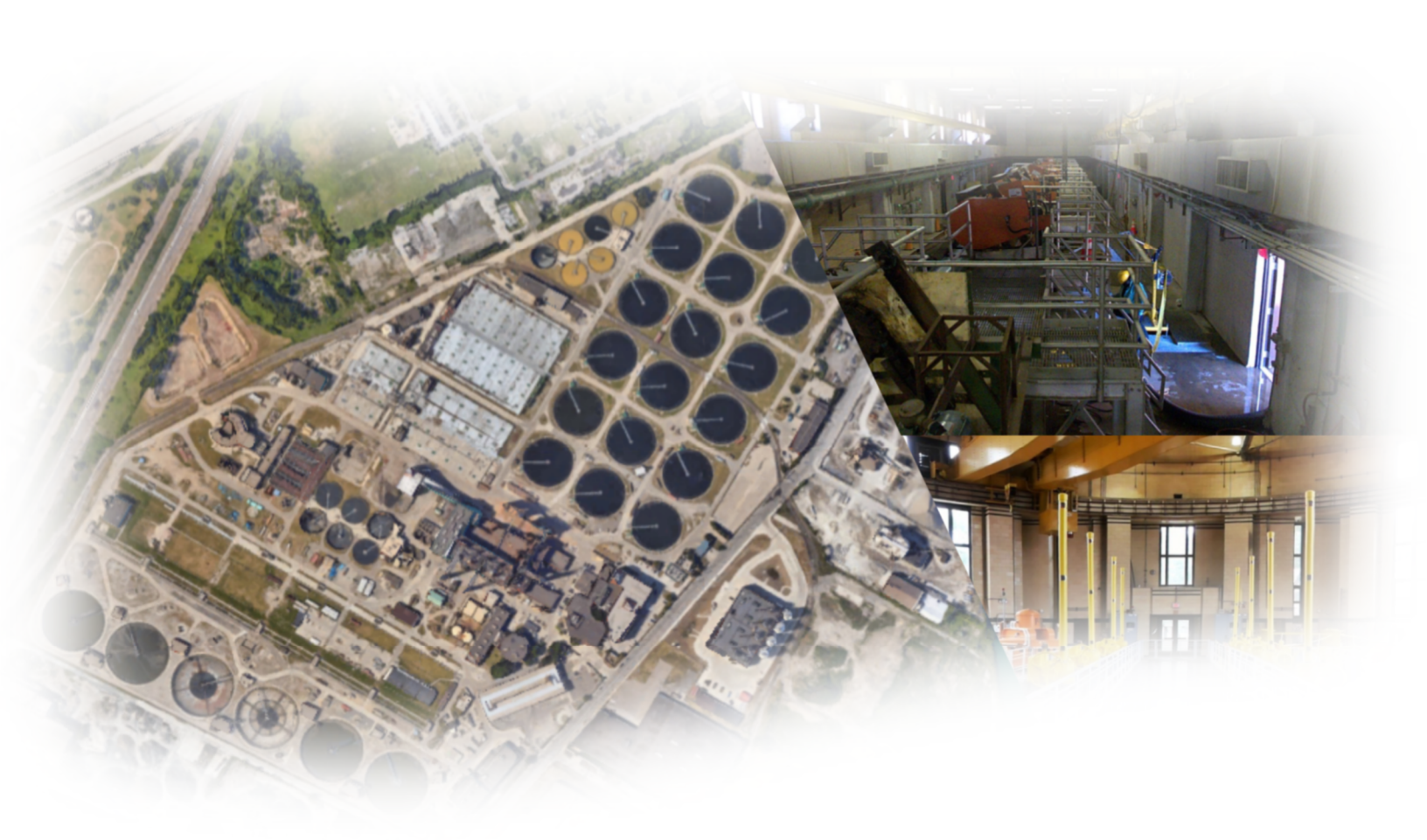
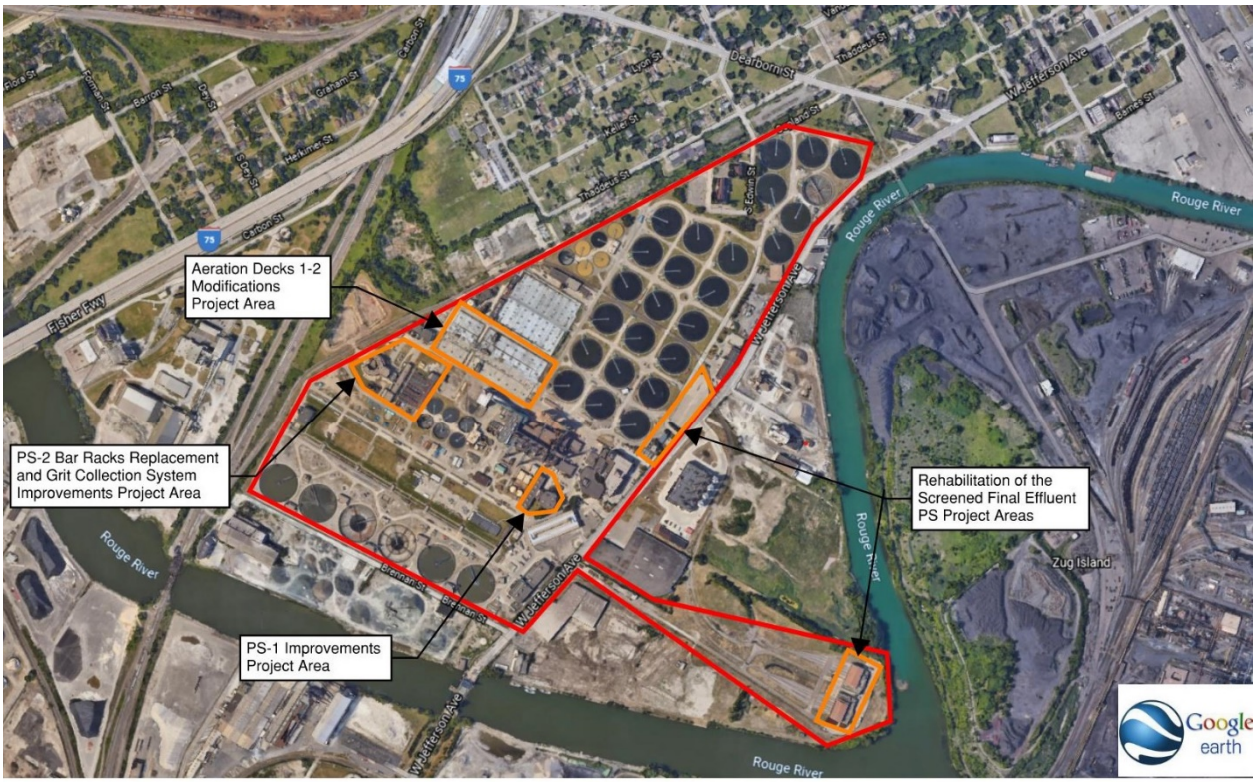


GLWA
Great Lakes Water Authority

2023 WRRF CLEAN WATER STATE REVOLVING FUND PROJECT PLAN SUMMARY

APRIL 15, 2022

WADE TRIM



Proposed Improvements

The Great Lakes Water Authority (GLWA) operates the Water Resource Recovery Facility (WRRF) located in the southwest corner of Detroit. The WRRF serves Detroit and the surrounding areas accepting wastewater and storm water from combined sewers. The water received is sent through multiple treatment processes within the WRRF. This treatment ensures the discharge meets the requirements of the National Pollutant Discharge Elimination System (NPDES) Permit for the WRRF.

To keep the WRRF functioning at a high level of effectiveness, four projects are being proposed to upgrade the facility's equipment, structures, and processes. GLWA has identified and prioritized these projects as follows: Priority 1A - Pump Station No. 1 Improvements (PS-1 Project); Priority 1B - Aeration Decks 1-2 Modifications (Aeration Decks Project), Priority 1C - Pump Station No. 2 Bar Racks Replacement and Grit Collection System Improvements (PS-2 Project); and Priority 1D - Rehabilitation of the Screened Final Effluent (SFE) Pump Station (SFE Project).

Summary of Project Needs

The needs, and goals of each project are presented below.

PS-1 Project (Priority 1A)

PS-1 is over 80 years old and is the primary pump station that conveys up to 1,200 million gallons per day (MGD) of sewage. Improvements are needed to ensure reliable service of the pumping equipment and to extend the estimated useful life of the station for another 20 years. Failure of PS-1 could result in overflow of dry weather and combined sewage to the Detroit and Rouge Rivers and violations of the NPDES permit.

Major goals of the PS-1 Project include:

- Provide NDPES required firm capacity
- Rehabilitate the pumps to run within the manufacturers' recommended operating ranges
- Meet Hydraulic Institute recommendations for suction intake conditions
- Decrease electrical consumption
- Right size utilities and mechanical systems
- Provide for a minimum design life of 20 years for the process equipment and building
- Improve the pump station's ability to address grit entering the wet well
- Improve the pump station's ability to meter flow
- Reduce the number of steps needed to properly operate the pump station
- Improve ability of operations and maintenance (O&M) staff to access and disassemble the pumps

Aeration Decks Project (Priority 1B)

The secondary treatment process is the capacity limiting process at the WRRF. Changes to the high-purity oxygen activated sludge system are needed to optimize the aeration system's performance and accommodate more stringent phosphorus limits that will be included in an upcoming NPDES Permit. These changes include better control flow (contact time) for dry and wet weather flows by controlling water tank levels and the opportunity to utilize biological phosphorus removal to meet the pending NPDES Permit limits.

The surface aerators are limited to a narrow range of water levels, i.e. about 5 inches. The Aeration Deck level control system cannot maintain the water elevation in that range, which is especially evident at low flows when up to 175 MGD (instantaneous) of clean water must be recycled to artificially maintain a higher minimum water level. The level control system relies on submerging the effluent weir and using downstream, manually-operated flow control valves to stabilize the level at the weir outlet. Restoring the system to free-discharge weirs will eliminate the need to manually manage the water level and give the weir complete, passive control of the bioreactor water levels. To limit the flow-induced water level variations in the secondary treatment process, the hydraulic loading rate range at the effluent weir must be narrowed.

Major goals for the Aeration Decks Project include:

- Increase the overall efficiency and wet weather treatment capacity of the secondary treatment process by providing step-feed and improving the performance efficiency of Intermediate Lift Pump (ILP) Station No. 1 by replacing ILPs 1 and 2.
- Provide better hydraulic control at Aeration Decks 1 and 2.
- Improve the system's energy efficiency by efficiently sizing the mixing and aeration equipment.
- Provide Biological Phosphorus (Bio P) removal to accommodate the more stringent NPDES standards.

Increasing the efficiency will improve the performance and reliability of the secondary treatment process. The increased capacity will also prepare the system for projected increased flows from service population growth.

PS-2 Project (Priority 1C)

The existing PS-2 Rack and Grit facilities remove sanitary trash and grit from up to 828 MGD of raw sewage that is treated at the WRRF. The screening and grit systems are not meeting expected removal standards, operate inefficiently, and are prone to failure.

Effective grit and screening removal can dramatically impact the performance and reliability of downstream treatment equipment. The cost of ineffective grit and screenings removal is difficult to quantify, but has been shown to manifest in excessive accumulation of grit in downstream channels and process tanks with severe consequences that include making gates difficult or impossible to operate; reducing conveyance capacities; inducing excessive wear and shortened life of primary sludge pumps and solids processing equipment; clogging the vertical turbine solids handling) inlet strainers on return activated sludge pumps; and reduced quality of the biosolids product which negatively impacts GLWA's long-term goal of adequate anaerobic digestion.

The following goals for the PS-2 Project have been set to address the potential consequences and increasing downtime of the aged equipment:

- Improve the systems to provide for significantly higher screenings and grit removal efficiencies
- Make changes that improve the long-term system reliability
- Simplify O&M

Upgrades will improve the WRRF's reliability by maintaining treatment processes with greater ease and reducing operating costs.

SFE Project (Priority 1D)

The SFE Pump Station at the WRRF provides water for treatment processes that do not require "potable quality" water. This pump station was originally constructed when the demand for SFE water was significantly higher than today. Eight existing pumps have a total capacity of 124 MGD while the current operational demand is only 23 MGD. Running these oversized pumps is over-pressurizing the system and wasting energy.

In addition, EGLE has expressed concerns regarding the availability of redundant water supplies to the WRRF process units. Processes that rely on water of higher quality, rather than SFE, use the secondary water system. Secondary water is sourced from the Detroit Water and Sewerage Department's (DWSD's) potable system into reservoirs and is repumped from the basement of the existing machine shop to the low, intermediate, and high-pressure systems throughout the plant. Currently, the WRRF does not have redundancy for the secondary water system, upon which many processes rely. The existing secondary water system uses almost 6 MGD of potable water.

If a water main supply line were to go down, several of the processes at the WRRF and the chlorination/dechlorination facilities on the east side of Jefferson Avenue would be interrupted, losing the water necessary to keep treatment running. This outage would cause the WRRF to be out of compliance with their NPDES Permit.

The following goals have been set for the SFE Project to address the risks associated with the existing process:

- Replace the aging SFE pump station with a new right-sized pump station
- Provide treatment to SFE water sufficient for use in the secondary water system
- Provide redundancy to the secondary water system.

Use of the existing SFE Pump Station cannot be optimized to meet the current operating demands. Coupled with the reliance on DWSD's potable water system, the SFE Pump Station and City water main are not suited to provide optimum performance for the WRRF treatment processes. Changes are needed to the SFE Pump Station to meet these needs.

Potential Alternatives

Multiple alternatives were considered for each project to provide the best and most cost-effective project plan. Brief descriptions of the alternatives evaluated and their determined feasibility are provided in the following sections.

Common Alternatives

Two initial alternatives were common to all projects: the "No Action" and "Regional" alternatives.

The "No Action" alternative was determined to be unacceptable for all projects based on the existing condition of the various treatment processes and was not evaluated further. This alternative would not address the identified needs for any project and put the ability to meet the NPDES Permit at risk, now and in the future.

The WRRF is the largest treatment plant in Michigan and is already considered a "Regional" treatment facility because it accepts flows from multiple communities in the surrounding areas. Thus, the "Regional" alternative was not relevant to these projects and was not evaluated further.

Specific additional technical alternatives considered and evaluated for each project are presented below.

PS-1 Project Alternatives

Three pump system alternatives were considered for the PS-1 Project: rehabilitation of the existing pumps and motors; replacement with new constant speed driven pumps and motors; and replacement with new variable speed driven pumps and motors.

Rehabilitation of the existing pumps and motors was determined to be the most cost-effective solution to extend the remaining useful life of the pump station to 20 years. A condition assessment of the pumps revealed that the pump casings had adequate remaining life (i.e., the entire pump did not need to be replaced). The original pumps and facility were designed to have the pullout assemblies replaced periodically, and this can be done at a much lower cost than full pump replacement. The constant speed motors, already some of the most efficient available, could also be rebuilt at a lower cost than providing new motors.

An analysis of pumping demands determined that the existing pump capacity combinations provides the WRRF with the ability to manage flow properly, thereby avoiding the expense associated with variable speed controls and variable speed compatible motors.

Additional improvements included within the recommended alternative that benefit operations and maintenance of the facility include: relocation of equipment to a new electrical room addition; addition of air-locks and other improvements to achieve NFPA-820 "unclassified" space in the pump station's dry spaces; structural and architectural improvements; replacement of gates, valves, and actuators; rehabilitation of the elevators; additional drains and sump pump replacements; replacement of instrumentation and controls that had exceeded their useful life; and addition of small cranes to facilitate the movement of maintenance materials.

Aeration Decks Project Alternatives

The Aeration Decks Project evaluated three alternatives for aeration/mixing and three alternatives for controlling the water level in the secondary system. An alternative for biological phosphorus removal (step-feed), which is dependent upon the selected aeration/mixing and water level control solution, was also evaluated. Finally, an alternative to replace, rather than maintain, intermediate lift pumps (ILPs) 1 and 2 was assessed.

The alternative selected includes a combination of mixers and aerators referred to as the "hybrid alternative"; three-stage weir modification; step feed to achieve biological phosphorus removal; and ILP replacement.
The Aeration Decks will have mixers in Bays 1 through 3 to create anoxic zones, and surface aerators in Bays 4 through 10 to create aerated zones. New weirs will be installed to create a three-stage system in the aeration decks, thus providing a more suitable/stable hydraulic profile. New ILPs will increase the reliability and efficiency of the improved secondary process.

PS-2 Project Alternatives

Alternatives prepared for the PS-2 Project addressed needed improvements to screening, grit removal, and grit processing.

Five screening alternatives were identified. All screening alternatives include replacement of the eight coarse screens with either coarse (¾-inch) or fine (¼-inch) screens. Also, a hydraulic analysis determined that more screens were required to meet the percent removal goals. Additional screening was considered at the screening building; downstream of the existing screen channels at the grit chamber inlet; and at the grit chamber outlet.

Due to space constraints in the existing screening building, a single stage of multi-rake bar screens was selected as the optimal arrangement. This alternative included replacement of the eight coarse screens with ¼-inch screens and the addition of two, ¼-inch fine screens, for a total of 10 screens. The additional screens require the extension of the screening building, influent channel, and effluent channel.

Other screening improvements include the addition of a new sluice channel to carry the screenings to dewatering drum conveyors; improvements to the dumpster roll-off configuration; the addition of gated, screenings bypass channels; mechanical improvements to plumbing and HVAC; and architectural improvements including lighting.

Three grit removal alternatives were identified, including rehabilitating the aerated grit

chambers and replacing the clamshell bucket system with a new grit removal method; retrofitting the aerated grit chambers with stacked tray grit removal units; and retrofitting the aerated grit chambers with stirred vortex grit removal units.

Aerated grit removal was eliminated from consideration due to low grit removal performance. Stacked tray grit removal was eliminated because it required 24 units compared to only 8 stirred vortex units for comparable performance. Additionally, operation of the stirred vortex technology will be similar to the existing grit removal process. The stirred vortex alternative combines lower operations and maintenance cost with improved grit removal performance.

Due to the greater efficiency of the new grit removal process, a separate grit processing facility is needed. The grit processing facility equipment alternatives considered were conventional grit cyclones and classifiers; vortex grit washers and grit dewatering; and fluidized bed grit washers and grit dewatering.

Cyclone-classifiers were selected because they have lower construction and operation and maintenance costs than the vortex and fluidized bed grit processing options.

The final recommended combined alternative for the PS-2 Project includes 10 new fine screen units; 8 stirred vortex grit removal units; and a new grit processing facility with 8 pairs of conventional grit cyclones and eight classifiers.

SFE Project Alternatives

The SFE Project considered 2 alternatives: a new elevated storage tank and a new SFE pump station and treatment facility. Evaluation of the tank showed that the space available for a facility sized to hold the required amount of water to supply all processes at the WRRF was not sufficient without encroaching on areas reserved for future expansion. In addition, the cost estimate for the storage tank was the highest of the alternatives. The need to treat the water within the tank or flush the system regularly to keep the water quality within acceptable limits also deterred the selection of this alternative.

Construction of a new SFE pump station and treatment facility was the alternative selected. While final selection of components in this progressive design-build project is still pending, this Project Plan assumes the new treatment and pumping facility will include reverse osmosis filtration, chlorination, and 8 centrifugal pumps with variable speed drives capable of discharging water at low, medium, and high pressures.

Environmental Evaluation

Short-term impacts, such as equipment noise and dust, cannot be avoided during construction of these proposed projects. However, thoroughly designed and well-planned construction sequencing should minimize impacts. Equipment noise impacts to surrounding areas can be minimized by controlling hours of work. Dust and soil deposits will be controlled through frequent watering and pavement sweeping. Soil erosion control measures will also be implemented as needed to reduce unwanted soil runoff. Specific techniques will be specified in the construction contract documents for each project.

A state historic resource evaluation and an endangered species and habitat review are underway for all projects at the WRRF. There are no known cases of conflict with the projects. Each project will be closely monitored, and any conflict will halt the project until the correct course of action is determined, and steps are taken for proper mitigation.

Estimated Project Costs

The total project costs for each project are summarized in the table below. These costs include estimated values for construction, project contingencies, and engineering.

Proposed Projects' Priorities and Costs

Priority	Project	Estimated Total Project Cost
1-A	PS-1 Project	$95,600,000
1-B	Aeration Decks Project	$74,100,000
1-C	PS-2 Project	$98,000,000
1-D	SFE Project	$80,100,000
Total		$347,800,000

Estimated User Cost Impact

Calculating the total present worth of each project, assuming a funding term of 20 years and a loan interest rate of 1.875% based on the EGLE posted loan rate, yields an equivalent annual cost of $29,606,000. According to the GLWA Master Plan and available housing data from the Southeast Michigan Council of Governments, an estimated 1,136,500 households will be impacted by these projects.

The per household user cost is estimated to be $26.05 per year, or $ 2.17 per month.

Proposed Implementation Schedule

The proposed schedule for the project plan and design and construction of the projects contained within it is presented in the table below.

Proposed Schedule of Projects

Project	Estimated Construction Start Date	Estimated Construction End Date
PS-1 Improvements Project (Design-Bid-Build) *Prepurchase of Equipment starts Q3 2022*	Q1 2023	Q1 2028
Aeration Decks 1-2 Modifications Project (Design-Build Contract) *Design starts Q1 2023*	Q2 2025	Q2 2031
PS-2 Bar Racks Replacement and Grit Collection System Improvements Project (Design-Bid-Build)	Q2 2023	Q3 2029
Rehabilitation of the Screened Final Effluent Pump Station Project (Progressive Design-Build)	Q1 2023	Q3 2026