

WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY

Prepared for:

Town of Woodstock, Vermont



PRELIMINARY ENGINEERING REPORT - FINAL



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Table of Contents

1. PROJECT PLANNING 1-1

 1.1 Background 1-1

 1.2 Scope of Services..... 1-1

 1.3 Location..... 1-2

 1.4 Environmental Resources 1-2

 1.4.1. Ottawaquechee River 1-2

 1.4.2. Floodplain..... 1-2

 1.4.3. Wetlands 1-3

 1.4.4. Rare and Endangered Species..... 1-3

 1.4.5. Archeological Resources 1-3

 1.4.6. Historical Preservation..... 1-3

 1.5 Population Trends..... 1-3

 1.6 Community Engagement 1-3

 1.6.1. Public Participation 1-3

2. EXISTING FACILITIES 2-1

 2.1 Location Map 2-1

 2.2 History 2-1

 2.3 Existing Discharge Permit..... 2-1

 2.4 Original Design Criteria 2-2

 2.5 Historical Operating Data..... 2-3

 2.5.1. Flow..... 2-3

 2.5.2. Biochemical Oxygen Demand (BOD)..... 2-4

 2.5.3. Total Suspended Solids (TSS) 2-5

 2.5.4. Total Nitrogen (TN) 2-7

 2.5.5. E. Coli..... 2-8

2.6	Condition of Existing Facilities	2-9
2.6.1.	Headworks Assessment	2-9
2.6.2.	Influent Pump Station	2-12
2.6.3.	Biological Process	2-13
2.6.4.	Secondary Clarification	2-17
2.6.5.	Return and Waste Activated Sludge Pump System & Scum Pumping	2-19
2.6.6.	Disinfection	2-21
2.6.7.	Effluent Flow Measurement	2-25
2.6.8.	Outfall	2-26
2.6.9.	Solids Handling.....	2-27
2.6.10.	Control Building	2-29
2.6.11.	Site	2-29
2.6.12.	WWTF Electrical System and Instrumentation	2-31
2.6.12.1.	Existing Conditions	2-32
2.6.12.2.	Summary of Code Related Items	2-36
2.7	Financial Status of Any Existing Facilities.....	2-38
2.8	Water/Energy/Waste Audits.....	2-38
3.	NEED FOR PROJECT	3-1
3.1	Health, Sanitation and Security.....	3-1
3.2	Aging Infrastructure	3-1
3.3	Reasonable Growth.....	3-2
4.	ALTERNATIVES CONSIDERED.....	4-1
4.1	Design Criteria.....	4-1
4.1.1.	Influent.....	4-1
4.1.2.	Effluent.....	4-1
4.2	Headworks	4-2
4.2.1.	Headworks Design Criteria.....	4-2
4.2.2.	Screening Alternatives Introduction	4-3

4.2.3.	Screening Alternative 1 – Rotary Fine Screen – Micro Strainer	4-4
4.2.4.	Screening Alternative 2 – Center Flow Fine Screen	4-8
4.2.5.	Screening Alternative 3 – Stair Fine Screen	4-12
4.2.6.	Comparison of Construction Cost Estimates of Screening Alternatives	4-15
4.2.7.	Life Cycle Cost Comparison – Screening Alternatives	4-16
4.3	Grit Removal	4-16
4.4	Influent Pumping.....	4-20
4.5	Biological Process.....	4-22
4.6	Chemical Feed and Storage for Phosphorus Removal	4-26
4.7	Secondary Clarifiers	4-27
4.8	Return and Waste Activated Sludge Pumping	4-30
4.9	Disinfection	4-32
4.9.1.	Disinfection Design Criteria.....	4-32
4.9.2.	Disinfection Alternative 1 – New Chlorine Contact Tank.....	4-33
4.9.3.	Disinfection Alternative 2 – Ultraviolet Disinfection	4-36
4.9.4.	Comparison of Construction Cost Estimates of Disinfection Alternatives.....	4-39
4.10	Effluent Flow Measurement	4-40
4.11	pH Adjustment Chemical Feed and Storage	4-41
4.12	Plant Water	4-42
4.13	Sludge Holding	4-44
4.14	Control Building	4-45
4.15	Site and Stormwater Pump Station	4-46
4.16	Recommendations for Electrical Modifications.....	4-48
4.17	Summary of Total Estimated Construction Costs	4-54
5.	SELECTION OF AN ALTERNATIVE.....	5-1
5.1	Introduction	5-1
5.2	Influent Screening.....	5-1
5.2.1.	Description	5-1



- 5.2.2. Life Cycle Cost Analysis5-2
- 5.2.3. Non-Monetary Factors.....5-2
- 5.2.4. Selected Alternative.....5-2
- 5.3 Disinfection5-2
 - 5.3.1. Description5-2
 - 5.3.2. Life Cycle Cost Analysis5-2
 - 5.3.3. Non-Monetary Factors.....5-3
 - 5.3.4. Selected Alternative.....5-3
- 6. PROPOSED PROJECT.....6-1
 - 6.1 Woodstock Main Wastewater Treatment Facility Proposed Project6-1
 - 6.2 Project Schedule6-7
 - 6.3 Total Project Cost.....6-8
 - 6.4 Sustainability Considerations.....6-10
 - 6.4.1. Water and Energy Efficiency6-10
 - 6.4.2. Green Infrastructure6-10
 - 6.5 Annual Operating Budget6-10
 - 6.5.1. Income6-10
 - 6.5.2. Annual O&M Costs.....6-10
 - 6.5.3. Debt Repayments.....6-11
 - 6.5.4. Reserves6-11
- 7 Conclusions and Recommendations7-1

List of Appendices

Appendix A – Figures

Appendix B – Natural Resource Atlas Maps

Appendix C – Hoyle Tanner Total Nitrogen Allocation Letter to VTDEC, April 2020

Appendix D – Engineer’s Opinions of Probable Construction Costs

1. PROJECT PLANNING

1.1 Background

The Town of Woodstock owns and operates the Woodstock Main WWTF (Main WWTF) which has a permitted capacity of 0.450 million gallons per day (MGD). The facility consists of a headworks structure that provides screening, grinding, grit removal, and influent pumping. Wastewater is pumped into two 5-celled aeration basins, with two secondary clarifiers followed by two contact chambers for chlorine disinfection and de-chlorination. Effluent flows are measured using a rectangular weir and ultrasonic level detector prior to discharge to the Ottauquechee River.

Solids handling facilities include two aerated holding tanks with 140,000 and 280,000 gallon capacities. Solids are contract dewatered and hauled away for disposal.

A 20-year Engineering Evaluation of the facility, including the collection system, was completed in 2005.

The following is a history of the facility as stated in the 2005 20-Year Engineering Evaluation and Report:

- 1968: Original Facility Constructed
- 1982: Secondary clarifiers, stormwater pump station, process building addition
- 1988: Sludge storage tank
- 1998: Sludge storage tank #2 and separate blower building
- 2006: Headworks improvements

This preliminary engineering study will assess the existing facility to identify needs, develop alternatives to address the needs, and select a recommended alternative.

1.2 Scope of Services

Hoyle, Tanner's scope of services for this study is summarized in the following:

The Preliminary Engineering Report (PER) will be prepared to incorporate the following information. The PER will follow the State Water Investment Division (WID) format.

- Project Planning (Section 1)
- Existing Wastewater Facilities (Section 2)
- Need for Project (Section 3)
- Alternatives Considered (Section 4)
- Selection of Alternative (Section 5)
- Proposed Project (Recommended Alternative) (Section 6)
 - Proposed Hydraulic Profile
 - Proposed Process Flow Diagram

- Proposed Site Plan
- Equipment selection details including design criteria and preliminary layouts
- Opinion of Probable Construction Cost
- Opinion of Probable Total Project Cost
- Project phasing defined in a Sequence of Work
- List of permits/approvals needed for State agencies
- Proposed project schedule
- Proposed next steps

1.3 Location

The Main WWTF is located on Maxham Meadow Way in the Village of Woodstock, Vermont. The Main WWTF receives wastewater from residential, commercial, and institutional sources and discharges to the adjacent Ottauquechee River through an outfall. An overall location map is provided in Figure A-1 in Appendix A.

1.4 Environmental Resources

The proposed project will not increase the hydraulic capacity of the Main WWTF as the improvements will be addressing age related needs. All proposed work will occur within the Town property at the Main WWTF in previously disturbed areas.

1.4.1. Ottauquechee River

The Main WWTF discharges to a waste management zone in the Ottauquechee River, a Class B water, and a designated Cold Water Fish Habitat.

1.4.2. Floodplain

The Main WWTF is located within the FEMA designated 100-year and 500-year floodplain but is not located within the regulatory floodway of the Ottauquechee River as shown in Figure B-1 in Appendix B. The 2007 National Flood Insurance Rate Map (FIRM) (Community Number 500181, Panel 0344, Suffix E) for the Ottauquechee River, shows the 100-year flood elevation at Main WWTF at 675.00 feet. Flood profiles for the Ottauquechee River show the 500-year flood elevation at the WWTF site to be approximately 676.00 feet based on the facility's approximate distance of 400 feet from cross-section "AQ" on Flood Profile 177P of the FEMA Flood Insurance Study No. 50027CV003A for Windsor County dated September 28, 2007. See Appendix B for river profile at the WWTF site.

According to record drawings, the 25-year flood elevation is 672.3 ft.

The Main WWTF is surrounded by an earthen berm to protect it from flooding. The top of berm elevation is 678.00 feet.

1.4.3. Wetlands

No portions of the WWTF property are part of a Wetlands Advisory Layer defined by the Vermont Agency of Natural Resources. There are no classified wetlands located on the property as shown in Figure B-2 in Appendix B.

1.4.4. Rare and Endangered Species

No portions of the WWTF property are located in an area designated with the element occurrence of a rare or endangered plant as shown in Figure B-3 of Appendix B.

1.4.5. Archeological Resources

Pending

1.4.6. Historical Preservation

Pending

1.5 Population Trends

The United States Census Bureau population data for the Town of Woodstock from 2000, 2010, and 2020 were 3,232, 3,048 and 3,005 respectively, a decrease of approximately 7% in population during this period. The Town & Village of Woodstock, Vermont Comprehensive Plan dated 2016 states “Population declines in the first 10 years of this new millennium are expected to stabilize, but significant growth is not anticipated.”

1.6 Community Engagement

1.6.1. Public Participation

For public participation, the Town of Woodstock reaches out to the public to educate and inform stakeholders of the needs of the Town’s wastewater infrastructure and any proposed recommended projects at public meetings where public comments can be received.

2. EXISTING FACILITIES

2.1 Location Map

A location map is shown in Figure A-1 in Appendix A.

2.2 History

The Town of Woodstock owns and operates the Woodstock Main Wastewater Treatment Facility (Main WWTF) and associated 8.5 miles of gravity sewer and one pump station that make up the collection system serving the service area. The history of the facility is as follows:

- 1967: Constructed as an activated sludge treatment process with a package aeration tank/secondary clarifier
- 1982: Major upgrade
- 1999: New sludge handling facilities and back-up generator
- 2006: Headworks was upgraded with a mechanical influent screening
- 2016: New aeration tank blowers with VFDs and a new motor control center (MCC) were installed.

Although some specific equipment upgrades and replacements have occurred in the past 6 to 23 years, the majority of the facility has not been upgraded since the major upgrade in 1982. The existing WWTF site plan, process flow diagram, and hydraulic profile are provided in Figures A-2, A-3, and A-4 respectively in Appendix A.

2.3 Existing Discharge Permit

The Woodstock Main WWTF is permitted under Discharge Permit No. 3-1228, effective date October 1, 2019, to discharge treated effluent from outfall S/N 001 to the Ottauquechee River.

Table 2.1 summarizes the WWTF's existing discharge permit flow and effluent quality requirements. The current version of the NPDES permit and fact sheet are publicly available at:

<https://dec.vermont.gov/watershed/wastewater/discharge-permits>

Table 2.1 Woodstock Main WWTF Current NPDES Discharge Permit

Effluent Parameter	Annual Limit	Monthly Average	Weekly Average	Daily Maximum	Instantaneous Maximum
Flow (annual average)	0.450 MGD	--	--	--	--
BOD ₅	--	30 mg/l 113 lbs	45 mg/l 248 lbs	50 mg/l --	--
TSS	--	30 mg/l 113 lbs	45 mg/l 248 lbs	50 mg/l --	--
Total Phosphorus	-	-	--	Monitor Only	-
Total Nitrogen	-	-	-	Monitor Only	-
Total Kjeldahl Nitrogen (TKN)	-	-	-	Monitor Only	-
Nitrate/Nitrite Nitrogen (NO _x)	-	-	-	Monitor Only	-
Settleable Solids	--	--	--	--	1.0 mg/l
Total Residual Chlorine	--	--	-	--	0.1 mg/l
E. Coli Bacteria	--	--	--	--	77 col/100 ml
pH	--	Between 6.5 and 8.5 Standard Units			--

In April 2020, Hoyle Tanner prepared a letter report recommending adjustments to the South Woodstock WWTF and Woodstock Main WWTF estimated total nitrogen (TN) allocations (see Appendix C). Currently the Woodstock Main WWTF has an estimated annual average TN allocation of 55 lbs/day. Based on review of the historical operating data for the Main WWTF, it was recommended to transfer 3 lbs/day TN from the Main WWTF to the South Woodstock WWTF. Therefore, the estimated allocation for the Main WWTF would be reduced to an annual average of 52 lbs/day TN.

2.4 Original Design Criteria

Table 2-2 summarizes the original WWTF design criteria.

Table 2-2 Existing Influent Design Criteria

Parameter	Design Criteria ¹	Current ²
Average Daily Flow	0.450 MGD	0.224 MGD
Peak Hourly Flow	0.750 MGD	> 0.750 MGD
Biochemical Oxygen Demand	117 mg/l 439 lbs/day	289 mg/l 540 lbs/day
Total Suspended Solids	101 mg/l 379 lbs/day	213 mg/l 394 lbs/day

Notes:

1. Source: Operations and Maintenance Manual, 1983.
2. Based on Daily Monitoring Report data from January 2016 to September 2021

2.5 Historical Operating Data

Historical operating data was reviewed from January 2016 to September 2021.

2.5.1. Flow

Influent flow is not measured at the Woodstock WWTF. Effluent flow is measured at the effluent v-notch weir in the chlorine contact tank (CCT).

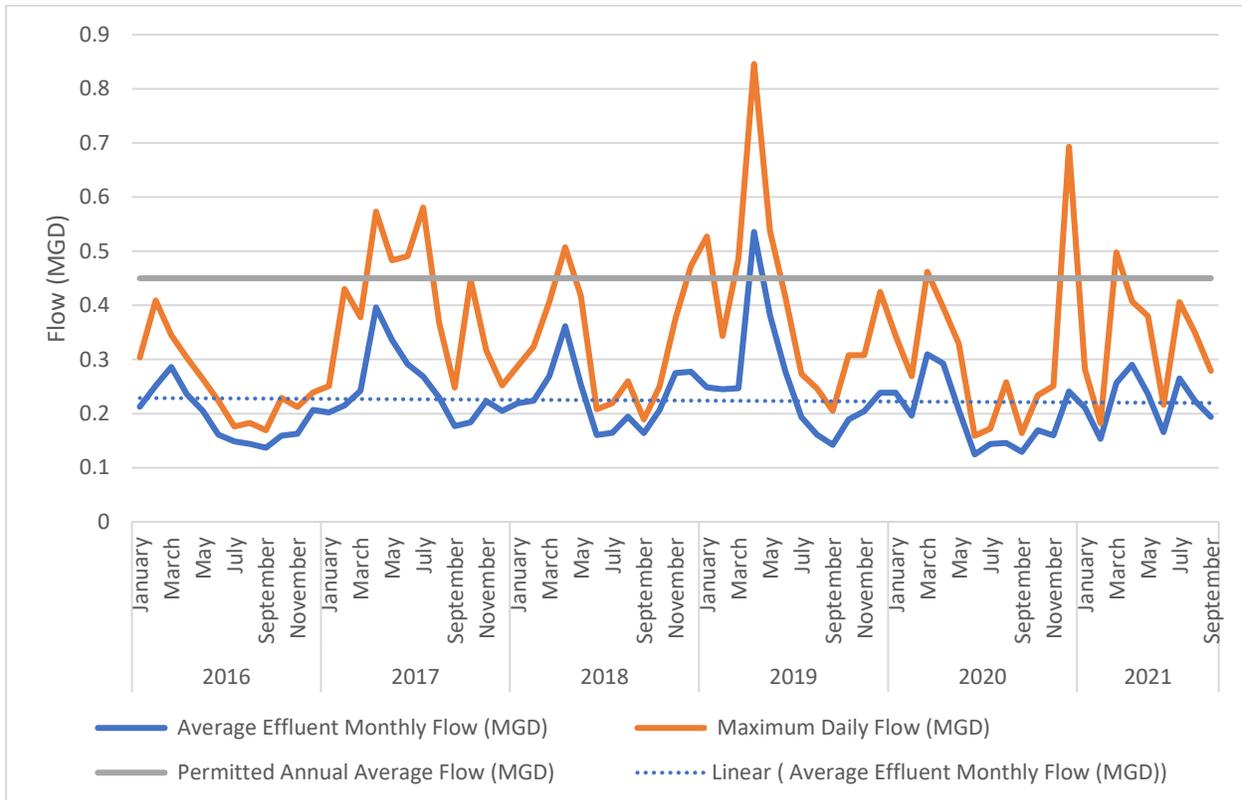


Figure 2.1 Influent and Effluent Flow

The average monthly effluent flow from January 2016 to September 2021 was 0.22 MGD, which is 49% of the design influent average daily flow of 0.450 MGD. The maximum monthly average influent flow during this period was 0.536 MGD in April 2019, which exceeds the design average monthly flow and permitted average annual flow of 0.450 MGD.

The peak day influent flow from January 2016 to September 2021 was 0.846 MGD in April 2019. The original 1983 design did not include design criteria for peak day flow. The 1983 design peak hourly flow was 0.750 MGD. Therefore, the peak day flow exceeded the design peak hour flow in April 2019. The effluent flow circular chart recording from April 15, 2019 showed a peak flow of approximately 0.972 MGD.

Based on the historical flow data, it appears flows exceed the 1983 design peak hourly flow.

2.5.2. Biochemical Oxygen Demand (BOD)

The average influent BOD concentration from January 2016 to September 2021 was 289 mg/l which is greater than the 1983 design influent BOD concentration of 117 mg/l. Influent BOD concentrations have been increasing over this time period. The average influent BOD concentration from January 2019 to September 2021 was 371 mg/l compared to 221 mg/l for 2016 to 2018, which is a 68% increase.

The influent BOD load has been at or exceeding the 1983 design BOD loading of 439 lbs/d since 2018. The average annual influent BOD load for 2019 through September 2021 was 772 lbs/d BOD. This is 1.76 times the 1983 design influent BOD load. Despite the loading exceeding the original design, the WWTF has been performing well and removes between 92-99+% of BOD. Average percent BOD removal from 2019 through September 2021 was 98%.

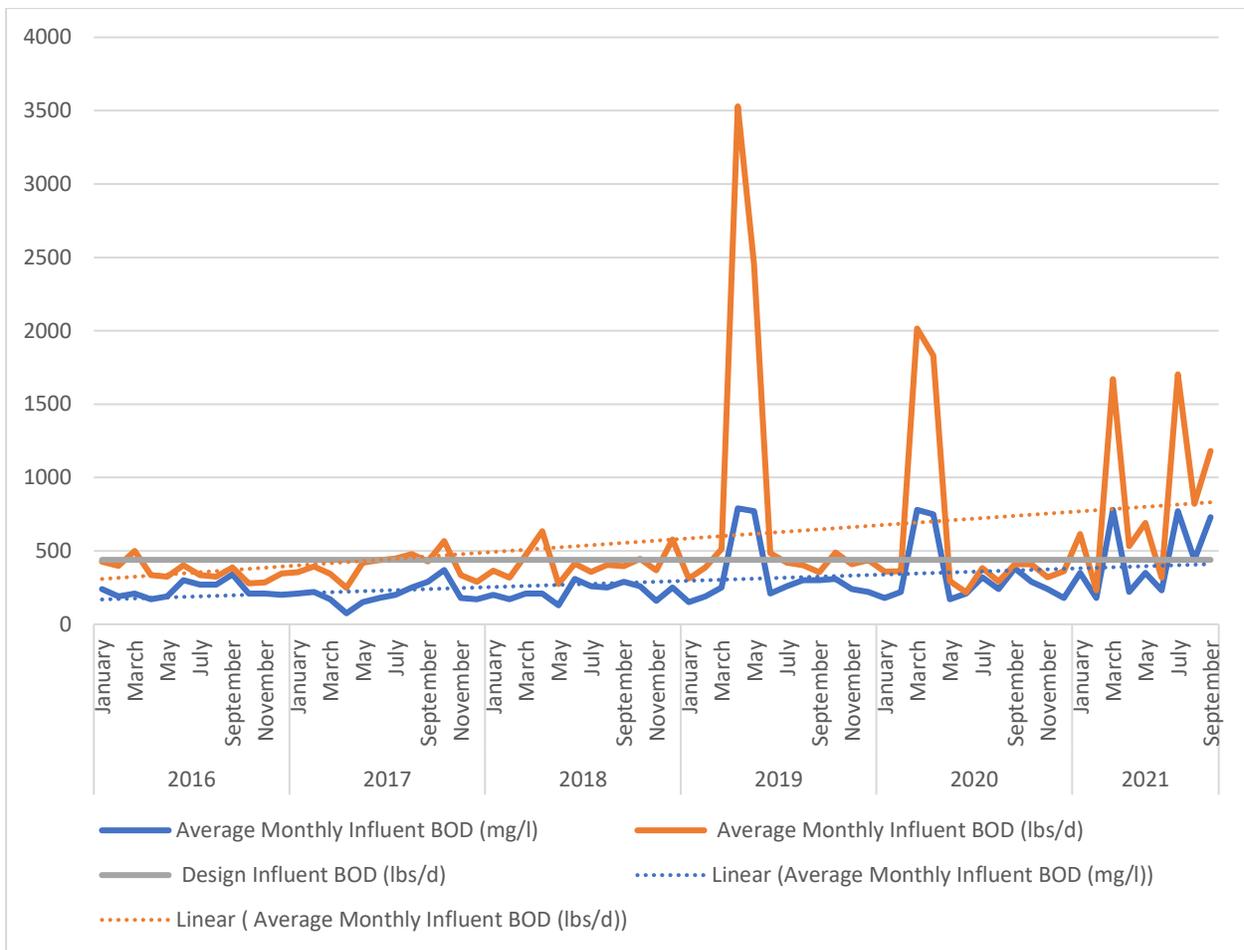


Figure 2.2 Influent BOD

Effluent BOD concentration ranged from 2.5 to 14 mg/l with an average of 4.9 mg/l. The average effluent BOD load was 8.8 lbs/day which is well below the permitted monthly average load of 113 lbs/d. Based on this data, it appears the existing extended aeration process provides conditions that support effective BOD removal at current loadings.

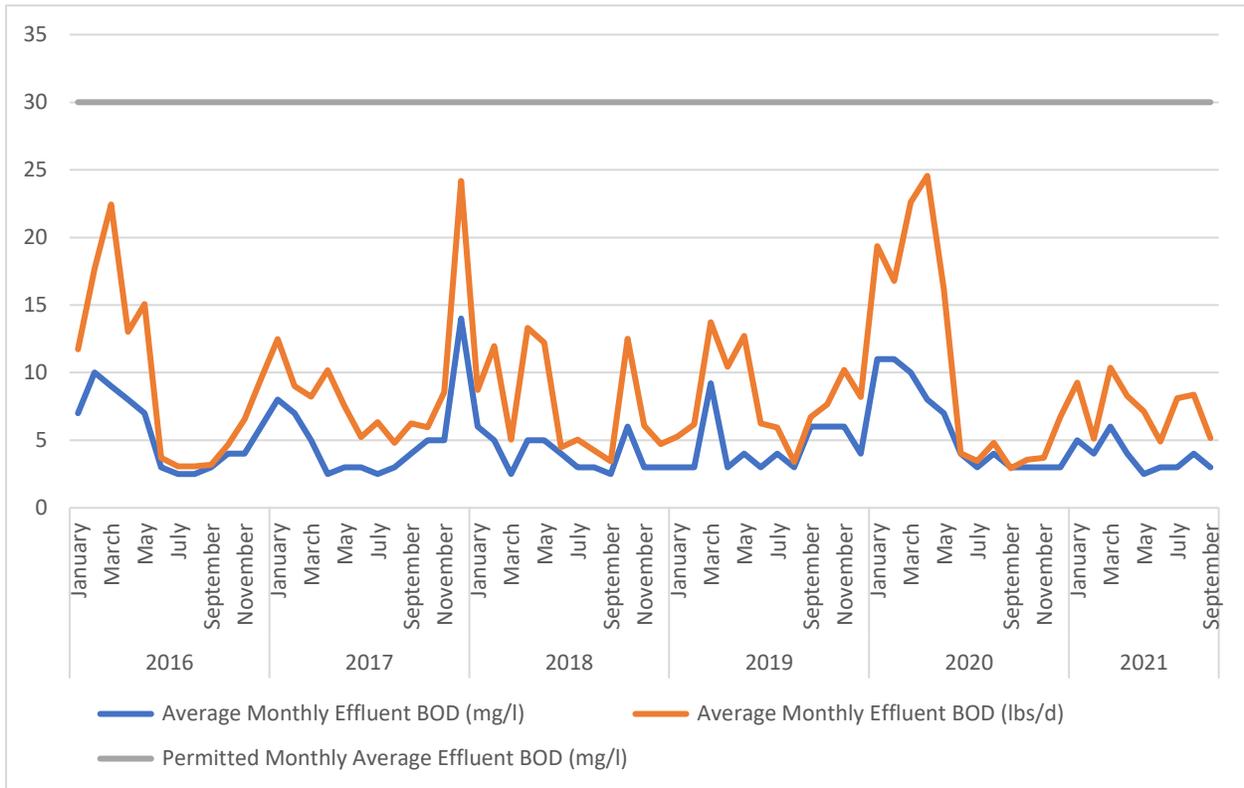


Figure 2.3 Effluent BOD

2.5.3. Total Suspended Solids (TSS)

The average influent TSS concentration from January 2016 to September 2021 was 213 mg/l which is greater than the 1983 design influent BOD concentration of 101 mg/l. Influent TSS concentrations have been increasing over this time period. The average annual influent TSS concentration from January 2019 to September 2021 was 243 mg/l compared to 185 mg/l for 2016 to 2018, which is a 31% increase.

The influent TSS load has been at or exceeding the 1983 design BOD loading of 379 lbs/d since 2019. The average annual influent TSS load for 2019 through September 2021 was 464 lbs/d TSS. This is 1.22 times the 1983 design influent TSS load. Despite the loading exceeding the original design, the WWTF has been performing well and removes between 94-99+% of TSS. Average percent TSS removal from 2019 through September 2021 was 99%.

Woodstock Main Wastewater Treatment Facility Upgrade
Preliminary Engineering Report
Section 2 – Existing Facilities

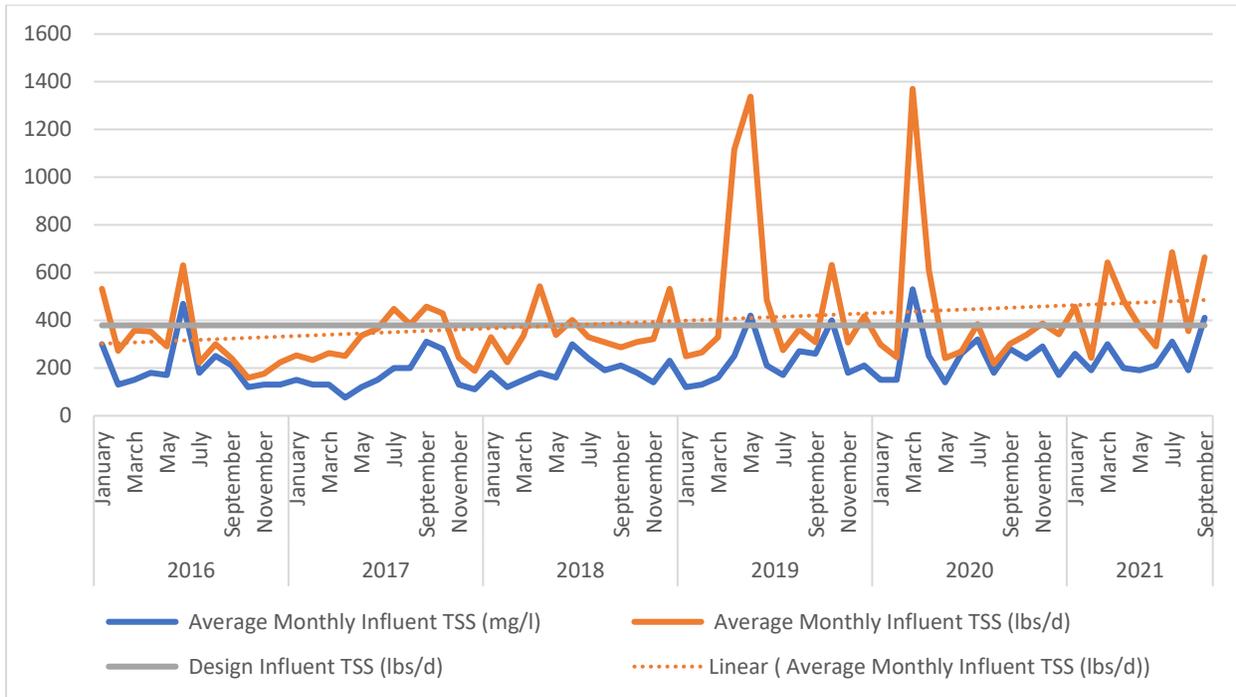


Figure 2.4 Influent TSS

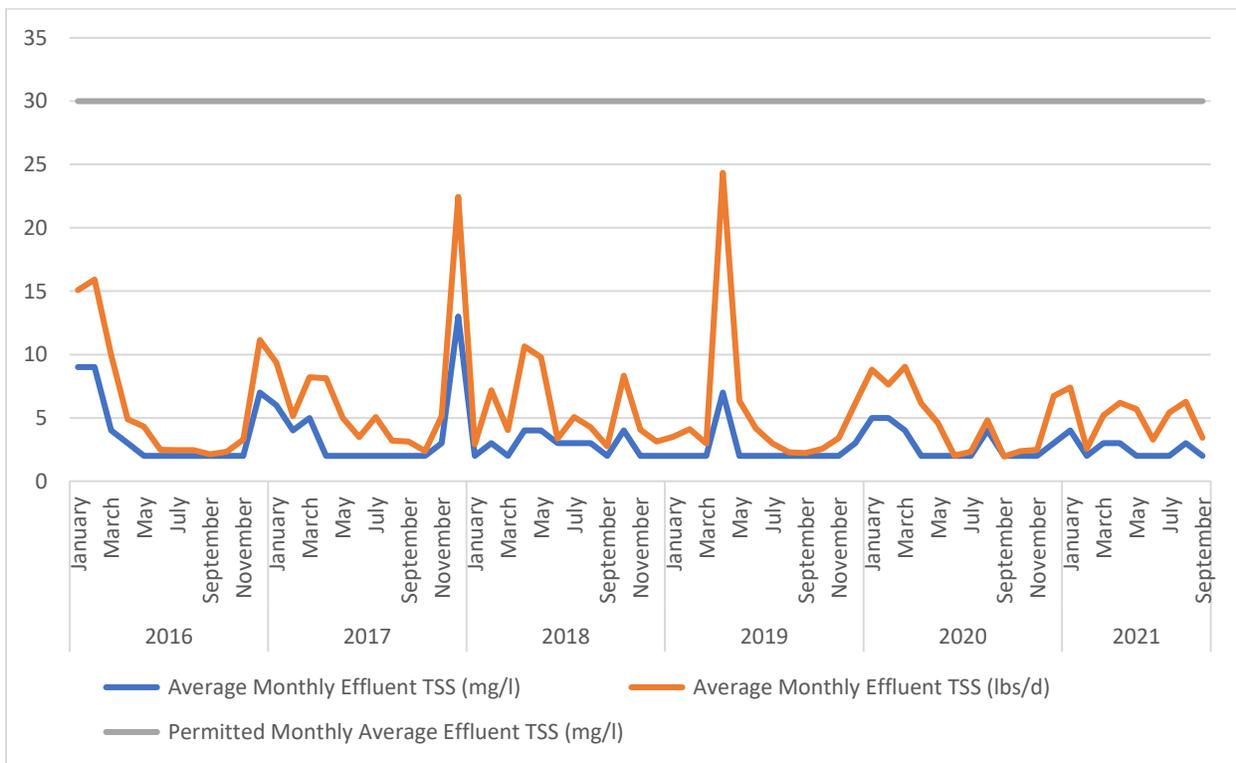


Figure 2.5 Effluent TSS

2.5.4. Total Nitrogen (TN)

From February 2016 to September 2021, influent total nitrogen concentrations have ranged from 24 mg/L to 130 mg/L with an average of 48 mg/L. Wastewater Engineering Treatment, Disposal and Reuse by Metcalf and Eddy, Inc. describes medium strength wastewater to have an influent TN concentration of 40 mg/l and strong wastewater to have a TN concentration of 85 mg/L. Six (6) months in this data set exceeded the strong concentration of 85 mg/L. *Further investigation is recommended to understand influent TN concentrations.*

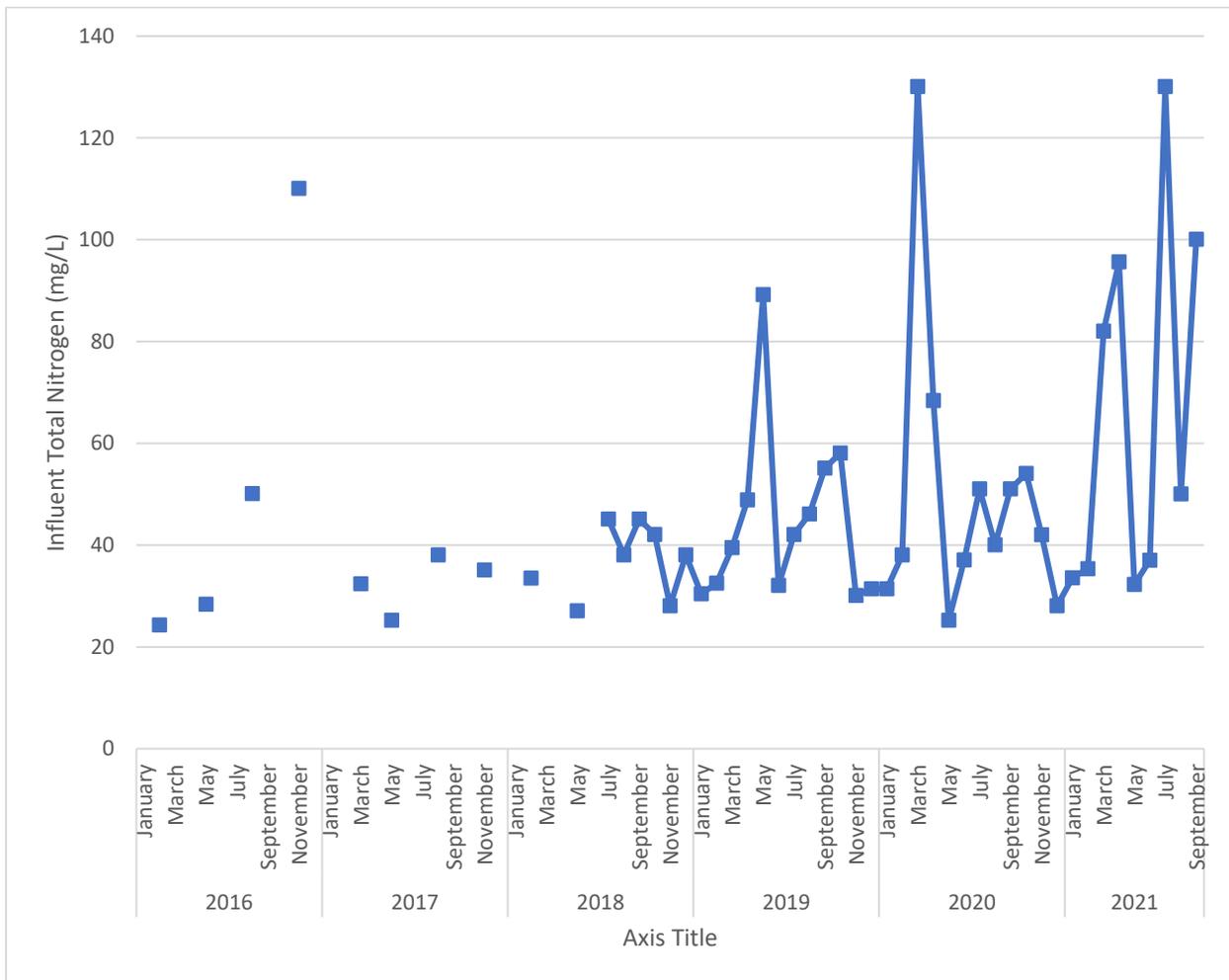


Figure 2.6 Influent TN

As discussed in Section 2.3, the recommended estimated allocation for the Main WWTF is an annual average of 52 lbs/day TN. From September 2018 to September 2021, the average monthly effluent TN load was 21.1 lbs/day, which is 41% of the estimated average annual TN allocation. The effluent total Kjeldahl nitrogen (TKN) ranged from 0.8 mg/l to 5.2 mg/l indicating that the Main WWTF is able to nitrify year round. Effluent TN concentrations ranged from 7.5 mg/L to 18 mg/L. Comparing effluent TN concentrations to influent TN concentrations, it appears the Main WWTF is able to partially denitrify.

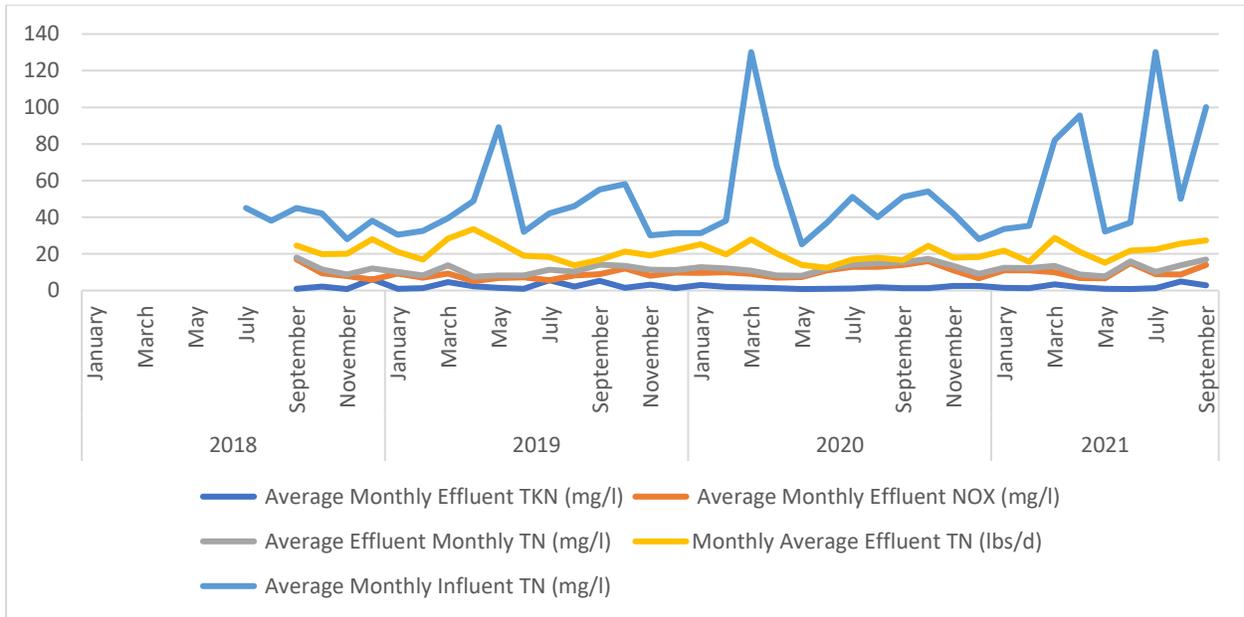


Figure 2.7 Effluent Nitrogen Data

2.5.5. E. Coli

The Main WWTF had no exceedances of the permitted instantaneous maximum e. coli limit of 77 counts per 100 ml. From January 2016 to September 2021, maximum effluent e. coli ranged from 0 to 42 counts per 100 ml.

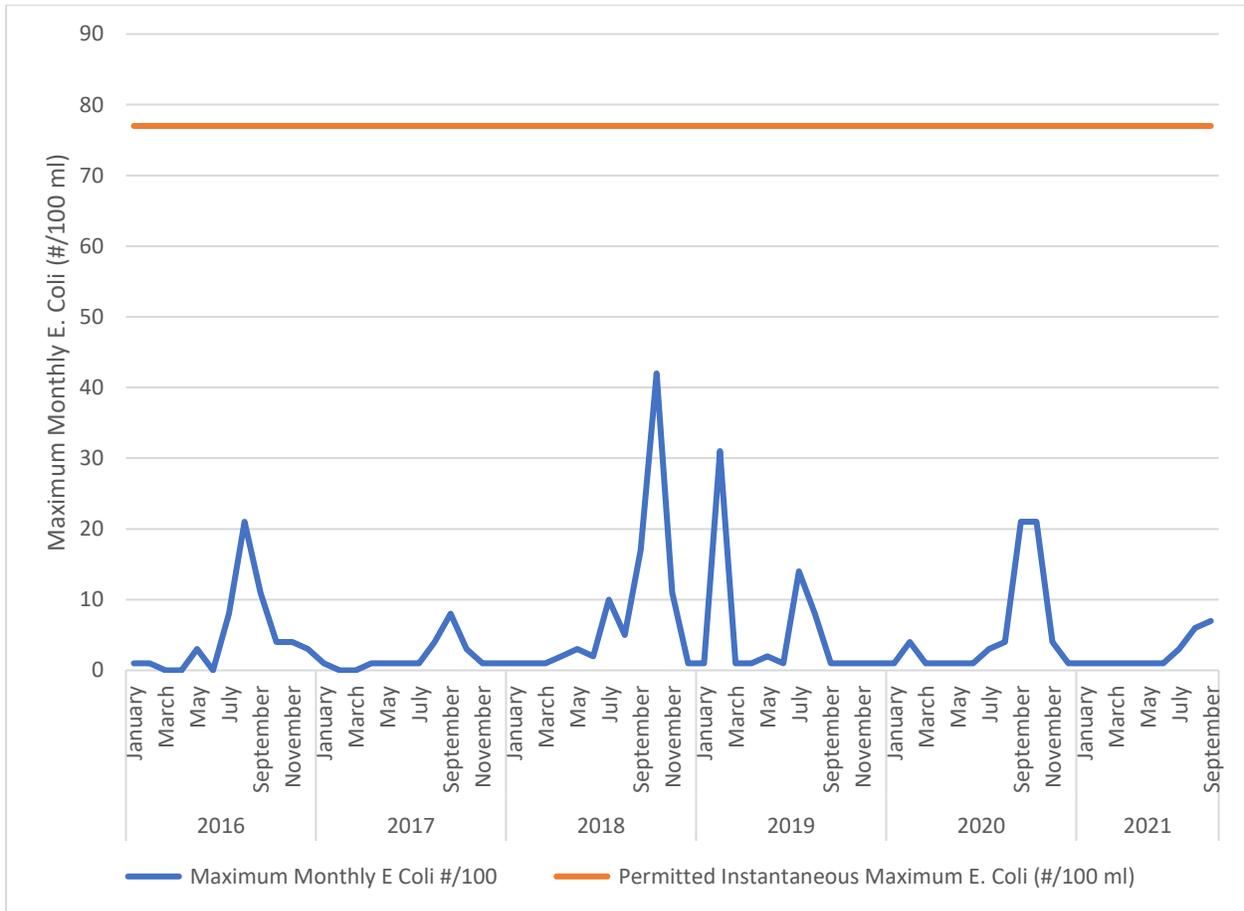


Figure 2.7 Effluent e. Coli

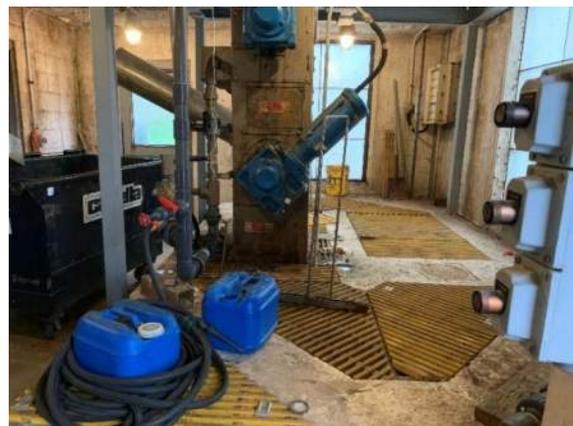
2.6 Condition of Existing Facilities

Hoyle, Tanner conducted a site visit on October 25, 2021, to the WWTF to assess the physical condition of WWTF process components and the site and the following section presents the findings of that assessment.

2.6.1. Headworks Assessment

Raw sewage enters the facility via 10-inch gravity sewer which transitions to a 12-inch gravity sewer prior to entering the Headworks Building where it is screened with a mechanical fine screen followed by grit removal.

Flow enters the Headworks building via a 16-inch wide by 11.25-foot-deep concrete channel. Wastewater first passes through a manual coarse bar rack with 1-inch spacing. Wastewater flows through a Jones & Atwood mechanically cleaned band fine screen with ¼-inch



perforated plate openings installed in 2006 as part of the Headworks upgrade. There is a by-pass channel with a manually cleaned bar rack with 1½-inch bar spacing. After fine screening, wastewater flows discharge to the grit chamber.

Grit removal systems consist of a 6-foot square Dorr Oliver vortex grit chamber, Dorr Clone cyclone unit, and a 12-inch Dorr Oliver Classifier. The grit chamber was installed during the 1982 upgrade and components of the grit removal system including the scraper mechanism and grit classifier were replaced during the 2006 Headworks upgrade.



The grit collecting mechanism is located in a square shallow tank. Grit settles as the sewage passes through the chamber and is collected by mechanical arms. The grit is then pumped into a Dorr Clone grit cyclone unit for separation from wastewater, and then discharged to a grit classifier for dewatering. The operators indicated that the grit pump has been rebuilt once and that it operates satisfactorily. Grit is discharged from the grit classifier to a dumpster located inside the building. It was noted that all components of the grit removal system are severely corroded.

The 250 square foot headworks building addition was built as part of the 2006 Headworks upgrade to house the existing grit chamber, new fine screen, new grit classifier, and new screenings/grit dumpster. The plant operators do not have an automatic influent sampler and are currently taking grab samples for an 8-hour composite.

Design Standards

- **Bypass Screens:** Installations using mechanically cleaned screens or comminution devices should include multiple units or a manually cleaned bypass screen. (TR-16 Standards)
- **Manually Cleaned Screens:** Unobstructed openings between bars should be 1–2 inches (2.5–5 cm) wide. Manually cleaned screens should be placed on a slope of 30–45 degrees with the horizontal. (TR-16 Standards)
- **Mechanically Cleaned Screens:** Unobstructed openings between bars are generally 0.25–1.5 inches (0.6–3.8 cm) wide. (TR-16 Standards)
- **Velocities:** Screen chambers should provide good velocity distribution across and through the screen. Approach velocities in screen channels should be at least 1.3 feet per second at minimum flows (2.0 ft/sec is preferred if possible), or 2.5 ft/sec during diurnal peak flow periods. Approach velocities in screen channels serving combined systems should be at least 3 ft/sec during storm flows. Velocities through openings of mechanically cleaned screens should be 2–4 ft/sec. Velocities through manually cleaned screens should be limited to 1–2 ft/sec. (TR-16 Standards)
- **Grit Removal:** Grit can be removed in grit chambers or by centrifugal separation of primary sludge. Acceptable grit chambers include aerated, vortex (including induced vortex and multi-tray vortex

units), detritus, and horizontal flow (velocity control tanks) units. A single, manually or mechanically cleaned grit chamber with bypass is acceptable for small plants serving sanitary sewer systems. (TR-16 Standards)

Assessment

The assessment of the major components for the Headworks is summarized below in Table 2.3, and the major needs are described as follows:

Findings

- The influent fine screen is severely corroded.
- Evidence of floatables in aeration tanks could indicate ineffective screening. Operators stated this is partially from 9 months of bypassing the fine screen while waiting for parts.
- The existing grit removal system is from 1982 upgrade and severely corroded.
- Building condition is showing signs of deterioration with corrosion of metal components and building materials.
- Headworks room is not up to NFPA code standards.
- Ventilation system need upgrading to provide adequate air changes.
- Building electric components need upgrading.

Table 2.3 – Headworks Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Coarse Bar Rack		✓				1982	0-5	
Vortex Grit Chamber		✓				1982	0-5	End of useful life
Grit Pump		✓				2006	0-5	Has been rebuilt once.
Grit Classifier		✓				2006	0-5	Severe corrosion observed
Fine Screen			✓			2006	5-10	Severe corrosion observed
By-Pass Bar Rack			✓			1982	0-5	
Building Structure		✓				2006	0-5	Severe corrosion observed
Electrical						1982	0-5	Severe corrosion observed
Ventilation		✓				1982	0-5	Severe corrosion observed.

2.6.2. Influent Pump Station

After the Headworks Building, flow enters the two (2) wet wells of the influent pump station that pumps wastewater flow up to the splitter box located at the inlet at the aeration tanks. Each wet well is capable of storing 5,500 gallons. The wet well was not observed and therefore the condition was not assessed. Two (2) Flygt Model CT 3127 dry-pit submersible, non-clog variable speed influent pumps lift flow from the wet wells to the influent channel for the process tanks. The design point for these pumps is unknown and as there is no flow meter on the discharge line, the operators do not know the pumped flow rate. Looking at pump curves from the manufacturer and using system curve information from the 1983 Basis of Design, it would appear that the pumps can each pump 100 gpm (0.144 MGD) at 40 hertz and 440 gpm (0.634 MGD) at 60 hertz. Each pump has a 6.9 HP motor and a maximum speed of 1,755 rpm. The operators indicated that both pumps come on at high flows. Operators also indicated that one of the pumps was replaced in 2021 and the other pump will be rebuilt this year. Each pump has a VFD for to control pump output between 40 and 60 hertz. The VFDs were replaced in 2014 and 2019.



The pump control system consists of a Flygt Multitrode conductive-type level sensor in the wetwell. The pump control system was not observed and therefore the condition was not assessed. The operators indicated that grease in the wet well routinely impacts the level sensor.

Pumps for the influent pump station are located inside in the lowest level of Operations Building. Many of the isolation valves on the suction and discharge side of the pumps are over 20 years old and may or may not be operable.

Table 2.4 Influent Pump Station Design Criteria

Item Description	Existing Design or Capacity
Pumps	
Quantity	2
Type	Flygt dry-pit submersible, non-clog
Capacity, each	100 gpm (0.144 MGD) @ 40 hertz 440 gpm (0.643 MGD) @ 60 hertz
Horsepower	6.9 HP
Variable Speed Control	Yes
Pump Control System	Multitrode Probe (conductive level sensor)
Wet Wells	
Quantity	2
Storage Volume, each	5,500 gallons
Storage Volume, total	11,000 gallons

Design Standards

- Convey peak design flow with largest pump out-of-service.

Assessment

The assessment of the major components for the Influent Pump Station is summarized in Table 2.5, and the major needs are described as follows:

Findings

- One pump was replaced last year and the second one is currently being rebuilt.
- Pumps may not be able to convey peak design flow with one out-of-service. In the absence of pump design information, a test should be conducted using a pressure gauge, flow meter, or draw down test to determine where these pumps are running on their curve.
- The pump control system level sensor is frequently impacted by grease build-up in the wet well. Either the grease in wet well should be addressed or alternate mode of pump control should be installed.
- Isolation and check valves should be replaced as needed for proper operation of influent pump system.
- A flow meter should be installed on the pump discharge line to record influent flow.

Table 2.5 – Influent Pump Station Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Wet well			✓			1967	5-10	Not able to assess
Influent Pumps				✓		2021/2022	5-10	May not be able to pass peak design flow with one out-of-service.
Pump VFDs				✓		2014/2017	5-10	
Level Control System			✓			2014	2-5	Impacted by grease

2.6.3. Biological Process

The package treatment tankage is contained within a 68 ft diameter circular reinforced concrete tank. The maximum water depth is 16 ft. A double splitter box divides the raw wastewater pumped from the influent pump station and the return activated sludge (RAS) between the two process trains. The tank is divided into five (5) cells per train that radiate outward from a circular aerobic sludge digestion tank in the center of the structure. A distribution launder located on the perimeter of the package treatment tankage allows for distribution to the first four (4) tanks within each process train. See Figure 2-8 for a layout of the aeration tanks.



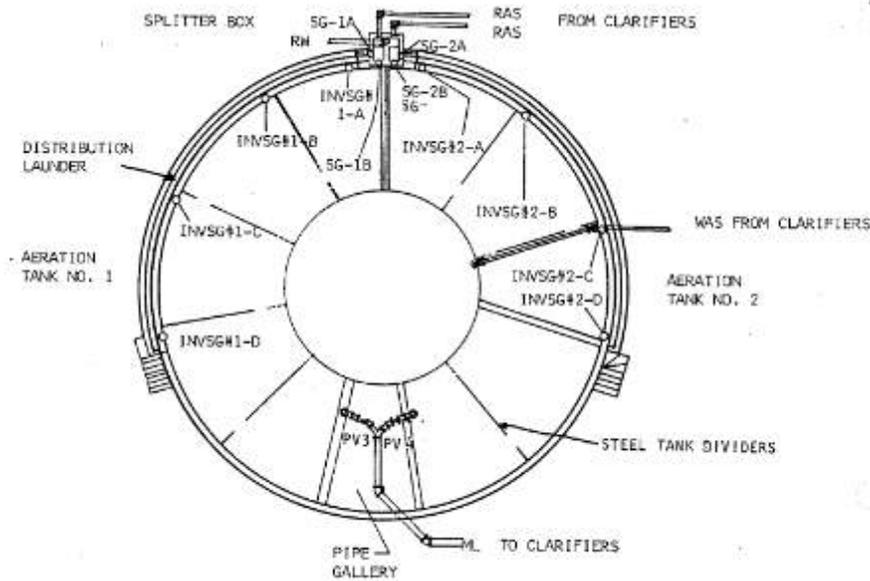


Figure 2.8 Plan of Aeration Tanks

The biological process is typically operated in a step feed manner with the first cell as an anoxic zone where RAS is returned. The configuration of the existing splitter box results in RAS cascading into the first cell of each train and introduces oxygen into the mixed liquor. The operators noted that dissolved oxygen (DO) levels in the first cell have typically measured 0.5 mg/L. DO concentrations in an anoxic zone should be less than 0.2 mg/L.

The aeration system in the tanks consist of a fine bubble diffuser system that was installed in 1995. Two (2) 50 HP Gardiner Denver Heliflow positive displacement blowers, each rated for 900 scfm at 6.9 psig provide air to the diffused aeration system within the process tanks. The blowers are equipped with variable frequency drives (VFDs) and blower speed and airflow is controlled by the DO probes located in cell 5 of each train. The blowers and VFDs were installed in 2016. The DO control loop setpoint is to maintain 2 mg/L DO in the 5th cell of the aeration tanks, however, the operators indicated that the blowers cannot be turned down low enough below 30 hertz and supply too much air to the aeration tanks. The operators indicated that they bleed off air to one of the sludge digesters if DO levels in the aeration tanks rises above 2 mg/L.



The concrete tankage and steel divider walls are original to the facility dating back to 1967. The steel beam supporting the steel center wall that divides the two trains has rusted through and is failing. The operators have noted that they are concerned if they drain one side down for maintenance on the steel center wall, then the supporting beam will fail. There is evidence of concrete damage with visible concrete cracks in tank walls and spalling observed. The bridge and walkway grating appeared to be corroded as well.



Table 2-6 Biological Process Existing Design

Item Description	Existing Design or Capacity
Biological Process Design	
Type	Step Feed/Contact Stabilization
Number of trains	2
Length	132.5 ft
Side water depth	13.07 ft
Reach (width)	18 ft
Volume (per train)	31,172 ft ³ 233,167 gallons
Freeboard	18 inches
RAS	60% of forward flow 0.27 MGD
Detention Time	12.4 hours
Detention Time w/return flow	7.77 hours
Aeration System	Fine Bubble Membrane Diffusers
Sludge Production	100 lbs/day
SRT	30 days
MLSS	3,000 mg/L
MLVSS	2,100 mg/L
F:M	0.31
Substrate Utilization Rate, U	14.09 lbs BOD ₅ /1000 ft ³
AOR	436.86 lbs O ₂ /day
Blowers	
Quantity	2
Type	Positive Displacement
Capacity, each	900 scfm @ 6.9 psig
Total Capacity	1950 scfm
Motor Size, each	50 HP
Speed Control	VFDs

Design Standards

- Liquid depths should not be less than 10 feet or more than 25 feet. (TR-16)
- Aeration systems should be sized for the maximum daily oxygen requirements (considering facility side streams, and seasonal variations in temperature and humidity) while maintaining an aeration basin DO concentration of 2 milligrams per liter. (TR-16)
- Oxygen supply should be designed based on 0.85–1.2 pounds of oxygen per pound of BOD removed plus 4.2 pounds of oxygen per pound of ammonia nitrogen oxidized at maximum daily loading conditions. (TR-16)
- Blower capacity must be based on the air volume required during summer temperature and humidity conditions. The size of motors for centrifugal compressors must be based on summer air flow rates and the coldest expected winter temperature (or other means provided to control mass air flow rate and prevent motor overload). (TR-16)
- Blower controls should be incorporated into the system, providing sufficient ability to meet oxygen demand in the various tanks in service through multiple blowers, variable blower output, dissolved oxygen monitoring, air flow measurement, and automated control valves. (TR-16)
- The size of air piping should be based on maximum expected summer temperatures and in-line velocities of 2,000–2,500 feet per minute. (TR-16)
- Fine bubble, full-floor coverage: 0.12 scfm per square foot of tank area. (TR-16)

Assessment

The assessment of the major components for biological process is summarized in Table 2-7, and the major needs are described as follows:

Findings

- Structurally the aeration tank is in poor condition with major concrete repair needed and potential for failure of the center steel wall dividing the two trains.
- RAS return needs to be reconfigured so as not to introduce oxygen into anoxic zone.
- Blowers are oversized for biological process and cannot be turned down low enough.
- Diffusers are at end of useful life.

Table 2.7 – Biological Process Equipment Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair		Good			
	1	2	3	4	5			
Aeration Tank steel support beam & divider walls	✓					1967	0-2	Severe corrosion of support beam make lead to failure of steel center wall that divides trains
Aeration Tank concrete		✓				1967	2-5	Severe cracking and spalling of concrete tank walls
Aeration Tank walkway/railings		✓				1967	2-5	Structurally unsound
Diffusers			✓			1995	2-5	End of useful life
Blowers					✓	2016	10-15	Blowers supply too much air and can't be turned down below 30 hertz
VFDs					✓	2016	10-15	

2.6.4. Secondary Clarification

There are two (2) 30-foot diameter circular Lakeside Spiraflow peripheral feed clarifiers at the WWTF which were installed during the 1983 upgrade. Each tank has a 12 ft side water depth. Mixed liquor from the aeration tanks flows to a common concrete influent trough where it is distributed to either clarifier. Sludge collected at the bottom of the clarifier is removed using mechanical scraping arms which rotate using a ½ HP drive. Each clarifier has an outside skirt and a scum skimmer assembly. Scum is collected in a scum box adjacent to clarifiers, where it is pumped by the scum pumps to the aerobic digester. Secondary clarified effluent flows over the effluent weir and through a 10-inch effluent pipe to the common effluent channel.



Structurally, the concrete on the clarifier influent channels is in poor condition with cracking and spalling observed. The concrete on the outer wall of the influent channel has a large crack and the operators noted their concern of failure. Due to the integrity of the concrete, structural stability of walkways, grating and handrails are also of a concern. Concrete condition for the secondary clarifier tankage appears acceptable.



Operators also noted that scum skimming is ineffective and improvements to the scum boxes are needed.

Table 2.8 Secondary Clarifier Design Criteria

Item Description	Existing Design or Capacity
Secondary Clarifiers	
Quantity	2
Type	Circular, Peripheral Feed
Diameter	30 ft
Surface Area, each	707 ft ²
Side Water Depth	12 ft
Capacity, each	8,482 ft ³ 63,448 gallons
Surface Loading Rate	
@ Average Daily Flow (0.45 MGD)	320 gpd/ft ²
@ 75% PHF (0.750 MGD) w/ 1 clarifier offline	796 gpd/ft ²

Design Standards

- Surface Overflow Rate @ PHF
 - TR-16 = 1,140 gpd/sf or MLSS = 3000 mg/L, SVI = 150 mg/L, RAS Rate = 40%
 - Ten States Standards: Extended Aeration 1,000 gpd/sf, 1,200 gpd/sf Contact Stabilization based on influent only
- Peak Solids Loading rate @ PDF + Peak RAS Flow
 - Ten States Standards: Extended Aeration 35 lbs/d/sf, Contact Stabilization 50 lbs/d/sf
- 10 States Standards recommends minimum of 12 ft side water depth.

Assessment

The assessment of the major components for the secondary clarifiers is summarized in Table 2.9, and the major needs are described as follows:

Findings

- Structurally the clarifier influent channel concrete is in poor condition with major concrete repair needed.
- Clarifiers meet surface overflow rate guidance at design flows and up to 1.26 MGD PHF
- Clarifier internal mechanisms and drives are at the end of their useful life.
- Scum skimming and scum box is ineffective.
- Existing clarifiers do not meet surface overflow or solids loading design guidelines with one unit out of service.

Table 2-9 Secondary Clarifier Condition Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Useful Life	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Clarifier #1 Drive		✓				1983	2-5	End of useful life
Clarifier #2 Drive		✓				1983	2-5	End of useful life
Internal mechanisms		✓				1983	2-5	End of useful life
Launders, weirs		✓				1983	2-5	End of useful life
Scum skimming & box		✓				1983	2-5	Ineffective
Tankage		✓				1983	0-2	Severe cracking and spalling of concrete
Walkway/railings		✓				1983	0-2	Structurally unsound

2.6.5. Return and Waste Activated Sludge Pump System & Scum Pumping

The return (RAS) and waste (WAS) sludge pumps are housed in the basement of a pump room located between the two clarifiers. There are three (3) Flygt Model NT 3102 vertical non-clog pumps used to return sludge to the aeration tanks and waste sludge to the sludge digester. The sludge pumps were rebuilt in 2012. All three pumps have 3.7 HP motors, and pumps No. 1 and 3 have VFDs. The design point for these pumps is unknown. Looking at pump curves from the manufacturer and using system curve information from the 1983 Basis of Design, it would appear that the pumps can each pump 160 gpm at 40 hertz and 330 gpm at 60 hertz.

The discharge manifold is configured such that when pumps No. 1 and 3 are used for RAS pumping depending on which clarifier is online, and pump No. 2 is used for WAS pumping (see Figure 2.9 for schematic layout). The RAS pumps are flow-paced off the effluent flow meter and have VFDs. The operators indicated RAS is set at approximately 65% of effluent flow. There is a magnetic flow meter on the RAS discharge. The WAS pumps are manually control based on maintaining a MLSS concentration between 2500-3000 mg/L and visually inspecting the waste coming into the digesters. Operators indicate that they currently waste sludge 3 times a week.

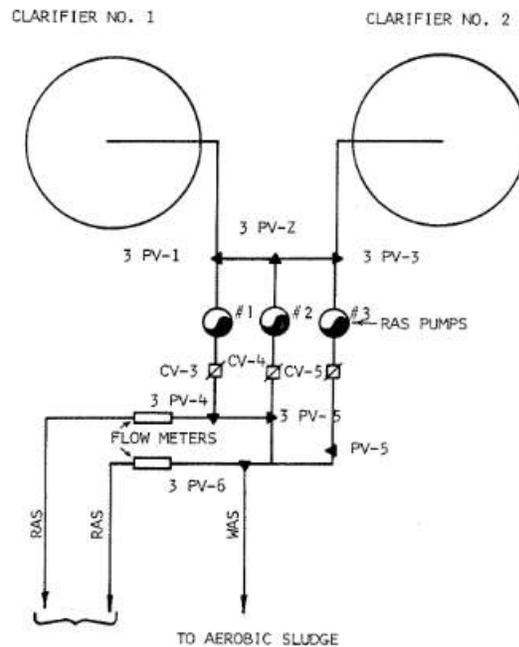


Figure 2.9 - Sludge Pump Schematic Layout



Scum pumping originally consisted of two (2) submersible pumps, one located in each scum box. The operators indicated that the scum pumps haven't been working for the last 20 years and that they drain the scum pits into the empty clarifier off-line and use the WAS pump to pump out of the clarifier to the sludge digester. Occasionally, they will use a vactor truck to remove contents from each scum box. The operators indicated that they empty the scum boxes once a year.

There are cracks in the concrete roof slab that allow water through the ceiling. Access to the pump room is by a metal spiral staircase which was showing signs of corrosion. Mechanical access for removing equipment is through a skylight in the top concrete roof slab, which is also cracked. Electrical and HVAC components inside the building appear to be heavily corroded. The operators indicated that they would prefer the electrical controls and VFDs be above grade. Operators also noted that all the valves on suction and

discharge side of pumps need replacement.

Table 2-10 Sludge Pumping Existing Design

Item Description	Existing Design or Capacity
Recycle Rate	65% of Effluent Flow @ Design ADF = 0.293 MGD (200 gpm)
WAS Control	Manual control based on MLSS
RAS/WAS Pumps	
Quantity	3
Type	Flygt, dry-pit, non-clog
Capacity, each	330 gpm at 60 hz 160 gpm at 40 hz
Horsepower	7.5 HP
Variable Speed Control	VFDs
Scum Pumps	
Quantity	0

Design Standards

- At facilities with an average design flow of 10 mgd or less, waste sludge pumping facilities should normally be designed with a maximum capacity of 25 percent of the average design flow and should provide a minimum flow rate of approximately 80 gallons per minute (to allow velocity of 2 feet per second in a 4-inch diameter pipe) (10 State Standards).
- Suitable devices for observing, sampling, and controlling return activated sludge flow from each settling tank hopper shall be provided (10 State Standards).

Assessment

The assessment of the major components for sludge pumping is summarized in 2-11, and the major needs are described as follows:

Findings

- RAS/WAS pumps are over 20 years old and were rebuilt approximately 10 years ago.
- Flow meters need replacement.
- All valves on suction and discharge side of pumps need replacement.
- Electrical controls and VFDs should be relocated above ground.
- Scum pumps and level control system are at end of useful life.
- Mechanical equipment access, as well as physical access, to lower level needs improvement.
- Cracks in top concrete slab need repair to keep space dry.
- Electrical and HVAC equipment need replacement due to corrosion.

Table 2-11 Sludge Pumping Condition Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Useful Life	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
RAS/WAS Pumps			✓			2000+/- Rebuilt 2012	2-5	End of useful life
Pump VFDs			✓			2000+/-	2-5	Should be located above grade
Flow Meters			✓			2000+/-	2-5	End of useful life
Scum Pumps		✓				1982	2-5	End of useful life
Scum Pump Level Control System		✓				1982	2-5	End of useful life
Hatch		✓				1982	2-5	Leaking
Roof		✓				1982	2-5	Leaking
Room Electrical & HVAC		✓				1982	2-5	Severe corrosion

2.6.6. Disinfection

Disinfection is achieved at the Woodstock Main WWTF using a chlorine contact tank (CCT). The 1983 WWTF upgrade raised the walls up to EL. 675.12 ft. which is only 2-inches above the 100-year flood elevation of EL. 675.0 ft. The CCT is divided into two cells providing parallel trains with interior timber baffle walls. Each train provides a volume of 12,566 gallons and at 30 minutes detention time can treat up to 0.603 MGD.





Chemical storage for chlorination and dechlorination is separated into two (2) rooms. Each room is accessed separately from the exterior of the main operations building. The chlorination chemical storage room contains a new 500-gallon storage tank installed in 2021 for sodium hypochlorite, one (1) Blue-White peristaltic chemical feed pump, and a cinder block containment wall. The dechlorination chemical feed room contains a 300-gallon double-walled storage tank for sodium bisulfide installed in around 2005, and a Blue-White peristaltic pump for chemical feed. For each pumping application, the operators indicated that they have spare Blue-White feed pumps “on-the-shelf” in the Operations Building due to the corrosive environment in the chemical storage rooms if the existing one should fail.

Make-up water to form the chlorine solution is supplied by the chlorine solution water supply pump in the pump vault at the effluent end of the CCT. Chlorine solution is piped through PVC pipes and can be dosed at several points, including the clarifier effluent trough, influent manhole, return sludge pipe, and waste sludge pipe. Operators indicated they are experiencing a problem with the dosing line to the clarifiers, which may be blocked or broken.

Dechlorination chemical is dosed to the dechlorination chamber manhole downstream of the CCT.

Table 2.12 Disinfection Existing Design

Item Description	Existing
Design Flows	
Average Daily Flow	0.450 MGD
Peak Hourly Flow	0.750 MGD
Chlorine Contact Tank	
Number of Trains	2
Liquid Depth	14 feet
Channel Width	1.5 feet
Length of Train, each	80 feet
Volume Provided per Train	12,566 gallons
Detention Time @ Design CCT PHF (0.750 MGD)	24.1 minutes
Max Flow Capacity at 30 mins Detention Time	0.603 MGD
Sodium Hypochlorite	
Average Daily Usage	10-10.5 gpd
Storage Tanks	
Quantity	1
Type	HDPE
Volume	500 gallons
Type of Containment	Concrete wall
Feed Pumps	
Quantity	1 (1 spare on-the-shelf)
Type	Blue-White peristaltic pump
Max pumping rate	52 gpd
Sodium Bisulfite	
Average Daily Usage	3-5 gpd
Storage Tanks	
Quantity	1
Type	HDPE
Volume	300 gallons
Type of Containment	Double walled tank
Feed Pumps	
Quantity	1
Type	Blue-White peristaltic pump
Max pumping rate	24 gpd

Design Standards

Chlorine Contact Tank

- Two (2) trains required with 100% redundancy
- Contact time of 30 minutes at design peak flow rate
- Minimum length-to-width ratio of 40:1
- Width-to-depth target ratio of 1:1
- Even flow distribution

Chemical Feed Systems

- Chemical feed pumps for sodium hypochlorite should be of the positive displacement type.
- Duplicate disinfection feed systems shall be provided, and each system shall be capable of handling maximum flow conditions.
- Continuous chlorination shall be provided during power outages.
- All chlorination and dechlorination feed, mixing, and control equipment must be connected to the emergency power system.

Chemical Storage

- All storage tanks that contain chemical solutions of chlorine and are in a liquid state at atmospheric pressure must be enclosed by secondary containment with a containment volume of 125 percent of the storage tank's volume.
- Storage tanks should be either located or vented outside.
- Provision shall be made for adequate protection from light and extreme temperatures.
- Eye-Wash Fountains and Emergency Showers: Should be provided no more than 25 feet from points of hazardous chemical exposure and supply tempered water at 30-50 gpm and 20-50 psi for 15-30 minutes. (TR-16 Standards)

Assessment

The assessment of the major components for the disinfection system is summarized in Table 2.13 and the major needs are described as follows:

Findings

CCT

- CCT has a maximum capacity of 0.804 MGD at standard requirement of 30-minute detention time. Peak flow has exceeded 0.804 MGD.
- Metal brackets for timber baffle walls are severely corroded.
- Heavy mat on surface of CCT observed during site visit

Chemical Storage and Feed Systems

- Doors to chemical storage rooms are severely corroded, as are most of the metal components inside storage rooms.
- HVAC does not work in either chemical storage area.
- Operators indication they are having problem with the chlorine line to clarifiers, may be blocked or broken.

Table 2.13 – Disinfection System Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Chlorine Contact Tanks (2)			✓			1967 & 1982	2-5	CCT doesn't meet detention time requirement at PHF. Walls are only 2-inches above 100-year flood elevation.
Chlorine Storage Tank					✓	2021	15-20	New Tank
Chlorine Feed Pump				✓		2021	2-5	Corrosive environment
Chlorine Storage Room		✓				1967	0-2	Severe corrosion observed on all electrical and metal components. HVAC not functional.
Sodium Bisulfite Storage Tank				✓		2005+/-	15+	
Sodium Bisulfite Feed Pump				✓		2021	2-5	Corrosive environment
Sodium Bisulfite Storage Room		✓				1967	0-2	Severe corrosion observed on all electrical and metal components. HVAC not functional.

2.6.7. Effluent Flow Measurement

Effluent flow measurement is achieved by the use of single sharp-crested rectangular weir plate with end contractions at the effluent end of CCT and an ultrasonic level detector. The crest length of rectangular weir is 12-inches and can accurately measure up to 0.685 MGD with 0.5 feet of head on the weir according to Isco Open Channel Flow Measurement Handbook, 6th Edition. The operators indicated that they have historically seen flows over the weirs maximum flow rate, however the effluent circular chart recorder has a maximum recording level of 1.0 MGD. Effluent flow is used for flow-pacing chlorine addition for disinfection.

The TR-16 Standard is to accurately measure peak flows at 25-yr flood elevation and protect against the 100-yr flood. According to the FEMA Flood Insurance Rate Map for Woodstock published in 2007, the 100-year flood elevation at the WWTF site is EL. 675.0 ft., and according to record drawings, the 25-year flood elevation is EL. 672.3 ft. The invert of the weir plate is at EL. 672.46 ft, which is above the 25-year flood elevation of 672.3 ft. by less than 2-inches. This condition would interfere with a free-flowing nappe and cause a submerged weir condition where the weir will not accurately measure the flow at the 25-year flood elevation. The top of concrete walls of the CCT and effluent flow measurement channel are at 675.12 ft. At the 100-year flood elevation, the ultrasonic flow meter would be submerged.

There is an effluent auto sampler that takes 24-hour composite samples located in a plywood structure that sits on top of the effluent manhole.

Assessment

The assessment of the major components for the effluent flow measurement system is summarized in Table 2.14, and the major needs are described as follows:

Findings

- The effluent weir cannot accurately measure peak flows over 0.685 MGD.
- The invert of the effluent weir is less than 2-inches above the elevation of the 25-year flood (672.3 ft.) and under a submerged weir condition, cannot accurately measure peak flows at the required flood elevation.
- At the 100-year flood elevation, the ultrasonic level detector would be submerged and is therefore not protected against this flood requirement.

Table 2.14 – Effluent Flow Measurement Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Effluent Flow Measurement – Rectangular Sharp-crested Weir			✓			1982	10+	Weir cannot accurately measure peak flows. Weir cannot accurately measure at the 25-year flood elevation.
Ultrasonic Level Detector			✓			2002-2005	2-5	

2.6.8. Outfall

Discharge of disinfected effluent from the CCT to the Ottauquechee River is achieved by means of a 16” outfall pipe. The outfall was not observed during the site visit and therefore the condition could not be assessed. The operators indicated that historically there have been no problems with the outfall.

Assessment

The assessment of the major components for the outfall is summarized in Table 2.15, and the major needs are described as follows:

Findings

- Condition assessment of the existing outfall was not performed.

Table 2.15 – Outfall Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
16" Outfall to Ottauquechee River			✓			1967	25+	A condition assessment of the outfall was not performed.

2.6.9. Solids Handling

The existing aeration tank has a center sludge aerobic digester in the middle where WAS is pumped to from the secondary clarifiers. The center steel tank sludge digester is approximately 28' in diameter with a 12' SWD and provides approximately 55,000 gallons of storage. Operators let the sludge gravity settle and then siphon off the supernatant to thicken waste sludge to approximately 1.9% solids. Decant from the center sludge digester flows back to the headworks. Air is supplied to coarse bubble diffusers in the sludge digester by the aeration tank blowers.



Settled sludge is pump from the aerobic digester via a Penn Valley positive displacement duplex plunger pump located in the lower level of the Control Building to sludge storage tanks. The waste sludge transfer pump is rated for 150-170 gpm at 20' TDH and has a 5 HP motor.



Waste sludge is stored in two (2) steel glass-fused circular sludge storage tanks, one with approximately 369,000-gallon capacity and one with 136,000-gallon capacity. The smaller sludge holding tank was installed in 1987. The larger holding tank was installed in 1999 as part of the solids handling upgrade. The insides of the sludge holding tanks were not inspected and the condition was not assessed. The operators indicated that AquaStore, the tank manufacturer, inspects the tanks every five years.



Air is provided to coarse bubble diffusers located in each of the steel sludge holding tanks from two (2) positive displacement (PD) blowers located in the Sludge Blower Building. The PD blowers were installed in 1999, and one was rebuilt in 2016 and the other in 2020. Both blowers are rated for 800 scfm at 7.5 psi. The operators indicate that the blowers only run one at a time and feed both tanks. With one blower running at 800 scfm, the blower provides 11.8 scfm/1000 ft³ of mixing to both sludge holding tanks and is within standard range of 10-30 scfm/ft³ for mixing.

Sludge is removed from these tanks twice a year, dewatered by Senesac, a contract dewatering company, and hauled to New Hampshire for disposal by RMI. Operators indicated that they would like to implement a decanter and use polymer to get higher concentration of solids to reduce the amount of sludge that is dewatered.

Assessment

The assessment of the major components for the solids handling facilities is summarized in Table 2.16, and the major needs are described as follows:

Findings

- Unable to observe aerobic sludge digester tank or diffusers and therefore condition was not assessed. It is assumed that the condition of steel walls is the same condition as the aeration tank steel walls.
- Operators indicate that they would like to implement decanter and use polymer to help produce a thicker sludge and reduce the amount of sludge to be contract dewatered.
- One of the PD blowers was replaced 5-years ago in 2017 and the other was rebuilt in 2020.
- Coarse bubble diffusers were not able to be observed and condition is unknown.

Table 2.16 – Solids Handling Facilities Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Aerobic Sludge Digester		✓				1967	0-2	Unable to assess steel walls of digester tank
Aerobic Sludge Digester Diffusers			✓			1967	2-5	Unable to assess diffusers in digester tank
Waste Sludge Transfer Pump				✓		1999 +/-	5-10	No redundancy provided.
369,000-gallon Sludge Storage Tank				✓		1987	15+	Unable to assess condition as tank was in service and full. AquaStore inspects every 5 years.
Diffusers – Coarse Bubble			✓			1987	5-10	Unable to assess condition as tank was in service and full.
136,000-gallon Sludge Storage Tank				✓		1999	20+	Unable to assess condition as tank was in service and full. AquaStore inspects every 5 years.
Diffusers – Coarse Bubble				✓		1999	10-15	Unable to assess condition as tank was in service and full.
Sludge Blowers (2 40 HP, PD)				✓		2017 2020	5-10 10-15	Roots blower replaced in 2016. Sutorbuilt rebuilt in 2020.

2.6.10. Control Building

The Control Building was built as part of the 1982 upgrade and houses the main office, laboratory, SCADA system, and electrical room for the facility. The roof was replaced in 2019 and was insulated at that time. The new more energy efficient windows were also installed in 2019.

Observations noted during the October 2021 site visit include the following:

- Laboratory is in the office area and there is no separate lunch area. The lab lacks a fume hood.
- Operators noted that the HVAC needs replacement.
- Building needs to be repainted inside and out.
- There is no insulation in cinder block walls
- Operators indicated they need a document storage area
- Operators indicated they need a dedicated office area that is not in the laboratory.

2.6.11. Site

The Main WWTF site sits on a piece of land adjacent to the Ottauquechee River. The facility is surrounded by an earthen dike to protect it from flooding, built after the flood of 1973 by the Army Corps of Engineers. The top of berm elevation is 678.00 feet. The 500-year flood elevation for the WWTF site is 676.00 feet as discussed in Section 1.4.2. Plant operators indicated the berm has had no observable deficiencies and that flood waters came up to 8 feet below the top of berm during Tropical Storm Irene on August 28, 2011, but did not flood the WWTF. The facility also has flood doors installed on all doorways that are located below the 100-year flood (675.00 ft) elevation for flood protection.

Plant Drainage Pump Station

As part of the flood control system, there is a drainage pump station that is used to dewater the site in the event that the site floods. The drainage pump station can also be used to pump effluent from the CCT to the river in the event river levels are high and effluent cannot flow by gravity from the CCT through the outfall. Plant operators indicated that they occasionally have had to use the plant drainage pumps to pump effluent to the river during the spring thaw if an ice jam block up the effluent pipe discharge at the river.

The pump station consists of a 10' square by 15' deep concrete wet well. Stormwater flows enter the wet well through two 15" diameter AC pipes and are discharged to the river through an 8" diameter force main. There is also an 18" diameter overflow drain from the wet well to the river.

The wet well has one (1) 8" Cascade axial flow propeller pump with a 15 HP motor. The pump is controlled by floats in the wet well. The pump station was constructed at the time of the flood control dike, after the flood of 1973. There have been no upgrades to the pumps or controls since then. The pump station was not observed and therefore the condition was not assessed. The operators indicated that the bottom 2-feet of the wet well is filled with sediment that they have not been able to remove with a vactor truck.



Other site observations made during the October 2021 site visit included the following:

Stand-by Generator: There is a 225 kW diesel generator installed in 1999. The condition of the stand-by power system is discussed in Section 2.6.11.

Plant Water System: The plant water system draws disinfected water out of the effluent end of the CCT for use with the spray wash system for the mechanical fine screen in the Headworks and for solution water for the disinfection chemicals. A pump and pneumatic tank located in the Headworks building are used for screen wash water, and a 1 HP Gould submersible pump located in the pump vault at the effluent end of the CCT is used to supply disinfected solution water to the chlorine and dechlorination feed pumps. The operators indicated that there is not enough room in the sump for a second pump and they keep one on-the-shelf as a spare.

Yard Hydrants: Yard hydrants are provided on the facility site. Operators indicated that there is break in the yard somewhere affecting the supply of water to the yard hydrants.

Site fence: The facility is surrounded by a security fence with an access gate at the driveway entrance. Portions of the existing security fence that surrounds the WWTF are in poor condition and need to be replaced. Operators have indicated that the entrance gate needs to be replaced as well.

Site pavement: Select pavement repair is needed.

Maintenance Garage: There is a large 3-bay maintenance garage at the far end of the site. The plant operators indicated that only the middle bay of the garage is heated, and the existing heating system needs to be replaced.

Assessment

The assessment of the major components is summarized in Table 2.17 for the WWTF site.

Table 2.17 – Site Assessment

Item	Ranking of Existing Condition					Year Installed	Projected Remaining Life (years)	Notes
	Poor		Fair	Good				
	1	2	3	4	5			
Plant Drainage Pump Station		✓				1973+/-	0-2	No upgrades since installation. No redundancy provided. Wetwell is full of sediment.
Plant water system & yard piping			✓			unknown	2-5	Break in yard piping needs to be repaired. No redundancy with solution water supply pump system
Security Fence & Entrance Gate		✓				unknown	0-2	Portions of fence and entrance gate need replacement
Yard Hydrants & yard piping			✓			1982	0-2	Break in yard piping needs to be repaired
Pavement			✓			unknown	2-5	Need spot pavement replacement

2.6.12. WWTF Electrical System and Instrumentation

General

The following observations are based on information obtained during a site visit with the plant’s operators on October 18, 2021.

Applicable Codes and Standards

The electrical systems design for the refurbishment of the wastewater treatment facility must meet applicable State of Vermont and Fire, Electrical and Energy codes. The electrical systems design for the planned upgrades at the WWTF will consider the following codes and standards:

- Vermont Fire and Building Safety Code (2015)
- The National Electrical Code (NFPA 70) (2020)
- The National Fire Alarm and Signaling Code (NFPA 72) (2013)
- Vermont Access Rules (2012)
- Americans with Disabilities Act Accessibility Guidelines (ADAAG), July 26, 1991
- Vermont Commercial Building Energy Standards (CBES) (2020)
- NFPA 1 (2015), Fire Code
- NFPA 101 (2015), Life Safety Code
- IBC (2015), International Building Code
- NFPA 37 (2010), Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines
- NFPA 110 (2013), Standard for Emergency and Standby Power Systems

- NFPA 820 (2012), Standard for Fire Protection in Wastewater Treatment and Collection Facilities
- Technical Report #16 (TR-16) Guides for the Design of Wastewater Treatment Works prepared by the New England Interstate Water Pollution Control Commission.

2.6.12.1. Existing Conditions

Electrical Service and Distribution Equipment

Service Equipment

Underground 208/120V, 3 phase secondary electrical power runs from a Green Mountain Power (GMP) pole on the east side of the Operations Building to an 800 amp disconnect switch located in the Operations Building electrical room. The switch is fused at 600 amps. The service entrance conductors are rated for 600 Amps. The main disconnect switch supplies power to the utility source connection of the automatic transfer switch in the same room. The load side of the transfer switch supplies the plant's motor control center. The entire facility is supplied from this MCC, except for one electrical feed to the Maintenance Garage and the two sludge blowers. All other plant loads can be supplied from the existing generator.

The utility transformer is a single 3 phase 150KVA mounted to the pole. It supplies the plant and an adjacent business that is located to the east.

The utility meter is located on the pole. It utilizes current transformers on the secondary feeders to the Operations Building, Maintenance Garage, and Blower/Generator Building. The power to the adjacent business is metered separately.

Electrical Distribution

All plant equipment operates at 208 or 120V. There are no dry type transformers.

The main disconnect switch supplies the utility connection of the automatic transfer switch. The standby generator is located in the Sludge Blower Building and supplies the ATS by an underground feeder that is rated for 500 amps. The load side of the ATS supplies the plant motor control center.

The existing motor control center is an Eaton 2100 Freedom Series. It was installed in 2016 as a replacement when the original MCC failed. The MCC consists of five bussed sections having circuit breaker feeder units and motor starters for various plant equipment. Two additional sections are located on the left side of the MCC for each of the aeration blower VFDs.

The Maintenance Garage is supplied with two electrical feeds. One feed is from the MCC via an underground feeder that runs out to a pedestal mounted junction box in front of the building. The conductors run underground from the junction box to an electrical panel inside the west part of the building.

The second feed to the Maintenance Garage originates at the GMP utility pole. A separate connection is made at the pole mounted transformer and runs underground to a panel located on the east side of the building. This service was originally intended to supply battery charging equipment for the Town's local area transportation trolley. It is currently used as a source of power for portable sludge dewatering.

The Blower/Generator building is supplied with two electrical feeds. One feed is from the MCC via an underground feeder. It supplies a 100A panel located in the generator room. The panel supplies building lighting, receptacle, HVAC, and generator equipment.

The second feed to the Blower/Generator Building originates at the GMP utility pole. A separate connection is made at the pole mounted transformer and runs underground to a 400A distribution panel with a 350A main breaker that is located in the generator room. This service and panel are dedicated to the two 40HP sludge blowers.

There are no surge protective devices on the electrical service or distribution system.

Age and Condition

The existing motor control center is in very good condition and the is the current model manufactured by Eaton. The existing MCC has available space for additional equipment.

Some of the electrical panels appear to have been installed as part of the original 1982 construction. Generally, these are in fair condition, but due to the age and availability of breakers and parts, replacement is warranted. Newer panels that were installed in later plant improvement projects are in good condition.

The existing variable frequency drives are all fairly new and could remain as long as they are compatible with equipment upgrades.

Generator and Automatic Transfer Switch

Generator

The existing generator is a diesel fueled Generac indoor unit with a base fuel tank. The generator's rating is 180KW/225KVA. This equates to a 100% current rating of 625 Amps at 208V, 3 phase.

The generator was manufactured in 1999. It has low hours and has been well maintained. No operational issues were identified.

Automatic Transfer Switch

The automatic transfer switch was manufactured by Generac. It appears that it was installed as part of the MCC upgrade in 2016. It is rated for 800A, and is 208/120V 3 pole. It is an open transition type and does not have provisions for bypassing the switch mechanism for servicing.

Existing Plant Electrical Demand

The Town provided electrical demand information for the plant based on GMP monthly statements for the period October 2020 through September 2021. The statements did not identify the power factor values or identify any penalties for a poor power factor (less than 95% per GMP standards). The following information was obtained from the data. Because it's unknown, a more conservative power factor of 90% was used to convert KW to KVA:

- The highest value of maximum electrical demand occurred in May 2021 (83KW), equal to 92.2KVA @ 90% PF = 256.0A at 208V, 3 phase.
- The lowest value of maximum electrical demand occurred in October 2020 (48KW), equal to 53.3KVA @ 90% PF = 148.0A at 208V, 3 phase.
- The average monthly maximum electrical on-peak demand: (61.6KW), equal to 68.4KVA @ 90% PF = 190.0A at 208V, 3 phase.
- The average monthly maximum electrical off-peak demand: (59.5KW), equal to 66.1.3KVA @ 90% PF = 183.5A at 208V, 3 phase.

There is significant fluctuation in electrical demand over the period with a span of 35KW. (83KW minus 48KW). The highest demand value occurring in May of 2021 does not correlate with a peak in plant flow such as the one that occurred in December of 2020 (0.693 MGD). The maximum demand in December 2020 was 56KW. Portable sludge dewatering would result in an increase in the monthly maximum demand, and could be a possible explanation for higher electrical demand that's outside of a high flow period.

The existing service rating of 600A, has a maximum continuous load capacity of 80%, or 480A. The maximum amperage value of 256 amps associated with the maximum demand of 83KW is 53% of this value.

It is difficult to evaluate the generator's present loading using this data because the GMP values include the sludge blowers and the Maintenance Garage. Neither of these are supplied by the generator. Therefore, the load on the generator should be less than this value assuming that at least one of the 40HP sludge blowers ran during the period. Even if the maximum GMP demand value of 83KW was to be supplied by the generator, it would result in approximately 46% of the generator's rated load capacity of 180KW.

Motor Controllers

The largest motor loads in the plant are the (2) 50HP aeration blowers. These are controlled by VFDs located adjacent to the MCC. It's understood that only one blower is operated at a time, and often at a minimum speed to maintain the dissolved oxygen level in the aeration basin.

The (2) 6.4HP intermediate pumps are controlled by VFDs. The VFDs are installed in a single duplex pump control panel located in the MCC room. Each VFD has an individual power feed from Panel PA. PA is an original panel and one that should be replaced.

The (3) RAS/WAS pumps located in the sludge vault are controlled by VFDs. The VFDS are installed in a single control panel located in the MCC room. Each VFD has an individual power feed from the MCC.

The process water pump that supplies the headwork's screen wash system is supplied by a standalone VFD that is located in the MCC room. The VFD appears to be in good condition.

The (2) 40HP sludge blowers are controlled by motor starters that are located in the blower room. Blower #1 starter is a reduced voltage type that lowers the inrush current during starting. Blower #2 has an across the line starter (no reduction to inrush current). Both starters should be replaced with VFDs to satisfy GMP's requirement for soft motor starting and to reduce energy consumption by operating at a reduced speed. Blower #1 motor has recently been replaced. Blower #2 motor is older. Both motors are listed as premium efficiency, have Class F insulation, and should be VFD compatible.

The motor starter for the process water pump at the contact tank that supplies chemical feed carrier water is located in the CCT pit. It is in poor condition.

All other motors are controlled by across the line starters located at the MCC, and operate at full speed only.

Lighting

The existing lighting consists of fluorescent, incandescent, and HID types. All lighting should be replaced with LED for improved life, energy savings, and to achieve compliance with current energy standards.

The lighting at the maintenance garage appears to be high output T5 fluorescent. They appear to be fairly new and provide good lighting in the space. However, fluorescent lighting is quickly being phased out and replacement will eventually be needed.

The facility has pole mounted site lighting consisting of original poles with upgraded LED fixtures. They could remain with new underground wiring installed.

There stanchion mounted lights at the process tanks and structures. They appear to be original and should be upgraded to LED.

Exit and Emergency Lighting

Exit and emergency lighting fixtures with battery backup are installed at the Blower/Generator building where generator power is not available. Generally these have a limited expected life and should be replaced with LED types having NiCad batteries, and self-testing diagnostic features.

New exit and emergency lighting fixtures with battery backup should be installed where they don't currently exist to comply with current NFPA 101 (The Life Safety Code) requirements.

PLC/SCADA System

There is no central plant PLC/SCADA system.

Communications

The plant telephone and internet services are supplied by an aerial cable that originates on the utility pole. The internet is DSL via the telephone service.

Fire and Security Alarms

The plant does not have fire or security alarm systems.

2.6.12.2. Summary of Code Related Items

National Electrical Code

The following existing conditions do not comply with NFPA 70 – 2020 (NEC):

- Egress Lighting in Buildings: The Vermont Fire and Safety code requires each building to have emergency lighting for egress paths and exits. NEC Article 700 includes specific requirements for the installation, protection, and testing of emergency equipment and wiring. The power for egress illumination must be supplied from a source that is designated as emergency and is separated from all other wiring. Because the existing generator power system supplies process equipment as well, it must be classified as a standby power source, and not an emergency power source. Although the normal room lighting fixtures are supplied from the generator, they cannot be classified as emergency because the power source and wiring are not dedicated to emergency use only. To avoid the need for a dedicated emergency transfer switch, panels, and wiring systems, battery operated exit and emergency lights must be provided.

Standard for Fire Protection in Wastewater Treatment and Collection Facilities

The facility must comply with the specific electrical requirements of NFPA 820 – 2012:

- Table 4.2 identifies the required electrical classification of collection systems including wastewater pump station wet wells and dry wells. Below grade pump rooms (dry wells) are class I division 2 explosion proof if ventilated at less than 6 air changes per hour. Rooms continuously ventilated at 6 ACH can be unclassified and non-explosion proof equipment and wiring is permitted.
- Table 5.2 Identifies the required electrical classification of coarse and fine screen facilities (Headworks Building) as class I division 1 explosion proof.
- Table 5.2 Row 1: Gas detection and evacuation alarms in accordance with Chapter 7 are required for enclosed coarse and fine screen facilities (Headworks Building). The system must be tested periodically and maintained. It must transmit alarms to a monitored location. The existing Headworks room has a Det-Tronics gas detection system.

- Table 5.2 identifies the dimensions of hazardous area envelopes around outdoor structures in the liquid stream such as equalization tanks, grit removal, selector tanks, aeration tanks, and primary sedimentation tanks. Explosion proof electrical equipment, wiring, and conduit seals are required in these locations. In many cases, the hazardous envelope extends from grade to 18" above the tank wall, and equipment must be explosion proof. Conduits passing through this zone to equipment located above the zone must be explosion proof and have sealing fittings.
- Table 5.2 identifies the required electrical classification of rooms containing open channel liquid stream or liquid stream process equipment. The hazard level is determined by the process function and the level of room ventilation.
- Table 5.3 identifies the required classification of the solids treatment process including grit, screening, scum, and sludge. Rooms containing sludge or scum pumps are class I division 2 explosion proof if ventilated at less than 6 air changes per hour. Rooms continuously ventilated at 6 ACH can be unclassified and non-explosion proof equipment and wiring is permitted.
- Continuous Ventilation at Pump Rooms: It's not practical to make these spaces explosion proof because of cost and availability of explosion proof equipment such as dehumidifiers and sump pumps. In addition, the hazardous area could extend to other floors in buildings with open stairs. Heating outside makeup air in a continuously ventilated system is an energy concern. The ventilation requirements needed to achieve unclassified basement wastewater, sludge, and scum pumping rooms needs to be carefully examined.
- The special fire protection measures described in Chapter 7 include a very general requirement for lightning protection in accordance with NFPA 780 - Standard for the Installation of Lightning Protection Systems. Roof mounted lightning protection systems should be installed on buildings for fire protection as intended by the standards, but also as a defense against lightning induced electrical surges for electrical equipment.

2020 Vermont Commercial Building Energy Standard Amendments

The following existing conditions do not comply with the Vermont Commercial Building Energy Standards – 2020 (CBES):

- The existing lighting does not satisfy the maximum permitted Watts per square foot allowed by the standard. This value varies with the specific use of the space.
- Additional automatic lighting controls are required such as multilevel switching, dimming, occupancy sensors, and automatic daylight sensing.

Fire and Security Alarms

- An automatic fire alarm system for the purpose of occupant notification is not a code requirement for this occupancy type. However, the treatment facility is critically important and a valuable City asset. Early detection of smoke and automatic notification to plant personnel or first responders could prevent significant damage to the facility.

- Fire detection devices should be installed in buildings that have the greatest chance for a fire to occur. Operations Buildings typically include storage of combustibles such as paper, cleaning, and maintenance supplies. They typically include cooking and laundry facilities. The likelihood of a fire in an operations building is much higher than a process equipment room containing pumps, blowers, and similar equipment. The installation of smoke detection in main electrical rooms is recommended. Electrical equipment failure could be identified by a smoke alarm.
- The installation of a security alarm system should be considered for the Operations Building since it typically contains computers and personal items most valued by thieves. Unauthorized intrusion with malicious intent could disrupt power to the entire facility.
- The fire detection system consisting of smoke and heat detectors for asset protection only, can be combined with a security system and sourced from a single panel.

2.7 Financial Status of Any Existing Facilities

The Town recently retired loan payments from a previous wastewater improvement loan in 2021. The loan payment for the South Woodstock WWTF Upgrade project is not scheduled to begin until 12 months after substantial completion of the project. The first anticipated debt payment for the South Woodstock WWTF project is therefore anticipated in near December 2024. Payments will be \$175,826 annually for 20 years.

2.8 Water/Energy/Waste Audits

No waste, energy or water audits have been completed for the WWTF.

3. NEED FOR PROJECT

3.1 Health, Sanitation and Security

Reliable function of the wastewater treatment system is required to protect public health and sanitation by meeting the requirements of the Woodstock Main WWTF NPDES discharge permit.

The 2018 Black and Ottauquechee Rivers and adjacent Connecticut River Tactical Basin Plan states that the Lower Ottauquechee River from the mount to Kedron is stressed for nutrients, organic enrichment, temperature, sediment, and E. coli.

The reach is stressed from Woodstock village to the reservoir for secondary contact recreation, aquatic biota/habitat, and aesthetics due to nutrients, organic enrichment, temperature, sediment, and E. coli, from golf course, road, and developed land runoff, septic systems, and fertilized turf.

The WWTF has had no effluent quality permit exceedances in the past six years. The maximum monthly average influent flow during this period was 0.536 MGD in April 2019, which exceeds the design average monthly flow and permitted average annual flow of 0.450 MGD. Much of the WWTF is designed for a peak hour flow of 0.75 MGD, which has been exceeded on several occasions. The design criteria for the following existing process elements cannot meet current peak hydraulic flows:

- Headworks
- Influent Pumps
- Chlorine contact tank
- Effluent Flow Measurement
- Plant Drainage Pump Station

VTDEC provided guidance on January 31, 2023 stating, “Upon direct discharge’s review of effluent and upstream phosphorus data from the facility, there appears to be reasonable potential for the effluent to contribute to a violation of Phosphorus Vermont Water Quality Standards in the receiving water. When the permit is renewed, this means the facility will likely be assigned a phosphorus limit.”

3.2 Aging Infrastructure

Age related needs were identified in the assessments completed in Section 2.6 for the Woodstock Main WWTF. All items requiring upgrade are original (1966) and/or have reached the end of their useful life and upgrade is recommended. Table 3.1 summarizes the needs for the WWTF.

Table 3.1 Summary of Major Deficiencies

Item Description	Projected Date of Required Upgrade		
	<2 Years	2 to 5 Years	6 to 10 Years
Screening	✓		
Grit Removal	✓		
Headworks Building	✓		
Influent Pumping			✓
Aeration Tanks	✓		
Aeration Tank Blowers			✓
Secondary Clarifiers	✓		
RAS/WAS Pumps		✓	
Chlorine Contact Tanks		✓	
Chemical Feed Systems	✓		
Effluent Flow Measurement		✓	
Aerobic Sludge Digester	✓		
Sludge Transfer Pumps			✓
Sludge Storage Tanks			✓
Sludge Storage Tank Aeration System			✓
Sludge Blowers			✓
Plant Drainage Pump Station	✓		
Plant Water System		✓	
Security Fence	✓		
Site Pavement		✓	

3.3 Reasonable Growth

This project does not increase the current design hydraulic capacity of the wastewater treatment facility. The Town does not intend to request an increase in permitted flow.

4. ALTERNATIVES CONSIDERED

4.1 Design Criteria

4.1.1. Influent

The original influent design criteria, current influent conditions, and proposed influent design criteria for the liquid treatment processes at the Woodstock Main WWTF are presented in Table 4-1. Historical operating data is discussed in Section 2.5. Proposed design criteria assume influent concentrations will remain stable, while flows will increase over the 20-year time frame. As discussed in Section 2.5.1, the peak hourly flow has been increased to reflect peaking factors observed in the historical flow data.

Table 4.1 Woodstock Main WWTF Proposed Influent Design Criteria

Parameter	Original Design ¹	Current Conditions ²	Proposed Design Criteria ^{3,4}
Average Daily Flow	0.450 MGD	0.224 MGD	0.450 MGD
Peak Hourly Flow	0.750 MGD	> 0.750 MGD	1.71 MGD
Biochemical Oxygen Demand	117 mg/l 439 lbs/day	289 mg/l 540 lbs/day	289 mg/l 1,885 lbs/d
Total Suspended Solids	101 mg/l 379 lbs/day	213 mg/l 394 lbs/day	213 mg/l 799 lbs/d
Total Nitrogen	--	48 mg/l 890 lbs/day	48 mg/l 890 lbs/day
Temperature (min/avg/max)		7.7/14.8/23.4 Deg. C	7.7/14.8/23.4 Deg. C ²

Notes:

1. Source: Operations and Maintenance Manual, 1983.
2. Based on Daily Monitoring Report data from January 2016 to September 2021
3. Peak Hourly Flow is based on a historical peaking factor of 3.8 from January 2016 to September 2021
4. Historical BOD, TSS, and TN concentrations are back calculated using historical average flows and loads.

4.1.2. Effluent

Effluent design criteria for the Woodstock Main WWTF are based on the existing NPDES permit and are provided in Table 4.2. The existing NPDES permit expires on September 30, 2024, and no changes to the existing effluent limitations are anticipated.

Table 4.2 Woodstock Main WWTF Upgrade Effluent Design Criteria

Parameter	Original Design Criteria ¹	Proposed Design Criteria ²
Flow (Annual Average)	0.450 MGD	0.450 MGD
BOD (Monthly Average)	30 mg/L	30 mg/L
TSS (Monthly Average)	30 mg/L	30 mg/L
Total Phosphorus (Daily Maximum)	Monitor Only	Monitor Only
Total Nitrogen (Annual Average) ³	Monitor Only	13.9 mg/L 52 lbs/day
Total Kjeldahl Nitrogen (TKN) (Daily Maximum)	Monitor Only	Monitor Only
Nitrate/Nitrite Nitrogen (NOx) (Daily Maximum)	Monitor Only	Monitor Only
Settleable Solids (Instantaneous Maximum)	1.0 mL/L	1.0 mL/L
Total Residual Chlorine (Instantaneous Maximum)	0.1 mg/L	0.1 mg/L
E. coli (Instantaneous Maximum)	77 CFU/100 ml	77 CFU//100 mL
pH	6.5-8.5 S.U.	6.5-8.5 S.U.

Notes:

1. Source: Woodstock Main WWTF current NPDES Discharge Permit No. 3-1228, effective date October 1, 2019.
2. Proposed Effluent Design Criteria is from the WWTF’s NPDES Discharge Permit No. 3-1228, effective date October 1, 2019.
3. Total Nitrogen Annual Average is based on adjustments to the South Woodstock WWTF and Woodstock Main WWTF estimated total nitrogen (TN) allocations (see Appendix C).

VTDEC provided guidance on January 31, 2023 stating, “Upon direct discharge’s review of effluent and upstream phosphorus data from the facility, there appears to be reasonable potential for the effluent to contribute to a violation of Phosphorus Vermont Water Quality Standards in the receiving water. When the permit is renewed, this means the facility will likely be assigned a phosphorus limit.” Based on discussions with VTDEC, the following is assumed for the upgrade:

- The future limit will not require tertiary treatment of the secondary effluent.
- Chemical addition of a metal salt for precipitation of ortho-phosphate would be adequate for meeting the potential future effluent total phosphorus limit.
- The design should allow for future addition of tertiary treatment in the hydraulic profile, if possible.

4.2 Headworks

Due to the age, condition, and inability of the existing headworks equipment to handle the proposed peak flow to the plant, a new Headworks Building with new HVAC and electrical components that meet NFPA 820 code standards, and new screening and grit removal equipment sized for the design peak flows is recommended.

4.2.1. Headworks Design Criteria

Table 4.3 summarizes the design criteria for the headworks.

Table 4-3 Headworks Design Criteria

Item Description	Existing Design	Current ²	Proposed Design
Flow			
Design ADF (MGD)	0.450 MGD ¹	0.224 MGD	0.450 MGD
Design Minimum Monthly Flow (MGD)	--	-	-
Design PHF (MGD)	0.750 MGD ¹	>0.750 MGD	1.710 MGD ³
Quality			
TSS	101 mg/L ¹ 379 lbs/d	213 mg/l 394 lbs/d	213 mg/l 799 lbs/d

Notes:

1. Source: Operations and Maintenance Manual, 1983.
2. Based on Daily Monitoring Report data from January 2016 to September 2021
3. Peak Hourly Flow is based on a historical peaking factor of 3.8 from January 2016 to September 2021

4.2.2. Screening Alternatives Introduction

Several mechanically cleaned screening alternatives were developed for evaluation, including the following screening technologies:

1. Rotary Fine Screen Micro Strainer with integrated Washer Compactor
2. Center Flow Fine Screen with Washer Compactor
3. Stair Fine Screen with Washer Compactor

Influent Channel

For each screening alternative, a new influent channel will need to be constructed. The existing 12-inch gravity influent sewer will be redirected to flow by gravity via a new 18-inch influent sewer to the new headworks facility location. Flow will enter a new Headworks Building in an approximately 18 to 24-inch wide by 11-foot deep influent channel (dimensions to be determined in final design based on screen selected) and be directed to a new fine screen.

Bypass Channel

A bypass channel with a manual bar rack will be provided around the screening equipment. Channels will be isolated using slide gates.

Screenings/Grit Disposal

The washed and compacted screenings will be discharged into a container for disposal.

Influent Sampling

A new refrigerated automatic sampler will be housed in the unclassified room and will draw a sample from the influent channel upstream of the new screen.

New Headworks Building

The Headworks Building will be classified as a Class 1, Division I space as required per NFPA 820. All electrical items located in the classified space will be suitable for this hazardous location and automatic ventilation and gas monitoring will be required. A separate, unclassified room will be provided in the Headworks Building for controls and electrical equipment. The Headworks Building will also house the grit removal vortex chamber, grit pump, and grit classifier equipment. A separate area for storage and feed equipment for pH adjustment chemicals will be provided as well in the new Headworks Building (refer to Section 4.10 for details).

4.2.3. Screening Alternative 1 – Rotary Fine Screen – Micro Strainer

Description

The Rotary Fine Screen Micro Strainer consists of:

- Cylindrical screenings basket
- Integrated rotating screw conveyor that removes debris and provides washing, compacting/dewatering of screenings

Wastewater flows from the influent channel directly into the semicircular screening basket where solids are retained. The unit's small apertures help capture plastics, hygienic articles, and fibers. A central screw conveyor removes the collected solids from the screenings basket and transports them out of the channel. As the solids travel up the screw conveyor into the lower section of the transport tube, they are macerated to break down large fecal matter and then spray washed so organic materials are returned to the wastewater stream. The washed screenings are compacted and dewatered as they travel to the discharge chute to a dry solids content of up to 40 percent. This step reduces the volume by up to 50 percent and weight by up to 67 percent.

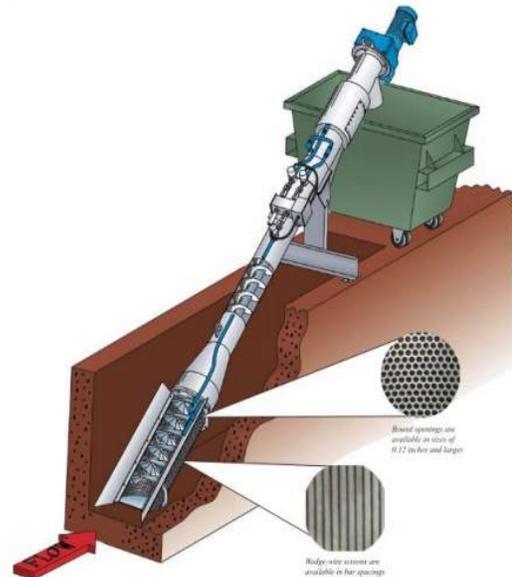


Figure 4-1 Typical Rotary Fine Screen

Screening Rotary Fine Screen Micro Strainer Alternative 1 includes the following components:

- 18-inch influent sewer line
- 20-inch wide x 11.25-foot deep influent channel
- Micro Strainer bars spaced at 0.12-inch (3mm) and integral dewatering screw
 - 304 stainless steel construction
 - 2 HP explosion proof drive motor
 - Level sensors

- 3-zone spray wash system with explosion proof solenoid valves
- Plant water filter
- Main control panel
- Local control station
- By-pass channel with manual bar rack
- 20-inch wide screening effluent channel to grit removal system
- Headworks Building rated for Class 1, Division I hazardous space, with a separate unclassified Electrical Room.
- Ventilation provided for compliance with current NFPA 820 requirements.

Rotary Fine Screen Micro Strainer Design Description

Design description for the Alternative 1 Rotary Fine Screen Screening Micro Strainer is summarized in Table 4-4.

Woodstock Main Wastewater Treatment Facility Upgrade
Preliminary Engineering Report
Section 4 – Alternatives Considered

Table 4.4 Screening Alternative 1 – Rotary Fine Screen Micro Strainer Screen Design

Item Description	Existing Design	Proposed Design	Design Standard
Design Flows			
Design Average Daily Flow	0.450 MGD	0.450 MGD	
Design Peak Hourly Flow	0.750 MGD	1.710 MGD	
Influent Channel			
Dimensions	16" W x 11.25' D	20" W x 11.25' D	
Channel Velocities	Unknown	TBD	>1.3 ft/s @ min Q, >2.5 ft/s @ PHF (TR-16)
Fine Screening with Integrated Washer Compactor			
Channel @ Screen	16" W x 11.25' D	20" W x 11.25' D	
Type	Jones & Atwood mechanically cleaned band fine screen	Rotary Fine Screen Micro Strainer	
Max Capacity	0.750 MGD	1.94 MGD	
Bar Spacing	1/4 inch	1/8 inch (3 mm)	
Inclination	none	45 deg	
Screen Velocities		1-3 fps	Channel velocity of 1.3 fps at min. flow, Velocities through openings 2-4 ft/sec (TR-16)
Drive Motor HP	2 HP	2 HP	
Water Requirements	Unknown	15 gpm at 60 psi	
Head Loss			
Downstream Water Level	Unknown	10"	
Maximum Head Loss @ PHF	Unknown	12.4"	
Max Upstream Level	Unknown	22.4"	
By-Pass Screening			
Channel	30" W x 11.25' D	20" W x 11.25' D	
Type	Manual Bar Rack	Manual Bar Rack	
Bar Spacing	1.5"	1.5"	1-2" (TR-16)
Screen Velocities	--	1-2 fps	1-2 fps (TR-16)

Non-Monetary Considerations

Advantages

- All stainless-steel construction resists corrosion.
- Dual spray wash system returns organic material to the wastewater flow.
- Single piece of equipment combining screening and washing/compacting.
- Integrated compaction zone reduces volume and weight of screening for disposal.
- Simple design with a single drive minimizes maintenance cost.
- Hinged structural support allows unit to pivot out of channel for maintenance at floor level.
- Several installations in New England

Disadvantages

- Slightly higher head loss compared to other alternatives considered (12.4" HL compared to 8").
- Depth of channel will increase length of shaft increasing length of screen channel and overall building.

Cost Estimate

A preliminary opinion of probable construction cost for a new Headworks Facility including Rotary Fine Screen Micro Strainer Screening Alternative 1 is provided in Table 4-5. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-5 Rotary Fine Screen Micro Strainer Alternative 1 – Construction Cost Estimate

Item	Cost ¹
Influent Sewer	\$33,000
Screening Equipment	\$517,000
Headworks Building	\$996,000
Effluent Pipe to Intermediate Pump Station Wet Well	\$10,000
Construction Cost Subtotal	\$1,556,000
Contractor Mark-Up ²	\$342,000
Total Construction Cost^{3,4}	\$1,898,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.2.4. Screening Alternative 2 – Center Flow Fine Screen

The second screening alternative is a center flow (center entrance/side exit) continuous band screen with 3 mm perforated spacings (1/8-inch).

Description

The center flow fine screen consists of:

- Center flow screen
- Separate washer compactor

Center Flow Screen

Flow passes into the center flow screen from the influent channel and is diverted through the laced link grid on each side of the unit. The center flow design directs water into the screen and exits out the sides. Solids larger than the openings in the screen's grid are collected and begin to form a mat which is removed undisturbed from the flow resulting in higher solids capture than rotary type screens and stair screen. Screening capture ratios increase as the solids form a thicker mat. Level sensing devices can be connected to variable speed drives to automatically compensate for high solids loading during peak flows or low flow conditions by proportionally speeding or slowing the grid travel speed. Solids are transported to the top of the screen as flow is constantly presented a clean grid surface. As screenings traverse up and over the top of the screen, spray wash nozzles direct pressurized water over the width of the grid to remove screening which are discharged into a screening wash compactor.

Washer Compactor

In the wash compactor, an auger moves the material forward as it is washed by rinse bars in the loading area of the unit. From there, the material continues to be pushed forward by the auger into the compression zone where screenings are both dewatered and compressed. The dewatered and compressed screenings then enter the pipe that moves it to the disposal point. Drained wash water is discharged upstream of the screening unit. The wash compactor reduces screening volume up to 85% and screening weight up to 80%, and results in organic removal up to 95% and dewatered screenings with a dry solids content up to 40%.

Center Flow Screen Alternative 2 includes the following components:

- 18" Influent sewer



Figure 4-2 Center Flow Screen

- 12-inch wide x 11.25-foot deep influent channel
- 30-inch wide x 11.25-foot deep channel at screen
- Center flow screen with 3 mm (1/8-inch) perforated UHMWPE openings
 - Stainless steel construction
 - 0.75 HP explosion proof drive motor
 - Ultrasonic level sensors
 - Float switches
 - Spray wash system with explosion proof solenoid valves
 - Plant water filter/strainer
 - Wash water pressure gauges
 - Main control panel
 - Local control station
- Wash Compactor
 - Stainless steel construction
 - 1.5 HP explosion proof drive motor
 - Spray wash system with explosion proof solenoid valves
 - Discharge chute to common screenings/grit dumpster
- By-pass channel with manual bar rack
- 18-inch wide screening effluent channel to grit removal system
- Headworks Building rated for Class 1, Division I hazardous space, with a separate unclassified Electrical Room.
- Ventilation provided for compliance with current NFPA 820 requirements.

Center Flow Screen Design Description

Design description for Alternative 2 Center Flow Screen is presented in Table 4-6.

Table 4-6 Screening Alternative 2 – Center Flow Screen Design Description

Item Description	Existing Design	Proposed Design	Design Standard
Flow			
Design Average Daily Flow	0.450 MGD	0.450 MGD	
Design Peak Hourly Flow	0.750 MGD	1.710 MGD	
Influent Channel			
Dimensions	16" W x 11.25' D	12" W x 11.25' D	
Channel Velocities	Unknown	TBD	>1.3 ft/s @ min Q, >2.5 ft/s @ PHF (TR-16)
Fine Screening			
Channel @ Screen	16" W x 11.25' D	30" W x 11.25' D	
Type	Jones & Atwood mechanically cleaned band fine screen	Center Flow Screen	
Max Capacity	0.750 MGD	1.71 MGD	
Bar Spacing	1/4 inch	1/8 inch (3 mm)	
Inclination	none	none (90 deg)	
Screen Velocities		TBD	Channel velocity of 1.3 fps at min. flow, Velocities through openings 2-4 ft/sec (TR-16),
Drive Motor HP	2 HP	0.5 HP	
Water Requirements	Unknown	See below for wash compactor	
Head Loss			
Downstream Water Level	Unknown	9"	
Maximum HL @PHF	Unknown	8"	
Maximum Upstream Level	Unknown	17"	
Washer Compactor			
Diameter of Screw	None	6"	
WC Drive Motor HP		1.5 HP	
Water Requirements (Screen & WC)		43 gpm @ 60 psi	
By-Pass Screening			
Channel	30" W x 11.25' D	18" W x 11.25' D	
Type	Manual Bar Rack	Manual Bar Rack	
Bar Spacing	1.5"	1.5"	1-2" (TR-16)
Screen Velocities	--	1-2 fps	1-2 fps (TR-16),

Non-Monetary Considerations

Advantages

- All stainless-steel construction resists corrosion.
- Laced link-style grid provides:
 - Strong grid.
 - High open area percentage results in lower grid velocities.
 - High open area percentage results in smaller footprint.
 - Good screening of FOG and stringy material.
 - Spray wash system returns organic material to the wastewater flow.
- Integrated compaction zone reduces volume and weight of screening for disposal.
- Higher screening capture than rotary screen.
- Lowest head loss of screen evaluated.
- Good track record of installations.
- Depth of channel doesn't impact laying length as screen is vertical.

Disadvantages

- Screen doesn't pivot out of channel.
- More complicated mechanical screen than rotary fine screen.

Cost Estimate

A preliminary opinion of probable construction cost for a new Headworks Facility including Screening Alternative 2 is provided in Table 4-7. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-7 Center Flow Screen Alternative 2 – Construction Cost Estimate

Item	Cost ¹
Influent Sewer	\$33,000
Screening Equipment	\$616,000
Headworks Building	\$825,000
Effluent Pipe to Intermediate Pump Station Wet Well	\$10,000
Construction Cost Subtotal	\$1,484,000
Contractor Mark-Up ²	\$327,000
Total Construction Cost^{3,4}	\$1,811,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.2.5. Screening Alternative 3 – Stair Fine Screen

The third screening alternative is a replacement of the existing rotary screen with a new stair screen with 3 mm spacings (1/8-inch).

Description

The stair fine screen consists of:

- Stair screen
- Separate washer compactor

Stair Screen

Stair screens operate on a system of alternating fixed and movable stair-shaped screening elements, or lamellas, that extend over the entire screening surface. Debris from the flow stream collects on the wastewater screening surface to form a mat. This mat acts as a filter to remove particles that would otherwise pass between the lamellas. Typically, a thick wastewater screenings mat can be formed due to the low head loss characteristics of this type of screen.

When the differential or high level reaches a predetermined level, the movable lamellas are activated. The movable lamellas rotate upward, lifting the debris to the next highest level of fixed lamellas, and then rotate back to their original position. The drive system provides a positive mechanical action throughout the complete rotation of the movable lamellas. This enables the unit to drive through any debris that may accumulate under the wastewater screening surface. The lamellas move the debris from the screening area in the channel to a transport area above the operating floor. The intermittent and slow progress from channel to discharge allows the debris to shed excess water while suspended on the fixed lamellas. Once the debris reaches the top step it is discharged to a washer compactor. The rotation of the movable lamellas mechanically forces debris off of the screen at the point of discharge into a wash compactor without the need for brushes or spray systems.

Washer Compactor

The washing compactor receives the screenings from the screen through the inlet hopper. The hollow shaft spiral transports the screenings from the inlet to the washing zone where they are compacted and washed. In the washing zone, wash water is injected into the screenings from the openings in the hollow shaft of the spiral and from a nozzle at the top of the unit. After the press compacts the screenings, the spiral reverses, pulling apart the compacted wastewater screenings. The cycle is repeated a minimum of four times, recompacting the screenings and squeezing out excess wash water and organics. The repetition helps the press achieve up to 90% organic removal from the screenings. As the screenings move into the dewatering zone, the pitch of the spiral decreases, further compacting the wastewater screenings for maximum water extraction prior to entering the discharge pipe. From inlet hopper to discharge, the wastewater screenings volume is reduced from 70% up to 85%.

The Stair Fine Screen Alternative 3 includes the following components:

- 18" Diameter influent sewer

- 24" wide x 11.25' deep influent channel
- Stair screen with 3 mm (1/8-inch) bar spacings
 - Stainless steel construction
 - 2 HP explosion proof drive motor
 - Ultrasonic level sensors
 - Main control panel for screen and wash compactor
 - Local control station
- Wash Compactor
 - Stainless steel construction
 - 5 HP explosion proof drive motor
 - Spray wash system with explosion proof solenoid valves
 - Discharge chute to common screenings/grit dumpster
 - Local control station
- By-pass channel with manual bar rack
- 24-inch wide screening effluent channel to grit removal system
- Headworks Building rated for Class 1, Division I hazardous space, with a separate unclassified Electrical Room.
- Ventilation provided for compliance with current NFPA 820 requirements

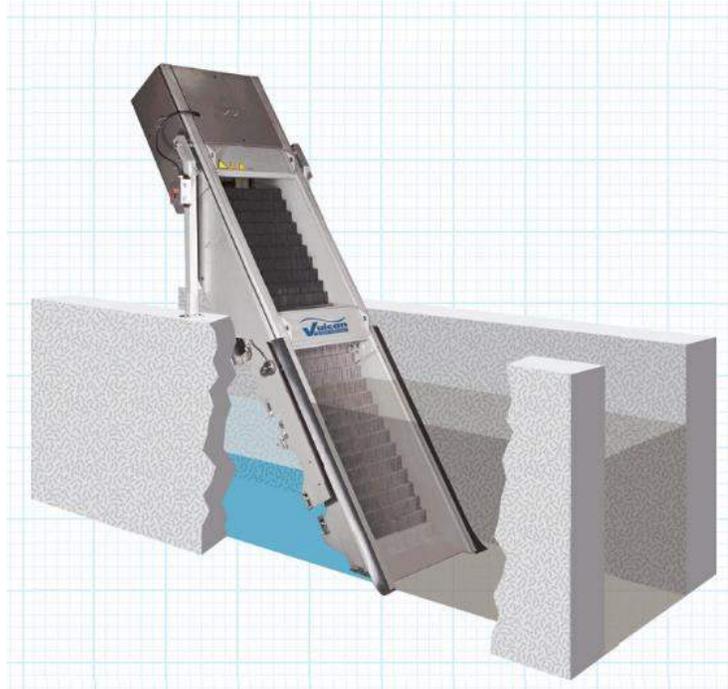


Figure 4-3 Stair Screen

Stair Screen Design Description

The design description for Alternative 3 Stair Screen is presented in Table 4-8.

Table 4-8 Screening Alternative 3 – Stair Screen Design Description

Item Description	Existing Design	Proposed Design	Design Standard
Flow			
Design Average Daily Flow	0.450 MGD	0.450 MGD	
Design Peak Hourly Flow	0.750 MGD	1.710 MGD	
Influent Channel			
Dimensions	16" W x 11.25' D	24" W x 11.25' D	
Channel Velocities	Unknown	TBD	>1.3 ft/s @ min Q, >2.5 ft/s @ PHF (TR-16)
Fine Screening			
Channel	16" W x 11.25' D	24" W x 11.25' D	
Type	Jones & Atwood mechanically cleaned band fine screen	Stair Screen	
Max Capacity	0.750 MGD	1.71 MGD	
Bar Spacing	1/4 inch	1/8 inch (3 mm)	
Inclination	none	57 deg	
Screen Velocities		1-3 fps	Channel velocity of 1.3 fps at min. flow, Velocities through openings 2-4 ft/sec (TR-16)
Drive Motor HP	2 HP	2 HP	
Water Requirements	Unknown	None	
Head loss			
Downstream Water Level	Unknown	10.03"	
Maximum Head Loss at PHF	Unknown	8.09"	
Maximum Upstream Level	Unknown	18.12"	
Washer Compactor			
Diameter of Hollow Shaft Spiral	None	8.5"	
WC Drive Motor HP		5 HP	
Water Requirements (Screen & WC)		19 gpm @ 35 psi	
By-Pass Screening			
Channel	30" W x 11.25' D	24" W x 11.25' D	
Type	Manual Bar Rack	Manual Bar Rack	
Bar Spacing	1.5"	1.5"	1-2" (TR-16)
Screen Velocities	--	1-2 fps	1-2 fps (TR-16)

Non-Monetary Considerations

Advantages

- All stainless steel construction resists corrosion.
- No spray wash system on screen, lowest water demand.

- Higher screening capture than rotary screen.
- All drive components are located above water level.
- Hollow spiral shaft efficiently moves material into compaction zone.
- Spray wash system in wash compactor returns organic material to the wastewater flow.
- Best dewatering and organics capture which reduces volume and weight of screening for disposal and reduces odors.
- Good track record of successful installations in New England.
- Screen pivots out of channel for maintenance.

Disadvantages

- More complicated mechanical screen than rotary type screen.
- Less efficient capture of hair and fibrous material compared to center flow screen.
- Depth of channel will increase length of stair.

Cost Estimate

A preliminary opinion of probable construction cost for a new Headworks Facility including Screening Alternative 3 is provided in Table 4-9. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-9 Stair Screen Alternative 3 – Construction Cost Estimate

Item	Cost ¹
Influent Sewer	\$33,000
Screening Equipment	\$612,000
Headworks Building	\$996,000
Effluent Pipe to Intermediate Pump Station Wet Well	\$10,000
Construction Cost Subtotal	\$1,651,000
Contractor Mark-Up ²	\$364,000
Total Construction Cost^{3,4}	\$2,015,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.2.6. Comparison of Construction Cost Estimates of Screening Alternatives

Detailed opinions of probable construction cost for each of the three screen treatment alternatives are provided in Appendix D. Table 4-10 provides a summary of the opinion of probable construction cost for each alternative that was considered.

Table 4-10 Summary of Screen Alternatives - Opinions of Probable Capital Cost

Item	Alt. 1 Rotary Fine Screen	Alt. 2 Center Flow Screen	Alt. 3 Stair Screen
Influent Sewer	\$33,000	\$33,000	\$33,000
Screening Equipment	\$517,000	\$616,000	\$612,000
Headworks Building	\$996,000	\$825,000	\$996,000
Effluent Pipe to Intermediate Pump Station Wet Well	\$10,000	\$10,000	\$10,000
Construction Cost Subtotal	\$1,556,000	\$1,484,000	\$1,651,000
Contractor Mark-Up ²	\$342,000	\$327,000	\$364,000
Total Construction Cost^{3,4}	\$1,898,000	\$1,811,000	\$2,015,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.2.7. Life Cycle Cost Comparison – Screening Alternatives

Life Cycle Costs

Life cycle costs including estimates of annual power consumption, replacement parts, and operation and maintenance time, were reviewed for each screening alternative considered and found to be equivalent for each of the different technologies. As there is negligible variation between the alternatives, a present worth analysis was not advanced.

4.3 Grit Removal

The grit removal technologies appropriate for the Woodstock Main WWTF include aerated grit chambers and vortex type grit chambers both with grit classifiers and are described as follows:

- **Aerated Grit Chambers:** Aerated grit chambers rely on air injected into the chamber to create a downward circulating flow pattern keeping the organics in suspension while allowing the heavier grit to settle at the bottom of the chamber. Settled grit is collected in a hopper and removed using either an air lift, grit pump, or screw auger.

- Vortex Grit Chambers: A vortex type grit chamber uses a circular tank and mechanical rotating paddles to induce a vortex environment and maintain flow velocities in the vortex chamber. The vortex environment keeps organics in suspension and allows heavier grit to settle into a lower grit hopper. Grit is removed from the hopper by either an air lift or self-priming suction lift grit pump.
- Grit Classifier: With both types of grit chambers, removed grit is sent to a grit classifier for washing and dewatering. The washed and dewatered grit is discharged into a container for disposal.

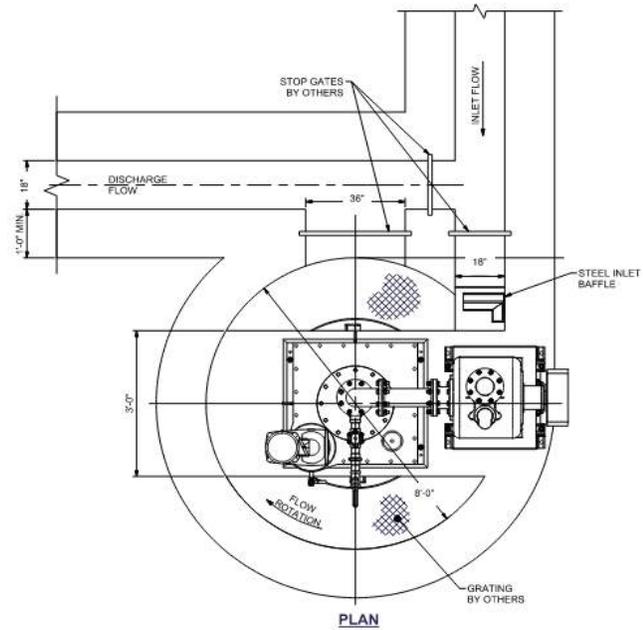


Figure 4-4 Vortex Grit Chamber Layout (Plan view)

Evaluation of Grit Alternatives
Aerated grit technology was not considered an appropriate technology for the Woodstock Main WWTF due to the small design flow capacity. The capital costs for a 1.710 MGD aerated grit system are significantly higher than a vortex grit system. Additionally, aerated grit systems require continuously operating blowers, and the annual energy costs associated with this equipment are significantly higher when compared with vortex grit technology. Based on higher capital and operating costs, the recommended grit removal system is a vortex type grit chamber. Vortex grit technology is commonly used with good grit removal performance at many New England installations of similar size.

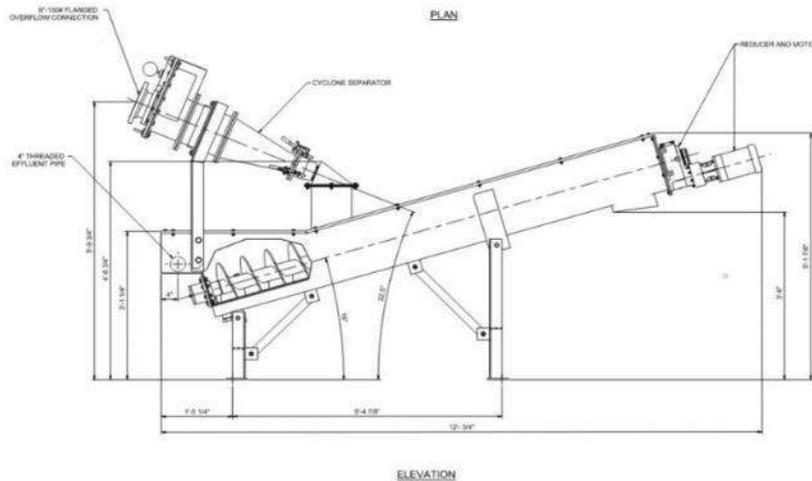


Figure 4-5 Vortex Grit Classifier Layout (Profile View)

Proposed Grit Removal Alternative

New grit removal equipment will be housed in a new Headworks Building rated for a Class 1, Division I space, and will be located downstream from the new fine screening equipment. Water levels in the

screen channel and grit vortex chamber are controlled by a fixed weir in the vortex chamber. The proposed grit removal system consists of the following components:

- Grit removal influent channel
- Grit removal system
 - Concrete grit chamber
 - Motor driven paddle assembly with integral air and water scour
 - Grit Pump
- Grit Classifier
 - Stainless Steel Construction
 - Grit cyclone separator
 - Grit classifier hopper
 - Grit screw conveyor
- Control Panel

Grit Removal Design Description

The design description for the proposed grit removal systems for all alternatives is presented in Table 4-11.

Table 4-11 Grit Removal Design Description

Item Description	Existing Design	Proposed Design	Design Standard
Flow			
Design Average Daily Flow	0.450 MGD	0.450 MGD	
Design Peak Hourly Flow	0.750 MGD	1.710 MGD	
Grit Removal			
Type of System	Dorr Oliver Vortex-Type Chamber	Vortex -Type Chamber	
Number of Channels	1 w/ bypass	1 w/ bypass	Must provide by-pass
Influent/Effluent Channel Dimensions	12" pipe	1'-6" W	
Chamber Dimensions	6'	Upper: Dia. 7' Lower: Dia. 3'	
Paddle Drive Motor	0.5 HP	0.75 HP	
Influent Channel Velocity			
At minimum flow	unknown	>0.5 ft/s	>0.5 ft/s (TR-16)
At ADF	unknown	2-3 ft/s	2-3 ft/s (TR-16)
At PHF	unknown	2-3 ft/s	2-3 ft/s (TR-16)
Grit Removal Pump			
Quantity	1	1	
Type	unknown	Self-Prime Suction Lift	
Capacity	unknown	250 GPM	
HP	unknown	7.5 HP	
Grit Classifier			
Type	12" Dorr Oliver	Helical Screw	
Conveying Capacity	unknown	30 ft ³ /hr	
Motor Size	unknown	1 HP	
Material	304 SS	304 SS	

Cost Estimate

A preliminary opinion of probable construction cost for new grit removal facilities is provided in Table 4-12. Grit removal tankage and equipment will be located inside the new Headworks Building. Costs for the Headworks Building are carried under each Screening Alternative in the previous sections. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-12 Grit Removal – Construction Cost Estimate

Item	Cost ¹
Grit Removal Equipment and Tank	\$534,000
Construction Cost Subtotal	\$534,000
Contractor Mark-Up ²	\$118,000
Total Construction Cost^{3,4}	\$652,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.4 Influent Pumping

The existing influent pumps do not provide redundancy at the design peak flow. The recommended upgrade is replacement of existing two (2) influent pumps with a triplex dry it submersible pump system to provide full redundancy at the design peak flow (1.71 MGD), while being able to be turned down to efficiently pump current average flows (currently at 0.224 MGD). A new pump discharge force main will be required as well to bring flows to the new biological process.

Design Criteria

Design criteria for the influent pumps are presented in Table 4-13.

Table 4-13 Influent Pumps Proposed Design Criteria

Item Description	Existing Design	Proposed Design	Design Standard
Flows			
Average Daily Flow	0.450 MGD ¹	0.450 MGD	
Current ADF	0.224 MGD ²	0.224 MGD ² (155 gpm)	
Peak Hourly Flow	0.750 MGD ¹	1.71 MGD ³ (1200 gpm)	
Influent Pumps			
Quantity	2 (1 duty, 1 standby)	3 (2 duty, 1 standby)	Full redundancy at PHF (TR-16)
Type	Flygt dry-pit submersible, non-clog	Dry-pit submersible, non-clog	
Capacity, each	100 gpm (0.144 MGD) @ 40 hertz 440 gpm (0.643 MGD) @ 60 hertz	100 gpm (0.144 MGD) @ 24' TDH 800 gpm (1.152 MGD) @ 35' TDH	
Horsepower	6.9 HP	12 HP	
Variable Speed Control	Yes	Yes	
Pump Control System	Multitrode Probe (conductive level sensor)	Multitrode Probe (conductive level sensor)	

Notes:

1. Source: Operations and Maintenance Manual, 1983.
2. Based on Daily Monitoring Report data from January 2016 to September 2021
3. Peak Hourly Flow is based on a historical peaking factor of 3.8 from January 2016 to September 2021

Description

The proposed refurbishment of the influent pumps includes:

- Replacement of existing two (2) influent pumps with three (3) dry pit submersible pumps
- New variable frequency drives
- New suction and discharge valves
- New magnetic flow meter on pump discharge header
- New level control system in pump wet well
- New pump force main to new biological process

Non-Monetary Considerations

- Construction sequencing and/or by-pass pumping will be required to ensure forward flow is provided at all times.

Cost Estimate

A preliminary opinion of probable construction cost for refurbishment of the influent pumps as described above is provided in Table 4-14. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-14 Influent Pumps Refurbishment – Cost Estimate

Item	Cost ¹
New Pump Force Main to New Biological Process	\$ 59,000
Pump Replacements (includes VFDs, valves, flow meter, level controls)	\$ 660,000
Construction Cost Subtotal	\$ 719,000
Contractor Mark-up ²	\$ 158,000
Total Construction Cost^{3,4}	\$ 877,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.5 Biological Process

Existing aeration tanks were found to be in poor condition, with visible concrete tanks in the tank walls, corroded grating, and a failing steel beam used to support the center wall. In order to address aging infrastructure and maintain effective biological treatment, it is recommended to replace the existing aeration tanks with new aeration tanks and aeration tank equipment.

Design Criteria

A Ludzack Ettinger (LE) process was considered. In a LE process, water enters an anoxic zone followed by an aerobic zone. Nitrate is provided to the anoxic zone solely through the RAS for denitrification, as seen in Figure 4-6. Nitrification and BOD removal occur in the aerobic zone. This process is equivalent to the existing operations at the Main WWTF.

When determining the required anoxic and aerobic volumes, a target MLSS of 3,000 mg/L was used which corresponds with the existing biological process design. The minimum aerobic solids retention time (SRT) was calculated to ensure a minimum nitrification safety factor of 1.5. Tankage was sized by optimizing effluent nitrate concentrations.

A process simulation software, Sumo, was used to check calculations and effluent concentrations. Sumo's default wastewater characteristics were used. The optimum SRT and WAS flow was determined to maintain a MLSS of 3,000 mg/L. The total tankage was 235,000 gallons. Analysis results from Sumo are provided in Table 4-15. The analysis was performed for a winter condition with temperature 8°C.

Note the LE process would be configured with subdivided anoxic tankage in each train with the flexibility to return RAS to any of the sub-divided anoxic tanks and flexibility to have influent enter any of the sub-divided anoxic tanks. This will allow for the flexibility for the facility to create anaerobic tankage, allowing for the potential for biological phosphorus removal in the process trains. Therefore, the biological process will have the flexibility to operate as an Anoxic Aerobic (AO) process or Anaerobic, Anoxic, Oxic (A2O) process.

Table 4-15 Summary of Results of Ludzack Ettinger Model

Parameter	Ludzack Ettinger	
MLSS	3,000	mg/L
Total SRT	17	days
Anoxic Volume	74,675	gal
Aerobic Volume	160,325	gal
Total Volume	235,000	gal
Effluent Ammonia	1.1	mg/L
Effluent Nitrate and Nitrite [NO _x]	24	mg/L

In addition to the LE process, a Modified Ludzack Ettinger (MLE) process was modeled. In a MLE process, nitrate is provided to the anoxic zone through the RAS as well as through an internal nitrate recycle (NRCY) that cycles from the end of the aerobic zone to the beginning of the anoxic zone. However, due to a lack of regulatory drivers, the MLE process was not further considered as a tankage volume that is significantly larger than currently needed would be required.

Biological Process Design Description

The design description for the proposed biological process is presented in Table 4-16.

Table 4-16 Biological Process Design Description

Item Description	Existing Design or Capacity	Proposed (Draft)	Design Standard
Biological Process Design			
Type	Step Feed/Contact Stabilization/ Ludzack Ettinger (LE)	Ludzack Ettinger (LE)	
Number of trains	2	2	VTDEC Guidance 75% ADF with one train out of service, TR-16
Length	132.5 ft (includes walls)	116.0 ft	Minimum 4:1 length:width ratio (TR-16)
Side water depth	13.07 ft	13.0 ft	Between 10-25 feet depth (TR-16)
Width	18 ft	21.0 ft	
Volume (per train)	233,167 gallons	235,000 gallons	
Anoxic Volume (per train)	58,300 gallons	74,700 gallons	
Oxic Volume (per train)	174,867 gallons	160,300 gallons	
Freeboard	18 inches	18 inches	Not less than 18 inches (TR-16)
RAS	Up to 60% of forward flow 0.27 MGD	60-150% of forward flow, 100% used for process model	
Aeration System	Fine Bubble Membrane Diffusers	Fine Bubble Membrane Diffusers	
SRT	30 days	17 days	
MLSS	3,000 mg/L	3,000 mg/L	
AOR (per train)	436.86 lbs O ₂ /day	367 lbs O ₂ /day	
Blowers			
Quantity	2 (1 duty, 1 standby)	2 (1 duty, 1 standby)	VTDEC 100% redundancy required
Type	Positive Displacement	Positive Displacement	
Capacity, each	900 scfm @ 6.9 psig	<i>234 scfm @ 6.9 psi</i>	0.85-1.2 lbs O ₂ /lb BOD removed plus 4.2 lbs O ₂ /lb NH ₃ oxidized at maximum daily loadings (TR-16)
Motor Size, each	40 HP	<i>25 HP</i>	
Speed Control	VFDs	VFDs	

Description

The proposed aeration tank and aeration tank equipment includes:

- Construction of new aeration tanks that include anoxic and aerobic zones
- Reconfiguration of splitter box

Exhibit

Figure 4-6 presents the process flow diagram for the proposed Ludzack Ettinger process. In the schematic, return activated sludge (RAS) joins the raw wastewater from the influent pump station before entering the anoxic zone, followed by the aerobic zone.

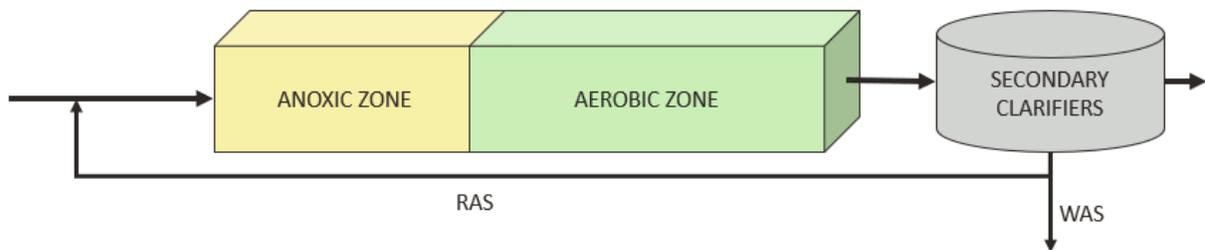


Figure 4-6 Ludzack Ettinger Process Flow

Non-Monetary Considerations

- Provides operational flexibility
- Addresses age-related equipment replacement needs
- Reduces amount of oxygen required for BOD removal

Cost Estimate

A preliminary opinion of probable construction costs for the biological process alternative is provided in Table 4-17. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-17 Biological Process – Construction Cost Estimate

Item	Cost ¹
New Aeration Tanks	\$1,548,000
Biological Process Equipment (mixers, diffusers, recycle pumps, piping)	\$980,000
Aeration Tank Effluent to Secondary Clarifiers	\$30,000
Construction Cost Subtotal	\$2,558,000
Contractor Mark-Up ²	\$563,000
Total Construction Cost^{3,4}	\$3,121,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.6 Chemical Feed and Storage for Phosphorus Removal

Description

The proposed chemical feed and storage facilities for phosphorus removal includes:

- Chemical yard piping to dosing points
- Rehabilitation of the existing chlor/dechlor storage and feed rooms including:
 - Demolition of existing disinfection equipment, storage tanks, interior components, and interior wall
 - New overhead doors and concrete containment area
 - Replacement of HVAC, plumbing, and electrical systems
 - New emergency eye wash and shower
 - New paint, coatings, and finishes
- New coagulant storage tanks
 - Two (2) 1000-gallon cross-linked HDPE tanks
 - Level detection system
- New chemical feed skid
 - Triplex pump skid with three (3) peristaltic pumps
- New chemical feed piping and valves

Cost Estimate

A preliminary opinion of probable construction costs for the proposed chemical feed and storage facilities for phosphorus removal is provided in Table 4-18. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-18 Chemical Feed and Storage Systems for Phosphorus Removal – Construction Cost Estimate

Item	Cost ¹
Chemical yard piping to dosing points	\$25,000
Rehabilitation of Existing Chemical Storage Rooms (includes, chemical containment, HVAC, plumbing, electrical, new overhead doors, piping, valves, etc.)	\$196,000
Chemical Storage Tanks (2 – 1000-gallon tanks)	\$30,000
Chemical Feed Pumps (triplex pump skid)	\$20,000
Construction Cost Subtotal	\$271,000
Contractor Mark-Up ²	\$60,000
Total Construction Cost^{3,4}	\$331,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.7 Secondary Clarifiers

The two existing Spiraflo secondary clarifiers are 30-foot diameter, 12-ft SWD peripheral feed, center take off clarifiers built in the late 1970s, and require age-related rehabilitation. Over time, deterioration of the internal components (drive, scum box, skimmer, scraper, access bridge) has occurred. Rehabilitation will include direct replacement of components to restore the clarifier to its original functionality. Additionally, concrete rehabilitation is required for the existing tankage (sand blasting, crack repair, concrete coating).

Scum box improvements will include providing suction piping from the scum boxes to the WAS pumps to waste directly to the sludge holding tanks, and replacement of the level detection systems in each box. Upgrade of the RAS and WAS pump systems is discussed in the following Section 6.1.5.

The recommended upgrade also includes refurbishment of the Clarifier House that is located between the two clarifier tanks to improve physical and mechanical equipment access to the lower level, repair cracks in the top concrete slab/roof, relocation of electrical components to an above-grade climate-controlled structure, and refurbishment of the electrical and HVAC systems.

Design Criteria

The existing clarifier setup currently meets surface loading requirements set forth by 10 State Standards and TR-16 for extended aeration up to a peak hourly flow of 1.26 MGD.

Design Criteria for the secondary clarifier and RAS/WAS system is presented in Table 4-19.

Table 4-19 Secondary Clarifier Proposed Design Criteria

Item Description	Existing Design	Current Flows	Proposed Design	Design Standard
Secondary Clarifiers				
Quantity	2		2	
Type	Circular, Peripheral Feed		Circular, Peripheral Feed	
Diameter (ft)	30		30	
Weir Length (lf)	94 (each) 188 (total)		94 (each) 188 (total)	
Side Water Depth	12		12	14 ft (TR-16) 12 ft (10 States Std)
Surface Area (ft)	707 (each) 1,414 (total)		707 (each) 1,414 (total)	
Capacity (ft ³)	8,482 (each) 16,965 (total)		8,482 (each) 16,965 (total)	
Capacity (gal)	16,965 (each) 63,452 (total)		16,965 (each) 63,452 (total)	
Average Daily Flow (MGD)	0.45	0.224	0.45	
Design Peak Hourly Flow (MGD)	0.75	0.972	1.71	
Surface Loading Rate (gpd/ft²)				
Peak Hourly Flow (2 units)	531	688	1,210	<1,200 gpd/sf (10 State Std)
75% Peak Hourly Flow (1 unit)	796	1,031	1,814	<1,200 gpd/sf (10 State Std)
Solids Loading Rate (lbs/day/ft²) – including RAS				
Peak Hourly Flow (2 units)	19	24	42	< 50 lbs/d-ft (10 State Std)
75% Peak Hourly Flow (1 unit)	28	36	64	< 50 lbs/d-ft (10 State Std)
Weir Loading Rate (gpd/lf)				
Peak Hourly Flow (2 units)	3,979	5,157	9,072	< 20,000 gpd/ft (10 State Std)
75% Peak Hourly Flow (1 unit)	5,968	7,735	13,608	< 20,000 gpd/ft (10 State Std)

Description

The proposed refurbishment of the secondary clarifier equipment includes:

- Concrete repair of two (2) existing tanks
- Replacement of two (2) existing Spiraflo Clarifier components:
 - Drive assembly
 - Inlet trough
 - Effluent weir

- Access Bridge
- Scraper assembly
- Surface skimmer assembly and scum box
- Scum Boxes
 - Replacement of scum pit level indicators
 - Hard-pipe scum pits to WAS pump
- Clarifier House Refurbishment
 - New above-grade Electrical Room Addition (approximately 200 sq. ft.)
 - Concrete repair of top slab/roof
 - Replacement of equipment access hatch
 - Replacement of electrical and HVAC
 - Replacement of spiral staircase

Exhibit

Figure 4-7 presents a 3D drawing of the existing clarifiers and components to be directly replaced during rehabilitation.

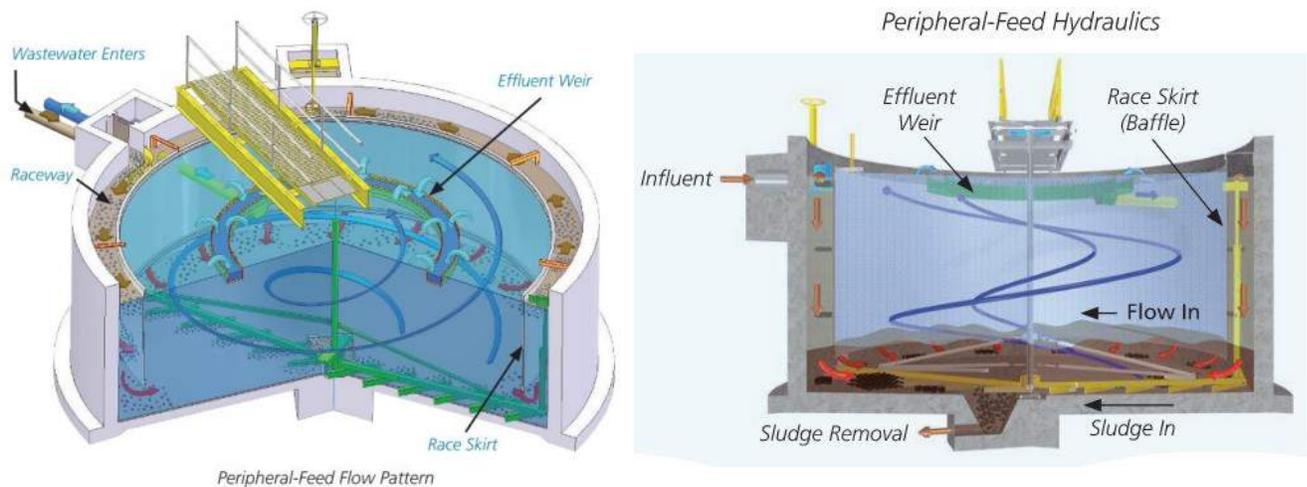


Figure 4-7: Spiraflo Secondary Clarifier (Provided by Spiraflo)

Non-Monetary Considerations

- Construction sequencing constraints are required to ensure one clarifier is in service at all times.

Cost Estimate

A preliminary opinion of probable construction cost for secondary clarifier refurbishment as described above is provided in Table 4-20. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-20 Secondary Clarifier Refurbishment – Cost Estimate

Item	Cost ¹
Clarifier Tank Concrete Repair	\$150,000
Clarifier Refurbishment (includes clarifier equipment, bridge, drive, scraper arms, inlet and effluent troughs, scum skimmer arms, and weirs)	\$541,000
Clarifier House Rehabilitation	\$283,000
Construction Cost Subtotal	\$974,000
Contractor Mark-up ²	\$214,000
Total Construction Cost^{3,4}	\$1,188,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.8 Return and Waste Activated Sludge Pumping

The existing RAS/WAS pumping system is at the end of its useful life and in need of replacement. The recommended project includes replacement of the three (3) existing RAS/WAS pumps with two (2) pumps dedicated for RAS and two (2) pumps dedicated for WAS. RAS pumps will be provide with new VFDs and a new flow meter for flow pacing. New RAS discharge piping will be directed to the new biological process, and new WAS discharge piping will be directed to the existing sludge holding tanks. The suction of the WAS pumps will also be piped to the scum boxes to allow wasting of scum directly to the sludge holding tanks. The improvements to the Clarifier House are discussed previously in Section 4.6.

Design Criteria

Design criteria for the RAS and WAS pump systems are presented in Table 4-21.

Table 4-21 RAS & WAS Pumps Proposed Design Criteria

Item Description	Existing Design	Proposed Design	Design Standard
RAS Pumps			
Quantity	2	2 (1 duty, 1 standby)	1 duty, 1 stand-by
Type	Flygt dry-pit vertical, non-clog	Dry-pit vertical, non-clog	
Control Method	VFD	VFD	
Target RAS Flow	65% of Effluent Q	65% - 150% of Effluent Q	
Capacity, each	160 - 330 gpm	200 – 470 gpm	
HP	3.7	TBD	
WAS Pumps			
Quantity	1	2 (1 duty, 1 standby)	1 duty, 1 stand-by
Type	Flygt dry-pit vertical, non-clog	Dry-pit vertical, non-clog	
Capacity, each	160 - 330 gpm	150 - 200 gpm	>80 gpm (>2 fps in 4" dia. Pipe. (10-States)
Horsepower	3.7 HP	TBD	
Variable Speed Control	No	No	
Pump Control System	manual	timer/manual	

Description

The proposed refurbishment of the RAS & WAS pumping systems includes:

- RAS Pumps
 - Two (2) new RAS pumps
 - New VFDs
 - New suction and discharge check and isolation valves
 - New magnetic flow meter
 - New RAS force main to new biological process
- WAS Pumps
 - Two (2) new WAS pumps
 - New suction and discharge check and isolation valves
 - New magnetic flow meter
 - New WAS force main to sludge holding tanks
 - New suction lines to existing scum boxes

Non-Monetary Considerations

- Construction sequencing and/or by-pass pumping will be required to ensure recycle and wasting is provided at all times.

Cost Estimate

A preliminary opinion of probable construction cost for refurbishment of the RAS and WAS pump systems as described above is provided in Table 4-22. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-22 RAS & WAS Pump Systems Refurbishment – Cost Estimate

Item	Cost ¹
RAS Pump Replacements	\$249,000
WAS Pump Replacements	\$231,000
Construction Cost Subtotal	\$480,000
Contractor Mark-up ²	\$106,000
Total Construction Cost^{3,4}	\$586,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.9 Disinfection

The existing CCT only provides 10 minutes of detention time at the design peak hourly flow of 1.71 MGD which is well below current design guidance of 30 minutes detention at PHF. The 1983 WWTF upgrade raised the walls of the existing CCT up to EL. 675.12 ft., however the elevation is only 2-inches above the 100-year flood elevation of EL. 675.0 ft. Based on these deficiencies, upgrades to the existing disinfection system will be required at the WWTF. Two alternatives were considered disinfection:

1. New chlorine contact tank (CCT) and refurbished chemical storage and feed systems
2. Ultraviolet disinfection

4.9.1. Disinfection Design Criteria

Table 4-23 summarizes the disinfection design criteria.

Table 4-23 Disinfection Design Criteria

Item Description	Existing Design ¹	Proposed Design ²	Design Standard
Disinfection Influent Design Criteria			
Max Flow to Disinfection (gpm)	0.750 MGD	1.71 MGD	
Solids to Disinfection System	Monthly Ave. 30 mg/l TSS	Monthly Ave. 30 mg/l TSS	<30 mg/L TSS (TR-16)
Disinfection Effluent Design Criteria			
Escherichia coli (Instantaneous Max)	77 CFU/100 ml	77 CFU/100 ml	

Notes:

1. Source: Woodstock Main WWTF current NPDES Discharge Permit No. 3-1228, effective date October 1, 2019.
2. Proposed Effluent Design Criteria is from the WWTF's NPDES Discharge Permit No. 3-1228, effective date October 1, 2019.

4.9.2. Disinfection Alternative 1 – New Chlorine Contact Tank

Disinfection Alternative 1 includes constructing an entirely new chlorine contact tank (CCT) sized to provide 30 minutes of detention time at the design peak hydraulic flow of 1.71 MGD and be protected against the 500-year flow elevation of 676.0 feet.

Under this alternative, new parallel-train CCTs will be provided, each sized to meet the required 30-minute detention time at peak flow. Each train will have a serpentine flow channel ending with a flow control device to measure flows. Internal baffles will be provided in the channel and mechanical mixing will be provided at the points of chemical addition to optimize mixing. Sodium hypochlorite will be dosed at the beginning of the CCT, and sodium bisulfite will be dosed after the effluent flow measurement weir (refer to Section 4.9 for the discussion on effluent flow measurement). The new CCT will be located in the vicinity of the existing aeration tanks once demolished.

The existing storage systems for sodium hypochlorite and sodium bisulfite will be refurbished with improvements to the existing HVAC to maintain adequate air changes and temperatures, replacement of electrical systems, as well as replacement of existing chemical feed pumps. The existing bulk storage containers for both chemical feed systems will remain in use.

Chlorine Contact Tank Design Description

A summary of the CCT disinfection system design is outlined in Table 4-24.

Table 4-24 Chlorine Contact Tank Design Description

Item Description	Existing Design	Proposed Design	Design Standard
Chlorine Contact Tank Influent Design Criteria			
Max Flow to Disinfection (gpm)	0.750 MGD	1.71 MGD	
Solids to Disinfection System	Monthly Ave. 30 mg/l TSS	Monthly Ave. 30 mg/l TSS	<30 mg/L TSS (TR-16)
Chlorine Contact Tank			
Number of Trains	2	2	100% redundancy (Min. of 2) (TR-16)
Liquid Depth	14 feet	6 feet	
Channel Width, each	1.5 feet	3 feet	
Length of Train, each	80 feet	270 feet	
Volume Provided per Train	12,566 gallons	36,353 gallons	
Detention Time @ PHF (1.71 MGD)	10.6 minutes	30.6 minutes	>30 minutes at PHF (TR-16)
Sodium Hypochlorite			
Average Daily Usage	10-10.5 gpd	10-10.5 gpd	
Storage Tanks			
Quantity	1	1	
Type	HDPE	HDPE	
Storage Volume	500 gallons	500 gallons	30-day supply
Containment Volume Required	625 gallons	625 gallons	125% of vol. (TR-16)
Type of Containment	Concrete berm wall	Concrete berm wall	
Feed Pumps			
Quantity	1 (1 spare on-the-shelf)	2 (1 duty, 1 spare)	Min. of 2 (TR-16)
Type	peristaltic pump	peristaltic pump	
Pumping rate	52 gpd	50-75 gpd	
Sodium Bisulfite			
Average Daily Usage	3-5 gpd	3-5 gpd	
Storage Tanks			
Quantity	1	1	
Type	HDPE	HDPE	
Storage Volume	300 gallons	300 gallons	30-day supply (TR-16-4.5.2.6)
Containment Volume Required	375 gallons	375 gallons	125% of vol. (TR-16)
Type of Containment	Double walled tank	Double walled tank	
Feed Pumps			
Quantity	1	2 (1 duty, 1 spare)	Min. of 2 (TR-16)
Type	peristaltic pump	peristaltic pump	
Max pumping rate	24 gpd	10-30 gpd	

Description

The proposed CCT alternative includes the following:

- New concrete Chlorine Contact Tank:
 - 2 train, with serpentine flow channels
 - Mechanical mixing at points of chemical application
 - Interior baffles
 - FRP grating
- New chemical metering pumps for chlorination and dechlorination chemicals.
- Refurbished chemical storage areas:
 - New HVAC will be provided to adequately provide required air changes in Chemical Room.
 - New electrical
 - New doors
 - New paint
 - Tempered eye wash and emergency shower will be provided in the Chemical Room.
- Effluent Flow Measurement
 - Level control weir
 - Ultrasonic level indicator
- Effluent automatic sampler

Non-Monetary Considerations

Advantages

- Simple, reliable disinfection process.

Disadvantages

- Construction of new chlorine contact tank would need to be sequenced for after demolition of existing aeration tanks.
- In storage and handling of hazardous chemicals.
- Disinfection and dechlorination chemicals are corrosive and will require replacement of metal storage room components on a routine basis.
- Interference from nitrite from partial nitrification can inhibit sodium hypochlorite.

Cost Estimate

A preliminary opinion of probable construction cost for a new chlorine contact tank alternative as described above is provided in Table 4-25. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-25 Disinfection Alternative 1 – New Chlorine Contact Tank – Cost Estimate

Item	Cost ¹
Chlorine Contact Tank Structure	\$1,127,000
Chemical Storage and Feed Systems Rehabilitation	\$253,000
Yard Piping to and from new CCT	\$26,000
Construction Cost Subtotal	\$1,406,000
Contractor Mark-up ²	\$309,000
Total Construction Cost^{3,4}	\$1,715,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.9.3. Disinfection Alternative 2 – Ultraviolet Disinfection

Ultraviolet light, at the germicidal wavelength of 253.7 nanometers (nm), disinfects wastewater by altering the genetic material (DNA) in cells so that bacteria, viruses, and other microorganisms can no longer reproduce. In UV disinfection systems, the UV light is produced by germicidal lamps that are submerged in an open channel. As the wastewater flows past the UV lamps, the microorganisms are exposed to the light and inactivated. The UV dose is measured as the product of UV light intensity times the exposure time within the UV lamp array. The ultraviolet light is generated by low-pressure mercury arc lamps which are set in an open channel. Over 85 percent of the UV output from these lamps is at the germicidal wavelength of 253.7 nm.

The proposed UV disinfection system will be composed of three (3) UV banks in series (two duty, one redundant) in a concrete channel with an integral level control weir. The disinfection system will be sized to treat a maximum flow of 1.71 MGD with one unit out of service, and an influent monthly average TSS concentration of 30 mg/L. The new disinfection system will be housed in a new UV Building located in the area of the existing aeration tank once demolished. The disinfection system will be equipped with a backup electrical supply capable of powering the entire system in the event of primary power failure. An automatic sampler will be provided downstream of the UV level control weir.

Ultraviolet Design Description

A summary of the UV disinfection system design is outlined in Table 4-26.

Table 4-26 UV Disinfection Design Description

Item Description	Existing Design	Proposed Design	Design Standard
UV Influent Design Criteria			
Max Flow to Disinfection (gpm)	0.750 MGD	1.71 MGD	
Solids to UV System	Monthly Ave. 30 mg/l TSS	Monthly Ave. 30 mg/l TSS	<30 mg/L TSS (TR-16)
UV Disinfection System			
Disinfection System Type	Hypochlorite	Ultraviolet Light	
Type	n/a	Low Pressure Lamps	
UV Radiation Wavelength (nm)		254 nm	TR16: 254 nm
UVT (%)		>65	65 minimum
Channels		1	
Banks/Channel		3 (2 duty, 1 standby)	100% Redundancy at PHF
Modules/Bank		3	
Lamps/Module		6	
Total UV Lamps		54	
Channel Dimensions		12" W x 36.5' L x 54" SWD (stainless steel)	
Max Power Draw		8.7 kW	
UV Dose at PHF		50 mJ/cm ²	>30 mW*sec/cm ² , or >30 mJ/cm ²

Description

The proposed UV disinfection system includes the following components:

- Concrete channel with:
 - 36'-6" length x 12" width x 54" depth
 - Module Support Rack
 - Level Control Weir
- Three (3) UV Banks, each containing:
 - 3 Type 316 stainless steel modules
 - 6 UV low pressure lamps/module
- Automatic chemical/mechanical cleaning system
- Monitoring system for indication of UV intensity, lamp age, and alarms
- Remote indication of UV intensity
- Remote indication of low UV intensity alarm
- Maintenance module cleaning rack
- Davit crane for UV module lifting
- Effluent Flow Measurement
 - Level control weir

- Ultrasonic level indicator
- Effluent automatic sampler

Exhibit

Figure 4-8 presents a three-dimensional drawing of ultraviolet banks in series:



Figure 4-8 Ultraviolet Banks in Series

Non-Monetary Considerations

Advantages

- Eliminates storage and handling of hazardous chemicals.

Disadvantages

- New UV disinfection system construction would need to be sequenced for after demolition of existing aeration tanks.
- More complex disinfection process than chemical disinfection.
- Will require upgrades to control panel and control systems over time.

Cost Estimate

A preliminary opinion of probable construction cost for the ultraviolet disinfection alternative as described above is provided in Table 4-27. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-27 Disinfection Alternative 2 – UV Disinfection – Cost Estimate

Item	Cost ¹
UV Building (includes channels, effluent flow measurement)	\$585,000
UV Disinfection System	\$286,000
Influent/Effluent Yard Piping	\$26,000
Construction Cost Subtotal	\$897,000
Contractor Mark-up ²	\$198,000
Total Construction Cost^{3,4}	\$1,095,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.9.4. Comparison of Construction Cost Estimates of Disinfection Alternatives

Detailed opinions of probable construction cost for each of the two disinfection alternatives are provided in Appendix D. Table 4-28 provides a summary of the opinion of probable construction cost for each alternative that was considered.

Table 4-28 Summary of Disinfection Alternatives - Opinions of Probable Capital Cost

Item	Alt. 1 New CCT	Alt. 2 UV
CCT Tank Structure	\$1,127,000	--
UV Building (includes channels, effluent flow measurement)	--	\$585,000
UV Disinfection System	--	\$286,000
Chemical Storage and Feed Systems Rehabilitation	\$253,000	--
Yard Piping to and from new disinfection system	\$26,000	\$26,000
Construction Cost Subtotal	\$1,406,000	\$897,000
Contractor Mark-Up ²	\$309,000	\$198,000
Total Construction Cost^{3,4}	\$1,715,000	\$1,095,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.10 Effluent Flow Measurement

Effluent flow measurement is currently achieved by the use of single sharp-crested rectangular weir plate with end contractions at the effluent end of CCT and an ultrasonic level detector. As the existing chlorine contact tank is recommended to be demolished, provisions for effluent flow measurement will be included following disinfection.

Flow measurement will consist of a new effluent flow control device (either v-notch weir or Parshall flume) in the channel downstream of disinfection and an ultrasonic level detector. Both v-notch weirs and Parshall flumes can accurately measure flows across the range of design flows at low head losses. The design criteria for effluent flow measurement are described in this section, however, final selection of a control device and location of effluent flow measurement channel will be made during detailed design.

Effluent Flow Measurement Design Description

The proposed effluent flow measurement design parameters are presented in Table 4-29.

Table 4-29 Effluent Flow Measurement Design Description

Item Description	Existing Design	Proposed Design	Design Standard
Effluent Flow Measurement			
ADF	0.450 MGD	0.450 MGD	
Max. Flow	0.750 MGD	1.71 MGD	
Control Device	Sharp-crested weir with end contractions	V-notch Weir or Parshall Flume	Accurate measurement over full range of design flows (TR-16)
Weir			
Weir Type	12" sharp-crested weir with end contractions	90° V-notch weir	
Measurement Range	0.1848 MGD ¹ - 0.685 MGD	0.0289 MGD ¹ – 9.141 MGD	0.2 ft ¹ – 2 ft of head
Head @ ADF	0.37 ft	0.60 ft	>0.2 ft ¹
Head @ Max Q	0.5 ft @ 0.685 MGD	1.03 ft	<2 ft
Parshall Flume			
Flume throat width	N/A	6-inch	
Measurement Range	--	0.035 – 2.526 MGD	0.10 ft ¹ – 1.5 ft
Head @ ADF	--	0.50 ft	>0.10 ft ¹
Head @ Max Q	--	1.17 ft	<1.5 ft

Notes:

1. Low measurement range is the minimum flows at the suggested minimum and maximum head level for the control device as per Isco Open Channel Flow Measurement Handbook, 6th Edition.

Description

The proposed effluent flow measurement includes the following:

Effluent Flow Measurement

- New concrete effluent channel
 - Width x length to be determined based on control device selected
 - Location: downstream of disinfection alternative selected
- Effluent flow measurement:
 - 90° v-notch weir, or
 - 6” Parshall flume
- Ultrasonic level detector

Cost Estimate

A preliminary opinion of probable construction cost for effluent flow measurement is provided under each of the disinfection alternatives described above in Section 4.8.

4.11 pH Adjustment Chemical Feed and Storage

Recommendations for the rehabilitation of the existing chemical feed and storage facilities for disinfection chemicals associated with the chlorine contact tank alternative 1 are discussed previously in Section 4.8.2.

Storage and chemical feed systems for sodium hydroxide for pH adjustment will be provided for in the new Headworks Building. Provision for several 55-gallon drums will be provided for and will include drum spill pallets for containment. Tempered eye wash and emergency shower will be provided in the storage area.

pH Adjustment Chemical Feed & Storage Design Description

A summary of the chemical feed and storage facilities for pH adjustment design is described in Table 4-30.

Table 4-30 Chemical Feed and Storage Systems for pH Adjustment Design Description

Item Description	Existing Design	Proposed Design	Design Standard
pH Adjustment			
Average Daily Usage	unknown	As needed	
Storage Tanks			
Quantity	unknown	2	
Type	unknown	55-gallon drums	30-day supply (TR-16-4.5.2.6)
Containment Volume Required	unknown	69 gallons/drum	125% of vol. (TR-16)
Type of Containment	unknown	Drum spill pallets	
Feed Pumps			
Quantity	unknown	2 (1 duty, 1 spare)	Min. of 2 (TR-16)
Type	unknown	peristaltic pump	

Description

The proposed chemical feed and storage system for pH adjustment includes the following:

- Chemical Room at New Headworks Building to house chemical storage drums and feed equipment.
 - Spill drum pallets for storage of 55-gallon drum of pH adjustment chemicals with containment sized to contain 125% of design volumes.
 - Emergency eyewash and shower.
- Chemical Feed
 - Shelf-mounted positive displacement chemical feed pumps
 - 2 (1 duty, 1 standby)

Cost Estimate

Costs for a pH adjustment feed system are provided under each of the headworks alternatives described above in Section 4.2.

4.12 Plant Water

The existing plant water system draws disinfected water out of the effluent end of the CCT for use with the spray wash system for the mechanical fine screen in the Headworks and for solution water for the disinfection chemicals. A pump and pneumatic tank located in the Headworks building are used for screen wash water, and a small submersible pump located in the pump vault at the effluent end of the CCT is used to supply disinfected solution water to the chlorine and dechlorination feed pumps. The operators indicated that there is not enough room in the sump for a second pump and they keep one on-the-shelf as a spare.

The recommended upgrade includes a new plant water system to provide filtered and disinfected effluent for non-potable water needs around the facility. It is estimated that 50 to 100 gpm of water is needed at a constant pressure of 60 to 70 psi to serve various non-potable water demands including spray water and wash down water in the headworks and yard hydrants, as well as solution water for disinfection chemicals if that disinfection alternative is selected.

To meet these requirements a skid-mounted duplex pump system is recommended. Vertical turbine pumps are recommended as they have better efficiency over a wide range of flows and pressure setpoints. The proposed plant water system will be located in either the UV Disinfection Building if that alternative is selected, or in the existing Operations Building, and a stilling well off the effluent flow measurement channel will be provided to reduce air entrainment in the suction line.

Plant Water Design Description

The proposed design criteria for the plant water system are presented in Table 4-31.

Table 4-31 Plant Water System – Design Description

Item Description	Existing Design	Proposed Design
Pumps		
Quantity	1 in Headworks Building, 1 in CCT pump vault	2, skid mounted
Capacity	unknown	50-100 gpm @ 70 psi
Type	unknown/submersible	Vertical Turbine
Horsepower (each)	unknown/1 HP	approx. 7.5 hp
Controls	unknown	Integral PLC rotates pumps based on run time to maintain system pressure setpoint
Stilling Well		
Location	CCT effluent sump	Precast concrete tank off proposed disinfection effluent
Volume	unknown	Approx. 4,000 gallons

Description

The proposed plant water system will include:

- One (1) pump skid consisting of
 - Two (2) variable speed vertical turbine pumps, 7.5 hp each
 - Design capacity 50-100 gpm @ 70psi pressure setpoint
- One (1) control panel with integral VFDs
- Climate controlled housing for pump skid, motors, control panel, and stilling well access
- 4,000-gallon capacity precast concrete stilling well
 - Level control system

Cost Estimate

A preliminary opinion of probable construction cost for the proposed plant water system is provided in Table 4-32. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-32 Plant Water System – Construction Cost Estimate

Item	Cost ¹
Plant Water Tank	\$10,000
Plant Water Pumps	\$119,000
Construction Cost Subtotal	\$129,000
Contractor Mark-Up ²	\$28,000
Total Construction Cost^{3,4}	\$157,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.13 Sludge Holding

As the existing sludge holding tanks provide ample sludge storage for the sludge produced at the WTWTF and the existing sludge blowers were recently replaced or rebuilt, improvements to the existing sludge holding facilities will include replacing the coarse bubble diffusers inside of each tank, implement a floating decanter and polymer feed system to help produce a thicker sludge and reduce the amount of sludge to be contract dewatered.

Sludge Storage Design Description

The design criteria for the sludge storage facilities upgrades are presented in Table 4-33.

Table 4-33 Sludge Storage Tank Dimensions

Item Description	Existing Design	Proposed Design	Design Standard
Sludge Holding Tanks			
Number of Tanks	2	2	
Volume per Tank	136,000 gallons 369,000 gallons	136,000 gallons 369,000 gallons	
Total Volume Provided	505,000 gallons 67,513 cf	505,000 gallons 67,513 cf	
Sludge Storage Mixing			
Type	Coarse Bubble Diffusers	Coarse Bubble Diffusers	
Mixing Requirements	10-30 scfm/1000 cf	10-30 scfm/1000 cf	10-30 scfm/1000 cf (TR-16)
Air Required for Mixing	675-2250 scfm	675-2250 scfm	

Description

The proposed upgrades to the sludge holding facilities will include:

- New floating decanters for each storage tank
- New polymer feed skid-mounted system
- Replacement of diffusers with new coarse bubble diffusers
- Process piping modifications and valve replacements
- Electrical and instrumentation upgrades

Cost Estimate

A preliminary opinion of probable construction cost for the proposed upgrades to the sludge holding facilities is provided in Table 4-34. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-34 Sludge Handling Facilities – Construction Cost Estimate

Item	Cost ¹
Floating Decanters for Sludge Holding Tanks	\$130,000
Polymer Feed System	\$46,000
Course Bubble Diffuser Replacement	\$104,000
Process Piping Modifications and Valve Replacement	\$65,000
Electrical and Instrumentation Upgrades	\$45,000
Construction Cost Subtotal	\$389,000
Contractor Mark-Up ²	\$85,000
Total Construction Cost^{3,4}	\$474,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.14 Control Building

Description

The existing Control Building was constructed in 1982 upgrade and the following items were identified as needing upgrade or refurbishment:

- Install a fume hood in laboratory
- Separate lab from office space
- Insulate cinder block walls
- Replace HVAC
- New interior and exterior paint
- Electrical and instrumentation upgrades

Cost Estimate

A preliminary opinion of probable construction cost for the proposed upgrades to the Control Building is provided in Table 4-35. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-35 Control Building Upgrades – Construction Cost Estimate

Item	Cost ¹
Refurbishment of Office Area/Lab Area into separate spaces	\$50,000
Lab Fume Hood	\$10,000
Insulation of CMU Walls	\$50,000
Painting – Interior and Exterior	\$50,000
HVAC Upgrade	\$100,000
Electrical, Instrumentation, Plant PLC/SCADA Upgrades	\$160,000
Construction Cost Subtotal	\$420,000
Contractor Mark-Up ²	\$92,000
Total Construction Cost^{3,4}	\$512,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.15 Site and Stormwater Pump Station

Recommended site improvements to the Woodstock Main WWTF were identified in Section 2.6.11 and include, among other items, refurbishment of the existing plant drainage pump station. The plant drainage pump station acts as both a pump station to dewater the WWTF site during a flooding event, but also to pump treated effluent in the event the outfall is submerged by high river levels. There is only one existing pump in this critical piece of infrastructure, which is original to the station's 1973 construction. The wet well of the pump station is deep and full of sediment that washes in through the storm drain lines. Plant operators have indicated that the depth makes it difficult to clean out the sump with their vacor truck.

Refurbishment of the plant drainage pump station includes raising the invert of the wet well with concrete fill, concrete repair work of the existing concrete, replacement of all metal components inside the wet well, and construction of a weatherproof superstructure over the top of the wet well. The existing pump will be replaced with two (2) suction lift high flow pumps each capable of pumping the peak design flow plus the design storm flow to provide full redundancy. The existing 8" diameter discharge force main will be replaced with a new 12" ductile iron force main. Figures showing the existing plant drainage pump station and proposed modifications are provided in Appendix A.

Design Criteria

Design criteria for the Plant Drainage Pump Station are presented in Table 4-36.

Table 4-36 Plant Drainage Pump Station Proposed Design Criteria

Item Description	Existing Design	Proposed Design	Design Standard
Design Flow			
Basin, acres	8.26	8.26	
Runoff (50-yr storm frequency, 15 min duration)	500 gpm ¹	500 gpm ¹	
Allowance for seepage & infiltration @ 0.5 gpm/LF levee	350 gpm ¹	350 gpm ¹	
WWTF PHF	--	1.71 MGD (1188 gpm)	
Total Design Flow	850 gpm	2038 gpm	
Drainage Pump(s)			
Quantity	1	2	1 duty, 1 stand-by
Type	8" Cascade axial flow propeller pump	Vertical turbine pumps	
Control Method	Level - float switches	Level – conductive probe	
Capacity, each	850 gpm @ 40' TDH	2200 gpm @ 50' TDH	
HP	15	30 (approx.)	
Force Main Diameter	8"	12"	

Note:

1. Woodstock Main WWTF 1983 Upgrade Basis of Design

Description

The following list provides a summary of proposed improvements to the existing facility site:

- Plant Drainage Pump Station
 - Raised invert of wet well
 - Concrete repair
 - New grating
 - New trash baskets and lifting mechanisms
 - New metal components inside wet well
 - Two (2) vertical turbine, high-flow pumps
 - New level control system
 - New process valves
 - New weatherproof superstructure
 - New 12" discharge force main
- New security fence and entrance gate

- New HVAC system in Maintenance Garage
- New yard hydrants
- New site lighting
- New yard process, plant water, and chemical piping where needed
- New electrical and instrumentation conduit and wire where needed
- New pavement
- Site restoration and landscaping

Cost Estimate

A preliminary opinion of probable construction cost for the recommended site improvements as described above is provided in Table 4-37. A detailed breakdown of this opinion of probable construction cost is provided in Appendix D.

Table 4-37 Site Improvements & Stormwater Pump Station– Cost Estimate

Item	Cost ¹
Plant Drainage Pump Station	\$342,000
New Security Fence and Gate	\$93,000
New HVAC System in Maintenance Garage	\$50,000
New Site Pavement, Cold Plane of Existing Pavement, & Subbase	\$116,000
Process, Plant Water & Chemical Yard Piping Allowance	\$100,000
Site Electrical/Instrumentation Wire & Conduit Allowance	\$65,000
Site Restoration	\$25,000
Construction Cost Subtotal	\$791,000
Contractor Mark-up ²	\$175,000
Total Construction Cost^{3,4}	\$966,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Total Construction Cost does not include contingency.

4.16 Recommendations for Electrical Modifications

Electrical Distribution

Recommendations:

- Electrical Service: Retain the existing GMP 208/120V 600A electrical service to the Operations Building, the 225KVA generator, automatic transfer switch, and motor control center.
- Blower/generator Building: Retain the existing standby power feeder and the separate utility service that currently supply the Blower/Generator building. The sludge aeration blowers that are supplied by the separate service do not require standby power.
- Maintenance Garage: Retain the existing standby power feeder and the separate utility service that currently supplies the Maintenance Garage. Standby power is available in the garage for

maintenance operations including lighting, receptacles, building heating. Sludge dewatering operations that are supplied by the separate service does not require standby power.

- Sludge Pumping: Provide a new 208/120V electrical panel to serve the building lighting, receptacles, heating, and ventilation equipment. The panel could supply the RAS/WAS pump VFDs if suitable space is created to locate this type of equipment at the clarifier structure.
- New Headworks Building: Provide a 208/120V panel and surge protector.
- Existing Electrical Panels: Replace older panels from the original construction.
- Surge Protection: Install surge protection devices at the power feed to each building and structure. Install surge protection on all outdoor instrumentation.
- Replace existing wiring devices such as lighting switches and receptacles. This will provide an opportunity to inspect the branch circuits for proper grounding and replace worn out devices. Generally, the wiring itself could remain and be reused unless specific problems are identified.
- Replace corroded metal fasteners and electrical supports with stainless steel.

Generator and ATS

Recommendations: Retain the existing diesel generator and automatic transfer switch.

Motor Controllers

Recommendations:

- Retain the existing aeration blower VFDs.
- Replace the intermediate wastewater pump VFDs. Provide separate enclosures for each VFD to facilitate servicing.
- Replace the RAS/WAS pump VFDs. Provide separate enclosures for each VFD to facilitate servicing.
- Replace the existing sludge blower starters with VFDs.
- Retain existing MCC motor starters at the Operations Building. Upgrade components as required.
- Install new standalone motor starters for process and building mechanical equipment where it's required.

Lighting

Recommendations:

- Replace all interior lighting with LED type.
- Provide interior lighting controls including dimming and occupancy sensing as appropriate for each location.
- Install battery powered exit and emergency lights at all locations.
- Install flood lighting at aeration tank and clarifier bridges. Two head LED floods with photoelectric and motion sensors, mounted to a 1" conduit mast, is recommended as an economical alternative to large industrial flood lights.
- Install wall mounted exterior lighting fixtures with photoelectric and motion sensors at each building entrance. Each light should have a switch inside the door that disables the automatic photo control. Lights that are switched off do not come on automatically at dusk unless motion is detected.
- Retain the existing pole mounted site lighting but replace the underground wiring.

- Replacement of the existing T5 fluorescent lighting in the Maintenance Garage to LED could be bid as a cost saving alternate.

PLC/SCADA

Recommendations:

- Provide a new PLC/SCADA system. The new system should be comprised of new PLCs at each building that are connected by a fiber optic network.
- Each PLC control panel should have a door mounted operator display panel for local viewing of process information.
- Install a SCADA computer workstation in the Operators office with a desktop PC, LED monitor, and laser printer. The SCADA software shall provide status and alarm reporting, permit Operator entry of adjustable setpoints, and have remote access and alarming capabilities.
- Internet connections should be provided with firewalls and virus protection. Two factor authentication should be used to control remote access.
- Install a backup means to communicate the most critical PLC generated plant alarms off site in the event of an internet failure. Relay outputs from the PLC system should be wired directly to a cellular based alarm panel (Mission Communications), or an automatic telephone dialer.
- Interface between the PLC system and control panels supplied by process equipment manufacturers should be hardwired I/O. Network connections to vendor supplied systems increases the risk of cyberattacks. They also require additional programming coordination between the two systems and can be a source of failure.

Communications

Recommendations:

- Install underground conduits between the buildings for telephone and data communications wiring.

Fire & Security

Recommendations:

- Install a security alarm system with fire detection at the Operations Building. This location has the highest risk for burglary and fire.

Lightning Protection

Recommendations:

- Install a UL certified lightning protection system at process buildings including the Operations, Headworks, Blower/Generator buildings for compliance with NFPA 820 and to provide additional protection from lightning induced surges.
- The system should consist of roof mounted air terminals and a buried copper ground ring around the perimeter of the building.

General Recommendations for Electrical Equipment and Materials

Conduit

Conduit in non-hazardous, non-corrosive, and non-process interior areas: Electrical metallic tubing (EMT). Generally, this includes office areas, electrical rooms, utility rooms, bath and locker rooms. MC cable should be permitted where concealed in walls or above ceilings. Boxes, fasteners and supports should be zinc plated steel.

Conduit in non-hazardous, non-corrosive, process areas: Galvanized threaded steel conduit (Rigid or IMC). Generally, this includes non-hazardous process equipment rooms, below grade pump rooms, and above grade exterior locations. Boxes will be cast aluminum. Fasteners and supports should be 304 stainless steel.

Conduit in hazardous, non-corrosive, process areas: Galvanized threaded steel conduit (Rigid or IMC) with sealing fittings. Generally, this includes hazardous process equipment rooms, below grade pump rooms, and above grade exterior locations. Boxes will be cast aluminum. Fasteners and supports should be 304 stainless steel.

Conduit in hazardous, corrosive process areas: PVC coated threaded metal conduit and fittings. Generally, this includes hazardous locations with open channel or exposed wastewater/solids such as wet wells, headworks building, grit removal, clarifiers, selector and aeration tanks. Boxes will be cast aluminum. Fasteners and supports should be 316 stainless steel.

Conduit in non-hazardous, wet, damp, and corrosive process areas: Schedule 40 PVC conduit and fittings. Generally, this includes UV rooms, chemical feed and storage areas. Boxes will be PVC. Fasteners and supports should be 316 stainless steel.

Conduit below grade: Schedule 40 PVC conduit and fittings, except where required for entrance to hazardous locations. Conduits entering hazardous locations as they exit from grade should be rigid steel or IMC in accordance with NEC requirements.

Wiring Devices

Wiring devices including switches, receptacles, and similar should be 20 Amp rated, specification grade. Device color to be determined. Wall plates in finished locations should be stainless steel. Plates in unfinished areas should match the box (steel, aluminum, or PVC).

Lighting

All lighting fixtures should be LED type, unless not available for very specific applications. Automatic lighting controls including dimming, occupancy sensors, and photocells should be specified where required by the Energy Code.

Exit lighting: Red LED with NiCad battery and self-testing diagnostics.

Exit lighting in hazardous areas: Self-powered exit lighting will be provided where explosion proof lighting is required.

Emergency lighting: Wall mounted battery units with aimable LED heads, NiCad battery, and self-diagnostics.

Emergency lighting in hazardous areas: 12V DC explosion proof remote heads that are powered from battery units located in an adjacent non-hazardous space.

Electrical Distribution and Motor Control Equipment

Electrical panels: Panelboard type construction with aluminum bussing and “door in door” type trim.

Circuit breakers: Molded case, bolt on type. Circuit breakers for power distribution to buildings or major equipment should be specified with electronic trip units having adjustable instantaneous trip settings for arc flash energy reduction.

Surge Protectors: Three phase surge protectors with a minimum rating of 150kA per phase should be installed at each building main panel or MCC. Additional surge protection should be installed downstream at control and instrumentation panels and equipment.

Motor starters: Combination type with disconnect switch, motor circuit protector, NEMA rated contactor, solid state overload device, control power transformer, Hand-Off-Auto selector switch, and green run pilot light.

Variable frequency drives: Provided with an enclosure mounted disconnect switch, Hand-Off-Auto selector switch, green run pilot light, door mounted keypad. VFDs should be specified with internal DC link choke for reduction of generated line side harmonics. Each VFD should be specified to have the following inputs and outputs for remote control and monitoring:

- Run Status
- Ready Status (VFD powered and set to AUTO)
- VFD Fault Status
- VFD Run Control
- VFD Speed Control
- VFD Speed Indication

Control Panels

All control panels must be constructed to UL Standard 508A and labeled as such in order to comply with State of Vermont Fire Safety Division requirements.

Building Security & Fire Detection

Provide a common panel for security and fire detection at each building being protected. Since it is not a required system and provided for asset protection only, alarms can be wired to the PLC system and communicated to the SCADA system and/or back up remote notification equipment.

Intrusion detection should consist of magnetic switches at entry doors and motion sensors for all rooms with a window. A keypad would be installed inside the building entry and a control panel at an interior location such as an office or electrical room.

Fire detection should consist of smoke and heat detectors as appropriate for the location installed.

PLC/SCADA System

Each PLC or control panel should be supplied with the following:

- Hinged door, NEMA 4/12 steel enclosure
- Door mounted HMI display
- Surge protection
- UPS
- Fiber to ethernet switch
- Terminals, power supplies, relays, etc.

The SCADA computer system should include a desktop computer, with printer, monitor, and UPS.

A wall mounted large screen display can be provided in the Control Room.

The SCADA software should provide a graphic representation of the process with the ability to view equipment status and process values, acknowledge and reset alarms, and communicate these offsite.

The automatic telephone dialer or cellular alarm panel for remote communications of alarms should be provided with adequate inputs plus spares. The panel should include a battery to permit communication during power outages.

Identification

All major equipment including panels, VFDs, control panels, disconnect switches, and similar should be provided with an engraved plastic nameplate to identify purpose or equipment served (black with white text). All minor devices such as receptacles and toggle switch disconnect switches should be provided with a dry transfer adhesive label that indicates the electric panel and circuit number (clear with black text).

4.17 Summary of Total Estimated Construction Costs

Table 4-37 provides a summary of the total estimated construction cost for upgrade of the Woodstock Main WWTF. The total construction cost estimate assumes selection of Headworks Alternative 2 – Center Flow Screen and Disinfection Alternative 2 – UV Disinfection. The total construction costs have been escalated to March 2025 construction dollars (assuming project is bid in Spring of 2025) using a linear progression of the Engineering New Record Construction Cost Indexes from January 2021 to March 2025. The resulting trend line projects the March 2025 ENR Cost Index to be approximately 15,500.

Table 4-37 Summary of Total Construction Costs

Item	Costs ^{1,2}
Screening & New Headworks Building – Alternative 2 – Center Flow Screen	\$1,811,000
Grit Removal	\$652,000
Intermediate Lift Station – Pump Replacement	\$877,000
Biological Treatment Process	\$3,121,000
Coagulant Chemical Feed Systems	\$331,000
Secondary Clarifier Rehabilitation	\$1,188,000
RAS/WAS Pump Replacements	\$586,000
Disinfection System – Alternative 2 – UV System & Building	\$1,095,000
Plant Water System	\$157,000
Solids Holding Tank Improvements	\$474,000
Control Building Modifications	\$512,000
Plant Drainage Pump Station and Site Modifications	\$966,000
Subtotal	\$11,770,000
Contingency @ 30%	\$3,531,000
Total Construction Cost^{3,4}	\$15,301,000
Total Construction Cost Escalated to March 2025 Dollars⁵	\$18,001,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)
2. Contractor Mark-Up is inclusive of Contractor's overhead and profit (15%), mobilization and demobilization (5%), and bonds (2%).
3. Total Construction Costs do not include engineering services, legal and administrative costs.
4. Projected ENR Construction Cost Index = 15,500 (March 2025)

5. SELECTION OF AN ALTERNATIVE

5.1 Introduction

Some of the alternatives considered in Section 4 were age related replacements where additional alternatives were not explored as the function of the process element remained well served as originally designed. This includes:

- Influent Pumping
- Secondary Clarification
- Return and waste activated sludge pumping
- Sludge Storage

For other process elements, one primary alternative for the upgrade was developed and described in Section 4 as it was determined to be the best fit for the proposed application not warranting further development of other alternatives. This includes:

- New headworks with vortex grit removal
- Biological process with flexibility to operate in LE, AO or A2O configurations
- Chemical feed and storage for phosphorus removal
- Effluent flow measurement
- pH adjustment chemical feed and storage
- Plant water
- Control Building Improvements
- Site and Stormwater Pump Station
- Electrical Modifications

Alternatives were developed for evaluation for:

- Influent screening
- Disinfection

For these two process elements, a summary of the selection of the recommended alternative is summarized in the sections below.

5.2 Influent Screening

5.2.1. Description

The following screening technologies were evaluated in Section 4:

1. Rotary Fine Screen Micro Strainer with integrated Washer Compactor

2. Center Flow Fine Screen with Washer Compactor
3. Stair Fine Screen with Washer Compactor

5.2.2. Life Cycle Cost Analysis

Life cycle costs including estimates of annual power consumption, replacement parts, and operation and maintenance time, were reviewed for each screening alternative considered and found to be equivalent for each of the different technologies. As there is negligible variation between the alternatives, a present worth analysis was not advanced.

Detailed opinions of probable construction cost for each of the three screen treatment alternatives are provided in Appendix D. Table 4-10 provided a summary of the opinion of probable construction cost for each alternative that was considered. The Center Flow Fine Screen with Washer Compactor was identified to have the lowest capital cost.

5.2.3. Non-Monetary Factors

Non-monetary factors were described in Section 4 for each alternative.

5.2.4. Selected Alternative

With the lowest anticipated capital cost, the Center Flow Fine Screen with Washer Compactor was identified as the recommended alternative.

5.3 Disinfection

5.3.1. Description

The following disinfection alternatives were evaluated in Section 4:

1. New chlorine contact tank (CCT) and refurbished chemical storage and feed systems
2. Ultraviolet disinfection

5.3.2. Life Cycle Cost Analysis

Detailed opinions of probable construction cost for each of the two disinfection alternatives are provided in Appendix D. Table 4-28 provided a summary of the opinion of probable construction cost for each alternative that was considered. The cost of the CCT Alternative was significantly higher at \$1,715,000 compared to the UV Disinfection Alternative at \$1,095,000.

The CCT alternative relies on sodium hypochlorite and sodium bisulfite chemical addition compared to the electrical cost and bulb replacement costs for the UV disinfection system. With the significant cost difference in the two alternatives a detailed life cycle cost analysis was not pursued as it was anticipated that UV disinfection would have the lowest life cycle cost.

5.3.3. Non-Monetary Factors

Non-monetary factors for considered for the two alternatives are summarized in Section 4. Most significantly, UV disinfection eliminates the need to handle, store and use hazardous and corrosive chemicals.

5.3.4. Selected Alternative

Based on the lower capital cost, anticipated lower life cycle cost, and reduced hazard for staff, UV disinfection was selected as the recommended alternative.

6. PROPOSED PROJECT

6.1 Woodstock Main Wastewater Treatment Facility Proposed Project

In order to address effluent permit requirements, age related needs, and redundancy requirements, an upgrade of the existing Main WWTF is recommended. Figure A-5 in Appendix A depicts the proposed site plan. The following summarizes the elements of the recommended project:

Liquid Stream

Screening:

- 18" Influent sewer
- 12-inch wide x 11.25-foot deep influent channel
- 30-inch wide x 11.25-foot deep channel at screen
- Center flow screen with 3 mm (1/8-inch) perforated UHMWPE openings
 - Stainless steel construction
 - 0.75 HP explosion proof drive motor
 - Ultrasonic level sensors
 - Float switches
 - Spray wash system with explosion proof solenoid valves
 - Plant water filter/strainer
 - Wash water pressure gauges
 - Main control panel
 - Local control station
- Wash Compactor
 - Stainless steel construction
 - 1.5 HP explosion proof drive motor
 - Spray wash system with explosion proof solenoid valves
 - Discharge chute to common screenings/grit dumpster
- By-pass channel with manual bar rack
- 18-inch wide screening effluent channel to grit removal system
- Headworks Building rated for Class 1, Division I hazardous space, with a separate unclassified Electrical Room.
- Ventilation provided for compliance with current NFPA 820 requirements.

Grit Removal:

- Grit removal influent channel
- Grit removal system
 - Concrete grit chamber

- Motor driven paddle assembly with integral air and water scour
 - Grit Pump
- Grit Classifier
 - Stainless Steel Construction
 - Grit cyclone separator
 - Grit classifier hopper
 - Grit screw conveyor
- Control Panel

Influent Pumping:

- Replacement of existing two (2) influent pumps with three (3) dry pit submersible pumps
- New variable frequency drives
- New suction and discharge valves
- New magnetic flow meter on pump discharge header
- New level control system in pump wet well
- New pump force main to new biological process

Biological Process:

- Construction of new aeration tanks that include two trains of anoxic, potential anaerobic and aerobic zones
- Reconfiguration of splitter box
- Two (2) 25 HP Blowers
- Fine Bubble Membrane Diffusers
- Mixing in anaerobic/anoxic tankage

Chemical Feed and Storage Facilities for Phosphorus Removal:

- Chemical yard piping to dosing points
- Rehabilitation of the existing chlor/dechlor storage and feed rooms including:
 - Demolition of existing disinfection equipment, storage tanks, interior components, and interior wall
 - New overhead doors and concrete containment area
 - Replacement of HVAC, plumbing, and electrical systems
 - New emergency eye wash and shower
 - New paint, coatings, and finishes
- New coagulant storage tanks
 - Two (2) 1000-gallon cross-linked HDPE tanks
 - Level detection system
- New chemical feed skid
 - Triplex pump skid with three (3) peristaltic pumps

- New chemical feed piping and valves

Secondary Clarification:

- Concrete repair of two (2) existing tanks
- Replacement of two (2) existing Spiraflo Clarifier components:
 - Drive assembly
 - Inlet trough
 - Effluent weir
 - Access Bridge
 - Scraper assembly
 - Surface skimmer assembly and scum box
- Scum Boxes
 - Replacement of scum pit level indicators
 - Hard-pipe scum pits to WAS pump
- Clarifier House Refurbishment
 - New above-grade Electrical Room Addition (approximately 200 sq. ft.)
 - Concrete repair of top slab/roof
 - Replacement of equipment access hatch
 - Replacement of electrical and HVAC
 - Replacement of spiral staircase

RAS and WAS Pumping:

- RAS Pumps
 - Two (2) new RAS pumps
 - New VFDs
 - New suction and discharge check and isolation valves
 - New magnetic flow meter
 - New RAS force main to new biological process
- WAS Pumps
 - Two (2) new WAS pumps
 - New suction and discharge check and isolation valves
 - New magnetic flow meter
 - New WAS force main to sludge holding tanks
 - New suction lines to existing scum boxes

Disinfection:

- Concrete channel with:
 - 36'-6" length x 12" width x 54" depth
 - Module Support Rack
 - Level Control Weir

- Three (3) UV Banks, each containing:
 - 3 Type 316 stainless steel modules
 - 6 UV low pressure lamps/module
- Automatic chemical/mechanical cleaning system
- Monitoring system for indication of UV intensity, lamp age, and alarms
- Remote indication of UV intensity
- Remote indication of low UV intensity alarm
- Maintenance module cleaning rack
- Davit crane for UV module lifting
- Effluent Flow Measurement
 - Level control weir
 - Ultrasonic level indicator
- Effluent automatic sampler

Effluent Flow Measurement:

- New concrete effluent channel
 - Width x length to be determined based on control device selected
 - Location: downstream of disinfection alternative selected
- Effluent flow measurement:
 - 90° v-notch weir, or
 - 6" Parshall flume
- Ultrasonic level detector

Chemical Feed and Storage System for pH Adjustment:

- Chemical Room at New Headworks Building to house chemical storage drums and feed equipment.
 - Spill drum pallets for storage of 55-gallon drum of pH adjustment chemicals with containment sized to contain 125% of design volumes.
 - Emergency eyewash and shower.
- Chemical Feed
 - Shelf-mounted positive displacement chemical feed pumps
 - 2 (1 duty, 1 standby)

Plant Water:

- One (1) pump skid consisting of
 - Two (2) variable speed vertical turbine pumps, 7.5 hp each
 - Design capacity 50-100 gpm @ 70psi pressure setpoint
- One (1) control panel with integral VFDs
- Climate controlled housing for pump skid, motors, control panel, and stilling well access
- 4,000-gallon capacity precast concrete stilling well
 - Level control system

Solids Stream

Sludge Holding Facilities:

- New floating decanters for each storage tank
- New polymer feed skid-mounted system
- Replacement of diffusers with new coarse bubble diffusers
- Process piping modifications and valve replacements
- Electrical and instrumentation upgrades

PLC/SCADA

- Provide a new PLC/SCADA system. The new system should be comprised of new PLCs at each building that are connected by a fiber optic network.
- Each PLC control panel should have a door mounted operator display panel for local viewing of process information.
- Install a SCADA computer workstation in the Operators office with a desktop PC, LED monitor, and laser printer. The SCADA software shall provide status and alarm reporting, permit Operator entry of adjustable setpoints, and have remote access and alarming capabilities.
- Internet connections should be provided with firewalls and virus protection. Two factor authentication should be used to control remote access.
- Install a backup means to communicate the most critical PLC generated plant alarms off site in the event of an internet failure. Relay outputs from the PLC system should be wired directly to a cellular based alarm panel (Mission Communications), or an automatic telephone dialer.
- Interface between the PLC system and control panels supplied by process equipment manufacturers should be hardwired I/O. Network connections to vendor supplied systems increases the risk of cyberattacks. They also require additional programming coordination between the two systems and can be a source of failure.

Electrical

Distribution:

- Sludge Pumping: Provide a new 208/120V electrical panel to serve the building lighting, receptacles, heating, and ventilation equipment. The panel could supply the RAS/WAS pump VFDs if suitable space is created to locate this type of equipment at the clarifier structure.
- New Headworks Building: Provide a 208/120V panel and surge protector.
- Existing Electrical Panels: Replace older panels from the original construction.
- Surge Protection: Install surge protection devices at the power feed to each building and structure. Install surge protection on all outdoor instrumentation.
- Replace existing wiring devices such as lighting switches and receptacles. This will provide an opportunity to inspect the branch circuits for proper grounding and replace worn out devices. Generally, the wiring itself could remain and be reused unless specific problems are identified.
- Replace corroded metal fasteners and electrical supports with stainless steel.

Motor Controllers

- Replace the intermediate wastewater pump VFDs. Provide separate enclosures for each VFD to facilitate servicing.
- Replace the RAS/WAS pump VFDs. Provide separate enclosures for each VFD to facilitate servicing.
- Replace the existing sludge blower starters with VFDs.
- Retain existing MCC motor starters at the Operations Building. Upgrade components as required.
- Install new standalone motor starters for process and building mechanical equipment where it's required.

Lighting

- Replace all interior lighting with LED type.
- Provide interior lighting controls including dimming and occupancy sensing as appropriate for each location.
- Install battery powered exit and emergency lights at all locations.
- Install flood lighting at aeration tank and clarifier bridges. Two head LED floods with photoelectric and motion sensors, mounted to a 1" conduit mast, is recommended as an economical alternative to large industrial flood lights.
- Install wall mounted exterior lighting fixtures with photoelectric and motion sensors at each building entrance. Each light should have a switch inside the door that disables the automatic photo control. Lights that are switched off do not come on automatically at dusk unless motion is detected.
- Retain the existing pole mounted site lighting but replace the underground wiring.
- Replacement of the existing T5 fluorescent lighting in the Maintenance Garage to LED could be bid as a cost saving alternate.

Communications

- Install underground conduits between the buildings for telephone and data communications wiring.

Fire and Security

- Install a security alarm system with fire detection at the Operations Building. This location has the highest risk for burglary and fire.

Lightning Protection

- Install a UL certified lightning protection system at process buildings including the Operations, Headworks, Blower/Generator buildings for compliance with NFPA 820 and to provide additional protection from lightning induced surges.
- The system should consist of roof mounted air terminals and a buried copper ground ring around the perimeter of the building.

Building/Site

Control Building:

- Separate lab from office space
- Insulate cinder block walls
- Replace HVAC
- New interior and exterior paint
- Electrical and instrumentation upgrades

Plant Drainage Pump Station

- Raised invert of wet well
- Concrete repair
- New grating
- New trash baskets and lifting mechanisms
- New metal components inside wet well
- Two (2) vertical turbine, high-flow pumps
- New level control system
- New process valves
- New weatherproof superstructure
- New 12" discharge force main

Site

- New security fence and entrance gate
- New HVAC system in Maintenance Garage
- New yard hydrants
- New site lighting
- New yard process, plant water, and chemical piping where needed
- New electrical and instrumentation conduit and wire where needed
- New pavement
- Site restoration and landscaping

6.2 Project Schedule

The proposed project schedule for the upgrade of the Woodstock Main WWTF is presented in Table 6-1.

Table 6-1 Woodstock Main WWTF Proposed Project Schedule

Task	Start	End	Duration
Pre-Design Phase			
Prepare Basis for Final Design	6/1/2023	8/30/2023	90
Prepare Environmental Report	6/1/2023	8/30/2023	90
Survey	6/1/2023	7/16/2023	45
Wetlands Survey	6/1/2023	7/16/2023	45
Geotechnical Borings & Analysis	6/1/2023	8/30/2023	90
Step II Final Design			
Execute Final Design Agreement	7/15/2023	8/14/2023	30
Prepare 30% Drawings & Specs	8/30/2023	12/28/2023	120
Prepare 60% Drawings & Specs	12/28/2023	4/26/2024	120
Prepare 90% Drawings & Specs	4/26/2024	7/25/2024	90
Prepare Bid Documents	7/25/2024	9/23/2024	60
Step III Construction			
Bid Advertisement	9/23/2024	11/7/2024	45
Bid Review & Award	11/7/2024	12/7/2024	30
NTP Issued	12/7/2024		
Contractor Mobilization	12/7/2024	1/6/2025	30
Initial Shop Drawing Prep	1/6/2025	3/7/2025	60
Shop Drawing Review & Approval	3/7/2025	4/6/2025	30
Major Equipment Lead Time	4/6/2025	8/4/2025	120
Overall Construction Period	12/7/2024	12/7/2026	730
1-Year Warranty Period	12/7/2026	12/7/2027	365

6.3 Total Project Cost

An opinion of probable construction cost for each unit process to be refurbished is presented in Section 4 and includes contractor markups (overhead, profit, mobilization, demobilization, bonds and insurance) and a 30% contingency. Detailed cost estimates for each unit process are presented in Appendix D. The total project cost for the recommended project includes construction, engineering, surveying, geotechnical investigations, wetlands screening, hazardous materials investigation, historic preservation/archeological investigation, permitting, legal and administrative fees. The VT DEC-WID engineering fee curve allowances were assumed for estimating engineering services for final design and construction phase services. A summary of total project costs for the age-related and hydraulic upgrades are presented in Table 6-2.

Table 6-2 Woodstock Main WWTF Upgrade – Estimated Total Project Cost

Construction Cost	Current Cost ¹	Projected Cost ²
	Nov-22	Mar-25
ENR Construction Cost Index	13174.98	15500
Screen and New Headworks Building - Center Flow Screen	\$1,811,000	\$2,131,000
Grit Removal	\$652,000	\$767,000
Intermediate Lift Pumps	\$877,000	\$1,032,000
Biological Process	\$3,121,000	\$3,672,000
Coagulant Chemical Feed Systems	\$331,000	\$389,000
Secondary Clarifier Rehab	\$1,188,000	\$1,398,000
RAS/WAS Pump Replacement	\$586,000	\$689,000
UV Disinfection System & Building	\$1,095,000	\$1,288,000
Plant Water System	\$157,000	\$185,000
Solids Holding Tank Improvements	\$474,000	\$558,000
Control Building Modifications	\$512,000	\$602,000
Plant Drainage Pump Station and Site Modifications	\$966,000	\$1,136,000
Subtotal	\$11,770,000	\$13,847,000
Construction Contingency	30%	30%
Contingency @ 30%	\$3,531,000	\$4,154,000
Total Construction Cost³	\$15,301,000	\$18,001,000
Engineering Costs		
Step I - Preliminary Engineering		
Preliminary Engineering - Step I 4	\$105,000	\$105,000
Estimated additional pre-design (SERP, Basis of Design, etc.)	\$60,000	\$60,000
Step II - Final Design		
Final Design - Step II ⁵	\$973,000	\$973,000
Survey	\$15,000	\$15,000
Geotechnical Investigation	\$15,000	\$15,000
Wetlands Screening	\$2,000	\$2,000
Asbestos/Lead Paint/PCB Testing	\$5,000	\$5,000
Historic Preservation/Archeological Investigation	\$5,000	\$5,000
Step III - Construction Phase		
Bid, Construction Administration & Inspection - Step III ⁵	\$1,784,000	\$1,784,000
Legal, Administrative, Permitting		
0.5%	\$90,000	\$90,000
Total Project Cost	\$18,355,000	\$21,055,000

Notes:

1) ENR Construction Cost Index = 13174.98 (November 2022)

- 2) Projected ENR Construction Cost Index = 15,500 (March 2025)
- 3) Construction Costs are inclusive of 15% Contractor Overhead and Profit and 7% Bonds and Mobilization/Demobilization
- 4) Signed Contract dated 10/21/21
- 5) Engineering Fee is calculated based on the VTDEC-FED Engineering Fee Allowance Guidelines dated 9/1/2011.

Based on a 20-year loan at a 2% interest rate, the annual loan payment for the \$21,055,000 total project cost is \$1,287,655.

6.4 Sustainability Considerations

6.4.1. Water and Energy Efficiency

Hoyle Tanner will work with Efficiency Vermont, Green Mountain Power, and the Town Energy Committee during the design phase to identify opportunities to incorporate energy efficient design into the project.

Where feasible, existing HVAC systems for the existing buildings will be replaced with more efficient, more environmentally friendly systems that do not rely on fossil fuels, including heat pump technology.

For water efficiency, equipment that can, will be designed to use plant water instead of potable water. Low flow plumbing fixtures will be incorporated into the mechanical design to improve water use efficiency.

6.4.2. Green Infrastructure

Increased impervious surface area associated with the proposed project may require the implementation of a stormwater practice to control and treat stormwater runoff. Green stormwater infrastructure (GSI) practices such as bioswales, bioretention cells, and permeable pavements will be evaluated for use during final design for implementation into the upgrade project.

6.5 Annual Operating Budget

6.5.1. Income

The Town collected \$1,150,419.10 in income from sewer fees in Fiscal Year 2023.

6.5.2. Annual O&M Costs

The current sewer budget approved in March 2023 for Fiscal Year 2024 is for \$1,214,123.70.

6.5.3. Debt Repayments

The Town will begin paying on the South Woodstock WWTF Upgrade debt in 2024 with an annual payment of \$105,853 retiring in 2044.

6.5.4. Reserves

Capital reserves in the current sewer budget are identified in the current budget at \$63,000.

7 Conclusions and Recommendations

In conclusion, the following next steps are recommended to advance the Woodstock Main WWTF Upgrade project:

- Initiate Pre-Design Agreement
 - Complete Basis for Final Design for Recommended Project
 - Complete site survey
 - Complete Environmental Report
 - Obtain concurrence from State Historic Preservation Office (SHPO) that there are no archeological impacts.
 - Complete geotechnical investigations based on recommended project to characterize subsurface conditions and provide basis for structural design.
- Complete public information and outreach on the project
- Complete Bond Vote
- Initiate Step II Final Design

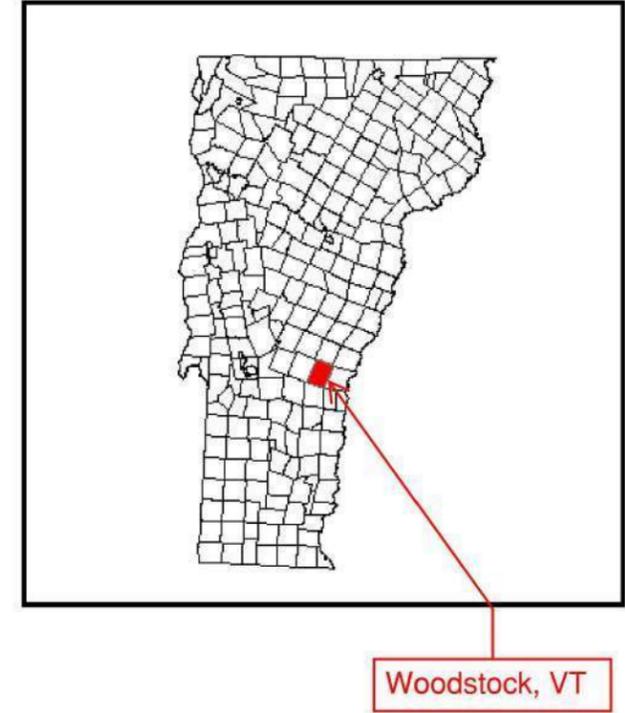
Appendix A
Figures

NOTES:

1 of xxx



APPROXIMATE MAP NORTH



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 www.hoyletanner.com



HOYLE, TANNER
 PROJECT NO.
 21-129901

FILE NAME
 21.129901-LOCMAP

TOWN OF WOODSTOCK, VERMONT
 WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
 PRELIMINARY ENGINEERING REPORT

LOCATION MAP

DATE
 MARCH 2022

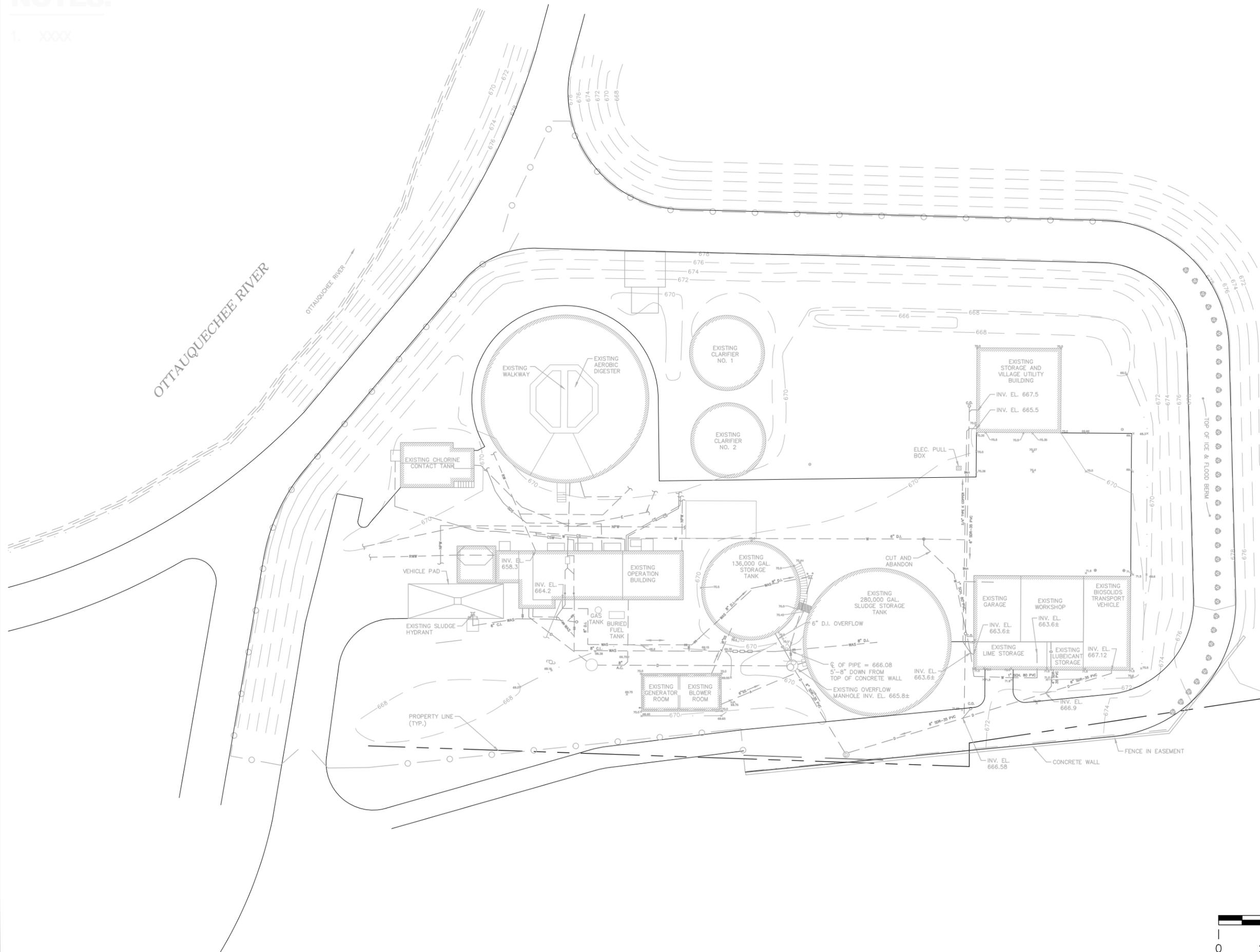
FIGURE

A-1

NOTES:

1. XXXX

APPROXIMATE MAP NORTH



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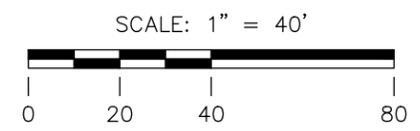


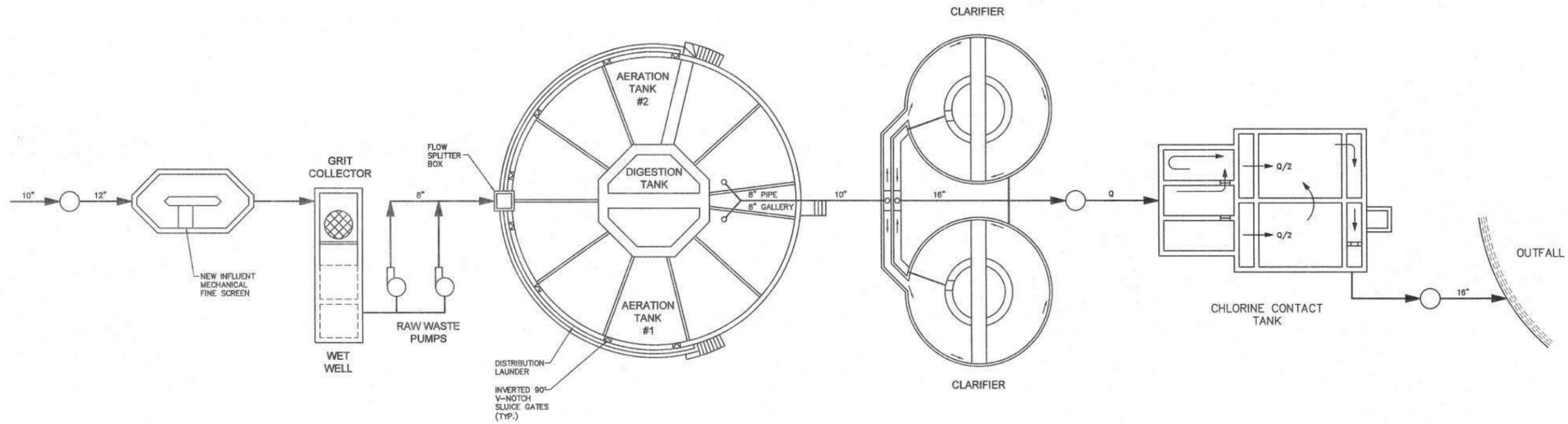
HOYLE, TANNER
 PROJECT NO.
 21-129901
 FILE NAME
 21.129901-EH01

TOWN OF WOODSTOCK, VERMONT
 WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
 PRELIMINARY ENGINEERING REPORT
EXISTING SITE PLAN

DATE
 MARCH 2022
 FIGURE

A-2

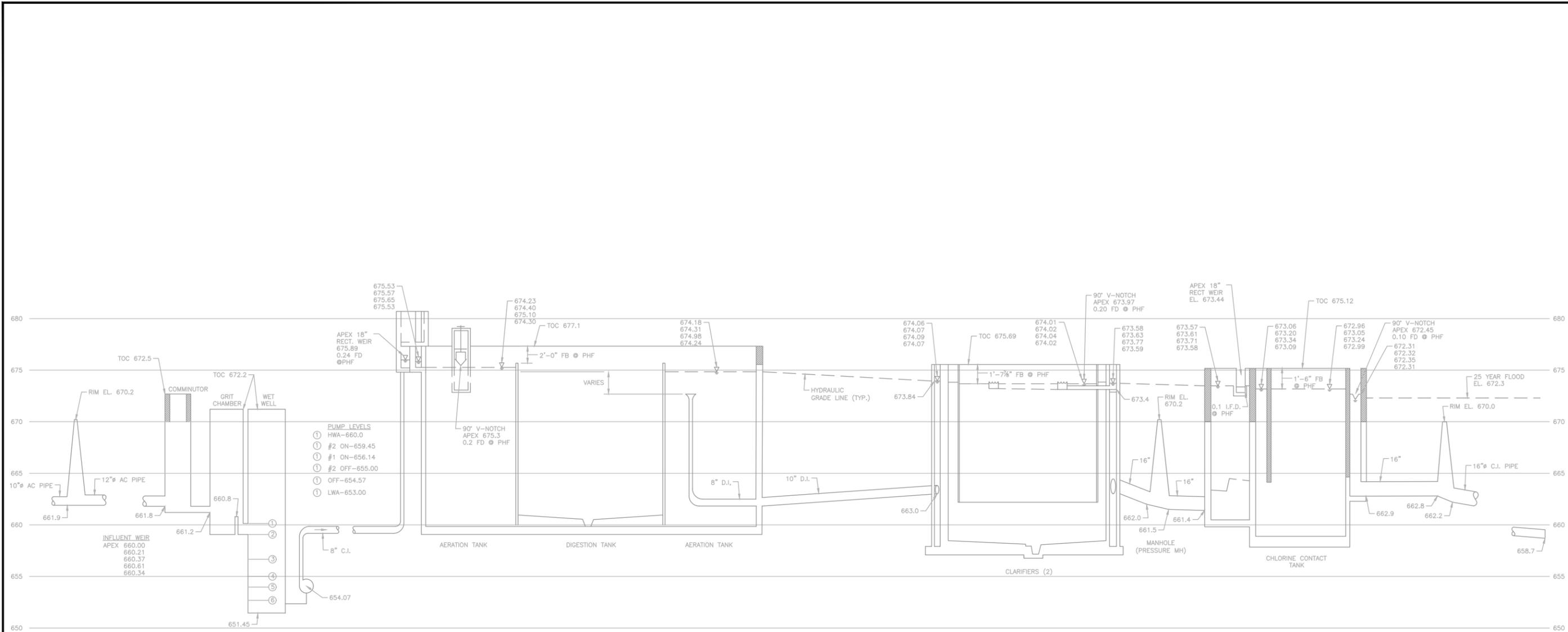




EXISTING PROCESS FLOW DIAGRAM
NOT TO SCALE

NOTES:

1. PROCESS FLOW DIAGRAM INCLUDED WASTEWATER LIQUID STREAM ONLY. SOLIDS HANDLING FACILITIES ARE NOT SHOWN.



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FILE NAME
21-129901-EH03

TOWN OF WOODSTOCK, VERMONT
WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
PRELIMINARY ENGINEERING REPORT
**EXISTING HYDRAULIC
PROFILE**

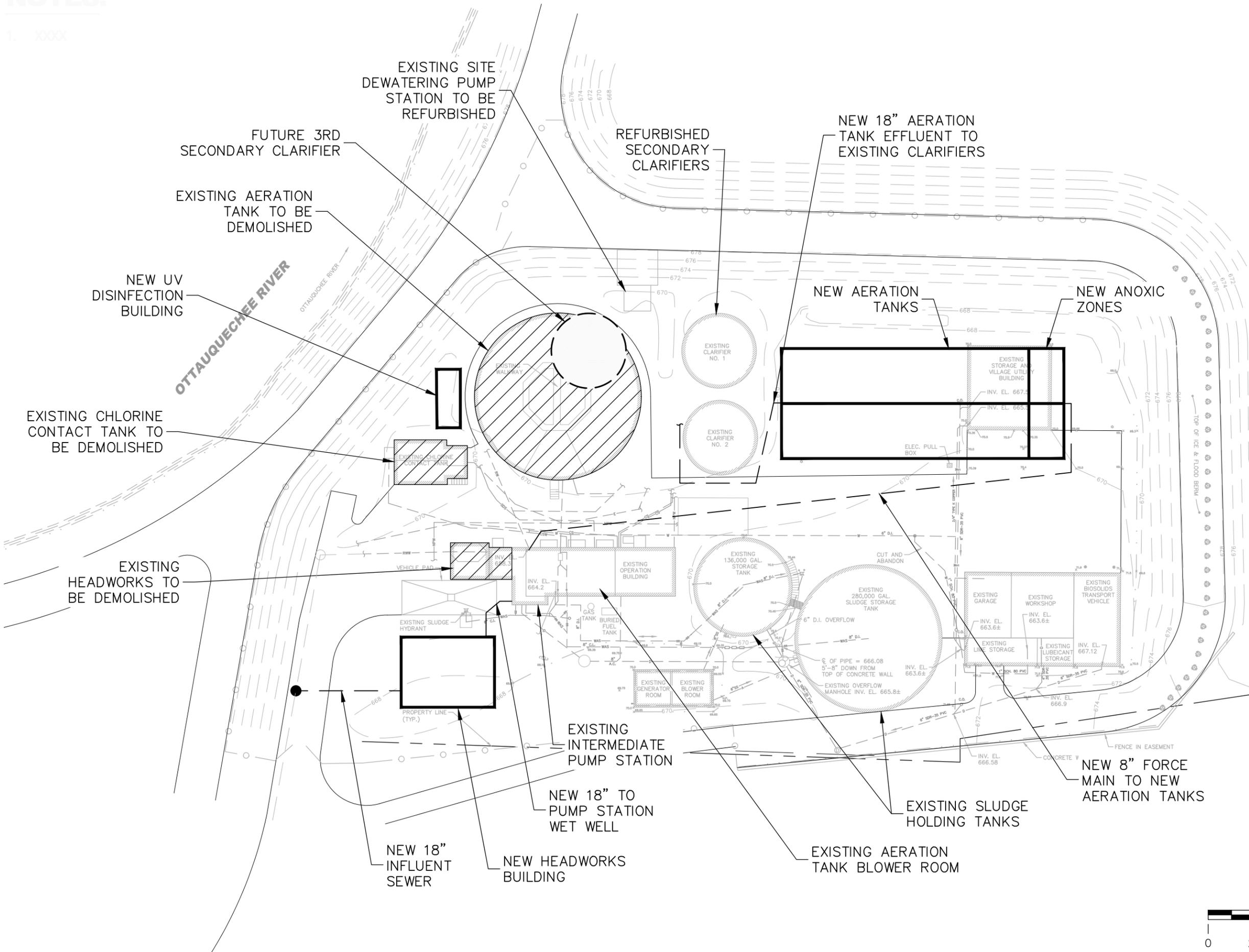
DATE
MARCH 2022

FIGURE
A-4

NOTES:

1. XXXX

APPROXIMATE MAP NORTH



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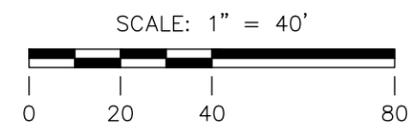


HOYLE, TANNER
 PROJECT NO.
 21-129901
 FILE NAME
 21-129901-EH01_JHV

TOWN OF WOODSTOCK, VERMONT
 WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
 PRELIMINARY ENGINEERING REPORT
PROPOSED SITE PLAN

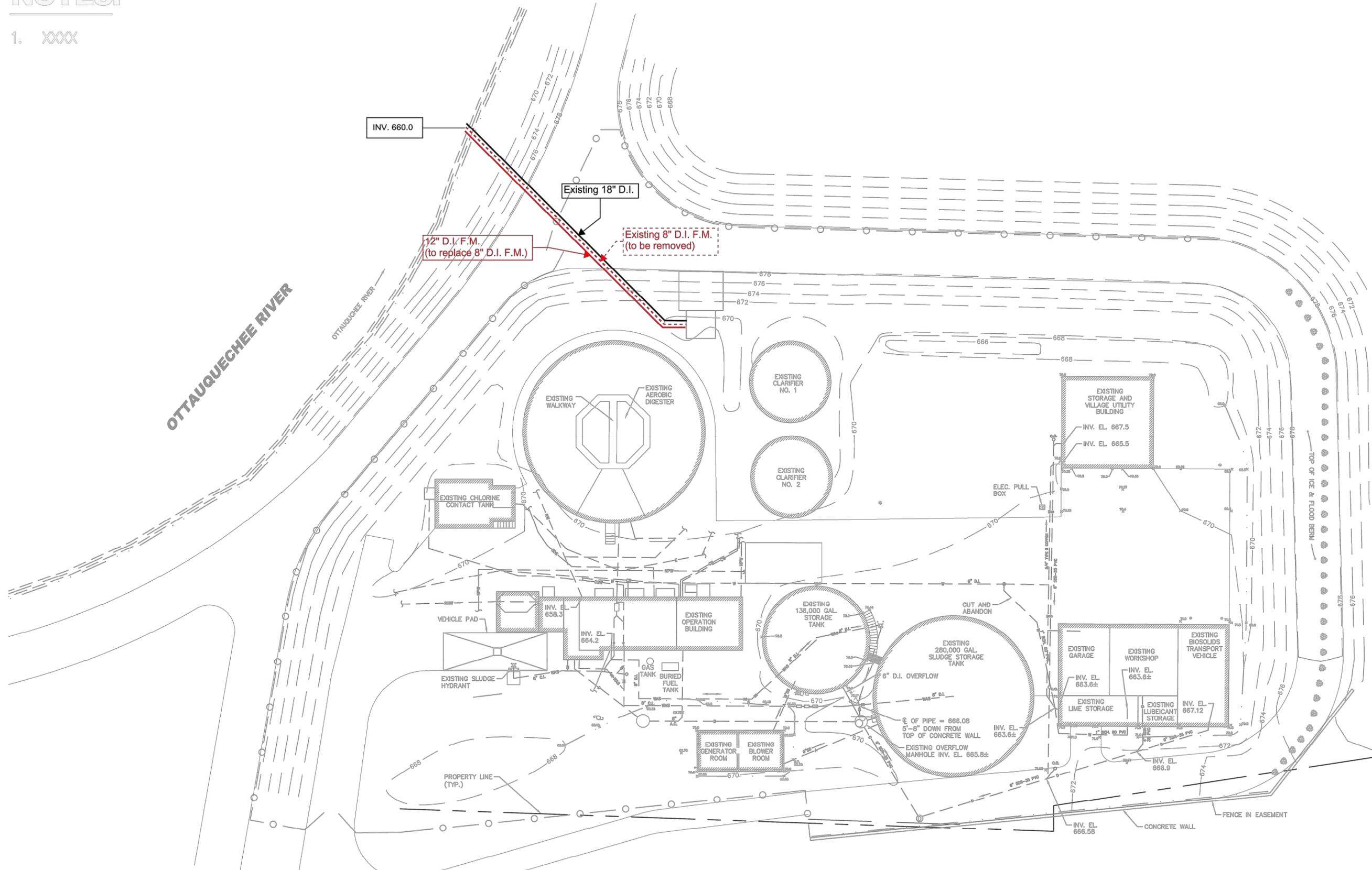
DATE
 JANUARY 2023
 FIGURE

A-5



NOTES:

1. XXXX



PLAN

SCALE: NOT TO SCALE

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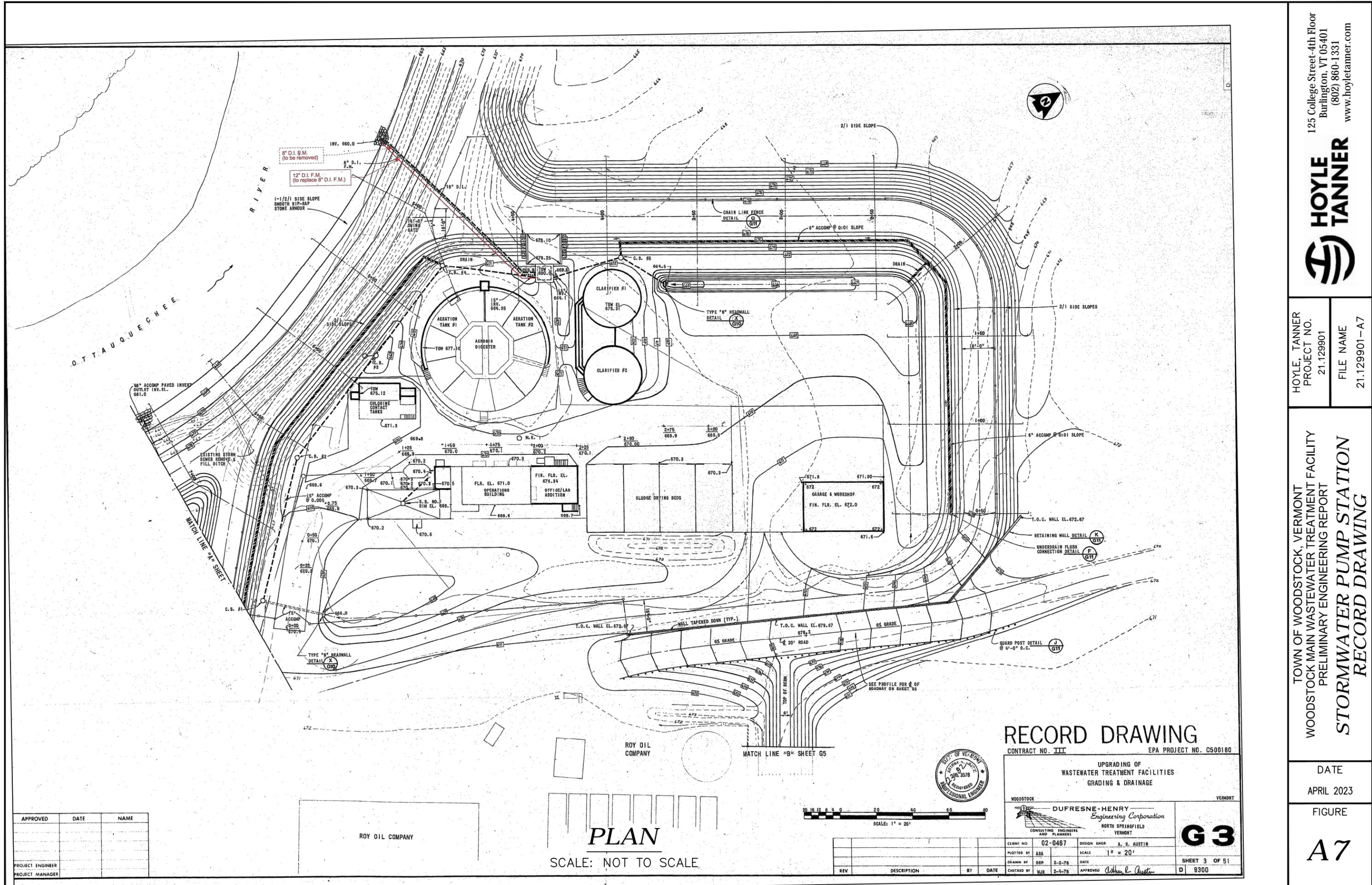


HOYLE, TANNER
PROJECT NO.
21-129901
FILE NAME
21.129901-A6

TOWN OF WOODSTOCK, VERMONT
WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
PRELIMINARY ENGINEERING REPORT
STORMWATER PUMP STATION
PLAN VIEW

DATE
APRIL 2023
FIGURE

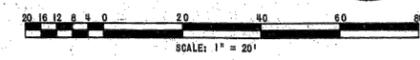
A6



APPROVED	DATE	NAME
PROJECT ENGINEER		
PROJECT MANAGER		

ROY OIL COMPANY

PLAN
SCALE: NOT TO SCALE



RECORD DRAWING
CONTRACT NO. IIII EPA PROJECT NO. C500180

UPGRADING OF WASTEWATER TREATMENT FACILITIES
GRADING & DRAINAGE

WOODSTOCK VERMONT

DUFRESNE-HENRY
Engineering Corporation
CONSULTING ENGINEERS AND PLANNERS
NORTH SPRINGFIELD VERMONT

G3

CLIENT NO.	02-0487	DESIGN ENGR.	A. R. AUSTIN
PLOTTED BY	ARA	SCALE	1" = 20'
DRAWN BY	ORP	DATE	2-2-78
CHECKED BY	WJR	APPROVED	<i>John L. Austin</i>

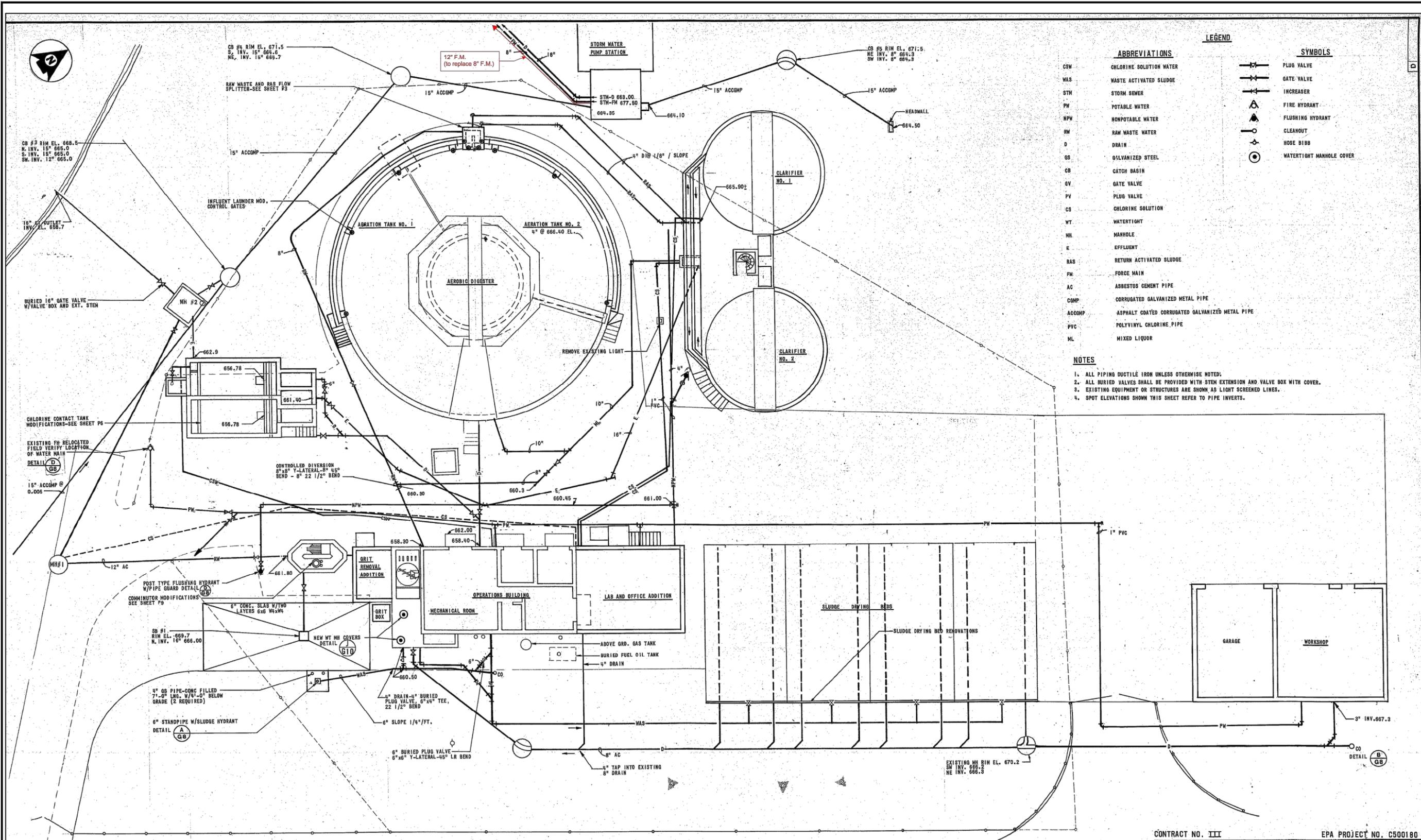
SHEET 3 OF 51
D 9300

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HOYLE, TANNER
PROJECT NO.
21-129901
FILE NAME
21-129901-A7

TOWN OF WOODSTOCK, VERMONT
WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
PRELIMINARY ENGINEERING REPORT
STORMWATER PUMP STATION
RECORD DRAWING

DATE
APRIL 2023
FIGURE
A7



ABBREVIATIONS

CSW	CHLORINE SOLUTION WATER
WAS	WASTE ACTIVATED SLUDGE
STM	STORM SEWER
PM	POTABLE WATER
NPW	NONPOTABLE WATER
RM	RAW WASTE WATER
D	DRAIN
GS	GALVANIZED STEEL
CB	CATCH BASIN
GV	GATE VALVE
PV	PLUG VALVE
CS	CHLORINE SOLUTION
WT	WATERTIGHT
MH	MANHOLE
E	EFFLUENT
RAS	RETURN ACTIVATED SLUDGE
FM	FORCE MAIN
AC	ASBESTOS CEMENT PIPE
CGMP	CORRUGATED GALVANIZED METAL PIPE
ACOMP	ASPHALT COATED CORRUGATED GALVANIZED METAL PIPE
PVC	POLYVINYL CHLORINE PIPE
ML	MIXED LIQUOR

LEGEND

	PLUG VALVE
	GATE VALVE
	INVERTER
	FIRE HYDRANT
	FLUSHING HYDRANT
	CLEANOUT
	HOSE BIBB
	WATERTIGHT MANHOLE COVER

- NOTES**
1. ALL PIPING DUCTILE IRON UNLESS OTHERWISE NOTED;
 2. ALL BURIED VALVES SHALL BE PROVIDED WITH STEM EXTENSION AND VALVE BOX WITH COVER.
 3. EXISTING EQUIPMENT OR STRUCTURES ARE SHOWN AS LIGHT SCREENED LINES.
 4. SPOT ELEVATIONS SHOWN THIS SHEET REFER TO PIPE INVERTS.

APPROVED	DATE	NAME
PROJECT ENGINEER		
PROJECT MANAGER		

PLAN
SCALE: NOT TO SCALE
RECORD DRAWING



CONTRACT NO. III EPA PROJECT NO. C500180

UPGRADING OF
WASTEWATER TREATMENT FACILITIES
YARD PIPING

WOODSTOCK VERMONT

DUPRESNE-HENRY
Engineering Corporation
CONSULTING ENGINEERS
AND PLANNERS
NORTH SPRINGFIELD
VERMONT

CLIENT NO. 02-0487 DESIGN ENGR. A. R. AUSTIN
 PLOTTED BY ABA SCALE 1" = 10'
 DRAWN BY ORP 2-14-78 DATE February 28, 1978
 CHECKED BY RMB 2-15-78 APPROVED *Arthur R. Austin*

G 7

SHEET 7 OF 51
D 9304

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FILE NAME
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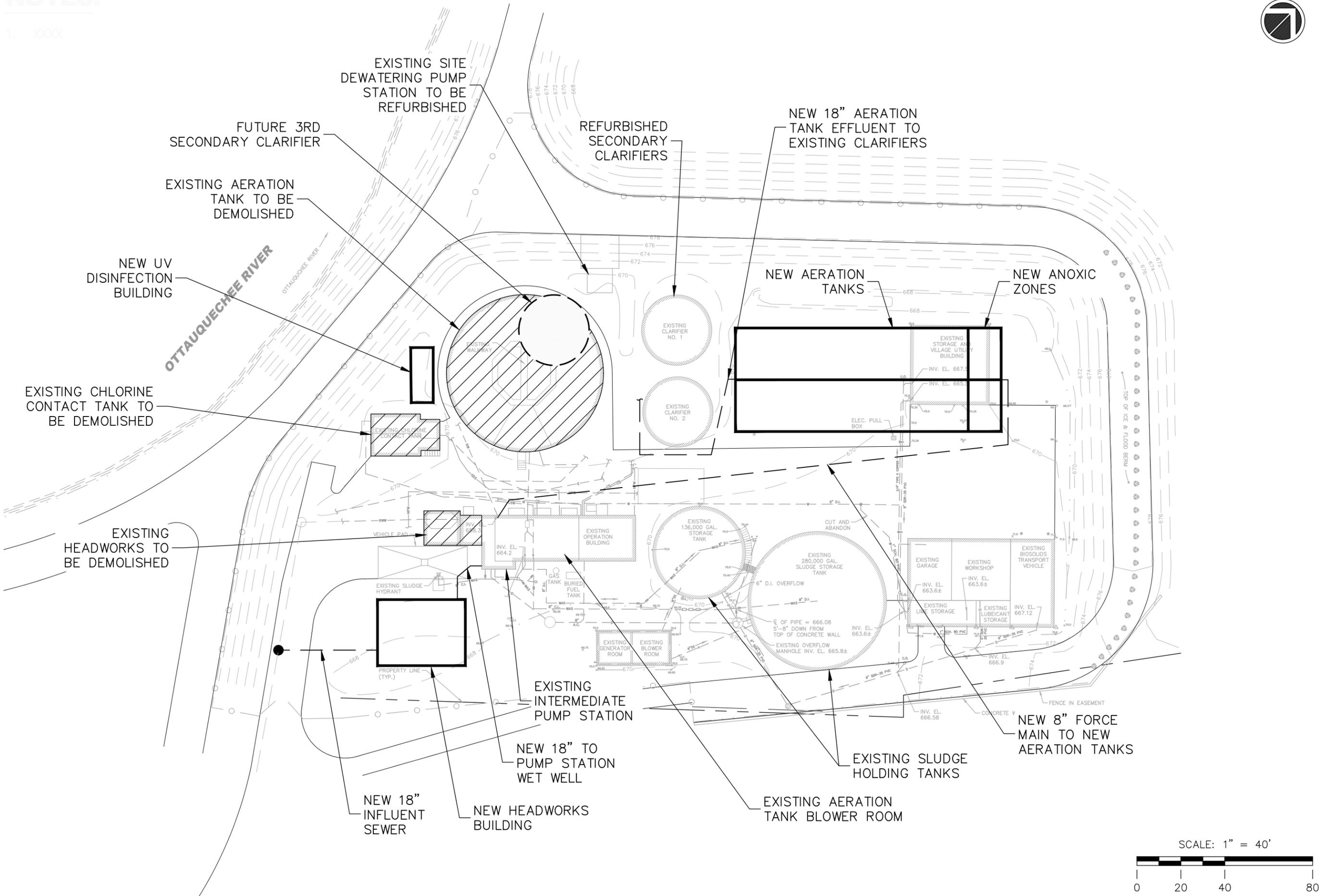
TOWN OF WOODSTOCK, VERMONT
WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
PRELIMINARY ENGINEERING REPORT
STORMWATER PUMP STATION
RECORD DRAWING

DATE
APRIL 2023
FIGURE
A8

NOTES:

1. XXXX

APPROXIMATE MAP NORTH



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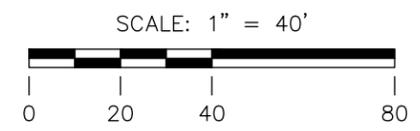
HOYLE, TANNER
 PROJECT NO.
 21-129901
 FILE NAME
 21-129901-EH01_JHV

TOWN OF WOODSTOCK, VERMONT
 WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
 PRELIMINARY ENGINEERING REPORT
PROPOSED SITE PLAN

DATE
 JANUARY 2023

FIGURE

A-5



Appendix B
Natural Resource Atlas Maps

NOTES:

1. 100-YEAR FLOOD BOUNDARY FROM 2007 NATIONAL FLOOD INSURANCE PROGRAM FIRM MAP COMMUNITY NUMBER 500181 PANEL 0344 SUFFIX E.
2. ZONE AE IS AREAS SUBJECT TO INUNDATION BY THE 100-YEAR FLOOD WITH BASE FLOOD ELEVATIONS DETERMINED.
3. ZONE X IS AREAS TO BE DETERMINED OUTSIDE OF THE 500-YEAR ANNUAL FLOOD.
4. 100-YEAR BASE FLOOD ELEVATION FROM FIRM MAP AT LOCATION OF WWTF IS ELEVATION 675.

100-YR FLOOD ELEVATION (SEE NOTE 4).

LEGEND:

-  ZONE AE FLOODWAY
-  ZONE AE-100 YEAR FLOODPLAIN

APPROXIMATE MAP NORTH



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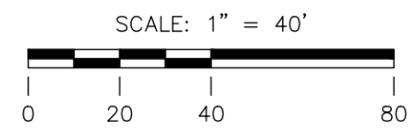
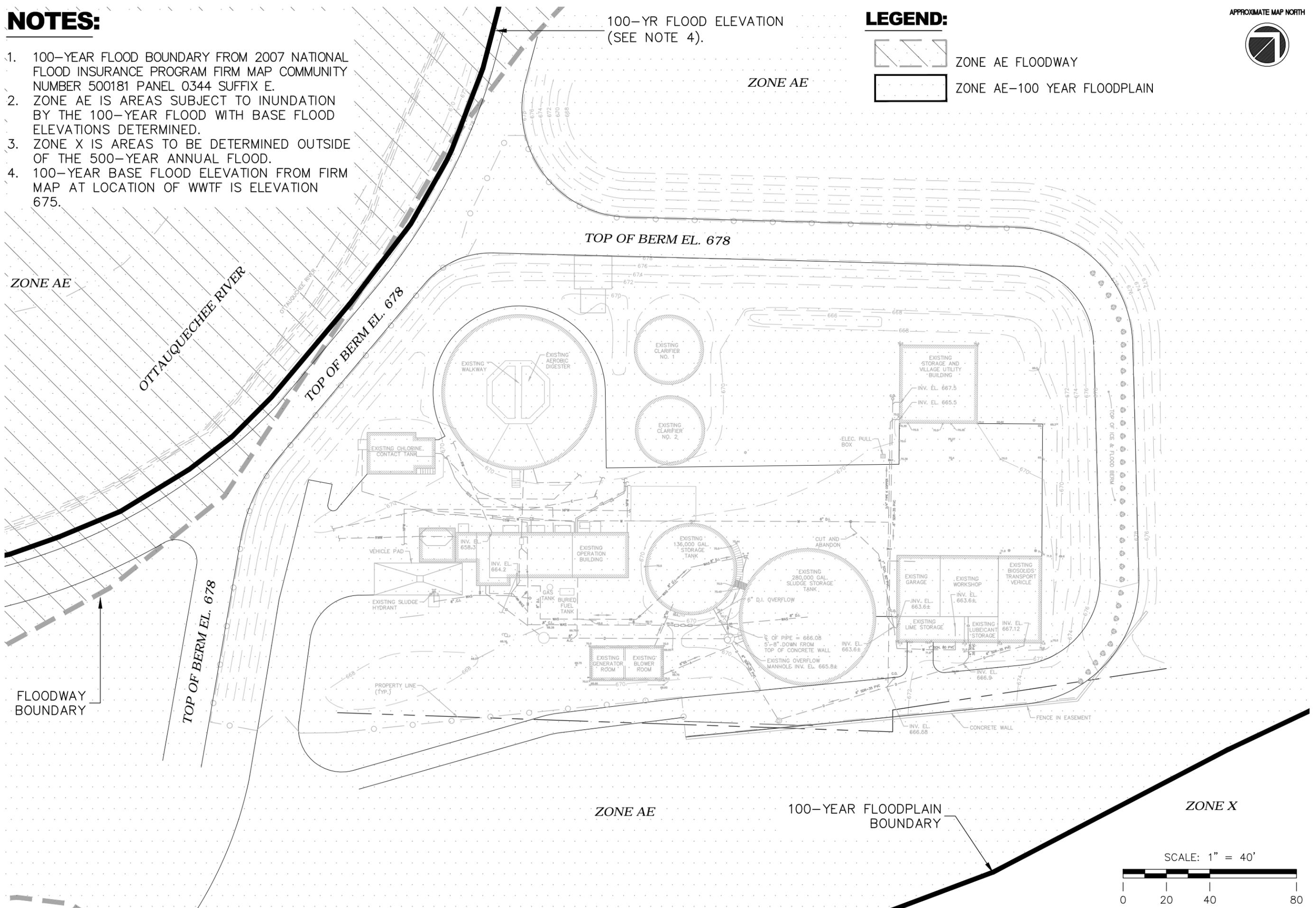


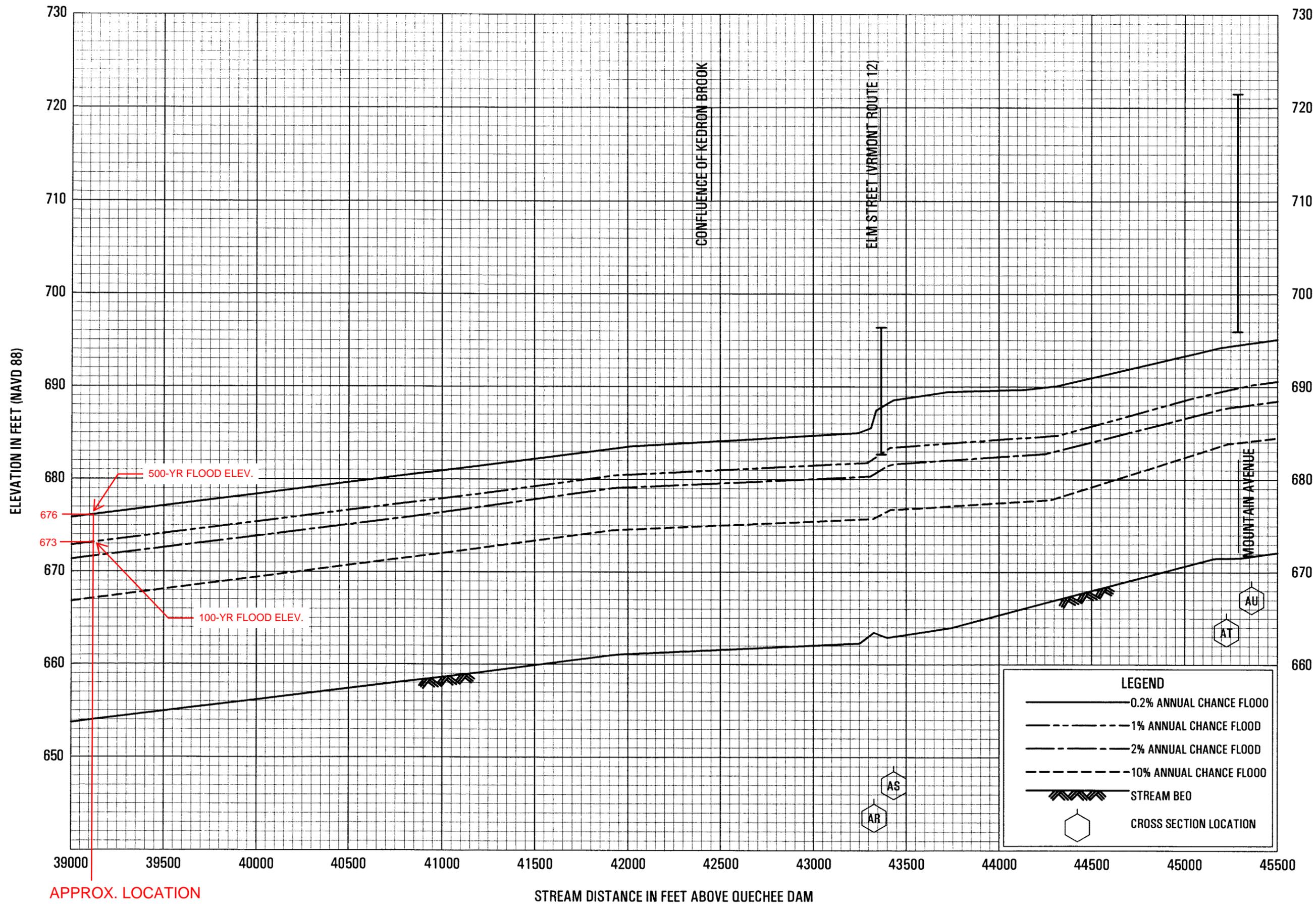
HOYLE, TANNER
PROJECT NO.
21-129901
FILE NAME
21.129901-EH02

TOWN OF WOODSTOCK, VERMONT
WOODSTOCK MAIN WASTEWATER TREATMENT FACILITY
PRELIMINARY ENGINEERING REPORT
FLOOD BOUNDARY MAP

DATE
MARCH 2022
FIGURE

B-1





APPROX. LOCATION
OF MAIN WWTF (400'
FROM X-SECTION
AQ AT 38720)



LEGEND

- Vernal Pools Confirmed – AE/VCE
- Vernal Pools Unconfirmed – AE/VCE
- Wetland Projects
- Wetland - VSWI
 - Class 1 Wetland
 - Class 2 Wetland
 - Buffer
- Wetlands Advisory Layer
- Soils - Hydric
- Parcels (standardized)
- Stream/River
 - Stream
 - Intermittent Stream
- Town Boundary
- County Boundary

508.0 0 254.00 508.0 Meters

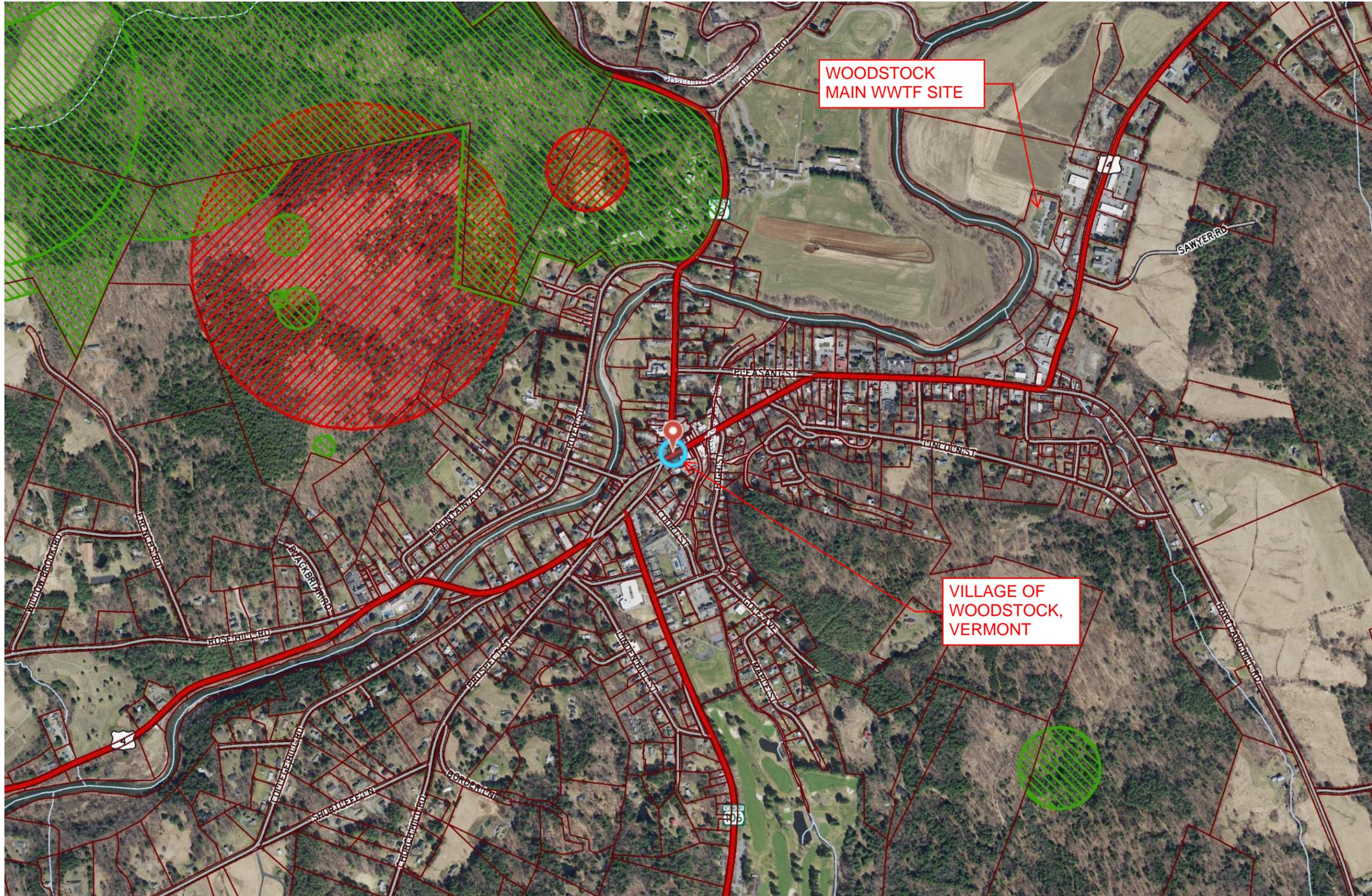
1: 10,000

1in = 833 ft.
1cm = 100 meters



NOTES

Map created using ANR's Natural Resources Atlas



LEGEND

Rare Threatened Endangered Species

- Threatened or Endangered (Red diagonal hatching)
- Rare (Green diagonal hatching)

Parcels (standardized)

Roads

- Interstate
- US Highway; 1
- State Highway
- Town Highway (Class 1)
- Town Highway (Class 2,3)
- Town Highway (Class 4)
- State Forest Trail
- National Forest Trail
- Legal Trail
- Private Road/Driveway
- Proposed Roads

Stream/River

- Stream
- Intermittent Stream

Town Boundary

1: 10,000

1in = 833 ft.
1cm = 100 meters

508.0 0 254.00 508.0 Meters

WGS_1984_Web_Mercator_Auxiliary_Sphere
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THIS MAP IS NOT TO BE USED FOR NAVIGATION

NOTES

Map created using ANR's Natural Resources Atlas

Appendix C

Hoyle Tanner Total Nitrogen Allocation Letter to
VTDEC, April 2020

April 14, 2020



125 College Street, 4th Floor
Burlington, Vermont 05401
802-860-1331
802-860-6499 fax
www.hoyletanner.com

Amy Polaczyk
Wastewater Program Manager
Vermont Department of Environmental Conservation
1 National Life Drive, Main 2
Montpelier, VT 05620-3522

Subject: Town of Woodstock Wastewater Treatment Facilities – Effluent Total Nitrogen Proposed Estimated Allocations

Dear Amy:

Hoyle Tanner is currently working on the preliminary engineering study for the upgrade of the South Woodstock WWTF. As we are currently developing alternatives for the upgrade of the South WWTF, it is important to identify the South WWTF effluent design criteria before completing the preliminary engineering study. Vermont DEC has provided us with the guidance that they would rely on our engineering judgment to provide a recommended allocation plan for effluent total nitrogen. Adjusting the allocations for the South and Main WWTFs will require an update of the Nitrogen Removal Optimizations Plans as well.

We have summarized the historical effluent total nitrogen data for the Town of Woodstock Main WWTF and South WWTF. Providing additional effluent TN allocation at the South WWTF than what is currently permitted, will allow the upgraded facility design to meet a higher effluent TN, which will reduce both projected capital costs for the upgrade and long-term operating costs. The reduction of effluent TN allocation at the Main WWTF is not anticipated to impact operations, as the Main WWTF has historically only used 39-41% of its permitted estimated TN allocation. Additionally, it is not anticipated that average daily flows will increase for the Main WWTF collection system based on increases in population. The United States Census Bureau from population data for the Town of Woodstock from 2000 and 2010 were 3,232 and 3,048, respectfully, showing a decrease of 5.7% in population during this period.

Table 1 summarizes the historical effluent total nitrogen (TN) for the Woodstock Main WWTF from September 2018 to January 2020. Based on this data set, the maximum 12-month running average was 22.5 lbs TN/day. Currently the Woodstock Main WWTF has a permitted estimated annual average daily TN allocation of 55 lbs/day. Therefore, the Main WWTF currently uses approximately 39-41% of the permitted estimated annual average daily TN allocation. The average daily flow (ADF) during this period was 0.248 MGD, which is approximately 55% of the permitted flow of 0.450 MGD. Based on review of this data, it would suggest that the Main WWTF could feasibly meet a lower annual effluent TN allocation without a change in operations.

Table 1: Woodstock Main WWTF Historical Effluent Total Nitrogen

Year	Month	Average Monthly Flow (MGD)	Average Effluent TN (mg/l)	Average Monthly Effluent TN Load (lbs/d)	12 Month Average Effluent TN (lbs/d)	Percentage of Baseline Annual TN Allocation (lbs/d)
2018	September	0.164	18	24.6	-	-
2018	October	0.206	11.6	19.9	-	-
2018	November	0.275	8.7	20.0	-	-
2018	December	0.277	12.1	28.0	-	-
2019	January	0.249	10.2	21.2	-	-
2019	February	0.245	8.3	17.0	-	-
2019	March	0.247	13.8	28.4	-	-
2019	April	0.536	7.5	33.5	-	-
2019	May	0.382	8.3	26.4	-	-
2019	June	0.277	8.2	18.9	-	-
2019	July	0.193	11.3	18.2	-	-
2019	August	0.161	10.3	13.8	22.5	41%
2019	September	0.142	14.1	16.7	21.8	40%
2019	October	0.189	13.5	21.3	21.9	40%
2019	November	0.204	11.3	19.2	21.9	40%
2019	December	0.238	11.1	22.0	21.4	39%
2020	January	0.239	12.7	25.3	21.7	40%
Average		0.248	11.2	22.0	21.9	40%
Max		0.536	18.0	33.5	22.5	41%

Tables 2 and 3 show the equivalent effluent TN concentrations at current and permitted flows at varied annual average daily effluent TN allocations for the Main and South WWTFs, respectively. Reduction of annual average daily effluent TN allocations at the Main WWTF are shown in Table 2. Increases of annual average daily effluent TN allocations at the South WWTF are shown in Table 3.

Table 2: Main WWTF Equivalent Effluent TN Concentrations at Varying Annual TN Allocations

Annual Average Daily Effluent TN Allocation (lbs/d)	Equivalent Effluent TN Concentration at Permitted Flow (mg/l)	Equivalent Effluent TN Concentration at Current ADF ⁽¹⁾ (mg/l)
55	14.7	26.5
54	14.4	26.1
53	14.1	25.6
52	13.9	25.1
51	13.6	24.6
50	13.3	24.1
49	13.1	23.6
48	12.8	23.2
47	12.5	22.7
46	12.3	22.2
45	12.0	21.7
44	11.7	21.2
43	11.5	20.8
42	11.2	20.3
41	10.9	19.8
40	10.7	19.3
39	10.4	18.8

Note:

1. Current average daily flow of 0.248 mgd based on average flow from December 2018 to January 2020. This is approximately 55% of the permitted flow of 0.450 mgd.
2. Current permitted estimated TN allocations are shaded in gray.
3. Proposed reduced allocation for Woodstock Main WWTF is shaded in green.

Table 3: South WWTF Equivalent Effluent TN Concentrations at Varying Annual TN Allocations

Annual Average Daily Effluent TN Allocation (lbs/d)	Equivalent Effluent TN Concentration at Permitted Flow (mg/l)	Equivalent Effluent TN Concentration at Current ADF ⁽¹⁾ (mg/l)
2	4.8	8.2
3	7.2	12.3
4	9.6	16.4
5	12.0	20.5
6	14.4	24.6
7	16.8	28.6
8	19.2	32.7
9	21.6	36.8
10	24.0	40.9
11	26.4	45.0
12	28.8	49.1

Note:

1. Current average daily flow of 0.0293 mgd based on average flow from January to December 2019. This is approximately 59% of the permitted flow of 0.050 mgd.
2. Current permitted estimated TN allocations are shaded in gray.
3. Proposed increased allocation for the South Woodstock WWTF is shaded in green.

At the South Woodstock WWTF, achieving the current average annual daily effluent TN at a design flow of 0.050 MGD results in a concentration of 4.8 mg/l, which is very challenging to consistently achieve. This would require year-round nitrification and denitrification. Process guarantees for meeting low effluent TN limits are generally not provided by manufacturers for wastewaters with monthly average temperatures less than 7-8 degrees Fahrenheit. Historically, the South WWTF has had monthly average wastewater temperatures as low as 6 degrees Fahrenheit. Additionally, the operating cost to achieve low level total nitrogen removal are significant. A carbon source, such as methanol, must be provided to allow for complete denitrification of wastewater. Capital costs are also higher as process tankage volumes are increased to allow for complete denitrification, and chemical feed and storage of a carbon source must be provided.

Based on our review of the historical operating data for the Main WWTF, we recommend transferring 3 lbs TN from the Main WWTF, reducing the permitted estimated allocation to an annual average daily effluent TN of 52 lbs/day. This is feasible without changes in Main WWTF operations since the WWT has historically only used 39-41%, or 21.4-22.5 lbs/day TN, of the permitted estimated TN allocation, well below the 52 lbs/day TN proposed. This would increase the South WWTF permitted estimated allocation to an annual average daily effluent TN of 5 lbs/day. These values are highlighted in green in Tables 2 and 3. The reduction in permitted estimated TN allocation for the Main WWTF will result in reducing the equivalent effluent TN concentration at design flow from 14.7 mg/l TN to 13.9 mg/l TN. At current flows, the reduction at the Main WWTF would result in reducing the equivalent effluent TN concentration from 26.5 mg/l TN to 25.1 mg/l TN. Conversely, the equivalent effluent TN concentrations for the South WWTF would increase from 4.8 mg/l to 12.0 mg/l TN at design flow and from 8.2 mg/l to 20.5 mg/l at current flow.

The proposed transfer of effluent TN estimated permitted allocation from the Main WWTF to the South WWTF will result in the following benefits for the upgrade of the South WWTF:

- Smaller process tankage which reduces cost of upgrade and feasibility of fitting new process tankage on the existing site
- Potential elimination of tertiary denitrification polishing filter which reduces cost of upgrade and feasibility of fitting new process tankage on the existing site
- Lower operating costs through reduction in chemical usage and energy usage
- Significantly less operator attention required to meet effluent permit limitations
- More flexibility to manage unexpected nitrification/denitrification process upsets while still meeting annual effluent TN permit

Sincerely,

For HOYLE, TANNER & ASSOCIATES, INC.:

A handwritten signature in blue ink that reads "Jennie Auster". The signature is fluid and cursive, with a large initial "J" and "A".

Jennie Auster, P.E.
Sr. Environmental Engineer

Appendix D
Engineer's Opinions of Probable Construction Costs

Town of Woodstock	Project No:	21.129901
Woodstock Main WWTF Upgrade PER	By:	KDW
Engineer's Opinion of Probable Project Costs	CK By:	KDW
Total Project Costs	Date:	2/16/2023
Construction Cost	Current Cost¹	Projected Cost²
	Nov-22	Mar-25
ENR Construction Cost Index	13174.98	15500
Screen and New Headworks Building - Alternative 2 - Center Flow Screen	\$1,811,000	\$2,131,000
Grit Removal	\$652,000	\$767,000
Intermediate Lift Pumps	\$877,000	\$1,032,000
Biological Process	\$3,121,000	\$3,672,000
Coagulant Chemical Feed Systems	\$331,000	\$389,000
Secondary Clarifier Rehab	\$1,188,000	\$1,398,000
RAS/WAS Pump Replacement	\$586,000	\$689,000
UV Disinfection System & Building	\$1,095,000	\$1,288,000
Plant Water System	\$157,000	\$185,000
Solids Holding Tank Improvements	\$474,000	\$558,000
Control Building Modifications	\$512,000	\$602,000
Plant Drainage Pump Station and Site Modifications	\$966,000	\$1,136,000
Subtotal	\$11,770,000	\$13,847,000
Construction Contingency	30%	30%
Contingency @ 30%	\$3,531,000	\$4,154,000
Total Construction Cost³	\$15,301,000	\$18,001,000
Engineering Costs		
Step I - Preliminary Engineering		
Preliminary Engineering - Step I ⁴	\$105,000	\$105,000
Estimated additional pre-design (SERP, Basis of Design, etc.)	\$60,000	\$60,000
Step II - Final Design		
Final Design - Step II ⁵	\$973,000	\$973,000
Survey	\$15,000	\$15,000
Geotechnical Investigation	\$15,000	\$15,000
Wetlands Screening	\$2,000	\$2,000
Asbestos/Lead Paint/PCB Testing	\$5,000	\$5,000
Historic Preservation/Archeological Investigation	\$5,000	\$5,000
Step III - Construction Phase		
Bid, Construction Administration & Inspection - Step III ⁵	\$1,784,000	\$1,784,000
Legal, Administrative, Permitting		
0.5%	\$90,000	\$90,000
Total Project Cost	\$18,355,000	\$21,055,000
Notes:		
1) ENR Construction Cost Index = 13174.98 (November 2022)		
2) Projected ENR Construction Cost Index = 15,500 (March 2025)		
3) Construction Costs are inclusive of 15% Contractor Overhead and Profit and 7% Bonds and Mobilization/Demobilization		
4) Signed Contract dated 10/21/21		
5) Engineering Fee is calculated based on the VTDEC-FED Engineering Fee Allowance Guidelines dated 9/1/2011.		

Hoyle, Tanner		Town of Woodstock				Project No: 21.129901		
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW		
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW		
802-860-1331		Headworks Alternative 1 - Micro Strainer				Date: 1/4/2023		
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost	
Influent Sewer								
	Site/Civil							
		New 18" Dia. 35 SDR PVC Pipe	50	LF	\$110		\$5,500	
		4' Diameter Sanitary Sewer Manhole	1	EA	\$12,000		\$12,000	
		Trench Excavation	120	CY	\$40		\$4,800	
		Subbase - pipe bedding	20	CY	\$55		\$1,100	
		Structural Backfill Material	100	CY	\$50		\$5,000	
		Abandonment of Existing 12" Influent Sewer	1	LS	\$5,000		\$5,000	
		Influent Sewer - Subtotal						\$33,400
Screening								
	Site/Civil							
		Covered under Headworks Building						
	Structural							
		Concrete - Channels	120	CY	\$1,400		\$168,000	
		Channel Grating - FRP	210	SF	\$60		\$12,600	
	Mechanical							
		Lakeside Raptor Screen Model 20MS-0.12-108	1	LS	\$176,000	30%	\$229,000	
		Bypass Manual Bar Screen	1	LS	\$5,000	30%	\$6,500	
		Slide Gates	4	EA	\$15,000	30%	\$78,000	
		Process piping and valves	1	LS	\$10,000	30%	\$13,000	
	Building Mechanical							
		N/A						
	Electrical							
		Process Electrical & Instrumentation	1	LS	\$10,000		\$10,000	
		Screening - Subtotal						\$517,100
Headworks Building								
	Site/Civil							
		Site Erosion Control	1	ALL	\$2,500		\$2,500	
		Utility Relocation Allowance	1	LS	\$10,000		\$10,000	
		Excavation for Structures	1,840	CY	\$30		\$55,200	
		Site Dewatering	1	LS	\$5,000		\$5,000	
		Subbase	170	CY	\$55		\$9,350	
		Structural Backfill	680	CY	\$50		\$34,000	
		Potable Water Service Extension to Building	1	LS	\$5,000		\$5,000	
	Structural							
		Headworks Building (52' x 30')	1560	SF	\$250		\$390,000	
		Frost Wall Foundation	100	CY	\$1,400		\$140,000	
		Concrete Slab	90	CY	\$1,200		\$108,000	
		Concrete Housekeeping Pads	5	CY	\$1,200		\$6,000	
	Process Mechanical							
		Sodium hydroxide chemical feed pump & drum storage pallet	1	EA	\$10,000		\$10,000	
		Influent Sampler	1	EA	\$15,000		\$15,000	
		Process Piping and Valves	1	LS	\$25,000	30%	\$32,500	
	Building Mechanical							
		Safety Shower and Eyewash	1	EA	\$5,000		\$5,000	
		HVAC & Plumbing	1	LS	\$85,000		\$85,000	
	Electrical/I&C							
		Gas Detection System	1	LS	\$15,000		\$15,000	
		Building Electrical Panels	1	LS	\$6,000		\$6,000	
		Building Basic Electrical	1	LS	\$52,000		\$52,000	
		Operations Building PLC Panel & Wiring	1	LS	\$10,000		\$10,000	
		Headworks Building - Subtotal						\$995,550
Effluent Sewer to Intermediate Pump Station Wetwell								
	Site/Civil							
		New 18" Dia. 35 SDR PVC Pipe	30	LF	\$110		\$3,300	
		Trench Excavation	70	CY	\$40		\$2,800	
		Subbase - pipe bedding	10	CY	\$55		\$600	
		Structural Backfill Material	60	CY	\$50		\$3,000	
		Effluent Sewer - Subtotal						\$9,700
						Construction Subtotal (Rounded)	\$1,556,000	
Contractor Markups								
		Contractor Overhead & Profit	15%				\$233,000	
		Mobilization/Demobilization	5%				\$78,000	
		Bonds & Insurance	2%				\$31,000	
						Total Construction Cost	\$1,898,000	

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)

Hoyle, Tanner	Town of Woodstock					Project No:	21.129901
125 College St., 4th Floor	Woodstock Main WWTF Upgrade PER					By:	KDW
Burlington, VT 05401	Engineer's Opinion of Probable Project Costs					CK By:	KDW
802-860-1331	Headworks Alternative 2 - Center Flow Screen					Date:	1/3/2023
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Influent Sewer							
	Site/Civil						
		New 18" Dia. 35 SDR PVC Pipe	50	LF	\$110		\$5,500
		4' Diameter Sanitary Sewer Manhole	1	EA	\$12,000		\$12,000
		Trench Excavation	120	CY	\$40		\$4,800
		Subbase - pipe bedding	20	CY	\$55		\$1,100
		Structural Backfill Material	100	CY	\$50		\$5,000
		Abandonment of Existing 12" Influent Sewer	1	LS	\$5,000		\$5,000
		Influent Sewer - Subtotal					\$33,400
Screening							
	Site/Civil						
		Covered under Headworks Building					
	Structural						
		Concrete - Channels	100	CY	\$1,400		\$140,000
		Channel Grating - FRP	190	SF	\$60		\$11,400
	Mechanical						
		HydroDyne Great White Center Flow Screen and Wash Compactor	1	LS	\$274,000	30%	\$357,000
		Bypass Manual Bar Screen	1	LS	\$5,000	30%	\$6,500
		Slide Gates	4	EA	\$15,000	30%	\$78,000
		Process piping and valves	1	LS	\$10,000	30%	\$13,000
	Building Mechanical						
		N/A					
	Electrical						
		Process Electrical & Instrumentation	1	LS	\$10,000		\$10,000
		Screening - Subtotal					\$615,900
Headworks Building							
	Site/Civil						
		Site Erosion Control	1	ALL	\$2,500		\$2,500
		Utility Relocation Allowance	1	LS	\$10,000		\$10,000
		Excavation for Structures	1,490	CY	\$30		\$44,700
		Site Dewatering	1	LS	\$5,000		\$5,000
		Subbase	140	CY	\$55		\$7,700
		Structural Backfill	590	CY	\$50		\$29,500
		Potable Water Service Extension to Building	1	LS	\$5,000		\$5,000
	Structural						
		Headworks Building (40' x 30')	1200	SF	\$250		\$300,000
		Frost Wall Foundation	80	CY	\$1,400		\$112,000
		Concrete Slab	60	CY	\$1,200		\$72,000
		Concrete Housekeeping Pads	5	CY	\$1,200		\$6,000
	Process Mechanical						
		Sodium hydroxide chemical feed pump & drum storage pallet	1	EA	\$10,000		\$10,000
		Influent Sampler	1	EA	\$15,000		\$15,000
		Process Piping and Valves	1	LS	\$25,000	30%	\$32,500
	Building Mechanical						
		Safety Shower and Eyewash	1	EA	\$5,000		\$5,000
		HVAC & Plumbing	1	LS	\$85,000		\$85,000
	Electrical/I&C						
		Gas Detection System	1	LS	\$15,000		\$15,000
		Building Electrical Panels	1	LS	\$6,000		\$6,000
		Building Basic Electrical	1	LS	\$52,000		\$52,000
		Operations Building PLC Panel & Wiring	1	LS	\$10,000		\$10,000
		Headworks Building - Subtotal					\$824,900
Effluent Sewer to Intermediate Pump Station Wetwell							
	Site/Civil						
		New 18" Dia. 35 SDR PVC Pipe	30	LF	\$110		\$3,300
		Trench Excavation	70	CY	\$40		\$2,800
		Subbase - pipe bedding	10	CY	\$55		\$600
		Structural Backfill Material	60	CY	\$50		\$3,000
		Effluent Sewer - Subtotal					\$9,700
						Construction Subtotal (Rounded)	\$1,484,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$223,000
		Mobilization/Demobilization	5%				\$74,000
		Bonds & Insurance	2%				\$30,000
						Total Construction Cost	\$1,811,000

Notes:

1. ENR Construction Cost Index = 13174.98 (November 2022)

Hoyle, Tanner	Town of Woodstock					Project No:	21.129901	
125 College St., 4th Floor	Woodstock Main WWTF Upgrade PER					By:	KDW	
Burlington, VT 05401	Engineer's Opinion of Probable Project Costs					CK By:	KDW	
802-860-1331	Headworks Alternative 3 - Stair Screen					Date:	1/4/2023	
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost	
Influent Sewer								
	Site/Civil							
		New 18" Dia. 35 SDR PVC Pipe	50	LF	\$110		\$5,500	
		4' Diameter Sanitary Sewer Manhole	1	EA	\$12,000		\$12,000	
		Trench Excavation	120	CY	\$40		\$4,800	
		Subbase - pipe bedding	20	CY	\$55		\$1,100	
		Structural Backfill Material	100	CY	\$50		\$5,000	
		Abandonment of Existing 12" Influent Sewer	1	LS	\$5,000		\$5,000	
		Influent Sewer - Subtotal						\$33,400
Screening								
	Site/Civil							
		Covered under Headworks Building						
	Structural							
		Concrete - Channels	120	CY	\$1,400		\$168,000	
		Channel Grating - FRP	210	SF	\$60		\$12,600	
	Mechanical							
		Vulcan Stair Fine Screen and Wash Compactor	1	LS	\$249,000	30%	\$324,000	
		Bypass Manual Bar Screen	1	LS	\$5,000	30%	\$6,500	
		Slide Gates	4	EA	\$15,000	30%	\$78,000	
		Process piping and valves	1	LS	\$10,000	30%	\$13,000	
	Building Mechanical							
		N/A						
	Electrical							
		Process Electrical & Instrumentation	1	LS	\$10,000		\$10,000	
		Screening - Subtotal						\$612,100
Headworks Building								
	Site/Civil							
		Site Erosion Control	1	ALL	\$2,500		\$2,500	
		Utility Relocation Allowance	1	LS	\$10,000		\$10,000	
		Excavation for Structures	1,840	CY	\$30		\$55,200	
		Site Dewatering	1	LS	\$5,000		\$5,000	
		Subbase	170	CY	\$55		\$9,350	
		Structural Backfill	680	CY	\$50		\$34,000	
		Potable Water Service Extension to Building	1	LS	\$5,000		\$5,000	
	Structural							
		Headworks Building (40' x 30')	1560	SF	\$250		\$390,000	
		Frost Wall Foundation	100	CY	\$1,400		\$140,000	
		Concrete Slab	90	CY	\$1,200		\$108,000	
		Concrete Housekeeping Pads	5	CY	\$1,200		\$6,000	
	Process Mechanical							
		Sodium hydroxide chemical feed pump & drum storage pallet	1	EA	\$10,000		\$10,000	
		Influent Sampler	1	EA	\$15,000		\$15,000	
		Process Piping and Valves	1	LS	\$25,000	30%	\$32,500	
	Building Mechanical							
		Safety Shower and Eyewash	1	EA	\$5,000		\$5,000	
		HVAC & Plumbing	1	LS	\$85,000		\$85,000	
	Electrical/I&C							
		Gas Detection System	1	LS	\$15,000		\$15,000	
		Building Electrical Panels	1	LS	\$6,000		\$6,000	
		Building Basic Electrical	1	LS	\$52,000		\$52,000	
		Operations Building PLC Panel & Wiring	1	LS	\$10,000		\$10,000	
		Headworks Building - Subtotal						\$995,550
Effluent Sewer to Intermediate Pump Station Wetwell								
	Site/Civil							
		New 18" Dia. 35 SDR PVC Pipe	30	LF	\$110		\$3,300	
		Trench Excavation	70	CY	\$40		\$2,800	
		Subbase - pipe bedding	10	CY	\$55		\$600	
		Structural Backfill Material	60	CY	\$50		\$3,000	
		Effluent Sewer - Subtotal						\$9,700
		Construction Subtotal (Rounded)						\$1,651,000
Contractor Markups								
		Contractor Overhead & Profit	15%				\$248,000	
		Mobilization/Demobilization	5%				\$83,000	
		Bonds & Insurance	2%				\$33,000	
		Total Construction Cost						\$2,015,000
Notes:								
1. ENR Construction Cost Index = 13174.98 (November 2022)								

Hoyle, Tanner		Town of Woodstock				Project No:	21.129901
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By:	KDW
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By:	KDW
802-860-1331		Grit Removal				Date:	1/3/2023
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Grit Removal							
	Site/Civil						
		Covered under Headworks Building					
	Structural						
		Concrete - Grit Vortex Influent and Effluent Channel	50	CY	\$1,400		\$70,000
		Concrete - Grit Vortex Tank	70	CY	\$1,400		\$98,000
		Channel Grating - FRP	90	SF	\$60		\$5,400
	Mechanical						
		Vortex Grit Chamber, Classifier, Grit Pump	1	LS	\$216,000	30%	\$281,000
		Slide Gates	3	EA	\$10,000	30%	\$39,000
		Process piping and valves	1	LS	\$20,000	30%	\$26,000
	Building Mechanical						
		N/A					
	Electrical						
		Process Electrical & Instrumentation	1	LS	\$15,000		\$15,000
		Grit Removal - Subtotal					\$534,400
						Construction Subtotal (Rounded)	\$534,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$80,000
		Mobilization/Demobilization	5%				\$27,000
		Bonds & Insurance	2%				\$11,000
						Total Construction Cost	\$652,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No: 21.129901	
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW	
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW	
802-860-1331		Intermediate Pumps and Forcemain Upgrade				Date: 1/3/2023	
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Intermediate Lift Pump Replacement and Forcemain							
	Site/Civil						
		New Pump Force Main to New Biological Process (8" Diameter DICL)	300	LF	\$70		\$21,000
		Trench Excavation	270	CY	\$40		\$10,800
		Subbase - pipe bedding	50	CY	\$50		\$2,500
		Structural Backfill Material	200	CY	\$50		\$10,000
		By-pass pumping	1	LS	\$10,000		\$10,000
		Abandonment of Existing Force Main	1	LS	\$5,000		\$5,000
		New Force Main - Subtotal					\$59,300
	Structural						
		Concrete Pump Pad Modifications	1	LS	\$5,000		\$5,000
	Process Mechanical						
		Existing Pump Demolition	1	LS	\$10,000		\$10,000
		Intermediate Pumps (3 - 12 HP pumps)	3	LS	\$107,000	30%	\$417,300
		Discharge Check Valves - 8"	3	EA	\$10,000	30%	\$39,000
		Pump Suction & Discharge 8" Gate Valve Replacements	8	EA	\$6,000	30%	\$62,400
		Process Piping Allowance	1	ALL	\$50,000		\$50,000
	Building Mechanical						
		N/A					
	Electrical/I&C						
		Intermediate Pump VFDs	3	EA	\$10,000		\$30,000
		Magnetic Flow Meter	1	LS	\$10,000		\$10,000
		Intermediate Pump Level Control System with back-up floats	1	LS	\$10,000		\$10,000
		Suction and Discharge Pressure Sensors	6	EA	\$1,000		\$6,000
		Pump Process Electrical	1	LS	\$10,000		\$10,000
		I&C Equipment and Integration Allowance	1	LS	\$10,000		\$10,000
		Lift Pump Replacement - Subtotal					\$659,700
						Construction Subtotal (Rounded)	\$719,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$108,000
		Mobilization/Demobilization	5%				\$36,000
		Bonds & Insurance	2%				\$14,000
						Total Construction Cost	\$877,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No: 21.129901		
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW		
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW		
802-860-1331		Biological Process Upgrade				Date: 1/3/2023		
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost	
Aeration Tank Structure								
	Site/Civil							
		Site Erosion Control	1	ALL	\$2,500		\$2,500	
		Excavation for Structures	1,920	CY	\$30		\$57,600	
		Site Dewatering	1	LS	\$10,000		\$10,000	
		Subbase	500	CY	\$55		\$27,500	
		Structural Backfill	460	CY	\$50		\$23,000	
		Demolition of Existing Aeration Tank	1	LS	\$50,000		\$50,000	
	Structural							
		Concrete Tank Slab	500	CY	\$1,200		\$600,000	
		Concrete Tank Walls	460	CY	\$1,400		\$644,000	
		Stairs	1	LS	\$20,000		\$20,000	
		Bridge/Walkway	490	SF	\$100		\$49,000	
		Aluminum Handrail	340	LF	\$100		\$34,000	
		Diversion Gates	2	EA	\$15,000		\$30,000	
	Process Mechanical							
		N/A						
	Building Mechanical							
		N/A						
	Electrical/I&C							
		N/A						
		Aeration Tank Structure - Subtotal						\$1,547,600
Biological Process								
	Site/Civil							
		N/A						
	Structural							
		N/A						
	Process Mechanical							
		Process Equipment Upgrade Including:						
		Mixing Equipment	2	EA	\$45,000	30%	\$117,000	
		Diffused Aeration System, includes:	1	LS	\$425,000	30%	\$552,500	
		PD Blowers (2)						
		Fine Bubble Aeration Grids (2 per train)						
		Modulating Plug Valves						
		Instrumentation (DO and ORP probes, air flow meters)						
		Process Piping & Valves	1	LS	\$100,000	30%	\$130,000	
		Air Piping & Valves	1	LS	\$100,000	30%	\$130,000	
	Building Mechanical							
		N/A						
	Electrical/I&C							
		Process Electrical, Instrumentation & Controls Installation	1	LS	\$50,000		\$50,000	
		Biological Process - Subtotal						\$979,500
Aeration Tank Effluent to Secondary Clarifiers								
	Site/Civil							
		New 18" DI&C Aeration Tank Effluent to Clarifier Influent Trough	125	LF	\$160		\$20,000	
		Trench Excavation	120	CY	\$40		\$4,800	
		Subbase - pipe bedding	20	CY	\$50		\$1,000	
		Structural Backfill Material	90	CY	\$50		\$4,500	
		Influent Sewer - Subtotal						\$30,300
						Subtotal (Rounded)	\$2,558,000	
Contractor Markups								
		Contractor Overhead & Profit	15%				\$384,000	
		Mobilization/Demobilization	5%				\$128,000	
		Bonds & Insurance	2%				\$51,000	
						Total Construction Cost	\$3,121,000	
Notes:								
1. ENR Construction Cost Index = 13174.98 (November 2022)								

Hoyle, Tanner		Town of Woodstock				Project No: 21.129901	
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW	
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW	
802-860-1331		Coagulant Chemical Feed Systems				Date: 2/16/2023	
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Coagulant Storage & Feed Systems							
	Site/Civil						
		New yard chemical piping to dosing points	300	LF	\$30		\$9,000
		Trench Excavation	180	CY	\$40		\$7,200
		Subbase - pipe bedding	30	CY	\$50		\$1,500
		Structural Backfill Material	140	CY	\$50		\$7,000
	Structural						
		Concrete Containment	1	LS	\$10,000		\$10,000
		New Overhead Doors	2	EA	\$10,000		\$20,000
		Structural Modifications to Existing Chemical Storage Areas	1	LS	\$10,000		\$10,000
		Finishes/Painting/Coatings	1	LS	\$10,000		\$10,000
	Process Mechanical						
		Coagulant Pump Skid ((3 Peristaltic Pumps, Skid Mount)	1	EA	\$20,000		\$20,000
		PVC Piping, Valves, Fittings, and Appurtenance Allowance	1	LS	\$25,000		\$25,000
		Storage Tanks	2	EA	\$15,000		\$30,000
		Storage Tank Level Detection Systems	2	EA	\$8,000		\$16,000
	Building Mechanical						
		Safety Shower and Eyewash	1	EA	\$5,000		\$5,000
		HVAC & Plumbing Improvements	1	LS	\$50,000		\$50,000
	Electrical/I&C						
		Chemical Storage Room Basic Electrical Rehabilitation	1	LS	\$30,000		\$30,000
		Chemical Storage Room Process Electrical Rehabilitation	1	LS	\$10,000		\$10,000
		Chemical Storage Room Instrumentation	1	LS	\$10,000		\$10,000
		<i>Coagulant Storage and Feed System - Subtotal</i>					\$270,700
						Construction Subtotal (Rounded)	\$271,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$41,000
		Mobilization/Demobilization	5%				\$14,000
		Bonds & Insurance	2%				\$5,000
						Total Construction Cost	\$331,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No:	21.129901	
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By:	KDW	
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By:	KDW	
802-860-1331		Secondary Clarifier Rehabilitation				Date:	1/3/2023	
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost	
Secondary Clarifier Rehabilitation								
	Site/Civil							
		N/A						
	Structural							
		Existing Clarifier Equipment Demo & Tank Cleaning	2	EA	\$10,000		\$20,000	
		Concrete Repair Allowance	1	LS	\$100,000		\$150,000	
	Process Mechanical							
		Lakeside Spiraflo Clarifiers (30-ft Diameter, 12' SWD)	2	EA	\$185,000	30%	\$481,000	
		o Drive Motor w/torque overload protection						
		o Full-span bridge/walkway						
		o Scraper arms						
		o Inlet trough, effluent weir trough, inlet pipe						
		o Scum pipe, skimmer arm, supports, blades, scum flush						
		o FRP Weirs						
	Electrical/I&C							
		Sludge Blanket Level Detectors	2	EA	\$10,000		\$20,000	
		Electrical, I&C Allowance	1	LS	\$20,000		\$20,000	
		Secondary Clarifier Rehabilitation - Subtotal						\$691,000
Clarifier House Rehabilitation								
	Site/Civil							
		N/A						
	Structural							
		Clarifier House - Upper Level Electrical Room Addition	200	SF	\$400		\$80,000	
		4' x 4' Access Hatch	1	EA	\$15,000		\$15,000	
		Roof Slab Rehabilitation	1	LS	\$25,000		\$25,000	
		Stairs Replacement	1	LS	\$25,000		\$25,000	
		Door Replacement	1	LS	\$5,000		\$5,000	
		Finishes (Paint)	1	LS	\$5,000		\$5,000	
	Process Mechanical							
		New Sump Pump	1	LS	\$5,000		\$5,000	
	Building Mechanical							
		HVAC Replacement Allowance	1	LS	\$75,000		\$75,000	
	Electrical/I&C							
		Clarifier Electrical Upgrades (2)	1	LS	\$10,000		\$10,000	
		New Electrical Panel	1	LS	\$3,000		\$3,000	
		Surge Protection	1	LS	\$5,000		\$5,000	
		Lighting Upgrades	1	LS	\$3,000		\$3,000	
		General Power Upgrades	1	LS	\$3,000		\$3,000	
		Security and Fire Detection	1	LS	\$0		\$0	
		Data & Communications	1	LS	\$0		\$0	
		Continuous Ventilation System for Pump Room	1	LS	\$4,000		\$4,000	
		Lightning Protection (150SF Roof)	1	LS	\$3,000		\$3,000	
		Miscellaneous Demolition	1	LS	\$2,000		\$2,000	
		Clarifier Building Instrumentation Installation	1	LS	\$5,000		\$5,000	
		Building PLC Panel & Wiring	1	LS	\$10,000		\$10,000	
		Clarifier House Rehabilitation - Subtotal						\$283,000
					Subtotal (Rounded)		\$974,000	
Contractor Markups								
		Contractor Overhead & Profit	15%				\$146,000	
		Mobilization/Demobilization	5%				\$49,000	
		Bonds & Insurance	2%				\$19,000	
					Total Construction Cost		\$1,188,000	
Notes:								
1. ENR Construction Cost Index = 13174.98 (November 2022)								

Hoyle, Tanner		Town of Woodstock				Project No:	21.129901	
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By:	KDW	
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By:	KDW	
802-860-1331		RAS/WAS System Rehabilitation				Date:	1/4/2023	
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost	
RAS System Rehabilitation								
	Site/Civil							
		New RAS Force Main to New Biological Process (4" Diameter DICL)	250	LF	\$50		\$12,500	
		Trench Excavation	230	CY	\$40		\$9,200	
		Subbase - pipe bedding	40	CY	\$50		\$2,000	
		Structural Backfill Material	170	CY	\$50		\$8,500	
		Abandonment of Existing RAS lines	1	LS	\$5,000		\$5,000	
		Yard valves with valve boxes & extension stem	1	LS	\$20,000		\$20,000	
	Structural							
		Pump Pad Modifications	2	EA	\$2,500		\$5,000	
	Process Mechanical							
		Demo Existing RAS Pumps	1	LS	\$10,000		\$10,000	
		New RAS Pumps	2	EA	\$30,000		\$60,000	
		VFDs	2	EA	\$5,000		\$10,000	
		Suction and Discharge Piping Modifications (inside Building)	1	LS	\$50,000		\$50,000	
		Check Valve Replacement (4")	2	EA	\$5,000	30%	\$13,000	
		Plug Valve Replacement (4")	8	EA	\$2,000	30%	\$20,800	
	Electrical/I&C							
		Magnetic Flow Meter for RAS Discharge	1	EA	\$10,000	30%	\$13,000	
		Electrical, I&C Allowance - (Conduit, wire, integration)	1	ALL	\$10,000		\$10,000	
		RAS System Rehabilitation - Subtotal						\$249,000
WAS System Rehabilitation								
	Site/Civil							
		New WAS Force Main to Sludge Holding Tanks (4" Diameter DICL)	150	LF	\$50		\$7,500	
		Trench Excavation	140	CY	\$40		\$5,600	
		Subbase - pipe bedding	30	CY	\$50		\$1,500	
		Structural Backfill Material	100	CY	\$50		\$5,000	
		Abandonment of Existing WAS lines	1	LS	\$5,000		\$5,000	
		Yard valves with valve boxes & extension stem	1	LS	\$20,000		\$20,000	
	Structural							
		Pump Pad Modifications	2	EA	\$2,500		\$5,000	
	Process Mechanical							
		Existing Pump Demolition	1	LS	\$10,000		\$10,000	
		New WAS Pumps	2	EA	\$25,000	30%	\$65,000	
		Suction and Discharge Piping Modifications (inside Building)	1	LS	\$50,000		\$50,000	
		Check Valve Replacement (4")	2	EA	\$5,000	30%	\$13,000	
		Plug Valve Replacement (4")	8	EA	\$2,000	30%	\$20,800	
	Building Mechanical							
		N/A						
	Electrical/I&C							
		Magnetic Flow Meter for WAS Discharge	1	EA	\$10,000	30%	\$13,000	
		Electrical, I&C Allowance - (Conduit, wire, integration)	1	ALL	\$10,000		\$10,000	
		WAS System Rehabilitation - Subtotal						\$231,400
						Subtotal (Rounded)	\$480,000	
Contractor Markups								
		Contractor Overhead & Profit	15%				\$72,000	
		Mobilization/Demobilization	5%				\$24,000	
		Bonds & Insurance	2%				\$10,000	
						Total Construction Cost	\$586,000	
Notes:								
1. ENR Construction Cost Index = 13174.98 (November 2022)								

Hoyle, Tanner		Town of Woodstock				Project No: 21.129901		
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW		
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW		
802-860-1331		Disinfection Alternative No. 1 - New Chlorine Contact Tank & Chemical Feed Systems				Date: 1/3/2023		
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost	
CCT Tank Structure								
	Site/Civil							
		Site Erosion Control	1	ALL	\$2,500		\$2,500	
		Excavation for Structures	1,160	CY	\$30		\$34,800	
		Site Dewatering	1	LS	\$10,000		\$10,000	
		Subbase	240	CY	\$55		\$13,200	
		Structural Backfill	200	CY	\$50		\$10,000	
		Demolition of Existing CCT	1	LS	\$50,000		\$50,000	
	Structural							
		Concrete Tank Slab	200	CY	\$1,200		\$240,000	
		Concrete Tank Walls	380	CY	\$1,400		\$532,000	
		Stairs	1	LS	\$20,000		\$20,000	
		FRP Grating	1620	SF	\$25		\$40,500	
		Aluminum Handrail	210	LF	\$100		\$21,000	
		Diversion Gates	2	EA	\$15,000		\$30,000	
		Effluent Weir	2	LS	\$5,000		\$10,000	
		Baffle Plate	2	LS	\$2,500		\$5,000	
	Process Mechanical							
		Effluent Sampler	1	LS	\$15,000		\$15,000	
		Process Piping & Valves	1	LS	\$25,000		\$25,000	
	Building Mechanical							
		N/A						
	Electrical/I&C							
		Heat Tracing	1	LS	\$10,000	30%	\$13,000	
		Ultrasonic Level Sensor for Effluent Q Measurement	2	LS	\$8,000		\$16,000	
		Chlorine Analyzer	2	LS	\$12,000		\$24,000	
		Process Electrical, Instrumentation & Controls Installation Allowance	1	ALL	\$15,000		\$15,000	
		<i>CCT Tank - Subtotal</i>						\$1,127,000
Chemical Storage & Feed Systems Rehabilitation								
	Site/Civil							
		New yard chemical piping to dosing points	300	LF	\$30		\$9,000	
		Trench Excavation	180	CY	\$40		\$7,200	
		Subbase - pipe bedding	30	CY	\$50		\$1,500	
		Structural Backfill Material	140	CY	\$50		\$7,000	
	Structural							
		Paint	1	LS	\$10,000		\$10,000	
		New Doors	2	EA	\$8,000		\$16,000	
	Process Mechanical							
		Chlorine Pump Skid ((2 Peristaltic Pumps, Skid Mount)	1	EA	\$17,000	30%	\$22,100	
		Dechlor Pump Skid ((2 Peristaltic Pumps, Skid Mount)	1	EA	\$17,000	30%	\$22,100	
		PVC Piping, Valves, Fittings, and Appurtenance Allowance	1	LS	\$25,000	30%	\$32,500	
	Building Mechanical							
		Safety Shower and Eyewash	2	EA	\$5,000		\$10,000	
		HVAC & Plumbing Improvements	1	LS	\$50,000		\$50,000	
		Storage Tank Level Detection Systems	2	EA	\$8,000		\$16,000	
	Electrical/I&C							
		Chemical Storage Room Basic Electrical Rehabilitation	1	LS	\$30,000		\$30,000	
		Chemical Storage Room Process Electrical Rehabilitation	1	LS	\$10,000		\$10,000	
		Chemical Storage Room Instrumentation	1	LS	\$10,000		\$10,000	
		<i>Chemical Storage and Feed System Rehabilitation - Subtotal</i>						\$253,400
Yard Piping to and from CCT								
	Site/Civil							
		New 24" DI/CL Clarifier Effluent to CCT & CCT to Effluent	80	LF	\$160		\$12,800	
		Trench Excavation	150	CY	\$40		\$6,000	
		Subbase - pipe bedding	30	CY	\$50		\$1,500	
		Structural Backfill Material	120	CY	\$50		\$6,000	
		<i>Yard Piping - Subtotal</i>						\$26,300
						Construction Subtotal (Rounded)	\$1,406,000	
Contractor Markups								
		Contractor Overhead & Profit	15%				\$211,000	
		Mobilization/Demobilization	5%				\$70,000	
		Bonds & Insurance	2%				\$28,000	
						Total Construction Cost	\$1,715,000	
Notes:								
1. ENR Construction Cost Index = 13174.98 (November 2022)								

Hoyle, Tanner		Town of Woodstock				Project No:	21.129901
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By:	KDW
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By:	KDW
802-860-1331		Disinfection Alternative No. 2 - New UV Disinfection System				Date:	1/3/2023
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
UV Building							
	Site/Civil						
		Site Erosion Control	1	LS	\$2,500		\$2,500
		Excavation for Structures	190	CY	\$30		\$5,700
		Site Dewatering	1	LS	\$10,000		\$10,000
		Subbase	40	CY	\$55		\$2,200
		Structural Backfill	100	CY	\$50		\$5,000
		Demolition of Existing CCT	1	LS	\$50,000		\$50,000
	Structural						
		Concrete for channels					
		Concrete Channel Walls	40	CY	\$1,400		\$56,000
		Concrete Channel Bottom	20	CY	\$1,200		\$24,000
		UV Building					
		UV Building (12' x 25')	300	SF	\$350		\$105,000
		Frost Wall Foundation	50	CY	\$1,400		\$70,000
		Concrete Slab	30	CY	\$1,200		\$36,000
		FRP Grating for Channels	60	SF	\$50		\$3,000
		Effluent Weir	1	LS	\$5,000		\$5,000
		Baffle Plate	1	LS	\$2,500		\$2,500
	Process Mechanical						
		Demolition of Existing Chemical Feed/Storage Facilities	1	LS	\$10,000		\$10,000
		Effluent Sampler	1	LS	\$15,000		\$15,000
		Process piping and valves	1	LS	\$25,000		\$25,000
	Building Mechanical						
		HVAC & Plumbing	1	LS	\$75,000		\$75,000
	Electrical/I&C						
		Ultrasonic Level Sensor for Effluent Q Measurement	1	LS	\$8,000		\$8,000
		UV Building Basic Electrical	1	LS	\$50,000		\$50,000
		UV Building Process Electrical	1	LS	\$15,000		\$15,000
		UV Building Instrumentation Installation	1	LS	\$10,000		\$10,000
		UV Building - Subtotal					\$584,900
UV Disinfection System							
		UV Disinfection System (3 banks - 2 duty, 1 standby)	1	LS	\$220,000	30%	\$286,000
		UV Disinfection System - Subtotal					\$286,000
Yard Piping to and from UV							
	Site/Civil						
		New 24" DI CL Clarifier Effluent to UV & UV to Effluent	80	LF	\$160		\$12,800
		Trench Excavation	150	CY	\$40		\$6,000
		Subbase - pipe bedding	30	CY	\$50		\$1,500
		Structural Backfill Material	120	CY	\$50		\$6,000
		Yard Piping - Subtotal					\$26,300
						Construction Subtotal (Rounded)	\$897,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$135,000
		Mobilization/Demobilization	5%				\$45,000
		Bonds & Insurance	2%				\$18,000
						Total Construction Cost	\$1,095,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No:	21.129901
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By:	KDW
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By:	KDW
802-860-1331		Plant Water System				Date:	1/3/2023
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Plant Water System							
	Site/Civil						
		N/A - Carried under Disinfection					
	Structural						
		Precast Concrete Tank (4,000 gals) for Plant Water Sump	1	LS	\$10,000		\$10,000
	Process Mechanical						
		Grundfos Hydro MPC 3CRE15-4 Pump Skid	1	LS	\$53,000	30%	\$68,900
		o Two (2) 7.5 hp pumps - 100 gpm @ 70 psi					
		o Control Panel with Integral VFDs					
		Process Piping, Valves, Fittings, and Appurtenance	1	LS	\$30,000		\$30,000
	Buidling Mechanical						
		N/A					
	Electrical/I&C						
		Plant Water Level Control System	1	LS	\$10,000		\$10,000
		Electrical, I&C Allowance	1	LS	\$10,000		\$10,000
		<i>Plant Water System - Subtotal</i>					\$128,900
						Subtotal (Rounded)	\$129,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$19,000
		Mobilization/Demobilization	5%				\$6,000
		Bonds & Insurance	2%				\$3,000
						Total Construction Cost	\$157,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No:	21.129901
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By:	KDW
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By:	KDW
802-860-1331		Solids Holding Facility Improvements				Date:	1/3/2023
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Solids Holding Improvements							
	Site/Civil						
		N/A					
	Structural						
		N/A					
	Process Mechanical						
		Floating Decanters for Sludge Holding Tanks	2	EA	\$50,000	30%	\$130,000
		Polymer Feed System	1	LS	\$35,000	30%	\$45,500
		Coarse Bubble Diffuser Replacement	2	EA	\$40,000	30%	\$104,000
		Process Piping and Valves	1	LS	\$50,000	30%	\$65,000
	Electrical						
		Sludge Blower VFDs (2)	1	LS	\$10,000		\$10,000
		Electrical Panels	1	LS	\$0		\$0
		Surge Protection	1	LS	\$5,000		\$5,000
		Lighting Upgrades	1	LS	\$7,000		\$7,000
		General Power Upgrades	1	LS	\$3,500		\$3,500
		Security and Fire Detection	1	LS	\$2,100		\$2,100
		Data & Communications	1	LS	\$2,100		\$2,100
		Lightning Protection (700SF Roof)	1	LS	\$7,000		\$7,000
		Misellaneous Demolition	1	LS	\$3,000		\$3,000
		Sludge Handling Process Instrumentation	1	LS	\$5,000		\$5,000
		Solids Holding Improvements - Subtotal					\$389,000
						Construction Subtotal (Rounded)	\$389,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$58,000
		Mobilization/Demobilization	5%				\$19,000
		Bonds & Insurance	2%				\$8,000
						Total Construction Cost	\$474,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No: 21.129901	
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW	
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW	
802-860-1331		Control Building Improvements				Date: 1/3/2023	
Process Area	Division/ Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Control Building Improvements							
	Site/Civil						
		N/A					
	Structural						
		Rehab of Office Area/Lab Area into separate areas	1	LS	\$50,000		\$50,000
		Laboratory - Fume Hood	1	LS	\$10,000		\$10,000
		Insulation of CMU Walls	1	LS	\$50,000		\$50,000
		Painting - Interior and Exterior	1	LS	\$50,000		\$50,000
	Process Mechanical						
		N/A					
	Buidling Mechanical						
		HVAC & Plumbing	1	LS	\$100,000		\$100,000
	Electrical/I&C						
		Process Equipment Electrical Upgrades	1	LS	\$25,000		\$25,000
		Electrical Panel Replacement (2)	1	LS	\$6,000		\$6,000
		Surge Protection	1	LS	\$5,000		\$5,000
		Lighting Upgrades	1	LS	\$25,000		\$25,000
		General Power Upgrades	1	LS	\$12,500		\$12,500
		Security and Fire Detection	1	LS	\$7,500		\$7,500
		Data & Communications	1	LS	\$7,500		\$7,500
		Continuous Ventilation System for Pump Room	1	LS	\$4,000		\$4,000
		Lightning Protection System (2000 SF Roof)	1	LS	\$18,000		\$18,000
		Miscellaneous Demolition	1	LS	\$4,000		\$4,000
		Operations Building PLC Panel & Wiring	1	LS	\$20,000		\$20,000
		SCADA Computer, software, and programming	1	LS	\$25,000		\$25,000
		<i>Control Building Improvements - Subtotal</i>					\$419,500
						Construction Subtotal (Rounded)	\$420,000
Contractor Markups							
		Contractor Overhead & Profit	15%				\$63,000
		Mobilization/Demobilization	5%				\$21,000
		Bonds & Insurance	2%				\$8,000
						Total Construction Cost	\$512,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							

Hoyle, Tanner		Town of Woodstock				Project No.: 21.129901	
125 College St., 4th Floor		Woodstock Main WWTF Upgrade PER				By: KDW	
Burlington, VT 05401		Engineer's Opinion of Probable Project Costs				CK By: KDW	
802-860-1331		Plant Drainage Pump Station & Site Improvements				Date: 1/3/2023	
Process Area	Division/Discipline	Description	Qty.	Unit	Unit Cost	Install	Total Cost
Plant Drainage Pump Station Upgrade							
	Site/Civil						
		New 12" ductile iron force main	160	LF	\$100		\$16,000
		Trench Excavation	240	CY	\$40		\$9,600
		Subbase - pipe bedding	50	CY	\$55		\$2,800
		Structural Backfill Material	180	CY	\$50		\$9,000
		Abandonment of existing 8" force main	1	LS	\$5,000		\$5,000
	Structural						
		Wetwell Improvements					
		Grout fill to raise invert	10	CY	\$1,200		\$12,000
		Concrete repair	1	LS	\$25,000		\$25,000
		New grating	1	LS	\$10,000		\$10,000
		New trash baskets	2	EA	\$2,000		\$4,000
		New misc. metals	1	LS	\$5,000		\$5,000
		New winches	2	EA	\$2,000		\$4,000
		Weatherproof Enclosure	1	LS	\$20,000		\$20,000
	Process Mechanical						
		Existing Pump Demolition	1	LS	\$5,000		\$5,000
		New Stormwater Dewatering Pumps (2)	2	EA	\$27,000	30%	\$70,200
		Process piping and valves	1	LS	\$30,000	30%	\$39,000
	Building Mechanical						
		N/A	1	LS	\$85,000		\$85,000
	Electrical/I&C						
		Intermediate Pump Level Control System with back-up floats	1	LS	\$10,000		\$10,000
		Pump Process Electrical	1	LS	\$10,000		\$10,000
		Plant Drainage Pump Station Upgrade - Subtotal					\$341,600
	Site						
	Site/Civil						
		New Chain-Link Security Fence	1300	LF	\$60		\$78,000
		New Security Gate - 24' wide	1	EA	\$15,000		\$15,000
		Process Yard Piping & Valve Allowance	1	LS	\$50,000		\$50,000
		Chemical Yard Piping Allowance	1	LS	\$20,000		\$20,000
		Yard Hydrants for Plant Water System	4	EA	\$7,500		\$30,000
		Cold Planing Existing Pavement	2000	SY	\$5		\$10,000
		New Pavement (3")	340	TON	\$164		\$55,800
		Pavement Subbase of Gravel, Fine Graded	1000	CY	\$50		\$50,000
		Site Restoration	1	LS	\$25,000		\$25,000
	Structural						
		N/A					
	Process Mechanical						
		N/A					
	Building Mechanical						
		HVAC Replacement in Maintenance Garage	1	LS	\$50,000		\$50,000
	Architectural						
		N/A					
	Electrical/I&C						
		Generator Building PLC Panel & Wiring	1	LS	\$10,000		\$10,000
		Maintenance Garage Electrical Upgrades	1	LS	\$15,000		\$15,000
		Electrical Site Work - Conduit & Wire	1	LS	\$15,000		\$15,000
		Site Lighting Rewiring	1	LS	\$5,000		\$5,000
		Fiber Optic Network Equip w/underground	1	LS	\$20,000		\$20,000
		Site - Subtotal					\$449,000
							Construction Subtotal (Rounded)
							\$791,000
	Contractor Markups						
		Contractor Overhead & Profit	15%				\$119,000
		Mobilization/Demobilization	5%				\$40,000
		Bonds & Insurance	2%				\$16,000
							Total Construction Cost
							\$966,000
Notes:							
1. ENR Construction Cost Index = 13174.98 (November 2022)							