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Engineers and
Scientists

Combined Sewer Overflow Informational Study

Southeast Michigan

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Executive Summary

The Erb Family Foundation's ("Foundation's") mission is to advance an environmentally healthy and culturally vibrant metropolitan Detroit and a flourishing Great Lakes ecosystem. The Foundation is committed to supporting initiatives to enhance Great Lakes water quality. For over ten years, the Foundation has supported programs and projects to reduce untreated combined sewer overflows (CSOs) and improve the water quality of the region's rivers and Lake Erie. In total, this support has amounted to over $20 million.

The Foundation commissioned this study to understand the sources and volumes of untreated CSO discharges in addition to future priorities for continued CSO reduction in the region (see Figure 1 map). The Foundation retained GEI Consultants to answer a series of targeted questions using readily available plans and data from local utilities, government agencies, and universities. Understanding there were many agencies in the study area with roles and interests that intersect with the Foundation's objectives, an Advisory Group was invited to inform the study and to make recommendations to the Foundation. Advisory Group members included the Great Lakes Water Authority (GLWA) Detroit Water & Sewerage Department, Southeast Michigan Council of Governments, the Macomb County Public Works Commissioner, Oakland County Water Resources Commissioner, and Wayne County Drain Commissioner.

Through discussion with Advisory Group members, several crosscutting-issues, which could help further prioritize future efforts emerged.

These crosscutting-issues include:

- CSO reduction efforts are part of a suite of actions being taken by stakeholders seeking to simultaneously protect public health and safety; preserve natural resources & a healthy environment; maintain reliable, high-quality service; assure value in investment; and contribute to economic prosperity.
- Solutions need to be tailored. One-size-fits-all approaches may undermine desired outcomes at the local level.
- CSO reduction must be balanced with addressing negative water quality outcomes that happen during dry weather and/or smaller storm events.
- Additional information is needed on many fronts and will be key to framing the Foundation's strategy.

In addition to highlighting cross-cutting issues, GEI, working with the Advisory Group, identified several measurable successes to date:

- More than $2 billion has been invested in CSO reduction.
- Nine new CSO facilities, collectively treating 97% of wet weather events, have been built.
- The number of uncontrolled CSOs in the region has declined from 310 to 76.

Moving forward, regional stakeholders are working to address the remaining 3% of untreated CSO discharges. This will require an estimated capital investment of $2.29 billion, not taking into account long-term operation and maintenance costs. Stakeholders are also working to understand and account for climate change and increasing regional precipitation. The summer of 2021 has set record events for precipitation in southeast Michigan. During the June 25-26, 2021, event, many rain gauges measured more than a 100-year event and three gauges registered a 1,000-year event. This contributed to flooded freeways, basement backups, and damage to businesses. While working internally to tackle and prioritize steps to address intersecting flooding and untreated CSO challenges, regional partners are also working to continuously improve public education and outreach.

Together, this report and input from the Advisory Group will be used to inform the Foundation's future grantmaking efforts aimed at improving Great Lakes water quality.

Background

Importance of CSOs, Water Quality, and Stormwater in Southeast Michigan

Southeast Michigan, like the rest of the Upper Midwest, is defined by water, with Lake St. Clair to the northeast of Detroit, Clinton River watershed to the north and northwest, and Rouge River watershed to the west and south, all feed the Detroit River and ultimately Lake Erie.

As Detroit (the City) grew, it focused on moving stormwater and wastewater to treatment plants as quickly as it could within the same conveyance system. Today, with a combined wastewater and stormwater conveyance system, CSOs act as relief points that discharge stormwater and wastewater to receiving waters when system conveyance/treatment capacity is exceeded. In addition, Detroit's system had to accommodate more flows as the suburbs grew faster than the City but still relied on the City to help manage their flows. And, as with so many other growing metro areas, the challenge surfaced that adding stormwater to wastewater can overwhelm water reclamation plants, contributing to water quality threats. Despite these challenges, Detroit's combined conveyance, drainage and treatment system has made significant progress over time in reducing CSOs.

To relieve wastewater reclamation plants and reduce CSOs, municipal water reclamation systems throughout the country, including those covered by this CSO Informational Study (Study), prioritized their work to improve water quality by addressing different kinds of overflows.

> *Dry Weather Sanitary Sewer Overflows v. Wet Weather Combined Sewer Overflows:*
>
> Typically, a majority of CSO events occur during wet weather (precipitation, snowmelt, etc.). While inflow and infiltration into underground wastewater collection systems can contribute to flow within a combined system, the amount of flow generated during dry weather is typically handled by the sewer system and the treatment facility with minimal issues. For example, within the GLWA system, all untreated CSO events in 2020 occurred as a result of rainfall to the GLWA system. In the past, some SSOs occurred during dry weather. Sanitary sewer overflows (SSOs) carry wastewater from homes, offices, and factories into receiving waters without first being treated. SSOs are regulated by National Pollutant Discharge Elimination System (NPDES) pollution discharge permits.
>
> Currently, however, system upgrades over the past several decades have resulted in untreated overflows occurring exclusively from wet weather, which remain a significant threat to water quality. As such, they are the focus of this Study.

Treated v. Untreated Combined Sewer Overflows:

The combined wastewater and stormwater systems within the Detroit River watershed are connected to multiple treatment facilities. The GLWA Water Resource Recovery Facility (WRRF) is the largest of these, and processes high volumes of combined stormwater and wastewater. When properly treated, these CSO discharges are safely discharged into waterways, according to permits, and do not pose hazards to the environment. In addition to facilities that treat wastewater to advanced ("secondary" and "tertiary") treatment standards, there are also "rapid" treatment methods that allow for primary settling and disinfection during storm events where more water exists in the system than can be fully treated through secondary and tertiary treatment.

Untreated CSOs occur when the system or a portion of the system is overwhelmed, and the water must be discharged prior to being routed through a facility for treatment. While progress has been made in reducing untreated CSOs, they still occur in large volumes annually, and planning and projects are continually being pursued to continue reducing them.

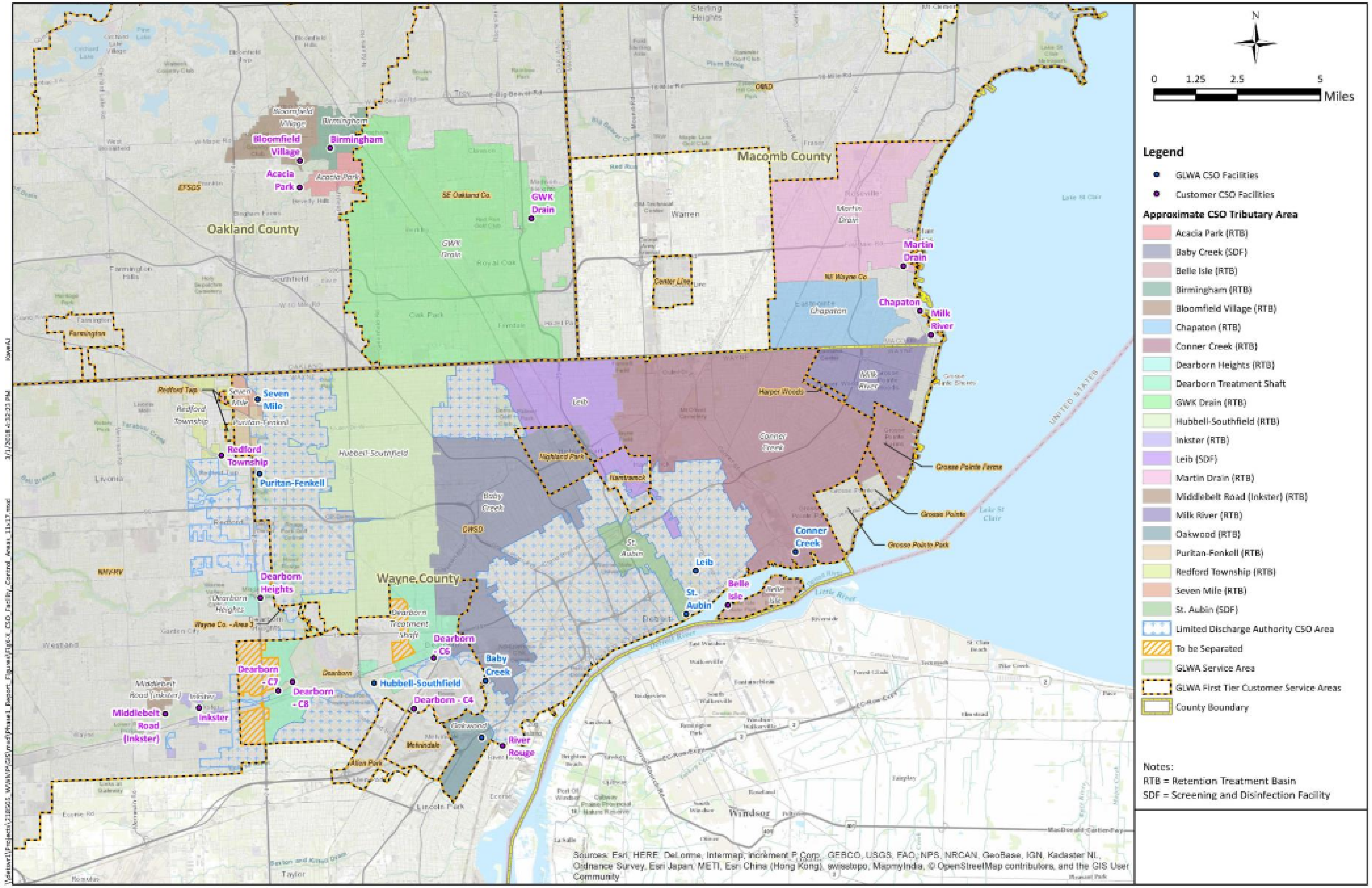

Figure 1: GLWA & Member CSO Control Facilities and Approximate Drainage Areas. Source: GLWA WWMP.

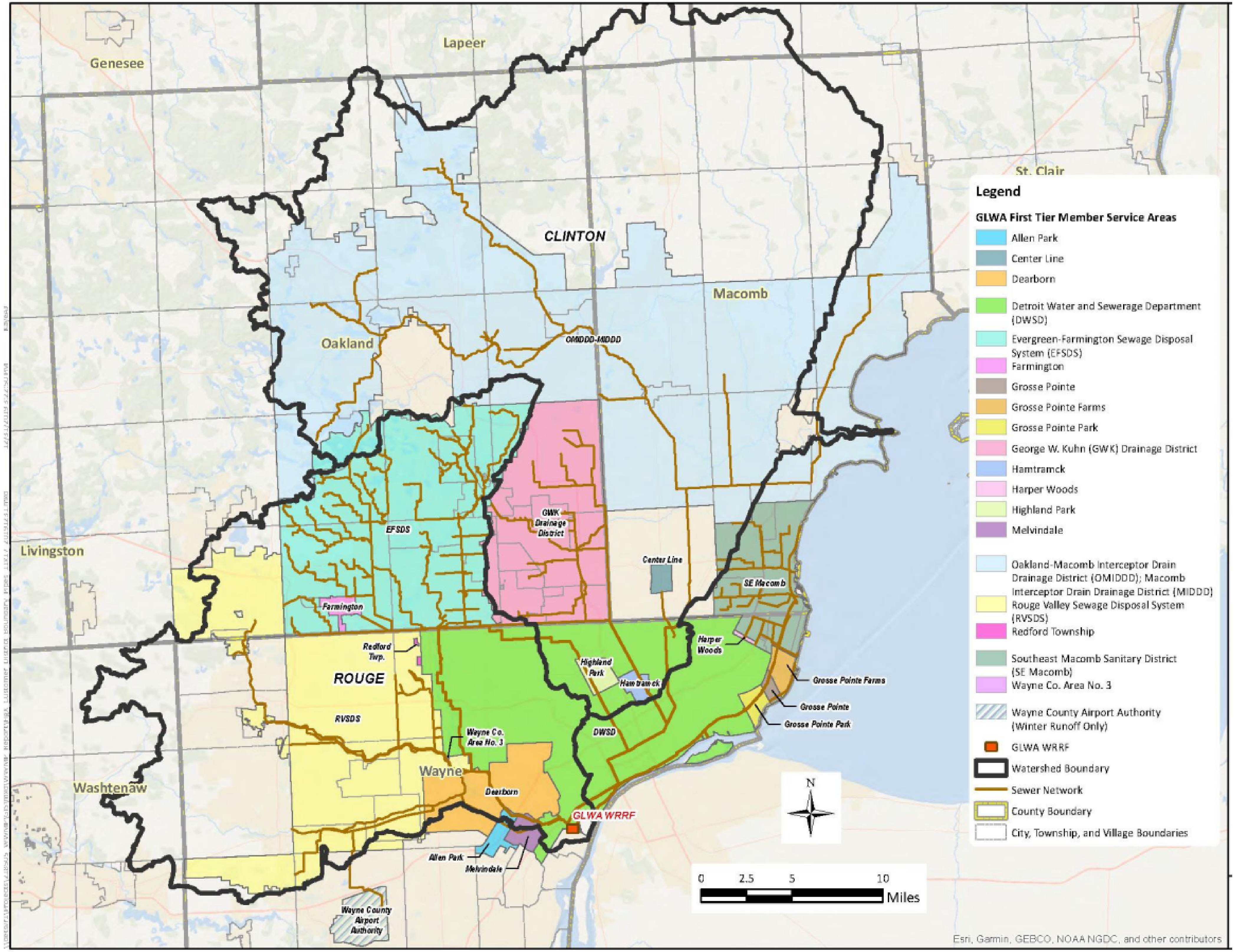

Figure 2: Lake St. Clair, Clinton, Detroit River & Rouge River Watersheds with Regional Sewer System. Source: GLWA WWMP.

Because immediately eliminating all overflows is recognized as prohibitively expensive, municipalities across the U.S. have been prioritizing alternative approaches, like large scale underground and aboveground storage, sewer separation, and Green Stormwater Infrastructure (GSI) to address the greatest threats to water quality first. In that way, wastewater treatment is optimized so that eliminating CSOs and other significantly polluted discharges can happen over time.

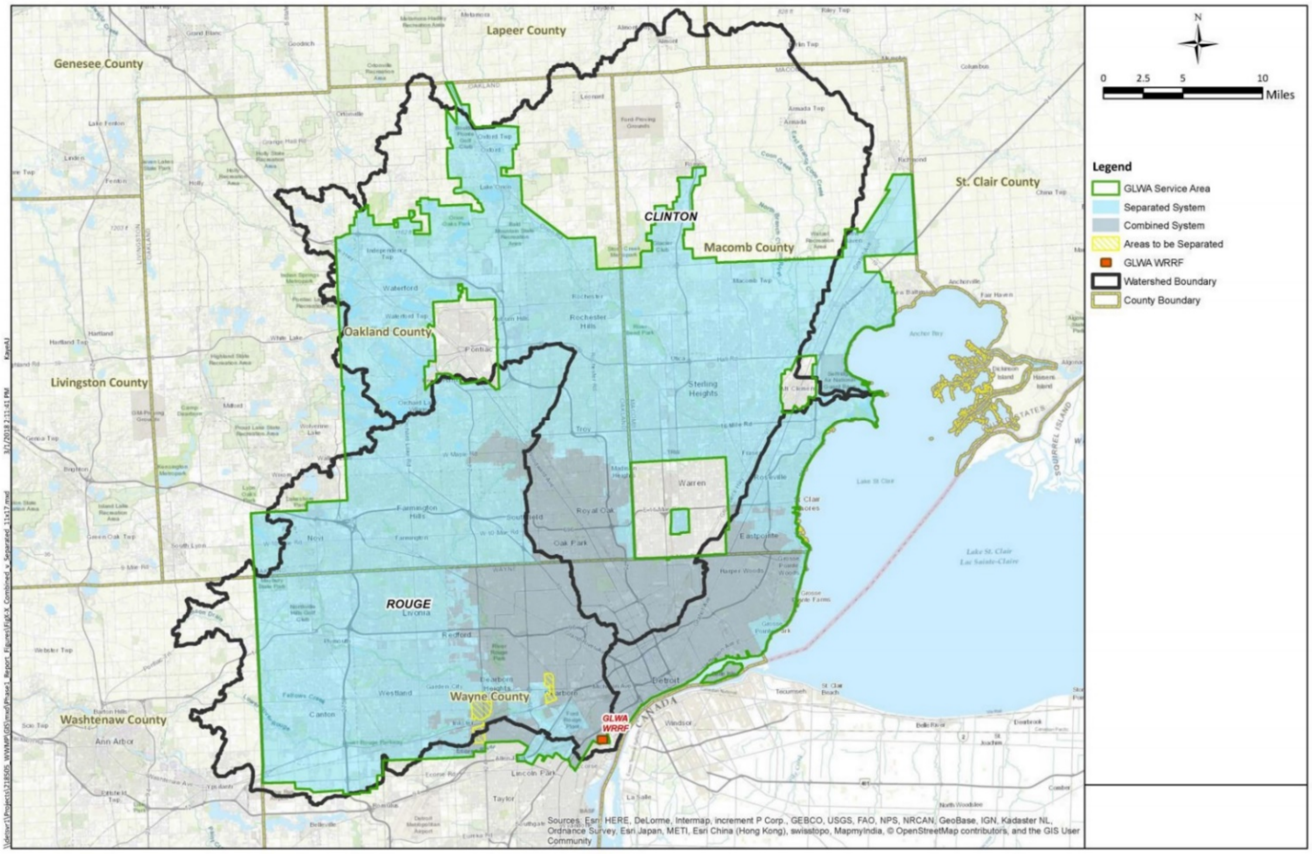

Figure 3: GLWA Separated & Combined Systems. Source: GLWA WWMP.

Southeast Michigan is making progress in controlling its CSOs through treatment, separation, and other means. Since 1988, the number of untreated CSO outfalls in the region have declined from 310 to 76. According to the Southeast Michigan Council of Governments (SEMCOG), 23 of the remaining untreated CSO outfalls[1] in suburban areas are scheduled to be eliminated by 2025, with the other high-priority Detroit outfalls scheduled for elimination by 2037. The Detroit Water & Sewerage Department (DWSD) and GLWA, have reduced CSOs over the past several years through new infrastructure, compliance with NPDES permits, and improved practices and policies. The GLWA Wastewater Master Plan (WWMP) includes CSO reduction in its regional framework for improving water quality. An updated Long-Term Control Plan (LTCP), to be completed in 2023, will provide further specifics on individual projects and their timing.

[1] https://semcog.org/wastewater

Still, as with many other communities throughout the country where aging water infrastructure exists, more progress is needed to combat CSOs while recognizing that prioritizing these efforts with limited funds is a significant challenge. For example, GLWA alone estimates a cost of $15 billion to fully separate the combined sewers of all the contributing systems. Progress is also complicated by difficulties in forecasting intensifying storm events and where within the system they will occur. Moreover, agencies work to balance the need to improve water quality through reduced CSOs from larger storm events, releases during smaller events, and programs to remedy dry weather sources.

GLWA and DWSD Frameworks for Managing Wastewater and Stormwater

GLWA's service area encompasses DWSD's service area, and parts of Macomb, Oakland, and Wayne Counties' service areas. GLWA's WWMP guides the region's overall goals for wastewater conveyance and treatment.

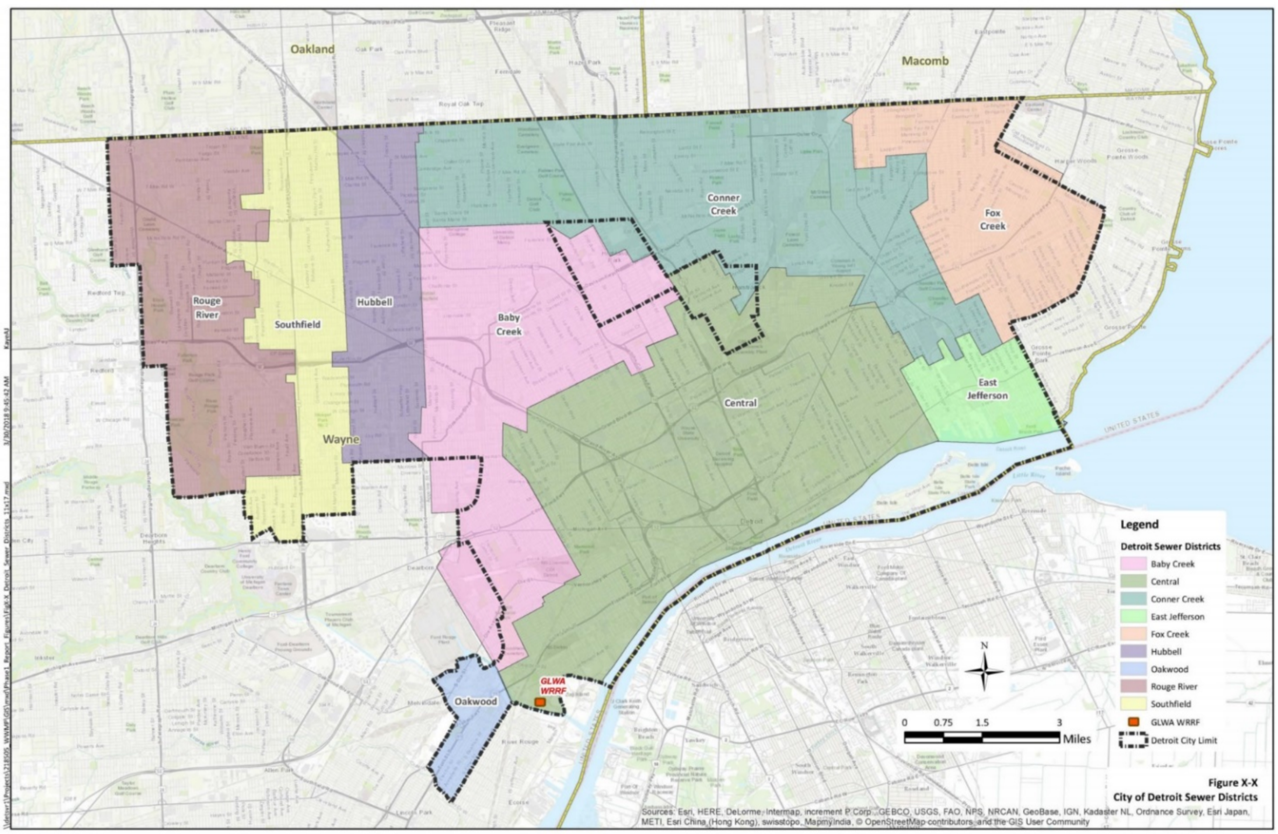

Figure 4: Sewer Districts within Detroit. Source: GLWA WWMP.

Erb Family Foundation Project Overview

It is the above challenge that the region faces – optimizing water quality improvements with limited funds and competing priorities – that prompted the Foundation to produce this Study. The Foundation retained GEI Consultants, Inc. to answer specific questions that will inform the Foundation's strategy to help the region make cost-effective decisions to reduce remaining untreated CSOs.

One of many ways in which the Foundation has already contributed to an environmentally healthy and culturally vibrant metropolitan Detroit and a flourishing Great Lakes ecosystem is through investments in education, outreach, planning, design, and construction of GSI. This Study will assist the Foundation in leveraging resources and support for the development of future water quality improvement strategies.

The geographic scope of this Study includes part of the Lake St. Clair, Clinton River, Rouge River, and Detroit River watersheds (Figure 2).

Project Goals & Objectives

In January 2021, the Foundation published a request for proposals (RFP) stating that the goal of this project is to inform the Foundation's strategies on how to reduce CSOs most cost-effectively. To achieve that goal, the Foundation has established several objectives:

- Develop questions, the answers to which will inform the Foundation's strategies. The answers to these questions comprise most of this Study.
- Retain a water resources engineering firm to study publicly accessible sources of information to answer the questions in this Study.
- Empanel an Advisory Group consisting of representatives of key agencies to provide the Foundation with input and information for the Study. The Foundation invited representatives of the following agencies to participate on its Advisory Group:
    - Detroit Water & Sewer Department
    - Great Lakes Water Authority
    - Macomb County
    - Oakland County
    - Wayne County
    - Southeast Michigan Council of Governments

The Advisory Group met June 1 and October 7. Technical staff to the Advisory Group met August 26. Each meeting resulted in refinements to the process and the report, with communications among agency representatives and GEI taking place between meetings.

The Advisory Group has reviewed drafts of this Study. This input, in addition to reports and other information that was requested, provided, and publicly available, served as the basis for this Study.

Questions

Final Study Questions

This Study is structured around answering a set of 11 questions developed by the Foundation to help manage untreated CSO and improve overall water quality for receiving waters. To the extent feasible we have provided objective answers to each question and the relevant references associated with each answer. Each question is followed by a brief answer to the question (where possible), followed by elaboration on the answer.

1. As part of larger planning efforts to continue improving water quality, what have you identified as the primary sources of the remaining untreated CSO discharge events in the Detroit River system, including the Rouge River and Lake St. Clair?

Primary sources of remaining untreated CSO discharge events occur when water flow to and through the system exceeds the capacity for that section of the combined system. While other factors, such as inflow and infiltration (I&I), wastewater, and other factors contribute to the problem, CSO discharge events typically occur as a direct result of rainfall events within the service area. When the system exceeds the capacity to transport to the treatment facilities, water above and beyond that capacity is then diverted to outfalls, and CSO events occur.

In 2020, the state of Michigan reported 182 total CSO discharge events for CSOs discharging to the Detroit River, Rouge River, and Lake St. Clair. These CSOs accounted for 28.2 billion gallons (BG) of discharge, 3.5 BG of which were untreated. This accounts for 12% of overall CSO discharge from these CSOs for the year. Sources of these discharges include the following. The number in parentheses are the untreated CSO volumes:

- Great Lakes Water Authority (1,964 million gallons) (MG)[2]
- Dearborn CSO (747 MG)
- Southgate/Wyandotte CSO RTF (338 MG)
- Wayne Co/Redford/Livonia CSO (217 MG)
- Wayne Co/Inkster/Dearborn Heights CSO (113 MG)
- Wayne Co/Inkster CSO (77 MG)
- Wayne Co/Dearborn Heights CSO (29 MG)

[2] Some data in this report is specific to GLWA while other data encompass all systems and outfalls within the 7-county Southeast Michigan region.

- Redford Township CSO (17 MG)
- Inkster/Dearborn Heights CSO (4 MG)

The GLWA Water Resource Recovery Facility (WRRF) is the largest single source of CSO discharges in the State. For example, during the 2020 reporting cycle this facility discharged 94 percent (23.1 BG of 24.7 BG) of the region's total treated CSO discharges. According to the Michigan Department of Environment, Great Lakes & Energy's 2020 Report[3] on CSOs, SSOs, and Retention Treatment Basin's discharges ("EGLE 2020 Annual Report," pp.6-7), the GLWA CSO system had an untreated discharge total of 1.9 BG, making up approximately 8% of the total CSO discharge from the GLWA system.

Each individual event in many cases encompasses multiple outfalls. Using GLWA as one example for a breakdown, there were 336 unique overflow occurrences from separate outfalls in 2020. These occurrences were reported for 44 total locations, of which 13 reported no significant volume. Of the remaining 31 outfalls, the top outfall contributed 20% of the annual overflow volume. The top 5 locations contributed 57% of the total overflow volume, and the top 10 locations contributed 85% of the total volume, meaning controlling these 10 outfalls could potentially reduce the untreated CSO volume by this 85% figure.

Table 1 is a summary of the contribution of those top 10 outfalls within the system in 2020.

Table 1: Contribution of Top 10 Untreated GLWA Outfalls

NPDES Outfall Number	Number of Events	Total Discharge	Contribution Ratio
60	11	386.6	19.7%
7	14	225.1	11.5%
64	22	180.3	9.2%
79	11	172	8.8%
35	1	170.8	8.7%
6	5	134.7	6.9%
61	8	113	5.8%
16	16	112.2	5.7%
31	8	104.8	5.3%
25	7	75.6	3.9%

3 https://www.michigan.gov/documents/egle/wrd-2020-CSO-SSO-RTB_Annual-Report_729069_7.pdf.

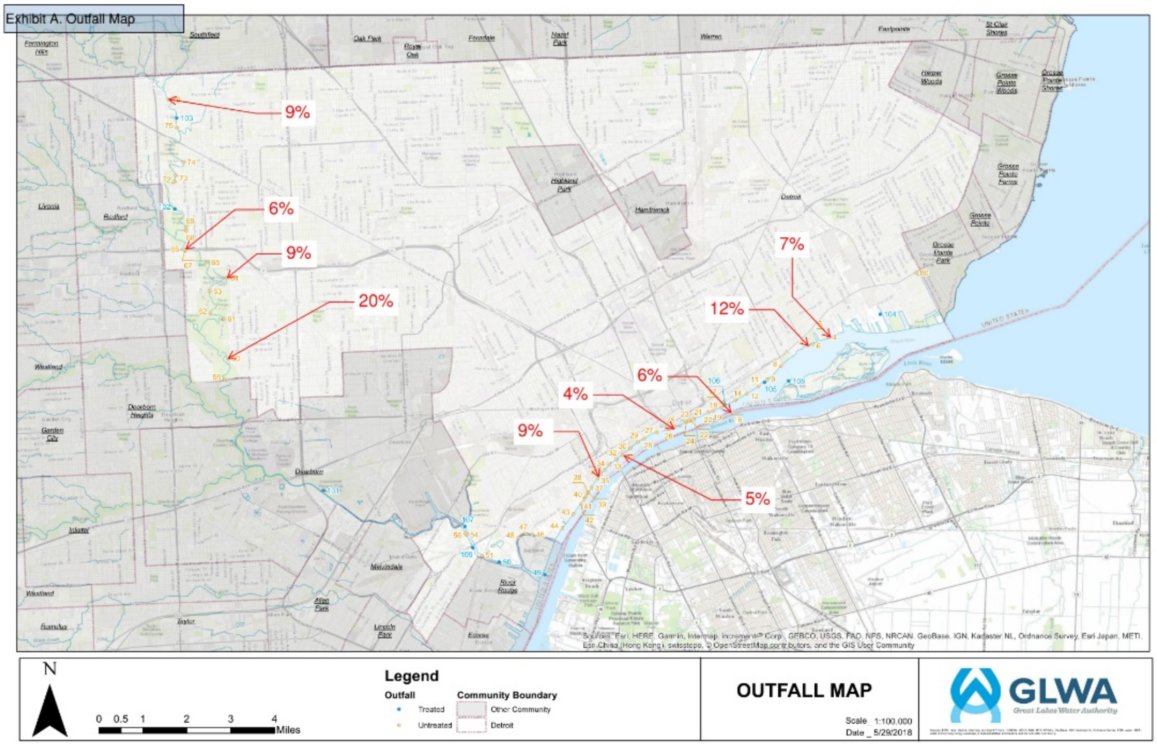

Figure 5: GLWA 2020 Outfall Locations and Top Contributions. Source: GLWA WWMP.

A review of overflow locations demonstrates that capacity issues are experienced at multiple points along the system. This suggests that no single improvement can be made that will eliminate CSOs. On the other hand, it may also mean that CSO reductions may be more feasible when broken down by contributing sewershed. The WWMP and EGLE have identified priorities for controlling GLWA's remaining untreated CSOs, and an evaluation of those priorities will be conducted as part of the LTCP.

In addition to reviewing locations of the events, the timing of events also provides some insights. For 2020, the top 5 events produced approximately 70% of the total untreated CSO discharge for the full year. Table 2 below breaks down those dates. However, the largest discharge events do not necessarily correlate with the most significant water quality impairments. For example, dissolved oxygen deficiencies are more closely correlated with smaller storms with less stormwater dilution.

Table 2: GLWA 2020 Top 5 Discharge Events. Source: EGLE 2020 Annual Report

Start Day	Recorded Rainfall (Inches)	Number of Discharge Locations	Total Discharge (MGAL)	Percent of Total Annual Discharge
8/28/2020	3.28	35	476.2	24.2%
6/26/2020	1.28	33	257.4	13.1%
9/7/2020	2.52	22	246.6	12.6%
3/28/2020	2.03	27	220.8	11.2%
8/2/2020	1.70	47	181.5	9.2%

2. How do GLWA, DWSD, and county governments plan to continue working to reduce the remaining CSOs? What timeline(s) exist for these efforts?

For GLWA, DWSD and member communities, the 2020 Wastewater Master Plan (WWMP) and the Long-Term Control Plan (LTCP) define efforts to reduce untreated CSOs within the system. The WWMP provides the vision and a regional approach to improvements that is focused on level of service and water quality improvements. The LTCP, originally developed by DWSD, was last updated in 2008.[4] The plan is undergoing its latest update and is scheduled to be completed in 2023. The new LTCP will identify high-priority outfalls and next priority outfalls to be addressed with specific projects and associated deadlines. The next NPDES permit will incorporate approved projects and deadlines from the LTCP.

The GLWA 2020 Wastewater Master Plan[5] (WWMP) was prepared by GLWA and its member communities and provides an outline for the improvements that will be made over the next 40 years within the system and member communities. The WWMP identified projects for implementation in the first 20 years of the planning period and provided strategic direction for the subsequent 20 years. How the agencies plan to continue working to reduce remaining CSOs is guided by desired outcomes in the WWMP that GLWA and its members and partners seek to achieve through the implementation of this master plan (pp. 1-4). The desired outcomes include:

- Protect Public Health and Safety
- Preserve Natural Resources and a Healthy Environment
- Maintain Reliable, High-Quality Service
- Assure Value of Investment
- Contribute to Economic Prosperity

A review of these outcomes shows that the first and second item on the list are directly correlated to efforts to reduce CSOs. In the context of the outcomes, the WWMP planning group identified three main phases, and five main steps for future efforts to reach the goals above.

The agencies' plan to reduce remaining CSOs is guided by five main steps in the WWMP, and their associated phases:

1.1 Non-Structural Optimization

This step concentrates on data gathering and collection efforts to make better use of the existing infrastructure. It includes updates and improvements to recent wet weather

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[4] Supplements to the 2008 LTCP include: Amendment Rouge (2008), Amendment Detroit (2008), Evaluation of CSO Control Alternative for Upper Rouge Outfalls (2009), Supplemental Report for Upper Rouge Outfalls (2010), Near East Side and Upper Rouge River (2013).
[5] https://www.glwater.org/wp-content/uploads/2020/12/Full_WWMP_Report_Final_June-2020.pdf.

operating plans, regional operating plans, and a new regional water quality monitoring plan.

1.2 Structural Optimization and Committed Projects

This step concentrates on improvements to the system that would allow for better optimization and use of existing storage and treatment facilities.

1.3 Phase 1 CSO Controls

This step allows for first flush capture of small storms. Improvement types will vary for this investment, and will include green infrastructure, new in-system storage, and interceptor management.

2.1 Phase 2 CSO Controls

This phase would attempt to capture first flush for larger storms. The project types implemented in phase 2 would be similar to those investments in phase 1, including green infrastructure, sewer separation, and storage conduits.

3.1 Phase 3 CSO Controls

This final step is to eliminate the remaining untreated CSOs with screening and disinfection where it is not cost-effective to capture the flow and return it to the collection system.

While the reports indicate phasing breakouts for these efforts, no timeframe is given for the completion of Phase 1 and the assumption of Phases 2 or 3. GLWA is now in the process of updating its LTCP. This LTCP, due to be completed in 2023, will provide more detail on when and how specific projects will be completed and provide more accurate projections of potential impacts. Progress will be monitored and evaluated against budgets and investments for every 5-year plan and permit renewal cycle.

3. Great strides have already been made to reduce untreated CSOs. For the remaining overflow events, what is the relative contribution of untreated CSOs v. treated CSOs?

According to EGLE’s 2020 Annual Report, 28.2 billion gallons of combined sewer overflow were reported for the year 2020. Of that volume, approximately 12% (3.5 BG) of the discharges were untreated. The remaining 24.7 billion gallons of discharge were treated.

Figure 6 below, from the EGLE annual CSO report, provides a very good picture of both the treated versus untreated volumes, as well as the progress that has been made in this regard since 2005.

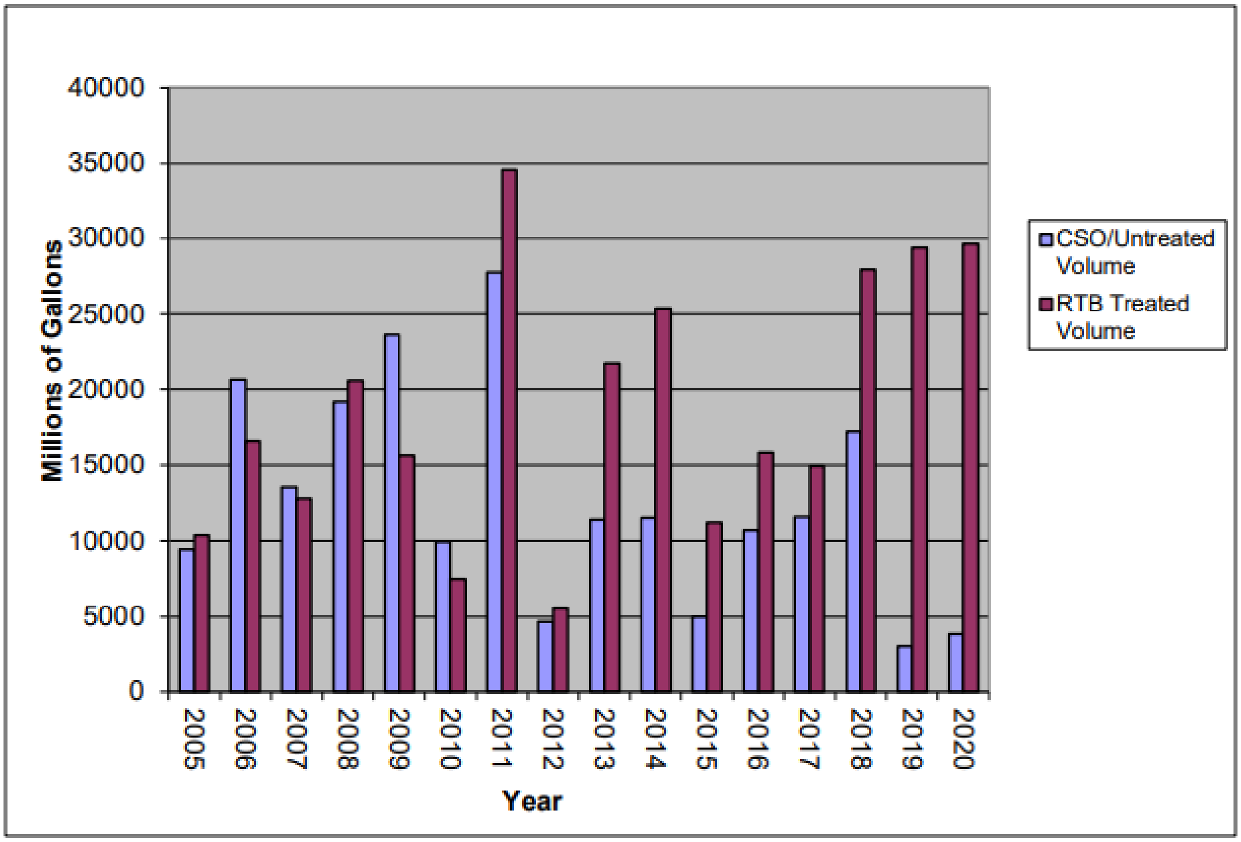

Figure 6: CSO Untreated vs. RTB Treated Volumes. Source: EGLE 2020 Annual Report.

4. What are the barriers to reducing remaining untreated CSOs by 2040? To reducing untreated CSOs by half by 2030? What are the approximate costs?

The primary barrier to any of the efforts being undertaken by the agencies is cost. Other factors include, but are not limited to, balancing other "level of service" (LOS) considerations such as public health, public safety, other water quality imperatives, and addressing climate change. For instance, to obtain 100% capture of CSOs in the system operated by GLWA, an estimated capital investment of approximately $2.29 billion would be required. Long-term operation and maintenance costs must also be factored in. The GLWA WWMP outlines model results for its current state of operation, as well as projected results of each of the efforts outlined in question 2 above. Not only is the cost a significant factor in its own right, it also creates opportunity cost issues. Large-scale projects require bonding with repayment schedules, and these debt obligations can prevent the utilities from taking on new projects and initiatives that would help provide better efficiency and a higher level of service.

Currently, the regional system captures and treats 96.4% of total flows into the collection system. This includes sewage, dry weather inflow and infiltration, rain-derived inflow and infiltration, and stormwater. This capture has progressively improved from the establishment date of the historic baseline of 1980, which was estimated at 75% capture.

The remaining 3.6% of annual untreated CSO (~3.5 BG in 2020) would be incrementally reduced by each of the steps within the WWMP. To reduce this by half would require the completion of Phase 1 of the program (see answer to question 2). This phase is projected to increase system capture to 98.8%. This phase is estimated to cost approximately $952 million, with approximately half of that cost being for "first flush" capture of small storms.

Elimination of untreated CSOs would require continuation of this program through Phases 2 and 3 to completion (see answer to question 2).

5. What are the top ten to twenty projects that would most cost-effectively reduce untreated CSOs by 2040? Cut them in half by 2030?

Publicly available information allows us to assess overall phases of improvements and their impact on the system; however, this information is not available at the project level. Available project-level data gives cost but does not provide projected system impact. Because of this, we did not find a systematic way to rank or score projects based on cost versus impact to CSO reduction on any individual project given the currently available information.

GLWA is updating its Long-term Control Plan (LTCP) for CSOs. The first plan was developed in 1996 by DWSD and updated in 2008. The 2008 LTCP, and associated updates, is the most recent version and includes projections for work up to 2030. The 2008 plan requires elimination of untreated CSO discharges by the year 2037. Completion of an updated LTCP is expected in 2023. Projects outlined in the 2023 LTCP should provide more clarity on a path to elimination of untreated CSOs, as well as projected impacts from individual projects.

From a phasing standpoint, the GLWA WWMP forecasts costs and associated impacts to the system from future GLWA and member community projects. Impacts to overall CSO volumes are estimated by a systemwide collection system model and by receiving water quality models. The collection system model is implemented in the current version of USEPA's Storm Water Management Model (SWMM). Table 6-11 of the WWMP (see appendices) provides an overview of each of the modeled conditions and their overall results, incremental costs, and cumulative costs. The WWMP (Table 6-8, pp. 6-23) also provides dependencies for the model as future project impacts depend on past project implementation. In order to produce the numbers provided, each step of the process is dependent on the prior step being implemented.

Phase 1 of the process outlined within the WWMP (See answer to question 2) includes collection system best practices, system-wide controls, and CSO controls. Combined, this phase would increase system capture from 96.4% to 98.8%, an approximately two-thirds reduction in remaining untreated CSO volume. In total, these efforts are expected to cost $952 million.

Phase 2 efforts, including more best practices and CSO controls, would further reduce untreated CSO volume by an additional 1/3 to approximately 22% of the current untreated CSO volume, at a price tag of $1.2 billion.

Phase 3 is one alternative to reduce untreated CSOs and provide 100% system capture. This would carry an additional $150 million cost.

Other alternatives have also been evaluated within the model, including increased use of GSI, increased WRRF capacity, and complete system separation. These alternatives have much higher costs, ranging from $7.1 billion for maximum GSI, to $15 billion for complete separation. The Capital Improvement Plans incorporate projects from the WWMP as a part of fiscal planning for system improvements.

One of the best local examples of matching individual project impacts to costs was recently completed by Macomb County for the Chapaton Basin. The example is provided here to demonstrate the relative magnitudes of various control scenario impacts and associated costs. The Table below shows the results of Macomb County's analysis on estimated costs and performance from different types of projects to address CSO volume reduction.

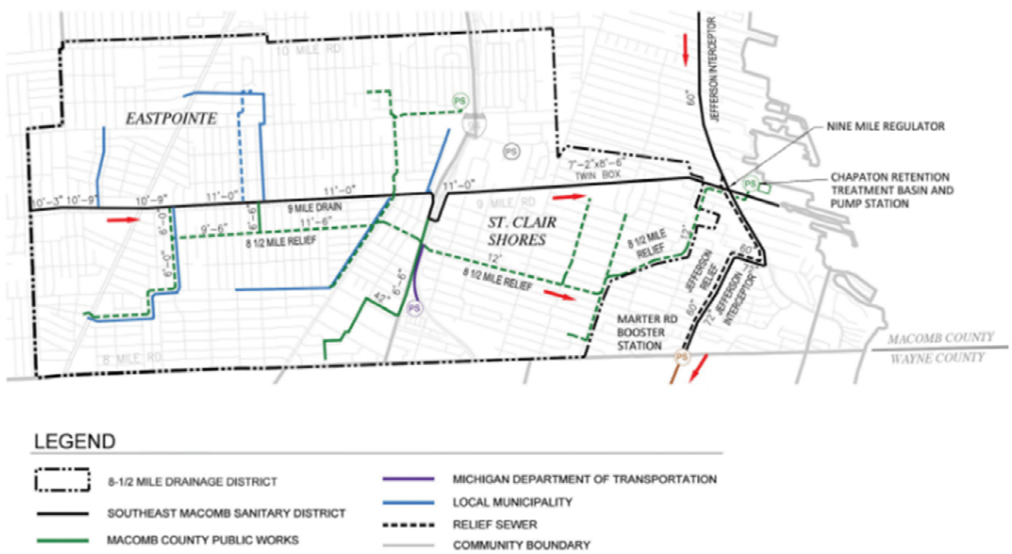

Figure 7: Macomb County Chapaton Basin Map. Source: Macomb County Chapaton RTB Expansion Study, Tetra Tech, 2018.

Table 3: Macomb County Chapaton Basin Alternatives Analysis.
Source: Macomb County Chapaton RTB Expansion Study, Tetra Tech, 2018.

Alternative	Total Present Worth	Million Gallons of Flow Removed (MG/year)	Cost of Flow Removed Annually ($/gallon)	Amount of Solids Removed (lb/year)	Cost for Solids Removed Annually ($/lb)
Sewer Separation (Phases I to III)	$314,300,000	265	$1.19	125,000	$2,600
Green Stormwater Infrastructure					
80% of Original Imperviousness	$130,700,000	62	$2.11	30,000	$4,400
60% of Original Imperviousness	$259,300,000	109	$2.38	52,000	$5,000
40% of Original Imperviousness	$390,000,000	159	$2.45	76,000	$5,200
20% of Original Imperviousness	$518,600,000	190	$2.73	91,000	$5,700
0% of Original Imperviousness	$647,300,000	225	$2.88	107,000	$6,100
Storage					
28 MG RTB Expansion	$113,100,000	123	$0.92	58,000	$2,000
48 MG RTB Expansion	$178,700,000	173	$1.03	82,000	$2,200
Enclose Chapaton Canal	$65,200,000	58	$1.12	27,000	$2,500
Move Gates in Chapaton Canal	$16,700,000	58	$0.29	27,000	$700
Wetland Addition to 28 MG Expansion	$763,000	5.1 Treated	$0.15	2,100	$370
Wetland Addition to 48 MG Expansion	$436,000	1.3 Treated	$0.34	540	$810
Wetland Addition to Chapaton Canal Storage	$378,000	2.4 Treated	$0.38	1,000	$380
In-system Storage	$9,570,000	52	$0.18	24,000	$400
CEPT to Existing Chapaton RTB	$4,380,000	--	--	37,000	$120

Though these data are for only one of the CSO treatment areas, costs range from $0.15 per gallon of flow removed from the system via wetland storage up to a cost of $2.88 to completely compensate for all impervious are with GSI. The relative costs of treatment types may be informative of typical project scoring region wide, where storage is the cheapest short-term option to control flows, aside from targeted projects to address system deficiencies such as the gate relocation in the above table.

Projects are scored in Capital Improvement Plans but using different criteria not related to untreated CSO volume control.

6. How much untreated CSO reduction could be achieved through efforts to address unutilized capacity in the system?

Phase 1 of the GLWA WWMP includes multiple methods to use existing system capacities to maximize CSO capture. This includes capitalizing on a Wet Weather Operations Plan and

Regional Operating Plan,[6] investing in diversion projects that will allow for the capacity to be used, and optimizing facilities to account for wet weather. Based on collection system modeling the optimization portion of this Phase would result in a reduction of untreated CSO by approximately 11%.

As part of the 2023 LTCP, system optimization will be re-evaluated. It is our understanding that the system-wide model to be used for the 2023 LTCP will be the most comprehensive model of the regional collection system and will be coupled with an updated model of the collection system in the City of Detroit. This modeling effort will also use a special computing algorithm that will test thousands of different design alternatives to optimize the use of system-wide assets. This will be a more comprehensive and rigorous evaluation of optimization than those developed previously.

7. How do GLWA, DWSD, and county government plans address inflow and infiltration (from groundwater and drinking water pipes) and how will that impact untreated CSOs? How many gallons of groundwater and drinking water are potentially infiltrating the sanitary and stormwater sewer systems?

The agencies' plans address inflow and infiltration (I&I) through monitoring, modeling, and pipeline and manhole rehabilitation plans as part of their overall system management strategy. Also, agencies are pursuing studies that will help to further understand I&I in the Detroit area, such as a groundwater study being performed by Wayne State University for GLWA.

We cannot answer the question regarding the impact of I&I on untreated CSOs on a volumetric basis. Like the answer to question 8A below, the significance of the impact on CSOs from I&I depends on the location of the I&I, flow rate, and many other factors. Fixing I&I in one location often means the problem has simply been relocated.

Groundwater is typically the source of infiltration into the sewer. Infiltrating groundwater gets into the sewer via holes, cracks, joint failures, and faulty connections. Groundwater intrusion into a combined sewer system is difficult to control. For instance, sliplining a pipe to shore up structural strength and attempt to limit groundwater intrusion, typically just shifts that intrusion to other un-lined pipe areas. Inflow is stormwater that gets into the system via downspouts, foundation drains, storm cross-connections and through holes in manhole covers. Frequently I&I is caused by aging infrastructure that needs maintenance or replacement.

Reducing I&I is a process of disconnecting downspouts, footing drains, and cross-connections as well as repairing or replacing sewer. Repairing or replacing sewers is expensive so typically the work is planned well in advance and is limited on annual basis, with the understanding that rehabilitation of the system is performed on a continuous basis.

[6] https://www.glwater.org/update-feeds/regional-operating-plan/.

One development in the works that will provide more incentive to control stormwater inflow into CSO systems is the proposed EGLE general permit for collection systems. While in the works for several years now, this permit is projected to include both outlet and internal capacity restrictions (Capacity, Management, Operation and Maintenance (CMOM)) to address flows that meet excessive I&I definition or other acceptable regional criteria. This would apply to current collection systems that are not already required to obtain a municipal separate storm sewer system (MS4) permit. This permit will affect all sanitary sewer systems and combined sewer collection systems contributing flows to the GLWA/DWSD system.

GLWA operates 183 miles of sewer. The GLWA regional collection system receives flow from approximately 3,400 miles of sewer owned by DWSD and 10,800 miles owned by other members. The total service area of GLWA is approximately 944 square miles, with 32 wastewater service contracts consisting of counties, drainage districts, and local units of government in the Detroit Metropolitan Area. The pipes themselves, every pipe joint, and every manhole or inlet, can be locations where groundwater or surface water can find its way into the collection system.

The GLWA "Collection System and Municipal Separate Storm Sewer System (MS4) Best Practices Program" was proposed for implementation starting in 2020 through a new collaborative workgroup of GLWA members called the Watershed Work Group. Initial activities of the Collection System and an MS4 Practices Program are proposed to include:

- Annual voluntary reporting of inspections, maintenance, sewer cleaning, catch basin cleaning, infiltration/inflow studies and rehabilitation.
- Development of a pilot program to identify cost-effective improvements to regional practices that will improve dry weather water quality.

Based on estimates developed during the collection system monitoring over 2018, dry weather I&I ranges between 190 MGD to 325 MGD (see Figure below, GLWA Tech Memo 4A, CDM, 2020).

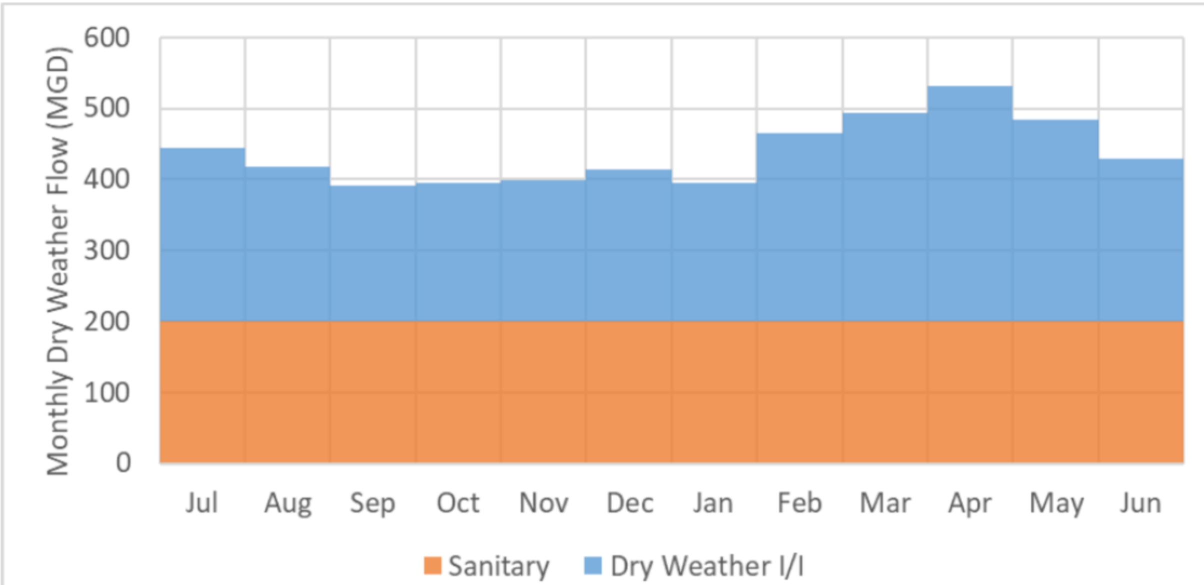

Figure 8: Collection System Monthly Dry Weather Flow FY2018. Source: GLWA WWMP.

In Tech Memo 4A, the CDM Smith modeling team note that one key groundwater assumption used to develop their estimate of RDII, is that Detroit has a shallow aquifer that sits on top of an aquitard – a layer of very poorly infiltrating clay and therefore groundwater either infiltrates into the collection system or is lost to evaporation. Only a small amount of groundwater is lost to deep infiltration.

During the modeling process, the CDM Smith team prepared a water balance over the approximately 222 square miles of CSO sewershed over the period of 2004-2018. Average annual precipitation over the districts was 34.5 inches. From the model water balance, 25% of precipitation became runoff into the sewer system, 10% was evaporated from surface and 65% infiltrated into the ground. After infiltration, 54% would eventually enter the sewer system as DWII or RDII. 43% of infiltrated water returned to atmosphere as evapotranspiration. Overall, 61% (25% + 36%) of rainfall ended up in the sewer system as runoff or groundwater inflow.

8. A) How many gallons of stormwater need to be removed from the system to eliminate untreated CSOs?

B) Is there a role for green stormwater infrastructure (GSI) in reducing untreated CSOs? Does this depend on usefulness of GSI to treat peak flow v. first-flush events?

C) Relatedly, does the economic viability of GSI vary throughout the study area and/or depend on the type of GSI employed, i.e., implementation of less-highly engineered projects such as tree plantings?

A) While there is a direct relationship between wet weather events and the occurrence of CSOs, we do not believe there is necessarily a 1:1 relationship between the amount of stormwater that falls in a particular sewershed and the CSO that occurs for that sewershed for that particular event. Outfalls are relief points for a collection system that is a set of interconnected pipes and sewersheds. The occurrence of a CSO is dependent on how much flow capacity is available at the time of a rainfall event (how much water is in the pipe from other sources), the characteristics of that precipitation event (e.g., duration, peak intensity, total volume, time since last event); the extent of the service area the precipitation event covers, how the precipitation is converted to runoff across its path; where the relief points – the CSOs – are distributed in relation to the stormwater generated and the physical characteristics of the collection system and CSO experiencing that precipitation at that time. Even the physical characteristics of a particular CSO are subject to change, for instance, as clogs, river water levels or capacity problems shift where and how relief occurs. All these factors are dynamic and interacting and therefore outcomes are hard to predict and attribute to any one input.

Collection system and treatment capacity for the stormwater component of CSOs is limited by sewage and dry weather and rainfall derived I&I already in the system and this varies by CSO and event to event for each CSO. To eliminate untreated CSOs, some combination of sewage, I&I and wet weather flows need to be either completely contained in the system and treated, or some combination of these flows needs to be removed from the system to provide the capacity to completely contain the peak flows caused by precipitation events.

B) Yes, there is a role for Green Stormwater Infrastructure (GSI) in reducing untreated CSO discharge events. But GSI's impact on untreated CSO discharge depends on several factors including: the extent of its deployment, where it is located in the sewershed and the capacity practice by practice to manage runoff volume, peak flows, and first-flush flows event by event. The ability of each practice to manage the runoff it receives depends on how well the practices are planned, designed, installed, and maintained. Projections developed to date about the impact of GSI on untreated CSO discharge also indicate that GSI located in the upstream sewershed areas are typically more effective at controlling CSOs than GSI located in the downstream sewershed areas.

This difference in performance is attributed to the fact that the collection systems in upstream areas generally have more flow capacity during wet weather events than downstream areas. That is, with flow capacity still available in the system, practices that control inflows and contribute to keeping flows below overflow thresholds will be effective. In upstream areas, the collection system only has to manage flows generated locally. In the downstream areas, where the collection system has to manage both local flows and flows passed from upstream, there is less available capacity. Modeling work by GLWA and the University of Michigan (2019) demonstrate that in some downstream areas, attempting to control local stormwater inflows in a system that is already beyond its flow capacity from local and upstream flows, provides only small differences in untreated CSO discharge reductions.

For example, in the Watershed Assessment of Detroit River Phosphorus Loads to Lake Erie,[7] a GSI performance analysis was conducted using the GLWA/DWSD collection system SWMM model. Rather than adding GSI to individual sites, the modeling analysis was performed by applying GSI to the runoff by sewershed. The GSI was applied as a percentage of the total drainage area, starting with 0% percent coverage up to 20% coverage of each sewershed's total area. Due to limitations with the collection system model for Detroit, only 14 CSOs were simulated with most of them on the Rouge River; some on Lake St. Clair, and a few on the Detroit River. The simulation found that for "upstream" CSOs, those CSOs closer to the area generating the flows, GSI could reduce overflows up to 18% under normal rainfall scenarios and up to 6% for extreme storms. However, for downstream CSOs – those CSOs that are managing not only their local flows but flows from upstream sewersheds, overflows were not substantially affected under either rainfall scenario.

C) The short answer to this question is unequivocally "yes." The degree to which projects are economically viable, however, depends on the type of GSI and how much of GSI is deployed. It also depends on where in the CSO sewershed GSI is sited, how much room exists for stormwater flows in the immediate CSO collection system, and how well the GSI practice is planned, designed, constructed, and maintained.

In its broadest sense, components of GSI include natural green features like trees, rain gardens and bioretention basins that rely on plants to provide some of the stormwater retention/detention benefits. But, in addition, part of the underlying philosophy of GSI is to establish control of stormwater as close to the source of the stormwater as possible with distributed, decentralized measures. Structure demolition (eliminating rooftops and driveways), downspout disconnect, underground storage and even sewer separation coupled with GSI, can all be considered GSI practices.

All these practices control stormwater, and some like structure demolition provide stormwater benefits without requiring any dedicated stormwater funds. Some GSI practices like tree planting also offer relatively low-cost stormwater control. Trees are also a good example of the combination of benefits that accrue to GI practices generally, e.g., carbon sequestration, runoff mitigation, air quality benefits, heat island mitigation, habitat improvement, emotional well-being, etc., that are overlooked when the focus of their impact is solely on untreated CSO control. A recent iTree hydrologic analysis[8] by the Detroit Reforestation Initiative (2021) has shown that increasing Detroit urban tree canopy coverage

[7] http://graham.umich.edu/project/assessing-detroit-river-nutrient-loads-lake-erie.
[8] https://design.itreetools.org/.

from an estimated 23.8% (Davey Tree, 2016) up to 30%, (a threshold all the surrounding counties - Livingston, Washtenaw, Oakland, and Macomb, except Monroe County, have met or exceeded) within 10 years could provide 2.17 BG of stormwater management annually. In fact, Davey estimated in 2017 that Detroit was losing 1-3% of its urban tree canopy annually. This loss has also been verified by Goumardis, et.al. (2020). A loss of 1% of Detroit's urban tree canopy could mean the additional generation of 300 MG of stormwater that GLWA and DWSD would potentially have to manage annually.

DWSD's 2021 GSI Performance Report[9] (Table 7, p. 44) provides a way to benchmark potential GSI costs, as measured by total annual runoff "removed" from the collection system. The report summarizes estimated performance data for twelve completed projects that cost a total of $11,435,000. An estimated 98 acres of impervious surfaces are managed by these projects. The amount of runoff managed was developed using some monitoring data and model analysis. The average annual total runoff managed was estimated to be 25.5 MG. Cost per gallon of runoff "removed" from the system ranged between $0.18 and $0.98 for these projects. This is comparable to the grey infrastructure costs estimated for the Chapman Basin Alternatives Analysis summarized in Question #5 above.

In addition, Detroit, the counties, and communities contributing flows to GLWA/DWSD facilities have adopted stormwater management rules, practices and ordinances that encourage and/or require the use, where feasible, of GSI. The implementation of GSI is being done both for public and private projects. While this is a process that has been at least a decade in the making, monitoring to validate performance has been spotty and there is still a need for more public education and outreach. Without more comprehensive validation data, there is no feedback about how these practices might be improved or strategically sited to better meet performance expectations. This feedback is also needed to help address some of the public and private development resistance against GSI that still persists.

GSI throughout Michigan and in other regions has been implemented mostly opportunistically. The design philosophy – emulating natural spaces and distributing runoff control practices so they are as closely connected to runoff-generating impervious areas as possible – seems intuitively attractive. But to have impact at a large, watershed/sewershed-wide scale well-sited, designed and maintained GSI must be generously distributed. It took decades to pave much of the metropolitan area and much of the road network that made that development possible was federally funded – as part of a very large, systematic federal and state effort. Mitigating the impacts of this hardscape will likewise take a determined, systematic effort to accomplish but now mostly without the help of systematic federal and state funding.

[9] https://detroitmi.gov/sites/detroitmi.localhost/files/2021-06/FINAL%20DWSD%20GSI%20Annual%20Report%20April%201%202021_Formatting%20edited.pdf.

With a regulatory framework in place in Detroit and in the surrounding communities that requires or incentivizes GSI, the number of practices will continue to grow. But the siting, design, and education about these practices still needs to improve. There is still a gap between understanding GSI performance, best siting and design practices, and long-term maintenance needs. Addressing this gap and continuing to install GSI will help improve stormwater management practice by practice and will also help build community resiliency. While the determination of GSIs impact on CSOs will take more time and effort to better understand systematically, the benefits to untreated CSO control will continue to improve as GSI manages more stormwater over time.

9. How do DWSD, GLWA, and county government plans account for the impact of climate change on CSOs over the next 20 years?

How the agencies' plans account for climate change impacts on CSOs – the process by which they work to mitigate climate change effects – involves (1) complying with legal requirements, (2) accessing data to support compliance with those requirements, (3) collaboration, and (4) adaptive management. This question has become even more important for Southeast Michigan following the significant storm events of 2021 (for example, June 25-26).

(1) *Legal Requirements*

Agencies first work to ensure they are complying with law. In broad terms, the agencies work to account for the impacts of climate change by meeting legal requirements. If legal requirements are outdated, not incorporating recent, relevant climate data, the agencies are not compelled to update CSO control plans but may do so at their discretion. To understand how CSOs are managed, it is first helpful to understand the overarching legal structure for these clean water requirements.

Combined sewer overflows are managed under the Federal Water Pollution Control Act (Clean Water Act). Congress charged USEPA with the Clean Water Act's oversight. While retaining overarching oversight, USEPA can delegate Clean Water Act implementation – including setting water quality standards and issuing NPDES permits that meet those standards – to the states. USEPA has delegated that authority to the state of Michigan through the Michigan Department of Environment, Great Lakes & Energy (EGLE), which issues NPDES pollution discharge permits to the municipal agencies to meet the Clean Water Act's goal restoring and maintaining the chemical, physical, and biological integrity of the Nation's waters.

CSO controls follow this federal —> state —> municipal relationship: USEPA establishes policies for states to follow in issuing NPDES permits to municipal agencies so that CSOs can be controlled.

The USEPA has established a CSO Control Policy[10] (Policy). The Policy includes "Nine Minimum Controls,"[11] requirements such as making sure that a wastewater system is operating properly, maximizing the system for storage, preventing pollution, monitoring CSOs, and other high-level guideposts. States then require permittees to implement "Long-Term Control Plans" (LTCPs) for CSOs. LTCPs are required in permittees' NPDES permits.

Figure 9: CSO Legal Authority & Requirements

The critical link in this chain is the design standard. The Michigan Combined Sewer Overflow Control Program Manual[12] (p. 4) advises permittees that they must design their systems to ensure treatment of CSOs up to a 10-year, 1-hour storm. If the 10-year, 1-hour storm design standard is met, regulatory agencies *assume* that CSOs are controlled to meet Clean Water Act requirements. As one agency's technical advisor comments: "Michigan's CSO program is regarded as one of the most ambitious in the country." Still, climate change, and in particular recent, significant storm events, reveal that these design standards are outdated in the face of new climate change realities. As such, agencies are re-assessing design standards because they must help mitigate against water quality and public welfare impacts and anticipation of future requirements, not to meet current design standards that were developed decades ago.

A 10-year storm[13] does not refer to a storm that happens once every 10 years. It refers to rainfall that has a ten percent probability of happening in that location in any given year, or an event that would statistically occur once every 10 years. For example, according to GLWA, many rain gauges during the June 25-26, 2021, storm in Southeast Michigan registered events beyond a 100-year event and three gauges in the City registered a 1000-year event.[14] While capacity can be increased for larger storm events, increased capacity will result in increased construction, operation, and maintenance costs that are, likewise, orders of magnitude higher. Additionally,

[10] https://www3.epa.gov/npdes/pubs/owm0111.pdf.
[11] https://www.epa.gov/sites/default/files/2015-10/documents/owm0130.pdf.
[12] https://www.michigan.gov/documents/deq/wrd-cso-sso-program-manual_650017_7.pdf.
[13] https://www.nrcs.usda.gov/wps/portal/nrcs/detail/wi/programs/?cid=nrcs142p2_020752.
[14] https://docplayer.net/214412023-Talking-points-for-sue-mccormick-june-25-26-rain-event-update-new-conference-july-2-2021.html.

while all systems are designed to capture 10-year events, many parts of the existing systems in Southeast Michigan are not able to operate at that level.

An updated LTCP will include a climate strategy, which may include a re-assessment of design capacity in part due to recent storm events.

(2) *Data Support for Forecasting Climate Change*

How the agencies' plans account for climate change impacts on CSOs depends significantly on the adequacy of data they rely on for their system designs. As a result, the agencies are taking steps now to ensure the climate data they rely on is as recent and relevant as possible.

To aid in the understanding of *how* a 10-year, 1-hour storm is changing, the agencies use a variety of forecasting tools curated by other agencies.

- The agencies – through SEMCOG and otherwise – use data from the Great Lakes Regional Integrated Sciences Assessment[15] (GLISA) and National Climate Assessment[16] that show trends in precipitation across the nation and Midwest. GLISA is comprised of representatives of the National Oceanic & Atmospheric Administration (NOAA), universities, and other scientific representatives. The National Climate Assessment is coordinated by more than 12 federal departments. These sources are scalable to some degree to the state[17] and regional level.
- SEMCOG also supports research that looks at the region's vulnerabilities through specific sectors. For example, after a significant 2014 rain event, SEMCOG and the Michigan Department of Transportation (MDOT) commissioned a study to look at impacts of heavy precipitation on area roadways. Again, in June 2020, SEMCOG and MDOT produced a report that anticipated precipitation patterns through 2050 and 2100. The report, *Southeast Michigan Current & Future Precipitation*,[18] also forecasts precipitation trends for its individual member counties.
- More recently, SEMCOG again partnered with MDOT to go beyond looking at precipitation trends, to understanding the risk of flooding to key infrastructure assets such as roads, bridges, culverts, and pump stations. While centered around risks to transportation assets in particular, the August 2020 *Climate Resiliency and Flooding Mitigation Study*,[19] can serve as a partial surrogate for CSO risks as well.

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[15] https://glisa.umich.edu/resources-tools/climate-impacts/precipitation/.
[16] https://nca2018.globalchange.gov/.
[17] https://glisa.umich.edu/media/files/ITCM_Extreme_Precip_Scenarios_v3_102017.pdf.
[18] https://www.semcog.org/Portals/0/Documents/Plans-For-The-Region/Environment/SE%20MI%20Current%20Future%20Precip%20June%202020.pdf?ver=UZcWge4Zq0G85YU7fAyr8g%3d%3d.
[19] https://www.semcog.org/Portals/0/Documents/Plans-For-The-Region/Environment/SEMCOG%20Climate%20Resiliency%20and%20Flooding%20Mitigation%20Study_Report_August%202020.pdf?ver=pjn6fTnLv9BZaM8MuasqVw%3d%3d.

- Individual member counties consult these information sources to help inform project planning and individually account for the impact of climate change through their own efforts, such as capital improvement plans.
- SEMCOG has also surveyed for regional infrastructure needs looking at the water distribution and sewer systems. Its data found $3.4 billion annually in needs, with some 20-30% of water infrastructure in "poor" condition. They are also in the process of surveying member agencies[20] and others to identify water and wastewater needs. Another survey is underway to look at how much municipalities are currently investing, and the additional investments needed (investment gap) to address these needs.
- All agencies understand that climate change poses a risk to their infrastructure and operations, including exacerbating CSOs.[21] They also understand that unless untreated CSOs are reduced, if not eliminated, water quality degradation could accelerate as warmer water temperatures lead to lower dissolved oxygen levels, excessive algae growth, and other risks. How this understanding translates into on-the-ground CSO reduction project planning and design to address climate uncertainty is variable.

(3) *Collaboration*

- SEMCOG is convening a group of engineers to develop "guidelines" based on its *Southeast Michigan Current & Future Precipitation*.[22] These guidelines are not intended to be standards, but a general agreement on approaches to address climate impacts on stormwater infrastructure. SEMCOG intends to invite agency representatives from local communities, road agencies, drain commissioners, and potentially other relevant experts.
- In anticipation of 2023 LTCP development, GLWA is deliberating about appropriate design targets. Additionally, Macomb County is working with Michigan State University, the University of Michigan, and SEMCOG for similar purposes.
- Tools are also being developed to allow the agencies, in addition to private and public infrastructure owners, to better coordinate infrastructure projects. For example, the Michigan Infrastructure Council is developing a "dig once" online portal.[23] These kinds of tools may support the agencies as they seek to coordinate climate change CSO mitigation projects into the future. SEMCOG is using a similar online portal for capital improvement project (CIP) coordination across agencies looking a project planning up to five years into the future.

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[20] https://www.surveymonkey.com/r/DVYM9RJ.
[21] Great Lakes Water Authority, Wastewater Master Plan, Section 5.8.3.
[22] https://www.semcog.org/Portals/0/Documents/Plans-For-The-Region/Environment/SE%20MI%20Current%20Future%20Precip%20June%202020.pdf?ver=UZcWge4Zq0G85YU7fAyr8g%3d%3d.
[23] https://content.govdelivery.com/accounts/MITREAS/bulletins/2c7632c.

- The agencies also account for the impacts of climate change through multi-agency coordination in subjects such as asset management[24] to maximize the use of their infrastructure. The Governor's Council on Climate Solutions[25] is another mechanism for coordinating.

(4) *Adaptive Management*

GLWA's WWMP also includes a feedback loop by which the agency, including its member agencies, learns from system performance and updates its plans to account for needed changes to meet WWMP goals. This includes using GSI to strengthen regional resilience, including to combat the effects of climate change.[26] Multiple agency representatives have cited, for example, the significant storms of summer 2021 that are informing future collaboration (see section above) and decisions for climate change planning.

<u>When</u>

The Foundation requested an explanation of how agencies plan for the impact of climate change on CSOs over the next 20 years.

The WWMP acknowledges the general impacts of climate change but does not connect these impacts over various time horizons to project-scale planning. The plan recommends assessments every five years regarding the impacts of climate change and discusses how these assessments should be used in the Capital Improvement Planning process. One approach for bridging this gap will be the LTCP (see answers above).

Data sets for planning look at multi-decadal or centennial time horizons. State regulatory tools cover different horizons, such as 5-year NPDES permits, 10-year system design lifetimes, and 30-year LTCPs (e.g., 2008-2037, but to be updated in 2023). In other words, short-term plans typically use existing regulations, whereas long-term plans take climate, public safety, cost, equity, and other factors into account. However, we found no regulatory mechanisms that use a 20-year timeframe as included in the original question. Moreover, there is a recognition that past State-derived design assumptions are now inadequate under emerging climate change scenarios. As a result, agencies are turning to other sources of climate forecasting over longer time horizons.

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[24] https://www.michigan.gov/egle/0,9429,7-135-3306_88771_90745---,00.html.
[25] https://www.michigan.gov/egle/0,9429,7-135-3306_88771_102482---,00.html.
[26] GLWA WWMP Chapter 9.

10. Is there real-time data related to capacity utilization in the whole system? Can CSO information and data be made available to the public in real-time? Are there gaps in knowledge where system-wide data analytics and methods can be helpful to solving this challenge?

No. Though real-time data exists, and covers much of the system, the entire system is not currently monitored in real time.

All the outfalls are monitored in real time either with area-velocity or depth-only meters. Area-velocity meters tend to provide more accurate flow estimates, while depth meters do not provide velocities and flows must be estimated from depths and model estimates. There are also meters throughout the collection system, although more metering is currently being done to support a more thorough evaluation of system capacity and better utilization of that capacity as part of the update to the LTCP.

Records of CSO events are typically made available to the public[27] by the State within 24 hours. Additionally, federal regulations[28] require public reporting of CSOs. These federal regulations, however, were established before real-time data systems began to be widely used. There are some limitations with reporting real-time data and vetting the quality and accuracy of that data. Remote meters are subject to errors and downtime and there has to be a process for verifying the data quality and accuracy before making it publicly available. There are other communities[29] pursuing publicly available real-time water quality information. For example, in Chicago, real-time water quality data (not limited to CSOs) is pursued through a partnership among non-profits, utilities, and others called H2Now.[30]

Yes, there are gaps in understanding system capacity. GLWI is currently pursuing better real-time control estimates as part of 2023 LTCP update. Limno-Tech (LTI) is working with Xylem on updating the real-time control study south of 9-Mile Road, while the University of Michigan is working on updating their portion of the study with LTI north of 9-Mile Road.

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27 https://miwaters.deq.state.mi.us/miwaters/external/overflow/list.
28 https://www.epa.gov/npdes/combined-sewer-overflows-public-notification-requirements-great-lakes.
29 http://greatriverschicago.com/goals/realtime.html.
30 https://www.h2nowchicago.org/.

11. What is the timeline for applying for federal relief and infrastructure funding? Is there a plan for coordinating and submitting funding requests? Are there projects that could be competitive for GLRI funding?

Timelines vary based on program for federal infrastructure funding. The American Rescue Plan Act (ARPA) includes Local Fiscal Recovery Funds with Coronavirus State and Local Fiscal Recovery Funds. Funding disbursements have begun to be disbursed. Michigan will receive $5,286,067, 526.40. Local units of government received 50% in May 2021 and the other 50% is expected for delivery by May 2022.[31]

Funding may be used for water projects, including Clean Water State Revolving Fund (CWSRF) projects. Early guidance from the U.S. Department of Treasury encouraged funds to be used, among other things, for GSI to strengthen municipal resilience to the effects of climate change.

The deadline to submit an Intent to Apply (ITA) for infrastructure loans under the CWSRF in Michigan is typically January 31 of each year. Applications are due by June 1. Funds under the ARPA for wastewater infrastructure will align with the CWSRF.

Other opportunities exist. Funding timelines under the Water Infrastructure Finance and Innovation Act (WIFIA)[32] are triggered upon a Notice of Funding Opportunity (NOFO). The most recent NOFO was published in the *Federal Register*[33] on April 29, with Letters of Intent (LOIs) due July 23. Full applications are typically due within one year of an applicant being invited to apply.

Projects can be competitive for Great Lakes Restoration Initiative (GLRI) funding. Recently, annual funding levels have been at or about $300 million. In January 2021, however, increased authorization levels were signed into law starting at $375 million for federal fiscal year 2022 (starting October 1, 2021) and increasing every year by $25 million to $475 million in FY26 (starting October 1, 2025). Funding up to these authorization levels must still be appropriated on an annual basis, but Congress has typically appropriated GLRI funds at the maximum authorization levels.

An additional $1 billion over five years has been proposed for the GLRI under the Infrastructure Investment and Jobs Act (IIJA). Congress is still in the process of working to pass IIJA.

Regardless of future appropriation levels and IIJA funding for the GLRI, the federal agencies continue to provide investments for municipal water agencies under the GLRI with existing funds. For example, EPA periodically announces requests for funding applications under

[31] Federal Funding Workshop: Water & Sewer Infrastructure, May 24, 2021, hosted by Oakland County Water Resources Commissioner Jim Nash, GLWA, and SEMCOG, slide 11.

[32] https://www.epa.gov/wifia.
[33] https://www.govinfo.gov/content/pkg/FR-2021-04-29/pdf/2021-08867.pdf.

the GLRI. EPA's most recent funding notice[34] requested applications by August 20, 2021, for green infrastructure, runoff reduction, and agricultural phosphorus reduction.

Funding coordination may improve chances of agencies' funding success. SEMCOG has received GLRI funding in the past to assist with programs. SEMCOG has also served as a coordination hub for funding and funding work itself, including its Planning Assistance Program for Transportation Equity and Sustainable Infrastructure,[35] including green infrastructure along transportation corridors. We can assist SEMCOG with GLRI funding discussions.

The federal government is increasingly funding infrastructure for resilience. The Federal Emergency Management Agency's (FEMA's) two prominent programs can offer relief to Southeast Michigan.

- FEMA's Hazard Mitigation Assistance (HMA) grants offer relief. On August 5, the Biden-Harris Administration approved the release of $3.46 billion in supplemental HMA funding[36] for states, municipalities, and other government agencies for flood reduction assistance. As flood reduction and CSO reduction are complementary efforts, HMA funding can support Southeast Michigan efforts.
- FEMA's Building Resilience in Communities (BRIC) program is expected to receive a significant increase in funding under proposed federal infrastructure legislation.[37] Resilience projects are documented to provide a 6:1 dollar-for-dollar return on investment.[38] GEI has assisted clients with BRIC proposals and BRIC entertains regional proposals comprised of several municipalities.

In recent weeks, the U.S. Senate passed an infrastructure bill (H.R. 3684). The bill has since been transmitted to the U.S. House of Representatives for further consideration.

Original Questions

The final questions that are the basis for this Informational Study are derived from original questions contained in its January 2021 RFP. The Foundation responded to input from its Advisory Group at its June 1 meeting by adjusting the original questions to arrive at the above final questions. Generally, the adjustments centered around a focus on *untreated* CSOs (as opposed to treated CSOs) and an emphasis on *reduction* of untreated CSOs (as opposed to the elimination of CSOs).

[34] https://www.epa.gov/great-lakes-funding/fy-2021-rfa-glri-nonpoint-source-runoff-nutrient-reduction-projects.
[35] http://smcg.informz.net/SMCG/pages/07122021_Planning_Assistance?_zs=M9tEX1&_zmi=8pur.
[36] https://www.fema.gov/press-release/20210805/biden-administration-commits-historic-346-billion-hazard-mitigation-funds.
[37] https://www.whitehouse.gov/briefing-room/statements-releases/2021/05/24/fact-sheet-biden-administration-invests-1-billion-to-protect-communities-families-and-businesses-before-disaster-strikes/
[38] https://nibs.org/projects/natural-hazard-mitigation-saves-2019-report.

Glossary

BMP – Best Management Practice.

CIP – Capital Improvement Plan or Capital Improvement Project.

CSO – A collection system that carries storm water as well as domestic and/or industrial wastewater to a publicly owned treatment facility is a combined sewer system. During wet weather, the volume of water may be so great as to cause overflows of untreated discharge into receiving waters. These overflows are known as combined sewer overflows, or CSOs.

Drainage Area/Contributing Area – This is the geographical area draining to a common point. Typically, in a natural system drainage area is defined by topography and the common drainage outlet is a stream or river.

DWSD – Detroit Water & Sewerage Department.

EGLE – The Michigan Department of Environment, Great Lakes & Energy.

First Flush – The first volume of runoff into a stormwater/wastewater collection system. The first flush is typically more polluted than subsequent flow into a system because the first flush typically picks up pollutants that have been deposited on roads since the previous rain. Typically, in Michigan, it is defined as the first 0.5-inch of rainfall.

GLWA – Great Lakes Water Authority

Grey Infrastructure –

GSI – Green Stormwater Infrastructure or Green Infrastructure.

I&I – Inflow and infiltration.

- **DWII** – Dry weather I&I.
- **RDII** – Rainfall derived I&I.

Interim Wet Weather Operating Plan (IWOP) –

Interceptor – In a combined sewer system sanitary sewage and collected stormwater flow together in system interceptors. These are typically the largest pipes in the system and “intercept” the combined flows for conveyance and treatment. When that conveyance capacity is exceeded CSOs occur.

LOS – Level of Service. This is a qualitative measure of the degree to which society assumes it should be protected from a threat, e.g., the degree to which all, most, or some roads will not be flooded to allow the flow of traffic, or the degree to which all, most, or some basements will not be backed up.

MS4 – Municipal Separate Storm Sewer System.

NPDES – National Pollutant Discharge Elimination System, pollution discharge permit. The USEPA has delegated permitting authority under the Clean Water Act to the state of Michigan. Therefore, pollution discharge permits are Michigan Pollutant Discharge Elimination System (MPDES) permits.

Outfall – Is a physical structure (e.g., a large pipe) where discharges of water and its contents occur into a receiving water. An "outfall" is a point of discharge where runoff, a CSO, or SSO can occur.

SEMCOG – Southeast Michigan Council of Governments

Sewershed – A geographic area served by a sewer system that drains to a common pipe. The difference between a drainage area and a sewershed is that the area drained is defined as much or more by where the inlets and pipes are located, rather than just a function of ground slope.

SSOs – Sanitary Sewer Overflows are a release of untreated or partially treated sewage from a municipal sanitary sewer.

Receiving Waters – The waterway into which stormwater or pollution is discharged.

Regulator – Regulators control the amount of flow to an interceptor sewer and provide an outlet (e.g., a CSO) for flows that exceed the sewer capacity. Adjustment of regulator settings, proper regulator maintenance and increasing a regulator outlet to the interceptor are control measures that can ensure optimal system performance and maximize in-line storage (USEPA).

RFP – Request for Proposals

USEPA – United States Environmental Protection Agency, responsible for Clean Water Act oversight throughout the U.S.

WRRF – Water Resource Recovery Facility, operated by the Great Lakes Water Authority.

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Project Team

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Appendix A – Decision Support Framework

Decision Support Framework Scoring December 31, 2019							Past Progress					Future Baseline	Phase 1 Collection System and MS4 Best Practices	Progressive Near Term System-Wide Control Steps			Phase 1 CSO Controls	Phase 2 Collection System and MS4 Best Practices	Phase 2 CSO Controls	Phase 3 Collection System and MS4 Best Practices	Phase 3 CSO Controls	Guidance for Adaptive Elements		Other Alternatives to Meet the Water Quality Requirements		
Desired Outcomes																										
Health & Safety	Natural Resources	Quality Service	Value of Investment	Economic Prosperity	Attainment Measure	Weighting Factor	1980 to 1989	1990 to 1999	2000 to 2009	2010 to 2019	Existing Conditions (EXC)	Future Conditions (FUT)	Base Flow & Stormwater Improved for Dry Weather Partial Body Contact (CM1)	IWOP / ROP (NST)	Committed Projects (NBL)	Wet Weather Facility Optimization (OPT)	Public Health Protection for Small Storms (RD1)	Base Flow & Stormwater Improved for Dry Weather Full Body Contact (CM2)	Extend Protection for Public Health and Aquatic Species (RD2)	Base Flow & Stormwater Improved for all Water Quality Standards (CM3)	Extend Protection for Extreme Wet Weather Events (RD3)	Maximum GSI (GSI)	Max GSI + Reduced DWR (RDA)	Plan of Record with Collection System and MS4 Best Practices (POR)	New Larger Interceptors and Increased Treatment at WRRF (CON)	Complete Sewer Separation (SEP)
											EXC	FUT	CM1	NST	NBL	OPT	RD1	CM2	RD2	CM3	RD3	GSI	RDA	POR	CON	SEP
					% of Time achieving Partial Body Contact Use	5%	45%	50%	65%	66%	66%	66%	91.3%	91.3%	92%	92%	92.2%	99.5%	99.5%	99.7%	99.9%	92.8%	92.7%	99.9%	99.9%	100%
					% of time achieving Full Body Contact Use	5%	8%	15%	24%	24.8%	24.8%	24.8%	39.2%	39.3%	39.5%	39.5%	38.9%	84.4%	84.4%	98.7%	99.9%	39.8%	39.6%	99.9%	99.9%	100%
					% of Time achieving Aquatic Life Use (DO WQS)	10%	80%	85%	90%	94.6%	94.6%	94.6%	94.7%	96.7%	95.2%	95.2%	95.4%	96.7%	96.8%	96.8%	96.8%	95.4%	95.5%	95.9%	96.8%	96.8%
					% of Rouge River Outfalls with First Flush Capture	10%	0%	6.7%	20%	35%	35%	35%	35%	35%	35%	35%	73.3%	73.3%	100%	100%	100%	73.3%	73.3%	100%	100%	100%
					Asset Management Score	15%	60%	50%	25%	30%	35%	37.2%	39.4%	50.6%	61.7%	72.8%	83.9%	95%	97.2%	99.4%	99.9%	99.4%	99.9%	77.2%	77.2%	24.4%
					% of Existing CSO Facility Activated during Wet Weather Events	10%	45%	45%	50%	70.5%	70.5%	70.2%	70.2%	70.3%	70.8%	70.5%	70.3%	70.3%	70.3%	70.3%	70.3%	67%	67.7%	70.8%	70.3%	70.3%
					% of time achieving Critical HGL Protection	15%	70%	75%	85%	87.6%	87.6%	87.7%	87.7%	90.2%	90.7%	91.2%	91.3%	91.3%	91.3%	91.3%	91.3%	92.1%	93%	90.2%	89%	89%
					% Capture	20%	60%	85%	95%	96.5%	96.5%	96.4%	96.4%	96.7%	97.9%	98.1%	98.8%	98.8%	99.2%	100%	100%	99.3%	99.3%	100%	96.7%	100%
					Economic Prosperity Score	10%	50%	50%	25%	25%	30%	32.2%	34.4%	45.6%	56.7%	67.8%	78.9%	90%	94.4%	96.7%	96.7%	92.2%	94.4%	72.2%	72.2%	24.4%

Appendix B – Advisory Group Recommendations on Potential Future Funding Opportunities

The Advisory Group suggests the Foundation consider the following in making future funding decisions:

- A Regional Watershed Hub (HUB) Partnership has formed as a result of the master plan. The Foundation can leverage its resources to advance this process. The HUB already includes active participation from all the major stakeholders across the region: SEMCOG, GLWA, DWSD, EGLE, Watershed groups, Counties, etc. The Foundation could support initial efforts that include procurement of equipment for data collection, data storage, data transparency, etc. for specific monitoring activities as they are identified. This includes watershed water quality monitoring to help direct resources more efficiently and cost effectively.
- Separate Storm Sewer GI – In both the Wastewater Master Plan and the Planning Report recently issued related to the June 2021 flooding, it is recommended that DWSD separate some areas of the Detroit local system. The Foundation could assist in creating green space/parks with Green Infrastructure to collect and clean the separated storm sewer before entering the rivers. The Far West Green Infrastructure Project includes such sewer separation combined with Green Infrastructure in its plan already.
- Supporting identified near-term projects that reduce or eliminate targeted CSOs and in certain cases, eliminate outfalls. The GLWA Masterplan identified Phase 1 CSO Controls which allow for first flush capture of small capacity storms. Improvement types will vary for this investment, and will include green infrastructure, new in-system storage, and interceptor management. ERB can support identified near-term projects that reduce or eliminate targeted CSOs and in certain cases, eliminate outfalls.
- Strategic Green Infrastructure can play a significant role in protecting water quality. While GI's value may be more limited during high volume storms, it can be a valuable component of protection of water quality in the far more typical and frequent smaller storms. In addition, GI improves community aesthetics in highly urban areas, supporting quality of life for residents.
- Log Jam Removal – Removal and maintenance of log jams along the Rouge River was also mentioned in both the Wastewater Master Plan and in the Planning Report recently issued related to the June 2021 flooding. Similar needs exist in the Clinton River. Maintenance and possible removal of log jams prevents river inflow from entering the combined sewer systems, allows GLWA to maximize the capacity of the treated combined sewer outfalls and increases the navigability/recreational use of the rivers.

- Continuing to reduce runoff is a water quality improvement priority across the region. The Foundation could support such efforts identified by the Watershed HUB and/or by transportation agencies to incorporate stormwater management into projects while also adding in community value/equity, etc.
- The Foundation could support a project to identify potential park space that could be used for storage across the region. For example, road agencies are moving toward better stormwater management and known locations for storage could help facilitate that process. The Foundation could also support an identification of all specific locations where storage would be beneficial.
- Partnerships and collaboration in the region to address these challenges are growing by the day. ERB could consider taking a leadership role in convening peer foundations to leverage all resources toward these same outcomes and project types.