TRI-TOWN JOINT REVIEW COMMITTEE MEETING

May 15, 2024
10:00 AM-11:00 AM

<u>MEETING LOCATION:</u> Via MS Teams

Agenda

1. Review and Approval of 2/15/24 meeting minutes
2. High Strength waste surcharge policy-discussion with Randy
   a. Magic Mann example-how to hold responsible for sampling before waste hauled to WWTF
3. Tri-town Allocation policy?
4. Digester update
5. 10-year evaluation progress report
6. Flexible Load Management Pilot #2
7. Next meeting date: Wed, Aug 21, 2024 10 AM-11AM

TRI-TOWN JOINT REVIEW COMMITTEE
MEETING MINUTES
February 15, 2024
10:00 AM-11:00 AM
MS Teams

In attendance: Bruce Hoar, Chelsea Mandigo, Jess Morris, Aaron Martin, Annie Costandi, Regina Mahony, Kendall Chamberlin

1. **Draft meeting minutes from November 30, 2023, approval**
    a. Annie made a motion to accept the minutes as drafted, Aaron second. Approved.
2. **FYE 2023 Reconciliation**
    a. The rate stabilization fund summarized by municipality was reviewed. Like previous years, no refunds were given to any of the municipalities.
    b. Kendall asked, Has the City been able to move accounts to high interest accounts? Jess responded not yet, but the reserve fund has a higher interest rate, so balances are being kept there.
3. **FY 2024 Budget update**
    a. The December and January budget summaries were reviewed. We are 58% of the way through the budget year. Wastewater is tracking right on course with 57% of budget.
    b. Jess asked if the Tri-town wanted to be added to the monthly email budget report. The group answered yes.
4. **FY 2025 Wholesale Rate**
    a. Jess reviewed the estimated Wholesale Rate determination spreadsheet for FY25 which is 4.194/1,000 gallon treated, representing a 1.2% increase from last year.
    b. Essex Jct led a discussion regarding the high amount of infiltration and inflow (I&I) to the facility since December 18, 2023, storm. The total effluent flow for the facility in December (88 MG) and January (79 MG) has been 20 Million Gallons above normal monthly average (60 MG).
        i. Since Dec 2023, Essex Town has had an issue with their Maple St flow meter artificially rising their flow total to the facility. This issue would influence the total flow of effluent leaving the facility.
        ii. A discussion occurred around how the flow to the WWTF is accounted for as a Tri-town and how a disproportionate amount of I&I is falling on to the Essex Junction percent of flow.
            1. Essex Town and Williston sending flow reports monthly. Essex Junction flow= total effluent flow for month-Essex Town-Williston.
            2. 2023 was a wet year, resulting in a significant increase of I&I in the collection systems. Looking at the data it is artificially raising Essex Junction flows and influencing projected sewer user rates. The upcoming FY25 is increasing 1.3% overall but the sewer rates are projected to increase 11.6%.
            3. Essex Junction asked the group if there would be consideration for adjusting I&I portion of the flow to be more equitable given the wet year. Williston said no since their flow is accounted for with one

metered inlet to the Essex Junction system. Essex Town said they would be open to a conversation since their flow has multiple entry points and not all metered.

   iii. A discussion occurred on how each community investigates I&I in their collection systems, including known problem areas and potential remedies being pursued.

5. **RFP for TV of sewer lines**
   - **a.** Is there was interest in conducting a joint RFP for camera services for a Tri-town I&I investigation? May result in better group pricing. Williston said you do not need someone that is certified pipe inspector and could go with one of the local wastewater hauling companies that has camera equipment which could result in cost savings.
6. **2023 Phosphorus Optimization Annual report**
   - a. The report was reviewed. This is an annual report due to the State as part of the permit for the facility. The facility was as high as 71% of the annual phosphorus load allocation but brought the number back down 54% by end of the year through optimization techniques.
7. **High Strength Waste Surcharge policy**
   - a. The group reviewed the policy with the comments/edits from the 11/30/23 meeting incorporated.
   - b. A discussion and edits occurred focusing on how to further adjust the language to reflect a policy and not an ordinance. Each community has their own sewer ordinance which we can reference in this policy.
   - c. A BOD allocation/municipality has not been set or discussed. The facility is currently under a 10-year evaluation where the BOD treatment capacity will be examined and then the allocation/municipality can be determined and discussed.
8. **Next meeting is 5/15/24.**
   - a. Agenda items
     - i. High Strength Waste Policy
     - ii. 10-year evaluation study
     - iii. I&I discussion

<u>**Adjourned**</u>: 10:45 AM

Respectfully submitted.
Chelsea Mandigo, Water Quality Superintendent

CITY OF ESSEX JUNCTION
TOWN OF ESSEX
and
TOWN OF WILLISTON

PROCEDURE
for the
CONTROL OF HIGH STRENGTH WASTES AND WATER DISCHARGES
and
SURCHARGES FOR INDUSTRIAL AND COMMERCIAL DISCHARGES

Part I

A. Purpose

The purpose of this Procedure is to:

1. Establish a process to review and control the discharges that contain high strength wastes or waters, or other regulated pollutants from industrial and commercial processes which may adversely impact the treatment process or the sludge (biosolids) at the City of Essex Junction Wastewater Treatment Facility (WWTF) via the Town of Essex, Town of Williston (Town(s)), and the City of Essex Junction (City) collection systems and to ensure that use of the WWTF is sustainable and maximized.

2. Establish a methodology to recover the costs associated with the treatment and the disposal of byproducts from high strength wastes and waters or other regulated pollutants discharged from industrial and commercial processes into the WWTF via the Towns' and City's collection systems.

B. Background

The Essex Junction WWTF has a finite capacity to process the organic pollutants in the wastewater it treats. The design volume and organic treatment capacity of the WWTF is based on the organic pollutant concentrations in typical domestic strength sewage.

The discharge of wastes or waters into a wastewater treatment facility from industrial or commercial process that have organic pollutant concentrations higher than typical domestic sewage consumes excessive organic treatment capacity and significantly increases the operational costs at the treatment facility and to the other system users inequitably and can cause upsets to the treatment process and violations the terms and conditions of the treatment facility's NPDES Discharge Permit.

The Essex Junction WWTF authorized to discharge into the Winooski River under the terms and conditions of Discharge Permit No. 3-1254 and currently has a permitted capacity to treat and discharge an annual average of 3.3 million gallons of per day of wastewater and has an organic treatment capacity to treat a monthly average influent loading o4,616 ounds per day of Biochemical Oxygen Demand.

Table 3.1
Influent Hydraulic/Organic Loadings

Influent Parameters	2012 Design Criteria
Flow	
Average Daily (1)	3.3 mgd
Peak Daily	6.6 mgd
Peak Hourly (2)	6.6 mgd
Biochemical Oxygen Demand (BOD_5) (3)	205 mg/l 4,616 lbs/day
Total Suspended Solids (TSS) (3)	199 mg/l 4,481 lbs/day
Total Kjeldahl Nitrogen (TKN)	40 mg/l
Total Phosphorus (TP)	7 mg/l

The Three-Party Agreement On Sewage Treatment (as Revised) identifies the allocation of treatment capacity of the WWTF between the Towns and the City.

In addition, the uncontrolled discharge of excessive concentrations of other regulated pollutants into a wastewater treatment facility such as heavy metals, volatile organic compounds, ammonia etc. can adversely impact the proper operation of the treatment facility. These impacts can include negatively affecting the biological treatment process and causing an operational upset, excessive pollutant accumulation in the biosolids, and effluent violations. These adverse impacts can result in a wastewater treatment facility incurring excessive operational costs to remediate the treatment process, to dispose of the biosolids, and to rectify potential violations of the effluent limitations.

C. Determination of High Strength Waters or Wastes
For the purposes of this Procedure a discharge of high strength waste or water is defined as a discharge to a collection system into the Essex Junction WWTF which has a reasonable potential to routinely exceed the following characteristics:

i. an average five (5) day Biochemical Oxygen Demand (BOD) concentration greater than 300 mg/l; or
ii. an average Total Suspended Solids (TSS) concentration greater than 300 mg/l; or
iii. an average Total Phosphorus (TP) concentration greater than 10 mg/l; ~~or~~
iv. an average Total Kjeldahl Nitrogen (TKN) of greater than 50 mg/l

D. Applicability to High Strength Wastes or Waters
This Procedure applies to the discharge of high strength wastes or waters from industrial or commercial processes or similar strength wastes including hauled wastes received from outside of the service area and processed as septage under the Essex Junction allocation.

This Procedure shall be applied to industrial or commercial discharges which have a reasonable potential to contain a daily average BOD loading (pounds) greater than **3%** of the organic (BOD) treatment capacity allocated to each party based on the pollutant concentration and flow.

The concentration of the pollutants in a discharge, the volume (flow) of a discharge, the frequency of a discharge, the rate of a discharge, and the impacts of the discharge at the Essex Junction WWTF over time shall be considered in applying this Procedure.

The City and Towns may allow flexibility within their respective organic capacity at their discretion but shall not exceed their proportional share of organic loading at the time of connection approval.

This Procedure shall not apply to discharges of residential wastewater or other discharges similar to typical domestic sewage strength unless a home or home business is found to be a significant contributor to a pollutant of concern.

Part II

A. Operation and Maintenance Surcharge
This Procedure establishes a surcharge on the discharge of significant high strength wastes and waters into the Essex Junction WWTF to offset the additional operational and maintenance costs and the additional biosolid disposal costs incurred at the WWTF caused by the treatment of these high strength wastes or waters and establishes an equitable and feasible method to recover these costs.

B. Authority
24 V.S.A. Sections 3615 and 3617 authorizes municipalities to establish "sewer disposal charges" including charges based upon "variable operations and maintenance costs" and the "strength and flow where wastes stronger than household are involved". The City and Towns sewer use ordinances have conditions which enable the municipality to charge for the discharge of waters or wastes stronger than typical domestic (household) wastes.

C. Applicability
Surcharges shall only be applied to industrial or commercial discharges of high strength waters or wastes which have a reasonable potential to contain a daily average BOD loading (pounds per day) greater than 3% of the organic (BOD) treatment capacity allocated to each party.

D. Implementation of Operational and Maintenance (O&M) Surcharges

1. **Operational and Maintenance (O&M) Surcharge Cost Allocation Factors**
   The O&M surcharge shall be based on the cost incurred by the City at the WWTF to treat the high strength wastes or waters and to dispose of the additional biosolids generated in treatment process.

   The O&M Surcharge shall be based upon the following pollutant discharged during billing period:

   a. pounds of Biochemical Oxygen Demand (BOD)
   b. pounds of Total Suspended Solids (TSS)
   c. pounds of Total Phosphorus (TP)
   d. pound of Total Kjeldahl Nitrogen (TKN)

   The cost breakdown of the O&M surcharge shall be:

   a. 60% Biochemical Oxygen Demand (BOD)
   b. 15% Total Suspend Solids (TSS)
   c. 15% Total Phosphorus (TP)
   d. 10% Total Kjeldahl Nitrogen (TKN)

The determination of the unit cost per pound of each pollutant treated shall be based on computing the cost of the per pound of the pollutant treated or removed as determined by the annual recorded operational and maintenance costs at the WWTF and the annual pounds of the pollutants treated or removed by the WWTF.

This cost shall then be applied to the pounds of the pollutant contributed into the WWTF by the high strength discharge.

The District shall annually re-evaluate this cost factor to the reflect the current costs incurred by the City at the WWTF to treat the high strength water or waste and to dispose of the additional biosolids generated due to the high strength water or waste. These costs will be prepared annually in the budget process and shall serve as the basis for the surcharge in the upcoming year.

2. **Determination of Flow, Pollutant Concentration, and Loading**

The O&M Surcharge shall be based on the measured or estimated pounds of pollutants discharged (loading) into the WWTF.

The determination of flow (volume) shall be based on metered measurements as determined by the Town or City capacity values. Sewer meter readings shall be considered more reliable than water meter readings. Adjustments may be allowed for liquid that is added or taken from the industrial or commercial process which may or may not enter the discharge. Any flow adjustments granted must be measurable and approved by the Towns.

The concentration of pollutants in a discharge shall be based on the representative sampling of the wastewater before it enters the collection system. Samples shall be collected at a location approved by the City and/or Town and shall representative of the entire operational day.

The pounds of pollutants in a discharge shall then be derived based on the flow discharged and the concentration of pollutants measured in the wastewater.

The pound of pollutants discharge shall be calculated using the formula:

Pounds of Pollutant = Flow (MGD) x Pollutant Concentration (mg/L) x 8.34 pounds per gallon

The City and/or Towns shall have the option of conducting periodic sampling and flow measurements to ensure that representative sampling and flow measurements are being conducted and to confirm that the pounds of pollutants being computed is accurate.

The customer shall have the primary responsibility for conducting the sampling and flow measurements on a regular basis to determine the pounds of pollutants discharged into the collection system. All costs associated with sampling, measurements, and reporting shall be the responsibility of the customer, unless waived by the Town or the City.

For discharges regulated under this Ordinance, the customer shall submit a report of the sampling results to the applicable Town and to the WWTF via email.

For discharges regulated by Pretreatment Discharge Permits issued by the Agency of Natural Resources, the monthly WR-43 Discharge Monitoring Report shall be used to derive the O&M Surcharge.

3. **Industries to Monitor Their Own Discharge**

All industries and commercial facilities discharging into a public sewer shall perform any monitoring of their discharges as the Towns or City may reasonably require, including installation, use, and maintenance of monitoring equipment, keeping records, and reporting the results of such monitoring to the Towns or City.

Records shall be made available, upon request, to the Towns or City and to other agencies having jurisdiction over the discharge. Where pretreatment discharge permits are issued by the State of Vermont, monitoring records shall also be submitted to the State in accordance with such permit. Records of any monitoring may be supplied by the Town or City to the State on request.

All measurements, tests and analyses of the characteristics of waters and wastes which are required by Towns or City shall be determined in accordance with the latest edition of "Standard Methods of the Examination of Water and Wastewater" published by the American Public Health Association.

Samples shall be collected at a sampling manhole or representative location. In the event that no sampling manhole has been required, or representative location available, the sampling manhole shall be considered to be the nearest downstream manhole in the public sewer from the point at which the building sewer is connected.

Sampling shall be carried out by qualified personnel by customarily accepted methods to reflect compliance with current municipal and Vermont Occupational Safety and Health standards

Any discharger held in violation of the provisions of this ordinance may have its disposal authorization terminated and may be assessed penalties by the Town or City, as permitted by law.

4. **Sampling Plan**

To determine the pounds of pollutants in a discharge, commercial and industrial customers subject to this Amendment shall prepare a Sampling Plan unless waived by the Town and WWTF staff.

The Sampling Plan shall be submitted to the Town and WWTF staff for review and approval prior to implementation. Pollution prevention measures shall be described, accompanied by plans and other documents to enable comprehensive review.

The Sampling Plan shall include but is not limited to identifying the methodology to measure flow, the minimum frequency of sampling the effluent, the sampling location, sample collection methodology, the parameters for analysis, and the protocol to process samples and reporting results to the Town and to the WWTF.

Samples shall be flow proportioned whenever feasible and shall be representative of the volume and quality of effluent discharged into the sewer collection system over the sampling and reporting period. All samples shall be taken during normal operating hours over the production day. The Town in conjunction with WWTF staff shall determine the appropriate composite sample duration or whether a grab sample or grab samples should be taken.

All measurements, tests, and analyses of the characteristics of waters and wastes which are required by the Town or City shall be determined in accordance with the latest edition of "Standard Methods of the Examination of Water and Wastewater" published by the American Public Health Association.

Part IV

Changes in Discharge
Any user discharging high strength waters or wastes to the Essex Junction WWTF and that is subject to this Procedure shall provide the Town and the WWTF staff 45-calendar day's prior notification of any of the following changes in writing:

1. any proposed substantial change in the volume, loading, or type of pollutants discharged to the WWTF.

2. any anticipated facility expansions, production increases, or process modifications which will result in new, different, or increased discharges of pollutants to the WWTF.

Part V

Applicability to Discharges of Metals and Other Regulated Pollutants
The uncontrolled or excessive discharge of metals or other regulated pollutants into a wastewater treatment facility can adversely impact the proper operations of treatment facility or the biosolids generated during the treatment process. These adverse impacts can result in a wastewater treatment facility incurring excessive operational costs to remediate the treatment process or disposal of the biosolids

The Essex Junction WWTF has experienced high concentrations of zinc in the biosolids generated as part of the wastewater treatment process. To ensure that the quality of the biosolids and the wastewater treatment process are protected, as directed by federal regulations (40 CFR Part 403.2), during the connection approval process for any new or increased industrial or commercial discharge into the WWTF having a reasonable potential to contain concentrations or loadings of zinc or other similarly regulated pollutant measurably greater than typical domestic sewage, WWTF staff shall be consulted.

Based on the pollutant concentrations and flow of the new or increased discharge, the Towns or City after consultation with the WWTF staff, may approve, deny, or require treatment to control or remove zinc or the other similar pollutants from the discharge as part of the connection review process.

Existing discharges which are identified to have a reasonable potential to contain concentrations or loadings of zinc or other similarly regulated pollutants that are measurably greater than typical domestic sewage may be required to reduce, control, or treat their discharge as mandated by the Towns or City after consultation with WWTF staff to prevent excessive pollutant accumulation in the biosolids, protect the WWTF treatment process, and/or prevent effluent violations.

Any additional costs incurred at the WWTF to dispose of biosolids which contains excessive zinc or other regulated pollutants, to remediate the WWTF treatment process, or to correct effluent violations due to an identified existing discharge shall be addressed through the Towns or City to the satisfaction of the District.

Date ____

____

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1. INTRODUCTION

1.1. Background

This facility was upgraded to secondary treatment in 1990, and the Village completed major upgrades at the wastewater treatment facility in 2011-12 and 2017-18. As some of the major structures, process equipment and mechanical/electrical systems are now approaching almost 30 years old, the Village wanted to evaluate the future needs. In addition, the Village has been working with Resource Management, Inc. (RMI) on the Shincci sludge dryer and wants to evaluate making this set up more permanent to better manage the future sludge disposal costs. This upgrade study is being funded by the Village and is not utilizing any State Clean Water planning funds.

1.2. Scope of Study

Since this last upgrade was completed about 10 years ago, the operations staff has identified several items to be evaluated for this 10-year planning study:

- Liquid Stream
    - Headworks/septage receiving: odor control
    - Gravity flow/EQ tank modifications
    - Nitrification/alkalinity recovery
    - New aeration tank(s)
    - Secondary clarifier flow split
    - Pephlo P removal
    - Ultraviolet disinfection
- Solids Train
    - Sludge dewatering
        - Centrate management strategies
        - Solids management – Screw press
    - Drying bed for pump station cleaning
- Cogeneration
    - Engine and gas conditioning system
- Buildings
    - Cold storage for equipment

2. EXISTING CONDITIONS

2.1. History

The last major upgrade project was completed In 2013-14, and included the following major components:

- Liquid Stream
  - Headworks upgrades
  - Primary clarifiers upgrades
  - Addition of new anaerobic selectors and upgrades to two aeration tanks
  - Addition of a third secondary clarifier and upgrades to two secondary clarifiers
  - New filter building containing three (3) new cloth media filters
  - Repurpose of the filter building to chemical feed and storage
- Solids Train
  - Anaerobic digestion upgrades
  - New sludge dewatering building containing sludge pumping, centrifuge, and sludge conveyors

2.2 Condition of Existing Facilities

For the items evaluated for this 10-year upgrade study, more detail on the condition is provided in the Project Need under Section 4.0.

3. OPERATING DATA

3.1 Basis of Design

Prior to the 2013-14 upgrade, a Basis for Final Design was prepared and the influent design criteria is summarized below. This design criteria is from 1982 and for the Biochemical Oxygen Demand (BOD_5) and Total Suspended Solids (TSS) organic loadings, was carried forward for the upgrade. The influent design conditions are summarized below in Table 3.1.

Table 3.1
Influent Hydraulic/Organic Loadings

Influent Parameters	2012 Design Criteria
Flow	
Average Daily (1)	3.3 mgd
Peak Daily	6.6 mgd
Peak Hourly (2)	6.6 mgd
Biochemical Oxygen Demand (BOD_5) (3)	205 mg/l 4,616 lbs/day
Total Suspended Solids (TSS) (3)	199 mg/l 4,481 lbs/day
Total Kjeldahl Nitrogen (TKN)	40 mg/l
Total Phosphorus (TP)	7 mg/l

Notes:
1. The original 1982 basis of design was based on the average daily flow of 2.75 mgd and peak flow of 6.0 mgd.
2. The peak hourly flow is after the post equalization tank.
3. The concentrations from the 1982 basis of design were used to calculate the lbs/day at the higher average daily flow of 3.3 mgd.

3.2 Permit Limitations

The current permit limitations under Discharge Permit No. 3-1254 are summarized in Table 3.2. This Permit is dated August 24, 2022 and expires on June 30, 2026.

Table 3.2
Permitted Effluent Limitations

Effluent Characteristics	Annual Limits	Monthly Average	Weekly Average	Maximum Day	Instantaneous Maximum	Instantaneous Minimum	% Removal Minimum
Flow (Annual Average) (MGD)	3.3	---	---	---	---	---	---
Biochemical Oxygen Demand (BOD_5) (mg/L) (lbs/d)	---	30 688	45 1032	50	---	---	85
Total Suspended Solids (TSS) (mg/L) (lbs/d)	---	30 688	45 1032	50	---	---	85
Total Phosphorus (TP) (lbs) (mg/L)	2008	0.8	---	---	---	---	---
Settleable Solids (mL / L)	---	---	---	---	1.0	---	---
E. Coli (# /100 mL)	---	---	---	---	77	---	---
pH	---	---	---	---	8.5	6.5	---
Chlorine, Total Residual (mg/L)	---	---	---	---	0.1	---	---
Ultimate Oxygen Demain (BOD) (lbs/d)	---	1820	---	---	---	---	---

3.3 Flow

3.1.1 Influent

The average daily influent flow from January 2021 through December 2023 was 1.86 mgd and highest peak day flow recorded was 10.04 mgd on multiple days. It is likely that this flow is the limit of the influent measurement device .

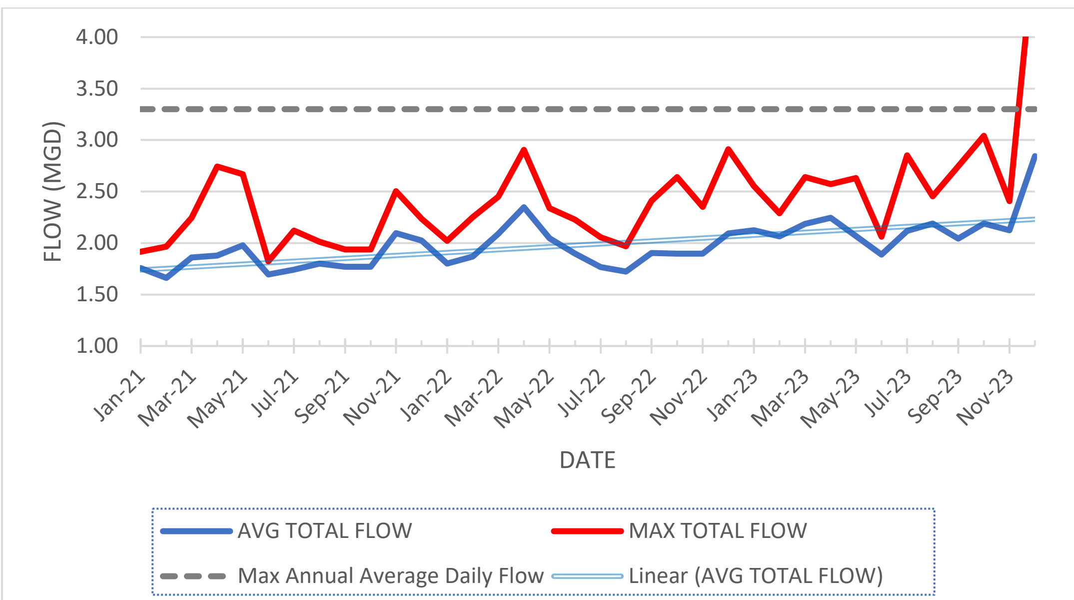
An average of 6,243 gallons of septage are received daily, and is input upstream of the existing Headworks structure.

3.1.2 Effluent

The permitted annual average flow is 3.3 mgd and the effluent flows from January 2021 through December 2023 are summarized in Figure 3.1. For this evaluation period, the average daily flow was 1.98 mgd or 60% of the permitted annual average flow. There was a slight increase from 2021 to 2022 of 1.84 mgd to 1.94 mgd from the new development occurring in Essex Jct., Essex Town, and Williston. As expected in 2023, the average flow increased to 2.17 mgd from the significant wet weather conditions and should decrease as we return to normal weather conditions.

A maximum peak daily flow of 4.92 mgd was recorded on December 12, 2023, during a significant rainfall and snowmelt event. Even with the excessive wet weather conditions from July to December 2023, the peak daily flow is typically less than 3.0 mgd or about 45% of the design peak daily flow. This about 150% of the average daily flow, well below the typical peaking factor of 200% used for most facilities.

Figure 3.1 - Effluent Flow



3.4. Biochemical Oxygen Demand (BOD_5)

3.4.1 Influent

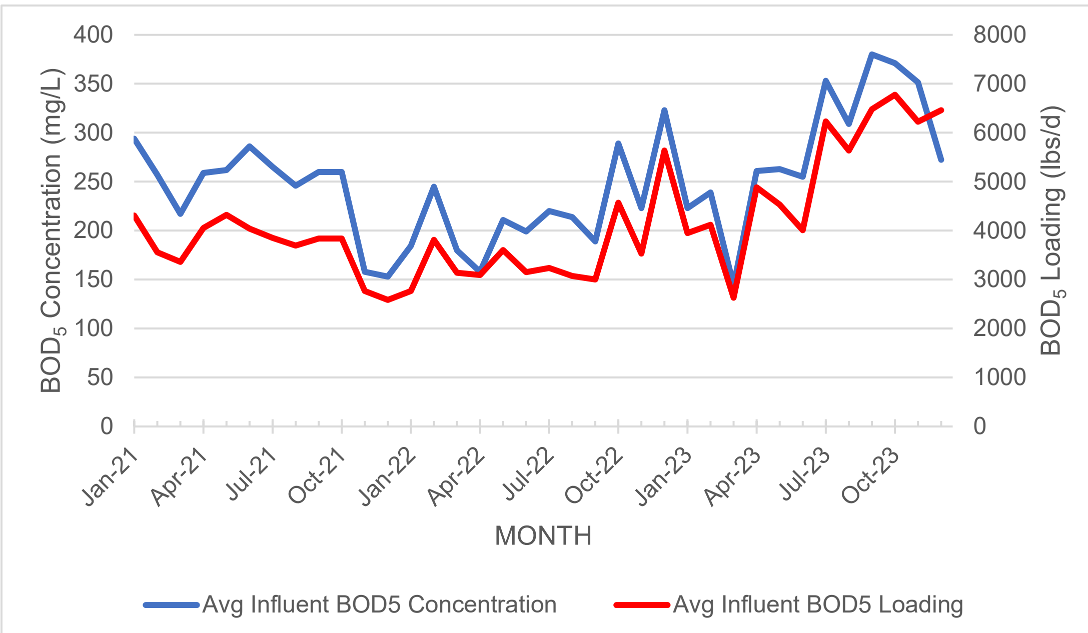
In the Basis for Final Design prepared for the latest upgrade, the influent biochemical oxygen demand ($BOD_{5)}$ loading remained at 4,616 lbs/day and was based on an original concentration of

205 mg/l at a flow of 2.75 mgd. At the design flow of 3.3 mgd, the average concentration would be 170 mg/l which is lower than the recommended BOD_5 design for this type of municipal wastewater facility.

For the evaluation period of January 2021 through December 2023, the BOD_5 loading averaged 4,133 lbs/day or 88% of the design loading and changed very little from 2021 to 2022. A significant increase in BOD_5 averages occurs after April 2023 with a high of 6,776 lbs/day.

At the average daily flow of 1.94 mgd, the concentration would be 237 mg/l, slightly higher than the original design concentration of 205 mg/l.

Figure 3.2 – Influent BOD_5

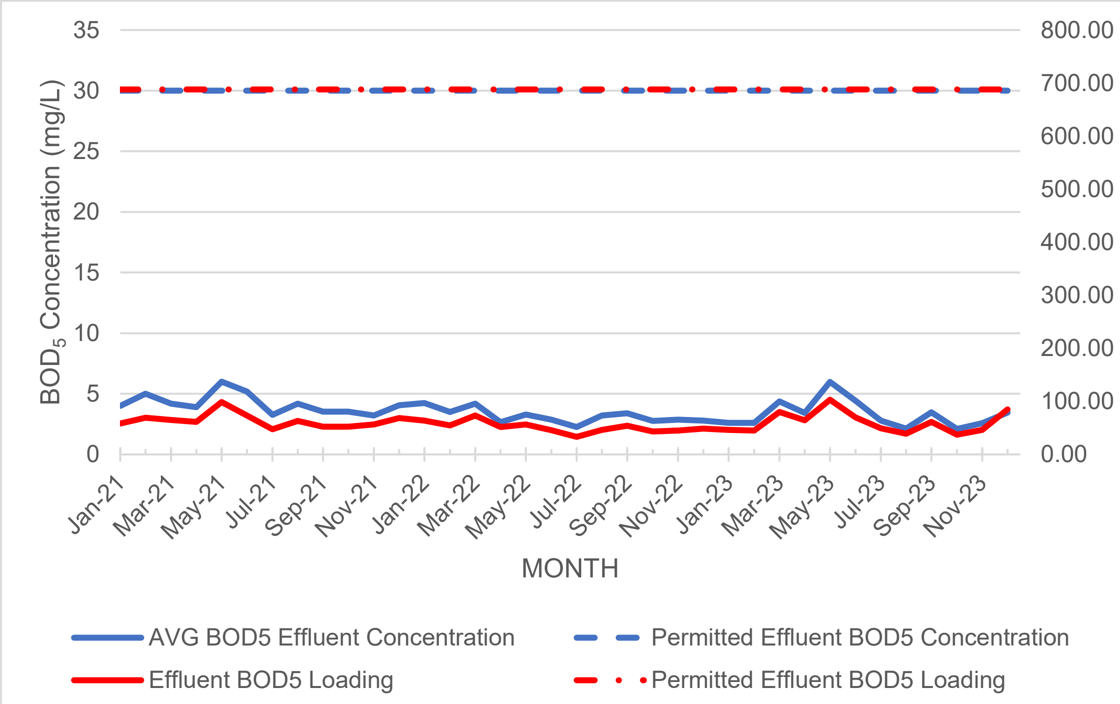


3.4.2 Effluent

Even though the influent concentrations for BOD_5 are higher than the original design criteria, this facility continues to perform very well, achieving excellent removals. These results are substantiated by the very low effluent BOD_5 concentrations which are consistently less than 5 mg/l. For the evaluation period of January 2021 through August 2023, the effluent monthly average concentration was 3.56 mg/l, about 12% of the effluent permit limit of 30 mg/l.

The permit limit for the monthly average BOD_5 loading is 688 lbs/day and for this evaluation period the average is 58.7 lbs/day, approximately 8.5% of the limit. The highest monthly average was recorded in May 2023 at 103.07 lbs/day, significantly below the permit limit.

Figure 3.3 – Effluent BOD_5



3.5 Total Suspended Solids (TSS)

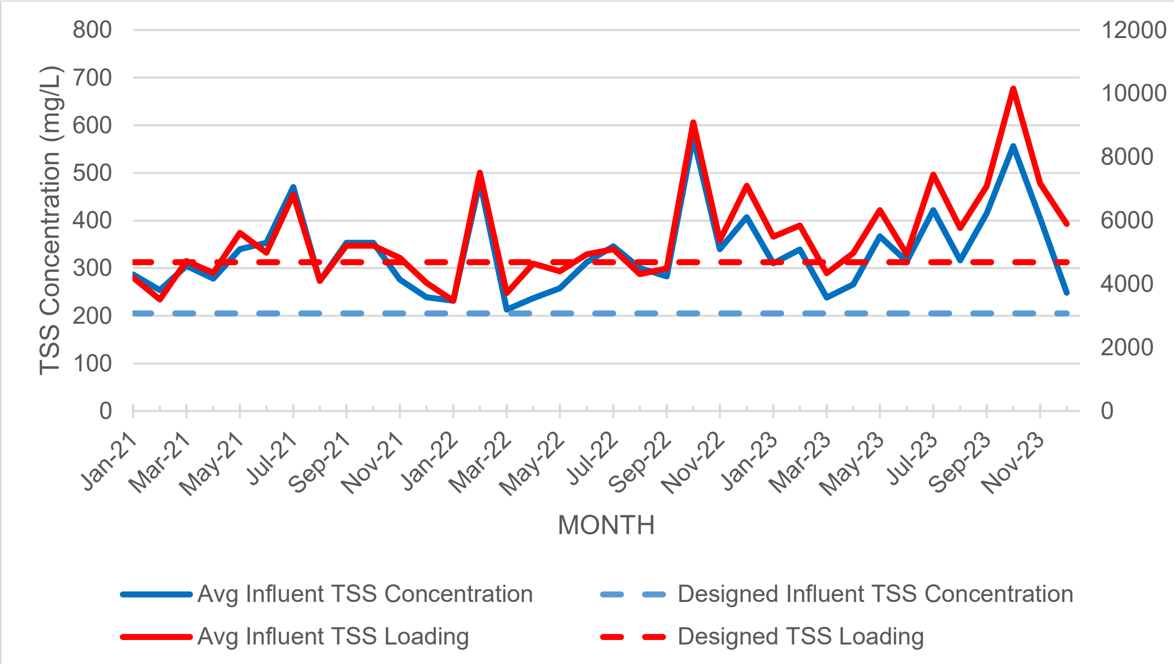
3.5.1 Influent

In the Basis for Final Design prepared for the latest upgrade, the influent total suspended solids (TSS) loading remained at 4,481 lbs/day and was based on an original concentration of 199 mg/l at a flow of 2.75 mgd. At the design flow of 3.3 mgd, the average concentration would be 166 mg/l which is lower than the recommended TSS design for this type of municipal wastewater facility.

For the evaluation period of January 2021 through December 2023, the TSS loading averaged 5,478 lbs/day or 117% of the design loading, and increased about 10% from 2021 to 2022, then further increased to 5,642 lbs/day in 2023.

At the average daily flow of 1.94 mgd, the concentration would be 237 mg/l, slightly higher than the original design concentration of 199 mg/l.

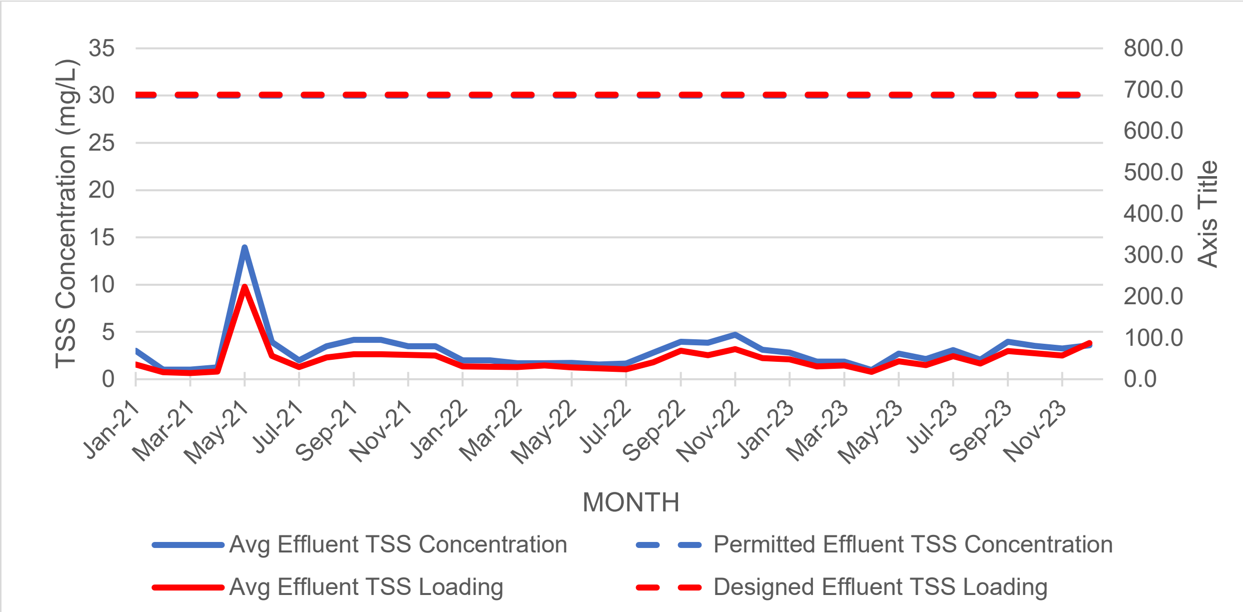
Figure 3.4 – Influent TSS



3.5.2 Effluent

Effluent TSS concentrations averaged 2.99 mg/L with a significant spike in May 2021 to 13.95 mg/L. The monthly TSS loading average also experienced a high average during this month to 223 lbs/day compared to its average of 48.8 lbs/day. Even with this event, the effluent TSS averages average well below the 10% of the permitted limits of 30 mg/L and 688 lbs/day.

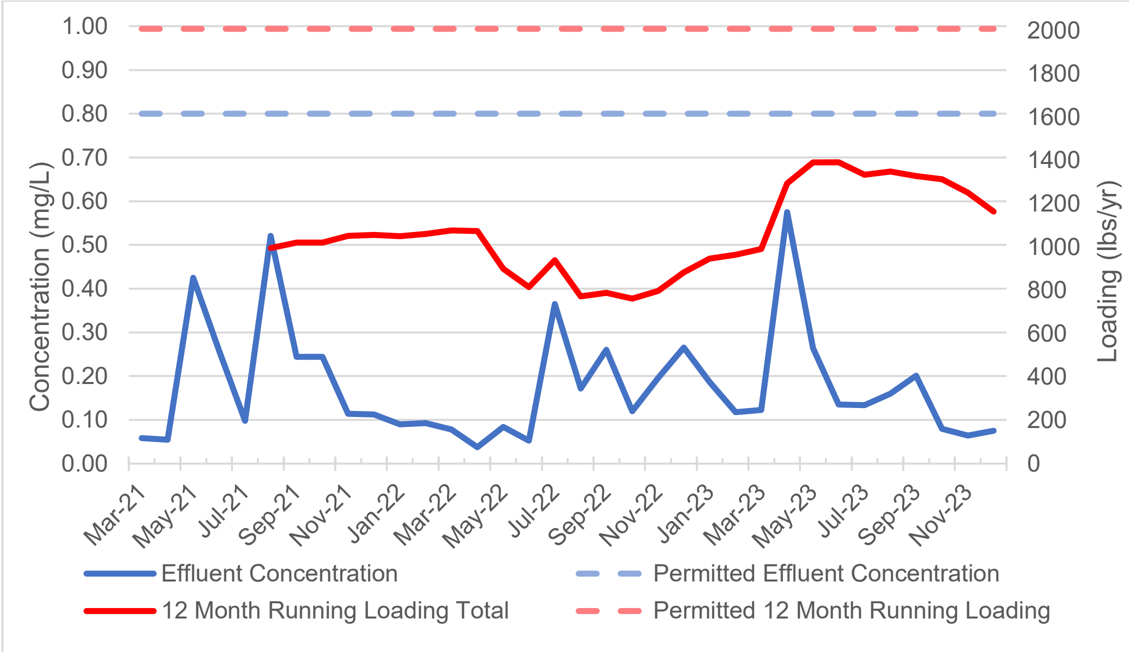
Figure 3.5 – Effluent TSS



3.6. Total Phosphorus (TP)

The Essex Junction WRRF has an average 12-month running TP load of 1061 lbs/year and a monthly concentration of 0.18 mg/L. As shown in Figure 3.6, effluent concentrations from March 2021 to August 2023 were consistently well below the limit of 0.80 mg/l, also resulting in good annual loading quantities at 47% of the limit of 2008 lbs/year. There was no data for effluent TP concentration in January and February of 2021 and no 12-month running total from January to July of 2021. Summer months from May to August see higher TP concentrations. The year of 2022 saw a generally lower average of 12-month running TP loading. In 2021 and 2023, the running TP was above 1000 lbs/year with the exception of July 2021.

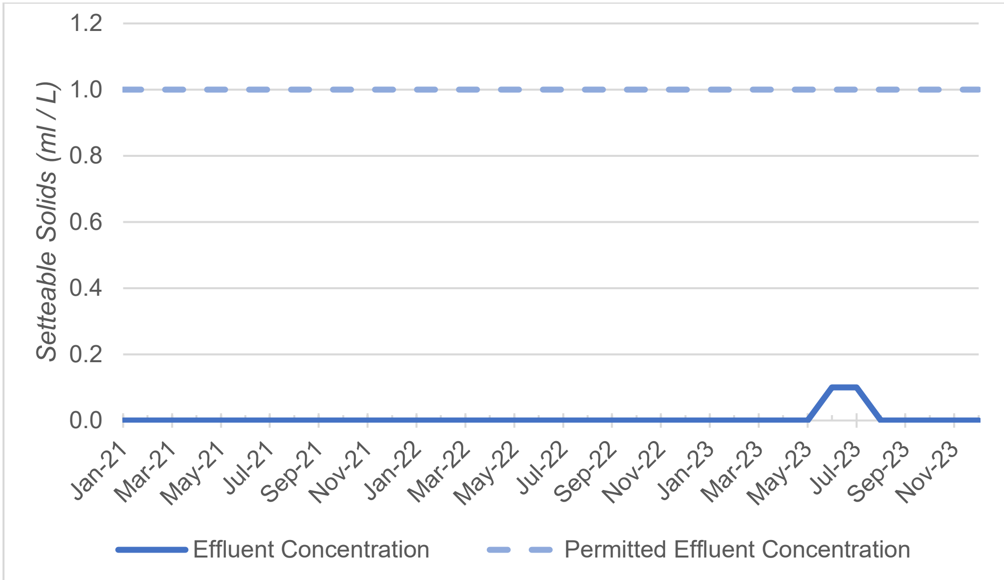
Figure 3.6 – Effluent TP Concentration & Annual Loading



3.7 Settleable Solids

The Essex Junction WRRF must not exceed 1.0 ml/L settleable solids for an instantaneous maximum as shown in Figure 3.7. From January 2021 to December 2023 only two months recorded values above 0.0 ml/L. In June and July of 2023 the maximum recorded settleable solids was 0.1 ml/L. The facility consistently complies with this requirement of the permit.

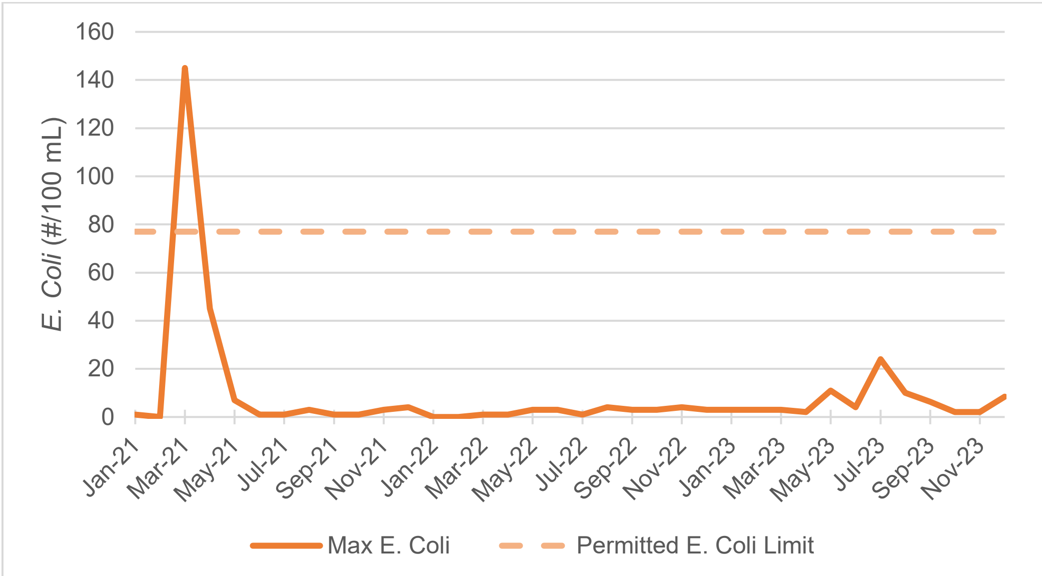
Figure 3.7 – Settleable Solids



3.8 E. Coli

The Essex Junction WRRF has an instantaneous maximum effluent E. Coli limit of 77 colonies per 100 mL. In March of 2021, an *E. Coli* violation, which was corrected the day after it was discovered. The March 2021 WR-43 form notes "Elevated *E.coli* due to chlorine control algorithm issues". The following month, April 2021, also saw a high count of colonies at 45 per 100 mL, although this was not in violation of the permit. The average count through the entire span of this data set was 8.8 colonies/100 mL. The effluent E. Coli counts tend to see higher numbers during May to August but consistently complies with the permit limit.

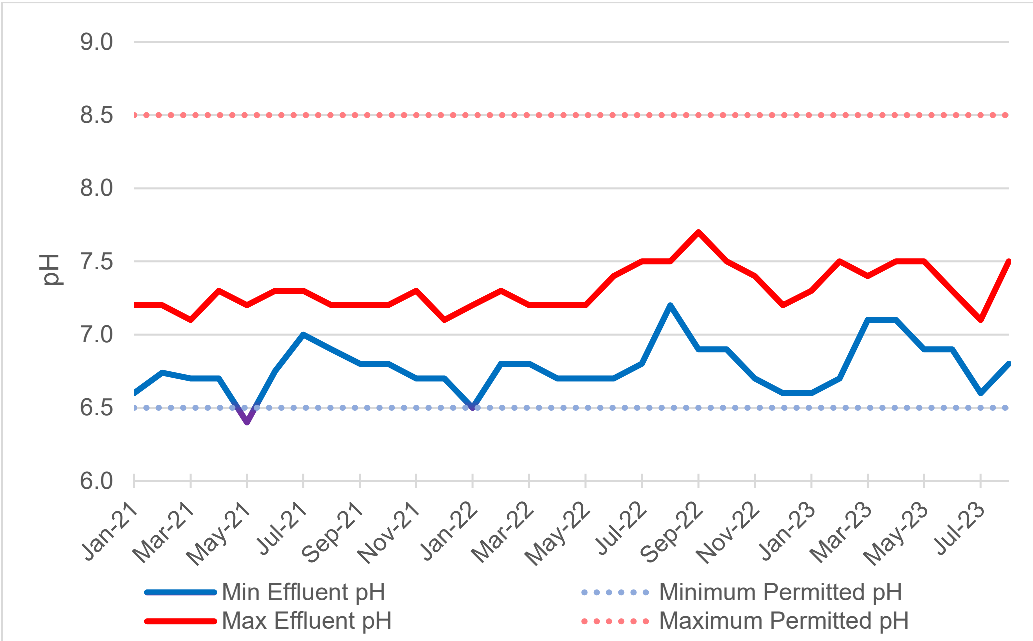
Figure 3.8 – *E. Coli*



3.9 pH

The effluent pH of the Essex Junction WRRF is permitted to be within a range of 6.5 to 8.5 SU. The maximum pH averages 7.30 and does not exceed a value of 7.70 in the period range from January 2021 to December 2023. The minimum pH is an average of 6.77 SU. In May 2021, there was one violation at a recording of 6.4 SU, 10% below the minimum, and January 2022 saw a minimum reading of 6.5, the exact value of the permitted minimum limit. There were no violations in maximum pH.

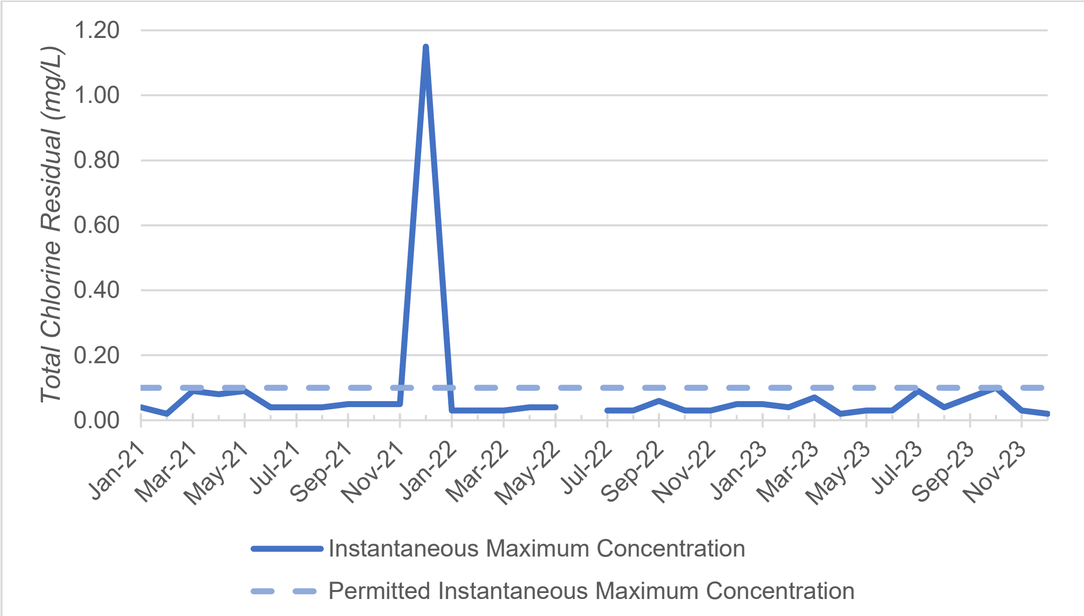
Figure 3.9 – Maximum & Minimum Effluent pH



3.10 Total Chlorine Residual (TRC)

The Essex Junction WRRF permit limits the effluent TRC concentration to an instantaneous maximums of 0.1 mg/L. In June 2022, a reading of 31.00 mg/L was recorded but is excluded from the average calculations and figure below due to the extremely high recording. The operator noted the violation was due "to testing of a third chlorine pump meant for seasonal demand, ended up being much higher output than in pump manual". The average instantaneous maximum concentration, excluding the extreme outlier, is 0.08 mg/L. An additional violation occurred in December 2021 with a reading of 1.15 mg/L, due to a failure of the chlorine controller, as stated by the operator. A reading of 0.1 mg/L was recorded in October 2023, the highest reading permitted without incurring a violation.

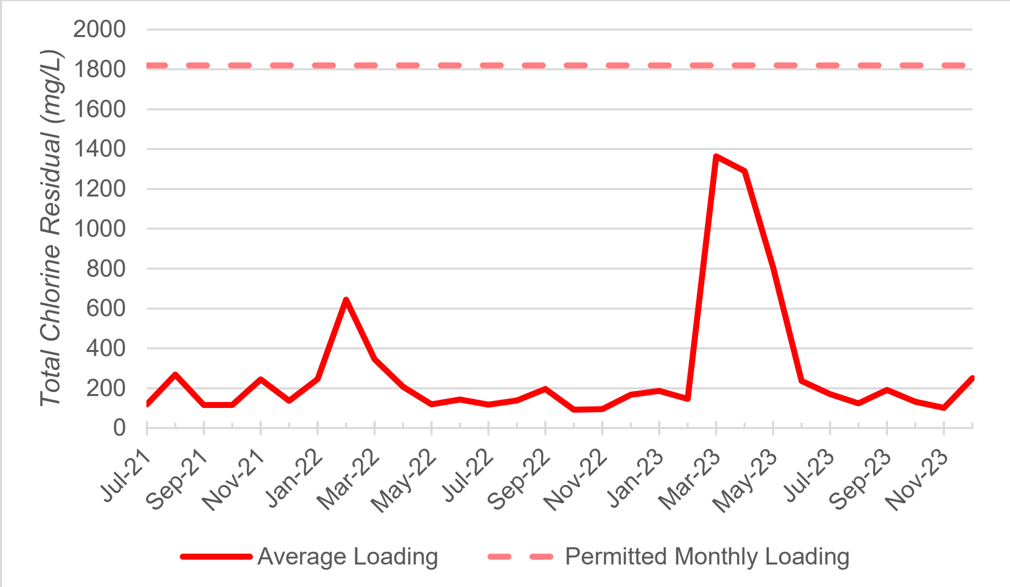
Figure 3.10 – Monthly Maximum Effluent TRC



3.11 Ultimate Oxygen Demand (UOD)

The Essex Junction WRRF is permitted for a monthly effluent UOD loading up to 1820 lbs/month. The average monthly loading is 280 lbs, only 15% of the maximum permitted amount. As shown in Figure 3.11, the maximum monthly loading recorded from July 2021 to December 2023 was 1364 lbs which occurred in March 2023.

Figure 3.11 – Effluent UOD



4. PROCESS MODELING

5. NEED FOR PROJECT

5.1 Background

Site visits were performed with City operations and A+E staff on November 15, and December 14, 2023, to observe and discuss the short-term project needs for this 10-year planning study. The results of these inspections and items of concern noted are discussed in the following narratives.

5.2 Liquid Stream

5.2.1 Septage Receiving/Headworks

Description
Improvements were constructed at the headworks in 2013, and included a new building and upgrade of the grit removal system. Shortly after this upgrade, a new Fairfield multi-rake screen and solids washer were installed.

Maintenance/Repairs
A summary of the recent and planned maintenance and repairs are:

- Influent Sampler: A new WAVE influent sampler was installed.
- Gas Detection System: The MSA TriGuard system is obsolete and is difficult to service.
- Multi-Rake Screen: The washer/compactor was not in operation and sent to Fairfield for repairs.
- Grit Removal System: The aerated grit chamber was cleaned last summer, and one of the bucket elevators fell off, requiring repair.

Operations
The layout of the septage receiving facility is not ideal as trucks back up in the driveway and discharge directly into the influent sewer, then this combined flow passes through the screening and grit removal systems. Odor can be an issue during the discharge, and no separate flow monitoring or treatment is provided for the septage as it is mixed with the influent flow.

Bypassing the flow equalization tank and maximizing the gravity flow from the grit removal system to the primary clarifiers has been identified for upgrade to reduce pumping and electrical costs. Automating this control system so it can be optimized during normal operations has been evaluated and improvements recommended. Additional information on these improvements is provided in Appendix .

5.2.2 Flow Equalization Tank/Influent Pumping

Description
This flow equalization tank and pumping structure were installed in 1999 to maintain a peak down stream flow of 6.6 mgd.

Maintenance/Repairs
A summary of the and recent and planned maintenance and repairs are:
- Cracks along the top of the concrete tanks were repaired in 2022.
- Aeration Blowers: Blower #1 is original and #2 was rebuilt.
- Sewage Pumps: The Flygt sewage pumps are original.
- Sewage Pump Control System: The PLC was replaced with an Allen Bradley Panel View 1000.

Operations
The westerly tank is used for flow equalization and the easterly tank is used for process control. Both tanks are continuously aerated. The centrate from the sludge dewatering is returned to the easterly tank cell and then slowly bled into the liquid stream at a controlled rate (about 2' per day) to reduce the impacts to the process. The centrate is pumped to the Headworks with a Gorman Rupp pump and operation is controlled manually with a timer.

Addition of a smaller fourth pump in the basement was discussed to better match the normal flow conditions and reduce the downstream process impacts.

The Pephlo pilot test unit is located in the Control Building garage, but the plan is to have an operating unit in a trailer at this location for phosphorus removal. The dewatering centrate would be pumped through this unit for removal of phosphorus and returned back to the liquid stream.

5.2.3 Primary Clarifiers

Description
The internal equipment in the two (2) primary clarifier tanks was upgraded in 2013.

Maintenance/Repairs
A summary of the recent and planned maintenance and repairs are:
- Repainting of some of the steel components is included in the capital plan.

Operations
Typically, only one of the two primary clarifiers are operated but this will be evaluated further with the process model.

5.2.4 Aeration Tanks

Description
The tanks were constructed in 1985, but were retrofitted during the 2013 upgrade with anaerobic selectors to provide enhanced biological phosphorus removal. The fine bubble aeration systems in each tank were replaced and since the upgrade, the buried aeration line was replaced.

All three (3) of the aeration blowers in the Control Building have been replaced and are three different sizes to provide improved process control and reduced operating costs. The blowers are: 75 hp, 100 hp, and 125 hp.

Recently, REXA automatic valves were installed with butterfly valves on the blower header to improve the air distribution and reduce operating costs. These improvements were funded through Efficiency Vermont.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- The primary influent sampler needs to be replaced.
- ORP: The ORP controllers were replaced.
- Aeration System: The diffuser membranes need to be replaced.

Operations
New REXA automatic valves were installed with butterfly valves and are currently being operated off DO control. LCS is still assisting with modifications to the programming so they operate properly to balance out the air flow to each tank.

Loss of alkalinity continues to be a challenging operational issue and requires addition of sodium hydroxide at the effluent channel to increase the pH.

There are concerns about the increasing influent BOD_5 loadings, so the operations staff wants to evaluate alternatives for expansion of the aeration tanks.

5.2.5 Secondary Clarifiers

Description
During the 2013 upgrade, new internal equipment was installed for Clarifiers No. 1 and 2, and a new third clarifier was added.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

-

Operations
Typically, two of the three clarifiers are operated. Clarifier No. 2 was off-line during the site visit.

5.2.6 Filters

Description
This filter structure was added during the 2013 upgrade, and includes three new cloth media filters.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- The filter cloth was replaced for all three filters.
- The operations staff would like to add a center catwalk to improve access for maintenance.

Operations
Typically, two of the three filters are operated. Filter No. 2 was off-line during the site visit.

5.2.7 Chemical Feed/Storage Building

Description
This original structure housed the automatic backwash filter and was converted to a chemical feed/storage structure during the 2013 upgrade.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- The layout and configuration of the chemical storage tanks was changed to provide more storage for sodium hydroxide.
- A third pump was added to increase the chlorine addition during higher flows.
- Dechlor Pump: This chemical pump was replaced.
- Laboratory: The staff would like to add an additional door and second sink.
- Process Water: The motor was replaced on Pump #3.

Operations
Sodium hydroxide (castic soda) is added for increasing the alkalinity but the operations staff plans to trial another type of chemical called Optical supplied by Coyne Chemical. Next steps are to run a trial and pilot test, and if effective, can reduce operating costs.

5.2.8 Disinfection System

Description
New chemical feed pumps and storage tanks were installed during the 2013 upgrade, and the chorine contact tank was constructed in 1985.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- Improved monitoring and control of the chorine residual was added.
- Chlorine Contact Tank: the outlet gate on the southerly channel is not operable.

Operations
The operations staff was to evaluate changing to ultraviolet disinfection to improve the reliability.

5.3 Solids Train

5.3.1 WAS Blend Tank/SludgeThickening

Description
The gravity belt thickener and appurtenances are located in the Control Building and was upgraded in 2003.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- The polymer tank has been replaced.
- Polymer Mix/Feed System: Requires replacement.

Operations
This thickening unit is typically run on Mondays and Fridays.

5.3.2 Anaerobic Digestion

Description
The anaerobic digestion system was upgraded in 2013, and primary digester tank exterior wall was in replaced in 2021.

A new 2G cogeneration system was installed in with a 125KW engine and gas conditioning system.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- Digester tank cleaning is planned at a total budget of $85,000 for FY 24 and 25.
- Cogeneration:
    - The engine was completely rebuilt in FY23 at a cost of $129,000.
    - This unit is now on a maintenance contract with 2G

Operations
When the cogeneration system is operable, the electrical usage is reduced significantly.

5.3.3 Sludge Storage Tanks

Description
The two above ground storage tanks were constructed in 1985.

Maintenance/Repairs
A summary of the planned and recent maintenance/repairs are:

-

Operations
Because of the concerns with PFAS, the City could lose the land application site which is a very cost effective method of sludge disposal.

5.3.4 Sludge Dewatering

Description
The sludge dewatering building was constructed during the 2013 upgrade.

Maintenance/Repairs
A summary of the planned and recent maintenance/repairs are:

- The operations staff would prefer a sound proof office.
- Centrifuge: A scheduled rebuild will be required.
- Sludge Distributor Conveyor: The level sensors don't work making automatic operation difficult.

Operations
The centrifuge is operated for sludge dewatering on Tuesday and Thursday. On Tuesday, operation hours are about 7:30 am to 2:30 pm, and on Thursday the operating hours are about 5:00 am to 2:30 pm.

If this system could be automated, it would provide the operations staff more flexibility in operating hours and could also be run off hours as is done with other sludge dewatering systems.

The operations staff also wants to evaluate other dewatering technologies, such as, screw press that can run automatically off hours.

5.4 Site and Buildings

5.4.1 Site

5.4.2 Admin Building

Description
Improvements for the Admin Building were completed in 2013 for the building, mechanical, and electrical components.

Maintenance/Repairs

- SCADA
  - The SCADA computer and software was replaced in 2019 at a cost of $40,000.
- Emergency Generator: The operations staff have identified adding a standby generator for this area in the capital budget.
- Geothermal Well: The circulator pumps were replaced.

Operations

5.4.3 Control Building

Description
This Control Building was constructed in 1985 and houses: sludge thickening, workshop, electrical, aeration blowers, sludge pumps, and garage.

The pilot test for the phosphorus Pephlo is located in the westerly garage bay.

Maintenance/Repairs
A summary of the recent and planned maintenance/repairs are:

- PLC: The PC desktop was replaced.
- New Powerside power factor unit was installed in 2021.
- Primary Sludge (WPS) Pump #2: Requires replacement.
- RAS Flow Meter: Requires replacement.
- Sump Pumps: Replacing with new Barnes pump units.
- Variable Frequency Drives: New Danfoss VFD’s installed.
- WAS Pumps: Original Crane Deming pumps need to be replaced.

- Improved drainage off the west side of the roof is required.
- Addition of cold storage, about 16' X 24'.

Operations
The garage bays at the south end are full, so cold storage is required on-site.

5.4. Sludge Drying Bed

Description
There is not a sludge drying bed on-site.

Maintenance/Repairs
A summary of the planned and recent and planned maintenance/repairs are:
- The operations staff wants to add a sludge drying bed on-site for disposal material removed from pump stations for the Tri-Town communities.

Operations
Material removed from pump stations is hauled to the sludge drying beds at the Winooski WWTF which is not very efficient.

5.5 Overview of Project Need

In Tables 5.1 through 5.3 below, a summary of the major items is provide for the liquid stream, solids train, and site and buildings for the next 10 year planning period.

Table 5.1
Summary of Project Need
Liquid Stream

Item Description		**Major Deficiencies and Needs**
Septage Receiving		Add odor control and/or improved septage receiving facility
Headworks		Automate and optimize gravity flow bypass
Pre EQ Tank		Sewage pumps are original, installed in 1999
		Add a smaller 4th pump
Aeration Tanks		Add aeration tank(s) to handle increased influent organic loading
		Improve aeration header distribution with proper operation and programming of the automated Rexa butterfly valves
		Improve alkalinity recovery to reduce sodium hydroxide addition and/or try other product
Disinfection		Evaluate ultraviolet disinfection as an alternative

Table 5.2
Summary of Project Need
Solids Train

Item Description		**Major Deficiencies and Needs**
Sludge Dewatering	Office	Add sound proofing
		Centrate management for phosphorus and ammonia
		Evaluate replacement of the centrifuge with other dewatering equipment
		Unable to run extended or off hours because level sensors for sludge distributor conveyors are not operable.

Table 5.3
Summary of Project Need
Site and Buildings

Item Description		**Major Deficiencies and Needs**
Storage		Add cold storage for equipment
Sludge Drying Beds		Add drying bed for pump station cleanings.

6. ALTERNATIVES CONSIDERED

6.1 Introduction

From the list of items developed for this 10-year upgrade planning study and identified during the site visits, alternatives were developed for evaluation as listed below.

- Gravity flow/EQ Modifications
- Aeration Tank Expansion
- Disinfection
    - Conversion to Ultraviolet Disinfection
- Sludge Dewatering
    - Replacement of the centrifuge with a screw press
- Dewatering Centrate

Other items were identified for upgrade but did not warrant an evaluation of alternatives and are listed below:

- Sludge Drying Bed
- Cold storage building

6.2 Gravity Flow/EQ Modifications

6.2.1 Description

The following alternatives were developed to address the upgrade of the influent pumps:

- #1: Do Nothing
- #2: Replace Pumps

6.2.2 Preliminary Design Criteria

The preliminary design criteria from the original design data is summarized below in Table 4.1, and additional information on the influent pumps is provided in Appendix D.

Table 4.1
Influent Pumps
Preliminary Design Criteria

Item Description	Design Year
Number of Units	3
Type of Pump	Vertical Centrifugal Dry Pit
Capacity of Each Pump	1,850 gpm
Capacity of Two Pumps	3,000 gpm
Total Dynamic Head	34 feet
Motor Size	25 hp
Type of Motor	Variable Speed

Notes:

1. From the 1986 Basis of Design included in the O&M Manual, Appendix VIII.

6.2.3 Alternative No. 1 – Do Nothing

From the project need in Section 3.0, the pumps are original and due for replacement. These pumps are critical infrastructure to lift the flow from the preliminary treatment to the remaining portion of the liquid stream. If not replaced, then maintaining long-term reliability will be a concern.

6.2.4 Alternative No. 2 – Replace Pumps

Alternative No. 2 includes replacement of the three (3) existing pumps in the same location, at the same pumping capacity as summarized in Table 4.1. For ease of replacement, it was assumed to install new Patterson vertical centrifugal dry pumps of the same model with new inverter duty motors as follows:

- Three (3) new vertical non-clog centrifugal pumps manufactured by Patterson Model 8X8X15.5 to match the existing pumps, supplied with 25 hp inverter duty motors.
- Each pump will have a capacity of 1,850 gpm at 34 feet to match the existing hydraulic conditions.

6.2.5 Estimated Costs

Estimated construction costs for the Influent pump replacement are summarized in Table 4.2, below. Detailed construction cost estimates can be found in Appendix J. Alternative No. 2, replace pumps, has an estimated construction cost of $405,000.

Table 4.2
Influent Pumps
Estimated Construction Cost

Alt. No.	Alternatives	Estimated Construction Cost (ENR 13150)[1]
1	Do Nothing	---
2	Replace Pumps	$405,000

Notes:

1. Construction costs based on ENR 13150 for December 2022

6.3. Aeration Tank Expansion

6.3.1 Description

6.4. Disinfection

6.4.1 Description

The facility currently utilizes liquid chlorine and sodium bisulfite for disinfection but wants to evaluate the conversion to ultraviolet disinfection, so the following alternatives are evaluated.

- Alternative #1: Continue with Liquid
- Alternative #2: Convert to UV Disinfection – Horizontal
- Alternative #3: Convert to UV Disinfection – Vertical Incline

6.4.2 Alternative No. 1 – Continue with Liquid

Description

This alternative is based on continuation of the disinfection process using the liquid chlorine and bisulfite and the existing chlorine contact tank. Upgrades to the chemical feed/storage were completed in 2013 and the original chlorine contact tank continues to be used. No major improvements are proposed beyond normal maintenance and equipment replacement.

Technical Analysis

A technical analysis of the liquid disinfection approach is provided in Table 6. below.

Table 6.
Liquid Disinfection
Technical Analysis

Advantages	Disadvantages
• The existing Chemical Feed/Storage Building can continue to be used to house the storage tanks and feed pumps • The existing chlorine contact tank is in good condition and is adequately sized for continued use. • Effluent flow measurement weir is above the 100-year flood elevation so the facility would still be operational during a flood event	• Requires additional operator attention and handling of bulk chemicals. • Continued use of chlorine as a disinfect does not achieve the water quality benefits to the Winooski River. • There have been reliability issues with maintaining the total residual chlorine and complying with the permit limits

6.4.3 Alternative No. 2 – Convert to UV Disinfection – Horizontal

Description

For the conversion to ultraviolet disinfection, existing structures will be used to the extent possible and will include the following upgrades:

- Abandonment of the existing storage tanks and feed pumps.
- Repurpose of the existing chlorine contact tank to a UV Disinfection structure to include:
  - Three (2 duty, 1 standby) horizontal UV banks in the northerly channel
  - Addition of a new building over the UV channels
  - Maintain the southerly channels for bypass

Preliminary Design Criteria

The preliminary design criteria for the conversion to a horizontal ultraviolet disinfection system is summarized below in Table 6. .

Table 6.
Ultraviolet Disinfection - Horizontal
Preliminary Design Criteria

Item Description	**Design Year**
Configuration	Horizontal
Number of Banks	3 (2 duty, 1 standby)
Type of Lamps	Low pressure – high Intensity
Number of Lamps	168
Peak Design Flow	6.6 mgd
UV Transmission	65%
Design Dose	35,000 μWs/cm^2
E. Coli Limit	77 col/100 ml
Channel	
Number	1
Length	40+ feet
Width	3’-0”
Water Depth (Average)	2’-6”
Chanel Depth	5’-2”
Level Control	Weir gate

Notes:

1.

Technical Analysis

The current design includes a three (3) bank variable output ultraviolet disinfection system located in the existing chlorine contact tank channel.

A technical analysis for the horizontal ultraviolet disinfection layout is provided in Table 6. .

Table 6.
Ultraviolet Disinfection – Horizontal
Technical Analysis

Advantages	Disadvantages
• Requires less operator attention with automatic operation and cleaning system • This variable output system has automatic monitoring that reduces the intensity during lower flows, thereby reducing electrical usage • UV disinfection provides water quality benefits to the Winooski River by not discharging chlorine • Can still use the existing chlorine contact tank for process water • Effluent weir is above the 100-year flood elevation so facility would still be operational during a flood event • The existing chlorine contact structure can be used for the ultraviolet disinfection structure and is adequate for a horizontal system	• To comply with the State requirements, a new heated structure needs to be constructed over the UV channel. • O&M costs are increased because of higher electrical usage and the additional bulbs for a horizontal system • Replacement of bulbs are required, increasing the O&M costs for a horizontal system

6.4.4 Alternative No. 3 – Convert to UV Disinfection – Vertical Incline

Description

For the conversion to ultraviolet disinfection, existing structures will be used to the extent possible and will include the following upgrades:

- Abandonment of the existing storage tanks and feed pumps.
- Repurpose of the existing chlorine contact tank to a UV Disinfection structure to include:
    - Four (3 duty, 1 standby) vertical inclined UV banks in the northerly channel
    - Addition of a new building over the UV channels
    - Maintain the southerly channels for bypass

Preliminary Design Criteria

The preliminary design criteria for the conversion to a vertical inclined ultraviolet disinfection system is summarized below in Table 6. .

Table 4.
Ultraviolet Disinfection – Vertical Incline
Preliminary Design Criteria

Item Description	Design Year
Configuration	Sloped
Number of Banks	4 (3 duty, 1 standby)
Type of Lamps	Low pressure – high Intensity
Number of Lamps	64
Peak Design Flow	6.6 mgd
UV Transmission	65%
Design Dose	35,000 μWs/cm^2
E. Coli Limit	77 col/100 ml
Channel	
Number	1
Length	40 feet
Width	3’-3”
Water Depth (Average)	5’-6”
Chanel Depth	7’-6”
Level Control	Weir gate

Notes:

Technical Analysis
The current design includes a four (4) bank variable output vertical incline ultraviolet disinfection system located in the existing chlorine contact tank channel.

A technical analysis for the vertical incline ultraviolet disinfection layout is provided in Table 6. .

Table 6.
Ultraviolet Disinfection – Vertical Incline
Technical Analysis

Advantages	Disadvantages
• Requires less operator attention with automatic operation and cleaning system • This variable output system has automatic monitoring that reduces the intensity during lower flows, thereby reducing electrical usage • UV disinfection provides water quality benefits to the Winooski River by not discharging chlorine • Can still use the existing chlorine contact tank for process water • Effluent weir is above the 100-year flood elevation so facility would still be operational during a flood event • The existing chlorine contact structure can be used for the ultraviolet disinfection structure and the depth is adequate for a vertical incline system • A vertical incline system has fewer bulbs than a horizontal system reducing O&M costs for electrical usage and bulb replacement	• To comply with the State requirements, a new heated structure needs to be constructed over the UV channel. • O&M costs are increased because of higher electrical usage • Replacement of bulbs are required, increasing the O&M costs

6.4.5 Estimated Costs

Estimated construction costs for the ultraviolet disinfection system alternatives are summarized in Table 6. , below. Detailed construction cost estimates can be found in Appendix .

Table 6.
Disinfection Alternatives
Estimated Construction Cost

Item Description	Alternative #2 – UV Horizontal	Alternative #3 – UV Vertical
General Requirements (10%)	$0	$
Demolition	$0	$
Sitework/Yard Piping	$0	$
Concrete	$0	$
Misc. Metals	$0	$
Building	$0	$
Equipment	$500,000	$400,000
Instrumentation	$0	$
Process Piping and Valves	$0	$
Mechanical	$0	$
Electrical/Controls	$0	$
Subtotal	$0	$
10% OH&P	$0	$
Total	$0	$
Use	**$0**	**$**

Information was provided by the City on the projected chemical costs for FY 24 and are summarized below.

- For chlorine, the unit price is $2.468 per gallon and the estimated usage is 107.5 gpd or 39,250 gallons per year.
- For sodium bisulfite, the unit price is $2.37 per gallon and the estimated usage is 26 gpd or 9,500 gallons per year.

A comparison of the annual operation and maintenance costs was prepared and is summarized below in Table 6. .

Table 6.
Disinfection Alternatives
Comparison of Annual O&M Costs

Item	**Alternative No. 1 - Liquid**	**Alternative No. 2 – UV Horizontal**	**Alternative No. 3 – UV Vertical**
Salary [(1) (2)]	$5,200	$2,600	$2,600
Benefits [(3)]	$2,080	$1,040	$1,040
Operating Supplies [(4)(5)]	$120,000	$22,400	$9,000
Utilities [(6)]	$1,500	$23,000	$17,100
Total	$128,780	$49,040	$29,740

Notes:
1. For the liquid disinfection, the operations are estimated at 4 hours per week.
2. For UV disinfection, the operations are estimated at 2 hours per week.
3. Benefits are estimated at 40% of labor.
4. For liquid disinfection, the City estimates spending $120,000 in FY 24 on chlorine and bisulfite chemicals.
5. Supplies for the UV include the bulb replacements every 12,000 hours at $400 per lamp for the horizontal and $750 per lamp for the vertical system. Assume replacement of 1/3 of the bulbs each year.
6. Electrical costs for the UV are based on $0.16 per KWH and operating flow.

6.5. Sludge Dewatering Equipment

6.5.1 Description

A centrifuge was installed in 2013 and is currently used for dewatering, but the operations staff wants to evaluate replacement with a screw press. The following alternatives were developed for the sludge dewatering equipment.

- Alternative #1: Continue with Centrifuge
- Alternative #2: Replace Centrifuge with a Screw Press
- Alternative #3:

6.5.2 Preliminary Design Criteria

The preliminary design criteria for the existing centrifuge is summarized below in Table 6. . Currently, secondary waste activated sludge is thickened with the gravity belt thickener, then transferred to the anaerobic digestion and mixed with the primary sludge.

Table 6.
Centrifuge Dewatering
Preliminary Design Criteria

Item Description	Design Year
Feed Concentration % Solids	3% - 6%
Sludge Feed Rate	200 gpm
Solids Loading	2,500 lbs/hr
Minimum Cake Solids	24%
Operating Hours Per Day	8.0

6.5.3 – Alternative #1: Continue with Centrifuge

Description
Under this alternative, no changes would be made to the sludge handling and dewatering process shown on the Process Schematic, Figure 3 in Appendix A, and as described below.

- Primary sludge is transferred to the primary anaerobic digester.
- Waste activated secondary sludge is pumped to the WAS blend tank, thickened with the gravity belt thickener, and transferred to the primary anaerobic digester, and mixed with the primary sludge.
- Anaerobically digested sludge is then pumped to one of two 1.0 MG sludge storage tanks.

- For dewatering, the sludge is pumped through a sludge grinder to the centrifuge for dewatering and polymer is added, then the sludge cake falls onto a sludge conveyor.
- The dewatered sludge moves to the distributor conveyor in the garage bay and falls into the dump trailer where it is transported off-site for disposal.

Technical Evaluation
A summary of the technical analysis is provided below in Table 6..

Table 6
Alternative #1 – Continue with Centrifuge
Technical Analysis

Advantages	Disadvantages
• The centrifuge has a higher throughput for the available space in the existing Dewatering Building. • There is better performance with a higher % solids produced, reducing disposal costs	• A centrifuge is more complicated operationally and the staff have difficulty running the unit automatically and are unable to operate off hours reliably. • Operating costs are higher because of the greater horsepower and associated electrical costs • The centrifuge runs at a very high speed, so requires more frequent maintenance and rebuild, increasing operating costs

6.5.4 – Alternative #2: Replace Centrifuge with a Screw Press

Description
Under this alternative, the centrifuge would be replaced with a screw press but no other changes would be made to the sludge handling and dewatering process shown on the Process Schematic, Figure 3 in Appendix A, and as described below.

- Primary sludge is transferred to the primary anaerobic digester.
- Waste activated secondary sludge is pumped to the WAS blend tank, thickened with the gravity belt thickener, and transferred to the primary anaerobic digester, and mixed with the primary sludge.
- Anaerobically digested sludge is then pumped to one of two 1.0 MG sludge storage tanks, and pumped to the sludge blend tank.
- For dewatering, the sludge is pumped through a sludge grinder to the screw press for dewatering and polymer is added, then the sludge cake falls onto a sludge conveyor.
- The dewatered sludge moves to the distributor conveyor in the garage bay and falls into the dump trailer where it is transported off-site for disposal.

A request for equipment information was sent to multiple screw press manufacturers as there are units of various sizes and differences in operability. Screw presses are becoming much more common for sludge dewatering when an anaerobically digested sludge is produced. These units can have a similar footprint and are much simpler with reliable off hours operation. Proposals were provided from Huber Technology, PW Tech, BDP Industries, and FKC. Additional information is provided in Appendix on several different types screw presses.

This alternative is based on providing one (1) new screw press to include the following appurtenances:

Preliminary Design Criteria

As a screw press has some different operating characteristics, the preliminary design criteria is summarized below in Table .

Table 6.
Screw Press Dewatering
Preliminary Design Criteria

Item Description	Current Year	Design Year
Feed Concentration % Solids	3% - 6%	
Sludge Feed Rate		
Solids Loading		
Minimum Cake Solids (1)	22% - 24%	
Operating Hours Per Day	16.0	

Notes:

1. Jar testing is recommended to confirm % cake solids.

Technical Evaluation

A summary of the technical analysis is provided below in Table 6..

Table 6.
Alternative #2 – Replace Centrifuge with a Screw Press
Technical Analysis

Advantages	Disadvantages
• The screw press is much simpler with improved reliability and reduced maintenance costs • Operating costs are lower because of smaller motors which are more energy efficient and use less electricity • Limited operator attention required • Compact design with small footprint	• Produces a sludge cake with a slightly lower % solids which increases disposal costs • Depending on the number and capacity of the unit selected, extended operation may be required • Some of the units proposed would not fit in place of the existing centrifuge requiring modification of the building

6.4.6. Estimated Costs

Estimated construction costs for the sludge dewatering equipment are summarized in Table 4., below. Only a construction cost is shown for Alternative #2 which involves replacement of the existing centrifuge with a screw press. Detailed budget estimates can be found in Appendix .

In addition to the construction costs, a comparison is provided for the annual operation and maintenance costs as summarized in Table 4. The basis for the O&M costs assumes weekly operation of the centrifuge at hours per week and extended hours for the screw press. Not all of the dewatering costs are included for some of the appurtenant equipment as this is assumed to be similar for either alternative.

Table 6.
Sludge Dewatering Alternatives
Estimated Construction Cost

Item Description	**Alternative #2**	**Alternative #3**
General Requirements (10%)	$	$
Demolition	$	$
Sitework/Yard Piping	$	$
Concrete	$	$
Misc. Metals	$	$
Building	$	$
Equipment	$	$
Instrumentation	$	$
Process Piping and Valves	$	$
Mechanical	$	$
Electrical/Controls	$	$
Subtotal	$855,000	$
10% OH&P	$85,500	$
Total	$940,500	$
Use	**$950,000**	**$**

Notes:

1. Construction costs based on ENR 13900 = June 2024.

Table 4.
Sludge Dewatering Alternatives
Annual O&M Costs

Item Description	**Alternative #1** (1)	**Alternative #2** (1)
Polymer		
Total Polymer Usage		44,200 lbs
Polymer Dilution Water		8.0 gpm
Polymer Cost	$	$117,000
Wear Parts		
Replaceable Flights	$	$2,775
Motors & Electrical Components	$	$415
Gearboxes, Bearings, Grease	$	$230
Maintenance Cost	$	$3,4
Energy Consumption		
Screw Press – 5 hp		
Filtrate Recyle Pump – 0.5		
Total KW – 4.10		
Electrical Cost	$	$2,1
Sludge Disposal		
Sludge Cost		
Total	$	$
Use	**$**	**$**

Notes:
1. O&M cost comparison is based on 40 hours per week for the centrifuge and 80 hours per week for the screw press.
2. Polymer cost estimated at $1.20/lb neat
3. Electrical costs estimated at $0.15/KW-Hr

7. SELECTION OF ALTERNATIVES

7.1. Life Cycle Analysis

7.1.1. Age Related Needs

From the project needs and alternatives evaluated in Section 4.0, the Village also wants to include upgrades to the following age related components:

- Influent Pumps
- Grit Removal System
- Motor Control Centers

For each of these age related items, the alternatives evaluation only included the do nothing and upgrade options as it consists of replacement of existing equipment in-kind with similar capacities and re-uses existing structures. A life cycle analysis was not performed for these items as the equipment has exceeded the useful life and requires replacement to continue to operate reliably and minimize increased O&M costs.

7.1.2. Sludge Handling and Storage System

For the purposes of this report, a life cycle analysis was not performed to compare the sludge alternatives. The Village purchased the sludge dryer and wants to control the operating costs for the handling and management of the sludge, and they want to focus this phase of the project on improving the safety and operation of this system to include the following improvements:

- Sludge loading and garage bay flood protection
- Sludge dryer access platform
- Sludge Loading Bay Ventilation
- Dried sludge handling

7.2. Non-Monetary Factors

7.2.1. Age Related Needs

For the equipment proposed for replacement, the non-monetary factors involve the improvement in long-term reliability of this equipment and will reduce the repairs and maintenance. In all cases, the do nothing alternative was not preferred as it would not improve the operability of this equipment. For the grit removal system, the condition of the equipment did not allow for operation so replacement is required to place this system back into operation.

7.2.2. Sludge Handling and Storage System

The objective of these improvements for the dried sludge handling and storage is to improve the operation by automating the system. This will help to reduce the staff attention required to maintain continuous operation of this system which currently requires monitoring of the filling of bags, moving of the bags when full, and assisting with transport of the material off-site.

8. PROPOSED PROJECT

8.1. Project Description – Capital Funds

For the proposed project, there are different approaches and funding available for implementing the needed improvements. Several of the smaller and less costly items can be addressed by the Village using capital funds and these items are listed in Table 6.1 below.

Table 6.1
Recommended Upgrades Using Capital Funds

Item		**Recommendation**
Headworks	Odor Control	Replace carbon media in filters. Work performed by Village staff.
Septage Treatment Unit		Purchase critical spare parts to have on hand. Unit inspected by manufacturer and recommendations issued.
Effluent Sampler		Purchase a new refrigerated sampler suitable for exterior use.

8.2. Project Description – Upgrade Project

The upgrade project is split into the age related and sludge dryer handling and storage system as described in the following narratives, and as shown on the overall plan on Figure 7 in Appendix A.

8.2.1 Age Related Components

The age related components include: replacement of the grit removal system, influent pumps, and motor control centers.

The influent pumps will be replaced in the same location as shown on Figure 8 in Appendix A, and as follows:

- Three (3) new vertical non-clog centrifugal pumps manufactured by Patterson Model 8X8X15.5 to match the existing pumps, supplied with 25 hp inverter duty motors.
- Each pump will have a capacity of 1,850 gpm at 34 feet to match the existing hydraulic conditions.

For the grit removal system, the existing building (Class 1, Division 1) and grit structure will be reused and will include the following upgrades:

- Screw bucket elevator with 1.5 hp drive motor and nylon grit buckets

- Grit classifier with 12” screw
- Grit system control panel
- Grit aeration blowers
- Aeration header and diffusers
- Building renovation
- Heating/ventilation upgrades
- Electrical upgrades

The preliminary design criteria for the grit removal system will follow that as outlined in Table 4.3.

The existing motor control centers will be replaced in the Operations Building and Sludge Pumping Building.

8.2.2. Sludge Handling and Storage System

As discussed in Section 5.0, a priority for the Village are the upgrades to the sludge dryer handling and storage system that will include the following items:

- Floodproofing
- Access Platform
- Heating/Ventilation
- Material Handling and Storage

Floodproofing will be provided for the Sludge Loading and Garage bays up to the level of the finish floor elevation of 225.6’ in the Operations Building. This flood proofing will include the following and additional information on the stop log flood barriers is provided in Appendix H.

- Overhead Door – Stop logs will be provided for the 12’ wide garage doors for the garage bay and sludge loading bay.
- Man Door – Stop logs will be provided for the man doors located in the garage bay and sludge loading bay.

Ventilation upgrades are planned in the Sludge Loading bay area to maintain suitable temperatures when the sludge dryer is operational. Based on the assessment of this space for fire and life safety issue by Triangle Fire Consultants, no special classifications or electrical upgrades are proposed. A copy of this Memo is provided in Appendix G.

Upgrades to the sludge dryer material handling and storge will include:

- Dewatered Sludge Conveyors
  - One transfer screw conveyor for dewatering press to dryer or hopper
  - One hopper feed screw conveyor
  - One dryer feed screw conveyor
- Dried Sludge Conveyors and Storage

- One shaftless screw conveyor with inlet hopper
- One shaftless screw conveyor from hopper to conveyor
- One shaftless screw conveyor with bypass chute to storage bin
- One 15 cy storage bin with service platform and ladder with two shaftless screw conveyors for unloading
- Control panel for operation of all of the conveyors
- Remote E-stop stations at each conveyor

All material for the screw conveyors and appurtenances are 304 stainless steel. Conceptual layouts are provided on Figures 7 and 8 in Appendix A, but will need to coordinate the addition of the bin and conveyors for the dewatered sludge with the conveyor manufacturer. Also, the conveyor discharge from the dried sludge may need to be vertical, then horizontal to maintain adequate clearance in the Garage Bay. General information on the screw conveyors, hoppers, and bins supplied by Thomas Conveyor, CleanTek and MLM Conveying are attached in Appendix I.

Weighing of the dried sludge hauled off-site will still need to be done at the truck scales located at the nearby Transfer Station.

8.3. Project Schedule

A project schedule was developed for implementing the improvements and is based on using a combination of ARPA and Clean Water (CWSRF)) revolving loan funds. If CWSRF funds are used, the Village will have to go through the Qualifications Based Selection (QBS) for consultants.

Also, the supply chain issues will factor into the schedule causing delays in the purchase and delivery of materials which is the basis for showing a spring 2025 construction completion.

Table 6.2
Project Schedule

Date		**Task**
2023	March 2	Submit CWSRF priority list application
	May	Bond Vote
	June	Begin final design
	August	Complete environmental review FONSI
	October	60% review meeting
	December	Village/State review
2024	January	Issue final contract documents
	February	Advertise for bids
	March	Open bids
	September	Start construction
2025	April	Complete construction

2026	April	End of one year warranty period

8.4. Permit Requirements

The following approvals and permits are potentially required for this project:

Water Investment Division (WID) Environmental Review – If State of Vermont Clean Water Funding is used, an Environmental Report will need to be prepared and submitted for approval to the Water Investment Division staff. To comply with the National Environmental Policy Act (NEPA), this document will need to be approved during final design (Step II). Due to the proximity to the floodway, a public hearing will be required to solicit comments on the environment review, a 30 day public comment period noticed, and a Finding of No Significant Impact (FONSI) issued.

Division of Historic Preservation Archeological Assessment – In conjunction with the environmental review, contact will be made with WID staff to initiate an Archeological and Historic Properties Review for this project at the beginning of final design (Step II). This review will be focused on areas that have not been previously disturbed. Depending on the results of the review, an archeological resource assessment may be required.

State of Vermont Act 250 Land Use Permit – There is not an existing Act 250 permit issued for this parcel, however, a request for a Project Review sheet will be submitted to confirm that an Act 250 Permit or amendment is not required.

Local Approvals – An application for a Zoning Permit will need to be submitted to the Town of Rockingham for the exterior storage bin located within the floodway.

8.5. Easements

The exterior portion of the work is planned on the wastewater treatment facility site which is owned by the Village of Bellow Falls, so no easements or land acquisition are required.

8.6. Constructability

There is limited sitework required for these improvements, but space is limited and work will need to be coordinated for the new storage bin and around the buried LP tanks.

8.7. Cost Estimates

8.7.1 Estimated Construction

A summary of the estimated construction cost for each age related component and the sludge handling and storage upgrades is provided in Tables 6.3 and 6.4, respectively. For projecting the cost to the start of construction, a 6.5% annual increase is assumed. The estimated construction cost for the age related components is $1,360,000 and for the sludge system upgrades is $920,000.

Table 6.3
Age Related Components
Estimated Construction Costs

Item Description	Estimated Cost (ENR 13150)(1)	Estimated Cost (ENR 14200)(2)
Influent Pumps	$405,000	$438,000
Grit Removal System	$650,000	$702,000
Motor Control Centers	$200,000	$216,000
Total		$1,356,000
Use		**$1,360,000**

Notes:
1. ENR 13150 = December 2022
2. ENR 14200 = February 2024

Table 6.4
Sludge Handling and Storage System Upgrades
Estimated Construction Costs

Item Description	Estimated Cost (ENR 13150)(1)	Estimated Cost (ENR 14200)(2)
Floodproofing	$80,000	$86,400
Access Platform	$35,000	$37,800
Ventilation (3)	$110,000	$118,800
Dried Sludge Handling and Storage (4)	$625,000	$675,000
	Total	$918,000
	Use	**$920,000**

Notes:
1. ENR 13150 = December 2022
2. ENR 14200 = February 2024
3. No electrical improvements are proposed based on RMI's documentation provided on the classification and compliance with NFPA 820.

4. Equipment costs for the sludge conveyors, bins, etc. are based on a quote by EV Systems New England using Thomas Conveyors.

8.7.1 Total Project Cost

In Table 6.4, separate total project costs are shown for the age related components and sludge system upgrades, at $1,835,000 and $1,270,000, respectively. Combined, the total project is $3,105,000. The total project cost includes: construction, construction contingency, engineering, administration, permit fees, land acquisition, legal, short term interest, etc.

Some of the assumptions in these total project costs are:

- The construction costs are based on the ENR cost index for the projected construction date.
- A 15% construction contingency is assumed.
- Engineering allowances are based upon State of Vermont Water Investment Division engineering fee curves.

Table 6.4
Total Project Cost Summary

Item Description	Age Related Cost	Sludge Related Cost	Total Estimated Cost
Construction			
Age Related Components	$1,360,000	$0	$1,360,000
Sludge System Upgrades [1]	$0	$920,000	$920,000
Construction Subtotal	$1,360,000	$920,000	$2,280,000
Construction Contingency			
Construction Contingency (15%)	$204,000	$138,000	$342,000
Construction Contingency Subtotal	$204,000	$138,000	$342,000
Step I – Preliminary Engineering [2]			
Preliminary Engineering	$2,500	$5,000	$7,500
Bond Vote Assistance	$1,500	$1,500	$3,000
Special Services	$1,500	$1,250	$2,500
Step I Subtotal	$5,250	$7,750	$13,000
Step II - Final Design and Permitting [2]			
Final Design Basic Services	$85,000	$70,000	$155,000
Special Services	$5,000	$5,000	$10,000
Step II Subtotal	$90,000	$75,000	$165,000
Step III - Construction Phase Services [2]			
Construction Services	$155,000	$110,000	$265,000
Special Services	$10,000	$10,000	$20,000
Step III Subtotal	$165,000	$120,000	$285,000
Other Costs			
Administration	$2,000	$1,500	$3,500
Permit Fees	$2,500	$2,500	$5,000
Easements/Land Acquisition	$0	$0	$0
Legal	$1,500	$1,500	$3,000
Short Term Interest	$5,000	$5,000	$10,000
Other Subtotal	$11,000	$10,500	$21,500
Total Cost	$1,835,200	$1,271,250	$3,106,500
Use	**$1,835,000**	**$1,270,000**	**$3,105,000**

Notes:
1. ENR 14200 = February 2024
2. Allowances for engineering fees based on State curve allowances.

8.8. Available Funding Sources

The Village wants to pursue grant opportunities through the Efficiency and Conservation Block Grant program and Efficiency Vermont for the Sludge Dryer Handling and Storage improvements, but there are several available funding sources that can be used for these types of wastewater projects as described below.

Capital Funds - These capital funds are allocated in the wastewater budget for smaller and simpler projects.

ARPA - The State and Local Fiscal Recovery funds were distributed directly to the Village in 2021 and 2022, and eligible categories are water and sewer infrastructure investments. Funds in this program must be committed by December 31, 2024 and spent by December 31, 2026.

State of Vermont Clean Water Revolving Funds - This program is administered by the State of Vermont Water Investment Division. Subsidy can be available for disadvantaged communities and the SRF loan has a 2% administrative fee and term of 20 to 30 years. If the project is not started before May 2022, this new funding is also subject to the BABA (Build America Buy America) requirements for these types of wastewater projects. A priority list application is due by March 2, 2023

USDA/Rural Development - The USDA/RD program includes both grants and loans, depending on the project and the community's ability to pay. Since the Village of Bellows Falls has a Median Household Income (MHI) below the Statewide average, this project would be eligible for a grant up to 45% and loan package could be offered at a market-based interest rate which varies based on the prime interest rate. Historically, a typical grant is issued in the range from 25 to 40% for eligible communities.

Funding offers from this program are not made until after a municipality has a positive bond vote for the project. Additionally, systems must use meter-based billing to make use of USDA/RD funding programs, though meter installation costs can also be funded through the USDA/RD program.

Vermont Bond Bank (VBB) - The Vermont Bond Bank (VBB); formerly the Vermont Municipal Bond Bank) provides financing for infrastructure projects at a market-based interest rate and a variety of loan terms, though it does not provide subsidies or grants. While VBB financing could be used for the proposed upgrades, it may not offer any advantage over CWSRF funding unless some portions of the project are not eligible for other State and Federal funding sources.

A funding summary is provided below in Table 6.5

Table 6.5
Funding Summary

Funding Source	**Estimated Amount**
Capital Funds	
ARPA	
State CW Funds	
USDA/Rural Development	
Total	

8.9. Next Steps