DRAFT

PRELIMINARY ENGINEERING REPORT

Barre, Massachusetts Wastewater Treatment Facility

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1. PROJECT PLANNING

1.1 Introduction

The Town of Barre Wastewater Treatment Facility (WWTF) is well-maintained but much of the equipment and infrastructure is over 20 years old and in need of improvements to be able to continue reliable performance. Through discussions with USDA Rural Development, the agency indicated that they are receptive to providing funding support for improvements to the WWTF through a combination of grants and loans. This Project Engineering Report (PER) describes the identified needs, proposed alternatives and recommended improvements.

The following recommended improvements are described in further detail in this report and are listed here in order of priority for the facility:

1) **Secondary Clarifier Mechanism Rehabilitation** – This includes new mechanisms and associated appurtenances for the two secondary clarifiers at the WWTF.

2) **Oxidation Ditch Rehabilitation** – This includes structural rehabilitation and relining of both oxidation ditches at the WWTF.

3) **Headworks Improvements** – An alternatives analysis has been completed to determine the scope of this upgrade. Recommended improvements include reconfiguration of the headworks processes, grit removal optimization, a new influent screen, a new headworks building, and a new chemical storage area with new chemical feed for alkalinity adjustment.

4) **Operations Building Improvements** – This includes replacement of doors, replacement of windows, repairs to the flooring, and repairs on the roof of the operations building.

5) **New Sludge Storage Tank** – This includes the construction of a new underground sludge storage tank to store WAS from the secondary clarifiers.

6) **Solids Handling Improvements** – This includes improvements to the WAS and RAS pumping system, RAS flow metering, and reconfiguration of the oxidation ditch splitter box for RAS distribution.

7) **Septage Receiving Station Upgrade** – This includes a new septage receiving station for the WWTF.

8) **Secondary Clarifier Splitter Box** – This includes the installation of a new splitter box after the oxidation ditches, prior to the secondary clarifiers to allow improved flow distribution to the clarifiers.

9) **Effluent Flow Monitoring Improvements** – This includes improvements effluent flow monitoring at the WWTF which includes a new effluent flow meter.

10) **Intermediate Flow Monitoring Improvements** – This includes improvements to flow monitoring after the equalization tanks.

11) **Anoxic/Equalization Tank Mixers** – This includes replacement of existing mixers in the anoxic/EQ tanks.

12) **Pump Station Improvements** – This includes addressing ragging issues and providing SCADA to the pump stations in the collection system.

1.2 Project Location

The Barre WWTF is located at 411 Wheelwright Road, in the Town of Barre, Massachusetts in Worcester County. The WWTF, constructed in 1985, is a 0.3 million gallons per day (MGD) and is operated by the Town of Barre. The WWTF is designed for secondary treatment and discharges to the Ware River, which ultimately discharges to the Long Island Sound. Figure 1-1 shows the WWTF location.

1.3 Environmental Resources Present

The proposed project will be completed within the existing WWTF footprint, within existing structures and previously-disturbed area on site.

1.4 Population Trends

The United States (US) Census estimates that the population of Barre was 5,398 in 2010 and projected a 2019 population of 5,578. This is a 3.3% increase over the last 9 years, which shows a very little growth in population in Barre. The population in Barre is not expected to increase significantly over the next 20 years.

Approximately 35% of the Town's population is served by the collection system and WWTF. While several small sewer extensions have been discussed, the Town does not expect any substantial projects to expand the collection system to serve more of the Town.

1.5 Community Engagement

A proactive approach will be taken by the Town to engage the community throughout the project planning process to help the community develop an overall understanding of the purpose and need for the project. Regular updates at Barre Sewer Commission meetings are anticipated.

2. EXISTING FACILITIES

The following sections provide a brief description of the existing WWTF, including the history of the facility and the current condition of the process components.

2.1 Project Location Map

The Barre WWTF is located at 411 Wheelwright Road, in Barre, Massachusetts. Figure 2-1 shows an aerial of the existing WWTF. All upgrades proposed in this report will take place within the existing limits of the WWTF.

Figure 2-1: Existing Barre WWTF Aerial

2.2 History

The original WWTF was constructed in 1985 with a design average flow of 0.30 MGD. The WWTF treats flow from the municipal sanitary collection system and trucked septage. The majority of the Barre wastewater collection system was constructed in 1985 and consists of 18 miles of sewer mains ranging in diameter from six to fifteen inches and a total of four lift stations. The original facility consisted of influent grit channels, oxidation ditches, secondary clarifiers, a UV disinfection unit, and a solids handling process consisting of a sludge holding tank and a belt filter press.

Tate & Howard, Inc. completed a facility plan in 2001, which provided recommended improvements for the facility. This resulted in a two-phase design project. Phase 1A, completed in 2003, included improvements to the oxidation ditch aeration system, installation of a new emergency generator, a new electrical and controls building, and other electrical improvements on site. Phase 1B, completed in 2005, included new grit removal and screening equipment, new equalization tanks, a new Parshall flume located after the equalization tanks and ahead of the oxidation ditches, a new return activated sludge (RAS) system, and general piping modifications on site. No other major upgrades have been completed at the WWTF since this project.

In late 2019, the Town of Barre was approached by the Town of Hardwick about accepting flow from the sewer service area associated with Hardwick's Wheelwright Water Pollution Control Facility (WPCF). Conceptual level project costs were developed for decommissioning the Wheelwright WPCF, constructing a new pump station and force main to the Barre WWTF, and upgrading the Barre WWTF. The total Opinion of Probable Project Cost (OPC) was $33 million of which $20 million was allotted to upgrading the Barre WWTF. The proposed funding for the project was a combination of grants and loans from USDA Rural Development. Ultimately, Hardwick decided not to move forward with the connection. Although this project is not moving forward, it highlighted some of the challenges the WWTF currently faces, including aging equipment and systems. Additionally, there are some operational challenges that compromise performance, increase operations and maintenance, and impede the operators' ability to collect accurate data for process control.

2.3 Condition of Existing Facility

The Barre WWTF treatment processes consist of a headworks, anoxic and equalization tanks, oxidations ditches, secondary clarifiers, UV disinfection, and solids handling. The unit processes are located in buildings and structures at the site. The hydraulic profiles for the WWTF can be found in Appendix A for reference. The figure shows the process flow diagram for the facility's current configuration.

2.3.1 Septage Receiving

Septage is received at the facility at a septage receiving station located behind the operations building. Septage is sent to a rock trap and then into a 6,500-gallon septage holding tank. Septage is pumped from this holding tank to the headworks via two air actuated septage ejector pumps.

2.3.2 Headworks

Flow from the collection system is pumped via pump stations to two (2) original influent grit channels at the headworks. Additionally, flow from the septage receiving tank is pumped to this location. An influent sampler shed is located at the beginning of the influent channels. The two channels have been reconfigured, one as a bypass channel and one that diverts flow into the Grit King mechanical grit removal system. A manual coarse bar rack was installed in the influent channel, upstream of the grit removal system, but was removed due to the rack requiring frequent manual cleaning throughout the day to prevent backup. Due to the configuration of the existing channels, operations staff has issues with floatables getting caught in the channel and grit settling out in the channel prior to the Grit King, required manual removal of grit. Grit King effluent flows through a channel monster grinder and an auger monster to remove large debris and wash the organics off the captured debris that are located in a small building. Several issues have been identified with the existing headworks. Because the grit removal system is located before the screening equipment, rags and other large debris get caught in the grit removal system, requiring frequent removal of these items by the operations staff. Additionally, the grinder has been removed from before the screen and the level sensors no longer function properly.

2.3.3 Anoxic and Equalization Tanks

The wastewater then flows by gravity to a 60,000-gallon tank that operates as an anoxic zone. A portion of the facilities RAS is sent to this tank and the tank is constantly mixed. Hydrated lime is added manually into the influent chamber of this tank daily to maintain alkalinity and pH in the system. The tanks themselves are in good condition. However, mixers in the tanks require frequent maintenance due to seal leaks.

The wastewater then flows to a second, adjacent 60,000-gallon equalization tank that contains a submersible pump. The pumping flowrate from the tank is regulated through SCADA with the use of level transducers to maintain an even flow to the oxidation ditches. This tank has overflow weirs to allow for gravity flow in case of a high level in this tank. One of these weir gates that regulate this no longer seals properly.

From the equalization tank, wastewater then passes through a Parshall flume where measurements are sent back to the SCADA system. Due to the current construction and hydraulic influence downstream of the flume, accurate flow measurements from the flume are not able to be obtained.

2.3.4 Oxidation Ditches

Flow enters the oxidation ditches through the distribution box where flow is split between the two ditches. A portion of the RAS flow is pumped to the distribution box, after the flow split to the oxidation ditches. Currently, the facility is adding RE300 into the distribution box from a tote using a metering pump in order to facilitate chemical phosphorus removal. Two brush-style aerators are located in each ditch and automatically operated by the SCADA system, receiving oxygen readings from Hach LDO probes and analyzers. There are also two Flygt mixers in each ditch to keep the mixed liquor thoroughly blended. The aeration equipment and mixers in these tanks are aging but operating as intended in the system. The lining in the ditches has failed in many locations and the concrete underneath is showing signs of corrosion.

2.3.5 Secondary Clarifiers

The discharge from the oxidation ditches passes over discharge weirs and into two secondary clarifiers. The clarifier mechanisms are original to the WWTF and have significant maintenance issues such as wear and corrosion of the operational components along with structural corrosion.

2.3.6 UV Disinfection and Outfall

Treated wastewater from the clarifiers passes over the weirs into an effluent trough. The effluent from both clarifiers combines and flows by gravity to the disinfection process, which consists of two parallel ultraviolet light (UV) disinfection trains. Disinfected effluent then flows by gravity through a pipeline with a mag-style effluent flow meter, located in the basement of the operations building. This flowmeter can be a bottleneck in the system under high flows, leading to surcharging of the UV units. Treated effluent then flows by gravity to the Ware River.

2.3.7 Solids Handling

Sludge collected in the secondary clarifiers is returned to both the oxidation ditches and the anoxic tank through pumps located in the basement of the operations building. Twice a week, operators manually turn off the RAS system and then batch waste from the secondary clarifiers to the **6,500-gallon** waste holding tank. From the waste tank waste activated sludge (WAS) is pumped to the belt filter press and dewatered. Dewatered sludge is transported to a local municipal landfill via a roll-off container by operations staff. Filtrate from the belt filter press is sent to the septage holding tank and then pumped to the headworks for treatment.

The waste holding tank, along with a septage tank on site, is used for septage storage if a large quantity of septage is received at the facility, limiting the volume available for waste activated sludge storage during the rest of the week.

The septage receiving area is showing extensive deterioration and contains a manual coarse bar rack that requires frequent cleaning. The septage then enters the 6,500-gallon septage holding tank where it is aerated for a period of time and then pumped to the headworks via pneumatic ejector pumps located in the basement of the operations building.

2.3.8 Operations Building

The Operations Building contains the unit processes including UV disinfection, the belt filter press, and pumping systems for the RAS/WAS, septage, plant water and belt filter press feed. Additionally, the Operations Building houses the control center, laboratory, restrooms, break/meeting room and garage bay where dewatered solids are deposited into a roll-off container. Due to the age of the building, the doors, windows, flooring and the building roof are in fair to poor condition and in need of replacement.

2.3.9 Remote Pump Stations

Throughout the collection system, there are four remote pump stations to convey flow in the collection system to the WWTF. The largest of these pump stations is the Ware River Pump Station, which has three pumps rated for 540 gpm. The three other stations in the system are duplex systems. The pump stations are generally operating as intended except for ragging issues at several of the stations that operators need to frequently address. Additionally, improved SCADA controls at the stations would be beneficial to provide increased remote monitoring.

2.4 Financial Status of Existing Facilities

The Town of Barre has separate enterprise funds for water and sewer operations. The sewer enterprise fund captures the revenue generated by rate payers to fund the annual operations and maintenance (O&M) costs of the wastewater utility. A summary of the fiscal year budgets is provided in Table 2-1 below.

Table 2-1: Annual Wastewater Budget

Fiscal Year	Annual Budget	Average Annual Sewer Cost Per EDU	Median Household Income (2010 Census)	Annual Sewer Bill as a % MHI
2018	$752,280	$1,200	$75,423	1.59%
2019	$778,136	$1,200	$75,423	1.59%
2020	$742,724	$1,200	$75,423	1.59%

The Town of Barre meets its operations and maintenance costs through its sewer user fees. The Town charges a quarterly flat sewer rate of $100.00 for usage up to 10 HCF and $10/HCF for all above 10 HCF. Unmetered accounts are charged a flat fee of $150/quarter. The current average residential user fee is approximately $1,200 per year based on 120 HCF. This current average annual user fee is approximately 1.59% of the Town's Median Household Income (MHI) of $75,423 (2010 US Census).

2.5 Water/Energy/Waste Audits

The Barre WWTF has not conducted water, energy, or waste audits.

3. NEED FOR PROJECT

The following sections describe the need for the project considering such factors as public health, sanitation and security.

3.1 Health, Sanitation and Security

Maintaining the reliability and functionality of wastewater disposal is critical to ensuring adequate public health and sanitation, especially during this current pandemic. While the WWTF continues to consistently meet the permit limits set forth in their NPDES permit (see Appendix B), equipment failure could lead to exceedances in these limits, leading to public health concerns. Additionally, many of the current practices at the WWTF are requiring operators to perform more maintenance on equipment and handle wastewater solids frequently, leading to safety concerns for the operators. With COVID-19, which can be found in wastewater, it has become even more critically important that operators have less contact with the wastewater, ensuring the safety of the operators. The facility, which was originally constructed in 1985, has systems that are inefficient compared to processes designed today. These systems include the septage receiving, solids wasting, and the headworks configuration at the WWTF.

3.2 Aging Infrastructure

The major need for the project proposed in this report is the aging infrastructure at the WWTF. While well maintained, the majority of the WWTF equipment is over 20 years old and approaching the end of its useful life. Items in need of replacement due to age include the lining in the oxidation ditches, the secondary clarifier mechanisms, the influent screen, and the structural items recommended in the operations building. All of these components are critical to the WWTF and deterioration due to age significantly impacts the WWTF's ability to treat the wastewater.

3.3 Reasonable Growth

As described in Section 1.4, major growth and significant collection system expansion is not anticipated in the Town of Barre over the 20-year planning period. The Town is preliminarily looking into two small collection system expansions. Based on an analysis of five years of WWTF data (2015 to 2020), the average flow to the facility is 0.19 MGD, which is approximately two third of the 0.3-MGD design capacity, and flow from any collection system extensions can be accommodated within the design capacity of the WWTF.

4. ALTERNATIVES CONSIDERED

This section contains a description of the alternatives considered for the project to meet the needs of the Town in the most economical way over the twenty-year planning period. An alternatives analysis was completed on the following processes.

1) Headworks Improvements
2) Effluent Flow Monitoring Improvements

Technically or economically infeasible alternatives that were considered have been noted, but a detailed analysis was not conducted for these alternatives. Additional recommended upgrades, where an alternatives analysis was not completed, are listed in Section 6 of this report.

4.1 Headworks Improvements

4.1.1 Description

The following headworks improvements alternatives were evaluated:

1. Do Nothing
2. Remove Grit Removal Equipment
3. Reconfigure Headworks in New Building

4.1.1.1 Description of Headworks Alternative 1: Do Nothing

The existing headworks consists of an influent channel which flows into a Grit King grit removal system and then into an Auger Monster screen to remove larger solids. Because the grit removal system is located upstream of the screening equipment, the larger solids, especially rags, get caught in the grit removal system instead of being captured by the screen. This results in the grit pump and classifier becoming clogged with rags, wipes, and other solids requiring operators to frequently clean the grit system. Typically, screening equipment is installed upstream of grit removal to capture the rags and larger solids prior to grit removal. Because the Town does not consider it safe or cost effective to continue to clean the grit system as currently installed, especially with the marked increase in the quantity of rags and wipes in the system, this alternative is considered infeasible for the Town and has not been considered further. .

4.1.1.2 Description of Headworks Alternative 2: Remove Grit Removal Equipment

The major issue with the existing headworks configuration is that rags are being capturing in the grit removal system before reaching the screen. This alternative would bypass the existing grit removal system, so WWTF influent is only flowing through the influent screen. This alternate is considered infeasible for the Town as it would allow grit to pass through the system into the anoxic and equalization tanks, requiring more frequent and more complicated regular maintenance and cleaning of these tanks. This alternate has not been considered further.

4.1.1.3 Description of Headworks Alternative 3: New Headworks Building

This alternative includes a major reconfiguration and update to the existing headworks to both solve the configuration issues describes above but also provide other improvements that will benefit the WWTF. For the alternative, a new building will be constructed in the area adjacent to the existing influent channel. A new channel will be constructed, with a new influent Parshall flume, and a new influent screen installed upstream of the existing grit removal system that will be reused.

The new building will house the existing composite sampler and be large enough to also house chemical storage and associated feed systems for chemicals used for alkalinity adjustment and phosphorus removal, dumpsters for solids collected by the screen and grit system, and a new electrical room.

4.1.2 Design Criteria

The headworks alternative will be designed to treat the WWTF influent minimize maintenance, automate operation, and reduce downstream impacts.

4.1.3 Map

The following figure shows the existing headworks at the WWTF. The proposed alternative will take place within the confirms of the existing headworks area. The preliminary approximate building footprint for Alternate 3 is also shown on this drawing.

Figure 4-1: WWTF Headworks

4.1.4 Environmental Impacts

There will be no environmental impacts as a result of the proposed alternatives, as they are in the confines of the existing site.

4.1.5 Land Requirements

All proposed upgrades will take place on the existing WWTF site in the area of the existing headworks, therefore no land purchase is required.

4.1.6 Potential Construction Problems

Construction problems for the proposed alternative are not anticipated. However, special consideration will have to be taken to ensure operation of existing system can be maintained during construction of the new system. Additionally, coordination for any existing utilities will be considered during design to avoid any construction conflicts.

4.1.7 Sustainability Considerations

The system will be designed to maintain gravity flow to preclude the need for pumping and its associated energy. The building will be designed to minimize HVAC requirements. The upgrades will be designed to be resilient and minimize operations and maintenance costs.

4.1.8 Water and Energy Efficiency

The overall water and energy efficiency at the existing WWTF will not be significantly impacted by the proposed headworks upgrade. New equipment has the potential to be more energy efficient than existing older equipment, but impacts are anticipated to be negligible.

4.1.8.1 Green Infrastructure

Green infrastructure will be considered for implementation during detailed design and will be used to the greatest practical extent.

4.1.8.2 Other

The proposed headworks upgrade will serve to significantly minimize the maintenance required by operators to ensure continuous operation. The reconfiguration of the screen and grit removal will eliminate the need to manually clean rags out of the grit system and will reduce contact with the material and the associated safety and health risks for the operators, including those from viruses. Additionally, the addition of automated chemical feed equipment will eliminate the manual addition the facility currently uses and will reduce the risk of injury.

4.1.9 Cost Estimates

The following tables provide an opinion of probable installation, construction, and non-construction project costs for the proposed headworks improvements.

Table 4-1: Construction Cost Estimate - Headworks Upgrade

Description	Cost
Construction Costs	
Building with New Channel, HVAC, Electrical Room & Chemical Room	$1,500,000
New Screen and Washpress	$340,000
Chemical Pumps & Storage	$110,000
Electrical	$400,000
Construction Subtotal	**$2,400,000**
Non-Construction Costs	
Design (15%)	$360,000
Project Contingency (10%)	**$240,000**
Total Project Cost (2020$ Rounded)	**$3,000,000**

4.2 Effluent Flow Monitoring Improvements

4.2.1 Description

The following effluent flow monitoring improvements alternatives were evaluated:

4.2.1.1 Description of Effluent Flow Monitoring Alternative 1: Do Nothing

The effluent flow is monitored with a 4-inch magnetic flow meter located in the effluent piping in the basement of the operations building. Piping upstream of the flowmeter is 8-inch but switch to 4-inch piping for the flow meter in order to provide an accurate flow range on the flow meter. However, this creates a bottleneck in the system under high flow conditions and leads to flow backing up in the UV system. Additionally, operators are not able to use the bypass around the UV system since this flowmeter does not monitor the flow through the bypass piping. This precludes them from taking the UV system fully offline during non-disinfection months. This alternative is considered infeasible for the Town and has not been considered further.

4.2.1.2 Description of Effluent Flow Monitoring 2: New Parshall Flume

The option of a new effluent Parshall flume was explored. This would include a new concrete channel being constructed with a new Parshall flume, which would be in the effluent piping downstream of where the UV bypass piping ties into the effluent piping. While this alternate would allow for monitoring of UV system effluent and the bypass flow, site constraints would make construction of a Parshall flume fed by gravity challenging and costly. For this reason, this alternative is considered infeasible for the Town and has not been considered further.

4.2.1.3 Description of Effluent Flow Monitoring 3: New Effluent Flow Meter in New Manhole

In order to satisfy the need to monitor both UV system effluent and the bypass, if in use, this alternative includes a new process manhole in the driveway area of the WWTF which will have a flowmeter to measure the effluent flows at the

WWTF. The existing flowmeter will be removed from the basement and 4-inch piping will be replaced with 8-inch piping to match other effluent piping. While this alternative provides flow monitoring of the existing effluent and bypass flows, a similar issue as with the existing setup is probable, where a small flowmeter is required for flow accuracy and a bottle neck may be created in the system. For this reason, this alternative is considered infeasible for the Town and has not been considered further.

4.2.1.4 Description of Effluent Flow Monitoring 4: Additional Flowmeter & Bypass in Basement

Another option explored for effluent flow monitoring was to install a second 4-inch magnetic flowmeter in the basement that can be used when flows at the facility are high. Automated valves on new piping would be controlled by SCADA to modulate the valve during high flows. In order to satisfy the requirement to also monitor flow that bypasses the UV system, a new UV bypass will be installed in the basement of the operations. The existing UV bypass from the secondary clarifiers to the discharge piping will be abandoned.

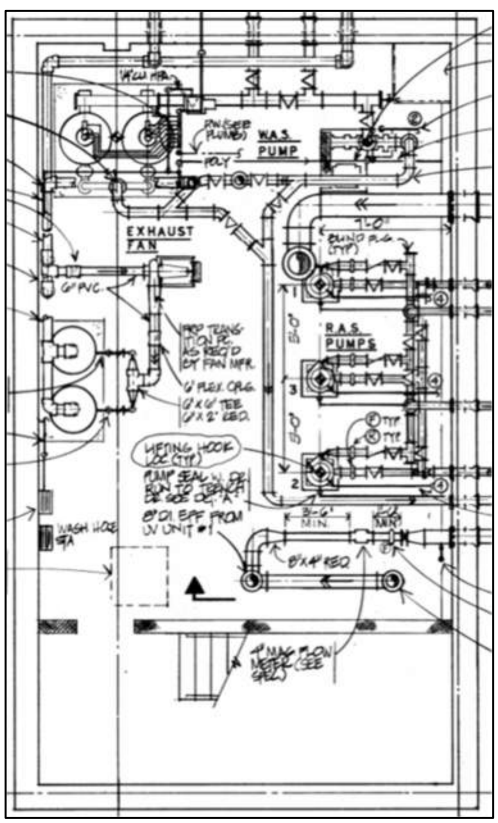
4.2.2 Design Criteria

The effluent flow monitoring improvement will be evaluated on its ability to measure all effluent flow at the WWTF, while minimizing impacts to upstream systems and maintenance requirements by operations staff.

4.2.3 Map

The proposed solution to this alternative will take place in the basement of the operations building at the WWTF. The following figure shows the existing layout of the WWTF basement, where the proposed upgrades will take place.

Figure 4-2: Operations Building Basement Layout



4.2.4 Environmental Impacts

There will be no environmental impacts as a result of the proposed alternatives, as they are in the confines of the existing site.

4.2.5 Land Requirements

All proposed upgrades will take place on the existing WWTF site; therefore, no land purchase will be required.

4.2.6 Potential Construction Problems

Construction problems for the proposed alternative are not anticipated. However, special consideration will have to be taken to ensure operation of existing system can be maintained during construction of the new system, which will include bypass pumping. Additionally, coordination for any existing utilities will be paid close attention to during design to avoid any construction conflicts.

4.2.7 Sustainability Considerations

Sustainable considerations are not applicable to the proposed alternative.

4.2.7.1 Water and Energy Efficiency

The overall water and energy efficiency at the existing WWTF will not be impacted by the proposed effluent flow monitoring upgrade.

4.2.7.2 Green Infrastructure

Green infrastructure is not applicable to the proposed alternative.

4.2.8 Cost Estimates

The following tables provide an opinion of probable installation, construction, and non-construction project costs for the proposed headworks improvements.

Table 4-2: Installation Cost Estimate- Effluent Flow Monitoring Upgrade

Description	Cost
Construction Costs	
UV System Bypass Piping	$38,000
Second Effluent Flow Meter	$42,000
Electrical, Instrumentation & Controls	$30,000
Construction Subtotal	**$110,000**
Non-Construction Costs	
Design (15%)	$18,000
Project Contingency (10%)	$12,000
Total Project Cost (2020$ Rounded)	**$140,000**

5. SELECTION OF AN ALTERNATIVE

The following section describe the process in which the selection of alternatives was completed.

5.1 Life Cycle Cost Analysis

All alternatives analyzed for this project resulted in only one feasible alternate for each process area based on the Town's needs. Therefore, an in-depth life cycle cost analysis was not completed for the alternatives presented.

5.2 Non-Monetary Factors

The two alternatives analyzed in Section 4 were chosen primarily due to non-monetary factors. For the headworks improvements, a properly functioning headworks is critical to the success of the rest of the downstream processes. Additionally, the reconfiguration of the screen and grit removal will eliminate the need to manually clean rags out of the grit system and will reduce contact with the material and the associated safety and health risks for the operators, including those from viruses. Therefore, a new headworks building that reconfigures the processes and provides additional area for automated chemical feed chosen in order to provide the most effective WWTF headworks while minimizing operator involvement in the processes.

For the effluent flow monitoring, prevent at bottleneck within the facility while monitoring all effluent flows drove the decision to install a new second effluent flow meter and a new UV system bypass. Additionally, constructability was a major component of this decision.

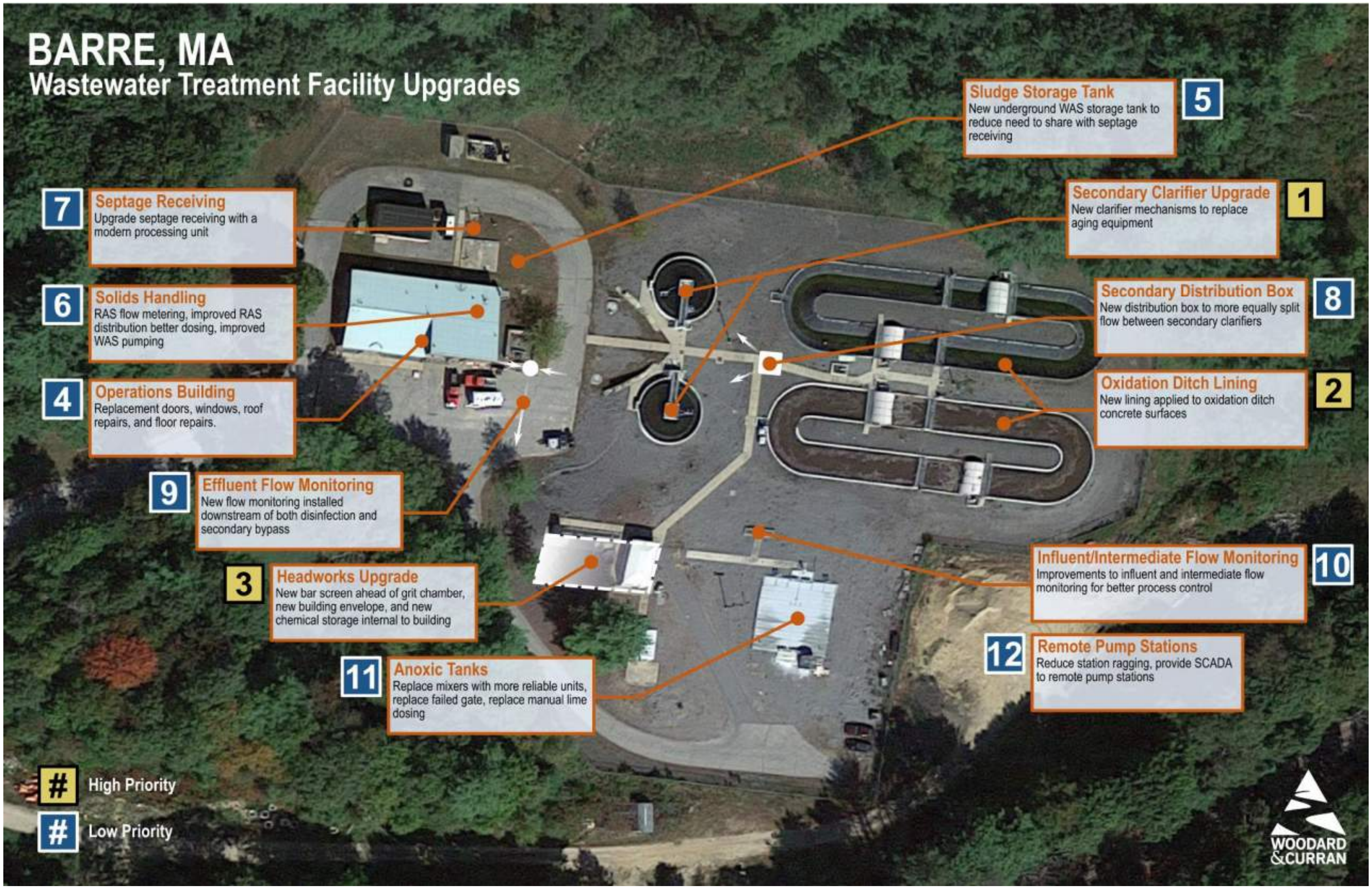
6. PROPOSED PROJECT

The following sections detail the entire proposed project for the Barre WWTF.

6.1 Preliminary Project Design

The following sections detail the recommended upgrades at the Barre WWTF in order of priority for the facility. Figure 6-1 shows the location of the proposed upgrades within the WWTF.

Figure 6-1: Proposed WWTF Upgrades



6.1.1 Secondary Clarifier Mechanism Rehabilitation

The first priority item for upgrades at the WWTF is replacement of the existing secondary clarifier mechanisms that are currently at the end of their useful life. This upgrade will consist of new clarifier mechanisms and installation of density current baffles in the tank.

6.1.2 Oxidation Ditch Rehabilitation

This upgrade consists of removing the remaining liner, repairing the concrete and relining the two oxidation ditches.

6.1.3 Headworks Improvements

As discussed in the alternative analysis, the recommended alternative for the headworks improvements is to build a new headworks building and reconfiguration the existing processes. A new headworks channel and screen will be installed upstream of the existing grit removal system, along with a new influent Parshall flume. Additionally, new automated chemical feed equipment will be located in the new headworks building.

6.1.4 Operations Building Improvements

Due to the age of the operations building, many structural components need repair or replacement to maintain the building and provide more efficient components. This upgrade consists of building roof repairs, replacement of all exterior windows, replacement of all exterior doors, flooring repairs and installation of gutters on the building.

6.1.5 New Sludge Storage Tank

As discussed in the alternatives analysis, the recommended alternative is to construct a new sludge storage tank next to the existing tanks to serve as only WAS storage, providing the facility with increased storage capacity and operation flexibility.

6.1.6 Solids Handling Improvements

Currently both the RAS and WAS systems at the WWTF need improvements to optimize the processes and create automated processes for operators. For the RAS system, this upgrade consists of new magnetic flow meter are the two RAS pipes installed in a new valve vault structure located outside the operations building. Additionally, piping modifications in the oxidation ditch splitter box are proposed to better distribute RAS to the oxidation ditches. Improvements to the WAS system include automation of the wasting at the WWTF, including controls to allow operators to waste small amounts daily to the new waste holding tank.

6.1.7 Septage Receiving Station Upgrade

The septage receiving at the WWTF currently consists of an open connection point to a rock trap and then a septage storage tank. Septage from the tank is then pumped to the headworks for treatment. Operators at the WWTF would like to provide more automation and improved receiving abilities at the WWTF. The proposed upgrade consists of the installation of a septage receiving station equipment will piping modification to connect effluent from the unit to the existing tank.

6.1.8 Secondary Clarifier Splitter Box

Currently flow from oxidation ditch one goes to directly to secondary clarifier one, and flow from oxidation ditch two goes to directly to secondary clarifier two. This upgrade consists of the installation of a concrete splitter box between the oxidation ditches and secondary clarifiers in order to provide a more even flow split to the secondary clarifiers

6.1.9 Effluent Flow Monitoring Improvements

As detailed in the alternatives analysis, the recommended alternative for the effluent flow monitoring is not demo the existing effluent magnetic flow meter and install a new flow meter in a manhole downstream of where the disinfection system bypass piping enters into the effluent piping.

6.1.10 Intermediate Flow Monitoring Improvements

Operations staff would like to maintain a means to measure flow after the equalization tanks in order to monitor the pumped flow to the equalization tanks. The existing Parshall flume does not properly measure flow. The recommended upgrade is to demo the existing flume and install new piping with a new flow meter to measure flow at this location. This project component is not anticipated to be included in the project scope at this time but will be completed if additional funding is available.

6.1.11 Anoxic/Equalization Tank Mixers

The mixers in the anoxic and equalization tanks at the WWTF are at the end of their useful life and require significant maintenance to continue operation. It is recommended that the mixers be replaced in this tank. Additionally, installation of a second mixer in each tank is being considered. This project component is not anticipated to be included in the project scope at this time but will be completed if additional funding is available.

6.1.12 Pump Station Improvements

The four pump stations in the WWTF collection system currently experience ragging issues in the pumps and are not connected to the SCADA system at the WWTF. This proposed upgrade would consist of new non-clog pumps at the pump stations and a new controls system to allow connected to SCADA. This project component is not anticipated to be included in the project scope at this time but will be completed if additional funding is available.

6.2 Project Schedule

A preliminary project schedule is provided in the following table. The preliminary schedule establishes an aggressive timeline for the project. The project schedule will be refined in subsequent phases of work based on the funding allocations and other factors.

Table 6-1: Project Schedule

Project Task	Start Date	End Date
Submit Funding Application	-	January 2021
Conduct Public Outreach & Project Approval	March 2021	June 2021
Preliminary Design	June 2021	September 2021
90% Design	September 2021	December 2021
Final 100% Design	January 2022	February 2022
Bid and Award	March 2022	April 2022
Construction	May 2022	May 2023
Startup/Closeout	June 2023	August 2023

6.3 Permit Requirements

Permitting required for this project should be minimal. No update will be required to the facilities discharge permit.

6.4 Sustainability Considerations

Sustainability considerations, which will be explored in more detail during design, include energy efficiency, reduction in carbon footprint, resiliency, and operational simplicity.

6.4.1 Water and Energy Efficiency

The plant-wide upgrades proposed in this project will have impacts to the energy efficiency of the WWTF through updates equipment and electrical components that will be more efficient that older equipment currently installed. Additionally, replacement windows and doors in the operations building should lead to a more efficient use of the HVAC system in the operations building. The project will have minimal impact to the water consumption at the WWTF. Improvements in the headworks may require more use of the plant water system then the WWTF currently sees, which will be further evaluated during design.

6.4.2 Green Infrastructure

Green infrastructure will be considered for implementation during detailed design and will be used to the greatest practical extent.

6.4.3 Other

Many of the proposed upgrades provide significant improvements to operational simplicity at the WWTF, created a more automated process for operations staff to maintain treatment at the WWTF. The improvements should minimize the need to manually handle WWTF solids.

6.5 Total Project Cost Estimate (Engineer's Opinion of Probable Cost)

The following Table 6-2 provides a summary table with a breakdown of the engineer's opinion of probable cost for each of the proposed upgrades. The project has been divided into two phases, Phase 1 and Phase 2. Phase 1 includes the project components operators consider critical to operations at the WWTF and minimizing long-term maintenance costs. Phase 2 consists of items that are a lesser priority to WWTF operations staff. These items are focused on improving plant efficiency. Based on available funding, project components can shift from Phase 1 to Phase 2, or vice versa, as needed.

Table 6-2: Engineer's Opinion of Probably Cost

Number	Project	Construction Cost Totals
PHASE 1		
1	Secondary Clarifier Mechanism Rehabilitation	$ 730,000
2	Oxidation Ditch Rehabilitation	$ 560,000
3	Headworks Improvements	$ 2,400,000
4	Operations Building improvements	$ 120,000
5	New Sludge Storage Tank	$ 360,000
6	Solids Handling Improvements	$ 250,000
7	Septage Receiving Station Upgrade	$ 610,000
8	Secondary Clarifier Splitter Box	$ 250,000
9	Effluent Flow Monitoring Improvements	$ 110,000
	Subtotal	**$ 5,400,000**
	Engineering/Construction Services Fees (15%)	$ 810,000
	Contingency (10%)	$ 540,000
	TOTAL (2020$ Rounded)	**$ 6,800,000**
PHASE 2		
10	Intermediate Flow Monitoring Improvements	$ 74,000
11	Anoxic/Equalization Tank Mixers	$ 66,000
12	Pump Station Improvements	$ 620,000
	Subtotal	**$ 760,000**
	Engineering/Construction Services Fees (15%)	$ 110,000
	Contingency (10%)	$ 76,000
	TOTAL (2020$ Rounded)	**$ 950,000**

6.6 Annual Operating Budget

The Town of Barre has separate enterprise funds for water and sewer operations. As stated in section 2.4 above the sewer enterprise fund captures the revenue generated by rate payers to fund operations and capital investments needed to maintain the system. The approved operating budget for Fiscal Year 2021 is provided in Table 6-3 below and includes operating costs, operations and maintenance costs, and debt service.

Table 6-3: Fiscal Year 2021 Operating Budget

Expenses	FY2021
Salaries	$294,041
Salaries Sub-Total	**$294,041**
Administration	$32,200
Sewer Operations	$251,700
Sewer Maintenance	$57,600
Infiltration/Inflow	$10,000
Replacement Fund	$40,000
Administration Sub-Total	**$391,500**
Debt Service – WWTF Upgrade	$81,600
Debt Service – Filter Upgrade	$77,000
Debt Service Sub-Total	**$158,600**
Total Budget	**$844,141**

6.6.1 Income

The Town of Barre meets its operations and maintenance costs through its sewer user fees. The Town charges a quarterly flat sewer rate of $100.00 for usage up to 10 HCF and $10/HCF for all usage in excess of 10 HCF. Unmetered accounts are charged a flat fee of $150/quarter.

In 2021, the Sewer Department's revenue is projected to total $885,820, this includes $730,000 anticipated in sewer rate revenue and $158,600 in retained earnings for existing sewer debt service. FY21 anticipated revenues are shown on the Table below.

Table 6-4: FY21 Sewer Department Anticipated Revenue

Description	Cost
Anticipated Sewer User Fees	$730,000
Retained Earnings toward Expenses	$0
Retained Earnings toward Debt Service	$158,600
Total Anticipated FY21 Revenue	**$888,660**

6.6.2 Annual O&M Costs

The following Table 6-5 presents the projected annual operations and maintenance costs for the WWTF.

Table 6-5: Projected Annual Operations & Maintenance Costs

Description	Estimated Cost
Sewer Operations	
Heating/Oil Propane	$20,000
Diesel for Generator	$1,500
Pager Alarms	$3,300
Electricity	$60,000
Water	$15,000
Chemicals	$30,000
Laboratory	$5,000
Uniforms	$2,400
Contract Lab Service	$18,000
Equipment Calibration	$2,000
Supplies	$3,500
Safety Equipment	$1,000
Sludge Disposal	$90,000
Subtotal Operations	**$251,700**
Sewer Maintenance	
Collection System	$6,000
Compressor	$600
Cleaning Supplies	$1,500
Vehicle Equipment Repairs	$4,000
Buildings/Yard	$1,000
Generators	$4,000
Electric/Plumbing/Heating	$6,000
Oil/Grease	$500
Equipment Parts/ Repairs	$34,000
Subtotal Maintenance	**$57,600**
Total Operations & Maintenance	**$309,300**

6.6.3 Debt Repayments

The USDA Water and Waste Disposal Interest Rates for FY2021 Q1 (October 1, 2020 to December 31, 2020) are:

- Poverty Rate of 1.250% if the median household income of the service area is 80% of the Massachusetts non-metropolitan median household income of $82,128 and the project is needed to meet regulatory agency or health or sanitary standards.

- Intermediate Rate of 1.750% if the non-metropolitan median household income of the service area is below $82,128 and the applicant does not qualify for the poverty rate.

- Market Rate of 2.125% if the median household income of the service area equals or exceeds the current Massachusetts non-metropolitan median household income of $82,128.

The Town of Barre's US Census 2010 Median Household Income is $75,432 and qualifies for an intermediate interest rate of 1.75%. The total debt repayment options for Phase 1 and Phase 2, as well as their impacts to the anticipated sewer user fees, are listed in Table Table 6-6, Table 6-7 and Table 6-8 below.

Table 6-6: Phase 1 User Fee Calculations

Item	Total Amount
1) Total Loan Amount	$6,800,000
2) Net Annual Debt Repayment, (40-year, 1.75%)	$237,810
3) Average Annual Rate Increase Per Connection 33%	**$396.00**
4) Sewer User Fee as % of MHI of $75,423 (2010 Census)	**2.12%**
5) Sewer User Fee as % of MHI of $69,735 (2015-2019 US Census ACS)	**2.29%**

Table 6-7: Phase 2 User Fee Calculations

Item	Total Amount
1) Total Loan Amount	$950,000
2) Net Annual Debt Repayment, (40-year, 1.75%)	$33,223
3) Average Annual Rate Increase Per Connection 4.55%	**$54.61**
4) Sewer User Fee as % of MHI of $75,423 (2010 Census)	**1.66%**
5) Sewer User Fee as % of MHI of $69,735 (2015-2019 US Census ACS)	**1.80%**

Table 6-8: Phase 1 & 2 User Fee Calculation

Item	Total Amount
1) Total Loan Amount	$7,750,000
2) Net Annual Debt Repayment, (40-year, 1.75%)	$271,034
3) Average Annual Rate Increase Per Connection 37.13%	**$445.56**
4) Sewer User Fee as % of MHI of $75,423 (2010 Census)	**2.18%**
5) Sewer User Fee as % of MHI of $69,735 (2015-2019 US Census ACS)	**2.36%**

6.6.4 Reserves

The Water and Sewer Departments' finances are managed under enterprise funds, separately from the general fund, which allows the Town to effectively identify these utilities' true delivery costs— direct, indirect, and capital—and set user fees at levels sufficient to recover them. Under this accounting, the Town may reserve each operation's generated surplus (referred to as retained earnings) rather than closing the amount to the general fund at year-end. Each enterprise reserve is used to provide rate stabilization and fund major capital projects. For each of the two enterprise funds, the Town maintains a minimum reserve amount of 25 percent of the operation's total budget. This represents about three months' worth of expenditures, but whenever any major infrastructure improvements are being planned for either enterprise operation, its minimum target should be revised upward. To maintain the target reserve level for either fund requires its Commissioners to periodically review, and when necessary, adjust user rates. .

7. CONCLUSIONS AND RECOMMENDATIONS

Woodard & Curran recommends that the Barre WWTF implement a two-phase project schedule to upgrade critical part of the plant. Phase 1 includes the following upgrades:

1) **Secondary Clarifier Mechanism Rehabilitation** – This includes new mechanisms and associated appurtenances for the two secondary clarifiers at the WWTF.

2) **Oxidation Ditch Rehabilitation** – This includes structural rehabilitation and relining of both oxidation ditches at the WWTF.

3) **Headworks Improvements** – An alternatives analysis has been completed to determine the scope of this upgrade. Recommended improvements include reconfiguration of the headworks processes, grit removal optimization, a new influent screen, a new headworks building, and a new chemical storage area with new chemical feed for alkalinity adjustment.

4) **Operations Building Improvements** – This includes replacement of doors, replacement of windows, repairs to the flooring, and repairs on the roof of the operations building.

5) **New Sludge Storage Tank** – This includes the construction of a new underground sludge storage tank to store WAS from the secondary clarifiers.

6) **Solids Handling Improvements** – This includes improvements to the WAS and RAS pumping system, RAS flow metering, and reconfiguration of the oxidation ditch splitter box for RAS distribution.

7) **Septage Receiving Station Upgrade** – This includes a new septage receiving station for the WWTF.

8) **Secondary Clarifier Splitter Box** – This includes the installation of a new splitter box after the oxidation ditches, prior to the secondary clarifiers to allow improved flow distribution to the clarifiers.

9) **Effluent Flow Monitoring Improvements** – This includes improvements effluent flow monitoring at the WWTF which includes a new effluent flow meter.

Phase 2 of the project includes the following upgrades:

10) **Intermediate Flow Monitoring Improvements** – This includes improvements to flow monitoring after the equalization tanks.

11) **Anoxic/Equalization Tank Mixers** – This includes replacement of existing mixers in the anoxic/EQ tanks.

12) **Pump Station Improvements** – This includes addressing ragging issues and providing SCADA to the pump stations in the collection system.

The scope of work defined in each phased can be altered based on available funding for the projects. Proposed improvements have been listed in order of priority in order to categorize project components when funding amount is determined.