MAPLETON AREA JOINT MUNICIPAL AUTHORITY
MAPLETON WASTEWATER TREATMENT FACILITY
MAPLETON BOROUGH, HUNTINGDON COUNTY, PENNSYLVANIA

NPDES # PA0087513

WASTEWATER TREATMENT EVALUATION

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pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION
WASTEWATER TECHNICAL ASSISTANCE PROGRAM

MAY 2018

Executive Summary

Technical Assistance staff from US-EPA Region III and PA Dept. of Environmental Protection conducted a joint evaluation of the Mapleton Sewage Treatment Plant (Mapleton) in Huntingdon County from March through May 2018. The purpose was to assist the plant operator, Bruce Richards, in evaluating energy conservation opportunities while optimizing the process for biological nutrient reduction (BNR). The evaluation produced some findings and recommendations that may enhance plant performance while reducing monthly operating costs.

For eight weeks during late winter and early spring, DEP staff deployed process monitoring instrumentation on site and recorded data as the facility operator adjusted the aeration regime. Over the course of the study, effluent nitrate concentrations dropped from 34 mg/L to 6-8 mg/L. While intermittent, timed aeration cycles were used to promote denitrification, the facility design and characteristics render it an excellent candidate for potential conversion to modified Ludzack Ettinger (MLE) process for biological nitrate reduction. Already nitrifying well by design, this facility would be expected to achieve total nitrogen (TN) reductions to between 4 and 6 mg/L through denitrification, meeting nitrogen loading limits imposed on discharges within the Chesapeake Bay drainage basin.

The energy evaluation included power logging the main aeration blower, which averaged 15 kW/day, and a review of utility billing that revealed inappropriate sales tax charges to an exempt organization, allowing for a refund of about $1,200. After optimizing nutrient reduction, aeration blower run time had been reduced by fifty percent (50%,) resulting in potential savings of approximately $2,600 per year.[1]

Concurrently, staff from EPA assisted Mapleton with an evaluation of energy consumption and with GPS-based mapping of the collection system. This ongoing work extends beyond the scope of this report.

Phosphorus reduction was not evaluated during this study, as biological phosphorus removal is more difficult to achieve on the fly, without having dedicated treatment facilities for that purpose.

Recommendations:

Considering the relative successes of the facility operator, working with USEPA and DEP staff, to establish credible reductions in both nitrate-nitrogen and total nitrogen through the use of intermittent aeration at this conventional activated sludge treatment facility, the DEP makes the following recommendations:

Based on the results of the field evaluation, the following recommendations are offered for both short- and long-term improvements to facility operation and, where applicable, process improvements:

Short-term:

1. Continue intermittent (ON/OFF) aeration as an operational strategy to reduce total nitrogen pollution in the final effluent;
2. Acquire the additional water quality monitoring capability necessary to test for nutrients, as demonstrated by DEP through its on-site tests during the evaluation. A list of the various equipment and reagents is provided in Attachment B;
3. Consider installing variable frequency drives for the main aeration blowers, using

[1] Source: https://www.electricitylocal.com/states/pennsylvania/mapleton/ , where average industrial electrical cost is listed as 4.68 ¢/kWh, which is 35% lower than the 7.23 ¢/kWh statewide average.

dissolved oxygen probes in a control feedback loop to match treatment demands and reduce energy consumption;
4. Schedule down-time and maintenance for each Dutchland vault to remove rags and detritus that accumulated prior to installation of the rotary fine-screen headworks;
5. Request electric sales tax refund for overpayments to current and former electric utility providers;
6. Consider purchasing energy through the Pennsylvania CO-STARS program to achieve more competitive pricing in future contracts.

Long-term:

1. Ask the Authority's consulting engineer to evaluate and propose process modifications that will permanently enhance effluent nutrient reduction at this facility. Consider modifying the existing Dutchland vault configuration to accommodate biological nitrogen removal via the modified Ludzack-Ettinger configuration, which may require downrating the facility's hydraulic capacity to realistically match the current and expected capacity of the service area. These modifications should consider:
    a. Existing and anticipated treatment capacity of the present system and any alternatives proposed;
    b. Aerator and blower improvements that will increase treatment and energy efficiency using dissolved oxygen probe feedback;
    c. Installing and using oxidation/reduction potential probes to monitor and optimize denitrification;
    d. Installing and operating alkalinity controls, possibly automated to more evenly distribute alkalinity amendment throughout the day. Alternatives to bagged lime are discussed in this report.
    e. Addition of automated effluent monitoring for pH and dissolved oxygen that exceeds the testing interval presently stated in the NPDES Permit.
2. Consider adding regular process monitoring tests for effluent nutrients such as ammonium nitrogen, nitrite-nitrogen, nitrate-nitrogen, total nitrogen, and total phosphorus. These colorimetric tests were demonstrated during the evaluation and are useful for process optimization and diagnosing operational conditions.

Wastewater Treatment Evaluation:

Mapleton Area Joint Municipal Authority (MAJMA) owns and operates a small, Dutchland vault-type wastewater treatment plant located along Hares Valley Creek in Union Township, Huntingdon County. The facility was designed as a 0.103 MGD conventional activated sludge treatment process which has averaged 0.030 MGD flow over the past five years. The facility serves 231 effluent domestic units (EDU) and discharges treated water to a tributary of the Juniata River in the Susquehanna River Basin, making it eligible for nutrient limits on nitrogen and phosphorus. The facility presently is required to "monitor and report" on its monthly discharge monitoring reports (DMR.)

The treatment plant consists of three trains of in-ground vaults, each vault having a capacity of about 7,200 gallons. Each train consists of, respectively, an equalization tank, three aeration vaults, a dual hopper-style secondary clarifier, and a sludge digestion vault. For practical purposes, the equalization tanks are interconnected, as are the digester tanks. Gate valves control flow among the clarifiers and return activated sludge (RAS) is conveyed using air-lift pumps integral to the vault-style clarifiers. The overall aeration capacity is 0.103 MG, but for practical operation, only two of the three trains is in service at any given time, providing treatment for up to 0.067 MGD.

Other processes include a recently installed rotary fine-screen headworks for trash removal, a sludge/filter bag system for consolidating digested solids, ultraviolet disinfection, and chemical addition points for phosphorus control, alkalinity addition, and solids coagulation. The control building houses three rotary lobe blowers, a workshop, the UV system, and the solids handling and bagging facility. Electrical service is a standard 480-volt, three phase system with four wires. Aeration blowers are controlled through motor starters, but no variable frequency drives are present. There are mechanical timers attached to the motor starters for the aeration blowers.

MAJMA's service area consists of gravity sewer and force main, and it is served by two pumping stations. The collection system includes seven stream crossings ranging from ten to forty linear feet, each.

In March 2018, following years of difficulty associated with hopper-style secondary clarifiers, MAJMA had a 0.125 MGD, 14'-0" diameter secondary clarifier installed to control solids losses and related NPDES permit violations. The authority's consulting engineers have been performing a shake down of the new clarifier and developing its operating procedures. The new clarifier will handle most of the treatment flow, with the hopper-style vaults retained as backup for high flow conditions and to provide relief for maintenance purposes. Should capacity or I/I contributions warrant, provision has been made for adding a second clarifier of similar design and construction.

The facility's Municipal Wasteload Management "Chapter 94" Report for 2017 noted that average annual daily flow was steady at 0.3 MGD with an average daily organic load of 69 lb./day. The hydraulic peaking factor is 1.20, and the one-month organic maximum-to-average ratio is 1.46. Since the customer base is extremely stable, only one EDU connection is anticipated per year through 2022.

During late February, EPA staff requested use of DEP monitoring equipment to characterize nutrient reduction and energy consumption while enacting a schedule of cycled, intermittent ("on/off") aeration as an operational control strategy for the treatment plant. Intermittent aeration has proven to reduce energy and chemical costs where it is successfully practiced, while providing for nitrate and total nitrogen reduction. DEP staff installed a "mini-SCADA" system consisting of four in-line probes (dissolved oxygen, pH/temperature, oxidation/reduction potential, and total suspended solids) into the second aeration vault of treatment train one, where EPA had been temporarily using a portable DO probe to monitor treatment. The four probes are continuously monitored by a controller unit, and data is recorded on a notebook computer located under roof in the workshop. DEP staff visited the site once per week to download data into a spreadsheet workbook for graphing and trending purposes. In addition to the automated data collection, DEP staff conducted weekly nutrient assays of treated effluent grab samples taken from the discharge end of the UV disinfection system. These data are recorded in Attachment C.

Nutrient Reduction Goals:

The facility's permit has "monitor and report" requirements for nutrients. For discharges contributing to the Susquehanna River Basin and the Chesapeake Bay, annual nutrient limits are calculated based on overall average total nitrogen (TN) and total phosphorus (TP) concentrations of 6.0 mg/L and 0.8 mg/L, respectively. MAJMA presently has no set capacity limits; however, it must report loadings based on routine nutrient testing.

Should MAJMA receive nutrient limits in a future permit, options could include purchasing nutrient credits for the overages or integrating nutrient reduction strategies into its operational controls, or a combination of both options.

Intermittent “on/off” aeration is a good first step toward nutrient reduction; however, it is not always effective. Over the course of the evaluation, technical assistance staff and the plant operator experimented with varying time settings on the blower runs, seeking a workable schedule for using intermittent aeration. This approach may be problematic in Dutchland vault plants, chiefly because of the use of air-lift pumps to return and to waste sludge: no blower running means no sludge transfer; however, it is anticipated that electro-mechanical, submersible sludge pumps for the new clarifier will alleviate this problem. Another potential problem is that the physical separation of the biomass into discrete, 7,200-gallon vaults may not efficiently promote denitrification.

An alternative to intermittent aeration would be to convert the first “aeration” vault in each train to anoxic mixing vaults where raw wastewater BOD_5 from the influent splitter box may provide sufficient carbon to drive denitrification. As a temporary measure, small 220V submersible grinder pumps could be fitted with baffled discharge to provide anoxic mixing in these anoxic vaults. Lastly, a nitrate recycle should be established to transfer mixed liquor from the last aeration vault in the sequence, back to the anoxic vault, using submersible pumps. This is the modified Ludzack-Ettinger (MLE) process.

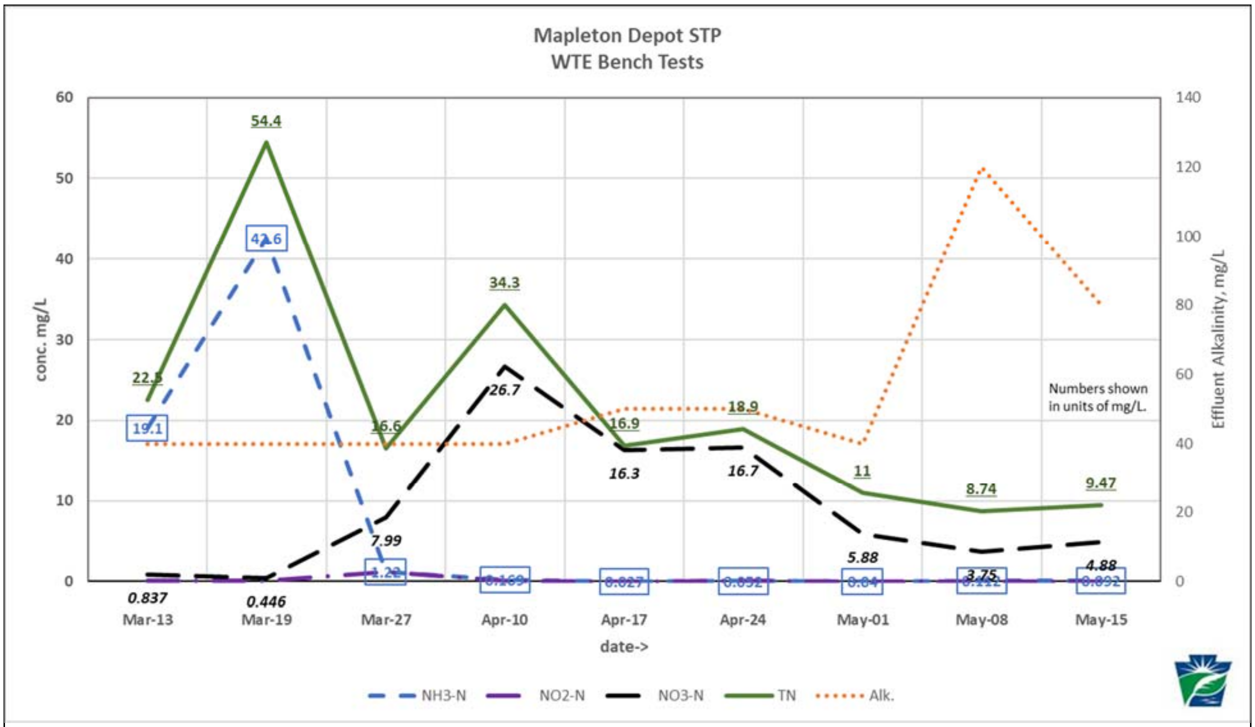

Chart: Bench tests verified reductions of nitrate and total nitrogen even in the absence of anoxic mixing or a dedicated nitrate recycle and carbon source.

In the chart shown above, test results for nitrogen-based compounds and for mixed liquor alkalinity demonstrated the positive effect of intermittent aeration, even in the absence of anoxic mixing, nitrate recycle, and secondary carbon source. Initially, the facility produced high ammonium concentrations (in March) during initial construction of the new secondary clarifier, resulting in low nitrate concentrations. (Nitrite was not a major consideration, because the facility does not employ halogen-based disinfection.) As the study progressed, with adjustments to the timing of the oxic and anoxic cycles, the total nitrogen concentration in the effluent decreased, from a high of 34.3 mg/L to as low as 8.74 mg/L, where the ideal target concentration would be 6.0 mg/L or lower. This is a rather encouraging outcome for a conventional treatment facility that has not undergone MLE modification.

Energy Reduction Goals:

Three different timing programs were tried before settling on a daily series of eight 90-minute nitrification cycles alternating with 90-minute denitrification cycles. Doing so reduced aeration electrical demand by half, or twelve hours per day, at an average 13 kW per day for the aeration blower. Naturally, with an MLE conversion, it is expected that the aeration blowers would be "right-sized" for the actual aeration demand, rather than continuing to use the oversized system that DEP staff recommended right-sizing.

Operations and Treatment Alternative Technology:

Due to the size of the treatment system, the operator can successfully treat average and peak loads using only two of three treatment trains on a consistent basis. This is not to say that design conditions for peak loading may not occur within the life of this facility. However, the evaluation data have demonstrated through intermittent aeration that nitrogen reduction (especially nitrate) reduction is readily achievable through operational controls. The methods employed during the evaluation may be made permanent through equipment upgrades and continued operational controls, but because MAJMA has some 33% of its hydraulic capacity unused, it should consider converting some of this unused capacity for exclusive use by a denitrification process.

It may prove easy to simply add anoxic mixers to each of the aeration vaults and continue with intermittent, timed oxic and anoxic cycles, but a more useful option may be to convert the facility with its unused capacity to a Modified Ludzack-Ettinger (MLE) process, reducing the number of treatment trains from three to two, adding anoxic treatment following the equalization tank and prior to the aeration tanks. An MLE configuration, governed by improved aeration and supervisory control technology, may be the best use of this facility's unused capacity.

The MLE process typically calls for alkalinity control in the mixed liquor and for an additional, supplemental carbon source to promote denitrification if the raw wastewater BOD5 loading is insufficient by itself to carry the biochemical process to completion. Although the facility operators employ lime addition when necessary, it may be beneficial to consider an automated process to wet-mix and add lime slurry on a more constant basis or to explore using alternatives such as magnesium hydroxide solution. [$Mg(OH)_2$] Alkalinity in the mixed liquor should be greater than 100 mg/L and even as high as 200 mg/L to buffer complete nitrification. The facility pH during the evaluation averaged 6.7 s.u., with minimum of 5.4 s.u. Ideally, pH of the mixed liquor would range between 7.0 and 8.5 for BNR. Alkalinity concentration of the mixed liquor was about 80 mg/L, while effluent alkalinity averaged 56 mg/L. It is possible that when BNR is completely established, the need for supplemental alkalinity will diminish. Therefore, Mapleton might consider using a temporary feed system until the alkalinity demand is fully known.

Although the common practice at small treatment facilities is to add bagged lime to the mixed liquor or to the raw wastewater as a slug when needed, the preferred way is to mix it with effluent water and add it over a continuous period. Doing so assures that the dose is attenuated so as not to shock the bacteria, maintaining a gradual rise to a concentration that is optimal for nitrification.

Alterations to Enhance BNR:

Cycling the aeration times is proven effective in promoting BNR. Some process improvements would make the system work better, in the long term. Chief among these would be to employ a dissolved oxygen feedback to control DO residuals in the aeration vaults. Addition of variable frequency drives (VFD) to the aeration blowers, in conjunction with the DO feedback, would promote energy efficiency while maintaining DO effectively for both nitrification during aeration and for denitrification during anoxic periods, where a lower DO at the start of this cycle assures quicker depletion to an anoxic state. The PD blowers would need evaluated to ensure operation within expected ranges.

During the evaluation, rag fibers frequently accumulated on the immersion probes. It is likely that they are also present on the aerators, occurring before the modernized screening headworks was added. This material will interfere with anoxic mixing and with instrumentation and could prove costly in terms of damage and reactive maintenance. It will not attenuate over time but must be manually removed from each vault during scheduled down-time. DEP recommends that the treatment units be purged of this material prior to installation of anoxic mixers, should BNR be pursued further.

Use of air-lift pumps, while economical in many treatment facilities, introduces oxygenation into return sludge or mixed liquor, which is counterproductive for anoxic denitrification. Where possible, use of such devices should be eliminated. At Mapleton, the air lift pumps remain operable to keep the hopper-style clarifier vaults from filling with water. Barring some future use of the clarifiers, it may be beneficial to replace air lift pumps with electromechanical ones.

Acknowledgements:

DEP WWTAP thanks the facility operator and the board of the Mapleton Area Joint Sewer Authority for the opportunity to demonstrate BNR and energy efficiency opportunities at this facility.

ATTACHMENT A: EVALUATION TEAM

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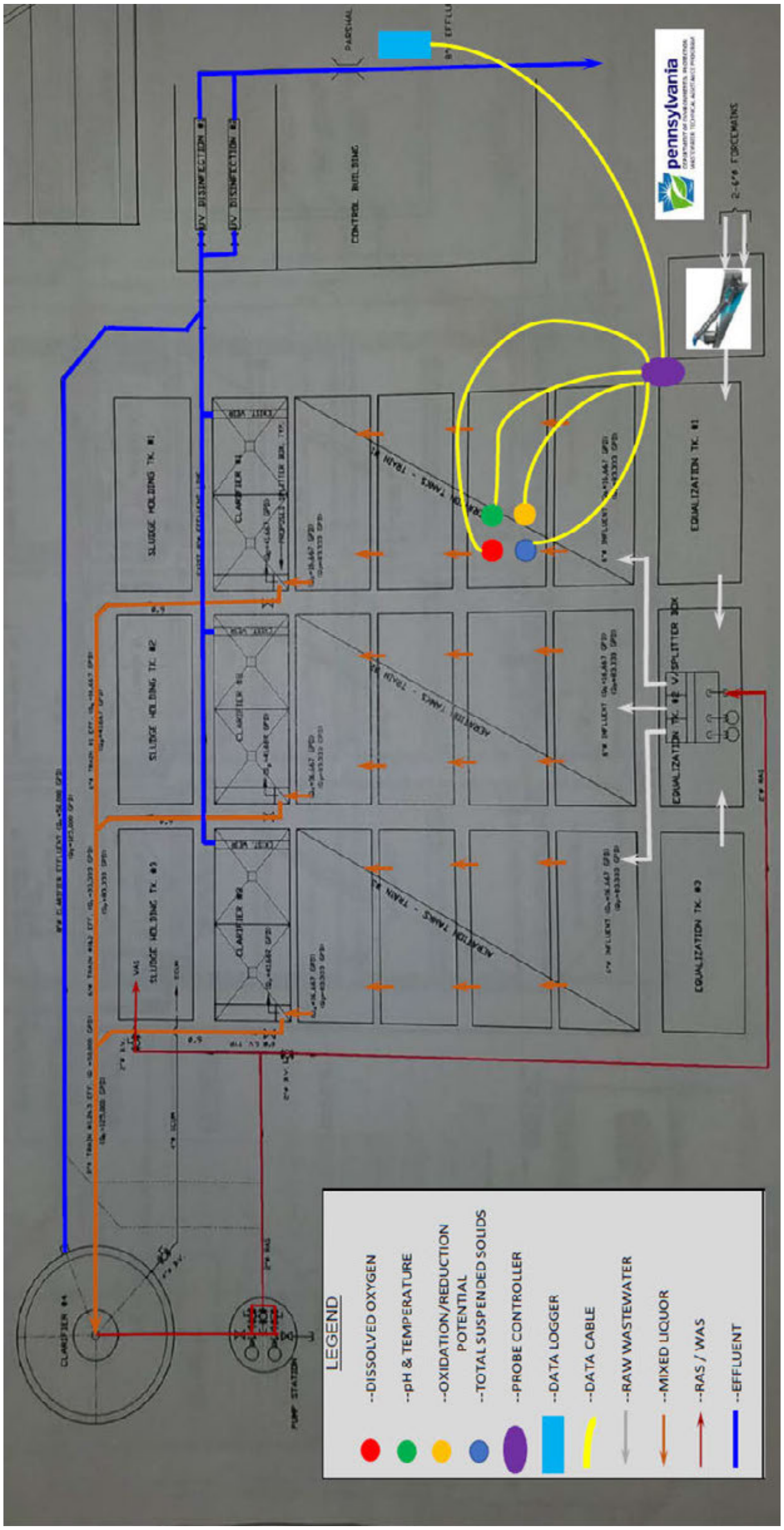
MAJMA Operations Staff
Bruce Richards, Operator MAJMA Mapleton STP 13343 Smith Valley Road Mapleton, PA 17052-0415 phone: 814-543-0853 email: brucerichards59@gmail.com

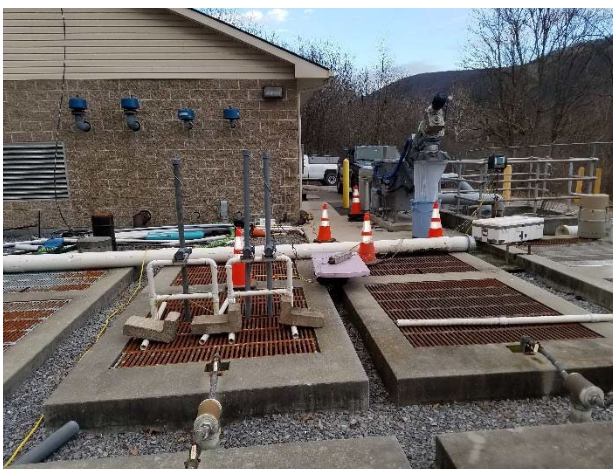
ATTACHMENT B: EQUIPMENT PLACEMENT SCHEMATIC

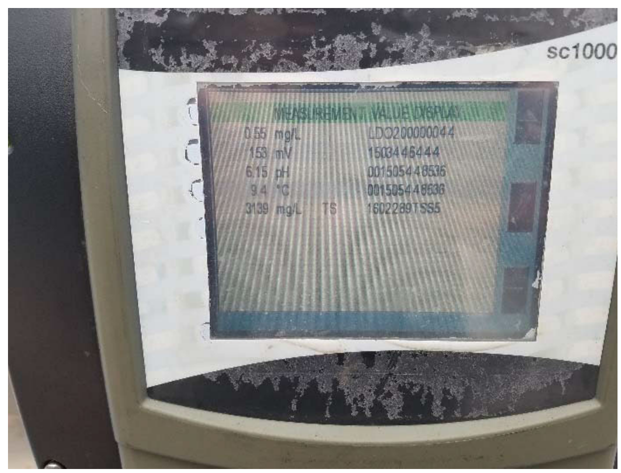


ATTACHMENT C: RECORD PHOTOGRAPHS


6 x 3 Dutchland Vault System


14'-diameter Secondary Clarifier & RAS Pit

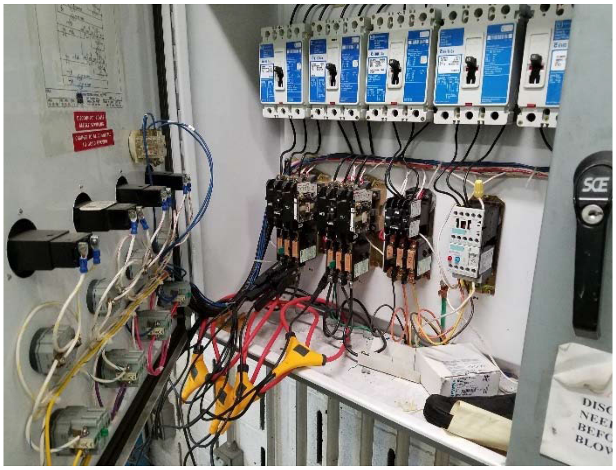

Aeration Probes & Data Controller Installation



Instantaneous Probe Data Output


Example probe mounts


Aeration Rotary Lobe Blower System


Motor controls for Facility's Blowers


Power Logger set for 30 day event

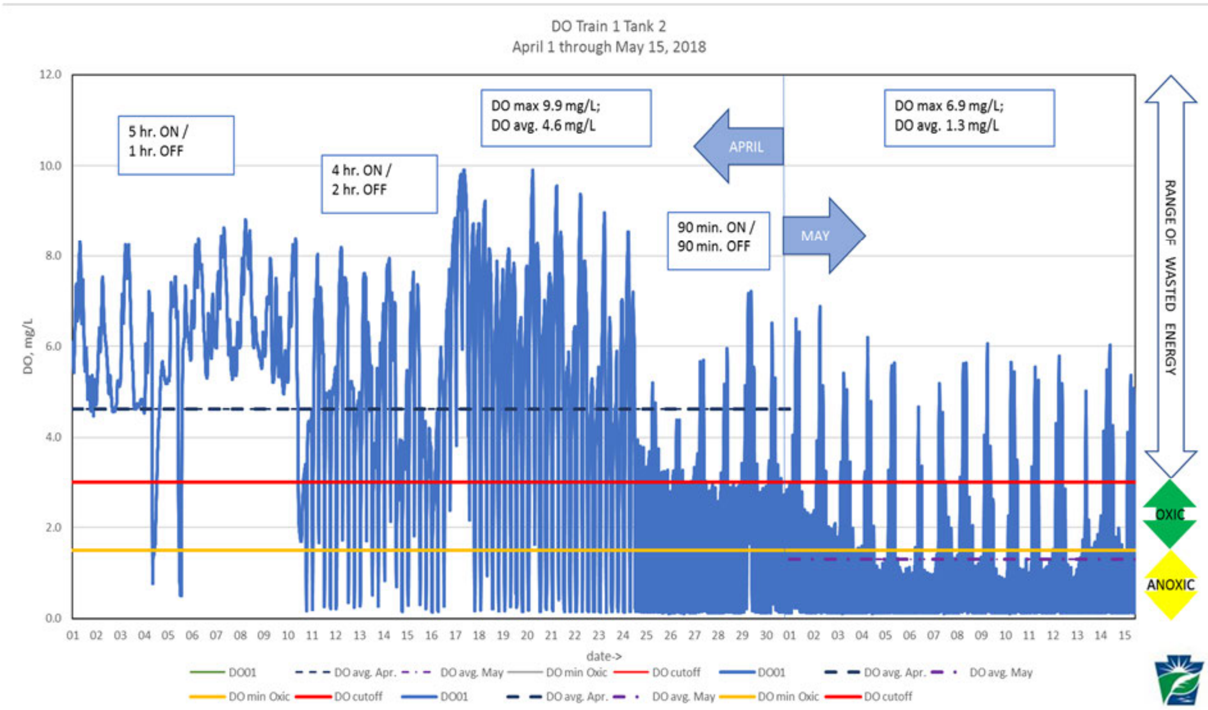

Clarifier Foundation Pour


Clarifier and Wet Well Set In Place

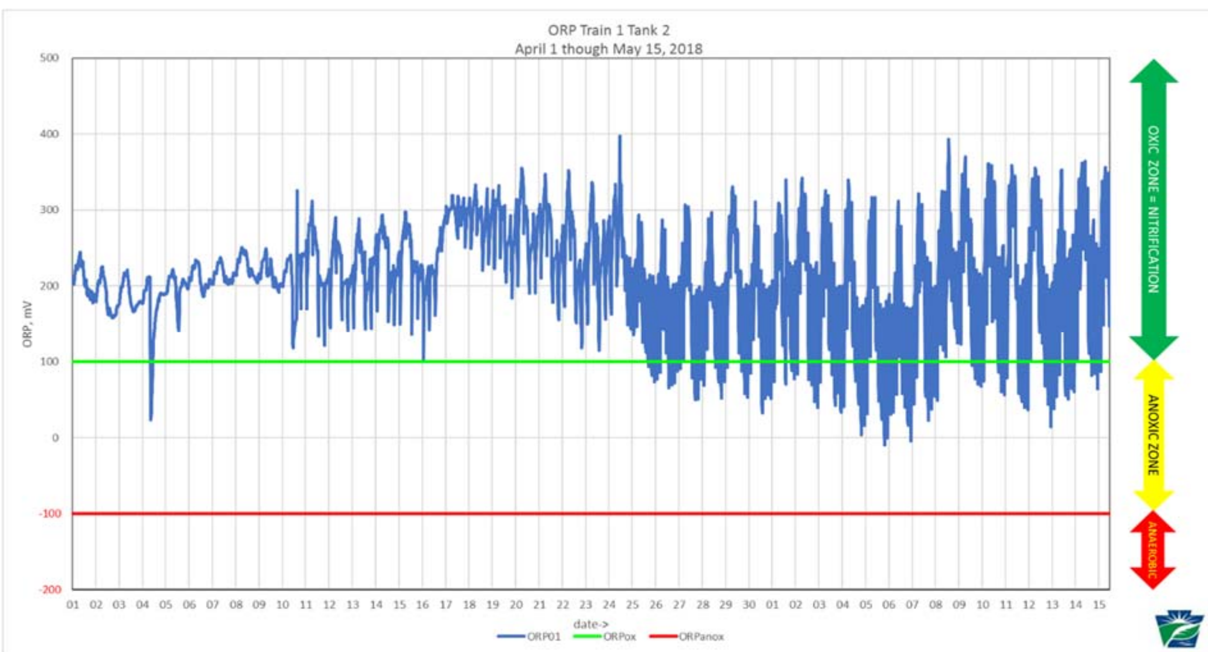

Wet Well for RAS Submersibles


Clarifier in-service; one problem solved

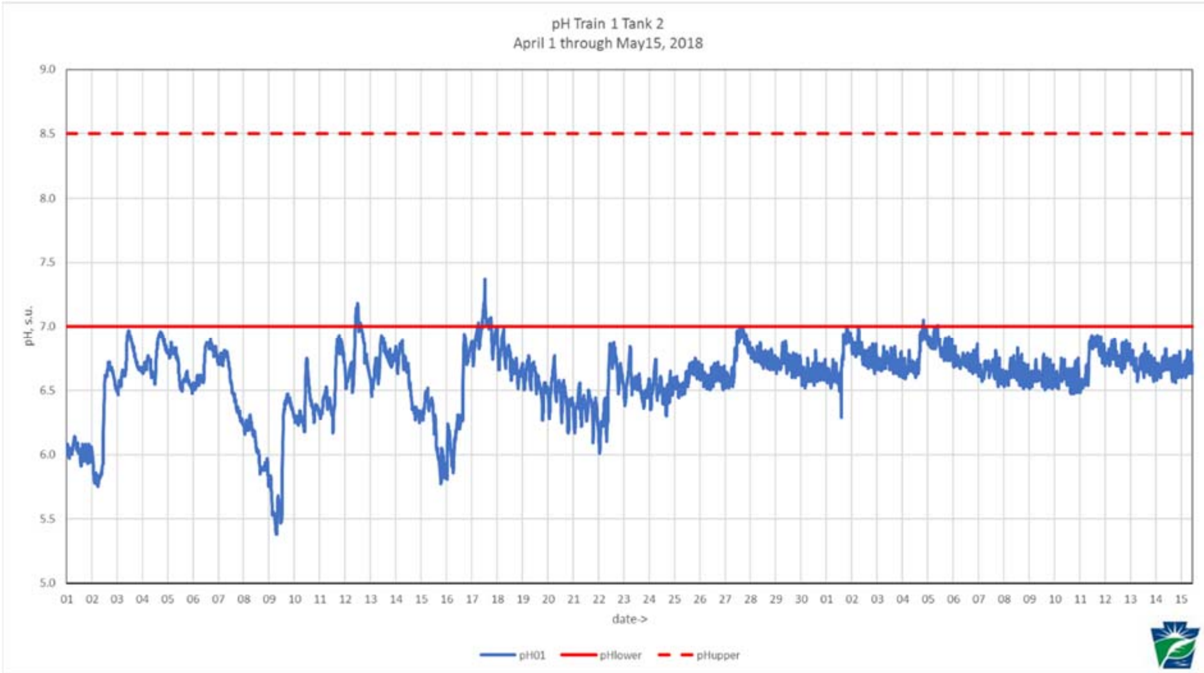
ATTACHMENT D: EXAMPLE TRENDS CHARTS



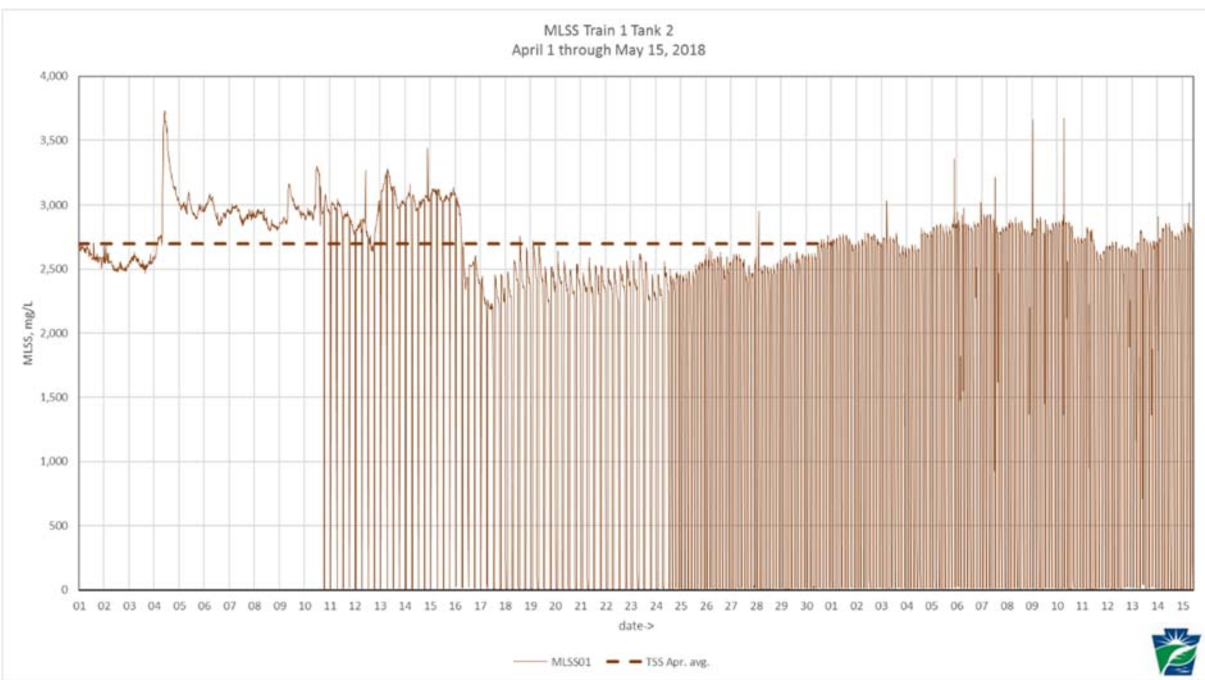
Dissolved Oxygen measurements during evaluation, showing max/min/avg for each month and time settings for intermittent aeration, recognizable by narrowing cycles of highs and lows. Note that, without aeration control, much energy is wasted as unnecessary DO above a 3.0 mg/L concentration.



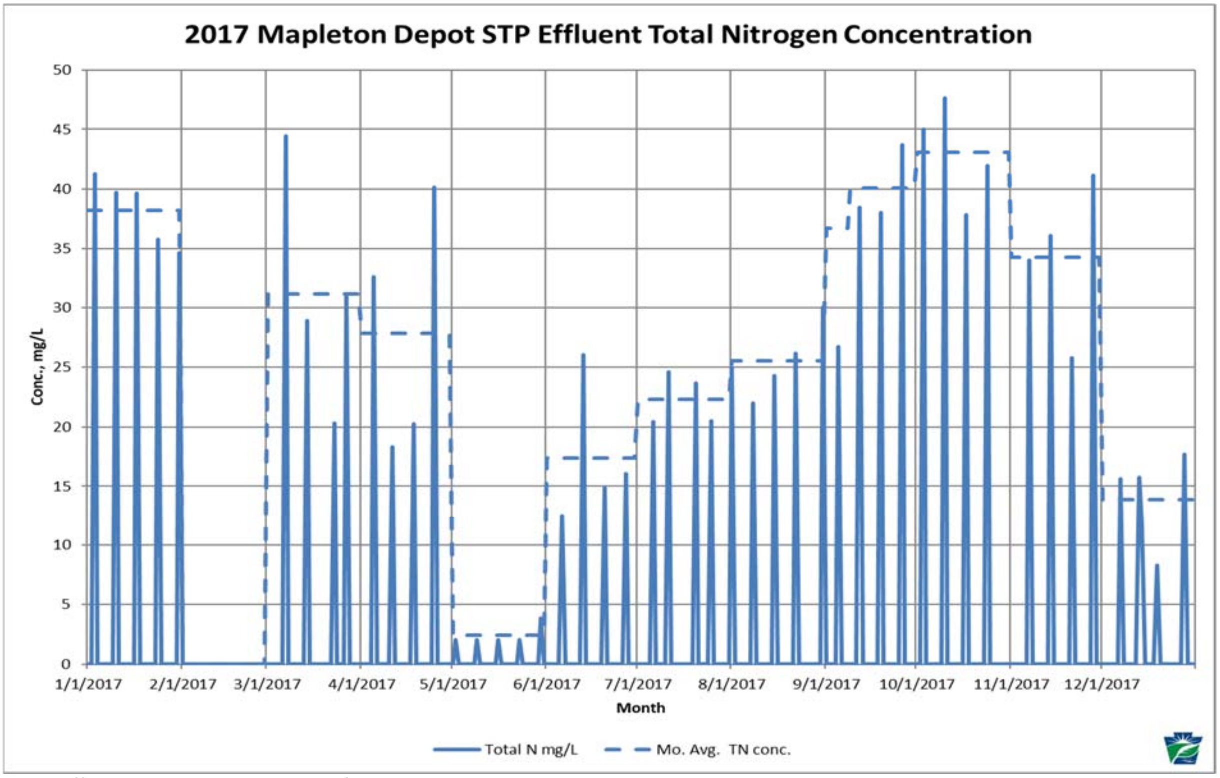
Oxidation/Reduction Potential: note that when anoxic mixing is not present, the probe readings are for ORP in the supernate. Most of the biological activity is occurring in the sludge blanket that forms, where ORP is more likely to be in the range of 0 mV to -100 mV.



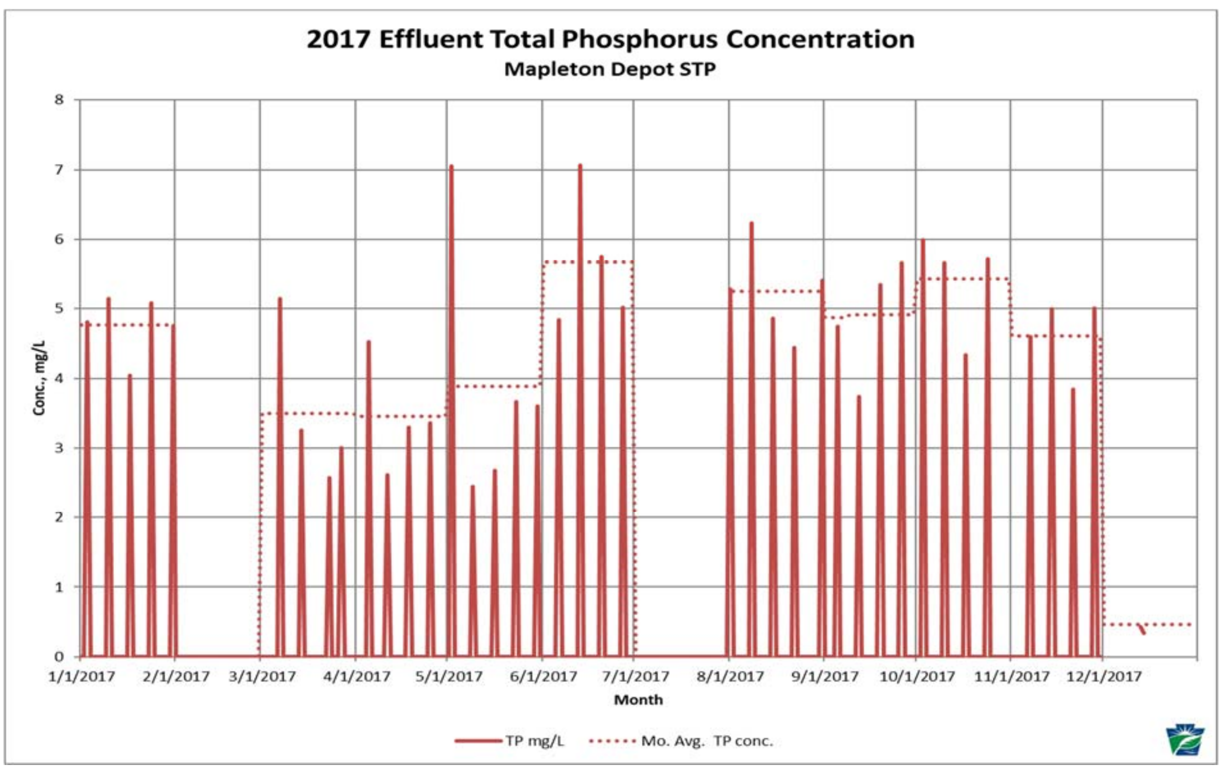
Mixed Liquor pH Trends during evaluation showed rise and fall in conjunction with aeration cycling: pH rose when alkalinity was increased through carbonate ion release during anoxic periods, and it fell during aeration periods when nitrifying bacteria produced nitrous and nitric acid by-products. The suggested buffered pH range is shown by the red lines. Alkalinity adjustment would improve this facility's pH.



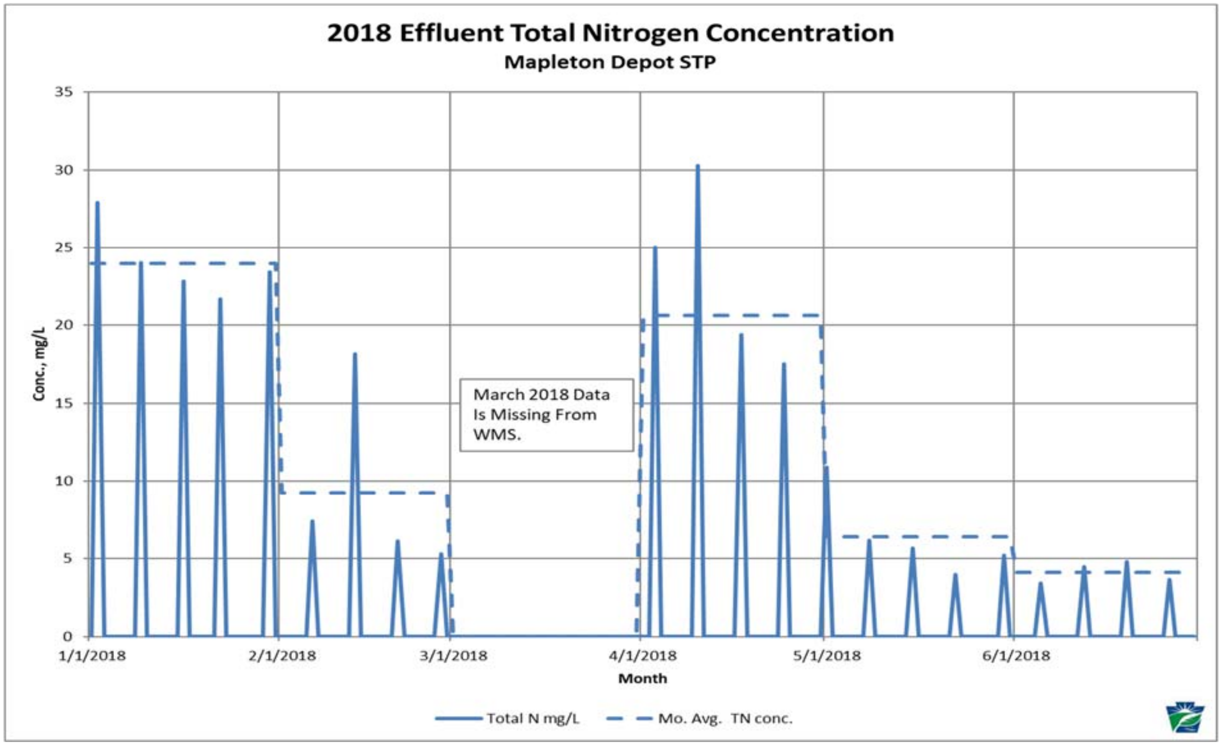
Mixed Liquor Suspended Solids, measured near surface of tank using an immersion probe: The trend displays oxic/anoxic cycling as the evaluation progressed, where narrowing bands of mixed MLSS to settled MLSS represent adjustments to aeration timing while optimizing for nitrogen removal.



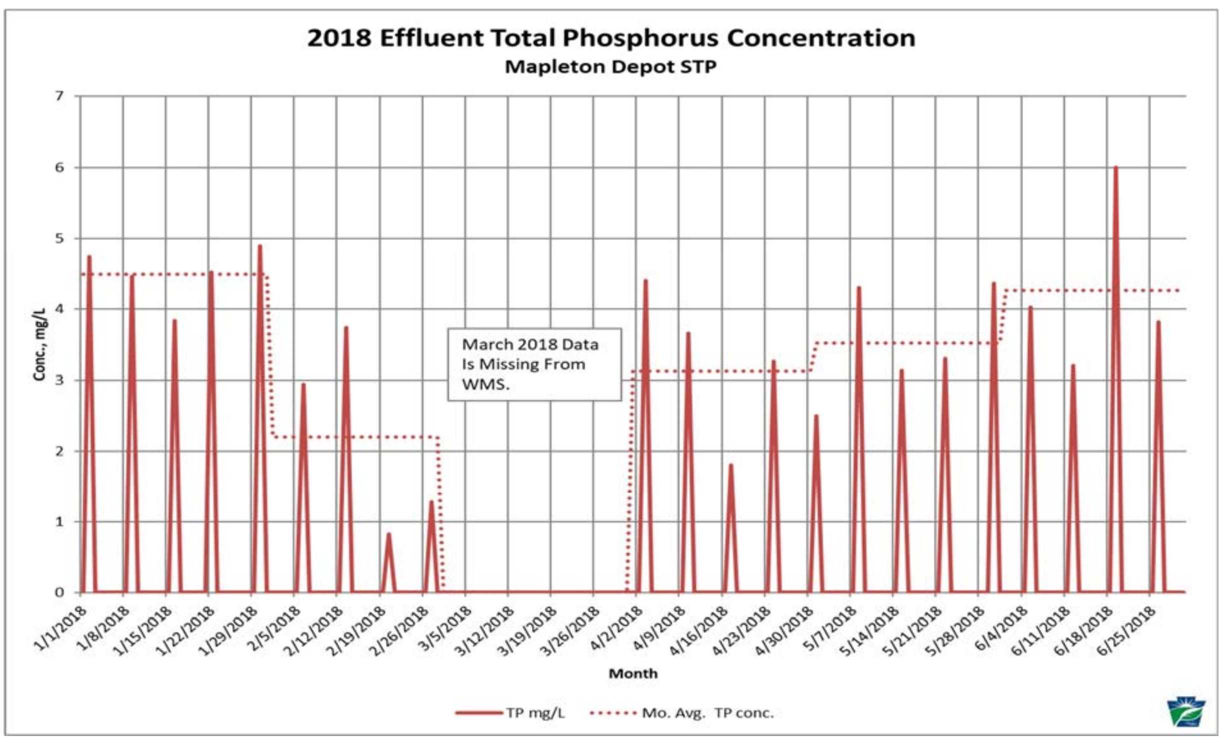
2017 Effluent Total Phosphorus Concentration, based on weekly 8-hour manual composite sampling.



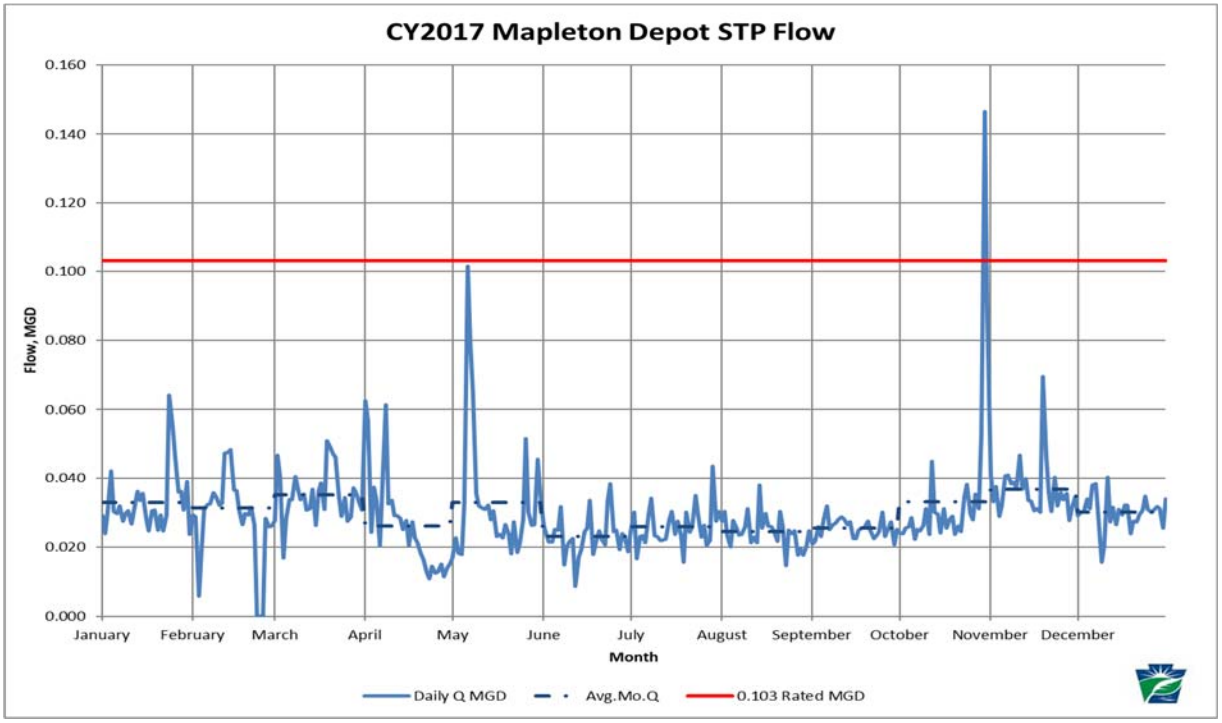
2017 Effluent Total Phosphorus Concentration, based on weekly 8-hour manual composite sampling.



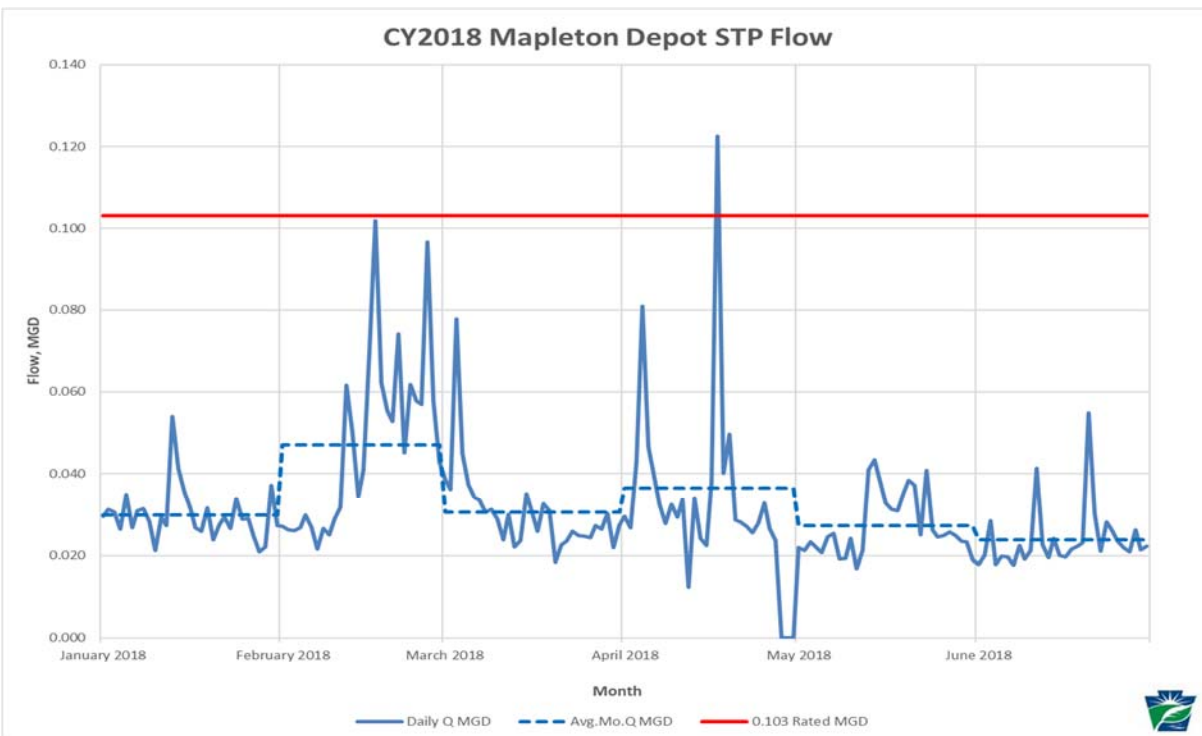
2018 Effluent Total Nitrogen Concentration, based on weekly 8-hour manual composite sampling.



2018 Effluent Total Phosphorus Concentration, based on weekly 8-hour manual composite sampling.



2017 Daily Effluent Flow, with Peak Daily of 0.146 MGD (October 30) and Rated Flow of 0.103 MGD



Jan.-Jun. 2018 Daily Effluent Flow, with Peak Daily of 0.123 MGD (April 17) and Rated Flow of 0.103 MGD

ATTACHMENT E: RECOMMENDED MONITORING TESTS & FREQUENCIES

PROCESS CONTROL TESTS FOR DOMESTIC WASTEWATER TREATMENT FACILITIES

Activated Sludge Facility: Conventional, Complete Mix, Step Feed, or Extended Air
Less than and including 1.0 MGD (Page1 of 1)

SAMPLE PARAMETER	SAMPLE LOCATION	SAMPLE TYPE	3/WEEK	1/WEEK	2/MONTH
Raw Influent*					
BOD_5 and/or COD	Influent	Grab			X
TSS/VSS, NH_3-N, and pH	Influent	Grab			X
* Frequency of sampling may need to be increased or decreased depending on plant size or conditions.					
Aeration Basin					
MLSS/MLVSS (or centrifuge, with correlated data from periodic MLVSS values)	RAS line and effluent	Grab			X
Dissolved oxygen	Effluent	In situ		X	
Settleability (SV30)	Effluent	Grab	X		
pH	Effluent	Grab		X	
Microscopic examination	Effluent	Grab			X
Computation of SVI, F/M ratio, sludge age, and/or MCRT, as desired	Effluent	—	As data collected		
Secondary Clarifier					
Sludge blanket depth	As appropriate	In situ		X	
Final Effluent					
Parameters, sample types, and frequencies as required by permits.					

The table reproduced above lists suggested sampling frequencies for facilities of capacity up to 1.0 MGD. This represents the minimum monitoring requirements; however, experience suggests that process monitoring tests be performed more frequently when a facility is experiencing any changes. These changes include any process changes made by the operators and any changes due to unavoidable circumstances, such as slug loading or equipment service interruptions. Generally, the higher the level of treatment, the more process control testing is necessary. For example, denitrification operations require additional process monitoring when compared to nitrification operations.

The facility employs the gravimetric solids test, which is the gold standard for solids testing. The DEP portable laboratory included a solids-by-volume centrifuge test that was unnecessary at Mapleton; however, the centrifuge test does in 15 minute what otherwise takes up to four hours. If used, centrifuge solids tests are done daily and are backed up with gravimetric solids tests at least twice per week to maintain centrifuge calibration (Weight-to-Concentration Ratio, or WCR.) Microscopy, Settleability, and water chemistry should be done on the mixed liquor at least twice per week until the operators have reasonable understanding of a 4-season set of reference data to which they may refer in future years. Whenever process or treatment methods change, the test data set would need to be reproduced. Also, whenever the facility experiences plant upset conditions more frequent process-monitoring and control testing should be performed by the operators, until conditions stabilize.

Process Monitoring testing is often not the same as those performed by contract laboratories in that approved test methods are not utilized. Compliance testing refers to those analyses used by certified laboratories for reporting parameters required by the NPDES permit. Over the years, many small treatment facilities began to contract compliance testing to certified environmental laboratories. This eased the burden on operators, and it saved the facility owner the cost of maintaining certification of its own laboratory. However, over time, many facilities ceased to perform regular process monitoring tests, as well. It is important for operators to know the condition of their facilities, the sludge solids inventory, and the qualities of the treatment solids (i.e., quantity and quality of "bugs") to effectively optimize operations.

DEP's WWTAP has adopted the process monitoring tests recommended by US-EPA and the professional trade organization, Water Environment Federation (WEF.) These tests include the following:

- Centrifuge solids test: percent volume/volume measurement of activated sludge solids for activated sludge-type plants: Calculations stemming from this data include solids inventory (expressed as "sludge units" (SLU).)
- Clarifier blanket level: a core-sampling of the clarifier contents provides a proportional quantity of mixed liquor and supernatant that can be used for developing awareness of how much mixed liquor is detained in the effluent clarifier, representing part of the overall sludge inventory.
- Settleometry test: 30- and 60- minute activated sludge settling rates in wide half-gallon or 1-liter, calibrated vessels: Settled sludge volume (SSV) is expressed in standard 30-minute intervals and used to calculate Settled Sludge Concentration (SSC) which is a qualitative measure of how well the activated sludge settles in the clarifier, mimicking clarifier performance in terms of supernatant quality as well. Using WCR, it is also possible to calculate and track Sludge Volume Index (SVI).
- Oxygen Uptake Rate (a.k.a. Soluble Oxygen Uptake Rate): By measuring the rate of dissolved oxygen depletion in a sample of mixed liquor, one may demonstrate the relative effect of BOD loading on the biomass, how quickly this material will be metabolized by the activated sludge organisms. Expressed in "milligrams Oxygen per hour," when mixed liquor volatile suspended solids concentration is known or can be extrapolated, then one may determine the actual Respiration Rate, in mg. Oxygen per hour per gram of activated sludge. OUR and RR are also useful for comparing the relative health of the biomass under toxic conditions, should there be undesirable contaminants in the raw wastewater, or anoxic conditions, should the aeration be insufficient to treat the incoming waste load using the available amount of oxygen.
- Raw Wastewater and Effluent Chemical Oxygen Demand (COD): an analog of the 5-day Biochemical Oxygen Demand test, COD can be determined in about three hours and give operators a quick assessment of relative strength of wastewater and/or the amount of material remaining in treated effluent, thereby providing an analog of treatment efficiency.
- Nutrient Tests: A portable wastewater laboratory provided during the WTE consists of materials for conducting various colorimetric analyses for nutrients such as ammonia-nitrogen, nitrite, nitrate, organic nitrogen, phosphorus, etc. to determine whether the facility is removing or treating nutrients. For process monitoring purposes, nutrient test strips provide ample, low-cost, low-trouble test results. They are available in most supplier catalogs (USA Blue Book, Hach, Grainger, et al.)
- Various other tests included in the portable wastewater laboratory include alkalinity testing (the buffering capacity of the mixed liquor or the clarified supernatant,) chlorides,

sulfides, halogens such as Total Residual Chlorine and Free Chlorine, and metals including aluminum and iron, known contaminants to downstream aquatic life.

The objective of all this testing is to develop a unique profile for the facility useful in developing operations trends, showing conditions that become predictive of how the facility responds to various beneficial or adverse conditions that could affect effluent quality and treatment efficiency. Once sufficient data exists, operators should have a cogent understanding of how the facility responds to process adjustments and what they must do to maintain it in good condition.

Typically, operators should determine an overall treatment strategy for their facility, using standard industry calculations for:

- Food to Mass Ratio (F/M)
- Mean Cell Residence Time (MCRT)
- Sludge Age or Dynamic Sludge Age

These values can be determined using the equipment described above. These calculations provide set-points unique to the facility that can be adjusted either through changes in sludge wasting rates or aeration capacity, assuming that the concentration of waste in the wastewater is a variable that operators cannot control.

UV Transmittance (UVT)

ABOUT UVT

UV transmittance, UV transmission or UVT is a measurement of the amount of ultraviolet light (commonly at 254 nm due to its germicidal effect) that passes through a water sample compared to the amount of light that passes through a pure water sample. The measurement is expressed as a percentage, % UVT.

WHY IS IT IMPORTANT?

Measurement of UV Transmittance is important for ultraviolet (UV) disinfection of drinking water, wastewater and process water. Low-pressure UV disinfection systems disinfect water using monochromatic UV light at the 254 nm wavelength. The effectiveness of a UV disinfection system is determined by the dose that the system is able to deliver to the target microorganisms in the water. The effective UV dose is dependent primarily on the combined effects of the UV light intensity, the exposure time and the UVT.

UV Transmission varies over time and from site to site as it is related to the quantity of organics, colloidal solids and other material in the water which absorb and scatter the UV light as it passes through the water column. In a UV disinfection system, if the UVT of the water is low, then the UV light is not able to penetrate the water as effectively, thereby reducing the potency of the dose. For this reason, it is very important to monitor UVT and ensure its levels are maintained above the manufacturer’s minimum for proper disinfection to occur.

LABORATORY UVT

Ultraviolet light (commonly at 254 nm) is passed through a 10 mm quartz cell containing the sample water. The intensity of attenuated light is measured with a sensor and compared to that of a pure water sample. The instrument then reports the UVT value as a percentage.