
**PARKLAND AREA SCHOOL DISTRICT
PARKLAND H.S. WASTEWATER TREATMENT FACILITY
SOUTH WHITEHALL TOWNSHIP, LEHIGH COUNTY, PENNSYLVANIA**

NPDES # PA0063631



WASTEWATER TREATMENT EVALUATION

Prepared by
Marc Austin Neville, WPS
Bureau of Clean Water
Rachel Carson State Office Building
PO Box 8774
400 Market Street
Harrisburg, PA 17105-8774



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Disclaimers:

The mention or use of a brand of equipment is not an endorsement for any manufacturer or vendor. The Department urges the 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 Department's Wastewater Optimization Program is to improve receiving water quality through training, troubleshooting, and monitoring. Permittees will be encouraged to achieve effluent quality above and beyond current permit requirements.

Executive Summary

Following a recent spate of effluent violations, Mr. Dean Miller of Miller Environmental, Inc., the contracted operator of the Parkland High School wastewater treatment facility in South Whitehall Township, Lehigh County, requested Operator Outreach assistance from U.S. Environmental Protection Agency's Region III operations staff (EPA.) Pennsylvania Department of Environmental Protection (DEP) regional inspection staff had noted several effluent violations at this facility, going back to mid-2015. EPA staff requested use of DEP's wastewater technical assistance equipment in evaluating plant performance, and DEP staff installed a small data acquisition network on site beginning February 5, 2020. The evaluation team is listed in Attachment A, following.

Technical assistance staff from EPA and DEP are not inspectors with their agencies' respective enforcement divisions; rather, they are licensed wastewater treatment operators employed as peer instructors who work to diagnose and recommend operational improvements using basic operational process monitoring and control. DEP's Operations Division in its Bureau of Clean Water, working under terms of a federal grant to minimize nutrient pollution in wastewater treatment effluents, deploys an array of continuous-monitoring immersion probes and a small wastewater process monitoring laboratory to client sites within the Commonwealth for up to eight weeks to diagnose operational problems and to optimize treatment processes. Staff visits to the sites occur once or twice per week to conduct supplemental process monitoring, check and clean their equipment, and recommend process adjustments that may improve facility operating performance.

EPA and DEP staff worked with treatment plant operators during February and March to diagnose operational problems that may have caused effluent violations. Work at the facility was interrupted by travel restrictions due to the worldwide coronavirus pandemic, during which time the Parkland school district closed its schools for the remainder of the academic year. Thus, the evaluation terminated prematurely. However, based on observations and testing data through early March, DEP makes the following recommendations toward improving performance at this treatment facility:

Recommendations:

Based on the results of field activities evaluating the treatment process and working with the operators, the facility engineer, and with EPA Region III outreach staff, DEP makes the following recommendations that may, if enacted, assist the facility owner and operators in producing an effluent of quality while avoiding NPDES Permit excursions:

- 1) The facility engineer has proposed upgrades to the facility headworks (replacing the comminutor with more modern fine-screening technology) and to the disinfection process (replacing halogenated disinfectant with ultraviolet light disinfection.) DEP concurs with these proposals and suggests that their implementation will improve treatment performance with minimal financial exposure.
- 2) DEP recommends that the facility engineer be engaged to evaluate the effectiveness of installing dissolved oxygen control on the facility's aspirating air pumps. DO setpoint control of the timed aspirator valves will allow the operators to maintain good air for nitrification while avoiding the potential of excess DO to poison the denitrification phase that requires anoxic mixing conditions.
- 3) DEP recommends that the facility owners consider installing oxidation/reduction potential probes that will allow the operators to optimize anoxic treatment phase for denitrification of soluble nitrate in the treated wastewater.
- 4) DEP concurs with the facility engineer that replacement of the hypochlorite-based disinfection system with ultraviolet (UV) disinfection is beneficial and will eliminate problems

that have been observed with the present method, such as nitrite lock causing excessive hypochlorite usage while also failing to eliminate fecal coliforms in the effluent. Also, elimination of chemical treatment for disinfection will produce a higher quality effluent.

- 5) DEP recommends more frequent cleaning of settled solids from the post-equalization tank and the chlorine contact tank. Addition of pumps and plumbed discharge or recirculation lines may be necessary if staffing is insufficient for regular use of portable pumps and hoses.
- 6) DEP recommends that the treatment plant operators consider adding equipment and testing to their process monitoring laboratory, specifically:
 - a. A suspended solids centrifuge for testing mixed liquor suspended solids by volume, a quick daily test that allows for development of sludge inventory and determination of wasting rates;
 - b. In-house testing of raw wastewater strength using chemical oxygen demand, a two-hour colorimetric or spectrophotometric test that will give operators information on loading rates and allow them to determine if supplemental organic loading is required;
 - c. Regular nutrient testing kits for ammonium, nitrate, nitrite, and phosphorus, any of which may hinder production of a quality effluent;
 - d. A high-school or collegiate quality microscope, to use for regular visual analysis of the biomass to assess its health and age;
 - e. Settled sludge core sampler, a tool that allows the operators to determine settling in the bioreactors that helps assure the sludge blanket that develops remains below the minimum decanter level before effluent batch discharge.

These items may be found in the catalogs of several vendors.

- 7) DEP suggests that the frequency of sampling and testing of the raw wastewater may be necessary for a more comprehensive understanding of organic loading to the facility. Influent samples ought to be tested twice per month for process monitoring purposes, based on twenty-four hour composite sampling while varying sampling events to capture full-load days, when school is in session, and underload days such as weekends and holidays, when school is out. The newest NPDES Permit for this facility suggests that the Regional Office may require use of Wasteload Management Reporting for this facility. The evaluation staff suggest that the operators use this available tool to annually assess organic and hydraulic loading, concurrently with more frequent sampling and testing, to assure that the facility does not become overloaded as the high school student population increases. Reporting templates and monitoring spreadsheets are available on the DEP website.
- 8) Due to the occasional problems with solids settling and with filamentous organisms that affect every suspended growth, activated sludge treatment system, DEP recommends that the operators maintain an inventory of polymer flocculants and related chemicals to use when necessary to avoid solids losses to Jordan Creek. Many reputable chemical vendors are willing to perform jar testing on site and make recommendations for products to use in these circumstances. Provision of day tanks, mixers, and chemical feed pumps may be necessary, in some cases.
- 9) Similarly, it may be beneficial for facility operators to keep bioaugmentation products on hand for supplemental seeding of the bioreactors, as a preventative measure. Again, vendors of such bacterial seed preparations can visit the site, perform assessments, and make recommendations for products tailored to the facility's needs.

Facility Background:

Parkland H.S. Sewage Treatment Plant (STP) is a sequencing batch reactor (SBR) activated sludge treatment facility designed circa 1998 to treat moderate-strength organic loading and high-strength ammonia waste emanating from the Parkland High School, a secondary educational institution of approximately 4,500 students and staff. The facility was designed as one of the first U.S. Filter Jet Tech SBR plants.¹ Unique to this facility are its activated sludge mixing and aerating equipment, large aspirating pumps having time-controlled actuated valves that allow atmospheric air to be injected into the bioreactor units to provide oxidation of organic loading with nitrification of ammonia wastes. The aspirator pumps provide contents mixing during periods when anoxic conditions are desirable. Flow into the treatment facility passes through a simple comminutor to macerate rags and debris, followed by two flow equalization tanks used for attenuating both hydraulic and organic loading. Dual SBR bioreactor units each of 16,000-gallon capacity provide adequate detention time for achieving effluent permit limits for treating the waste stream. Following the SBRs, decanted supernatant enters post-treatment equalization that provides for attenuation of effluent flow through downstream hypochlorite disinfection and sulfonation processes. The post equalization tank also provides a hedge against solids carryover to the receiving stream should the activated sludge in the bioreactors not achieve acceptable flocculation and settling to levels below the decanter mechanisms in the two bioreactors. Treated effluent is chlorinated, dechlorinated and then flows to Jordan Creek through a gravity discharge main and a sidewall stream outfall.

The treatment facility serves only Parkland High School, a public institution for secondary education located in North Whitehall Township, Lehigh County, part of the Parkland School District. Design hydraulic flow was based on 10 gallons/day per capita. Average five-year influent flow is 20,000 gpd with peak flow about 27,000 gpd. The facility is permitted for 32,500 gpd. The 2019-19 academic census had been 3,216 students and 190 FTE faculty. The design organic loading is 60 lb./day, and the 5-year average has been 37 lb./day, with a 2019 peak load of 74 lb./day.

Activated sludge that is wasted from the bioreactors is sequestered in an aerobic digester tank where it is stabilized prior to being sent to nearby public wastewater treatment facilities for further consolidation and ultimate disposal. Because of the headworks comminutor, macerated trash and debris is also wasted out of the system to the digester and is disposed off-site.

Chemical treatment at Parkland includes halogen-based disinfection and sulfur-based dechlorination, and operators add soda ash to the biomass in order to stabilize alkalinity and maintain proper system pH for effective nitrification. During slack loading periods, such as weekends, holidays, and summer break, sucrose is added to the wastewater to provide carbon.

The treatment facility has a small lab and control building that houses the switchgear for operating the two SBRs and associated equipment. Adjacent is a chemical room for the sodium hypochlorite and other additives. A refrigerated composite sampler is used to collect 8-hour effluent samples for compliance testing that is performed by Suburban Labs to ensure discharge monitoring limits are met. The lab is equipped with Settlemeters, a microscope, and several colorimetric testing kits used for monitoring wastewater nutrients, pH, temperature, and alkalinity. The contracted laboratory also occasionally tests MLSS for concentration so that wasting adjustments and sludge production calculations can be made. Because the facility processes less than 50,000 gallons per day, the frequency of compliance testing, specified in the NPDES permit, is somewhat less than optimal for good process control.

A schematic that maps the location of DEP monitoring equipment and plan and elevation drawings

¹ U.S. Filter is now part of Evoqua Water Technologies, LLC

of the bioreactors are shown in Attachment B. Record photographs of the equipment installation follow in Attachment D.

Observations:

Initial observation suggested that the facility was experiencing a filamentous bacteria problem that might be due to either inconsistent organic loading or to nutrient imbalance. Activated sludge systems rely on stability of loading and do not respond well to rapid changes, such as “feast or famine” syndrome that is observed at this facility, which receives steady organic loading during the week but experiences underloading on the weekends. Initial dissolved oxygen (DO) assessment showed that DO was over double the recommended maximum concentration during aeration. Recommended DO range for activated sludge falls between 1.0 and 3.0 mg/L. The two sequencing batch reactors had DO maxima above 10 mg/L, suggesting that excess oxygen would inhibit denitrification during anoxic phase of treatment.

On February 5, staff noted that a thick layer of floating solids was present in the chlorine contact tank, where any solids carryover will interfere with chlorine disinfection of fecal coliforms.² A pump located in the post-decant tank appeared to be stirring up a sludge blanket there, transferring solids to the contact tank where the solids would interfere with sodium hypochlorite disinfection. This could be confirmed by analyzing hypochlorite use to see if increased dosages were necessary to achieve proper disinfection.

Another suspected problem with the chlorine disinfection may be occasions of nitrite-lock, where nitrite, an intermediate product made by *nitrosomonas*, combines with chlorine to render it inert. Either scenario supports the frequent occurrence of coliform violations.

Presence of trash and debris was observed in the equalization tanks downstream of the plant comminutor. Trash, grease, and debris has accumulated on the float control switches in the treatment units and will interfere with their functioning. This material will shorten the service life of pumps, mixing equipment, and instrumentation if left untended.

Treatment Facility Loading Data:

The treatment facility was designed based on a population of 2,733 pupils and faculty, where each capita contributes 10 gpd flow and 0.022 lb./day organic loading.³ The new draft NPDES Permit effluent loadings were calculated based on annual average daily flow (AADF) of 32,400 gpd, and the organic design capacity is 67.6 lb./day. Measured flow during the past five years has averaged ~20,000 gpd and the loading averaged ~37 lb./day, with a five-year maximum three-month flow of 32,000 gpd and a maximum-month loading of 93 lb./mo. In 2019, the average flow was 18,000 gpd and the average loading was 34 lb./day, and there were two months where average monthly organic loading had been 68 and 74 lb./day. The influent loading data may have been less than consistent because of the limited number of tests and the sampling method.

Design AADF	32,400 gpd	Design Organic Load	67.6 lb./day
5-Yr. Avg. DF	20,000	Organic 5-Yr. Avg.	37
3-Mo. Max. Flow	32,000	1-Mo. Max.	74
2019 Avg. Flow	18,000	2019 Avg. Org. Load	24
2019 Max. Mo. Avg. Daily Flow:	24,447		
2019 Max DF on 2/2/2019:	68,500		

² This is also confirmed by the frequency of recent coliform violations.

³ Metcalf & Eddy value for maximum organic load per capita being 0.22 lb./day, so this is 1/10th of that.

Applying the last fifty-six months' worth of flow and loading data into the Chapter 94 data spreadsheet, including test result data for samples sent to an accredited lab for analysis, there were three months where average daily organic loading had been exceeded.⁴ During the 2018-2019 academic year, the school district reported a census of 3,216 pupils and 190 full-time equivalent (FTE) staff. Using the original design criteria, the AADF would have increased to 34,060 gpd and the organic loading to 75 lb./day.

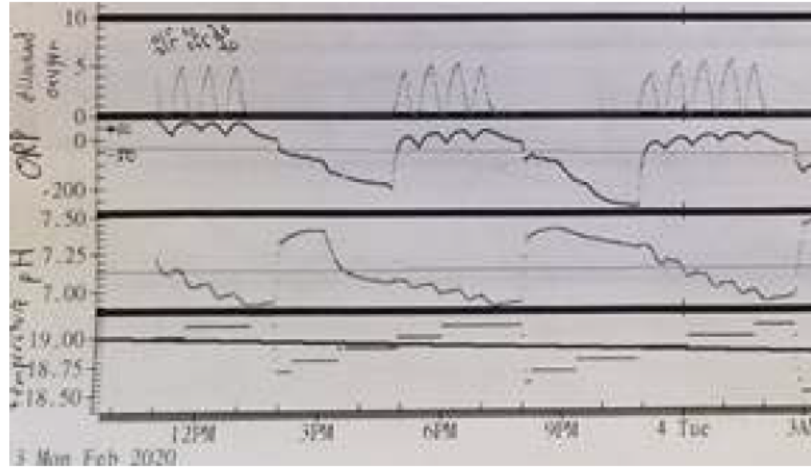
The NPDES Permit for this facility is undergoing renewal. A copy of the proposed permit limits is provided as Attachment J. The previous Permit ran from 2013 through 2018, with its limits in effect through the renewal period. A draft NPDES Permit was advertised in the Pennsylvania Bulletin in March 2020. The data set available for the loading analysis in this report was based on influent BOD test results for 8-hr. composite samples taken sporadically over the past five years, although testing was more frequent during the last two years. The new Permit cycle will require influent testing once per month based on 24-hr. composite sampling, but the draft specifies the raw wastewater be tested for carbonaceous BOD₅, seemingly excluding the greater-than-average nitrogenous-BOD₅ loading present in this waste stream.

The Permit encourages more frequent sampling and testing. (See Permit Part A, footnote 2.) It is important here to distinguish between testing that is done for permit compliance and testing that is necessary for process monitoring and control. Using only one sample per month may misestimate the organic and solids loading for the entire month, skewing the data used by the operators to manage the treatment process. DEP encourages more frequent composite testing of the raw wastewater, and the evaluator recommends that raw wastewater be tested at least twice per month, four times ideally, using 24-hour, flow-proportioned composite sampling. Samples should be taken immediately downstream of the preliminary treatment unit. Because this facility employs flow equalization, while the equalization tank may routinely be seen as a large composite storage, it has also been recommended that this tank receive recycled effluent water from the post-EQ tank when solids must be purged from that location. Such dilution would adversely affect the loading data were the sample to be taken there.

Dissolved Oxygen Control:

The Evoqua Jet-Tech aspirating pumps provide mixing and oxygenation of the mixed liquor suspended solids bacteria in the Parkland SBRs. Actuated valves allow air to be aspirated into the mixed liquor according to timed intervals. It may prove beneficial to the operation if these automatic actuated valves on the aspirator pumps were controlled by continuous monitoring DO probes in the two bioreactors. The following chart depicts a "sawtooth" profile of DO concentration in the two bioreactors during aeration and nitrification. This pattern of excessive/insufficient DO residual hinders the ability for nitrifying bacteria to effectively oxidize ammonia consistently throughout the mixed aeration cycle. Use of automated DO control to

⁴ Please see Attachment F for supporting information.



Sawtooth Aeration Pattern: These changes in oxygen levels may affect destruction of ammonia wastes.

operate the aspirator valves, instead of simple timers, would allow DO to reach and maintain an optimal DO set point throughout the aeration cycle. Doing so will allow the biomass to cope with the frequent changes in organic and ammonium loading that occur throughout the school week. As time and testing verify, the upper DO set point should be gradually lowered to promote denitrification during the anoxic phase while maintaining good nitrification during the aerobic phase of treatment. If the time cycles for the batches prove too short for effective nitrification, consider lengthening the duration of the batch and reducing the number of batches per day, as flow permits.

Similarly, increased aeration of the equalization tanks, sometimes combined with chemical pretreatment, may reduce influent ammonia through desorption (stripping). This could be explored as a way to balance nitrogen loading.

Headworks Improvements to Reduce Trash and Detritus:

During onsite evaluation activities, EPA and DEP staff met with the facility engineer. Among topics discussed was the need to reduce the amount of trash entering the treatment works, because of the damage that it could do to downstream equipment. The engineer noted that he is proposing to replace the comminutor with a fine-screen trash removal system. Doing so will eliminate a costly source of damage as seen in these photos, where grease, re-knit rags, and other detritus cling to control floats and other components of the treatment system.

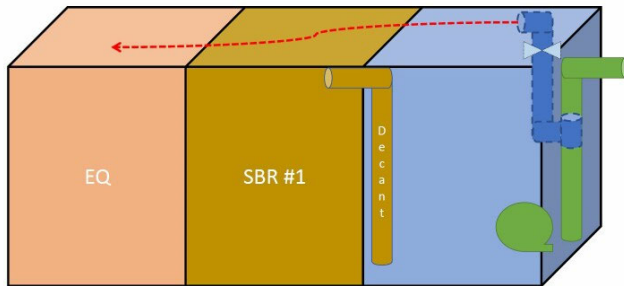


Photo of rags and debris: The weight of these masses, in the turbulence of stirred mixed liquor, will damage electrical cables and cause ground faults.

Post-Equalization Tank Improvements to Reduce TSS Accumulation:

Following decant, SBR effluent flows into a large post-treatment equalization tank from which it is pumped to the disinfection tank. In many early SBR designs, this “post EQ tank” was a buffer

Experiment with weekly cleaning of effluent holding tank. Tap into Sch80 pipe and plumb to grade with valve and adapter for flexible pipe. Weekly pump out tank while decanting/mixing effluent tank.



against solids loss downstream if the decant arm pulled solids because of poor sludge settleability or hydraulic overloading. Unfortunately, due to the poor settling attributed to filamentous organisms, the SBR effluent apparently had discharged suspended solids to this tank, where the TSS formed a blanket. When the discharge pump feeds the disinfection system, it stirs up the TSS, causing the water to appear brown. These solids carry over to the disinfection system, interfere with chlorine disinfection, and may

ultimately slip past the make-shift weir baffle and degrade discharge quality. EPA staff suggested that to achieve better removal of accumulated solids, the operators should construct a dedicated line returning these TSS to the head of the plant or to the equalization tank. Doing this would require more frequent transfer of settled TSS to the digester. In that case, automation would help, but this would require use of timers and valve actuators.

Another option that would assist with TSS settling would be to use polyacrylamide flocculants here, or to add polyaluminum chloride (PAC) to the SBRs near the end of the aeration cycle. A benefit of using PAC is that it removes excess *ortho*-Phosphate by precipitation followed by disposal through sludge wasting.

Disinfection System Improvements to Reduce Nitrite-Lock and Fecal Coliform Violations

The existing problem with floating solids in the disinfection process may be amenable to the use of polymer flocculants to consolidate solids in the post-equalization tank for removal to the digester. Polymer can also be used in the SBR tanks to promote settling during the settling and decant cycle. A chemical representative should be able to perform jar tests on site and recommend a polymer that may work well with your sludges. This should not be seen as a permanent remedy because it will treat only a symptom. The disinfection system will not work properly if excessive solids are present. Chlorine will be tied up by the solids before an acceptable kill of fecal coliforms is attained.

In addition, when nitrification is incomplete and produces intermediate nitrite ion in solution, this nitrite will react with the bleach solution at the disinfection tank and consume chlorine in excessive amounts. This reaction is called “nitrite lock.” It converts the chlorine from an oxidizing agent to inert chloride.

The original design for this facility included adding sodium bisulfite solution to the discharged effluent. After that pump failed, a contract operator at the time suggested replacing it with the use of sulfite tablets placed in a strainer bucket aft of the discharge weir. However, no proper modifications were made to minimize tablet erosion; the tablets simply dissolved en masse in the submerged bucket.

The use of sulfite tablets for dechlorination following disinfection has been problematic. The disintegrating sulfite tablets produce a floating scum. The overuse of this chemical, while it may not affect measured discharge parameters, creates an unsightly overdose of yet another pollutant in the receiving stream. A more effective way to deliver the sulfite for dechlorination would be to install a tablet stack such as that pictured to



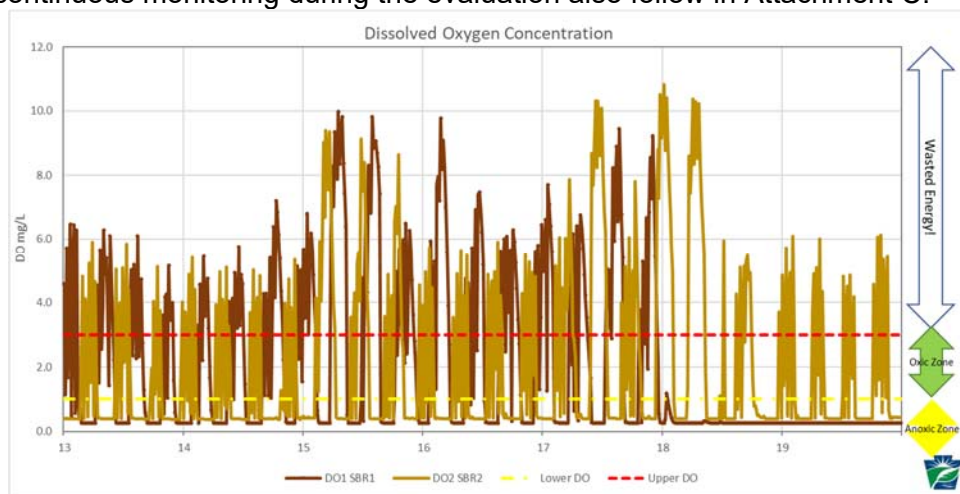
the right. This tablet feeder, about \$510, may be butt fit and caulked against the weir, or it may be used with a \$360 drop box.

Alternatively, the original chemical feed pump system may be replaced, albeit at greater expense.

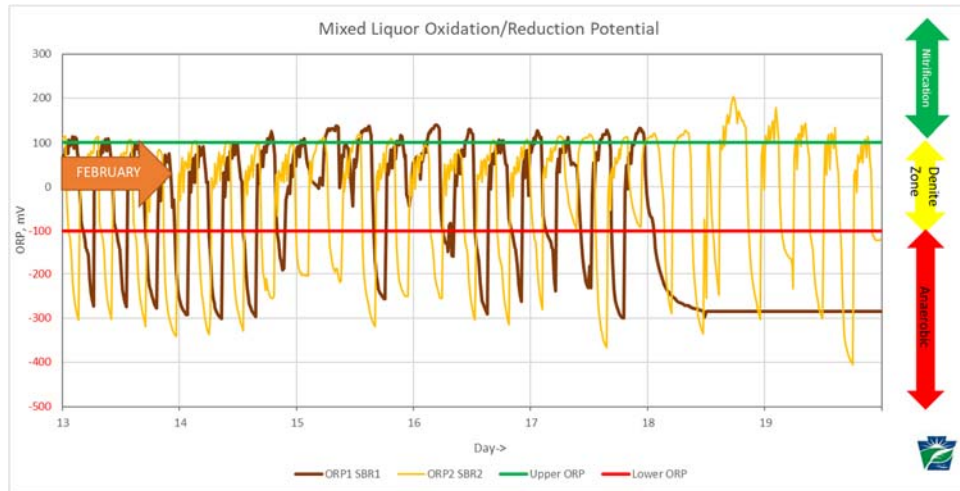
The facility engineer reported that a long term replacement of the existing disinfection system is being considered: this may solve many of the liabilities associated with chemical disinfection.

Operational Graphs:

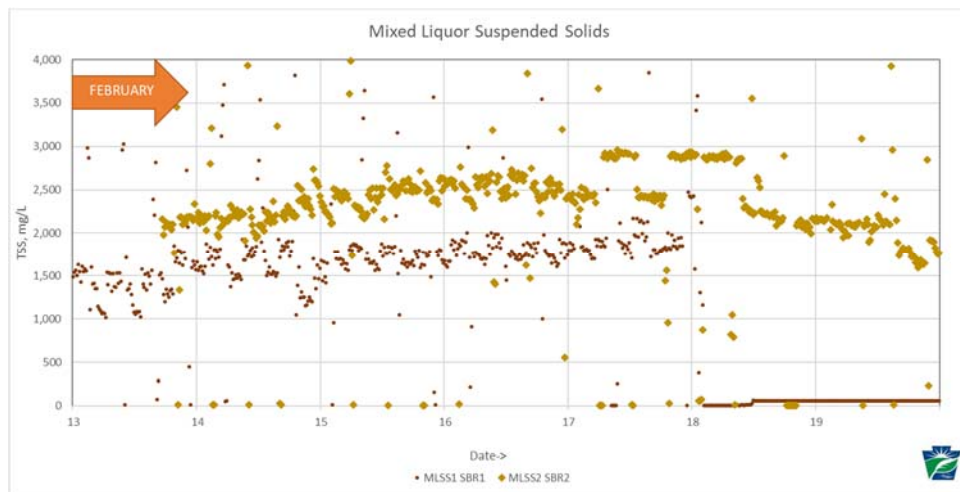
Following are example operational graphs. The probes monitored six operations parameters in fifteen-minute intervals. The data was collected and parsed into month, week, and day reports. Graphs for continuous monitoring during the evaluation also follow in Attachment C.



Week 2 Dissolved Oxygen Profile: This shows two DO probes, one in each bioreactor. The red line is set at 3.0 mg/L, considered the top range for aeration/nitrification in BNR treatment. The existing aeration system is not controlled; therefore, DO rises as high as eight or ten ppm at times, with an average high value of 5.8 ppm and an instantaneous maximum at 11.7 ppm. This represents wasted energy, and the oxygen will poison later efforts to denitrify the nitrate-ion that is a product of ammonia oxidation. The DRBC would rather have nitrogen leave the water as molecular nitrogen gas than remain as a eutrophying pollutant downstream of the plant. Fortunately, the nearest drinking water intake is seventeen river miles downstream from Parkland, and effluent volume is quite low, so nitrate pollution of downstream drinking water may not be considered significant.



This **profile of the Oxidation/Reduction Potential (ORP)** in the bioreactors, also from Week 2, shows that denitrification is probable in the presence of a supplemental carbon source; however, the profile also shows that ORP doesn't reach truly effective levels of oxidation for nitrification, which is between +200 mV and +300 mV. Indeed, the ORP drops below the "red line" into anaerobic territory where, depending on the duration, anaerobic waste products like organic acids, esters, ketones, aldehydes, methane, and hydrogen sulfide may occur. These chemicals may be toxic to the beneficial activated sludge organisms, and sulfides will lead to corrosion of mild steel equipment.



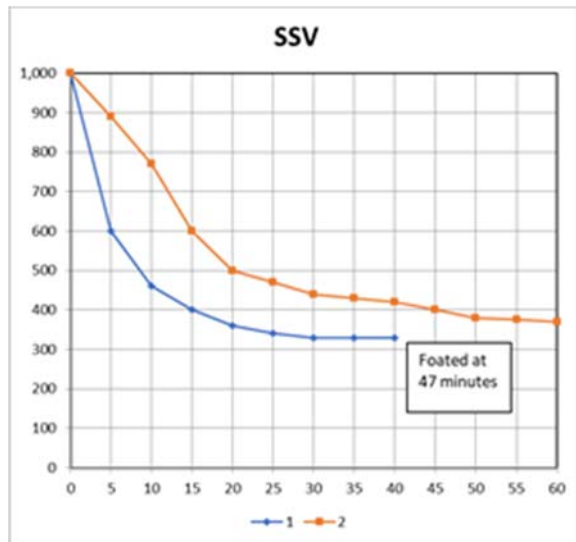
This graph from Week 2 at Parkland shows the **concentrations of MLSS in bioreactors** one (brown) and two (mustard). Lab testing showed that, a week before the circulator pump went down, the solids level in Unit 1 was about 1,600 mg/L while that of Unit 2 had been closer to 2,500 mg/L. Sludge Settleometry testing showed poor settling characteristics with high SVI at this time, with the worst being in Unit 1 which has much more filamentous organisms. Microscopic exam showed a lack of indicator organisms in either bioreactor.



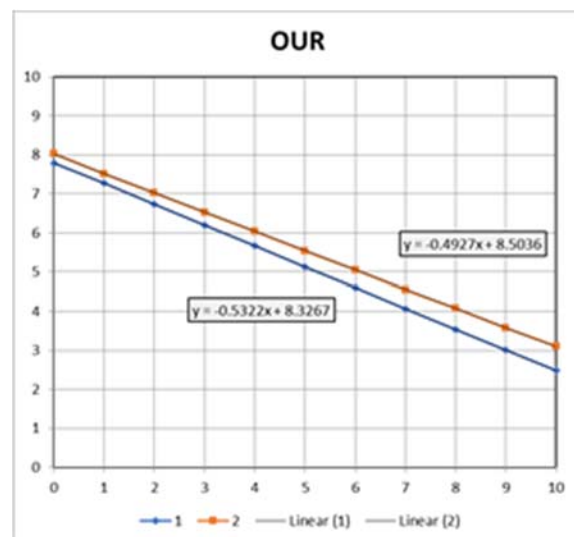
SSV profile: Unit 2 at 69 minutes



Unit 1 at 47 minutes



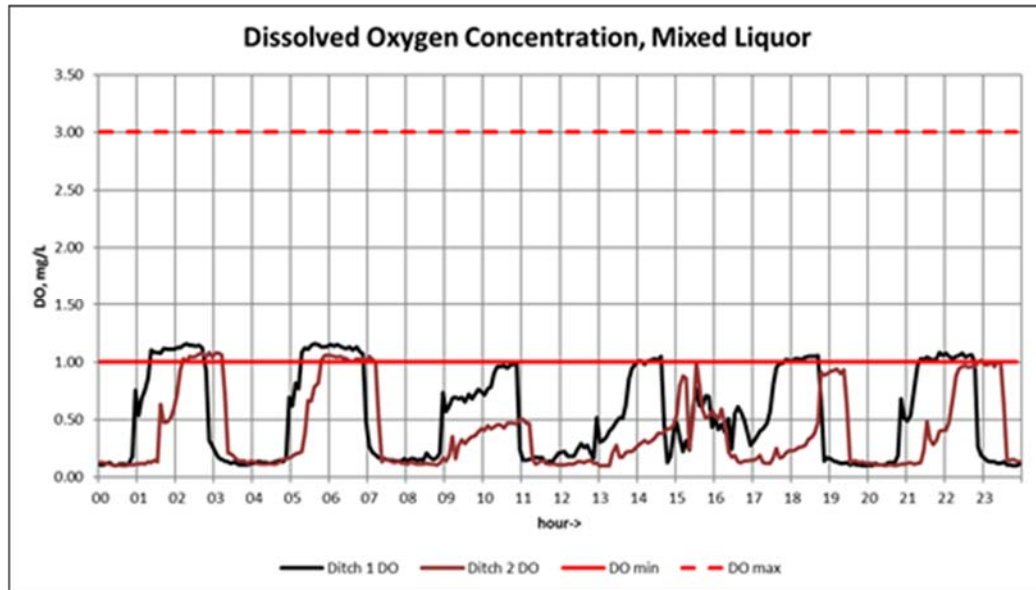
SSV Graph: Good settling curve, but denitrification in SBR 1 would cause solids in the decanted supernate.



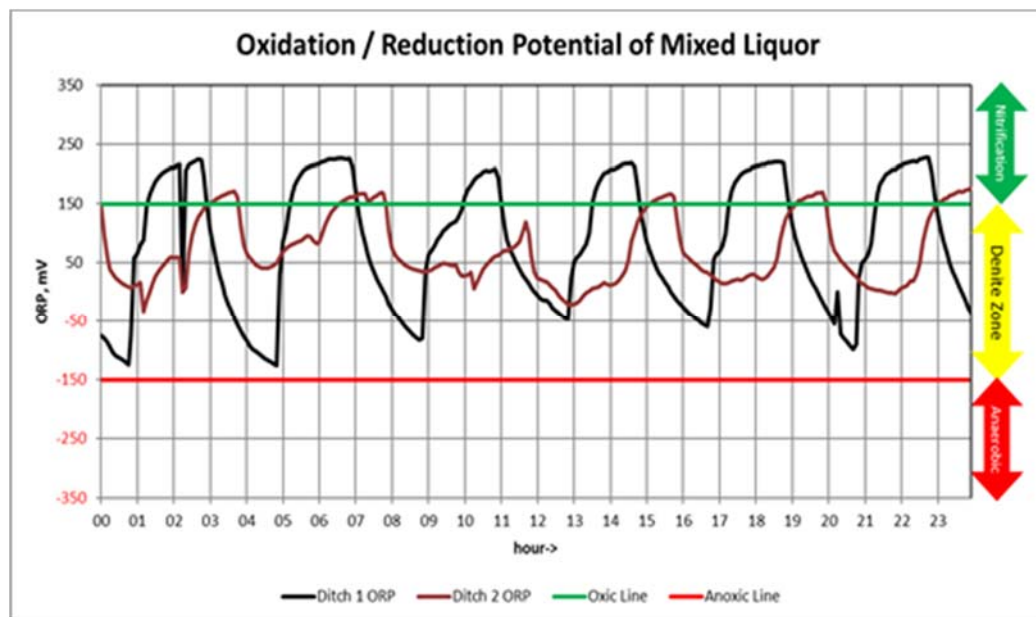
Oxygen Uptake Profile:
Unit 1 = 25 mgO₂/hr/gm, cf to Unit 2 at 18.
(Higher OUR at lower MLSS usually signals trouble.)

The lab tests showed that the biomass is in overoxidized state, with no indicator organisms observed under the microscope, probably with endogenous-phase bacteria lacking much-needed food and balance. Many conditions simultaneously are contributing to the poor sludge characteristics observed here.

On the next page, time profiles from another treatment facility is shown, for the sake of comparison. These are examples of desirable Dissolved Oxygen and Oxidation / Reduction Potential records from another facility:

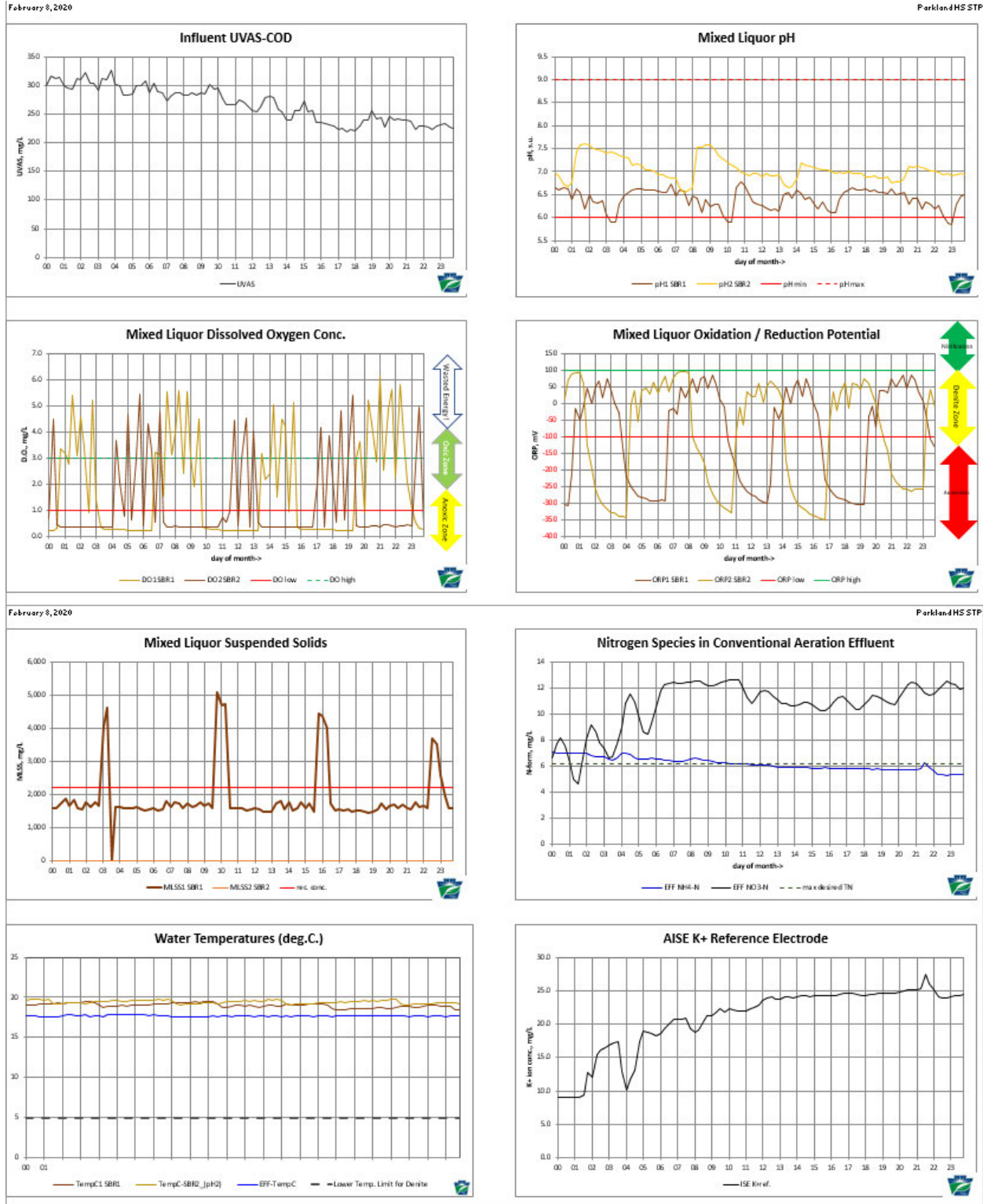


In this **graph from an oxidation ditch with automated DO control**, the operator was achieving both nitrification and denitrification by setting his DO to max at 1 mg/L. Aeration was followed by timed anoxic treatment cycles. Note that the minimum setpoint for DO is 0.1 mg/L. Typically, DO residual must be under 0.2 mg/L to achieve optimized denitrification.



This **ORP profile** shows the same facility achieving nitrification in the range above +150 mV and good denitrification between +50 mV and -50 mV. The optimal ORP for denitrification is usually between 0 mV and -50 mV, although some manufacturers recommend a wider setpoint range.

Following is a sample profile of daily monitoring records from Parkland H.S. STP:

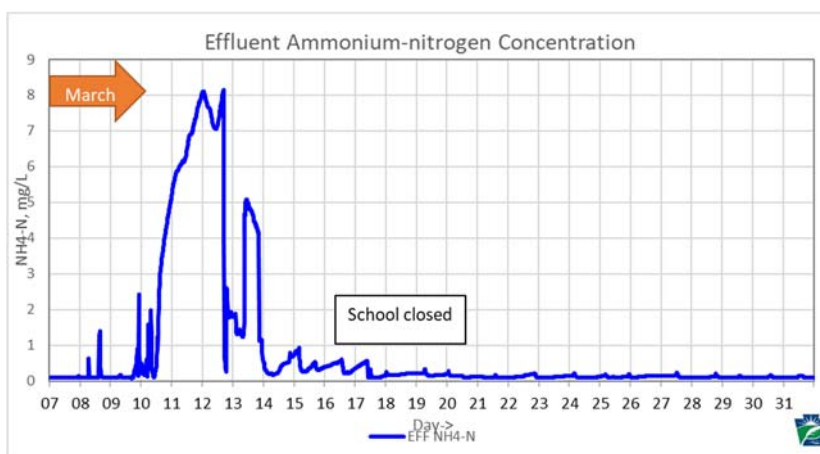


Regularly graphing operational data allows operators to “see” what is taking place in the system, making it possible to observe trends and predict behavior:

- The pH profile shows mixed liquor pH changing during aeration, probably dropping as nitrous acid is made as a waste product during nitrification. To counteract acidification,

operators supplement naturally occurring alkalinity using compounds such as lime, carbonate or bicarbonate, soda ash, caustic soda, or magnesium hydroxide. Dosing additional alkalinity may be calculated at 7.2 lb. alkalinity as CaCO_3 (calcium carbonate) for every 1.0 pound of Total Kjeldahl Nitrogen (TKN—the combination of ammonium and organically-bound amines) present in the raw wastewater, less the amount of naturally occurring alkalinity. Alkalinity dosing is explained further in Attachment H.

- The UVAS-COD probe in the equalization tank shows a stable organic load on this day, as expected in facilities equipped with equalization tanks. Facilities lacking flow equalization typically display a diurnal effect in organic loading, with high BOD concentration during the day and low BOD concentration overnight.
- SBR dissolved oxygen is unregulated, peaking at five to six mg/L residual. Excess DO in the water during the anoxic period may prevent biological denitrification, although the record shows that DO in the SBRs depletes effectively during the denite periods.
- Mixed liquor ORP recording shows that the ORP on this day barely rose into the aerobic zone and that it dropped into the anaerobic zone during aeration-off cycles. Experience has shown that ORP below -150 millivolts represents anaerobic processes, where chemical reduction of oxides will produce excessive floating sludges.
- The TSS probe in Unit 1 registered some interesting spikes, but these are likely the result of rags and debris momentarily caught on the wiper blade of the sensor window. Average MLSS concentration was close to that confirmed by lab testing.
- The nitrate profile (black line in nitrogen graph) shows that denite was occurring, but it isn't optimal under the present conditions. Supplemental carbon may be necessary to optimize this; lab tests demonstrated good alkalinity, adequate pH, and temperature for conversion of nitrate to nitrogen gas, but the biomass wasn't healthy, and it would be useful to figure out why. Because of the low organic loading that is abundant in ammonia-nitrogen, inefficient denitrification may be the result of imbalanced nutrient ratios (100 lb. C to 5 lb. N to 1 lb. P to 0.1 lb. S) and unavailability of consistent organic loading over seven days of the week.
- The Potassium (K^+) reference electrode chart shows that the ammonium probe head was near the end of its life, after which DEP staff installed a new one on March 6. Ammonia in a well-oxidized effluent is typically close to zero. The following graph from March 7 to 31 shows what were likely more accurate ammonium levels, although it should be noted that treatment plant loading declined greatly following school closing during the coronavirus quarantine. The spike in ammonium during the last week of on-campus classes occurred while operators were shutting down SBR #2 for maintenance. After March 18, influent loadings fell off considerably, and the facility began adapting for reduced campus operations.



Recommended Operational Enhancements:

Balance of Organic and Nutrient, Micronutrient Loading: It may be necessary to find a reliable backup food supply for maintaining the facility on low-loading days. The evaluators generally recommend using waste food products such as Whey Powder or non-fat dairy waste, juice waste, or some other source of simple organic molecules. Sugar by itself does not provide sources of nitrogen and sulfur needed by bacteria to replicate themselves, creating a less-than-ideal supplement.

Dog food, if pre-digested to break down complex components into simple, bug-ready molecules, may work, but it is expensive in the long run. Rabbit food is also used by some facility operators, although it is more expensive. Here are some things to consider:

- Sourcing waste food products for Organic Supplementation: In the urban Allentown-Bethlehem-Easton region, it should be possible to find food manufacturers who can provide supplemental organic loading at low-to-no cost beyond the hauling charges. The evaluators recommend that the operators contact manufacturers in their region.
- Plant shutdowns & waste hauling during Summer: During long periods of prolonged absence of adequate organic loading, the operators typically have shut down one of the two SBR units. The remaining organic loading may be processed in only one bioreactor. Sometimes, when both organic and hydraulic loading are sufficiently low enough, the bioreactors can be converted to holding tanks and the wastewater shipped off-site for treatment. This can be very expensive. The concentration of working biomass should be matched to the availability of raw wastewater and organic loading. Some operators have found that they could treat intermittently, allowing much of the biomass to degrade in order to provide food for microorganisms when the next modified aeration cycle starts. This may be problematic in Parkland's case, because swinging the sludge age between very young and moderately old will result in cloudy effluent.
- Plant restarts in August for the pending school year: When preparing for the academic year, in early August, the operators should seed the bioreactors using activated sludge from another treatment facility. It may not be possible to "grow" a biomass in a short amount of time to cope with the waste load when the school reopens at full capacity.

The evaluators recommend periodic bioaugmentation using commercially prepared bacterial cultures, as a preventative measure, to introduce beneficial organisms to the biomass. Given the irregular pattern of organic loading, it is necessary to add these preparations once or twice a week to each bioreactor. A reputable vendor may be able to determine a good mixture of bacteria product for this facility.

Carbon Supplementation: discussed above, denitrification requires carbon to drive the reaction. If carbon is insufficient or no secondary source is provided, such as methanol, "Micro-C", glycerol, or waste sugars, the denitrifying bacteria will go dormant. At Parkland, the operators have routinely been adding fifty-pound sacks of sugar directly to the SBR tanks. Ideally, this sugar is to be added at the beginning of anoxic mixing, but if aeration occurs too soon, the sugar will be metabolized by the aerobic bacteria and will not be available to the denitrifiers. In the long run, if nitrate entering the receiving stream becomes a regulated nutrient, Parkland should consider having its facility engineer investigate and design an engineered carbon supplementation system.

Filamentous Organism Control: The facility may experience a Microthrix problem during the winter months. It has a problematic low Food-to-Mass Ratio, and it may have a septicity and

nutrient imbalance problem, too. Spraying bleach on the filamentous foam may help to kill the *Microthrix* seeding the reactor biomass, but bleach kills all bacteria non-selectively. Depending on the metabolism of the filaments, anoxic conditions may kill them off faster than lack of oxygen will harm the “good” bacteria. However, *Microthrix* is not easily killed by anoxic treatment.

Filamentous organisms at Parkland likely favor imbalanced diet or poor nutrient conditions. Nutrients in wastewater are primarily products of the decay of protein and amino acids in biologic waste. Wastewater treatment textbooks typically list the ideal ratio of carbon to nutrient as 100 C : 5 N : 1 P : 0.5 S. Problems with filaments are likely when the nitrogen is off-balance. (Usually, when the nitrogen is lower than recommended; however, at Parkland nitrogen is excessive due to the high concentrations of urea-nitrogen in the waste stream.) If filamentous organisms persist, the facility engineer may recommend taxonomy analysts who can identify the problem organisms and suggest ways to deter filamentous growth.

Control of toxic disinfectants, chemicals in the academic setting: Institutions may employ the use of quaternary ammonium disinfection products. These are very effective cleaners, but their introduction into wastewater treatment facilities usually results in damage to the biomass that treats the wastewater. A half-gallon of undiluted quaternary ammonium cleaner will kill off a treatment plant for weeks at a time. However, if used judiciously, “quats” are no more dangerous than any other commercial product, cooling tower chemicals, or boiler water amendments. The evaluators suggest that the operators check and pay attention to the types and amounts of disinfectants being used in the high school. The manufacturer’s Safety Data Sheets for these chemicals may supply information useful in determining which should be monitored more intensively.

Recirculation of Effluent during Weekends and Holidays/Summertime: The evaluators suggested that, instead of discharging effluent heading into the weekends, the operators should recirculate effluent water back through the head of the plant. This water may be used as a diluent for supplemental organic loading that has been recommended.

[Automation for adjusting SBR cycles according to hydraulic and organic loading](#)

Instrumentation for process control is recommended, not simply for trending data to make process control decisions, but importantly for controlling mechanical adjustments to the process, such as DO-controlled feedback of aeration cycles. The facility engineer should evaluate the efficacy of installing dissolved oxygen (DO) and oxidation / reduction potential probes (ORP) at this facility to control aeration and anoxic cycles, where the DO probes control the automatic actuated valves for the aeration system. Installing pH probes in the SBRs may provide useful information leading to more frequent alkalinity adjustments that optimize nitrification.

Total Suspended Solids (TSS) probes are nice to have but not “need to have.” More frequent in-house testing of MLSS concentration, using the relatively inexpensive TSS centrifuge DEP lent to the facility for trial-use, will provide adequate information. The TOC probe used to monitor wastewater strength is not necessary, because a facility such as this can substitute more frequent Chemical Oxygen Demand (COD) testing in-house for the five-day BOD test. DEP’s evaluators recommend that, for process control, more frequent testing of the raw wastewater may be necessary.

Information on pricing for continuous monitoring immersion probes is provided in Attachment G as a guide for budgeting. Engineering and installation costs are not included in this list. DEP recommends that any facility considering adding instrumentation should carefully examine the products of different manufacturers and vendors in order to make the best possible choices for their facility and its use of the products.

The operators had ample test equipment on site for monitoring nitrogen forms (ammonia, nitrite, nitrate) and phosphorus. It is recommended that they continue using these methods, since the automated immersion probes are probably cost-prohibitive. A brief discussion of continuous monitoring immersion probes and their costs follow in Attachment E.

Process Monitoring in the Laboratory:

Finally, the evaluators appreciate that contract operations are difficult, especially when it comes to scheduling lab time. However, it is strongly recommended that operators perform more frequent and more diverse process monitoring at this facility. That requires that the owner and the operators provision more time and materials for lab tests and monitoring.

Attachment G lists recommended process monitoring tests for small treatment facilities. The testing frequency is based on normal operation. When starting a new process or recovering from a plant upset, more frequent monitoring is always recommended. The contract operators may be required to provide their own testing equipment, although it is recommended that the facility owner have and provide basic laboratory equipment.

While reviewing data on plant loading and operations since 2015, the evaluators noted the lack of ongoing characterization of the waste stream (food coming to the plant) and biomass analysis in the written record. Testing has improved greatly in the past couple of years, under Miller Environmental. As part of the optimization program, DEP staff typically recommend more frequent monitoring of MLSS that is necessary to maintain a Food-to-Mass balance at this facility. DEP had provided a Solids Centrifuge for volumetric solids accounting (AI West Method) while on site: this solids test is less time consuming (15-minutes) than the traditional oven-and-balance method, and solids monitoring should be done at least twice per week, perhaps as often as sludge settleability tests are performed. The goal is to operate this plant based on its Food-to-Mass Ratio.

If it is possible, all influent and effluent sampling should be based on 24-hour, flow composited sampling. For compliance reporting, this sampling is typically done on a certain day throughout the reporting cycle. For process monitoring, though, it may be useful to characterize the influent waste stream by sampling on a rotating basis, across the calendar, to characterize both raw wastewater and finished effluent over the entire week. (Test Wednesday, then next Monday, then Saturday, then Tuesday, etc., to cover all the possibilities.) Wastewater strength should be frequently tested and characterized. (An Oxygen Uptake Rate test can suspect toxicity in an otherwise innocuous raw wastewater sample.) Microscopy should be done regularly. (Lack of abundant indicator organisms may suggest underloading, overoxidation, toxicity, or a need for bioaugmentation.) And since nutrient probes are very expensive, more frequent nutrient testing using colorimetry kits in the lab will help further the knowledge base required by the operators to react to rapid changes at this treatment plant.

ATTACHMENT A: EVALUATION TEAM

--for PA Dept. of Environmental Protection

Marc Neville, Water Program Specialist
DEP- RCSOB Bur. Clean Water
400 Market Street; POB 8774
Harrisburg, PA 17105-8774

717.772.4019
mneville@pa.gov

Walter Higgins
EPA Region III Water Division
Infrastructure and Assistance Section (3WP32)
1650 Arch Street
Philadelphia, PA 19103-2029

215.814.5476
higgins.walter@epa.gov

--for Parkland HS STP

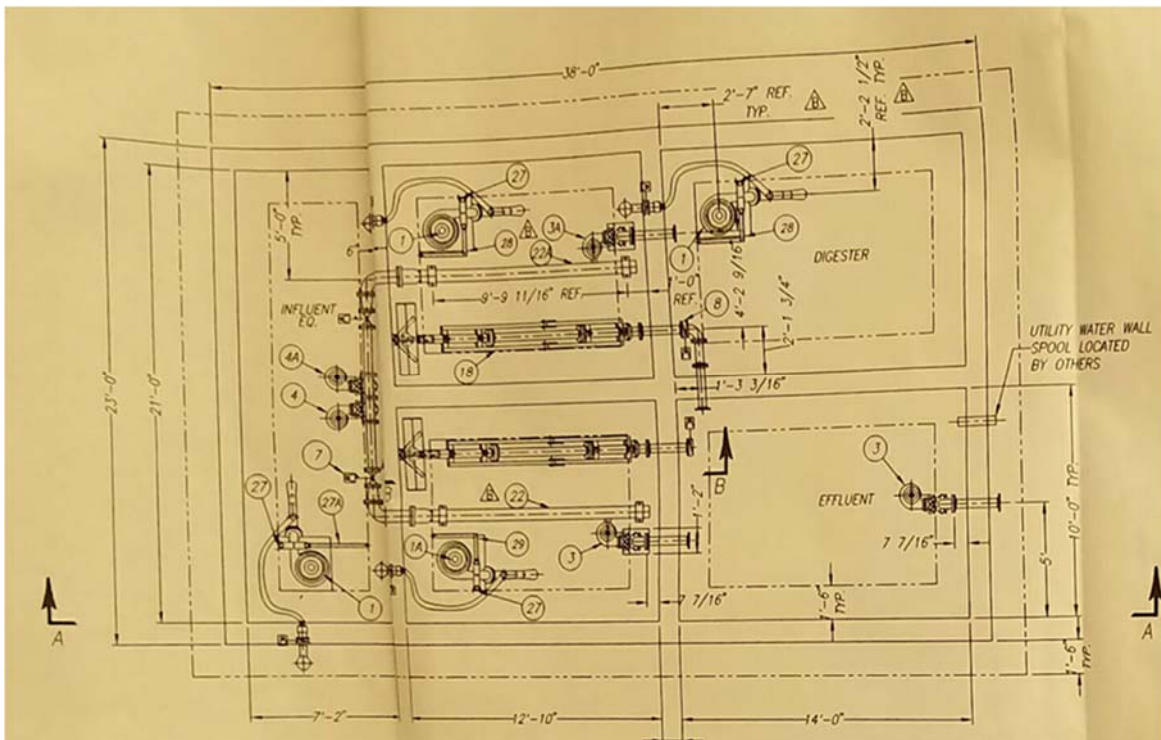
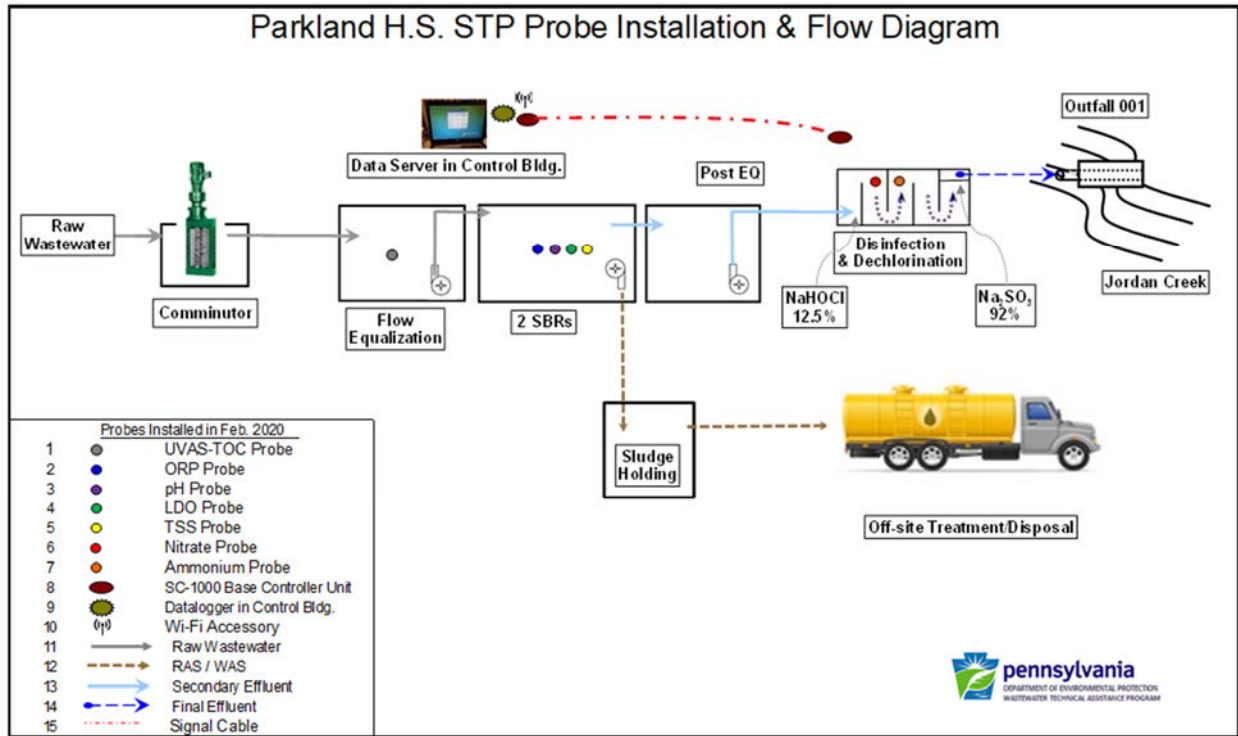
Dean Miller, Operator-in-Responsible-Charge
Certificate S8983
Miller Environmental
320 S 17th Street
Reading, PA 19602

610.376.9162
info@miller-env.com

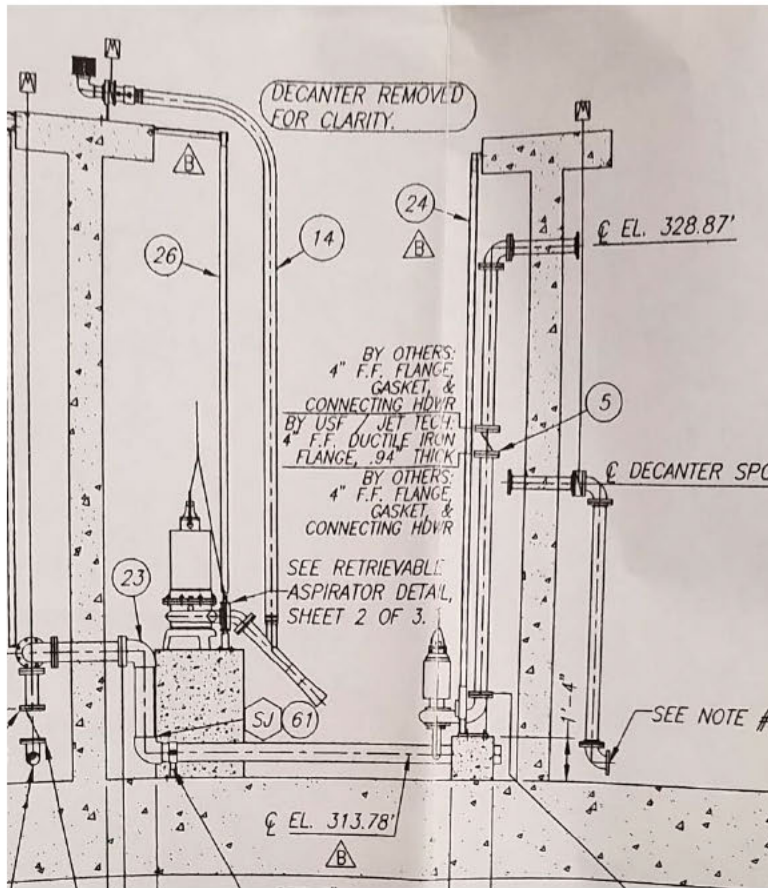
Jose Rodriguez-Leon, Operator
Jason Larson, Operator
Miller Environmental
320 S 17th Street
Reading, PA 19602

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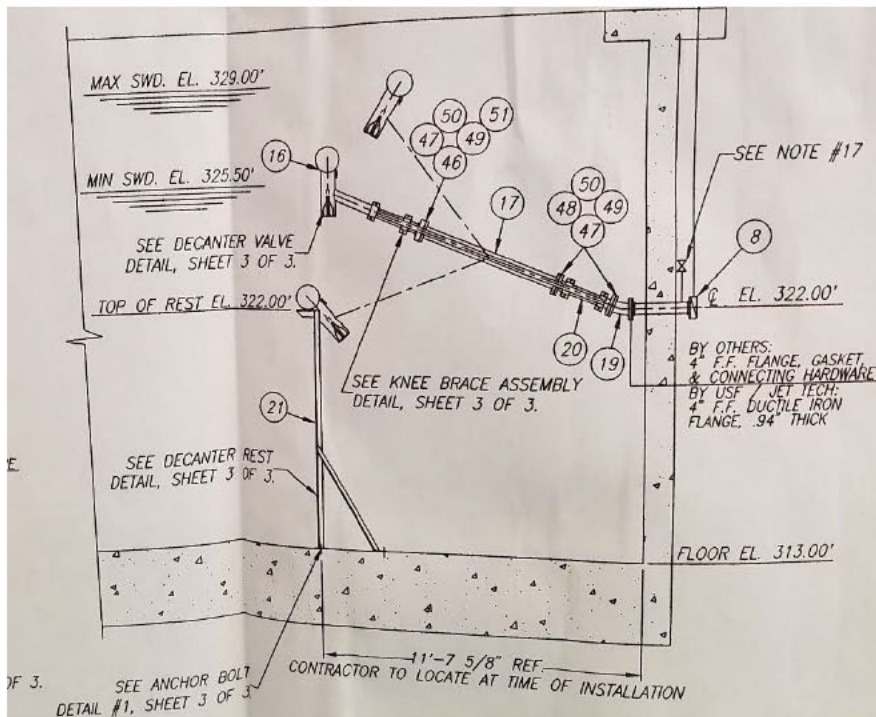
ATTACHMENT B: EQUIPMENT PLACEMENT SCHEMATIC



Plan drawing of Jet Tech system with aspirator pumps and decant apparatus

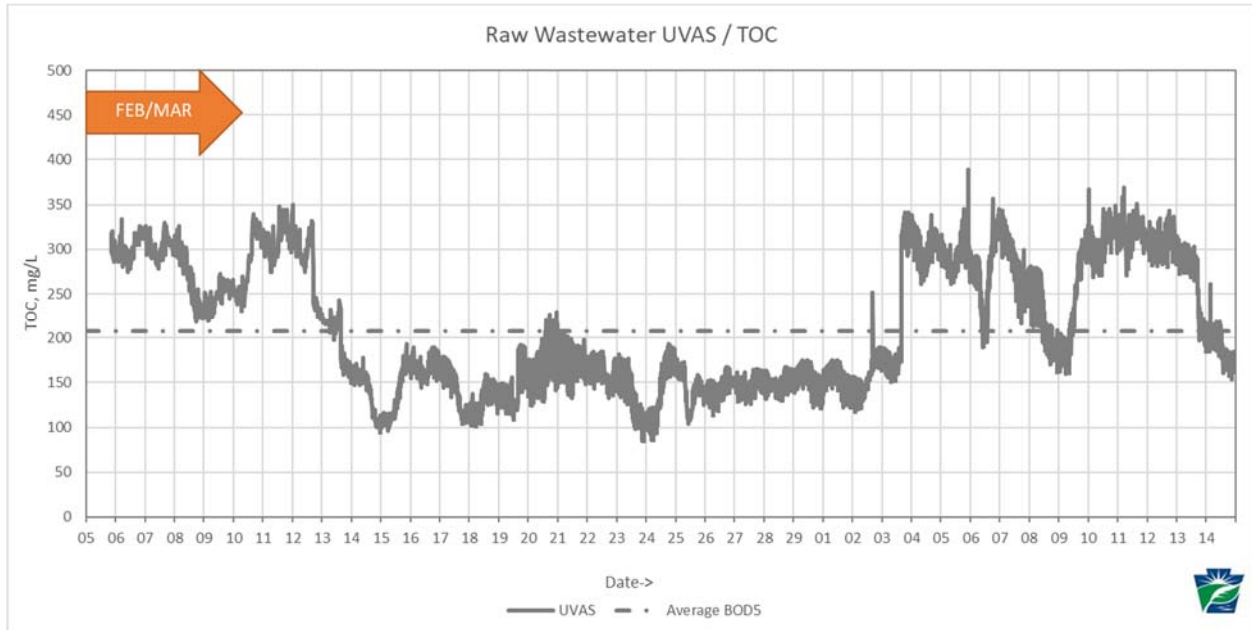


Elevation drawing of Jet Tech aspirator mixing pump with timer-actuated air intake valve at top of tank wall.

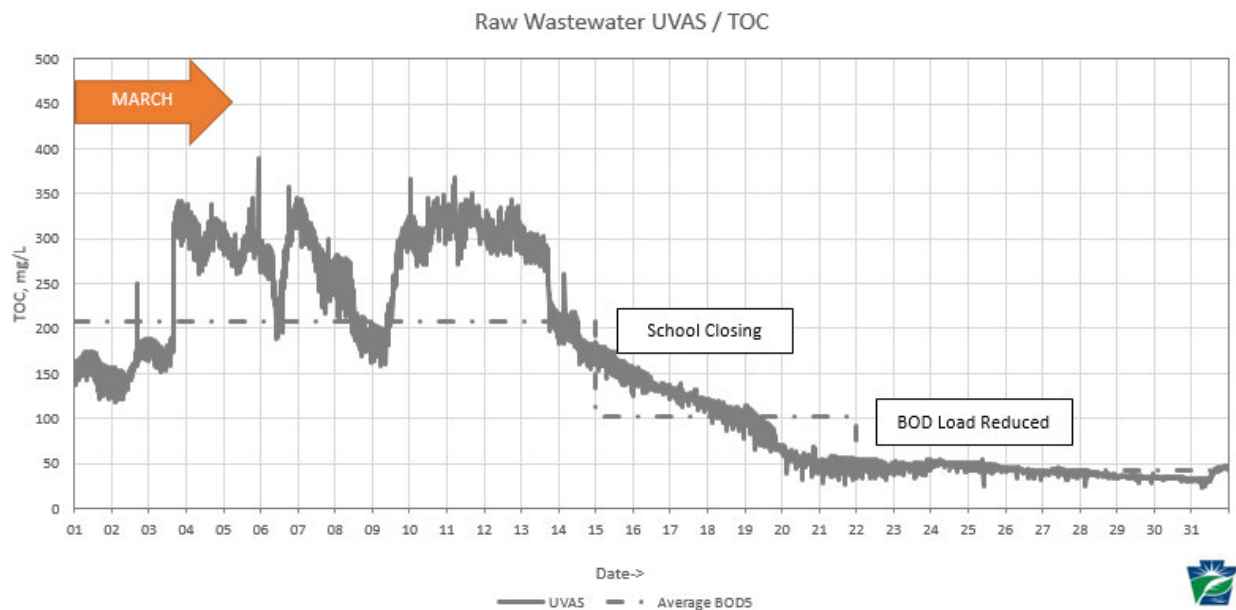


Elevation detail of decant apparatus showing 7 ft. (6,720 gal.) maximum decant range, and 3.5 ft. (3,360 gal.) minimum decant range

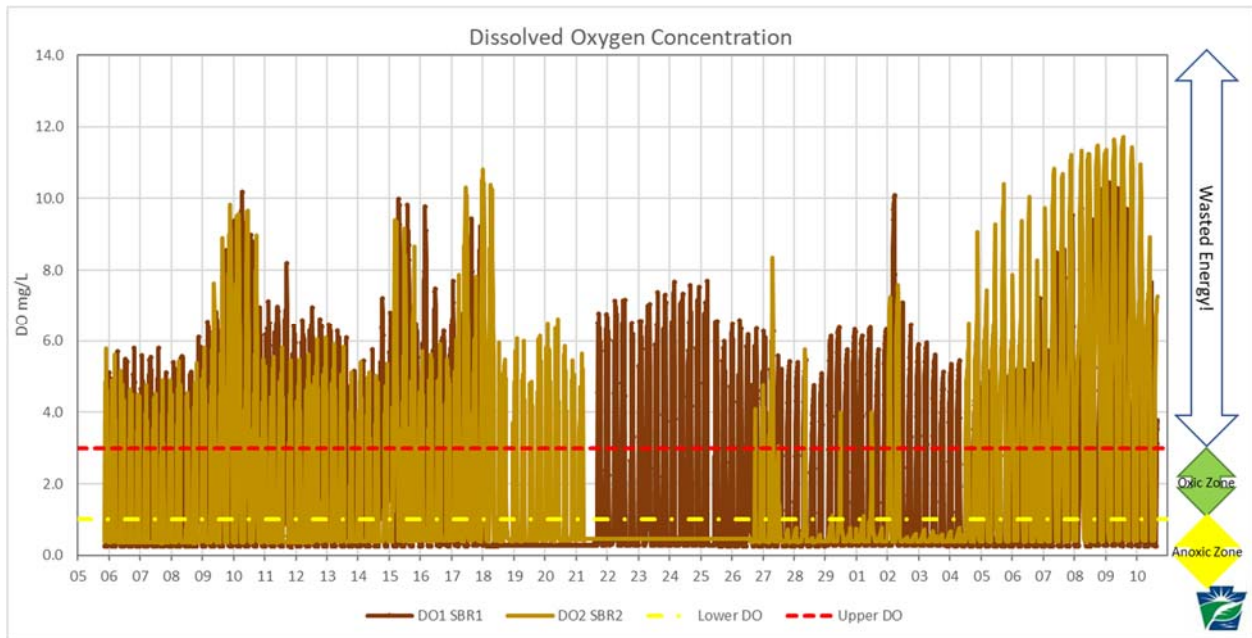
ATTACHMENT C: EXAMPLE DATA GRAPHS



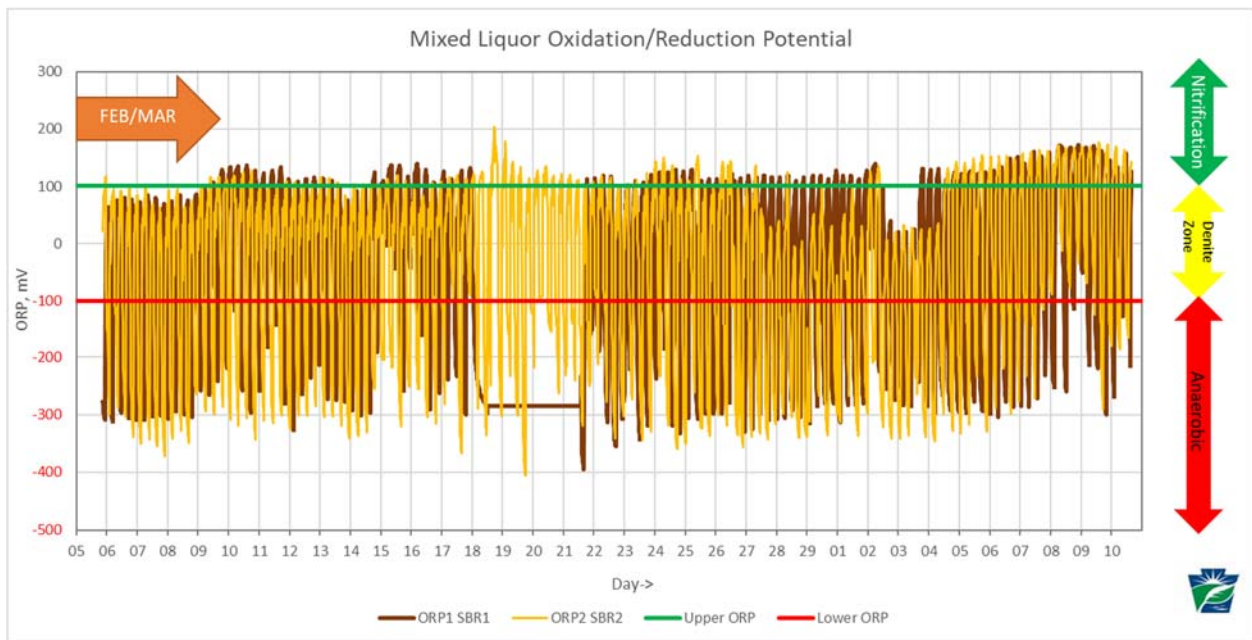
Raw Wastewater Total Organic Carbon calibrated to the 5-day BOD test: in this graph, loading during the academic year appears to be adequate, averaging 207 mg/L.



Graph for late March shows decline of organic loading as a result of campus closure during beginning of COVID-19 epidemic. In response, facility moved to operating one bioreactor at reduced solids concentration.

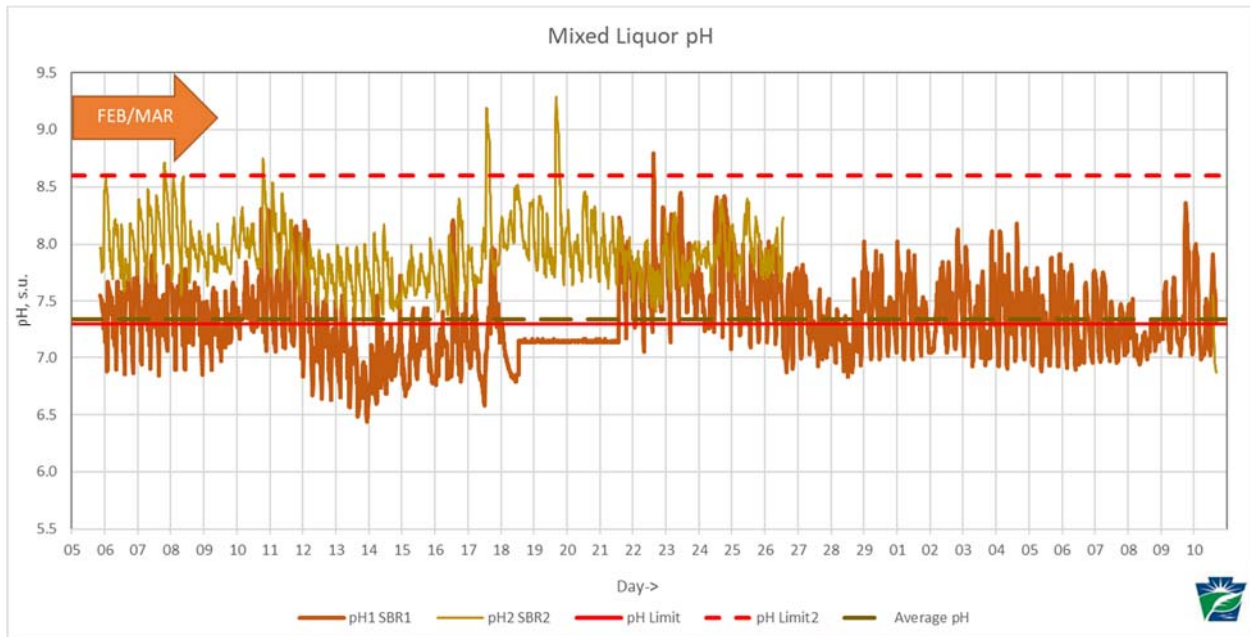


Mixed Liquor Dissolved Oxygen Residual: This profile shows that DO frequently surpasses the recommend maximum for aerated activated sludge. Oxygen retention is a function of temperature, MLSS concentration, and organic loading. In this case, it appeared that the aeration actuator valves could benefit from installation of a DO feedback that would regulate aeration better than the use of simple timing devices. DO in excess of the maximum recommended (red) level essentially represents “wasted energy,” although energy consumption of the aspirator pumps that also provide anoxic mixing may be irrelevant in this particular application.

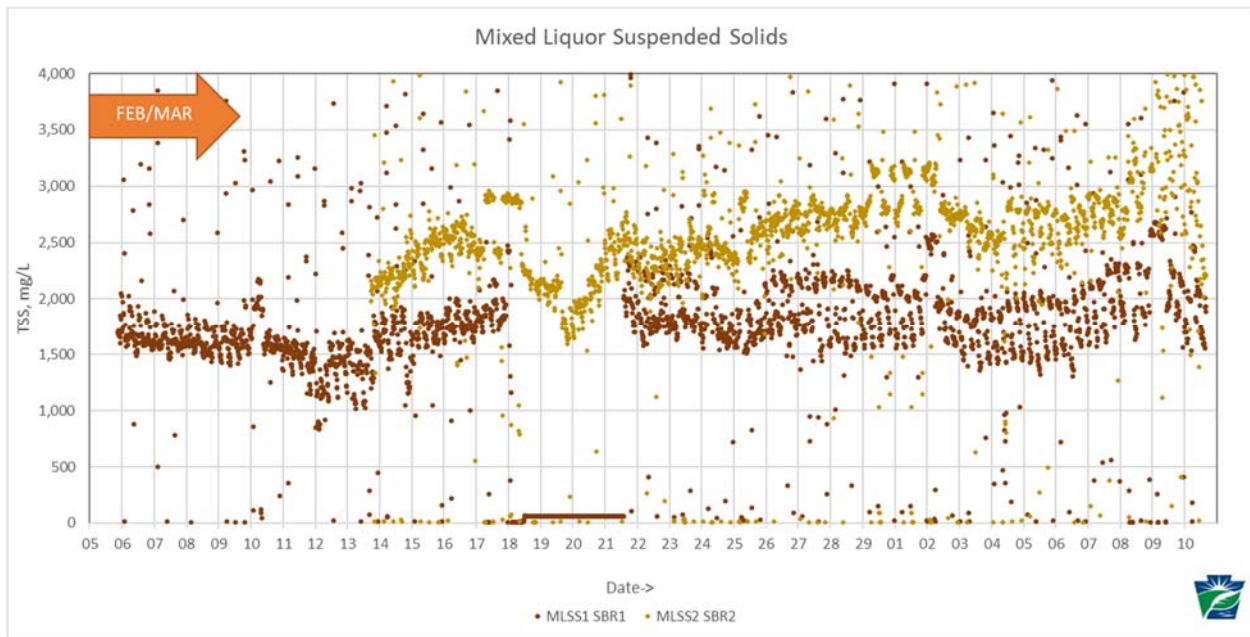


Oxidation / Reduction Potential: This graph shows that ORP was held generally in the anoxic and anaerobic regions of the typical ORP Profile. The range for anoxic denitrification is shown bounded at limits of +100 mV and -100 mV, respectively. Aerobic ORP is typically to be in the +300 mV range not observed here. The record shows that SBR1 was out of service between Feb. 18 to 22 due to a failed

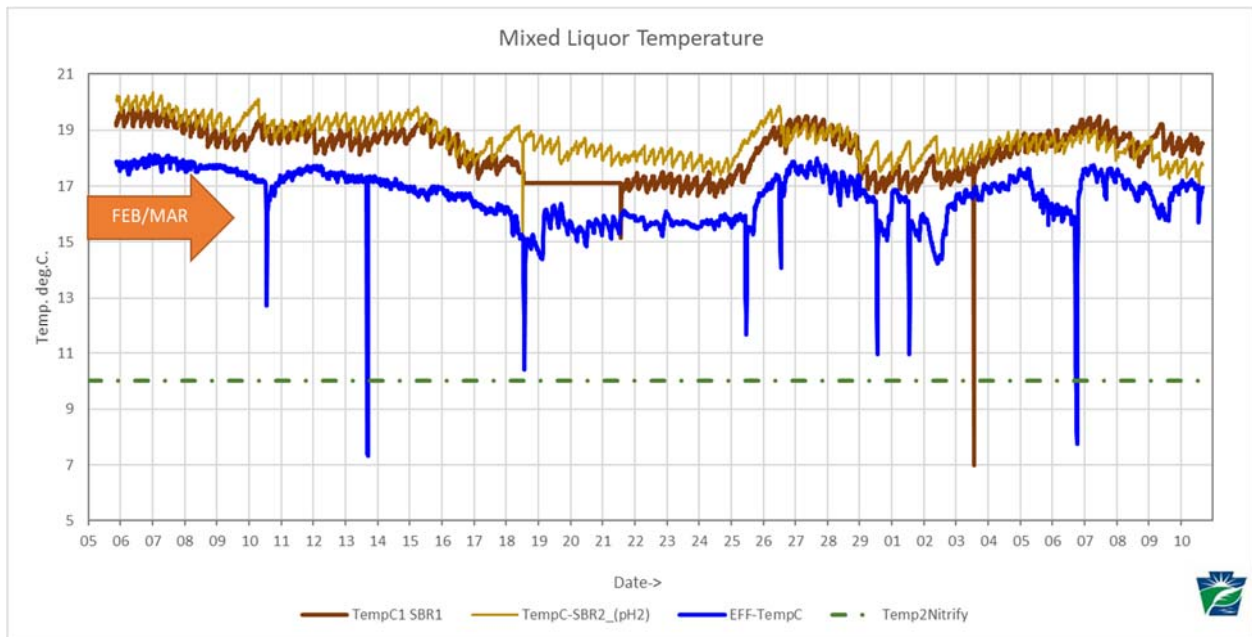
aspirator pump. Note: the ORP ranges at right depict the ranges where the three biological processes are at optimal conditions; the bacteria may actually perform these functions outside of these ranges as well.



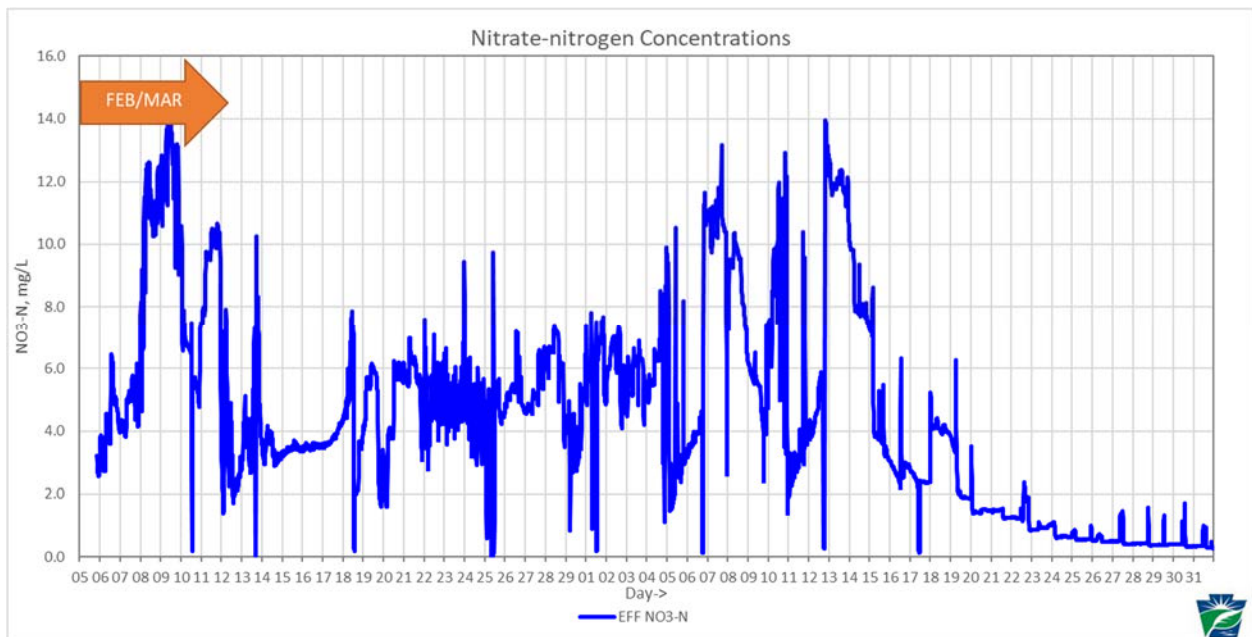
pH of Biomass in SBRs: The pH typically varies according to nitrification of ammonia. Nitrosomonas bacteria form nitrite as an acid byproduct, resulting in lowered MLSS pH. Here, SBR1 average pH is close to the recommended minimum pH for nitrification, 7.3 s.u.



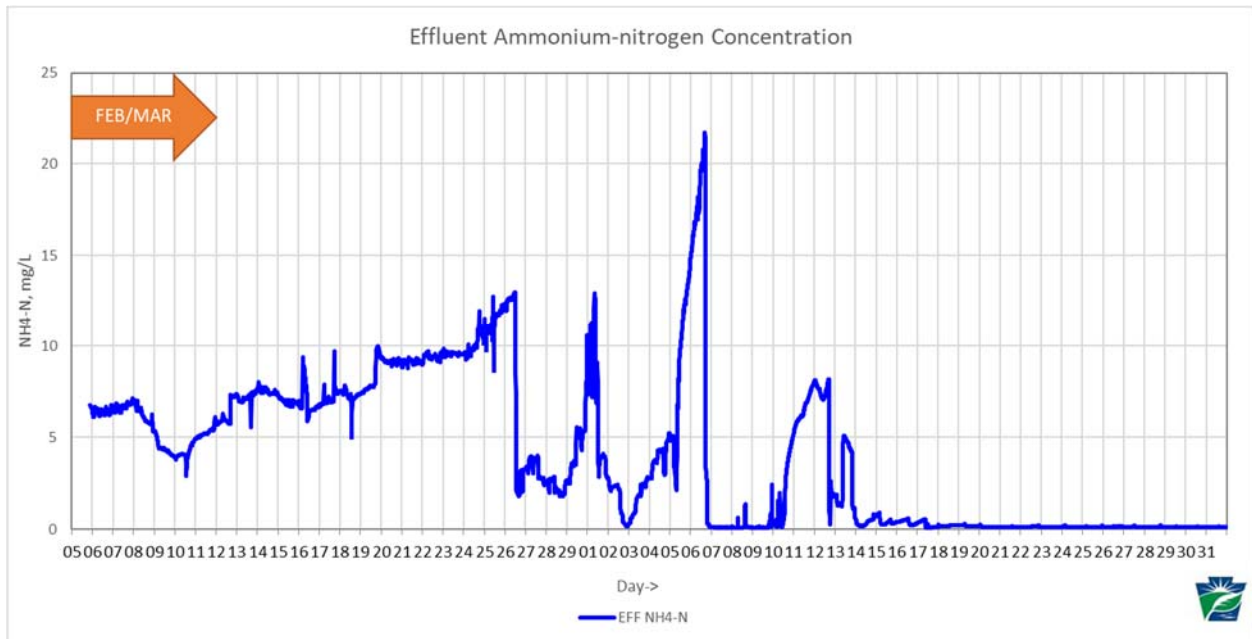
MLSS concentration: This is depicted as data points, showing the MLSS average range of concentration in each SBR. The two SBRs usually had different concentrations, averaging 1,700 and 2,600 mg/L, respectively. A remedy to this may be to mix solids between the two bioreactors so that the two units operate similarly. The idea is to operate one process instead of managing two distinct processes.



Temperature profile: Bioreactors and Final Effluent: The sawtooth pattern of temperature in the bioreactors is the result of aspirating colder atmospheric air into the SBRs. Dips in the effluent data represent probe cleaning periods or times when the probes were not submerged.



Effluent Nitrate Concentration: Nitrate concentration varied over the evaluation period, depending on the efficiency of both nitrification (conversion of NH_4^+ to NO_3^- , with interruptions of the reaction to form NO_2^- that causes “Nitrite Lock” during disinfection.) The period average was 6.8 mg/L.



Effluent Ammonium Concentration: The ammonium probe did not provide useful results in February, due to a degraded membrane head. When the ammonium head was exchanged on March 6 with a new one, the recordings were much in line with laboratory results: typical NH₃-N in the effluent averaged 0.3 mg/L after replacing the cartridge.

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ATTACHMENT D: RECORD PHOTOGRAPHS



Overview of SBR Installation



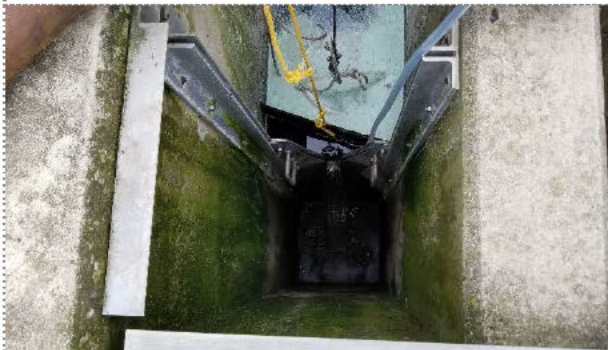
Assembly of Immersion Probes in SBR1



Chlorine Contact Tank, Influent End, solids present indicates carryover



Chlorine Contact Tank, Effluent End—floating blue material are dissolved sulfite tablets



Baffle to Prevent Solids Carryover



Headworks w/ Comminutor



View of Filamentous Foaming in Mixed Liquor



View of Post-Equalization w/TSS



SBR Control: timer relays and switches



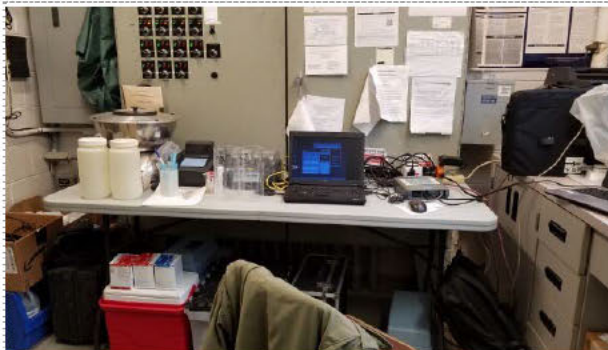
Operators' testing equipment on site



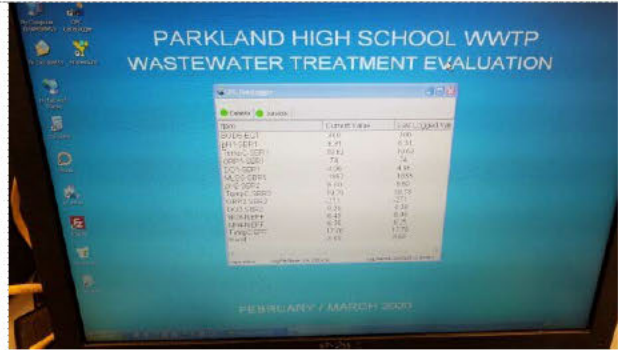
Probe controller set up by DEP



Effluent monitoring equipment



DEP wastewater lab & Data acquisition system



Real-time monitoring for operators' use



Evoqua / Jet Tech aspirator nozzle



Post-EQ tank with settled solids

ATTACHMENT E: COST ESTIMATES FOR MONITORING PROBES

During the evaluation, DEP staff installed several inline, digital recording probes at the facility to monitor plant performance. Many of these types of probes are now considered vital to the management of sequencing batch reactor type wastewater treatment facilities, especially those where biological nutrient reduction (BNR) is desirable.

To increase the efficacy of biological nitrogen removal in the aeration tanks, using intermittent aeration, DEP staff recommends the inclusion of Dissolved Oxygen (DO) and Oxidation / Reduction Potential (ORP) probes in the bioreactors. The following table summarizes projected initial and ongoing costs that should be budgeted as part of the facility's maintenance budget.

Probe Installation and Maintenance Parts Pricing:			
Hach.com	List price	Qty	Cost:
LDO Model 2 Diss. O ₂ Probe	\$ 2,131	2	\$ 4,262
Annual sensor cap replacement	\$ 215	2	\$ 430
Probe Controller (see below)			
Probe mounting accessories, 9253000	\$ 537	2	\$ 1,074
PHD sc pH Immersion Probe, DPD1P1	\$ 920	2	\$ 1,840
pH/ORP Immersion Probe, DRD1P5	\$ 1,208	2	\$ 2,416
Salt Bridge for pH & ORP Probe, annually	\$ 81	4	\$ 322
Probe mounting accessories, 9253000	\$ 537	4	\$ 2,148
Salt Bridge for pH & ORP Probe, annually	\$ 81	4	\$ 322
Std.Cell Solution for Salt Bridge, annually	\$ 72	1	\$ 72
200mV ORP Sol'n. 500 ml., annually	\$ 63	2	\$ 127
		Sub-Total:	\$ 9,469

Service plans are available for these three types of probes, but care and maintenance is relatively easy to do, so maintenance plans were not explored for pH, DO, or ORP.

Controller Recommendations:

1. The cost for an SC1000 controller base with full capability is \$2,586 but it also requires a universal display module for another \$2,520. Total cost for SC1000 with six to eight probe connections would be: **\$5,106**.
2. The SC200 controller with two probe connections price new is **\$1,965**.
3. If only DO Probes are added for controlling the aspirator valves, the SC200 controller is recommended.
4. If three probes are added to each bioreactor, the SC1000 controller with its universal display module is recommended.

Based on the pricing shown, DO control equipment alone would cost **\$ 7,731**, and pH, DO, ORP equipment would cost **\$18,119**.

Automation Improvements:

1. Cost of probes to automate the final effluent compliance testing, as recommended in the evaluation, includes the following:

1 Chlorine analyzer & accessories:	\$5,300
------------------------------------	---------

 Costs do not include installation and electrical work that is done in-house.
2. The operators desired to have digital recording of probe output on the computer used in their control building, which would require connecting all SC200 to one another and a digital converter for the lab computer, with software. The digital converter is about \$170140, but the software may cost up to \$1,200. A notebook computer would cost about \$800 without peripherals, and addition of keyboards, printers, mice, etc. would be optional, although productivity is better when fully equipped. This would provide continuous data recording and display, and data could be graphed and displayed, as had been done by DEP's evaluator, for analysis of operational trends and for reporting purposes.
3. Costs for wiring the DO feedback loop into the SBR control panel, for controlling the aspirator valves, has not been estimated. When evaluating further automation of the Jet Tech system, the facility engineer would consult with the manufacturer to develop a cost proposal. Since the probe controllers may be equipped with simple relays, addition of logic controllers to the panel may not be necessary for actuating the valves.
4. As part of an overall project to upgrade the facility, it may be useful to evaluate using variable speed drive technology to operate the aspirator-mixer pumps. This may entail re-engineering SBR control panel, but it would also be an opportunity to construct a modern supervisory control and data acquisition system (SCADA).

Nitrogen Nutrient Probes⁵:

While the NPDES permit for this facility does not explicitly require BNR for meeting total nitrogen or total phosphorus reduction in the effluent, the receiving stream does benefit from a reduction in nitrate-nitrogen and total phosphorus. BNR treatment facilities generally require a higher standard of process monitoring, including monitoring of ammonium and nitrate nitrogen in addition to process alkalinity and nitrite-nitrate, nitrite nitrogen, total Kjeldahl (organic nitrogen + ammonium,) and orthophosphate. While considered "luxury" items in smaller treatment facilities, pricing information for ammonium and nitrate probes are here provided for possible consideration in future planning:

1. Cost of probes to automate monitoring of ammonium and nitrate, exclusive of a probe controller (the facility may employ one of eight repaired SC200 with these):

1 Ammonium + Nitrate ISE Probe, # LXV440.99.00002	\$10,205
1 Wall Mount Kit, # 6184900	471
1 Air-blast Cleaning Harness, # LZY706	313
1 Air-blast 120vac Compressor, # 6860000	2,079
2 Probe heads per year, # LZY694	2,134
<u>2 Nitrate Standard solution for calibration, # 194749</u>	<u>52</u>
Total these items:	\$15,254
2. A separate probe controller might be an added cost: either controller discussed above would require a relay module for the air compressor;

⁵ Phosphorus monitoring equipment costs are impractical and not considered.

however, AN-ISE could be wired to an 8-input Controller.

3. Like all immersion probes, these probes require regularly scheduled maintenance, and the ISE probe requires replacement of the sensor head every six months. Parts and bench calibration should be budgeted as recurring costs.

AN-ISE annual bench service, includes	
2 new probe heads per year	\$ 3,309
AN-ISE annual bench service only:	\$ 720

4. These probes are usually installed post-secondary treatment, usually in the effluent stream or following secondary clarifiers.

Suspended Solids Probe:


DEP employed a suspended solids probes in the bioreactors to monitor the concentration of mixed liquor suspended solids (MLSS.) During the evaluation, it was noted that regular testing for MLSS has been infrequent, and this is a detriment to good process monitoring and control. For facilities that lack full-time operating personnel, use of the TSS probe may prove beneficial. The pricing is provided, following, for planning purposes.

Solitax sc Probe, # LXV423.99.00100	\$4,539
Rail Mount Kit, # LZY714.99.53120	537
<u>Annual bench service</u>	<u>510</u>
Total these items:	\$5,586 Each SBR

The cost for two such probes, one for each bioreactor, would be \$ 11,172, excluding the controller, which could be another \$ 1965 to \$ 2,586, noting that installation of a second SC1000 controller would not require purchasing a second universal display module.

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ATTACHMENT F: LOADING ANALYSIS



**PADEP Chapter 94 Spreadsheet
Sewage Treatment Plants**

Reporting Year:

Facility Name: Permit No.: Capita:

Existing Hydraulic Design Capacity: MGD Existing Organic Design Capacity: lbs BOD5/day

Upgrade Planned in Next 5 Years? Year: Upgrade Planned in Next 5 Years? Year:

Future Hydraulic Design Capacity: MGD Future Organic Design Capacity: lbs BOD5/day

Monthly Average Flows for Past Five Years (MGD)

Month	2015	2016	2017	2018	2019
January		0.01816	0.01712	0.03084	0.01833
February		0.01882	0.01764	0.02843	0.01788
March		0.01534	0.0184	0.02585	0.01788
April		0.02081	0.01894	0.0389	0.02087
May	0.02097	0.02195	0.02462	0.03217	0.02447
June	0.01432	0.01265	0.01903	0.01577	0.01476
July	0.01091	0.00912	0.00951	0.0195	0.01033
August	0.01147	0.01032	0.01972	0.01352	0.01003
September	0.02198	0.02615	0.02601	0.02234	0.01923
October	0.02224	0.02341	0.03505	0.02252	0.02182
November	0.02366	0.01814	0.03163	0.01904	0.02132
December	0.01763	0.0161	0.02714	0.02053	0.01766
	8	12	12	12	12
Annual Avg	0.0179	0.0174136	0.0220671	0.02411647	0.01788453
Max 3-Mo Avg	0.02262	0.02256489	0.03127455	0.03230534	0.02100717
Max : Avg Ratio	1.26	1.30	1.42	1.34	1.18
Existing Capita	3,400	3,400	3,369	3,400	3,408
Flow/Capita (GPD)	5.3	5.1	6.6	7.1	5.2

Exist. Overload? **NO NO NO NO**

Monthly Average BOD5 Loads for Past Five Years (lbs/day)

Month	2015	2016	2017	2018	2019
January	44	30	43	42	74
February	44	24	20	65	21
March	44	39	43	42	68
April	44	24	43	42	47
May	44	24	43	42	36
June	20	24	43	42	13
July	6	24	43	42	18
August	12	24	43	13	9
September	93	6	65	48	31
October	64	20	43	24	35
November	44	24	43	44	36
December	66	24	43	56	19
	12	12	12	12	12
Annual Avg	44	24	43	42	34
Max Mo Avg	93	39	65	65	74
Max : Avg Ratio	2.13	1.63	1.51	1.55	2.18
Existing Capita	3,400	3,400	3,369	3,400	3,408
Load/Capita	0.013	0.007	0.013	0.012	0.010

Exist. Overload? **YES NO NO NO YES**

Projected Flows for Next Five Years (MGD)

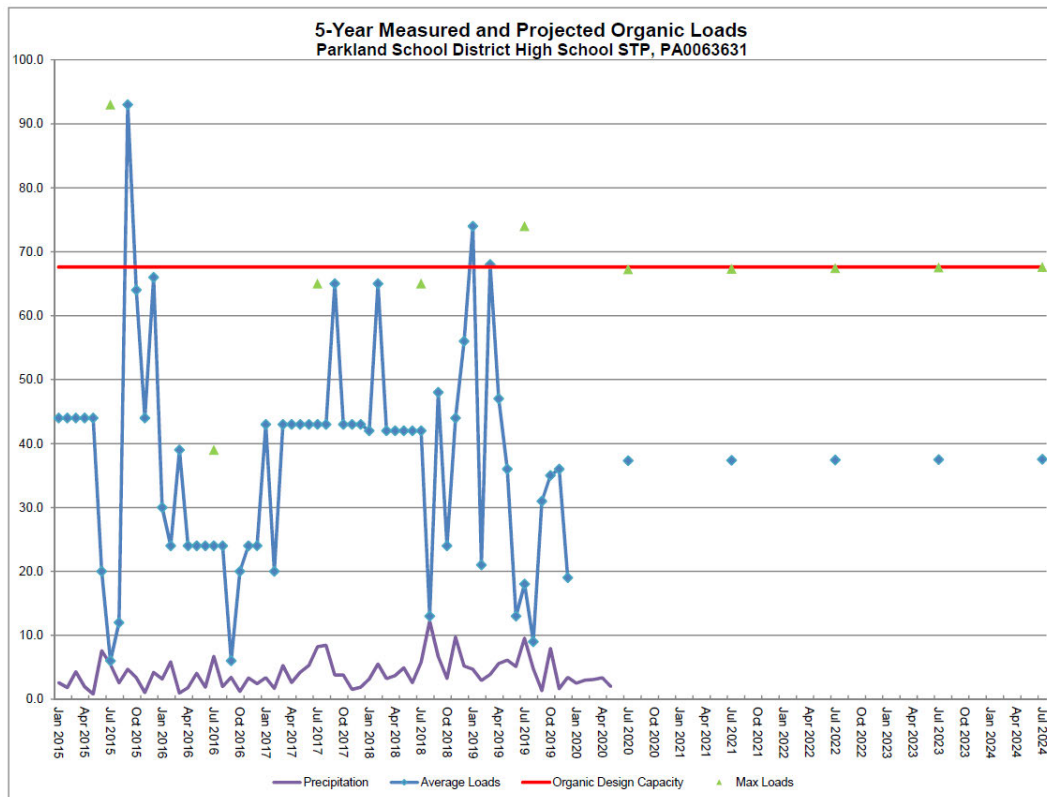
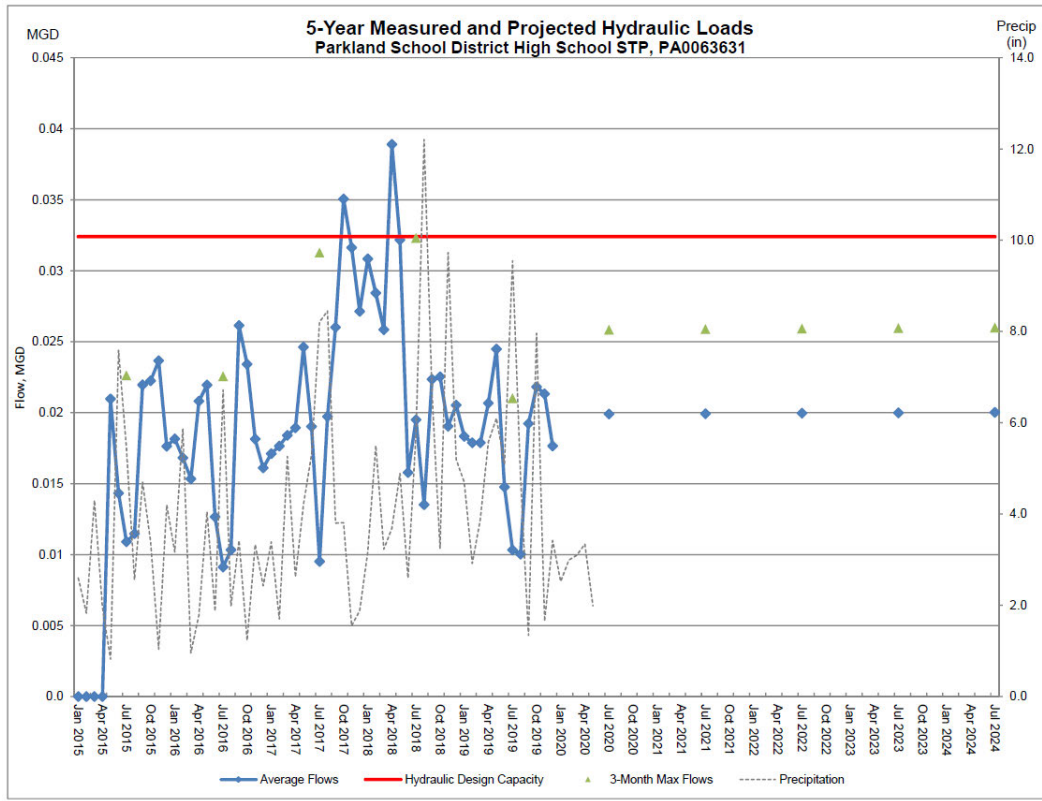
	2020	2021	2022	2023	2024
New Capita	5.0	5.0	5.0	5.0	5.0
New Capita Flow	29.3	29.3	29.3	29.3	29.3
Proj. Annual Avg	0.0199	0.01993	0.01996	0.01999	0.02002
Proj. Max 3-Mo Avg	0.02584	0.02588	0.02592	0.02596	0.02599
Proj. Overload?	NO	NO	NO	NO	NO

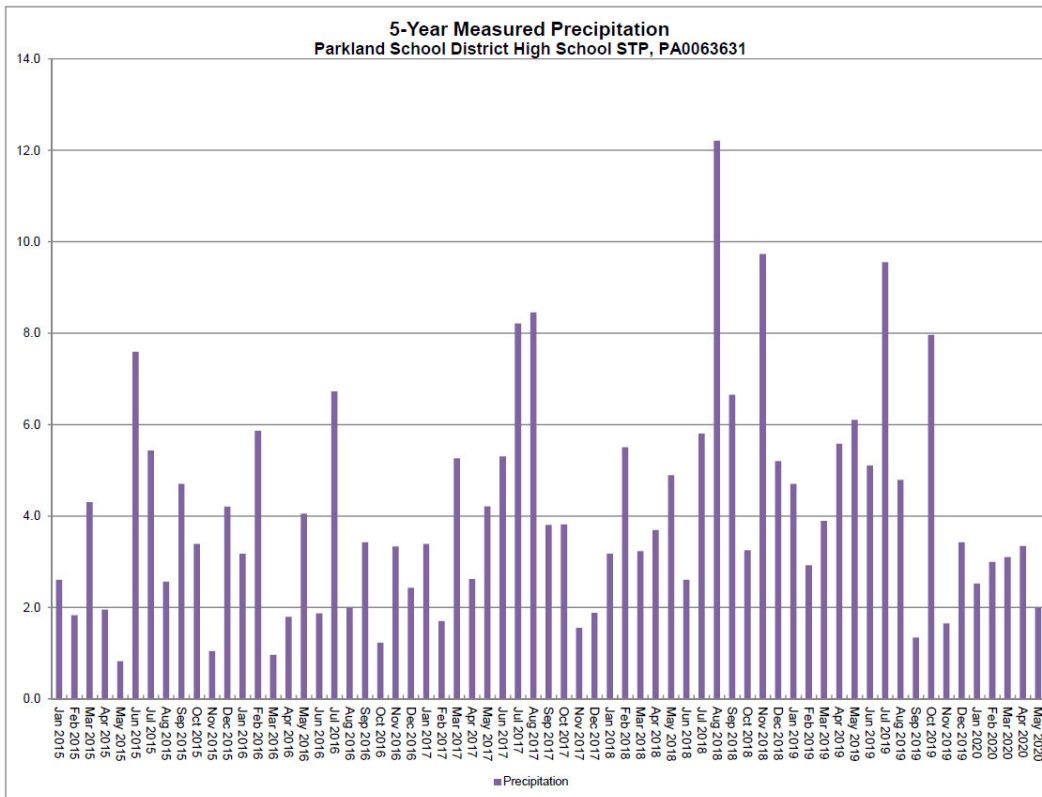
Projected BOD5 Loads for Next Five Years (lbs/day)

	2020	2021	2022	2023	2024
New Capita	5	5	5	5	5
New Capita Load	0.0549	0.0525	0.0583	0.0557	0.0498
Proj. Annual Avg	37.32	37.37	37.43	37.49	37.54
Proj. Max Avg	67.23	67.32	67.43	67.53	67.62
Proj. Overload?	NO	NO	NO	NO	YES

Show Precipitation Data on Hydraulic Graph?

Month	2015	2016	2017	2018	2019
January	2.6	3.17	3.39	3.17	4.7
February	1.83	5.86	1.7	5.5	2.92
March	4.3	0.96	5.28	3.23	3.89
April	1.95	1.79	2.62	3.69	5.58
May	0.82	4.05	4.21	4.89	6.1
June	7.59	1.87	5.3	2.6	5.1
July	5.43	6.72	8.21	5.8	9.55
August	2.56	1.99	8.45	12.21	4.79
September	4.7	3.42	3.8	6.65	1.34
October	3.39	1.23	3.81	3.25	7.96
November	1.04	3.33	1.55	9.73	1.65
December	4.2	2.43	1.88	5.2	3.42





Parkland School District, High School STP
 Pitter Road, South Whitehall Twp., Lehigh County
 NPDES # PA063831

Influent Record Data:

2015	Inf		BOD5 conc mo avg	BOD Load mo avg	TSS conc mo avg	TSS Load mo avg	MLSS	Wasted
	mo avg	mo max						
Jan								
Feb								
Mar								
Apr								
May	0.0210	0.0392					2,675	237
Jun	0.0143	0.0267	174	30	180	19	2,343	237
Jul	0.0109	0.0206	47	6	85	11	2,140	237
Aug	0.0115	0.0249	149	12	178	14	1,520	237
Sep	0.0220	0.0339	454	93	92	19	1,843	187
Oct	0.0222	0.0352	202	64	315	101	1,682	186
Nov	0.0237	0.0435					2,594	222
Dec	0.0176	0.0407	305	66	300	64	2,180	222
avg	0.0179		222	44	204	41	2,012	218

2016	Inf		BOD5 conc mo avg	BOD Load mo avg	TSS conc mo avg	TSS Load mo avg	MLSS	Wasted
	mo avg	mo max						
Jan	0.0182	0.0385	200	30	210	32	2,800	222
Feb	0.0168	0.0312					2,425	222
Mar	0.0153	0.0328	305	39	254	34	1,980	222
Apr	0.0208	0.0455					3,450	250
May	0.0220	0.0551					2,945	329
Jun	0.0127	0.0223					2,000	344
Jul	0.0091	0.0191					1,580	215
Aug	0.0103	0.0249					1,280	194
Sep	0.0261	0.0576	27	6	24	5	1,280	97
Oct	0.0234	0.0399	103	20	110	21	2,580	210
Nov	0.0181	0.0422					3,455	313
Dec	0.0161	0.0345					3,520	484
avg	0.0174		158	24	152	23	2,480	258

2017	Inf		BOD5 conc mo avg	BOD Load mo avg	TSS conc mo avg	TSS Load mo avg	MLSS	Wasted
	mo avg	mo max						
Jan	0.0171	0.0389					4,430	289
Feb	0.0176	0.0211	138	20	119	18	2,580	250
Mar	0.0184	0.0214					2,050	391
Apr	0.0189	0.0480					2,580	570
May	0.0246	0.0440					2,250	271
Jun	0.0190	0.0234					2,085	311
Jul	0.0098	0.0285					1,880	271
Aug	0.0197	0.0204						155
Sep	0.0260	0.0805	298	65	308	67	1,420	75
Oct	0.0261	0.0211					1,820	119
Nov	0.0316	0.0464					1,820	183
Dec	0.0271	0.0332					1,430	183
avg	0.0221	0.0241	219	43	214	42	2,194	256

2018	Inf		BOD5 conc mo avg	BOD Load mo avg	TSS conc mo avg	TSS Load mo avg	MLSS	Wasted
	mo avg	mo max						
Jan	0.0308	0.0274					1,580	183
Feb	0.0284	0.0246	176	65	528	175	1,730	183
Mar	0.0258	0.0265					1,800	183
Apr	0.0389	0.1278					1,580	183
May	0.0322	0.0225						183
Jun	0.0198	0.0212						183
Jul	0.0198	0.0440						
Aug	0.0135	0.0285	160	13	216	17		158
Sep	0.0223	0.0279	288	48	424	70		158
Oct	0.0225	0.0765	169	24	240	34		183
Nov	0.0190	0.0463	149	44	96	29	2,383	123
Dec	0.0205	0.0345	212	56	310	82	3,250	92
avg	0.0241	0.0265	192	42	303	68	2,106	152

2019	Inf		BOD5 conc mo avg	BOD Load mo avg	TSS conc mo avg	TSS Load mo avg	MLSS	Wasted
	mo avg	mo max						
Jan	0.0183	0.0371	396	74	470	87	2,118	144
Feb	0.0179	0.0437	194	21	234	25	2,510	98
Mar	0.0179	0.0407	249	68	485	133	2,325	65
Apr	0.0207	0.0463	234	47	431	87	3,225	40
May	0.0245	0.1003	278	36	432	56	3,020	36
Jun	0.0146	0.0416	142	13	300	27		
Jul	0.0103	0.0334	66	18	158	44		840
Aug	0.0100	0.0150	97	9	186	17		
Sep	0.0192	0.0468	159	31	382	75	1,720	
Oct	0.0218	0.0428	185	35	248	47	2,025	
Nov	0.0213	0.0449	186	35	239	44	1,957	
Dec	0.0177	0.0382	97	19	185	18	1,944	45
avg	0.0179		190	34	312	55	2,188	71

ATTACHMENT G: 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 (Page 1 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, hydraulic overloads (“storm mode”), 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 gravimetric solids test method is the gold standard for solids testing. The DEP portable laboratory included a solids-by-volume centrifuge test method that 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 month 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 and the daily required effluent testing for dissolved oxygen (DO,) pH, and total residual chlorine (TRC.) 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 analyzed for percent suspended solids (TSS) using the centrifuge. Test results are 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 to resist changes in pH,) 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 creating visual graphs of operational 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 of activated sludge treatment facilities should determine an overall treatment strategy for their facility, using standard industry calculations for constant:

- 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.

Since operators have the most control over sludge wasting rates, adjusting any of these process control strategies can be done successfully by adjusting the concentration (or load) of suspended solids (biomass) under aeration.

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ATTACHMENT H: CALCULATING ALKALINITY DEMAND

Typically, alkalinity in effluent should be 50 mg/L or match that of the receiving stream; however, because of bioavailability of alkalinity at the pH range needed by nitrifying bacteria, this concentration should be higher in the Aeration Tanks, 100 mg/L up to 220 mg/L.

Alkalinity demand should be calculated. Since each 1 mg/L of ammonium in the secondary influent requires 7.14 mg/L alkalinity as CaCO_3 ⁶, multiply the influent (or raw) TKN (total Kjeldahl nitrogen, which is organic nitrogen and ammonium nitrogen, combined)⁷ concentration in mg/L X 7.14 mg/L alkalinity to determine a minimum amount of alkalinity needed for ammonia removal through nitrification. Then determine the influent alkalinity concentration already present and subtract this from the alkalinity demand you just calculated for your influent ammonium.

Example:

42 mg/L Influent TKN x 7.14 mg/L alkalinity per 1 mg/L TKN = 300 mg/L alkalinity required

If the secondary influent already has 56 mg/L of alkalinity, then the net alkalinity demand is:

300 mg/L alkalinity needed to treat – 56 mg/L alkalinity in Influent = 244 mg/L alkalinity demand

To convert this to an actual chemical dose, you will have to multiply the net demand concentration by the Influent flow rate:

If the average flow is 0.020 MGD, then the amount of alkalinity required would be

$$244 \text{ mg/L} \times 0.020 \text{ MGD} \times 8.34 \text{ lb./gal} = 41 \text{ lb./day.}$$

After choosing a chemical, you will have to determine the available alkalinity in the chemical. For example, 1 lb. **soda ash** has 1.06 lb. alkalinity⁸. This means that to provide 41 lb./day alkalinity as CaCO_3 , you need to divide this by the ratio of chemical to alkalinity:

$$41 \div 1.06 = 38.7 \text{ (~ 39) lb./day of soda ash (NaOH)}$$

Figure adding 40 pounds added over 24 hours, not all at once. Using the 100-gallon day tank, dilute 40 lb. into approximately 70 gallons, slowly, and then dilute to 100 gallons.

Caution: Caustic soda, Flake caustic, Lye, or NaOH pellets react violently with water during dilution. Always add chemical to water slowly. Never add water to chemical! Wear personal protective equipment—safety goggles or face shield, chemical-resistant gloves, coveralls—when working with this chemical. If caustic soda gets on skin, flush with cold water thoroughly for 30 minutes and seek medical attention.

⁶ To account for bioavailability of alkalinity at the desired MLSS pH of 7.2 to 7.5, substitute 8 mg/L for 7.14 mg/L. This increased the alkalinity required but is also more realistic, since 7.14 mg/L is the **minimum** required.

⁷ If you can't test for TKN, substitute a test for ammonia-nitrogen and multiply the result by 1.25 to approximate the combination of organic nitrogen and ammonium nitrogen, together.

⁸ See the table on the next page.

The feed rate would be

$$40 \text{ lb./day} \div 24 \text{ hours} = 1\text{-}2/3 \text{ lb./hr. (100 gal. per day = c. 4.2 gal./hr.)}$$

Keeping track of the alkalinity demand over time should help when determining the size and capacity of the chemical feed pump and the size of the line needed.

Supplemental Alkalinity Buffering Compounds

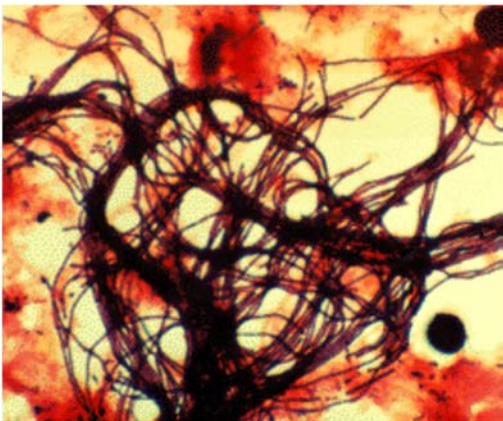
Compounds	Chemical Formula	Alkalinity-Ratio, ppm/ppm CaCO ₃
Soda Ash	Na ₂ CO ₃	1.06
Sodium Acetate	H ₃ CCOONa	0.82
Hydrated Lime	Ca(OH) ₂	0.74
Quick Lime	CaO	0.56
Bicarbonate	NaHCO ₃	1.68
Caustic soda, Lye	NaOH	0.80
Magnesium hydroxide, Magnesia	Mg(OH) ₂	0.50

ATTACHMENT I: FILAMENTOUS GROWTHS / MICROTHRIX PARVICELLA

During the evaluation, DEP and EPA staff tentatively identified the offending filamentous organism affecting this facility as *Microthrix parvicella*. This is a common nuisance growth in Pennsylvania activated sludge treatment facilities, especially during winter months when it causes significant solids settleability and effluent quality problems. This attachment discusses this pest.

What is Microthrix Parvicella?

- Gram positive, un-branched filament
- Neisser positive (poly-P granules). These granules become smaller if the growth stagnates.
- immobile;
- bent/twisted filaments, free in the water or in/around the flocs;
- filament length often < 200 µm;
- cell diameter ca. 0.5 µm;
- usually no attached growth;
- no sheath;
- septa not clearly visible;
- no sulphur storage;
- Surveys in many countries show MP dominates bulking sludges and foams
- Favored by:
 - Long SRTs (BNR Plants)
 - Alternating aerated/ non-aerated zones (BNR plants)
 - Foam trapping environments
 - Low T (Winter/Spring)
 - Long Chain Fatty Acids (LCFA) food source (FOG)



Gram Stain – x1000



Microthrix parvicella foam

M. parvicella resembles *Nostocoida limicola* I. However, this latter organism forms more robust filaments and stains grey-violet with Neisser staining.

Occurrence in activated sludge

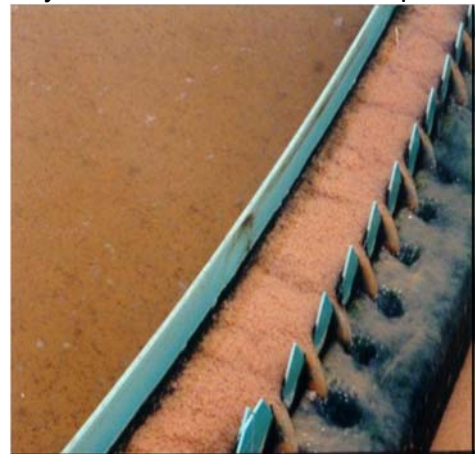
M. parvicella commonly occurs in low loaded domestic treatment plants. This filamentous bacterium is the most important cause of bulking sludge in many countries and is also frequently responsible for scum formation. Transport of surplus sludge containing many *M. parvicella* filaments to the sludge digestion tank can also cause scum to arise in this tank. The population size of *M. parvicella* shows a marked seasonal pattern: the population is at its maximum at the end of the winter and at its minimum in summer.

The following process conditions are favorable to the growth of *M. parvicella*:

- Sludge loading level < ca. 0.2 kg BOD/kg MLSS – day;
- Waste water containing a substantial amount of higher fatty acids, such as oleic acid. This is always the case with normal domestic waste water;
- Circumstances in which the fats/lipids present in the influent are hydrolyzed before they reach the aeration tank. This releases the higher fatty acids. Consequently, a long hydraulic retention time in the sewer, the primary sedimentation tank, or in the anaerobic zone with Bio-P processes is favorable to *M. parvicella*;
- Low oxygen level in the aeration tank;
- Large (> 40% of the total volume) anoxic zone in the aeration tank;
- Water temperature of < c. 50°F. *M. parvicella* grows principally in the late autumn and winter;
- Supply of reduced sulfur and nitrogen compounds is also a possible cause. On account of this, recycling of water from the sludge dewatering unit is 'suspect'. This combination means that the process conditions in plants for nutrient removal are extremely favorable to the growth of *M. parvicella*. It hardly ever occurs in industrial treatment plants.
- BNR conditions favor growth of *M. parvicella*, particularly when nitrification is incomplete.

Why *Microthrix parvicella* is such a problem:

- Foaming causes aesthetic and sampling problems
- Foam leads to high TSS = increased filter backwashing
- Carryover to effluent
- Breeding ground for more filaments
- Digester foaming and upsets
- Poor Settling Characteristics
- Formation of high sludge blankets
- High effluent TSS
- Loss of Clarifier capacity
- Requires low SRT to wash out or chemicals to kill
- Nitrification can be inhibited
- Disinfection process can be inhibited



Bulking sludge overflowing clarifier

Control of *Microthrix*

Various control measures exist for controlling *Microthrix parvicella*:

- Eliminate FOG/food sources
 - Addresses cause of filament growth
 - Difficult to accomplish
- Lower SRT, wash out filaments

- Simple, addresses cause
- Washes out filaments
- Loss of nitrification, more WAS
- Surface spraying of foam (polymer, hypo)
 - Difficult to do if covered tanks, maintenance
 - Treats symptom, not cause
- RAS injection of chemical (Cl₂)
 - Loss of nitrification, increased eff TSS
- Digester modifications (water sprays, submerged fixed cover)
 - Treats symptom, not cause
 - Expensive capital costs
- Polyaluminum Chloride addition
 - Specific to Microthrix, treats cause
- Surface wasting of ML (Classifying Selector) and/or foam
 - Eliminates Microthrix at source

Control strategies

1. Dosing with aluminum salts (3.5 g Al/kg MLSS. day). Up to now, this is the only method that has a “guaranteed” effect and which hardly ever negatively influences the desired treatment results. However, a reduction in the average floc size must be considered.
2. Strong reduction of the retention time in anoxic zones in the plant. This action is often not possible, depending upon the need for extended denitrification.
3. This is also valid for a major reduction of the sludge age (loss of nitrification).
4. A mixing phase (a few minutes) of raw waste water and returned sludge – before they reach the aeration tank – followed by alternated anoxic and aerobic process conditions (Bio-Denitro). This method is effective for controlling *M. parvicella*, but stimulates the development of Type 0041, which does not grow quite so massively and does not contribute to scum arising, however.
5. Experience with various types of selectors for controlling *M. parvicella* have not been consistent up to the present. A non-aerated selector has been introduced between the anaerobic zone (Bio-P) and the anoxic tank in some treatment. Experiences with this configuration have been positive.

The PAX Solution

M. parvicella sensitivity to PAX-14 (no other PAX forms found effective)

- pre-polymerized aluminum hydroxide
- Used extensively in Europe for control of *M. parvicella*
- PAX diminishes *M. parvicella* ability to use lipids
- Effectively “starves” *M. parvicella*

Downside

- Process is chemically dependent
- Continuous expenditures: at c. \$3.50 per gallon, 2.6 MGD, PAX dose is 65 to 85 gpd, initially, and then 11 to 13 gpd for maintenance, or \$230-\$300 per day, initially, and then about \$40 to \$45 per day for maintenance

Other Methods: Surface Foam Wasting

When foam concentrates at surface, MP retained longer than average biomass

- Foam trapping aggravates problem and must be minimized for effective control
- Surface foam removal removes foaming filaments first rather than last, eliminating nuisance foams
- May require constant foam wasting or a classifying selector with baffles
 - Downsides to classifying selectors:
 - Continuous surface wasting = thin WAS
 - Thickening prior to digestion is very important
 - Results of non-continuous wasting
 - Remove foam when it becomes a problem
 - Can still lead to bulking and may require secondary bulking control method like PAX addition
 - Could lead to Digester foaming

The InDense RAS/WAS Hydrocyclone

- Applied to Waste Sludge stream, the device uses hydrocyclones to classify dense mixed liquor suspended solids from less dense material that usually includes living filamentous bacteria or their degraded remains, either of which interfere with sludge settleability and cause high sludge volume index.
 - Lighter solids are removed to a waste stream and disposed through anaerobic digestion.
 - Eliminates the need for chemical addition for enhanced settleability
 - Removes need for toxic filamentous control substances such as chlorine or peroxides.
- Capital expense is low, and ongoing energy and maintenance costs are more reasonable than continued chemical expenses.



ATTACHMENT J: DRAFT NPDES PERMIT LIMITS

PA0063631, Sewage, SIC Code 8211, Parkland School District, 2219 N Cedar Crest Boulevard, Allentown, PA 18104-9665. Facility Name: Parkland High School High School STP. This existing facility is located in South Whitehall Township, Lehigh County.

Description of Existing Activity: The application is for a renewal of an NPDES permit for an existing discharge of treated Sewage.

The receiving stream(s), Jordan Creek (TSF, MF), is located in State Water Plan watershed **2-C** and is classified for Migratory Fishes and Trout Stocking, aquatic life, water supply and recreation. The discharge is not expected to affect public water supplies.

The proposed effluent limits for Outfall 001 are based on a design flow of **32,400 gpd**.

Parameters	Mass Units (lbs/day)		Concentrations (mg/L)			
	Average Monthly	Average Weekly	Minimum	Average Monthly	Daily Maximum	IMAX
Flow (MGD)	Report	Report Daily Max	XXX	XXX	XXX	XXX
pH (S.U.)	XXX	XXX	6.0 Inst Min	XXX	XXX	9.0
Dissolved Oxygen	XXX	XXX	3.0 Inst Min	XXX	XXX	XXX
Total Residual Chlorine (TRC)	XXX	XXX	XXX	0.20	XXX	0.48
Carbonaceous Biochemical Oxygen Demand (CBOD5)	Report	XXX	XXX	25.0	Report	50.0
CBOD5 Minimum % Removal (%)	85 Min Mo Avg	XXX	XXX	XXX	XXX	XXX
Total Suspended Solids	Report	XXX	XXX	30.0	Report	60.0
Total Suspended Solids Minimum % Removal (%)	85 Min Mo Avg	XXX	XXX	XXX	XXX	XXX
Total Dissolved Solids	Report	XXX	XXX	Report	Report	XXX
Fecal Coliform (No./100 ml) Oct 1 - Apr 30	XXX	XXX	XXX	2000 Geo Mean	XXX	10000
Fecal Coliform (No./100 ml) May 1 - Sep 30	XXX	XXX	XXX	200 Geo Mean	XXX	1000
Total Nitrogen	Report	XXX	XXX	Report	Report	XXX
Ammonia-Nitrogen Nov 1 - Apr 30	Report	XXX	XXX	14.9	Report	29.8
Ammonia-Nitrogen May 1 - Oct 31	Report	XXX	XXX	4.9	Report	9.9
Nitrate as N	Report	XXX	XXX	15.0	Report	30.0
Nitrite as N	Report	XXX	XXX	Report	Report	XXX
Total Kjeldahl Nitrogen (lbs/min, ug/L)	Report	XXX	XXX	Report	Report	XXX
Total Phosphorus	Report	XXX	XXX	Report	Report	XXX

Continued on next page...

The proposed effluent limits for Outfall 101 (influent raw sewage monitoring point) are based on a design flow of **32,400 gpd**.

Parameters	Mass Units (lbs/day)		Concentrations (mg/L)			
	Average Monthly	Daily Maximum	Minimum	Average Monthly	Daily Maximum	IMAX
Carbonaceous Biochemical Oxygen Demand (CBOD5) Raw Sewage Influent	Report	Report	XXX	Report	Report	XXX
Total Suspended Solids Raw Sewage Influent	Report	Report	XXX	Report	Report	XXX

Sludge use and disposal description and location(s): Disposal at Lehigh County Authority Pretreatment Plant or Delcora WWTP

In addition, the permit contains the following major special conditions:

Stormwater prohibition; Necessary property rights; Residuals management; Chlorine minimization; Dry stream discharge; SBR batch discharge; Responsible operator; WQM permit application requirement for additional groundwater monitoring wells; Chapter 94 Reporting upon request.

