Curwensville Borough Authority

Curwensville Wastewater Treatment Facility

Curwensville Borough, Clearfield County
NPDES Permit No. PA0024759

Wastewater Treatment Evaluation

Pennsylvania
Department of
Environmental Protection

Bureau of Clean Water
Rachel Carson State Office Building
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Harrisburg, PA 17105-8774

Disclaimers:

Pennsylvania Regulations at 25 Pa. Code § 91.12 state, inter alia, that "Employees of the Department [Department of Environmental Protection] may not act as consulting engineers for a party or recommend the employment of a particular consultant, gather the data for the design of [a] his treatment plant, prepare plans or act as an inspector on the construction of the project…". This report and any recommendations represent an interpretation of data collected during the project and the best professional judgement of Department staff. Permittees, in conjunction with certified wastewater operators and consulting engineers, should continue an independent investigation to determine the guidance and procedures necessary to optimize operations of the publicly owned treatment works (wastewater treatment facility and sanitary sewer collection and conveyance system).

The mention of a brand of equipment is in no way an endorsement for any specific company. The Pennsylvania Department of Environmental Protection (PADEP) Wastewater Technical Assistance Program (WWTAP) urges the facility owner / permittee to research available products and select those which are the most applicable for its situation and compatible with existing equipment.

The goal of the PADEP WWTAP is to improve receiving water quality through troubleshooting, training, and monitoring. Permittees are encouraged to achieve effluent quality above and beyond current permit requirements.

Additional data and results from the PADEP WWTAP for this project may be available upon request. Please contact the WWTAP staff listed in Appendix A of this report or the Pennsylvania Department of Environmental Protection Bureau of Clean Water at RA-EPWWTAPROVIDER@pa.gov / (717) 787-6744

Executive Summary:

From March through May of 2024, staff from the Pennsylvania Department of Environmental Protection (PADEP) and the Curwensville Municipal Authority (Authority) collaborated on a project to evaluate and improve wastewater treatment at the Authority's wastewater treatment facility (WWTF) located in the Borough of Curwensville. The purpose of this Wastewater Treatment Evaluation (WTE) project was to monitor water quality parameters throughout the WWTF during periods where wastewater operators adjust the activated sludge treatment system's aeration strategy to determine whether changes in the treatment strategy result in reduced nutrient loadings in the WWTF final effluent discharge to the West Branch of the Susquehanna River.

This WTE was performed at the request of the WWTF Superintendent and included staff from PADEP Wastewater Technical Assistance Program (WWTAP) and Wastewater Operations Outreach & Technical Assistance - Public Service Institute Instructor (PSII) Program. During the evaluation, WWTAP staff visited the WWTF weekly to maintain the continuous-monitoring probe network and perform routine process monitoring and nutrient testing for a selection of water quality parameters through the treatment system. WWTAP staff discussed continuous monitoring probe system data, weekly testing results, and observations with PADEP PSII staff and the WWTF Superintendent.

WWTAP offers the WTE at no or little cost to the Authority. The WTE comprises round-the-clock monitoring of key treatment parameters with laboratory and practical experiences to optimize effluent quality by making process changes that do not typically involve significant capital projects. The WTE may be thought of as a custom-tailored comprehensive site inspection that aims to solve common wastewater treatment problems through interaction with licensed wastewater treatment operators. PADEP operates this program as part of a federal grant to reduce nutrient pollution in waters of the United States.

While the data collected during this WTE appear inconclusive regarding the project objectives, WWTAP have included a few recommendations in this report to ensure that the facility continues to achieve the current standard of facility operations.

Operational Strengths

The following items are Operational Strengths that were identified by PADEP WWTAP staff during the WTE. These include strengths of both the operators and the facility itself:

1. WWTF treatment units appear well maintained and are normally operated in compliance with permit conditions and requirements.
2. The facility has a laboratory for testing wastewater strength, gravimetric solids, and nutrient levels for process monitoring purposes. The laboratory is well-organized for its current purposes.
3. Facility operators complete responsive operational process monitoring and control of the treatment system.
4. Facility operators conduct routine assessments of treatment facility on a regular basis.
5. Facility Superintendent / operator-in-responsible-charge ensures efficient overall supervision of staff and treatment processes.
6. Facility operators implement effective preventative maintenance of collection systems and wastewater treatment equipment,

7. Facility operators make ongoing efforts to improve biosolids/sludge production and management,
8. Ongoing Inflow & Infiltration (I&I) detection and elimination activities in the sanitary sewer collection and conveyance system.
9. WWTF operators generally achieve compliance with NPDES Permit final effluent discharge limits. A review of annual Discharge Monitoring Reports (DMRs) submitted by the Authority for 2019 through 2024 comply with the WWTF NPDES Permit final effluent limitations for total nitrogen and total phosphorous annual loading limits.

Recommendations

While on-site, PADEP WWTAP and PSII staff often discussed ways to improve performance of the wastewater treatment process with the WWTF Superintendent and certified operators, some of which follow in the body of the report. Based on the outcome of the WTE and additional discussions with the WWTF operators, the following recommendations are made for ongoing and future improvement of the WWTF:

Optimizing Biological Nutrient Removal in WWTF Treatment Units

- WWTF operators should continue to optimize treatment by adjusting SBR react phase Dissolved Oxygen (D.O.) program setpoints and SBR blower aeration times with the goal of achieving additional reductions in WWTF final effluent discharge nutrient loadings.
- If the budget allows, the Authority could investigate purchase & installation of oxidation/reduction potential (ORP) probes in the SBR treatment tanks. At times of the year when it is favorable to control the SBR aeration blower operations using ORP-based control the Authority could see reduced energy costs due to refined SBR blower operations.
- If the budget allows, the Authority could investigate purchase & installation of additional immersion probes that monitor pH at the influent splitter box and in the aeration tanks to use with the chemical alkalinity feed system.
- WWTF operators could implement additional process control testing to optimize solids mass balance in the WWTF activated sludge biomass. The frequency of this type of testing can be determined by the facility operators with input from the facility engineers. The Authority could expand its process control testing program to monitor Mean Cell Residence Time (MCRT), food to microorganism ratio (F/M), and Sludge Age. Monitoring for these parameters may prove to be a useful part of the WWTF operations strategy and a successful solids inventory program would account for treatment of sludge solids from cradle-to-grave, generating efficiencies that enhance both biosolids quality and energy reduction.
- The Authority should request that the facility engineer evaluate ways to better deliver alkalinity chemicals to the secondary process.

Data Accessibility & Electronic Recordkeeping

- Automation of data management is useful, and trending of process monitoring data should be readily available for WWTF operators. Observing real-time data and trends can help operators see what is happening when WWTF conditions are favorable or not.

- If installing additional continuous monitoring probes in the WWTF, consider having readily accessible graphics included in the Supervisory Control and Data Acquisition (SCADA) system programming, giving the operator ability to review trends in water quality data.

Training and Support for Operators & Staff

- WWTF operators should continue cross-training personnel in all aspects of operation and maintenance of the POTW. Since the Authority plans to add new technology to the treatment system, requiring increased specialization for power controls, process instrumentation, and SCADA, plant staff should all pursue training to upgrade and maintain their skills.
- The Authority should consider hiring seasonal help to assist with routine maintenance (grass cutting, plowing, clearing/maintaining easements, painting, building maintenance, etc.) related to the Publicly Owned Treatment Works (POTW). This will allow certified operators to focus solely on the operation & maintenance of the WWTF and sanitary sewer collection & conveyance system (SSCS).

Curwensville WWTF – WTE Results

In October 2023, the PADEP WWTAP staff conducted a site visit at the Authority's WWTF in response to a request submitted by the WWTF superintendent. Following the October 2023 site visit, PADEP WWTAP and PSII program staff coordinated with the WWTF Superintendent and certified operators to develop and complete a WTE project in the spring of 2024.

The WWTF was constructed in 2015 to address aging infrastructure and to comply with the addition of Chesapeake Bay nutrient requirements in the facility's National Pollutant Reduction and Elimination System (NPDES) Permit No. PA0024759. The WWTF is designed and operated as a continuous-fill Intermittent Cycle Extended Aeration (ICEAS) SBR.

The SBR is a biological system for wastewater treatment and performs equalization, biological treatment (activated sludge), and secondary clarification in a single tank using timed control sequences. An ICEAS SBR receiving influent flow continuously during all treatment phases (react [mixed and/or aerated], settle, decant, & idle) which differs from conventional SBR units that only receive influent flow in a separate fill phase (mixed and/or aerated) during the treatment cycle. WWTF operators use a SCADA system designed by Sanitaire/Xylem to monitor and control SBR treatment phase and cycle times. One feature of the SCADA system interface provides operators with the ability to change setpoints for SBR aeration blower operations based on dissolved oxygen concentration data provided by probes installed in each SBR tank.

For this WTE, WWTAP staff deployed continuous monitoring submersible probes in the WWTF influent after primary treatment (screening & grit removal), SBR activated sludge treatment units, and final effluent discharge. Diagrams of the WWTP and WWTAP continuous monitoring probe system are included in Attachment D of this report.

The continuous monitoring probe system was programmed to collect data for a selection of water quality parameters that could be observed in real-time and for analysis of data trends to guide project participants in optimizing biological nutrient removal (BNR) and pollutant removal efficiencies in the SBR activated sludge treatment units. This strategy allowed for comparison of data collected before and after WWTF operations were changed and determine whether the adjustments to D.O. setpoints achieved observable changes in effluent quality.

Wastewater operators at the facility regularly consulted with WWTAP and PSII staff to adjust SBR dissolved oxygen (D.O.) concentration setpoints and aeration timing during SBR cycles to determine whether the WWTF could optimize treatment to achieve lower nutrient concentrations (total nitrogen and total phosphorous) in the final effluent discharge to the West Branch of the Susquehanna River. The WWTF has historically reported modest concentrations (<10 milligrams per liter [mg/L]) of total nitrogen in the final effluent discharge and the facility is normally operated in compliance with NPDES Permit requirements

Weekly project updates were provided by WWTAP to PADEP PSII staff, and WWTF operators. The weekly project updates included a summary of process control and bench testing data and graphs of continuous monitoring probe system data collected during the study period. Graphs of continuous monitoring probe system data for the project period and the weekly process control & bench testing results are included in Appendix E of this report.

Over the WTE period, data and information collected by WWTAP staff identified that:

1) The WWTF experiences significant increases in flow due to Inflow & Infiltration (I&I) in the Sanitary Sewer Collection and Conveyance System (SSCS).
2) WWTF operators can support efficient biological nutrient removal in the activated sludge biomass by instituting a dynamic SBR aeration strategy and robust process control testing program.

Inflow & Infiltration and Wet Weather Operations

Significant storm events in Curwensville area causes flow increases in the Authority's SSCS through I&I sources. As with many systems in the Northeastern United States, the Authority's sewerage system is adversely impacted by wet weather events. This extra water enters the systems during wet weather events or snow melt creating conditions where the treatment plant receives excessive unwanted water. This often results in the lowering of the temperature, reducing the efficiency of the activated sludge biomass to remove pollutants & nutrients from the wastewater flows, and a potential for washing out of biological solids from the treatment system. Temperature changes and the wash out of solids can easily lead to a loss of nitrification

All publicly owned treatment works in Pennsylvania submit an Annual Municipal Wasteload Management Report, or Chapter 94 Report, that includes a summary of WWTF hydraulic loadings. A review of the Authority's 2024 Chapter 94 Report did not indicate existing or projected hydraulic overload conditions at the WWTF, but the Authority did report that the WWTP experiences significant increases in flow due to significant sources of I&I in the SSCS. Figure 1 below graphs daily/24-hour precipitation totals in the Curwensville area against reported daily WWTF flows for the project period.

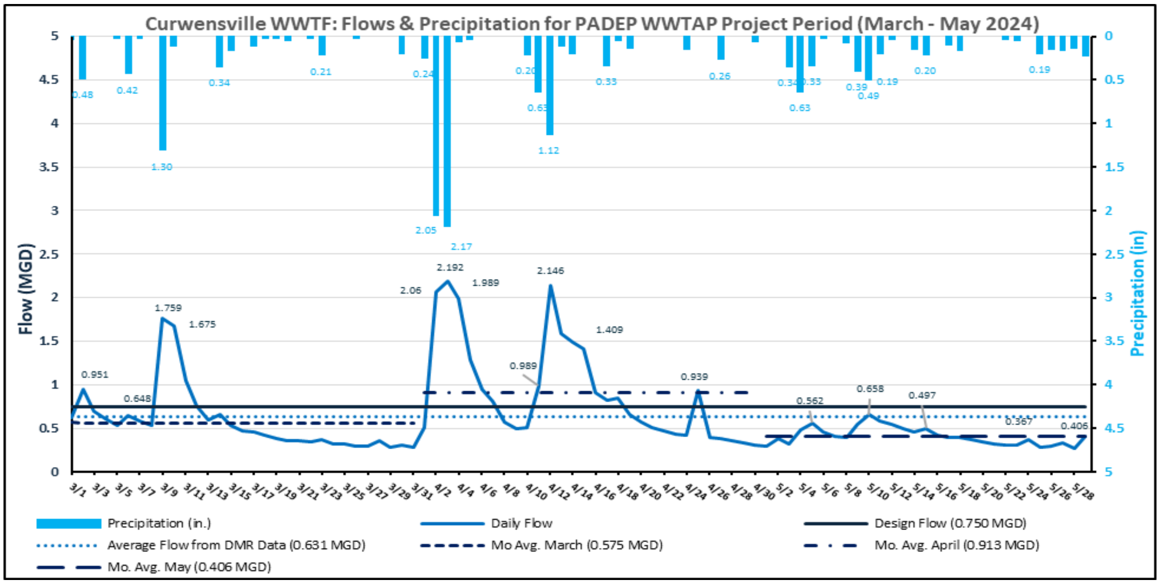

Figure 1. Graph of WWTF flows reported in eDMR during the WTE project period (March - May 2024) Flows are plotted against daily/24-hour precipitation totals observed at the Clearfield Airport (FAA ID: KFIG), the closest location with readily available meteorological data.

To address the significant increases in flow, the Authority and certified wastewater operators have implemented a program in the SSCS for I&I detection and elimination, and a Wet Weather Operations strategy for the WWTF. The Authority's I&I detection and elimination program includes the periodic inspection and cleaning of the SSCS with a repair and maintenance program to attenuate excess flows that impact WWTP operations. The WWTF Wet Weather Operations strategy was developed to maximize the flow through the treatment plant while maintaining compliance with the NPDES Permit. Under this plan, influent flow is diverted to a series of three (3) surge/equalization (EQ) tanks that can either flow to the normal treatment system or to a supplemental chorine contact tank for disinfection before discharging to the West Branch of the Susquehanna River. Facility records indicate that the operators do a remarkable job in maintaining compliance under these difficult circumstances.

The Curwensville area experienced two (2) significant storm events during the evaluation project. The first event from April 1st through 4th caused the facility to divert influent flow to the influent EQ tanks, causing a discharge of partially treated wastewater from the EQ tanks and a secondary disinfection to the receiving stream. A second storm event on April 12th caused elevated flows at the WWTF to continue. In response, WWTAP staff elected to extend the project an additional two (2) weeks to collect data during periods where WWTF flows were closer to the annual average reported flow (2023 - 0.323 MGD). Due to these storm events and elevated flows at the WWTF, WWTAP staff elected to extend the length of the WTE by two weeks to ensure that adequate data were collected by the continuous monitoring probe system during periods where the WWTF flows were expected range of "normal" flows (0.4 to 0.75 MGD).

WWTAP Data & SBR Dissolved Oxygen Setpoint Adjustments

WWTAP continuous monitoring probes installed in the WWTF SBR activated sludge treatment units provided some data that captured changes in water quality parameters during periods where WWTF operators adjusted SBR blower control D.O. setpoints in the Xylem/Sanitaire SCADA programming. Photographs of the SCADA display with programmable SBR D.O. set points are included in figure 2, below.

Figure 2. Photographs of the WWTF Sanitaire/Xylem SCADA system user interface for SBR treatment unit aeration blower control setpoints.

On April 3rd and 27th, 2024, PADEP WWTAP and PSII staff coordinated with the WWTF Superintendent to reduce SBR aeration blower setpoints. Data collected by the D.O. and ORP probes installed in the WWTF SBR treatment units did indicate observable changes in those water quality parameters. These changes are observed in graphs of the SBR treatment unit D.O. and ORP probe data included in figures 3 and 4, below.

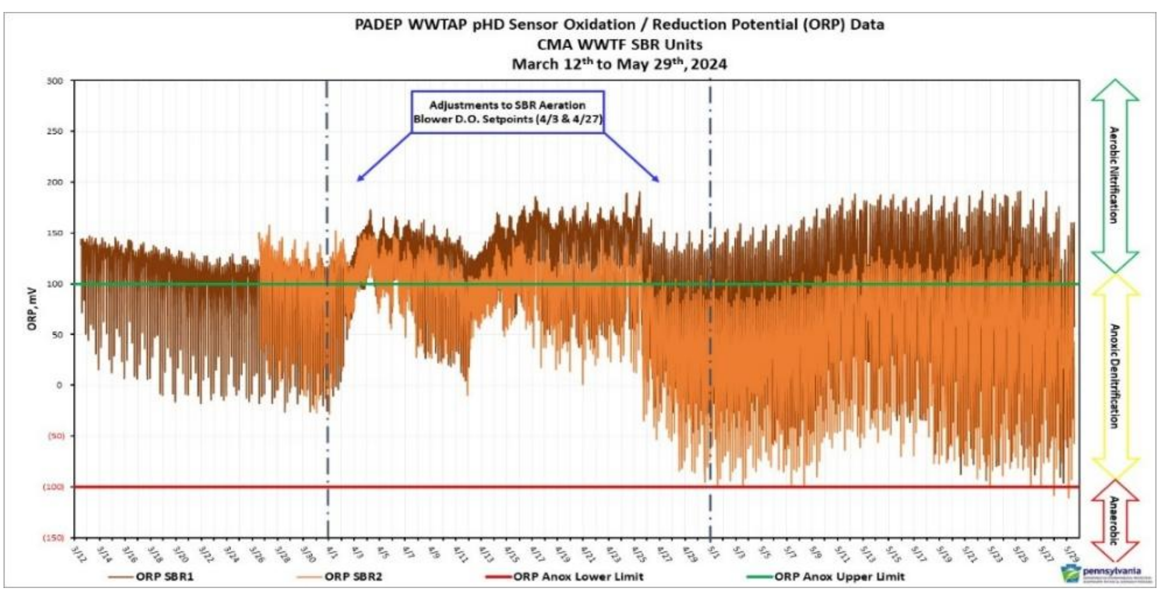

Figure 3. WWTAP LDO probe data for SBR Dissolved Oxygen concentrations (March - May 2024).

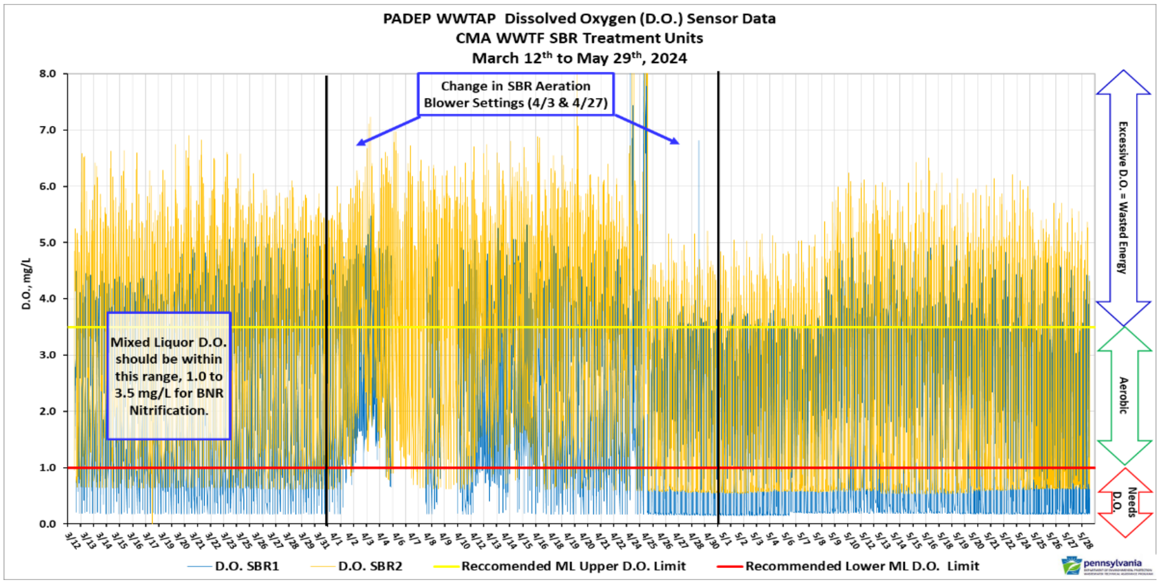

Figure 4. WWTAP ORP probe data for SBR Oxidation / Reduction Potential (March - May 2024).

While probe data for the SBR treatment units showed some changes in data trends, the nitrate-nitrogen (NO3-N) and ammonium-nitrogen (NH4-N) continuous monitoring probes installed in the WWTF final effluent discharge did not change significantly. Figures 5 and 6, below, include data collected by the final effluent nitrate-nitrogen and ammonium-nitrogen probes.

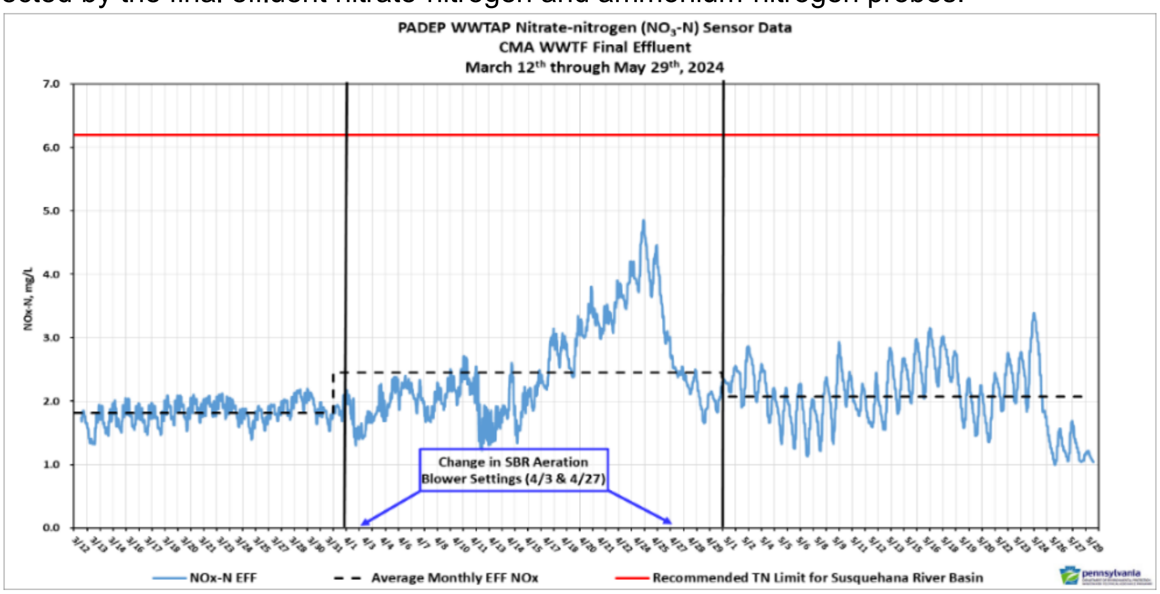

Figure 5. WWTAP Nitrate-Nitrogen probe data for WWTF final effluent discharge (March - May 2024).

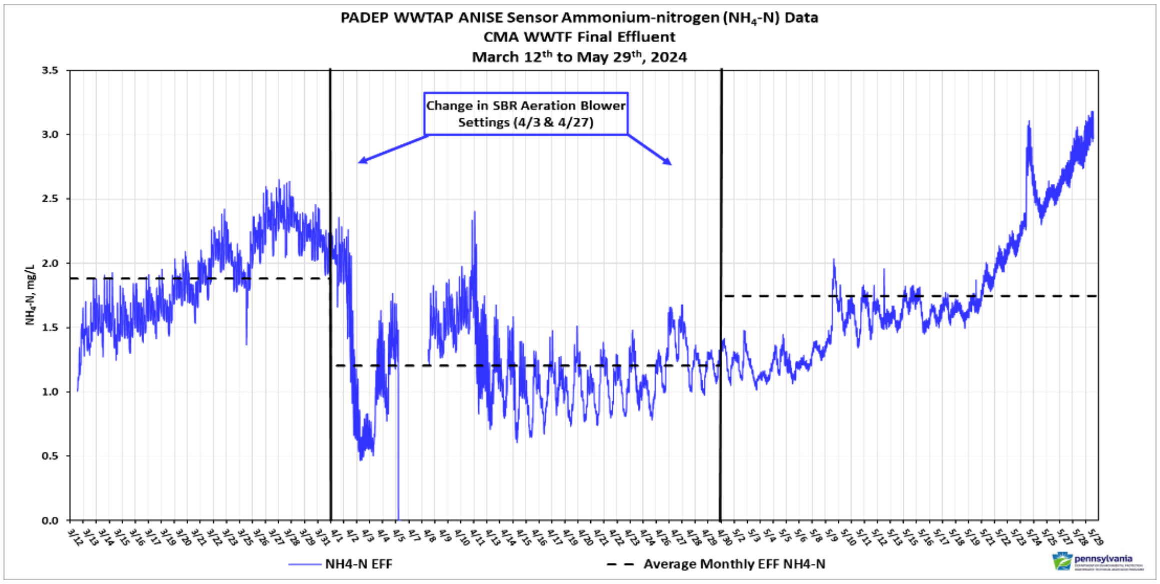

Figure 6. WWTAP Ammonium-Nitrogen probe data for WWTF final effluent discharge (March - May 2024).

Continuous monitoring probe data installed in the WWTF final effluent did not indicate an observable change in the quality or nutrient loading in discharge after the D.O. setpoint adjustments and aeration blower settings were changed during SBR treatment phases. The results may be due to the accuracy and precision of WWTAP continuous monitoring probes, or other variables such WWTF flows or the facility's ability to provide supplemental alkalinity concentrations in the wastewater to support efficient nutrient removal efficiencies by the activated sludge biomass in the SBR treatment units.

Closing Comments & Acknowledgements

WWTAP would like to thank the Curwensville Borough Authority WWTF Superintendent, WWTF wastewater operators & staff, and the consulting operators & engineers from Entech for the opportunity to perform this study and for their participation in the monitoring of the WWTF and assisting WWTAP staff in completing this evaluation. The PADEP wastewater technical assistance program stands ready to assist Curwensville Borough Authority with any of the recommendations or observations mentioned in this report

LIST OF ATTACHMENTS

- ***Upon request, WWTAP* will *provide CMA with complete copies of all data & documentation generated during this project.***
- ***Additional WWTAP data & results for this project may be available upon request. Please contact the project manager listed in Appendix A of this report or the PADEP Bureau of Clean Water WWTAP at RA-EPWWTAPROVIDER@pa.gov / (717) 787-6744.***

Attachment A: RRMSA STP – Intermittent Aeration Study Project Team

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Brandon Nelson (CID 341139)
WWTF Certified Operator

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Attachment B: Curwensville Authority WTE - WWTAP EQUIPMENT

WWTAP Continuous Monitoring Equipment Deployment Photographs

Figure B-1: Photo of UVAS continuous monitoring probe installation location in the Curwensville WWTF.

Figure B-2 & B-3: Photos of WWTAP continuous monitoring equipment installation locations in the Curwensville WWTF SBR treatment unit tanks.

Figure B-4: Photo of continuous monitoring probe mounting installation location in the Curwensville *WWTF SBR treatment unit tanks.*

Attachment B: Curwensville Authority WTE - WWTAP EQUIPMENT

WWTAP Continuous Monitoring Equipment Deployment Photographs

Figure B-6: Photo of HACH Nitratax (nNO3-N, nitrate) and HACH AISEsc (NH4-N, ammonium) probe installation location in the Curwensville *WWTF final effluent chlorine contact tank from March- May 2024.*

Figure B-7: Photo of WWTAP continuous monitoring network data logging, telemetry & display systems at the *Curwensville WWTF.*

Figure B-8: Photo of PADEP WWTAP process control & bench testing laboratory at *Curwensville* WWTF.

ATTACHMENT C: Curwensville Authority WWTF - WWTAP WTE Project Outline

Project Outline

PADEP WWTAP Wastewater Treatment Evaluation Project
Curwensville Municipal Authority Wastewater Treatment Plant
PA National Pollutant Discharge and Elimination System (NPDES) Permit No. PA0024759

Background:

On October 18, 2023, a wastewater operations advisor from the Pennsylvania Department of Environmental Protection (PADEP), Bureau of Clean Water, Wastewater Technical Assistance Program (WWTAP) conducted a site visit at the Curwensville Municipal Authority (CMA) wastewater treatment plant (WWTP) in Curwensville Borough, Clearfield County, Pennsylvania. Following the October 2023 site visit, CMA, PADEP WWTAP staff, and PADEP Public Service Institute Instructors (PSII) coordinated to propose a WWTAP project to investigate optimization of biological nutrient removal in the WWTP activated sludge treatment system and reduce the effluent discharge load of total phosphorous and total nitrogen to the West Branch of the Susquehanna River & the Chesapeake Bay watershed.

On February 20th, 2024, WWTAP and PSII staff conducted a second site visit at the WWTP to plan for the project. During the February 20th site visit, CMA staff and WWTAP & PSII staff reached a consensus regarding the type and location of continuous monitoring equipment to be deployed at the WWTP.

WWTAP Project Proposal:

WWTAP staff will install a selection of continuous monitoring equipment at the WWTP to optimize biological nutrient removal of the activated sludge treatment system and complete at least one (1) weekly site visit to clean & maintain probes and complete process control/bench testing.

PADEP PSII staff will review data and results collected by WWTAP continuous monitoring equipment and process control/bench testing. Based on those data, WWTAP and PSII staff will consult with the WWTP operator(s) to determine whether there are any recommended treatment system adjustments to optimize biological nutrient removal and reduce WWTP effluent discharge nutrient loading.

Within twelve (12) weeks of striking equipment, WWTAP will deliver a project report that will include, at minimum; a summary of data & relevant findings and recommendations for WWTP optimization.

WWTAP Project Timeline:

Project duration is eight (8) to ten (10) weeks from deployment to striking of WWTAP equipment.
WWTAP equipment deployment and setup completed on March 11th & 12th, 2024.

WWTAP Resource Requests for CMA:

- WWTAP requests access to the facility at reasonable times (M-F 0700-1600).
- Reliable power source(s) for WWTAP equipment. (120 VAC)
- Access to 24-months of operating records, including Chapter 94 and industrial user information, lab reports, results of any other relevant studies such as WETT or design improvements reports.
- Availability to discuss project status and WWTAP continuous monitoring & process control data
- Discrete influent grab samples for BOD_5 concurrent with WWTAP monitoring equipment installation & startup.

  **If possible, WWTAP requests that CMA complete weekly influent BOD_5 grabs for project duration and/or with observed qualitative impacts of WWTP influent flow.*

Document C-1: Curwensville WWTF Wastewater Treatment Evaluation - WWTAP Project Outline

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ATTACHMENT D: Curwensville Authority WWTF Reference Schematics:

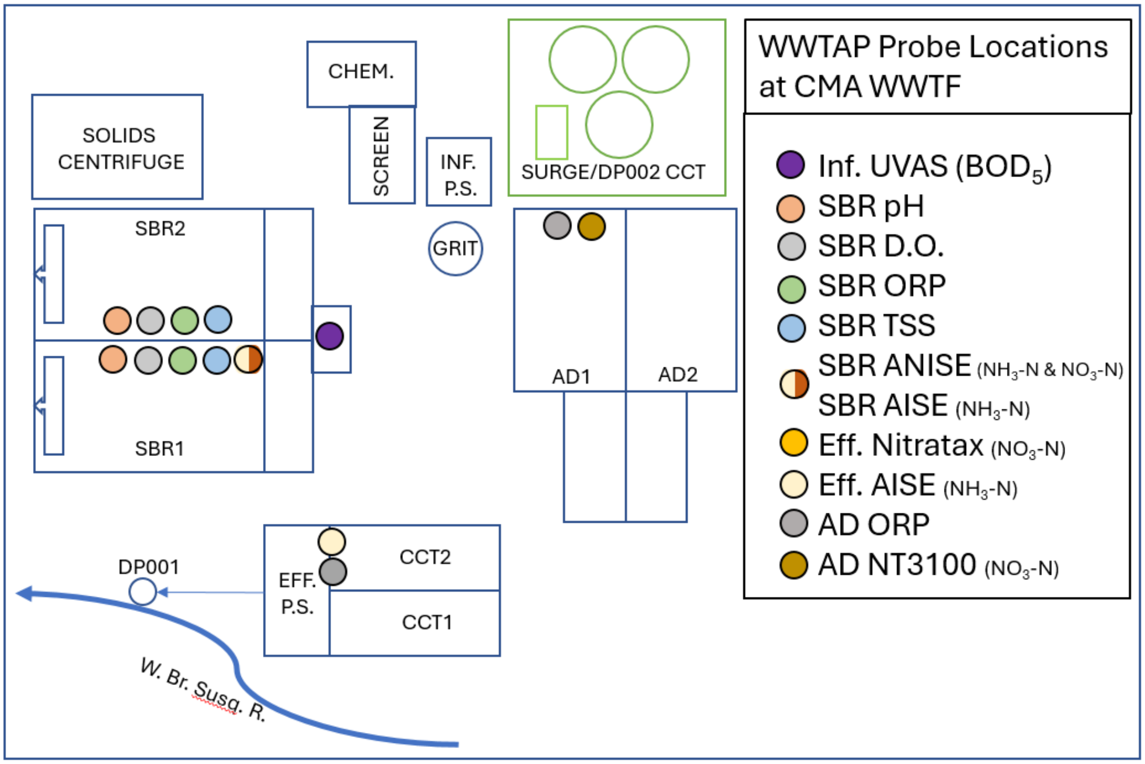

Figure D-1: WWTAP continuous monitoring probe installation locations at Curwensville WWTF from March 12th to May 29th, 2024. [N.B. ANISE installed March 12th was replaced with AISE in SBR1 on May 6th, 2024].

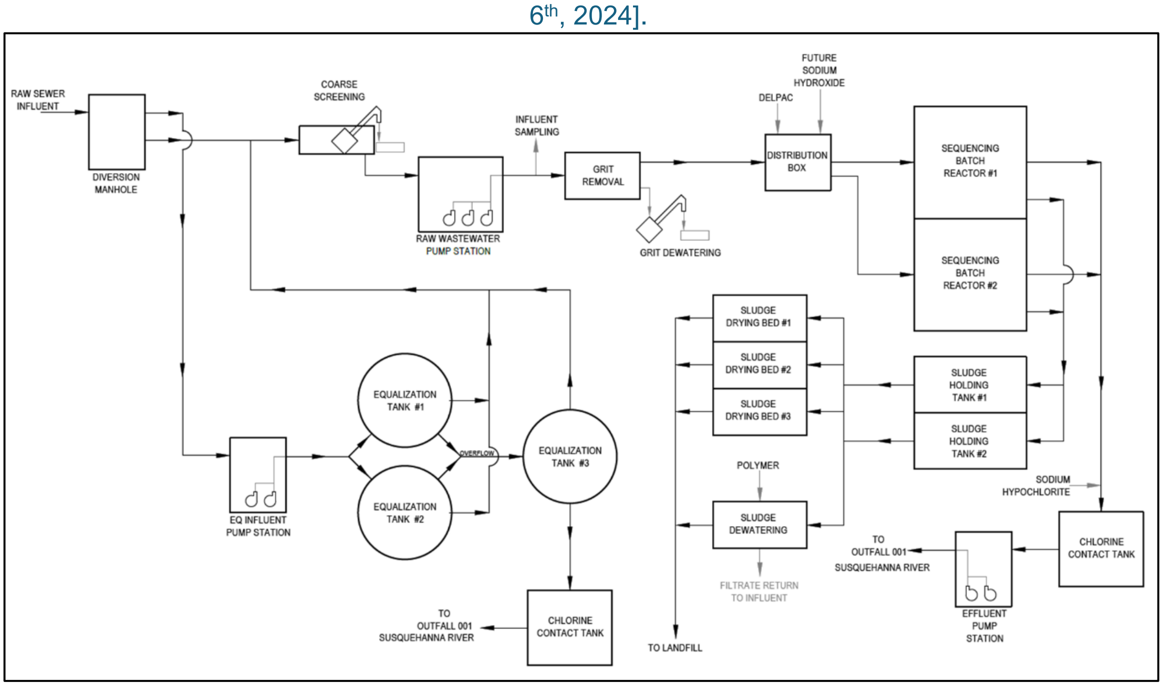

Figure D-2: Curwensville WWTF Process Schematic from 2022 NPDES Renewal Application submitted by GHD. [N.B. Sludge Drying Beds no longer in use after solids treatment upgrade to add centrifuge].

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Attachment E: WWTAP DATA & GRAPHS

Continuous Monitoring Probe System data - March 12th to May 29th, 2024

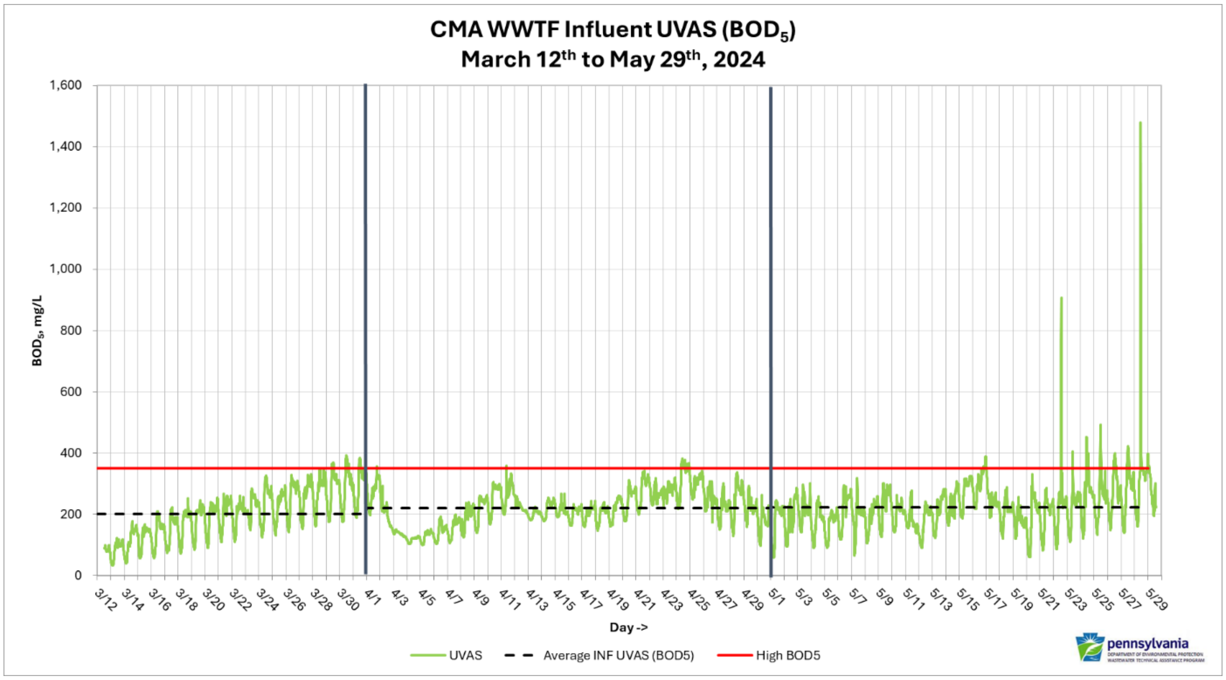


Figure E-1) Influent BOD₅ Data - HACH UVAS SC Probe

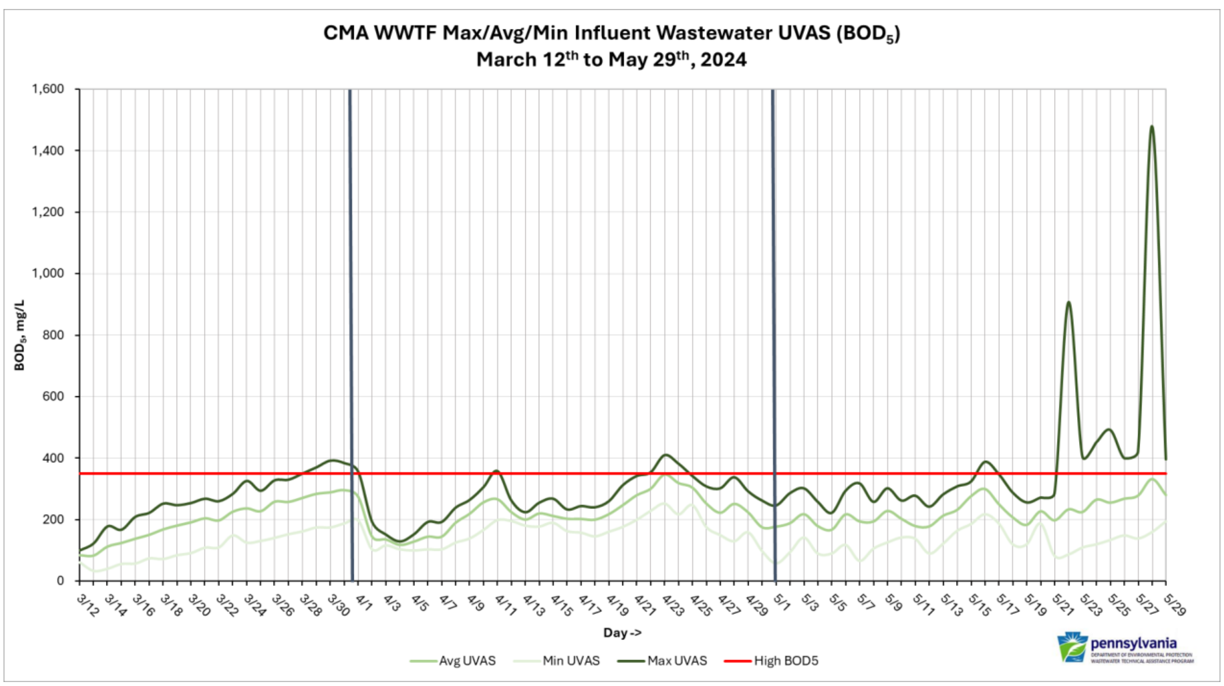


Figure E-2) Influent BOD₅ Minimum/Maximum/Average Data - HACH UVAS SC Probe

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont.)

Continuous Monitoring Probe System data - March 12th to May 29th, 2024 (Cont'd.)

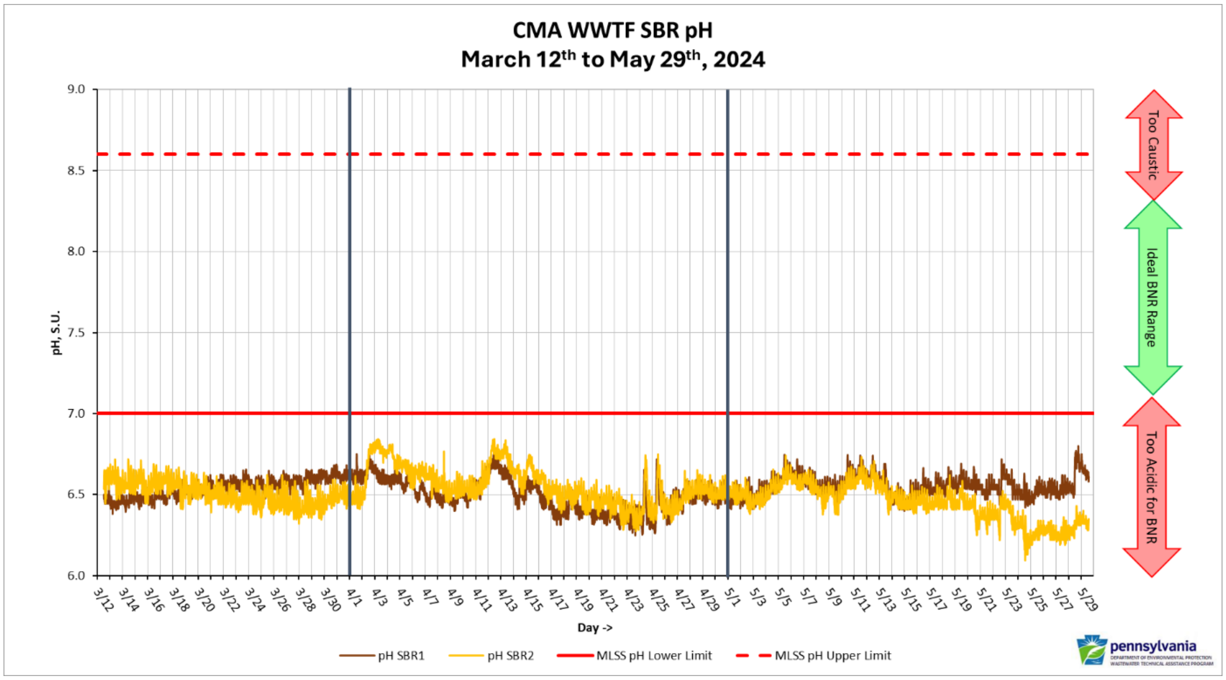


Figure E-3) pH Data – SBR1 and SBR2 pH Probes (with pH sensor)

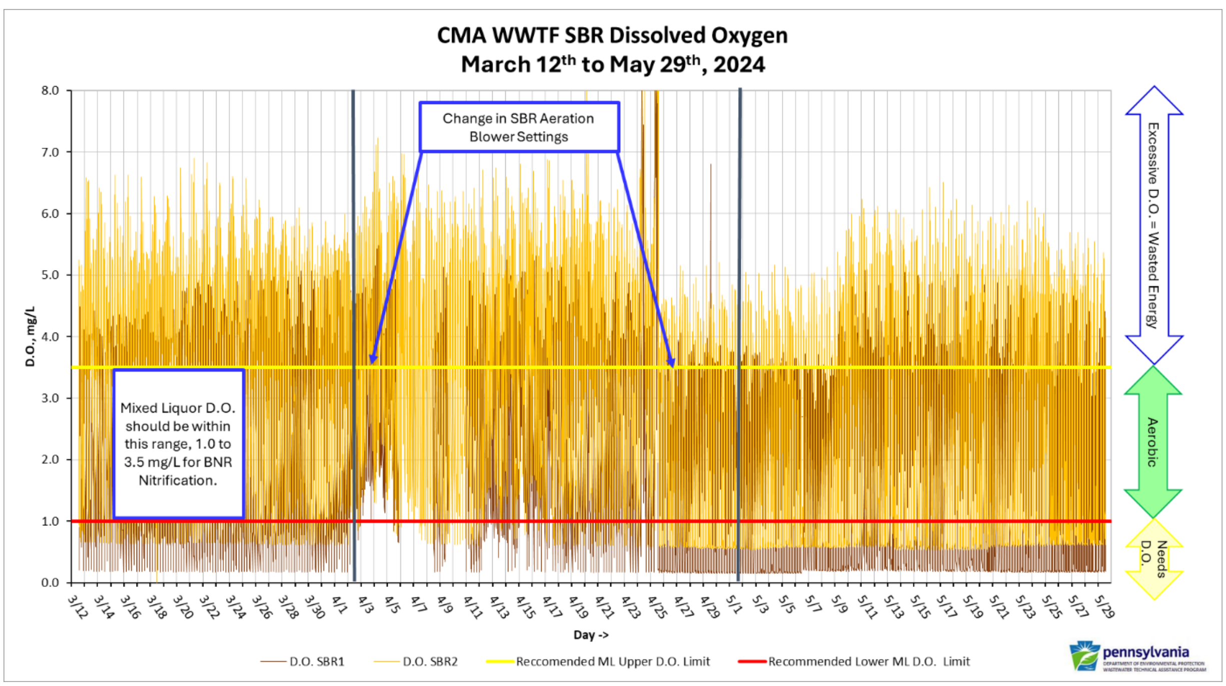


Figure E-4) D.O. Data – SBR1 & SBR2 LDO Probes

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont.)

Continuous Monitoring Probe System data - March 12th to May 29th, 2024 (Cont'd.)

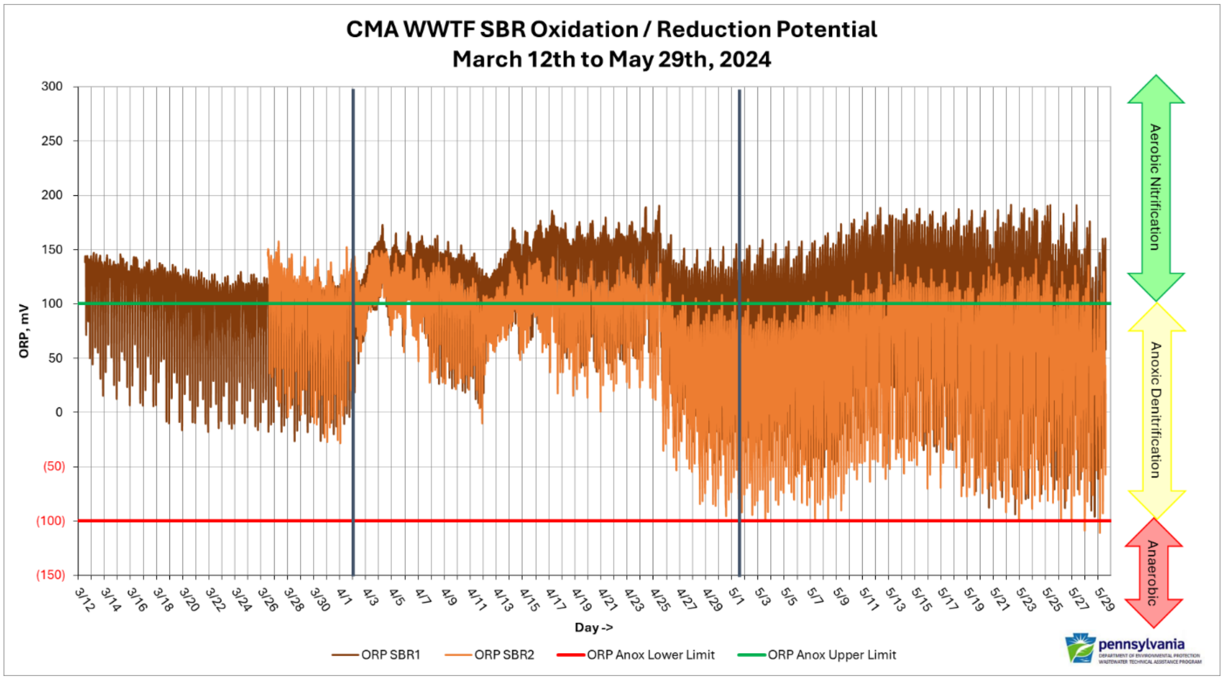


Figure E-5) ORP Data – SBR1 & SBR2 ORP Probes

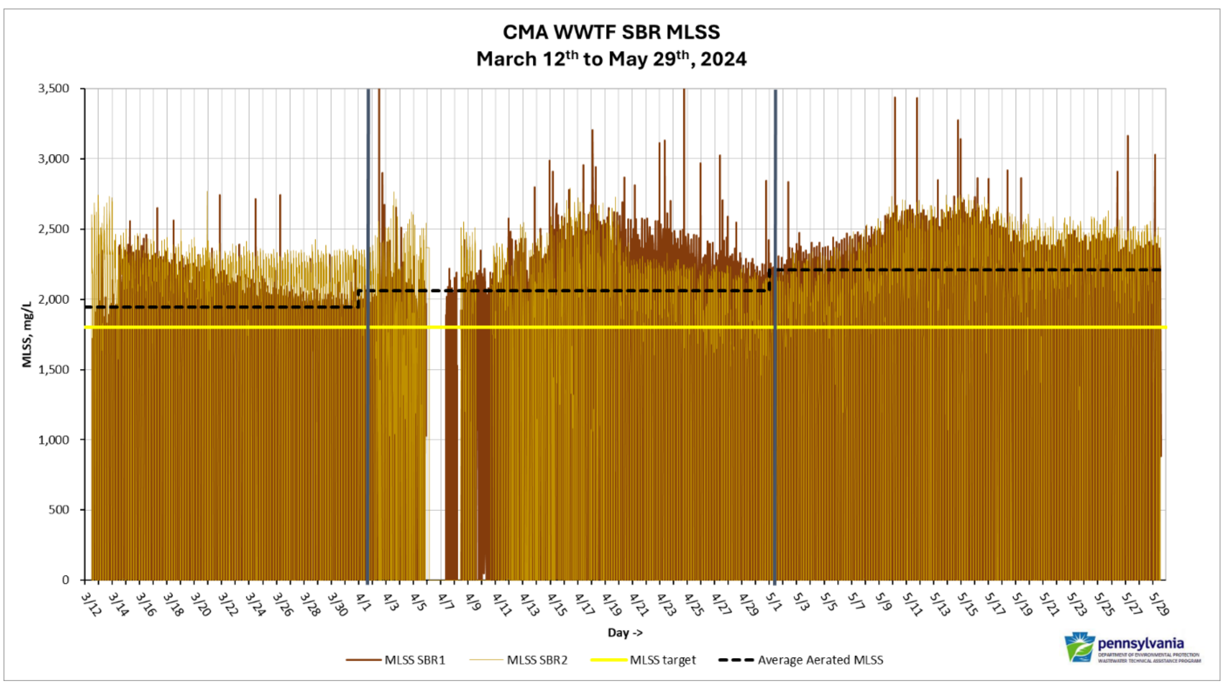


Figure E-6) MLSS Data – SBR1 & SBR2 Solitax (MLSS) Probes

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont.)

Continuous Monitoring Probe System data - March 12th to May 29th, 2024 (Cont'd.)

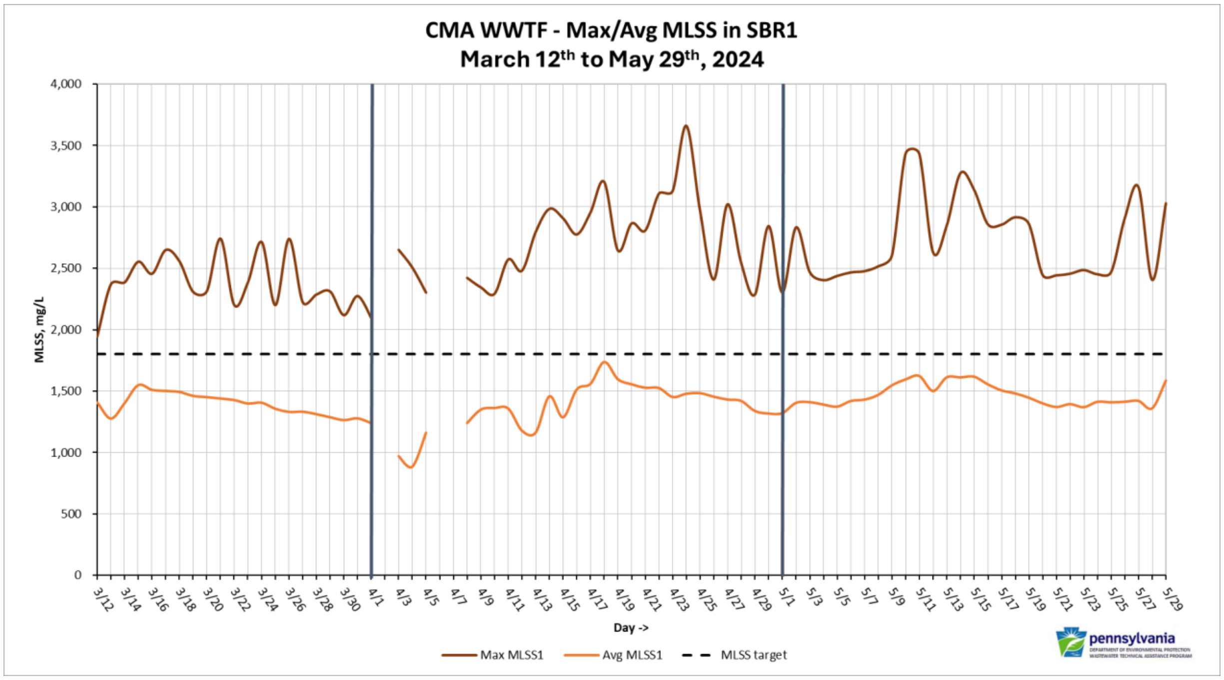


Figure E-7: SBR1 MLSS Min & Max values from March 12th to May 29th, 2024.

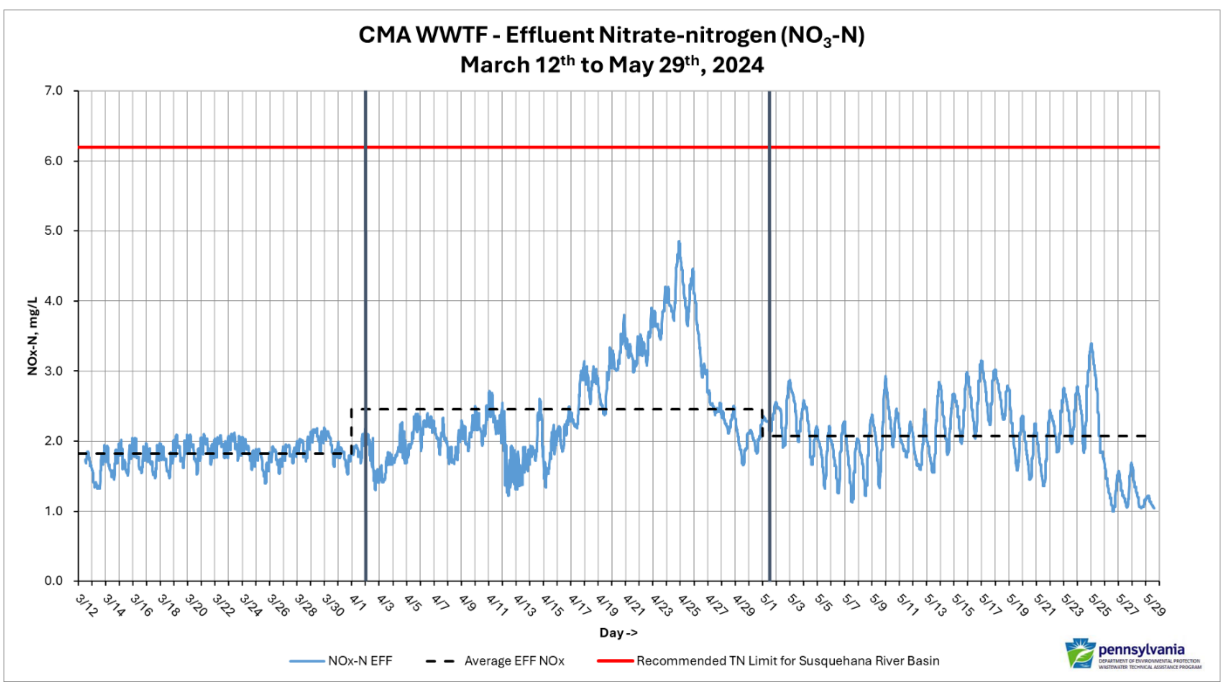


Figure E-8) NOx-N Data – Final Effluent Nitratax (NO_3-N - Nitrate-Nitrogen) Probes

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont)

Continuous Monitoring Probe System data - March 12th to May 29th, 2024 (Cont'd.)

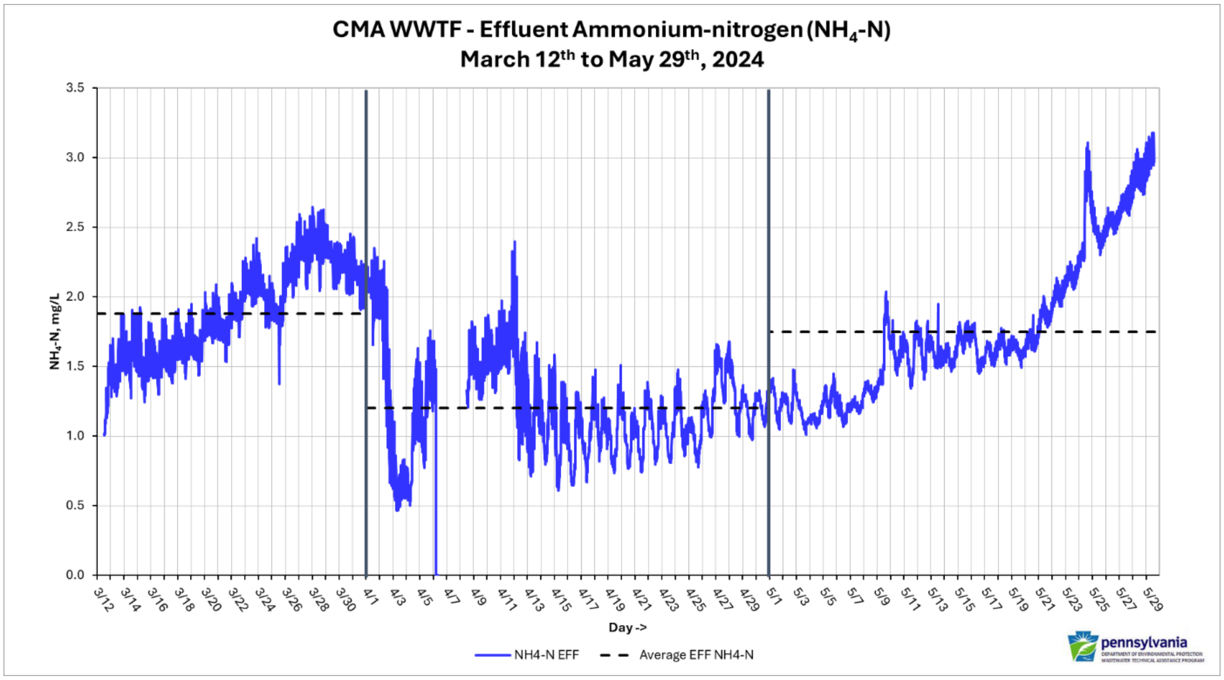


Figure E-9) Effluent Ammonium-Nitrogen (NH_4-N) – Effluent AISE (NH_4-N) Probe.

❖ ***Monthly, Weekly, & Daily graphs of WWTAP continuous monitoring data may also be available upon request.***

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont'd)

WWTAP Bench Testing Results Graphs for Full Study Period (March 12th to May 29th, 2024)

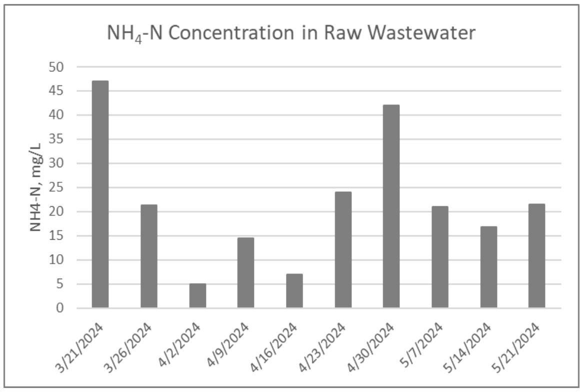


Figure E-10) Influent Ammonia-nitrogen concentrations.

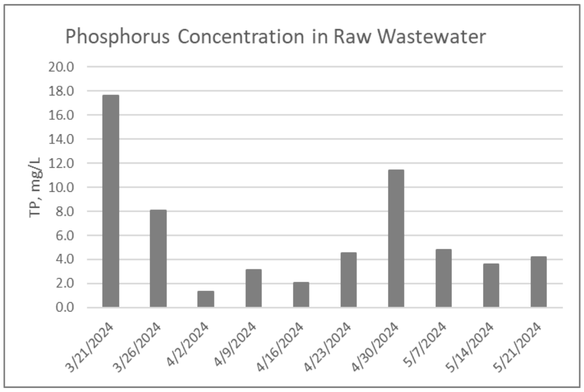


Figure E-11) Influent Phosphorous (PO_4-P) concentrations

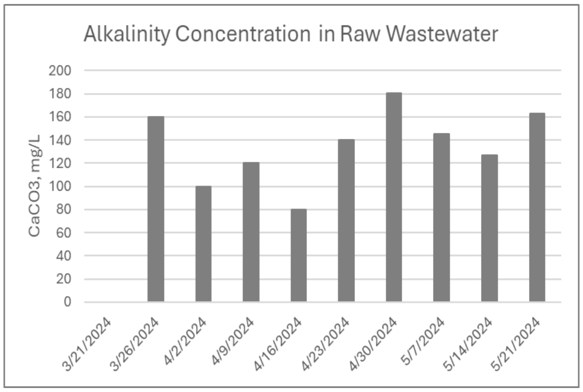


Figure E-12) Influent Alkalinity ($CaCO_3$) concentrations

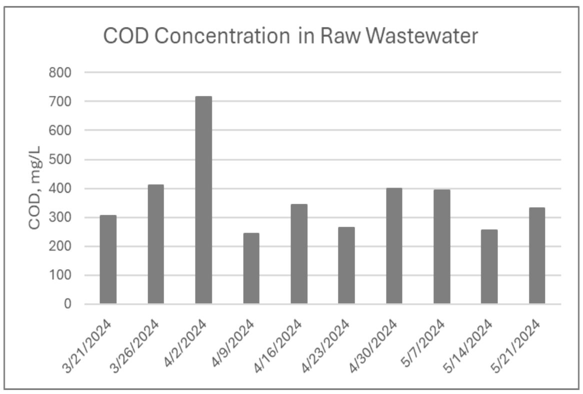
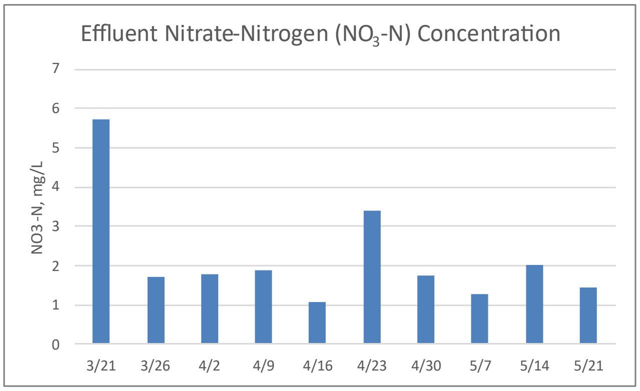


Figure E-13) Influent Chemical Oxygen Demand (COD) concentrations.

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont'd)

WWTAP Bench Testing Results Graphs for Full Study Period (March 12th to May 29th, 2024)



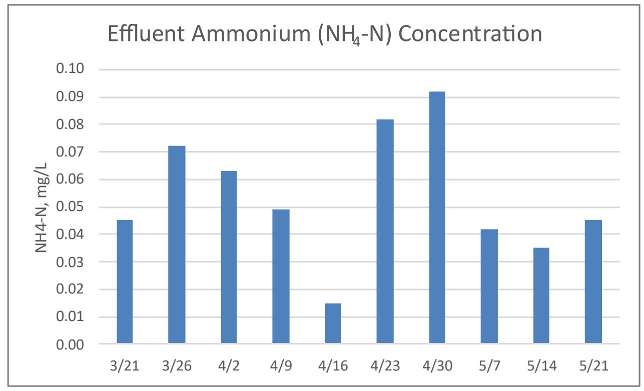
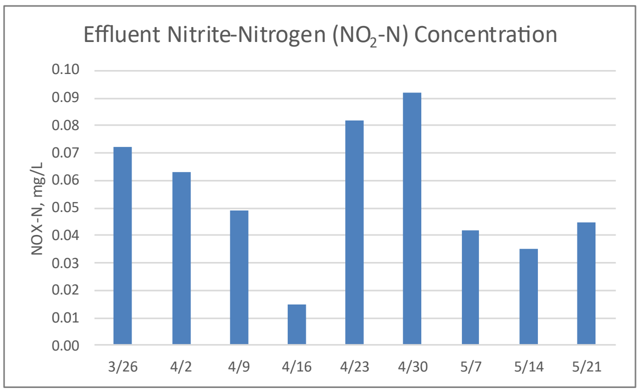


Figure E-14) Effluent Nitrate Nitrogen Conc.

Figure E-15) Effluent Ammonium-nitrogen Conc.



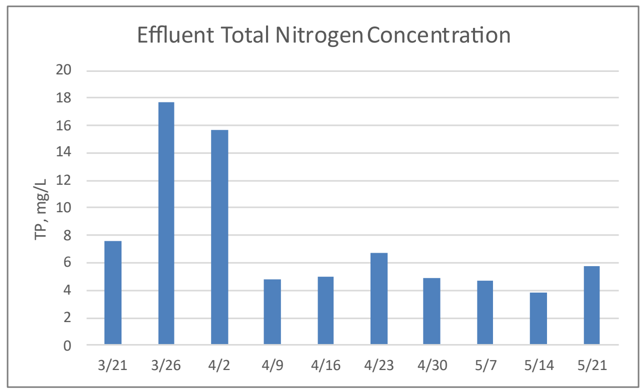
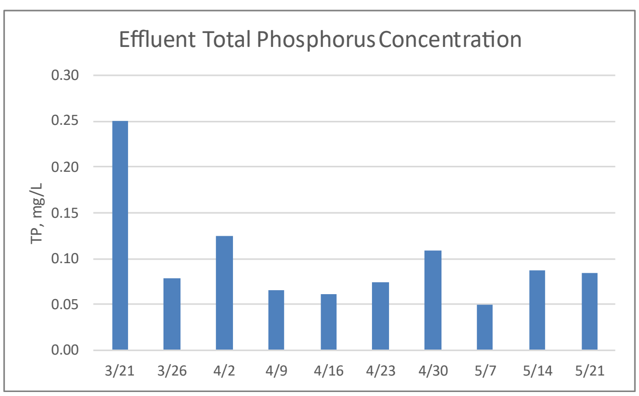


Figure E-16) Effluent Nitrate-nitrogen Conc.

Figure E-17) Effluent Total Nitrogen Conc.



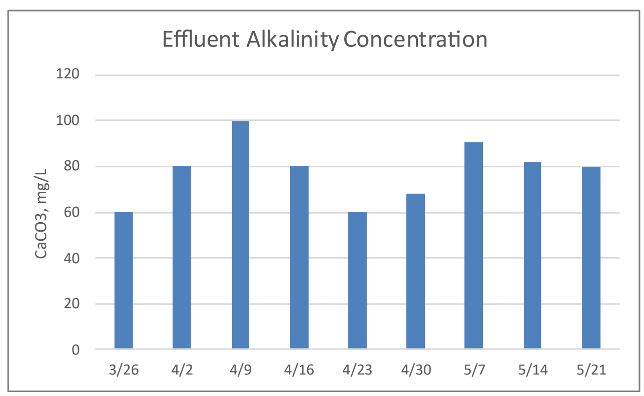


Figure E-18) Effluent Total Phosphorous Conc.

Figure E-19) Effluent Alkalinity Conc.

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont'd)

WWTAP Process Control Testing Results Graphs for Full Study Period (March 12th to May 29th, 2024)

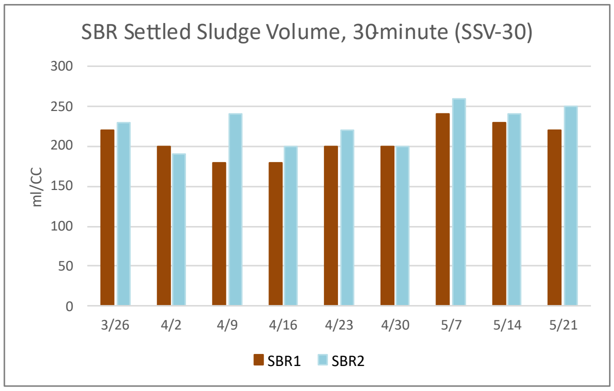


Figure E-20) 30-Minute Settleability (SSV)

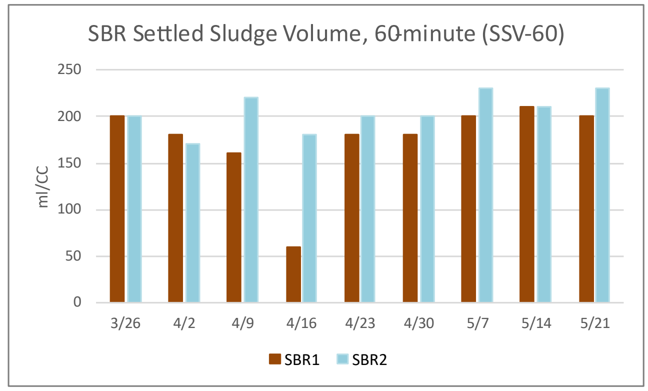


Figure E-21) 60-Minute Settleability (SSV).

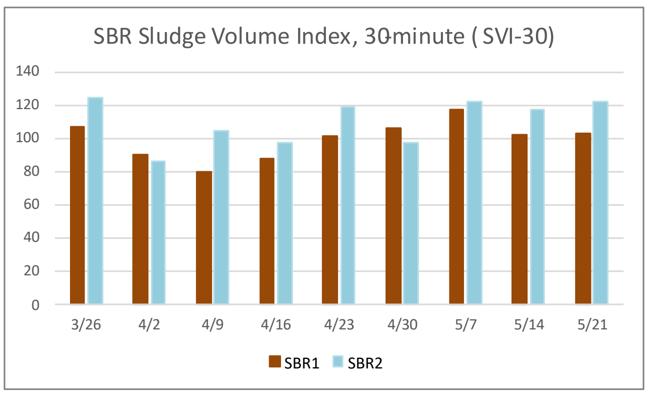


Figure E-22) 30-Minute SVI

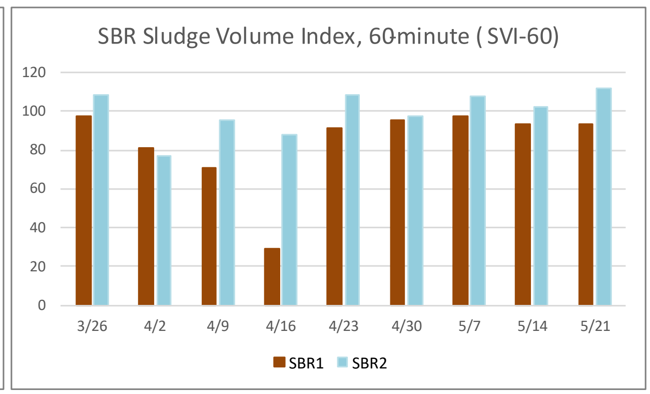


Figure E-23) 60-Minute SVI

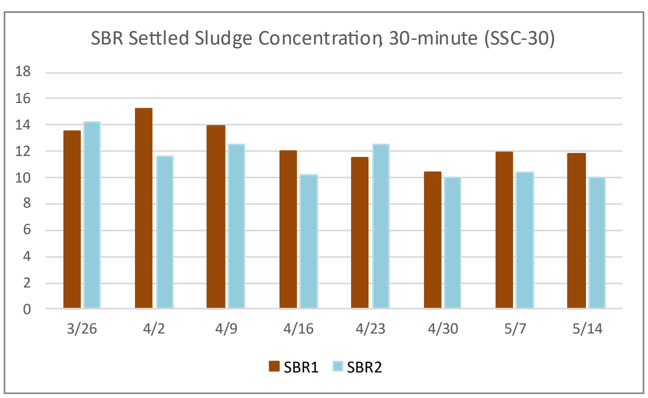


Figure E-24) 30-Minute SSC

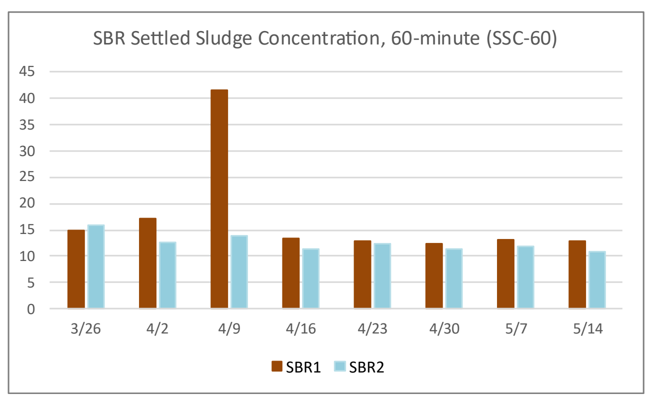


Figure E-25) 60-Minute SSC

ATTACHMENT E: WWTAP DATA & GRAPHS (Cont'd)

WWTAP Process Control Testing Results Graphs for Full Study Period (March 12th to May 29th, 2024)

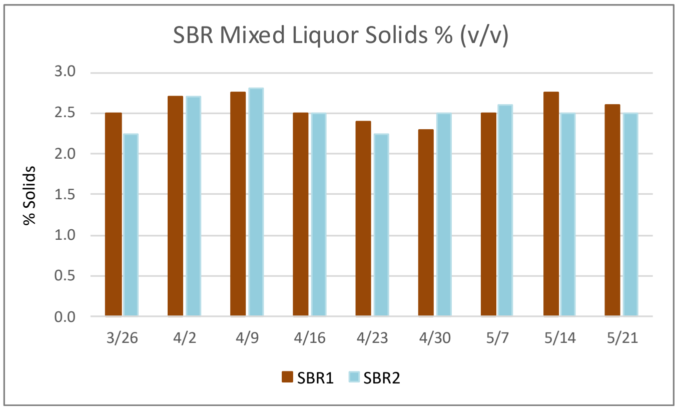


Figure E-26) Mixed Liquor % Solids

**15-Minute Centrifuge Spin Test*

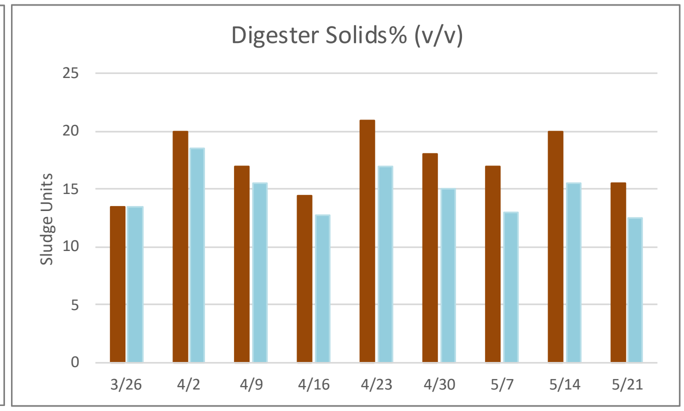


Figure E-27) Return Activated Sludge % Solids

**15-Minute Centrifuge Spin Test*

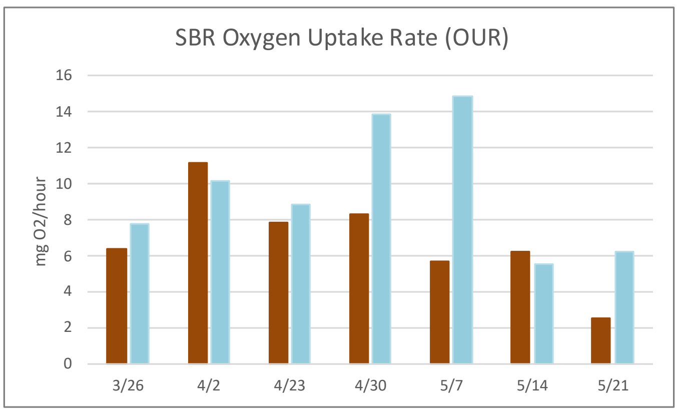


Figure E-28) Mixed Liquor Oxygen Uptake Rates

**15-Minute OUR Test*

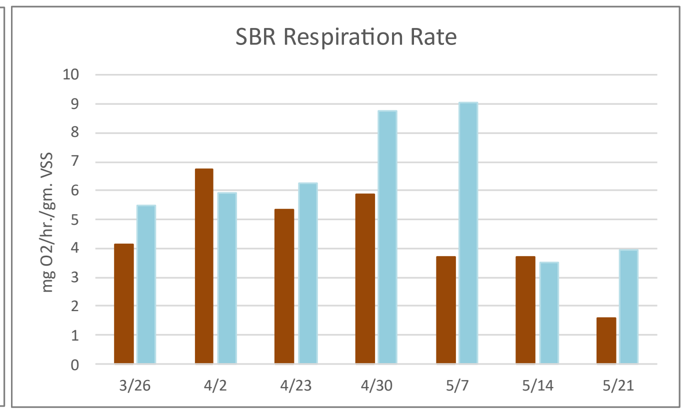


Figure E-29) Mixed Liquor Respiration Rate

**Calculated with 15-minute OUR Test*

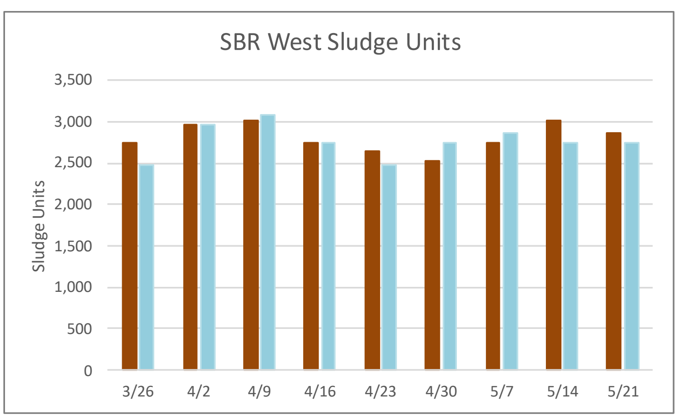


Figure E-30) Oxidation Ditch Sludge Age

** Calculated*

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Department of
Environmental Protection