achieve a standard way of evaluating system performance, generate or compare uncertainty in model output, compare model validation (see Table A3) and assess the relative effectiveness of GI practices. It will remain an open ended question as to the accuracy of modeled SW volumes, reduction in CSO volume, impacts due to GI; all leading to an increase in uncertainty on costs, compliance, and ability to trade green for gray. Using a single modeling platform would make this process comparable clear, cohesive and integrated amongst the different conditions proposed.	While the District's H&H modeling platforms currently do vary, the processes used to simulate system-wide hydraulics is generally consistent between MIKE Urban and InfoWorks. The District will use a consistent approach for the hydrologic simulation of GI projects. If necessary, this consistent approach for hydrologic simulation of GI projects can be performed outside of the MIKE Urban and InfoWorks modeling applications to calculate runoff hydrographs resulting from the construction of GI projects. These externally calculated stormwater runoff hydrographs can be directly entered into the CSO hydraulic models in place of the stormwater runoff hydrographs calculated by the native hydrologic model. Where appropriate, the District will use SWMM5 or equivalent hydrologic modeling applications consistently for the simulation of GI projects.	N/A
	33	It was insufficiently explained in Appendix D how the District will determine a ratio of storm water capture volume to CSO reduction used (along with costs and other criteria) to select a subset of projects to implement. It wasn't made clear how each of the GI project's reduction in storm water runoff was computed, how this reduction was translated into the "area" reductions used in their model runs, and why only two storms (instead of the full typical year) were analyzed using the system hydraulic model to determine actual overflow volume. It is unclear if best modeling practices were followed or not.	The modeling evaluations conducted to develop the stormwater capture to CSO reduction ratios were intended to provide the District with planning level metrics useful for the evaluation of a large number of conceptual GI projects. These planning level metrics were suitable for the GI project evaluations conducted to develop the GI Plan, but will be replaced with more detailed, GI project specific, evaluations in future design phases of the District's GI program. Table A.3 of Appendix D, summarizes a comparison of the CSO volume reduction calculated through the stormwater capture to CSO reduction ratio, and full typical year model simulations of four specific conceptual GI project areas evaluated to validate the planning level metrics. It shows that the planning level metrics were generally representative of the impact of stormwater control on CSO volume reductions. Appendix D was modified to include additional discussion of the specific steps followed to create the stormwater capture to CSO reduction ratios.	Appendix D

Chapter-Page	#	Comment	Response	GI Plan Updated Section
	34	Each of the feasible sites is evaluated in isolation from one another. NEORSD does not consider possible interactions between GI installations at combinations of feasible locations. The District's current approach guarantees that only a few of the many possible designs actually get evaluated. It is likely that more effective designs exist, but these were excluded from the earliest point in the analysis. One way to accomplish this is to apply the targeted criteria first, then the Baseline index. This may correct unwittingly removing the most effective locations from consideration based on relatively "soft" criteria.	The H&H modeling performed as part of the GI plan development was used to determine the CSO reduction potential and relative cost to prioritize GI project areas for further evaluation. Future model evaluations will be setup to more specifically represent the configuration of actual GI projects, and will evaluate all GI projects anticipated to be implemented within each interceptor system. The Baseline Index, which considered the presence of well drained soils, available land, imperviousness, partnering opportunities, parks, greenways and development opportunities all of which are not viewed as soft criteria by the District, was developed to determine the potential opportunity and suitability for GI in a particular area but did not exclude any areas from consideration. The 44-MG Targeted Index is intended to represent performance effectiveness in terms of CSO reduction towards the 44 MG. CSOs with minimal or no remaining overflow volumes have no effect towards achieving the 44 MG target regardless of the level of GI implementation. The GI index equally considered the numeric scores of the 2 indices through a cumulative 20-point scale.	N/A
	35	There is scant mention in the Plan of training for maintenance by and for either NEORSD or external partners on how to maintain and operate (and some of these GI methodologies will require "operation" by personnel) the structures. NEORSD should develop a training program for NEORSD personnel, and the external partners.	The District will engage the Operations and Maintenance (O&M) Department as the Candidate GI Projects are refined and specific GI control measures are selected to ensure they are informed on the type of maintenance that will be required in each GI Project area that is implemented. The District will then work on training internal staff and external partners once there is more certainty on the type of GI control measures to be applied as a part of the GI Plan. It would be premature to develop these programs prior to the development of more specific information on GI projects to be implemented. The District O&M Department will be well equipped to manage the O&M requirements of the GI control measures with the implementation of the District Regional Stormwater Management Program. Under this program the O&M Department will be responsible for the long-term inspection, operation and maintenance for stormwater control measures along the regional stormwater system.	N/A
	36	It is important to define environmental justice both generally and in the context that it will be applied in the NEORSD GI program. A clear definition of environmental justice in the document will impart a guiding set of principles to help NEORSD place their planned activities in context and how these with furthermore address commonly-accepted attributes of EJ. It seems like NEORSD could leverage their existing education and outreach team to develop, or adapt an existing program, that would be targeted solely to working with and within communities on this GI matter.	Additional language has been added to Section 2.6 of the document including a description of environmental justice beyond the "environmental justice considerations" defined/required per Appendix 3.	2.6

Chapter-Page	#	Comment	Response	GI Plan Updated Section
	37	The purpose of a continuous simulation hydraulic-hydrologic model is to account for changes in water balance components in response to rainfall events distributed over the course of a specified time interval. Two storms were chosen to represent conditions leading to CSO volume, even though there exists a fully-implemented gray infrastructure. These storms are not described quantitatively, and there is no discussion of the time of year or antecedent conditions preceding these two storms. Since these factors would impact the model output, they should be discussed.	The planning level evaluations conducted as part of the GI Plan development considered the two largest storm events in the District's CSO Phase II Facilities Plan defined "typical year" for purposes of targeting remaining overflow volume after implementation of the required gray infrastructure. This targeted evaluation of the two largest storms was done to simplify the planning process and allow for the evaluation of a significant number of alternative GI projects in a limited schedule. Future design and performance compliance evaluations of specific GI projects will include a continuous simulation of the full typical year of rainfall using the CSO Phase II Facilities Plan models. This continuous simulation models/modeling will consider the time decay and recharge of soil storage capacity representing antecedent moisture conditions.	N/A
	38	The possibility of GI impacts on rainfall-derived inflow and infiltration (RDII) into wastewater pipes, water table inflow-infiltration, and exfiltration from leaky wastewater pipes should be mentioned. As a site where I&I of any type is not expected, such as the U. Circle Courtyard Hotel, deep vertical infiltration-percolation is expected since subsoils are sandy. Include contrasting example where I&I of some type may be an issue, and how it might be dealt with.	As with all GI control measures, considerations that ensure accurate estimation and required performance of GI control measures employing infiltration and evapotranspiration will be made during project design, implementation, and performance evaluation. Example: Candidate GI Project S-7 includes an area known as the Agricultural Innovation Zone. One of the alternatives under consideration for this area is the creation of a highly pervious agricultural area that is drained by a system of vegetated swales to promote infiltration and evapotranspiration. The vegetated swales would discharge into a stormwater control measure to provide water quality treatment and storage. This area is currently drained by a network of combined sewers that provide stormwater and sanitary drainage for a land use that no longer remains. The conceptual plan for this Candidate GI project would require the existing combined sewers to be abandoned and bulkheads be placed to eliminate discharge of I&I into downstream combined sewers. This example is likely representative of conditions that exist within many of the Candidate GI Project areas.	N/A