Green Infrastructure Plan for the Upper Rouge Tunnel Area

Detroit Water and Sewerage Department
735 Randolph
Detroit, MI 48226

August 1, 2014

Green Infrastructure Plan
Upper Rouge Tunnel Area

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NPDES Permit No. MI0022802

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TABLE OF CONTENTS

1.0 EXECUTIVE SUMMARY 1

1.1 Introduction and Background 1
1.2 Proposed Plan 1

2.0 INTRODUCTION AND BACKGROUND 5

2.1 Overview of the NPDES Permit 6
2.1.1 Green Infrastructure Plan 6
2.1.2 Expenditure Requirements 7
2.1.3 Design Standards for Redevelopment 7
2.1.4 Hydrologic Goals 7
2.1.5 Geographic Scope and Priority Areas 8
2.2 Description of the Project Area 10
2.3 Overview of Implementation Efforts to Date 12
2.4 Organization of the Plan 12

3.0 TECHNICAL APPROACH 13

3.1 Funding 13
3.2 Performance 13
3.2.1 Performance Considerations 13
3.2.2 Initial Performance Objectives 15
3.2.3 Refining Performance Objectives 15
3.3 Quantifying Runoff 15
3.3.1 Initial Approach 15
3.3.2 Future Approach 17
3.4 Project Identification, Characterization, and Selection 18
3.4.1 Identification Methods 18
3.4.2 Prototype Projects 19
3.4.3 Project Characterization 19
3.4.4 Project Selection 21
3.5 Tracking and Performance Assessment 21
3.5.1 Approach 22
3.5.2 Data 22

4.0 PROGRAM MANAGEMENT EFFORTS 22

4.1 Communication and Outreach 22
4.1.1 Partner Collaboration 22
4.1.2 Outreach Vision 27
4.1.3 Green Infrastructure Outreach Process 28
4.1.4 Current Outreach and Engagement Activities 29
4.2 Financing Green Infrastructure 30
4.3 Practice Sustainment & Maintenance 30
4.3.1 Sustainment of Green Infrastructure 30
4.3.2 Maintenance of Green Infrastructure 31
4.4 Adaptive Management 31

5.0 PARCEL-RELATED POLICIES AND STANDARDS 32

5.1 Drainage Charge System 32
5.2 Code and Ordinance Review 33

6.0 GREEN INFRASTRUCTURE PRACTICES 33

6.1 Downspout Disconnection 34
6.1.1 Residential Disconnections 34

6.1.2 Non-Residential Properties 38
6.2 Public Facilities Flow Management 39
6.2.1 Opportunity Identification Process 40
6.2.2 Opportunity Evaluation 41
6.3 Park Flow Management 45
6.3.1 Practice Types 45
6.3.2 Opportunity Identification Process 47
6.3.3 Opportunity Evaluation 47
6.4 Demolitions and Removal of Structures on Vacant Properties 49
6.4.1 Prior and Current Demolition Activities 49
6.4.2 Demolition Opportunities 56
6.4.3 Lot Greening Opportunities 56
6.5 Tree Planting 59
6.5.1 Current Conditions 59
6.5.2 Opportunity Identification 65
6.5.3 Quantification 68
6.6 Transportation Corridor Flow Management 68
6.6.1 Roadway Types 69
6.6.2 Practice Types 71
6.6.3 Opportunity Identification Process 72
6.6.4 Opportunity Evaluation 77
6.7 Other GI Implementation Projects 80
6.7.1 Large Impervious Property Owners 80
6.7.2 Collection System Characterization, Open Stream Connections 82

7.0 ACTION PLAN 86

7.1 Introduction 86
7.2 Implementation Schedule 86
7.3 Summary of Activities 86
7.4 Activities Descriptions 88

APPENDIX

Appendix A – Example Maintenance Covenants

LIST OF TABLES

Table 1 Action Item Summary 4
Table 2 Project Area Land Cover Summary 10
Table 3 Runoff per Impervious Acre 15
Table 4 Precipitation Frequency 15
Table 5 Curve Numbers Representing Land Cover Classifications 17
Table 6 Characterization and Evaluation of Opportunities 21
Table 7 DWSD's Green Infrastructure Partners and Their Role 23
Table 8 Residential Home Disconnection Potential 37
Table 9 Non-Residential Disconnection Potential 39
Table 10 URT Area Public Properties 40
Table 11 Detroit Public Schools 40
Table 12 City and Governmental Owned Properties within NWI Area 41
Table 13 Opportunity Evaluation: Managing Park Runoff 47
Table 14 Opportunity Evaluation: Redirecting Road Runoff into Parks 48
Table 15 2010 Baseline Conditions of Vacant Parcels (No Structures) 50
Table 16 Impact of Demolitions, 2010 – 2014 50

Table 17 DWSD Funded Demolitions through June 30, 2014 53
Table 18 Identified Proposed Demolitions in URT 53
Table 19 2014-2015 Demolition Programs 56
Table 20 Large Scale Greening Impacts 59
Table 21 Davey Tree Inventory Results 60
Table 22 Tree Planting Summary 62
Table 23 Storm Water Benefits of Tree Planting 68
Table 24 Transportation Corridor Area Summary 68
Table 25 Transportation Corridor Runoff Summary 69
Table 26 Correlation of Practice Type to Roadway Type 72
Table 27 Data Used in the Opportunity Identification 73
Table 28 Opportunity Evaluation: Road Lane Removal 78
Table 29 Opportunity Evaluation: Right-of-Way Practices 79
Table 30 Redirecting Road Runoff to Adjacent Parcels Opportunity Evaluation 79
Table 31 Redirecting MDOT Storm Water Pump Station Discharge Opportunity Evaluation 79
Table 32 Top 25 Impervious Parcels in the URT Area 80
Table 33 Open Stream Evaluations 84
Table 34 Inflow Contribution from Open Streams 84
Table 35 Action Item Summary 87

LIST OF FIGURES

Figure 1 Geographic Priority Areas 9
Figure 2 Detroit Future City Vacancy Classifications 11
Figure 3 Neighborhood Locations and Community Associations 26
Figure 4 Residential Property Ownership and Status 34
Figure 5 Downspout Disconnection Display and Brochure 35
Figure 6 Residential Rain Barrel and Rain Garden 37
Figure 7 Non-residential Property Ownership and Status 38
Figure 8 6th/8th Police Precinct and Park 43
Figure 9 School/Health Services/Park 43
Figure 10 Garden View Estates Site 44
Figure 11 Ludington Magnet Middle School/ 44
Figure 12 Public Park Locations 46
Figure 13 Stoepel Park Number 1 Green Infrastructure Opportunities 49
Figure 14 Demolitions 2010 - 2014 51
Figure 15 DWSD Funded Demolitions 2010-2014 52
Figure 16 Hardest Hit Fund Priority Neighborhoods 55
Figure 17 Brightmoor Large Scale Greening Opportunities 58
Figure 18 Davey Tree Inventory Results of Healthy Street Trees 61
Figure 19 Street Tree Planting Efforts from High School Students and Local Residents 62
Figure 20 Street Tree Planting Locations 64
Figure 21 Tree Box Concept 65
Figure 22 Davey Tree Survey –Residential Structures with No Street Tree 66
Figure 23 Proposed 2014 Tree Plantings 67
Figure 24 Roadway Jurisdictions in the URT Area 70
Figure 25 SEMCOG Excess Roadway Capacity Analysis 74
Figure 26 PASER Road Survey Data 75
Figure 27 Motor City Mapping Parcel Survey Data 76
Figure 28 Overall Map of Green Infrastructure Opportunities in Transportation Corridors 77
Figure 29 Top 25 Impervious Parcels 81
Figure 30 Open Channel Connection Locations 83
Figure 31 Berg South of Seven Mile (left) and Fenkell and Bentler (right) 85
Figure 32 Drainage Area for Connected Open Channels 85

ACRONYMS/ABBREVIATIONS

Acronyms/ Abbreviations	Definition
ASCE	American Society of Civil Engineers
BMP	Best Management Practice
BSEED	City of Detroit Building, Safety Engineering and Environmental Department
CDBG	Community Development Block Grant
cfs	Cubic feet per second
CN	Curve Number
CSO	Combined Sewer Overflow
DBA	Detroit Building Authority
DFC	Detroit Future City
DLBA	Detroit Land Bank Authority
DPW	City of Detroit Department of Public Works
DWSD	Detroit Water and Sewerage Department
EPA	U. S. Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
fps	Feet per second
GDRSS	Greater Detroit Regional Sewer System
GI	Green Infrastructure
GSD	General Services Department
HSG	Hydrologic Soil Group
HUD	Housing and Urban Development
LID	Low Impact Development
MCM	Motor City Mapping
MDEQ	Michigan Department of Environmental Quality
MDOT	Michigan Department of Transportation
MS4	Municipal Separate Storm Sewer System
MSHDA	Michigan State Housing Development Authority
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service (formerly Soil Conservation Service, SCS)
NSP	Neighborhood Stabilization Program
NWI	Northwest Interceptor
O&M	Operations and Maintenance
P&DD	Planning and Development Department
PASER	Pavement Surface Evaluation and Rating
PS	Pump Station
RCP	Reinforced Concrete Pipe
ROW	Right-of-way
SCS	Soil Conservation Service (now the NRCS)
SEMCOG	Southeast Michigan Council of Governments
SFR	Single Family Residential
Tc	Time of Concentration
Tt	Travel Time
TR-55	Technical Release No. 55
URT	Upper Rouge Tunnel

1.0 EXECUTIVE SUMMARY

On May 19, 2010, the Michigan Department of Environmental Quality (MDEQ) approved projects that would replace the then proposed Upper Rouge Tunnel (URT). The alternate projects included a $50 million investment in green infrastructure to occur between 2010 and 2029. Over the period of 2013 – 2017, an investment of $15 million is required by the permit, with a performance expectation of 2.8 million gallons (MG) of flow reduction in a two-year design storm. The permit language identifies a number of specific green infrastructure project types, including downspout disconnections, demolition and removal of vacant structures, bioswales along roadways and parking lots, tree planting and other projects.

1.1 INTRODUCTION AND BACKGROUND

The Green Infrastructure Program (Program) is focused on a 37.5-square-mile area which was the tributary area to the proposed URT. The area includes a variety of neighborhoods, industrial, and commercial areas which are in varying states of stability. As with the vast majority of the City of Detroit, this area is a combined sewer system. Some of the combined sewage flows generated in this area are managed at the Hubbell-Southfield CSO Facility, while other combined sewage flows are tributary to uncontrolled outfalls. The primary purpose of the Program is the reduction of combined sewage overflows through storm water management. However, a significant benefit of green infrastructure is its ability to support improved socio-economic conditions. Therefore, both CSO control and potential for community benefits will be a key determinant in the type of project selected and implemented.

In July 2013, the City of Detroit filed for bankruptcy. The bankruptcy was preceded by the March 2013 appointment of an emergency financial manager and followed by the election of Mike Duggan as mayor, with administration beginning in January 2014. These noteworthy events highlight the significant institutional changes that are occurring in Detroit. Some of these changes, such as the consolidation of demolitions under the Detroit Building Authority (DBA), and the major new role of the Detroit Land Bank Authority (DLBA) require adjustments to processes. Others, such as the completion of the Motor City Mapping Project, provide new sources of information and data that are highly beneficial to the Green Infrastructure Program. Overall, the changes in the institutional landscape provide additional opportunities for the implementation of green infrastructure in the City of Detroit. There is significant motivation and momentum to use green infrastructure not only for CSO control, but also to improve the social and economic conditions in the City.

Also in 2013, DWSD implemented the selection process for DWSD Contract No. CS-1522 - Green Infrastructure Program. This contract provides for $14.5 million to assist DWSD with the evaluation, design, and implementation of green infrastructure improvements over the course of the next five (5) years. Tetra Tech was selected for this contract, with work initiated in February 2014.

As a result of the myriad changes, not only in DWSD's team for the Green Infrastructure Program, but also within other agencies and institutions in the City of Detroit, the Green Infrastructure Plan developed in 2013 has been significantly updated. The 2014 version of the Green Infrastructure Plan (Plan) therefore replaces the 2013 version. It has been prepared pursuant to the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit No. MI0022802 and consistent with the report, Evaluation of CSO Control Alternatives, dated December 15, 2009. The Plan will lead to the reduction in storm water inputs into the DWSD combined sewer system, and thus aid in the reduction of combined sewer overflow (CSO) discharges. This Plan is intended to more specifically define potential project types and locations versus the 2013 version of the plan. It also addresses a series of comments on the 2013 document provided by the Michigan Department of Environmental Quality (MDEQ) dated October 16, 2013. The Plan includes a specific action plan that includes five major activities that will result in green infrastructure implementation and the development of institutional structures and complex prototype projects.

1.2 PROPOSED PLAN

DWSD's Green Infrastructure Program will be a continually evolving effort to identify and implement projects and programs that will reduce CSO discharges while benefiting the community. Ultimate benefits associated with green infrastructure will accumulate as land uses change and sites are redeveloped, vacated, or retrofitted.

Therefore, the Plan establishes a balanced suite of activities which consider long-term and short-term objectives, and balance institutional structures with project implementation.

DWSD's Green Infrastructure Program has identified the following major activities which will establish policies and processes and will gradually transition the program into long-term implementation.

Activity 1. Policies, Procedures and Standards

Institutional processes that are put in place by DWSD and the City of Detroit will drive implementation of green infrastructure on parcels and private property in the long term. Within the URT area, approximately 70 percent of the land area is made up of parcels and 63 percent of the total impervious area is located on parcels. Managing flow from these parcels is directly related to the institutional processes that are in development.

Code and Ordinance Review. DWSD is working with the Building, Safety Engineering and Environmental Department (BSEED), and the Planning and Design Division (P&DD) to identify code and ordinance barriers to green infrastructure. In addition, these efforts are intended to address questions related to roof drain disconnections and site development standards.

Drainage Charge System. DWSD is in the process of updating the drainage charge system to take advantage of new technology and more accurate data. As part of this effort, DWSD intends to include a calculation methodology that will recognize the benefits associated with green infrastructure. In addition, DWSD intends to provide credits for implementation of green infrastructure against any drainage charge back bills.

Activity 2. Prototype Projects

Implementation of green infrastructure requires the development of new policies, processes, and procedures. It also requires additional understanding of the performance, costs, and implementation realities associated with various project types. DWSD has worked to form relationships with a number of relevant agencies, organizations and community groups. In the process of working with these entities, a number of issues have been discussed regarding project responsibilities and concerns. The realities of policies, processes, and procedures can best be realized in the process of implementing projects. DWSD intends to launch a series of prototype projects that will help to answer the following questions:

- What policy issues need to be addressed and what procedures need to be developed in order to implement a specific project type?
- What is the timeframe associated with implementing various types of projects? What is the appropriate planning cycle?
- How well does the project type control runoff and reduce CSO discharge?
- How much does the project cost to implement?
- What technical issues need to be addressed to design and implement the project?
- What institutional issues need to be addressed to design and implement the project?
- Who will own and maintain the project upon completion?
- What project types will the community accept and under what conditions?

A variety of project types have been identified for the prototype implementation. These project types include:

- Land assembly and large-scale greening
- Right-of-way bioretention and curb extension
- Street runoff diversion onto parcels
- Community enhancement projects with parcel and roadway bioretention and impervious area removal

Activity 3. Continued Implementation Projects

DWSD has previously implemented a series of early action projects that include downspout disconnection, demolitions and site restoration, and planting trees in the program area. Each of these activities will be continued in the future, modified based on lessons learned, and adapted for current conditions. Current focus for each of these projects includes the following:

Downspout Disconnection. As noted previously, DWSD is working with BSEED on code and ordinance review. This will help improve the options for downspout disconnection, both for residential and nonresidential properties. Downspout disconnection programs for residential properties will be expanded throughout the area.

Modifications to the program to improve cost-effectiveness will be implemented. For non-residential downspouts, the primary focus will be on the institutional issues previously identified.

Demolitions and Site Restoration. The responsibilities for demolitions in the city of Detroit have shifted to the DBA. DWSD is working with the DBA on processes and funding of demolitions. DWSD's strategy will be to support demolitions which cannot be funded through other mechanisms and will result in removal of significant impervious area. As such, these demolitions may include isolated single-family homes that facilitate wider scale greening or properties with larger impervious areas (e.g. non-single-family residential properties). DWSD-funded demolitions will require control of runoff from the site as a condition of the funding.

Site restoration following demolition is a second issue being addressed. Currently, MDEQ, EPA and others are working with the DBA to develop site restoration specifications. These specifications are expected to provide reasonable runoff management from these sites. In addition, the University of Michigan is researching installation of storm water practices in the former basement excavation on demolition sites. DWSD intends to work with others to better define site runoff characteristics, implement enhanced storm water management on select parcels, and test greening techniques on vacant lots that work within the neighborhood and enhance storm water management.

Tree Planting. To date, a significant number of street trees have been planted in the URT area. Future tree planting in rights-of-way will need to be coordinated with street bioretention facilities and will also be based on neighborhood stability. DWSD also intends to work with The Greening of Detroit on other large-scale tree planting projects. These include additional trees for Rouge Park and evaluation of locations for carbon forest in proximity to I-96 or the Southfield Freeway. DWSD's investment in trees will emphasize the storm water management potential.

Activity 4. Long Term Performance

The ultimate goal of green infrastructure implementation is the reduction of CSO discharges. The benefits associated with green infrastructure may reduce the extent of future constructed CSO controls. Under the terms of DWSD's NPDES permit, the sewer system model for the URT area is being refined and recalibrated to new flow data. This updated model will be used to identify probable CSO reduction benefit from green infrastructure, while the prototype projects will help to establish practice performance, feasible levels of implementation, and cost. Long-term performance will identify probable level of implementation, costs of implementation and cumulative flow benefits associated with various projects. Long-term performance will also address questions of maintenance, sustainability through direct ownership, deed restrictions, drainage charge related sustainability requirements or other mechanisms.

Activity 5. Stakeholder and Community Engagement and Coordination

Stakeholder and community engagement is fundamentally a part of all priorities. However, it merits special discussion as a priority of the program. DWSD recognizes that the success of green infrastructure implementation and long-term maintenance depends on generating stakeholder support through a combination of tailored education and meaningful engagement activities. DWSD's approach to engagement and outreach focuses on communicating, collaborating, and coordinating with key partners at all levels. The first step has been listening to these key partners about what outreach and engagement activities will and won't work with residents and the business community, based on their experience. Using this information, DWSD has initiated the development of a green infrastructure outreach strategy to support the Green Infrastructure Program. DWSD anticipates three branches of outreach: (1) outreach and engagement related to "Green Rewards" discounts on the drainage charge; (2) project-specific outreach tailored to meet the specific needs and characteristics of stakeholders affected by green infrastructure project planning, implementation, and maintenance and (3) an overarching educational campaign developed and implemented as a collaborative effort with other key partners. To support all three branches of outreach, DWSD intends to listen to key partners and affected stakeholders to gain a better understanding of their concerns, perceptions, and vision for green infrastructure.

Table 1 Action Item Summary

No.	Activities	Schedule
Activity 1 – Policies, Procedures and Standards		
1-1	Codes and Ordinances	Complete review and recommendations by June 30, 2015.
1-2	Storm Water Technical Reference Manual	Draft of manual complete by March 31, 2015. Final version complete by March 31, 2016.
1-3	Drainage Charge Credit System	Complete initial standards and processes by April 30, 2015. Finalize by November 30, 2015.
1-4	Green Streets Standards	Draft standards by June 30, 2016. Final by June 30, 2017.
1-5	Structure Demolition and Lot Greening Standards	Provide technical support upon request.
1-6	Public Storm Water Maintenance Guidance	Draft guidance complete by June 30, 2015. Final version complete by June 30, 2016.
1-7	Municipal Storm Water Maintenance Manual	Draft manual complete by July 31, 2016. Final by July 31, 2017.
1-8	Tracking System	Draft tracking system by July 31, 2015. Final by July 31, 2016.
Activity 2 - Prototype Projects		
2-1	Small Scale Greening	Ecological restoration of demolition sites constructed by December 31, 2014. Other opportunities on-going.
2-2	Large Scale Greening	Begin stakeholder and community engagement by September 1, 2014; complete engagement process and conceptual designs by August 31, 2016.
2-3	Public Facilities Flow Management	Develop prioritized opportunity list by January 31, 2015. Project selection and implementation schedule by July 31, 2015.
2-4	Open Stream Connections	Develop prioritized opportunity list by January 31, 2015. Complete conceptual designs by June 30, 2015. Project selection and implementation schedule by July 31, 2015.
2-5	Municipal Parks Flow Management	Develop prioritized opportunity list by January 31, 2015. Project selection and implementation schedule by May 31, 2015.
2-6	Transportation Corridor Flow Management	Develop prioritized opportunity list by January 31, 2015. Project selection and implementation schedule by May 31, 2015. Annual updates and coordination with city departments, county and state.
Activity 3 - Continued Implementation		
3-1	Downspout Disconnection - Homes	Process update by November 30, 2014. Coordination with major landlords, neighborhood groups and organization by April 30, 2015. Major implementation emphasis in Spring 2015 and on-going through June 2017.

No.	Activities	Schedule
3-2	Downspout Disconnection - Multi-Family Residential, Commercial, and Industrial	Site characterization assessment complete by January 31, 2015. Approach methodology by May 31, 2015. Pilot disconnection projects by November 30, 2015.
3-3	Demolitions and Site Restoration	Budget planning by October 31, 2014. Coordination with DBA on-going.
3-4	Tree Plantings	Opportunity assessment by October 31, 2014. Additional planting beginning Fall 2014.
Activity 4 - Long Term Performance		
4-1	Updated Collection Systems Model	Complete by April 1, 2015.
4-2	Green Infrastructure Performance Planning	Complete by June 30, 2015.
4-3	Green Infrastructure Benefits Evaluation	Complete by June 30, 2016.
4-4	Amendment to the Supplemental Report on Alternative CSO Controls for the Upper Rouge	Complete by January 1, 2017.
4-5	Legal agreements for long-term sustainability	Ongoing.
Activity 5 - Stakeholder and Community Engagement		
5-1	Green Infrastructure Website	Functional by February 15, 2015.
5-2	Green Rewards Program Stakeholder Engagement	Stakeholder team formation launched August 2014 and following Drainage Charge System Schedule.
5-3	Green Rewards Toolbox	Materials available in draft form by January 31, 2016.
5-4	Green Rewards Training Workshops	Concurrent with Green Rewards Public Launch.
5-5	Green Infrastructure Case Studies and Demonstration Projects	Ongoing with initial case studies developed by June 2015.
5-6	Green Infrastructure Forum	Annually in May.
5-7	Stakeholder Involvement and Education Strategy	Draft by September 30, 2014. Finalize Plan with input by December 31, 2015.
5-8	Overarching Green Infrastructure Educational Campaign	On-going.

2.0 INTRODUCTION AND BACKGROUND

The Detroit Water and Sewerage Department (DWSD) is responsible for developing and implementing the Alternative Rouge River Combined Sewer Overflow (CSO) Control Program. This CSO Control Program is designed to restore water quality and protect public health while staying within its financial means by controlling rate increases that will be needed to pay for new projects. The program encompasses a 25-year, phased plan that focuses on green infrastructure solutions along with “right-sized” conventional CSO control facilities.

To promote efficient, targeted investments in green infrastructure, DWSD has developed this updated Green Infrastructure Plan (Plan). The goals of this Plan are to (1) fulfill DWSD’s obligations under its National Pollutant Discharge Elimination System (NPDES) permit and (2) provide a framework for moving green infrastructure implementation forward throughout Detroit, with a specific emphasis on high-priority CSO areas within DWSD’s service area.

This section provides a brief background of DWSD’s Green Infrastructure Program, including DWSD’s NPDES permit and associated green infrastructure requirements; the green infrastructure implementation geographic scope and priority areas; green infrastructure implementation efforts to date; and the organization of this Plan.

2.1 OVERVIEW OF THE NPDES PERMIT

Green infrastructure is the future of DWSD's CSO Control Program. This is reflected in the NPDES permit (Permit No. MI0022802) issued by the Michigan Department of Environmental Quality (MDEQ) to DWSD on March 1, 2013, with an effective date of May 1, 2013. The permit contains the following types of green infrastructure requirements:

- Green Infrastructure Plan
- Expenditure Requirement
- Design Standards for Redevelopment
- Hydrologic Goals

An overview of these requirements is provided below.

2.1.1 Green Infrastructure Plan

The permit requires DWSD to develop and implement a Green Infrastructure Plan for 17 specific outfalls along the Rouge River.

> *The permittee shall develop and implement a Green Infrastructure ("GI") Plan for this area consistent with the "Evaluation of CSO Control Alternatives" report dated December 15, 2009. The Plan shall be submitted to the Department for approval by August 1, 2013. The Plan shall describe a process for locating, designing, constructing, operating, and evaluating GI in these sewersheds. GI implementation shall be planned to capture wet weather flows that would otherwise flow into the sewer system and contribute to CSOs. The Plan shall include the following elements: (see Part I A.15.d.5.a.).*
>
> 1) *Provisions for disconnection of residential downspouts and disconnection of commercial and industrial downspouts where feasible (see Part I A.15.d.5.a.1.).*
> 2) *Provisions for demolition and removal of vacant structures and replacement with pervious land cover. Where demolition is planned and implemented at sites that will be re-purposed for GI, the demolition specifications shall ensure that basements and other impervious surfaces at the sites are removed, that the site is raked to remove large rocks and construction debris, and that engineered soils consisting of an appropriate mix of topsoil, compost, and sand is applied following the demolition to support plant growth and promote infiltration. (see Part I A.15.d.5.a.2.).*
> 3) *Provisions for installation of bioswales along roadways and parking lots to intercept runoff and reduce storm water inputs to the combined sewer system from impervious surfaces. (see Part I A.15.d.5.a.3.).*
> 4) *Provisions for installation of rain barrels and rain gardens at commercial and residential properties to capture and retard storm water runoff. (see Part I A.15.d.5.a.4.).*
> 5) *Provisions for tree planting for uptake and evapotranspiration along roadways and open spaces. (see Part I A.15.d.5.a.5.).*
> 6) *Provisions for other Green Infrastructure implementation projects as determined to be appropriate. (see Part I A.15.d.5.a.6.).*
> 7) *Prioritization criteria for sites where green infrastructure practices will be implemented. Prioritization criteria should focus on locations and designs that will provide the greatest benefits in terms of keeping flows out of the sewer system and helping to reduce CSOs. Additional prioritization criteria could include locations that could help reduce localized flooding or basement back-ups. (see Part I A.15.d.5.a.7.).*
> 8) *Processes for public outreach and public participation in selecting sites and implementing GI practices. (see Part I A.15.d.5.a.8.).*
> 9) *Procedures/methods for tracking green infrastructure implementation and measuring effects. (see Part I A.15.d.5.a.9.).*

10) *Provisions for ensuring appropriate maintenance of sites where green infrastructure has been implemented, including roles and schedules for maintenance. (see Part I A.15.d.5.a.10.).*

11) *Provisions for ensuring storm water management (runoff reduction) benefits associated with GI implementation continue over time, even as redevelopment may occur in the sewersheds. (see Part I A.15.d.5.a.11.).*

A green infrastructure Plan was submitted to the MDEQ on August 1, 2013. DWSD received conditional approval of the plan on October 16, 2013. As a part of the conditional approval, a revised Plan is required to be submitted by August 1, 2014, to address deficiencies noted in the MDEQ letter. This document represents the revised Plan.

2.1.2 Expenditure Requirements

In addition to the Plan requirement, the NPDES permit contains an expenditure requirement (Part I.A.15.d.5.a at page 40). This requirement states the following:

> *The investment in GI in these sewersheds will be an average of 3 million dollars per fiscal year for the ten-year period ending 2019 (for a total of $30 million), and an average of 2 million dollars per year for the following 10 years (for a total of $20 million).*

In a letter to MDEQ on November 15, 2013, DWSD committed to meeting the permit requirements during the permit cycle. However, DWSD anticipates a lower spending rate initially with increased spending rates for later years of the permit cycle as the program matures.

2.1.3 Design Standards for Redevelopment

The permit discusses future CSO control projects (Part I.A.15.d.9) and contains requirements for storm water runoff controls applied to new development and redevelopment.

> *As part of this adaptive management approach, storm water runoff from new development and redevelopment that will be conveyed through storm sewers to DWSD's combined sewers will require control to help further reduce volume and frequency of untreated CSO discharges. These are projects that will require construction plan review by the permittee, and a Part 41 construction permit issued by the Department.*
>
> *This storm water control requirement is primarily a focus within the Rouge Sewer District and Central Sewer District, as it is these Districts that have untreated CSOs. Therefore, the permittee shall propose a level of storm water control for new development and redevelopment in these two sewer districts, and for the circumstances stated above, that is designed to help further reduce the volume and frequency of untreated CSO discharges, and a procedure and schedule for implementing this control requirement. The control level, implementation procedure, and implementation schedule shall be submitted by April 1, 2017, along with the reapplication for permit.*

Under the terms of DWSD's NPDES permit, storm water controls must be implemented as part of projects that require a Part 41 permit. The NPDES permit language requires that DWSD identify a control level, implementation procedure, and implementation schedule by April 1, 2017.

It is expected that the criteria that is applied to the drainage charge system will also be applied in this instance.

2.1.4 Hydrologic Goals

The permit also introduces a performance goal (Part I.A.15.d.5.a).

> *The performance goal is that by June 30, 2017, the permittee have in place in these sewersheds GI practices that cumulatively have the capacity to reduce flows into the sewer system in a 2-year, 24-hour storm event by at least 2,800,000 gallons, as determined by using modeling and quantification methods and data sources mutually agreed to in writing between the permittee and the Department.*

The performance goal in the permit is not a requirement. Rather it is viewed as a target which will be reported on but not used as the measure of success in meeting the permit requirements.

DWSD's Green Infrastructure Program seeks to address the suite of NPDES permit requirements, using the approach presented in this updated Plan.

2.1.5 Geographic Scope and Priority Areas

DWSD's focus for green infrastructure implementation is in the Upper Rouge Tunnel (URT) area. The Upper Rouge Tunnel was a planned CSO project that was cancelled in 2009. This tunnel was planned to roughly parallel the Rouge River and collect CSO discharges from the outfalls along the Rouge River. The URT nomenclature is retained as part of the Green Infrastructure Program, as the portion of the combined sewer system that is part of the program is the same as for the planned tunnel project.

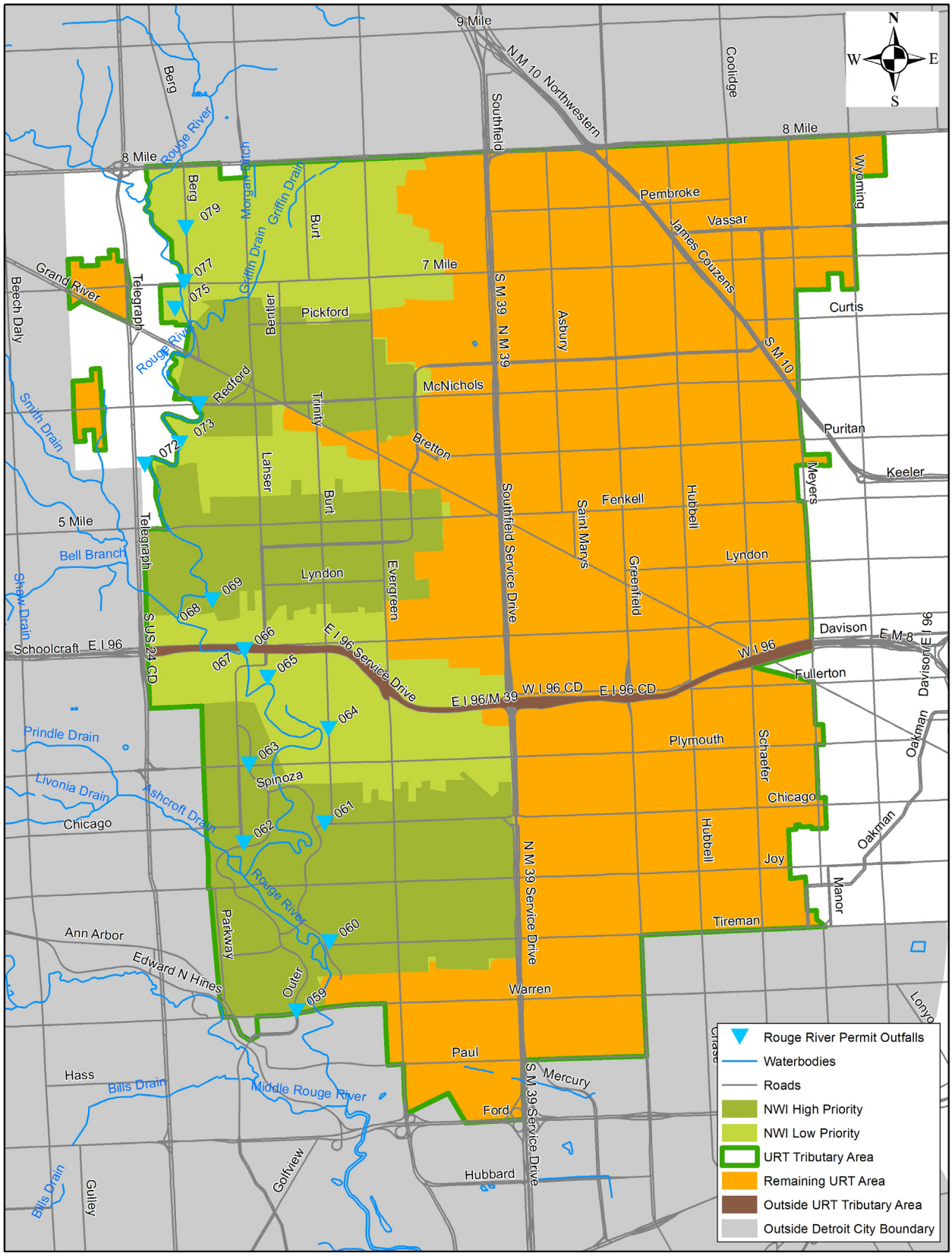
The URT area includes approximately 24,000 acres (37.5-square miles) on the west side of Detroit. The URT area is comprised of three sewer districts: Northwest Interceptor (NWI area), Hubbell, and Southfield. The combined sewer system in this area is a branched and looped system, in which the direction of flow may change based on the storm event conditions. During dry weather and small storm events, the storm water runoff from Hubbell and Southfield districts entering the combined sewer system is primarily conveyed to either the WWTP or the Hubbell-Southfield retention treatment basin. The westerly portion of the URT is directed to the Northwest Interceptor. As a result, the methodology, approach and presentation of green infrastructure opportunities contained in this Plan are focused within the Northwest Interceptor. However dependent on the flow conditions, flow from all locations in the URT has the potential to be discharged via these outfalls.

The prioritization within the URT area is based on the NPDES permit. The permit requires DWSD's Green Infrastructure Program to target the Rouge River Outfalls 059-069, 072-075, 077, and 079 (Part I.A.15.d.5.a). The NPDES permit further distinguishes high and low priority outfalls in the "Future CSO Control Projects" portion of the permit (Part I.A.15.d.9). The Rouge River CSOs are prioritized as:

- High Priority Outfalls: 059, 060, 061, 062, 069, and 074
- Low Priority Outfalls: 064, 065, 066, 067, 068, 072, 073, 075, 077, and 079

Figure 1 illustrates the tributary drainage areas, based on the GDRSS model information, along with the geographic priority areas.

Figure 1 Geographic Priority Areas



2.2 DESCRIPTION OF THE PROJECT AREA

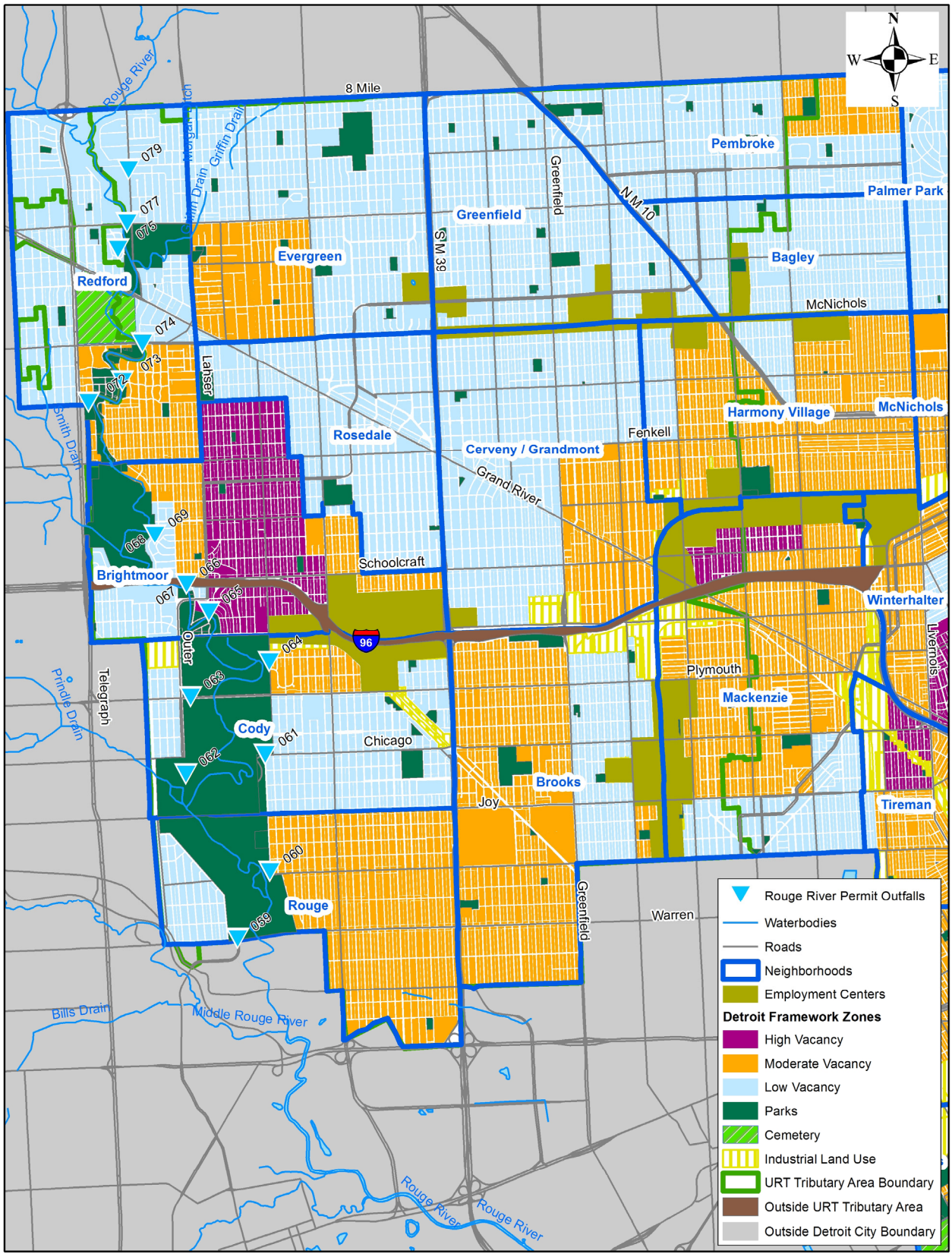
The URT area encompasses approximately 24,000 acres (37.5-square miles) and contains over 100,000 individual parcels. The largest land use coverage is single-family residential followed by roads, alleys and respective rights-of-way. The remaining 29 percent is comprised of public and vacant properties and private facilities.

Table 2 provides a summary of the land cover within the URT area and broken down in the priority areas. Figure 2 displays the vacancy classifications identified by Detroit Future City.

Table 2 Project Area Land Cover Summary

Land Cover	NWI High Priority (acres)	NWI Low Priority (acres)	NWI Total (acres)	URT Total (acres)
Single-Family Residential	2,016	1,620	3,636	10,263
Multi-Family Residential, Commercial and Industrial	209	425	634	1,698
Governmental and Institutional	131	160	291	818
Parks and Open Space	1,203	484	1,687	1,985
Vacant (No Structure)	597	417	1,014	2,419
Transportation Corridors	1,280	1,263	2,543	6,904
Total	**5,436**	**4,369**	**9,805**	**24,087**

Figure 2 Detroit Future City Vacancy Classifications



2.3 OVERVIEW OF IMPLEMENTATION EFFORTS TO DATE

Since 2010, DWSD has implemented a variety of green infrastructure projects to reduce the amount of storm water entering the combined sewer system. Program management support for these efforts was provided by the Southeast Council of Governments (SEMCOG) through calendar year 2013. These efforts included the initial concept of green infrastructure in the 2009 URT CSO Control Alternatives, preparation of the 2013 Green Infrastructure Plan, and coordination of a number of implementation activities. Additional efforts through that period included gathering stakeholder groups and partners to collaborate on GI implementation. Beginning in 2014, the support for the Green Infrastructure Program transitioned to Tetra Tech under contract CS-1522. Tetra Tech provided consultant services for DWSD in the development of the 2014 Plan.

Green infrastructure implementation efforts are summarized annually in progress reports. A total of four reports, covering fiscal years 2010-2011 through 2013-2014 have been prepared. A summary of work includes:

- ***Tree Plantings.*** DWSD contracted tree planting through The Greening of Detroit. A total of 5,342 trees were planted from Spring 2011 through Fall 2013. These included 4403 street trees and 939 trees in parks. Trees were selected based on species biodiversity, appropriateness for southeast Michigan urban areas and interception/infiltration/evapotranspiration potential.
- ***Demolitions and Greening Vacant Properties.*** DWSD funded a total of 98 demolitions during fall 2013 and spring 2014 in the URT area. DWSD also worked with The Greening of Detroit to restore ten Michigan Lank Bank vacant lots in the Cody Rouge community.
- ***Downspout Disconnection.*** DWSD initiated a residential education and voucher program through a contract with The Greening of Detroit in both the Rouge/Cody and Grandmont Rosedale neighborhood areas. DWSD via Greening of Detroit hosted 44 workshops (between November 2012 and June 2013) on “how to” disconnect downspouts. Approximately 211 households participated. In addition, materials were distributed to 177 households for downspout disconnection and 127 rain barrels were purchased.
- ***Roadways and Parking Lots.*** DWSD has initiated discussions with various road agencies in order to identify projects for runoff management. DWSD is also identifying sites for management of roof and parking lot runoff for municipal properties.
- ***Municipal Properties.*** DWSD is working with various city departments to explore green infrastructure opportunities. These include parks and other municipal and public facilities.

2.4 ORGANIZATION OF THE PLAN

Details of DWSD’s Green Infrastructure Plan are presented in this document. A brief overview of the organization of the Plan is presented below.

Section 3. Technical Approach. This section provides technical information on green infrastructure performance objectives, runoff quantification approach, initial practice selection ideas, prioritization criteria, and performance tracking.

Section 4. Program Management Efforts. This section describes the key program management elements needed to ensure that DWSD’s Green Infrastructure Program is successful in both the near- and long-term, including adaptive management, funding, partners and collaboration, maintenance and sustainability, and communications and outreach. These components are integral to helping the Green Infrastructure Program function and evolve over time.

Section 5. Parcel-Related Policies and Standards. This section identifies the parcel-related policies and standards in Detroit that will affect DWSD’s efforts to implement green infrastructure in the URT area, including the drainage charge system, DWSD’s review of construction plans for permit to connect to the sewer system, and codes and ordinances that facilitate low impact development practices and include requirements for storm water management practices.

Section 6. Green Infrastructure Practices. This section provides details on the residential and non-residential green infrastructure practices that DWSD will promote to achieve the goals of the Green Infrastructure Program.

Section 7. Action Plan. This section details how the individual steps that DWSD intends to take to implement the Green Infrastructure Program to achieve the NPDES permit goals. Activities in this section are grouped by

priority areas: Policies, Procedures and Standards; Prototype Projects; Continued Implementation; Long Term Performance; Stakeholder and Community Engagement.

3.0 TECHNICAL APPROACH

This section includes technical information on green infrastructure performance objectives, runoff quantification approach, initial practice selection ideas, prioritization criteria, and performance tracking. This section focuses on the methodologies used, whereas subsequent sections discuss specific programs and practices.

3.1 FUNDING

The primary NPDES requirement relative to green infrastructure is the investment of financial resources in the program. Funding of green infrastructure is presumed to include:

- Direct expenditures by DWSD to consultants and contractors for planning, outreach, implementation and evaluation of green infrastructure projects. This includes technical support for such efforts as codes and ordinances and the development of drainage charge system discounts.
- Interagency transfers of funds for DWSD selected projects implementation (for example, prior funding of demolitions through BSEED).
- Ongoing expenditures for maintenance and sustainment of practices following implementation.
- Land acquisition.
- Waivers of prior drainage charge billings in response to property owner investment in new green infrastructure practices.
- Reductions in drainage charges based on new green infrastructure practices implemented by the property owner.
- Staff time associated with management and implementation of the program.

As part of the green infrastructure tracking, records of these investments will be maintained. Staff time value will be based on estimated time investment.

3.2 PERFORMANCE

The performance objectives for green infrastructure are a major component of project design. While the permit identifies a specific flow reduction goal, this must be considered in the context of the CSO control objective. In reality, green infrastructure can benefit the wet weather system performance in multiple ways. These include control of peak flow as well as volume. The performance of green infrastructure practices in Detroit will be better understood over time as they are implemented, and as data are collected. As green infrastructure is implemented, a better understanding of the space requirements necessary to accomplish various performance objectives will also be developed. This will help to inform the level of control that can be accomplished in various settings.

3.2.1 Performance Considerations

Runoff Retention refers to permanently removing storm water runoff from entering the collection system. Reduced runoff results in less water treated at the wastewater treatment plant (WWTP) and less CSOs (both frequency and volume). Reduced runoff may also alleviate surface or basement flooding issues and reduce the size of the sewer conveyance system requirements. Runoff retention is typically quantified as a volume reduction based on the volume of runoff captured by the practice.

> *90 percent Non-Exceedance.* In storm sewer systems, treatment is commonly provided for the 90 percent non-exceedance storm event and targets removal of suspended sediments. Based on historical hourly precipitation records from the Detroit Metropolitan Airport, 90 percent of the runoff producing rainfall events has a total rainfall amount of approximately 1 inch and less. Complete retention of the

runoff associated with this event may also accomplish the treatment. Because low flows in a combined sewer system go through the WWTP, explicit water quality treatment is not necessary, although water quality treatment may aid in reducing the pollutant loads to the treatment plant. A reduction in the pollutant load to the plant will reduce the costs of treatment and enhance DWSD's treatment process.

2-year, 24-hour Event. The permit includes a target goal for the 2-year, 24-hour event for the Green Infrastructure Program. The language implies that this relates to an actual removal of volume, although deferring the volume for later dewatering may also be appropriate. The specific permit language is: "*GI practices that cumulatively have the capacity to reduce flows into the sewer system in a 2-year, 24-hour storm event by at least 2,800,000 gallons*" (NPDES permit section I.A.15.d.5.a. March 2013).

Average Annual Volume. A benefit will be realized from a reduction in the average annual volume of storm water that enters the combined sewer system. This will lead directly to reduce costs for conveyance and treatment. Therefore, the volume of storm water that is removed from the sewer system over the course of a year is a relevant metric.

Peak Flow Control refers to limiting the peak rate of flow entering the collection system. Limiting the peak flow rate from a site results in less frequent overflows and less overflow volume. Reduced peak flow rates can also reduce the size of the sewer conveyance system requirements, for both separate and combined sewer systems. Limiting the peak flow rate but not reducing the runoff volume may be sufficient for control of CSO discharges. Dewatering of storm water detention facilities may result in an increase in the volume of water treated at the WWTP similar to dewatering of CSO facilities.

Michigan CSO Criteria. The current NPDES permit language for CSO control reads as follows: "*Note that for purposes of designing CSO correction projects, elimination is defined as no more than 1 untreated discharge in ten years from a CSO outfall during the April through October period."* (NPDES permit section I.A.15.d.9. March 2013).

In earlier discussions on the tunnel sizing it was noted that: "A MDEQ Presumptive Criteria for sizing capture tunnels that require an effective tunnel volume to capture CSO and maintain an overflow frequency to the river of less than one overflow per year" was agreed to (CS-1281 Assistance with Phase III CSO Control Program: Upper Rouge Tunnel (URT) Sizing February 8, 2005).

While these two CSO control criteria are stated differently, and the 2013 permit language is more current, they may reflect similar endpoints. Volumes of wet weather flow are significantly greater in the "dormant season" (November through March), than they are in the "growing season" (April through October). The actual seasonal statistics of combined sewer systems is a site-specific question.

To illustrate the impact of various performance objectives, the flow generated on an existing impervious acre is used as a method of comparison; refer to Table 3. For example, the 90 percent non-exceedance event produces 0.79 inches of runoff from an impervious surface. This is equivalent to 21,000 gallons of runoff from 1 acre of impervious surface, or 0.021 MG per acre. The volume goal in the permit is 2.8 MG. Dividing the volume goal by the volume per acre indicates that the equivalent of 133 acres of impervious surfaces needs to be managed if the green infrastructure practices are designed to capture the 90 percent non-exceedance rainfall event.

Similarly, a 2-year, 24-hour storm event generates 0.058 MG per acre of runoff. Therefore, if the green infrastructure practices are sized to capture the 2-year event, then the equivalent of 48 acres of impervious surfaces are needed to be managed to achieve the permit goal.

Consider the case of a design criteria including retention for the 90 percent non-exceedance and detention for the 10-year, 24-hour storm event. The green infrastructure practices would be designed to capture 0.084 MG per acre. Of this, 0.021 MG per acre would be retained and the remaining 0.063 MG per acre (0.084 - 0.021) would be designed as detention. Detention would presumably be designed such that the peak release rate would not cause an overflow to occur. The permit goal is stated as "*reduce flows into the sewer system in a 2-year 24-hour storm event by at least 2,800,000 gallons*." Even though the goal is stated as *reduce flows into the sewer system*, it is DWSD's understanding that the intent is to prevent combined sewer system overflows. For this example design criteria, a portion of the runoff volume from the 2-year, 24-hour would be retained (0.021 MG per acre) and the remaining volume (0.037 MG per acre) would be detained with a peak release rate which does not cause an overflow. It is DWSD's opinion that this design would meet the intent of the permit. Therefore, the equivalent of 48 acres of impervious surfaces would need to be managed. The overall design

would result in a higher level of service being provided for those 48 acres since additional detention would be provided up to the 10-year event.

Table 3 Runoff per Impervious Acre

Rain Event	Precipitation (inches)[1]	Precipitation Excess (inches)[2]	Volume (MG per acre)
90% Non-Exceedance	0.98	0.79	0.021
2-year 24-hour	2.34	2.13	0.058
10-year 24-hour	3.30	3.09	0.084
Average Annual	30.76	25.06	0.680

1. Rainfall records from Detroit Metropolitan Airport.
2. Discrete precipitation excess based on SCS Curve Number hydrology with initial abstractions based on 0.05 times the potential maximum storage. Average Annual based on National Stormwater Calculator assuming an infiltration rate of 0.04 inch/hour, a site slope of 2% and 20-years of rainfall records.

3.2.2 Initial Performance Objectives

The performance of green infrastructure will be evaluated based on a variety of criteria which are relevant to DWSD's long-term objectives. The extent to which green infrastructure practices can retain (permanently remove volume from entering the sewer system) and detain (temporarily delay volume from entering the sewer system) is important to practice design. In addition, volume retention in smaller wet weather events will provide a significant benefit to the sewerage system.

Studies performed throughout the United States have shown that overall performance is more a function of the amount of area controlled with green infrastructure than the design criteria applied to those controls. This suggests that the emphasis should be on area managed versus a high level of control. Furthermore, the soil conditions in the City limit infiltration which is necessary for retention of relatively large events. Therefore, the intent is to explore designs which will work within site constraints to:

- target retention of volumes between the 90 percent non-exceedance storm event and the 2-year, 24-hour and
- detain volumes up to the 10-year storm event.

3.2.3 Refining Performance Objectives

An objective of early project implementation will be to better understand the true performance that can be achieved both for retention and detention to inform future design standards.

3.3 QUANTIFYING RUNOFF

3.3.1 Initial Approach

Rainfall data are based on the Detroit Metropolitan Airport National Weather Service monitoring site. Precipitation frequency data is based on NOAA Atlas 14 dataset, Table 4.

Table 4 Precipitation Frequency

Duration	Recurrence Interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min:	0.31	0.37	0.46	0.54	0.66	0.74	0.83	0.93	1.05	1.15
10-min:	0.46	0.54	0.68	0.80	0.96	1.09	1.22	1.36	1.54	1.69
15-min:	0.56	0.66	0.83	0.97	1.17	1.33	1.49	1.66	1.88	2.06

Duration	Recurrence Interval (years)									
	1	2	5	10	25	50	100	200	500	1000
30-min:	0.76	0.90	1.13	1.33	1.61	1.83	2.05	2.29	2.60	2.84
60-min:	0.97	1.15	1.45	1.70	2.06	2.35	2.65	2.97	3.39	3.73
2-hr:	1.18	1.40	1.76	2.07	2.52	2.88	3.25	3.65	4.19	4.61
3-hr:	1.31	1.54	1.94	2.28	2.78	3.19	3.62	4.07	4.69	5.18
6-hr:	1.55	1.80	2.23	2.62	3.20	3.67	4.18	4.72	5.47	6.08
12-hr:	1.80	2.06	2.52	2.93	3.56	4.08	4.64	5.25	6.11	6.80
24-hr:	2.06	2.34	2.84	3.30	3.97	4.54	5.14	5.79	6.70	7.44
2-day:	2.35	2.68	3.26	3.76	4.50	5.10	5.73	6.40	7.33	8.06
3-day:	2.58	2.92	3.52	4.04	4.80	5.41	6.05	6.72	7.65	8.39
4-day:	2.78	3.13	3.75	4.28	5.05	5.67	6.31	7.00	7.93	8.67
7-day:	3.29	3.68	4.35	4.92	5.74	6.40	7.08	7.79	8.76	9.52
10-day:	3.74	4.17	4.88	5.50	6.36	7.05	7.76	8.49	9.49	10.27
20-day:	5.09	5.60	6.44	7.15	8.13	8.89	9.66	10.45	11.51	12.31
30-day:	6.26	6.87	7.84	8.64	9.73	10.56	11.38	12.20	13.27	14.07
45-day:	7.79	8.55	9.75	10.70	11.96	12.88	13.76	14.61	15.67	16.43
60-day:	9.13	10.04	11.46	12.57	13.99	14.99	15.93	16.80	17.84	18.53

Hourly rainfall data from October 1959 to December 2013 were used to determine that 90 percent of the runoff producing rainfall events had a total precipitation of 0.98 inches or less. Runoff producing rainfall events are defined as events with a total precipitation amount greater than 0.10 inches.

The runoff volume estimates for discrete storm events are based on NRCS curve number hydrology calculations. Green infrastructure practices that are designed to manage storm water runoff are calculated based on the runoff volume from the tributary area. For example, a bioswale along a roadway which is designed to control the 2-year 24-hour event is based on the total runoff from the roadway entering the bioswale. The assumption is that the bioswale is properly sized to manage the runoff. In the case of practices which result in a land cover conversion the managed runoff calculation is based on the change in curve numbers. For example, a building demolition site in which the impervious surfaces (e.g., roof, parking, driveway) are removed and replaced with vegetated cover, the curve number representing the impervious surface would change from 98 to perhaps 78.

Detailed information of the NRCS Curve Number approach is available in the NRCS Part 630 National Engineering Handbook. The initial abstractions assumption inherent in the NRCS approach was updated according to the ASCE *State of the Practice Curve Number Hydrology* by Richard Hawkins et. al (2009).

Assumptions utilized for the base approach include the following:

- 2-year, 24-hour rain event.
- Hydrologic Soil Group D soils were assumed in order to demonstrate a more conservative estimate of runoff reduction.
- Slopes were assumed to range from 1-2 percent.
- Land cover information is based on spring 2010 aerial mapping and was then compared against the Motor City Mapping project (January 2014) to identify vacant land. 2014 City of Detroit assessor data were used to determine parcel ownership.

Table 5 lists the curve numbers utilized in the analysis.

Table 5 Curve Numbers Representing Land Cover Classifications

Land Cover Classification	Curve Number
Impervious Cover: Buildings (rooftops)	98
Impervious Cover: Paved: Drains to Sewer (roads, parking lots)	98
Impervious Cover: Paved: Drains to Open Swales	93
Open Space — Grass & Scattered Trees	84
Trees with Grass/Turf Understory > 75%	79
Trees with Grass/Turf Understory 50-75%	82
Trees with Impervious Understory	86
Urban: Bare (soil)	92
Meadow	78

Average annual runoff volumes are estimated using the National Stormwater Calculator. The following input assumptions are used in the calculator:

- Soil drainage is assumed at 0.04 inch per hour for the underlying soil
- Topography is assumed flat (2 percent slope)
- Precipitation and evaporation are taken from the Detroit Metro AP site
- Climate change is ignored.

Rainfall interception of trees was calculated based on literature information. A journal article by James Urban on *Bringing Order to the Technical Dysfunction with the Urban Forest* (Journal of Arboriculture 18(2), March 1992) provided a relationship between the caliper of the tree and the crown projection. A second journal article by Qingfu Xiao and E. Gregory McPherson on *Rainfall Interception of Three Trees in Oakland, California* (Urban Ecosyst 14:755-769, 2011) related interception and rainfall quantity.

3.3.2 Future Approach

Ultimately, the desire is to predict the change on the frequency and volume of CSOs as a function of the green infrastructure implementation. Efforts are currently under way to refine the existing hydrologic model of the combined sewer system. Once the model is updated, more detailed runoff calculations and runoff reduction estimated may be developed using the GDRSS updated model.

Flow monitoring is currently being conducted in the collection system to further calibrate the GDRSS model. These monitoring efforts are principally at the downstream end of the collection system. Additional monitoring of selected green infrastructure practices and the collection system in the URT area is envisioned. Other institutions such as Lawrence Technology University, University of Michigan, and Wayne State University are conducting similar monitoring work. The objective of this interagency coordination will be to improve the shared understanding of study questions, provide consistency and results, and pool the body of knowledge to improve efficiency of monitoring efforts. In addition to DWSD's Green Infrastructure Program, monitoring efforts are being performed as part of the Shoreline Cities Grant which will provide information on green infrastructure performance city-wide. In addition to local efforts, green infrastructure monitoring is a significant area of research throughout the country. Coordination with other researchers will help in the transfer of data that will provide useful for DWSD's assessment.

The monitoring information will be used to improve the methodologies and variables used in the modeling efforts. Ultimately, the runoff calculations are envisioned to mature into flow predictions for the overflows (frequency and volume) along with rates and volumes at the WWTP.

The calculation methodology for the interception of rainfall by trees is expected to continue to improve. The current methodology is based on limited literature information. Methods to improve the crown projection estimates, growth rate, and three-dimensional characteristics of the trees are being explored.

3.4 PROJECT IDENTIFICATION, CHARACTERIZATION, AND SELECTION

3.4.1 Identification Methods

DWSD will identify green infrastructure practices based on a range of methods, including but not limited to project types listed in the permit. Methods that will be used for identification of green infrastructure include:

- *Project Types Identified in the Permit*. These types include downspout disconnection, demolition of vacant structures and replacement with pervious land cover, bioswales along roadways and parking lots, installation of rain barrels and rain gardens at commercial and residential properties, and tree planting. DWSD will assess future implementation of each of these project types based on previous work performed, its associated costs, and benefits. DWSD intends to employ adaptive management to continually refine the approach to implementation of these technologies.
- *Integrated Projects*. To the extent practicable, DWSD will identify green infrastructure projects that provide synergistic results to the community. For example, if a street is decommissioned and the pavement removed, that will help reduce the runoff contribution into the collection system by removing the pavement. If in addition to the pavement removal, a bioretention system were created to manage runoff from nearby impervious surfaces, then an even larger runoff volume may be removed. Overall, the project could also help to stabilize a neighborhood. Integrated projects allow for the development of policies and processes that address a number of issues. In this Plan, these projects are referred to as prototype projects and are one of the major program activities.
- *Earlier Planning Efforts*. Prior versions of the Green Infrastructure Plan identified specific project locations and concepts. As the current Plan was being prepared, these locations were further evaluated for feasibility. In some cases, the previously identified locations were determined to be infeasible. Other locations have been retained for further review.
- *Collection System Characterization*. Opportunities can occasionally be identified based on an examination of the sewerage system. For example, Garden View Estates is a redevelopment project within the URT area. It comprises approximately 160 acres including streets and new housing. This development included a storm water retention basin to control runoff. The Green Infrastructure Plan will assess the ability to maximize the benefit of this retention basin.

  Another unique characteristic of the collection system is the discharge of storm water from the Southfield Freeway into the combined sewer system. These flows are pumped discharges that have the potential to be managed at the outlet.

  Identification of historic stream corridors provides another opportunity to identify green infrastructure projects. The 2003 Wastewater Master Plan evaluated some potential opportunities for daylighting streams and other connections to the sewer system. This concept is being revisited as part of the Green Infrastructure Plan.
- *Community Enhancement Projects*. As part of efforts to revitalize Detroit, it is anticipated that various projects may be initiated in the URT area. DWSD may partner with others on these projects to implement green infrastructure techniques. These projects are highly desirable because the costs of the overall project are shared between multiple partners, and DWSD's role is appropriately targeted at storm water management.
- *Future Land Use*. In the Detroit Strategic Framework, certain portions of the URT area are identified as "innovation productive" and "innovation ecological." This shifting of existing residential areas to less-developed land-use types will provide an opportunity for alternative storm water management and implementation of storm water management features.
- *Large Impervious Surfaces*. The most significant sources of runoff in the URT area on a per acre basis are large impervious surfaces such as large roof areas and large parking lots. These parcels are also likely to have the largest dollar value drainage charges. Identification of property owners with these site characteristics will result in an opportunity to target the specific properties for green infrastructure retrofits.

3.4.2 Prototype Projects

Implementation of green infrastructure requires the development of new policies, processes, and procedures. It also requires additional understanding of the performance, costs, and implementation realities associated with various project types. DWSD has worked to form relationships with a number of relevant agencies, organizations and community groups. In the process of working with these entities, a number of issues have been discussed regarding project responsibilities and concerns. The realities of policies, processes, and procedures can best be realized in the process of implementing projects. DWSD intends to launch a series of prototype projects that will help to answer a series of questions. A range of project types are planned during prototype implementation such as: land assembly and large scale greening; right-of-way bioretention and curb extension; and community enhancement projects with parcel and roadway bioretention and impervious area removal (refer to Activity 2 - Prototype Projects on page 92).

3.4.3 Project Characterization

Projects that are being considered for implementation can be characterized based on what they would look like "if constructed". Projects can also be characterized based on the complexity of constructing and maintaining them, both from a feasibility and a financial perspective. For this program, the primary objective is storm water (and CSO) reduction. The ability of a project to address the primary objective is its *Impact,* while other positive (or negative) outcomes are considered under the general term of *Benefits.* The ability to construct and maintain is the *Feasibility,* which is further broken down into *Technical Feasibility* and *Institutional Feasibility.* The project cost is considered based on its *Cost Effectiveness* relative to meeting the project objective.

3.4.3.1 Impact

Impact for the DWSD Green Infrastructure program relates to the projects' ability to reduce storm water inputs that would lead to CSO discharges. Relevant metrics include:

- *Collection system location* refers to what part of the collection system the project is located in. The priority area identified in the NPDES permit is the area draining to Rouge River outfalls 059-069, 072-075, 077, and 079. High priority outfalls are identified as 059, 060, 061, 062, 063, 069 and 074; low priority include 064, 065, 066, 067, 068, 072, 073, 075, 077 and 079 (*Part I Section A.15.d.9).* The outfalls listed in the permit are direct discharges from the Northwest Interceptor (NWI) area. The rest of the URT area may discharge to these outfalls under certain flow conditions. Hence the entire URT area is assumed applicable for the volume reduction metric; however, priority is given to the NWI subarea. Projects located in other parts of the URT area are scored slightly lower; combined sewer areas outside the URT area are not considered.
- *Runoff retention* refers to permanently removing storm water runoff from entering the collection system. Runoff retention is typically quantified as a volume reduction based on the volume of runoff captured by the practice. Projects that maximize the permanent removal of volume are preferred.
- *Peak flow control* refers to limiting the peak rate of flow entering the collection system. Ideally, peak flows would be controlled to a level of performance consistent with the CSO control criteria for the system.
- *Area managed* refers to the acres of total or impervious area that are controlled, or managed, by the project.

3.4.3.2 Benefits

The benefits category addresses both the positive and potentially negative outcomes of the projects.

- *Impact to public lands* is a general category regarding improvements on publicly owned land. Most often the public lands, in this context, are centered on parks and recreational areas that are used by the general population. Quantifying the level of impact is subjective in nature and best accomplished by a consensus of stakeholders or professionals in charge of the land.
- *Impact on local drainage or flooding problems* refers to whether or not the proposed practice will improve local drainage problems or decrease flooding problems. Water backing up in the sewer system

which backs up into a basement is included in the reference to flooding problems. Specific hydrologic/hydraulic studies are not expected as a part of the analysis. The quantification of the impact is subjective and is based on the existing understanding of the system and the estimated impact.

- *Educational benefit* refers to projects which offer an opportunity to increase public awareness and knowledge of water resource issues. Projects which offer an educational benefit are often placed at public facilities such as schools and parks, and may include interpretive signage or other form of communication for the explicit purpose of improving awareness. Facilities constructed as outdoor teaching laboratories, for example areas designed to encourage public participation such as chemical and biological testing, would likely be ranked high in their educational benefit. The quantification of the benefit is subjective and is based on the perceived value provided.
- *Technology demonstration* projects refer to those projects that fill a gap in the use or understanding of a particular practice. The use may be something unique to the geographic area. In order to provide a benefit in the technology demonstration category, the practice must have some unique element which DWSD or the professional community will benefit from. A benefit may include improved performance prediction capabilities. Practices targeted for the general public are more appropriately ranked under the educational category. The quantification of the benefit provided is subjective and is based on the perceived value provided.
- Projects that result in improved *neighborhood stabilization* are desirable. Neighborhood stabilization may take a number of different forms such as demolition projects located in priority areas for demolitions; tree plantings in areas targeted for street tree improvements; and improvements projects in the areas targeted as the employment centers. A high rank is achieved when the right practice type for the specific geographic area is used.
- *Green jobs* refers to a project that will result in the creation of local jobs. This includes jobs related to the initial installation as well as jobs dedicated to the continued operation and maintenance of the practice.

3.4.3.3 Feasibility

The feasibility of project implementation and maintenance includes technical and institutional components. Institutional issues to construct a project play a large role in the practice selection and prioritization process. As the DWSD program is working towards both short term and long term implementation efforts, the selection of projects is expected to include both those that are less complicated from an institutional perspective and ones which are more complicated. As indicated in Section 3.4.2, prototype projects are specifically intended to help determine the policies and processes that will be required to implement these efforts. Nevertheless, projects that are less complex from a feasibility perspective can be implemented more quickly.

- *Technical considerations* relate to such items as loading ratio (tributary area relative to space for storm water practices), topography, soil conditions, environmental factors and similar issues.
- *Institutional considerations* include site ownership (immediate and long term), number of property owners, institutional complexities, and participation/ willingness of property owner to use of space for storm water practices.
- *Timing* relates to the overall project duration from identification through construction. More complex projects will take longer to implement, and this will be a consideration in project selection. It also considers some issues relative to when work should be performed based on other activities. For example, planting of street trees would be delayed in the immediate vicinity of planned demolitions.
- *Moments of opportunities* refers to coordinating efforts with other projects or initiatives. It also may relate to synchronizing the work with other planned projects. An example would be two city departments coordinating capital improvements (e.g. a road reconstruction project and a storm water improvement project). This type of collaboration often results in cost sharing and hence an overall reduction in cost.

3.4.3.4 Cost Effectiveness

Project cost considers the project costs and cost effectiveness.

- *Project costs* are those expenditures that are required to construct, operate and maintain the practice. As a project moves from the planning stage into the design and implementation stage, the level of project definition increases, thus allowing for a more accurate cost estimate. Screening-level cost estimates are used to screen out disproportionately expensive alternatives in determining what alternatives should be retained for detailed analysis. For the purposes of evaluation, only costs incurred by DWSD are considered. These may include direct DWSD project implementation, funding of other agencies, or support to other projects through drainage charge reductions.
- *Cost Effectiveness* relates to the performance of the project relative to its cost. Projects that are receiving funds from multiple agencies are viewed much more favorably compared to projects funded only by DWSD.

3.4.4 Project Selection

The initial project selection and installation will include both those projects that can be implemented quickly and prototype projects that will help establish methodologies for the long term. As more opportunities are identified, they will be characterized and filtered based on the criteria in Table 6.

Table 6 Characterization and Evaluation of Opportunities

Factor	Description	Metric
Impact	Considers location, scale and level of control included. Also considers long-term potential for sustainment.	• Collection system location • Runoff retention • Peak flow control
Benefits	Additional benefits include aesthetic enhancements, improved storm water management that reduces nuisance flooding, and other triple bottom line benefits. The benefits category also considers potential negative impacts of the project.	• Impact to public lands • Impact on local drainage or flooding problems • Educational benefits • Technology demonstration • Neighborhood stabilization • Green jobs
Technical Feasibility	Considers the technical aspect of siting, space, topography, groundwater, environmental and other issues	• Topography, soils, existing and future pipe placement (pipe elevations) existing known or potential environmental hazards.
Institutional Feasibility	Land ownership, competition for the potential implementation location, public acceptance and coordination with other projects	• Ownership of the land • Status of ownership (multiple parties, property likely to change hands) • Impact to public lands • Moments of Opportunity
Cost Effectiveness	The lifecycle cost of the project relative to project performance. Costs can be determined for the project as a whole or from the perspective of a specific payment source if costs are shared.	• Project costs for implementation and maintenance • Funding of other agencies • Drainage charge reduction

3.5 TRACKING AND PERFORMANCE ASSESSMENT

DWSD is developing a tracking and performance assessment database for green infrastructure implementation activities. The objective of this database is to define, at a minimum, the location, ownership, financial investment, performance, and installation date of the green infrastructure practices. In particular, DWSD's investment in green infrastructure projects will be tracked to show compliance with Section A.5.a of the permit.

3.5.1 Approach

The database will track several general categories of information on green infrastructure. These include the following:

- DWSD Green Infrastructure Practices – These practices include those described in Section 6.0 that are implemented with participation from DWSD. Although tracking of non-DWSD practices is also important, initial efforts will give priority to tracking DWSD practices.
- Non-DWSD Green Infrastructure Practices - These practices include those described in Section 6.0 that are implemented without participation from DWSD. They also include private practices that would qualify for a drainage charge discount.
- Area Scale – DWSD will work to quantify changes in land cover over the long-term. This may include cooperating with other entities in gathering aerial imagery and conducting a land cover analysis every five years.

3.5.2 Data

The primary data categories reflect information that will be used to benefit the long-term sustainability of the practices. Additional data will be collected as available to enhance basic information. The categories of tracking data include the following:

- Practice Data (priority)
  - Physical description (type, location, tributary area, etc.).
  - Cost (amount and by whom, various cost components)
  - Quantification of flow performance
  - Ownership
  - Maintenance (schedule, responsibilities)
- Additional Data (as available)
  - Selection justification/prioritization
  - Triple bottom line benefit quantification
  - Special studies/ monitoring
  - Educational attributes

4.0 PROGRAM MANAGEMENT EFFORTS

This section of the plan addresses a series of umbrella activities that will be performed in support of the program and projects. The key managerial efforts include communication and outreach, funding, maintenance and practice sustainment, and adaptive management.

4.1 COMMUNICATION AND OUTREACH

Early and sustained two-way communication, both listening and outreach, on all facets of green infrastructure is integral to widespread implementation and effective maintenance. Given the list of green infrastructure partners committed to green infrastructure implementation and outreach, DWSD's vision for successful outreach focuses on communicating, coordinating, and collaborating with partners. Doing so will ensure that DWSD understands the type of approaches that will work in different neighborhoods with different stakeholders while ensuring consistency in green infrastructure messaging, effective targeting of resources, and shared ownership (actual and perceived) of green infrastructure efforts citywide. This section presents DWSD's vision and process for communication and outreach and the key partners integral to supporting green infrastructure implementation.

4.1.1 Partner Collaboration

Achieving the overarching vision for green infrastructure in Detroit will require participation from a variety of partners at the federal, state, regional, city, neighborhood, and individual levels. Planning and implementing green infrastructure projects that move DWSD toward Detroit's volume reduction goal will require coordination, collaboration, two-way communication, education, and participation among all partners at all levels. This section

presents an overview of key green infrastructure implementation partners and their possible roles to support green infrastructure implementation in Detroit.

4.1.1.1 DWSD's Key Green Infrastructure Partners

Implementation of green infrastructure involves a combination of changing decision-making processes and land management approaches on both public and private property. As a result, DWSD will continue to communicate, coordinate, and collaborate with a wide range of partners that influence various aspects of green infrastructure implementation. Table 7 presents an overview of some of the key partners at federal, state, regional, city, and neighborhood levels. This list of partners is likely to grow as DWSD's Green Infrastructure Program evolves.

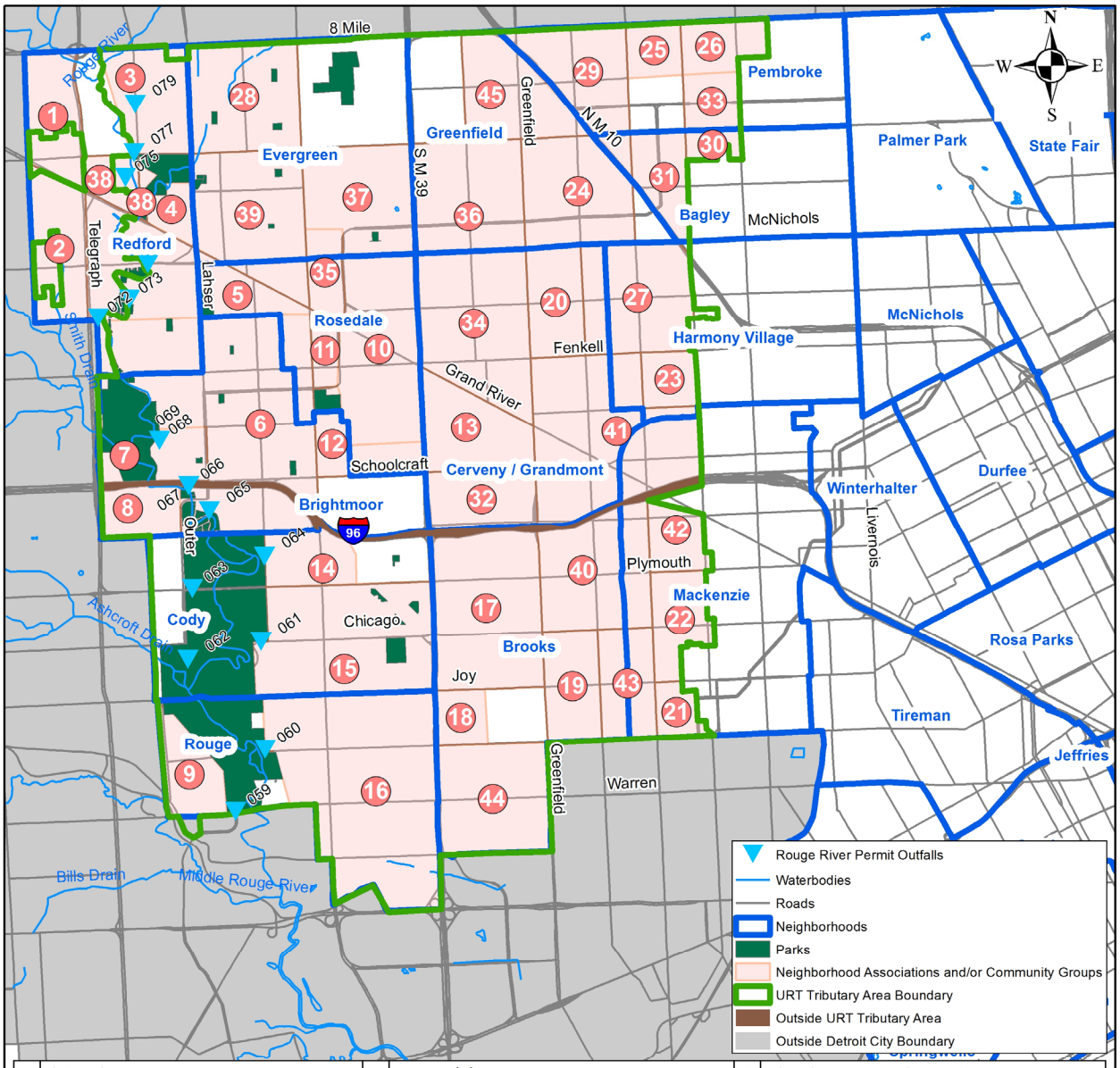
Table 7 DWSD's Green Infrastructure Partners and Their Role

Partner	Current and Potential Roles in Green Infrastructure
Federal	
U.S. Environmental Protection Agency	Encourages green infrastructure implementation through federal coordination; Clean Water Act regulatory support; research and information exchange; funding and financing; and capacity building.
U.S. Housing and Urban Development (HUD)	Major landowner in URT, residential properties. Relevant to downspout disconnection efforts.
State	
Michigan Department of Environmental Quality	Developed DWSD's NPDES permit with an emphasis on green infrastructure. Reviews and approves DWSD's green infrastructure planning and implementation efforts related to NPDES permit compliance.
Michigan Department of Transportation	Has jurisdiction over state trunk line roads and highways located within the URT. Participates in discussions with DWSD about incorporating green infrastructure into future roadway projects.
Michigan Land Bank	Promotes economic growth through the acquisition, assembly and disposal of public property, including tax reverted property, in a coordinated manner to foster the development of that property. Promotes and supports Detroit Land Bank activities. DWSD has discussed a partnership with the Michigan Land Bank to hold and assemble property for green infrastructure implementation opportunities.
Michigan State Housing Authority	Owns Renaissance Village at 19301 Evergreen.
Regional	
Southeast Michigan Council of Governments (SEMCOG)	Assisted DWSD in the early facilitation of the Green Infrastructure Program with cooperation and collaboration from other key partners. Developed DWSD's initial Green Infrastructure Plan. Continues to promote green infrastructure in Detroit and southeast Michigan.
Sierra Club Great Lakes Program	Conducts green infrastructure outreach and engagement activities in Detroit, including partnering with SEMCOG and other organizations to host rain barrel workshops and distributing information about DWSD's downspout disconnection program. Compiles and shares information about existing examples of green infrastructure in Detroit through their website. Participates on various Detroit green infrastructure task forces and work groups.
County	
Wayne County Environmental Services Group; Water Quality Division	Responsible for storm water management, drainage code administration (drain commissioner function) and green infrastructure efforts at the county level.
Wayne County Roads Division	Has jurisdiction over many primary roadways located within the URT area. Reviews roadway design, capacity and existing traffic counts.

Partner	Current and Potential Roles in Green Infrastructure
City	
City Leadership	
City Council Green Task Force	Meets to promote green infrastructure and jobs and address environmental concerns of the residents of Detroit. Led by Councilman Scott Benson.
City Departments and Agencies	
Buildings, Safety Engineering and Environment	Enforces building codes and ordinances, including plumbing requirements, which impact roof water management and downspout disconnections. Performs site plan reviews. Involved with demolitions process.
Detroit Building Authority	Manages and implements demolition contracts. Assists city departments in carrying out their capital improvement programs. Initiates design and construction of the project for requesting city departments.
General Services	Oversees facility maintenance at municipal buildings and parks and maintenance of vacant property. Coordinates all efforts for street tree planting and removal of dead street trees.
Neighborhoods	Coordinates with community organizations and city departments to eliminate blight in neighborhood districts.
Planning and Development	Ensures green infrastructure efforts are consistent with the City's long-term vision for planning and development, most specifically as it relates to uses of the extensive amount of vacant properties.
Public Lighting	Provides lighting for the City of Detroit. May be involved in specific green infrastructure projects that may affect public lighting assets and property.
Public Works	Maintains city roadways and oversees road projects. Collaborates on retrofitting existing city streets and would be involved in green streets design criteria.
Recreation	Maintains and conducts planning for parks and recreational facilities. Coordinates with DWSD on park-related green infrastructure implementation opportunities on park properties.
Transportation	Responsible for operating and maintaining transportation facilities within the Detroit metro area, including 6,000 bus stops and facilities for repair and maintenance. Can coordinate with DWSD on green infrastructure opportunities at transportation facilities.
City-focused Authorities and Non-Profit Organizations	
Detroit Land Bank Authority	Stimulates neighborhood stabilization and economic growth through the acquisition, management, and disposition of tax reverted and acquired properties.
Detroit Future City	Steward of the Detroit Future City Strategic Framework that promotes implementation of blue/green infrastructure in Detroit. Coordinates actions and resources among key partners to facilitate green infrastructure implementation. As an initiative of the Detroit Economic Growth Corporation, the DFC has a strong collaborative working relationship with the City of Detroit and the Mayor's Office and works closely with the City's Executive of Jobs and Economic Growth.
Detroit Greenways Coalition	Creates, conserves and promotes greenways and green spaces in order to connect people, places and nature.
Detroit Economic Growth Corporation	Provides support to existing businesses and seeks to bring new companies and investments to the city. DEGC currently houses the implementation of the Detroit Future Cities program and convenes public land stakeholders to coordinate land assembly
Detroit Housing Commission	Operates a number of properties within the project area, including Smith homes and Garden View Estates. Also owns and manages a number of single family homes.
Detroit Public Schools	Owns and operates multiple facilities within the URT area representing significant land area.

Partner	Current and Potential Roles in Green Infrastructure
The Greening of Detroit	Supports aspects of DWSD's green infrastructure program via contract, including the street tree program, downspout disconnection education and workshops, and the greening individual vacant lot program. Has the capacity to provide other support services to DWSD's Green Infrastructure Program, including broader outreach and engagement, green infrastructure maintenance, and inspection workforce training.
Foundations	
Erb Family Foundation	Funds green infrastructure projects in Detroit to support green infrastructure education, implementation, and collaboration.
The Kresge Foundation	Funds projects to develop a green workforce in Detroit. Participated on the Detroit Blight Removal Task Force Steering Committee. Recently provided funding to Detroit Economic Growth Corporation to conduct a deconstruction project and the Motor City Mapping project.
Neighborhood	
Grandmont Rosedale Development Corporation	Represents the homeowners located in the Grandmont Rosedale Park Development. Selected as a pilot area to represent how homeowners can take ownership of green infrastructure techniques within their own neighborhoods.
Joy Southfield Development Corporation	Represents the Cody Rouge neighborhood. Selected as a pilot area for green infrastructure implementation. This area represents a challenge in achieving economic development while stabilizing existing neighborhoods. Raised the Cody Rouge community to state-level awareness with the commercial corridor being selected as one of seven business districts identified as part of the Downtowns of Promise program through the Michigan State Housing Development Authority.
Brightmoor Alliance	Formed as a coalition of nearly 50 organizations dedicated to serving northwest Detroit's Brightmoor community. Established in response to conditions in the community, including poor housing, a high crime rate, and a staggering amount of vacant land. Community organizations - many of which had partnered with one another over the years - felt that the time was right to mobilize community resources and focus their combined efforts to revitalize the area. Promotes urban agriculture in the Brightmoor community and identifies other green infrastructure opportunities that align with the vision for Brightmoor's future.
Other Neighborhood Organizations	Figure 3 identifies other neighborhood identities and organizations that represent the interests of neighborhoods. DWSD will coordinate with specific neighborhood groups on a project-by-project basis.
Educational Institutions/ Research	
University of Michigan Water Center	Implementing research on ecological designs at demolition sites. DWSD is participating in this project and constructing the green infrastructure practices.
Wayne State University	Participating in ecological design project with the University of Michigan Water Center
Lawrence Technological University	Performing research on green infrastructure practices in Detroit
Utility Companies	
DTE	Owns and operates gas and electric utilities in the city.

Figure 3 Neighborhood Locations and Community Associations



1	Five Points	16	Warrendale	31	Tri-Point Community Assoc.
2	The Eye	17	Grandale	32	Schoolcraft Improvement Assoc.
3	Breg-Lasher Community Assoc.	18	Garden View Estates	33	McDow Community Council
4	Old Redford	19	Fishkom	34	Crary-St. Mary's Community Council
5	Riverdale	20	Belmont	35	Ardmore-Brookline Community Assoc.
6	Brightmoor	21	Aviation Subdivision	36	College Park
7	Eliza Howell Neighborhood Council	22	Barton McFarland Neighborhood Assoc.	37	Evergreen Neighborhood
8	Castle Rouge	23	Littlefield	38	Glenbrook Heights Community Assoc.
9	Parkland	24	Winship Community Assoc.	38	Glenbrook Heights Community Assoc.
10	Rosedale Park	25	Blackstone Community Assoc.	39	Redford Gardens
11	Minock Park Block Assoc.	26	8 Mile Wyoming	40	Churchhill Park Association
12	Westwood Park	27	Bethune Community Council	41	Grand River Greenfield Civic Association
13	Grandmost-Rosedale	28	Evergreen-Lahser-7/8 Mile Comm. Council	42	Triangle Community Association
14	Weatherby	29	Schaefer-7/8-Lodge Assoc.	43	Renaissance West
15	Franklin Park	30	Schultz Community Council	44	Warren Avenue Community Association
				45	Maloney Park Civic Association

4.1.2 Outreach Vision

DWSD's vision for green infrastructure outreach includes three branches of outreach that will reach various target audiences at three levels. DWSD intends to address each branch of outreach after having meaningful conversations with partners and stakeholders.

4.1.2.1 Three Branches of Green Infrastructure Outreach

To support green infrastructure implementation efforts, DWSD will participate in three distinct, yet related, branches of outreach.

- *Green Infrastructure Outreach Branch 1: Storm water drainage charge reduction through green infrastructure implementation.* DWSD is developing a methodology to recognize green infrastructure in the storm water drainage charge system. This is expected to be a primary driver for residential and non-residential ratepayers to implement green infrastructure practices throughout Detroit. DWSD intends to conduct meaningful conversations with ratepayers and stakeholders on the storm water drainage charge system that will influence both the structure of the discounts and the outreach strategies related to communicate information. DWSD will craft an outreach strategy with specific messaging needed to raise awareness about the storm water drainage charge and green infrastructure implementation discounts, provide education to ratepayers on how to achieve the green infrastructure discounts, and motivate participation in the green infrastructure implementation discount program. While the storm water drainage charge and associated green infrastructure implementation discounts would apply throughout DWSD's service area, there will be a focused effort to motivate green infrastructure implementation in the URT area where green infrastructure implementation is needed to achieve CSO control, as identified in the NPDES permit.
- *Green Infrastructure Outreach Branch 2: Green infrastructure project-specific outreach.* As described in Section 4.1.1, DWSD will work with partners to identify high priority green projects in the URT area to achieve the goals of the NPDES permit. Each project will require DWSD and project-specific partners to conduct stakeholder outreach and engagement to ensure stakeholders understand the purpose and benefits of the project, and support both implementation and the required maintenance of the green infrastructure project. DWSD acknowledges that outreach for each green infrastructure project in the URT area, as well as other green infrastructure projects around Detroit, should be tailored to the unique characteristics of the project's stakeholders. While DWSD might use a common framework for developing a green infrastructure project outreach strategy (see below), the resulting suite of outreach and engagement activities will be crafted to meet the needs of the project stakeholders. Partners involved in project-specific outreach and engagement activities are also likely to vary, depending on the type, location, and characteristics of the project.
- *Green Infrastructure Outreach Branch 3: Overarching, collaborative green infrastructure public education campaign.* The third branch of outreach consists of overarching green infrastructure outreach activities that will be planned and executed through collaboration with multiple partners listed in Table 7. Many of these partners, specifically those participating on the Erb Family Foundation's Detroit Blue Green Infrastructure Work Group have expressed an interest in developing collaborative, cooperative public relations/educational campaign with distinct branding that provides positive messages related to the benefits of green infrastructure for Detroit and city residents. In addition to the public relations/educational campaign, partners would like to have a centralized website that is a repository for green infrastructure information, organized by key target audience with messages that start broad but allow interested users to drill down into the site for more technical information. DWSD would not "own" the public relations/education campaign or the centralized green infrastructure website, but would collaborate with other partners to craft the campaign's branding and the centralized website's design, functionality, and content. DWSD's involvement is particularly important to ensure that technical information provided on a collaborative website aligns with technical information that DWSD creates to support green infrastructure plan implementation and fulfill the NPDES permit requirements. Another component of this outreach branch would be working with partners to plan and host regularly scheduled stakeholder meetings to discuss aspects of green infrastructure issues in Detroit.

4.1.2.2 Three-Levels of Green Infrastructure Outreach

DWSD's green infrastructure outreach activities are likely to occur on one or more levels: (1) internal outreach; (2) local external outreach; and (3) state and national external outreach.

- *Outreach Level 1: Internal*. This level of outreach focuses on communication and engagement within DWSD, as well as city departments and agencies that are critical to policies and processes related to decisions that affect green infrastructure implementation and maintenance. This level of outreach is most critical to outreach branches 1 and 2.
- *Outreach Level 2: Local external.* This level of outreach moves beyond city departments and agencies to other stakeholders within Detroit at the neighborhood and business district levels. Most of DWSD's outreach efforts will focus at this level for all three branches of outreach.
- *Outreach Level 3: State and national external*. This level of outreach focuses on sharing DWSD's experiences in developing and implementing the Green Infrastructure Plan to achieve the goals and objectives of the Green Infrastructure Program and the requirements of the NPDES permit with other green infrastructure practitioners at the state and national levels.

4.1.3 Green Infrastructure Outreach Process

DWSD's process for developing and implementing effective stakeholder outreach and engagement activities uses the six elements presented in EPA's *Getting In Step Guide*. The six elements are intended to ensure green infrastructure outreach and engagement activities are targeted, effective, and efficient. This process applies to all three branches and all three levels of outreach discussed above. It is important to note that DWSD does not intend to conduct this process in a vacuum. Developing successful outreach strategies depends on listening to key partners and stakeholders throughout the process. DWSD will ensure that meaningful two-way communication occurs during planning, implementation, and evaluation of outreach and engagement activities. The six elements are as follows:

- *Outreach Element 1: Goals and Objectives*. These are the goals and objectives for outreach and engagement activities to support DWSD's Green Infrastructure Plan and related green infrastructure projects. Goals and objectives will vary for each branch and level of outreach, but ultimately the goal is to motivate green infrastructure implementation and maintenance activities to support DWSD in achieving the Green Infrastructure Plan goals and objectives driven by the NPDES permit.
- *Outreach Element 2: Key Target Audience Characterization.* This element identifies the key target audiences for specific outreach and engagement activities related to the three branches of outreach. It will identify the key target audiences and sub-target audiences in each of the three levels of outreach (internal, local external, state and national external). Through this element, DWSD will characterize the key target audiences' perspectives on, concerns about, and potential benefits of green infrastructure. This element also provides details on how these key target audiences currently obtain information on green infrastructure related issues, trusted messengers, and other important factors that will affect messaging, outreach and involvement formats, and distribution channels.
- *Outreach Element 3: Tailored Messages.* Using information from Element 2, this element identifies potential messages about green infrastructure for key target audiences to help raise awareness, encourage involvement, and promote green infrastructure implementation support. The objective is to create messages for the key target audiences that will resonate and achieve either green infrastructure project support or motivate a change in behavior (e.g., green infrastructure project implementation and maintenance or a change in policy or process to eliminate barriers to green infrastructure implementation).
- *Outreach Element 4: Effective Formats.* The information about communication channels in Element 2 will also help to identify effective formats for conveying the messages developed under Element 3. Formats for green infrastructure outreach and engagement will likely include presentations, videos, case studies, how-to-fact sheets, public service announcements, training, and demonstration projects.
- *Outreach Element 5: Efficient Delivery Mechanisms.* Not all key target audiences get or want their information in the same manner. The way in which messages are delivered, and the nature of the

messenger, can affect how key target audiences perceive and respond to messages. DWSD will identify a range of possible delivery mechanisms for distributing the formats with tailored green infrastructure messages that are most effective for specific key target audiences.

- *Outreach Element 6: Evaluation Measures*. Evaluating the success of outreach and engagement activities will be one way to also help measure the success of DWSD's Green Infrastructure Plan. Tracking which stakeholders have participated in green infrastructure projects, and how their perceptions, awareness, and involvement has changed over time, will help DWSD and other green infrastructure partners in Detroit gauge progress and adapt strategies. Evaluation mechanisms will be tailored to the specific type of outreach and engagement format, as well as the key target audience. Potential evaluation mechanisms include pre-/post-event surveys to gauge changes in awareness or behavior, measures of participation over time, calls or emails to DWSD, hits on a website, and number of articles in local newspapers with positive messages about green infrastructure and DWSD.

DWSD will address each of these elements in an overall Green Infrastructure Outreach Strategy that will incorporate all three branches of outreach and all three levels of outreach. For Outreach Branch 2, green infrastructure project-specific outreach, DWSD will develop project-specific outreach strategies using this process to ensure communications and engagement activities are tailored to the needs of the project stakeholder. The Green Infrastructure Outreach Strategy will serve as an internal DWSD roadmap for use by DWSD staff and the consulting team to ensure coordination of stakeholder involvement and education activities.

4.1.4 Current Outreach and Engagement Activities

DWSD has initiated green infrastructure outreach and engagement activities to support the Green Infrastructure Program since program initiation. Recent activities include the following:

- *Transitional meetings with key partners and stakeholders.* DWSD has participated in a number of meetings with key partners and stakeholders as green infrastructure support transitions from SEMCOG to the Tetra Tech consulting team. The purpose of these meetings has been to introduce key partners and stakeholders to DWSD's new consultant, provide a vision for the future of DWSD's Green Infrastructure Program, and obtain input from partners and stakeholders about their concerns and perceptions of the Green Infrastructure Program. In addition to critical stakeholders in the previously listed group of departments and agencies, meetings have occurred with members of the Green Infrastructure Task Force (under Councilman Scott Benson), the Erb Family Foundation's Detroit Blue Green Infrastructure Work Group, Detroit Future City, and The Greening of Detroit. During these meetings, participants provided DWSD's new consultants with valuable insights about successful approaches to outreach and engagement, the type of benefits to highlight, the most useful formats, and the most effective distribution channels.
- *Partnering with DWSD on Implementing Green Infrastructure on the West Side of Detroit workshop.* On June 20, 2014, DWSD led a workshop for green infrastructure key partners, including city departments, other governmental representatives, and non-governmental organizations, organized by SEMCOG. This workshop included a breakout session on green infrastructure communication during which stakeholders had the opportunity to share ideas on communication tools, messages, audiences, and distribution channels. During the breakout session, key partners stated the need for an overarching education campaign and a central website to serve as a portal to all green infrastructure information.
- *Developing internal Green Infrastructure Outreach Strategy.* DWSD is currently working on an internal Green Infrastructure Outreach Strategy to support implementation of the Green Infrastructure Plan. The Green Infrastructure Outreach Strategy will address each of the three branches of outreach and identify outreach approaches for specific green infrastructure projects and activities where they have been identified and a process for identifying outreach approaches for future green infrastructure projects. Input from project partners obtained during the meetings described above have helped to craft the Green Infrastructure Outreach Strategy. Key project partners will continue to have the opportunity to provide input on outreach and engagement activities to support green infrastructure projects.

4.2 FINANCING GREEN INFRASTRUCTURE

Green infrastructure is often performed as a component of other projects. Therefore, financing of green infrastructure will need to consider a variety of scenarios in which green infrastructure may be implemented. These include:

- *DWSD Led Projects*. These projects will be implemented as part of contract CS-1522 or through other contract vehicle dependent on size and type of project. DWSD may retain an asset with these projects that would enable bond financing.
- *Other Agency Led Projects*. Examples of this type of project would be a City or County road project or DBA led demolition. In this situation, DWSD would fund a share of the project that directly relates to green infrastructure or the storm water benefit value the project provides. For example, it may fund the storm water practices associated with a road project, or may contribute to the demolition relative to the amount of impervious area removed. In general, DWSD would not retain an asset resulting from these projects, although DWSD may perform maintenance in some instances.
- *Projects on Private Property*. DWSD will financially support projects on private property in the URT area through funding for downspout disconnection materials for residential properties and drainage charge modifications for larger sites. In these instances, the property owner will own and maintain the practices.

Many of the details of green infrastructure financing will be developed as part of implementation projects in 2015 and 2016. Funding of the program has been established in the CS-522 contract, with $14.5 million of contract capacity. This contract capacity, along with the work performed through other agreements, will accomplish the permit required spending of $15 million.

4.3 PRACTICE SUSTAINMENT & MAINTENANCE

The strategies discussed in this section relate to ensuring that green infrastructure practices are kept in place and properly maintained. This will be accomplished through a mix of project selection, property ownership, and formal and informal agreements. Dependent on the future development of the City of Detroit, some of the practices implemented may be removed. The policies, procedures and standards that are part of activity one (section 7.0) will help to ensure that future redevelopment of parcels and rights-of-way provides for beneficial storm water management, even in those isolated instances where green infrastructure practices may be removed or modified.

4.3.1 Sustainment of Green Infrastructure

Sustainment of green infrastructure relates to ensuring that practices that have been implemented or constructed are not later removed. Green infrastructure practices that are constructed by DWSD will typically be located on public lands. DWSD will also invest in flow reduction strategies (such as downspout disconnection) on private property and will support private implementation of green infrastructure practices through drainage charge discounts. Generally the practices are expected to be owned by the entity that owns the property on which it is located. Long-term sustainment of the green infrastructure will be promoted through the following mechanisms:

- City-owned properties (parcels and rights-of-way). Green infrastructure investments on public land will be selected based on the anticipated long term future status of the location. Interdepartmental or inter-agency agreements will be established to reimburse DWSD if practices that are DWSD funded are removed prior to a reasonable depreciation period based on the practice type. Public facilities will not necessarily remain so in perpetuity. For example, the Detroit Public Schools are selling a significant number of properties. Long-term ownership expectations will be considered in project selection.
- It is expected that parcels where DWSD has funded demolitions and lot greening will be protected through ownership mechanisms, such as deed restrictions. Legal agreements were previously explored with the Michigan Land Bank. These have not been completed as a result of the changing role of the Detroit/Michigan Land Bank and the transition of staff in these agencies. However, the goal is to include such limitations in future funding agreements for demolitions.

- Residential downspouts, once disconnected, will remain disconnected per City building code and Michigan plumbing code.
- Private properties that receive a discount on their drainage charge, would lose that discount if the practice is removed. This will motivate property owners to keep in place (or potentially replace) such storm water management facilities.

4.3.2 Maintenance of Green Infrastructure

Long-term maintenance of green infrastructure projects is critical and is embedded into each project at the onset. All structural and vegetative green infrastructure practices will include a plan for maintaining maximum design performance through long-term operation and maintenance (O&M). The O&M plan will ensure that the green infrastructure practices continue to meet storm water runoff reduction targets as designed and will include regular inspections.

Larger green infrastructure projects will include:

- A process to ensure the contractor correctly installs the green infrastructure and includes a requirement for the contractor to fix any problems if the practice fails or reduces in performance within a specified time period.
- A maintenance plan that will include a maintenance schedule and maintenance activities that will be followed. DWSD will budget a portion of their green infrastructure commitment to include ongoing maintenance for a specified period.

For DWSD constructed practices, DWSD will either commit to maintaining the green infrastructure practices or require an agreement to be signed by the entity taking ownership or responsibility for the long-term maintenance of the green infrastructure practices. Formal agreements, deed restrictions or other partnerships may provide this continued maintenance function. One opportunity that is currently being employed and will continue to be reviewed with entities such as Greening of Detroit and the Michigan Land Bank is the use of Detroiters through their workforce development program to assist in maintenance of the green infrastructure.

A maintenance process is in place for existing implementation activities, including street tree plantings and greening of individual vacant lots.

For private practices, the property owner will be required to perform long-term maintenance in order to receive the drainage charge discount. In some communities, maintenance agreements are required that include a provisions for right of entry for the purpose of inspections and right to perform maintenance if the property owner fails to do so. Costs associated with these efforts would be charged to the property owner. A storm water management easement may also be required. DWSD will consider such requirements as the drainage charge manual is developed. Refer to Appendix A for examples of maintenance agreements.

4.4 ADAPTIVE MANAGEMENT

The Green Infrastructure Plan employs adaptive management, an iterative decision making process where incremental measures are matched with feedback mechanisms. Better decisions in successive rounds lead to a process and culture of continual improvement. This learning-by-doing framework is appropriate for contexts where there is considerable uncertainty. Adaptive management is a necessary approach to address green infrastructure due to the uncertainty of various jurisdictions and stakeholders involved, detailed infrastructure existing conditions, labor costs, material costs, and new technologies. This Plan provides lists of potential project opportunities organized by project type with the intent that a priority group of these opportunities will become implemented prototype projects. The prototype projects are intended to help assess the viability of various green infrastructure practices over the long-term through performance and outcome monitoring. This learning-by-doing approach will lead to continual improvement and revisiting of the Green Infrastructure Program along with an evolving list of proposed projects.

5.0 PARCEL-RELATED POLICIES AND STANDARDS

In the URT area, over 65 percent of the total area is made up of parcels. Management of storm water from parcels is typically addressed through institutional methods that either require or incentivize parcel owners to adopt green infrastructure practices to manage storm water generated onsite. The ability to encourage implementation and maintenance of green infrastructure (GI) on private properties is directly related to the zoning and financial structures that relate to on-site storm water management. Private investment in GI may occur as a repurposing (redevelopment) of land or as a retrofit. Maximum implementation will occur when the requirements are clear, the process is simplified and the business incentives are beneficial to the property owner. The relevant institutional methods include:

- Drainage charge calculation methodologies that incentivize green infrastructure, and
- Codes and ordinances that facilitate low impact development practices and include requirements for storm water management practices.

Each of these methodologies must be structured so that it is consistent with the others. DWSD is currently working on each of these institutional items. A summary of approach is presented in the following sections. Specific actions are addressed in the action plan, section 7.4 of this Plan.

In addition to the site-based institutional standards, many communities have adopted green streets standards to manage runoff from rights-of-way. DWSD will evaluate the appropriateness of a Green Streets Design Manual as part of coordination with City DPS on work within the rights-of-way.

5.1 DRAINAGE CHARGE SYSTEM

DWSD is in the process of updating its drainage charge system. The drainage charge system distributes costs associated with wet weather flows based on parcel imperviousness. It has been in place since 1984. DWSD is using improved site characteristic data which will allow for more precise quantification of individual parcel imperviousness.

Parallel with the refinements in the data underlying the drainage charge system, DWSD is developing an approach to recognize storm water management and green infrastructure practices that are implemented on parcels. The calculation methodology will provide an opportunity for property owners to reduce their bills. This, in turn, will result in a reduction in combined sewer overflows as a result of storm water controls. The following general concepts have been identified:

- Reduced drainage charges will be based on the implementation of storm water management practices that reduce peak flow and total volume of discharge. The site performance objectives will be based on the CSO control criteria that are relevant to DWSD's NPDES permit and sewerage system. Preferred storm water management practices are expected to include green infrastructure, such as bioretention and bioswales (for parking lot and roof runoff), permeable pavement, and green roofs, as these practices provide for volumetric reduction as well as peak flow management. More traditional storm water management practices such as detention basins will be necessary on some sites due to site constraints, and these will also be recognized in the program.
- Reductions in individual drainage charges will be based on the effectiveness of the practices and the real benefits / reductions in DWSD's cost of operations. Because of prior expenditures associated with CSO control, and because of the residual flow into the sewerage system, drainage charges will not be eliminated.
- The requirements to request a revised drainage charge calculation should be clear in order to encourage participation and to streamline processing of applications.
- Property owners will be responsible for ongoing maintenance of their storm water practices in order to continue to receive a reduced drainage charge.
- Currently, DWSD is meeting with owners of large properties upon request. Property owner proposals to reduce their drainage charges by modification to their sites and implementation of storm water management are being considered on a case-by-case basis.

- Drainage charge reductions for single-family residential properties are being considered in the approach. As disconnection of downspouts is embodied in state law, a credit for simple disconnection is not anticipated. However, credits may be available for rain barrels, rain gardens, or other implementation of green infrastructure.
- The drainage charge system needs to be coordinated with the City of Detroit's codes and ordinances so that practices that are identified in the drainage charge system are consistent with the zoning requirements.
- Specifics relative to the green infrastructure component of the drainage charge system will be developed through a community conversation and stakeholder input.

DWSD will promote green infrastructure through the development of the storm water drainage charge system. Current policy allows for credits to back bills for a portion of the property owner investment in green infrastructure. The future system will provide property owners with a means to reduce their ongoing bill based on the implementation of stormwater management practices and green infrastructure. It is expected that education and technical assistance to property owners will be provided to property owners to facilitate their implementation of green infrastructure. This represents a portion of the DWSD investment in green infrastructure.

5.2 CODE AND ORDINANCE REVIEW

Codes and ordinances play a significant role in the ability to implement green infrastructure and other storm water management practices within the City. The extent of impact is not limited to storm water management practices only, but also relates to such issues as parking requirements and landscaping. Low impact development approaches can affect the amount of storm water runoff by helping to reduce the amount of impervious areas on a site.

Within the City of Detroit there is significant interest in modifying codes and ordinances to make them friendlier to green infrastructure. This has been a focal interest of the Green Infrastructure Task Force Water Subcommittee and Detroit Future City. DWSD is supporting the technical review of codes and ordinances as well as working through the process details of making changes. DWSD will also support education efforts on codes and ordinances.

In addition to the written codes and ordinances, DWSD is working to identify areas where lack of familiarity with green infrastructure limits its acceptance within the flexibility offered in the code. An example of this relates to direction of roof drainage to storm water practices prior to eventual discharge to the combined sewer system. Lack of familiarity with design of these practices may limit their implementation on non-residential properties. As part of the code review effort, there is an objective to determine how a design manual and training in green infrastructure can better support its implementation.

6.0 GREEN INFRASTRUCTURE PRACTICES

This section provides information related to green infrastructure practices, both structural and non-structural. Practices include downspout disconnection (Section 6.1), public facilities flow management (Section 6.2), park flow management (Section 6.3), demolitions and removal of structures on vacant property (Section 6.4), tree planting (Section 6.5), and transportation corridor flow management (Section 6.6).

Each subsection provides the following:

- Description of the green infrastructure practice
- Implementation efforts completed to-date if applicable
- Identification process for potential project opportunities
- List of opportunities or types of opportunities
- Estimated runoff reduction as a result of implementing green infrastructure

Other green infrastructure implementation projects are described (Section 6.7) that do not fit in the primary practice types. These include large impervious property owners and collection system characterization.

Green infrastructure opportunities identified within this Section exceed the Program's funding capacity and outperform the flow reduction target within the five year permit cycle. They represent a series of opportunities that will be used for final project selection.

6.1 DOWNSPOUT DISCONNECTION

DWSD is implementing a downspout disconnection effort as part of the Green Infrastructure Program for the URT area. This effort initiated with residential properties and will progress to commercial and industrial properties. Initial efforts included downspout disconnection workshops and materials distribution in a pilot neighborhood. DWSD intends to build on experience gained through this pilot to expand downspout disconnections to a broader geographical area.

Permit Requirement:
"Provisions for disconnection of residential downspouts and disconnection of commercial and industrial downspouts where feasible."

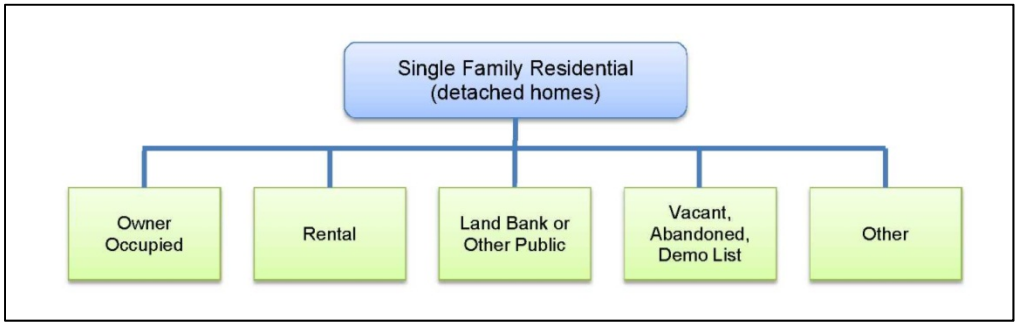
Disconnection of Eaves Troughs and Roof Downspouts

The permittee shall eliminate direct connections of eaves troughs and roof downspouts to the sewer system throughout the service area tributary to the Upper Rouge CSO outfalls (Outfalls 059-069, 072-075, 077, and 079). This requirement shall be completed by June 28, 2012, for residential property and by June 28, 2016, for commercial and industrial properties, or as may otherwise be approved by the Department consistent with the permittee's implementation of the Green Infrastructure program. In addition, the permittee shall eliminate direct connections of eave troughs and roof downspouts in the service areas tributary to the DWDS's CSO RTBs (see Part I.A.6. of this permit), to the DWSD's CSO Screening & Disinfection Facilities (see Part I.A.7. of this permit), and to the remaining untreated CSOs, upon completion of the Upper Rouge Outfall area. This requirement does not apply if the permittee demonstrates that the disconnection of eaves troughs and roof downspouts is not a cost-effective means of reducing the frequency or duration of combined sewer overflows or of maintaining compliance with this permit. Such a demonstration and supporting documentation shall be submitted to the Department for approval. (Part I A.15.c.)

6.1.1 Residential Disconnections

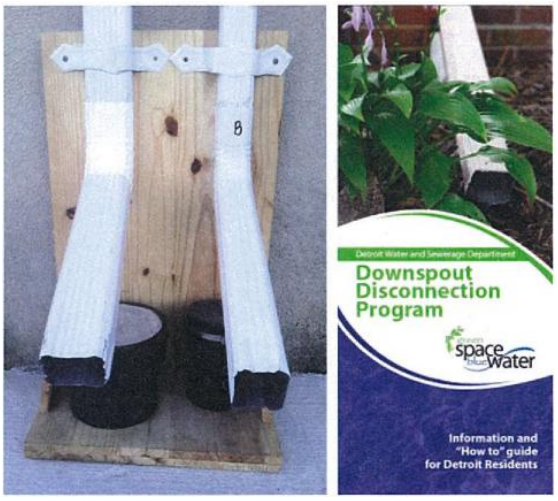
Residential disconnection programs will be structured around the various types of property ownership and the condition of the property and neighborhood. Residential property ownership and status is diagramed in Figure 4. The series of ownership scenarios includes owner occupied, rental property or land bank/ public owned. In addition, there are properties which are unoccupied and may either have an absent owner or are scheduled for demolition.

Figure 4 Residential Property Ownership and Status



Primarily targeting owner-occupied housing, DWSD initiated a residential downspout disconnect program in 2011/2012 in the pilot areas of the Cody, Rouge, Grandmont and Rosedale neighborhoods, which continued through September 2013. These neighborhoods include approximately 12,300 households. Spearheaded by SEMCOG and implemented by Greening of Detroit, the program included downspout disconnection workshops and a help line for those residents needing additional assistance. Individuals who attended the workshops received vouchers which allowed them to pick up free disconnection materials to utilize in completing the disconnection from the combined sewer system. Additional materials were also provided to local neighborhood associations and development corporations with existing home repair programs with the intent to assist with disconnection for elderly and disabled persons. Figure 5 shows a disconnected downspout and the educational brochure utilized in this program.

Figure 5 Downspout Disconnection Display and Brochure



According to Greening of Detroit's records, this initiative provided 177 residential properties with the necessary materials needed to disconnect some or all of their downspouts, thereby discharging roof runoff drainage to available green space. As part of this Plan, 30 percent of the residential properties that collected the disconnect materials were inspected from the street to determine if workshop participants followed through with the disconnection of their downspouts. Based upon the June 2014 investigation of the previous effort for downspout disconnection, approximately 50 percent of residences had disconnected or partially disconnected downspouts, while the remaining had downspouts (visible from the street) still connected to the sewer system.

Overall, the effectiveness of the downspout disconnection program relative to the level of investment demonstrates room for improvement. Greening of Detroit identified several recommendations going forward in downspout disconnections which are being incorporated into the action plan. These recommendations include:

- Identify the neighborhood groups or other organizations that operate effectively in the various neighborhoods and determine the extent of coverage these provide. Meet with as many community leaders from each neighborhood as can be identified. Explain that the program goal is to disconnect every possible downspout and ask for their advice about the approaches that should be used. This will create local buy-in and an on-the-ground network which will help with program acceptance, trouble-shooting, feedback and evaluation.
- Develop neighborhood timetable and clear performance dates.
- Review the workshop/ materials pickup process to encourage additional participation. Consider giveaways to increase attendance.
- Consider an approach where a contractor or civic group implements disconnections at residential properties and receives a "reward".
- Develop a process to address rental properties.
- Develop a process to address land bank-owned properties that are currently connected.

In addition to the downspout disconnection program, DWSD has supported the distribution of rain barrels through the Greening of Detroit. A total of 127 rain barrels were distributed at the Northwest Farmer's Market.

6.1.1.1 Code and Enforcement Issues

In the City of Detroit, the Building, Safety, Engineering and Environmental Department (BSEED) is responsible for building inspections and code enforcement. Thus an understanding of the code and ordinance structures is important. Historically the City of Detroit codes and ordinances required that all buildings be constructed with

internally separate plumbing (roof water and sanitary flows in separate systems) until they exited the building. These systems then joined outside the building prior to going to the sewer system.

A timeline of milestones in the law, code and regulations relative to residential downspouts include the following:

- Typical construction after 1940 – downspouts and foundation tile connected to service lateral.
- 1978. City of Detroit formally adopted Michigan Plumbing Code. Michigan plumbing code was largely based on the City's plumbing standards.
- January 30, 1998. State of Michigan Public Act 451 amended to include the following language: "When a permit for a discharge from a combined sewer system is issued or renewed under this part, the [MDEQ] shall require as a condition of the [NPDES] permit that eaves troughs and roof downspouts for the collection of storm water throughout the tributary service area are not directly connected to the sewer system".
- July 2000. Bulletin No. 2-2000 between DWSD and BSEED requires storm water drainage systems for new single family residential and duplex to have disconnected downspouts.
- Prior to July 2003, provisions in City Code Section 26-5-11(a) required gutters and downspouts to be fitted to discharge water from the roof to the sewer system or in a manner approved by the enforcing official.
- July 2003. City Code Section 26-5-11(a) was repealed and replaced by the Detroit Property Maintenance Code, Section 9-1-206. Roofs and Drainage, which states that "Water running off of the roof shall not be discharged in a manner that undermines the foundation or maintenance of any building, structure, sidewalk or drive. Drainage of roofs and paved areas, yards and courts, and other open areas on the premises shall not be discharged in a manner that creates a public nuisance."
- Michigan Plumbing Code (2012) Section 1101.2 reads "For one- and two-family dwellings, and where approved, storm water is permitted to discharge onto flat areas, such as streets and lawns, provided that the storm water flows away from the building."
- 2014. BSEED Housing Inspection Division, "pre-sale notice of deficiencies report" includes the following language under the "exterior: structural" checklist – "Repair/ replace defective or missing gutters and downspouts so water ***will properly drain away from the dwelling foundation***" (Emphasis added).

BSEED staff indicated that there are concerns over downspout disconnections that may result in a nuisance. Downspout disconnections that could be considered a nuisance include those which discharge directly onto hard surfaces, such as driveways, or in immediate proximity to sidewalks. The predominant concern relative to these disconnections is the potential for ice to form during cold weather. Specific instances of concern include:

- Downspouts that discharge onto driveways (side downspouts)
- Downspouts on homes that have limited setback from the sidewalk (discharge onto the sidewalk)
- Downspouts that discharge toward an adjacent property or foundation

Inspections of downspout disconnections could be performed by BSEED upon completion to confirm proper implementation of the disconnection. Illustrations and methods for disconnection should be reviewed with BSEED and clear guidance provided so that work is done in accordance with BSEED expectations.

6.1.1.2 Feasible Levels of Implementation

Disconnection or partial disconnection of residential property downspouts can significantly reduce flows to the combined sewer system. In order to determine the feasible level of implementation, the residential properties within the Upper Rouge Tunnel were inventoried and categorized based upon the style of house and location of downspouts.

Properties were evaluated by using the following available resources:

- City of Detroit Assessors data GIS information (DWSD)

- Google Earth (Street View)
- Limited field investigations

Based on a review of the typical house configuration relative to the driveway and the amount of green space in the vicinity of homes, approximately 75 percent of the homes with connected downspouts should be able to disconnect.

Implementation is impacted by the property ownership in the area. Many of the properties in the URT area are not owner occupied. In some cases many properties are owned by a single entity. This provides opportunities for coordination directly with the property owners of these homes.

Figure 6 Residential Rain Barrel and Rain Garden

6.1.1.3 Residential Rain Barrels and Rain Gardens

Rain barrels and rain gardens help in reducing the runoff volume from smaller rain events, help promote an understanding of storm water management, and aid in keeping water away from the foundation of homes (Figure 6). Rain barrel programs have been promoted by the Sierra Club and other organizations.

DWSD's primary emphasis is for proper disconnection of downspouts, with drainage directed away from the foundation. However, DWSD will support the implementation of rain barrels and rain gardens on residential property. The initial focus of this effort will be related to the codes and ordinance review, and collaboration with other groups.

6.1.1.4 Quantification

Table 8 identifies the characteristics from the rooftops of homes and the potential runoff reductions that can be achieved if these areas are removed. The number of homes that can contribute to runoff reduction as a result of downspout disconnection is estimated by subtracting out houses marked for demolition and houses with downspouts previously disconnected. This number is multiplied by the average residential building footprint representing the roof surface area. The feasible disconnected area assumes that 75 percent of the homeowners actually implement downspout disconnection. Hydrology calculations are then computed for the feasible disconnected area assuming a change from impervious surface to a vegetated lawn to obtain the runoff reduction.

Table 8 Residential Home Disconnection Potential

Statistic	NWI High Priority	NWI Low Priority	URT Total
Number of homes	15,627	12,382	82,668
Identified demolitions[1]	3,152	1,745	11,656
Estimated homes disconnected[2]	1,780	1,410	9,420
Net homes with connected roof (estimated)	10,695	9,227	61,592
Average building footprint/house (square feet)			1,013
Connected area (square feet)	10,834,035	9,316,951	62,462,196
Connected area (acres)	249	215	1,432
Feasible disconnect area (acres)	187	161	1074
Runoff reduction (MG)[3]	**5.7**	**4.9**	**32.7**

[1]From demolition list
[2]Based on windshield inventory, for homes not on demolition list
[3]Assumes 75% disconnection

6.1.2 Non-Residential Properties

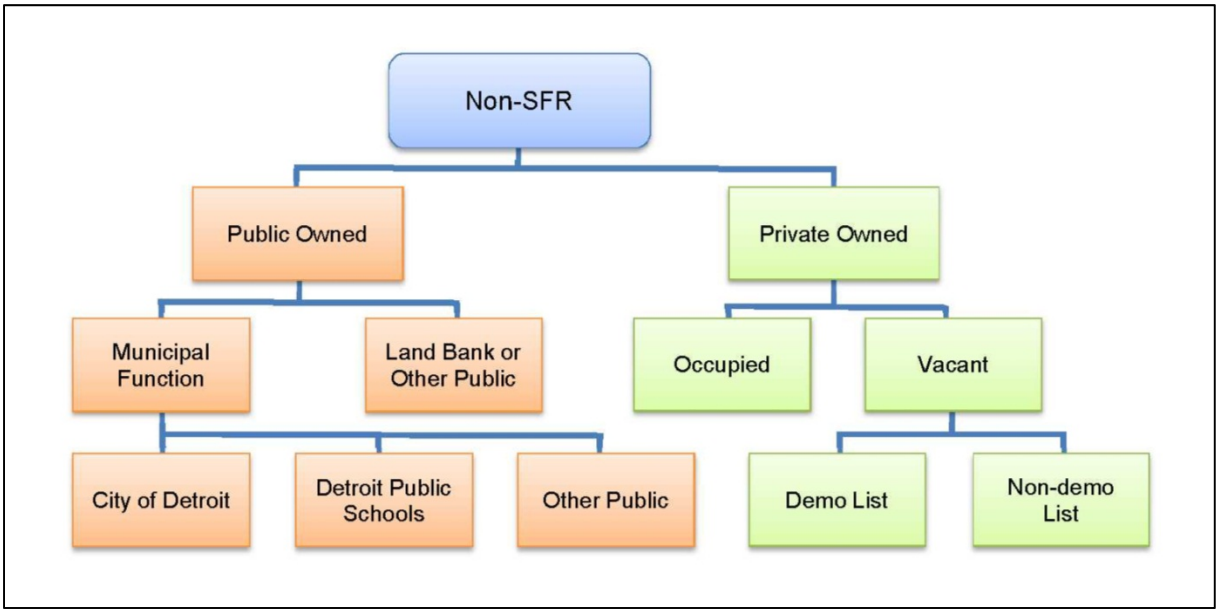
Non-residential properties include a variety of commercial, industrial, and institutional structures. Multifamily residential (apartment buildings) are also included in this category.

Disconnection of non-residential properties is complicated by a number of factors:

- The code and ordinance picture is less clear for non-residential properties. The current codes and ordinances require discharge of non-residential roof drains either to the sewer system or "an approved place of disposal". DWSD is working with BSEED and P&DD on a review of codes and ordinances, and the addition of storm water management practices to the list of acceptable approaches for site drainage with the objective of streamlining disconnections of non-residential properties.
- The work required to disconnect non-single family residential (SFR) roof drains can be significantly more complex, as more area is needed to manage the quantities of runoff. Often the management of roof water should be considered in conjunction with other site drainage (addressing the entire site in a one-step process), versus looking at these items individually (two-step process).
- Many of the commercial properties do not have external eave troughs and downspouts. In this case rerouting of roof drainage is more complex. While the language in the state law and NPDES permit may not pertain to these buildings, some property owners may be interested in controlling their roof runoff if it reduces their drainage charge.

As with residential disconnection programs, approaches to non-residential properties disconnects must be considered based on the various types of property ownership and the condition of the property and neighborhood. Non-residential property ownership and status is diagramed in Figure 7. The series of ownership scenarios includes public versus private, and occupied or vacant.

Figure 7 Non-residential Property Ownership and Status



Of these public properties, municipal or governmental functioning buildings provide opportunities for downspout disconnection. Because of the ownership and function, the Plan considered these locations both for the building and the site. They are discussed in Section 6.2, Public Facilities Flow Management.

The City of Detroit and the land banks in the City have acquired a variety of other nonresidential parcels. A limited review of the assessor's database indicated that many of the structures on these publicly owned parcels have been demolished.

The initial focus of the Plan for private, nonresidential parcels involves resolving institutional issues associated with the drainage charge structure, and codes and ordinances. From this framework, DWSD intends to develop a more specific approach to nonresidential downspout disconnection.

6.1.2.1 Quantification

Feasible downspout disconnection for nonresidential properties is believed to be more limited unless other green infrastructure practices are implemented concurrent with the disconnection. For initial quantification purposes, it is assumed that approximately 10 percent of these roof areas provide feasible disconnection opportunities. The volume associated with this level of disconnection is shown in Table 9.

Table 9 Non-Residential Disconnection Potential

Land Cover	NWI High Priority	NWI Low Priority	URT Total
Number of Structures	5,427	3,441	22,598
Total Roof Area (acres)	184.0	172.7	1,012.2
Estimated Feasible Disconnect Area (acres)	18.4	17.3	101.2
Runoff Reduction (MG)	**0.56**	**0.53**	**3.1**

6.2 PUBLIC FACILITIES FLOW MANAGEMENT

Permit Requirement:
"Provisions for installation of rain barrels and rain gardens at commercial and residential properties to capture and retard storm water runoff."

City-owned buildings and sites provide potential opportunities for DWSD to work toward reducing the amount of storm water entering the combined sewer system through a mix of roof and site drainage management. Publically-owned facilities include a wide range of properties with a diverse group of owners comprised of City departments as well as county and state agencies. Detroit Public Schools (DPS) is also a major landowner in the project area, although DPS is working to sell many of the closed schools in the area, so the status of many of these facilities is changing. The City of Detroit, Wayne County and State of Michigan also own a mix of properties that have been acquired through tax foreclosure and other means. The intent of the public facility evaluation was to identify and consider opportunities for greening of publically-owned buildings and sites. Land bank-related parcels (without structures) are addressed in other opportunity evaluation.

Table 10 is a list of the different types of public facilities. The number, total acreage, and impervious acreage of each facility type in the table are estimates and will be updated as more data is available and analyzed. Note that recreational facilities and parks are included in Section 6.3. Table 11 provides a breakdown of the Detroit Public School facilities.

Table 10 URT Area Public Properties

Property Type	Number of Facilities or Parcels[1]	Total Area (acres)	Impervious Area (acres)
Detroit Housing Commission[2]	300	90.9	15.0
Detroit Public Schools	26	325.0	115.6
DWSD Properties	7	11.7	5.0
DPW Yards	2	23.4	15.6
Fire Station/sites	6	4.0	1.7
Health and Human Services	2	3.6	1.0
Housing Complexes	20	193	42
Libraries	4	2.1	1.8
MDOT Pump Stations	14	6.2	2.3
Parking lots or paved sites	12	8.2	2.3
Police Facilities/ sites	5	16.5	12.3
Post Offices	4	18.9	6.1
Public Lighting	3	3.5	0.8
Wayne County Community College	2	81.8	28.8
Total	**407**	**788.7**	**250.3**

1 – some contiguous sites include multiple parcels
2 – includes some single family homes

Table 11 Detroit Public Schools

School Status	Number of Facilities	Total Area (acres)	Impervious Area (acres)
Open	26	255.0	118.1
Leased	8	45.1	20.7
Closed (for sale)	47	189.3	63.3
Total	**81**	**489.4**	**202.1**

6.2.1 Opportunity Identification Process

The identification of public facilities was completed using parcel and ownership data based on 2014 City of Detroit assessor information. The following property categories were identified as public properties:

- Board of Education
- City-Owned
- County-Owned
- Detroit Housing Commission
- Federal
- Public Lighting
- State-Owned
- Water Department

6.2.2 Opportunity Evaluation

Properties located in the NWI area were evaluated to determine the potential to disconnect downspouts or route storm water to green infrastructure practices. Critical decision elements in determining the opportunity available were related to type of downspout and amount of green space available. In some cases multiple public properties were in close proximity to each other, providing specific opportunities for flow management.

Table 12 represents the opportunity set for public facilities, which will be revised as more information is gathered about the sites.

Table 12 City and Governmental Owned Properties within NWI Area

Facility	Owner	Roof Area (Ac)	Down-spout Type	Parking Lot (Ac)	Parking Lot Condition	Green Space (Ac)	Runoff Reduction (MG)
Police: 6th & 8th Precinct, 11450 Warwick and parking lot[1]	Police	0.6	Internal	2.1	Fair	0.2	0.16
Fire Dept E-55, 18140 Joy/ 8826 Ashton	Fire	0.1	External, connected	0.2	Fair	0.0	0.00
Fire Dept E-57, 13960 Burt	Fire	0.0	External, connected	0.0	Fair	0.0	0.00
Fire Dept E-54, 16825 Trinity	Fire	0.1	External, connected	0.3	Fair	0.3	0.02
Detroit Public Library, Redford Branch, 21208 W Grand River	Library	0.3	Internal	0.6	Fair	0.2	0.01
Detroit Public Lighting, 16861 Trinity	P&DD	0.1	Internal	0.1	Poor	0.3	0.01
DPS, 18500 Dover (Detroit Institute of Technology Cody)	DPS	2.9	Internal	6.3	Fair	6.0	0.35
DPS, 19351 Edinborough (Closed for Sale) (Former Ludington Middle School)	DPS	0.7	Internal	0.7	Poor	1.4	0.08
DPS, 9983 Auburn (Mann Elementary)	DPS	0.5	Internal	0.9	Poor	2.0	0.08
DPS, 19590 Tireman (Closed – For Sale) (Dixon K-8)	DPS	0.7	Internal	0.5	Poor	2.0	0.07
DPS, 12886 Patton (Closed – For Sale) (Gompers Elementary)	DPS	0.7	Internal	0.9	Poor	1.3	0.08
DPS, 20390 Tireman (Closed – For Sale) (Kosciusko VL)	DPS	0.6	Internal	0.4	Poor	2.3	0.06
DPS, 19750 Burt (Closed) (McKenny)	DPS	0.8	Internal	1.7	Poor	0.5	0.03

Facility	Owner	Roof Area (Ac)	Down-spout Type	Parking Lot (Ac)	Parking Lot Condition	Green Space (Ac)	Runoff Reduction (MG)
DPS, 18100 Bentler (Closed – For Sale) (Holcomb)	DPS	0.9	Internal	0.6	Fair	1.4	0.08
DPS, 19900 McIntyre (Corner Stone Charter Academy)	DPS	0.8	Internal	0.3	Good	0.7	0.04
DPS 19931 Berg Road (Ludington and Wright Schools)[1]	DPS	3.4	Internal	3.9	Good	4.2	0.24
DPS, Briethaupt Vocational Tech Center, 9300 Hubell	DPS	3.4	Internal	4.2	Fair	1.1	0.06
DPS, Edison School/Health Services/Park[1]	DPS/Private	4.4	Internal			3.6	0.21
US Postal Service, 20645 Fenkell/15146 Braile	USPS	1.0	Internal	1.4	Good	1.7	0.10
Renaissance Village, 19301 Evergreen	MSHDA	6.8	External	3.0	Good	6.3	0.36
Garden View Estates[1](adjacent to NWI Area)	Detroit Housing Commission	21.9	External			133.1	1.26
Total		**50.7**		**28.1**		**168.6**	**3.1**

[1]Additional site details are provided in subsequent sections

Several specific opportunities were considered in more detail. A discussion of these potential projects follows.

City of Detroit Police Department 6th and 8th Precinct and Fitzpatrick-Warwick Playground. The City of Detroit Police Department 6th and 8th Precinct building is located within the NWI area at 11450 Warwick Street. The precinct building and parking lot are located adjacent to Fitzpatrick-Warwick Playground (Figure 8). Both the police station and the park are owned by the City. The police station is fairly new and likely has separated storm pipes. The parking lot off of Fitzpatrick Street has a curb and gutter drainage system with catch basins connected to the sewer. With the close proximity to the open space in the park, there may be an opportunity to intercept the building storm sewer and parking lot drainage and direct storm water to the open space. The green infrastructure practice could be a surface feature or a subsurface feature depending on the outcome of the implementation process. Note that directing runoff from Fitzpatrick Street to the park could be integrated with this project. The redirection of road runoff to park space for storage is addressed in Section 6.3.

Figure 8 6th/8th Police Precinct and Park

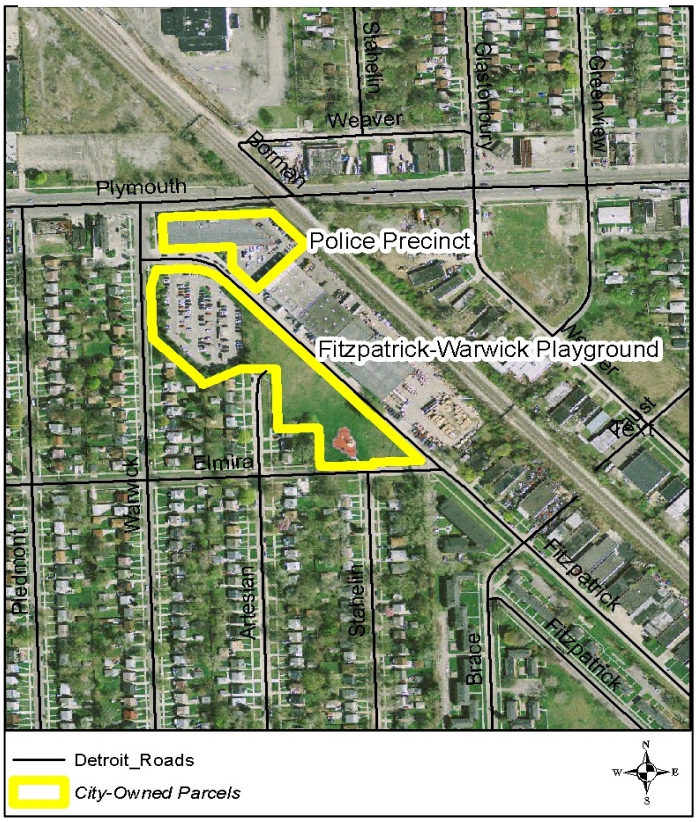
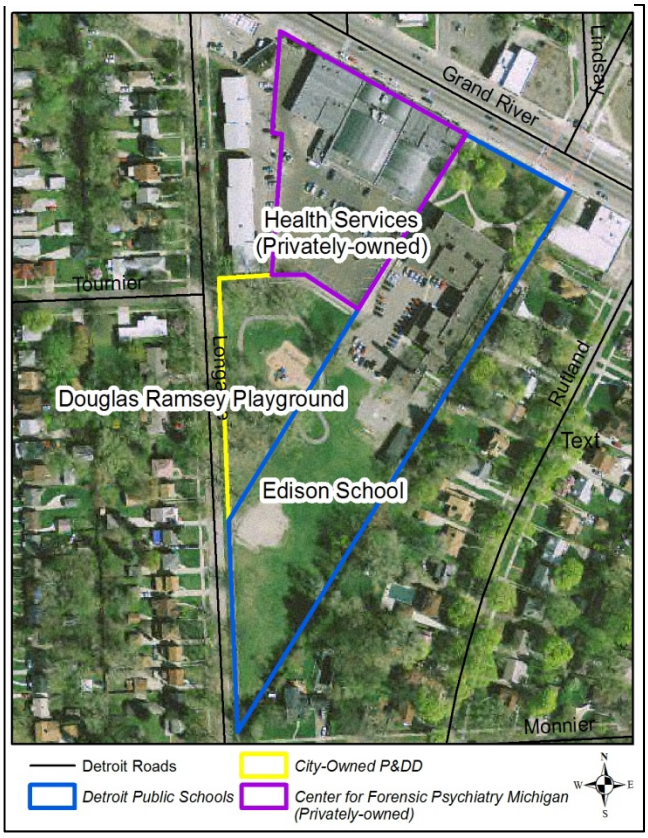


Figure 9 School/Health Services/Park



Edison School/Health Services Building/Douglas Ramsey Playground. Edison School is located in the Southfield tributary area within the URT area at Grand River Avenue and Rutland Street just east of M-39. It is adjacent to a health services building and Douglas Ramsey Playground (Figure 9). The park, school, and health services building are owned by the City of Detroit, Detroit Public Schools, and a private entity, respectively. The Department of Human Services is housed in the building and the owner is affiliated with the State of Michigan, so there may be a partnership opportunity. It is likely that the buildings and parking lots associated with these parcels are directly connected to the sewer system. With the close proximity to the open space in the park and the school yard, there may be an opportunity to intercept roof and parking lot drainage and direct it to the open space. The green infrastructure practice could be a surface feature or a subsurface feature depending on the outcome of the implementation process.

Garden View Estates. Garden View Estates is a 160-acre large redevelopment site located on the east side of the Southfield Freeway, bordered on the north by Joy Road, on the south by Tireman Street, and Asbury Park to the east (Figure 10). The redevelopment site will include more than 600 new single family and rental homes, including multi-family rental units and senior rental units. The larger development will also include an early learning center and a central park and pond and the entire site is anticipated to be complete at the end of 2015. The site appears to be constructed as a separated storm and sanitary sewer system. The storm sewer discharges to a large retention/detention pond on the site before release into the City's combined sewer system. DWSD has requested the site plans to review the exact configuration of the storm sewer system and design of the detention pond. The configuration and controls on the pond present an opportunity to manage storm water on the site to decrease the impact on the City's combined sewer system. Once plans have been reviewed for GI opportunities, DWSD will meet with the housing commission to discuss potential projects.

Figure 10 Garden View Estates Site

Directly to the east of Garden View Estates is a property owned by the Boys and Girls Club of SE Michigan and a property owned by Detroit Public Schools. This is another opportunity to implement an integrated project or large scale greening project.

Figure 11 Ludington Magnet Middle School/

Ludington Magnet Middle School and Wright Academy of Arts and Science. This project demonstrates a potential school project. Both of these schools are located within the NWI tributary area along the Rouge River at 19931 Berg Road (Figure 11). This property's proximity to the Rouge River provides opportunity for storm water drainage to be directed to the river through the use of greening efforts such as the installation of bioswales that discharge storm water directly to the river. Collecting the storm water from roof drains and paved areas and rerouting it to green space that allows for infiltration and conveyance to receiving waters will reduce a significant amount of storm water contribution to the combined sewer system.

6.3 PARK FLOW MANAGEMENT

Municipal properties, including parks, school property and other municipal buildings provide an opportunity to increase green infrastructure. This section discusses the opportunities identified in parks. Municipal and other public properties are discussed in Section 6.2.

The City of Detroit has 80 parks located within the URT project area, of which 32 are located in the NWI area. The parks range in size from less than ½ acre to over 700 acres, totaling 1,985 acres within the URT area. Figure 12 displays the locations of each of the project area parks. The Detroit Recreation Departments Strategic Master Plan for the parks system categorizes them into two basic types; local parks and city-wide parks. The city also makes a distinction between major parks, playgrounds and playfields as well as parks that have city funds allocated for maintenance and parks which do not.

Local parks generally provide daily recreation opportunities for the areas immediately surrounding them. These parks function as providing activities such as walking, basketball, softball and children's play activities and as such are generally small and distributed throughout the City. Within this category, parks are further broken down into the following facility types:

- Mini-park
- Neighborhood park
- Community park

City-wide parks have the goal to support a wider range of specialty recreation activities, such as swimming and facilities for organized sports. These parks are sporadic throughout the city and will not always be within walking distance to the residents. These parks are further broken down into the following facility types:

- Regional parks
- Plaza parks
- Sports parks

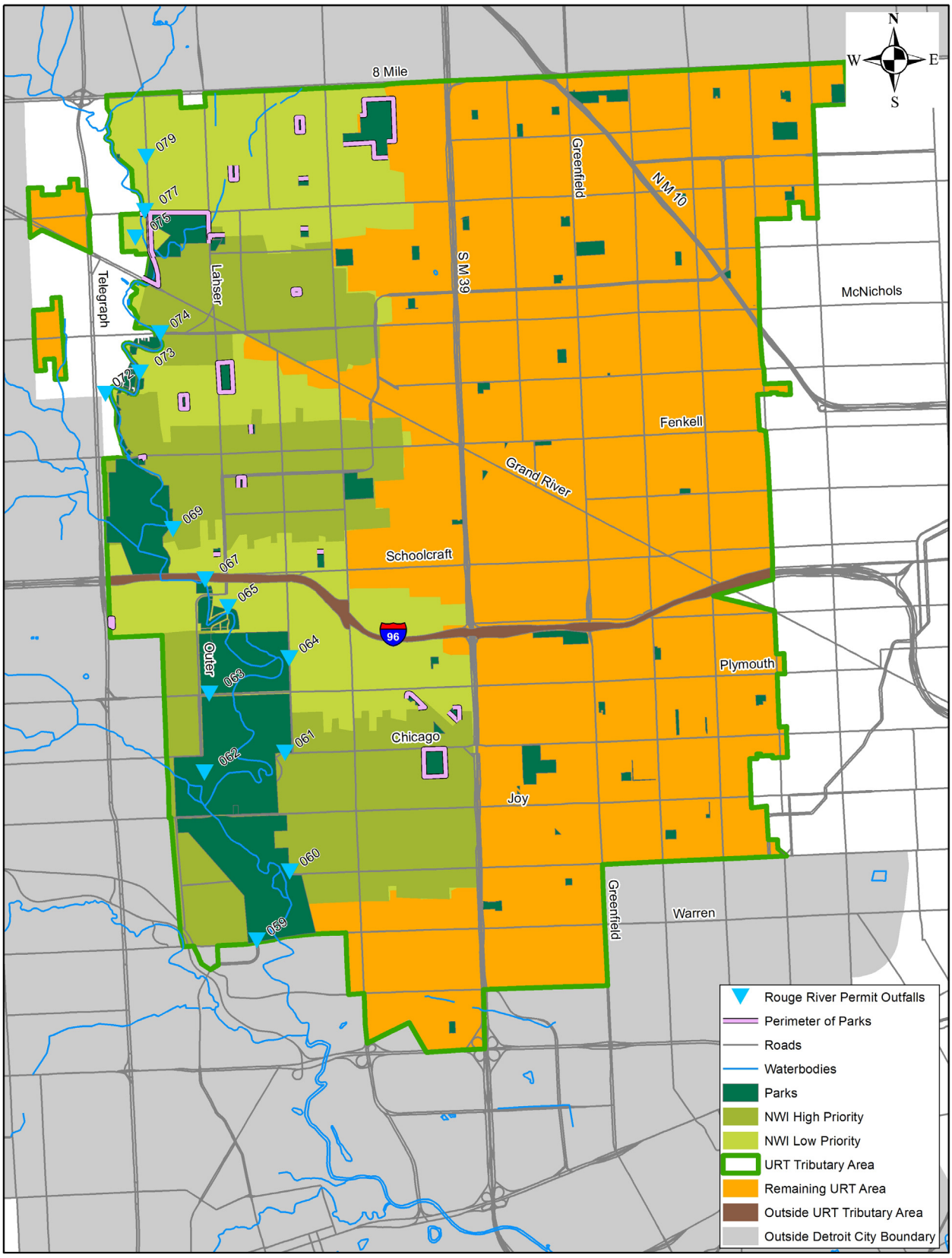
6.3.1 Practice Types

Green infrastructure in and surrounding parks can include a variety of techniques such as redirecting road runoff into the park, managing storm water runoff from the park space and facilities, and increasing tree canopy (planting trees) in areas of open space/turf grass. Tree plantings are discussed in Section 6.5, Tree Planting. This section will describe the first two practice types.

Managing Park Flow. Incorporating green infrastructure such as bioretention, permeable pavement tree boxes and directing storm water runoff generated in the park to these practices. Potential impervious surfaces that could be redirected include roofs, parking lots, play surfaces, etc.

Redirecting Road Runoff to Park Parcel. Redirecting road runoff through curb inlets or a swale to a park area. The area is graded to detain/retain water and may include tree plantings or other native vegetation.

Figure 12 Public Park Locations



6.3.2 Opportunity Identification Process

Green infrastructure opportunities can be incorporated into many of the types of parks and facilities. Opportunities were identified and analyzed based on the following data sets of information:

- Road jurisdiction and geometric characteristics; and
- Parcel data and ownership based on City of Detroit assessor's data (identified parks locations); and
- Parcel impervious cover data.

6.3.3 Opportunity Evaluation

This section provides an estimate of runoff reduction based on capture of runoff generated from impervious surfaces within parks and runoff generated from adjacent roads. Table 13 is a list of parks and the associated runoff reduction as a result of managing park runoff from impervious surfaces. Storm water runoff generated on park property was estimated based on impervious cover and total park area. The assumption is that all of the runoff generated on the park could be managed on-site in a green infrastructure practice.

Table 13 Opportunity Evaluation: Managing Park Runoff

Description	Total Area (acres)	Impervious Area (acres)	Runoff Reduction (MG)
Parks within the NWI Area			
Belden-Santa Maria	0.02	0.02	0.00
Clarita-Stout	3	0.02	0.00
Eliza Howell	249	16	0.92
Eliza Howell (Walnut Hills Apt.)	2	1	0.06
Fitzpatrick	3	0.03	0.00
Fitzpatrick-Warwick	4	1.5	0.09
Greenview-Wadsworth	3	0.01	0.00
Hackett	3	0.04	0.00
Hope	17	2.3	0.13
Lahser-Clarita	3	0.05	0.00
Midland-Bentler	2	0.07	0.00
Mt. Hazel Cemetary	4	0.2	0.01
O'Hair	69	0.17	0.01
Optimist-Stout	4	0.67	0.04
Outer Drive-Burgess	3	0.03	0.00
Outer Drive-Fullerton	46	0.09	0.01
Reid Park	1	0.08	0.00
Riordan	4	0.7	0.04
Rockdale-Kendale	2	0.3	0.02
Rogell Golf Course	90	2.6	0.15
Rouge Park	724	64	3.69
Rouge Valley Parkway	357	25	1.44
Simmons	4	0.05	0.00
Stein	25	3.9	0.22
Stoepel Park No. 1	29	3.8	0.22
Tuttle	4	0	0.00
Votrobeck	3	0	0.00
Weaver-Penrod	4	0.1	0.01
Total	**1662**	**123**	**7.1**
Parks within the URT Area Total	**1986**	**145**	**8.4**

Table 14 is a list of identified parks within the NWI area that border roads and an associated estimate of the runoff reduction based on redirecting road runoff into the parks. Of the 32 parks within the NWI, a total of 21 parks were evaluated for accepting additional road runoff. Runoff reduction volumes were estimated by measuring the length of road along the perimeter of each park. Half the roadway was assumed to be redirected into the park. The estimated runoff reduction assumes that the volume generated from the impervious surface is stored in the park. Road lane removal (road decommissioning or road diet) can be coupled with green infrastructure practices that manage runoff from the roadway.

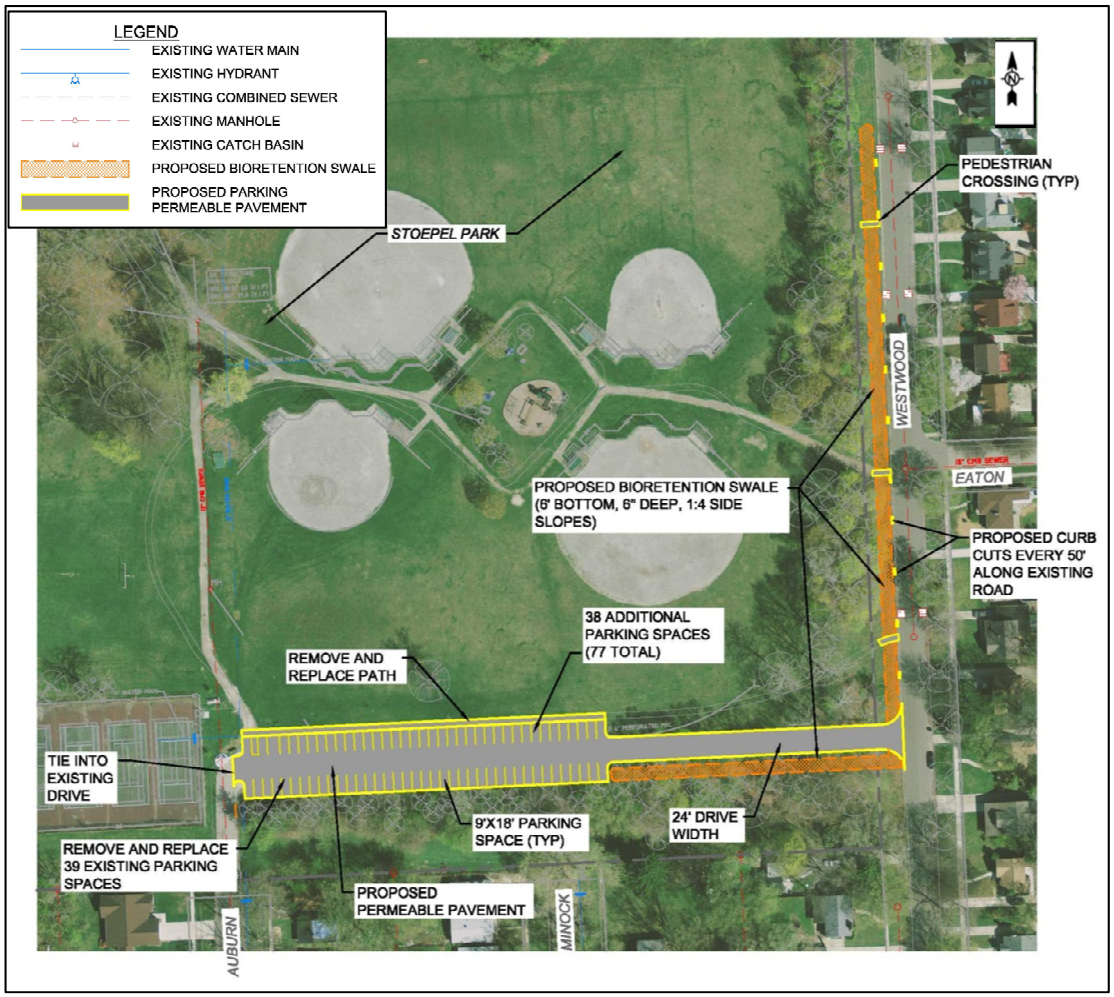
Table 14 Opportunity Evaluation: Redirecting Road Runoff into Parks

Park Name	Park Area (acres)	Perimeter Length (miles)	Adjacent Road	Runoff Reduction (MG)
Clarita-Stout	4	0.06	Clarita	0.01
Eliza Howell (Walnut Hills Apts)	4	0.08	Fenkell & Grayfield	0.01
Fitzpatrick	2	0.82	Fitzpatrick	0.09
Fitzpatrick-Warwick	4	0.29	Fitzpatrick	0.03
Hope	17	0.71	Lahser Rd	0.07
Lahser-Clarita	3	0.16	Lahser & Clarita	0.02
Midland-Bentler	2	0.08	Bentler Rd	0.01
O'Hair	69	0.49	Pembroke	0.05
Optimist-Stout	4	0.05	Kendall Rd	0.01
Outer Drive-Burgess	3	0.22	Burgess	0.02
Reid	1	0.18	Santa Clara	0.02
Riordan	4	0.33	Lamphere & Pilgrim	0.03
Rockdale-Kendale	2	0.06	Kendall Rd	0.01
Rogell Golf Course	90	1.92	Berg Rd	0.20
Simmons	4	0.28	Vassar Rd	0.03
Stein	25	0.80	Cathedral Rd	0.08
Stoepel Park No. 1	29	0.14	Westwood St	0.01
Tuttle	4	0.33	Stout Rd	0.04
Votrobeck	3	0.08	Votrobeck	0.01
Weaver-Penrod	4	0.27	Weaver Rd	0.03
Wilson	1	0.18	Dale Rd	0.02
Total	**278**	**7.6**		**0.78**

An example of a design incorporating storm water management and green infrastructure into a park is provided for Stoepel Park Number 1. The park is located in the Rosedale neighborhood bordering the Brightmoor neighborhood. Concepts include removing and replacing the existing parking lot with permeable pavement and installing a series of curb cuts and bioretention systems to manage runoff from Westwood Street and from Evergreen Street. Other options considered were conveying storm water runoff from the blocks surrounding the park via storm sewer pipes to an underground detention system under the parking lot. Figure 13 depicts some of the opportunities that are feasible at Stoepel Park Number 1.

This park is widely used for little league baseball games and tournaments and parking is very limited. Additional benefits for the surrounding community would be realized with an expanded parking lot and would enhance the improvements already underway in and around the park.

Figure 13 Stoepel Park Number 1 Green Infrastructure Opportunities



6.4 DEMOLITIONS AND REMOVAL OF STRUCTURES ON VACANT PROPERTIES

Changes in land use in the URT area have occurred over several decades. One of the more significant changes in land use results from demolitions and replacement of structures/ impervious area with vegetated surfaces. Understanding the potential opportunities associated with demolitions and lot greening requires an overview of the current status of properties and changes in recent years, as well as the consideration of opportunities that exist.

6.4.1 Prior and Current Demolition Activities

Tracking of land use changes for the purposes of DWSD's Green Infrastructure Program will use a base year of 2010, as previously discussed. Conditions in 2010 were documented through an aerial survey, and conditions in late 2013/early 2014 were documented through the Motor City Mapping Project (MCM). This provides the data necessary to evaluate the recent extent of change. DWSD has contributed to some of the recent demolitions in the area. A portion of this demolition work has been supported with DWSD funds. Baseline parcel status is identified in Table 15.

Table 15 2010 Baseline Conditions of Vacant Parcels (No Structures)

Statistic	NWI High Priority	NWI Low Priority	URT Total Area
Number of Parcels[1] with no structures	3,626	2,408	13,841
Impervious Cover (acres)	66	39	330
Open Space (acres)	158	104	604
Trees (acres)	191	132	623
Urban Bare (acres)	9	3	40
Water (acres)	1	1	3
Total Area (acres)	425	279	1,600

[1] Excludes park parcels.

The estimated impact of demolitions in the project area from 2010 through 2013 is estimated in Table 16. The 2010 baseline information is based on the 2010 aerial photography which was collected in the spring. The 2014 information is based on the Motor City Mapping project, which is assumed to reflect conditions as of December 31, 2013. Some structures are located on multiple parcels. Therefore, the number of parcels with structures may be greater than the number of buildings. This was quantified based on a GIS analysis. Locations of demolished properties are shown in Figure 14. Runoff reduction is based on the effective impervious area removed from the combined sewer system.

Table 16 Impact of Demolitions, 2010 – 2014

Statistic	NWI High Priority	NWI Low Priority	URT Totals
Number of parcels with structures, 2010	21,913	16,335	92,666
Number of parcels with structures, 2014	21,055	15,916	90,048
Building footprint area in 2010 (acres)	594	596	3,557
Estimated building footprint removed as of 2014 (acres)	22	24	114
Estimated total impervious area removed as of 2014 (acres)	48	49	259
Est. effective impervious area removed assumes 95% effective (acres)	46	47	246
Runoff Reduction (MG)	**1.4**	**1.4**	**7.5**

Since 2010, DWSD has funded the demolition of approximately 80 single-family homes. The estimated impervious surface removed as part of these demolitions is 4.9 acres. DWSD demolitions are shown on Figure 15 and summarized in Table 17.

Figure 14 Demolitions 2010 – 2014

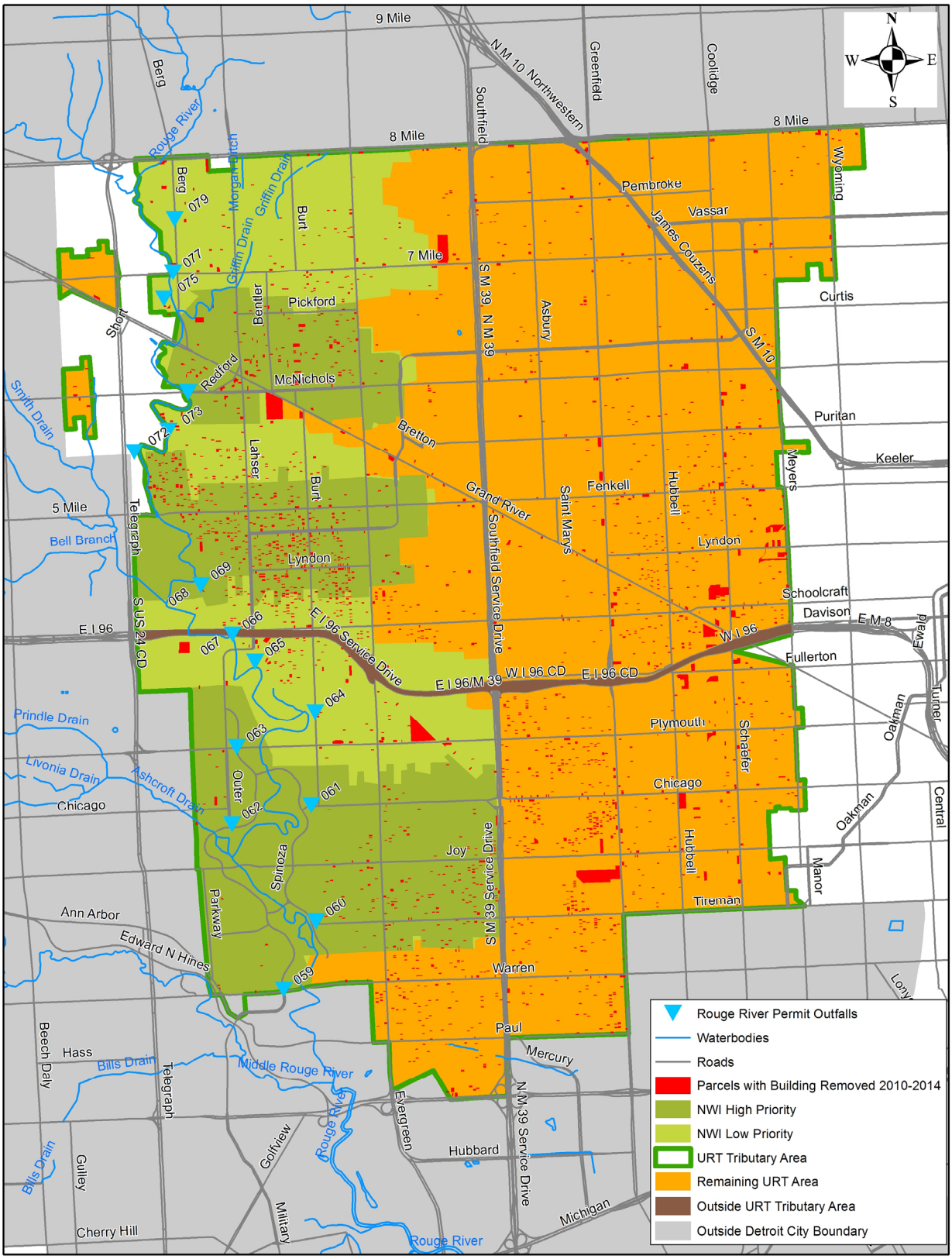


Figure 15 DWSD Funded Demolitions 2010-2014

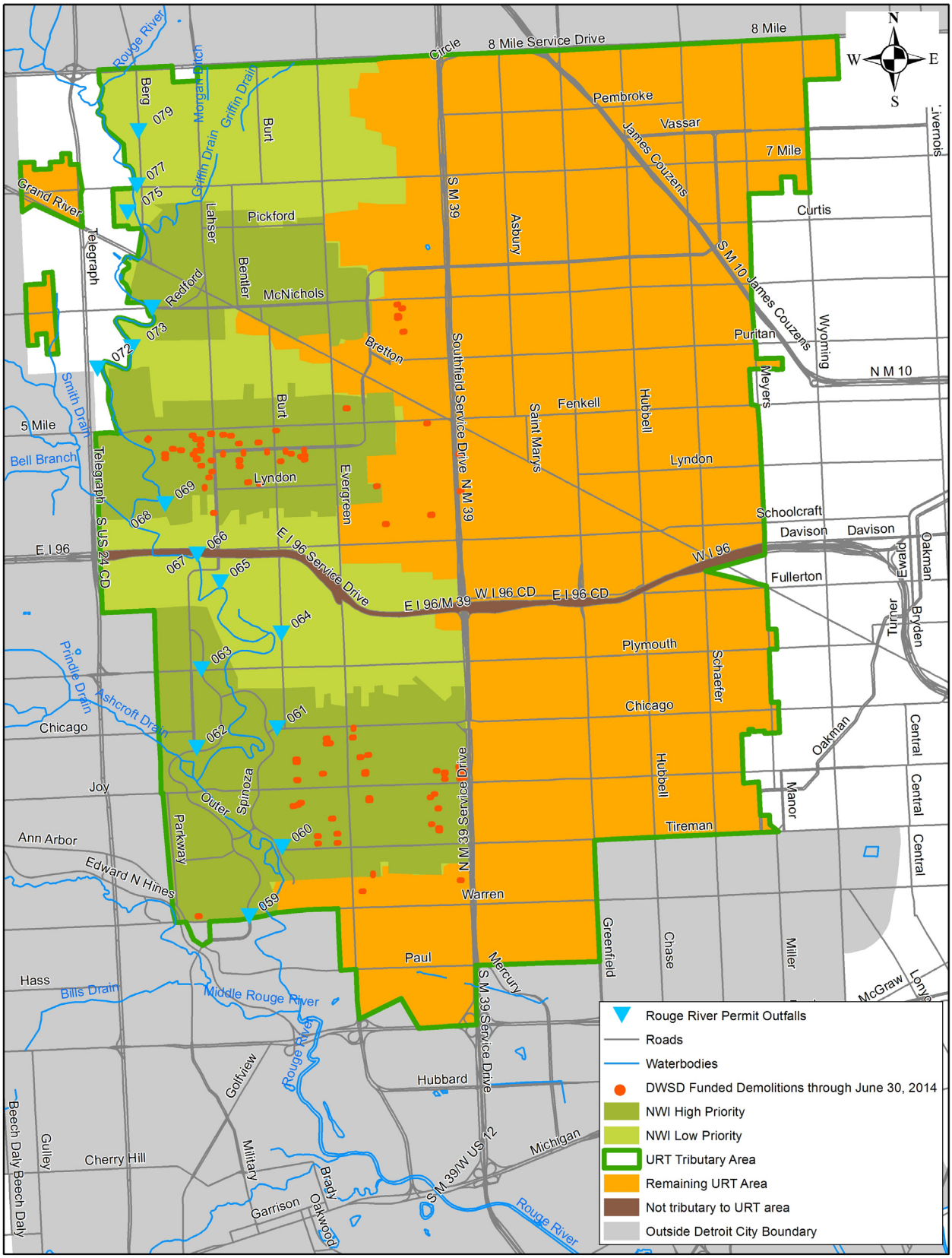


Table 17 DWSD Funded Demolitions through June 30, 2014

Description	Quantities
Number of Demolitions	80
Total lot area (acres)	9.5
Original impervious cover (acres)	4.9
Post demolition impervious cover (acres)	0.0
Runoff Reduction (MG)	**0.13**

A list of buildings has been identified by BSEED that are proposed for demolition. The total number of these proposed demolitions in the URT area is 11,697. This listing represents, in part, properties that the City has received resident complaints about or locations where structure fires occurred. Funds are not necessarily available for all the demolitions that have been identified. The overall timeframe for the structures to either be removed or renovated is not known. Statistics related to the proposed demolitions are shown in Table 18. Runoff reduction potential is based on the presumed removal of the parcel impervious area.

Table 18 Identified Proposed Demolitions in URT

Statistic	NWI High Priority	NWI Low Priority	URT Total Area
Identified demolitions, number	3152	1744	11,697
Residential	2736	1515	8,949
Commercial	70	43	416
Other	346	186	2,332
Identified demolitions, building area			
Residential (acres)	59	33	195
Commercial (acres)	3	2	11
Other (acres)	8	4	61
Identified demolitions, parcel impervious area			
Residential (acres)	151	132	474
Commercial (acres)	59	6	117
Other (acres)	22	12	187
Identified demolitions, parcel total area			
Residential (acres)	341	183	1054
Commercial (acres)	507	9	577
Other (acres)	47	25	335
Runoff Reduction Potential (MG)	**13.4**	**8.6**	**44.8**

Institutionally, there are a number of agencies involved with the demolition efforts. These include:

- The Detroit Building Authority (DBA), a City Department, is the leading agency of demolition activities for commercial and residential properties. The DBA is tasked with the central oversight of demolition activities for various departments across the city. They are responsible for implementation of demolition of properties and Environmental Best Practices. The DBA provides Construction Management and Technical/Engineering services and is developing a demolition specification with input from MDEQ, EPA, demolition contractors, and other expert advisors. This work is coordinated with Buildings Safety Engineering and Environmental Department (BSEED). Several departments coordinate with the DBA including BSEED, Planning and Development Department (P&DD), Detroit Public Works (DPW), DWSD and the Detroit Land Bank Authority (DLBA).
- BSEED enforces state and local building and construction codes. BSEED previously coordinated the procurement and general contractors for the demolition efforts.
- P&DD designates sites for removal and allocates funds received from the United States Department of Housing and Urban Development (HUD).

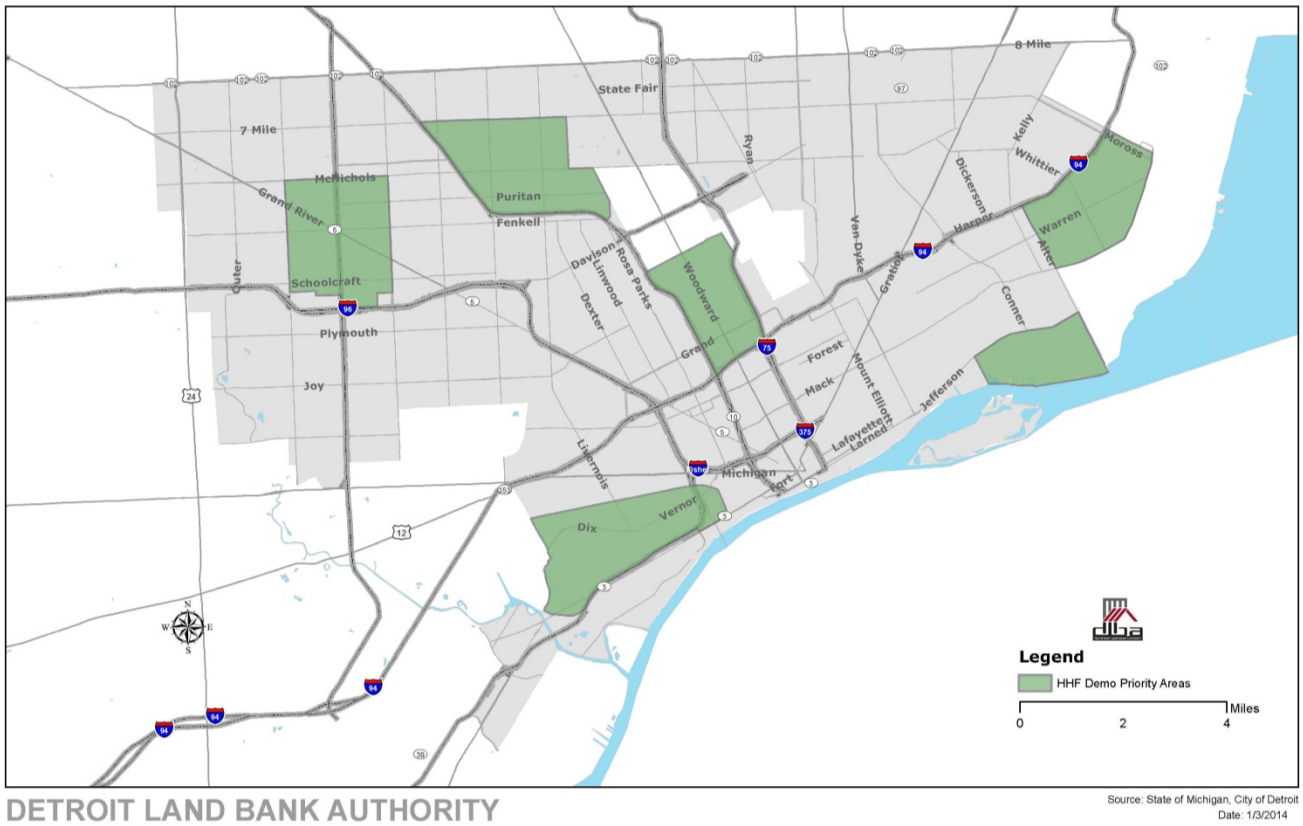
- The General Services Department (GSD) is responsible for maintenance of vacant lots.
- The Department of Administrative Hearings adjudicates blight violations and imposes civil penalties where appropriate.
- DLBA is a legal entity separate from the City that was formed by an intergovernmental agreement between the City of Detroit and the Michigan Land Bank Fast-Track Authority. It has a seven-member Board of Directors, with five members appointed by the Mayor and City Council. The two other members are the Director of P&DD and the Director of the City Planning Commission. In general, many of the city-owned vacant and abandoned properties within the City of Detroit will be transferred to the DLBA. The DLBA works closely with the DBA on the coordination of demolitions. The DLBA and the Detroit Housing Commission are two of the city's largest landlords.
- The mission of the Michigan Land Bank Fast-Track Authority is to promote economic growth in the state through the acquisition, assembly and disposal of public property to foster the development of property and to promote and support land bank operations at the county and local levels. This includes tax reverted properties.
- The Wayne County Treasurer controls the inventory of tax foreclosed properties.

As of 2014, there are approximately 78,000 abandoned and blighted residential structures within the City of Detroit. In May 2014, the City proposed to invest a total of $440.3 million for citywide residential blight removal in the next six fiscal years. This investment will increase the average number of demolitions budgeted per month. A variety of these funding sources are being used for demolitions in the URT areas. These include the following:

- **Hardest Hit Funds.** The Hardest Hit Fund is designed to provide $7.6 billion to the 18 states plus the District of Columbia hardest hit by foreclosures to develop locally-tailored programs to assist struggling homeowners in their communities. The Michigan State Housing Development Authority (MSHDA) has allocated $100 million for demolitions, $52 million of which is designated for the City of Detroit. These funds are administered by the Detroit Land Bank Authority (DLBA), in conjunction with the Michigan Land Bank, for program management, acquisition and land banking. The City of Detroit BSEED will provide candidate determinations and inspections. The Hardest Hit Fund demolition program is intended to stabilize lower-vacancy neighborhoods and is not meant for clearance of vacant structures in high vacancy areas. Moreover, this demolition program requires public ownership of the structure before it is demolished. Priority locations for the City of Detroit are shown in Figure 16.
- **Quality of Life Loan Dollars**. This funding source is a $120-million loan from Barclays of London, for the City of Detroit to begin spending quickly on critical public service needs. $35.6 million of this fund is slated for tear down of blighted homes. These homes are abandoned, vacant, or are not salvageable.
- **Neighborhood Stabilization Program.** The Detroit Land Bank Authority has access to $4.3 million in NSP II program income, and the city has an additional $3 million in NSP funds that it is continuing to expend. This funding is more flexible for a range of activities: residential and commercial demolition; developing financing mechanisms; and to purchase, rehabilitate, and redevelop residential structures. NSP II funding has income restrictions that affect where resources can be applied in Detroit. Within these program restrictions, the city has some latitude in allocating annual funds to specific uses.
- **Fire Escrow Funds**. The Fire Escrow Funds limits funding to a $6,000 cap per structure and these funds are restricted to fire-damaged buildings. In the case of a building fire, the owner's insurance company sends a percentage of insurance money (typically 5-10 percent) to the municipality where the building is located to be held in escrow for demolition. If the structure will be repaired by the owner, a permit must be issued to do the work. When work is completed, a certificate of completion is issued by the city. The owner or the contractor files paperwork with the municipality and escrow funds are returned to the property owner after approximately 30 days. If the property owner chooses to demolish the property, the demolition contractor must be issued a permit. After the contractor completes demolition and receives a certificate of completion, the owner or contractor files paperwork with the municipality and the escrow funds are disbursed to the contractor after approximately 30 days. If a fire-damaged building is abandoned and the municipality deems the structure to be a community hazard, the city may demolish the building and seek the insurance escrow funds to cover a portion of the costs of asbestos abatement and demolition. Although there are plenty of such structures in Detroit, some escrow-eligible structures can be demolished using other funds.
- **Community Development Block Grants.** The CDBG program is a Federal grant program operated by the U.S. Department of Housing and Urban Development. This program provides entitlement grants to

local government for community development activities. The overall goal of Detroit's CDBG program is to develop a viable urban community by providing funding for decent housing, economic opportunities, needed services and a suitable living environment, primarily for persons of low and moderate income. CDBG funds may be used for a wide variety of activities including home rehabilitation, construction and rehabilitation of community facilities, demolition of blighted buildings, acquisition, relocation and preparation of property for new development, economic development, public services, planning, and administration of the program. The Mayor and City Council of the City of Detroit determine how these grant funds will be spent after a citizen participation process, including requests for and submission of proposals from community organizations, public service agencies, and City agencies and public meetings and hearings.

Figure 16 Hardest Hit Fund Priority Neighborhoods



A summary of the demolition programs is included in Table 19. These demolitions are being carried out using a variety of funding sources. Each funding source has its own requirements and limitations. The funding levels shown are total for the City of Detroit, and are not for the URT area only.

Table 19 2014-2015 Demolition Programs

Program	Citywide Funding (million dollars)	Requirements
Hardest Hit Funds	52.3	Requires public ownership
Quality of Life Loan Dollar	35.6	
Neighborhood Stabilization Program	7.3	Income restrictions
Fire Escrow	20.0	$6,000 cap per structure to fire-damaged buildings
Block Grants	8.0	Primarily for low and moderate income
Total	**87.6**	

6.4.2 Demolition Opportunities

Demolitions are included as a component of DWSD's green infrastructure program because they beneficially remove impervious surfaces that generate storm water runoff. Nevertheless, DWSD will use care in funding demolitions to ensure that they are a strategic application of storm water funds. In principle, DWSD will focus funding demolitions that meet the following criteria:

- Removes significant impervious area cost-effectively (this may be accomplished by sharing the cost of the demolition with other funding sources)
- Funding is not provided by other demolition programs
- Demolition provides desirable location for green infrastructure practice
- Demolition contributes to land assembly opportunities
- Long-term storm water benefits can be ensured through property ownership or deed restrictions

Many of the funding sources that are available are targeted toward residential structures. Immediate storm water reduction benefits associated with large impervious parcels are more significant and may be more cost-effective. Demolitions of interest to DWSD may not be limited to structures but may also include parking lots that are abandoned or in public ownership.

It is anticipated that both DWSD and DBA will identify locations that fit the established criteria. These demolition projects will be carried out by DBA through a memorandum of understanding with DWSD. Following demolition, DWSD may enhance the extent of lot greening.

6.4.3 Lot Greening Opportunities

For sites where demolition has already occurred, and in locations where new demolitions are implemented, the condition of the soil and vegetation on the parcel directly influence the amount of runoff generated. In addition, these parcels could be used for storm water management from adjacent roadways or from a larger area.

Several evaluations of the hydrologic performance of existing vacant sites are being implemented. Collectively, these studies will help to identify the additional benefit that can be achieved through greening of previously vacant land and the improved performance that can be achieved for newly demolished sites.

- Joan Nassauer from the University of Michigan is implementing a study of ecological site designs following demolition. These designs take advantage of the basement footprint for the installation of a green infrastructure practice. For this study, DWSD is funding the construction of the green infrastructure practices. The performance of these practices will be monitored and help to inform the broader opportunities associated with demolition site restoration.
- DFC and the Blue Green Task Force are working on a vacant land toolkit to identify a suite of alternatives that can be applied to existing vacant land or newly demolished structures. The intent of the toolkit is to provide options to local residents that will enhance their neighborhood while supporting good storm water management practices.
- Through the Shoreline Cities Grant, a number of partners, including DWSD, will be working to assess the hydrologic characteristics of vacant land where demolitions have previously occurred.

The primary opportunities for greening vacant property, the area immediately surrounding the vacant property, and the areas where demolitions are complete, include:

- Greening individual vacant lots, including those lots designated through the City's side lot adoption program.
- Large-scale green infrastructure implementation.
- Decommissioning roads where no or minimal occupied structures exist.
- Diverting road runoff onto assemblages of vacant lots.

6.4.3.1 Greening Lots

Greening opportunities associated with vacant land vary by the condition of the neighborhood in which they are located. In low vacancy and moderate vacancy neighborhoods, side lot adoption is often the preferred disposition of parcels where residential demolitions have occurred. In this instance, the neighboring homeowner either acquires ownership of the parcel or “adopts” it to function as an extension of their yard. This practice provides beneficial management of the site from DWSD’s perspective.

Side lot adoption becomes less feasible when the number of vacant parcels becomes large or the parcels are contiguous. In this case vacant lot greening to ensure a good vegetative cover on the parcel provides benefits. Priority candidates for DWSD greening of these lots would include ones which have limited established vegetation.

6.4.3.2 Large Scale Greening

In areas of high vacancy, there is an opportunity to assemble vacant lots and implement larger green infrastructure techniques. These techniques would manage nearby roadway runoff, implement large forests/meadows, and decommission some local roads.

Property Ownership Issues. In order to make this type of project a reality, land would need to be sufficiently under public control to allow for streets to be vacated and storm water to be managed and larger scale practices. Land ownership issues will need to be discussed with the Michigan Land Bank, the DLB and other public or nonprofit agencies.

Project Concepts. Large scale greening opportunities could include activities such as creating large forest and meadows areas, diverting and managing runoff from nearby roads into constructive storm water practices, and decommissioning and removal of selected local streets. Potential project locations identified in the Brightmoor neighborhood are shown in Figure 17. These areas include locations that were identified in the 2013 Green Infrastructure Plan. Priority project areas would include those that have a minimal number of residual structures, have a majority of parcels which are owned by public agencies, and have a surface grade that allows for draining storm water into the greened area.

The potential area managed through these projects is identified in Table 20. Smaller scale roadway diversion into vacant lots is discussed in Section 6.6.4.4.

Figure 17 Brightmoor Large Scale Greening Opportunities

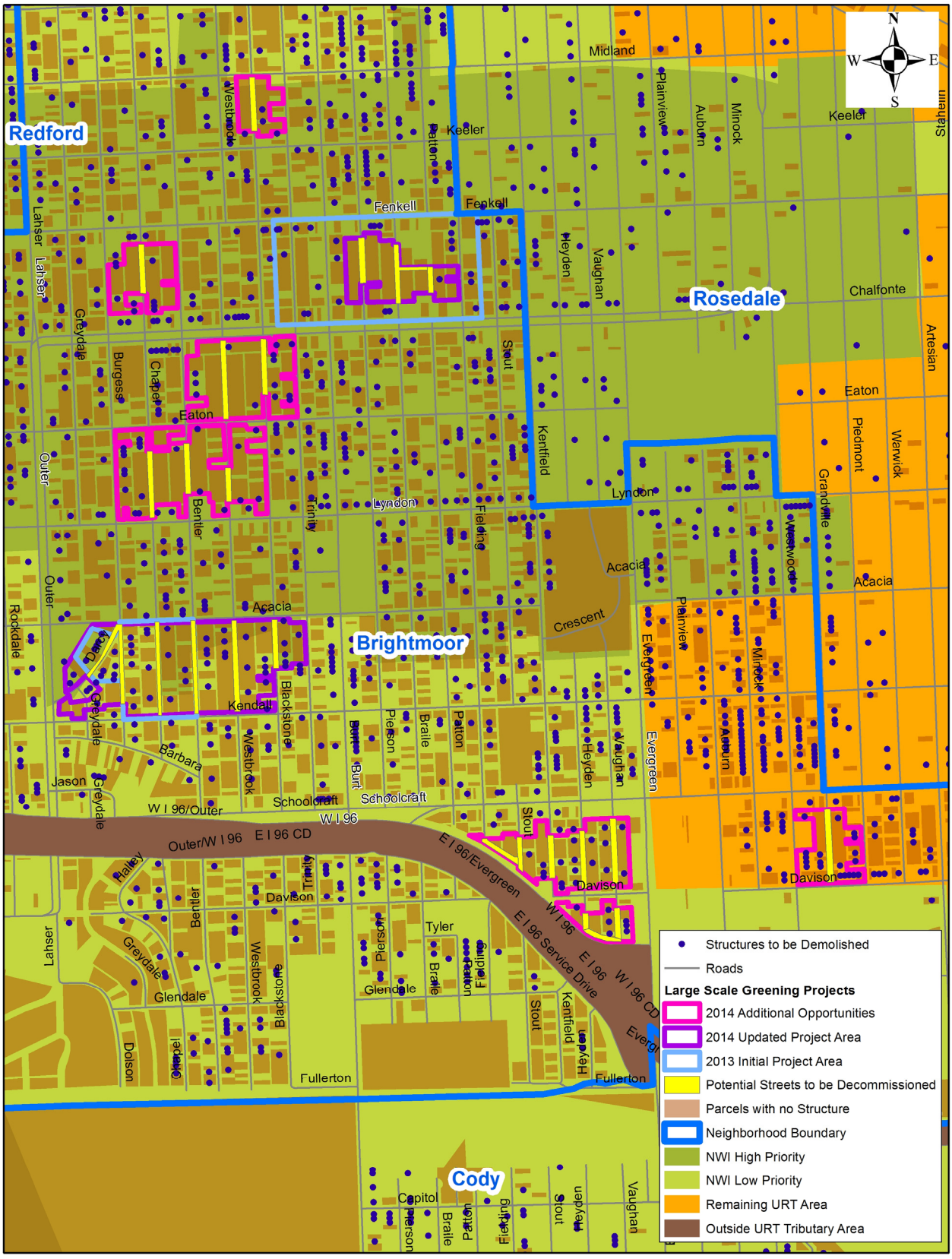


Table 20 Large Scale Greening Impacts

Location	Potential Assembled Area (acres)	Potential Area Managed (acres)	Potential Impervious Area Managed[1] (acres)	Runoff Reduction (MG)
Blackstone between Keeler and Midland	4.00	4.36	0.93	0.04
Chapel between Outer Dr. and Fenkell	7.26	7.56	0.83	0.03
Pierson, Braile, and Patton between Outer Dr. and Fenkell	9.27	11.75	4.01	0.19
Westbrook and Blackstone between Eaton and Outer Dr.	14.45	16.19	3.1	0.14
Chapel between Lyndon and Eaton	20.06	23.17	4.62	0.23
Westbrook,Blackstone, Bentler, Chapel, Burgess, Darcy between Kendall and Acacia	34.68	37.30	6.48	0.27
Stout, Kentfield, Heyden, and Vaughan between Davison and Schoolcraft west of Evergreen	12.64	14.07	3.86	0.16
Heyden and Vaughan between I-96 and Davison west of Evergreen	3.45	3.72	1.1	0.04
Grandville between Davison and Schoolcraft	6.86	7.52	1.5	0.06
Total				**1.16**

[1] This analysis only includes potential managed road surface runoff. With further review of the drainage areas, adjacent impervious surfaces may also be directed to the assembled land (i.e. roofs, parking lots). Hydrology of proposed decommissioned roads assumes this surface is converted to open space. Runoff redirection from portions of roads adjacent to the assembled land was also evaluated. It was assumed that the redirected runoff is detained within the assembled land.

6.5 TREE PLANTING

Tree planting aids in the reduction of storm water as a result of the interception of rainwater as it falls and as through the use of groundwater by the tree. In addition, trees provide a substantial impact on the aesthetic and environmental character of an area, which provides benefits to residents of the area in which they are placed.

Planting of trees will include street trees and clusters of trees in open spaces in what has been termed “storm water forests”. Street trees will initially be focused on residential areas, with commercial and industrial corridors handled as part of greening efforts on those streets

Permit Requirement:
“Provisions for tree planting for uptake and evapotranspiration along roadways and open spaces.”

6.5.1 Current Conditions

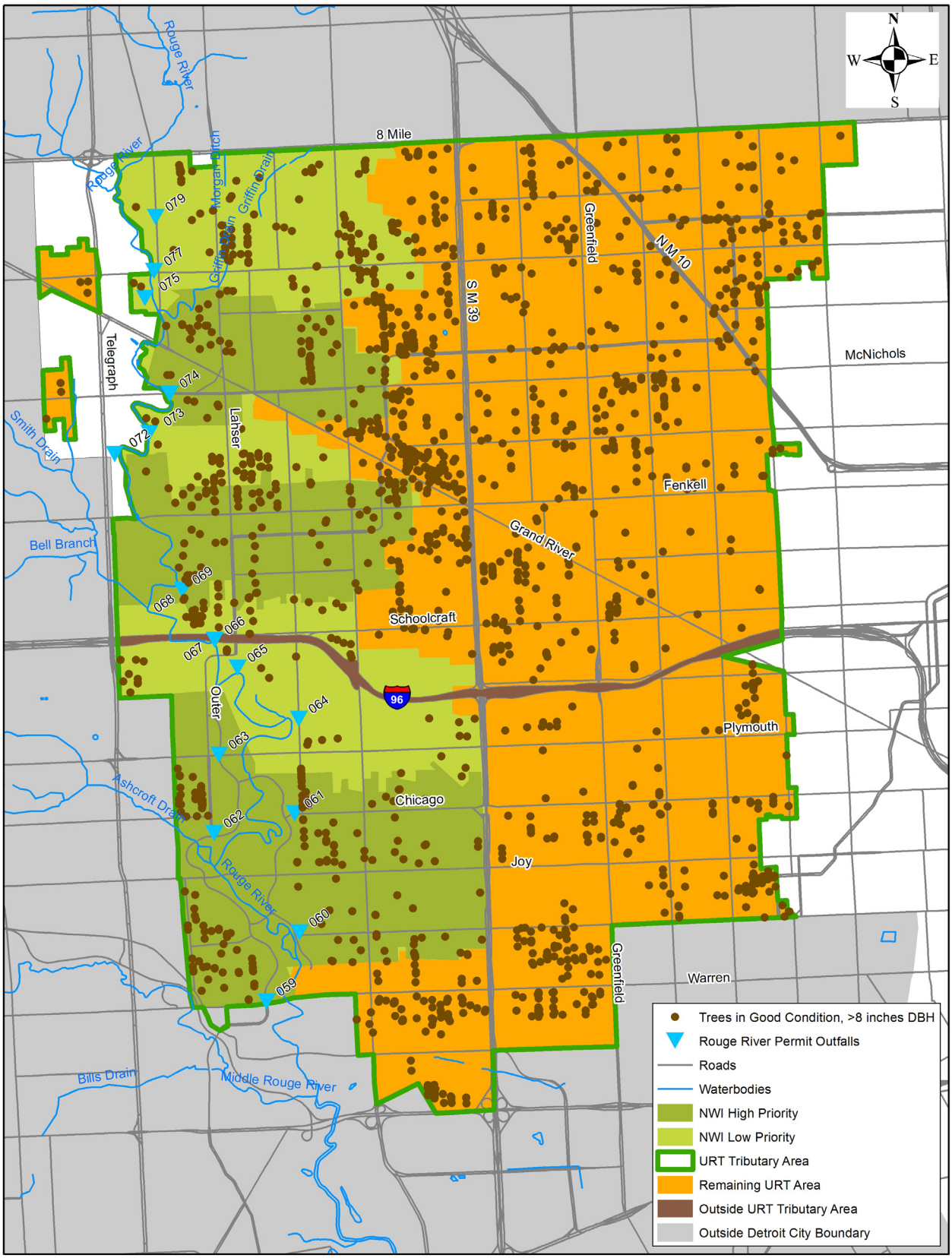
Street tree spacing in residential areas frequently includes one tree per lot. Other references suggest that street trees can be planted at a spacing of 30 feet on center, or 1 per lot where the typical lot is 30 feet wide. For planning of street tree implementation, DWSD assumed one tree per residential lot as a standard. The existing inventory of street trees was estimated based on an inventory of street trees performed by Davey Tree Service in 2011 throughout the City of Detroit as well as prior planting efforts by DWSD through Greening of Detroit.

The Davy Tree Service survey noted whether a street tree was present or absent, the diameter, tree species, condition, probability of failure and whether or not a specific disease or hazard was observed (for example – Emerald ash borer). The inventory results assessed over 91,000 locations in the URT area and 41,120 locations in the NWI area. In the NWI area, 30 percent of locations were considered to be in good condition with a diameter greater than 8 inches, locations of which are shown in Figure 18 and summarized in Table 21. The results show that in the URT area overall, approximately 5,800 street trees are in poor condition and should be considered for removal. This is generally due to a disease/decay or insect infestation.

Table 21 Davey Tree Inventory Results

Description	NWI High Priority	NWI Low Priority	URT Total
Stump Removal	382	289	1,241
No Tree	13,081	11,579	41,814
Tree Removal Recommended	944	701	5,858
Total, Lack of Healthy Trees	**14,344**	**12,569**	**48,913**
Recently Planted	889	223	3,596
Up to 8-inch Established	495	254	1,396
Greater than 8-inch Established	7,250	5,097	37,388
Total, Live Trees	**8,634**	**5,574**	**42,380**

Figure 18 Davey Tree Inventory Results of Healthy Street Trees



DWSD initiated a tree planting program in the spring of 2011 with Greening of Detroit to plant trees along road rights-of-way on city and county roads between the sidewalk and curb, in parks, on vacant properties, and in front of occupied homes. Since the tree planting program's inception, approximately 5,342 trees have been planted within the URT. Of these trees, an estimated 4,403 are street trees that were planted subsequent to the Davey Tree Service inventory.

Figure 19 Street Tree Planting Efforts from High School Students and Local Residents

The following list identifies the tree species that were planted within the URT area:

- Red Maple
- Swamp White Oak
- London Planetree
- American Elm
- Hackberry
- Red Oak
- River Birch
- Serviceberry
- Sweet Gum
- Kentucky Coffee Tree
- Winter King Hawthorn

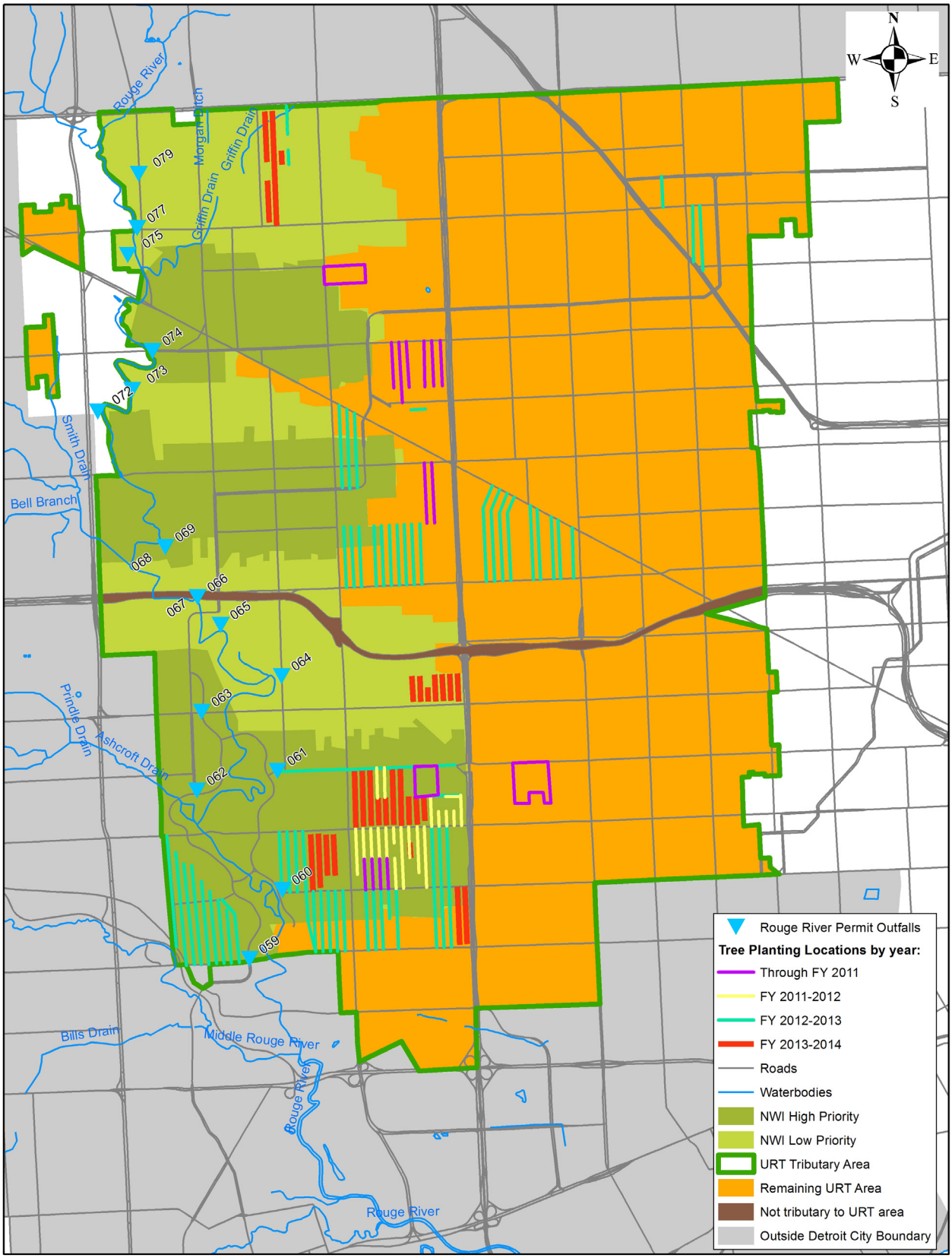
Tree planting locations by year are summarized in Table 22 and shown in Figure 20.

Table 22 Tree Planting Summary

Time Frame	# Trees Planted in URT Area	Estimated Runoff Reduction (MG)
Through FY 2011 Street Trees	332	0.009
Through FY 2011 Park Trees	769	0.022
FY 2011-2012 Street Trees	985	0.028
FY 2012-2013 Street Trees	1,867	0.052
FY 2012-2013 Park Trees	170	0.005
FY 2013-2014 Street Trees	1,219	0.034
Total	**5,342**	**0.150**

In addition to the street tree plantings, additional plantings have occurred in parks spaces in order to create storm water forests. Approximately 940 trees have been planted in these areas. These trees were planted in 2010 at Stoepel Park Number 1 and at Milan Playfield and Stein Park in 2012.

Figure 20 Street Tree Planting Locations



6.5.2 Opportunity Identification

There is an opportunity to plant street trees in areas where there currently are no trees. Tree planting locations will be limited to parcels that have the highest chances of survivability. The preferred planting locations include parcels with a viable structure on the property, followed by parcels with no structure in otherwise stable neighborhoods. Based on the tree inventory, prior Greening of Detroit plantings and the above parcel criteria, there are approximately 34,000 locations in the URT area where a viable structure was present (i.e. not on the demolition list) but no street tree was identified (see Figure 22 for locations). A number of these locations are places where residents have requested no tree be planted.

Approximately 950 street trees are proposed to be planted in Fall 2014 by the Greening of Detroit (Figure 23). Although 950 street tree locations are identified, resource limitations will only allow about 800 trees to be planted in Fall 2014.

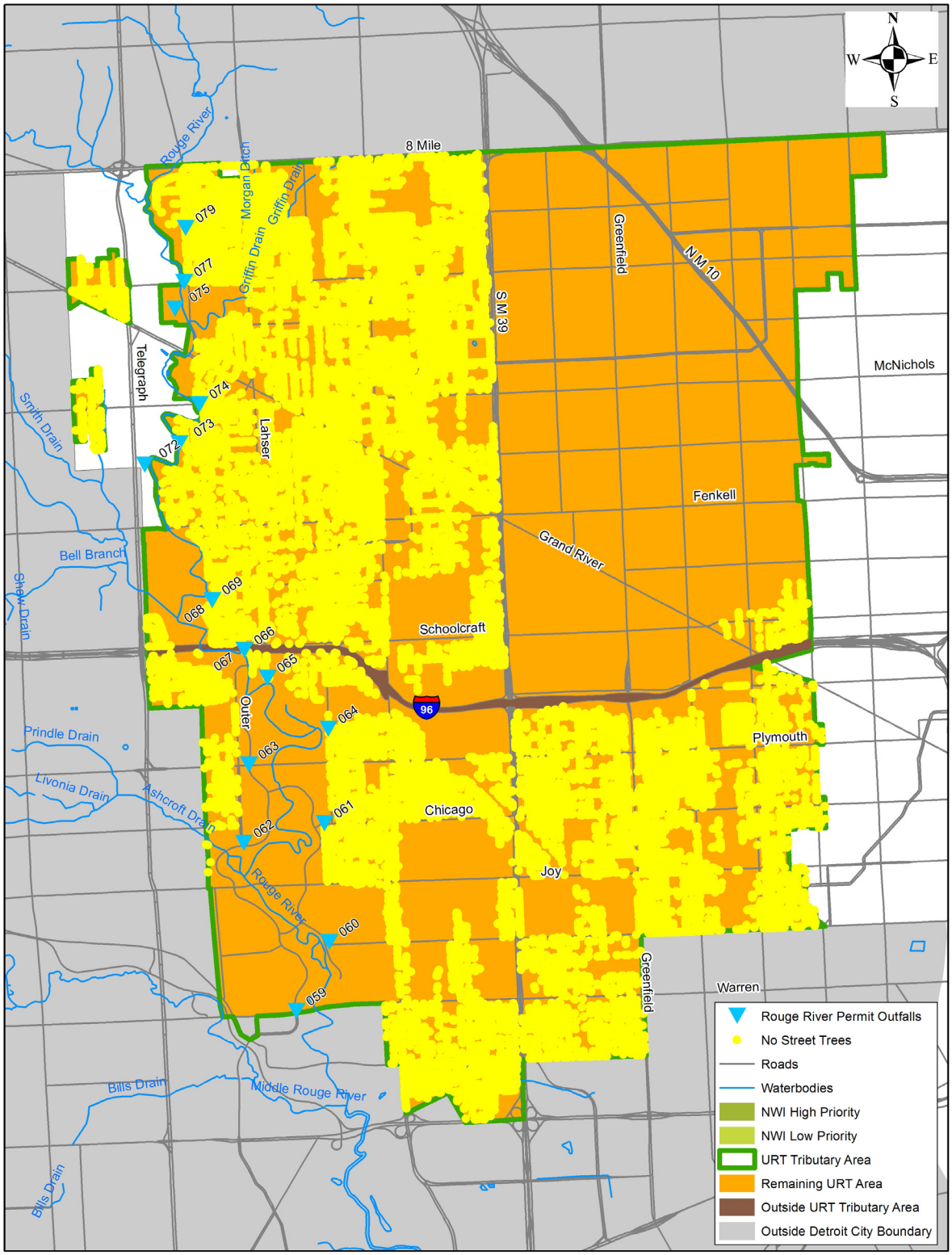
Street tree plantings will need to be coordinated with green infrastructure in transportation corridors. Established trees often limit the locations where bioretention and curb extensions can be implemented. Considered in advance, these efforts can be coordinated in order to provide a unified result. Thus new street tree locations also need to be coordinated with potential roadway practices on a block by block basis. Alternately, tree boxes can be considered in more congested areas for storm water benefits and beautification (Figure 21).

Figure 21 Tree Box Concept

Both Interstate-96 and Southfield Freeway (M-39) are located within the URT area. I-96 travels east-west and almost bisects the URT area while M-39 travels north-south and almost bisects the URT area separating the Rouge River district area from the Hubbell and Southfield district areas. The *2012 Detroit Strategic Framework Plan* identifies the areas surrounding both highways as opportunities for constructing carbon forests with a recommended width of 500 feet. These plantings require a 5- to 10-acre contiguous land area, which could be made up of a parcel or parcels.

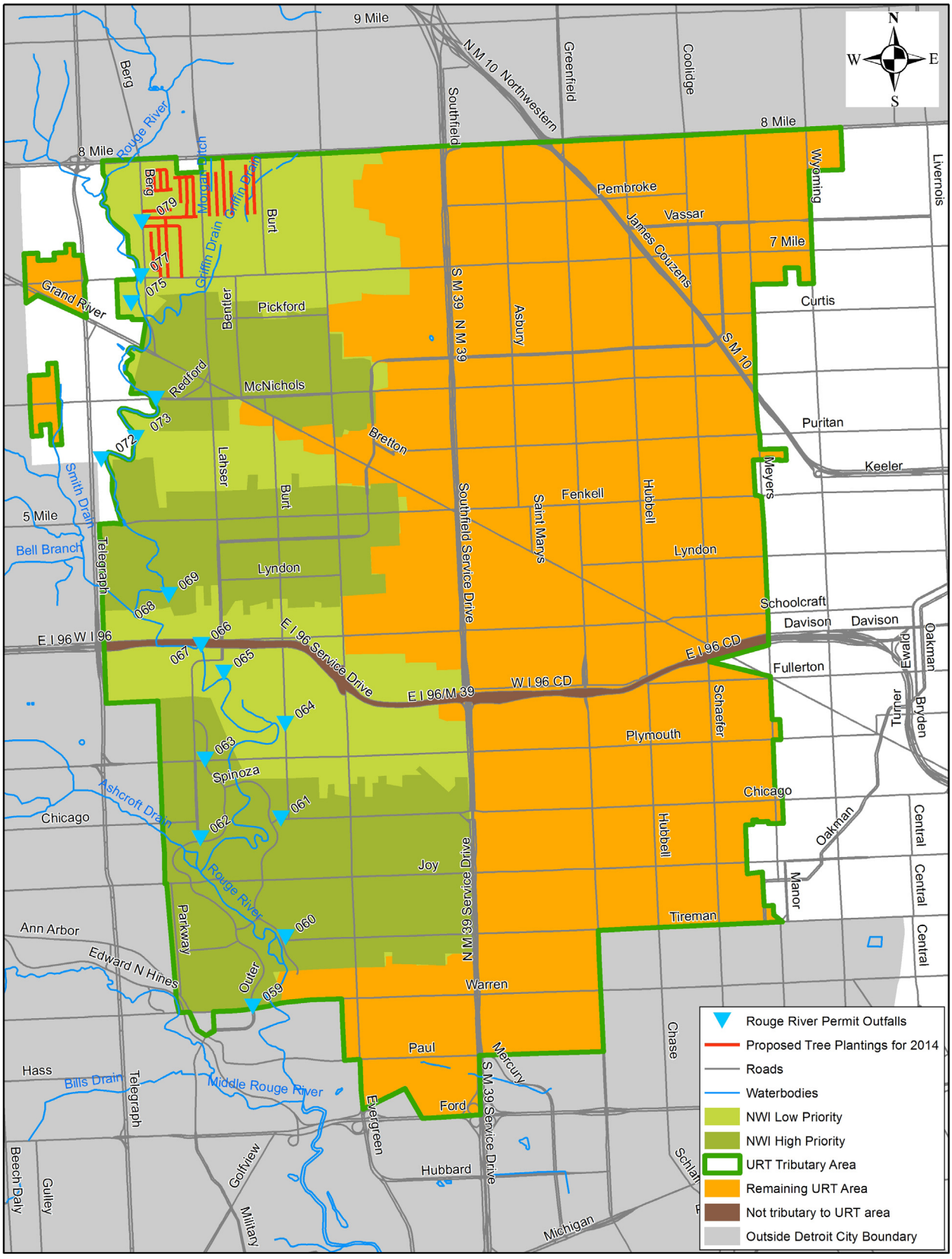
Presently, approximately 90 acres of vacant property and identified demolitions have been identified for potential carbon forests adjacent to I-96 and M-39. Funding for approximately 1,000 trees is available if land can be secured. DWSD will work as a partner in this effort to maximize storm water reduction associated with these projects. Due to funding timing and access to land, early carbon forest efforts may be outside of the URT area.

Figure 22 Davey Tree Survey –Residential Structures with No Street Tree



Note: The area east of the Southfield Freeway and north of I-96 shows little data because Davey Tree did not record “no street tree” in this area.

Figure 23 Proposed 2014 Tree Plantings



6.5.3 Quantification

As the tree canopy coverage increases over time, the rainfall interception rates will also increase with a decrease in storm water runoff entering the system. Table 23 summarizes the storm water-related benefits attributed to these trees as planted. Interception refers to rainfall which does not reach the soil but is instead intercepted by the leaves and branches of the trees.

Table 23 Storm Water Benefits of Tree Planting

	Total Number of Trees	Estimated Runoff Reduction (MG)
Street Trees (implemented)	4,403	0.12
Street Trees (2014 potential)	950	0.03
Trees in Parks and Open Spaces (implemented)	939	0.03
Trees in Carbon Forests, Parks and Open Spaces (proposed)[1]	470	0.01
Total	**6,762**	**0.19**

[1]This is an estimate for planting 1-inch caliper trees in Rouge Park.

6.6 TRANSPORTATION CORRIDOR FLOW MANAGEMENT

This section presents green infrastructure project types applicable to roadways, the processes associated with identifying and implementing project opportunities, and an initial list of roadway projects.

Permit Requirement:
"Provisions for installation of bioswales along roadways and parking lots to intercept runoff and reduce stormwater inputs to the combined sewer system from impervious surfaces."

Roads, including those under the jurisdiction of the City of Detroit, Wayne County and MDOT, represent the largest amount of impervious surfaces within the urban areas. The total transportation corridor area within the tributary area to the URT area is approximately 6,900 acres, of which approximately 4,800 acres, or 70 percent, is paved (impervious) surface. Table 24 identifies the contributing area information and Table 25 contains the estimated runoff volume from the transportation corridors within the project area.

Table 24 Transportation Corridor Area Summary

Jurisdiction	NWI High Priority (acres)	NWI Low Priority (acres)	NWI Total (acres)	URT Total (acres)
City	978	965	1,944	5,277
County	178	176	354	962
State[1]	113	111	224	608
Undefined	10	10	20	54
Total	**1,280**	**1,262**	**2,542**	**6,902**

[1]The I-96 corridor is not tributary to the DWSD combined sewer system and is not included in this total.

Table 25 Transportation Corridor Runoff Summary

Jurisdiction	NWI High Priority (MG)	NWI Low Priority (MG)	NWI Total (MG)	URT Total (MG)
City	41	40	82	221
County	1.5	1.5	3	8
State[1]	0.8	0.7	2	4
Undefined	0.0	0.0	0	0.02
Total	**43**	**43**	**86**	**234**

[1]The I-96 corridor is not tributary to the DWSD combined sewer system and is not included in this total.

6.6.1 Roadway Types

Roadway type influences the applicability of different green infrastructure techniques within the right-of-way. Roadway types within the URT area include the following:

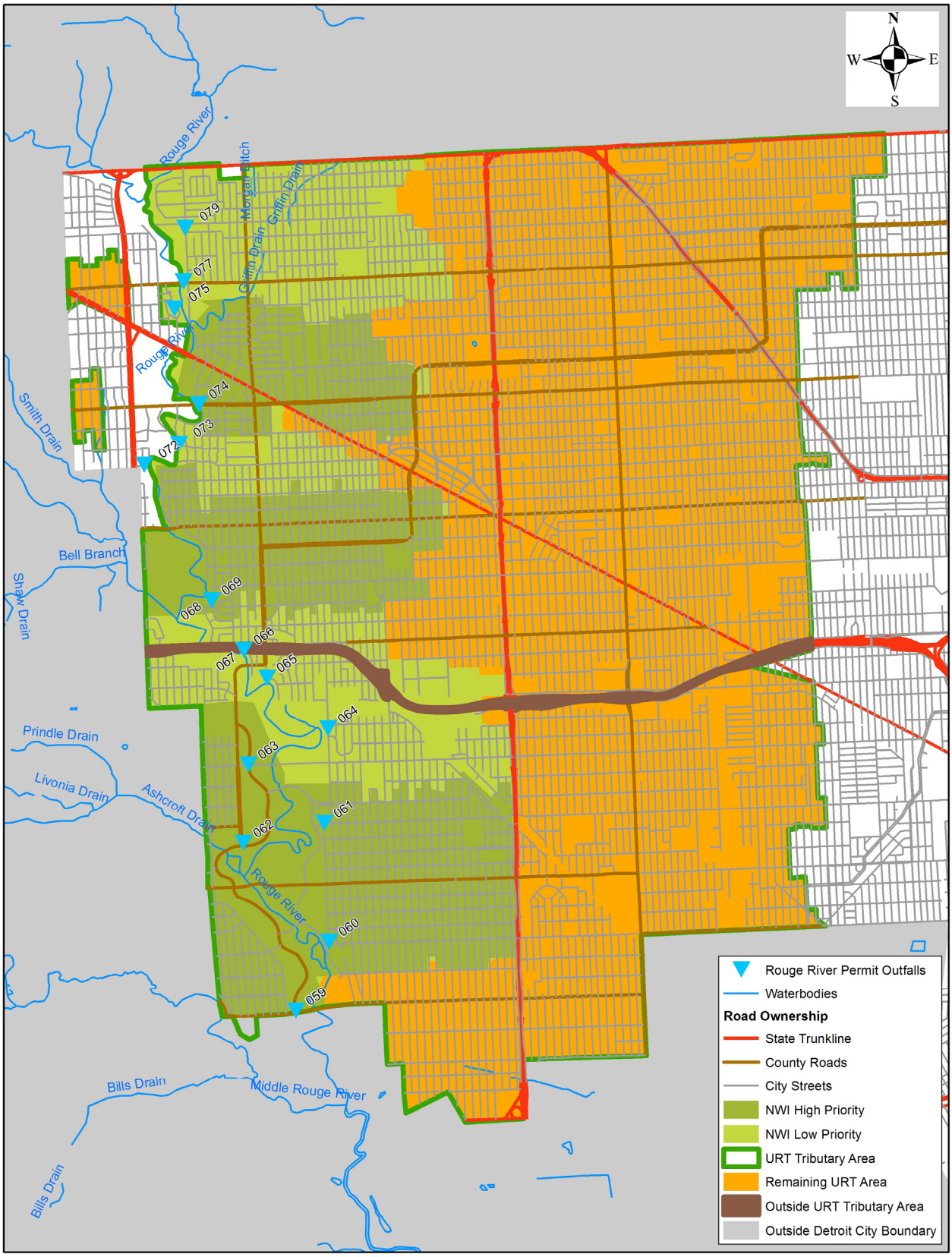
- *Interstate.* A high speed arterial with limited access; provides the longest uninterrupted distance for travel (e.g. Interstate-96)
- *Arterial Street.* Primarily carries local and through traffic; connects cities, and carries moderate to heavy volume of traffic at moderate to high speeds (e.g. Grand River Avenue)
- *Collector.* A collector links neighborhoods with major activity centers other neighborhoods and arterials. They carry low to moderate volumes of traffic at low to moderate speeds. (e.g., Seven Mile Road)
- *Local.* The primary access to residential areas and businesses (e.g. Evergreen Road, Schoolcraft Street)
- *Residential.* The streets within residential neighborhoods (e.g. Thatcher Avenue, Burt Road)
- *Alleys.* A narrow road providing rear access to houses or businesses

Roadway jurisdiction (ownership) also impacts the coordination for green infrastructure projects that address roadway runoff. Roadway jurisdictions within the URT area include the following entities:

- *City of Detroit DPW.* The DPW is responsible for paving and maintaining city streets and providing engineering and inspection services for all road construction work performed in the City's right-of-way.
- *Wayne County Roads Division.* The County Roads Division is responsible for all maintenance of county roads as well as the townships and villages within the County.
- *MDOT.* The DOT is responsible for planning, designing and operating streets owned by MDOT. It has seven region offices (Metro, Grand, University, Bay, Southwest, North, and Superior) to handle transportation-related business within each geographic boundary. The URT area is located in the Metro region.

Figure 24 displays streets within the URT area by jurisdiction.

Figure 24 Roadway Jurisdictions in the URT Area



6.6.2 Practice Types

Green infrastructure along roadways can include a variety of techniques such as road decommissioning, road lane removal, right-of-way practices, redirecting road runoff to adjacent parcels, and redirecting storm water pump station discharge to adjacent parcels. Street tree plantings are also applicable but are discussed in Section 6.5. The 2012 Detroit Strategic Framework Plan outlines these types of opportunities along roadway corridors.

This section will describe each practice type and correlate practice type with roadway type.

6.6.2.1 General Descriptions

There are many different types of green infrastructure practice and strategies used to detain or retain storm water runoff within transportation corridors. The primary practices considered include:

- *Road Decommissioning*. Road decommissioning includes pavement removal and restoration with a vegetated cover. Curb, driveways, sidewalk, and utilities may also be removed as part of this process.
- *Road Lane Removal (also referred to as "Road Diet").* Removing a lane from a road identified as having excess capacity based on traffic counts. This could entail removing a lane from one side of the road or half a lane from both sides of the road.
- *Right-of-Way Practices*. These are structural practices implemented within the road right-of-way.
    - *Vegetated Curb Extension*. A bioretention practice incorporated into the space between a curb line that is extended into the parking lane and the sidewalk or parkway.
    - *Bioswale.* A linear bioretention practice that is used to convey and store water along a road right-of-way. A bioswale may be located behind the curb or with a median.
    - *Pervious Pavement.* Pervious pavement that is installed linearly within a parking lane of a road or within an alley.
    - *Tree Trenches.* The practice of directing road runoff through curb inlets to a trench of engineered media running parallel to the road within the right-of-way. Trees or other vegetation are planted in the media.
- *Redirecting Road Runoff to Adjacent Parcels.* Redirecting road runoff through curb inlets or a swale to a previously vacated and cleared parcel or a park area. The area is graded to detain/retain water.
- *Redirecting Storm Water Pump Station Discharge to Adjacent Parcels.* Redirecting (a portion of) pump station discharge water to a previously vacated and cleared parcel or a park area. The area is graded to detain/retain water. Use of a pump station is typical of a depressed roadway (e.g. M-39).

6.6.2.2 Applicability to Roadway Type

Table 26 correlates the roadway types to applicable practice types. In addition to the function of the roadway, other factors will influence the type of practice selected for a given location. These additional factors are discussed in Section 6.6.3.

Table 26 Correlation of Practice Type to Roadway Type

Practice Types	Interstate	Arterial	Collector	Local	Residential	Alley
Road Decommissioning					Yes	Yes
Road Lane Removal		Yes	Yes	Yes	Yes	
Right-of-Way Practices						
• Vegetated Curb Extension		Yes	Yes	Yes	Yes	
• Bioswale	Yes	Yes	Yes	Yes	Yes	
• Pervious Pavement		Yes	Yes	Yes	Yes	Yes
• Tree Trenches		Yes	Yes	Yes	Yes	
Redirecting Road Runoff to Adjacent Parcels		Yes	Yes	Yes	Yes	Yes
Redirecting Storm Water Pump Station Discharge to Adjacent Parcels	Yes	Yes				

6.6.3 Opportunity Identification Process

Roadway opportunities are based on evaluation of the data sets described below. Table 27 provides a correlation between the data sets used and the applicable practice types.

- Priority areas within URT area as defined by the permit (Figure 1 on page 9). Impact = prioritized projects.
- SEMCOG's Excess Roadway Capacity Analysis – SEMCOG transportation planners conducted an excess traffic capacity analysis for the 2040 Regional Transportation Plan and to identify strategic investment and disinvestment opportunities to work towards a wider sustainable infrastructure approach. (IA10 model network, E5 TransCad model and 2040 Regional Demographic Forecast) (Figure 25). Impact = potential for road diets.
- Pavement Surface Evaluation and Rating (PASER) Road Survey data – The State of Michigan Transportation Asset Management Council coordinates the collection of the conditions of federal aid eligible roads and bridges through the PASER Road Survey. Road conditions are rated annually and this information is used to assist county road commissions and city roads departments in making informed decisions on funding allocations for road projects. (Figure 26). Impact = prioritization of right-of-way opportunities.
- Detroit Future City Vacancy Classification – high, moderate, low, municipal parks (Figure 2). Impact = opportunities for roadway decommissioning.
- Davey Tree Survey – street tree location (Figure 18). Impact = ability to site practices
- Road right-of-way characteristics – road width, parkway width (needs to be collected), right-of-way width (needs to be collected), topography (feasibility of directing drainage outside of the right-of-way)
- Other infrastructure work – This information is gathered annually by DWSD for water main work. Other utilities compile upcoming projects as well. Coordination of road work with other infrastructure work creates a more cost-effective opportunity for implementing green infrastructure.
- 2014 Motor City Mapping Data – The status of each parcel within the City was documented: existence of structure, condition of structure, whether the structure is occupied. (Figure 27)
- MDOT Storm Water Pump Stations – MDOT uses pump stations to lift storm water from depressed freeways, such as M-39, to the DWSD combined sewer system. There is an opportunity to disconnect the pump station discharge pipe from the sewer system and redirect the water to an adjacent park or vacant parcel. (Figure 28)

Table 27 Data Used in the Opportunity Identification

Practice Type	Land Cover			ROW Characteristics				Condition		Infrastructure	
	High vacancy classification	Motor City Mapping	Topography	Mature trees	Parkway width	Right-of-way width	Roadway width	PASER survey data	Excess Capacity Analysis	Upcoming utility work	Pump Station design and location
Road Decommissioning	√	√									
Road Lane Removal	√						√	√	√		
Vegetated Curb Extension					√			√		√	
Bioswale				√	√			√		√	
Pervious Pavement								√		√	
Tree Trenches				√		√		√		√	
Redirecting Road Runoff to Adjacent Parcels		√	√								
Redirecting Storm Water Pump Station Discharge to Adjacent Parcels		√	√								√

Figure 25 SEMCOG Excess Roadway Capacity Analysis

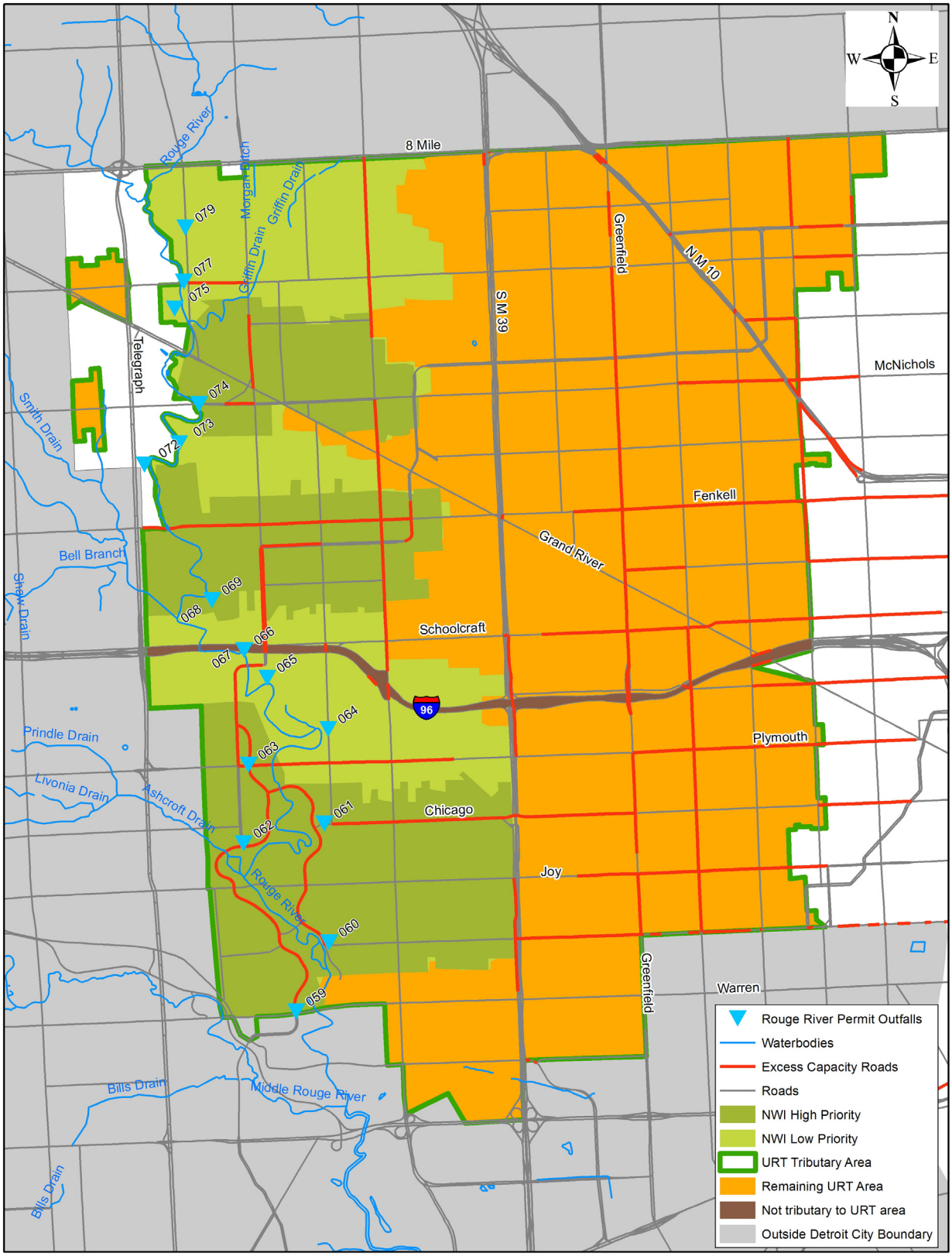


Figure 26 PASER Road Survey Data

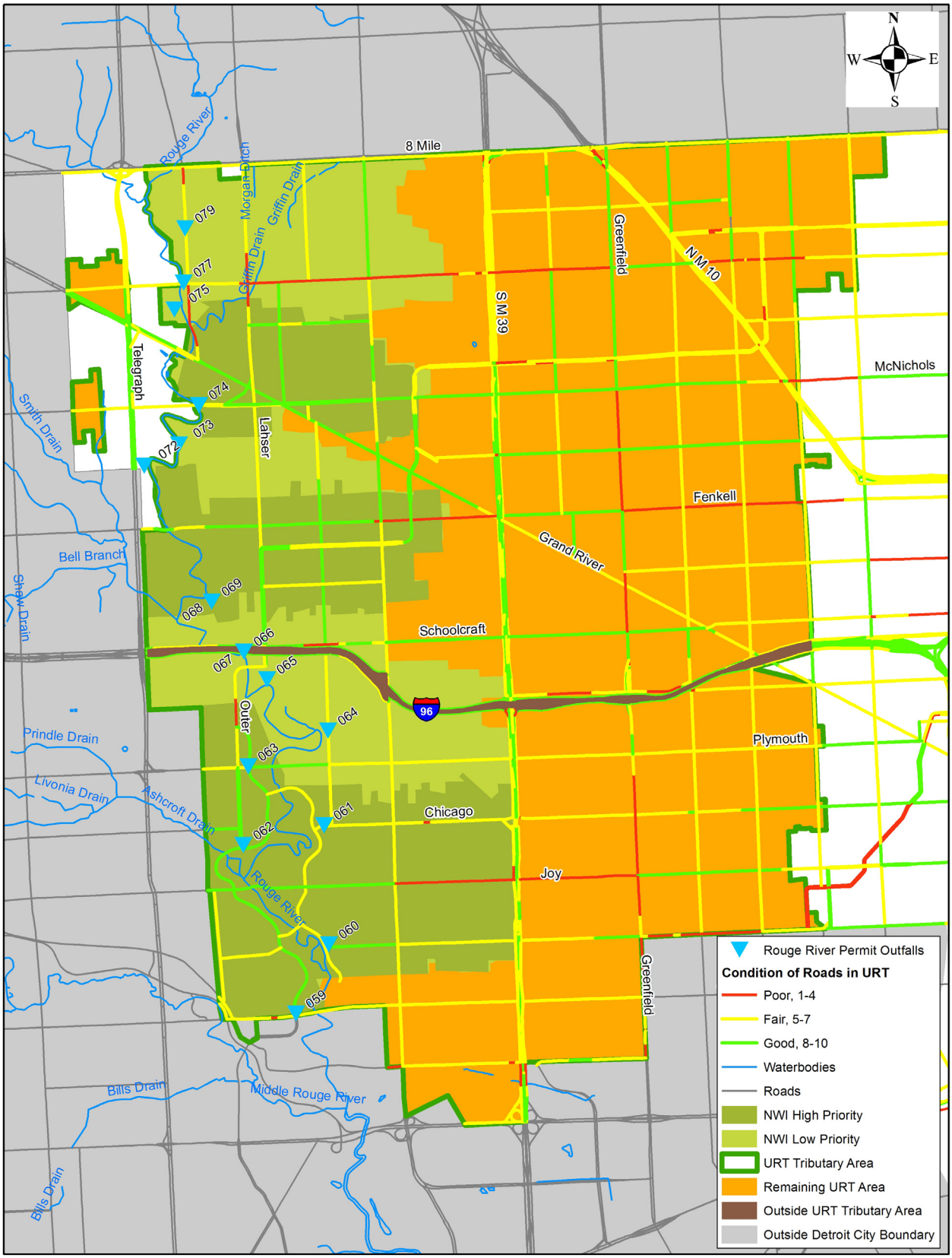
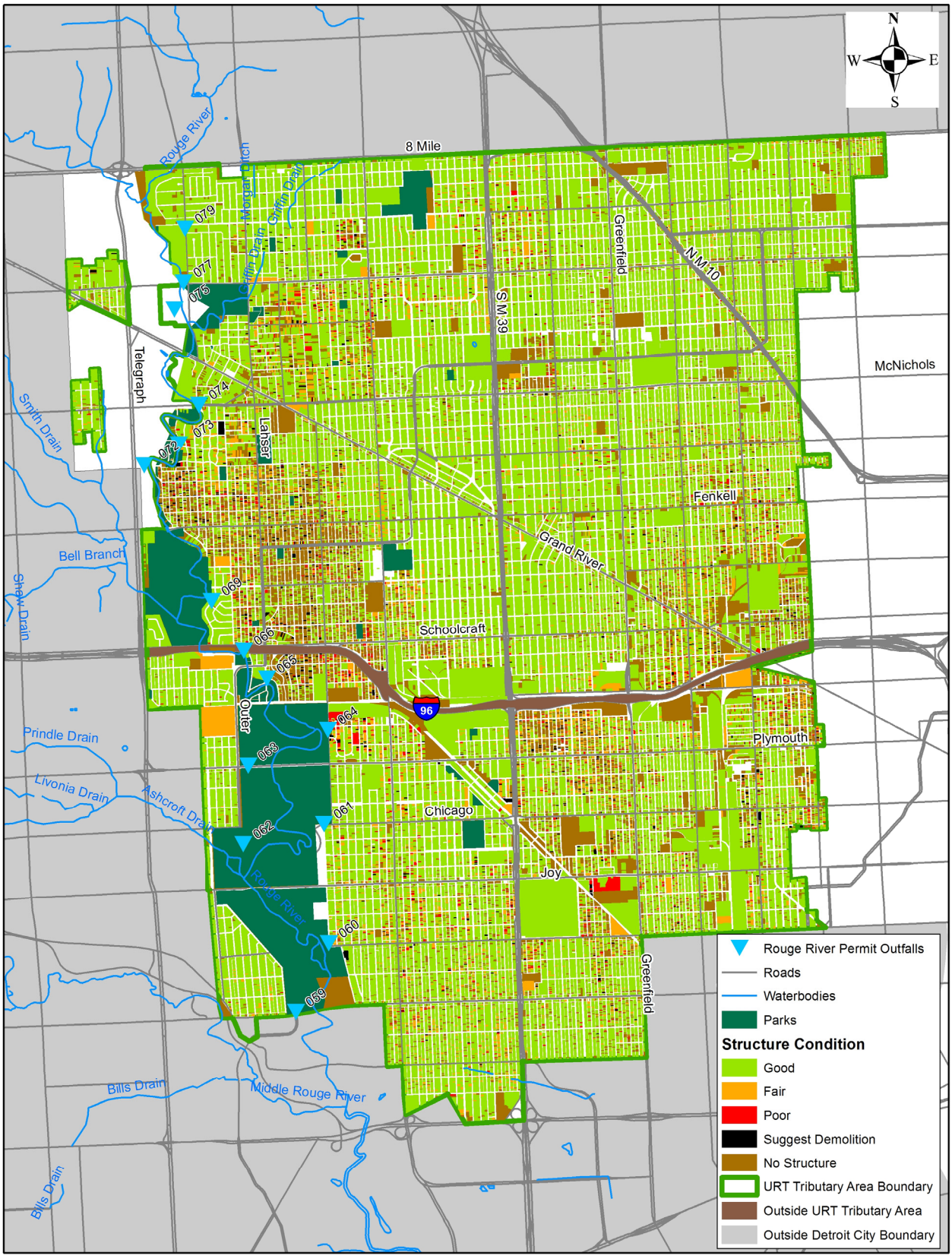


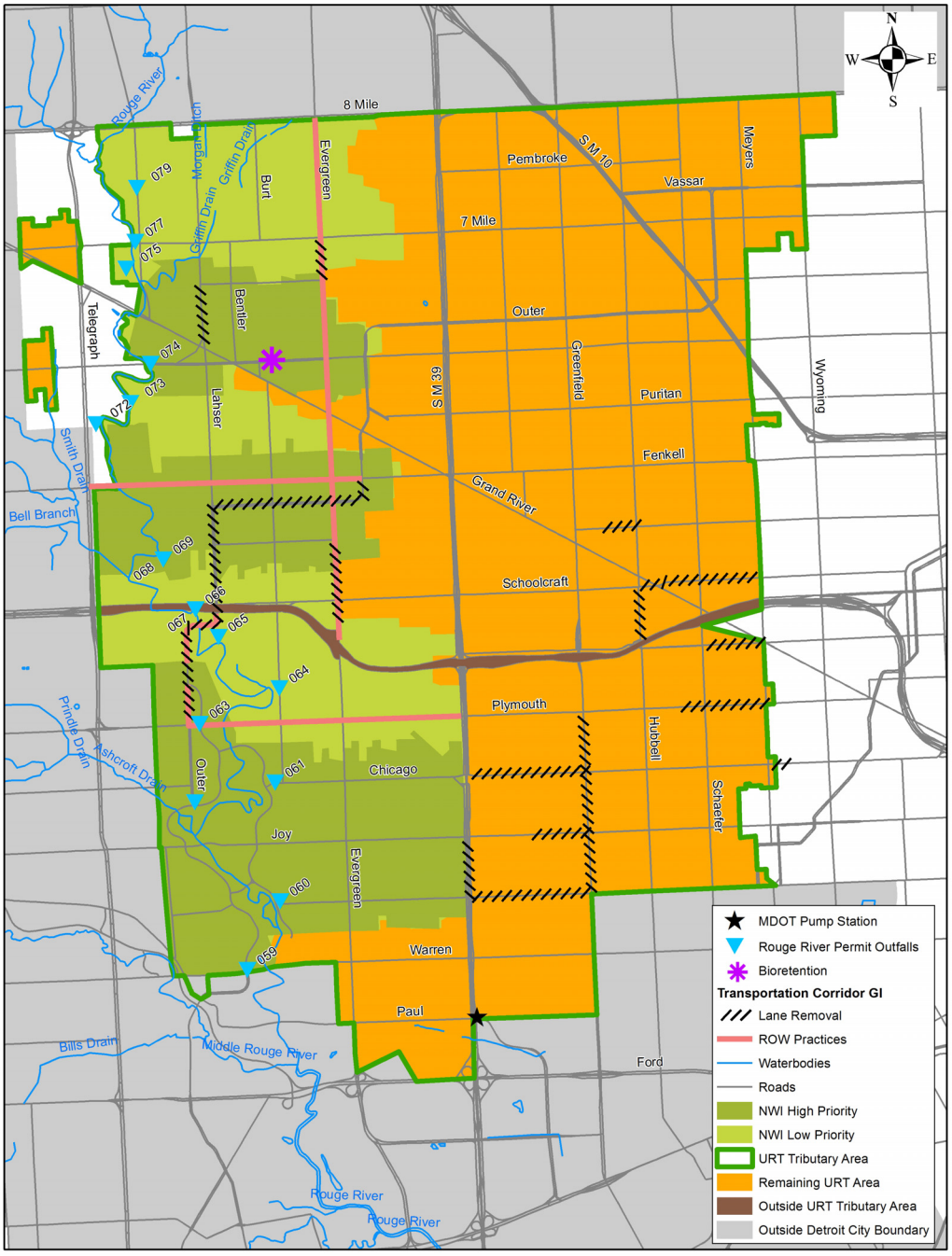
Figure 27 Motor City Mapping Parcel Survey Data



6.6.4 Opportunity Evaluation

This section identifies potential transportation corridor opportunities or examples of opportunities organized by road practice type. Road practice types include road decommissioning, road lane removal, right-of-way practices, redirecting road runoff to adjacent parcels, and redirecting storm water pump station discharge to adjacent parcels. Figure 28 shows the opportunities presented within this section.

Figure 28 Overall Map of Green Infrastructure Opportunities in Transportation Corridors



6.6.4.1 Road Decommissioning

Implementation of road decommissioning projects is part of a large-scale greening project, identified in Section 6.4.3.2. Road decommissioning is focused in the Brightmoor neighborhood as it is a high vacancy area with large areas that currently have no structures. The estimated runoff reduction associated with replacing impervious cover (i.e. road, sidewalk and driveway approaches) with top soil and grass is included in Section 6.4.3.2.

6.6.4.2 Road Lane Removal

The projects listed in Table 28 were identified within the URT area by crossing SEMCOG's excess capacity road analysis with PASER ratings 1 to 7. Then, these locations were crossed with high and moderate vacancy classes. Further traffic counts and early coordination will be needed for any selected projects. The estimated runoff reduction assumes that the removed lane is replaced with turf grass. Right-of-way projects will be considered in coordination with road lane removal (road diet) in Section 6.6.4.2.

Table 28 Opportunity Evaluation: Road Lane Removal

Road Name	Length (miles)	Segment	Jurisdiction	PASER (10=best)	Runoff Reduction (MG)
Chicago	0.18	Meyers to Mendola	City	6,7	0.02
Chicago	0.97	M-39 to Greenfield	City	6,7	0.08
Evergreen	0.35	7 Mile to Pickford	City	6,7	0.03
Evergreen	0.65	Lyndon to Davison	City	6,7	0.05
Fullerton	0.50	Schaefer to Meyers	City	5	0.04
Greenfield	1.50	Plymouth to Tireman	County	1,3,4	0.13
Hubbell	0.45	Schoolcraft to I-96	City	7	0.04
Joy	0.55	Asbury Park (RR) to Greenfield	County	3	0.05
Lahser	0.42	Grand River to Karl	County	6	0.04
Lyndon	0.31	Sussex to Hubbell	City	7	0.03
Outer	3.40	Fenkell to Plymouth	County	4-8	0.28
Plymouth	0.73	Shirley to Meyers	City	6	0.06
Schoolcraft	1.00	Hubbell to Meyers	County and City	7	0.08
Southfield Service (east)	0.50	Joy to Tireman	City	6,7	0.04
Tireman	1.00	M-39 to Greenfield	City	5	0.08
Total					**1.05**

6.6.4.3 Right-of-Way Practices

Implementation of right-of-way practices may be completed as retrofit projects or in combination with road resurfacing/reconstruction or road lane removal. Right-of-way practices include curb extensions, bioswales, pervious pavement and tree trenches. Further evaluation is needed to determine the most cost-effective implementation method for each project idea listed in Table 29. Early coordination will be used to address maintenance and ownership of these practices.

Table 29 Opportunity Evaluation: Right-of-Way Practices

Road Name	Length (miles)	Segment	Jurisdiction	PASER (10=best)	Runoff Reduction (MG)
Fenkell	0.18	Telegraph to Outer	County	8	0.05
Plymouth	0.97	Chatham to I-96	City	7	0.61
Outer	2.35	RR north of Rouge Park to Auburn	County	4-8	1.15
Evergreen	0.65	8 Mile to I-96	City	7	0.18
Burt Road	0.15	Lyndon to Acacia	City	Not ranked	0.04
Lyndon Street (1 lane)	0.11	Trinity to Pierson	City	Not ranked	0.02
Total					**2.05**

6.6.4.4 Redirecting Road Runoff to Adjacent Parcels

There are numerous opportunities to redirect road runoff to adjacent parcels as indicated by the number of vacant parcels. The next step is to follow the implementation process outlined in Section 7.0 to instigate a prototype project of redirecting road runoff to adjacent parcels. An example of a project is included in Table 30.

Table 30 Redirecting Road Runoff to Adjacent Parcels Opportunity Evaluation

Road Location	Discharge Location	Parcels Area (acre)	Parcel Owner	Jurisdiction	Runoff Reduction (MG)
Thatcher between Lahser and Bentler	21468, 21460, 21452 Thatcher	0.35 (3 parcels)	Private	City	0.01

6.6.4.5 Redirecting MDOT Storm Water Pump Station Discharge to Adjacent Parcels

Within the URT area, MDOT storm water pump stations discharging to the combined sewer system exist along M-39. One pump station was found adjacent to an open area. A portion of the pump station discharge could be redirected to a detention facility in the open area. The list in Table 31 identifies a runoff reduction opportunity but much more would need to be understood about this pump station and the drainage area before escalating the project. It is understood that MDOT pump stations are designed for larger storm events (i.e., 50-year storm). Therefore, only a small portion of the total flow that is conveyed to the pump station is expected to be managed in the available area for green infrastructure.

Table 31 Redirecting MDOT Storm Water Pump Station Discharge Opportunity Evaluation

Pump Station Location	Discharge Location	Available Area (acre)	Parcel Owner	Runoff Reduction (MG)
M-39 and Paul Avenue	Parcel at the NE corner of Paul Avenue and Southfield Road	0.6	Private	0.08

6.7 OTHER GI IMPLEMENTATION PROJECTS

In general, green infrastructure opportunities were categorized into one of the specific practice types identified in the permit. Additional opportunities to implement green infrastructure can include working with large property owners or large impervious blocks and daylighting historic streams. These opportunities are discussed in this section.

Permit Requirement: "Provisions for other green infrastructure implementation projects as determined to be appropriate."

6.7.1 Large Impervious Property Owners

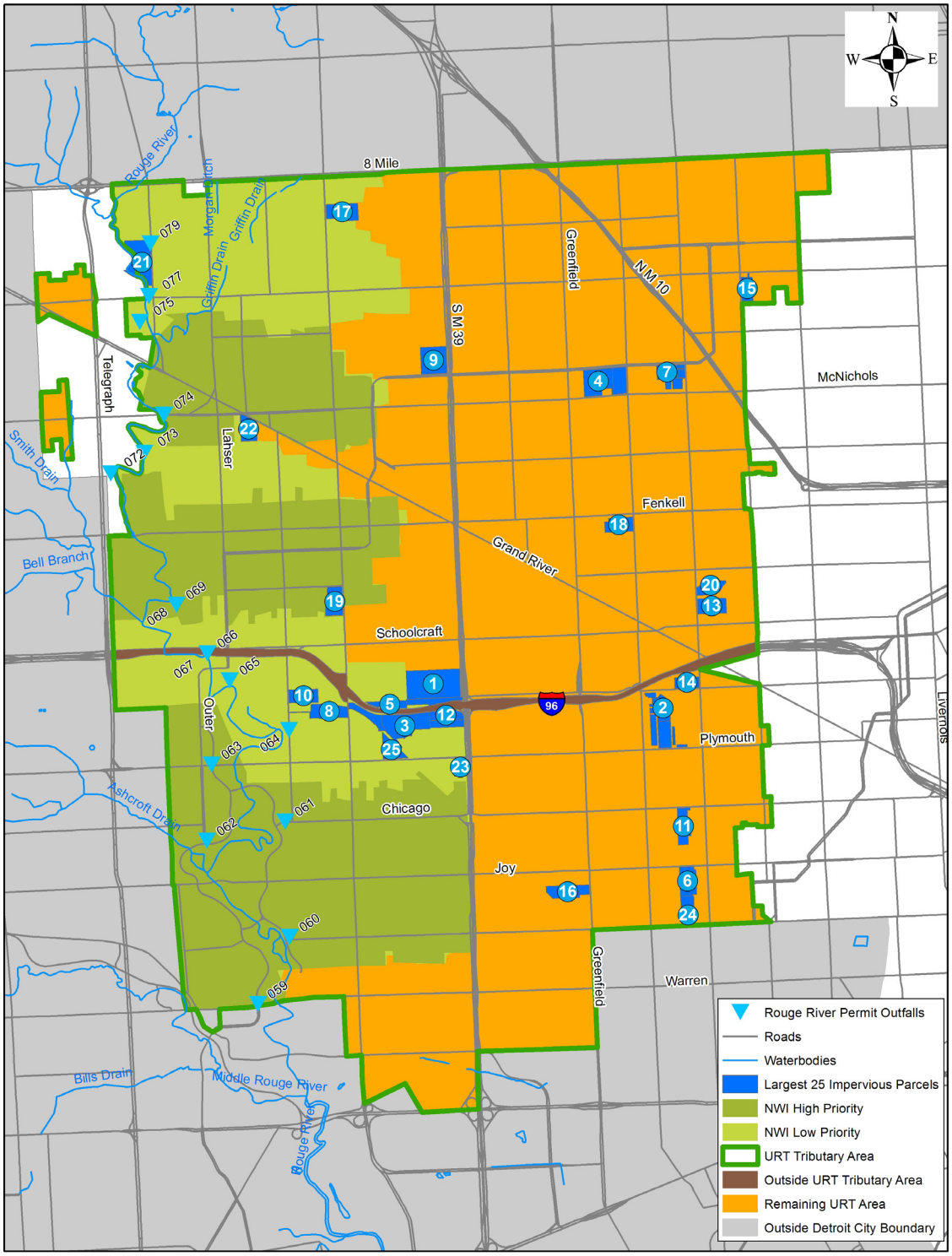
Large impervious properties provide an opportunity to manage significant runoff that is generated on a volume per acre basis that is higher than most properties. Total area for each parcel in the URT area was crossed with the percent impervious to compute the total impervious acres and then ranked. Table 32 lists the top 25 impervious parcels by impervious acre and Figure 29 shows the locations in the project area. Some of these parcels are publically owned and may also be included in the discussion in Section 6.2.

Table 32 Top 25 Impervious Parcels in the URT Area

No.	Parcel Area (acres)	Impervious (%)	Impervious Area (acres)	Runoff Reduction (MG)
1	69.0	78%	53.6	3.1
2	46.8	96%	44.8	2.6
3	42.9	81%	34.9	2.0
4	48.1	70%	33.6	1.9
5	36.8	87%	31.9	1.8
6	26.7	95%	25.3	1.5
7	24.6	95%	23.5	1.4
8	23.0	89%	20.5	1.2
9	31.5	56%	17.7	1.0
10	17.7	94%	16.7	1.0
11	18.5	87%	16.1	0.9
12	25.1	62%	15.6	0.9
13	19.7	69%	13.6	0.8
14	12.2	96%	11.7	0.7
15	12.3	94%	11.6	0.7
16	22.0	51%	11.1	0.6
17	23.0	48%	11.1	0.6
18	17.8	56%	9.9	0.6
19	20.2	48%	9.7	0.6
20	13.6	71%	9.6	0.6
21	34.3	27%	9.3	0.5
22	17.3	52%	9.0	0.5
23	9.7	91%	8.8	0.5
24	11.2	77%	8.6	0.5
25	15.2	53%	8.0	0.5
Total	**639.2**		**466.2**	**26.9**

In addition to large sites or parcels in the URT, some landowners own multiple sites throughout the project area. As previously discussed, there are multiple school sites which cumulatively represent a significant area an opportunity to manage storm water for the benefit of CSO control. There are similar private landowners or institutions with multiple sites. These represent a similar opportunity to work with a single point of contact to effect change.

Figure 29 Top 25 Impervious Parcels



6.7.2 Collection System Characterization, Open Stream Connections

Historically, there were both natural and manmade ditches and streams located throughout the City of Detroit that routed storm water to nearby rivers or storm drains. As the City developed, these open drains were frequently enclosed and connected to the City's combined sewer system. The open streams evaluation under the Plan sought to identify remaining open streams, locate remnants of enclosed streams and identify the potential to daylight streams, directly discharge separated storm water to the Rouge River, or implement storm water management projects to control the rate of flows entering the combined sewer system.

As part of the Plan, open stream connections located within the NWI area were field evaluated from the ground surface to determine their connection status as well as potential runoff contribution to the CSO system.

6.7.2.1 Approach to Stream Flow Management

The objective of the GI Program is to develop an approach that will reduce the impact of direct storm water contributions to the combined sewer system. This may be accomplished through a variety of approaches, including:

- Redirecting the flow to the river
- Partial daylighting of the stream with storm water management practices to control rate and volume.
- Limited storm water management at connection point of the stream to the sewer system.

All of these approaches require access to land for either the stream channel or the storm water practices. Feasibility of options may be limited by the ditch elevation relative to the combined sewer system elevation. All projects of this type will also need to seek input from the local neighborhood.

The appropriate method to eliminate each connection will be evaluated and determined through the use of the following:

- Aerial photography to determine potentially available green space
- Review of City of Detroit Assessor Data to determine ability to acquire available land for rerouting and storm water practices
- Review of as-built sewer drawings for elevation details
- Field investigations to confirm existing drainage areas, open stream condition and connection to the sewer. Sewers that may be functioning as storm sewers (versus combined sewers) may be evaluated with Closed Circuit Television (CCTV) inspection.
- Neighborhood outreach activities to engage local residents and property owners in the project concept.
- Development of projected cost versus flow reduction benefit.
- Implementation plan.

6.7.2.2 Evaluation Process

Historical and current open stream connections were inventoried and categorized using the following available resources:

- USGS historic topographic maps
- City of Detroit Assessor's data GIS information
- Historical sewer plan and profile drawings
- DWSD sewer atlas maps
- Google Earth
- Limited field investigations
- DWSD Wastewater Master Plan

Historical sewer drawings show many open stream connections throughout the URT area that were connected to the sewer system between 1925 and 1929. A majority of these open stream connections posed a direct grade conflict with the sewer that was being installed. Since the connection of the open streams, the area has been developed into commercial and residential properties that in many cases resulted in changes to the upstream stream through:

- Backfill of the ditch to allow for sidewalks and roadways to be constructed

- Conversion of the ditch as a closed storm drain below grade
- Rerouting of the ditch
- Leaving the stream or ditch in place

Follow-up investigations were performed for 32 open streams identified from sewer drawings in order to determine whether a remnant open stream remained upstream of the connection point. This review included examination of the atlas maps and a visual inspection. Figure 30 illustrates the locations investigated. Table 33 summarizes the location and status of the historic open streams based on the site assessment. Four (4) locations were observed to have an open channel system entering the sewer system.

Figure 30 Open Channel Connection Locations

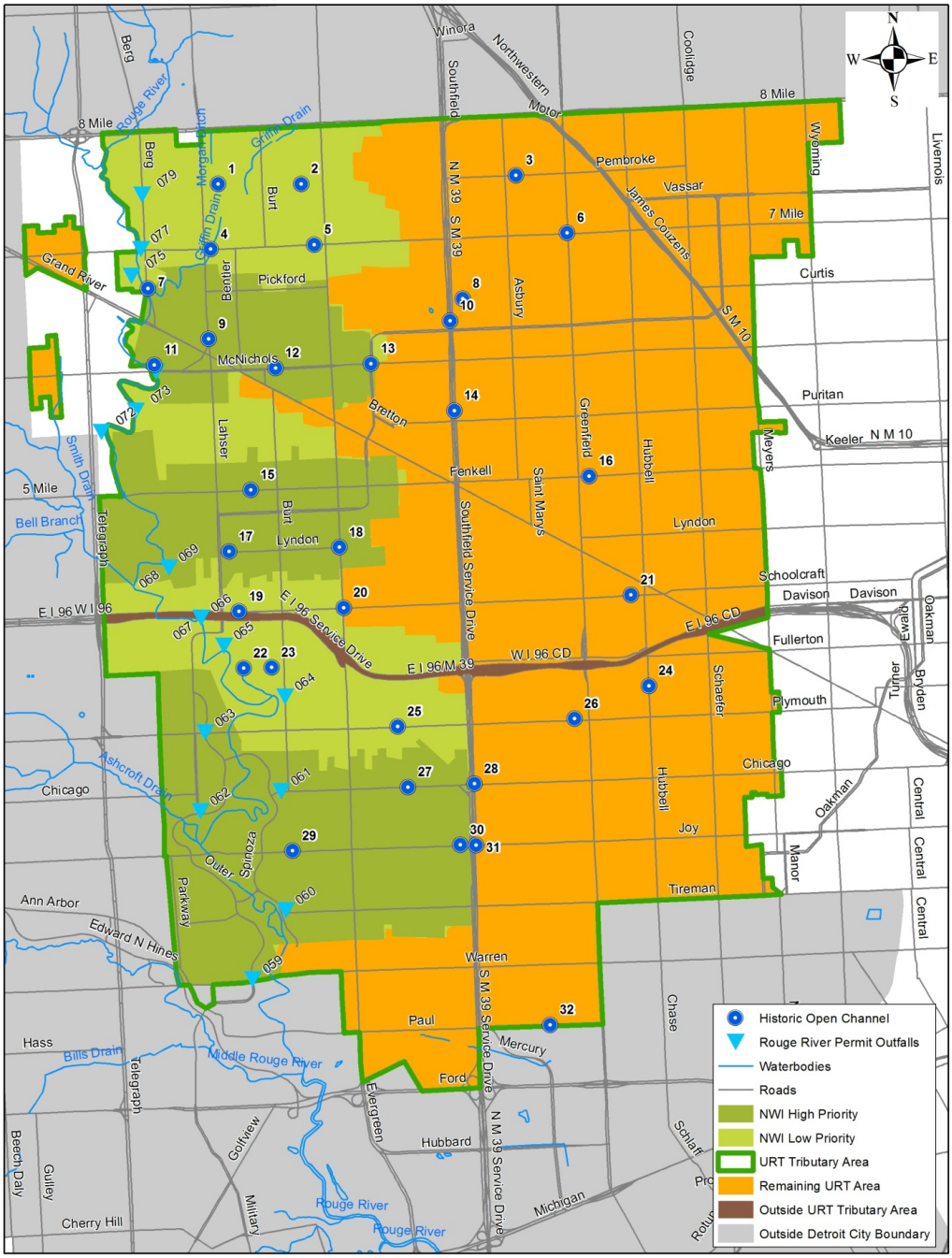


Table 33 Open Stream Evaluations

ID	Location	Status
1	Near Pembroke and Burgess	Hard Piped or Backfilled
2	At Pembroke and Kentfield	Hard Piped or Backfilled
3	Pembroke and Murray Hill	Hard Piped or Backfilled
4	Seven Mile and Lahser	Hard Piped or Backfilled
5	Seven Mile and Heyden Avenue	Hard Piped or Backfilled
6	Seven Mile and Greenfield	Hard Piped or Backfilled
7	Berg South of Seven Mile	Open Channel
8	Curtis and Archdale	Hard Piped or Backfilled
9	Lahser and Santa Clara	Hard Piped or Backfilled
10	Southfield and Thatcher	Hard Piped or Backfilled
11	Beaverland and Six Mile	Open Channel
12	Six Mile and Pierson	Hard Piped or Backfilled
13	Six Mile and Outer Drive	Hard Piped or Backfilled
14	Southfield and Florence	Hard Piped or Backfilled
15	Fenkell and Bentler	Open Channel
16	Fenkell and Prest	Hard Piped or Backfilled
17	Lyndon and Greydale	Open Channel
18	Lyndon and Evergreen	Hard Piped or Backfilled
19	Schoolcraft and Jason	Hard Piped or Backfilled
20	Schoolcraft and Evergreen	Hard Piped or Backfilled
21	Schoolcraft and Lauder	Hard Piped or Backfilled
22	Fullerton and Greydale (extended) (Accolade on plan)	Hard Piped or Backfilled
23	Fullerton and Blackstone	Hard Piped or Backfilled
24	Along Hubbell south of Capital	Hard Piped or Backfilled
25	Plymouth and Piedmont	Hard Piped or Backfilled
26	Plymouth and Montrose	Hard Piped or Backfilled
27	W. Chicago and Artesian	Hard Piped or Backfilled
28	W. Chicago and Archdale	Hard Piped or Backfilled
29	Joy and Burt	Hard Piped or Backfilled
30	Joy and Rosemont	Hard Piped or Backfilled
31	Joy and Archdale	Hard Piped or Backfilled
32	Paul and St. Mary's	Hard Piped or Backfilled

Table 34 lists the four verified open stream connections that are still active and the estimated runoff volume that enters DWSD's sewer system from these connections. There may be opportunities at these sites to better manage the storm water drainage before entering the sewer system. Figure 31 provides example photographs of two of the sites. Figure 32 illustrates the approximate drainage area of the open channel sections.

Table 34 Inflow Contribution from Open Streams

Reference ID	Location	Drainage Area (acre)	Runoff Volume (MG)
7	Berg South of Seven Mile	5.4	0.15
11	Beaverland and Six Mile	4.1	0.13
15	Fenkell and Bentler	29.9	0.96
17	Lyndon and Greydale	37.5	1.21

Figure 31 Berg South of Seven Mile (left) and Fenkell and Bentler (right)

Figure 32 Drainage Area for Connected Open Channels

7.0 ACTION PLAN

7.1 INTRODUCTION

This section details the individual steps planned. To facilitate the presentation of the information, the actions have been grouped into the categories below:

1. Policies, Procedures and Standards
2. Prototype Projects
3. Continued Implementation
4. Long Term Performance
5. Stakeholder and Community Engagement

7.2 IMPLEMENTATION SCHEDULE

The schedule for implementation of green infrastructure projects includes consideration for planning projects in relation to others as well as an implementation schedule once projects have been selected for design and construction. Of equal importance is to ensure that the implementation schedule is consistent with DWSD's permit requirements, including operation and evaluation of green infrastructure practices.

Green infrastructure projects will require various timeframes for planning and implementation. Generally, the greater the complexity of the project and the more decision-makers involved, the longer the implementation timeframe will be. The intent of the green infrastructure program is to identify the planning steps necessary so that the green infrastructure effort can be coordinated with other infrastructure work as applicable. For example, street resurfacing projects by the City of Detroit, and roadway resurfacing and reconstruction projects by Wayne County are identified one to five years in advance of actual implementation. Green infrastructure needs to be identified during the scoping phase of other infrastructure efforts in order to be incorporated.

Larger greening efforts may require the acquisition of privately held parcels in order to be implemented. Timelines for land assembly are unknown at this time. However, some projects of this type have been delayed for years in order to successfully assemble required land. DWSD is interested in larger greening efforts, but will need to work with partners, and be realistic, about land acquisition issues.

Overall, DWSD has committed to a green infrastructure program that will extend to 2029 at a minimum. Therefore, projects that have long implementation schedules can be accommodated in the overall program. However, progress in the near-term will need to recognize the time issues and strike a balance between short-term and long-term implementation timeframes.

7.3 SUMMARY OF ACTIVITIES

Table 35 provides an overview of the action items planned. Additional details describing the individual activities are provided in the subsequent sections.

Table 35 Action Item Summary

No.	Activities	Schedule
Activity 1 – Policies, Procedures and Standards		
1-1	Codes and Ordinances	Complete review and recommendations by June 30, 2015.
1-2	Storm Water Technical Reference Manual	Draft of manual complete by March 31, 2015. Final version complete by March 31, 2016.
1-3	Drainage Charge Credit System	Complete initial standards and processes by April 30, 2015. Finalize by November 30, 2015.
1-4	Green Streets Standards	Draft standards by June 30, 2016. Final by June 30, 2017.
1-5	Structure Demolition and Lot Greening Standards	Provide technical support upon request.
1-6	Public Storm Water Maintenance Guidance	Draft guidance complete by June 30, 2015. Final version complete by June 30, 2016.
1-7	Municipal Storm Water Maintenance Manual	Draft manual complete by July 31, 2016. Final by July 31, 2017.
1-8	Tracking System	Draft tracking system by July 31, 2015. Final by July 31, 2016.
Activity 2 - Prototype Projects		
2-1	Small Scale Greening	Ecological restoration of demolition sites constructed by December 31, 2014. Other opportunities on-going.
2-2	Large Scale Greening	Begin stakeholder and community engagement by September 1, 2014. Complete engagement process and conceptual designs by August 31, 2016.
2-3	Public Facilities Flow Management	Develop prioritized opportunity list by January 31, 2015. Project selection and implementation schedule by July 31, 2015.
2-4	Open Stream Connections	Develop prioritized opportunity list by January 31, 2015. Complete conceptual designs by June 30, 2015. Project selection and implementation schedule by July 31, 2015.
2-5	Municipal Parks Flow Management	Develop prioritized opportunity list by January 31, 2015. Project selection and implementation schedule by May 31, 2015.
2-6	Transportation Corridor Flow Management	Develop prioritized opportunity list by January 31, 2015. Project selection and implementation schedule by May 31, 2015. Annual updates and coordination with city departments, county and state.
Activity 3 - Continued Implementation		
3-1	Downspout Disconnection - Homes	Update process by November 30, 2014. Coordination with major landlords, neighborhood groups and organization by April 30, 2015. Major implementation emphasis in Spring 2015 and on-going through June 2017.

No.	Activities	Schedule
3-2	Downspout Disconnection - Multi-Family Residential, Commercial, and Industrial	Site characterization assessment complete by January 31, 2015. Approach methodology by May 31, 2015. Pilot disconnection projects by November 30, 2015.
3-3	Demolitions and Site Restoration	Budget planning by October 31, 2014. Coordination with DBA on-going.
3-4	Tree Plantings	Opportunity assessment by October 31, 2014. Additional planting beginning Fall 2014.
Activity 4 - Long Term Performance		
4-1	Updated Collection Systems Model	Complete by April 1, 2015.
4-2	Green Infrastructure Performance Planning	Complete by June 30, 2015.
4-3	Green Infrastructure Benefits Evaluation	Complete by June 30, 2016.
4-4	Amendment to the Supplemental Report on Alternative CSO Controls for the Upper Rouge	Complete by January 1, 2017.
4-5	Legal agreements for long-term sustainability	Ongoing.
Activity 5 - Stakeholder and Community Engagement		
5-1	Green Infrastructure Website	Functional by February 15, 2015.
5-2	Green Rewards Program Stakeholder Engagement	Stakeholder team formation launched August 2014 and following Drainage Charge System Schedule.
5-3	Green Rewards Toolbox	Materials available in draft form by January 31, 2016.
5-4	Green Rewards Training Workshops	Concurrent with Green Rewards Public Launch.
5-5	Green Infrastructure Case Studies and Demonstration Projects	Ongoing with initial case studies developed by June 2015.
5-6	Green Infrastructure Forum	Annually in May.
5-7	Stakeholder Involvement and Education Strategy	Draft by September 30, 2014. Finalize Plan with input by December 31, 2015.
5-8	Overarching Green Infrastructure Educational Campaign	On-going.

7.4 ACTIVITIES DESCRIPTIONS

ACTIVITY 1 – POLICIES, PROCEDURES AND STANDARDS

Institutional processes will drive implementation of green infrastructure on both parcels and rights-of-way in the long term. DWSD will implement processes within its ability and will work with other City departments to promote other institutional processes. DWSD is currently in the early stages of development of these programs. Efforts will initially be focused on working through policy and process issues on the variety of programs. These programs are expected to evolve and the action plan as presented is based on the current definition of objectives and constraints.

1-1 Codes and Ordinances

DWSD is working with the Building, Safety Engineering and Environmental Department and the Planning and Design Division. These efforts are intended to address questions related to roof drain disconnections and site development standards. The following activities are envisioned to be part of this effort:

- Identify barriers within the existing codes and ordinances to implementing low impact development methods and green infrastructure. Facilitate acceptance of green infrastructure practices for managing runoff on parcels. Identify revisions to codes and ordinances that will facilitate storm water management.
- Coordinate with BSEED, PPD and other relevant departments that manage the zoning and building codes in the city.
- Qualitatively assess barriers posed by existing regulations, internal policies and land use plans which may hinder the implementation of green infrastructure.
- Recommend modification of existing language to facilitate green infrastructure.
- Identify the potential for a storm water ordinance and how that would be structured in City code and ordinances.
- Provide education and training for City staff that are unfamiliar with green infrastructure and how it performs.
- Coordinate the development of the Storm Water Technical Reference Manual with the modifications to the City's codes and ordinances.
- Present findings as appropriate to stakeholder groups and decision-makers.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-1-1	Code and ordinance review and recommended modifications	June 1, 2014	June 30, 2015
1-1-2	Provide education and training for City staff	April 1, 2014	Ongoing

1-2 Storm Water Technical Reference Manual

A technical reference manual for managing storm water runoff will be developed. This will serve as a resource manual that will support both the drainage charge system and the code and ordinance effort. The manual will also address the permit requirements (Part I.A.15.d.9) pertaining to storm water controls for projects requiring a Part 41 construction permit issued by MDEQ. Design of green infrastructure practices will be addressed in the manual. The manual is envisioned to cover the following topics:

- Applicability of the requirements for new development, redevelopment, and municipal projects including roadway improvements.
- Design criteria for site drainage, roadway and parking lots, and flow conveyance of sewers, culverts, and open channels. The design criteria will address water quantity and quality considerations. Design standards for both the combined sewered areas and the separately sewered areas will be addressed.
- Overview of drainage design methodologies and acceptable practices.
- Storm water control measures design considerations for systems such as green roofs, water harvesting, bioretention, tree plantings, porous pavements, and detention and retention basins.
- Special conditions and constraints for environmentally sensitive areas, floodplain encroachments, and contaminated sites.
- Procedures and submittals requirements for site plan approval.
- Operation and maintenance practices, agreements and easements.
- Design and construction performance certifications.
- Erosion and sediment control for construction sites.

Development of the manual will be collaborative effort between City departments. As such, a working group will be convened for the manual development. Development of the manual will also be coordinated with Wayne County and other agencies and groups as appropriate. DWSD will take a lead role in drafting the manual but has limited authority in requiring the manual to be used and adopted.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-2-1	Draft Manual	August, 1, 2014	March 31, 2015
1-2-2	Final Manual	April 1, 2015	March 31, 2016
1-2-3	Provide education and training	February 1, 2015	Ongoing

1-3 Drainage Charge Credit System

DWSD is in the process of updating its drainage charge system. The drainage charge system distributes costs associated with wet weather flows based on parcel imperviousness. This task is focused on the development of a drainage charge credit system to encourage implementation of green infrastructure and other storm water management practices on parcels. These practices may be implemented as redevelopment occurs or as retrofits to existing sites. The following activities are envisioned as a part of developing a credit system:

- Evaluation of similar programs in other communities for criteria and process.
- Defining potential drainage charge reductions that are consistent with DWSD's permit compliance goals to reduce storm water volume, CSO discharges, and total volume to treatment.
- Meetings with ratepayers to identify areas of flexibility that should be considered in the drainage charge calculation methodology.
- Identification of an internal DWSD task force that would include key decision makers throughout the organization, including executive management, customer service, financial planning and green infrastructure. This team would work to define policies and clarify processes.
- Coordination with code and ordinance issues to facilitate property owner ability to implement green infrastructure practices.
- Implementation of community conversation with stakeholder group and broader audience. (under activity 5-2).
- Development of a summary policy and procedures manual (under activity 1-3) and a "toolbox" for ratepayers (under activity 5-3).
- Quantification of DWSD investment through direct support and credits
- Instructional workshops.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-3-1	Draft Manual for Drainage Charge System	August 1, 2014	April 30, 2015
1-3-2	Final Manual	April 30, 2015	November 30, 2015
1-3-3	Provide education and training	May 1, 2015	Ongoing

1-4 Green Streets Standards

Green Street standards will document the process, procedures and design standards for managing runoff on City streets and county roadways. These standards may be developed as a reference manual or have the force of policy. Green streets design needs to involve a variety of departments and agencies representing City (and potentially other streets), utilities, DDOT (bus service), planning, emergency services (e.g., fire), and other stakeholders. These standards would be developed subsequent to completion of early pilot projects, when issues are better understood and processes have been tested.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-4-1	Draft Standards	July 1, 2015	June 30, 2016
1-4-2	Final Standards	July 1, 2016	June 30, 2017
1-4-3	Provide education and training	May 1, 2016	Ongoing

1-5 Structure Demolition and Lot Greening Standards

As demolitions are performed in the project area and throughout the City, the means of restoring the site will impact the amount of runoff that is generated. Demolition specifications need to balance a variety of issues such as environmental, dust control, materials reuse, runoff control objectives, community vision for appearance of the site, long-term maintenance, and cost. A working group that includes the Detroit Building Authority, BSEED, MDEQ, EPA, and demolition contractors is working through a variety of issues with demolition standards. DWSD is not directly involved in this working group, but will provide technical support upon request.

A variety of concurrent efforts are underway related to greening of vacant lots. Refer to Activity 2-1 Small Scale Greening.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-5-1	Lot Greening Standards	As-needed support	

1-6 Public Storm Water Maintenance Guidance

A maintenance guidance document will be developed for the general public in caring for storm water management features such as rain gardens, rain barrels, disconnected downspouts, porous pavements, and detention basins. A target audience for this guidance is private property owners receiving drainage credits for storm water management practices. This guidance will address common types and frequency of maintenance activities. Inspection and recordkeeping for practices receiving storm water drainage credits will also be addressed. Development of the manual will be coordinated with a work group of stakeholders and the final manual will be published for general use.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-6-1	Draft Guidance	October 1, 2014	June 30, 2015
1-6-2	Final Guidance	July 1, 2015	June 30, 2016
1-6-3	Provide education and training	May 1, 2015	Ongoing

1-7 Municipal Storm Water Maintenance Manual

The target audience for this manual is the municipal staff responsible for caring for the publically owned and maintained storm water management practices. Municipal staff includes but is not limited to DWSD. The objective of the manual is to identify methods and approaches to maintain green infrastructure practices. This manual will address institutional and technical issues, inspections, and recordkeeping, amongst other efforts.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-7-1	Draft Manual	August 1, 2015	July 31, 2016
1-7-2	Final Manual	August 1, 2016	July 31, 2017
1-7-3	Provide education and training	June 1, 2016	Ongoing

1-8 Tracking System

DWSD is developing a tracking and performance assessment database for green infrastructure implementation activities. The objective of this database is to define, at a minimum, the location, ownership, financial investment, performance, and installation date of the green infrastructure practices. Implementing the tracking database for DWSD green infrastructure practices will include the following activities:

- Developing a GIS-based database that will be maintained by DWSD.
- Developing clear metadata description and format.
- Documenting DWSD investment, including direct and indirect costs.
- Evaluating and adapting the database to meet evolving uses of the data.

Supplemental efforts will include the following:

- Identifying other green infrastructure inventories within southeast Michigan.
- Coordinating with other data managers relative to data coordination.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
1-8-1	Draft Tracking System	June 1, 2014	July 31, 2015
1-8-2	Final Tracking System	August 1, 2015	July 31, 2016
1-8-3	Provide education and training	June 1, 2015	Ongoing

ACTIVITY 2 - PROTOTYPE PROJECTS

Implementation of green infrastructure requires the development of new policies, processes, and procedures. It also requires additional understanding of the performance, costs, and implementation realities associated with various project types. DWSD has worked to form relationships with a number of relevant agencies, organizations and community groups. In the process of working with these entities, a number of issues have been discussed regarding project responsibilities and concerns. The realities of policies, processes, and procedures can best be realized in the process of implementing projects. DWSD intends to launch a series of prototype projects that will help to answer the following questions:

- What policy issues need to be addressed and what procedures need to be developed in order to implement a specific project type?
- What is the timeframe associated with implementing various types of projects? What is the appropriate planning cycle?
- How well does the project type control runoff and reduce CSO discharge?
- How much does the project cost to implement?
- What technical issues need to be addressed to design and implement the project?
- What institutional issues need to be addressed to design and implement the project?
- Who will own and maintain the project upon completion?
- What project types will the community accept and in what conditions?

A range of project types has been identified for inclusion in the prototype implementation. These project types include:

- Land assembly and large scale greening
- Municipal property roof and parking lot management
- Municipal parks
- Road decommissioning
- Rights-of-way storm water management
- Managing ROW runoff on vacant lots
- Managing pump stations discharge on vacant lots

2-1 Small Scale Greening

Small scale greening projects include parcel-based practices on individual parcels. Several small parcels grouped together are also considered small scale. Examples of greening practices include bioretention, porous pavements, underground detention or retention, infiltration basins, green roofs, and water harvesting projects. Storm water runoff from the site is managed and additional runoff from adjacent parcels and the roadway may also be managed.

An example of a project in the planning phase is individual vacant lot greening done in conjunction with building demolitions. In this case, the void left after removing a demolished structure (including the basement) is converted to a bioretention system and road runoff is diverted into the practice. Four of these systems are being planned and designed in the short term as part of a research project. Partners on this project include DLBA, DBA, University of Michigan and Wayne State University. This project is referred to as *Ecological Restoration of Demolition Sites.*

Based on the nature of these projects, identifying opportunities is done predominately by discussions and brainstorming ideas with stakeholders. Hence long-term project opportunities are not known at this time. The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
2-1-1	Ecological Restoration of Demolition Sites – site selection and design	July 1, 2014	August 31, 2014
2-1-2	Ecological Restoration of Demolition Sites – construction	September 1, 2014	December 31, 2014
2-1-3	Identification of project opportunities, selection, design and construction	On-going	

2-2 Large Scale Greening

Large scale greening encompasses projects that synergize individual activities together into one larger implementation project. An example of this type of project includes road decommissioning with vacant parcel greening.

- Identify large scale greening project opportunities. This would include evaluation of individual project opportunities identified in this Plan for incorporation into a larger greening effort.
- Coordinate concepts with City departments and stakeholders and select projects for implementation based on feasibility. Based on the scale of the projects, the coordination and outreach process is expected to take an extended period of time.
- Over the extended outreach and education period, concept alternatives will be developed. These will provide detail for cost, implementation and policy issues.
- Develop a schedule for implementation, design and construction.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
2-2-1	Identify large scale greening project opportunities	July 1, 2014	September 30, 2014
2-2-2	Stakeholder and community engagement	September 1, 2014	August 31, 2016
2-2-3	Develop conceptual designs	September 1, 2014	August 31, 2016
2-2-4	Develop a schedule for implementation, design and construction	September 1, 2015	TBD

2-3 Public Facilities Flow Management

Management of storm water from public buildings and parking lots focuses on redirecting roof and parking lot runoff from the sewer system to surface or subsurface storage.

- Develop a prioritized list of public properties for potential projects. This effort would build on the impervious area quantification included in this Plan. It would also evaluate available space to construct practices and coordination with property management. Identify and evaluate issues of funding, ownership, maintenance, open space programming, education, and coordination with other capital improvement projects.
- Develop specific project concepts for five buildings/sites. These project concepts will provide detail for cost, implementation and policy issues.
- Select projects for implementation and develop an implementation schedule for design and construction.
- Move the project(s) into the design and construction phase. Develop post-construction management plan for maintenance and performance assessment.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
2-3-1	Identify and prioritize opportunities; evaluation of institutional issues.	August 1, 2014	January 31, 2015
2-3-2	Develop conceptual designs, five sites	February 1, 2015	May 31, 2015
2-3-3	Select projects and develop an implementation schedule	June 1, 2015	July 31, 2015

Task ID	Activity	Target Start	Target Complete
2-3-4	Final design and construction	August 1, 2015	TBD
2-3-5	Refine action plan for other opportunities	August 1, 2015	December 31, 2015

2-4 Open Stream Connections

Management of storm water from open streams focuses on disconnecting the stream from the combined sewer system and rerouting it to open water bodies or temporary surface storage for natural ground infiltration.

- Conduct detailed field investigations into open stream connection status for both visible and covered historical streams. This effort would build on the details for drainage areas and identify opportunities for daylighting covered streams. It would also evaluate available space to reroute the streams or use alternative management practices. Identify and evaluate issues of funding, ownership, maintenance, open space programming, education, and coordination with other capital improvement projects.
- Develop specific project concepts for three historical open streams. These project concepts will provide detail for cost, implementation and policy issues.
- Select projects for implementation and develop an implementation schedule for design and construction.
- Move the project(s) into the design and construction phase. Develop post-construction management plan for maintenance and performance assessment.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
2-4-1	Identify and prioritize opportunities; evaluation of institutional issues.	August 1, 2014	January 31, 2015
2-4-2	Develop conceptual designs, 3 streams	February 1, 2015	June 30, 2015
2-4-3	Select projects and develop an implementation schedule	June 1, 2015	July 31, 2015
2-4-4	Final design and construction	August 1, 2015	TBD

2-5 Municipal Park Flow Management

Management of runoff generated on municipal park parcels is often accomplished by redirecting the impervious surfaces to open spaces within the park or reconstructing the paved surfaces as porous pavement. Additional storm water from adjacent roads can sometimes be directed to the public park in an effort to further manage storm water. Storm water management projects on municipal park land will be coordinated with the Parks Department. Several conceptual designs have already been prepared for storm water management options at Stoepel Park.

- Develop a prioritized list of municipal parks for potential projects. This effort would build on the strategic plan that includes repositioning some existing park sites and incorporating new parks in strategic locations. Identify and evaluate issues of funding, maintenance, education, and coordination with other improvements identified in the strategic plan.
- Develop specific project concepts for five parks. These project concepts will provide detail for cost, implementation and policy issues. Estimated runoff volumes and compare with available storage area and volume.
- Stoepel Park. Review conceptual design and identify the appropriate course of action.
- Select projects for implementation and develop an implementation schedule for design and construction.
- Move the project(s) into the design and construction phase. Develop post construction management plan for maintenance, and performance assessment.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
2-5-1	Identify and prioritize opportunities; evaluation of institutional issues.	June 1, 2014	January 31, 2015
2-5-2	Stoepel Park, review conceptual design and determine future actions.	June 1, 2014	October 31, 2014
2-5-3	Develop conceptual designs, five sites	November 1, 2014	March 31, 2015
2-5-4	Select project and develop an implementation schedule	April 1, 2015	May 31, 2015
2-5-5	Final design and construction	June 1, 2015	TBD
2-5-6	Refine action plan for other opportunities	June 1, 2015	December 31, 2015

2-6 Transportation Corridor Flow Management

Transportation corridor flow management will involve early coordination with one or more road agencies. This section describes the activities planned to coordinate and implement green infrastructure projects along transportation corridors. It is envisioned that discussions with the road agencies would encompass all possible types of road projects integrating them as much as possible. Descriptions of the various types of road projects are in Section 6.6.

- Coordinate with the Detroit Department of Public Works (DPW) on roadway resurfacing projects annually. DWSD will develop a list of green infrastructure road projects updated annually. This list will be discussed with DPW so that they can potentially incorporate them into their list of road resurfacing projects. Their road resurfacing list is updated annually between late summer and early fall, for construction the following summer.
- DWSD will coordinate with the Wayne County Roads Division at least annually on upcoming county road improvement projects and where DWSD green infrastructure project ideas might fit in. The greatest potential of coordinating with Wayne County is on directing runoff to adjacent vacant parcels and on road resurfacing projects that align with DWSD utility work that is being designed. DWSD will propose a list of projects to discuss with the road commission so that these projects can be prioritized by the road commission and incorporated into their upcoming projects. Once a project is selected, DWSD will work directly with the county and any other stakeholders to implement the project.
- Annually review the MDOT 5-Year Transportation Plan for opportunities to incorporate green infrastructure. Coordinate with MDOT as appropriate. Within the next five years, MDOT has no plans for major roadwork in the URT area. Potential redirection of MDOT pump station discharge water from M-39 is a project type that would be initiated by DWSD in cooperation with MDOT.
- Develop a prioritized list of roads for the various types of road projects as described in Section 6.6. This effort will include coordination/discussions with road agencies, utility companies, and other stakeholders. This may also include further study of the road segment as a candidate for a particular practice type. For example, a traffic count analysis may be needed for lane removal candidates. The potential to integrate the various types of projects into one project will be investigated. For example, road decommissioning will be implemented as part of a large-scale greening effort. Funding, ownership, maintenance, education, and coordination with other capital improvement projects will be identified and evaluated.
- Develop five specific projects. These project concepts will provide detail for cost, implementation and policy issues.
- Based on further evaluation of the five projects, select projects for implementation and develop an implementation schedule for design and construction.
- Move the project(s) into the design and construction phase. Develop post-construction management plan for maintenance and performance assessment.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
2-6-1	Early coordination with Detroit DPW. Review planned road improvement projects and identify green infrastructure project opportunities.		Annually
2-6-2	Early coordination with Wayne County Roads Division. Review planned road improvement projects and identify green infrastructure project opportunities.		Annually
2-6-3	Early coordination with MDOT. Review planned road improvement projects and identify green infrastructure project opportunities.		Annually
2-6-4	Identify and prioritize opportunities; evaluation of institutional issues.	June 1, 2014	January 31, 2015
2-6-5	Develop conceptual designs, five sites	August 1, 2014	March 31, 2015
2-6-6	Select projects and develop an implementation schedule	April 1, 2015	May 31, 2015
2-6-7	Final design and construction. Development of a post construction operation and maintenance plan.	June 1, 2015	TBD
2-6-8	Refine action plan for other opportunities	June 1, 2015	December 31, 2015

ACTIVITY 3 - CONTINUED IMPLEMENTATION

DWSD has previously participated in a series of projects including downspout disconnection, demolitions and site restoration, and planting trees in the area. Each of these activities will be continued in the future, and adapted for current conditions. Current focus for each of these projects includes the following:

3-1 Downspout Disconnection - Homes

Disconnection of downspouts for homes, including single family residential, duplex and townhomes requires working with the property owner, resident and BSEED. Disconnection of these downspouts does not require any change to codes and ordinances, as it is in compliance with City code and the state plumbing code. Downspout disconnection work will be directed to those homes that are in relatively good condition.

The primary components of the proposed future downspout disconnection effort include the following steps:

- Develop processes to directly support disconnections, including potential implementation by non-profit groups or local neighborhood organizations.
- Prepare updates to outreach materials clarifying disconnection methods and approaches to specific downspout conditions (e.g. downspouts at driveways). Work with BSEED to clarify permitting requirements and inspection processes. Address rain barrels and rain gardens in the outreach materials.
- Develop improved quantification of status of downspouts for non-blighted homes by owner.
- Target specific disconnection outreach efforts to the following groups:
  - City- or Land Bank-owned residential properties.
  - Detroit Housing Commission
  - Private property owners that own multiple properties. These property owners include landlords, land speculators and banks. These property owner groups will be prioritized based on the number of non-blighted structures owned.
  - Neighborhood organizations or groups throughout the NWI area. This work will include identification of candidate local groups to assist in outreach to individual home owners. These groups would be tasked with reaching out to owner occupied homes.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
3-1-1	Policy, and process elements	June 1, 2014	November 30, 2014
3-1-2	Outreach materials	August 1, 2014	January 31, 2015
3-1-3	Coordination with major landlords	November 1, 2014	April 30, 2015
3-1-3	Coordination with neighborhood groups or organizations	November 1, 2014	April 30, 2015
3-1-4	Downspout disconnections (SFR)	On-going	June 30, 2017

3-2 Downspout Disconnection - Multi-Family Residential, Commercial, and Industrial

Disconnection of downspouts for properties other than homes would be initially focused on buildings that have external downspouts. Disconnection of buildings with internal downspouts is desirable but is more complicated and may not be feasible.

The feasibility of non-residential downspout disconnection needs further study and coordination with BSEED for options for downspout disconnect. Evaluations will include:

- Physical characterization of properties. These evaluations will address such questions as the amount of green space available on parcels relative to roof and other impervious area. Lack of green space may be a limiting factor for many buildings of this type.
- Identification of standard approaches for roof water management. These evaluations will be performed in conjunction with the institutional efforts previously discussed. Guidance information and public outreach information will be developed as appropriate.
- Pilot downspout disconnection projects for public buildings. Downspout disconnection plans will be developed for approximately five public buildings to better define costs associated with these project types. These plans will help inform the feasibility of non-residential building disconnections. These plans will be coordinated with broader concept plans for public facilities. Refer also to Activity 2-3 Public Facilities Flow Management.
- Develop and implement a strategy to target downspout disconnection of multi-family residential, commercial, and industrial buildings. The implementation strategy will be coordinated with Activity 1-3 Drainage Charge Credit System and Activity 2-1 Small Scale Greening.

Regardless of overall feasibility of non-residential property disconnections, this effort is intended to promote the disconnection of feasible properties.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
3-2-1	Physical characterization of properties	June 1, 2014	January 31, 2015
3-2-2	Roof water management standard approaches	October 1, 2014	May 31, 2015
3-2-3	Public buildings pilot downspout disconnection projects	June 1, 2015	November 30, 2015
3-2-4	Downspout disconnection strategy implementation (non-SFR)	On-going	

3-3 Demolitions and Site Restoration

The responsibilities for demolitions in the city of Detroit have shifted to the Detroit Building Authority (DBA). DWSD is working with the DBA on processes and funding of demolitions. DWSD's strategy will be to support demolitions which cannot be funded through other mechanisms and will result in removal of significant impervious area. As such, these demolitions may include isolated single-family homes or non-single-family residential properties. DWSD funded demolitions will require control of runoff from the site as a condition of the funding.

The tasks associated with this activity are focused on working with DBA on basic building demolition projects. DWSD intends to work with others to better define site runoff characteristics, implement enhanced storm water

management on select parcels, and test greening techniques on vacant lots that work within the neighborhood and enhance storm water management. These tasks include:

- Determine annual level of funding for basic building demolitions.
- Coordinate with DBA and implement building demolitions.

Other activities identified in this plan address standards associated with the demolition process and prototype projects. Related activities include:

- Activity 1-5 Structure Demolition and Lot Greening Standards
- Activity 2-1 Small Scale Greening
- Activity 2-2 Large Scale Greening

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
3-3-1	Budget planning for building demolitions	August 1, 2014	October 31, 2014
3-3-2	Coordinate with DBA and implement building demolitions	On-going	

3-4 Tree Planting

Tree planting efforts have focused on street trees in low vacancy areas. It is believed that there are still significant opportunities where street trees can be planted and provide a benefit in line with DWSD's permit goals.

- Evaluate additional tree planting opportunities in rights-of-way cross-referencing neighborhood stability and other green infrastructure practices. This is to ensure that trees are not planted and then later removed to install other green infrastructure practices.
- Plant approximately 800 additional trees in the NWI area.
- Identify large scale tree planting projects in coordination with Greening of Detroit. These include additional trees for Rouge Park and evaluation of locations for carbon forest in proximity to I-96 or the Southfield Freeway.
- Select, schedule and implement tree planting projects.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
3-4-1	Evaluate opportunities	August 1, 2014	October 31, 2014
3-4-2	Plant approximately 800 additional trees in the NWI	August 1, 2014	December 31, 2014
3-4-2	Identify projects	November 1, 2014	January 31, 2015
3-4-3	Select, schedule and implement projects	Fall 2014	Ongoing

ACTIVITY 4 - LONG TERM PERFORMANCE

The objective of the Green Infrastructure Program is ultimately to reduce CSO discharges. As green infrastructure projects are implemented, a better understanding will be developed of the performance of green infrastructure. This improved understanding will support an update to the "Supplemental Report on Alternative CSO Controls for the Upper Rouge River" (dated April 30, 2010). This is a requirement of the NPDES permit and is due January 1, 2017. The ability to predict the longer term performance of green infrastructure will be based on the following components:

- Understanding of green infrastructure performance through monitoring of installed practices.
- Improved sewer system modeling based on current flow monitoring data and current land cover in the URT area. The NPDES permit requires a monitoring and study approach plan (completed) to accurately determine the volume and frequency of discharge and the determination of peak flows.
- Better understanding of the extent to which green infrastructure can realistically be implemented, through early project implementation and development of processes.
- Data on the installed costs associated with green infrastructure and the extent to which costs are shared amongst parties.

- Legal agreements between DWSD and the property owners for green infrastructure sites will be prepared to ensure long-term sustainability. The agreements will be prepared in conjunction with the project design and construction. The prototype projects will likely be the first projects for which formal legal agreements are developed.

Task ID	Activity	Target Start	Target Complete
4-1	Sewer system flow monitoring program and updated model in support of CSO frequency and volume determination	January 1, 2014	April 1, 2015
4-2	Development of monitoring plans and implementation to evaluate questions of hydrology and green infrastructure performance	August 1, 2014	June 30, 2015
4-3	Study to evaluate benefits that can be achieved through green infrastructure implementation based on projects implemented and data collected	August 1, 2015	June 30, 2016
4-4	Amendment to the Supplemental Report on Alternative CSO Controls for the Upper Rouge	January 1, 2016	January 1, 2017
4-5	Legal agreements for long-term sustainability.	August 1, 2014	On-going

ACTIVITY 5 - STAKEHOLDER AND COMMUNITY ENGAGEMENT

DWSD will continue to work with key partners to collaborate on stakeholder involvement and education activities with the goal of gaining insight, input, implementation support, and balanced public policy. Educate land-owners about the program and process to enhance participation and effectiveness of program.

All activities that develop new standards and protocols will be implemented in conjunction with stakeholder groups and with opportunity for public comment. Many of the activities highlighted will have internal working groups that will be necessary to identify the process and procedures for implementation. More detail is provided in Section 4.1, Communication and Outreach.

While DWSD has actively engaged a wide variety of stakeholders in the Green Infrastructure Program, stakeholder involvement and education efforts will significantly increase in 2014-2015 as many of the policy and procedural issues are addressed. Each program will have a defined stakeholder involvement and education component. Although DWSD will engage in a wide variety of stakeholder involvement and education activities to support the Green Infrastructure Program, there are a few significant actions that will influence the perception of DWSD's green infrastructure efforts. The key actions related to stakeholder involvement and education in the near-term is described below. The detailed stakeholder involvement and education strategies discussed in Activities 5-2 and 5-3 will contain a longer list of action items with greater specificity.

5-1 Green Infrastructure Website

DWSD's website will be the primary distribution channel for many of the stakeholder outreach materials and messages, as well as technical documentation, on green infrastructure. It is anticipated that the website will address a variety of topics. These include (1) the storm water drainage charge, (2) green infrastructure program projects and implementation and (3) green infrastructure educational resources for general public, engineering community and small and large property owners. Relative to the green infrastructure educational resources, local partners in Detroit are envisioning an overarching green infrastructure website that DWSD will develop collaboratively. This website could potentially provide links to DWSD's website to provide information on the storm water drainage charge and green rewards, but would provide additional outreach information that goes beyond achieving a discounted rate.

A prominent web page dedicated to information about the storm water drainage charge and green rewards is recommended as this effort moves forward. Specific concepts for the dedicated DWSD storm water drainage charge and green rewards webpage are as follows:

- Clear, branded storm water drainage charge/green rewards tag-line and logo on DWSD's main page (similar to current When It Rains, It Drains logo on the right-hand sidebar of the DWSD homepage)

- Add specific link to storm water drainage charge/green rewards webpage under About DWSD tab across top of DWSD homepage. Don't embed it under NPDES Permit/Storm Water Master Plans.
- Use content from some overview outreach materials (e.g., FAQ document) as content for the storm water drainage charge/green rewards webpage.
- Include calendar of workshops and other training or educational events.
- Showcase one or more case study examples, with a target of one per month.
- Provide links to the green infrastructure educational campaign website developed in collaboration with other local green infrastructure partners (see DWSD Green Infrastructure Outreach Strategy)
- Provide links to other local green infrastructure partners' websites as resources for more information (might be unnecessary if everything falls under GI educational campaign website)
- Depending on structure of Green Rewards, consider dividing webpage into residential and non-residential information subpages.

The milestone schedule for these efforts is shown below. Note that the website is an ongoing effort and draft and final milestones relate to concepts of website structure and population of the website with current information:

Task ID	Activity	Target Start	Target Complete
5-1-1	Draft Website	September 1, 2014	November 30, 2014
5-1-2	Final Website	December 1, 2014	February 1, 2015

5-2 Green Rewards Program Stakeholder Engagement

This activity is the outreach component associated with Drainage Charge System and associated discounts for green infrastructure implementation. For the purposes of this Plan, this is preliminarily referred to as a "Green Rewards" program.

DWSD has committed to community conversations that will engage stakeholders in the development of the Green Rewards program. Elements to be addressed include the Green Rewards component of the drainage charge system, and the associated green infrastructure implementation protocols. DWSD is working to define the specific stakeholder involvement and education approaches. These approaches need to ensure successful engagement and transparency in the process. They should result in a collaborative program design with improved acceptance. Efforts would begin with the definition of a stakeholder group and identification of the issues to be discussed. It is expected that this group would include a wide variety of stakeholders that represent various perspectives (e.g. industry, development, faith based institutions), residential and non-residential ratepayers, DEQ and others. DWSD will also define an initial process and structure for this stakeholder group (e.g., a "Green Rewards Action Team"), allowing flexibility for the stakeholder group to determine such items as the level of time investment.

The stakeholder group and associated efforts are considered phase I of the program, while rollout to a broader audience is considered phase II. The ongoing engagement program involves efforts to educate and support customers in navigating the drainage charge system and the Green Rewards opportunities.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
5-2-1	Engagement Program (phase I)	August 1, 2014	April 30, 2015
5-2-2	Engagement Program (phase II)	July 1, 2015	November 30, 2015
5-2-3	Engagement Program (ongoing)	November 30, 2015	Ongoing

5-3 Green Rewards Toolbox

In addition to implementing a stakeholder-based approach with a Green Rewards Action Team, DWSD will also develop materials for various messaging and outreach formats. These information formats would be structured for ratepayers, other city departments, and local media. This information would help to educate property owners in site development approaches and media in how the program is implemented. Technical support documents,

such as a protocol handbook on how to generate and maintain green rewards, checklists, decision trees, and how-to information on specific types of green infrastructure practices, will collectively form a Green Rewards toolbox for use by residential and non-residential ratepayers. The components of the toolbox will be developed as the specifics of the Green Rewards program is crafted, ideally with input from the stakeholder-based Green Rewards Action Team. They will form companion elements to the Drainage Charge System Manual and the Storm Water Technical Reference Manual. These materials can be distributed via DWSD's Green Infrastructure website, as well as through other city departments and key education partners that are likely to play a role in providing technical assistance to ratepayers.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
5-3-1	Draft Technical Support Materials	May 1, 2015	January 31, 2016
5-3-2	Final Technical Support Materials	February 1, 2016	June 30, 2016

5-4 Green Rewards Training Workshops

DWSD will develop and implement two types of training workshops to promote implementation of green infrastructure and participation in the Green Rewards program: 1) training for city department staff and other local partners that will help educate ratepayers on DWSD's programs and requirements; and 2) training for ratepayers seeking to learn more about the storm water drainage charge and how to obtain a discount through the Green Rewards program. The types of workshops may be modified or expanded to specifically target other audiences such as consulting engineers, small businesses or faith community/non-profit properties. Workshops will be tailored to the audience and present instruction in the various materials that have been developed.

The schedule for these activities will parallel the drainage charge system development. Initial expectations include:

Task ID	Activity	Target Start	Target Complete
5-4-1	Draft Workshop Materials	May 1, 2015	August 1, 2015
5-4-2	Final Workshop Materials	April 1, 2016	May 1, 2016

5-5 Green Infrastructure Case Studies and Demonstration Projects

Examples of successful green infrastructure implementation by residential and non-residential ratepayers in both the URT and other areas of Detroit can help highlight technical, financial, programmatic, and social components of various green infrastructure projects for other ratepayers considering undertaking similar projects. DWSD will highlight these examples through case studies, distributed as fact sheets on the DWSD Green Infrastructure website or through presentation materials. Other city departments and key outreach partners (e.g., Detroit Future City) can use the case study examples to help illustrate the benefits of green infrastructure implementation and the technical considerations. In addition to case studies, DWSD can work with city departments and other key outreach partners to identify potential demonstration projects that can serve as hands-on teaching examples of green infrastructure at work in Detroit. These demonstration projects could be integrated into educational tours or workshops to promote green infrastructure implementation and participation in the Green Rewards program.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
5-5-1	Draft Case Studies	June 30, 2015	January 31, 2016
5-5-2	Final Case Studies	February 1, 2016	June 30, 2016

5-6 Green Infrastructure Forum

DWSD recognizes the importance of sustaining communication and coordination among City department staff and key green infrastructure partners throughout the city that play a role in green infrastructure implementation. DWSD will plan and host, with assistance from other key green infrastructure partners, a regularly scheduled forum or conference for a variety of stakeholders to discuss issues related to green infrastructure. At a

minimum, this forum will occur annually. It is expected that the forum will be held in May to support the development of the Annual Progress Report and subsequent year's plan.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
5-6-1	2014 – 2015 recap green infrastructure forum		May 2015
5-6-2	Ongoing annual forums		Ongoing

5-7 Stakeholder Involvement and Education Strategy

DWSD is in the process of developing a comprehensive Stakeholder Involvement and Education Strategy to support the Green Infrastructure Program. This strategy will identify the process for conducting outreach and engagement on a project-by-project basis, using the six-elements of outreach and involvement described in Section 4.1.3 of this Plan. The Strategy will include the Green Rewards specific stakeholder involvement and engagement activities, identify collaborative stakeholder involvement and education efforts with key partners and existing task forces and work groups throughout Detroit. DWSD is in the process of crafting the Strategy using input from key partners provided during various one-on-one discussions, task force meetings, and through a review of recent media reports to ensure the Strategy addresses stakeholders' perceptions, concerns, values, and vision regarding green infrastructure in Detroit. DWSD will provide key partners with the opportunity to review and comment on the Strategy, particularly where key partners will play a collaborative role in helping DWSD educate, engage, and motivate green infrastructure implementation in the URT area and citywide.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
5-7-1	Draft Strategy	June 1, 2014	September 30, 2014
5-7-2	Final Strategy	October 1, 2014	December 1, 2014

5-8 Overarching Green Infrastructure Educational Campaign

During the June 20, 2014 stakeholder meeting on the DWSD Green Infrastructure Program hosted by SEMCOG, participating stakeholders identified the need for a collaborative, cooperative citywide green infrastructure educational campaign to raise awareness about the benefits of green infrastructure. DWSD will continue to have conversations with key partners about developing and implementing an overarching green infrastructure educational campaign that would likely include branding the green infrastructure movement in Detroit, creating public service announcements about the benefits of green infrastructure, developing a centralized, branded, collaborative green infrastructure website that isn't perceived as being "owned" by any one particular entity, and generating local support for green infrastructure through one or two high-profile campaign spokespersons.

The milestone schedule for these efforts is:

Task ID	Activity	Target Start	Target Complete
5-8-1	Overarching green infrastructure educational campaign		On-going

APPENDIX A
Example of Maintenance Covenants

Amendment of Declaration of Covenants
Stormwater Management Maintenance Covenant

THIS AMENDMENT OF DECLARATION (the "Amendment") is made this ____ day of _____, 20__, between _____, hereinafter referred to as the "Owner", located at _____ and the Detroit Water and Sewerage Department, located at 6425 Huber Street, Detroit, MI 48211.

RECITALS

1. _____ is the current title holder (the "Owner") of certain real property located in _____ (the "Property"), which real property is more particularly described in **Exhibit A** attached hereto and made a part hereof.

2. The former Owner of the Property, _____, executed a Grant of Stormwater Management Easement and Right of Way to the Detroit Water and Sewerage Department, which was dated _____ and recorded in the office of the _____ County Register of Deeds in Liber _____, pages _____ on _____, and also executed a Stormwater Management Maintenance Covenant (the "Covenant") for the inspection and maintenance of on-site stormwater management facilities (the "Facility"), which was dated _____ and recorded in the Office of the _____ County Register of Deeds in Liber _____, pages, on _____. The Facility is located in the area described in **Exhibit A** and shown in more detail on **Exhibit B** (the "Easement Area"), which is attached hereto and made part hereof.

3. Subsequent to the recording of the Stormwater Management Easement and Covenant, the Owner of the property described in **Exhibit A** petitioned the Detroit Water and Sewerage Department to assume responsibility for _____), provided that the Owner satisfies certain conditions acceptable to the Detroit Water and Sewerage Department and executes an easement and maintenance agreement granting the Detroit Water and Sewerage Department a perpetual right of access to the Facility for the purpose of performing all structural maintenance functions.

4. In order to accurately delineate the new terms, conditions and responsibilities of the Covenant, the parties hereto agree that it is necessary to amend the Covenant.

NOW THEREFORE, in consideration of the recitals, the mutual promises of the parties, and other good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties agree hereto as follows:

A. The Amendment replaces and supersedes paragraphs _____ in the Stormwater Management Maintenance Covenant for the inspection and maintenance of the Facility dated _____, which was executed by _____ and recorded in Liber _____, pages _____ of the Office of the _____ County Register of Deeds, a copy of which is attached hereto as **Exhibit C**. In the event of conflict between this Amendment and other provisions in the Covenant, this Amendment shall control.

B. The Owner must maintain the Easement Area depicted in **Exhibit B** by providing trash removal, grass cutting and landscaping on the Property described in **Exhibit A** and performing other nonstructural maintenance for the Facility serving the Property.

C. The Detroit Water and Sewerage Department must provide routine inspection and maintenance for structural components of the Facility as needed to ensure that the Facility remains in proper working condition in accordance with approved design standards.

D. The Owner must provide and maintain perpetual access from public rights-of-way to the Facility for the Detroit Water and Sewerage Department, its agents and its contractors.

E. The Owner must grant the Detroit Water and Sewerage Department, its agents and its contractors a right of entry to the Facility for the purpose of inspecting, operating, monitoring, installing, constructing, reconstructing, modifying, altering or repairing the Facility.

F. Except in the case of emergency, the Detroit Water and Sewerage Department will provide reasonable notice to the Owner before performing any structural maintenance or repair of the Facility in accordance with this Amendment.

G. If, after reasonable notice by the Detroit Water and Sewerage Department, the Owner fails to maintain the Easement Area in accordance with this Amendment, the Detroit Water and Sewerage Department may perform any nonstructural maintenance needed to correct a condition that impacts the effectiveness of routine structural maintenance and collect any cost incurred as a result from the Owner of the Facility and in the same manner as real property taxes are collected. In addition, the Detroit Water and Sewerage Department may seek reimbursement under any other method legally available to collect debts owed to Detroit Water and Sewerage Department.

H. The Owner agrees to indemnify and save the Detroit Water and Sewerage Department harmless from any and all claims for direct damages to persons or property arising from maintenance of the Easement Area in accordance with this Amendment. The Detroit Water and Sewerage Department agrees to indemnify and save the Owner harmless from any and all claims for direct damages to persons or property caused by an act or omission of the Detroit Water and Sewerage Department during the routine inspection and structural maintenance of the Facility.

I. The Owner must promptly notify the Detroit Water and Sewerage Department when the owner legally transfers any of the Owner's responsibilities for the Facility. The Owner must provide the Detroit Water and Sewerage Department a certified copy of any full executed document of transfer.

J. The covenants contained herein shall run with the land and shall bind the Detroit Water and Sewerage Department, the Owner and the Owner's successors and assignee, and shall bind all present and subsequent owners of the property served by the Facility.

K. This Amendment shall be recorded in the office of the Wayne County Register of Deeds and may not be released or modified except by written consent of the Detroit Water and Sewerage Department.

IN WITNESS WHEREOF, the Owner and Detroit Water and Sewerage Department have executed this Amendment of Stormwater Maintenance Covenant on the date first above written.

DECLARATION OF DRAINAGE EASEMENT AND RESTRICTIONS

THIS DECLARATION OF DRAINAGE EASEMENTS and RESTRICTIONS made this _____ day of_____, ____, by _____ (Developer/Landowner), a _____ Corporation, hereinafter called the “Grantor."

WHEREAS, the Grantor is the owner of certain property containing a total of acres, more or less, in the City of Detroit, Michigan, and more particularly described as follows:

(Insert Description)

further known or designated on a construction plan dated _____ as _____.

WHEREAS, the Grantor has created perpetual non-exclusive drainage easements for the benefit of the lots and parcels shown on the condominium, plat or plan referenced above, which easements shall be for the purpose of maintaining private storm drainage facilities and for the collection and transmission of private stormwater through and across the areas designated as "private drainage easement" on said condominium, plat or plans.

NOW, THEREFORE, in consideration of the mutual benefits accruing to the Grantor and to future owners of the lots and parcels hereinabove described, the Grantor does hereby declare, create and constitute a perpetual nonexclusive drainage easement over and across the (side and rear) of _____ as shown on the plan dated _____ or on the condominium or subdivision plat recorded in the office of the _____ County Register of Deeds for the purposes referenced herein.

The owners of the above referenced lot(s) shall use the rights granted by this instrument with due regard to the rights of others and their use of such easement, and shall not use the drainage easement in any way that will impair the rights of others to use it, and shall not obstruct drainage thereon.

The easement hereinabove granted shall run with the land and shall be for the benefit and use of the owners of the lots and parcels shown on the plat referenced above, his or her heirs and assigns, and to the benefit and use of the Grantor and its heirs, successors and assigns.

Document signed by Grantor, witnessed by notary.

GRANT OF STORMWATER MANAGEMENT EASEMENT

THIS DEED OF EASEMENT, made and entered into this _____ day of _____, _____, by and between _____, herein referred to as the Owner; and the Detroit Water and Sewerage Department, located at 6425 Huber Street, Detroit, MI 48211.

WITNESSETH:

FOR AND IN CONSIDERATION of mutual benefits accruing or to be accrued to the above mentioned parties, and other good and valuable consideration, the receipt whereof is hereby acknowledged, the Owner grants and conveys unto the Detroit Water and Sewerage Department, its agents, assigns and successors the following rights in real property situated in _____ County, Michigan, to-wit:

EXHIBIT A

The privilege and easement in perpetuity for a right-of-way to maintain, repair, inspect, improve and operate within the easements works and systems for the collection, conveyance, storage, treatment or distribution of raw or treated water associated with storm water drainage over, upon, across, and under property of the Owner, including right of ingress and egress to the same, the said easements being shown and designated in Exhibit B (attached).

The further terms and conditions of this grant of easement are as follows:

1. That the Owner may but is not required to trim, cut, remove and keep clear all trees, limbs, under¬¬growth, and any and all other obstructions, within the said right-of-way or easement strip, except that which may, in the judgment of the Detroit Water and Sewerage Department, endanger or interfere with the proper and efficient operations of the works and systems therein or thereon, and the Detroit Water and Sewerage Department shall have all such other rights and privileges as are reasonably necessary or convenient for the full enjoyment and use of the easement herein granted for the aforesaid purposes.

2. The granting of the easement herein described neither expresses nor implies payment, nor the waiver of any obligations for the payment, by the Owner or his successors or assigns, of any fee or charge, tax, assessment or other obligation whatsoever now due or heretofore due or hereafter to become due and payable to the Detroit Water and Sewerage Department, or to any person, firm or other corporation whatsoever.

3. The Detroit Water and Sewerage Department will exercise reasonable care to protect Owner's property from damage or injury occasioned in the enjoyment of the easement and rights herein granted, and to promptly repair the said property or reimburse the Owner for any property damaged beyond repair.

4. The Owner, its agents, assigns and successors agree that when requested by the Detroit Water and Sewerage Department, it shall remove any fences, structures, landscaping, vehicle parking or other obstruction within forty-eight hours (48 hours) of receipt of written notice requesting such removal. Except that in an emergency or failure to remove after written notice the Detroit Water and Sewerage Department will remove, or have removed by others, any impediment to access, maintenance or operation, and the Owner agrees to be responsible for replacement of the same.

5. The Owner covenants and agrees for himself, his assigns and successors, that the consideration aforementioned shall be in lieu of any and all claims of compensation and damages by reason of the location, construction, reconstruction, alteration or maintenance of the said facility.

6. The Owner shall defend the Detroit Water and Sewerage Department from all claims for damages to surrounding properties caused by Owner's failure to construct and/or maintain the facility as approved.

7. The Detroit Water and Sewerage Department will exercise reasonable care when pursuing rights and responsibilities set forth by the Stormwater Maintenance Covenant for Private Storm Drain Systems attendant to the property, and will defend the Owner from all claims for damages to surrounding properties resulting from acts of omission or neglect by its employees or contractors. Detroit Water and Sewerage Department liability will be limited to damages to adjoining properties only and not the lands of the Owner. Nothing in this agreement shall prevent Detroit Water and Sewerage Department from seeking reimbursement, by any means, for all or any portion of its costs.

The Owner further covenants that it has the right to convey the said easement; that the Detroit Water and Sewerage Department shall have quiet and peaceful enjoyment and possession of said easement, and access thereto, and that the Owner will execute such further assurances of the said grant of easement herein contained as may be required by the Detroit Water and Sewerage Department.

Exempt from the Michigan Real Estate Transfer Tax Act (MCL.207.505).

Document signed by Owner and Detroit Water and Sewerage Department.

Attach Exhibit A: description of property

Attach Exhibit B: visual layout of easement within property