November 2024

ENGINEERING REPORT

THE CITY OF WATERTOWN

Wastewater Treatment Plant Facility Plan

Applied Technologies
Engineers - Architects

PN6573

Engineering Report

City of Watertown

WASTEWATER TREATMENT PLANT FACILITY PLAN

November 2024

Prepared by:
Applied Technologies, Inc.
13400 Bishop's Lane, Suite 270
Brookfield, WI 53005
(262) 784-7690

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Chapter 1
EXECUTIVE SUMMARY

The City of Watertown owns and operates a 5.2 million gallon per day (mgd) advanced wastewater treatment plant (WWTP) that serves all property within the City limits and discharges treated effluent to the Rock River. The WWTP's previous Facility Plan was completed in 2000, and a new wastewater treatment plant was constructed in 2004. The City is currently meeting its permitted discharge standards; however, plant loadings have begun to exceed design values outlined in the previous Facility Plan. The City authorized this Facility Plan to evaluate wastewater treatment alternatives for the planning area over a 20-year period (2027 through 2047) for the following reasons:

1. Influent loadings to the WWTP are exceeding the plant's rated capacity.
2. Existing treatment plant components are becoming obsolete due to age and condition.
3. The existing plant has reached the end of its 20-year design life.
4. To provide a plan for adequate capacity for future growth over the next 20 years.

The population of the City of Watertown was 24,357 in 2022 and is projected to grow to 27,492 by the year 2047. Waste load projections were developed based on the population growth and waste loads from major industrial dischargers. Figure 1-1 through Figure 1-5 present the existing and projected flows and pollutant loadings at the WWTP. These figures show that the existing plant is currently at 90-110% of rated plant capacity for BOD, TSS and TKN loading and will increase to 110-130% of its design capacity by the year 2047.

The WWTP has consistently met current effluent limits in its discharge permit. This excellent treatment performance is due to the diligence and hard work of the plant's operating staff. However, as the existing facilities and equipment age, it will be difficult to meet increasingly stringent discharge limits in the future.

An analysis of infiltration and inflow (I/I) indicated that the Watertown WWTP is experiencing excessive inflow. The City is drafting a new ordinance to require disconnection of drain tiles, and the WWTP will continue its current regime for handling and repairing I/I sources.

FIGURE 1-1
Annual Average Plant Flows

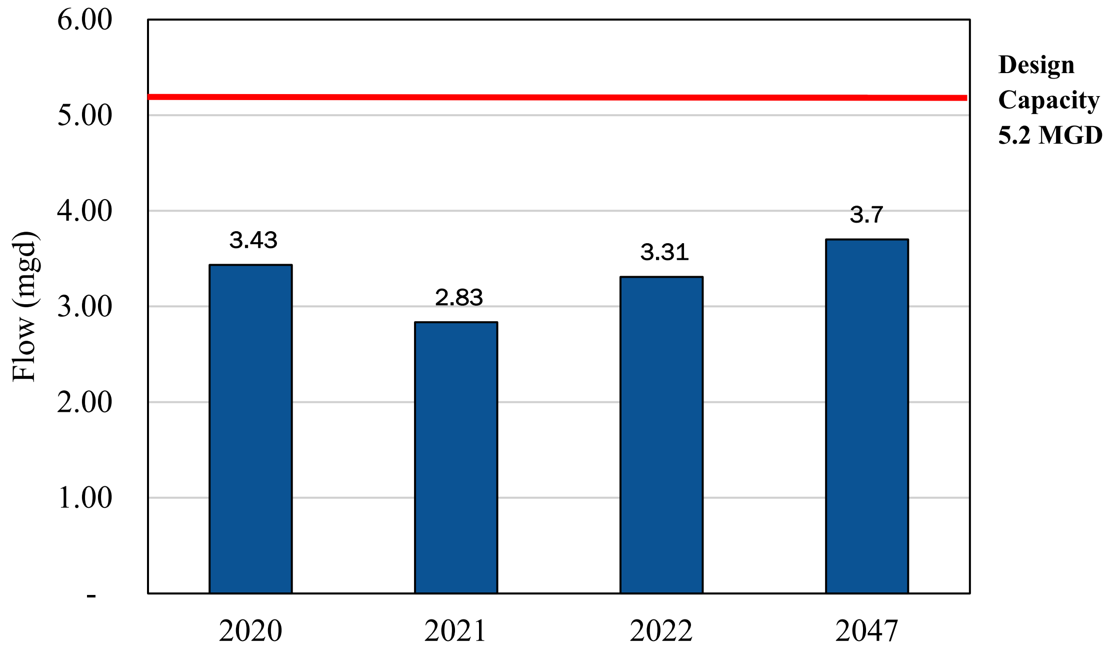


FIGURE 1-2
Annual Average BOD Loading

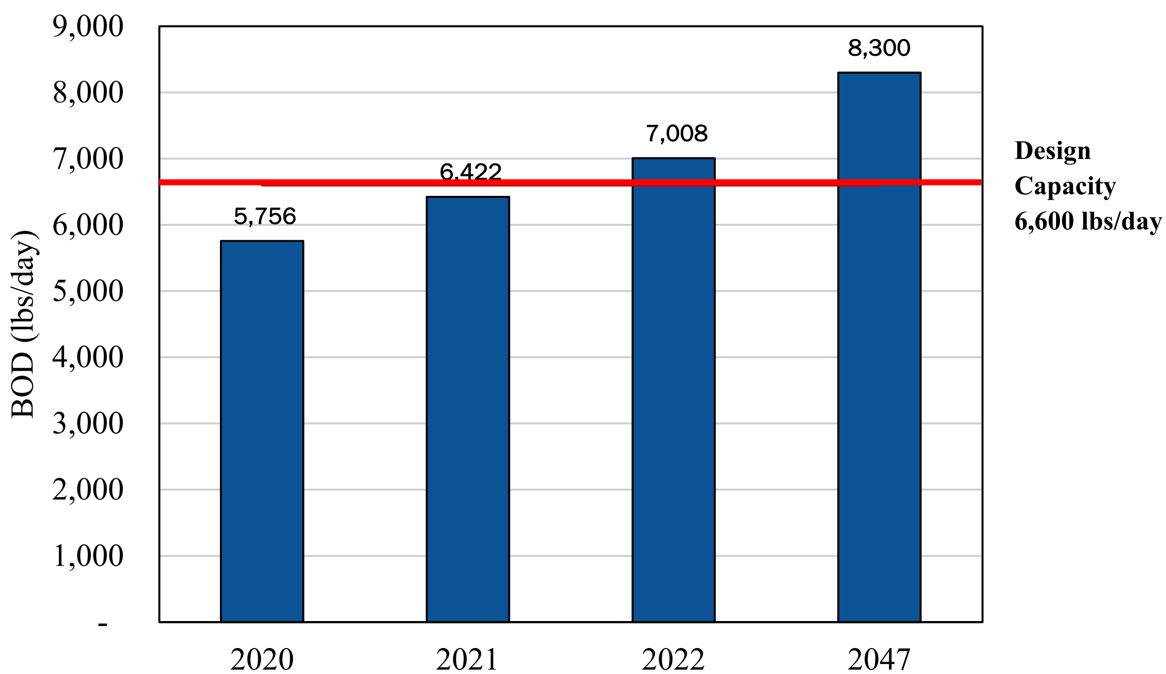


FIGURE 1-3
Annual Average TSS Loading

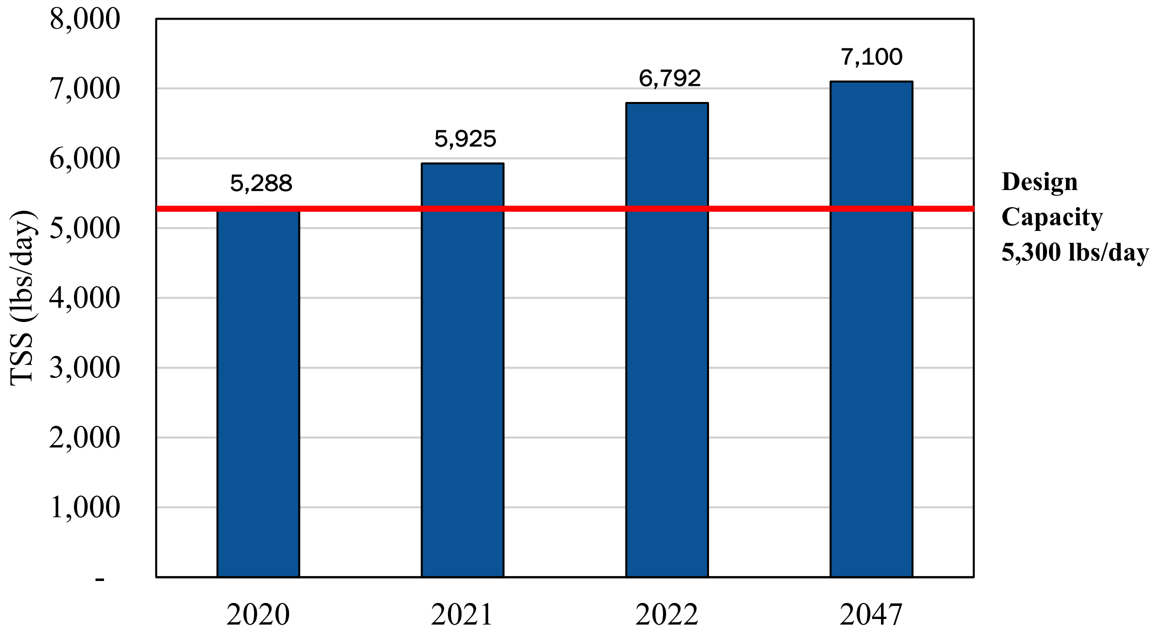


FIGURE 1-4
Annual Average TKN Loading

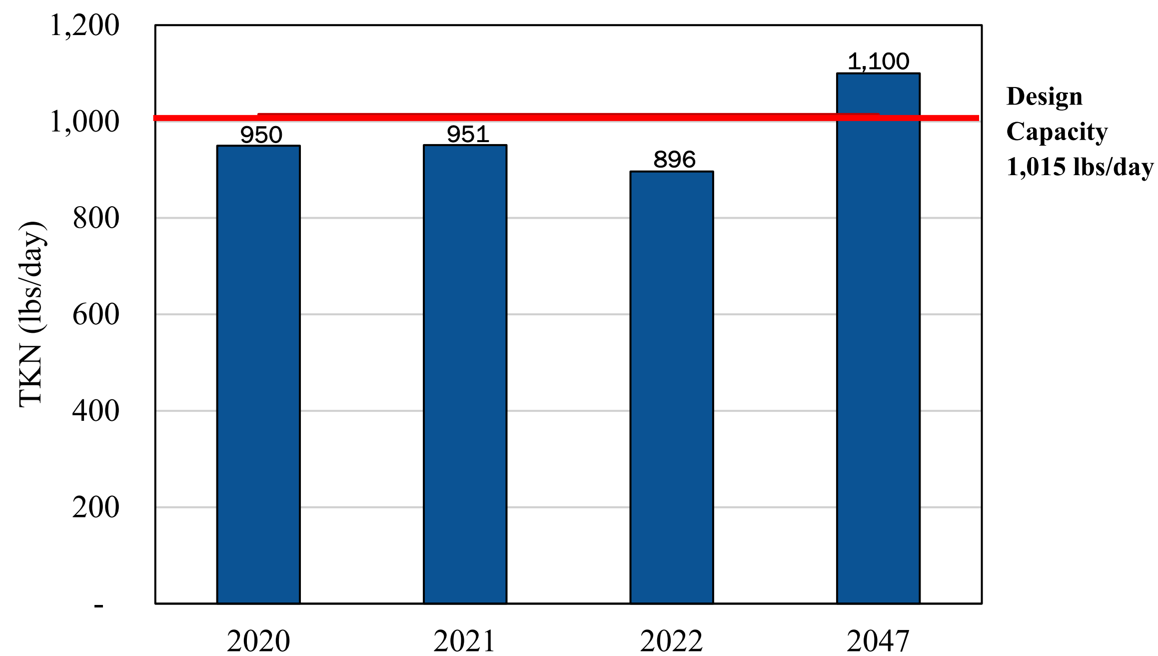
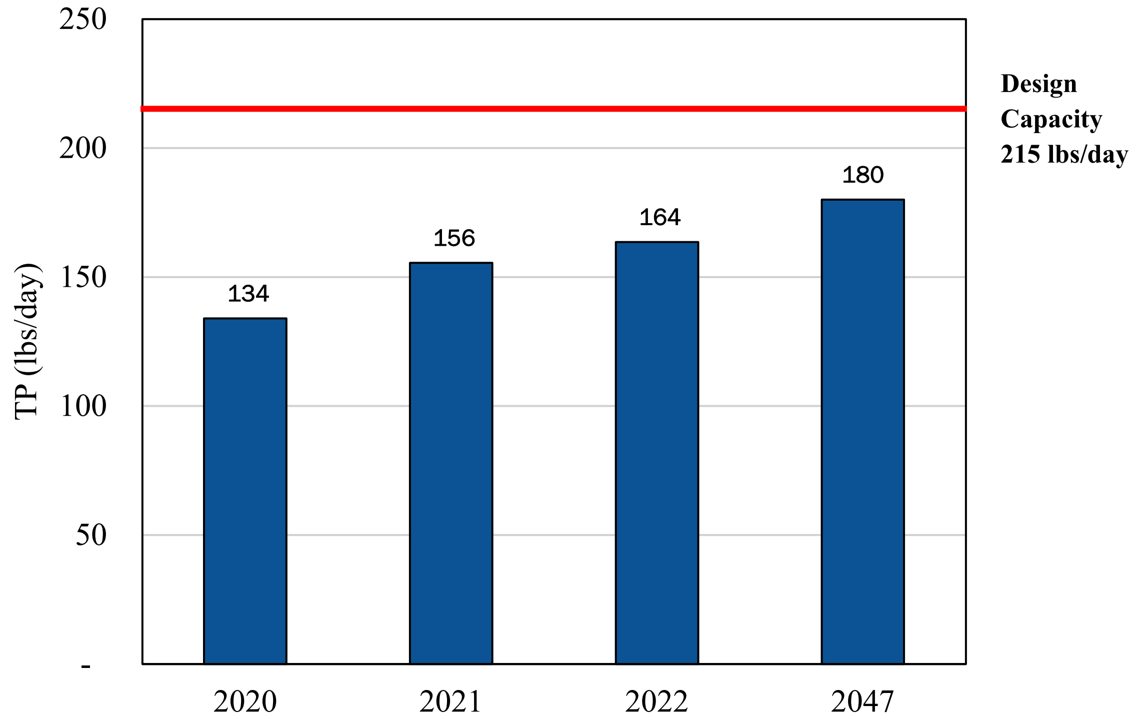


FIGURE 1-5
Annual Average TP Loading



Annual average design flows and loadings for the year 2047 were calculated by estimating residential and industrial flows and loadings. Design year flows were determined to remain less than the rated capacity of the WWTP. Therefore, the existing design flows will be used for capacity analysis and equipment sizing. Current peaking factors were used to calculate design maximum month, peak week, and peak day loadings. Results are summarized in Table 1-1.

Table 1-1
Influent Flows and Loadings, Design Year 2047

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	5.2	8,300	7,100	750	1,100	180
Maximum Month	8.8	13,900	15,000	1,000	1,400	400
Peak Week	10.4	16,300	19,500	1,300	1,900	550
Peak Day	24	29,100	44,500	2,000	2,800	710
Peak Hour	27	-	-	-	-	-

Evaluations of selected facilities at the Watertown WWTP were performed, focusing on the areas identified at the Facility Plan Kickoff meeting and subsequent update meetings. The capacities of the facilities were compared to the current wasteloads and projected design year 2047 waste loads. Deficiencies and shortfalls were discussed, and alternatives for upgrading the existing facilities were identified and evaluated via present worth economic analyses.

A majority of the recommended plan includes replacing in kind the aging equipment that has reached the end of its 20-year design life. Upgrades to select treatment process will be completed to allow the Watertown WWTP to handle the projected flows and loadings for the design year 2047. The plan is outlined in a phased approach, with required upgrades being separated into near-term (0-2 years), mid-term (3-5 years), or long-term (5-10 years) improvements. These improvements are described below and summarized in Table 1-2 through Table 1-4.

Mid-term improvements will be made to the Raw Sewage Pump Station with provisions to operate a sixth raw sewage pump using a portable standby generator. The primary influent force mains will be equipped with electrically actuated valves for remote flushing of grit buildup in either pipe. Long-term improvements include the replacement of the raw sewage pumps in kind.

The Preliminary Treatment facilities will be upgraded in the near term with replacement fine screens, grit removal and grit washing equipment rated for the same hydraulic capacity as the existing systems.

Near-term Primary Treatment improvements include replacement of the primary sludge and scum pumps. Mid-term improvements include the addition of primary sludge line cleanouts to control vivianite buildup in the pipelines, and replacement of the mixers. The primary scum well will also be modified to reroute the subnatant to the headworks of the WWTP to avoid the buildup of fats, oils, and grease downstream of the Primary Clarifiers. Long-term improvements include replacing the primary clarifier mechanisms and drives.

The Secondary Treatment facilities will continue utilizing the existing activated sludge system, but the aging blowers and fine bubble diffusers will be upgraded in the mid-term to accommodate the increase in waste loads at the plant and maintain compliance with effluent limits. The Secondary Splitter Structure will be upgraded with isolation gate valves to allow the two treatment trains to operate in parallel, and the aging chemical feed system will be replaced. Chemical phosphorus removal will continue to be the primary system used to meet effluent total phosphorus limits throughout the planning period. Long-term improvements include replacing the secondary sludge pumps, mixers, and final clarifier mechanisms and drives.

The ultraviolet disinfection system will be replaced in the near term to match the disinfection capacity with the 27 mgd hydraulic capacity of the existing system. A structural analysis of the cascade aerator and effluent outfall will be completed as part of the mid-term improvements to ensure the structures remain in good condition throughout the planning period.

Mid- and long-term improvements to the Biosolids Handling facilities will include replacing the aging boiler, centrifuges, sludge grinders, polymer system, and sludge discharge conveyors. The anaerobic digesters date from the 1970s, so a structural assessment of the digesters and digester covers will be completed to ensure they will remain in good condition through the planning period. Other improvements include replacing the anaerobic digester mixers, waste gas burner and ancillary gas safety equipment.

Several miscellaneous upgrades will be made throughout the wastewater treatment facilities, including the near-term replacement of the transformer near the Raw Sewage Pump Station, standby power generator and automatic transfer switch, instrumentation and control systems, fire alarm, gas monitoring system, and HVAC systems. The site's storm water pumps will be replaced in kind within the planning period.

TABLE 1-2
Summary of Near-Term Plant Improvements

Unit Process	No.	Size/Capacity
Preliminary Treatment		
Fine Screens	2	13.5 mgd, each
Grit Removal System Upgrades	1	18-ft Dia, 20-ft depth
Primary Treatment		
Primary Sludge and Scum Pumps	4	54 gpm, each
Disinfection		
UV Disinfection System	1	27 mgd
Biosolids Treatment		
Polymer System	2	94 lb/hr, each
Miscellaneous Improvements		
Transformers/Electrical Service Upgrade	1	N/A
SCADA Improvements	1	N/A
Gas Monitoring System Replacement	1	N/A
Fire Alarm System Replacement	1	N/A

TABLE 1-3
Summary of Mid-Term Plant Improvements

Unit Process	No.	Size/Capacity
Raw Sewage Pumping		
Auxiliary Generator Upgrades	1	N/A
Primary Treatment		
Scum Well Upgrades	1	N/A
Scum Well Pump	1	250 gpm
Scum Well Mixer	1	N/A
Secondary Treatment		
Secondary Splitter Upgrades	1	N/A
Aeration Basin Concrete Rehabilitation	1	N/A
Aeration Blowers*	3	3,000 scfm, each
Fine Bubble Diffusers*	1	N/A
Chemical Feed Pumps	3	5-30 gpm, each
Chemical Storage Tank	1	10,000 gal
Biosolids Treatment		
Primary Sludge Line Cleanout Improvements	1	N/A
Anaerobic Digester Structural Assessment	1	N/A
Centrifuges	2	1,500 lb/hr, each
Sludge Grinders	2	170 gpm, each
Sludge Discharge Conveyor	1	N/A
Miscellaneous Improvements		
Cascade Aeration Assessment	1	N/A
Effluent Outfall Assessment	1	N/A
Generator/ATS	1	N/A
HVAC System Improvements*	1	N/A

TABLE 1-4
Summary of Long-Term Plant Improvements

Unit Process	No.	Size/Capacity
Raw Sewage Pumping		
Raw Sewage Pumps	5	4,700 gpm, each
Primary Treatment		
Primary Clarifier Mechanisms/Drives	2	85-ft Dia, 12-ft SWD
Secondary Treatment		
Anoxic Mixers	3	1,500 gpm, each
Mixed Liquor Recycle Pumps	3	2,600 gpm, each
Return Sludge Pumps	3	2,300 gpm, each
Waste Sludge Pumps	2	380 gpm, each
Final Scum Pump	1	150 gpm, each
Final Clarifier Mechanisms/Drives	2	90-ft Dia, 16-ft SWD
Biosolids Treatment		
Anaerobic Digester Mixers	5	9,000 gpm, each
Dual Fueled Boiler	1	3,400 MBh
Waste Gas Burner	1	7,900 scf/hr
Miscellaneous Improvements		
Storm Water Pumps	2	1,670 gpm, each

The estimated capital costs and debt service for the three projects are shown in Table 1-5, with the debt service estimated using the September 2024 Clean Water Fund (CWF) interest rate of 2.365%.

Table 1-5
Debt Service Estimate

Project	Project Cost	Loan Amount	Annual Principal and Interest Payment
Near-Term Improvements	$9,098,000	$8,188,000	$519,000
Mid-Term Improvements	$10,261,000	$9,235,000	$585,000
Long-Term Improvements	$14,063,000	$12,657,000	$802,000

It is estimated that the current utility rates are sufficient for the additional revenue requirements for the proposed Near-Term project. It should be noted that the final cost allocation and user charge rates will be determined from a user charge study after final project costs, CWFP impacts, and method of financing are determined

The steps and anticipated schedule for implementing the recommended plant are outlined below:

- Conduct Public Hearing .... November 2024
- Submit Facility Plan to DNR .... December 2024
- DNR Approval of Facility Plan .... March 2025
- Near-Term Improvements
  - Begin Design .... January 2025
  - Submit Plans and Specifications to the DNR .... September 2025
  - Bidding .... November 2025
  - DNR Approval of Plans and Specifications .... December 2025
  - Submit Clean Water Fund Application .... December 2025
  - Award of Contract .... January 2026
  - Begin Construction .... March 2026
  - Final Completion/Startup of Facilities .... May 2027
- Mid-Term Improvements .... January 2028
- Long-Term Improvements .... January 2030

Chapter 2

INTRODUCTION

This report presents the conclusions and recommendations of the Wastewater Facility Plan for the City of Watertown (City) Wastewater Treatment Plant (WWTP) in Jefferson County, Wisconsin. The planning area includes the City of Watertown and adjacent portions of the Towns of Watertown, Ixonia, and Milford in Jefferson County, and the Towns of Emmet, Lebanon and Shields in Dodge County. This project was undertaken by the City to evaluate wastewater treatment alternatives for the planning area over the next 20 years.

The facility planning process is required by the Wisconsin Department of Natural Resources (WDNR) and U.S. Environmental Protection Agency (EPA) prior to the expansion or modification of a wastewater treatment plant or to receive any grant money for the construction of wastewater treatment facilities. The planning process is a systematic, economic, technical, and environmental evaluation of alternatives for wastewater treatment and disposal. The recommended wastewater treatment alternative must meet the required effluent limitations and be cost effective. The facility planning procedure assures the public and all levels of government that decisions regarding the facilities are soundly made and consider all relevant factors.

PROJECT BACKGROUND

The City of Watertown owns and operates a 5.2 mgd conventional activated sludge WWTP that serves all property within the City limits. The WWTP's previous Facility Plan was completed in 2000, and a new wastewater treatment plant was constructed in 2004. The WWTP upgrade increased the loading capacity to 6,600 lb/day of BOD and maintained the 5.2 mgd design flow. The WWTP upgrade included raw sewage pumping, fine screening and grit removal, primary clarification, activated sludge treatment, chemical phosphorus removal, final clarification, UV disinfection, anaerobic digestion, sludge dewatering and cake sludge storage.

The WWTP discharges to the Rock River (Middle Rock River Watershed, UR01 – Upper Rock River Basin) in Jefferson County. The WWTP is located within the Hahns Lake-Rock River subwatershed of the Middle Rock River, defined by defined by its 12-digit hydrological unit code (HUC-12) 070900011103 and shown in Figure 2-1. The WWTP site is located outside of the Federal Emergency Management Agency (FEMA) 100-year floodplain as shown in Figure 2-2.

FIGURE 2-1
HUC-12 Watersheds

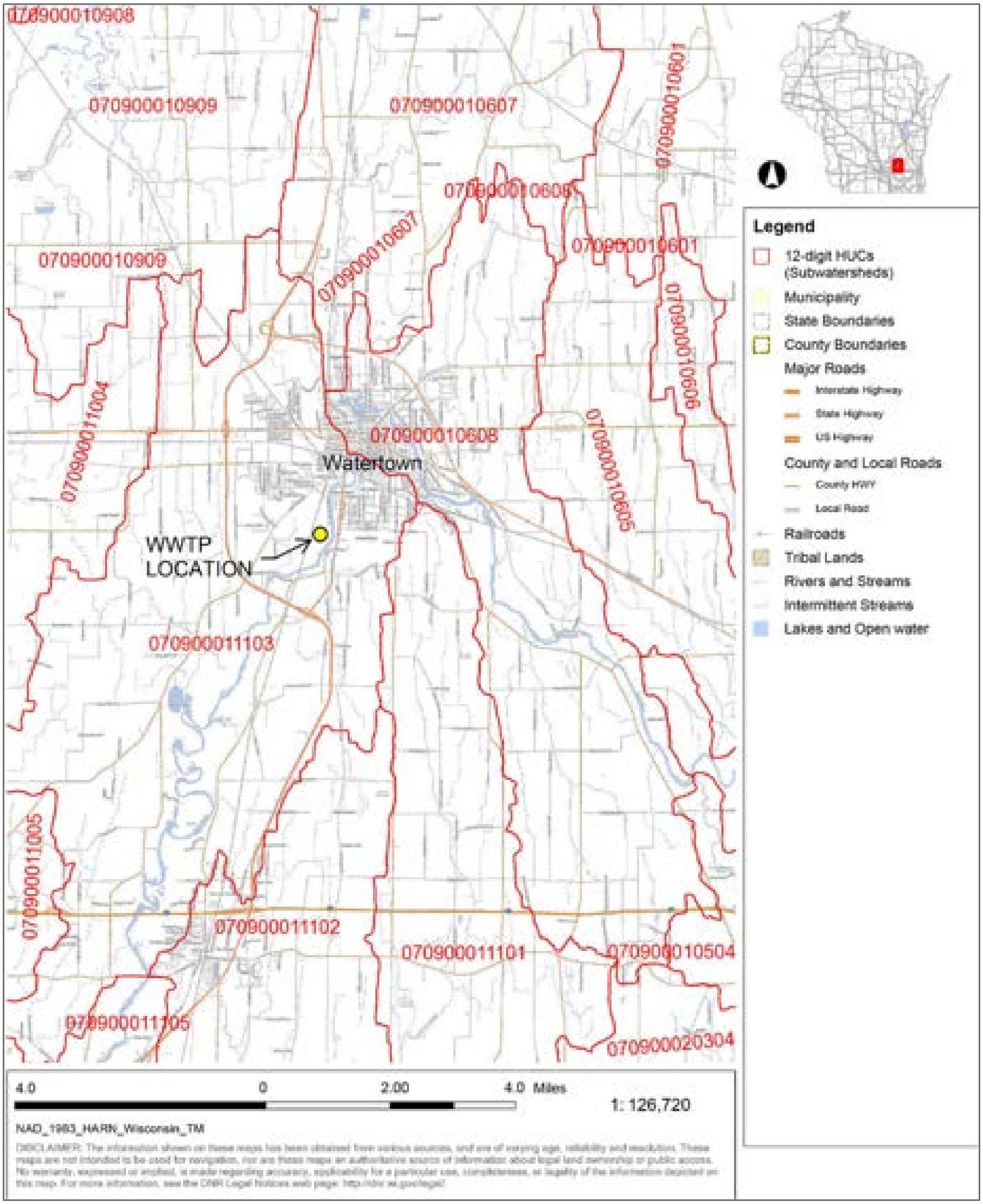


FIGURE 2-2
Flood Hazard Zones

The City of Watertown WWTP is currently meeting its permitted discharge standards. Effluent quality in 2020-2022 averaged 4.5 mg/L BOD, 4.5 mg/L total suspended solids (TSS), 0.12 mg/L ammonia nitrogen (NH3-N) and 0.44 mg/L total phosphorus (TP). However, influent plant loadings have begun to exceed design values outlined in the 2000 Facility Plan. Waste loadings for BOD, TSS, TKN, and TP are in the range of 90-110% of rated plant capacity. Future effluent limitations will also place greater demands on the existing plant infrastructure.

The City decided to undertake this Facility plan for the following reasons:

1. Influent loadings to the WWTP are exceeding the plant's rated capacity.
2. Existing treatment plant components are becoming obsolete due to age and condition.
3. The existing plant has reached the end of its 20-year design life.
4. To provide a plan for adequate capacity for future growth over the next 20 years.

PURPOSE AND SCOPE

A Facilities Plan develops the most cost-effective and environmentally sound plan for wastewater management to abate existing sources of pollution, provide adequate treatment capacity for future growth in the planning area, and meet area wide water quality standards and water management goals issues by the WDNR. The most current planning guidelines and regulations distributed by the U.S. EPA and WDNR were used to prepare this report.

The scope of work for this Facility Plan included the following activities:

1. Review and develop project goals and objectives by conducting a meeting with the City. The meeting will include discussion of items such as the City's objectives, scope of services, schedule, key project personnel, and project concerns.
2. Review existing data and facilities including the following tasks:
   - A. Obtain influent, effluent, and biosolids data for a minimum of three years.
   - B. Acquire previous reports.
   - C. Analyze the performance of the existing plant and individual plant operations.
   - D. Visit the facilities to identify items that will require upgrade or replacement.
3. Prepare an infiltration/inflow (I/I) analysis to determine the amount and type of I/I. Perform a cost-effectiveness analysis to evaluate the cost of additional plant hydraulic capacity to convey and treat I/I versus typical I/I reduction measures. Determine cost-

effective approach and whether I/I is “non excessive” according to EPA and DNR guidelines.

4. Prepare a 10- and 20-year population and flow projections using existing wastewater and population data and population projections from the Southeast Wisconsin Regional Planning Committee (SEWRPC) and Wisconsin Department of Administration (DOA).
5. Prepare and send industrial surveys to determine future capacity needs. Review existing industrial monitoring test results as provided by the Cit to obtain current baseline loading levels. Revise loading projections with information obtained from the industrial survey.
6. Correspond with the WDNR to develop effluent limits as appropriate for the projected wastewater flows.
7. Summarize condition and performance of existing facilities based on the current and projected flows and loadings, the stated design capacities from previous reports, and an updated condition assessment.
8. Identify, develop, and evaluate viable alternative that address the needs of the City. Conduct a brainstorming meeting with City staff to obtain their input and screen the alternatives.
9. Prepare sizing and layouts for the viable alternatives. Identify unit process dimensions and potential arrangements on the present facility sites.
10. Prepare a cost-effectiveness analysis and evaluate the non-monetary advantages and disadvantages of the viable alternatives. Estimate capital costs and operations and maintenance costs for each. Compile and submit this information to City staff for their review and input. After obtaining the City’s input, meet with City staff and recommend a preferred alternative.
11. Estimate the impact of the selected alternative on the City’s sewer user charge system and the average residential homeowner.
12. Develop an implementation plan and schedule for the selected alternative.
13. Prepare a draft Wastewater Treatment Facility Plan for review and input by City staff. Revise the draft Plan, if necessary, and present it at a City meeting.
14. Assist the City in conducting a public hearing on the City-approved draft Wastewater Treatment Facility Plan.
15. Finalize the Wastewater Treatment Facility Plan, incorporating comments from the City, and submit it to the WDNR. Review WDNR comments and respond.

PLANNING AREA AND STUDY PERIOD

The planning area for the Facility Plan was developed based on the City's Comprehensive Master Plan. The Comprehensive Master Plan was finalized in December 2019 and presents a plan for the short- and long-range growth and development of the City of Watertown. The general planning area is considered to be the City of Watertown 3-mile Extraterritorial Jurisdiction Limit (ETJ). The planning area encompasses the current Urban Service Area, which is the area where the City expects to be able to provide municipal services within the next 20 years. The planning area is located in southeast central Wisconsin, approximately 45 miles west of Milwaukee and 35 miles east of Madison. A map of the planning area for the Facility Plan is provided in the Appendix.

In accordance with NR 110 of the Wisconsin Administrative Code, the planning period for the Facility Plan will be 20 years. The planning period begins with the start-up of the proposed facilities, which should occur in 2027. Therefore, the planning period encompasses the years 2027 through 2047.

Chapter 3

EFFLUENT LIMITATIONS

Effluent limitations are based on the water use objectives and water quality standards that are developed to achieve the desired results. In Wisconsin, these objectives and standards are established by Federal, State, and regional agencies and are administered through the Wisconsin Pollutant Discharge Elimination System (WPDES). Under this system, the Wisconsin Department of Natural Resources (WDNR) issues WPDES permits to each discharger in the state, setting forth the effluent limitations that must be met.

This chapter briefly reviews Federal and State water use objectives and water quality standards, the water quality of the receiving stream, and the proposed WPDES permits and related effluent limitations.

WATER QUALITY STANDARDS

Recognizing the need for a nationwide approach to water quality, the U.S. Congress, through the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500), declared its objective to restore and maintain the chemical, physical and biological integrity of the nation's waters. Congress also required the establishment of water quality standards for all waters consistent with the applicable requirements of the Act.

The Wisconsin Legislature, in Chapter 281 of the Wisconsin Statues, recognized that different standards should be required for different waters. Wisconsin water use objectives and water quality standards have been identified and cited in Chapters NR 102 through NR 106 of the Wisconsin Administrative Code with amendments and revisions created as needed.

The Watertown WWTP discharges to the Rock River within the Middle Rock River Watershed in the Upper Rock River Basin in Jefferson County. The Rock River is classified by the WDNR to meet the water quality standards for Warm Water Sport Fish community, in accordance with NR102 and 104. The City is required to meet Water Quality Based Effluent Limits (WQBELs) based on chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code. The City is also required to meet additional mass limitations for total phosphorus (TP) and total suspended solids (TSS) in accordance with the Rock River Basin Total Maximum Daily Loads (TMDL).

DISCHARGE PERMIT REQUIREMENTS

Public Law 92-500 requires a National Pollutant Discharge Elimination System (NPDES) permit for any point sources discharge of pollutants into the nation's navigable waters. Chapter 283 of the Wisconsin Statues authorizes the DNR to "establish, administer, and maintain a state pollutant discharge elimination system." This permit system, known as WPDES, conforms to the objectives and requirements of Public Law 92-500. The State of Wisconsin has expanded the permit system beyond the navigable waters concept by applying it to all of the State's receiving waters.

The Watertown WWTP operates under WPDES Permit No. WI-0028541-09-3, for discharging effluent to the Rock River within the Middle Rock River Watershed in the Upper Rock River Basin in Jefferson County. A copy of the current permit is included in the Appendix. The permit was issued in September 2020 and expires on September 30th, 2025. Several permit modifications have been authorized during the permit term:

- The permit was initially modified to authorize blending and to modify flow and metals sampling frequency.
- The permit was modified on October 1, 2022, to authorize Water Quality Trading for phosphorus, remove the Multi Discharger Variance, and remove bacteria monitoring requirements for fecal coliform. Fecal coliform limits were replaced with requirements for E. coli monitoring and limitations.
- The permit was modified on March 13, 2024, to authorize Water Quality Trading for TSS.

Planning effluent discharge limits were requested from the WDNR during the facility planning effort. The effluent limits request was based on the proposed 20-year design flows and loadings for the wastewater treatment plant. The WDNR provided an WQBEL memorandum that described recommended effluent limitations for the 20-year planning period. A copy of the WQBEL memorandum is provided in the Appendix, and a summary of recommended effluent limitations is provided in Table 3-1.

Additional TP and TSS mass limitations are required in accordance with the waste load allocations specified in the Rock River TMDL. The mass limitations are summarized in Table 3-2.

TABLE 3-1
WDNR Recommended Effluent Limitations

Parameter		Average Weekly	Average Monthly	Daily Maximum	Daily Minimum
BOD_5	January	31 mg/L (1,400 lbs/d)	30 mg/L		
	February	35 mg/L (1,500 lbs/d)	30 mg/L		
	March – May	45 mg/L	30 mg/L		
	June	16 mg/L (690 lb/d)	16 mg/L		
	July and October	12 mg/L (530 lb/d)	12 mg/L		
	August – September	10 mg/L (450 lb/d)	10 mg/L		
	November	25 mg/L (1,100 lb/d)	25 mg/L		
	December	29 mg/L (1,300 lb/d)	29 mg/L		
TSS	January	31 mg/L	30 mg/L		
	February	35 mg/L	30 mg/L		
	March – May	45 mg/L	30 mg/L		
	June	16 mg/L	16 mg/L		
	July and October	12 mg/L	12 mg/L		
	August – September	10 mg/L	10 mg/L		
	November	25 mg/L	25 mg/L		
	December	29 mg/L	29 mg/L		
Ammonia Nitrogen	November – March	20 mg/L	20 mg/L	20 mg/L	
	April – May	No Limit	No Limit	No Limit	
	June	17 mg/L	17 mg/L	No Limit	
	July	9.0 mg/L	9.0 mg/L	No Limit	
	August	6.4 mg/L	6.4 mg/L	No Limit	
	September	8.9 mg/L	8.9 mg/L	No Limit	
	October	13 mg/L	9.3 mg/L	No Limit	
Phosphorus[1,3]	July – March, May			1.0 mg/L	
	April – June			0.8 mg/L	
Bacteria[2] (*E. coli*)			126 #/100 mL		
pH				9.0 s.u.	6.0 s.u.
Dissolved Oxygen					6.0 mg/L

1. Geometric mean. Bacteria limits apply during the disinfection season of May through September. Additional limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100mL.
2. If water quality trading is used as compliance option for phosphorus, the concentration limits shown in Table 3-1 would be required to continue as minimum control levels.

TABLE 3-2
Total Phosphorus and Total Suspended Solids Mass Limitations

Month	Weekly Average TSS Effluent Limit (lbs/day)[1]	Monthly Average TSS Effluent Limit (lbs/day)	Monthly Average TP Effluent Limit (lbs/day)
January	1,400	1,270	13.7
February	1,500	1,410	19.5
March	2,270	1,270	18.4
April	2,340	1,310	18.3
May	2,270	1,270	16.5
June	690	700	17.6
July	530	510	17.7
August	450	430	16.2
September	440	440	14.8
October	530	510	12.3
November	1,100	1,100	12.3
December	1,300	1,230	11.9

1. The TMDL-derived weekly average TSS limits are superseded by more stringent TSS limits for the months of June through February that were included in the permit prior to the TMDL. The most restrictive limits are presented in the table above.

Chapter 4

CURRENT SITUATION

This chapter presents an analysis of the existing collection system's infiltration/inflow and the current flows and waste loadings received at the Watertown WWTP. The examined wasteloads include residential, commercial, institutional, and industrial sources.

INFILTRATION AND INFLOW ANALYSIS

Sanitary sewer systems are designed to transport the wastewater of a community to the wastewater treatment plant. Rainfall, snowmelt, or high groundwater conditions can cause clearwater to enter the sewer system through system defects or illegal connections. This clearwater is called infiltration/inflow (I/I). I/I uses the capacity of the sanitary sewers and treatment plant and increases the cost of transporting and treating the wastewater. I/I can also affect the performance of the sewer system and treatment plant.

Infiltration is defined as clearwater entering the sewer system from the ground through defective pipes, joints, connections, or manholes. Inflow is defined as clearwater discharged into a sewer system from sources such as roof drains, foundation drains, manhole covers, cross connections from storm sewers, surface runoff, and cellar, yard, and area drains.

The WDNR uses the following parameters as general indicators of possibly "excessive" I/I (i.e., potentially cost-effective to remove) for sanitary sewer systems:

- **Infiltration:** The infiltration threshold criterion is whether the dry weather flow (the highest base flow plus infiltration occurring for a seven- to 14-day dry weather period during a year) is less than or equal to 120 gallons per capita per day (gpcd).
- **Inflow:** The inflow threshold criterion is whether the maximum daily flow during a storm is less than or equal to 275 gpcd.

An evaluation was made to determine if the Watertown collection system is experiencing excessive I/I. Table 4-1 provides an analysis of the amount of I/I based on the 7-day rolling average of influent flow to the WWTP during the years 2020-2022 as it relates to the total average daily per capita flow. For the purposes of this analysis, population data from 2022 was used for determining total average daily per capita flow.

TABLE 4-1
Inflow and Infiltration Analysis, 2020-2022

Parameter	Value
Population of Watertown, 2022	24,357
Dry Weather Flow (Infiltration Threshold), gpcd	90
Maximum Wet Weather Flow (Inflow Threshold), gpcd	320

The table shows dry weather flow at approximately 90 gpcd, and maximum daily flow during a storm at approximately 320 gpcd. Therefore, the Watertown collection system can be identified as experiencing excessive inflow. According to the Wisconsin Department of Natural Resources (WDNR), separate studies for an "Infiltration/Inflow Analysis" and a "Sewer System Evaluation Survey" (SSES) may be required depending on the extent of additional clear water flows.

The City is aware of the excessive inflow to the WWTP, which is primarily caused by drain tile and sump pump connections to the sanitary sewer. An ordinance is currently being drafted for new City projects to include drain tile disconnections, and public/private partnerships are being developed encourage replacing privately owned laterals and disconnecting sump pumps from the sanitary sewer.

WASTEWATER TREATMENT PLANT INFLUENT FLOWS AND LOADINGS

Flows and loadings from January 2020 through December 2022 were analyzed to determine current annual average, maximum month, peak week, and peak day influent flows and loadings. This includes residential and non-residential loadings, including those from industrial contributors. Influent TKN data was not available and was estimated by assuming ammonia-nitrogen was 70% the TKN value. Results are summarized in Table 4-2.

TABLE 4-2
Current Influent Flows and Loadings

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	3.2	6,400	6,000	650	930	150
Maximum Month	5.1	10,700	12,600	860	1230	340
Peak Week	7.7	12,500	16,400	1,140	1630	460
Peak Day	13.1	22,400	37,300	1,670	2400	600
Outlier (removed)	2.9	47,625	100,756	1,728	2,468	880

As shown Table 4-2, significant influent BOD and TSS loadings were observed on December 21, 2021. Peak day loadings have a significant impact on plant capacity evaluation and sizing equipment. To avoid oversizing facility equipment, further statistical analysis of the data was completed to establish whether the data point could be removed from the set. Dixon's Q-Test was completed utilizing a 99% confidence interval, *and it was determined that the data point was an outlier and was eliminated.*

The WWTP effluent quality remained consistent in the days following the extreme loading event, and constituent concentrations and loadings remained within the limits set by the WPDES permit. Figure 4-1 through Figure 4-4 show BOD and TSS influent and effluent loadings for December 2021 through January 2022.

FIGURE 4-1
Influent and Effluent BOD Loading, December 21, 2021

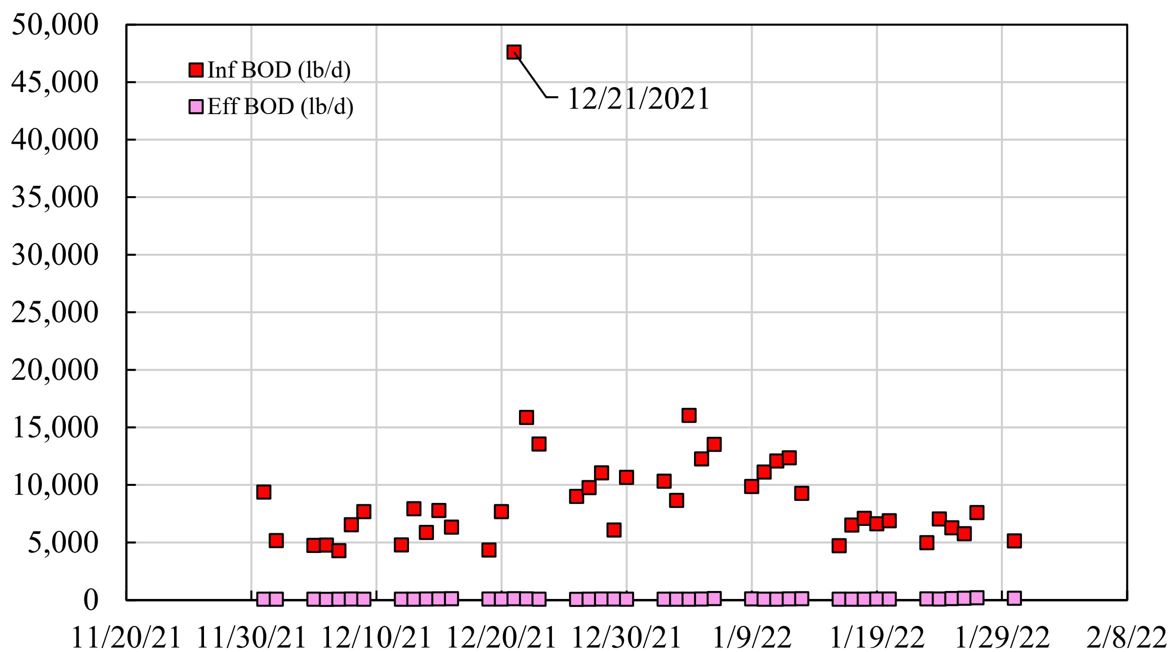


FIGURE 4-2
Effluent BOD Concentration, December 21, 2021

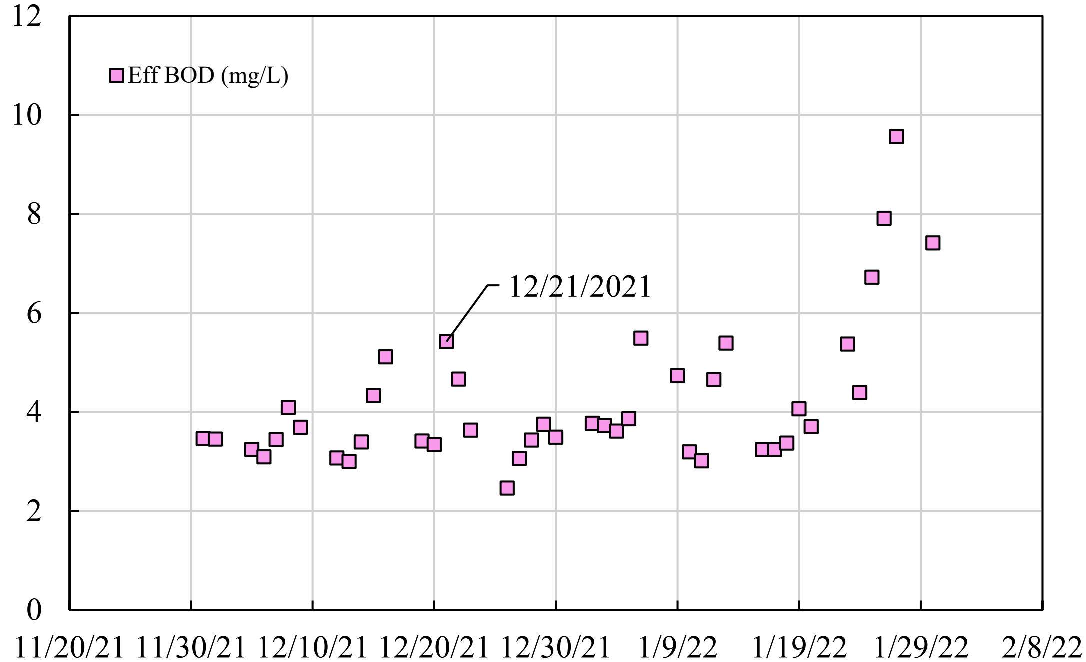


FIGURE 4-3
Influent and Effluent TSS Loading, December 21, 2021

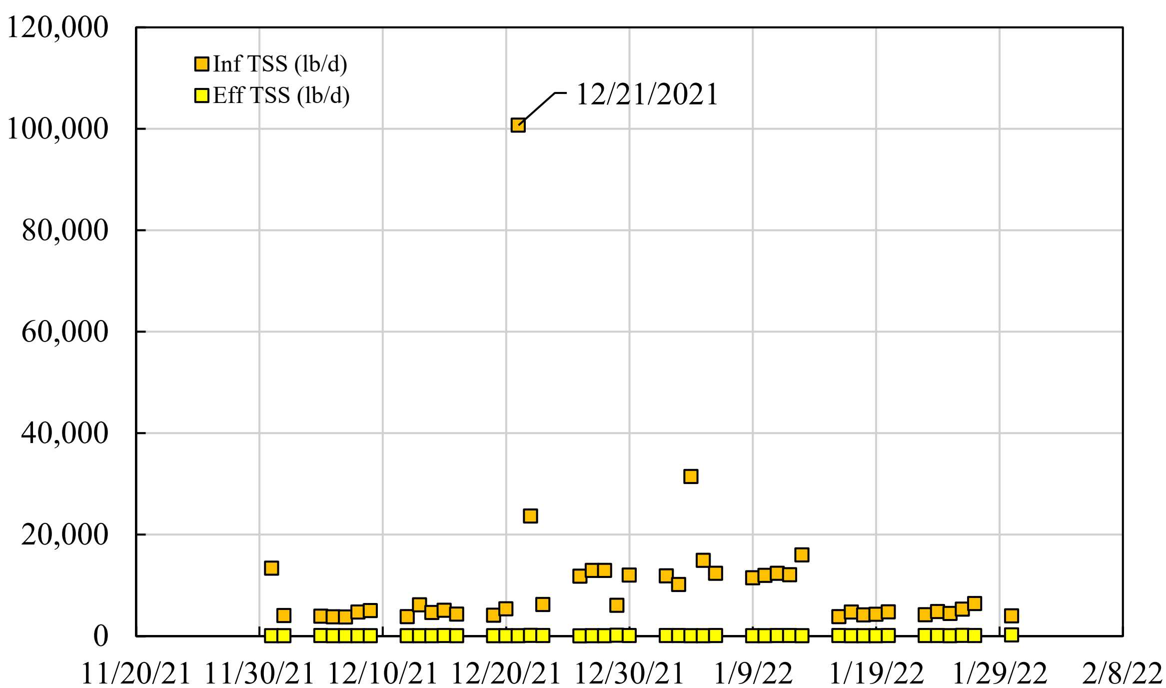
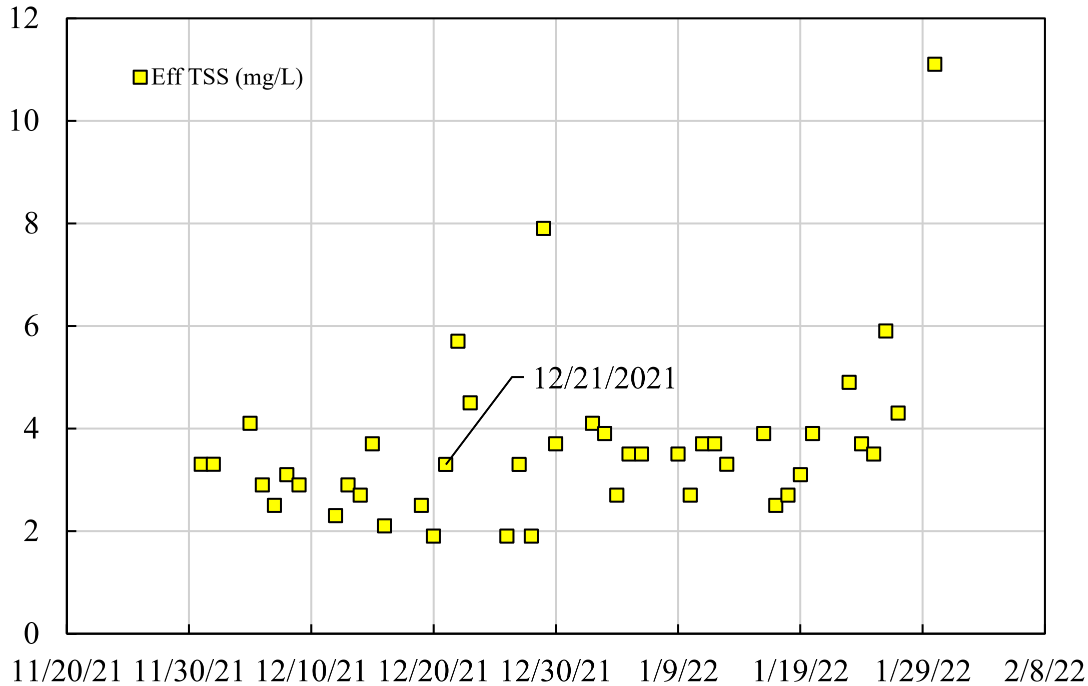


FIGURE 4-4
Effluent TSS Concentration, December 21, 2021



Industrial Flows and Loadings

A number of industries discharge to the City's sewerage system; however, only the following industries were determined to be significant users:

- Johnsonville Sausage LLC
- Clasen Quality Chocolate
- Wis-Pak, Inc.
- Ad-Tech Industries, Inc.
- Watertown Hops
- Wisconsin Investcast
- Specialty Ingredients
- Diversey, Inc.

A survey was sent to each industry to identify current and projected wastewater contributions. Johnsonville Sausage was the only significant contributor that returned the survey. The remainder of the current loading estimates were based on City data. The City completes industrial sampling annually, and flows were estimated based on monthly water usage data. Data from 2020 – 2022 was analyzed to determine the estimated annual average flows and loadings for current industrial users. Results are summarized in Table 4-3.

TABLE 4-3
Current Industrial Flows and Loadings

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	0.317	4,300	1,300	100	150	40

Wasteload contributions from other industrial users were determined to be similar in strength to residential wastewater based on the annual sampling results provided by the City[1].

Non-Industrial Flows and Loadings

Current annual average non-industrial flows and loadings were calculated by subtracting the average influent flows and loadings in Table 4-2 from the average influent flows and loadings in Table 4-3. Non-industrial flows include the contributions from residential and commercial sources, as well as I/I. Results are summarized in Table 4-4.

TABLE 4-4
Current Non-Industrial Flows and Loadings

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	2.88	2,080	4,700	550	790	110

Peaking Factors

Peaking factors were determined for the wasteloads shown in Table 4-2 by dividing each maximum month, peak week, and peak day value by the corresponding annual average value. These peaking factors will be used in projecting the maximum loadings for future design capacity. Results are summarized in Table 4-5.

[1] Contributions from Fisher Barton Blades Inc., Baso Holdings LLC, and Glory Global Solutions Inc. were determined to be similar in strength to typical residential wastewater.

TABLE 4-5
Current Influent Peaking Factors

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Maximum Month	1.58	1.67	2.10	1.32	1.32	2.24
Peak Week	2.42	1.96	2.74	1.75	1.75	3.08
Peak Day	4.11	3.51	6.23	2.57	2.57	3.95

WASTEWATER TREATMENT PLANT PERFORMANCE

In its 2021 and 2022 CMAR report, the WWTP received grades of ‘C’ and ‘F’, respectively, for Influent Flows and Loadings. Influent BOD loading had consistently exceeded 90% of rated design capacity outlined in the 2000 Facility Plan. The rated design capacity is provided in Table 4-6.

TABLE 4-6
Rated Influent Design Capacities

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	5.2	6,600	5,300	-	1,015	215
Maximum Month	8.8	7,700	6,400	-	1,250	260
Peak Week	10.4	10,300	8,300	-	1,460	-
Peak Day	24.0	17,000	23,000	-	1,840	500
Peak Hour	27.0	-	-	-	-	-

Figure 4-5 through Figure 4-9 present the annual average flow and BOD, TSS, TKN, and TP loadings for the years 2020 through 2022, as well as the plant’s annual average design capacity provided in Table 4-6. These figures show that while there is adequate capacity for flow and TP, loadings for BOD, TSS and TKN have approached or exceeded rated design capacities. Annual average influent loadings for BOD, TSS and TKN have ranged between 90-130% of rated plant capacity between 2020-2022.

FIGURE 4-5
Annual Average Plant Flows

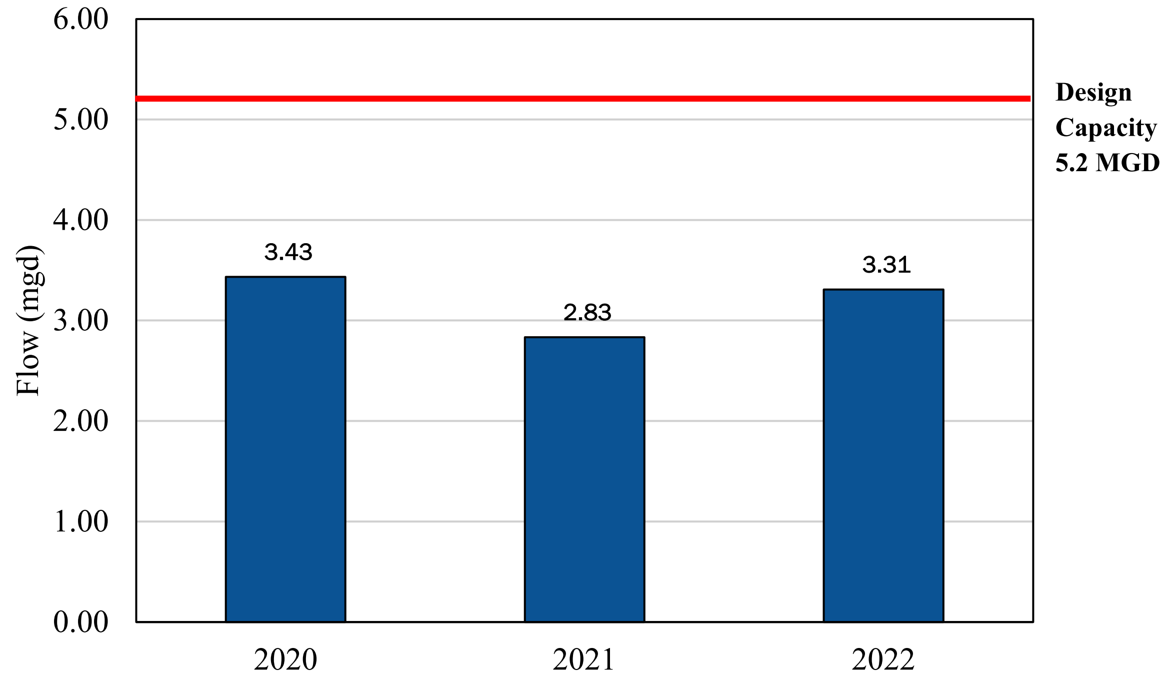


FIGURE 4-6
Annual Average Plant BOD Loadings

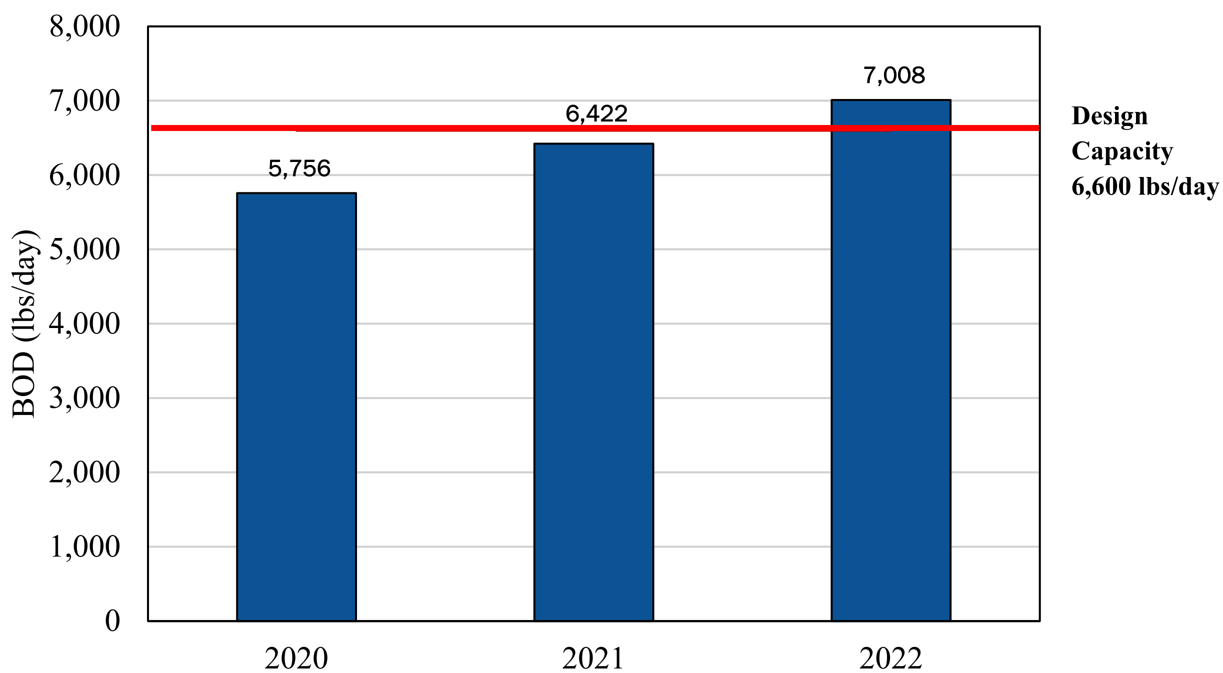


FIGURE 4-7
Annual Average Plant TSS Loadings

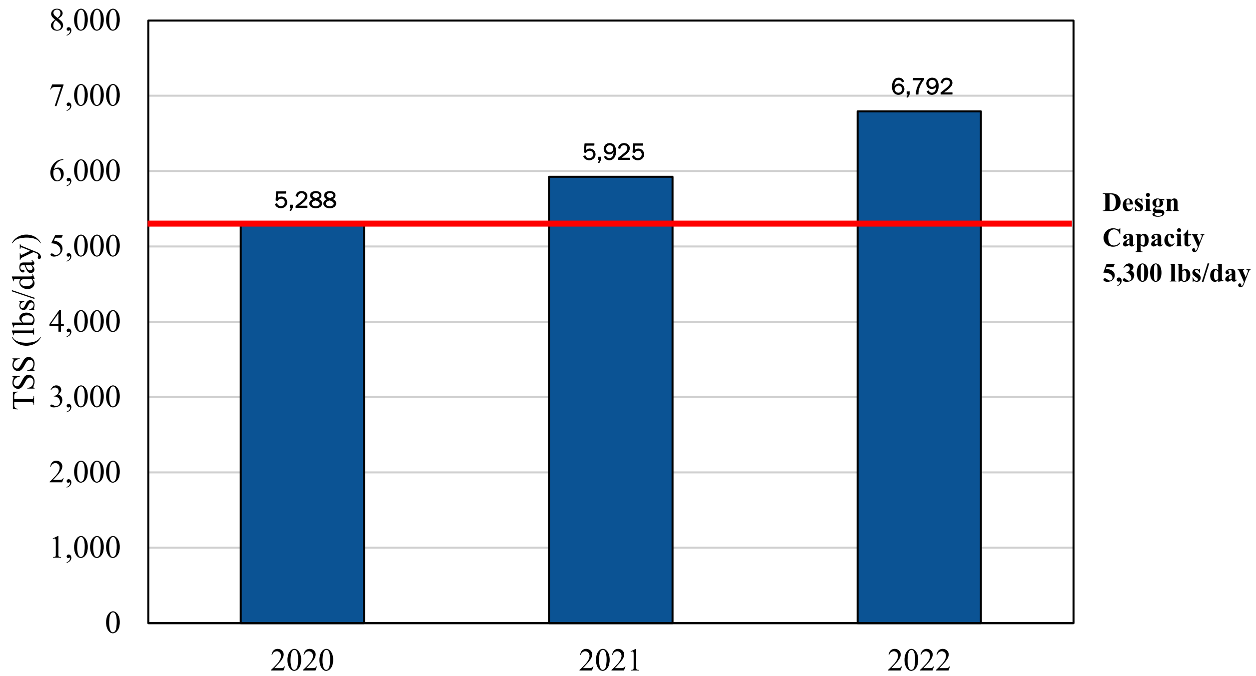


FIGURE 4-8
Annual Average Plant TKN Loadings

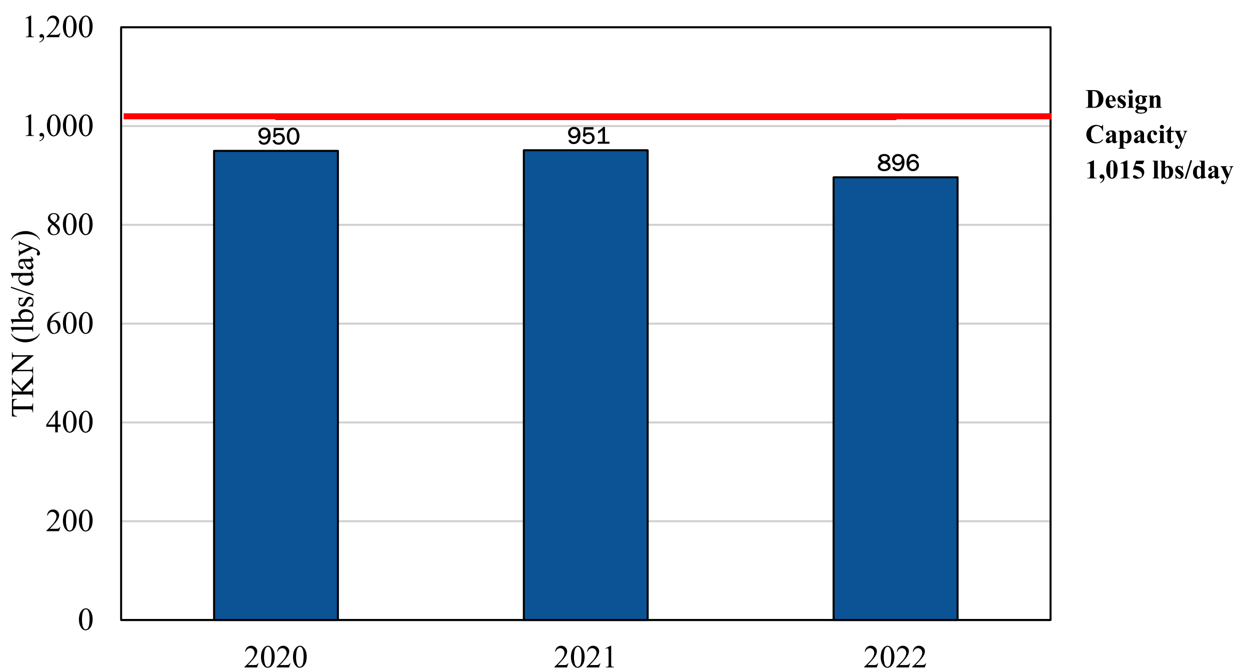
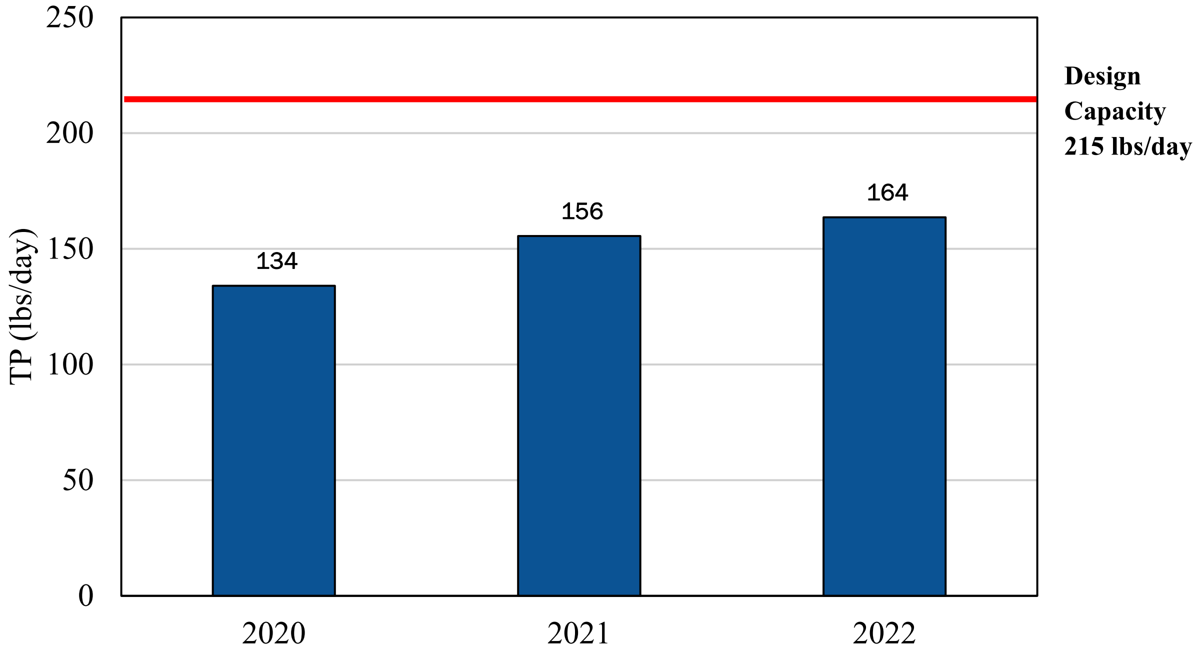


FIGURE 4-9
Annual Average Plant TP Loadings



Although the WWTP has approached or exceeded its rated capacity for BOD, TSS, and TKN, the City is consistently meeting its effluent limits outlined in the WPDES discharge permit. Figure 4-10 through Figure 4-21 show the performance of the treatment plant for BOD, TSS and NH_3-N and TP from 2020 through 2022 by comparing weekly and monthly limits set by the WPDES discharge permit to the corresponding 7- and 30-day rolling averages of each constituent concentration and load. From 2020 – 2022, there have been no monthly or weekly average effluent violations. Rolling averages results in a conservative estimate of treatment plant performance and are not identical to values reported to the WDNR. Therefore, some values in the figures may appear as limit exceedances.

FIGURE 4-10
Weekly Average Effluent BOD Concentration, 2020-2022

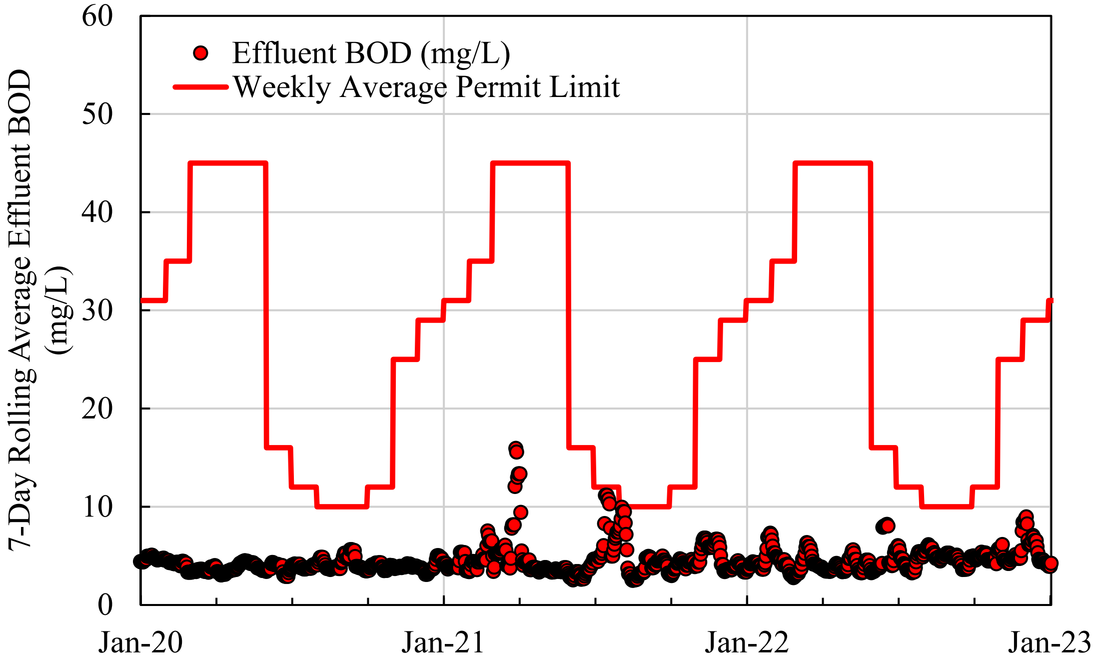


FIGURE 4-11
Monthly Average Effluent BOD Concentration, 2020-2022

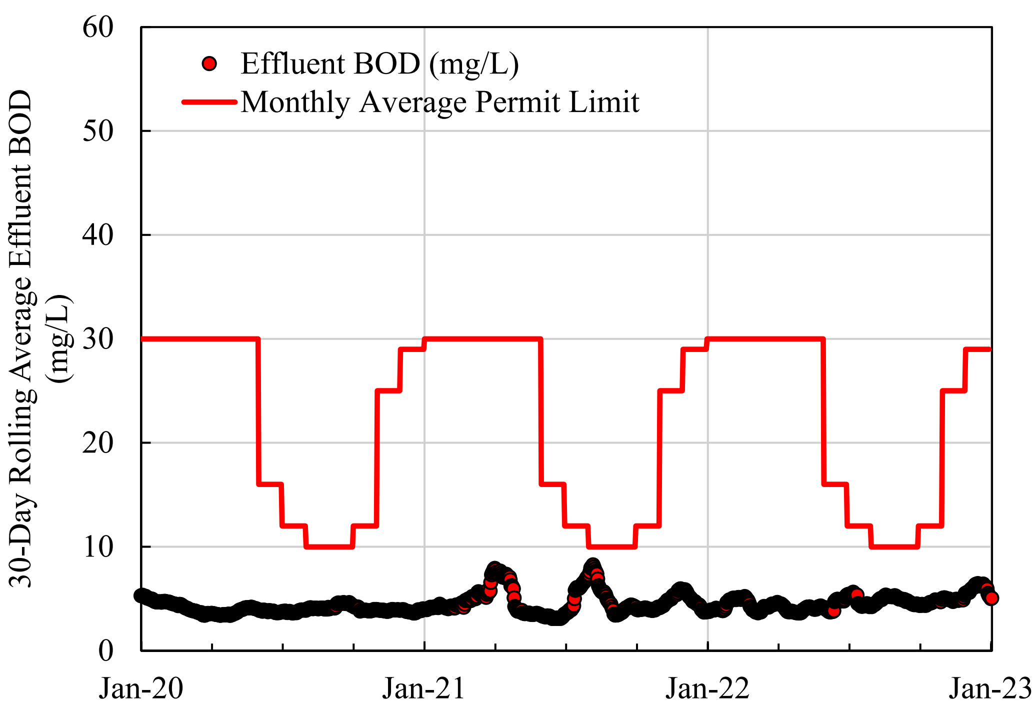


FIGURE 4-12
Weekly Average Effluent BOD Loading, 2020-2022

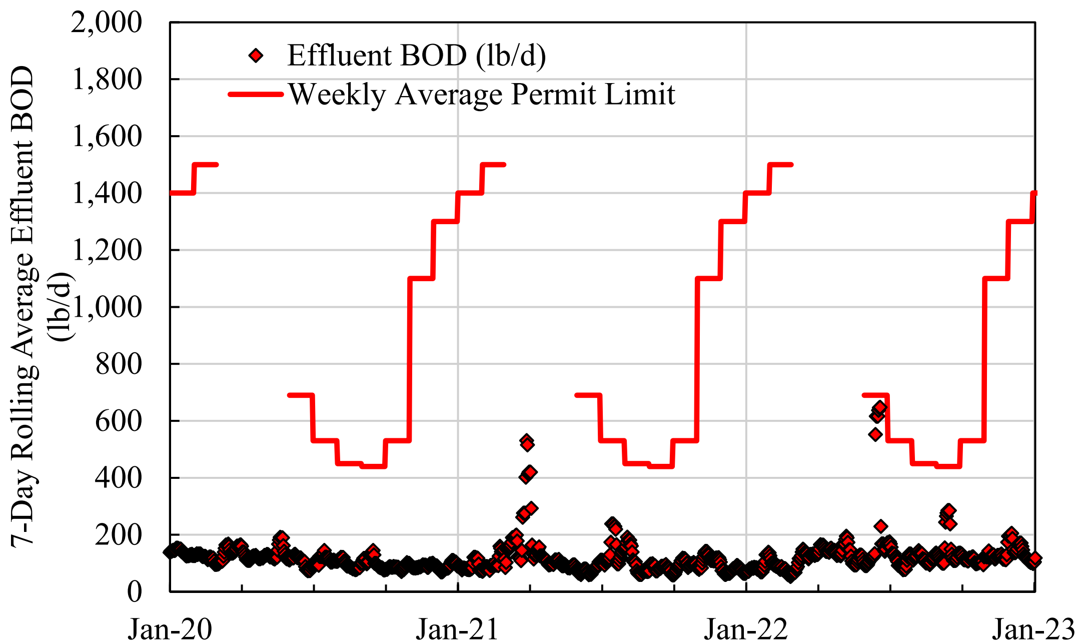


FIGURE 4-13
Weekly Average Effluent TSS Concentration, 2020-2022

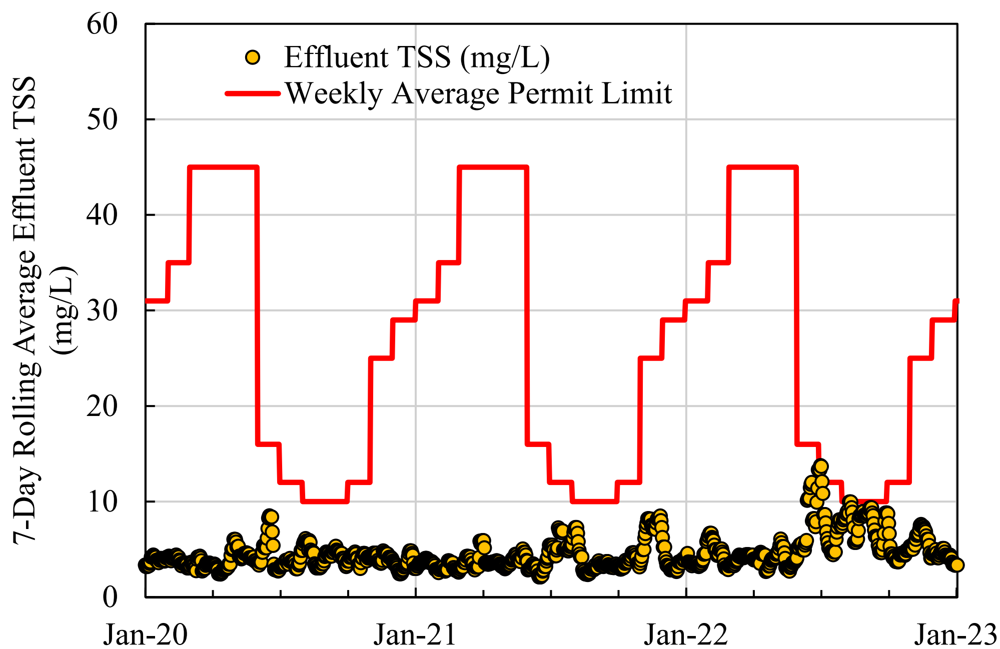


FIGURE 4-14
Monthly Average Effluent TSS Concentration, 2020-2022

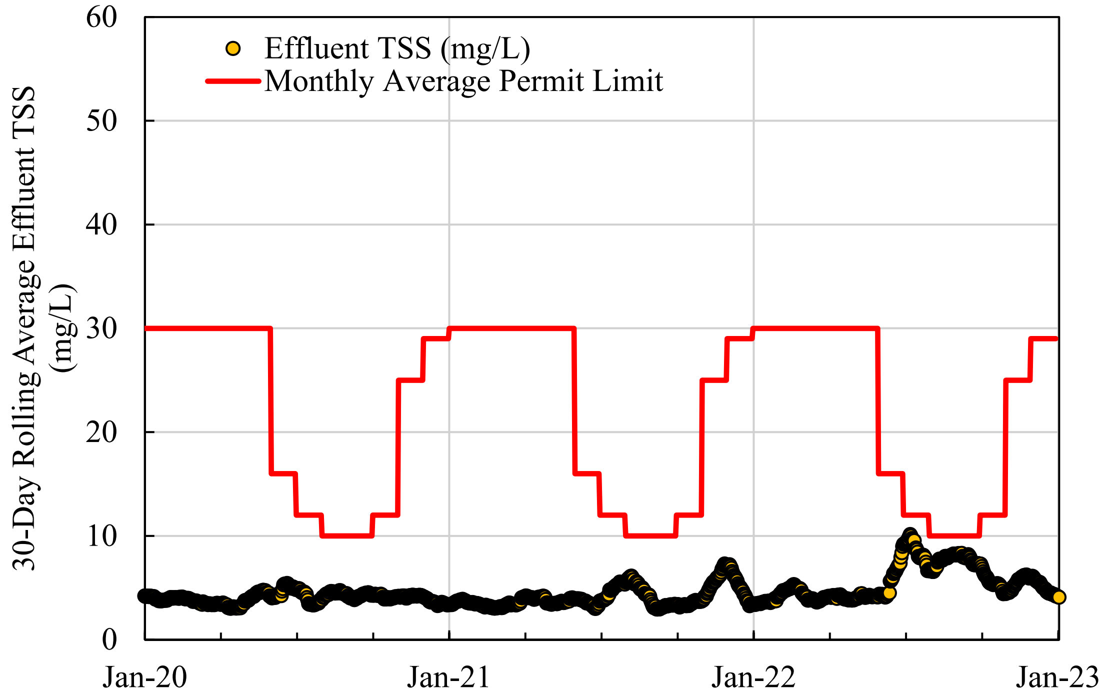


FIGURE 4-15
Weekly Average Effluent TSS Loading, 2020-2022

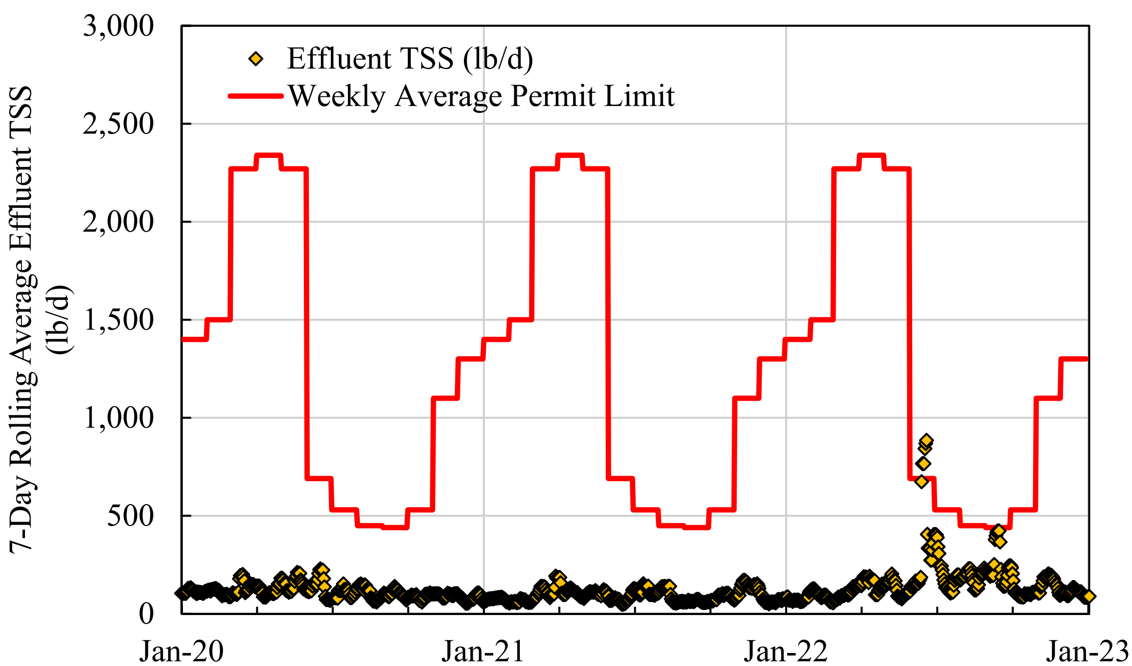


FIGURE 4-16
Monthly Average Effluent TSS Loading, 2020-2022

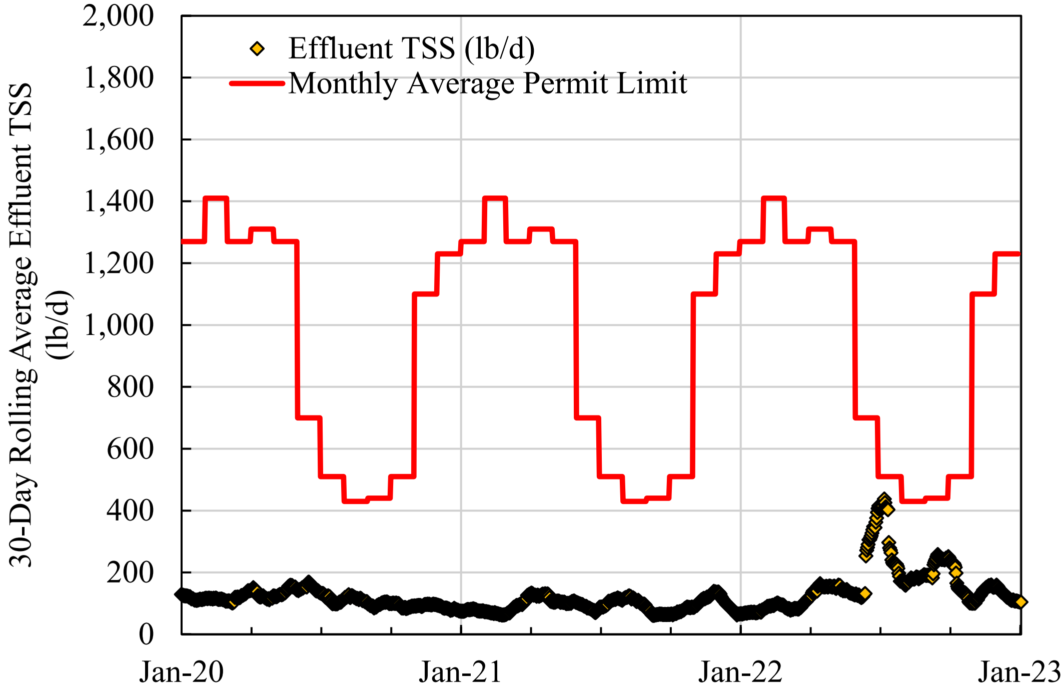


FIGURE 4-17
Daily Effluent Ammonia-N Concentration, 2020-2022

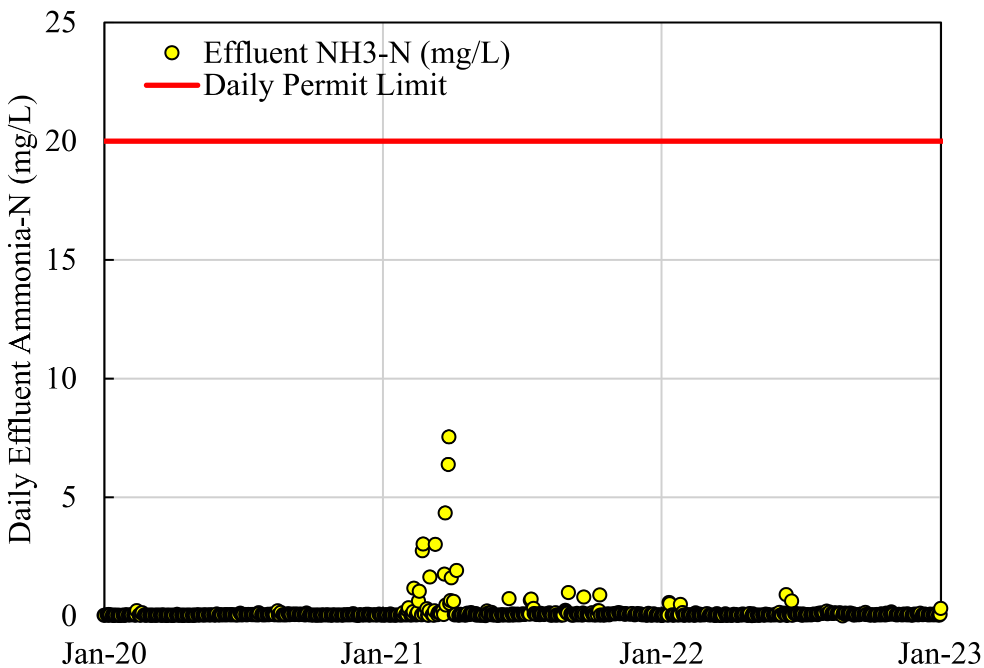


FIGURE 4-18
Weekly Average Effluent Ammonia-N Concentration, 2020-2022

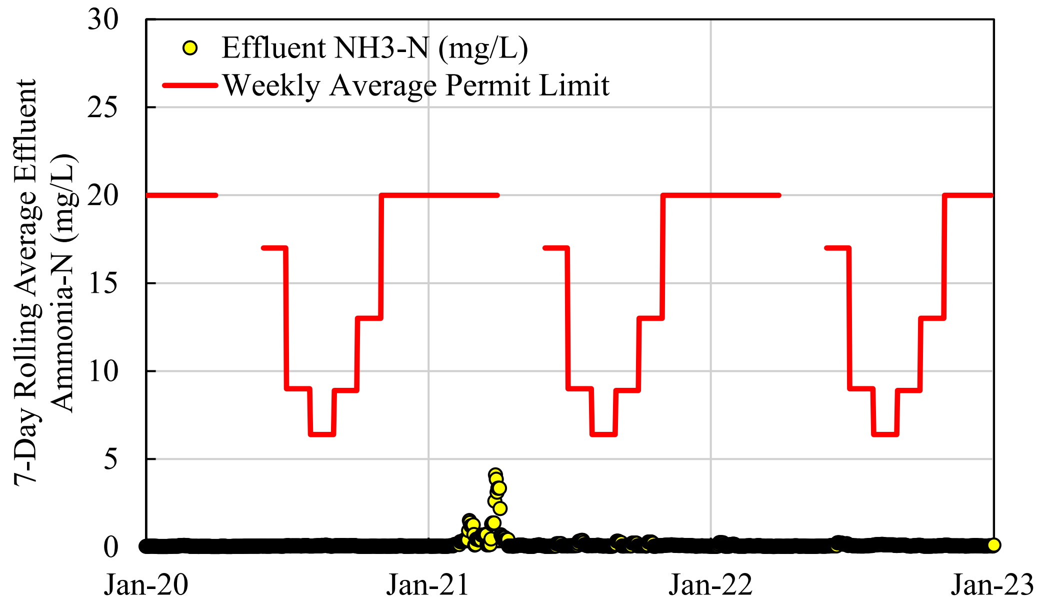


FIGURE 4-19
Monthly Average Effluent Ammonia-N Concentration, 2020-2022

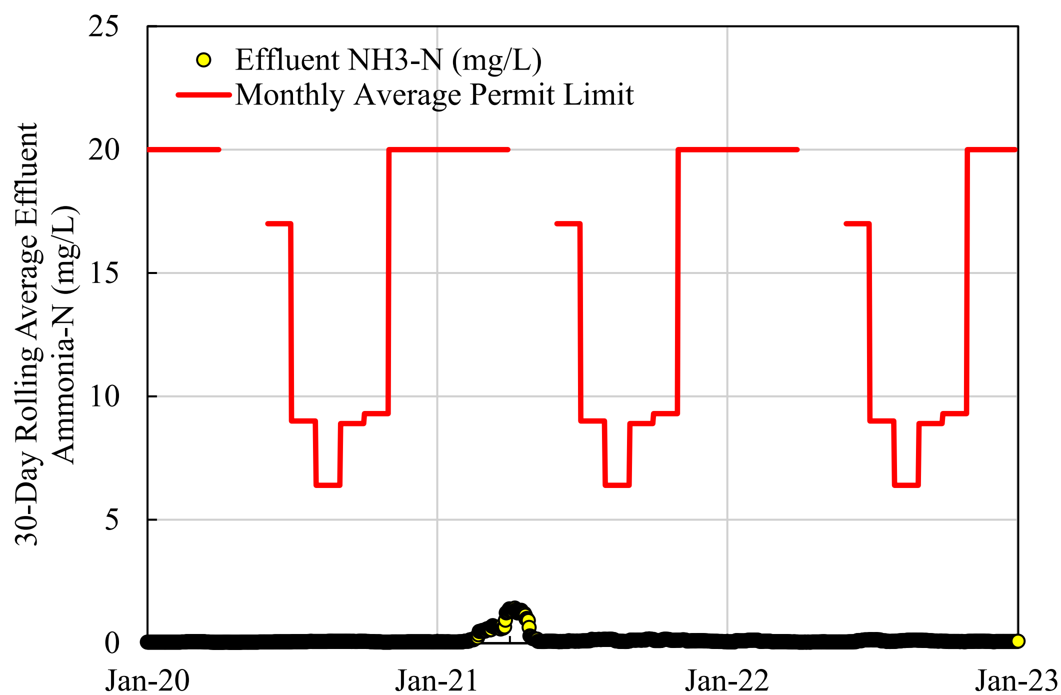


FIGURE 4-20
Monthly Average Effluent Total Phosphorus Concentration, 2020-2022

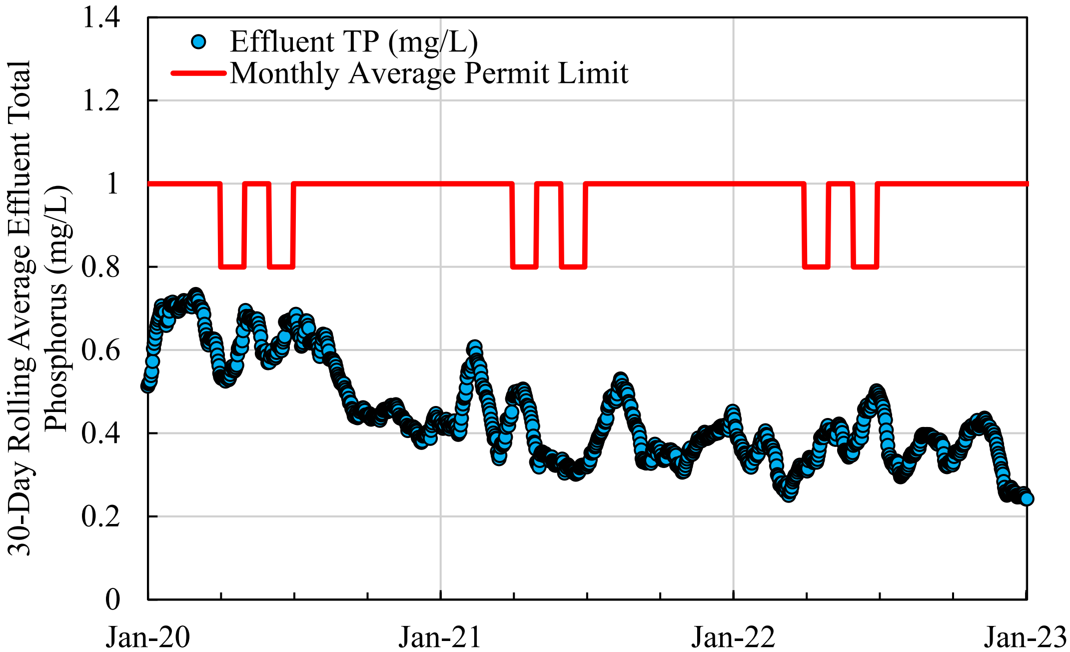
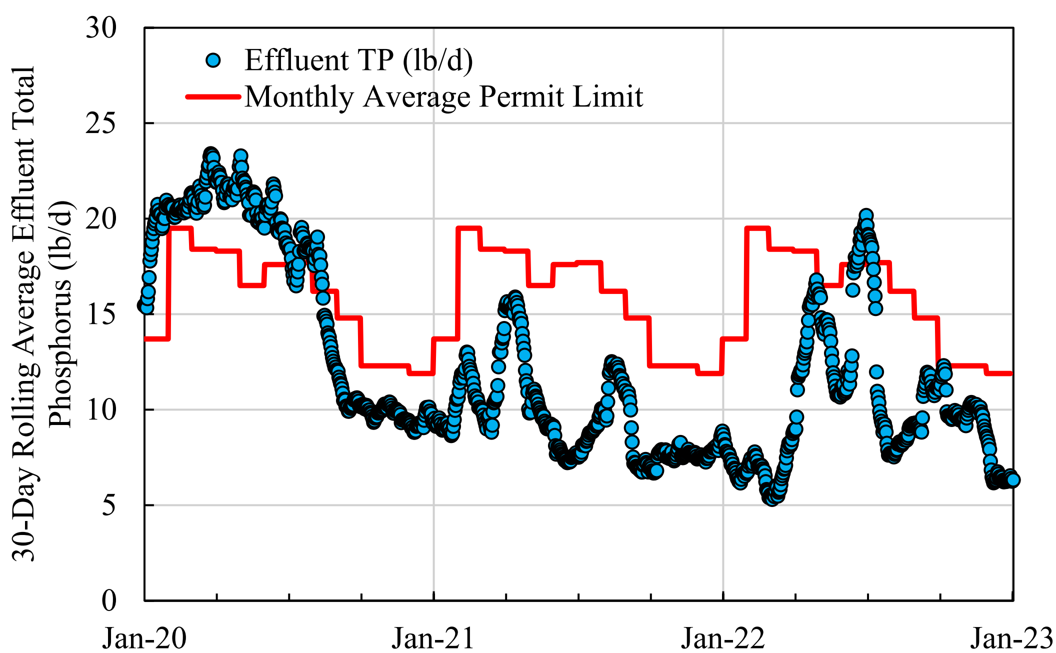


FIGURE 4-21
Monthly Average Effluent Total Phosphorus Loading, 2020-2022



Note: Effluent TP loading exceedances are offset by the City's phosphorus water quality trading credits.

Chapter 5

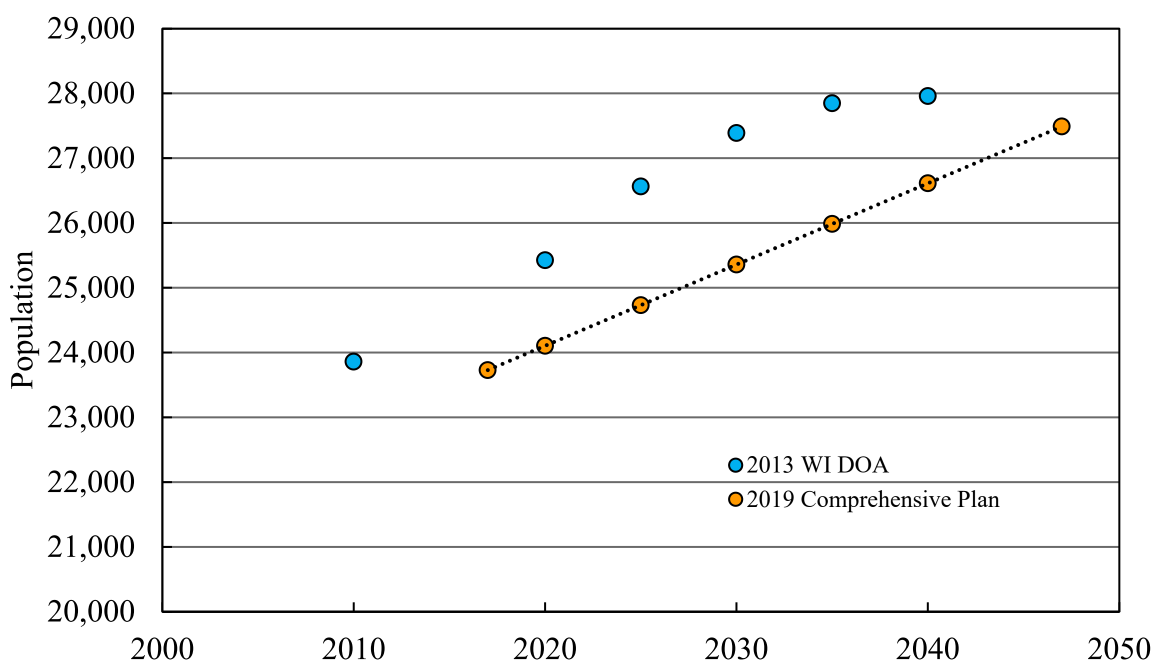
PROJECTED FLOWS AND LOADINGS

This chapter contains information on population and wasteload projections for the planning area. As presented in Chapter 2, the planning period is 20 years and encompasses the years 2027 through 2047. Population and wasteload projections are used to evaluate the existing facilities at the Watertown WWTP and then develop wastewater treatment alternatives for the plant.

POPULATION PROJECTION

Population projections for the City of Watertown are shown in Figure 5-1. These projections are based on information from the 2013 Wisconsin Department of Administration (DOA) municipal projections for 2020-2040, and the linear population projection model in the 2019 City of Watertown Comprehensive Plan. The 2019 Comprehensive Plan population model was used in developing future flows and loadings for the WWTP. The City's population is expected to grow 13% from 24,357 in 2022 to 27,492 by 2047, an increase of 3,135 people.

FIGURE 5-1
Population Projections, Design Year 2047



DESIGN FLOWS AND LOADINGS

The influent flows and loadings to the treatment plant are comprised of residential, commercial, and industrial flows and loadings, plus infiltration/inflow (I/I). To project flows and loadings to the year 2047, it is necessary to project the annual average loadings and then use the historical peaking factors to estimate the maximum month, peak day, and peak hour loadings. The 2047 annual average loadings are based on the current non-industrial and industrial flows and loadings, including annual average I/I.

Non-Industrial Flows and Loadings

The increase in non-industrial flows and loadings are based on per capita unit loads for the expected 3,135 person increase. Per capita unit loads were determined based on current non-industrial flows and loadings provided in Table 4-4 and population projections provided in Figure 5-1. Results are summarized in Table 5-1.

TABLE 5-1
Non-Industrial Flows and Loadings, Design Year 2047

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Population Growth	3,135					
Per Capita	100 gpcd	0.1 ppcd	0.2 ppcd	0.02 ppcd	0.03 ppcd	0.004 ppcd
Total	0.314	270	600	70	100	15
Current Annual Avg	2.88	2,080	4,700	550	790	110
Design Year Annual Avg	**3.19**	**2,350**	**5,300**	**620**	**890**	**120**

Note: Both current and design year non-industrial flows include contributions from inflow and infiltration (I/I).

Industrial Flows and Loadings

In accordance with NR 110.09(2)(j)(3), flow projections for industrial contributions may include a nominal flow allowance for future unplanned industrial expansions. This allowance should normally not exceed 5% of the total non-industrial design flow or 25% of the total industrial flow, whichever is greater. It was presumed that loadings from future unplanned industrial expansions could be estimated based on the same allowances for unplanned industrial flows, per NR110.09(2)(j)(3). Similar to the 2000 Facility Plan, a 5% increase in flow and a 25% increase in loadings is assumed for projected industrial growth for the design year 2047 conditions.

Staff at Johnsonville Sausage stated that production was estimated to increase by 100% over current levels within the planning period. Consequently, it was projected that flows and loadings from Johnsonville will increase by 100% over current levels summarized in the industrial survey. Average annual industrial contributions are summarized in Table 5-2.

TABLE 5-2
Industrial Flows and Loadings, Design Year 2047

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	0.461	6,000	1,800	130	180	60

Design Year 2047 Flows and Loadings

Non-industrial and industrial flows and loadings were summed to calculate the average design year flows and loadings to the WWTP. Design year flows were determined to remain less than the rated capacity of the WWTP. Therefore, the existing design flows will be used for capacity analysis and equipment sizing. Current peaking factors from Table 4-5 were used to calculate design maximum month, peak week, and peak day loadings. Results are summarized in Table 5-3.

TABLE 5-3
Influent Flows and Loadings, Design Year 2047

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	NH3-N (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	5.2	8,300	7,100	750	1,100	180
Maximum Month	8.8	13,900	15,000	1,000	1,400	400
Peak Week	10.4	16,300	19,500	1,300	1,900	550
Peak Day	24	29,100	44,500	2,000	2,800	710
Peak Hour	27	-	-	-	-	-

Chapter 6

EXISTING FACILITIES EVALUATION AND ALTERNATIVE ANALYSIS

This chapter presents an evaluation of the existing facilities and unit processes at the City of Watertown WWTP. The capacities of the facilities are compared to the current flows and loadings and project year 2047 design flows and loadings. Deficiencies and shortfalls are identified, and alternatives for upgrading or expanding the existing facilities are then identified and evaluated.

GENERAL DESCRIPTION

The Watertown WWTP is an advanced wastewater treatment plant that treats wastewater generated within the City limits and discharges treated effluent to the Rock River. The majority of the plant was constructed in 2004. The current rated design capacities of the plant, based on the 2004 upgrade, are presented in Table 6-1.

TABLE 6-1
Rated Influent Design Capacities

	Flow (mgd)	BOD (lb/d)	TSS (lb/d)	TKN (lb/d)	TP (lb/d)
Annual Average	5.2	6,600	5,300	1,015	215
Maximum Month	8.8	7,700	6,400	1,250	260
Peak Week	10.4	10,300	8,300	1,460	-
Peak Day	24.0	17,000	23,000	1,840	500
Peak Hour	27.0	-	-	-	-

Figure 6-1 presents a process flow diagram of the existing Watertown WWTP. Raw sewage enters the Raw Sewage Pump Station through a 60-inch gravity sewer. Raw sewage is pumped to the Preliminary Treatment Building, where fine screening and influent sampling occur. Fine screens are compacted and landfilled, and flow continues to outdoor grit removal. Grit is settled out in vortex settling tanks, washed, and is sent to a dumpster for landfill disposal.

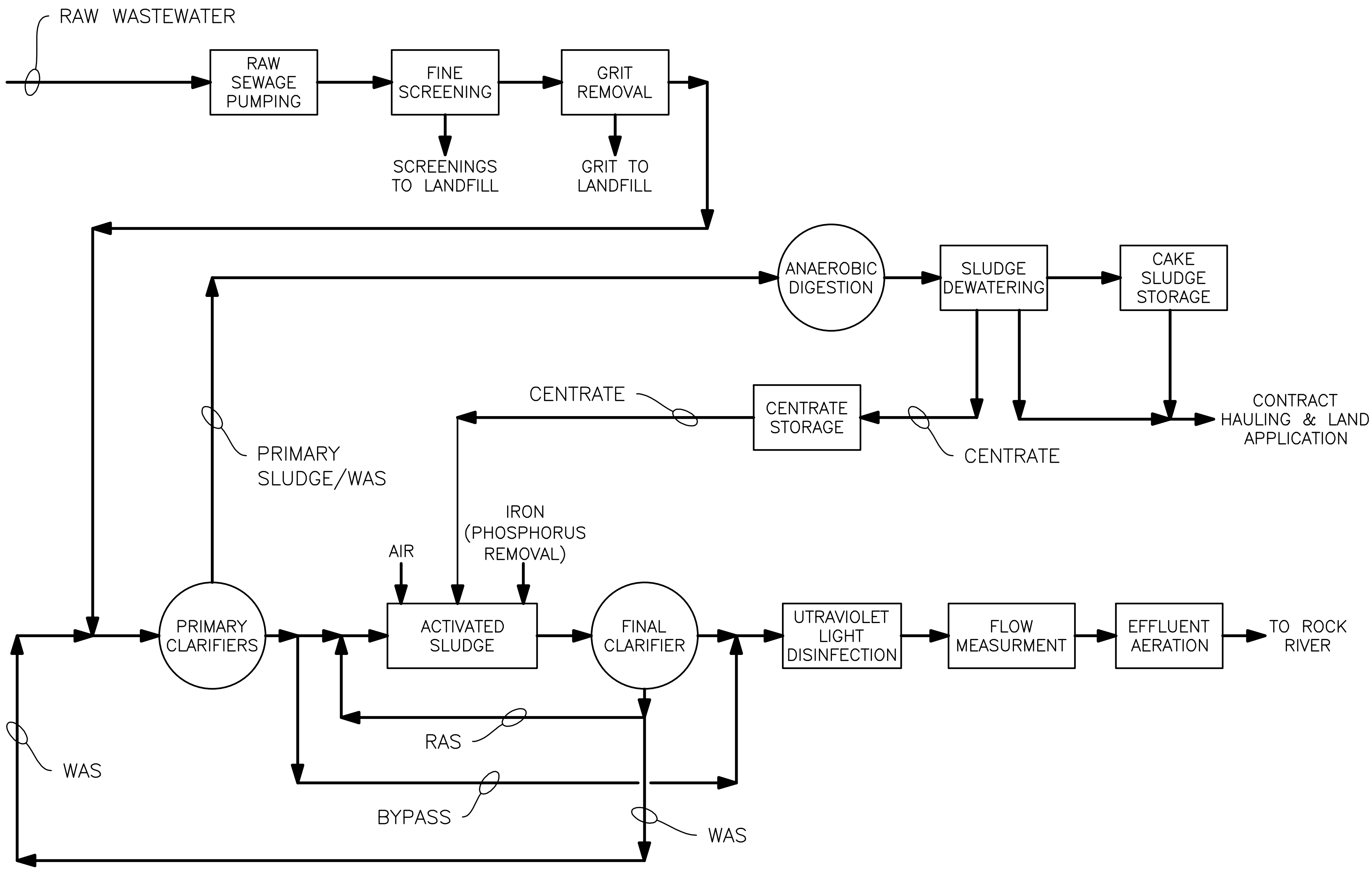


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FIGURE 6-1
PROCESS FLOW DIAGRAM
Watertown, WWTP

After grit removal, flow is split between two Primary Clarifiers. Solids settle out of the waste stream in the clarifiers, and scum is skimmed off the clarifier surface and sent to the Primary Scum Well. Settled solids are wasted to the Digester Complex for anaerobic digestion. Fats, oils, and grease that build up in the Primary Scum Well are hauled away for landfill disposal, and subnatant is conveyed to the aeration basins for secondary treatment.

Primary effluent flows to the Secondary Splitter Box, which combines return activated sludge (RAS) with the primary effluent, and splits flow between Aeration Basin 1, 2 and 3 to provide secondary treatment through single stage nitrification. Ferric chloride is dosed in the effluent stream of the aeration basins to achieve chemical phosphorus removal.

The mixed liquor flows to the Final Clarifiers, where solids are settled out of the waste stream. Final Clarifier effluent flows to UV Disinfection, consisting of an open channel with two banks of lamps. Disinfected effluent then flows to the cascade aeration before it is discharged to the Rock River.

Settled sludge in the Final Clarifiers is either returned to the aeration basins or wasted to co-settle in the Primary Clarifiers and pumped to the Digester Complex. The Digester Complex consists of two mesophilic anaerobic digesters connected by a pipe tunnel, which are used to stabilize the primary and secondary sludge. The digesters also collect and store biogas generated from the digestion process for use as a fuel for heating and provides short term storage of sludge for periodic dewatering.

Stabilized biosolids are then sent to the Solids Handling Building, where biosolids are dewatered using centrifuges, creating sludge cake. Sludge cake is then conveyed to the Sludge Cake Storage Building before it is hauled and land applied. The centrate from dewatered sludge is sent to the Centrate Storage Tank and is eventually returned to the Aeration Basins.

Figure 6-2 shows a site plan of the existing facilities at the wastewater treatment plant.

WWTP STRUCTURE LEGEND	
STRUCTURE NUMBER	STRUCTURE NAME
25	ADMINISTRATION BUILDING
30	NEW MAINTENANCE BUILDING
32	EXISTING MAINTENANCE BUILDING
35	GENERATOR BUILDING
40	RAW SEWAGE PUMP STATION
42	DUMP STATION
45	PRIMARY BUILDING
47	GRIT CHAMBERS
50	PRIMARY CLARIFIERS
52	SECONDARY SPLITTER STRUCTURE
55	AERATION TANKS
60	SECONDARY BUILDING
65	FINAL CLARIFIERS
70	EXISTING DIGESTER COMPLEX
75	SOLIDS HANDLING BUILDING
80	SLUDGE STORAGE BUILDING
85	EFFLUENT AERATION STRUCTURE

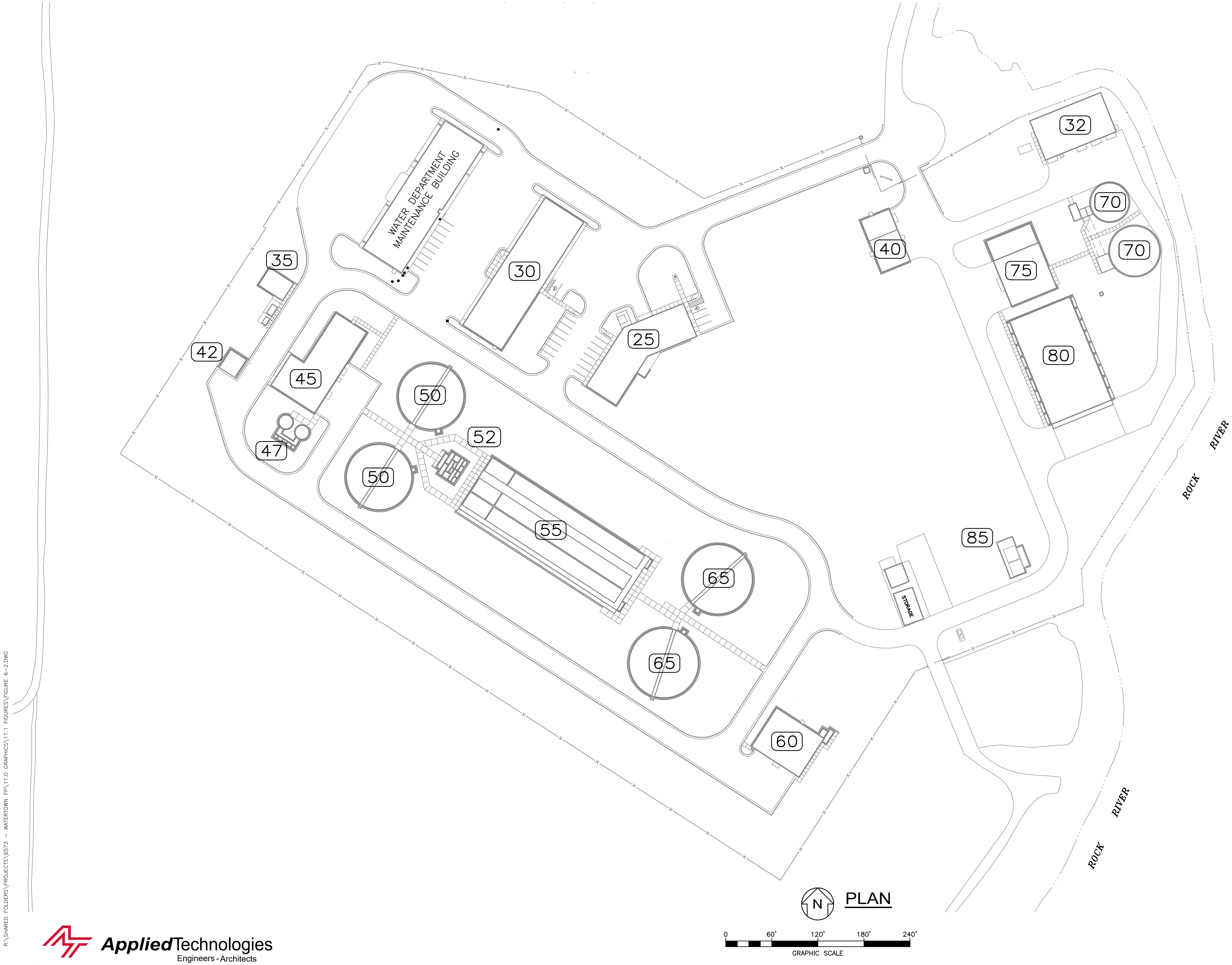

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FIGURE 6-2
EXISTING SITE PLAN
Watertown WWTP

UNIT PROCESS EVALUATION AND ALTERNATIVE ANALYSIS

The unit process evaluation presents the design and capacity of each existing unit process at the Watertown WWTP. Select unit processes that were identified at the Facility Plan kickoff and subsequent update meetings are discussed in further detail and the basis of design is compared to current and future loads. Alternatives for upgrading or expanding the selected unit processes are identified and evaluated.

Raw Sewage Pumping

The Raw Sewage Pump Station is equipped with five 4,700 gpm pumps split between two influent wet wells. Three pumps draw raw sewage from one well and two draw from the other. Both wells are mechanically mixed. Sewage is pumped through two 20-inch force mains that discharge to the screening channels in the Primary Building. The two force mains are equipped with flow meters to monitor and totalize flow, and manually actuated shut off valves to isolate flow to either screening channel. During normal operation, both force mains discharge sewage to the screening channels. The City has identified the continual buildup of grit within the 20” elbow of both force mains just before the screening channel while both force mains are in operation. The grit buildup is occasionally flushed by manually isolating flow through each pipe. Table 6-2 summarizes the existing equipment and its design criteria.

TABLE 6-2
Raw Sewage Pumping Equipment

Equipment	Design Criteria
Raw Sewage Pumps	
No. of Units	5
Type	Submersible
Design Capacity	4,700 gpm @ 100 ft TDH
Wet Well Mixers	
No. of Units	2
Type	Submersible Direct Drive Axial Flow
Design Capacity	1,700 gpm @ 1660 rpm
Influent Flow Measurement	
No. of Units	2
Type	Magnetic
Size	18-inch

All five raw sewage pumps have been rehabilitated within the last five years, and the mechanical mixers have been recently replaced. Although the pumps have adequate capacity to handle peak hour flow, the equipment is original and has reached the end of its 20-year design life.

Because of the age of the existing equipment, five new raw sewage pumps each with the same capacity as the existing equipment (4,700 gpm) will be provided to allow the WWTP to pump peak hour flows with one pump out of service. Additional space is provided in the wet well for a future sixth pump to be installed, and provisions will be included for the future pump to be operated by a portable standby generator. The manually actuated shut off valves will be replaced with electrically actuated valves to allow for remote flushing of grit buildup in either force main.

Preliminary Treatment

Preliminary treatment consists of fine screening and grit removal systems. Table 6-3 lists the existing equipment and its design criteria.

TABLE 6-3
Preliminary Treatment Equipment

Equipment	Design Criteria
Fine Screens	
No. of Units	2
Type	Continuous self-cleaning fine screens
Design Capacity	13.5 mgd
Bar Spacing	0.25-inch
Channel Dimensions	4.0 ft W x 5.5 ft D
Grit Chamber	
No. of Units	2
Type	Vortex Separator
Dimensions	18-ft Diameter, 20-ft Depth
Removal Efficiency	95% of 150 micron and larger grit
Grit Washer	
No. of Units	2
Capacity	7-ft^3/hr
Design Flow	200 gpm
Grit Pumps	
No. of Units	2
Type	Dry-pit Centrifugal
Capacity, each	200 gpm @ 32-ft TDH

Screening

Fine screening is performed by two Parkson AquaGuard continuous self-cleaning fine screens each rated for 13.5 mgd. Each screen is installed in a 4.0-foot wide by 5.5-foot deep channel and utilizes plastic rake elements with 0.25-inch bar spacing to screen material from the wastewater. Screenings drop from the discharge chute to a compactor, which compresses screenings and transports them to a dumpster for disposal in a landfill.

The City has reported that the solids removal rate of the existing fine screens are inadequate under average flow conditions and the equipment must be raised from the channel during high flow events. Furthermore, the screens are original and have reached the end of their 20-year design life. A replacement fine screen rated for 13.5 mgd will be installed in each of the existing channels and will be designed to provide a higher solids removal rate than the existing screens. Headloss through the screens will be no greater than 1.9 feet to allow for adequate freeboard on the upstream side of the channel. The screens will have pivoting supports for equipment removal and access during maintenance periods.

Grit Removal

Grit removal is performed by two Grit King 18-foot vortex settling tanks with internal stainless-steel baffles to direct flow within each unit. Grit settles by gravity within into the collection hopper, while wastewater exits at the top of the unit through an open channel to the Primary Splitter Structure. Grit is fluidized with plant effluent water and the slurry is pumped to cyclones to reduce the flow rate into the TruGrit grit washers. The grit washers wash, dewater, and discharge grit to a dumpster for disposal in a landfill.

The City has reported no concerns with grit removal performance, and the grit pumps have been recently rebuilt; however, the grit washer system has not been performing adequately, and the equipment has reached the end of its 20-year design life. Due to the age and condition of the existing equipment, it is recommended a replacement grit handling system be installed. The Grit King settling tanks will remain in place, and mechanical equipment including the stainless-steel baffles, grit pumps, cyclones, and TruGrit grit washers will be replaced.

Primary Treatment

Primary treatment is provided by two Primary Clarifiers that receive effluent from Preliminary Treatment. The system includes the Primary Splitter Structure, the Primary Clarifiers, and primary sludge and scum pumps. Table 6-4 lists the existing equipment and its design criteria.

TABLE 6-4
Primary Treatment Equipment

Equipment	Design Criteria
Primary Clarifiers	
No. of Units	2
Clarifier Mechanism	Suction
Dimensions	85-ft Diameter, 12-ft SWD
Total Volume	1.02 MG
Total Surface Area	11,350-ft^2
Total Weir Length	534-ft
Primary Sludge and Scum Pumps	
Number of Units	4
Type	Air Operated Diaphragm
Capacity, each	54 gpm @ 12 strokes/min
Scum Well Decant Pump	
No. of Units	1
Type	Submersible
Capacity	250 gpm @ 7-ft TDH
Scum Well Mixer	
No. of Units	1
Type	Submersible Mixer
Capacity	860 rpm

Primary Splitter Structure

The Primary Splitter Structure is a concrete structure that receives flow from the grit chambers and waste activated sludge (WAS) from the final clarifiers. Stainless steel weir plates equally split flow through open channels to two Primary Clarifiers. Manually actuated slide gates are installed upstream of the weir plates to shut off flow to the clarifiers. The structure contains a third channel to accommodate the construction of a future clarifier.

The City reports no operational concerns with the splitter structure or equipment, but it is recommended that the condition of each be assessed. It is recommended that the slide gates be replaced within the planning period due to exceeding their 20-year design life.

Primary Clarifiers

Two center-feed type Primary Clarifiers are used to remove the readily settleable solids and floating material from the wastewater. The settled sludge is removed from the Primary Clarifiers by scraper-type sludge removal mechanisms that transport sludge to a central collection hopper.

Mechanical drive units that power the sludge collection mechanisms are mounted on the central pier of the clarifiers. A beach and scraper style skimmer arm removes scum from the clarifier surface.

The City reports no concerns with the operation of the Primary Clarifiers. Table 6-5 summarizes hydraulic loading to the clarifiers for current and design year 2047 conditions. The Appendix shows the mass balance calculations for the WWTP.

TABLE 6-5
Primary Clarifier Loading Conditions

Condition	Surface Settling Rate (gpd/ft^2)	Weir Overflow Rate (gpd/ft)
Current Average Day	285	6,064
Design Average Day	462	9,825
Design Peak Hour	2,398	-
NR 110 Code, Annual Average	**1,000**	**10,000**
NR 110 Code, Peak Hour	**1,500**	**-**

The surface settling rates and weir overflow rates for the current and design average conditions are below the NR 110 limit. However, the peak hour settling rate of 2,398 gpd/ft^2 exceeds the code requirement of 1,500 gpd/ft^2. The primary clarifiers were constructed in 2004, and the design year hydraulic loadings have not changed since the previous planning period. Conforming to NR 110 code would have required two 110-foot diameter clarifiers or three 90-foot diameter clarifiers, leading to excessively long detention times during average flows and high capital costs. Due to the infrequency of peak hour flow occurrences and the City's capability of meeting required effluent limits during peak flow events, the high peak hour settling rate will not have a significant impact on the activated sludge process and overall plant performance. Additional primary clarification capacity is therefore not recommended.

Both clarifiers' mechanisms and drives are original and have been rehabilitated within the last ten years. Due to the age of the equipment, it is recommended they be assessed and rehabilitated or replaced within the planning period.

Primary Sludge and Scum Pumping

Four air-operated diaphragm (AOD) sludge and scum pumps are utilized to transfer sludge from the Primary Clarifiers to the Digester Complex. A decant pump in the Primary Scum Well is utilized for pumping scum subnatant to the Aeration Basins, and a submersible mixer was provided with the intention of homogenizing scum prior to being pumped to the Digester Complex.

The four primary sludge and scum pumps have reached the end of their 20-year design life. The City is interested in replacing the pumps with an alternative technology to remove the need for air compressors, replacing antiquated parts, and reducing noise. The AOD pumps will be replaced with an alternate type of positive displacement pump.

The Primary Scum Well was designed to mix and transfer scum to the anaerobic digesters; however, the excessive buildup of FOG through the pipe prevents contents from being pumped. Instead, scum builds up in the tank and is occasionally vacuumed out and hauled away for disposal. Subnatant continues to be decanted to the aeration basins, sending scum through the remainder of the WWTP. To avoid FOG buildup downstream, it is recommended that the scum well decant line be rerouted to recycle flow to the head of the WWTP to retain scum in the Primary Scum Well.

Additionally, one of the two primary sludge lines that convey sludge from the Primary Clarifiers to the Digester Complex has a significant buildup of vivianite. The line is approximately 1,500 feet in length and is constructed out of 6-inch high-density polyethylene pipe. It is recommended that both lines be jetted to remove the vivianite. Pipe cleanouts will be constructed for accessible buildup removal in the future.

Secondary Treatment

Secondary treatment is provided by an activated sludge system that is designed for BOD_5 removal and single stage nitrification. The system includes the secondary splitter box, aeration basins, aeration system, final clarifiers, return sludge pumping, mixed liquor recycle pumping, waste sludge pumping, and a chemical phosphorus removal system. Table 6-6 lists the existing equipment and its design capacities.

TABLE 6-6
Secondary Treatment Equipment

Equipment	Design Criteria
Anoxic Selectors	
No. of Basins	3
Dimensions	25-ft W x 35-ft L x 16-ft SWD
Total Volume	314,100 MG
Aeration Basins	
No. of Basins	3
Dimensions	25-ft W x 236-ft L x 16-ft SWD
Total Volume	2.1 MG
Aeration Diffusers	Fine Bubble
Aeration Blowers	
No. of Units	5
Type	(2) Turbo Blowers, (3) Rotary Lobe Positive Displacement
Capacity, each	Turbo Blowers, 2,200 scfm Rotary Lobe PD, 2,363 scfm @ 8.2 psi
Anoxic Mixers	
Number of Units	3
Type	Submersible Mixer
Capacity, each	1,500 gpm @ 860 rpm
Return Sludge Pumps	
No. of Units	2 Duty, 2 Backup
Type	Screw Impeller Dry-pit Centrifugal
Capacity, each	2,300 gpm @ 42 ft TDH

Equipment	Design Criteria
Waste Sludge Pumps	
No. of Units	2
Type	Screw Impeller Dry-pit Centrifugal
Capacity, each	380 gpm @ 46-ft TDH
Mixed Liquor Recycle Pumps	
No. of Units	3
ype	Submersible Axial Flow Pump
Capacity, each	2,600 gpm @ 1-ft TDH
Secondary Scum Pump	
No. of Units	1
Type	Submersible
Capacity	150 gpm @ 71-ft TDH
Ferric Chloride Pumps	
No. of Units	3
Type	Chemical Metering Pump
Capacity, each	5-30 gpm @ 50 psig
Chemical Storage Tank	
No. of Units	1
Capacity	10,000 gallons
Final Clarifiers	
No. of Units	2
Clarifier Mechanism	Suction
Dimensions	90-ft Diameter, 16-ft SWD
Total Volume	1.523 MG
Total Surface area	12,700-ft^2
Total Weir Length	530

Secondary Splitter Structure

The Secondary Splitter Structure is a concrete structure that receives flow from the Primary Clarifiers, where it is mixed with return activated sludge (RAS) from the Final Clarifiers. The splitter structure equally splits flow between the three aeration basins, and provisions have been made for a future fourth aeration basin. Due to the RAS piping configuration, the splitter box is unable to allow the plant to run as two parallel treatment trains. The Secondary Splitter Structure will be modified with additional isolation gate valves to allow for either treatment train to run independently.

Aeration Basins

The three aeration basins each include a mechanically mixed anoxic selector to promote growth of floc-forming organisms and an aerobic zone to provide BOD_5 removal and nitrification. Each aeration basin is equipped with ceramic fine bubble diffusers and aeration blowers. Mixed liquor recycle pumps are used to supply adequate nitrate to the anoxic selector.

Table 6-7 summarizes mass balances for current and design year 2047 loading conditions using the existing aeration basins. The Appendix shows the mass balance calculations for the current and design year conditions.

TABLE 6-7
Aeration Basin Loading Conditions

Condition	WWTP Influent BOD_5 (lb/day)	Aeration Basin BOD_5 (lb/day)	Volumetric BOD_5 Loading (lb/day/kcf)	F/M (lb BOD_5/day per lb MLVSS)
Current Average Day	6,400	4,500	16	0.15
Design Year 2047 Average Day	8,300	5,800	21	0.20
NR 110 Code (Conventional)	**-**	**-**	**40**	**0.2 – 0.5**

Table 6-8 shows that all loading conditions are less than the NR 110 limit of 40 lbs BOD_5/kcf and within the F/M ratio range of 0.2 to 0.5. Therefore, the existing aeration basin volume will be adequate to effectively treat the design average day BOD_5 loading.

The aeration basins are equipped with three 2,363 scfm positive displacement blowers and two 2,200 scfm high speed turbo blowers to provide oxygen for the aerobic zone. Oxygen requirements are determined based on 1.1 pounds of oxygen per pound of BOD_5 removed and 4.6 pounds of oxygen per pound of TKN removed, per NR 110. Oxygen requirements and corresponding air flow requirements for the design year loadings are described in Table 6-8.

TABLE 6-8
Aeration Basin Air Requirements

Parameter	Current Average	Design Average	Design Peak Hour
Oxygen Required (lb/d)	8,200	10,200	25,900
Air Demand (scfm)	2,800	3,500	8,800

Note: Air required based on alpha = 0.6, beta = 0.98, theta = 1.024, DO = 2.0 mg/L, T = 20°C, SOTE 32% (2% per ft SWD)

Per NR 110.21(6)(a), "*The blowers shall be sized to meet the maximum air demand with the largest blower out of service…Diffusers and air piping shall be capable of supplying the peak hour air demand or 200% of the design average air demand, whichever is larger.*"

The City has the capability to bypass flow around the activated sludge system during high flow events. Bypassing occurs when a preset influent flow rate is exceeded, which opens gates in the secondary splitter box. The preset flow rate values were determined based on actual performance of the activated sludge system during high flow events. The City bypasses around the activated sludge system when flow exceeds 20.16 mgd. Therefore, design peak hour oxygen air demand was calculated based on 20.16 mgd, rather than the stated 27 mgd peak hour flow.

To meet NR 110 air demand requirements, a firm capacity of 8,800 scfm must be maintained in the aeration basins with the largest unit out of service. The current system has a firm capacity of 9,126 scfm. The positive displacement blowers have reached the end of their 20-year design life, so it is recommended they be replaced with three 2,200 scfm high speed turbo blowers within the planning period to maintain the required firm capacity. The ceramic fine bubble diffusers and low-pressure air piping are original, but the City completes routine maintenance, and the equipment is in good condition. Due to age, it is recommended that diffusers and piping be replaced within the planning period.

The City reports spalling and cracking of aeration basin concrete, and it is recommended the deficiencies be inspected and repaired. There are no operational concerns with the anoxic mixers or mixed liquor recycle pumps. The units are 20 years old and have been recently rehabilitated. Due to age, it is recommended they be replaced within the planning period.

Final Clarifiers

The two center-feed type Final Clarifiers are used to separate activated sludge from the treated wastewater using rotating sludge collection mechanisms. Mechanical drive units that power the mechanisms are mounted on the central pier of the clarifiers. Settled sludge is returned to the Aeration Basins by the two RAS pumps or wasted to the Primary Clarifiers by the three WAS pumps. Scum is collected from the clarifiers a skimmer arm on each mechanism, which is then pumped into the waste sludge line.

The City reports no concerns with the operation of the Final Clarifiers. Table 6-9 summarizes hydraulic and solids loading to the clarifiers for current and design year 2047 conditions. The Appendix shows the mass balance calculations for the WWTP.

TABLE 6-9
Final Clarifier Loading Conditions

Condition	Surface Settling Rate (gpd/ft^2)	Solids Loading Rate (lb/ft^2–hr)	Weir Overflow Rate (gpd/ft)
Current Average Day	251	0.25	5,639
Design Average Day	408	0.51	9,171
Design Peak Hour	2,117	2.3	51,000
NR 110 Code, Annual Average	**-**	**1.4**	**10,000**
NR 110 Code, Peak Hour	**1,200**	**2.0**	**-**

The surface settling rates, solids overflow rates, and weir overflow rates for the current and design average conditions are below the NR 110 limit. However, the design peak hour solids loading rate of 2.3 lb/ft^2-hr exceeds the code requirement of 2.0 lb/ft^2-hr. The peak hour solids loading rate was calculated based on the design concentration of 3,000 mg/L of mixed liquor suspended solids under aeration and a maximum day design flow of 24 mgd plus the maximum design return sludge rate requirement of 3.9 mgd (75% of average design flow for conventional activated sludge systems), per NR 110.

It is expected that MLSS concentrations will be less than 3,000 mg/L during peak flow conditions, decreasing the peak hour solids loading to a rate that is within the NR 110 code requirement. Furthermore, the City has the ability to divert primary effluent around the secondary treatment process to prevent overloading of the final clarifiers and ensure the secondary treatment process maintains operation during high flow events.

Due to the infrequency of peak hour flow occurrences and the City’s capability of meeting required effluent limits during peak flow events, the high peak hour solids loading rate will not have a significant impact on overall plant performance. Additional final clarifier capacity may lead to stagnation and denitrification in the final clarifiers during average flow conditions. Therefore, additional final clarifier capacity is not recommended.

The mechanisms and drives of both clarifiers, as well as the RAS, WAS, and Scum Pumps, are 20 years old and have been rehabilitated within the last ten years. Due to the age of the equipment, it is recommended the equipment be rehabilitated or replaced within the planning period.

Phosphorus Removal

The City of Watertown has phosphorus limits based on the Rock River Total Maximum Daily Load (TMDL) allocations, which result in more restrictive limits than in previous permits. The City currently achieves phosphorus removal at the WWTP through the addition of ferric chloride at the effluent end of the aeration basins

To supplement chemical phosphorus removal at the plant, a Water Quality Trading (WQT) plan was developed and approved by the Wisconsin Department of Natural Resources (WDNR) in June 2022 to comply with the TMDL limits. The nonpoint-to-point trade includes wetland restoration and perennial vegetation best management practices (BMPs) to generate nonpoint source credits on City-owned fields. Beginning in 2023, the City has 102 lbs/yr of available TP credits to demonstrate compliance as long as the approved WQT Plan BMPs are maintained.

Chemical Phosphorus Removal

Phosphorus removal is performed through chemical addition using ferric chloride, with two dosing points located at the end of the aeration basins. The chemical metering pumps are controlled using an ortho-phosphate analyzer, which measures ortho-phosphate levels in the plant effluent by taking a sample every 15 minutes. A 10,000-gallon chemical storage tank is located in the Secondary Treatment Building, near the final clarifiers.

Both the chemical pumps and chemical storage tank have reached the end of their 20-year design life. Due to the corrosive nature of ferric chloride and the age and condition of the equipment, new chemical metering pumps and a storage tank sized for 30-days of chemical storage are recommended.

Tertiary Treatment/Filtration

Alternatively, the installation of a tertiary treatment system could be used to meet TMDL limits. The WWTP’s effluent concentrations at average day and maximum month flows are in a range that can typically be treated using conventional filtration systems. Therefore, a 10.4 mgd disc filter system would be installed to receive flow from the Final Clarifiers. Per NR 110, the system would be sized to treat 200% the design annual average flow and achieve an average effluent phosphorus concentration of 0.2 mg/L. Construction, operation and maintenance, and present worth cost estimates comparing the disc filtration system and chemical treatment is summarized in Table 6-10. Further details are provided in the Appendix.

TABLE 6-10
Tertiary Treatment 20-Year Present Worth Comparison

Item	Alternative 1 Disc Filter	Alternative 2 Chemical Treatment
Capital Cost	$7,266,000	-
Salvage Value	$460,000	-
Present Worth O&M	$2,684,000	$2,226,000
Total Present Worth	**$9,491,000**	**$2,226,000**

Given the large present worth cost of the disc filter installation, it is recommended the City continues using a combination of ferric chloride treatment and WQT credits to achieve their phosphorus limits through the planning period.

Ultraviolet Disinfection

Disinfection is currently performed by an ultraviolet (UV) system that consists of two medium pressure, high intensity submerged lamp banks located in a concrete channel in the Secondary Building. The system disinfects secondary effluent from the Final Clarifiers. The disinfected effluent flow is measured by the effluent flow meter before it is aerated and discharged to the Rock River. The system has a treatment capacity of 24 mgd and a hydraulic capacity of 27 mgd. Table 6-11 lists the existing equipment and its design criteria.

TABLE 6-11
Disinfection Equipment

Equipment	Design Criteria
UV Disinfection	
No. of Units	1
No. of Banks	2
Modules per Bank	3
Lamps per Module	10
Total No. of Lamps	60
Channel Dimensions	4.5-ft W x 32-ft L x 9.5-ft D
Number of Channels	1, with bypass
Peak Capacity	24 mgd, Disinfection; 27 mgd, Hydraulic
Effluent Flow Monitoring	
Number of Units	1
Type	Parshall Flume
Size	36-inch

The UV disinfection system is nearing the end of its 20-year design life and the manufacturer will no longer provide parts or support for the system. It is recommended that a new UV disinfection system rated for a disinfection capacity of 27 mgd be installed to match the existing hydraulic capacity. The new system will be a low pressure, high intensity submerged lamp bank system that will be installed inside of the existing UV channel.

Cascade Aeration and Effluent Outfall

Disinfected effluent flows through a channel and down the existing cascade aerator to a 42-inch pipe that discharges to the Rock River. The cascade aerator is used to provide sufficient aeration to meet the effluent dissolved oxygen requirement of 6.0 mg/L. The existing cascade aerator has sufficient capacity to meet the dissolved oxygen requirement through the planning period.

The City reports no concerns with the cascade aerator but has noted erosion around the wing walls of the outfall. It is recommended a structural analysis of both structures be completed to ensure they remain in good condition throughout the planning period.

Biosolids Treatment

Biosolids Treatment consists of anaerobic digestion, biosolids dewatering, and dewatered sludge storage. Table 6-12 lists the existing equipment and its design capacities.

TABLE 6-12
Biosolids Treatment Equipment

Equipment	Design Criteria
Anaerobic Digesters	
No. of Units	2
Dimensions	Primary Digester: 65-ft Diameter x 24-ft D Secondary Digester: 50-ft Diameter, 24-ft D
Total Volume	79,600-ft^3
Operation Temperature	Mesophilic, 95°F +/- 2°F
Hydraulic Regime	Completely Mixed
Digester Mixers	
No. of Units	5, (3) Primary, (2) Secondary
Type	Roof Mounted Draft Tube
Design Capacity	9,000 gpm
Sludge Recirculation Pumps	
No. of Units	3
Type	Rotary Lobe Positive Displacement
Design Capacity	360 gpm, 30 psi, 230 rpm
Sludge Grinders	
No. of Units	2
Type	In-line Grinder
Design Capacity	170 gpm sludge, 400 gpm clean water
Maximum Solids Content	3%
Passing Solid Size	0.25-inch
Boilers	
No. of Units	2
Type	Three-pass wetback firebox
Design Capacity	3,400 MBh

Equipment	Design Criteria
Boiler Recirculation Pumps	
No. of Units	2
Type	Centrifugal
Design Capacity	300 gpm @ 60-ft TDH
Heat Exchangers	
No. of Units	2
Type	Spiral
Design Capacity	355,000 BTU/hr
Exchanger Recirculation Pumps	
No. of Units	3
Type	Centrifugal
Design Capacity	120 gpm @ 60-ft TDH
Centrifuges	
No. of Units	2
Sludge Feed Rate	40-150 gpm
Design Capacity	1,500 lb/hr
Centrifuge Feed Pumps	
No. of Units	2
Type	Rotary Lobe Positive Displacement
Design Capacity	150 gpm, 50 psi, 260 rpm
Polymer Mixing System	
No. of Units	2
Capacity	94 lb/hr
Sludge Storage Building	
No. of Units	1
Capacity	52,600-ft^3
Waste Gas Burner (Gas Safety Equipment)	
No. of Units	1
Capacity	7,900 scf/hr @ 0.5-in W.C.

Anaerobic Digestion

Primary sludge and WAS is co-settled in the Primary Clarifiers and pumped to the Digester Complex for stabilization using anaerobic digestion. The Digester Complex consists of a primary mesophilic digester operated at 95°F, followed by a secondary digester used to store digested sludge and digester gas. Both digesters are mixed and heated, so the secondary digester can be operated as the primary digester during periods of shutdown or maintenance.

The two digesters were originally constructed in the 1930s and were modified/rehabilitated in the 1980s and in 2004. The 2004 upgrade included new covers, new mechanical mixers on both digesters, and new sludge heating and recirculation equipment. The volatile solids loadings and solids retention times for the existing digesters are presented in the mass balance calculations in the Appendix and are summarized in Table 6-13.

TABLE 6-13
Anaerobic Digester Loading Conditions

Condition	Volatile Solids Mass (lbs VS/day)	Sludge Volume (gpd)	Volatile Solids Loading (lbs VSS/day/kcf)	Solids Retention Time (days)
Current Average Day	4,600	24,800	58	24
Design Average Day	5,700	30,000	71	20
NR 110 Code	**-**	**-**	**80**	**15**

The volatile solids loading rate and solids retention time (SRT) for the digesters meet the NR 110 requirements through the planning period. The existing digester volume will be adequate to effectively stabilize the design average primary sludge and WAS loading.

Digester Structures

The Anaerobic Digester structures date from the 1930s and new covers were installed in the 2004 WWTP upgrade. The Primary Digester has a floating cover, and the Secondary Digester has a gas holding cover. The Primary Digester was cleaned and visually inspected in 2023; however, a complete structural analysis of both digester concrete structures and covers should be completed to ensure they will remain in good condition throughout the planning period.

Digester Mixing

Sludge mixing in each digester is accomplished using roof-mounted draft tube mixers. Three mixers are installed on the Primary Digester, and two mixers are installed on the Secondary Digester. The mixers were recently rehabilitated but are 20 years old and continually exposed to corrosive environments. Due to age and condition, it is recommended they be replaced within the planning period to maintain digester operation and performance.

Digester Heating

The heating system for the anaerobic digesters is composed of two (2) three-pass wetback fire-box hot water boilers, two boiler recirculation water pumps, two spiral heat exchangers, three exchanger recirculation pumps, and three rotary lobe sludge recirculation pumps. A blend of digester gas and natural gas is used to heat the digesters, and any excess gas is sent to the waste gas burner.

The spiral heat exchangers, one boiler, sludge, boiler and exchanger recirculation have been recently replaced. The Hurst dual-fueled boiler and the waste gas burner have exceeded their 20-year design lives and should be replaced within the planning period.

Biosolids Dewatering

The City currently dewaters its digested sludge with two centrifuges that can be operated together or separately. Separate sludge grinders, feed pumps, polymer systems, and discharge conveyors are provided for each centrifuge unit. Dewatered biosolids are discharged to the Biosolids Storage Building, and centrate from the dewatering process is sent to a centrate storage tank and eventually returned to the Aeration Basins for treatment.

The City reports no operational issues with the centrifuges. The centrifuge gearboxes and sludge feed pumps have recently been replaced on both systems, and liners on the conveyance systems were recently replaced. The City reports that parts and controls for the centrifuges are becoming antiquated and difficult to maintain. The centrifuges, polymer systems, sludge grinders, and discharge conveyors were installed during the 2004 upgrade and have reached the end of their 20-year design life. It is recommended they be replaced due to age and condition.

Biosolids Storage

Dewatered sludge is stored in the Sludge Storage Building that was constructed during the 2004 upgrade. The building is approximately 83.5 ft by 141.5 ft and was designed to store 52,600 ft^3 of sludge cake. The building was sized based on the NR 110 requirement for 180 days of sludge storage capacity. Current and design year sludge storage requirements are provided in Table 6-14.

TABLE 6-14
Sludge Storage Requirements

Condition	Dewatered Sludge Production (lbs/day)	180 Day Storage Requirements (lbs)	Estimated Storage Volume (ft^3)
Current Average Day	4,700	841,000	52,500
Design Average Day	5,600	1,008,000	63,000
Rated Storage Capacity	4,751	855,180	52,600
Actual Storage Capacity	9,500	1,710,400	105,200

Note: Based on dewatering sludge to 25% TS.

The design average day loading for dewatered sludge exceeds the rated capacity of the Sludge Storage Building. However, the City has made operational changes to allow storage capacity in the building to be greater than its original rated capacity. The City has achieved up to a year of storage at current loading conditions, providing an actual capacity of 105,200 ft^3. When necessary, concrete blocks are stacked on the south side of the building to allow for additional sludge to be stored. Additionally, the City has a significant amount of available acreage for land application of sludge, which allows more opportunities for sludge hauling through the year. For these reasons, the Sludge Storage Building is expected to have adequate capacity to maintain the required 180-days of storage through the planning period. No improvements are recommended.

Miscellaneous Modifications

Electrical System

The WWTP Electrical System has not been updated since its initial construction in 2004 and has reached the end of its 20-year design life. The transformer near the Raw Sewage Pump Station is not sealed properly, causing water to leak through the conduit into the basement of the building. The City reports no concerns with the transformer near the Generator Building or Primary Building. Power will need to be shut down to the WWTP to replace the equipment, so bypass pumping around the Raw Sewage Pump Station will be required to keep the plant in operation during the installation. Bypass pumping will be equipped to handle the peak hour flow of the WWTP.

The City reports no operational concerns with the generator or automatic transfer switch (ATS), but the equipment has exceeded their typical design lives. It is recommended the generator and ATS be replaced within the planning period.

HVAC System

The existing HVAC at the WWTP is 20 years old and has reached the end of its design life. It is recommended the HVAC system be upgraded to continue operating effectively through the planning period.

Instrumentation and Controls System

The existing instrumentation and control (I&C) system at the WWTP is 20 years old and has reached the end of its design life. The City has reported that PLC components and replacement parts are difficult to obtain. The SCADA network software, LCPs and PLCs should be upgraded to continue operating effectively through the planning period.

Fire Alarm System

The Fire Alarm system for the WWTP is currently out of service. A new monitoring system installation is currently being planned.

Gas Monitoring System

The gas monitoring system in the Raw Sewage Pump Station, Primary Building and Solids Handling Building are currently out of service. The City has been using portable gas monitors while occupying these spaces, but the monitoring system is recommended to be replaced to ensure operator safety when working in these spaces.

Storm Water Pumping

The WWTP has a storm sewer system design to collect the storm water from the plant site and convey it to the river. The storm water pump station structure contains two submersible storm water pumps each rated for 1,670 gpm. The pumps have been recently rehabilitated but have reached the end of their 20-year design life. It is recommended they be replaced within the planning period.

Chapter 7

RECOMMENDED PLAN AND IMPLEMENTATION

This chapter summarizes the recommendations in the preceding chapter to upgrade and expand the Watertown WWTP to accommodate wastewater flows and loadings over the next 20 years. This chapter also includes an environmental/resources impact summary, detailed project capital costs, funding availability, impacts on sewer user charge rate, and an implementation schedule.

PRELIMINARY SCREENING OF ALTERNATIVES

No Action Alternative

The current Watertown WWTP has an average design capacity of 5.2 mgd, 6,600 lbs BOD_5/day, 5,300 lbs TSS/day, 1,015 lbs TKN/day, and 215 lbs TP/day. The current BOD_5, TSS, and TKN loadings have ranged between 90-130% of rated plant capacity and will consistently exceed rated plant capacity by design year 2047. The majority of the plant dates to 2004, and much of the facility equipment has or will have exceeded their useful lives by the end of the planning period.

The "No Action" alternative represents continued operation of the existing facilities with no additions to the facilities and no changes to present operation and maintenance procedures. This alternative recognizes the fact that the present facilities and staff are producing effluent that is generally in compliance with permit requirements.

However, the "No Action" alternative does not address multiple key issues. First, the treatment plant does not possess adequate capacity to handle the increasing loads over the 20-year planning period. Second, much of the mechanical equipment in the plant is aging and will exceed its useful lifespan during the planning period. Decreased efficiency and aging of the equipment could lead to short-term permit violations and increased costs to repair and maintain the equipment.

The "No Action" alternative would likely lead to future effluent permit violations, which could subject the City to stringent fines. The WDNR could then impose a schedule to comply with effluent limits, which would mean the City would still have to upgrade and expand its treatment plant. However, once a community is in violation of its discharge permit, they are no longer eligible for a low interest loan from the Clean Water Fund, and a moratorium on new sewer construction is imposed.

The Rock River is classified by the WDNR for fish and aquatic life and warm water sport fishery. Permit violations would cause stream degradation because of the discharge of additional quantities of suspended solids and oxygen consuming material (BOD_5). The negative effect on fish and aquatic life would also affect other downstream recreational uses in the Rock River. Due to the eventual possibility of WDNR prosecution, environmental damage, and negative economic impact, the "No Action" alternative is eliminated from further consideration.

Upgrade Operation and Maintenance Alternative

This alternative includes improvements to the methods of operating and maintaining the present facilities, along with minor facilities improvements. No areas have been identified where changes in operations and maintenance would have a significant impact on the treatment capacity of the facility. Operations personnel have already optimized the facilities' treatment capabilities in order to meet permit limits.

The "Upgrade O&M" alternative fails to address the same key problems noted in the "No Action" alternative: projected increases in loads and equipment age. The same problems of future WDNR prosecution, environmental damage, and negative economic impact could potentially occur. Therefore, the "Upgrade O&M" alternative is eliminated from further consideration.

RECOMMENDED PLAN

The current Watertown WWTP capacity for BOD_5, TSS, NH_3-N, TKN, and TP will be exceeded due to projected increases in wasteloads by the year 2047. To provide adequate capacity through the planning period, it is recommended that the existing wastewater treatment plant be upgraded.

The recommended plan includes the major plant improvements presented in Table 7-1 through Table 7-3. The recommended plan is outlined in a phased approach, with required upgrades being separated into either near-term (0-2 years), mid-term (3-5 years), or long-term (5-10 years) improvements. Upon completion of construction, these improvements will allow the Watertown WWTP to handle the projected flows and loadings through the year 2047. Mass balance calculations for the upgraded treatment plant are contained in the Appendix.

The majority of the equipment recommended for replacement will be improvements that will not affect the quality or quantity of WWTP effluent. These projects are considered by the WDNR to be "maintenance projects" and not "reviewable projects" and may not require plan approval, unless the project is financed through the Clean Water Fund (CWF). According to the WDNR, *"a reviewable project may also consist of modifications that do not directly have potential effects on the quality or quantity of effluent but are subject to design requirements in ch. NR 110, Wis. Adm. Code."*, such as ventilation requirements for chemical storage facilities. Additional information on reviewable projects are listed in NR 108.02 and NR 281.41, as well as the WNDR website.

Table 7-1 and Table 7-2 indicate which of the proposed improvements may be considered reviewable. No proposed improvements in Table 7-3 are considered reviewable.

TABLE 7-1
Summary of Near-Term Plant Improvements

Unit Process	No.	Size/Capacity
Preliminary Treatment		
Fine Screens	2	13.5 mgd, each
Grit Removal System Upgrades	1	18-ft Dia, 20-ft depth
Primary Treatment		
Primary Sludge and Scum Pumps	4	54 gpm, each
Disinfection		
UV Disinfection System*	1	27 mgd
Biosolids Treatment		
Polymer System	2	94 lb/hr, each
Miscellaneous Improvements		
Transformers/Electrical Service Upgrade	1	N/A
SCADA Improvements	1	N/A
Gas Monitoring System Replacement	1	N/A
Fire Alarm System Replacement	1	N/A

* Indicates a potentially reviewable project.

TABLE 7-2
Summary of Mid-Term Plant Improvements

Unit Process	No.	Size/Capacity
Raw Sewage Pumping		
Auxiliary Generator Upgrades	1	N/A
Primary Treatment		
Scum Well Upgrades	1	N/A
Scum Well Pump	1	250 gpm
Scum Well Mixer	1	N/A
Secondary Treatment		
Secondary Splitter Upgrades	1	N/A
Aeration Basin Concrete Rehabilitation	1	N/A
Aeration Blowers*	3	3,000 scfm, each
Fine Bubble Diffusers*	1	N/A
Chemical Feed Pumps	3	5-30 gpm, each
Chemical Storage Tank	1	10,000 gal
Biosolids Treatment		
Primary Sludge Line Cleanout Improvements	1	N/A
Anaerobic Digester Structural Assessment	1	N/A
Centrifuges	2	1,500 lb/hr, each
Sludge Grinders	2	170 gpm, each
Sludge Discharge Conveyor	1	N/A
Miscellaneous Improvements		
Cascade Aeration Assessment	1	N/A
Effluent Outfall Assessment	1	N/A
Generator/ATS	1	N/A
HVAC System Improvements*	1	N/A

* Indicates a potentially reviewable project.

TABLE 7-3
Summary of Long-Term Plant Improvements

Unit Process	No.	Size/Capacity
Raw Sewage Pumping		
Raw Sewage Pumps	5	4,700 gpm, each
Primary Treatment		
Primary Clarifier Mechanisms/Drives	2	85-ft Dia, 12-ft SWD
Secondary Treatment		
Anoxic Mixers	3	1,500 gpm, each
Mixed Liquor Recycle Pumps	3	2,600 gpm, each
Return Sludge Pumps	3	2,300 gpm, each
Waste Sludge Pumps	2	380 gpm, each
Final Scum Pump	1	150 gpm, each
Final Clarifier Mechanisms/Drives	2	90-ft Dia, 16-ft SWD
Biosolids Treatment		
Anaerobic Digester Mixers	5	9,000 gpm, each
Dual Fueled Boiler	1	3,400 MBh
Waste Gas Burner	1	7,900 scf/hr
Miscellaneous Improvements		
Storm Water Pumps	2	1,670 gpm, each

ENVIRONMENTAL/RESOURCES IMPACT SUMMARY

The recommended plan will upgrade and increase the capacity of the existing Watertown WWTP. It will have an overall positive impact on the surrounding environment including the Rock River and the entire Watertown community. This is in contrast to the negative impacts of the "No Action" and "Improved O&M" alternatives.

Water Quality

The recommended plan will provide the WWTP with a greater capacity for removing BOD, TSS, NH_3-N, TKN, and TP than the existing facilities. These improvements will allow the plant to consistently produce an effluent that achieves the required effluent quality through the 20-year planning period.

Soil erosion and sedimentation occurring during construction of the recommended plan should be minimal. The construction plans and specifications will contain provisions for the installation of erosion control measures to protect adjacent areas from run-off and siltation.

Air Quality

The recommended plan may improve air quality since the overloaded treatment plant will be upgraded to accommodate current and future waste loads. Portions of the existing wastewater treatment plant site are within 500 feet of some commercial establishments. While the plant has not received any odor complaints, an overloaded treatment facility is susceptible to periodic odors.

Plant staff may notice temporary dust from any excavation equipment used during construction. However, the construction specifications will require that fugitive dust control measures be implemented. Furthermore, no additional structures are recommended to be constructed for the proposed upgrade, which will limit the use of excavation equipment.

Historical and Archeological Sites

The proposed treatment plant upgrade will take place on the existing plant site, which has been the subject of archeological investigations dating back to the 1980s. Investigations have taken place throughout the previous treatment plant upgrade to recover archeological features and determine the location of burial sites on the treatment plant site. The recommended plan is not expected to disrupt any existing archeological features or burial sites.

Floodplains and Environmentally Significant Lands

The recommended plan involves construction on the existing plant site. The site is not located adjacent to any environmentally sensitive lands. The existing plant site is located within the 100-year flood elevation; however, the existing site has been flood proofed to prevent flooding of the site.

Public Health

The recommended plan will provide substantial benefits to public health, including upgrading pumping to prevent sewer backups into basements, proper wastewater treatment prior to discharge to the Rock River, and sludge stabilization to reduce the likelihood of pathogens in the environment and exposure to the public.

CAPITAL COST OF RECOMMENDED PLAN

The estimated capital cost for the recommended near-term, mid-term, and long-term plan is $9,098,000, $10,261,000 and $14,063,000, respectively, as summarized in Table 7-4 through Table 7-6. This capital cost includes construction, engineering, legal, and administrative costs.

TABLE 7-4
Summary of Near-Term Project Costs

Item	Unit	Unit Cost	Quantity	Total Cost
Preliminary Treatment				
Fine Screens	Ea	$317,000	2	$634,000
Grit Removal System Upgrades	Lot	$778,000	1	$778,000
Primary Treatment				
Primary Sludge and Scum Pumps	Ea	$47,000	4	$188,000
Disinfection				
UV Disinfection System	Ea	$1,136,000	1	$1,136,000
Biosolids Treatment				
Polymer System	Ea	$175,000	2	$350,000
Miscellaneous Improvements				
SCADA Improvements	Lot	$500,000	1	$500,000
Transformers and Electrical Service Upgrades	Lot	$200,000	1	$200,000
Fire Alarm System	Lot	$120,000	1	$120,000
Gas Monitoring System	Ea	$52,000	3	$156,000
Instrumentation and Control	Lot	18%		605,000
Electrical	Lot	20%		712,000
Mechanical	Lot	15%		481,000
Subtotal				5,860,000
Contingencies @ 25%				1,465,000
Subtotal Construction Cost				7,325,000
General Conditions, Bonds and Insurance @ 8%				586,000
Construction Cost				7,911,000
Engineering and Administration Fees @ 15%				1,187,000
Total Project Cost				**9,098,000**

TABLE 7-5
Summary of Mid-Term Project Costs

Item	Unit	Unit Cost	Quantity	Total Cost
Raw Sewage Pumping				
Auxiliary Generator Upgrades	Lot	$250,000	1	$250,000
Primary Treatment				
Scum Well Upgrades	Lot	$125,000	1	$125,000
Scum Well Pump	Ea	$25,000	1	$25,000
Scum Well Mixer	Ea	$25,000	1	$25,000
Secondary Treatment				
Secondary Splitter Upgrades	Lot	$63,000	1	$63,000
Aeration Basin Concrete Rehabilitation	Lot	$25,000	1	25,000
Aeration Blowers	Ea	$168,000	3	$504,000
Fine Bubble Diffusers	Lot	$475,000	1	$475,000
Chemical Feed Pumps	Ea	$15,000	3	$45,000
Chemical Storage Tank	Ea	$108,000	1	$108,000
Biosolids Treatment				
Primary Sludge Line Cleanout Improvements	Lot	$40,000	1	$40,000
Anaerobic Digester Assessment	Lot	$50,000	1	$50,000
Centrifuges	Ea	$569,000	2	$1,138,000
Sludge Grinders	Ea	$23,000	2	$46,000
Sludge Discharge Conveyor	Lot	$159,000	1	$159,000
Miscellaneous Improvements				
Cascade Aeration Assessment	Lot	$8,000	1	$8,000
Effluent Outfall Assessment	Lot	$140,000	1	$8,000
HVAC System Improvements	Lot	$1,100,000	1	1,143,000
Generator/ATS	Lot	691,000	1	$691,000
Instrumentation and Control	Lot	18%		$535,000
Electrical	Lot	20%		$595,000
Mechanical	Lot	15%		$565,000
Subtotal				$6,623,000
Contingencies @ 25%				$1,639,000

Item	Unit	Unit Cost	Quantity	Total Cost
Subtotal Construction Cost				$8,262,000
General Conditions, Bonds and Insurance @ 8%				$661,000
Construction Cost				$8,923,000
Engineering and Administration Fees @ 15%				$1,338,000
Total Project Cost				**$10,261,000**

TABLE 7-6
Summary of Long-Term Project Costs

Item	Unit	Unit Cost	Quantity	Total Cost
Raw Sewage Pumping				
Raw Sewage Pumps	Ea	$194,000	5	$970,000
Primary Treatment				
Primary Clarifier Mechanisms and Drives	Ea	$537,000	2	$1,074,000
Secondary Treatment				
Anoxic Mixers	Ea	$140,000	3	$420,000
Mixed Liquor Recycle Pumps	Ea	$82,000	3	$246,000
Return Sludge Pumps	Ea	$131,000	3	$393,000
Waste Sludge Pumps	Ea	$35,000	2	$70,000
Final Scum Pump	Ea	$25,000	1	$25,000
Final Clarifier Mechanisms and Drives	Ea	$556,000	2	$1,112,000
Biosolids Treatment				
Anaerobic Digester Mixers	Ea	$181,000	5	$905,000
Dual Fueled Boiler	Ea	$207,000	1	$207,000
Waste Gas Burner	Lot	$290,000	1	$290,000
Miscellaneous Improvements				
Stormwater Pumps	Ea	$104,000	2	$208,000
Instrumentation and Control	Lot	18%		$1,066,000
Electrical	Lot	20%		$1,184,000
Mechanical	Lot	15%		$888,000
Subtotal				$9,058,000
Contingencies @ 25%				$2,265,000
Subtotal Construction Cost				$11,323,000
General Conditions, Bonds and Insurance @ 8%				$906,000
Construction Cost				$12,229,000
Engineering and Administration Fees @ 15%				$1,834,000
Total Project Cost				**$14,063,000**

FINANCING AND RATE IMPACTS

One source of funds for these projects is the plant's Equipment Replacement Fund. An additional funding source is a low interest loan from the Clean Water Fund Program. The DNR Bureau of Environmental Loans administers the Clean Water Fund Program that provides reduced interest rate loans for eligible wastewater projects. The current interest rate for eligible projects is 2.365%, as of September 2024 (55% of market rate). Flows from industrial dischargers and reserve capacity at the treatment plant for flows beyond 10 years from the time of the project completion are not eligible for the low-interest rate financing. The costs associated with facilities to treat these flows would be financed at the current market interest rate of 4.3%.

It is estimated that the annual operational and maintenance (O&M) costs for the wastewater treatment plant will be similar to the current annual O&M costs of $2.6 million, per the City's 2023 financial audit.

Assuming that the three proposed projects are 90 percent eligible for a reduced interest rate loan (assumed to be 2.365%) with the remaining amounts financed with the equipment replacement fund, the debt retirement for a 20-year bond to finance the outstanding capital costs for the recommended alternatives is shown in Table 7-7.

TABLE 7-7
Debt Service Estimate

Project	Project Cost	Loan Amount	Annual Principal and Interest Payment
Near-Term Improvements	$9,098,000	$8,188,000	$519,000
Mid-Term Improvements	$10,261,000	$9,235,000	$585,000
Long-Term Improvements	$14,063,000	$12,657,000	$802,000

The impact on user charge rates is dependent on the exact method of allocating the annual revenue requirement for capital and annual operating costs over the various user categories and will require a detailed user charge study. The new user charge rates will have to generate sufficient revenue to pay for the annual debt services for the new loans.

Based on the estimated operating income from the 2023 audit, it is estimated that the current utility rates are sufficient for the additional revenue requirements for the proposed Near-Term project. It should be noted that the final cost allocation and user charge rates will be determined from a user charge study after final project costs, CWFP impacts, and method of financing are determined

IMPLEMENTATION SCHEDULE

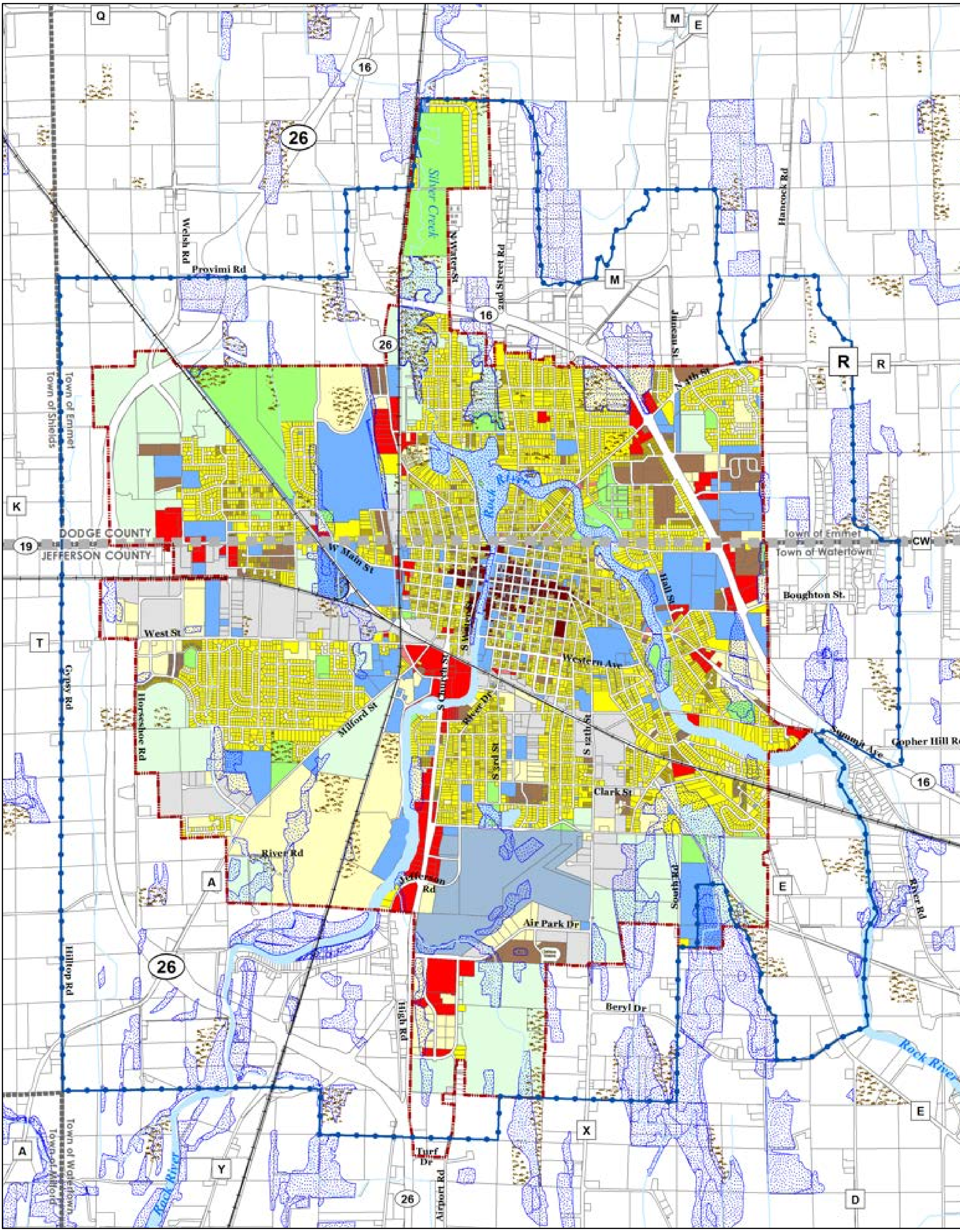
The steps and anticipated schedule for implementing the recommended plant are outlined below:

Conduct Public Hearing..November 2024
Submit Facility Plan to DNR..December 2024
DNR Approval of Facility Plan..March 2025
Near-Term Improvements
    Begin Design..January 2025
    Submit Plans and Specifications to the DNR..September 2025
    Bidding..November 2025
    DNR Approval of Plans and Specifications..December 2025
    Submit Clean Water Fund Application..December 2025
    Award of Contract..January 2026
    Begin Construction..March 2026
    Final Completion/Startup of Facilities..May 2027
Mid-Term Improvements..January 2028
Long-Term Improvements..January 2030

PUBLIC HEARING

Per Wisconsin Administrative code NR 110.09(4), municipalities must conduct at least one public hearing prior to the facility plan being adopted. A copy of the facility plan report will be available for public review before the meeting and at the meeting. The City will schedule a public hearing to present the Facility Planning report and solicit questions and comments from regulatory and governmental agencies and the general public. A ten (10) day comment period will be provided following the hearing to allow submission of written comments regarding the Facility Plan. A copy of the public hearing notice, transcripts from the hearing, and written comments received during the comment period will be included in an Appendix in the final Facility Plan.

APPENDIX A
Facility Planning Area



Existing Land Use

Map 5

THE CITY OF WATERTOWN
Opportunity runs through it.

City of Watertown Comprehensive Plan

- City of Watertown
- County Boundary
- Town Boundary
- Parcels
- Urban Service Area Boundary
- Railroad

Land Use Categories

- Agriculture
- Single Family Residential - Unsewered
- Single Family Residential - Sewered
- Two-Family Residential
- Multi-Family Residential
- Vacant
- Airport
- Institutional
- Neighborhood Mixed Use
- Business
- Central Mixed Use
- Mixed Industrial
- Parks & Recreation

- Rights-of-Way
- Surface Water
- Wetland
- Woodland

Draft: July 1, 2019

Source: WisDNR, FEMA, City of Watertown, Dodge Co. LIO & Jefferson Co. LIO, V&A

0 0.3 0.6 1.2 Miles

N W E S

VANDEWALLE & ASSOCIATES INC.
Shaping places, shaping change

APPENDIX B
WPDES Permit

WPDES PERMIT

STATE OF WISCONSIN
DEPARTMENT OF NATURAL RESOURCES

PERMIT TO DISCHARGE UNDER THE WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM

CITY OF WATERTOWN

is permitted, under the authority of Chapter 283, Wisconsin Statutes, to discharge from a facility located at
800 HOFFMAN DRIVE, WATERTOWN, WISCONSIN
to
Rock River (Middle Rock River Watershed, UR01 – Upper Rock River Basin)
in Jefferson County

in accordance with the effluent limitations, monitoring requirements and other conditions set forth in this permit.

The permittee shall not discharge after the date of expiration. If the permittee wishes to continue to discharge after this expiration date an application shall be filed for reissuance of this permit, according to Chapter NR 200, Wis. Adm. Code, at least 180 days prior to the expiration date given below.

State of Wisconsin Department of Natural Resources
For the Secretary

By ______________________
Thomas Bauman
Wastewater Field Supervisor

March 13, 2024
Date Permit Signed/Issued

PERMIT TERM: EFFECTIVE DATE - October 01, 2020 **EXPIRATION DATE - September 30, 2025**
Modification Date Effective – October 1, 2022
Modification -3 Date Effective – April 1, 2024

TABLE OF CONTENTS

1 Influent Requirements

1.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
701	Influent: 24-Hr flow proportional sampler located after raw influent screening. Flow meter located after raw wastewater pumps.

1.2 Monitoring Requirements

The permittee shall comply with the following monitoring requirements.

1.2.1 Sampling Point 701 - INFLUENT

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
BOD_5, Total		mg/L	5/Week	24-Hr Flow Prop Comp	
Suspended Solids, Total		mg/L	5/Week	24-Hr Flow Prop Comp	
Cadmium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Chromium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Copper, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Lead, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Nickel, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Zinc, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Mercury, Total Recoverable		ng/L	Quarterly	24-Hr Flow Prop Comp	See Mercury Monitoring section

1.2.1.1 Total Metals Analyses

Measurements of total metals and total recoverable metals shall be considered as equivalent.

1.2.1.2 Sample Analysis

Samples shall be analyzed using a method which provides adequate sensitivity so that results can be quantified at a level of quantitation below the calculated/potential effluent limit, unless not possible using the most sensitive approved method.

1.2.1.3 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

2 In-Plant Requirements

2.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
102	Collect the mercury field blank using sample handling procedures specified in NR 106.145(9), Wisconsin Administrative Code.
103	Sample point for reporting diverted flow from the primary clarifiers during high flow events. Flow bypasses the aeration basins and final clarifiers but receives disinfection prior to discharge. Department approval for blending shall be obtained prior to use of this sample point. Any flow diverted prior to blending approval shall be considered to be a bypass, is prohibited, and should be reported to the Department as such. The permittee shall notify the Department when blending occurs. See Blending requirements in the Standard Requirements section of the permit.

2.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

2.2.1 Sampling Point 102 - GEN PLANT (Hg blank)

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Mercury, Total Recoverable		ng/L	Quarterly	Blank	See Mercury Monitoring section

2.2.1.1 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wisconsin Administrative Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

2.2.2 Sampling Point 103 - BLENDING

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Per Occurrence	Continuous	See Blending Flow permit section.
Time		hours	Per Occurrence	Calculated	Report the total duration of blending within a given day (12:00 am - 11:59 pm) in which blending occurs. See Blending Flow permit

					section.

2.2.2.1 Blending Flow

Flow measurement shall start at the commencement of blending operations and shall be maintained for the duration of the blending operation. Measure flow in daily increments until operation ends and report daily flow on the eDMR. The permittee shall report the volume of wastewater that is diverted around secondary treatment processes whenever in-plant diversion (blending) occurs. See "Blending" requirements in the Standard Requirements section for additional requirements.

3 Surface Water Requirements

3.1 Sampling Point(s)

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
001	Effluent: 24-Hr flow proportional sampler located prior to UV disinfection. Grab samples taken post aeration prior to discharge to the Rock River.

3.2 Monitoring Requirements and Effluent Limitations

The permittee shall comply with the following monitoring requirements and limitations.

3.2.1 Sampling Point (Outfall) 001 - EFFLUENT

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		MGD	Daily	Continuous	
BOD_5, Total	Monthly Avg	30 mg/L	5/Week	24-Hr Flow Prop Comp	Effective January through May
BOD_5, Total	Monthly Avg	16 mg/L	5/Week	24-Hr Flow Prop Comp	Effective June
BOD_5, Total	Monthly Avg	12 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July and October
BOD_5, Total	Monthly Avg	10 mg/L	5/Week	24-Hr Flow Prop Comp	Effective August and September
BOD_5, Total	Monthly Avg	25 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November
BOD_5, Total	Monthly Avg	29 mg/L	5/Week	24-Hr Flow Prop Comp	Effective December
BOD_5, Total	Weekly Avg	31 mg/L	5/Week	24-Hr Flow Prop Comp	Effective January
BOD_5, Total	Weekly Avg	35 mg/L	5/Week	24-Hr Flow Prop Comp	Effective February
BOD_5, Total	Weekly Avg	45 mg/L	5/Week	24-Hr Flow Prop Comp	Effective March through May
BOD_5, Total	Weekly Avg	16 mg/L	5/Week	24-Hr Flow Prop Comp	Effective June
BOD_5, Total	Weekly Avg	12 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July and October
BOD_5, Total	Weekly Avg	10 mg/L	5/Week	24-Hr Flow Prop Comp	Effective August and September

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
BOD_5, Total	Weekly Avg	25 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November
BOD_5, Total	Weekly Avg	29 mg/L	5/Week	24-Hr Flow Prop Comp	Effective December
BOD_5, Total	Weekly Avg	1,400 lbs/day	5/Week	Calculated	Effective January
BOD_5, Total	Weekly Avg	1,500 lbs/day	5/Week	Calculated	Effective February
BOD_5, Total	Weekly Avg	690 lbs/day	5/Week	Calculated	Effective June
BOD_5, Total	Weekly Avg	530 lbs/day	5/Week	Calculated	Effective July and October
BOD_5, Total	Weekly Avg	450 lbs/day	5/Week	Calculated	Effective August
BOD_5, Total	Weekly Avg	440 lbs/day	5/Week	Calculated	Effective September
BOD_5, Total	Weekly Avg	1,100 lbs/day	5/Week	Calculated	Effective November
BOD_5, Total	Weekly Avg	1,300 lbs/day	5/Week	Calculated	Effective December
Suspended Solids, Total	Monthly Avg	30 mg/L	5/Week	24-Hr Flow Prop Comp	Effective January through May
Suspended Solids, Total	Monthly Avg	16 mg/L	5/Week	24-Hr Flow Prop Comp	Effective June
Suspended Solids, Total	Monthly Avg	12 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July and October
Suspended Solids, Total	Monthly Avg	10 mg/L	5/Week	24-Hr Flow Prop Comp	Effective August and September
Suspended Solids, Total	Monthly Avg	25 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November
Suspended Solids, Total	Monthly Avg	29 mg/L	5/Week	24-Hr Flow Prop Comp	Effective December
Suspended Solids, Total	Weekly Avg	31 mg/L	5/Week	24-Hr Flow Prop Comp	Effective January
Suspended Solids, Total	Weekly Avg	35 mg/L	5/Week	24-Hr Flow Prop Comp	Effective February
Suspended Solids, Total	Weekly Avg	45 mg/L	5/Week	24-Hr Flow Prop Comp	Effective March through May
Suspended Solids, Total	Weekly Avg	16 mg/L	5/Week	24-Hr Flow Prop Comp	Effective June
Suspended Solids, Total	Weekly Avg	12 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July and October
Suspended Solids, Total	Weekly Avg	10 mg/L	5/Week	24-Hr Flow Prop Comp	Effective August and September
Suspended Solids, Total	Weekly Avg	25 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November
Suspended Solids, Total	Weekly Avg	29 mg/L	5/Week	24-Hr Flow Prop Comp	Effective December
Suspended Solids, Total		lbs/day	5/Week	Calculated	Report daily mass discharged using Equation 1a. in the “Water Quality Trading (WQT)” section.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
WQT Credits Used (TSS)		lbs/month	Monthly	Calculated	Report WQT TSS Credits used per month using Equation 3c. in the Water Quality Trading (WQT) section. Available TSS Credits are specified in Table 3 and in the approved Water Quality Trading Plan.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	1,270 lbs/day	Monthly	Calculated	Effective January, March, and May. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	1,410 lbs/day	Monthly	Calculated	Effective February. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	1,310 lbs/day	Monthly	Calculated	Effective April. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	700 lbs/day	Monthly	Calculated	Effective June. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	510 lbs/day	Monthly	Calculated	Effective July and October. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	430 lbs/day	Monthly	Calculated	Effective August. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	440 lbs/day	Monthly	Calculated	Effective September. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	1,100 lbs/day	Monthly	Calculated	Effective November. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Monthly Avg	Monthly Avg	1,230 lbs/day	Monthly	Calculated	Effective December. Report the WQT TSS Computed Compliance value using Equation 5a. in the “Water Quality Trading (WQT)” section. Value entered on the last day of the month.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	1,400 lbs/day	Weekly	Calculated	Effective January. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	1,500 lbs/day	Weekly	Calculated	Effective February. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	2,270 lbs/day	Weekly	Calculated	Effective March and May. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	2,340 lbs/day	Weekly	Calculated	Effective April. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	690 lbs/day	Weekly	Calculated	Effective June. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	530 lbs/day	Weekly	Calculated	Effective July and October. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	450 lbs/day	Weekly	Calculated	Effective August. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	440 lbs/day	Weekly	Calculated	Effective September. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	1,100 lbs/day	Weekly	Calculated	Effective November. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT Computed Compliance (TSS) – Weekly Avg	Weekly Avg	1,300 lbs/day	Weekly	Calculated	Effective December. Report the WQT TSS Computed Compliance value using Equation 5b. in the “Water Quality Trading (WQT)” section. Values entered on the last day of each week.
WQT TSS Annual Credits Used	Annual Total	3,200 lbs/yr	Annual	Calculated	The sum of total monthly credits used may not exceed Table 3 values listed below.
Nitrogen, Ammonia (NH_3-N) Total	Daily Max	20 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November through March
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	20 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November through March
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	17 mg/L	5/Week	24-Hr Flow Prop Comp	Effective June
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	9.0 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	6.4 mg/L	5/Week	24-Hr Flow Prop Comp	Effective August
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	8.9 mg/L	5/Week	24-Hr Flow Prop Comp	Effective September
Nitrogen, Ammonia (NH_3-N) Total	Weekly Avg	13 mg/L	5/Week	24-Hr Flow Prop Comp	Effective October
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	20 mg/L	5/Week	24-Hr Flow Prop Comp	Effective November through March
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	17 mg/L	5/Week	24-Hr Flow Prop Comp	Effective June
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	9.0 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	6.4 mg/L	5/Week	24-Hr Flow Prop Comp	Effective August
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	8.9 mg/L	5/Week	24-Hr Flow Prop Comp	Effective September
Nitrogen, Ammonia (NH_3-N) Total	Monthly Avg	9.3 mg/L	5/Week	24-Hr Flow Prop Comp	Effective October
Dissolved Oxygen	Daily Min	6.0 mg/L	Daily	Grab	
pH Field	Daily Max	9.0 su	Daily	Grab	

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
pH Field	Daily Min	6.0 su	Daily	Grab	
E. coli	Geometric Mean - Monthly	126 #/100 ml	2/Week	Grab	Limit effective May - September annually, per the "Effluent Limitations for E. coli" Schedule.
E. coli	% Exceedance	10 Percent	Monthly	Calculated	Limit effective May - September annually. See the "E. coli Percent Limit" section below. Enter the result in the DMR on the last day of the month.
Phosphorus, Total	Monthly Avg	1.0 mg/L	5/Week	24-Hr Flow Prop Comp	Effective July to March and May. This technology-based limit is retained as it represents a minimum control level to prevent backsliding. See "Water Quality Trading (WQT)" sections for more information.
Phosphorus, Total	Monthly Avg	0.8 mg/L	5/Week	24-Hr Flow Prop Comp	Effective April and June. The MDV limit for April and June is retained for anti-backsliding purposes.
Phosphorus, Total		lbs/day	5/Week	Calculated	Report daily mass discharged using Equation 1a. in the "Water Quality Trading (WQT)" section.
WQT Credits Used (TP)		lbs/month	Monthly	Calculated	Report WQT TP Credits used per month using Equation 2b. in the "Water Quality Trading (WQT)" section. Available TP Credits are specified in Table 2 and in the approved Water Quality Trading Plan.
WQT Computed Compliance (TP)	Monthly Avg	13.7 lbs/day	Monthly	Calculated	Effective January. Report the WQT TP Computed Compliance value using Equation 4a. in the "Water Quality Trading (WQT)" section. Value entered on the last day of the month.
WQT Computed Compliance (TP)	Monthly Avg	19.5 lbs/day	Monthly	Calculated	Effective February. Calculate using Eq. 4a.

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
WQT Computed Compliance (TP)	Monthly Avg	18.4 lbs/day	Monthly	Calculated	Effective March. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	18.3 lbs/day	Monthly	Calculated	Effective April. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	16.5 lbs/day	Monthly	Calculated	Effective May. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	17.6 lbs/day	Monthly	Calculated	Effective June. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	17.7 lbs/day	Monthly	Calculated	Effective July. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	16.2 lbs/day	Monthly	Calculated	Effective August. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	14.8 lbs/day	Monthly	Calculated	Effective September Calculate using Eq. 4a..
WQT Computed Compliance (TP)	Monthly Avg	12.3 lbs/day	Monthly	Calculated	Effective October and November. Calculate using Eq. 4a.
WQT Computed Compliance (TP)	Monthly Avg	11.9 lbs/day	Monthly	Calculated	Effective December. Calculate using Eq. 4a.
WQT Credits Used (TP)	Annual Total	25.5 lbs/yr	Annual	Calculated	Effective 2022.The sum of total monthly credits used after the effective date of the permit modification may not exceed Table 2 values listed below.
WQT Credits Used (TP)	Annual Total	102 lbs/yr	Annual	Calculated	Effective 2023-2025. The sum of total monthly credits used may not exceed Table 2 values listed below.
Chloride		mg/L	4/Month	24-Hr Flow Prop Comp	Monitoring only in 2024
Mercury, Total Recoverable	Daily Max	3.7 ng/L	Quarterly	Grab	This is an Alternative Mercury Effluent Limit. See Mercury section and schedule.
Temperature Maximum		deg F	3/Week	Continuous	
Acute WET		TU_a	See Listed Qtr(s)	24-Hr Flow Prop Comp	See WET section.
Chronic WET	Monthly Avg	1.5 TUc	See Listed Qtr(s)	24-Hr Flow Prop Comp	See WET section.
Cadmium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Chromium, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Copper, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Lead, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Nickel, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Zinc, Total Recoverable		µg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Total Kjeldahl		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Nitrite + Nitrate Total		mg/L	Quarterly	24-Hr Flow Prop Comp	
Nitrogen, Total		mg/L	Quarterly	Calculated	Total Nitrogen shall be calculated as the sum of reported values for Total Kjeldahl Nitrogen and Total Nitrite + Nitrate Nitrogen.

3.2.1.1 Annual Average Design Flow

The annual average design flow of the permittee's wastewater treatment facility is 5.2 MGD.

3.2.1.2 *E. coli* Percent Limit

No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 #/100 ml. Bacteria samples may be collected more frequently than required. All samples shall be reported on the monthly discharge monitoring reports (DMRs). The following calculation should be used to calculate percent exceedances.

$$\frac{\#\ of\ Samples\ greater\ than\ 410\ \#/100}{Total\ \#\ of\ samples} \times 100 = \%\ Exceedance$$

3.2.1.3 Mercury Monitoring

The permittee shall collect and analyze all mercury samples according to the data quality requirements of ss. NR 106.145(9) and (10), Wis. Adm. Code. The limit of quantitation (LOQ) used for the effluent and field blank shall be less than 1.3 ng/L, unless the samples are quantified at levels above 1.3 ng/L. The permittee shall collect at least one mercury field blank for each set of mercury samples (a set of samples may include combinations of intake, influent, effluent or other samples all collected on the same day). The permittee shall report results of samples and field blanks to the Department on Discharge Monitoring Reports.

3.2.1.4 Mercury Variance – Implement Pollutant Minimization Program Plan

This permit contains a variance to the water quality-based effluent limit (WQBEL) for mercury granted in accordance with s. 283.15, Stats. As conditions of this variance the permittee shall (a) maintain effluent quality at or below the interim effluent limitation specified in the table above, (b) follow the Pollutant Minimization Program Plan and (c) perform the actions listed in the compliance schedule (See the Schedules section herein

3.2.1.5 Effluent Temperature Monitoring

For monitoring temperature continuously, collect measurements in accordance with s. NR 218.04(13), Wis. Adm Code. This means that discrete measurements shall be recorded at intervals of not more than 15 minutes during the 24-hour period. Report the maximum temperature measured during the day on the DMR.

3.2.1.6 TMDL Limitations for Total Suspended Solids

The Rock River TMDL for Total Phosphorus (TP) and Total Suspended Solids (TSS) was approved by the Environmental Protection Agency (EPA) September 2011. The TMDL derived TSS limits are expressed as weekly average and monthly average effluent limits. The approved TSS TMDL limits for this permittee are included in the following table*:

Total Suspended Solids Effluent Limitations

Month	Monthly Average TSS Effluent Limit (lbs/day)	Weekly Average TSS Effluent Limit (lbs/day)*
Jan	1270	2270
Feb	1410	2500
March	1270	2270
April	1310	2340
May	1270	2270
June	700	1250
July	510	910
Aug	430	760
Sept	440	770
Oct	510	910
Nov	1100	1950
Dec	1230	2190

* The TMDL derived weekly average TSS limits in the table above are superseded by more stringent water quality based effluent limits for the months of June through February.

3.2.1.7 TMDL Limitations for Total Phosphorus

The Rock River TMDL for Total Phosphorus (TP) and Total Suspended Solids (TSS) was approved by the Environmental Protection Agency (EPA) September 2011. The TMDL derived phosphorus limits are expressed as monthly average effluent limits. The approved total phosphorus TMDL limits for this permittee are included in the following table:

Total Phosphorus Effluent Limitations

Month	Monthly Average Total P Effluent Limit (lbs/day)
Jan	13.7
Feb	19.5
March	18.4
April	18.3
May	16.5
June	17.6
July	17.7
Aug	16.2
Sept	14.8
Oct	12.3
Nov	12.3
Dec	11.9

3.2.1.8 Phosphorus Water Quality Trading (WQT)

The permittee may use water quality trading to demonstrate compliance with TMDL derived WQBELs for total phosphorus (TP) in the list above. Pollutant reduction credits for total phosphorus are available as specified in Water Quality Trading Plan **WQT-2022-0006** or approved amendments thereof.

Table 2. Available Phosphorus Credits per WQT-2022-0006

Year	Available TP Credits (lbs/yr) – Total
2022	25.5
2023	102
2024	102
2025	102
2026	102
2027	102

*In the event that this permit is not reissued prior to the expiration date, 102 lbs/yr of long-term credits will be available in subsequent year(s).

Only those pollutant reduction credits established by a water quality trading plan approved by the Department may be used by the permittee to demonstrate compliance with the WQBELs identified in this subsection. If the permittee wishes to use pollutant reduction credits not identified in an approved water quality trading plan, the permittee must amend the plan or develop a new plan and obtain Department approval of the amended or new plan prior to use of the new pollutant reduction credits. Prior to Department approval, the amended or new water quality trading plan will be subject to notice and opportunity for public comment. Any change in the number of available credits requires a permit modification.

In the event pollutant reduction credits as defined in the approved water quality trading plan are no longer generated, the permittee shall comply with the WQBELs for TP contained in this subsection. The sum of available interim and long-term credits shown in Table 2 may be used to demonstrate compliance for a given year. Interim credits are subject to duration limits and may not be used past the duration defined in Water Quality Trading Plan **WQT-2022-0006.**

3.2.1.9 Demonstrating Compliance with TP WQBELs Using Water Quality Trading

Use the following methods to demonstrate compliance with the TP WQBELs contained in the Water Quality Trading subsection above.

TOTAL POLLUTANT DISCHARGED (TP)
Use the following equations to calculate the amount of pollutant discharged for Monthly Avg TP [lbs/day].

TP Discharged [lbs/day] = TP Discharged [mg/L] × Daily Flow [MGD] × 8.34 *(Eq. 1a.)*

Monthly or Weekly Average = Σ daily results ÷ # of results *(Eq. 1b.)*

WQT CREDITS USED (TOTAL PHOSPHORUS)

Use the following method to calculate the credits to be used expressed as a mass in lbs/month:

WQT TP Credits Needed [lbs/day] = Monthly Avg TP [lbs/day] – {the Monthly Avg limit} [lbs/day] *(Eq. 2a.)*

Note: When the TP discharge is less than {the monthly average limit} lbs/day as a monthly avg, report 0 (zero) as the "WQT Credits Used (TP)". The monthly limit for each month ({Monthly Avg limit} [lbs/day]) is located in the Total Phosphorus TMDL WQBELS Table above at 2.1.2.7.

WQT TP Credits Used [lbs/month] = WQT TP Credits Needed [lbs/day] × # of days of discharge/month *(Eq. 2b.)*

WQT COMPUTED COMPLIANCE (TOTAL PHOSPHORUS)
Use the following method to demonstrate compliance with TP WQBELs expressed as a mass in lbs/day:

WQT TP Computed Compliance [lbs/day] = Monthly Avg TP [lbs/day] – [WQT TP Credits Needed [lbs/day] *(Eq. 4a.)*

Negative computed compliance values should be entered as zero - "0".

3.2.1.10 TSS Water Quality Trading (WQT)

The permittee may use water quality trading to demonstrate compliance with WQBELs for total suspended solids (TSS) of TSS Mass limits listed in table above. Pollutant reduction credits for TSS are available as specified in Water Quality Trading Plan **WQT-2023-0004** or approved amendments thereof.

Table 3 Available TSS Credits per WQT-2023-0004

Year	Available TSS Credits (lbs/yr) – Total	Available TSS Credits (lbs/yr) – Total

	Interim	Long Term
2024	500	3,200
2025	500	3,200

*In the event that this permit is not reissued prior to the expiration date, 3,200 lbs/yr of long-term credits will be available in subsequent year(s).

Only those pollutant reduction credits established by a water quality trading plan approved by the Department may be used by the permittee to demonstrate compliance with the WQBELs identified in this subsection. If the permittee wishes to use pollutant reduction credits not identified in an approved water quality trading plan, the permittee must amend the plan or develop a new plan and obtain Department approval of the amended or new plan prior to use of the new pollutant reduction credits. Prior to Department approval, the amended or new water quality trading plan will be subject to notice and opportunity for public comment. Any change in the number of available credits requires a permit modification.

In the event pollutant reduction credits as defined in the approved water quality trading plan are no longer generated, the permittee shall comply with the WQBELs for TSS contained in this subsection. The sum of available interim and long-term credits shown in Table 3 may be used to demonstrate compliance for a given year. Interim credits are subject to duration limits and may not be used past the duration defined in Water Quality Trading Plan **WQT-2023-0004.**

3.2.1.11 Demonstrating Compliance with TSS WQBELs Using Water Quality Trading

Use the following methods to demonstrate compliance with the TSS WQBELs contained in the Water Quality Trading subsection above.

TOTAL POLLUTANT DISCHARGED (TSS)

Use the following equations to calculate the amount of pollutant discharged for Weekly Avg TSS [lbs/day] and Monthly Avg TSS [lbs/day].

TSS Discharged [lbs/day] = TSS Discharged [mg/L] × Daily Flow [MGD] × 8.34 *(Eq. 1a.)*

Monthly or Weekly Avg = Σ daily results ÷ # of results *(Eq. 1b.)*

WQT CREDITS USED (TSS)

Use the following method to calculate the credits to be used expressed as a mass in lbs/month:

WQT TSS Credits Needed [lbs/day] = Monthly Avg TSS [lbs/day] – {the Monthly Avg limit} *(Eq. 3a.)*

For each week,

WQT TSS Credits Needed [lbs/day] = Weekly Avg TSS [lbs/day] – {the Weekly Avg limit} *(Eq. 3b.)*

Using values calculated in the above Equations 3a and 3b, calculate the “WQT TSS Credits Needed” for the entire month in lbs/month. If multiple weeks need credits, sum the credits in lbs/week to get credits in lbs/month.

WQT TSS Credits Used [lbs/month] = WQT TSS Credits Needed [lbs/day] × # of days of discharge in averaging period *(Eq. 3c.)*

After calculating “WQT TSS Credits” in lbs/month based on both overall weekly and monthly credit needs, report the greater of the two values as the “WQT TSS Credits.”

Note: When the TSS discharge is less than {the Weekly Avg limit} lbs/day as a weekly avg AND {the Monthly Avg limit} lbs/day as a monthly avg, report 0 (zero) as the “WQT TSS Credits”.

WQT COMPUTED COMPLIANCE (TSS)

Use the following method to demonstrate compliance with TSS WQBELs expressed as a mass in lbs/day:

WQT TSS Computed Compliance - Monthly Avg [lbs/day] = Monthly Avg TSS [lbs/day] – WQT TSS Credits Needed [lbs/day]* *(Eq. 5a.)*

*Depending on Equation 3a.

WQT TSS Computed Compliance - Weekly Avg [lbs/day] = Weekly Avg TSS [lbs/day] – WQT TSS Credits Needed [lbs/day] ** *(Eq. 5b.)*

**Depending on Equation 3b.

3.2.1.12 Additional Water Quality Trading Requirements

When using water quality trading to demonstrate compliance with WQBELs for TP, the permittee shall comply with the following:

• Failure to implement any of the terms or conditions of the approved water quality trading plan is a violation of this permit.

• Each month the permittee shall certify that the nonpoint source management practices installed to generate pollutant reduction credits are operated and maintained in a manner consistent with that specified in the approved water quality trading plan. Such a certification may be made by including the following statement as a comment on the monthly discharge monitoring report:

> I certify that management practices identified in the approved water quality trading plan as the source of pollutant reduction credits are installed, established and properly maintained.

• At least once a year the permittee or the permittee’s agent shall inspect each nonpoint source management practice that generates pollutant reduction credits to confirm the implementation of the management practice and their appropriate operation and adequate maintenance.

• The permittee shall notify WDNR by telephone within 24 hours or next business day of becoming aware that pollutant reduction credits used or intended for use by the permittee are not being implemented or generated as defined in the approved trading plan. A written notification shall be submitted to the Department within 5 days regarding the status of the permittee’s pollutant reduction credits.

• The permittee shall provide WDNR written notice within 7 days of the trade agreement upon which the approved water quality trading plan is based being amended, modified, or revoked. This notification shall include the details of any amendment or modification in addition to the justification for the changes.

• The permittee shall not use pollutant reduction credits for the demonstration of compliance when pollutant reduction credits are not being generated.

3.2.1.13 Water Quality Trading Reopener Clause

Under any of the following conditions as provided by s. 283.53(2), Wis. Stats. and Wis. Adm. Code NR 203.135 and 203.136, the Department may modify or revoke and reissue this permit to modify or eliminate permit terms and conditions related to water quality trading:

• The permittee fails to implement the water quality trading plan as approved;

• The permittee fails to comply with permit terms and conditions related to water quality trading;

• New information becomes available that would change the number of credits available for the water quality trade or would change the Department's determinations that water quality trading is an acceptable option.

3.2.1.14 Submittal of Permit Application for Next Reissuance and Pollutant Trading Plan

The permittee shall submit the permit application for the next reissuance at least 6 months prior to expiration of this permit.

The permittee has submitted a Water Quality Trading Plan that was approved by WDNR on June 9, 2022. If the permittee intends to pursue pollutant trading to achieve compliance in a future permit term, and updated water quality trading plan is due with the application for the next reissuance. If system upgrades will be used in combination with pollutant trading the permittee shall submit plans for any system upgrade.

3.2.1.15 MDV (Multi-Discharger Variance) Requirements – MDV Not in Effect after Modification

Watershed Provisions: The permittee is required to implement watershed measures to reduce the amount of phosphorus entering the receiving water. The permittee has selected the following approved watershed measure.

Payment to County for Phosphorus Reduction: The permittee shall make payments for phosphorus reduction to the county or counties approved by the Department per s. 283.16(8), Wis. Stats. The permittee shall make a total payment by March 1 of each year in the amount equal to the per pound amount of $54.23 times the number of pounds by which the effluent phosphorus discharged during the previous year exceeded the permittee's target value or $640,000, whichever is less. The target value is based on the TMDL-derived limit per s. 283.16(1)(h), Wis. Stats., and is applicable during the months that the MDV is in effect. The MDV is in effect for April and June. Refer to the Schedules section for the scheduled annual requirements.

Annual Payment Calculation: The annual payment is equal to the phosphorus load that exceeds the target value multiplied by $54.23 per pound. Use the steps shown below to calculate the annual payment. In addition, the Department shall send a statement to the permittee specifying total payment due to the participating counties each year in accordance with the Schedules section.

Annual Payment = [Annual Phosphorus Load – Annual Target Load] × Price Per Pound
Calculation Steps:
●Calculate pounds of phosphorus discharged for each month that the MDV is in effect:

Monthly Phosphorus Load (lbs/month) = Total Monthly Flow (MG) × Monthly Avg. TP effluent conc. (mg/L) × 8.34

●Sum the lbs/month discharged for the months that the MDV is in effect to calculate the annual phosphorus load:

Annual Phosphorus Load (lbs/year) = ∑ [Monthly Phosphorus Load (lbs/month)]

ROCK RIVER TMDL Target Value Calculations:

Target Value = TMDL Derived Limit

Month	Monthly Ave Total P Effluent Limit (lbs/day)	Monthly Target Load = Monthly Ave. TP Limit (lbs/day) × Number of Days in Month
April	18.3	549.04
June	17.6	528.7

●Calculate the monthly payment for each month the MDV is in effect:

Monthly Payment = [Monthly Phosphorus Load (lbs/month) – Monthly Target Load (lbs/month)] × Price Per Pound

●Calculate the annual payment:

Annual Payment ($) = ∑ [Monthly Payment ($)]

3.2.1.16 Whole Effluent Toxicity (WET) Testing

Primary Control Water: Rock River

Instream Waste Concentration (IWC): 67%

Acute Mixing Zone Concentration: N/A

Dilution series: At least five effluent concentrations and dual controls must be included in each test.

- **Acute:** 100, 50, 25, 12.5, 6.25% and any additional selected by the permittee.
- **Chronic:** 100, 75, 50, 25, 12.5% and any additional selected by the permittee.

WET Testing Frequency:

Acute tests shall be conducted once each year rotating quarters in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Acute:** October – December 2020; January – March 2021; April – June 2022; July – September 2023; January – March 2024; April – June 2025

Acute WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in January – March 2026.

Chronic tests shall be conducted once each year in rotating quarters in order to collect seasonal information about the discharge. Tests are required during the following quarters.

- **Chronic:** October – December 2020; January – March 2021; April – June 2022; July – September 2023; January – March 2024; April – June 2025

Chronic WET testing shall continue after the permit expiration date (until the permit is reissued) in accordance with the WET requirements specified for the last full calendar year of this permit. For example, the next test would be required in January – March 2026.

Testing: WET testing shall be performed during normal operating conditions. Permittees are not allowed to turn off or otherwise modify treatment systems, production processes, or change other operating or treatment conditions during WET tests.

Reporting: The permittee shall report test results on the Discharge Monitoring Report form, and also complete the "Whole Effluent Toxicity Test Report Form" (Section 6, "*State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition*"), for each test. The original, complete, signed version of the Whole Effluent Toxicity Test Report Form shall be sent to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., P.O. Box 7921, Madison, WI 53707-7921, within 45 days of test completion. The Discharge Monitoring Report (DMR) form shall be submitted electronically by the required deadline.

Determination of Positive Results: An acute toxicity test shall be considered positive if the Toxic Unit - Acute (TU_a) is greater than 1.0 for either species. The TU_a shall be calculated as follows: $TU_a = 100 \div LC_{50}$. A chronic toxicity test shall be considered positive if the Toxic Unit - Chronic (TU_c) is greater than 1.5 for either species. The TU_c shall be calculated as follows: $TU_c = 100 \div IC_{25}$.

Additional Testing Requirements: Within 90 days of a test which showed positive results, the permittee shall submit the results of at least 2 retests to the Biomonitoring Coordinator on "Whole Effluent Toxicity Test Report Forms". The 90 day reporting period shall begin the day after the test which showed a positive result. The retests shall be completed using the same species and test methods specified for the original test (see the Standard Requirements section herein).

4 Land Application Requirements

4.1 Sampling Point(s)

The discharge(s) shall be limited to land application of the waste type(s) designated for the listed sampling point(s) on Department approved land spreading sites or by hauling to another facility.

Sampling Point Designation	
Sampling Point Number	**Sampling Point Location, WasteType/Sample Contents and Treatment Description (as applicable)**
002	Representative samples of class B, anaerobically digested liquid sludge shall be collected from the secondary digester, if this sludge is land applied. If this sample point is activated, the sludge shall be analyzed for List 2 parameters (Nutrients) just prior to land application and DNR shall be notified prior to land application.
004	Representative samples of class B, anaerobically digested cake sludge shall be collected from the centrifuge.

4.2 Monitoring Requirements and Limitations

The permittee shall comply with the following monitoring requirements and limitations.

4.2.1 Sampling Point (Outfall) 002 - LIQUID SLUDGE and 004- CAKE SLUDGE

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Solids, Total		Percent	Quarterly	Composite	
Arsenic Dry Wt	Ceiling	75 mg/kg	Quarterly	Composite	
Arsenic Dry Wt	High Quality	41 mg/kg	Quarterly	Composite	
Cadmium Dry Wt	Ceiling	85 mg/kg	Quarterly	Composite	
Cadmium Dry Wt	High Quality	39 mg/kg	Quarterly	Composite	
Copper Dry Wt	Ceiling	4,300 mg/kg	Quarterly	Composite	
Copper Dry Wt	High Quality	1,500 mg/kg	Quarterly	Composite	
Lead Dry Wt	Ceiling	840 mg/kg	Quarterly	Composite	
Lead Dry Wt	High Quality	300 mg/kg	Quarterly	Composite	
Mercury Dry Wt	Ceiling	57 mg/kg	Quarterly	Composite	
Mercury Dry Wt	High Quality	17 mg/kg	Quarterly	Composite	
Molybdenum Dry Wt	Ceiling	75 mg/kg	Quarterly	Composite	
Nickel Dry Wt	Ceiling	420 mg/kg	Quarterly	Composite	
Nickel Dry Wt	High Quality	420 mg/kg	Quarterly	Composite	
Selenium Dry Wt	Ceiling	100 mg/kg	Quarterly	Composite	
Selenium Dry Wt	High Quality	100 mg/kg	Quarterly	Composite	
Zinc Dry Wt	Ceiling	7,500 mg/kg	Quarterly	Composite	
Zinc Dry Wt	High Quality	2,800 mg/kg	Quarterly	Composite	
Nitrogen, Total Kjeldahl		Percent	Quarterly	Composite	

Monitoring Requirements and Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Nitrogen, Ammonium (NH_4-N) Total		Percent	Quarterly	Composite	
Phosphorus, Total		Percent	Quarterly	Composite	
Phosphorus, Water Extractable		% of Tot P	Quarterly	Composite	
Potassium, Total Recoverable		Percent	Quarterly	Composite	
Radium 226 Dry Wt		pCi/g	Annual	Composite	
PCB Total Dry Wt	Ceiling	50 mg/kg	Once	Composite	Monitor for PCB's as part of the priority pollutant scan in 2022.
PCB Total Dry Wt	High Quality	10 mg/kg	Once	Composite	Monitor for PCB's as part of the priority pollutant scan in 2022.
Municipal Sludge Priority Pollutant Scan			Once	Composite	As specified in ch. NR 215.03 (1-4), Wis. Adm. Code

Other Sludge Requirements	
Sludge Requirements	**Sample Frequency**
List 3 Requirements – Pathogen Control: The requirements in List 3 shall be met prior to land application of sludge.	**Annual**
List 4 Requirements – Vector Attraction Reduction: The vector attraction reduction shall be satisfied prior to, or at the time of land application as specified in List 4.	**Annual**

4.2.1.1 List 2 Analysis

If the monitoring frequency for List 2 parameters is more frequent than "Annual" then the sludge may be analyzed for the List 2 parameters just prior to each land application season rather than at the more frequent interval specified.

4.2.1.2 Changes in Feed Sludge Characteristics

If a change in feed sludge characteristics, treatment process, or operational procedures occurs which may result in a significant shift in sludge characteristics, the permittee shall reanalyze the sludge for List 1, 2, 3 and 4 parameters each time such change occurs.

4.2.1.3 Multiple Sludge Sample Points (Outfalls)

If there are multiple sludge sample points (outfalls), but the sludges are not subject to different sludge treatment processes, then a separate List 2 analysis shall be conducted for each sludge type which is land applied, just prior to land application, and the application rate shall be calculated for each sludge type. In this case, List 1, 3, and 4 and PCBs need only be analyzed on a single sludge type, at the specified frequency. If there are multiple sludge sample points (outfalls), due to multiple treatment processes, List 1, 2, 3 and 4 and PCBs shall be analyzed for each sludge type at the specified frequency.

4.2.1.4 Sludge Which Exceeds the High Quality Limit

Cumulative pollutant loading records shall be kept for all bulk land application of sludge which does not meet the high quality limit for any parameter. This requirement applies for the entire calendar year in which any exceedance of Table 3 of s. NR 204.07(5)(c), is experienced. Such loading records shall be kept for all List 1 parameters for each site land applied in that calendar year. The formula to be used for calculating cumulative loading is as follows:

[(Pollutant concentration (mg/kg) x dry tons applied/ac) ÷ 500] + previous loading (lbs/acre) = cumulative lbs pollutant per acre

When a site reaches 90% of the allowable cumulative loading for any metal established in Table 2 of s. NR 204.07(5)(b), the Department shall be so notified through letter or in the comment section of the annual land application report (3400-55).

4.2.1.5 Sludge Analysis for PCBs

The permittee shall analyze the sludge for Total PCBs one time during **2022**. The results shall be reported as "PCB Total Dry Wt". Either congener-specific analysis or Aroclor analysis shall be used to determine the PCB concentration. The permittee may determine whether Aroclor or congener specific analysis is performed. Analyses shall be performed in accordance with Table EM in s. NR 219.04, Wis. Adm. Code and the conditions specified in Standard Requirements of this permit. PCB results shall be submitted by January 31, following the specified year of analysis.

4.2.1.6 Lists 1, 2, 3, and 4

List 1 **TOTAL SOLIDS AND METALS** See the Monitoring Requirements and Limitations table above for monitoring frequency and limitations for the List 1 parameters
Solids, Total (percent)
Arsenic, mg/kg (dry weight)
Cadmium, mg/kg (dry weight)
Copper, mg/kg (dry weight)
Lead, mg/kg (dry weight)
Mercury, mg/kg (dry weight)
Molybdenum, mg/kg (dry weight)
Nickel, mg/kg (dry weight)
Selenium, mg/kg (dry weight)
Zinc, mg/kg (dry weight)

List 2 **NUTRIENTS** See the Monitoring Requirements and Limitations table above for monitoring frequency for the List 2 parameters
Solids, Total (percent)
Nitrogen Total Kjeldahl (percent)
Nitrogen Ammonium (NH4-N) Total (percent)
Phosphorus Total as P (percent)
Phosphorus, Water Extractable (as percent of Total P)
Potassium Total Recoverable (percent)

List 3

PATHOGEN CONTROL FOR CLASS B SLUDGE

The permittee shall implement pathogen control as listed in List 3. The Department shall be notified of the pathogen control utilized and shall be notified when the permittee decides to utilize alternative pathogen control.

The following requirements shall be met prior to land application of sludge.

Parameter	Unit	Limit
Fecal Coliform*	MPN/gTS or CFU/gTS	2,000,000
OR, ONE OF THE FOLLOWING PROCESS OPTIONS		
Aerobic Digestion	Air Drying	
Anaerobic Digestion	Composting	
Alkaline Stabilization	PSRP Equivalent Process	

***** The Fecal Coliform limit shall be reported as the geometric mean of 7 discrete samples on a dry weight basis.

List 4

VECTOR ATTRACTION REDUCTION

The permittee shall implement any one of the vector attraction reduction options specified in List 4. The Department shall be notified of the option utilized and shall be notified when the permittee decides to utilize an alternative option.

One of the following shall be satisfied prior to, or at the time of land application as specified in List 4.

Option	Limit	Where/When it Shall be Met
Volatile Solids Reduction	≥38%	Across the process
Specific Oxygen Uptake Rate	≤1.5 mg O_2/hr/g TS	On aerobic stabilized sludge
Anaerobic bench-scale test	<17 % VS reduction	On anaerobic digested sludge
Aerobic bench-scale test	<15 % VS reduction	On aerobic digested sludge
Aerobic Process	>14 days, Temp >40°C and Avg. Temp > 45°C	On composted sludge
pH adjustment	>12 S.U. (for 2 hours) and >11.5 (for an additional 22 hours)	During the process
Drying without primary solids	>75 % TS	When applied or bagged
Drying with primary solids	>90 % TS	When applied or bagged
Equivalent Process	Approved by the Department	Varies with process
Injection	-	When applied
Incorporation	-	Within 6 hours of application

4.2.1.7 Daily Land Application Log

Daily Land Application Log		
Discharge Monitoring Requirements and Limitations The permittee shall maintain a daily land application log for biosolids land applied each day when land application occurs. The following minimum records must be kept, in addition to all analytical results for the biosolids land applied. The log book records shall form the basis for the annual land application report requirements**.**		
Parameters	**Units**	**Sample Frequency**
DNR Site Number(s)	Number	Daily as used
Outfall number applied	Number	Daily as used
Acres applied	Acres	Daily as used
Amount applied	As appropriate * /day	Daily as used
Application rate per acre	unit */acre	Daily as used
Nitrogen applied per acre	lb/acre	Daily as used
Method of Application	Injection, Incorporation, or surface applied	Daily as used

*gallons, cubic yards, dry US Tons or dry Metric Tons

5 Schedules

5.1 Mercury Pollutant Minimization Program

Required Action	Due Date
Annual Mercury Progress Reports: Submit an annual mercury progress report. The annual mercury progress report shall: Indicate which mercury pollutant minimization activities or activities outlined in the approved Pollutant Minimization Plan have been implemented; Include an analysis of trends in monthly and annual total effluent mercury concentrations based on mercury sampling; and Include an analysis of how influent and effluent mercury varies with time and with significant loading of mercury such as loads from industries into the collection system. The first annual mercury progress report is to be submitted by the Due Date.	01/31/2021
Annual Mercury Progress Report #2: Submit a mercury progress report as defined above.	01/31/2022
Annual Mercury Progress Report #3: Submit a mercury progress report as defined above.	01/31/2023
Annual Mercury Progress Report #4: Submit a mercury progress report as defined above.	01/31/2024
Final Mercury Report: Submit a final report documenting the success in reducing mercury concentrations in the effluent, as well as the anticipated future reduction in mercury sources and mercury effluent concentrations. The report shall summarize mercury pollutant minimization activities that have been implemented during the current permit term and state which, if any, pollutant minimization activities from the approved pollutant minimization plan were not pursued and why. The report shall include an analysis of trends in monthly and annual total effluent mercury concentrations based on mercury sampling during the current permit term. The report shall also include an analysis of how influent and effluent mercury varies with time and with significant loading of mercury such as loads from industries into the collection system. If the permittee intends to reapply for a mercury variance per s. NR 106.145, Wis. Adm. Code, for the reissued permit, a detailed pollutant minimization plan outlining the pollutant minimization activities proposed for the upcoming permit term shall be submitted along with the final report.	01/31/2025
Annual Mercury Reports After Permit Expiration: In the event that this permit is not reissued on time, the permittee shall continue to submit annual mercury reports each year covering pollutant minimization activities implemented and mercury concentration trends.	

5.2 Effluent Limitations for E. coli (Outfall 001)

Required Action	Due Date
Status Update: The permittee shall submit information within the discharge monitoring report (DMR) comment section documenting the steps taken in preparation for properly monitoring and testing for E. coli including, but not limited to, selected test method and location of sampling.	11/21/2020
Operational Evaluation Report: The permittee shall prepare and submit an Operational Evaluation Report to the Department for review and approval. The report shall include an evaluation of collected	10/31/2021

effluent data and proposed operational improvements that will optimize efficacy of disinfection at the treatment plant during the period prior to complying with final E. coli limitations and, to the extent possible, enable compliance with the final E. coli limitations. The report shall include a plan and schedule for implementation of the operational improvements. These improvements shall occur as soon as possible, but not later than April 30, 2022. The report shall state whether the operational improvements are expected to result in compliance with the final E. coli limitations. The permittee shall implement the operational improvements in accordance with the approved plan and schedule specified in the Operational Evaluation Report and in no case later than April 30, 2022 If the Operational Evaluation Report concludes that the operational improvements are expected to result in compliance with the final E. coli limitations, the permittee shall comply with the final E. coli limitations by April 30, 2022 and the permittee is not required to comply with subsequent milestones identified below in this compliance schedule (‘Submit Facility Plan’, 'Final Plans and Specifications', 'Treatment Plant Upgrade to Meet Limitations', ‘Construction Upgrade Progress Report’, 'Complete Construction', 'Achieve Compliance'). FACILITY PLAN - If the Operational Evaluation Report concludes that operational improvements alone are not expected to result in compliance with the final E. coli limitations, the permittee shall initiate development of a facility plan for meeting final E. coli limitations and comply with the remaining required actions in this schedule of compliance. If the Department disagrees with the conclusion of the report, and determines that the permittee can achieve final E. coli limitations using the existing treatment system with only operational improvements, the Department may reopen and modify the permit to include an implementation schedule for achieving the final E. coli limitations sooner than April 30, 2025.	
Achieve Compliance: The permittee shall achieve compliance with final E. coli limitations.	05/01/2022

5.3 Water Quality Trading (WQT) Management Plan

Required Action	Due Date
Complete Installation of Management Practices: Complete the installation of management practices as identified in the Water Quality Management Plan WQT-2022-0006 as approved by the Department.	09/30/2022
Management Practices: The Management Practices as identified in the Water Quality Trading Plan shall become effective and the permittee shall submit a completed Management Practice Registration Form 3400-207 for each site.	09/30/2022

5.4 Annual Water Quality Trading (WQT) Report

Required Action	Due Date
Annual WQT Report: Submit an annual WQT report that shall cover the first year of the permit term. The WQT Report shall include: The number of pollutant reduction credits (lbs/month) used each month of the previous year to demonstrate compliance; The source of each month’s pollutant reduction credits by identifying the approved water quality	01/31/2023

trading plan that details the source; A summary of the annual inspection of each nonpoint source management practice that generated any of the pollutant reduction credits used during the previous year; and Identification of noncompliance or failure to implement any terms or conditions of this permit with respect to water quality trading that have not been reported in discharge monitoring reports.	
Annual WQT Report #2: Submit an annual WQT report that shall cover the previous year.	01/31/2024
Annual WQT Report #3: Submit the 3rd annual WQT report. If the permittee wishes to continue to comply with phosphorus and total suspended solids limits through WQT in subsequent permit terms, the permittee shall submit a revised WQT plan including a demonstration of credit need, compliance record of the existing WQT, and any additional practices needed to maintain compliance over time.	01/31/2025
Annual WQT Report Required After Permit Expiration: In the event that this permit is not reissued by the expiration date, the permittee shall continue to submit annual WQT reports by January 31 each year covering the total number of pollutant credits used, the source of the pollution reduction credits, a summary of annual inspection reports performed, and identification of noncompliance or failure to implement any terms or conditions of the approved water quality trading plan for the previous calendar year.	

5.5 Phosphorus Schedule - Optimization Plan

Required Action	Due Date
Optimization Plan: The permittee shall prepare an Optimization Plan and submit it for Department approval. The plan shall include an evaluation of collected effluent data, possible source reduction measures and operational improvements to optimize performance to control phosphorus discharges. The plan shall contain a schedule for implementation of the measures and improvements. Once the plan is approved by the Department, the permittee shall take the steps called for in the Optimization Plan and follow the schedule of implementation as approved.	06/30/2021
Progress Report #1: Submit a progress report on optimizing removal of phosphorus.	06/30/2022

5.6 Phosphorus Payment per Pound to County

Required Action	Due Date
Annual Verification of Phosphorus Payment to County: The permittee shall make a total payment to the participating county or counties approved by the Department by March 1 of each calendar year. The amount due is equal to the following: (lbs of phosphorus discharged minus the permittee's target value) times ($54.23 per pound) or $640,000, whichever is less. See the payment calculation steps in the Surface Water section. The permittee shall submit Form 3200-151 to the Department by March 1 of each calendar year indicating total amount remitted to the participating counties to verify that the correct payment was made. The first payment verification form is due by the specified Due Date. Note: The applicable Target Value is the TMDL derived limit value as defined by s. 283.16(1)(h), Wis. Stats. The "per pound" value is $50.00 adjusted for CPI.	03/01/2021

Annual Verification of Payment #2: Submit Form 3200-151 to the Department indicating total amount remitted to the participating counties.	03/01/2022
Annual Verification of Payment #3: Submit Form 3200-151 to the Department indicating total amount remitted to the participating counties.	03/01/2023

6 Standard Requirements

NR 205, Wisconsin Administrative Code: The conditions in ss. NR 205.07(1) and NR 205.07(2), Wis. Adm. Code, are included by reference in this permit. The permittee shall comply with all of these requirements. Some of these requirements are outlined in the Standard Requirements section of this permit. Requirements not specifically outlined in the Standard Requirement section of this permit can be found in ss. NR 205.07(1) and NR 205.07(2).

6.1 Reporting and Monitoring Requirements

6.1.1 Monitoring Results

Monitoring results obtained during the previous month shall be summarized and reported on a Department Wastewater Discharge Monitoring Report. The report may require reporting of any or all of the information specified below under 'Recording of Results'. This report is to be returned to the Department no later than the date indicated on the form. A copy of the Wastewater Discharge Monitoring Report Form or an electronic file of the report shall be retained by the permittee.

Monitoring results shall be reported on an electronic discharge monitoring report (eDMR). The eDMR shall be certified electronically by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

If the permittee monitors any pollutant more frequently than required by this permit, the results of such monitoring shall be included on the Wastewater Discharge Monitoring Report.

The permittee shall comply with all limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even with monthly monitoring. The permittee may monitor more frequently than required for any parameter.

6.1.2 Sampling and Testing Procedures

Sampling and laboratory testing procedures shall be performed in accordance with Chapters NR 218 and NR 219, Wis. Adm. Code and shall be performed by a laboratory certified or registered in accordance with the requirements of ch. NR 149, Wis. Adm. Code. Groundwater sample collection and analysis shall be performed in accordance with ch. NR 140, Wis. Adm. Code. The analytical methodologies used shall enable the laboratory to quantitate all substances for which monitoring is required at levels below the effluent limitation. If the required level cannot be met by any of the methods available in NR 219, Wis. Adm. Code, then the method with the lowest limit of detection shall be selected. Additional test procedures may be specified in this permit.

6.1.3 Pretreatment Sampling Requirements

Sampling for pretreatment parameters (cadmium, chromium, copper, lead, nickel, zinc, and mercury) shall be done during a day each month when industrial discharges are occurring at normal to maximum levels. The sampling of the influent and effluent for these parameters shall be coordinated. All 24 hour composite samples shall be flow proportional.

6.1.4 Recording of Results

The permittee shall maintain records which provide the following information for each effluent measurement or sample taken:

- the date, exact place, method and time of sampling or measurements;
- the individual who performed the sampling or measurements;
- the date the analysis was performed;

- the individual who performed the analysis;
- the analytical techniques or methods used; and
- the results of the analysis.

6.1.5 Reporting of Monitoring Results

The permittee shall use the following conventions when reporting effluent monitoring results:

- Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 0.1 mg/L, report the pollutant concentration as < 0.1 mg/L.
- Pollutant concentrations equal to or greater than the limit of detection, but less than the limit of quantitation, shall be reported and the limit of quantitation shall be specified.
- For purposes of calculating NR 101 fees, the 2 mg/l lower reporting limits for BOD5 and Total Suspended Solids shall be considered to be limits of quantitation
- For the purposes of reporting a calculated result, average or a mass discharge value, the permittee may substitute a “0” (zero) for any pollutant concentration that is less than the limit of detection. However, if the effluent limitation is less than the limit of detection, the department may substitute a value other than zero for results less than the limit of detection, after considering the number of monitoring results that are greater than the limit of detection and if warranted when applying appropriate statistical techniques.
- If no discharge occurs through an outfall, flow related parameters (e.g. flow rate, hydraulic application rate, volume, etc.) should be reported as “0” (zero) at the required sample frequency specified for the outfall. For example: if the sample frequency is daily, “0” would be reported for any day during the month that no discharge occurred.

6.1.6 Compliance Maintenance Annual Reports

Compliance Maintenance Annual Reports (CMAR) shall be completed using information obtained over each calendar year regarding the wastewater conveyance and treatment system. The CMAR shall be submitted and certified by the permittee in accordance with ch. NR 208, Wis. Adm. Code, by June 30, each year on an electronic report form provided by the Department.

In the case of a publicly owned treatment works, a resolution shall be passed by the governing body and submitted as part of the CMAR, verifying its review of the report and providing responses as required. Private owners of wastewater treatment works are not required to pass a resolution; but they must provide an Owner Statement and responses as required, as part of the CMAR submittal.

The CMAR shall be certified electronically by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The certification verifies that the electronic report is true, accurate and complete.

6.1.7 Records Retention

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings or electronic data records for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit for a period of at least 3 years from the date of the sample, measurement, report or application. All pertinent sludge information, including permit application information and other documents specified in this permit or s. NR 204.06(9), Wis. Adm. Code shall be retained for a minimum of 5 years.

6.1.8 Other Information

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or correct information to the Department.

6.1.9 Reporting Requirements – Alterations or Additions

The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is only required when:

- The alteration or addition to the permitted facility may meet one of the criteria for determining whether a facility is a new source.
- The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification requirement applies to pollutants which are not subject to effluent limitations in the existing permit.
- The alteration or addition results in a significant change in the permittee’s sludge use or disposal practices, and such alteration, addition, or change may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional use of disposal sites not reported during the permit application process nor reported pursuant to an approved land application plan. Additional sites may not be used for the land application of sludge until department approval is received.

6.2 System Operating Requirements

6.2.1 Noncompliance Reporting

Sanitary sewer overflows and sewage treatment facility overflows shall be reported according to the ‘Sanitary Sewer Overflows and Sewage Treatment Facility Overflows’ section of this permit.

The permittee shall report the following types of noncompliance by a telephone call to the Department's regional office within 24 hours after becoming aware of the noncompliance:

- any noncompliance which may endanger health or the environment;
- any violation of an effluent limitation resulting from a bypass;
- any violation of an effluent limitation resulting from an upset; and
- any violation of a maximum discharge limitation for any of the pollutants listed by the Department in the permit, either for effluent or sludge.

A written report describing the noncompliance shall also be submitted to the Department's regional office within 5 days after the permittee becomes aware of the noncompliance. On a case-by-case basis, the Department may waive the requirement for submittal of a written report within 5 days and instruct the permittee to submit the written report with the next regularly scheduled monitoring report. In either case, the written report shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times; the steps taken or planned to reduce, eliminate and prevent reoccurrence of the noncompliance; and if the noncompliance has not been corrected, the length of time it is expected to continue.

A scheduled bypass approved by the Department under the ‘Scheduled Bypass’ section of this permit shall not be subject to the reporting required under this section.

NOTE: Section 292.11(2)(a), Wisconsin Statutes, requires any person who possesses or controls a hazardous substance or who causes the discharge of a hazardous substance to notify the Department of Natural Resources immediately of any discharge not authorized by the permit. **The discharge of a hazardous substance that is not authorized by this permit or that violates this permit may be a hazardous substance spill. To report a hazardous substance spill, call DNR's 24-hour HOTLINE at 1-800-943-0003.**

6.2.2 Flow Meters

Flow meters shall be calibrated annually, as per s. NR 218.06, Wis. Adm. Code.

6.2.3 Raw Grit and Screenings

All raw grit and screenings shall be disposed of at a properly licensed solid waste facility or picked up by a licensed waste hauler. If the facility or hauler are located in Wisconsin, then they shall be licensed under chs. NR 500-555, Wis. Adm. Code.

6.2.4 Sludge Management

All sludge management activities shall be conducted in compliance with ch. NR 204 "Domestic Sewage Sludge Management", Wis. Adm. Code.

6.2.5 Prohibited Wastes

Under no circumstances may the introduction of wastes prohibited by s. NR 211.10, Wis. Adm. Code, be allowed into the waste treatment system. Prohibited wastes include those:

- which create a fire or explosion hazard in the treatment work;
- which will cause corrosive structural damage to the treatment work;
- solid or viscous substances in amounts which cause obstructions to the flow in sewers or interference with the proper operation of the treatment work;
- wastewaters at a flow rate or pollutant loading which are excessive over relatively short time periods so as to cause a loss of treatment efficiency; and
- changes in discharge volume or composition from contributing industries which overload the treatment works or cause a loss of treatment efficiency.

6.2.6 Bypass

This condition applies only to bypassing at a sewage treatment facility that is not a scheduled bypass, approved blending as a specific condition of this permit, a sewage treatment facility overflow or a controlled diversion as provided in the sections titled ‘Scheduled Bypass’, ‘Blending’ (if approved), ‘SSO’s and Sewage Treatment Facility Overflows’ and ‘Controlled Diversions’ of this permit. Any other bypass at the sewage treatment facility is prohibited and the Department may take enforcement action against a permittee for such occurrences under s. 283.89, Wis. Stats. The Department may approve a bypass if the permittee demonstrates all the following conditions apply:

- The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;
- There were no feasible alternatives to the bypass, such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or maintenance during normal periods of equipment downtime. This condition is not satisfied if adequate back-up equipment should have been installed in the exercise of reasonable engineering judgment to prevent a bypass which occurred during normal periods of equipment downtime or preventative maintenance. When evaluating feasibility of alternatives, the department may consider factors such as technical achievability, costs and affordability of implementation and risks to public health, the environment and, where the permittee is a municipality, the welfare of the community served; and
- The bypass was reported in accordance with the Noncompliance Reporting section of this permit.

6.2.7 Scheduled Bypass

Whenever the permittee anticipates the need to bypass for purposes of efficient operations and maintenance and the permittee may not meet the conditions for controlled diversions in the ‘Controlled Diversions’ section of this permit, the permittee shall obtain prior written approval from the Department for the scheduled bypass. A permittee’s written request for Department approval of a scheduled bypass shall demonstrate that the conditions for bypassing specified in the above section titled ‘Bypass’ are met and include the proposed date and reason for the bypass, estimated volume and duration of the bypass, alternatives to bypassing and measures to mitigate environmental harm caused by the bypass. The department may require the permittee to provide public notification for a scheduled bypass if it is determined there is significant public interest in the proposed action and may recommend mitigation measures to minimize the impact of such bypass.

6.2.8 Controlled Diversions

Controlled diversions are allowed only when necessary for essential maintenance to assure efficient operation. Sewage treatment facilities that have multiple treatment units to treat variable or seasonal loading conditions may shut down redundant treatment units when necessary for efficient operation. The following requirements shall be met during controlled diversions:

- Effluent from the sewage treatment facility shall meet the effluent limitations established in the permit. Wastewater that is diverted around a treatment unit or treatment process during a controlled diversion shall be recombined with wastewater that is not diverted prior to the effluent sampling location and prior to effluent discharge;
- A controlled diversion does not include blending as defined in s. NR 210.03(2e), Wis. Adm. Code, and as may only be approved under s. NR 210.12. A controlled diversion may not occur during periods of excessive flow or other abnormal wastewater characteristics;
- A controlled diversion may not result in a wastewater treatment facility overflow; and
- All instances of controlled diversions shall be documented in sewage treatment facility records and such records shall be available to the department on request.

6.2.9 Blending

The Department has determined that blending as defined in s. NR 210.03(2e), Wis. Adm. Code, may occur at this sewage treatment facility. The following requirements shall apply whenever blending operations are in effect:

- Blending may occur temporarily only during wet weather or other high flow conditions when peak wastewater flow to the sewage treatment facility exceeds the maximum design and operating capacity of the biological treatment processes and when necessary to avoid severe property damage to the sewage treatment facility as described in NR 210.12, Wis. Adm. Code.;
- Untreated, or partially treated wastewater that is routed around the biological treatment process, or a portion of a biological treatment process, shall be recombined with the biologically treated wastewater and the combined flow shall be disinfected, if required by this permit, prior to discharge;
- Effluent from the sewage treatment facility shall be monitored to include all wastewater that is discharged from the facility, including those wastewaters that are diverted around the biological treatment process. Final discharged effluent shall meet the effluent limitations for outfalls included in this permit; and
- Blending under this section and the circumstances that lead to blending shall be reported to the Department by telephone or email no later than 24 hours from the time each blending operation ceases at the sewage treatment facility. Permittees shall also report the time, duration and volume of wastewater routed around the biological treatment process on the wastewater Discharge Monitoring Report (DMR) forms.

6.2.10 Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training as required in ch. NR 114, Wis. Adm. Code, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of the permit.

6.2.11 Operator Certification

The wastewater treatment facility shall be under the direct supervision of a state certified operator. In accordance with s. NR 114.53, Wis. Adm. Code, every WPDES permitted treatment plant shall have a designated operator-in-charge holding a current and valid certificate. The designated operator-in-charge shall be certified at the level and in all subclasses of the treatment plant, except laboratory. Treatment plant owners shall notify the department of any changes in the operator-in-charge within 30 days. Note that s. NR 114.52(22), Wis. Adm. Code, lists types of facilities that are excluded from operator certification requirements (i.e. private sewage systems, pretreatment facilities discharging to public sewers, industrial wastewater treatment that consists solely of land disposal, agricultural digesters and concentrated aquatic production facilities with no biological treatment).

6.3 Sewage Collection Systems

6.3.1 Sanitary Sewage Overflows and Sewage Treatment Facility Overflows

6.3.1.1 Overflows Prohibited

Any overflow or discharge of wastewater from the sewage collection system or at the sewage treatment facility, other than from permitted outfalls, is prohibited. The permittee shall provide information on whether any of the following conditions existed when an overflow occurred:

- The sanitary sewer overflow or sewage treatment facility overflow was unavoidable to prevent loss of life, personal injury or severe property damage;
- There were no feasible alternatives to the sanitary sewer overflow or sewage treatment facility overflow such as the use of auxiliary treatment facilities or adequate back-up equipment, retention of untreated wastes, reduction of inflow and infiltration, or preventative maintenance activities;
- The sanitary sewer overflow or the sewage treatment facility overflow was caused by unusual or severe weather related conditions such as large or successive precipitation events, snowmelt, saturated soil conditions, or severe weather occurring in the area served by the sewage collection system or sewage treatment facility; and
- The sanitary sewer overflow or the sewage treatment facility overflow was unintentional, temporary, and caused by an accident or other factors beyond the reasonable control of the permittee.

6.3.1.2 Permittee Response to Overflows

Whenever a sanitary sewer overflow or sewage treatment facility overflow occurs, the permittee shall take all feasible steps to control or limit the volume of untreated or partially treated wastewater discharged, and terminate the discharge as soon as practicable. Remedial actions, including those in NR 210.21 (3), Wis. Adm. Code, shall be implemented consistent with an emergency response plan developed under the CMOM program.

6.3.1.3 Permittee Reporting

Permittees shall report all sanitary sewer overflows and sewage treatment overflows as follows:

- The permittee shall notify the department by telephone, fax or email as soon as practicable, but no later than 24 hours from the time the permittee becomes aware of the overflow;
- The permittee shall, no later than five days from the time the permittee becomes aware of the overflow, provide to the department the information identified in this paragraph using department form number 3400-184. If an overflow lasts for more than five days, an initial report shall be submitted within 5 days as required in this paragraph and an updated report submitted following cessation of the overflow. At a minimum, the following information shall be included in the report:
    - The date and location of the overflow;
    - The surface water to which the discharge occurred, if any;
    - The duration of the overflow and an estimate of the volume of the overflow;

- A description of the sewer system or treatment facility component from which the discharge occurred such as manhole, lift station, constructed overflow pipe, or crack or other opening in a pipe;
- The estimated date and time when the overflow began and stopped or will be stopped;
- The cause or suspected cause of the overflow including, if appropriate, precipitation, runoff conditions, areas of flooding, soil moisture and other relevant information;
- Steps taken or planned to reduce, eliminate and prevent reoccurrence of the overflow and a schedule of major milestones for those steps;
- A description of the actual or potential for human exposure and contact with the wastewater from the overflow;
- Steps taken or planned to mitigate the impacts of the overflow and a schedule of major milestones for those steps;
- To the extent known at the time of reporting, the number and location of building backups caused by excessive flow or other hydraulic constraints in the sewage collection system that occurred concurrently with the sanitary sewer overflow and that were within the same area of the sewage collection system as the sanitary sewer overflow; and
- The reason the overflow occurred or explanation of other contributing circumstances that resulted in the overflow event. This includes any information available including whether the overflow was unavoidable to prevent loss of life, personal injury, or severe property damage and whether there were feasible alternatives to the overflow.

NOTE: A copy of form 3400-184 for reporting sanitary sewer overflows and sewage treatment facility overflows may be obtained from the department or accessed on the department's web site at http://dnr.wi.gov/topic/wastewater/SSOreport.html. As indicated on the form, additional information may be submitted to supplement the information required by the form.

- The permittee shall identify each specific location and each day on which a sanitary sewer overflow or sewage treatment facility overflow occurs as a discrete sanitary sewer overflow or sewage treatment facility overflow occurrence. An occurrence may be more than one day if the circumstances causing the sanitary sewer overflow or sewage treatment facility overflow results in a discharge duration of greater than 24 hours. If there is a stop and restart of the overflow at the same location within 24 hours and the overflow is caused by the same circumstance, it may be reported as one occurrence. Sanitary sewer overflow occurrences at a specific location that are separated by more than 24 hours shall be reported as separate occurrences; and
- A permittee that is required to submit wastewater discharge monitoring reports under NR 205.07 (1) (r) shall also report all sanitary sewer overflows and sewage treatment facility overflows on that report.

6.3.1.4 Public Notification

The permittee shall notify the public of any sanitary sewer and sewage treatment facility overflows consistent with its emergency response plan required under the CMOM (Capacity, Management, Operation and Maintenance) section of this permit and s. NR 210.23 (4) (f), Wis. Adm. Code. Such public notification shall occur promptly following any overflow event using the most effective and efficient communications available in the community. At minimum, a daily newspaper of general circulation in the county(s) and municipality whose waters may be affected by the overflow shall be notified by written or electronic communication.

6.3.2 Capacity, Management, Operation and Maintenance (CMOM) Program

- The permittee shall have written documentation of the Capacity, Management, Operation and Maintenance (CMOM) program components in accordance with s. NR 210.23(4), Wis. Adm. Code. Such documentation shall be available for Department review upon request. The Department may request that the permittee provide this documentation or prepare a summary of the permittee's CMOM program at the time of application for reissuance of the WPDES permit.
- The permittee shall implement a CMOM program in accordance with s. NR 210.23, Wis. Adm. Code.
- The permittee shall at least annually conduct a self-audit of activities conducted under the permittee's CMOM program to ensure CMOM components are being implemented as necessary to meet the general standards of s. NR 210.23(3), Wis. Adm. Code.

6.3.3 Sewer Cleaning Debris and Materials

All debris and material removed from cleaning sanitary sewers shall be managed to prevent nuisances, run-off, ground infiltration or prohibited discharges.

- Debris and solid waste shall be dewatered, dried and then disposed of at a licensed solid waste facility.
- Liquid waste from the cleaning and dewatering operations shall be collected and disposed of at a permitted wastewater treatment facility.
- Combination waste including liquid waste along with debris and solid waste may be disposed of at a licensed solid waste facility or wastewater treatment facility willing to accept the waste.

6.4 Surface Water Requirements

6.4.1 Permittee-Determined Limit of Quantitation Incorporated into this Permit

For pollutants with water quality-based effluent limits below the Limit of Quantitation (LOQ) in this permit, the LOQ calculated by the permittee and reported on the Discharge Monitoring Reports (DMRs) is incorporated by reference into this permit. The LOQ shall be reported on the DMRs, shall be the lowest quantifiable level practicable, and shall be no greater than the minimum level (ML) specified in or approved under 40 CFR Part 136 for the pollutant at the time this permit was issued, unless this permit specifies a higher LOQ.

6.4.2 Appropriate Formulas for Effluent Calculations

The permittee shall use the following formulas for calculating effluent results to determine compliance with average concentration limits and mass limits and total load limits:

Weekly/Monthly/Six-Month/Annual Average Concentration = the sum of all daily results for that week/month/six-month/year, divided by the number of results during that time period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Weekly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the week.

Monthly Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the month.

Six-Month Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the six-month period. [Note: When a six-month average effluent limit is specified for Total Phosphorus the applicable periods are May through October and November through April.]

Annual Average Mass Discharge (lbs/day): Daily mass = daily concentration (mg/L) x daily flow (MGD) x 8.34, then average the daily mass values for the entire year.

Total Monthly Discharge: = monthly average concentration (mg/L) x total flow for the month (MG/month) x 8.34.

Total Annual Discharge: = sum of total monthly discharges for the calendar year.

12-Month Rolling Sum of Total Monthly Discharge: = the sum of the most recent 12 consecutive months of Total Monthly Discharges.

6.4.3 Effluent Temperature Requirements

Weekly Average Temperature – If temperature limits are included in this permit, Weekly Average Temperature shall be calculated as the sum of all daily maximum results for that week divided by the number of daily maximum results during that time period.

Cold Shock Standard – Water temperatures of the discharge shall be controlled in a manner as to protect fish and aquatic life uses from the deleterious effects of cold shock pursuant to Wis. Adm. Code, s. NR 102.28. 'Cold Shock' means exposure of aquatic organisms to a rapid decrease in temperature and a sustained exposure to low temperature that induces abnormal behavior or physiological performance and may lead to death.

Rate of Temperature Change Standard – Temperature of a water of the state or discharge to a water of the state may not be artificially raised or lowered at such a rate that it causes detrimental health or reproductive effects to fish or aquatic life of the water of the state pursuant to Wis. Adm. Code, s. NR 102.29.

6.4.4 Visible Foam or Floating Solids

There shall be no discharge of floating solids or visible foam in other than trace amounts.

6.4.5 Surface Water Uses and Criteria

In accordance with NR 102.04, Wis. Adm. Code, surface water uses and criteria are established to govern water management decisions. Practices attributable to municipal, industrial, commercial, domestic, agricultural, land development or other activities shall be controlled so that all surface waters including the mixing zone meet the following conditions at all times and under all flow and water level conditions:

a) Substances that will cause objectionable deposits on the shore or in the bed of a body of water, shall not be present in such amounts as to interfere with public rights in waters of the state.

b) Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to interfere with public rights in waters of the state.

c) Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to interfere with public rights in waters of the state.

d) Substances in concentrations or in combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts which are acutely harmful to animal, plant or aquatic life.

6.4.6 Percent Removal

During any 30 consecutive days, the average effluent concentrations of BOD_5 and of total suspended solids shall not exceed 15% of the average influent concentrations, respectively. This requirement does not apply to removal of total suspended solids if the permittee operates a lagoon system and has received a variance for suspended solids granted under NR 210.07(2), Wis. Adm. Code.

6.4.7 Fecal Coliform

The monthly limit for fecal coliform shall be expressed as a geometric mean. In calculating the geometric mean, a value of 1 is used for any result of 0.

6.4.8 *E. coli*

The monthly limit for *E. coli* shall be expressed as a geometric mean. In calculating the geometric mean, a value of 1 is used for any result of 0.

6.4.9 Seasonal Disinfection

Disinfection shall be provided from May 1 through September 30 of each year. Monitoring requirements and the limitations for Fecal Coliform (interim) and *E. coli* apply only during the period in which disinfection is required. Whenever chlorine is used for disinfection or other uses, the limitations and monitoring requirements for residual chlorine shall apply. A dechlorination process shall be in operation whenever chlorine is used.

6.4.10 Whole Effluent Toxicity (WET) Monitoring Requirements

In order to determine the potential impact of the discharge on aquatic organisms, static-renewal toxicity tests shall be performed on the effluent in accordance with the procedures specified in the *"State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, 2nd Edition" (PUB-WT-797*, November 2004) as required by NR 219.04, Table A, Wis. Adm. Code). All of the WET tests required in this permit, including any required retests, shall be conducted on the *Ceriodaphnia dubia* and fathead minnow species. Receiving water samples shall not be collected from any point in contact with the permittee's mixing zone and every attempt shall be made to avoid contact with any other discharge's mixing zone.

6.4.11 Whole Effluent Toxicity (WET) Identification and Reduction

Within 60 days of a retest which showed positive results, the permittee shall submit a written report to the Biomonitoring Coordinator, Bureau of Water Quality, 101 S. Webster St., PO Box 7921, Madison, WI 53707-7921, which details the following:

- A description of actions the permittee has taken or will take to remove toxicity and to prevent the recurrence of toxicity;
- A description of toxicity reduction evaluation (TRE) investigations that have been or will be done to identify potential sources of toxicity, including the following actions:
    - a) Evaluate the performance of the treatment system to identify deficiencies contributing to effluent toxicity (e.g., operational problems, chemical additives, incomplete treatment)
    - b) Identify the compound(s) causing toxicity. Conduct toxicity screening tests on the effluent at a minimum of once per month for six months to determine if toxicity recurs. Screening tests are WET tests using fewer effluent concentrations conducted on the most sensitive species. If any of the screening tests contain toxicity, conduct a toxicity identification evaluation (TIE) to determine the cause. TIE methods are available from USEPA “Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures (EPA/600/6-91/003) and “Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I” (EPA/600/6-91/005F).
    - c) Trace the compound(s) causing toxicity to their sources (e.g., industrial, commercial, domestic)
    - d) Evaluate, select, and implement methods or technologies to control effluent toxicity (e.g., in-plant or pretreatment controls, source reduction or removal)
- Where corrective actions including a TRE have not been completed, an expeditious schedule under which corrective actions will be implemented;
- If no actions have been taken, the reason for not taking action.

The permittee may also request approval from the Department to postpone additional retests in order to investigate the source(s) of toxicity. Postponed retests must be completed after toxicity is believed to have been removed.

6.4.12 Reopener Clause

Pursuant to s. 283.15(11), Wis. Stat. and 40 CFR 131.20, the Department may modify or revoke and reissue this permit if, through the triennial standard review process, the Department determines that the terms and conditions of this permit need to be updated to reflect the highest attainable condition of the receiving water.

6.5 Pretreatment Program Requirements

The permittee is required to operate an industrial pretreatment program as described in the program initially approved by the Department of Natural Resources including any subsequent program modifications approved by the Department, and including commitments to program implementation activities provided in the permittee's annual pretreatment program report, and that complies with the requirements set forth in 40 CFR Part 403 and ch. NR 211, Wis. Adm. Code. To ensure that the program is operated in accordance with these requirements, the following general conditions and requirements are hereby established:

6.5.1 Inventories

The permittee shall implement methods to maintain a current inventory of the general character and volume of wastewater that industrial users discharge to the treatment works and shall provide an updated industrial user listing annually and report any changes in the listing to the Department by March 31 of each year as part of the annual pretreatment program report required herein.

6.5.2 Regulation of Industrial Users

6.5.2.1 Limitations for Industrial Users:

The permittee shall develop, maintain, enforce and revise as necessary local limits to implement the general and specific prohibitions of the state and federal General Pretreatment Regulations.

6.5.2.2 Control Documents for Industrial Users (IUs)

The permittee shall control the discharge from each significant industrial user through individual discharge permits as required by s. NR 211.235, Wis. Adm. Code and in accordance with the approved pretreatment program procedures and the permittee's sewer use ordinance. The discharge permits shall be modified in a timely manner during the stated term of the discharge permits according to the sewer use ordinance as conditions warrant. The discharge permits shall include at a minimum the elements found in s. NR 211.235(1), Wis. Adm. Code and references to the approved pretreatment program procedures and the sewer use ordinance.

6.5.2.3 Review of Industrial User Reports, Inspections and Compliance Monitoring

The permittee shall require the submission of, receive, and review self-monitoring reports and other notices from industrial users in accordance with the approved pretreatment program procedures. The permittee shall randomly sample and analyze industrial user discharges and conduct surveillance activities to determine independent of information supplied by the industrial users, whether the industrial users are in compliance with pretreatment standards and requirements. The inspections and monitoring shall also be conducted to maintain accurate knowledge of local industrial processes, including changes in the discharge, pretreatment equipment operation, spill prevention control plans, slug control plans, and implementation of solvent management plans.

The permittee shall inspect and sample the discharge from each significant industrial user as specified in the permittee's approved pretreatment program or as specified in NR 211.235(3). The permittee shall evaluate whether industrial users identified as significant need a slug control plan according to the requirements of NR 211.235(4). If a slug control plan is needed, the plan shall contain at a minimum the elements specified in s. NR 211.235(4)(b), Wis. Adm. Code.

6.5.2.4 Enforcement and Industrial User Compliance Evaluation & Violation Reports

The permittee shall enforce the industrial pretreatment requirements including the industrial user discharge limitations of the permittee's sewer use ordinance. The permittee shall investigate instances of noncompliance by collecting and analyzing samples and collecting other information with sufficient care to produce evidence admissible in enforcement proceedings or in judicial actions. Investigation and response to instances of noncompliance shall be in accordance with the permittee's sewer use ordinance and approved Enforcement Response Plan.

The permittee shall make a semiannual report on forms provided or approved by the Department. The semiannual report shall include an analysis of industrial user significant noncompliance (i.e. the Industrial User Compliance Evaluation, also known as the SNC Analysis) as outlined in s.NR 211.23(1)(j), Wis. Adm. Code, and a summary of the permittee's response to all industrial noncompliance (i.e. the Industrial User Violation Report). The Industrial User Compliance Evaluation Report shall include monitoring results received from industrial users pursuant to s. NR 211.15(1)-(5), Wis. Adm. Code. The Industrial User Violation Report shall include copies of all notices of noncompliance, notices of violation and other enforcement correspondence sent by the permittee to industrial users, together with the industrial user's response. The Industrial User Compliance Evaluation and Violation Reports for the period January through June shall be provided to the Department by September 30 of each year and for the period July through December shall be provided to the Department by March 31 of the succeeding year, unless alternate submittal dates are approved.

6.5.2.5 Publication of Violations

The permittee shall publish a list of industrial users that have significantly violated the municipal sewer use ordinance during the calendar year, in the largest daily newspaper in the area by March 31 of the following year pursuant to s. NR 211.23(1)(j), Wis. Adm. Code. A copy of the newspaper publication shall be provided as part of the annual pretreatment report specified herein.

6.5.2.6 Multijurisdictional Agreements

The permittee shall establish agreements with all contributing jurisdictions as necessary to ensure compliance with pretreatment standards and requirements by all industrial users discharging to the permittee's wastewater treatment system. Any such agreement shall identify who will be responsible for maintaining the industrial user inventory, issuance of industrial user control mechanisms, inspections and sampling, pretreatment program implementation, and enforcement.

6.5.3 Annual Pretreatment Program Report

The permittee shall evaluate the pretreatment program, and submit the Pretreatment Program Report to the Department on forms provided or approved by the Department by March 31 annually, unless an alternate submittal date is approved. The report shall include a brief summary of the work performed during the preceding calendar year, including the numbers of discharge permits issued and in effect, pollution prevention activities, number of inspections and monitoring surveys conducted, budget and personnel assigned to the program, a general discussion of program progress in meeting the objectives of the permittee's pretreatment program together with summary comments and recommendations.

6.5.4 Pretreatment Program Modifications

- Future Modifications: The permittee shall within one year of any revisions to federal or state General Pretreatment Regulations submit an application to the Department in duplicate to modify and update its approved pretreatment program to incorporate such regulatory changes as applicable to the permittee. Additionally, the Department or the permittee may request an application for program modification at any time where necessary to improve program effectiveness based on program experience to date.

- Modifications Subject to Department Approval: The permittee shall submit all proposed pretreatment program modifications to the Department for determination of significance and opportunity for comment in accordance with the requirements and conditions of s. NR 211.27, Wis. Adm. Code. Any substantial proposed program modification shall be subject to Department public noticing and formal approval prior to implementation. A substantial program modification includes, but is not limited to, changes in enabling legal authority to administer and enforce pretreatment conditions and requirements; significant changes in program administrative or operational procedures; significant reductions in monitoring frequencies; significant reductions in program resources including personnel commitments, equipment, and funding levels; changes (including any relaxation) in the local limitations for substances enforced and applied to users of the sewerage treatment works; changes in treatment works sludge disposal or management practices which impact the pretreatment program; or program modifications which increase pollutant loadings to the treatment works. The Department shall use the procedures outlined in s. NR 211.30, Wis. Adm. Code for review and approval/denial of proposed pretreatment program modifications. The permittee shall comply with local public participation requirements when implementing the pretreatment program.

6.5.5 Program Resources

The permittee shall have sufficient resources and qualified personnel to carry out the pretreatment program responsibilities as listed in ss. NR 211.22 and NR 211.23, Wis. Adm. Code.

6.6 Land Application Requirements

6.6.1 Sludge Management Program Standards And Requirements Based Upon Federally Promulgated Regulations

In the event that new federal sludge standards or regulations are promulgated, the permittee shall comply with the new sludge requirements by the dates established in the regulations, if required by federal law, even if the permit has not yet been modified to incorporate the new federal regulations.

6.6.2 General Sludge Management Information

The General Sludge Management Form 3400-48 shall be completed and submitted prior to any significant sludge management changes.

6.6.3 Sludge Samples

All sludge samples shall be collected at a point and in a manner which will yield sample results which are representative of the sludge being tested, and collected at the time which is appropriate for the specific test.

6.6.4 Land Application Characteristic Report

Each report shall consist of a Characteristic Form 3400-49 and Lab Report. The Characteristic Report Form 3400-49 shall be submitted electronically by January 31 following each year of analysis.

Following submittal of the electronic Characteristic Report Form 3400-49, this form shall be certified electronically via the ‘eReport Certify’ page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The ‘eReport Certify’ page certifies that the electronic report is true, accurate and complete. The Lab Report must be sent directly to the facility’s DNR sludge representative or basin engineer unless approval for not submitting the lab reports has been given.

The permittee shall use the following convention when reporting sludge monitoring results: Pollutant concentrations less than the limit of detection shall be reported as < (less than) the value of the limit of detection. For example, if a substance is not detected at a detection limit of 1.0 mg/kg, report the pollutant concentration as < 1.0 mg/kg .

All results shall be reported on a dry weight basis.

6.6.5 Calculation of Water Extractable Phosphorus

When sludge analysis for Water Extractable Phosphorus is required by this permit, the permittee shall use the following formula to calculate and report Water Extractable Phosphorus:
Water Extractable Phosphorus (% of Total P) =
[Water Extractable Phosphorus (mg/kg, dry wt) ÷ Total Phosphorus (mg/kg, dry wt)] x 100

6.6.6 Annual Land Application Report

Land Application Report Form 3400-55 shall be submitted electronically by January 31, each year whether or not non-exceptional quality sludge is land applied. Non-exceptional quality sludge is defined in s. NR 204.07(4), Wis. Adm. Code. Following submittal of the electronic Annual Land Application Report Form 3400-55, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.7 Other Methods of Disposal or Distribution Report

The permittee shall submit electronically the Other Methods of Disposal or Distribution Report Form 3400-52 by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied. Following submittal of the electronic Report Form 3400-52, this form shall be certified electronically via the 'eReport Certify' page by a responsible executive or municipal officer, manager, partner or proprietor as specified in s. 283.37(3), Wis. Stats., or a duly authorized representative of the officer, manager, partner or proprietor that has been delegated signature authority pursuant to s. NR 205.07(1)(g)2, Wis. Adm. Code. The 'eReport Certify' page certifies that the electronic report form is true, accurate and complete.

6.6.8 Approval to Land Apply

Bulk non-exceptional quality sludge as defined in s. NR 204.07(4), Wis. Adm. Code, may not be applied to land without a written approval letter or Form 3400-122 from the Department unless the Permittee has obtained permission from the Department to self approve sites in accordance with s. NR 204.06 (6), Wis. Adm. Code. Analysis of sludge characteristics is required prior to land application. Application on frozen or snow covered ground is restricted to the extent specified in s. NR 204.07(3) (l), Wis. Adm. Code.

6.6.9 Soil Analysis Requirements

Each site requested for approval for land application must have the soil tested prior to use. Each approved site used for land application must subsequently be soil tested such that there is at least one valid soil test in the four years prior to land application. All soil sampling and submittal of information to the testing laboratory shall be done in accordance with UW Extension Bulletin A-2100. The testing shall be done by the UW Soils Lab in Madison or Marshfield, WI or at a lab approved by UW. The test results including the crop recommendations shall be submitted to the DNR contact listed for this permit, as they are available. Application rates shall be determined based on the crop nitrogen recommendations and with consideration for other sources of nitrogen applied to the site.

6.6.10 Land Application Site Evaluation

For non-exceptional quality sludge, as defined in s. NR 204.07(4), Wis. Adm. Code, a Land Application Site Request Form 3400-053 shall be submitted to the Department for the proposed land application site. The Department will evaluate the proposed site for acceptability and will either approve or deny use of the proposed site. The permittee may obtain permission to approve their own sites in accordance with s. NR 204.06(6), Wis. Adm. Code.

6.6.11 Class B Sludge: Fecal Coliform Limitation

Compliance with the fecal coliform limitation for Class B sludge shall be demonstrated by calculating the geometric mean of at least 7 separate samples. (Note that a Total Solids analysis must be done on each sample). The geometric mean shall be less than 2,000,000 MPN or CFU/g TS. Calculation of the geometric mean can be done using one of the following 2 methods.

Method 1:

Geometric Mean = $(X_1 \times X_2 \times X_3 \ldots \times X_n)^{1/n}$

Where X = Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Method 2:

Geometric Mean = antilog$[(X_1 + X_2 + X_3 \ldots + X_n) \div n]$

Where X = $\log_{10}$ of Coliform Density value of the sludge sample, and where n = number of samples (at least 7)

Example for Method 2

Sample Number	Coliform Density of Sludge Sample	$\log_{10}$
1	6.0×10^5	5.78
2	4.2×10^6	6.62
3	1.6×10^6	6.20
4	9.0×10^5	5.95
5	4.0×10^5	5.60
6	1.0×10^6	6.00
7	5.1×10^5	5.71

The geometric mean for the seven samples is determined by averaging the $\log_{10}$ values of the coliform density and taking the antilog of that value.

(5.78 + 6.62 + 6.20 + 5.95 + 5.60 + 6.00 + 5.71) ÷ 7 = 5.98

The antilog of 5.98 = 9.5×10^5

6.6.12 Class B Sludge: Anaerobic Digestion

Treat the sludge in the absence of air for a specific mean cell residence time at a specific temperature. Values for the mean cell residence time and temperature shall be between 15 days at 35° C to 55° C and 60 days at 20° C. Straight-line interpolation to calculate mean cell residence time is allowable when the temperature falls between 35° C and 20° C.

6.6.13 Vector Control: Volatile Solids Reduction

The mass of volatile solids in the sludge shall be reduced by a minimum of 38% between the time the sludge enters the digestion process and the time it either exits the digester or a storage facility. For calculation of volatile solids reduction, the permittee shall use the Van Kleeck equation or one of the other methods described in "Determination of Volatile Solids Reduction in Digestion" by J.B. Farrell, which is Appendix C of EPA's *Control of Pathogens in Municipal Wastewater Sludge* (EPA/625/R-92/013). The Van Kleeck equation is:

$$VSR\% = \frac{VS_{IN} - VS_{OUT}}{VS_{IN} - (VS_{OUT} \times VS_{IN})} \times 100$$

Where: VS_{IN} = Volatile Solids in Feed Sludge (g VS/g TS)

VS_{OUT} = Volatile Solids in Final Sludge (g VS/g TS)

VSR% = Volatile Solids Reduction, (Percent)

6.6.14 Class B Sludge - Vector Control: Incorporation

Class B sludge shall be incorporated within 6 hours of surface application, or as approved by the Department.

6.6.15 Land Application of Sludge Which Contains Elevated Levels of Radium-226

When contributory water supplies exceed 2 pci per liter of Radium 226, monitoring for Radium 226 in sludge is required. Sludge containing Radium 226 shall be land applied in accordance with the requirements in s. NR 204.07(3)(n), Wis. Adm. Code.

7 Summary of Reports Due

FOR INFORMATIONAL PURPOSES ONLY

Description	Date	Page
Mercury Pollutant Minimization Program -Annual Mercury Progress Reports	January 31, 2021	27
Mercury Pollutant Minimization Program -Annual Mercury Progress Report #2	January 31, 2022	27
Mercury Pollutant Minimization Program -Annual Mercury Progress Report #3	January 31, 2023	27
Mercury Pollutant Minimization Program -Annual Mercury Progress Report #4	January 31, 2024	27
Mercury Pollutant Minimization Program -Final Mercury Report	January 31, 2025	27
Mercury Pollutant Minimization Program -Annual Mercury Reports After Permit Expiration	See Permit	27
Effluent Limitations for E. coli (Outfall 001) -Status Update	November 21, 2020	27
Effluent Limitations for E. coli (Outfall 001) -Operational Evaluation Report	October 31, 2021	28
Effluent Limitations for E. coli (Outfall 001) -Achieve Compliance	May 1, 2022	28
Water Quality Trading (WQT) Management Plan -Complete Installation of Management Practices	September 30, 2022	28
Water Quality Trading (WQT) Management Plan -Management Practices	September 30, 2022	28
Annual Water Quality Trading (WQT) Report -Annual WQT Report	January 31, 2023	28
Annual Water Quality Trading (WQT) Report -Annual WQT Report #2	January 31, 2024	29
Annual Water Quality Trading (WQT) Report -Annual WQT Report #3	January 31, 2025	29
Annual Water Quality Trading (WQT) Report -Annual WQT Report Required After Permit Expiration	See Permit	29
Phosphorus Schedule - Optimization Plan -Optimization Plan	June 30, 2021	29
Phosphorus Schedule - Optimization Plan -Progress Report #1	June 30, 2022	29
Phosphorus Payment per Pound to County -Annual Verification of Phosphorus Payment to County	March 1, 2021	29
Phosphorus Payment per Pound to County -Annual Verification of Payment #2	March 1, 2022	30
Phosphorus Payment per Pound to County -Annual Verification of Payment #3	March 1, 2023	30
Compliance Maintenance Annual Reports (CMAR)	by June 30, each year	32
Industrial User Compliance Evaluation and Violation Reports	Semiannual	42
Pretreatment Program Report	Annually	42
General Sludge Management Form 3400-48	prior to any significant sludge	43

	management changes	
Characteristic Form 3400-49 and Lab Report	by January 31 following each year of analysis	43
Land Application Report Form 3400-55	by January 31, each year whether or not non-exceptional quality sludge is land applied	44
Other Methods of Disposal or Distribution Report Form 3400-52	by January 31, each year whether or not sludge is hauled, landfilled, incinerated, or exceptional quality sludge is distributed or land applied	44
Wastewater Discharge Monitoring Report	no later than the date indicated on the form	31

Report forms shall be submitted electronically in accordance with the reporting requirements herein. Any facility plans or plans and specifications for municipal, industrial, industrial pretreatment and non industrial wastewater systems shall be submitted to the Bureau of Water Quality, P.O. Box 7921, Madison, WI 53707-7921. All other submittals required by this permit shall be submitted to:
South Central Region, 3911 Fish Hatchery Road, Fitchburg, WI 53711-5397

APPENDIX C
WQBEL Memorandum

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: September 5, 2024

TO: Brett Schmidt – WY/3

FROM: Sarah Luck – SCR/Fitchburg

SUBJECT: Facility Planning Water Quality-Based Effluent Limitations for Watertown Wastewater Treatment Facility
WPDES Permit No. WI-0028541

This is in response to your request for an evaluation of the need for water quality-based effluent limitations (WQBELs) using chapters NR 102, 104, 105, 106, 207, 210, 212, and 217 of the Wisconsin Administrative Code (where applicable), for the discharge from the Watertown Wastewater Treatment Facility in Jefferson County. This municipal wastewater treatment facility (WWTF) discharges to the Rock River, located in the Middle Rock River Watershed in the Upper Rock River Basin. This discharge is included in the Rock River TMDL as approved by EPA. The evaluation of the permit recommendations is discussed in more detail in the attached report.

Based on our review, the following recommendations are made on a chemical-specific basis at Outfall 001 based on the facility upgrade plans and data available at this time. Limits will be recalculated at the next permit issuance which may deviate from the following recommendations.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
BOD_5					2
January			31 mg/L (1400 lbs/day)	30 mg/L	
February			35 mg/L (1500 lbs/day)	30 mg/L	
March			45 mg/L	30 mg/L	
April			45 mg/L	30 mg/L	
May			45 mg/L	30 mg/L	
June			16 mg/L (690 lbs/day)	16 mg/L	
July			12 mg/L (530 lbs/day)	12 mg/L	
August			10 mg/L (450 lbs/day)	10 mg/L	
September			10 mg/L (440 lbs/day)	10 mg/L	
October			12 mg/L (530 lbs/day)	12 mg/L	
November			25 mg/L (1100 lbs/day)	25 mg/L	
December			29 mg/L (1300 lbs/day)	29 mg/L	
TSS					2,3
January			31 mg/L	30 mg/L	
February			35 mg/L	30 mg/L	
March			45 mg/L	30 mg/L	
April			45 mg/L	30 mg/L	
May			45 mg/L	30 mg/L	
June			16 mg/L	16 mg/L	
July			12 mg/L	12 mg/L	
August			10 mg/L	10 mg/L	
September			10 mg/L	10 mg/L	
October			12 mg/L	12 mg/L	
November			25 mg/L	25 mg/L	

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
December			29 mg/L	29 mg/L	
pH	9.0 s.u.	6.0 s.u.			2
Dissolved Oxygen		6.0 mg/L			2
Ammonia Nitrogen					2,4
November – March	20 mg/L		**20 mg/L**	**20 mg/L**	
April – May	No Limit		No Limit	No Limit	
June	No Limit		17 mg/L	**17 mg/L**	
July	No Limit		9.0 mg/L	**9.0 mg/L**	
August	No Limit		6.4 mg/L	**6.4 mg/L**	
September	No Limit		8.9 mg/L	**8.9 mg/L**	
October	No Limit		13 mg/L	9.3 mg/L	
Bacteria					2,5
E. coli				126 #/100 mL geometric mean	
Mercury					6
Chloride					1
PFOS and PFOA					7
Phosphorus					3,8
July – March, May				1.0 mg/L	
April and June				0.8 mg/L	
Temperature					1
Cadmium, Chromium, Copper, Lead, Nickel, and Zinc					9
TKN, Nitrate+Nitrite, and Total Nitrogen					10
Acute WET					11,13
Chronic WET				1.5 TU_c	12,13

Footnotes:

1. Monitoring only.
2. No changes from the current permit.
3. Additional phosphorus and TSS mass limitations are required in accordance with the waste load allocations specified in the Rock River TMDL.

Month	Weekly Average TSS Effluent Limit (lbs/day)*	Monthly Average TSS Effluent Limit (lbs/day)	Monthly Average Total P Effluent Limit (lbs/day)
Jan	1400	1270	13.7
Feb	1500	1410	19.5
March	2270	1270	18.4
April	2340	1310	18.3
May	2270	1270	16.5
June	690	700	17.6
July	530	510	17.7
Aug	450	430	16.2
Sept	440	440	14.8

Month	Weekly Average TSS Effluent Limit (lbs/day)*	Monthly Average TSS Effluent Limit (lbs/day)	Monthly Average Total P Effluent Limit (lbs/day)
Oct	530	510	12.3
Nov	1100	1100	12.3
Dec	1300	1230	11.9

* The TMDL-derived weekly average TSS limits are superseded by more stringent TSS limits for the months of June through February that were included in the permit prior to the TMDL. The most restrictive limits are presented in the table above.

4. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code, are included in bold.
5. Bacteria limits apply during the disinfection season of May through September. Additional limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.
6. Monitoring only. Source pollutant minimization procedures put in place should continue in order to prevent backsliding.
7. PFOS and PFOA monitoring is recommended at a frequency of once every two months.
8. If water quality trading is used as compliance option for phosphorus, the concentration limits of 1.0 mg/L, effective July – March and May, and 0.8 mg/L, effective April and June, would be required to continue as minimum control levels.
9. Monitoring for total recoverable cadmium, chromium, copper, lead, nickel, and zinc is required because Watertown Wastewater Treatment Facility operates a local pretreatment program for the industries that discharge to the treatment facility.
10. As recommended in the Department's October 1, 2019 *Guidance for Total Nitrogen Monitoring in Wastewater Permits*, quarterly total nitrogen monitoring is recommended for all municipal major permittees. Total Nitrogen is the sum of nitrate (NO_3), nitrite (NO_2), and total kjeldahl nitrogen (TKN) (all expressed as N).
11. Annual acute WET monitoring is recommended.
12. Annual chronic WET monitoring is recommended. The Instream Waste Concentration (IWC) to assess chronic test results is 67%. According to the *State of Wisconsin Aquatic Life Toxicity Testing Methods Manual* (s. NR 219.04, Table A, Wis. Adm. Code), chronic testing shall be performed using a dilution series of 100%, 75%, 50%, 25% & 12.5%, and the dilution water used in WET tests conducted on Outfall 001 shall be a grab sample collected from the Rock River.
13. Sampling WET concurrently with any chemical-specific toxic substances is recommended. Tests should be done in rotating quarters, to collect seasonal information about this discharge and should continue after the permit expiration date (until the permit is reissued).

The test for antidegradation is whether any of the effluent limitations is an increased discharge as defined in ch. NR 207, Wis. Adm Code, because this facility is an existing discharge. “Increased discharge” means any change in concentration, level or loading of a substance which would exceed an effluent limitation specified in a current WPDES permit. No effluent limitations outlined above would constitute an increased discharge as defined in ch. NR 207, Wis. Adm. Code, as they are equal to or less than the existing permit limitations or are the first-time imposition of the limit. Therefore, the limits do not change due to this consideration.

Please consult the attached report for details regarding the above recommendations. If there are any questions or comments, please contact Sarah Luck (Sarah.Luck@wisconsin.gov) or Diane Figiel (Diane.Figiel@wisconsin.gov).

Attachments (2) – Narrative and Site Map

PREPARED BY: Sarah Luck Date: September 5, 2024

Sarah Luck
Water Resources Engineer

E-cc: Ashley Brechlin, Wastewater Engineer – SCR/Fitchburg
Diane Figiel, Water Resources Engineer – WY/3

Attachment #1

Water Quality-Based Effluent Limitations for
Watertown Wastewater Treatment Facility

WPDES Permit No. WI-0028541

PART 1 – BACKGROUND INFORMATION

Facility Description
The City of Watertown operates a wastewater treatment facility to treat an average daily flow of 5.2 MGD of domestic, commercial, and industrial wastewater. Treatment units include parallel bar screens and grit removal, primary clarifying, three activated sludge tanks with an anoxic selector in the front of the basins, ferric chloride addition to bind phosphorus, final clarification, ultraviolet light disinfection, and effluent cascade aeration.

The facility has submitted a plan for a facility upgrade which proposes **no increase in design flow or discharge location**. The purpose of this memo is to evaluate any changes to effluent limitations resulting from the upgrade. The most recent WQBEL recommendations are from the memo dated September 20, 2019 and addendums dated May 1, 2020 and June 9, 2020.

Attachment #2 is a map of the area showing the approximate location of Outfall 001.

Existing Permit Limitations
The current permit, expiring on September 30, 2025, includes the following effluent limitations and monitoring requirements.

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
Flow Rate					1
BOD_5					-
January			31 mg/L (1400 lbs/day)	30 mg/L	
February			35 mg/L (1500 lbs/day)	30 mg/L	
March			45 mg/L	30 mg/L	
April			45 mg/L	30 mg/L	
May			45 mg/L	30 mg/L	
June			16 mg/L (690 lbs/day)	16 mg/L	
July			12 mg/L (530 lbs/day)	12 mg/L	
August			10 mg/L (450 lbs/day)	10 mg/L	
September			10 mg/L (440 lbs/day)	10 mg/L	
October			12 mg/L (530 lbs/day)	12 mg/L	
November			25 mg/L (1100 lbs/day)	25 mg/L	
December			29 mg/L (1300 lbs/day)	29 mg/L	
TSS					2
January			31 mg/L	30 mg/L	
February			35 mg/L	30 mg/L	
March			45 mg/L	30 mg/L	

Attachment #1

Parameter	Daily Maximum	Daily Minimum	Weekly Average	Monthly Average	Footnotes
April May June July August September October November December			45 mg/L 45 mg/L 16 mg/L 12 mg/L 10 mg/L 10 mg/L 12 mg/L 25 mg/L 29 mg/L	30 mg/L 30 mg/L 16 mg/L 12 mg/L 10 mg/L 10 mg/L 12 mg/L 25 mg/L 29 mg/L	
pH	9.0 s.u.	6.0 s.u.			-
Dissolved Oxygen		6.0 mg/L			-
Ammonia Nitrogen November – March April – May June July August September October	 20 mg/L No Limit No Limit No Limit No Limit No Limit No Limit		 **20 mg/L** No Limit 17 mg/L 9.0 mg/L 6.4 mg/L 8.9 mg/L 13 mg/L	 **20 mg/L** No Limit **17 mg/L** **9.0 mg/L** **6.4 mg/L** **8.9 mg/L** 9.3 mg/L	3
Bacteria					4
E. coli				126 #/100 mL geometric mean	
Mercury	3.7 ng/L				5
Phosphorus July – March, May April and June				 1.0 mg/L 0.8 mg/L	2,6
Temperature					1
Cadmium, Chloride, Chromium, Copper, Lead, Nickel, and Zinc					1
TKN, Nitrate+Nitrite, and Total Nitrogen					1
Acute WET					7
Chronic WET				1.5 TU_c	7

Footnotes:

1. Monitoring only.
2. Additional phosphorus and TSS mass limitations are required in accordance with the waste load allocations specified in the Rock River TMDL.

Month	**Weekly Average TSS Effluent Limit (lbs/day)***	**Monthly Average TSS Effluent Limit (lbs/day)**	**Monthly Average Total P Effluent Limit (lbs/day)**
Jan	1400	1270	13.7

Attachment #1

Month	Weekly Average TSS Effluent Limit (lbs/day)*	Monthly Average TSS Effluent Limit (lbs/day)	Monthly Average Total P Effluent Limit (lbs/day)
Feb	1500	1410	19.5
March	2270	1270	18.4
April	2340	1310	18.3
May	2270	1270	16.5
June	690	700	17.6
July	530	510	17.7
Aug	450	430	16.2
Sept	440	440	14.8
Oct	530	510	12.3
Nov	1100	1100	12.3
Dec	1300	1230	11.9

* The TMDL-derived weekly average TSS limits are superseded by more stringent TSS limits for the months of June through February that were included in the permit prior to the TMDL. The most restrictive limits are presented in the above.

3. Additional limits to comply with the expression of limits requirements in ss. NR 106.07 and NR 205.065(7), Wis. Adm. Code, are included in bold.
4. Bacteria limits apply during the disinfection season of May through September. Additional limit: No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 count/100 mL.
5. The current permit contains a variance to the water quality-based effluent limit (WQBEL) for mercury; this is the alternative effluent concentration limit.
6. The concentration limits represent minimum control levels as required for water quality trading.
7. Annual acute and chronic WET testing.

Receiving Water Information

- Name: Rock River
- Waterbody Identification Code (WBIC): 788800
- Classification used in accordance with chs. NR 102 and 104, Wis. Adm. Code: Warm Water Sport Fish (WWSF) community, non-public water supply.
- Low flows used in accordance with chs. NR 106 and 217, Wis. Adm. Code: The following 7-Q_{10} and 7-Q_2 values are from USGS for Station UR5 – located 700 feet downstream of the Milwaukee Street Bridge in Watertown – upstream of where Outfall 001 is located. These updated values were provided in a September 20, 3013 memo from USGS. The Harmonic Mean has been estimated as recommended in *State of Wisconsin Water Quality Rules Implementation Plan* (Publ. WT-511-98)

  7-Q_{10} = 16 cfs (cubic feet per second)
  7-Q_2 = 51 cfs
  90-Q_{10} = 43 cfs
  Harmonic Mean Flow = 204 cfs

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
7-Q_{10} (cfs)	45	56	109	278	109	48	30	22	20	21	45	47
7-Q_2 (cfs)	169	184	440	819	365	180	109	86	77	102	193	184

- Hardness = 320 mg/L as $CaCO_3$. This value represents the geometric mean of data (n=7) from WET testing done by Watertown Wastewater Treatment Facility from 2019 through 2024.
- % of low flow used to calculate limits in accordance with s. NR 106.06(4)(c)5., Wis. Adm. Code: 25%
- Source of background concentration data: Background metals concentrations were measured as Total Recoverable from the Rock River at Waupun. Chloride data measured from the Rock River at the Milwaukee Street Bridge in Watertown is used as a background concentration for chloride. The geometric mean of the chloride concentration at this location was 62.7 mg/L from 7/30/01 to 2/15/18.
- Multiple dischargers: There are several other dischargers to the Rock River; however, they are not in the immediate vicinity and the mixing zones do not overlap. Therefore, the other dischargers do not impact this evaluation.
- Impaired water status: The Rock River is listed as impaired for phosphorus at the point of discharge. An EPA-approved TMDL addresses the phosphorus and TSS impairments in this waterbody and downstream waters.

Effluent Information

- Flow rate:

  Design annual average = 5.2 MGD (Million Gallons per Day)
  Peak daily = 24 MGD
  Peak weekly = 10.4 MGD
  Peak monthly = 8.8 MGD
  The peak design flows are from the Effluent Limits request, Table 5, from Applied Technologies, Inc. dated June 13, 2024.
  For reference, the actual average flow from June 2019 through July 2024 was 3.3 MGD.
- Hardness = 415 mg/L as $CaCO_3$. This value represents the geometric mean of data (n=4) from March 2018 reported on the 2019 permit application.
- Acute dilution factor used in accordance with s. NR 106.06(3)(c), Wis. Adm. Code: Not applicable – this facility does not have an approved Zone of Initial Dilution (ZID).
- Water source: Domestic, commercial, and industrial wastewater with water supply from wells with industrial sources from the City of Watertown.
- Additives: Ferric chloride for phosphorus removal.
- Effluent characterization: This facility is categorized as a major municipal discharger. The permit-required monitoring for Cd, Cl, Cr, Cu, Pb, Ni, Hg and Zn from June 2019 through July 2024 is used in this evaluation.

PART 2 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR TOXIC SUBSTANCES – EXCEPT AMMONIA NITROGEN

Permit limits for toxic substances are required whenever any of the following occur:

1. The maximum effluent concentration exceeds the calculated limit (s. NR 106.05(3), Wis. Adm. Code)
2. If 11 or more detected results are available in the effluent, the upper 99^{th} percentile (or P_{99}) value exceeds the comparable calculated limit (s. NR 106.05(4), Wis. Adm. Code)
3. If fewer than 11 detected results are available, the mean effluent concentration exceeds 1/5 of the calculated limit (s. NR 106.05(6), Wis. Adm. Code)

Attachment #1

Acute Limits based on 1-Q_{10}

Daily maximum effluent limitations for toxic substances are based on the acute toxicity criteria (ATC), listed in ch. NR 105, Wis. Adm. Code. Previously daily maximum limits for toxic substances were calculated as two times the ATC. However, changes to ch. NR 106, Wis. Code, (September 1, 2016) require the Department to calculate acute limitations using the same mass balance equation as used for other limits along with the 1-Q_{10} receiving water low flow to determine if more restrictive effluent limitations are needed to protect the receiving stream from discharges which may cause or contribute to an exceedance of the acute water quality standards. The mass balance equation is provided below.

$$\text{Limitation} = \frac{(WQC)\,(Qs + (1-f)\,Qe) - (Qs - f\,Qe)\,(Cs)}{Qe}$$

Where:

WQC =Acute toxicity criterion or secondary acute value according to ch. NR 105, Wis. Adm. Code.

Qs = average minimum 1-day flow which occurs once in 10 years (1-day Q_{10})
if the 1-day Q_{10} flow data is not available = 80% of the average minimum 7-day flow which occurs once in 10 years (7-day Q_{10}).

Qe = Effluent flow (in units of volume per unit time) as specified in s. NR 106.06(4)(d), Wis. Adm. Code.

f = Fraction of the effluent flow that is withdrawn from the receiving water, and

Cs = Background concentration of the substance (in units of mass per unit volume) as specified in s. NR 106.06(4)(e), Wis. Adm. Code.

If the receiving water is effluent dominated under low stream flow conditions, the 1-Q_{10} method of limit calculation produces the most stringent daily maximum limitations and should be used while making reasonable potential determinations. This is not the case for Watertown Wastewater Treatment Facility, and the limits are set based on two times the acute toxicity criteria.

The following tables list the calculated WQBELs for this discharge along with the results of effluent sampling. All concentrations are expressed in terms of micrograms per Liter (µg/L), except for hardness and chloride (mg/L) and mercury (ng/L).

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)

RECEIVING WATER FLOW = 12.8 cfs, (1-Q_{10} (estimated as 80% of 7-Q_{10})), as specified in s. NR 106.06(3)(bm), Wis. Adm. Code.

SUBSTANCE	REF. HARD.* mg/L	ATC	MAX. EFFL. LIMIT**	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	1-day P_{99}	1-day MAX. CONC.
Arsenic		340	679.6	135.9			
Cadmium	415	52.7	105.4	21.1	0.03		
Chromium	301	4446	8891.7	1778	0.37		
Copper	415	59.4	118.8			31	30
Lead	356	365	729.3	145.9	<4.3		
Mercury (ng/L)		830	1660			1.4	1.2
Nickel	268	1080	2160.6	432		15	13
Zinc	333	345	689.4	137.9	18		
Chloride (mg/L)		757	1514			555.9	499.8

Attachment #1

* The indicated hardness may differ from the effluent hardness because the effluent hardness exceeded the maximum range in ch. NR 105 over which the acute criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

* * The 2 × ATC method of limit calculation yields a more restrictive limit than consideration of ambient concentrations and 1-Q_{10} flow rates per the changes to s. NR 106.07(3), Wis. Adm. Code, effective 09/01/2016.

Weekly Average Limits based on Chronic Toxicity Criteria (CTC)

RECEIVING WATER FLOW = 4.0 cfs (¼ of the 7-Q_{10}), as specified in s. NR 106.06(4)(c), Wis. Adm. Code.

SUBSTANCE	REF. HARD.* mg/L	CTC	MEAN BACK-GRD.	WEEKLY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	4-day P_{99}
Arsenic		152.2		228	45.6		
Cadmium	175	3.82		5.72	1.1	0.03	
Chromium	301	325.75		488	97.5	0.37	
Copper	320	28.02		42.0			22
Lead	320	86.20		129.1	25.8	<4.3	
Mercury (ng/L)		440	4.74	656	131.3		1.0
Nickel	268	120.18		180			10
Zinc	320	333.02		499	99.7	18	
Chloride (mg/L)		395	62.70	560			492.2

* The indicated hardness may differ from the receiving water hardness because the receiving water hardness exceeded the maximum range in ch. NR 105, Wis. Adm. Code, over which the chronic criteria are applicable. In that case, the maximum of the range is used to calculate the criterion.

Monthly Average Limits based on Wildlife Criteria (WC)

RECEIVING WATER FLOW = 10.8 cfs (¼ of the 90-Q_{10}), as specified in s. NR 106.06(4), Wis. Adm. Code

SUBSTANCE	WC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	30-day P_{99}
Mercury (ng/L)	1.3	4.74	1.3	0.77

Monthly Average Limits based on Human Threshold Criteria (HTC)

RECEIVING WATER FLOW = 51 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HTC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT	MEAN EFFL. CONC.	30-day P_{99}
Cadmium	370		2718	543.6	0.03	
Chromium (+3)	3818000		28044310	5608862	0.37	
Lead	140		1028	205.7	<4.3	
Mercury (ng/L)	1.5	4.74	1.5			0.77
Nickel	43000		315847			7.2

Attachment #1

Monthly Average Limits based on Human Cancer Criteria (HCC)

RECEIVING WATER FLOW = 51 cfs (¼ of Harmonic Mean), as specified in s. NR 106.06(4), Wis. Adm. Code.

SUBSTANCE	HCC	MEAN BACK-GRD.	MO'LY AVE. LIMIT	1/5 OF EFFL. LIMIT
Arsenic	13.3		97.7	19.54

Conclusions and Recommendations

Based on a comparison of the effluent data and calculated effluent limitations, **no effluent limitations are required. Continued monitoring is recommended, and reasonable potential for limitations will be evaluated at the next permit reissuance.**

Mercury – The WQBEL for total recoverable mercury is set equal to the most stringent criterion of 1.3 ng/L, according to s. NR 106.06(6), Wis. Adm. Code, because the background concentration in the receiving water and similar inland streams is known to exceed 1.3 ng/L.

Effluent sampling from July 2019 through July 2024 is shown in the table below.

Mercury Effluent Data

	Mercury (ng/L)
1-day P_{99}	1.4
4-day P_{99}	1.0
30-day P_{99}	0.77
Mean	0.67
Std	0.22
Sample size	21
Range	0.35 - 1.2

The 30-day P_{99} of representative data is 0.77 ng/L, which is less than the most stringent limit (wildlife criterion of 1.3 ng/L); therefore, **no limit for mercury is required. Monitoring and the continuation of pollutant minimization procedures should continue.**

Antidegradation and Antibacksliding

Since current treatment capability and pollutant minimization procedures are expected to remain in place, the removal of the daily maximum mercury variance limit will not increase the concentration, level, or loading of mercury to the Rock River. Therefore, antidegradation would not be applicable. To be consistent with antibacksliding requirements, the current limit may be removed in accordance with s. NR 207.12(4)(b), Wis. Adm. Code.

PFOS and PFOA – The need for PFOS and PFOA monitoring is evaluated in accordance with s. NR 106.98(2), Wis. Adm. Code. Previous monitoring produced a PFOS result of 4.17 ng/L and a PFOA result of 2.74 ng/L. The PFOS result is greater than one fifth of the criteria. Based on the effluent flow rate, **PFOS and PFOA monitoring is recommended at a once every two months frequency.**

PART 3 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR AMMONIA NITROGEN

Daily Maximum Limits based on Acute Toxicity Criteria (ATC)
Daily maximum limitations are based on acute toxicity criteria in ch. NR 105, Wis. Adm. Code, which are a function of the effluent pH and the receiving water classification. The effluent pH data from June 2019 through 2024 were examined as part of this evaluation. A value of 7.79 s.u. is believed to represent the maximum reasonably expected pH, and therefore most appropriate for determining daily maximum limitations for ammonia nitrogen. Substituting a value of 7.79 s.u. yields a daily maximum limit of 24 mg/L which is greater than the current daily maximum limit of 20 mg/L. If Watertown Wastewater Treatment Facility would like to request an increase to the existing permit limits, an assessment of their effluent data consistent with the requirements of ss. NR 207.04(1)(a) and (c), Wis. Adm. Code, must be provided. Without a demonstration of need for a higher limit in accordance with s. NR 207.04, Wis. Adm. Code, **the current daily maximum limit of 20 mg/L, effective November – March**, **must be continued.**

Watertown Wastewater Treatment Facility also has the option to change to a daily maximum limit that varies based on the effluent pH in lieu of fixed single daily maximum limit. Presented below is a table of daily maximum limitations corresponding to various effluent pH values. Use of this table is not necessarily recommended, but it is presented herein for informational purposes.

Daily Maximum Ammonia Nitrogen Limits – WWSF

Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L	Effluent pH s.u.	Limit mg/L
6.0 ≤ pH ≤ 6.1	108	7.0 < pH ≤ 7.1	66	8.0 < pH ≤ 8.1	14
6.1 < pH ≤ 6.2	106	7.1 < pH ≤ 7.2	59	8.1 < pH ≤ 8.2	11
6.2 < pH ≤ 6.3	104	7.2 < pH ≤ 7.3	52	8.2 < pH ≤ 8.3	9.4
6.3 < pH ≤ 6.4	101	7.3 < pH ≤ 7.4	46	8.3 < pH ≤ 8.4	7.8
6.4 < pH ≤ 6.5	98	7.4 < pH ≤ 7.5	40	8.4 < pH ≤ 8.5	6.4
6.5 < pH ≤ 6.6	94	7.5 < pH ≤ 7.6	34	8.5 < pH ≤ 8.6	5.3
6.6 < pH ≤ 6.7	89	7.6 < pH ≤ 7.7	29	8.6 < pH ≤ 8.7	4.4
6.7 < pH ≤ 6.8	84	7.7 < pH ≤ 7.8	24	8.7 < pH ≤ 8.8	3.7
6.8 < pH ≤ 6.9	78	7.8 < pH ≤ 7.9	20	8.8 < pH ≤ 8.9	3.1
6.9 < pH ≤ 7.0	72	7.9 < pH ≤ 8.0	17	8.9 < pH ≤ 9.0	2.6

Weekly and Monthly Average Limits based on Chronic Toxicity Criteria (CTC)
No changes are recommended for the weekly and monthly average ammonia nitrogen limits since the facility plan does not include changes in either the effluent or receiving water flow rates.

PART 4 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR BACTERIA

Section NR 210.06(2)(a)1, Wis. Adm. Code, includes two limits which must be included in permits for facilities which are required to disinfect:

1. The geometric mean of *E. coli* bacteria in effluent samples collected in any calendar month may not exceed 126 counts/100 mL.

2. No more than 10 percent of *E. coli* bacteria samples collected in any calendar month may exceed 410 counts/100 mL.

Since Watertown Wastewater Treatment Facility's permit requires twice weekly monitoring, the 410 counts/100 mL limit will effectively function as a daily maximum limit unless the facility performs additional monitoring. Any additional monitoring beyond what is required by the permit must also be reported on the DMR as required in the standard requirements section of the permit.

These limits are required during May through September. **No changes to the current bacteria limits, recreational period, or the required disinfection season are recommended.**

PART 5 – PHOSPHORUS

Technology-Based Effluent Limit

Subchapter II of Chapter NR 217, Wis. Adm. Code, requires municipal wastewater treatment facilities that discharge greater than 150 pounds of Total Phosphorus per month to comply with a monthly average limit of 1.0 mg/L, or an approved alternative concentration limit.

Since Watertown Wastewater Treatment Facility has phosphorus limits in effect that are more stringent than 1.0 mg/L, the need for a TBEL will not be considered further.

In addition, the need for a WQBEL for phosphorus must be considered.

TMDL Limits

The current permit includes monthly average total phosphorus mass limits based on the wasteload allocation specified in the Rock River TMDL. **These limits do not need to be reevaluated at this time since the effluent flow rate will not be changing and are recommended to continue after the facility upgrade.**

For informational purposes, the following table lists the statistics for total phosphorus in the discharge as concentration and mass from June 2019 through July 2024.

Total Phosphorus Effluent Data

	mg/L	lbs/day
1-day P_{99}	1.20	43.06
4-day P_{99}	0.77	25.54
30-day P_{99}	0.55	16.71
Mean	0.44	12.72
Std	0.22	8.40
Sample Size	1349	1349
Range	0.095 - 1.672	1.78 - 84.86

Water Quality Trading

Water quality trading is being used in the current permit to achieve phosphorus compliance. If water quality trading is pursued after the upgrade is complete, the phosphorus WQBELs may be expressed as computed compliance limits, but a Minimum Control Level (MCL) must be set as a limit not to be exceeded at the outfall location. **The existing MCLs of 1.0 mg/L, effective July – March and May, and**

0.8 mg/L, effective April and June, would continue.

PART 5 – TOTAL SUSPENDED SOLIDS

Mass Limits

The current permit includes weekly and monthly average total suspended solids (TSS) mass limits based on existing mass limits as well as from the wasteload allocation specified in the Rock River TMDL. **Since Watertown Wastewater Treatment Facility is currently meeting these limits, the limits do not need to be reevaluated at this time, and the limits are recommended to continue after the facility upgrade.**

For informational purposes, the following table lists the statistics for total phosphorus in the discharge as concentration and mass from June 2019 through July 2024.

Total Suspended Solids Effluent Data

	mg/L	lbs/day
1-day P_{99}	11.7	536.5
4-day P_{99}	7.6	299.7
30-day P_{99}	5.4	177.2
Mean	4.3	124.4
Std	2.2	107.8
Sample Size	1349 (27 ND)	1349
Range	<2 - 26.4	0 - 2629.56

"<" means that the pollutant was not detected at the indicated level of detection. The mean concentration was calculated using zero in place of the non-detected results.

Pilot Study

Watertown Wastewater Treatment Facility is currently undergoing a three-year pilot study using fathead minnows to reduce daphnia. The need for any additional TSS limits if the long-term use of fish at the treatment facility is approved will be reevaluated following the conclusion of the pilot study.

PART 6 – WATER QUALITY-BASED EFFLUENT LIMITATIONS FOR THERMAL

Surface water quality standards for temperature took effect on October 1, 2010. These regulations are detailed in chs. NR 102 (Subchapter II – Water Quality Standards for Temperature) and NR 106 (Subchapter V – Effluent Limitations for Temperature) of the Wisconsin Administrative Code. Daily maximum and weekly average temperature criteria are available for the 12 different months of the year depending on the receiving water classification.

Reasonable potential for a weekly average temperature limit of 66°F is shown based on thermal monitoring data from October 2020 through July 2024 and effluent flow data from June 2019 through July 2024. However, Watertown Wastewater Treatment Facility completed a dissipative cooling study in October 2019 that was approved by the Department on June 9, 2020. **Assuming the proposed facility upgrade includes no substantial changes to operation or thermal loadings, no thermal limits are expected to be needed. It is likely thermal monitoring will be required once the upgrade is complete in order to assess reasonable potential** at future permit reissuances.

Attachment #1

Future WPDES Permit Reissuance
Dissipative cooling (DC) requests must be reevaluated every permit reissuance. The permittee is responsible for submitting an updated DC request prior to permit reissuance. Such a request must either include:

a) A statement by the permittee that there have been no substantial changes in operation of, or thermal loadings to, the treatment facility and the receiving water; or
b) New information demonstrating DC to supplement the information used in the previous DC determination. If significant changes in operation or thermal loads have occurred, additional DC data must be submitted to the Department.

PART 7 – WHOLE EFFLUENT TOXICITY (WET)

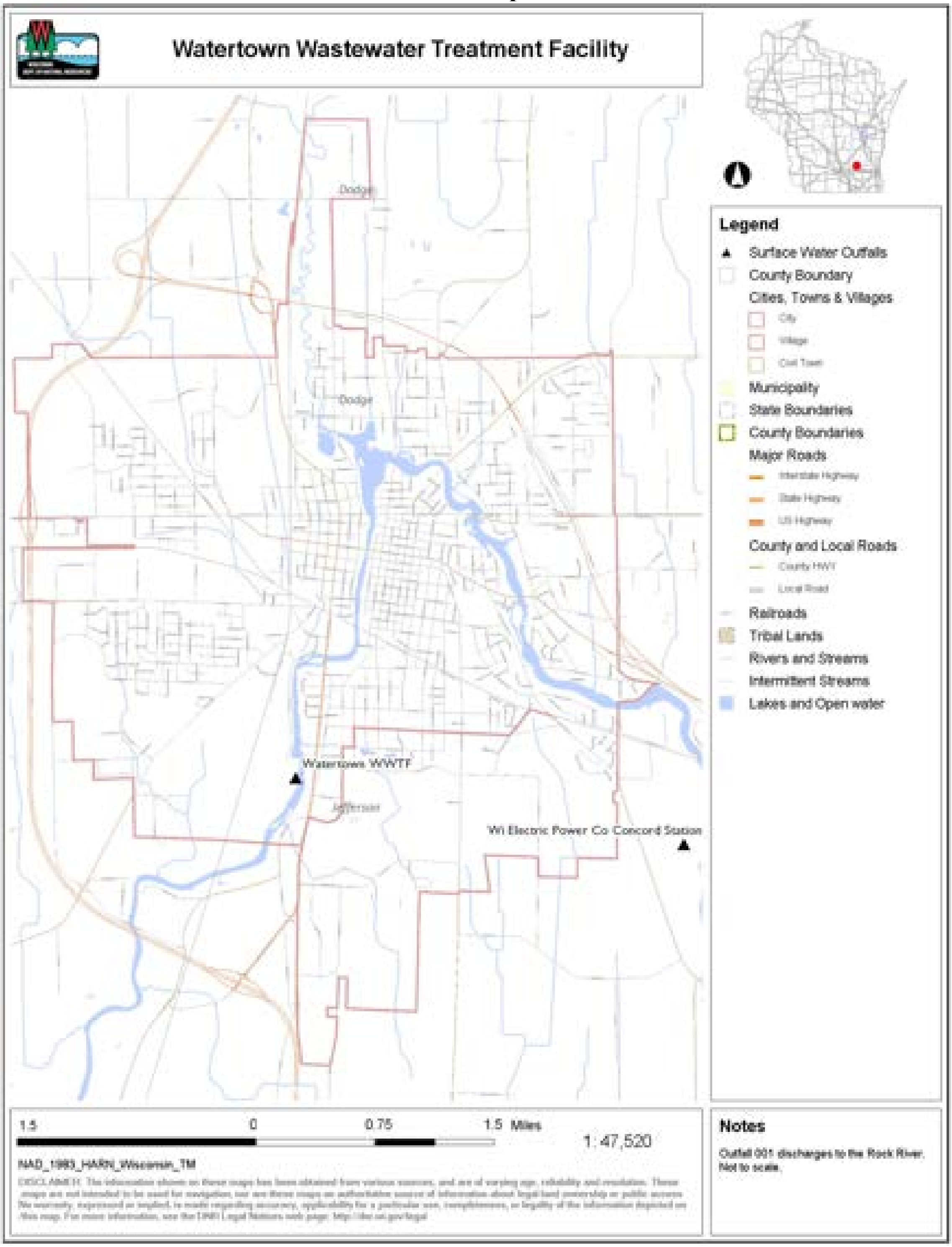
WET testing is used to measure, predict, and control the discharge of toxic materials that may be harmful to aquatic life. In WET tests, organisms are exposed to a series of effluent concentrations for a given time and effects are recorded. Decisions below related to the selection of representative data and the need for WET limits were made according to ss. NR 106.08 and 106.09, Wis. Adm. Code. WET monitoring frequency and toxicity reduction evaluation (TRE) recommendations were made using the best professional judgment of staff familiar with the discharge after consideration of the guidance in the *Whole Effluent Toxicity (WET) Program Guidance Document* (2022).

The only change pertaining to WET testing that may occur due to the changes in design flow is a new instream waste concentration (IWC) for evaluating chronic WET tests. However, since the design flow is not changing, **there are no changes to the WET recommendations. A minimum of annual acute and chronic monitoring is required** because Watertown Wastewater Treatment Facility is a major municipal discharger with a design flow greater than 1.0 MGD and because a chronic WET limit is in place.

Note: Since Watertown Wastewater Treatment Facility currently uses a chemical additive to remove phosphorus, it is recommended that a Standard Operating Procedure (SOP) document be developed and submitted to the Department for approval (if not already done). Development of this document is voluntary, but the absence of an approved SOP may result in more frequent WET testing to ensure the additive is not causing toxicity due to overdosing. Please reach out to your compliance engineer if you have any questions or would like more information.

Attachment #2

Site Map



APPENDIX D
Mass Balance Calculations

Input Assumptions			**Calculations**			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Influent Parameters			**Influent Parameters**			
Flow	**3.200**	MGD				
BOD5	**6,400**	lbs/day	BOD5	240	3.200	6,400
Soluble BOD5	**40**	% of BOD5	Soluble BOD5	96	3.200	2,560
TSS	**6,000**	lbs/day	TSS	225	3.200	6,000
VSS	**80**	% of TSS	VSS	180	3.200	4,800
ISS	**20**	% of TSS	ISS	45	3.200	1,200
TKN	**930**	lbs/day	TKN	34.8	3.200	930
Ammonia-N	**70**	% of TKN	Ammonia-N	24.4	3.200	651
Organic-N	**30**	% of TKN	Organic-N	10.5	3.200	279
Total-P	**150**	lbs/day	Total-P	5.6	3.200	150
Ortho-P	**70**	% of T-P	Ortho-P	3.9	3.200	105
Organic-P	**30**	% of T-P	Organic-P	1.7	3.200	45
Recycle Streams to Pump Station			**Recycle Streams to Pump Station**			
Recycle Stream from Filtrate and Washwater			**Recycle Stream from Filtrate and Washwater**			
			BOD5	292	0.0135	33
			Soluble BOD5	3	0.0135	0
			TSS	1090	0.0135	123
			VSS	515	0.0135	58
			ISS	575	0.0135	65
			TKN	1030	0.0135	116
			Ammonia-N	616	0.0135	70
			Organic-N	414	0.0135	47
			Total-P	650	0.0135	73
			Ortho-P	182	0.0135	21
			Organic-P	122	0.0135	14
…Assumed that all Chemical-P is recycled as Ortho-P.			Chemical-P	414	0.0135	47
Preliminary Treatment			**Preliminary Treatment**			
Preliminary Treatment Effluent			**Preliminary Treatment Effluent**			
			BOD5	240	3.214	6,433
…Any removals obtained in the Grit Basins and Fine Screens are negligible.			Soluble BOD5	96	3.214	2,560
			TSS	228	3.214	6,123
			VSS	181	3.214	4,858
			ISS	47	3.214	1,265
			TKN	39.0	3.214	1,046
			Ammonia-N	26.9	3.214	721
			Organic-N	12.2	3.214	326
			Total-P	8.3	3.214	223
			Ortho-P	6.4	3.214	172
			Organic-P	2.2	3.214	59
			Vol. Content of Solids		79.3%	
Waste Activated Sludge to the Primary Clarifiers			**Waste Activated Sludge to the Primary Clarifiers**			
			BOD5	0	0.0250	0
			Soluble BOD5	0	0.0250	0
			TSS	20,000	0.0250	4,176
			VSS	10,506	0.0250	2,194
			ISS	9,494	0.0250	1,983
			Total Nitrogen	1,103	0.0250	230
			Nitrate-N	28	0.0250	6
			TKN	1,075	0.0250	225
			Ammonia-N	0	0.0250	0
			Organic-N	1,075	0.0250	225
			Total-P	809	0.0250	169
			Ortho-P	0	0.0250	0
			Organic-P	206	0.0250	43
			Chemical-P	602	0.0250	126
			Fraction of Nutrients in Sludge:			
			Nitrogen:	5.4%		
			Phosphorus:	4.0%		
			Volatile Content:	52.5%		

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}		{D}	{E}	{F}	{G}
Primary Treatment				**Primary Treatment**			
Primary Clarifier Influent				**Primary Clarifier Influent (WAS + Preliminary Effluent)**			
				BOD5	238	3.239	6,433
				Soluble BOD5	95	3.239	2,560
				TSS	381	3.239	10,299
				VSS	261	3.239	7,052
				ISS	120	3.239	3,247
				Nitrate-N	8	3.239	225
				TKN	47	3.239	1,271
				Ammonia-N	27	3.239	721
				Organic-N	20	3.239	550
				Total-P	15	3.239	392
				Ortho-P	6	3.239	172
				Organic-P	4	3.239	102
				Chemical-P	5	3.239	126
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter	**85**	ft					
No. of Clarifiers	**2**						
Clarifier Depth	**12**	ft					
Total Surface Area	11,349	ft^2		Surface Overflow Rate (SOR)	285	$gal/day/ft^2$	
Total Weir Length	534	ft		Weir Overflow Rate (WOR)	6,064	gal/day/ft	
Volume	1,018,755	gallons		Hydraulic Retention Time	7.5	hours	
Primary Clarifier Effluent From Preliminary Effluent				**Primary Clarifier Effluent From Preliminary Effluent**			
BOD5 Removal	**30.0**	%		BOD5	169	3.203	4,503
				Soluble BOD5	96	3.203	2,552
TSS Removal	**50.0**	%		TSS	115	3.203	3,061
				VSS	90	3.203	2,409
				ISS	24	3.203	653
TKN Removal: Based on sludge content				TKN	36.2	3.203	967
Ammonia Removal	**0**	%		Ammonia-N	26.9	3.203	718
				Organic-N	9.3	3.203	249
Total-P Removal: Based on sludge content				Total-P	6.6	3.203	177
Ortho-P Removal	**0**	%		Ortho-P	6.4	3.203	172
				Organic-P	0.2	3.203	5.1
				Vol. Content of Solids		78.7%	
Primary Sludge From Preliminary Treatment Effluent				**Primary Sludge From Preliminary Treatment Effluent**			
Percent Solids	**3.50**	%		TSS	35,000	0.0105	3,061
Volatile Content	**80**	% of TSS		VSS	28,000	0.0105	2,449
				ISS	7,000	0.0105	612
Nitrogen Content	**2.5**	% of TSS		TKN	902	0.0105	79
				Ammonia-N	27	0.0105	2
				Organic-N	875	0.0105	77
Phosphorus Content	**1.5**	% of TSS		Total-P	531	0.0105	46
				Ortho-P	6	0.0105	1
				Organic-P	525	0.0105	46
				TKN Removal		7.5%	
				Total-P Removal		20.8%	

Input Assumptions				Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Clarifier Effluent From WAS				**Primary Clarifier Effluent From WAS**			
				BOD5	0	0.011	0
Total WAS Removal		**100**	%	Soluble BOD5	0	0.011	0
				TSS	0	0.011	0
				VSS	0	0.011	0
				ISS	0	0.011	0
				Nitrate-N	0	0.011	0
				TKN	0	0.011	0
				Ammonia-N	0	0.011	0
				Organic-N	0	0.011	0
				Total-P	0	0.011	0
				Ortho-P	0	0.011	0
				Organic-P	0	0.011	0
				Chemical-P	0	0.011	0
				Vol. Content of Solids			
Primary Sludge From WAS				**Primary Sludge From WAS**			
Percent Solids		**3.50**	%	TSS	35,000	0.0143	4,176
				VSS	18385	0.0143	2,194
				ISS	16615	0.0143	1,983
				Nitrate-N	48	0.0143	6
				TKN	1882	0.0143	225
				Ammonia-N	0	0.0143	0
				Organic-N	1882	0.0143	225
				Total-P	1415	0.0143	169
				Ortho-P	1	0.0143	0
				Organic-P	361	0.0143	43
				Chemical-P	1054	0.0143	126
				TKN Removal		100.0%	
				Total-P Removal		100.0%	
Total Primary Clarifier Effluent				**Total Primary Clarifier Effluent**			
				BOD5	168	3.214	4,503
				Soluble BOD5	95	3.214	2,552
				TSS	114	3.214	3,061
				VSS	90	3.214	2,409
				ISS	24	3.214	653
				Nitrate-N	0	3.214	0
				TKN	36.1	3.214	967
				Ammonia-N	26.8	3.214	718
				Organic-N	9.3	3.214	249
				Total-P	6.6	3.214	177
				Ortho-P	6.4	3.214	172
				Organic-P	0.2	3.214	5
				Chemical-P	0.0	3.214	0
				Vol. Content of Solids		78.7%	
Total Primary Sludge				**Total Primary Sludge**			
				TSS	35,000	0.0248	7,238
				VSS	22,452	0.0248	4,643
				ISS	12,548	0.0248	2,595
				Nitrate-N	28	0.0248	5.8
				TKN	1,467	0.0248	303
				Ammonia-N	12	0.0248	2.4
				Organic-N	1,456	0.0248	301
				Total-P	1,041	0.0248	215
				Ortho-P	3	0.0248	1
				Organic-P	430	0.0248	89
				Chemical-P	608	0.0248	126
				TKN Removal		24%	
				Total-P Removal		55%	

Input Assumptions			Calculations			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Secondary Treatment - Activated Sludge			**Secondary Treatment - Activated Sludge**			
Aeration Basin Influent			**Aeration Basin Influent**			
			BOD5	168	3.214	4,503
			Soluble BOD5	95	3.214	2,552
			TSS	114	3.214	3,061
			VSS	90	3.214	2,409
			ISS	24	3.214	653
			TKN	36.1	3.214	967
			Ammonia-N	26.8	3.214	718
			Organic-N	9.3	3.214	249
			Total-P	6.6	3.214	177
			Ortho-P	6.4	3.214	172
			Organic-P	0.2	3.214	5
			Vol. Content of Solids		78.7%	
Nutrient Conversions						
Organic-N Conversion			**Organic-N Conversion**			
… A portion of the Influent Organic-N is			Influent Organic-N			249
converted to Ammonia-N			Influent Ammonia-N			718
Assume Conversion of	**95** %		Organic-N Converted			237
			Resulting Ammonia-N			955
			Remaining Organic-N			12
Organic-P Conversion			**Organic-P Conversion**			
… A portion of the Influent Organic-P is			Influent Organic-P			5
converted to Ortho-P			Influent Ortho-P			172
Assume Conversion of	**95** %		Organic-P Converted			5
			Resulting Ortho-P			177
			Remaining Organic-P			0
VSS Biodegradation			**VSS Biodegradation**			
… A portion of the Influent VSS			Influent VSS			2,409
is Biodegradable						
Assumed Biodegradable Fraction	**80** %		VSS Biodegraded			1,927
… Remaining VSS is incorportated into the Sludge			Non-Biodegradable VSS			482
Nutrient Requirements						
Carbonaceous						
… Based on weight ratio of VSS produced			VSS Produced			1,638
Nitrogen Req'd as Ammonia-N	**12.4** %		Ammonia-N Req'd			203
Phosphorus Req'd as Ortho-P	**2.5** %		Ortho-P Req'd			41
Nitrification						
… Based on weight ratio of VSS produced			VSS Produced			74
Nitrogen Req'd as Ammonia-N	**12.4** %		Ammonia-N Req'd			9
Phosphorus Req'd as Ortho-P	**2.5** %		Ortho-P Req'd			2
			Remaining Ammonia-N			743
			Remaining Ortho-P			134
			BOD:N:P Ratio			
			Nutrients Utilized:			
			Influent BOD5			4,503
			Ammonia-N			212
			Ortho-P			43
			Therefore the BOD5:N:P Ratio is:			
			BOD5	100		
			Ammonia-N	4.7		
			Ortho-P	1.0		

Input Assumptions			**Calculations**			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Nitrification			**Nitrification**			
			Ammonia-N remaining after satisfying nutrient requirements			743
Ammonia Oxidation	**99.5**	%	Ammonia-N Oxidized; i.e. NO_3-N			739
			Ammonia Remaining			4
Denitrification			**Denitrification**			
…A portion of the NO3-N is used is converted to nitrogen gas			Ammonia-N Oxidized; i.e. NO_3-N			739
Denitrification	**0**	%	Total NO_3-N reduced			0
			NO_3-N Remaining			739
Chemical Phosphorus Removal			**Chemical Phosphorus Removal**			
			Ortho-P remaining after satisfying nutrient requirements			134
Ortho-P Removed	**94.0**	%	Ortho-P Removed			126
			Ortho-P Remaining			8
Ferric Chloride Density	**12**	lbs Sol'n/gal				
Iron Content	**0.15**	lbs Fe/lbs Sol'n	Ferric Chloride Contains:	0.4357	lbs $FeCl_3$/lb Sol'n	
Ferric Chloride Dosage	**2.00**	moles Fe to moles Ortho-P	Weight Ratio	3.61	lbs Fe/lb Ortho-P Removed	
			Iron Required	453	lbs Fe/day	
			Ferric Chloride Required	1317	lbs $FeCl_3$/day	
Dosing approximately 100 gpd of ferric chloride				252	gal $FeCl_3$/day	
Solids Produced Due to Chemical Precipitation			**Solids Produced Due to Chemical Precipitation**			
Ferric Phosphate Produced	4.9	lbs/lb P rem.	Ferric Phosphate Produced			612
Ferric Hydroxide Produced	3.5	lbs/lb P rem.	Ferric Hydroxide Produced			434
			Total Chemical Sludge Produced			1,046
…Assume that chemcical is added to tail end of the aeration basins and that 100% of the chemical sludge is removed with the biological sludge.			Chemical-P Incorporated Into Sludge			126
Secondary Effluent			**Secondary Effluent**			
BOD5 Removal	**97**	%	BOD5	5	3.189	135
			Soluble BOD5	3	3.189	77
TSS Removal	**96**	%	TSS	5	3.189	122
			VSS	4	3.189	104
			ISS	1	3.189	18
			Total Nitrogen	28.3	3.189	752
			Nitrate-N	27.6	3.189	733
			TKN	0.7	3.189	19
			Ammonia-N	0.1	3.189	4
Organic-N	12.4	% of TSS + Inf. Fraction	Organic-N	0.6	3.189	16
			Total-P	0.4	3.189	11
			Ortho-P	0.3	3.189	8
Organic-N	2.5	% of TSS + Inf. Fraction	Organic-P	0.1	3.189	3
			Vol. Content of Solids		85.0%	

Input Assumptions {A}	{B}	{C}	Calculations {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Secondary Sludge			**Secondary Sludge**			
Sludge Production due to BOD Removal			**Sludge Production due to BOD Removal**			
Yield Coefficient (lb VSS Produced			BOD5 Removed			4,368
/ lb BOD5 Removed)	**0.60**		Observed Yield	0.375	lbs VSS / lb BOD_5	
Decay Coefficient	**0.06**	/day				
Mean Cell Residence Time	**10**	days	VSS Produced			1,638
Sludge Production due to Nitrification			**Sludge Production due to Nitrification**			
Yield Coefficient (lb NVSS Produced			Ammonia-N Removed			739
/ lb Ammonia Oxidized)	**0.15**		Observed Yield	0.100	lbs VSS / lb BOD_5	
Decay Coefficient	**0.05**	/day				
Mean Cell Residence Time	10	days	NVSS Produced			74
			Total Biological Sludge Production			
			Net VSS Produced			1,712
Volatile Content of MLTSS Produced	**85**	%	Net TSS Produced			2,014
Sludge Production due to Influent Solids			**Sludge Production due to Influent Solids**			
			Influent ISS			653
…Difference incorportated into sludge			Effluent ISS			18
			Inf. ISS incorp. Into sludge			634
			Influent ISS fraction in sludge	97.2%		
			Organic-N			
			Organic-N Remaining after Solub.			12
… Assume same ratio as ISS			Organic -N incorported into sludge			12
			Remaining Organic-N			0
			Nitrate-N			
			Ammonia-N Nitrified			739
			Conc. Based on Influent Flow	27.6	mg/L	
			Nitrate in WAS			6
			Organic-P			
			Organic-P Remaining after Solub.			0.2541
… Assume same ratio as ISS			Organic -P incorported into sludge			0.2470
			Remaining Organic-P			0.0072
Waste Activated Sludge			**Waste Activated Sludge**			
… Assume Net TSS is wasted			TSS	20,000	0.0250	4,176
… Sludge is Wasted from Return Sludge			VSS	10,506	0.0250	2,194
Percent Solids	**2.000**	%	ISS	9,494	0.0250	1,983
… Assume Nutrients consumed are incorportated into cell mass.			Total Nitrogen	1,103	0.0250	230
			Nitrate-N	28	0.0250	6
			TKN	1,075	0.0250	225
			Ammonia-N	0.1	0.0250	0
			Organic-N	1,075	0.0250	225
			Total-P	809	0.0250	169
			Ortho-P	0.3	0.0250	0
			Organic-P	206	0.0250	43
			Chemical-P	602	0.0250	126
			Fraction of Nutrients in Sludge:			
			Nitrogen:	5.4%		
			Phosphorus:	4.0%		
			Volatile Content:	52.5%		

Input Assumptions {A}	{B}	{C}	Calculations {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Activated Sludge Parameters			**Activated Sludge Parameters**			
Aeration Basin Volume	**282,000**	ft^3	Aeration Basin Volume	2.110	Million Gallons	
Solids Under Aeration:			Solids Under Aeration:			
MLTSS	2,486	mg/L	MLTSS	43,744	lbs	
MLVSS	1306		MLVSS	22,978	lbs	
			MLVSS Conc	1,306	mg/L	
			Mixed Liquor Volatile Fraction	52.5%		
			Organic Volumetric Loading	16	lb/1000 ft^3	
			F:M Ratio	0.196		
			Mean Cell Residence Time	10.00	days	
Anoxic Selector Parameters						
Anoxic Selector Volume	0.22	MG	Selector HRT	1.7	hours	
			Selector F:M Ratio	1.8		
Aeration System			**Aeration System**			
BOD Oxygen Requirement	**1.1**	lb O_2/ lb BOD rem.	BOD5 Removed		4,368	lbs/day
			BOD5 Oxygen Requirement		4,805	lbs/day
TKN Oxygen Requirement	**4.6**	lb O_2/ lb TKN rem.	TKN Removed		739	lbs/day
			TKN Oxygen Requirement		3,399	lbs/day
			Total Oxygen Requirement		8,204	lbs/day
			Total NO3-N reduced		0	lbs/day
Oxygen Recovery from Denitrification	**2.86**	lbs O_2/ lb NO_3 reduced	Denitrification Oxygen Credit		0	lbs/day
			Actual Oxygen Requirement		8,204	lbs/day
Return Activated Sludge			**Return Activated Sludge**			
			TSS	20,000	0.428	71,335
			VSS	10,506	0.428	37,471
			Vol. Content of Solids		52.5%	
			RAS Ratio		13.4%	
Final Clarifiers			**Final Clarifiers**			
			Secondary Clarifier Influent			
			MLTSS	2,486	3.641	75,511
			MLVSS	1,306	3.641	39,664
			Vol. Content of Solids		52.5%	
Clarifier Dimensional Parameters			**Loading Rates**			
Clarifier Diameter	**90**	ft				
No. of Clarifiers	**2**					
Clarifier Depth	**16**	ft				
Total Surface Area	12,723	ft^2	Surface Overflow Rate (SOR)	251	gal/day/ft^2	
Total Weir Length	565	ft	Weir Overflow Rate (WOR)	5,639	gal/day/ft	
Volume	1,522,844	gallons	Solids Loading Rate	5.9	lb/day/ft^2	
			or	0.25	lb/hr/ft^2	

Input Assumptions {A}	{B}	{C}	**Calculations** {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Anaerobic Digestion (No Supernating)			**Anaerobic Digestion (No Supernating)**			
Digester Influent			**Digester Influent = WAS + Primary Sludge**			
			TSS	35,000	0.0248	7,238
			VSS	22,452	0.0248	4,643
			ISS	12,548	0.0248	2,595
			Total Nitrogen	1,495	0.0248	309
			Nitrate-N	28	0.0248	5.8
			TKN	1,467	0.0248	303
			Ammonia-N	12	0.0248	2.4
			Organic-N	1,456	0.0248	301
			Total-P	1,041	0.0248	215
			Ortho-P	3	0.0248	1
			Organic-P	430	0.0248	89
			Chemical-P	608	0.0248	126
			Vol. Content of Solids		64.1%	
Removals and Conversions			**Removals and Conversions**			
VSS Destruction			**VSS Destruction**			
VSS Destruction	**50**	%	VSS Destruction			2,321
Gas Production	**15**	ft^3/lb VSS des.	Digester Gas Production		34,822	ft^3 /day
Organic-N Conversion			**Organic-N Conversion**			
Conversion of influent Organic-N	50	%	Influent Organic-N			301
			Organic-N Converted			151
…A portion of the influent Organic-N is converted to Ammonia-N			Organic-N Remaining			151
			Ammonia-N Produced			151
Nitrate-N Conversion			**Nitrate-N Conversion**			
Conversion of influent Nitrate-N	**100**	%	Influent Nitrate-N			6
			Nitrate-N Converted			6
…The influent Nitrate-N is converted to Nitrogen Gas			Nitrate-N Remaining			0
Organic-P Solubilized			**Organic-P Solubilized**			
Conversion of influent Organic-P	50	%	Influent Organic-P			89
			Organic-P Converted			44
…A portion of the influent Organic-P is converted to Ortho-P			Organic-P Remaining			44
			Ortho-P Produced			44
Digested Sludge			**Digested Sludge**			
			TSS	23,774	0.0248	4,916
			VSS	11,226	0.0248	2,321
			ISS	12,548	0.0248	2,595
			Total Nitrogen	1,467	0.0248	303
			Nitrate-N	0	0.0248	0
			TKN	1,467	0.0248	303
			Ammonia-N	739	0.0248	153
			Organic-N	728	0.0248	151
			Total-P	1,041	0.0248	215
			Ortho-P	218	0.0248	45
			Organic-P	215	0.0248	44
			Chemical-P	608	0.0248	126
			Vol. Content of Solids		47.2%	
			Fraction of Nutrients in Sludge:			
			Nitrogen:	6.2%		
			Phosphorus:	4.4%		
Digester Dimensional Parameters			**Loading Rates**			
			Digester Influent VS	4,643	lbs/day	
Digester Volume	**79,600**	ft^3	Volatile Solids Loading	0.058	lb VS/day/ft^3	
			or	58	lb VS/ 1000 ft^3 /day	
			Digester Influent Flow Rate	24,795	gpd	
			Digester Volume	595,448	gallons	
			HRT = SRT =	24	days	

Input Assumptions			Calculations			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Digested Sludge To Centrifuges			**Digested Sludge to Centrifuges**			
			TSS	23,774	0.0620	12,291
			VSS	11,226	0.0620	5,804
			ISS	12,548	0.0620	6,487
			Total Nitrogen	1,467	0.0620	759
			Nitrate-N	-	0.0620	-
			TKN	1,467	0.0620	759
			Ammonia-N	739	0.0620	382
			Organic-N	728	0.0620	376
			Total-P	1,041	0.0620	538
			Ortho-P	218	0.0620	113
			Organic-P	215	0.0620	111
			Chemical-P	608	0.0620	314
Dewatered Digested Sludge			**Dewatered Digested Sludge**			
Solids Capture	**95**	%	TSS	250,000	0.0056	11,676
Percent Solids	**25.0**	%	VSS	118,048	0.0056	5,513
			ISS	131,952	0.0056	6,163
			Total Nitrogen	3,801	0.0056	178
			Nitrate-N	-	0.0056	-
… Organic-N, Organic-P, and Chemcial-P are assumed to be related to			TKN	3,801	0.0056	178
TSS and assumed to be removed at the same rate.			Ammonia-N	739	0.0056	35
Ammonia-N, Ortho-P are assumed to be soluble.			Organic-N	3,062	0.0056	143
			Total-P	3,681	0.0056	172
			Ortho-P	218	0.0056	10
			Organic-P	905	0.0056	42
			Chemical-P	2,558	0.0056	119
					47.2%	
			Centrate			
…Assume that the ratio of the filtrate BOD5/VSS						
			BOD5	350	0.0564	165
			Soluble BOD5	3	0.0564	1
			TSS	1,307	0.0564	615
			VSS	617	0.0564	290
			ISS	690	0.0564	324
			Total Nitrogen	1,235	0.0564	581
			Nitrate-N	0	0.0564	0
…Assume that Ortho-P and Ammonia-N concentrations			TKN	1,235	0.0564	581
are the same as that in Secondary Effluent.			Ammonia-N	739	0.0564	348
			Organic-N	496	0.0564	233
			Total-P	779	0.0564	366
			Ortho-P	218	0.0564	103
			Organic-P	147	0.0564	69
			Chemical-P	414	0.0564	195

Input Assumptions				Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Washwater				**Washwater**			
…Assume that Secondary Effluent is used for washwater				BOD5	5	0.0113	0.5
				Soluble BOD5	3	0.0113	0.3
				TSS	5	0.0113	0.4
				VSS	4	0.0113	0.4
				ISS	1	0.0113	0.1
				Total Nitrogen	28.3	0.0113	2.7
				Nitrate-N	27.6	0.0113	2.6
				TKN	0.7	0.0113	0.1
				Ammonia-N	0.1	0.0113	0.0
				Organic-N	0.6	0.0113	0.1
				Total-P	0.4	0.0113	0.0
				Ortho-P	0.3	0.0113	0.0
				Organic-P	0.1	0.0113	0.0
	Centrifuge Feed Rate	**220**	gpm	… Average Operating Time	4.70	hrs/day	
	Belt Washwater	**100**	gpm	… Ave. Solids Loading	2,617	lbs/hr	
				… Belt Washwater	28,176	gpd	
				… Average Operating Time / Week	9.39	hrs/week	
Centrate and Washwater				**Centrate and Washwater**			
				BOD5	292	0.014	33
				Soluble BOD5	3	0.014	0
				TSS	1090	0.014	123
				VSS	515	0.014	58
				ISS	575	0.014	65
				Total Nitrogen	1034	0.014	117
				Nitrate-N	5	0.014	1
				TKN	1030	0.014	116
				Ammonia-N	616	0.014	70
				Organic-N	414	0.014	47
				Total-P	650	0.014	73
				Ortho-P	182	0.014	21
				Organic-P	122	0.014	14
				Chemical-P	414	0.014	47

Input Assumptions			Calculations			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Influent Parameters			**Influent Parameters**			
Flow	**5.200**	MGD				
BOD5	**8,300**	lbs/day	BOD5	191	5.200	8,300
Soluble BOD5	**40**	% of BOD5	Soluble BOD5	77	5.200	3,320
TSS	**7,100**	lbs/day	TSS	164	5.200	7,100
VSS	**80**	% of TSS	VSS	131	5.200	5,680
ISS	**20**	% of TSS	ISS	33	5.200	1,420
TKN	**1,100**	lbs/day	TKN	25.4	5.200	1,100
Ammonia-N	**70**	% of TKN	Ammonia-N	17.8	5.200	770
Organic-N	**30**	% of TKN	Organic-N	7.6	5.200	330
Total-P	**180**	lbs/day	Total-P	4.2	5.200	180
Ortho-P	**70**	% of T-P	Ortho-P	2.9	5.200	126
Organic-P	**30**	% of T-P	Organic-P	1.2	5.200	54
Recycle Streams to Pump Station			**Recycle Streams to Pump Station**			
Recycle Stream from Filtrate and Washwater			**Recycle Stream from Filtrate and Washwater**			
			BOD5	322	0.0164	44
			Soluble BOD5	2	0.0164	0
			TSS	1085	0.0164	149
			VSS	519	0.0164	71
			ISS	566	0.0164	78
			TKN	1066	0.0164	146
			Ammonia-N	637	0.0164	87
			Organic-N	429	0.0164	59
			Total-P	645	0.0164	88
			Ortho-P	185	0.0164	25
			Organic-P	125	0.0164	17
…Assumed that all Chemical-P is recycled as Ortho-P.			Chemical-P	403	0.0164	55
Preliminary Treatment			**Preliminary Treatment**			
Preliminary Treatment Effluent			**Preliminary Treatment Effluent**			
			BOD5	192	5.216	8,344
…Any removals obtained in the Grit Basins and Fine Screens are negligible.			Soluble BOD5	76	5.216	3,320
			TSS	167	5.216	7,249
			VSS	132	5.216	5,751
			ISS	34	5.216	1,498
			TKN	28.6	5.216	1,246
			Ammonia-N	19.7	5.216	857
			Organic-N	8.9	5.216	389
			Total-P	6.2	5.216	268
			Ortho-P	4.7	5.216	206
			Organic-P	1.6	5.216	71
			Vol. Content of Solids		79.3%	
Waste Activated Sludge to the Primary Clarifiers			**Waste Activated Sludge to the Primary Clarifiers**			
			BOD5	0	0.0309	0
			Soluble BOD5	0	0.0309	0
			TSS	20,000	0.0309	5,156
			VSS	10,786	0.0309	2,781
			ISS	9,214	0.0309	2,375
			Total Nitrogen	1,140	0.0309	294
			Nitrate-N	20	0.0309	5
			TKN	1,120	0.0309	289
			Ammonia-N	0	0.0309	0
			Organic-N	1,120	0.0309	289
			Total-P	792	0.0309	204
			Ortho-P	0	0.0309	0
			Organic-P	216	0.0309	56
			Chemical-P	575	0.0309	148
			Fraction of Nutrients in Sludge:			
			Nitrogen:	5.6%		
			Phosphorus:	4.0%		
			Volatile Content:	53.9%		

Input Assumptions				Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Primary Treatment				**Primary Treatment**			
Primary Clarifier Influent				**Primary Clarifier Influent (WAS + Preliminary Effluent)**			
				BOD5	191	5.247	8,344
				Soluble BOD5	76	5.247	3,320
				TSS	283	5.247	12,405
				VSS	195	5.247	8,532
				ISS	89	5.247	3,873
				Nitrate-N	7	5.247	289
				TKN	35	5.247	1,535
				Ammonia-N	20	5.247	857
				Organic-N	15	5.247	678
				Total-P	11	5.247	472
				Ortho-P	5	5.247	207
				Organic-P	3	5.247	127
				Chemical-P	3	5.247	148
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter	**85**	ft					
No. of Clarifiers	**2**						
Clarifier Depth	**12**	ft					
Total Surface Area	11,349	ft^2		Surface Overflow Rate (SOR)	462	gal/day/ft^2	
Total Weir Length	534	ft		Weir Overflow Rate (WOR)	9,825	gal/day/ft	
Volume	1,018,755	gallons		Hydraulic Retention Time	4.7	hours	
Primary Clarifier Effluent From Preliminary Effluent				**Primary Clarifier Effluent From Preliminary Effluent**			
BOD5 Removal	**30.0**	%		BOD5	135	5.204	5,841
				Soluble BOD5	76	5.204	3,312
TSS Removal	**50.0**	%		TSS	84	5.204	3,624
				VSS	66	5.204	2,852
				ISS	18	5.204	773
TKN Removal: Based on sludge content				TKN	26.6	5.204	1,153
Ammonia Removal	**0**	%		Ammonia-N	19.7	5.204	855
				Organic-N	6.9	5.204	298
Total-P Removal: Based on sludge content				Total-P	4.9	5.204	213
Ortho-P Removal	**0**	%		Ortho-P	4.7	5.204	206
				Organic-P	0.2	5.204	7.5
				Vol. Content of Solids		78.7%	
Primary Sludge From Preliminary Treatment Effluent				**Primary Sludge From Preliminary Treatment Effluent**			
Percent Solids	**3.50**	%		TSS	35,000	0.0124	3,624
Volatile Content	**80**	% of TSS		VSS	28,000	0.0124	2,899
				ISS	7,000	0.0124	725
Nitrogen Content	**2.5**	% of TSS		TKN	895	0.0124	93
				Ammonia-N	20	0.0124	2
				Organic-N	875	0.0124	91
Phosphorus Content	**1.5**	% of TSS		Total-P	530	0.0124	55
				Ortho-P	5	0.0124	0
				Organic-P	525	0.0124	54
				TKN Removal		7.4%	
				Total-P Removal		20.4%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Clarifier Effluent From WAS				**Primary Clarifier Effluent From WAS**			
				BOD5	0	0.013	0
	Total WAS Removal	**100**	%	Soluble BOD5	0	0.013	0
				TSS	0	0.013	0
				VSS	0	0.013	0
				ISS	0	0.013	0
				Nitrate-N	0	0.013	0
				TKN	0	0.013	0
				Ammonia-N	0	0.013	0
				Organic-N	0	0.013	0
				Total-P	0	0.013	0
				Ortho-P	0	0.013	0
				Organic-P	0	0.013	0
				Chemical-P	0	0.013	0
				Vol. Content of Solids			
Primary Sludge From WAS				**Primary Sludge From WAS**			
	Percent Solids	**3.50**	%	TSS	35,000	0.0177	5,156
				VSS	18876	0.0177	2,781
				ISS	16124	0.0177	2,375
				Nitrate-N	35	0.0177	5
				TKN	1960	0.0177	289
				Ammonia-N	0	0.0177	0
				Organic-N	1960	0.0177	289
				Total-P	1385	0.0177	204
				Ortho-P	0	0.0177	0
				Organic-P	378	0.0177	56
				Chemical-P	1007	0.0177	148
				TKN Removal		100.0%	
				Total-P Removal		100.0%	
Total Primary Clarifier Effluent				**Total Primary Clarifier Effluent**			
				BOD5	134	5.217	5,841
				Soluble BOD5	76	5.217	3,312
				TSS	83	5.217	3,624
				VSS	66	5.217	2,852
				ISS	18	5.217	773
				Nitrate-N	0	5.217	0
				TKN	26.5	5.217	1,153
				Ammonia-N	19.7	5.217	855
				Organic-N	6.9	5.217	298
				Total-P	4.9	5.217	213
				Ortho-P	4.7	5.217	206
				Organic-P	0.2	5.217	8
				Chemical-P	0.0	5.217	0
				Vol. Content of Solids		78.7%	
Total Primary Sludge				**Total Primary Sludge**			
				TSS	35,000	0.0301	8,781
				VSS	22,642	0.0301	5,680
				ISS	12,358	0.0301	3,100
				Nitrate-N	20	0.0301	5.1
				TKN	1,520	0.0301	381
				Ammonia-N	8	0.0301	2.1
				Organic-N	1,512	0.0301	379
				Total-P	1,032	0.0301	259
				Ortho-P	2	0.0301	1
				Organic-P	439	0.0301	110
				Chemical-P	591	0.0301	148
				TKN Removal		25%	
				Total-P Removal		55%	

Input Assumptions	{A}	{B}	{C}	Calculations {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Secondary Treatment - Activated Sludge				**Secondary Treatment - Activated Sludge**			
Aeration Basin Influent				**Aeration Basin Influent**			
				BOD5	134	5.217	5,841
				Soluble BOD5	76	5.217	3,312
				TSS	83	5.217	3,624
				VSS	66	5.217	2,852
				ISS	18	5.217	773
				TKN	26.5	5.217	1,153
				Ammonia-N	19.7	5.217	855
				Organic-N	6.9	5.217	298
				Total-P	4.9	5.217	213
				Ortho-P	4.7	5.217	206
				Organic-P	0.2	5.217	8
				Vol. Content of Solids		78.7%	
Nutrient Conversions							
Organic-N Conversion				**Organic-N Conversion**			
… A portion of the Influent Organic-N is				Influent Organic-N			298
converted to Ammonia-N				Influent Ammonia-N			855
Assume Conversion of		**95** %		Organic-N Converted			283
				Resulting Ammonia-N			1,138
				Remaining Organic-N			15
Organic-P Conversion				**Organic-P Conversion**			
… A portion of the Influent Organic-P is				Influent Organic-P			8
converted to Ortho-P				Influent Ortho-P			206
Assume Conversion of		**95** %		Organic-P Converted			7
				Resulting Ortho-P			213
				Remaining Organic-P			0
VSS Biodegradation				**VSS Biodegradation**			
… A portion of the Influent VSS				Influent VSS			2,852
is Biodegradable							
Assumed Biodegradable Fraction		**80** %		VSS Biodegraded			2,281
… Remaining VSS is incorportated into the Sludge				Non-Biodegradable VSS			570
Nutrient Requirements							
Carbonaceous							
… Based on weight ratio of VSS produced				VSS Produced			2,125
Nitrogen Req'd as Ammonia-N		**12.4** %		Ammonia-N Req'd			263
Phosphorus Req'd as Ortho-P		**2.5** %		Ortho-P Req'd			53
Nitrification							
… Based on weight ratio of VSS produced				VSS Produced			86
Nitrogen Req'd as Ammonia-N		**12.4** %		Ammonia-N Req'd			11
Phosphorus Req'd as Ortho-P		**2.5** %		Ortho-P Req'd			2
				Remaining Ammonia-N			864
				Remaining Ortho-P			158
				BOD:N:P Ratio			
				Nutrients Utilized:			
				Influent BOD5			5,841
				Ammonia-N			274
				Ortho-P			55
				Therefore the BOD5:N:P Ratio is:			
				BOD5	100		
				Ammonia-N	4.7		
				Ortho-P	0.9		

Input Assumptions

	{A}	{B}	{C}
Nitrification			
Ammonia Oxidation		**99.5**	%
Denitrification			
…A portion of the NO3-N is used is converted to nitrogen gas			
Denitrification		**0**	%
Chemical Phosphorus Removal			
Ortho-P Removed		**94.0**	%
Ferric Chloride Density		**12**	lbs Sol'n/gal
Iron Content		**0.15**	lbs Fe/lbs Sol'n
Ferric Chloride Dosage		**2.00**	moles Fe to moles Ortho-P
Dosing approximately 100 gpd of ferric chloride			
Solids Produced Due to Chemical Precipitation			
Ferric Phosphate Produced		4.9	lbs/lb P rem.
Ferric Hydroxide Produced		3.5	lbs/lb P rem.
…Assume that chemcical is added to tail end of the aeration basins and that 100% of the chemical sludge is removed with the biological sludge.			
Secondary Effluent			
BOD5 Removal		**97**	%
TSS Removal		**96**	%
Organic-N		12.4	% of TSS + Inf. Fraction
Organic-N		2.5	% of TSS + Inf. Fraction

Calculations

{D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Nitrification			
Ammonia-N remaining after satisfying nutrient requirements			864
Ammonia-N Oxidized; i.e. NO_3-N			860
Ammonia Remaining			4
Denitrification			
Ammonia-N Oxidized; i.e. NO_3-N			860
Total NO_3-N reduced			0
NO_3-N Remaining			860
Chemical Phosphorus Removal			
Ortho-P remaining after satisfying nutrient requirements			158
Ortho-P Removed			148
Ortho-P Remaining			9
Ferric Chloride Contains:	0.4357	lbs $FeCl_3$/lb Sol'n	
Weight Ratio	3.61	lbs Fe/lb Ortho-P Removed	
Iron Required	535	lbs Fe/day	
Ferric Chloride Required	1554	lbs $FeCl_3$/day	
	297	gal $FeCl_3$/day	
Solids Produced Due to Chemical Precipitation			
Ferric Phosphate Produced			723
Ferric Hydroxide Produced			512
Total Chemical Sludge Produced			1,234
Chemical-P Incorporated Into Sludge			148
Secondary Effluent			
BOD5	4	5.186	175
Soluble BOD5	2	5.186	99
TSS	3	5.186	145
VSS	3	5.186	123
ISS	1	5.186	22
Total Nitrogen	20.3	5.186	878
Nitrate-N	19.8	5.186	855
TKN	0.5	5.186	23
Ammonia-N	0.1	5.186	4
Organic-N	0.4	5.186	18
Total-P	0.3	5.186	13
Ortho-P	0.2	5.186	9
Organic-P	0.1	5.186	4
Vol. Content of Solids		85.0%	

Input Assumptions {A}	{B}	{C}	Calculations {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Secondary Sludge			**Secondary Sludge**			
Sludge Production due to BOD Removal			**Sludge Production due to BOD Removal**			
Yield Coefficient (lb VSS Produced			BOD5 Removed			5,666
/ lb BOD5 Removed)	**0.60**		Observed Yield	0.375	lbs VSS / lb BOD_5	
Decay Coefficient	**0.06**	/day				
Mean Cell Residence Time	**10**	days	VSS Produced			2,125
Sludge Production due to Nitrification			**Sludge Production due to Nitrification**			
Yield Coefficient (lb NVSS Produced			Ammonia-N Removed			860
/ lb Ammonia Oxidized)	**0.15**		Observed Yield	0.100	lbs VSS / lb BOD_5	
Decay Coefficient	**0.05**	/day				
Mean Cell Residence Time	10	days	NVSS Produced			86
			Total Biological Sludge Production			
			Net VSS Produced			2,211
Volatile Content of MLTSS Produced	**85**	%	Net TSS Produced			2,601
Sludge Production due to Influent Solids			**Sludge Production due to Influent Solids**			
			Influent ISS			773
…Difference incorportated into sludge			Effluent ISS			22
			Inf. ISS incorp. Into sludge			751
			Influent ISS fraction in sludge	97.2%		
			Organic-N			
			Organic-N Remaining after Solub.			15
… Assume same ratio as ISS			Organic -N incorported into sludge			14
			Remaining Organic-N			0
			Nitrate-N			
			Ammonia-N Nitrified			860
			Conc. Based on Influent Flow	19.8	mg/L	
			Nitrate in WAS			5
			Organic-P			
			Organic-P Remaining after Solub.			0.3750
… Assume same ratio as ISS			Organic -P incorported into sludge			0.3645
			Remaining Organic-P			0.0106
Waste Activated Sludge			**Waste Activated Sludge**			
… Assume Net TSS is wasted			TSS	20,000	0.0309	5,156
… Sludge is Wasted from Return Sludge			VSS	10,786	0.0309	2,781
Percent Solids	**2.000**	%	ISS	9,214	0.0309	2,375
… Assume Nutrients consumed are incorportated into cell mass.			Total Nitrogen	1,140	0.0309	294
			Nitrate-N	20	0.0309	5
			TKN	1,120	0.0309	289
			Ammonia-N	0.1	0.0309	0
			Organic-N	1,120	0.0309	289
			Total-P	792	0.0309	204
			Ortho-P	0.2	0.0309	0
			Organic-P	216	0.0309	56
			Chemical-P	575	0.0309	148
			Fraction of Nutrients in Sludge:			
			Nitrogen:	5.6%		
			Phosphorus:	4.0%		
			Volatile Content:	53.9%		

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}		{D}	{E}	{F}	{G}
Activated Sludge Parameters				**Activated Sludge Parameters**			
Aeration Basin Volume	**282,000**	ft^3		Aeration Basin Volume	2.110	Million Gallons	
Solids Under Aeration:				Solids Under Aeration:			
MLTSS	3,061	mg/L		MLTSS	53,849	lbs	
MLVSS	1651			MLVSS	29,042	lbs	
				MLVSS Conc	1,651	mg/L	
				Mixed Liquor Volatile Fraction	53.9%		
				Organic Volumetric Loading	21	lb/1000 ft^3	
				F:M Ratio	0.201		
				Mean Cell Residence Time	10.00	days	
Anoxic Selector Parameters							
Anoxic Selector Volume	0.22	MG		Selector HRT	1.0	hours	
				Selector F:M Ratio	1.9		
Aeration System				**Aeration System**			
BOD Oxygen Requirement	**1.1**	lb O_2/ lb BOD rem.		BOD5 Removed		5,666	lbs/day
				BOD5 Oxygen Requirement		6,232	lbs/day
TKN Oygen Requirement	**4.6**	lb O_2/ lb TKN rem.		TKN Removed		860	lbs/day
				TKN Oxygen Requirement		3,956	lbs/day
				Total Oxygen Requirement		10,188	lbs/day
				Total NO3-N reduced		0	lbs/day
Oxygen Recovery from Denitrification	**2.86**	lbs O_2/ lb NO_3 reduced		Denitrification Oxygen Credit		0	lbs/day
				Actual Oxygen Requirement		10,188	lbs/day
Return Activated Sludge				**Return Activated Sludge**			
				TSS	20,000	0.906	151,157
				VSS	10,786	0.906	81,521
				Vol. Content of Solids		53.9%	
				RAS Ratio		17.5%	
Final Clarifiers				**Final Clarifiers**			
				Secondary Clarifier Influent			
				MLTSS	3,061	6.123	156,314
				MLVSS	1,651	6.123	84,302
				Vol. Content of Solids		53.9%	
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter	**90**	ft					
No. of Clarifiers	**2**						
Clarifier Depth	**16**	ft					
Total Surface Area	12,723	ft^2		Surface Overflow Rate (SOR)	408	gal/day/ft^2	
Total Weir Length	565	ft		Weir Overflow Rate (WOR)	9,171	gal/day/ft	
Volume	1,522,844	gallons		Solids Loading Rate	12.3	lb/day/ft^2	
				or	0.51	lb/hr/ft^2	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Anaerobic Digestion (No Supernating)				**Anaerobic Digestion (No Supernating)**			
Digester Influent				**Digester Influent = WAS + Primary Sludge**			
				TSS	35,000	0.0301	8,781
				VSS	22,642	0.0301	5,680
				ISS	12,358	0.0301	3,100
				Total Nitrogen	1,541	0.0301	386
				Nitrate-N	20	0.0301	5.1
				TKN	1,520	0.0301	381
				Ammonia-N	8	0.0301	2.1
				Organic-N	1,512	0.0301	379
				Total-P	1,032	0.0301	259
				Ortho-P	2	0.0301	1
				Organic-P	439	0.0301	110
				Chemical-P	591	0.0301	148
				Vol. Content of Solids		64.7%	
Removals and Conversions				**Removals and Conversions**			
VSS Destruction				**VSS Destruction**			
VSS Destruction		**50**	%	VSS Destruction			2,840
Gas Production		**15**	ft^3/lb VSS des.	Digester Gas Production		42,603	ft^3 /day
Organic-N Conversion				**Organic-N Conversion**			
Conversion of influent Organic-N		50	%	Influent Organic-N			379
				Organic-N Converted			190
…A portion of the influent Organic-N is converted to Ammonia-N				Organic-N Remaining			190
				Ammonia-N Produced			190
Nitrate-N Conversion				**Nitrate-N Conversion**			
Conversion of influent Nitrate-N		**100**	%	Influent Nitrate-N			5
				Nitrate-N Converted			5
…The influent Nitrate-N is converted to Nitrogen Gas				Nitrate-N Remaining			0
Organic-P Solubilized				**Organic-P Solubilized**			
Conversion of influent Organic-P		50	%	Influent Organic-P			110
				Organic-P Converted			55
…A portion of the influent Organic-P is converted to Ortho-P				Organic-P Remaining			55
				Ortho-P Produced			55
Digested Sludge				**Digested Sludge**			
				TSS	23,679	0.0301	5,941
				VSS	11,321	0.0301	2,840
				ISS	12,358	0.0301	3,100
				Total Nitrogen	1,520	0.0301	381
				Nitrate-N	0	0.0301	0
				TKN	1,520	0.0301	381
				Ammonia-N	764	0.0301	192
				Organic-N	756	0.0301	190
				Total-P	1,032	0.0301	259
				Ortho-P	221	0.0301	56
				Organic-P	219	0.0301	55
				Chemical-P	591	0.0301	148
				Vol. Content of Solids		47.8%	
				Fraction of Nutrients in Sludge:			
				Nitrogen:	6.4%		
				Phosphorus:	4.4%		
Digester Dimensional Parameters				**Loading Rates**			
				Digester Influent VS	5,680	lbs/day	
Digester Volume		**79,600**	ft^3	Volatile Solids Loading	0.071	lb VS/day/ft^3	
				or	71	lb VS/ 1000 ft^3 /day	
				Digester Influent Flow Rate	30,081	gpd	
				Digester Volume	595,448	gallons	
				HRT = SRT =	20	days	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Digested Sludge to Centrifuges				**Digested Sludge to Centrifuges**			
				TS	23,679	0.0752	14,851
				VS	11,321	0.0752	7,100
				ISS	12,358	0.0752	7,751
				Total Nitrogen	1,520	0.0752	953
				Nitrate-N	-	0.0752	-
				TKN	1,520	0.0752	953
				Ammonia-N	764	0.0752	479
				Organic-N	756	0.0752	474
				Total-P	1,032	0.0752	647
				Ortho-P	221	0.0752	139
				Organic-P	219	0.0752	138
				Chemical-P	591	0.0752	371
				Vol. Content of Solids		47.8%	
Dewatered Digested Sludge				**Dewatered Digested Sludge**			
	Solids Capture	**95** %					
	Percent Solids	**25.0** %		TS	250,000	0.0068	14,109
				VS	119,526	0.0068	6,745
				ISS	130,474	0.0068	7,363
				Total Nitrogen	3,957	0.0068	223
… Organic-N, Organic-P, and Chemcial-P are assumed to be related to				Nitrate-N	-	0.0068	-
TSS and assumed to be removed at the same rate.				TKN	3,957	0.0068	223
Ammonia-N, Ortho-P are assumed to be soluble.				Ammonia-N	764	0.0068	43
				Organic-N	3,193	0.0068	180
				Total-P	3,645	0.0068	206
				Ortho-P	221	0.0068	12
				Organic-P	926	0.0068	52
				Chemical-P	2,497	0.0068	141
				Vol. Content of Solids		47.8%	
Centrate				**Centrate**			
…Assume that the ratio of the centrate BOD5/VSS				BOD5	385	0.0684	220
				Soluble BOD5	2	0.0684	1
				TSS	1,301	0.0684	743
…Assume that Ortho-P and Ammonia-N concentrations				VSS	622	0.0684	355
are the same as that in Secondary Effluent.				ISS	679	0.0684	388
				Total Nitrogen	1,279	0.0684	730
				Nitrate-N	0	0.0684	0
				TKN	1,279	0.0684	730
				Ammonia-N	764	0.0684	436
				Organic-N	515	0.0684	294
				Total-P	774	0.0684	442
				Ortho-P	221	0.0684	126
				Organic-P	149	0.0684	85
				Chemical-P	403	0.0684	230

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Washwater				**Washwater**			
…Assume that Secondary Effluent is used for washwater				BOD5	4	0.0137	0.5
				Soluble BOD5	2	0.0137	0.3
				TSS	3	0.0137	0.4
				VSS	3	0.0137	0.3
				ISS	1	0.0137	0.1
				Total Nitrogen	20.3	0.0137	2.3
				Nitrate-N	19.8	0.0137	2.3
				TKN	0.5	0.0137	0.1
				Ammonia-N	0.1	0.0137	0.0
				Organic-N	0.4	0.0137	0.0
				Total-P	0.3	0.0137	0.0
				Ortho-P	0.2	0.0137	0.0
				Organic-P	0.1	0.0137	0.0
Centrifuge Feed Rate		**220**	gpm	… Average Operating Time	5.70	hrs/day	
Belt Washwater		**100**	gpm	… Ave. Solids Loading	2,607	lbs/hr	
				… Belt Washwater	34,183	gpd	
				… Average Operating Time / Week	11.39	hrs/week	
Centrate and Washwater				**Centrate and Washwater**			
				BOD5	322	0.016	44
				Soluble BOD5	2	0.016	0
				TSS	1085	0.016	149
				VSS	519	0.016	71
				ISS	566	0.016	78
				Total Nitrogen	1070	0.016	146
				Nitrate-N	3	0.016	0
				TKN	1066	0.016	146
				Ammonia-N	637	0.016	87
				Organic-N	429	0.016	59
				Total-P	645	0.016	88
				Ortho-P	185	0.016	25
				Organic-P	125	0.016	17
				Chemical-P	403	0.016	55

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Influent Parameters				**Influent Parameters**			
Flow	**8.800**	MGD					
BOD5	**13,900**	lbs/day		BOD5	189	8.800	13,900
Soluble BOD5	**40**	% of BOD5		Soluble BOD5	76	8.800	5,560
TSS	**15,000**	lbs/day		TSS	204	8.800	15,000
VSS	**80**	% of TSS		VSS	164	8.800	12,000
ISS	**20**	% of TSS		ISS	41	8.800	3,000
TKN	**1,400**	lbs/day		TKN	19.1	8.800	1,400
Ammonia-N	**70**	% of TKN		Ammonia-N	13.4	8.800	980
Organic-N	**30**	% of TKN		Organic-N	5.7	8.800	420
Total-P	**400**	lbs/day		Total-P	5.5	8.800	400
Ortho-P	**70**	% of T-P		Ortho-P	3.8	8.800	280
Organic-P	**30**	% of T-P		Organic-P	1.6	8.800	120
Recycle Streams to Pump Station				**Recycle Streams to Pump Station**			
Recycle Stream from Filtrate and Washwater				**Recycle Stream from Filtrate and Washwater**			
				BOD5	245	0.0331	68
				Soluble BOD5	2	0.0331	1
				TSS	1110	0.0331	307
				VSS	497	0.0331	137
				ISS	612	0.0331	169
				TKN	919	0.0331	254
				Ammonia-N	549	0.0331	152
				Organic-N	371	0.0331	102
				Total-P	693	0.0331	191
				Ortho-P	173	0.0331	48
				Organic-P	116	0.0331	32
…Assumed that all Chemical-P is recycled as Ortho-P.				Chemical-P	485	0.0331	134
Preliminary Treatment				**Preliminary Treatment**			
Preliminary Treatment Effluent				**Preliminary Treatment Effluent**			
				BOD5	190	8.833	13,968
…Any removals obtained in the Grit Basins and Fine Screens are negligible.				Soluble BOD5	75	8.833	5,561
				TSS	208	8.833	15,307
				VSS	165	8.833	12,137
				ISS	43	8.833	3,169
				TKN	22.5	8.833	1,654
				Ammonia-N	15.4	8.833	1,132
				Organic-N	7.1	8.833	522
				Total-P	8.0	8.833	591
				Ortho-P	6.3	8.833	462
				Organic-P	2.1	8.833	152
				Vol. Content of Solids		79.3%	
Waste Activated Sludge to the Primary Clarifiers				**Waste Activated Sludge to the Primary Clarifiers**			
				BOD5	0	0.0605	0
				Soluble BOD5	0	0.0605	0
				TSS	20,000	0.0605	10,092
				VSS	9,627	0.0605	4,858
				ISS	10,373	0.0605	5,234
				Total Nitrogen	944	0.0605	476
				Nitrate-N	13	0.0605	7
				TKN	931	0.0605	470
				Ammonia-N	0	0.0605	0
				Organic-N	931	0.0605	470
				Total-P	897	0.0605	452
				Ortho-P	0	0.0605	0
				Organic-P	183	0.0605	92
				Chemical-P	714	0.0605	360
				Fraction of Nutrients in Sludge:			
				Nitrogen:	4.7%		
				Phosphorus:	4.5%		
				Volatile Content:	48.1%		

Input Assumptions				**Calculations**	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Treatment				**Primary Treatment**			
Primary Clarifier Influent				**Primary Clarifier Influent (WAS + Preliminary Effluent)**			
				BOD5	188	8.894	13,968
				Soluble BOD5	75	8.894	5,561
				TSS	342	8.894	25,399
				VSS	229	8.894	16,995
				ISS	113	8.894	8,403
				Nitrate-N	6	8.894	470
				TKN	29	8.894	2,124
				Ammonia-N	15	8.894	1,132
				Organic-N	13	8.894	992
				Total-P	14	8.894	1,044
				Ortho-P	6	8.894	462
				Organic-P	3	8.894	244
				Chemical-P	5	8.894	360
Clarifier Dimensional Parameters				**Loading Rates**			
	Clarifier Diameter	**85**	ft				
	No. of Clarifiers	**2**					
	Clarifier Depth	**12**	ft				
	Total Surface Area	11,349	ft^2	Surface Overflow Rate (SOR)	784	gal/day/ft^2	
	Total Weir Length	534	ft	Weir Overflow Rate (WOR)	16,653	gal/day/ft	
	Volume	1,018,755	gallons	Hydraulic Retention Time	2.7	hours	
Primary Clarifier Effluent From Preliminary Effluent				**Primary Clarifier Effluent From Preliminary Effluent**			
	BOD5 Removal	**30.0**	%	BOD5	133	8.807	9,777
				Soluble BOD5	75	8.807	5,544
	TSS Removal	**50.0**	%	TSS	104	8.807	7,653
				VSS	82	8.807	6,015
				ISS	22	8.807	1,638
	TKN Removal: Based on sludge content			TKN	19.9	8.807	1,459
	Ammonia Removal	**0**	%	Ammonia-N	15.4	8.807	1,128
				Organic-N	4.5	8.807	331
Total-P Removal: Based on sludge content				Total-P	6.5	8.807	475
	Ortho-P Removal	**0**	%	Ortho-P	6.3	8.807	460
				Organic-P	0.2	8.807	14.9
				Vol. Content of Solids		78.6%	
Primary Sludge From Preliminary Treatment Effluent				**Primary Sludge From Preliminary Treatment Effluent**			
	Percent Solids	**3.50**	%	TSS	35,000	0.0262	7,653
	Volatile Content	**80**	% of TSS	VSS	28,000	0.0262	6,123
				ISS	7,000	0.0262	1,531
	Nitrogen Content	**2.5**	% of TSS	TKN	890	0.0262	195
				Ammonia-N	15	0.0262	3
				Organic-N	875	0.0262	191
	Phosphorus Content	**1.5**	% of TSS	Total-P	531	0.0262	116
				Ortho-P	6	0.0262	1
				Organic-P	525	0.0262	115
				TKN Removal		11.8%	
				Total-P Removal		19.6%	

Input Assumptions				Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Clarifier Effluent From WAS				**Primary Clarifier Effluent From WAS**			
				BOD5	0	0.026	0
	Total WAS Removal	**100**	%	Soluble BOD5	0	0.026	0
				TSS	0	0.026	0
				VSS	0	0.026	0
				ISS	0	0.026	0
				Nitrate-N	0	0.026	0
				TKN	0	0.026	0
				Ammonia-N	0	0.026	0
				Organic-N	0	0.026	0
				Total-P	0	0.026	0
				Ortho-P	0	0.026	0
				Organic-P	0	0.026	0
				Chemical-P	0	0.026	0
				Vol. Content of Solids			
Primary Sludge From WAS				**Primary Sludge From WAS**			
	Percent Solids	**3.50**	%	TSS	35,000	0.0346	10,092
				VSS	16848	0.0346	4,858
				ISS	18152	0.0346	5,234
				Nitrate-N	23	0.0346	7
				TKN	1629	0.0346	470
				Ammonia-N	0	0.0346	0
				Organic-N	1629	0.0346	470
				Total-P	1569	0.0346	452
				Ortho-P	1	0.0346	0
				Organic-P	320	0.0346	92
				Chemical-P	1249	0.0346	360
				TKN Removal		100.0%	
				Total-P Removal		100.0%	
Total Primary Clarifier Effluent				**Total Primary Clarifier Effluent**			
				BOD5	133	8.833	9,777
				Soluble BOD5	75	8.833	5,544
				TSS	104	8.833	7,653
				VSS	82	8.833	6,015
				ISS	22	8.833	1,638
				Nitrate-N	0	8.833	0
				TKN	19.8	8.833	1,459
				Ammonia-N	15.3	8.833	1,128
				Organic-N	4.5	8.833	331
				Total-P	6.5	8.833	475
				Ortho-P	6.2	8.833	460
				Organic-P	0.2	8.833	15
				Chemical-P	0.0	8.833	0
				Vol. Content of Solids		78.6%	
Total Primary Sludge				**Total Primary Sludge**			
				TSS	35,000	0.0608	17,745
				VSS	21,657	0.0608	10,981
				ISS	13,343	0.0608	6,765
				Nitrate-N	13	0.0608	6.7
				TKN	1,310	0.0608	664
				Ammonia-N	7	0.0608	3.4
				Organic-N	1,304	0.0608	661
				Total-P	1,122	0.0608	569
				Ortho-P	3	0.0608	2
				Organic-P	408	0.0608	207
				Chemical-P	710	0.0608	360
				TKN Removal		31%	
				Total-P Removal		54%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}		{B}	{C}	{D}	{E}	{F}	{G}
Secondary Treatment - Activated Sludge				**Secondary Treatment - Activated Sludge**			
Aeration Basin Influent				**Aeration Basin Influent**			
				BOD5	133	8.833	9,777
				Soluble BOD5	75	8.833	5,544
				TSS	104	8.833	7,653
				VSS	82	8.833	6,015
				ISS	22	8.833	1,638
				TKN	19.8	8.833	1,459
				Ammonia-N	15.3	8.833	1,128
				Organic-N	4.5	8.833	331
				Total-P	6.5	8.833	475
				Ortho-P	6.2	8.833	460
				Organic-P	0.2	8.833	15
				Vol. Content of Solids		78.6%	
Nutrient Conversions							
Organic-N Conversion				**Organic-N Conversion**			
… A portion of the Influent Organic-N is				Influent Organic-N			331
converted to Ammonia-N				Influent Ammonia-N			1,128
Assume Conversion of		**95** %		Organic-N Converted			315
				Resulting Ammonia-N			1,443
				Remaining Organic-N			17
Organic-P Conversion				**Organic-P Conversion**			
… A portion of the Influent Organic-P is				Influent Organic-P			15
converted to Ortho-P				Influent Ortho-P			460
Assume Conversion of		**95** %		Organic-P Converted			14
				Resulting Ortho-P			475
				Remaining Organic-P			1
VSS Biodegradation				**VSS Biodegradation**			
… A portion of the Influent VSS				Influent VSS			6,015
is Biodegradable							
Assumed Biodegradable Fraction		**80** %		VSS Biodegraded			4,812
… Remaining VSS is incorportated into the Sludge				Non-Biodegradable VSS			1,203
Nutrient Requirements							
Carbonaceous							
… Based on weight ratio of VSS produced				VSS Produced			3,557
Nitrogen Req'd as Ammonia-N		**12.4** %		Ammonia-N Req'd			441
Phosphorus Req'd as Ortho-P		**2.5** %		Ortho-P Req'd			89
Nitrification							
… Based on weight ratio of VSS produced				VSS Produced			98
Nitrogen Req'd as Ammonia-N		**12.4** %		Ammonia-N Req'd			12
Phosphorus Req'd as Ortho-P		**2.5** %		Ortho-P Req'd			2
				Remaining Ammonia-N			990
				Remaining Ortho-P			383
				BOD:N:P Ratio			
				Nutrients Utilized:			
				Influent BOD5			9,777
				Ammonia-N			453
				Ortho-P			91
				Therefore the BOD5:N:P Ratio is:			
				BOD5	100		
				Ammonia-N	4.6		
				Ortho-P	0.9		

Input Assumptions			Calculations			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Nitrification			**Nitrification**			
			Ammonia-N remaining after satisfying nutrient requirements			990
Ammonia Oxidation	**99.5**	%	Ammonia-N Oxidized; i.e. NO_3-N			985
			Ammonia Remaining			5
Denitrification			**Denitrification**			
…A portion of the NO3-N is used is converted to nitrogen gas			Ammonia-N Oxidized; i.e. NO_3-N			985
Denitrification	**0**	%	Total NO_3-N reduced			0
			NO_3-N Remaining			985
Chemical Phosphorus Removal			**Chemical Phosphorus Removal**			
			Ortho-P remaining after satisfying nutrient requirements			383
Ortho-P Removed	**94.0**	%	Ortho-P Removed			360
			Ortho-P Remaining			23
Ferric Chloride Density	**12**	lbs Sol'n/gal				
Iron Content	**0.15**	lbs Fe/lbs Sol'n	Ferric Chloride Contains:	0.4357	lbs $FeCl_3$/lb Sol'n	
Ferric Chloride Dosage	**2.00**	moles Fe to moles Ortho-P	Weight Ratio	3.61	lbs Fe/lb Ortho-P Removed	
			Iron Required	1299	lbs Fe/day	
			Ferric Chloride Required	3773	lbs $FeCl_3$/day	
Dosing approximately 100 gpd of ferric chloride				722	gal $FeCl_3$/day	
Solids Produced Due to Chemical Precipitation			**Solids Produced Due to Chemical Precipitation**			
Ferric Phosphate Produced	4.9	lbs/lb P rem.	Ferric Phosphate Produced			1,754
Ferric Hydroxide Produced	3.5	lbs/lb P rem.	Ferric Hydroxide Produced			1,243
			Total Chemical Sludge Produced			2,997
…Assume that chemcical is added to tail end of the aeration basins and that 100% of the chemical sludge is removed with the biological sludge.			Chemical-P Incorporated Into Sludge			360
Secondary Effluent			**Secondary Effluent**			
BOD5 Removal	**97**	%	BOD5	4	8.772	293
			Soluble BOD5	2	8.772	166
TSS Removal	**96**	%	TSS	4	8.772	306
			VSS	4	8.772	260
			ISS	1	8.772	46
			Total Nitrogen	14.0	8.772	1,021
			Nitrate-N	13.4	8.772	978
			TKN	0.6	8.772	43
			Ammonia-N	0.1	8.772	5
Organic-N	12.4	% of TSS	Organic-N	0.5	8.772	38
		+ Inf. Fraction	Total-P	0.4	8.772	31
			Ortho-P	0.3	8.772	23
Organic-N	2.5	% of TSS	Organic-P	0.1	8.772	8
		+ Inf. Fraction	Vol. Content of Solids		85.0%	

Applied Technologies, Inc.
Mass Balance Calculations
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Project: Watertown WWTP
Event: Design Max Month
Rev. on: 9/25/2024 13:04

Input Assumptions {A}	{B}	{C}	Calculations {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Secondary Sludge			**Secondary Sludge**			
Sludge Production due to BOD Removal			**Sludge Production due to BOD Removal**			
Yield Coefficient (lb VSS Produced			BOD5 Removed			9,484
/ lb BOD5 Removed)	**0.60**		Observed Yield	0.375	lbs VSS / lb BOD_5	
Decay Coefficient	**0.06**	/day				
Mean Cell Residence Time	**10**	days	VSS Produced			3,557
Sludge Production due to Nitrification			**Sludge Production due to Nitrification**			
Yield Coefficient (lb NVSS Produced			Ammonia-N Removed			985
/ lb Ammonia Oxidized)	**0.15**		Observed Yield	0.100	lbs VSS / lb BOD_5	
Decay Coefficient	**0.05**	/day				
Mean Cell Residence Time	**10**	days	NVSS Produced			98
			Total Biological Sludge Production			
			Net VSS Produced			3,655
Volatile Content of MLTSS Produced	**85**	%	Net TSS Produced			4,300
Sludge Production due to Influent Solids			**Sludge Production due to Influent Solids**			
			Influent ISS			1,638
…Difference incorportated into sludge			Effluent ISS			46
			Inf. ISS incorp. Into sludge			1,593
			Influent ISS fraction in sludge	97.2%		
			Organic-N			
			Organic-N Remaining after Solub.			17
… Assume same ratio as ISS			Organic -N incorported into sludge			16
			Remaining Organic-N			0
			Nitrate-N			
			Ammonia-N Nitrified			985
			Conc. Based on Influent Flow	13.4	mg/L	
			Nitrate in WAS			7
			Organic-P			
			Organic-P Remaining after Solub.			0.7466
… Assume same ratio as ISS			Organic -P incorported into sludge			0.7256
			Remaining Organic-P			0.0209
Waste Activated Sludge			**Waste Activated Sludge**			
… Assume Net TSS is wasted			TSS	20,000	0.0605	10,092
… Sludge is Wasted from Return Sludge			VSS	9,627	0.0605	4,858
Percent Solids	**2.000**	%	ISS	10,373	0.0605	5,234
… Assume Nutrients consumed are incorportated into cell mass.			Total Nitrogen	944	0.0605	476
			Nitrate-N	13	0.0605	7
			TKN	931	0.0605	470
			Ammonia-N	0.1	0.0605	0
			Organic-N	931	0.0605	470
			Total-P	897	0.0605	452
			Ortho-P	0.3	0.0605	0
			Organic-P	183	0.0605	92
			Chemical-P	714	0.0605	360
			Fraction of Nutrients in Sludge:			
			Nitrogen:	4.7%		
			Phosphorus:	4.5%		
			Volatile Content:	48.1%		

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}		{D}	{E}	{F}	{G}
Activated Sludge Parameters				**Activated Sludge Parameters**			
Aeration Basin Volume	**282,000**	ft^3		Aeration Basin Volume	2.110	Million Gallons	
Solids Under Aeration:				Solids Under Aeration:			
MLTSS	6,044	mg/L		MLTSS	106,327	lbs	
MLVSS	2909			MLVSS	51,182	lbs	
				MLVSS Conc	2,909	mg/L	
				Mixed Liquor Volatile Fraction	48.1%		
				Organic Volumetric Loading	35	lb/1000 ft^3	
				F:M Ratio	0.191		
				Mean Cell Residence Time	10.00	days	
Anoxic Selector Parameters							
Anoxic Selector Volume	0.22	MG		Selector HRT	0.6	hours	
				Selector F:M Ratio	1.8		
Aeration System				**Aeration System**			
BOD Oxygen Requirement	**1.1**	lb O_2/ lb BOD rem.		BOD5 Removed		9,484	lbs/day
				BOD5 Oxygen Requirement		10,432	lbs/day
TKN Oygen Requirement	**4.6**	lb O_2/ lb TKN rem.		TKN Removed		985	lbs/day
				TKN Oxygen Requirement		4,529	lbs/day
				Total Oxygen Requirement		14,962	lbs/day
				Total NO3-N reduced		0	lbs/day
Oxygen Recovery from Denitrification	**2.86**	lbs O_2/ lb NO_3 reduced		Denitrification Oxygen Credit		0	lbs/day
				Actual Oxygen Requirement		14,962	lbs/day
Return Activated Sludge				**Return Activated Sludge**			
				TSS	20,000	3.738	623,537
				VSS	9,627	3.738	300,147
				Vol. Content of Solids		48.1%	
				RAS Ratio		42.6%	
Final Clarifiers				**Final Clarifiers**			
				Secondary Clarifier Influent			
				MLTSS	6,044	12.571	633,629
				MLVSS	2,909	12.571	305,005
				Vol. Content of Solids		48.1%	
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter	**90**	ft					
No. of Clarifiers	**2**						
Clarifier Depth	**16**	ft					
Total Surface Area	12,723	ft^2		Surface Overflow Rate (SOR)	689	gal/day/ft^2	
Total Weir Length	565	ft		Weir Overflow Rate (WOR)	15,513	gal/day/ft	
Volume	1,522,844	gallons		Solids Loading Rate	49.8	lb/day/ft^2	
				or	2.08	lb/hr/ft^2	

Input Assumptions

	{A}	{B}	{C}
Anaerobic Digestion (No Supernating)			
Digester Influent			
Removals and Conversions			
VSS Destruction			
VSS Destruction		**50**	%
Gas Production		**15**	ft^3/lb VSS des.
Organic-N Conversion			
Conversion of influent Organic-N		50	%
…A portion of the influent Organic-N is converted to Ammonia-N			
Nitrate-N Conversion			
Conversion of influent Nitrate-N		**100**	%
…The influent Nitrate-N is converted to Nitrogen Gas			
Organic-P Solubilized			
Conversion of influent Organic-P		50	%
…A portion of the influent Organic-P is converted to Ortho-P			
Digested Sludge			
Digester Dimensional Parameters			
Digester Volume		**79,600**	ft^3

Calculations

{D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Anaerobic Digestion (No Supernating)			
Digester Influent = WAS + Primary Sludge			
TSS	35,000	0.0608	17,745
VSS	21,657	0.0608	10,981
ISS	13,343	0.0608	6,765
Total Nitrogen	1,324	0.0608	671
Nitrate-N	13	0.0608	6.7
TKN	1,310	0.0608	664
Ammonia-N	7	0.0608	3.4
Organic-N	1,304	0.0608	661
Total-P	1,122	0.0608	569
Ortho-P	3	0.0608	2
Organic-P	408	0.0608	207
Chemical-P	710	0.0608	360
Vol. Content of Solids		61.9%	
Removals and Conversions			
VSS Destruction			
VSS Destruction			5,490
Digester Gas Production		82,354	ft^3 /day
Organic-N Conversion			
Influent Organic-N			661
Organic-N Converted			330
Organic-N Remaining			330
Ammonia-N Produced			330
Nitrate-N Conversion			
Influent Nitrate-N			7
Nitrate-N Converted			7
Nitrate-N Remaining			0
Organic-P Solubilized			
Influent Organic-P			207
Organic-P Converted			103
Organic-P Remaining			103
Ortho-P Produced			103
Digested Sludge			
TSS	24,171	0.0608	12,255
VSS	10,829	0.0608	5,490
ISS	13,343	0.0608	6,765
Total Nitrogen	1,310	0.0608	664
Nitrate-N	0	0.0608	0
TKN	1,310	0.0608	664
Ammonia-N	658	0.0608	334
Organic-N	652	0.0608	330
Total-P	1,122	0.0608	569
Ortho-P	207	0.0608	105
Organic-P	204	0.0608	103
Chemical-P	710	0.0608	360
Vol. Content of Solids		44.8%	
Fraction of Nutrients in Sludge:			
Nitrogen:	5.4%		
Phosphorus:	4.6%		
Loading Rates			
Digester Influent VS	10,981	lbs/day	
Volatile Solids Loading	0.138	lb VS/day/ft^3	
or	138	lb VS/ 1000 ft^3 /day	
Digester Influent Flow Rate	60,793	gpd	
Digester Volume	595,448	gallons	
HRT = SRT =	10	days	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
<u>Digested Sludge Dewatering</u>				**Digested Sludge to Centrifuges**			
Digested Sludge							
					24,171	0.1520	30,638
					10,829	0.1520	13,726
					13,343	0.1520	16,912
					1,310	0.1520	1,661
					-	0.1520	-
					1,310	0.1520	1,661
					658	0.1520	835
					652	0.1520	826
					1,122	0.1520	1,422
					207	0.1520	263
					204	0.1520	259
					710	0.1520	900
Dewatered Digested Sludge				**Dewatered Digested Sludge**			
Solids Capture	**95** %						
Percent Solids	**25.0** %			TSS	250,000	0.0140	29,106
				VSS	112,000	0.0140	13,039
				ISS	138,000	0.0140	16,066
				Total Nitrogen	3,355	0.0140	391
… Organic-N, Organic-P, and Chemcial-P are assumed to be related to				Nitrate-N	-	0.0140	-
TSS and assumed to be removed at the same rate.				TKN	3,355	0.0140	391
Ammonia-N, Ortho-P are assumed to be soluble.				Ammonia-N	658	0.0140	77
				Organic-N	2,696	0.0140	314
				Total-P	3,990	0.0140	465
				Ortho-P	207	0.0140	24
				Organic-P	844	0.0140	98
				Chemical-P	2,939	0.0140	342
				Vol. Content of Solids		44.8%	
Centrate				**Centrate**			
…Assume that the ratio of the centrate BOD5/VSS							
				BOD5	293	0.1380	338
				Soluble BOD5	2	0.1380	3
				TSS	1,331	0.1380	1,532
				VSS	596	0.1380	686
				ISS	735	0.1380	846
				Total Nitrogen	1,103	0.1380	1,270
				Nitrate-N	0	0.1380	0
…Assume that Ortho-P and Ammonia-N concentrations				TKN	1,103	0.1380	1,270
are the same as that in Secondary Effluent.				Ammonia-N	658	0.1380	758
				Organic-N	445	0.1380	512
				Total-P	831	0.1380	957
				Ortho-P	207	0.1380	238
				Organic-P	139	0.1380	160
				Chemical-P	485	0.1380	558

Input Assumptions				**Calculations**				
						CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}		{D}	{E}	{F}	{G}
Washwater				**Washwater**				
…Assume that Secondary Effluent is used for washwater					BOD5	4	0.0276	0.9
					Soluble BOD5	2	0.0276	0.5
					TSS	4	0.0276	1.0
					VSS	4	0.0276	0.8
					ISS	1	0.0276	0.1
					Total Nitrogen	14.0	0.0276	3.2
					Nitrate-N	13.4	0.0276	3.1
					TKN	0.6	0.0276	0.1
					Ammonia-N	0.1	0.0276	0.0
					Organic-N	0.5	0.0276	0.1
					Total-P	0.4	0.0276	0.1
					Ortho-P	0.3	0.0276	0.1
					Organic-P	0.1	0.0276	0.0
	Centrifuge Feed Rate	**220**	gpm	… Average Operating Time		11.51	hrs/day	
	Belt Washwater	**100**	gpm	… Ave. Solids Loading		2,661	lbs/hr	
				… Belt Washwater		69,083	gpd	
				… Average Operating Time / Week		23.03	hrs/week	
Centrate and Washwater				**Centrate and Washwater**				
					BOD5	245	0.033	68
					Soluble BOD5	2	0.033	1
					TSS	1110	0.033	307
					VSS	497	0.033	137
					ISS	612	0.033	169
					Total Nitrogen	922	0.033	255
					Nitrate-N	2	0.033	1
					TKN	919	0.033	254
					Ammonia-N	549	0.033	152
					Organic-N	371	0.033	102
					Total-P	693	0.033	191
					Ortho-P	173	0.033	48
					Organic-P	116	0.033	32
					Chemical-P	485	0.033	134

Applied Technologies, Inc.
Mass Balance Calculations
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Project: Watertown WWTP
Event: Design Peak Week
Rev. on: 9/25/2024 13:17

Input Assumptions			Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Influent Parameters			**Influent Parameters**			
Flow	**10.400**	MGD				
BOD5	**16,300**	lbs/day	BOD5	188	10.400	16,300
Soluble BOD5	**40**	% of BOD5	Soluble BOD5	75	10.400	6,520
TSS	**19,500**	lbs/day	TSS	225	10.400	19,500
VSS	**80**	% of TSS	VSS	180	10.400	15,600
ISS	**20**	% of TSS	ISS	45	10.400	3,900
TKN	**1,900**	lbs/day	TKN	21.9	10.400	1,900
Ammonia-N	**70**	% of TKN	Ammonia-N	15.3	10.400	1,330
Organic-N	**30**	% of TKN	Organic-N	6.6	10.400	570
Total-P	**550**	lbs/day	Total-P	6.3	10.400	550
Ortho-P	**70**	% of T-P	Ortho-P	4.4	10.400	385
Organic-P	**30**	% of T-P	Organic-P	1.9	10.400	165
Recycle Streams to Pump Station			**Recycle Streams to Pump Station**			
Recycle Stream from Filtrate and Washwater			**Recycle Stream from Filtrate and Washwater**			
			BOD5	216	0.0428	77
			Soluble BOD5	2	0.0428	1
			TSS	1124	0.0428	401
			VSS	485	0.0428	173
			ISS	639	0.0428	228
			TKN	867	0.0428	310
			Ammonia-N	518	0.0428	185
			Organic-N	350	0.0428	125
			Total-P	727	0.0428	260
			Ortho-P	167	0.0428	60
			Organic-P	112	0.0428	40
…Assumed that all Chemical-P is recycled as Ortho-P.			Chemical-P	538	0.0428	192
Preliminary Treatment			**Preliminary Treatment**			
Preliminary Treatment Effluent			**Preliminary Treatment Effluent**			
			BOD5	188	10.443	16,377
…Any removals obtained in the Grit Basins and			Soluble BOD5	75	10.443	6,521
Fine Screens are negligible.			TSS	229	10.443	19,901
			VSS	181	10.443	15,773
			ISS	47	10.443	4,128
			TKN	25.4	10.443	2,210
			Ammonia-N	17.4	10.443	1,515
			Organic-N	8.0	10.443	695
			Total-P	9.3	10.443	810
			Ortho-P	7.3	10.443	637
			Organic-P	2.4	10.443	205
			Vol. Content of Solids		79.3%	
Waste Activated Sludge to the Primary Clarifiers			**Waste Activated Sludge to the Primary Clarifiers**			
			BOD5	0	0.0780	0
			Soluble BOD5	0	0.0780	0
			TSS	20,000	0.0780	13,009
			VSS	9,027	0.0780	5,872
			ISS	10,973	0.0780	7,137
			Total Nitrogen	871	0.0780	567
			Nitrate-N	16	0.0780	10
			TKN	856	0.0780	556
			Ammonia-N	0	0.0780	0
			Organic-N	855	0.0780	556
			Total-P	962	0.0780	626
			Ortho-P	0	0.0780	0
			Organic-P	168	0.0780	109
			Chemical-P	794	0.0780	517
			Fraction of Nutrients in Sludge:			
			Nitrogen:	4.3%		
			Phosphorus:	4.8%		
			Volatile Content:	45.1%		

Input Assumptions

	{A}	{B}	{C}
Primary Treatment			
Primary Clarifier Influent			
Clarifier Dimensional Parameters			
	Clarifier Diameter	**85**	ft
	No. of Clarifiers	**2**	
	Clarifier Depth	**12**	ft
	Total Surface Area	11,349	ft^2
	Total Weir Length	534	ft
	Volume	1,018,755	gallons
Primary Clarifier Effluent From Preliminary Effluent			
	BOD5 Removal	**30.0**	%
	TSS Removal	**50.0**	%
	TKN Removal: Based on sludge content		
	Ammonia Removal	**0**	%
Total-P Removal: Based on sludge content			
	Ortho-P Removal	**0**	%
Primary Sludge From Preliminary Treatment Effluent			
	Percent Solids	**3.50**	%
	Volatile Content	**80**	% of TSS
	Nitrogen Content	**2.5**	% of TSS
	Phosphorus Content	**1.5**	% of TSS

Calculations

	{D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Primary Treatment				
Primary Clarifier Influent (WAS + Preliminary Effluent)				
	BOD5	187	10.521	16,377
	Soluble BOD5	74	10.521	6,521
	TSS	375	10.521	32,910
	VSS	247	10.521	21,645
	ISS	128	10.521	11,265
	Nitrate-N	6	10.521	556
	TKN	32	10.521	2,766
	Ammonia-N	17	10.521	1,515
	Organic-N	14	10.521	1,251
	Total-P	16	10.521	1,436
	Ortho-P	7	10.521	637
	Organic-P	4	10.521	314
	Chemical-P	6	10.521	517
Loading Rates				
	Surface Overflow Rate (SOR)	927	gal/day/ft^2	
	Weir Overflow Rate (WOR)	19,699	gal/day/ft	
	Hydraulic Retention Time	2.3	hours	
Primary Clarifier Effluent From Preliminary Effluent				
	BOD5	132	10.409	11,464
	Soluble BOD5	75	10.409	6,500
	TSS	115	10.409	9,951
	VSS	90	10.409	7,813
	ISS	25	10.409	2,138
	TKN	22.5	10.409	1,956
	Ammonia-N	17.4	10.409	1,510
	Organic-N	5.1	10.409	446
	Total-P	7.6	10.409	658
	Ortho-P	7.3	10.409	635
	Organic-P	0.3	10.409	23.7
	Vol. Content of Solids		78.5%	
Primary Sludge From Preliminary Treatment Effluent				
	TSS	35,000	0.0341	9,951
	VSS	28,000	0.0341	7,961
	ISS	7,000	0.0341	1,990
	TKN	892	0.0341	254
	Ammonia-N	17	0.0341	5
	Organic-N	875	0.0341	249
	Total-P	532	0.0341	151
	Ortho-P	7	0.0341	2
	Organic-P	525	0.0341	149
	TKN Removal		11.5%	
	Total-P Removal		18.7%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Clarifier Effluent From WAS				**Primary Clarifier Effluent From WAS**			
				BOD5	0	0.033	0
Total WAS Removal		**100**	%	Soluble BOD5	0	0.033	0
				TSS	0	0.033	0
				VSS	0	0.033	0
				ISS	0	0.033	0
				Nitrate-N	0	0.033	0
				TKN	0	0.033	0
				Ammonia-N	0	0.033	0
				Organic-N	0	0.033	0
				Total-P	0	0.033	0
				Ortho-P	0	0.033	0
				Organic-P	0	0.033	0
				Chemical-P	0	0.033	0
				Vol. Content of Solids			
Primary Sludge From WAS				**Primary Sludge From WAS**			
Percent Solids		**3.50**	%	TSS	35,000	0.0446	13,009
				VSS	15798	0.0446	5,872
				ISS	19202	0.0446	7,137
				Nitrate-N	28	0.0446	10
				TKN	1497	0.0446	556
				Ammonia-N	0	0.0446	0
				Organic-N	1497	0.0446	556
				Total-P	1684	0.0446	626
				Ortho-P	1	0.0446	0
				Organic-P	293	0.0446	109
				Chemical-P	1390	0.0446	517
				TKN Removal		100.0%	
				Total-P Removal		100.0%	
Total Primary Clarifier Effluent				**Total Primary Clarifier Effluent**			
				BOD5	132	10.442	11,464
				Soluble BOD5	75	10.442	6,500
				TSS	114	10.442	9,951
				VSS	90	10.442	7,813
				ISS	25	10.442	2,138
				Nitrate-N	0	10.442	0
				TKN	22.5	10.442	1,956
				Ammonia-N	17.3	10.442	1,510
				Organic-N	5.1	10.442	446
				Total-P	7.6	10.442	658
				Ortho-P	7.3	10.442	635
				Organic-P	0.3	10.442	24
				Chemical-P	0.0	10.442	0
				Vol. Content of Solids		78.5%	
Total Primary Sludge				**Total Primary Sludge**			
				TSS	35,000	0.0787	22,959
				VSS	21,086	0.0787	13,832
				ISS	13,914	0.0787	9,127
				Nitrate-N	16	0.0787	10.4
				TKN	1,235	0.0787	810
				Ammonia-N	8	0.0787	5.0
				Organic-N	1,227	0.0787	805
				Total-P	1,185	0.0787	777
				Ortho-P	4	0.0787	2
				Organic-P	394	0.0787	258
				Chemical-P	787	0.0787	517
				TKN Removal		29%	
				Total-P Removal		54%	

Input Assumptions			**Calculations**			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Secondary Treatment - Activated Sludge			**Secondary Treatment - Activated Sludge**			
Aeration Basin Influent			**Aeration Basin Influent**			
			BOD5	132	10.442	11,464
			Soluble BOD5	75	10.442	6,500
			TSS	114	10.442	9,951
			VSS	90	10.442	7,813
			ISS	25	10.442	2,138
			TKN	22.5	10.442	1,956
			Ammonia-N	17.3	10.442	1,510
			Organic-N	5.1	10.442	446
			Total-P	7.6	10.442	658
			Ortho-P	7.3	10.442	635
			Organic-P	0.3	10.442	24
			Vol. Content of Solids		78.5%	
Nutrient Conversions						
Organic-N Conversion			**Organic-N Conversion**			
… A portion of the Influent Organic-N is			Influent Organic-N			446
converted to Ammonia-N			Influent Ammonia-N			1,510
Assume Conversion of	**95** %		Organic-N Converted			424
			Resulting Ammonia-N			1,934
			Remaining Organic-N			22
Organic-P Conversion			**Organic-P Conversion**			
… A portion of the Influent Organic-P is			Influent Organic-P			24
converted to Ortho-P			Influent Ortho-P			635
Assume Conversion of	**95** %		Organic-P Converted			22
			Resulting Ortho-P			657
			Remaining Organic-P			1
VSS Biodegradation			**VSS Biodegradation**			
… A portion of the Influent VSS			Influent VSS			7,813
is Biodegradable						
Assumed Biodegradable Fraction	**80** %		VSS Biodegraded			6,250
… Remaining VSS is incorportated into the Sludge			Non-Biodegradable VSS			1,563
Nutrient Requirements						
Carbonaceous						
… Based on weight ratio of VSS produced			VSS Produced			4,170
Nitrogen Req'd as Ammonia-N	**12.4** %		Ammonia-N Req'd			517
Phosphorus Req'd as Ortho-P	**2.5** %		Ortho-P Req'd			104
Nitrification						
… Based on weight ratio of VSS produced			VSS Produced			139
Nitrogen Req'd as Ammonia-N	**12.4** %		Ammonia-N Req'd			17
Phosphorus Req'd as Ortho-P	**2.5** %		Ortho-P Req'd			3
			Remaining Ammonia-N			1,399
			Remaining Ortho-P			550
			BOD:N:P Ratio			
			Nutrients Utilized:			
			Influent BOD5			11,464
			Ammonia-N			534
			Ortho-P			108
			Therefore the BOD5:N:P Ratio is:			
			BOD5	100		
			Ammonia-N	4.7		
			Ortho-P	0.9		

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Nitrification				**Nitrification**			
				Ammonia-N remaining after satisfying nutrient requirements			1,399
	Ammonia Oxidation	**99.5**	%	Ammonia-N Oxidized; i.e. NO_3-N			1,392
				Ammonia Remaining			7
Denitrification				**Denitrification**			
…A portion of the NO3-N is used is converted to nitrogen gas				Ammonia-N Oxidized; i.e. NO_3-N			1,392
	Denitrification	**0**	%	Total NO_3-N reduced			0
				NO_3-N Remaining			1,392
Chemical Phosphorus Removal				**Chemical Phosphorus Removal**			
				Ortho-P remaining after satisfying nutrient requirements			550
	Ortho-P Removed	**94.0**	%	Ortho-P Removed			517
				Ortho-P Remaining			33
	Ferric Chloride Density	**12**	lbs Sol'n/gal				
	Iron Content	**0.15**	lbs Fe/lbs Sol'n	Ferric Chloride Contains:	0.4357	lbs $FeCl_3$/lb Sol'n	
	Ferric Chloride Dosage	**2.00**	moles Fe to moles Ortho-P	Weight Ratio	3.61	lbs Fe/lb Ortho-P Removed	
				Iron Required	1863	lbs Fe/day	
				Ferric Chloride Required	5411	lbs $FeCl_3$/day	
Dosing approximately 100 gpd of ferric chloride					1035	gal $FeCl_3$/day	
Solids Produced Due to Chemical Precipitation				**Solids Produced Due to Chemical Precipitation**			
	Ferric Phosphate Produced	4.9	lbs/lb P rem.	Ferric Phosphate Produced			2,516
	Ferric Hydroxide Produced	3.5	lbs/lb P rem.	Ferric Hydroxide Produced			1,783
				Total Chemical Sludge Produced			4,298
…Assume that chemcical is added to tail end of the aeration basins and that 100% of the chemical sludge is removed with the biological sludge.				Chemical-P Incorporated Into Sludge			517
Secondary Effluent				**Secondary Effluent**			
	BOD5 Removal	**97**	%	BOD5	4	10.364	344
				Soluble BOD5	2	10.364	195
	TSS Removal	**96**	%	TSS	5	10.364	398
				VSS	4	10.364	338
				ISS	1	10.364	60
				Total Nitrogen	16.6	10.364	1,439
				Nitrate-N	16.0	10.364	1,382
				TKN	0.7	10.364	57
				Ammonia-N	0.1	10.364	7
	Organic-N	12.4	% of TSS + Inf. Fraction	Organic-N	0.6	10.364	50
				Total-P	0.5	10.364	43
				Ortho-P	0.4	10.364	33
	Organic-N	2.5	% of TSS + Inf. Fraction	Organic-P	0.1	10.364	10
				Vol. Content of Solids		85.0%	

Input Assumptions				Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Secondary Sludge				**Secondary Sludge**			
Sludge Production due to BOD Removal				**Sludge Production due to BOD Removal**			
Yield Coefficient (lb VSS Produced				BOD5 Removed			11,120
/ lb BOD5 Removed)	**0.60**			Observed Yield	0.375	lbs VSS / lb BOD_5	
Decay Coefficient	**0.06**	/day					
Mean Cell Residence Time	**10**	days		VSS Produced			4,170
Sludge Production due to Nitrification				**Sludge Production due to Nitrification**			
Yield Coefficient (lb NVSS Produced				Ammonia-N Removed			1,392
/ lb Ammonia Oxidized)	**0.15**			Observed Yield	0.100	lbs VSS / lb BOD_5	
Decay Coefficient	**0.05**	/day					
Mean Cell Residence Time	10	days		NVSS Produced			139
				Total Biological Sludge Production			
				Net VSS Produced			4,309
Volatile Content of MLTSS Produced	**85**	%		Net TSS Produced			5,070
Sludge Production due to Influent Solids				**Sludge Production due to Influent Solids**			
				Influent ISS			2,138
…Difference incorportated into sludge				Effluent ISS			60
				Inf. ISS incorp. Into sludge			2,078
				Influent ISS fraction in sludge	97.2%		
				Organic-N			
				Organic-N Remaining after Solub.			22
… Assume same ratio as ISS				Organic -N incorported into sludge			22
				Remaining Organic-N			1
				Nitrate-N			
				Ammonia-N Nitrified			1,392
				Conc. Based on Influent Flow	16.0	mg/L	
				Nitrate in WAS			10
				Organic-P			
				Organic-P Remaining after Solub.			1.1836
… Assume same ratio as ISS				Organic -P incorported into sludge			1.1505
				Remaining Organic-P			0.0330
Waste Activated Sludge				**Waste Activated Sludge**			
… Assume Net TSS is wasted				TSS	20,000	0.0780	13,009
… Sludge is Wasted from Return Sludge				VSS	9,027	0.0780	5,872
Percent Solids	**2.000**	%		ISS	10,973	0.0780	7,137
… Assume Nutrients consumed are incorportated into cell mass.				Total Nitrogen	871	0.0780	567
				Nitrate-N	16	0.0780	10
				TKN	856	0.0780	556
				Ammonia-N	0.1	0.0780	0
				Organic-N	855	0.0780	556
				Total-P	962	0.0780	626
				Ortho-P	0.4	0.0780	0
				Organic-P	168	0.0780	109
				Chemical-P	794	0.0780	517
				Fraction of Nutrients in Sludge:			
				Nitrogen:	4.3%		
				Phosphorus:	4.8%		
				Volatile Content:	45.1%		

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Activated Sludge Parameters				**Activated Sludge Parameters**			
Aeration Basin Volume		**282,000**	ft^3	Aeration Basin Volume	2.110	Million Gallons	
Solids Under Aeration:				Solids Under Aeration:			
MLTSS		7,820	mg/L	MLTSS	137,583	lbs	
MLVSS		3530		MLVSS	62,101	lbs	
				MLVSS Conc	3,530	mg/L	
				Mixed Liquor Volatile Fraction	45.1%		
				Organic Volumetric Loading	41	lb/1000 ft^3	
				F:M Ratio	0.185		
				Mean Cell Residence Time	10.00	days	
Anoxic Selector Parameters							
Anoxic Selector Volume		0.22	MG	Selector HRT	0.5	hours	
				Selector F:M Ratio	1.7		
Aeration System				**Aeration System**			
BOD Oxygen Requirement		**1.1**	lb O_2/ lb BOD rem.	BOD5 Removed		11,120	lbs/day
				BOD5 Oxygen Requirement		12,232	lbs/day
TKN Oygen Requirement		**4.6**	lb O_2/ lb TKN rem.	TKN Removed		1,392	lbs/day
				TKN Oxygen Requirement		6,405	lbs/day
				Total Oxygen Requirement		18,637	lbs/day
				Total NO3-N reduced		0	lbs/day
Oxygen Recovery from Denitrification		**2.86**	lbs O_2/ lb NO_3 reduced	Denitrification Oxygen Credit		0	lbs/day
				Actual Oxygen Requirement		18,637	lbs/day
Return Activated Sludge				**Return Activated Sludge**			
				TSS	20,000	6.577	1,096,960
				VSS	9,027	6.577	495,134
				Vol. Content of Solids		45.1%	
				RAS Ratio		63.5%	
Final Clarifiers				**Final Clarifiers**			
				Secondary Clarifier Influent			
				MLTSS	7,820	17.019	1,109,969
				MLVSS	3,530	17.019	501,005
				Vol. Content of Solids		45.1%	
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter		**90**	ft				
No. of Clarifiers		**2**					
Clarifier Depth		**16**	ft				
Total Surface Area		12,723	ft^2	Surface Overflow Rate (SOR)	815	gal/day/ft^2	
Total Weir Length		565	ft	Weir Overflow Rate (WOR)	18,328	gal/day/ft	
Volume		1,522,844	gallons	Solids Loading Rate	87.2	lb/day/ft^2	
				or	3.63	lb/hr/ft^2	

Input Assumptions			**Calculations**			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Anaerobic Digestion (No Supernating)			**Anaerobic Digestion (No Supernating)**			
Digester Influent			**Digester Influent = WAS + Primary Sludge**			
			TSS	35,000	0.0787	22,959
			VSS	21,086	0.0787	13,832
			ISS	13,914	0.0787	9,127
			Total Nitrogen	1,251	0.0787	821
			Nitrate-N	16	0.0787	10.4
			TKN	1,235	0.0787	810
			Ammonia-N	8	0.0787	5.0
			Organic-N	1,227	0.0787	805
			Total-P	1,185	0.0787	777
			Ortho-P	4	0.0787	2
			Organic-P	394	0.0787	258
			Chemical-P	787	0.0787	517
			Vol. Content of Solids		60.2%	
Removals and Conversions			**Removals and Conversions**			
VSS Destruction			**VSS Destruction**			
VSS Destruction	**50**	%	VSS Destruction			6,916
Gas Production	**15**	ft^3/lb VSS des.	Digester Gas Production		103,742	ft^3 /day
Organic-N Conversion			**Organic-N Conversion**			
Conversion of influent Organic-N	50	%	Influent Organic-N			805
			Organic-N Converted			403
…A portion of the influent Organic-N is converted to Ammonia-N			Organic-N Remaining			403
			Ammonia-N Produced			403
Nitrate-N Conversion			**Nitrate-N Conversion**			
Conversion of influent Nitrate-N	**100**	%	Influent Nitrate-N			10
			Nitrate-N Converted			10
…The influent Nitrate-N is converted to Nitrogen Gas			Nitrate-N Remaining			0
Organic-P Solubilized			**Organic-P Solubilized**			
Conversion of influent Organic-P	50	%	Influent Organic-P			258
			Organic-P Converted			129
…A portion of the influent Organic-P is converted to Ortho-P			Organic-P Remaining			129
			Ortho-P Produced			129
Digested Sludge			**Digested Sludge**			
			TSS	24,457	0.0787	16,043
			VSS	10,543	0.0787	6,916
			ISS	13,914	0.0787	9,127
			Total Nitrogen	1,235	0.0787	810
			Nitrate-N	0	0.0787	0
			TKN	1,235	0.0787	810
			Ammonia-N	621	0.0787	408
			Organic-N	614	0.0787	403
			Total-P	1,185	0.0787	777
			Ortho-P	200	0.0787	131
			Organic-P	197	0.0787	129
			Chemical-P	787	0.0787	517
			Vol. Content of Solids		43.1%	
			Fraction of Nutrients in Sludge:			
			Nitrogen:	5.0%		
			Phosphorus:	4.8%		
Digester Dimensional Parameters			**Loading Rates**			
			Digester Influent VS	13,832	lbs/day	
Digester Volume	**79,600**	ft^3	Volatile Solids Loading	0.174	lb VS/day/ft^3	
			or	174	lb VS/ 1000 ft^3 /day	
			Digester Influent Flow Rate	78,655	gpd	
			Digester Volume	595,448	gallons	
			HRT = SRT =	8	days	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Digested Sludge to Centrifuges				**Digested Sludge to Centrifuges**			
				TSS	24,457	0.1966	40,108
				VSS	10,543	0.1966	17,290
				ISS	13,914	0.1966	22,818
				Total Nitrogen	1,235	0.1966	2,025
				Nitrate-N	-	0.1966	-
				TKN	1,235	0.1966	2,025
				Ammonia-N	621	0.1966	1,019
				Organic-N	614	0.1966	1,006
				Total-P	1,185	0.1966	1,943
				Ortho-P	200	0.1966	329
				Organic-P	197	0.1966	323
				Chemical-P	787	0.1966	1,291
				Vol. Content of Solids		43.1%	
Dewatered Digested Sludge				**Dewatered Digested Sludge**			
	Solids Capture	**95** %					
	Percent Solids	**25.0** %		TS	250,000	0.0183	38,103
				VS	107,773	0.0183	16,426
				ISS	142,227	0.0183	21,677
				Total Nitrogen	3,131	0.0183	477
				Nitrate-N	-	0.0183	-
… Organic-N, Organic-P, and Chemcial-P are assumed to be related to				TKN	3,131	0.0183	477
TSS and assumed to be removed at the same rate.				Ammonia-N	621	0.0183	95
Ammonia-N, Ortho-P are assumed to be soluble.				Organic-N	2,509	0.0183	382
				Total-P	4,225	0.0183	644
				Ortho-P	200	0.0183	31
				Organic-P	805	0.0183	123
				Chemical-P	3,220	0.0183	491
				Vol. Content of Solids		43.1%	
Centrate				**Centrate**			
…Assume that the ratio of the centrate BOD5/VSS							
				BOD5	258	0.1784	384
				Soluble BOD5	2	0.1784	3
				TSS	1,348	0.1784	2,005
				VSS	581	0.1784	865
				ISS	767	0.1784	1,141
				Total Nitrogen	1,041	0.1784	1,548
				Nitrate-N	0	0.1784	0
…Assume that Ortho-P and Ammonia-N concentrations				TKN	1,041	0.1784	1,548
are the same as that in Secondary Effluent.				Ammonia-N	621	0.1784	924
				Organic-N	419	0.1784	624
				Total-P	873	0.1784	1,299
				Ortho-P	200	0.1784	298
				Organic-P	135	0.1784	200
				Chemical-P	538	0.1784	801

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Washwater				**Washwater**			
…Assume that Secondary Effluent is used for washwater				BOD5	4	0.0358	1.2
				Soluble BOD5	2	0.0358	0.7
				TSS	5	0.0358	1.4
				VSS	4	0.0358	1.2
				ISS	1	0.0358	0.2
				Total Nitrogen	16.6	0.0358	5.0
				Nitrate-N	16.0	0.0358	4.8
				TKN	0.7	0.0358	0.2
				Ammonia-N	0.1	0.0358	0.0
				Organic-N	0.6	0.0358	0.2
				Total-P	0.5	0.0358	0.1
				Ortho-P	0.4	0.0358	0.1
				Organic-P	0.1	0.0358	0.0
	Centrifuge Feed Rate	**220**	gpm	… Average Operating Time	14.90	hrs/day	
	Belt Washwater	**100**	gpm	… Ave. Solids Loading	2,692	lbs/hr	
				… Belt Washwater	89,381	gpd	
				… Average Operating Time / Week	29.79	hrs/week	
Centrate and Washwater				**Centrate and Washwater**			
				BOD5	216	0.043	77
				Soluble BOD5	2	0.043	1
				TSS	1124	0.043	401
				VSS	485	0.043	173
				ISS	639	0.043	228
				Total Nitrogen	870	0.043	311
				Nitrate-N	3	0.043	1
				TKN	867	0.043	310
				Ammonia-N	518	0.043	185
				Organic-N	350	0.043	125
				Total-P	727	0.043	260
				Ortho-P	167	0.043	60
				Organic-P	112	0.043	40
				Chemical-P	538	0.043	192

Input Assumptions			**Calculations**			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Influent Parameters			**Influent Parameters**			
Flow	**24.000**	MGD				
BOD5	**29,100**	lbs/day	BOD5	145	24.000	29,100
Soluble BOD5	**40**	% of BOD5	Soluble BOD5	58	24.000	11,640
TSS	**44,500**	lbs/day	TSS	222	24.000	44,500
VSS	**80**	% of TSS	VSS	178	24.000	35,600
ISS	**20**	% of TSS	ISS	44	24.000	8,900
TKN	**2,800**	lbs/day	TKN	14.0	24.000	2,800
Ammonia-N	**70**	% of TKN	Ammonia-N	9.8	24.000	1,960
Organic-N	**30**	% of TKN	Organic-N	4.2	24.000	840
Total-P	**710**	lbs/day	Total-P	3.5	24.000	710
Ortho-P	**70**	% of T-P	Ortho-P	2.5	24.000	497
Organic-P	**30**	% of T-P	Organic-P	1.1	24.000	213
Recycle Streams to Pump Station			**Recycle Streams to Pump Station**			
Recycle Stream from Filtrate and Washwater			**Recycle Stream from Filtrate and Washwater**			
			BOD5	186	0.0824	128
			Soluble BOD5	2	0.0824	1
			TSS	1069	0.0824	735
			VSS	533	0.0824	367
			ISS	535	0.0824	368
			TKN	861	0.0824	592
			Ammonia-N	514	0.0824	353
			Organic-N	347	0.0824	238
			Total-P	525	0.0824	361
			Ortho-P	176	0.0824	121
			Organic-P	119	0.0824	82
…Assumed that all Chemical-P is recycled as Ortho-P.			Chemical-P	276	0.0824	189
Preliminary Treatment			**Preliminary Treatment**			
Preliminary Treatment Effluent			**Preliminary Treatment Effluent**			
			BOD5	146	24.082	29,228
…Any removals obtained in the Grit Basins and			Soluble BOD5	58	24.082	11,641
Fine Screens are negligible.			TSS	225	24.082	45,235
			VSS	179	24.082	35,967
			ISS	46	24.082	9,268
			TKN	16.9	24.082	3,392
			Ammonia-N	11.5	24.082	2,313
			Organic-N	5.4	24.082	1,078
			Total-P	5.3	24.082	1,071
			Ortho-P	4.0	24.082	808
			Organic-P	1.5	24.082	295
			Vol. Content of Solids		79.5%	
Waste Activated Sludge to the Primary Clarifiers			**Waste Activated Sludge to the Primary Clarifiers**			
			BOD5	0	0.1283	0
			Soluble BOD5	0	0.1283	0
			TSS	20,000	0.1283	21,395
			VSS	10,470	0.1283	11,201
			ISS	9,530	0.1283	10,194
			Total Nitrogen	917	0.1283	981
			Nitrate-N	9	0.1283	10
			TKN	908	0.1283	971
			Ammonia-N	0	0.1283	0
			Organic-N	908	0.1283	971
			Total-P	651	0.1283	697
			Ortho-P	0	0.1283	0
			Organic-P	175	0.1283	187
			Chemical-P	476	0.1283	510
			Fraction of Nutrients in Sludge:			
			Nitrogen:	4.5%		
			Phosphorus:	3.3%		
			Volatile Content:	52.4%		

Input Assumptions {A}	{B}	{C}
Primary Treatment		
Primary Clarifier Influent		
Clarifier Dimensional Parameters		
Clarifier Diameter	**85**	ft
No. of Clarifiers	**2**	
Clarifier Depth	**12**	ft
Total Surface Area	11,349	ft^2
Total Weir Length	534	ft
Volume	1,018,755	gallons
Primary Clarifier Effluent From Preliminary Effluent		
BOD5 Removal	**30.0**	%
TSS Removal	**50.0**	%
TKN Removal: Based on sludge content		
Ammonia Removal	**0**	%
Total-P Removal: Based on sludge content		
Ortho-P Removal	**0**	%
Primary Sludge From Preliminary Treatment Effluent		
Percent Solids	**3.50**	%
Volatile Content	**80**	% of TSS
Nitrogen Content	**2.5**	% of TSS
Phosphorus Content	**1.5**	% of TSS

Calculations {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Primary Treatment			
Primary Clarifier Influent (WAS + Preliminary Effluent)			
BOD5	145	24.211	29,228
Soluble BOD5	58	24.211	11,641
TSS	330	24.211	66,629
VSS	234	24.211	47,167
ISS	96	24.211	19,462
Nitrate-N	5	24.211	971
TKN	22	24.211	4,363
Ammonia-N	11	24.211	2,314
Organic-N	10	24.211	2,049
Total-P	9	24.211	1,767
Ortho-P	4	24.211	808
Organic-P	2	24.211	482
Chemical-P	3	24.211	510
Loading Rates			
Surface Overflow Rate (SOR)	2,133	gal/day/ft^2	
Weir Overflow Rate (WOR)	45,332	gal/day/ft	
Hydraulic Retention Time	1.0	hours	
Primary Clarifier Effluent From Preliminary Effluent			
BOD5	102	24.005	20,460
Soluble BOD5	58	24.005	11,604
TSS	113	24.005	22,617
VSS	89	24.005	17,873
ISS	24	24.005	4,745
TKN	14.1	24.005	2,819
Ammonia-N	11.5	24.005	2,306
Organic-N	2.6	24.005	513
Total-P	3.6	24.005	729
Ortho-P	4.0	24.005	805
Organic-P	-0.4	24.005	-76.2
Vol. Content of Solids		79.0%	
Primary Sludge From Preliminary Treatment Effluent			
TSS	35,000	0.0775	22,617
VSS	28,000	0.0775	18,094
ISS	7,000	0.0775	4,523
TKN	887	0.0775	573
Ammonia-N	12	0.0775	7
Organic-N	875	0.0775	565
Total-P	529	0.0775	342
Ortho-P	4	0.0775	3
Organic-P	525	0.0775	339
TKN Removal		16.9%	
Total-P Removal		31.9%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Clarifier Effluent From WAS				**Primary Clarifier Effluent From WAS**			
				BOD5	0	0.055	0
	Total WAS Removal	**100**	%	Soluble BOD5	0	0.055	0
				TSS	0	0.055	0
				VSS	0	0.055	0
				ISS	0	0.055	0
				Nitrate-N	0	0.055	0
				TKN	0	0.055	0
				Ammonia-N	0	0.055	0
				Organic-N	0	0.055	0
				Total-P	0	0.055	0
				Ortho-P	0	0.055	0
				Organic-P	0	0.055	0
				Chemical-P	0	0.055	0
				Vol. Content of Solids			
Primary Sludge From WAS				**Primary Sludge From WAS**			
	Percent Solids	**3.50**	%	TSS	35,000	0.0733	21,395
				VSS	18323	0.0733	11,201
				ISS	16677	0.0733	10,194
				Nitrate-N	16	0.0733	10
				TKN	1589	0.0733	971
				Ammonia-N	0	0.0733	0
				Organic-N	1589	0.0733	971
				Total-P	1140	0.0733	697
				Ortho-P	0	0.0733	0
				Organic-P	306	0.0733	187
				Chemical-P	834	0.0733	510
				TKN Removal		100.0%	
				Total-P Removal		100.0%	
Total Primary Clarifier Effluent				**Total Primary Clarifier Effluent**			
				BOD5	102	24.060	20,460
				Soluble BOD5	58	24.060	11,604
				TSS	113	24.060	22,617
				VSS	89	24.060	17,873
				ISS	24	24.060	4,745
				Nitrate-N	0	24.060	0
				TKN	14.0	24.060	2,819
				Ammonia-N	11.5	24.060	2,306
				Organic-N	2.6	24.060	513
				Total-P	3.6	24.060	729
				Ortho-P	4.0	24.060	805
				Organic-P	-0.4	24.060	-76
				Chemical-P	0.0	24.060	0
				Vol. Content of Solids		79.0%	
Total Primary Sludge				**Total Primary Sludge**			
				TSS	35,000	0.1508	44,012
				VSS	23,296	0.1508	29,294
				ISS	11,704	0.1508	14,717
				Nitrate-N	8	0.1508	9.8
				TKN	1,228	0.1508	1,544
				Ammonia-N	6	0.1508	7.5
				Organic-N	1,222	0.1508	1,537
				Total-P	826	0.1508	1,039
				Ortho-P	2	0.1508	3
				Organic-P	419	0.1508	526
				Chemical-P	405	0.1508	510
				TKN Removal		35%	
				Total-P Removal		59%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Secondary Treatment - Activated Sludge				**Secondary Treatment - Activated Sludge**			
Aeration Basin Influent				**Aeration Basin Influent**			
				BOD5	102	24.060	20,460
				Soluble BOD5	58	24.060	11,604
				TSS	113	24.060	22,617
				VSS	89	24.060	17,873
				ISS	24	24.060	4,745
				TKN	14.0	24.060	2,819
				Ammonia-N	11.5	24.060	2,306
				Organic-N	2.6	24.060	513
				Total-P	3.6	24.060	729
				Ortho-P	4.0	24.060	805
				Organic-P	-0.4	24.060	-76
				Vol. Content of Solids		79.0%	
Nutrient Conversions							
Organic-N Conversion				**Organic-N Conversion**			
… A portion of the Influent Organic-N is				Influent Organic-N			513
converted to Ammonia-N				Influent Ammonia-N			2,306
Assume Conversion of	**95**	%		Organic-N Converted			487
				Resulting Ammonia-N			2,793
				Remaining Organic-N			26
Organic-P Conversion				**Organic-P Conversion**			
… A portion of the Influent Organic-P is				Influent Organic-P			-76
converted to Ortho-P				Influent Ortho-P			805
Assume Conversion of	**95**	%		Organic-P Converted			-72
				Resulting Ortho-P			733
				Remaining Organic-P			-4
VSS Biodegradation				**VSS Biodegradation**			
… A portion of the Influent VSS				Influent VSS			17,873
is Biodegradable							
Assumed Biodegradable Fraction	**80**	%		VSS Biodegraded			14,298
… Remaining VSS is incorportated into the Sludge				Non-Biodegradable VSS			3,575
Nutrient Requirements							
Carbonaceous							
… Based on weight ratio of VSS produced				VSS Produced			7,442
Nitrogen Req'd as Ammonia-N	**12.4**	%		Ammonia-N Req'd			923
Phosphorus Req'd as Ortho-P	**2.5**	%		Ortho-P Req'd			186
Nitrification							
… Based on weight ratio of VSS produced				VSS Produced			184
Nitrogen Req'd as Ammonia-N	**12.4**	%		Ammonia-N Req'd			23
Phosphorus Req'd as Ortho-P	**2.5**	%		Ortho-P Req'd			5
				Remaining Ammonia-N			1,848
				Remaining Ortho-P			542
				BOD:N:P Ratio			
				Nutrients Utilized:			
				Influent BOD5			20,460
				Ammonia-N			946
				Ortho-P			191
				Therefore the BOD5:N:P Ratio is:			
				BOD5	100		
				Ammonia-N	4.6		
				Ortho-P	0.9		

Input Assumptions

	{A}	{B}	{C}
Nitrification			
	Ammonia Oxidation	**99.5**	%
Denitrification			
…A portion of the NO3-N is used is converted to nitrogen gas			
	Denitrification	**0**	%
Chemical Phosphorus Removal			
	Ortho-P Removed	**94.0**	%
	Ferric Chloride Density	**12**	lbs Sol'n/gal
	Iron Content	**0.15**	lbs Fe/lbs Sol'n
	Ferric Chloride Dosage	**2.00**	moles Fe to moles Ortho-P
Dosing approximately 100 gpd of ferric chloride			
Solids Produced Due to Chemical Precipitation			
	Ferric Phosphate Produced	4.9	lbs/lb P rem.
	Ferric Hydroxide Produced	3.5	lbs/lb P rem.
…Assume that chemcical is added to tail end of the aeration basins and that 100% of the chemical sludge is removed with the biological sludge.			
Secondary Effluent			
	BOD5 Removal	**97**	%
	TSS Removal	**96**	%
	Organic-N	12.4	% of TSS + Inf. Fraction
	Organic-N	2.5	% of TSS + Inf. Fraction

Calculations

{D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Nitrification			
Ammonia-N remaining after satisfying nutrient requirements			1,848
Ammonia-N Oxidized; i.e. NO_3-N			1,838
Ammonia Remaining			9
Denitrification			
Ammonia-N Oxidized; i.e. NO_3-N			1,838
Total NO_3-N reduced			0
NO_3-N Remaining			1,838
Chemical Phosphorus Removal			
Ortho-P remaining after satisfying nutrient requirements			542
Ortho-P Removed			510
Ortho-P Remaining			33
Ferric Chloride Contains:	0.4357	lbs $FeCl_3$/lb Sol'n	
Weight Ratio	3.61	lbs Fe/lb Ortho-P Removed	
Iron Required	1838	lbs Fe/day	
Ferric Chloride Required	5337	lbs $FeCl_3$/day	
	1021	gal $FeCl_3$/day	
Solids Produced Due to Chemical Precipitation			
Ferric Phosphate Produced			2,481
Ferric Hydroxide Produced			1,758
Total Chemical Sludge Produced			4,239
Chemical-P Incorporated Into Sludge			510
Secondary Effluent			
BOD5	3	23.932	614
Soluble BOD5	2	23.932	348
TSS	5	23.932	905
VSS	4	23.932	769
ISS	1	23.932	136
Total Nitrogen	9.8	23.932	1,951
Nitrate-N	9.2	23.932	1,829
TKN	0.6	23.932	122
Ammonia-N	0.0	23.932	9
Organic-N	0.6	23.932	113
Total-P	0.3	23.932	55
Ortho-P	0.2	23.932	33
Organic-P	0.1	23.932	23
Vol. Content of Solids		85.0%	

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Secondary Sludge				**Secondary Sludge**			
Sludge Production due to BOD Removal				**Sludge Production due to BOD Removal**			
Yield Coefficient (lb VSS Produced				BOD5 Removed			19,846
/ lb BOD5 Removed)	**0.60**			Observed Yield	0.375	lbs VSS / lb BOD_5	
Decay Coefficient	**0.06**	/day					
Mean Cell Residence Time	**10**	days		VSS Produced			7,442
Sludge Production due to Nitrification				**Sludge Production due to Nitrification**			
Yield Coefficient (lb NVSS Produced				Ammonia-N Removed			1,838
/ lb Ammonia Oxidized)	**0.15**			Observed Yield	0.100	lbs VSS / lb BOD_5	
Decay Coefficient	**0.05**	/day					
Mean Cell Residence Time	10	days		NVSS Produced			184
				Total Biological Sludge Production			
				Net VSS Produced			7,626
Volatile Content of MLTSS Produced	**85**	%		Net TSS Produced			8,972
Sludge Production due to Influent Solids				**Sludge Production due to Influent Solids**			
				Influent ISS			4,745
…Difference incorportated into sludge				Effluent ISS			136
				Inf. ISS incorp. Into sludge			4,609
				Influent ISS fraction in sludge	97.1%		
				Organic-N			
				Organic-N Remaining after Solub.			26
… Assume same ratio as ISS				Organic -N incorported into sludge			25
				Remaining Organic-N			1
				Nitrate-N			
				Ammonia-N Nitrified			1,838
				Conc. Based on Influent Flow	9.2	mg/L	
				Nitrate in WAS			10
				Organic-P			
				Organic-P Remaining after Solub.			-3.8090
… Assume same ratio as ISS				Organic -P incorported into sludge			-3.7001
				Remaining Organic-P			-0.1089
Waste Activated Sludge				**Waste Activated Sludge**			
… Assume Net TSS is wasted				TSS	20,000	0.1283	21,395
… Sludge is Wasted from Return Sludge				VSS	10,470	0.1283	11,201
Percent Solids	**2.000**	%		ISS	9,530	0.1283	10,194
… Assume Nutrients consumed are incorportated into cell mass.				Total Nitrogen	917	0.1283	981
				Nitrate-N	9	0.1283	10
				TKN	908	0.1283	971
				Ammonia-N	0.0	0.1283	0
				Organic-N	908	0.1283	971
				Total-P	651	0.1283	697
				Ortho-P	0.2	0.1283	0
				Organic-P	175	0.1283	187
				Chemical-P	476	0.1283	510
				Fraction of Nutrients in Sludge:			
				Nitrogen:	4.5%		
				Phosphorus:	3.3%		
				Volatile Content:	52.4%		

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Activated Sludge Parameters				**Activated Sludge Parameters**			
Aeration Basin Volume		**282,000**	ft^3	Aeration Basin Volume	2.110	Million Gallons	
Solids Under Aeration:				Solids Under Aeration:			
MLTSS		12,996	mg/L	MLTSS	228,634	lbs	
MLVSS		6803		MLVSS	119,695	lbs	
				MLVSS Conc	6,803	mg/L	
				Mixed Liquor Volatile Fraction	52.4%		
				Organic Volumetric Loading	73	lb/1000 ft^3	
				F:M Ratio	0.171		
				Mean Cell Residence Time	10.00	days	
Anoxic Selector Parameters							
Anoxic Selector Volume		0.22	MG	Selector HRT	0.2	hours	
				Selector F:M Ratio	1.6		
Aeration System				**Aeration System**			
BOD Oxygen Requirement		**1.1**	lb O_2/ lb BOD rem.	BOD5 Removed		19,846	lbs/day
				BOD5 Oxygen Requirement		21,830	lbs/day
TKN Oygen Requirement		**4.6**	lb O_2/ lb TKN rem.	TKN Removed		1,838	lbs/day
				TKN Oxygen Requirement		8,456	lbs/day
				Total Oxygen Requirement		30,287	lbs/day
				Total NO3-N reduced		0	lbs/day
Oxygen Recovery from Denitrification		**2.86**	lbs O_2/ lb NO_3 reduced	Denitrification Oxygen Credit		0	lbs/day
				Actual Oxygen Requirement		30,287	lbs/day
Return Activated Sludge				**Return Activated Sludge**			
				TSS	20,000	44.273	7,384,715
				VSS	10,470	44.273	3,866,069
				Vol. Content of Solids		52.4%	
				RAS Ratio		185.0%	
Final Clarifiers				**Final Clarifiers**			
				Secondary Clarifier Influent			
				MLTSS	12,996	68.333	7,406,109
				MLVSS	6,803	68.333	3,877,269
				Vol. Content of Solids		52.4%	
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter		**90**	ft				
No. of Clarifiers		**2**					
Clarifier Depth		**16**	ft				
Total Surface Area		12,723	ft^2	Surface Overflow Rate (SOR)	1,881	gal/day/ft^2	
Total Weir Length		565	ft	Weir Overflow Rate (WOR)	42,320	gal/day/ft	
Volume		1,522,844	gallons	Solids Loading Rate	582.1	lb/day/ft^2	
				or	24.25	lb/hr/ft^2	

Input Assumptions			Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Anaerobic Digestion (No Supernating)			**Anaerobic Digestion (No Supernating)**			
Digester Influent			**Digester Influent = WAS + Primary Sludge**			
			TSS	35,000	0.1508	44,012
			VSS	23,296	0.1508	29,294
			ISS	11,704	0.1508	14,717
			Total Nitrogen	1,236	0.1508	1,554
			Nitrate-N	8	0.1508	9.8
			TKN	1,228	0.1508	1,544
			Ammonia-N	6	0.1508	7.5
			Organic-N	1,222	0.1508	1537
			Total-P	826	0.1508	1039
			Ortho-P	2	0.1508	3
			Organic-P	419	0.1508	526
			Chemical-P	405	0.1508	510
			Vol. Content of Solids		66.6%	
Removals and Conversions			**Removals and Conversions**			
VSS Destruction			**VSS Destruction**			
VSS Destruction	**50**	%	VSS Destruction			14,647
Gas Production	**15**	ft^3/lb VSS des.	Digester Gas Production		219,708	ft^3 /day
Organic-N Conversion			**Organic-N Conversion**			
Conversion of influent Organic-N	50	%	Influent Organic-N			1537
			Organic-N Converted			768
…A portion of the influent Organic-N is converted to Ammonia-N			Organic-N Remaining			768
			Ammonia-N Produced			768
Nitrate-N Conversion			**Nitrate-N Conversion**			
Conversion of influent Nitrate-N	**100**	%	Influent Nitrate-N			10
			Nitrate-N Converted			10
…The influent Nitrate-N is converted to Nitrogen Gas			Nitrate-N Remaining			0
Organic-P Solubilized			**Organic-P Solubilized**			
Conversion of influent Organic-P	50	%	Influent Organic-P			526
			Organic-P Converted			263
…A portion of the influent Organic-P is converted to Ortho-P			Organic-P Remaining			263
			Ortho-P Produced			263
Digested Sludge			**Digested Sludge**			
			TSS	23,352	0.1508	29,365
			VSS	11,648	0.1508	14,647
			ISS	11,704	0.1508	14,717
			Total Nitrogen	1,228	0.1508	1,544
			Nitrate-N	0	0.1508	0
			TKN	1,228	0.1508	1,544
			Ammonia-N	617	0.1508	776
			Organic-N	611	0.1508	768
			Total-P	826	0.1508	1,039
			Ortho-P	211	0.1508	266
			Organic-P	209	0.1508	263
			Chemical-P	405	0.1508	510
			Vol. Content of Solids		49.9%	
			Fraction of Nutrients in Sludge:			
			Nitrogen:	5.3%		
			Phosphorus:	3.5%		
Digester Dimensional Parameters			**Loading Rates**			
			Digester Influent VS	29,294	lbs/day	
Digester Volume	**79,600**	ft^3	Volatile Solids Loading	0.368	lb VS/day/ft^3	
			or	368	lb VS/ 1000 ft^3 /day	
			Digester Influent Flow Rate	150,777	gpd	
			Digester Volume	595,448	gallons	
			HRT = SRT =	4	days	

Input Assumptions	{A}	{B}	{C}	**Calculations** {D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Digested Sludge to Centrifuge				**Digested Sludge to Centrifuge**			
				TSS	23,352	0.3769	73,412
				VSS	11,648	0.3769	36,618
				ISS	11,704	0.3769	36,794
				Total Nitrogen	1,228	0.3769	3,860
				Nitrate-N	-	0.3769	-
				TKN	1,228	0.3769	3,860
				Ammonia-N	617	0.3769	1,939
				Organic-N	611	0.3769	1,921
				Total-P	826	0.3769	2,597
				Ortho-P	211	0.3769	665
				Organic-P	209	0.3769	658
				Chemical-P	405	0.3769	1,274
				Vol. Content of Solids		49.9%	
				Dewatered Digested Sludge			
Solids Capture		**95** %					
Percent Solids		**25.0** %		TS	250,000	0.0334	69,741
				VS	124,701	0.0334	34,787
				ISS	125,299	0.0334	34,954
				Total Nitrogen	3,233	0.0334	902
… Organic-N, Organic-P, and Chemcial-P are assumed to be related to				Nitrate-N	-	0.0334	-
TSS and assumed to be removed at the same rate.				TKN	3,233	0.0334	902
Ammonia-N, Ortho-P are assumed to be soluble.				Ammonia-N	617	0.0334	172
				Organic-N	2,616	0.0334	730
				Total-P	2,843	0.0334	793
				Ortho-P	211	0.0334	59
				Organic-P	896	0.0334	250
				Chemical-P	1,735	0.0334	484
				Vol. Content of Solids		49.9%	
Centrate				**Centrate**			
…Assume that the ratio of the centrate BOD5/VSS							
				BOD5	223	0.3435	638
				Soluble BOD5	2	0.3435	5
				TSS	1,281	0.3435	3,671
				VSS	639	0.3435	1,831
				ISS	642	0.3435	1,840
				Total Nitrogen	1,033	0.3435	2,958
				Nitrate-N	0	0.3435	0
…Assume that Ortho-P and Ammonia-N concentrations				TKN	1,033	0.3435	2,958
are the same as that in Secondary Effluent.				Ammonia-N	617	0.3435	1,767
				Organic-N	416	0.3435	1,191
				Total-P	630	0.3435	1,803
				Ortho-P	211	0.3435	606
				Organic-P	142	0.3435	408
				Chemical-P	276	0.3435	790

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Washwater				**Washwater**			
…Assume that Secondary Effluent is used for washwater				BOD5	3	0.0685	1.8
				Soluble BOD5	2	0.0685	1.0
				TSS	5	0.0685	2.6
				VSS	4	0.0685	2.2
				ISS	1	0.0685	0.4
				Total Nitrogen	9.8	0.0685	5.6
				Nitrate-N	9.2	0.0685	5.2
				TKN	0.6	0.0685	0.3
				Ammonia-N	0.0	0.0685	0.0
				Organic-N	0.6	0.0685	0.3
				Total-P	0.3	0.0685	0.2
				Ortho-P	0.2	0.0685	0.1
				Organic-P	0.1	0.0685	0.1
	Centrifuge Feed Rate	**220**	gpm	… Average Operating Time	28.56	hrs/day	
	Belt Washwater	**100**	gpm	… Ave. Solids Loading	2,571	lbs/hr	
				… Belt Washwater	171,338	gpd	
				… Average Operating Time / Week	57.11	hrs/week	
Centrate and Washwater				**Centrate and Washwater**			
				BOD5	186	0.082	128
				Soluble BOD5	2	0.082	1
				TSS	1069	0.082	735
				VSS	533	0.082	367
				ISS	535	0.082	368
				Total Nitrogen	862	0.082	593
				Nitrate-N	2	0.082	1
				TKN	861	0.082	592
				Ammonia-N	514	0.082	353
				Organic-N	347	0.082	238
				Total-P	525	0.082	361
				Ortho-P	176	0.082	121
				Organic-P	119	0.082	82
				Chemical-P	276	0.082	189

Input Assumptions

{A}	{B}	{C}
Influent Parameters		
Flow	**27.000**	MGD
BOD5	**29,100**	lbs/day
Soluble BOD5	**40**	% of BOD5
TSS	**44,500**	lbs/day
VSS	**80**	% of TSS
ISS	**20**	% of TSS
TKN	**2,800**	lbs/day
Ammonia-N	**70**	% of TKN
Organic-N	**30**	% of TKN
Total-P	**710**	lbs/day
Ortho-P	**70**	% of T-P
Organic-P	**30**	% of T-P
Recycle Streams to Pump Station		
Recycle Stream from Filtrate and Washwater		
…Assumed that all Chemical-P is recycled as Ortho-P.		
Preliminary Treatment		
Preliminary Treatment Effluent		
…Any removals obtained in the Grit Basins and Fine Screens are negligible.		
Waste Activated Sludge to the Primary Clarifiers		

Calculations

{D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Influent Parameters			
BOD5	129	27.000	29,100
Soluble BOD5	52	27.000	11,640
TSS	198	27.000	44,500
VSS	158	27.000	35,600
ISS	40	27.000	8,900
TKN	12.4	27.000	2,800
Ammonia-N	8.7	27.000	1,960
Organic-N	3.7	27.000	840
Total-P	3.2	27.000	710
Ortho-P	2.2	27.000	497
Organic-P	0.9	27.000	213
Recycle Streams to Pump Station			
Recycle Stream from Filtrate and Washwater			
BOD5	186	0.0824	128
Soluble BOD5	2	0.0824	1
TSS	1069	0.0824	735
VSS	533	0.0824	367
ISS	536	0.0824	368
TKN	860	0.0824	591
Ammonia-N	514	0.0824	353
Organic-N	347	0.0824	238
Total-P	525	0.0824	361
Ortho-P	176	0.0824	121
Organic-P	119	0.0824	82
Chemical-P	276	0.0824	190
Preliminary Treatment			
Preliminary Treatment Effluent			
BOD5	129	27.082	29,228
Soluble BOD5	52	27.082	11,641
TSS	200	27.082	45,235
VSS	159	27.082	35,967
ISS	41	27.082	9,268
TKN	15.0	27.082	3,391
Ammonia-N	10.2	27.082	2,313
Organic-N	4.8	27.082	1,078
Total-P	4.7	27.082	1,071
Ortho-P	3.6	27.082	808
Organic-P	1.3	27.082	295
Vol. Content of Solids		79.5%	
Waste Activated Sludge to the Primary Clarifiers			
BOD5	0	0.1283	0
Soluble BOD5	0	0.1283	0
TSS	20,000	0.1283	21,396
VSS	10,470	0.1283	11,201
ISS	9,530	0.1283	10,196
Total Nitrogen	916	0.1283	980
Nitrate-N	8	0.1283	9
TKN	908	0.1283	971
Ammonia-N	0	0.1283	0
Organic-N	908	0.1283	971
Total-P	651	0.1283	697
Ortho-P	0	0.1283	0
Organic-P	175	0.1283	187
Chemical-P	476	0.1283	510
Fraction of Nutrients in Sludge:			
Nitrogen:	4.5%		
Phosphorus:	3.3%		
Volatile Content:	52.3%		

Input Assumptions			Calculations	CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Primary Treatment			**Primary Treatment**			
Primary Clarifier Influent			**Primary Clarifier Influent (WAS + Preliminary Effluent)**			
			BOD5	129	27.211	29,228
			Soluble BOD5	51	27.211	11,641
			TSS	294	27.211	66,631
			VSS	208	27.211	47,167
			ISS	86	27.211	19,464
			Nitrate-N	4	27.211	971
			TKN	19	27.211	4,362
			Ammonia-N	10	27.211	2,313
			Organic-N	9	27.211	2,049
			Total-P	8	27.211	1,768
			Ortho-P	4	27.211	808
			Organic-P	2	27.211	482
			Chemical-P	2	27.211	510
Clarifier Dimensional Parameters			**Loading Rates**			
Clarifier Diameter	**85**	ft				
No. of Clarifiers	**2**					
Clarifier Depth	**12**	ft				
Total Surface Area	11,349	ft^2	Surface Overflow Rate (SOR)	2,398	$gal/day/ft^2$	
Total Weir Length	534	ft	Weir Overflow Rate (WOR)	50,950	gal/day/ft	
Volume	1,018,755	gallons	Hydraulic Retention Time	0.9	hours	
Primary Clarifier Effluent From Preliminary Effluent			**Primary Clarifier Effluent From Preliminary Effluent**			
BOD5 Removal	**30.0**	%	BOD5	91	27.005	20,459
			Soluble BOD5	52	27.005	11,608
TSS Removal	**50.0**	%	TSS	100	27.005	22,617
			VSS	79	27.005	17,873
			ISS	21	27.005	4,745
TKN Removal: Based on sludge content			TKN	12.5	27.005	2,819
Ammonia Removal	**0**	%	Ammonia-N	10.2	27.005	2,306
			Organic-N	2.3	27.005	513
Total-P Removal: Based on sludge content			Total-P	3.2	27.005	729
Ortho-P Removal	**0**	%	Ortho-P	3.6	27.005	805
			Organic-P	-0.3	27.005	-76.2
			Vol. Content of Solids		79.0%	
Primary Sludge From Preliminary Treatment Effluent			**Primary Sludge From Preliminary Treatment Effluent**			
Percent Solids	**3.50**	%	TSS	35,000	0.0775	22,617
Volatile Content	**80**	% of TSS	VSS	28,000	0.0775	18,094
			ISS	7,000	0.0775	4,523
Nitrogen Content	**2.5**	% of TSS	TKN	885	0.0775	572
			Ammonia-N	10	0.0775	7
			Organic-N	875	0.0775	565
Phosphorus Content	**1.5**	% of TSS	Total-P	529	0.0775	342
			Ortho-P	4	0.0775	2
			Organic-P	525	0.0775	339
			TKN Removal		16.9%	
			Total-P Removal		31.9%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Primary Clarifier Effluent From WAS				**Primary Clarifier Effluent From WAS**			
				BOD5	0	0.055	0
Total WAS Removal		**100 %**		Soluble BOD5	0	0.055	0
				TSS	0	0.055	0
				VSS	0	0.055	0
				ISS	0	0.055	0
				Nitrate-N	0	0.055	0
				TKN	0	0.055	0
				Ammonia-N	0	0.055	0
				Organic-N	0	0.055	0
				Total-P	0	0.055	0
				Ortho-P	0	0.055	0
				Organic-P	0	0.055	0
				Chemical-P	0	0.055	0
				Vol. Content of Solids			
Primary Sludge From WAS				**Primary Sludge From WAS**			
Percent Solids		**3.50** %		TSS	35,000	0.0733	21,396
				VSS	18322	0.0733	11,201
				ISS	16678	0.0733	10,196
				Nitrate-N	14	0.0733	9
				TKN	1589	0.0733	971
				Ammonia-N	0	0.0733	0
				Organic-N	1588	0.0733	971
				Total-P	1140	0.0733	697
				Ortho-P	0	0.0733	0
				Organic-P	306	0.0733	187
				Chemical-P	834	0.0733	510
				TKN Removal		100.0%	
				Total-P Removal		100.0%	
Total Primary Clarifier Effluent				**Total Primary Clarifier Effluent**			
				BOD5	91	27.060	20,459
				Soluble BOD5	51	27.060	11,608
				TSS	100	27.060	22,617
				VSS	79	27.060	17,873
				ISS	21	27.060	4,745
				Nitrate-N	0	27.060	0
				TKN	12.5	27.060	2,819
				Ammonia-N	10.2	27.060	2,306
				Organic-N	2.3	27.060	513
				Total-P	3.2	27.060	729
				Ortho-P	3.6	27.060	805
				Organic-P	-0.3	27.060	-76
				Chemical-P	0.0	27.060	0
				Vol. Content of Solids		79.0%	
Total Primary Sludge				**Total Primary Sludge**			
				TSS	35,000	0.1508	44,013
				VSS	23,295	0.1508	29,294
				ISS	11,705	0.1508	14,719
				Nitrate-N	7	0.1508	8.7
				TKN	1,227	0.1508	1,543
				Ammonia-N	5	0.1508	6.7
				Organic-N	1,222	0.1508	1,536
				Total-P	826	0.1508	1,038
				Ortho-P	2	0.1508	2
				Organic-P	419	0.1508	526
				Chemical-P	405	0.1508	510
				TKN Removal		35%	
				Total-P Removal		59%	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}		{B}	{C}	{D}	{E}	{F}	{G}
Secondary Treatment - Activated Sludge				**Secondary Treatment - Activated Sludge**			
Aeration Basin Influent				**Aeration Basin Influent**			
				BOD5	91	27.060	20,459
				Soluble BOD5	51	27.060	11,608
				TSS	100	27.060	22,617
				VSS	79	27.060	17,873
				ISS	21	27.060	4,745
				TKN	12.5	27.060	2,819
				Ammonia-N	10.2	27.060	2,306
				Organic-N	2.3	27.060	513
				Total-P	3.2	27.060	729
				Ortho-P	3.6	27.060	805
				Organic-P	-0.3	27.060	-76
				Vol. Content of Solids		79.0%	
Nutrient Conversions							
Organic-N Conversion				**Organic-N Conversion**			
… A portion of the Influent Organic-N is converted to Ammonia-N				Influent Organic-N			513
				Influent Ammonia-N			2,306
Assume Conversion of		**95** %		Organic-N Converted			487
				Resulting Ammonia-N			2,794
				Remaining Organic-N			26
Organic-P Conversion				**Organic-P Conversion**			
… A portion of the Influent Organic-P is converted to Ortho-P				Influent Organic-P			-76
				Influent Ortho-P			805
Assume Conversion of		**95** %		Organic-P Converted			-72
				Resulting Ortho-P			733
				Remaining Organic-P			-4
VSS Biodegradation				**VSS Biodegradation**			
… A portion of the Influent VSS is Biodegradable				Influent VSS			17,873
Assumed Biodegradable Fraction		**80** %		VSS Biodegraded			14,298
… Remaining VSS is incorportated into the Sludge				Non-Biodegradable VSS			3,575
Nutrient Requirements							
Carbonaceous							
… Based on weight ratio of VSS produced				VSS Produced			7,442
Nitrogen Req'd as Ammonia-N		**12.4** %		Ammonia-N Req'd			923
Phosphorus Req'd as Ortho-P		**2.5** %		Ortho-P Req'd			186
Nitrification							
… Based on weight ratio of VSS produced				VSS Produced			184
Nitrogen Req'd as Ammonia-N		**12.4** %		Ammonia-N Req'd			23
Phosphorus Req'd as Ortho-P		**2.5** %		Ortho-P Req'd			5
				Remaining Ammonia-N			1,848
				Remaining Ortho-P			542
				BOD:N:P Ratio			
				Nutrients Utilized:			
				Influent BOD5			20,459
				Ammonia-N			946
				Ortho-P			191
				Therefore the BOD5:N:P Ratio is:			
				BOD5	100		
				Ammonia-N	4.6		
				Ortho-P	0.9		

Input Assumptions	{A}	{B}	{C}	Calculations	{D}	CONC (mg/L) {E}	FLOW (MGD) {F}	MASS (lbs/day) {G}
Nitrification				**Nitrification**				
				Ammonia-N remaining after satisfying nutrient requirements				1,848
Ammonia Oxidation		**99.5**	%	Ammonia-N Oxidized; i.e. NO_3-N				1,839
				Ammonia Remaining				9
Denitrification				**Denitrification**				
…A portion of the NO3-N is used is converted to nitrogen gas				Ammonia-N Oxidized; i.e. NO_3-N				1,839
Denitrification		**0**	%	Total NO_3-N reduced				0
				NO_3-N Remaining				1,839
Chemical Phosphorus Removal				**Chemical Phosphorus Removal**				
				Ortho-P remaining after satisfying nutrient requirements				542
Ortho-P Removed		**94.0**	%	Ortho-P Removed				510
				Ortho-P Remaining				33
Ferric Chloride Density		**12**	lbs Sol'n/gal					
Iron Content		**0.15**	lbs Fe/lbs Sol'n	Ferric Chloride Contains:		0.4357	lbs $FeCl_3$/lb Sol'n	
Ferric Chloride Dosage		**2.00**	moles Fe to moles Ortho-P	Weight Ratio		3.61	lbs Fe/lb Ortho-P Removed	
				Iron Required		1838	lbs Fe/day	
				Ferric Chloride Required		5339	lbs $FeCl_3$/day	
Dosing approximately 100 gpd of ferric chloride						1021	gal $FeCl_3$/day	
Solids Produced Due to Chemical Precipitation				**Solids Produced Due to Chemical Precipitation**				
Ferric Phosphate Produced		4.9	lbs/lb P rem.	Ferric Phosphate Produced				2,482
Ferric Hydroxide Produced		3.5	lbs/lb P rem.	Ferric Hydroxide Produced				1,759
				Total Chemical Sludge Produced				4,241
…Assume that chemcical is added to tail end of the aeration basins and that 100% of the chemical sludge is removed with the biological sludge.				Chemical-P Incorporated Into Sludge				510
Secondary Effluent				**Secondary Effluent**				
BOD5 Removal		**97**	%	BOD5		3	26.932	614
				Soluble BOD5		2	26.932	348
TSS Removal		**96**	%	TSS		4	26.932	905
				VSS		3	26.932	769
				ISS		1	26.932	136
				Total Nitrogen		8.7	26.932	1,952
				Nitrate-N		8.1	26.932	1,830
				TKN		0.5	26.932	122
				Ammonia-N		0.0	26.932	9
Organic-N		12.4	% of TSS + Inf. Fraction	Organic-N		0.5	26.932	113
				Total-P		0.2	26.932	55
				Ortho-P		0.1	26.932	33
Organic-N		2.5	% of TSS + Inf. Fraction	Organic-P		0.1	26.932	23
				Vol. Content of Solids			85.0%	

Input Assumptions			**Calculations**			
				CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}	{C}	{D}	{E}	{F}	{G}
Secondary Sludge			**Secondary Sludge**			
Sludge Production due to BOD Removal			**Sludge Production due to BOD Removal**			
Yield Coefficient (lb VSS Produced			BOD5 Removed			19,846
/ lb BOD5 Removed)	**0.60**		Observed Yield	0.375	lbs VSS / lb BOD_5	
Decay Coefficient	**0.06**	/day				
Mean Cell Residence Time	**10**	days	VSS Produced			7,442
Sludge Production due to Nitrification			**Sludge Production due to Nitrification**			
Yield Coefficient (lb NVSS Produced			Ammonia-N Removed			1,839
/ lb Ammonia Oxidized)	**0.15**		Observed Yield	0.100	lbs VSS / lb BOD_5	
Decay Coefficient	**0.05**	/day				
Mean Cell Residence Time	10	days	NVSS Produced			184
			Total Biological Sludge Production			
			Net VSS Produced			7,626
Volatile Content of MLTSS Produced	**85**	%	Net TSS Produced			8,972
Sludge Production due to Influent Solids			**Sludge Production due to Influent Solids**			
			Influent ISS			4,745
…Difference incorportated into sludge			Effluent ISS			136
			Inf. ISS incorp. Into sludge			4,609
			Influent ISS fraction in sludge	97.1%		
			Organic-N			
			Organic-N Remaining after Solub.			26
… Assume same ratio as ISS			Organic -N incorported into sludge			25
			Remaining Organic-N			1
			Nitrate-N			
			Ammonia-N Nitrified			1,839
			Conc. Based on Influent Flow	8.1	mg/L	
			Nitrate in WAS			9
			Organic-P			
			Organic-P Remaining after Solub.			-3.8098
… Assume same ratio as ISS			Organic -P incorported into sludge			-3.7008
			Remaining Organic-P			-0.1090
Waste Activated Sludge			**Waste Activated Sludge**			
… Assume Net TSS is wasted			TSS	20,000	0.1283	21,396
… Sludge is Wasted from Return Sludge			VSS	10,470	0.1283	11,201
Percent Solids	**2.000**	%	ISS	9,530	0.1283	10,196
… Assume Nutrients consumed are incorportated into cell mass.			Total Nitrogen	916	0.1283	980
			Nitrate-N	8	0.1283	9
			TKN	908	0.1283	971
			Ammonia-N	0.0	0.1283	0
			Organic-N	908	0.1283	971
			Total-P	651	0.1283	697
			Ortho-P	0.1	0.1283	0
			Organic-P	175	0.1283	187
			Chemical-P	476	0.1283	510
			Fraction of Nutrients in Sludge:			
			Nitrogen:	4.5%		
			Phosphorus:	3.3%		
			Volatile Content:	52.3%		

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
{A}	{B}		{C}	{D}	{E}	{F}	{G}
Activated Sludge Parameters				**Activated Sludge Parameters**			
Aeration Basin Volume	**282,000**	ft^3		Aeration Basin Volume	2.110	Million Gallons	
Solids Under Aeration:				Solids Under Aeration:			
MLTSS	12,997	mg/L		MLTSS	228,651	lbs	
MLVSS	6803			MLVSS	119,695	lbs	
				MLVSS Conc	6,803	mg/L	
				Mixed Liquor Volatile Fraction	52.3%		
				Organic Volumetric Loading	73	lb/1000 ft^3	
				F:M Ratio	0.171		
				Mean Cell Residence Time	10.00	days	
Anoxic Selector Parameters							
Anoxic Selector Volume	0.22	MG		Selector HRT	0.2	hours	
				Selector F:M Ratio	1.6		
Aeration System				**Aeration System**			
BOD Oxygen Requirement	**1.1**	lb O_2/ lb BOD rem.		BOD5 Removed		19,846	lbs/day
				BOD5 Oxygen Requirement		21,830	lbs/day
TKN Oygen Requirement	**4.6**	lb O_2/ lb TKN rem.		TKN Removed		1,839	lbs/day
				TKN Oxygen Requirement		8,458	lbs/day
				Total Oxygen Requirement		30,288	lbs/day
				Total NO3-N reduced		0	lbs/day
Oxygen Recovery from Denitrification	**2.86**	lbs O_2/ lb NO_3 reduced		Denitrification Oxygen Credit		0	lbs/day
				Actual Oxygen Requirement		30,288	lbs/day
Return Activated Sludge				**Return Activated Sludge**			
				TSS	20,000	49.849	8,314,852
				VSS	10,470	49.849	4,352,693
				Vol. Content of Solids		52.3%	
				RAS Ratio		185.1%	
Final Clarifiers				**Final Clarifiers**			
				Secondary Clarifier Influent			
				MLTSS	12,997	76.909	8,336,248
				MLVSS	6,803	76.909	4,363,893
				Vol. Content of Solids		52.3%	
Clarifier Dimensional Parameters				**Loading Rates**			
Clarifier Diameter	**90**	ft					
No. of Clarifiers	**2**						
Clarifier Depth	**16**	ft					
Total Surface Area	12,723	ft^2		Surface Overflow Rate (SOR)	2,117	gal/day/ft^2	
Total Weir Length	565	ft		Weir Overflow Rate (WOR)	47,626	gal/day/ft	
Volume	1,522,844	gallons		Solids Loading Rate	655.2	lb/day/ft^2	
				or	27.30	lb/hr/ft^2	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Anaerobic Digestion (No Supernating)				**Anaerobic Digestion (No Supernating)**			
Digester Influent				**Digester Influent = WAS + Primary Sludge**			
				TSS	35,000	0.1508	44,013
				VSS	23,295	0.1508	29,294
				ISS	11,705	0.1508	14,719
				Total Nitrogen	1,234	0.1508	1,552
				Nitrate-N	7	0.1508	8.7
				TKN	1,227	0.1508	1,543
				Ammonia-N	5	0.1508	6.7
				Organic-N	1,222	0.1508	1536
				Total-P	826	0.1508	1038
				Ortho-P	2	0.1508	2
				Organic-P	419	0.1508	526
				Chemical-P	405	0.1508	510
				Vol. Content of Solids		66.6%	
Removals and Conversions				**Removals and Conversions**			
VSS Destruction				**VSS Destruction**			
VSS Destruction		**50**	%	VSS Destruction			14,647
Gas Production		**15**	ft^3/lb VSS des.	Digester Gas Production		219,708	ft^3 /day
Organic-N Conversion				**Organic-N Conversion**			
Conversion of influent Organic-N		50	%	Influent Organic-N			1536
				Organic-N Converted			768
…A portion of the influent Organic-N is converted to Ammonia-N				Organic-N Remaining			768
				Ammonia-N Produced			768
Nitrate-N Conversion				**Nitrate-N Conversion**			
Conversion of influent Nitrate-N		**100**	%	Influent Nitrate-N			9
				Nitrate-N Converted			9
…The influent Nitrate-N is converted to Nitrogen Gas				Nitrate-N Remaining			0
Organic-P Solubilized				**Organic-P Solubilized**			
Conversion of influent Organic-P		50	%	Influent Organic-P			526
				Organic-P Converted			263
…A portion of the influent Organic-P is converted to Ortho-P				Organic-P Remaining			263
				Ortho-P Produced			263
Digested Sludge				**Digested Sludge**			
				TSS	23,352	0.1508	29,366
				VSS	11,648	0.1508	14,647
				ISS	11,705	0.1508	14,719
				Total Nitrogen	1,227	0.1508	1,543
				Nitrate-N	0	0.1508	0
				TKN	1,227	0.1508	1,543
				Ammonia-N	616	0.1508	775
				Organic-N	611	0.1508	768
				Total-P	826	0.1508	1,038
				Ortho-P	211	0.1508	266
				Organic-P	209	0.1508	263
				Chemical-P	405	0.1508	510
				Vol. Content of Solids		49.9%	
				Fraction of Nutrients in Sludge:			
				Nitrogen:	5.3%		
				Phosphorus:	3.5%		
Digester Dimensional Parameters				**Loading Rates**			
				Digester Influent VS	29,294	lbs/day	
Digester Volume		**79,600**	ft^3	Volatile Solids Loading	0.368	lb VS/day/ft^3	
				or	368	lb VS/ 1000 ft^3 /day	
				Digester Influent Flow Rate	150,782	gpd	
				Digester Volume	595,448	gallons	
				HRT = SRT =	4	days	

Input Assumptions				Calculations			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Digested Sludge to Centrifuge				**Digested Sludge to Centrifuge**			
				TSS	23,352	0.3770	73,416
				VSS	11,648	0.3770	36,618
				ISS	11,705	0.3770	36,798
				Total Nitrogen	1,227	0.3770	3,858
				Nitrate-N	-	0.3770	-
				TKN	1,227	0.3770	3,858
				Ammonia-N	616	0.3770	1,937
				Organic-N	611	0.3770	1,921
				Total-P	826	0.3770	2,596
				Ortho-P	211	0.3770	664
				Organic-P	209	0.3770	658
				Chemical-P	405	0.3770	1,274
				Vol. Content of Solids		49.9%	
Dewatered Digested Sludge				**Dewatered Digested Sludge**			
Solids Capture		**95** %					
Percent Solids		**25.0** %			250,000	0.0335	69,745
					124,694	0.0335	34,787
					125,306	0.0335	34,958
					3,232	0.0335	902
… Organic-N, Organic-P, and Chemcial-P are assumed to be related to					-	0.0335	-
TSS and assumed to be removed at the same rate.					3,232	0.0335	902
Ammonia-N, Ortho-P are assumed to be soluble.					616	0.0335	172
					2,616	0.0335	730
					2,843	0.0335	793
					211	0.0335	59
					896	0.0335	250
					1,736	0.0335	484
						49.9%	
Centrate				**Centrate**			
…Assume that the ratio of the centrate BOD5/VSS				BOD5	222	0.3435	637
				Soluble BOD5	2	0.3435	4
				TSS	1,281	0.3435	3,671
				VSS	639	0.3435	1,831
				ISS	642	0.3435	1,840
				Total Nitrogen	1,032	0.3435	2,956
				Nitrate-N	0	0.3435	0
				TKN	1,032	0.3435	2,956
…Assume that Ortho-P and Ammonia-N concentrations				Ammonia-N	616	0.3435	1,765
are the same as that in Secondary Effluent.				Organic-N	416	0.3435	1,191
				Total-P	629	0.3435	1,803
				Ortho-P	211	0.3435	605
				Organic-P	142	0.3435	408
				Chemical-P	276	0.3435	790

Input Assumptions				**Calculations**			
					CONC (mg/L)	FLOW (MGD)	MASS (lbs/day)
	{A}	{B}	{C}	{D}	{E}	{F}	{G}
Washwater				**Washwater**			
…Assume that Secondary Effluent is used for washwater				BOD5	3	0.0685	1.6
				Soluble BOD5	2	0.0685	0.9
				TSS	4	0.0685	2.3
				VSS	3	0.0685	2.0
				ISS	1	0.0685	0.3
				Total Nitrogen	8.7	0.0685	5.0
				Nitrate-N	8.1	0.0685	4.7
				TKN	0.5	0.0685	0.3
				Ammonia-N	0.0	0.0685	0.0
				Organic-N	0.5	0.0685	0.3
				Total-P	0.2	0.0685	0.1
				Ortho-P	0.1	0.0685	0.1
				Organic-P	0.1	0.0685	0.1
	Centrifuge Feed Rate	**220**	gpm	… Average Operating Time	28.56	hrs/day	
	Belt Washwater	**100**	gpm	… Ave. Solids Loading	2,571	lbs/hr	
				… Belt Washwater	171,344	gpd	
				… Average Operating Time / Week	57.11	hrs/week	
Centrate and Washwater				**Centrate and Washwater**			
				BOD5	186	0.082	128
				Soluble BOD5	2	0.082	1
				TSS	1069	0.082	735
				VSS	533	0.082	367
				ISS	536	0.082	368
				Total Nitrogen	862	0.082	592
				Nitrate-N	1	0.082	1
				TKN	860	0.082	591
				Ammonia-N	514	0.082	353
				Organic-N	347	0.082	238
				Total-P	525	0.082	361
				Ortho-P	176	0.082	121
				Organic-P	119	0.082	82
				Chemical-P	276	0.082	190

APPENDIX E
Detailed Cost Estimates

TABLE A-1
Present Worth Evaluation Cost Estimating Criteria
August 2024

Item	Value
Operation and Maintenance Costs (O&M)	
Labor	
Operators/Technicians/Mechanics	$60/hr
Electrical Energy	$0.1/kWh
Annual Maintenance Cost (% of Equipment Cost)	1.0%
Present Worth Analysis	
Interest Rate	2.365%
Present Worth Factors (20 years)	
Present Worth of Salvage Value	0.627
Present Worth of Annual O&M Costs	15.790
Monetary Cost Planning Period	20 Years
Useful Life	
Land	Permanent
Sewers & Force Mains	50 years
Structures & Piping	40 years
Process Equipment, I&C, and Electrical	20 years

TABLE A-2
Chemical Treatment – Ferric Chloride Dosing
Annual Operation and Maintenance Costs

Parameter	Value
Sludge Equipment Annual Usage (hrs)	1,248
Motor Size (HP)	245
Electrical Cost ($/kWh)	$0.10
Annual Power Cost	$30,600
Sludge Polymer Costs ($/lb)	$2.25
Annual Polymer Costs[1]	$45,000
Sludge Disposal Costs ($/$yd^3$)	$29.15
Annual Sludge Disposal Costs[2]	$87,500
Chemical Addition (gpd)	110
Chemical Costs ($/gal)	$2.75
Annual Chemical Cost[3]	$110,400

1. Based on annual polymer usage of 20,000 lb/yr
2. Based on annual sludge disposal of 3,000 yd^3/yr
3. Based on average chemical addition of 110 gpd

TABLE A-3
Present Worth Evaluation
Disc Filtration System – Construction Cost

Item	Total Cost
Building Excavation and Backfill	$187,000
Filter Building	$781,000
Floc Tank	$62,000
Floc Tank Mixer	$62,000
Filter Feed Pumps	$475,000
Disc Filters	$2,246,000
Site Work (20% of Building and Excavation Costs)	$206,000
Mechanical Piping and Valves (15% of Equipment Costs)	$417,000
I&C (16% of Equipment Costs)	$445,000
Electrical (18% of Equipment Costs)	$501,000
Subtotal	$5,382,000
Contingencies (25%)	$1,346,000
Subtotal Construction Cost	$6,728,000
General Conditions, Bonds, and Insurance (8%)	$538,000
Construction Cost	**$7,226,000**

TABLE A-4
Present Worth Evaluation
Disc Filtration System – Salvage Costs

Item	Initial Cost	Life (Years)	Total Cost
Building Excavation and Backfill	$187,000	-	-
Filter Building	$781,000	40	$390,500
Floc Tank	$62,000	40	$31,000
Floc Tank Mixer	$62,000	20	$31,000
Filter Feed Pumps	$475,000	20	$0
Disc Filters	$2,246,000	20	$0
Site Work	$206,000	40	$103,000
Mechanical Piping and Valves	$417,000	40	$208,500
I&C	$445,000	20	$0
Electrical	$501,000	20	$0
Subtotal of Salvage Value			$733,000
Present Worth of Salvage Value			**$459,300**

TABLE A-5
Present Worth Evaluation
Operation and Maintenance Costs

Item	Disc Filtration System ($/yr)	Chemical Treatment ($/yr)
Electrical Power	$68,000	$31,000
Chemical Addition	$80,000	$110,000
General Maintenance (1% of Equipment Cost)	$22,000	-
Total Annual O&M	$193,000	$141,000
Present Worth Factor (20 years @ 2.365%)	15.79	15.79
Present Worth O&M	**$2,684,000**	**$2,226,000**

APPENDIX F
Public Hearing