
WASTEWATER PLANT PERFORMANCE EVALUATION

August 19 through October 5, 2009

Atglen Borough Sewer Authority
Atglen Contact-Stabilization Sewage Treatment Facility

NPDES #PA0024651



Bureau of Water Standards & Facility Regulation
POTW Optimization Program



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Disclaimers:

The mention of a particular brand of equipment is in no way an endorsement for any specific company. The Department urges the permittee to research available products and select those which are the most applicable for its situation.

The goal of the Department's Wastewater Optimization Program is to improve water quality at drinking water intakes by optimizing upstream wastewater plant effluent quality. This often times involves permittees achieving effluent quality above and beyond any permit requirements.

1 Optimization Report

The WPPE program is funded under an Environmental Protection Agency (EPA) grant for studying the effect of process optimization on the reduction of dangerous waterborne pathogens found at drinking water treatment facilities within a ten-mile distance downstream from municipal wastewater plant discharges. The nearest water intake is on the East Branch Octoraro Creek, approximately 11 miles downstream from the discharge of the Atglen plant. DEP staff employed continuous-recording nutrient and water chemistry probes and a portable wastewater laboratory to effect process optimization, following an initial evaluation of the candidate facilities.

The WPPE program focuses on optimizing each treatment process in order to produce the best water quality possible. Optimization often requires setting voluntary goals for each treatment process which are better than the minimum permit requirements. For example, although there may be no requirement to maintain low phosphorus loading to the receiving stream during the winter months, the facility may voluntarily set a limit and strive to meet it through continued treatment, while carefully recording and reporting progress.

Operators should see their job not as “running a sewage treatment plant” but “manufacturing a high quality effluent and/or a Class A biosolids” for further utilization. It’s a mindset that is adopted and cultivated through ongoing self-improvement and continuing education.

On-site activities for the WPPE took place during late August and through early October 2009. DEP staff installed both the continuously monitoring digital probes and portable wastewater laboratory during the third week of August and began automatically collecting data recorded at fifteen-minute intervals, downloading probe data to a notebook computer set up in the facility’s office and lab area inside a building that sits atop a large pumping station. In addition, staff conducted a variety of process monitoring tests when on-site. This data generally confirmed the data already being recorded by plant staff in their process monitoring activities, and DEP staff also obtained aqueous samples from different sampling points in the treatment process on a weekly basis, delivering the samples to PA-DEP’s Bureau of Laboratories facility in Harrisburg for supplemental routine analysis and to calibrate the digital instruments. Generally, WPPE staff attended the site two or three days per week during the WPPE. Specific sampling required under terms of the study grant was undertaken, were 10-liter samples of final effluent, background receiving stream, and impacted surface waters downstream were analyzed using EPA Method 1623 for waterborne pathogens *Cryptosporidium* oocyst and *Giardia lamblia* cyst, two species of particularly noxious drinking water pathogens which must be removed by downstream potable water filtration facilities.

DEP staff completed on-site activities on October 5, 2009, and the last of laboratory reporting was completed by February. The WPPE examined the site history, its operations and operations data for the previous year, and looked for operations issues

that might be improved in order to increase the water quality for downstream users. Findings and recommendations are summarized in this section, below.

A description of the WPPE Program follows as Attachment A, with a listing of program participants in Attachment B. Descriptions of the Atglen facility, its design operational characteristics, and a schematic of the current flow configuration is attached at C, and Attachment D summarizes operational data developed during the WPPE, with discussions of process monitoring and control conditions observed during the on-site activities or researched during file reviews and discussions with facility staff, other DEP personnel, or EPA regulators. Attachment M lists the current NPDES permit discharge conditions.

Lists of the monitoring equipment used, a schematic, and photos of the installation are provided in attachments E and F, with tables of test results and graphic representations following in attachments G through K. Attachment Q is a graphic representation of the Dissolved Oxygen profile for one of the North contact-stabilization unit prior to its temporary conversion to step-feed conventional aeration, while Attachment N lists the NPDES permit requirements, and N and O refer to biosolids production and nutrient reduction, respectively.

Attachment L lists recommended process control tests, observations, and calculations for small activated sludge facilities.

Results of the evaluation are summarized below as Operational Strengths and Focus Points for Improvement. A third category of Design/Process Changes to Consider suggests process modifications that would require study and implementation by a professional engineer, the technical details of which are outside the professional qualifications of the WPPE evaluators.

1.1 Operational Strengths

The following items are Operational Strengths that were identified during the WPPE. These include strengths of both the operators and the facility itself.

- The facility typically sends aqueous samples to a commercial environmental lab for analysis, as the NPDES Permit does not require frequent testing. In-house laboratory activities typically include checking dissolved oxygen, pH, temperature, and chlorine residual. Effluent samples are obtained through use of a composite sampler located at the effluent flow metering station.
- Waste sludge solids are digested aerobically, concentrated through gravity thickening in the digesters, and off-loaded as liquid for further treatment at the nearby Christiana wastewater facility, where there is a belt filter press. The facility removes about 4,000 gallons of sludge per month from its digesters, according to DMR reports.
- Maintenance items are resolved quickly, and records are maintained for reference.
- Facility generally has maintained continual NPDES compliance.

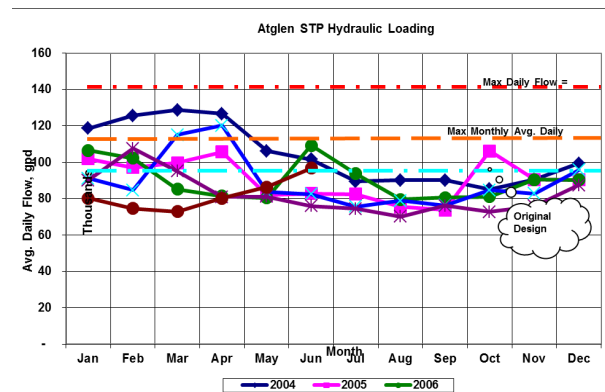
- Automatic composite sampler is located at the metering pit for effluent discharge to the creek and obtains samples at timed intervals.
- Operators are conscientious and workflow is coordinated according to plan.
- Operators have achieved certification for their system.
- Inflow/Infiltration control activities in the collection system are ongoing.
- Atglen began submitting eDMR in December 2010. This reporting utility increases efficiency and removes some potential error in the transcription process while assuring data integrity. DEP commends the operators for taking this step.

1.2 Focus Points for Improvement:

The following items have been identified as focus points to assist in optimization efforts, and they are ranked “High,” “Medium,” and “Low” in terms of their importance to optimized functioning of the treatment facility. The priority levels are defined below next to each ranking. Focus points include both operational tactics and physical plant issues that can or do impact optimization efforts. These items generally demand more of the operator’s attention and therefore require more of the operator’s time to perform. The benefits of addressing these focus points are expected to be favorable by improving the plants discharge quality and thereby improving downstream water quality. Focus points are informal recommendations made as a result of the on-site evaluation, but they are voluntary considerations for the Authority and are not official mandates by the Department of Environmental Protection. In some cases, it may be necessary to refer these matters to the Authority’s consulting engineer for evaluation, and any changes made to flow patterns or treatment methodology must be approved by DEP as a Water Management Permit Amendment. The Authority is free to consider or reject these recommendations in the normal business of operating the facility. Nevertheless, the recommendations are prioritized in order from most immediate consideration to longer-term consideration, based in part upon what will most quickly benefit plant operation and then upon what is most quickly feasible from a funding standpoint.

High- Major impact on plant performance on a repetitive basis and/or has been associated with a regulatory violation:

- **Hydraulic Overload of Existing Facility:**
It is apparent that the existing facility is operating at or above its hydraulic capacity with the primary limiting factor being the secondary clarifiers and disinfection detention tanks. This has resulted in regulatory violations and poor plant performance. Specifically, hydraulic overloading is responsible for solids carryover (see photo right,) inadequate disinfection contact time, and elevated nutrient concentration in the final effluent. Tests performed during the WPPE found elevated concentrations of solids, fecal Coliforms, orthophosphate, and

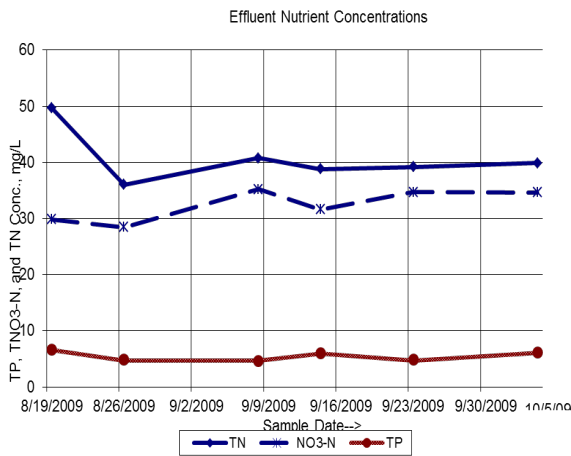


ammonia nitrogen, as seen in the lab data in Attachment J. Atglen should budget and plan for plant upgrades that will accommodate future and peak hydraulic needs. Also see the comment below regarding the need for redundant processes.

- Inadequate Removal of Suspended Solids:** Typically, one may observe solids and greases floating in the settling tanks of the facility, in the effluent metering pit, and at the outfall. An example is shown in the photo at the right: The use of coagulants and polymers may reduce the ashing of solids; however, prolonged use is generally not recommended, as it results in adding more untreated chemical oxygen demand to the effluent and may provide material that adversely reacts with disinfectants, reducing their ability to control pathogenic organisms. High amounts of ashing solids have been correlated to the presence of filterable pathogens such as giardia.



- Chesapeake Bay Tributary Strategy:** Atglen discharges to a tributary of the Chesapeake Bay. Under the tributary strategy for improving the quality of that estuary, annualized loading limits have been imposed on all point-source discharges

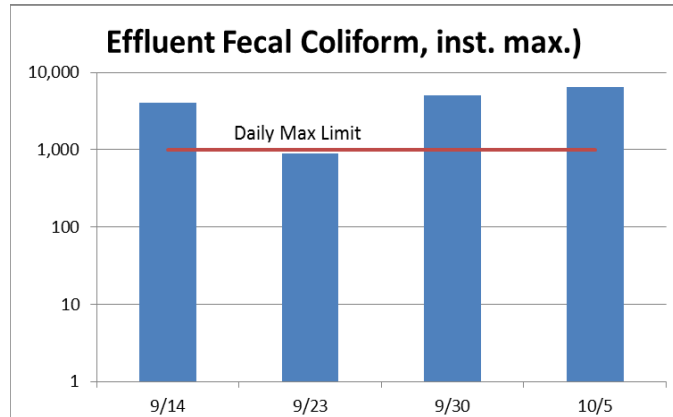


from municipal treatment works. For Atglen, the limits are 7,306 lb/yr for Total Nitrogen and 974 lb/yr for Total Phosphorus. These concentrations will be difficult to meet under the present operations conditions, and the costs of buying pollution credits from another facility may prove high. As seen in the graph at left, the effluent total nitrogen ranges from 37 to 50 mg/L for the days tested, equating to about 50,000 lb/yr of TN. Similarly, TP loading to the Bay

would be 8,400 lb./yr. Therefore, Atglen should consult with their engineer to develop a strategy to meet the nutrient removal requirements through operational and physical improvements.

- Disinfection Facilities Compromised:** The disinfection tanks are not hydraulically capable of meeting current peak flows. Disinfection is an integral treatment process at any wastewater treatment plant. Adequate detention time is necessary for achieving pathogen kills when employing halogen disinfectants. The existing tanks are too small for adequate detention time. The chart below shows three of four instantaneous samples of effluent testing above the daily maximum grab limit of 1000 mpn/100 ml for fecal coliform. The actual high number was 6500 mpn/100 ml, while the lowest was 900. Atglen should budget and plan to upgrade the disinfection process to accommodate future and peak hydraulic needs.

Consideration should be given to eliminating halogen disinfectants, which can produce unwanted chloramines in plant effluent, and installing ultraviolet disinfection to provide adequate treatment in a small footprint. In addition, the ultraviolet disinfection can inactivate some organisms that are resistant to chlorination and can treat some of the emerging contaminants that will pass through chlorination.



- Data Integrity of Fecal Coliform Testing:** Fecal Coliform testing conducted by the Department trended 3 log higher than results collected by Atglen. Atglen should consider evaluating their Fecal Coliform sampling and testing by conducting a special study with an independent 3rd party. In addition chlorine residual grab samples should be collected at the same time as Fecal Coliform sampling to rule out any occurrence of chlorine residual spikes. Accurate Fecal Coliform data is needed in order for Atglen to make reliable data-based decisions regarding plant operations and facility upgrades.
- Redundancy of Plant Processes:** Atglen's wastewater treatment plant no longer has redundant treatment processes, as its daily flow no longer permits bypassing one of the reactors for maintenance purposes. This inhibits Atglen from performing preventative maintenance while providing adequate wastewater treatment at the same time. Atglen should budget and plan for process redundancy during any plant upgrades to accommodate future and peak treatment needs while a process is out of service for maintenance.
- Plant Conditions and Maintenance:** The wastewater plant exhibits evidence of deferred major maintenance, due in part to the ongoing inability to shut down reactors for sustained periods. The plant has run at capacity for many years. Maintenance becomes reactive rather than preventative, drawing away valuable time that should be spent conducting process control monitoring and making process control adjustments. This is a performance problem that will need corrected regardless of building a new plant. Without proactive preventive maintenance, the life of a new plant will be significantly shortened.
- Wastewater Plant is Antiquated:** Contact / Stabilization Activated Sludge in this small footprint was designed primarily for the removal of suspended solids and soluble organic material (BOD5.) Nitrification was not a major consideration. In addition, unit performance is temperamental or inconsistent, because some of the manual adjustments, especially those involving air-lift pumps, are not precise. Access to plant components is difficult, time-consuming. Newer technology facilities not only treat for solids and organics; they also treat for dissolved nutrients such as nitrogen and phosphorus. The facility as it exists does produce adequate nitrification most of the time, but there are no provisions for efficiently controlling nitrates and phosphates.

Medium- Minimal impact on plant performance on a repetitive basis;

- Increase Frequency of Process Monitoring: Atglen currently conducts some basic process monitoring once or twice per week. The operators should consider increasing the frequency and range of process monitoring for their facility. Because the plant is operated at the very edge of compliance, and at times out of compliance it is imperative to avoid upsets through frequent analysis of the condition of biological activity, loadings, and nutrients. In addition, the sampling data will need to be accurate and should be trended so Atglen can use this data to make accurate data-based decisions regarding treatment. This can be done using equipment similar to that provided by DEP during the WPPE and tests listed in Attachments E and L. This is a performance problem that will need corrected regardless of building a new plant. Without proper process control performance problems will continue.
- Need for Ongoing Tank Maintenance: Currently, Atglen only conducts tank maintenance for emergency repairs. It is not uncommon for inert material and grit to accumulate causing poor plant performance. All tanks should be drained and cleaned at least once per year and be checked for cracks, leaks, corrosion, spalling, and diffuser damage. This activity is essential to maintaining adequate wastewater treatment.
- Screening of Raw Wastewater at Headworks: An excessive amount of inorganic solids, trash, and detritus was observed throughout various treatment processes. This debris adversely impacts downstream treatment processes, especially pumps and valves. The facility would benefit from installation of an automated screening facility at the plant headworks to remove this debris. Screening can also remove up to 30% of the organic loading on the activated sludge treatment tanks. In the interim, debris should be removed manually at least once per day.
- Convert Contact-Stabilization to Conventional Activated Sludge Aeration: As shown during the study, redistributing some of the raw wastewater brought about immediate cessation of the occurrence of ammonium in excess of irritant levels in the mixed liquor and clarifier effluent. This change effectively turned the plant from being contact/stabilization to convention, using step-feed distribution of the influent. This practice ought to be made permanent. Doing so will promote complete conversion of ammonia-nitrogen and organic nitrogen to nitrates. Those soluble nitrates can be later controlled using methods of biological nutrient removal, BNR, such as on/off aeration to reduce the effluent concentration of nitrates. In the hierarchy of nitrogen forms, the least desirable in wastewater is ammonium (reduced), then nitrates (oxidized). One cannot consider denitrification until first completing deammonification.

Low- Minimal impact on plant performance on a rare basis or has the potential to impact plant performance:

- Biomass enhancement: Although the facility appears to maintain adequate sludge age, it remains necessary to seed the biomass on a regular schedule. Different formulations of bacteria compounds may be found from vendors, and some may be customized to the needs of your particular facility, especially for the reduction of fats,

oils, and greases (FOG) that tend to float in the clarifiers and disinfection tanks. Such material risks being carried forward into the effluent. Use of seed sludge from other activated sludge processes or digesters is not favored, because such biomass may be contaminated or inert and is generally unreliable.

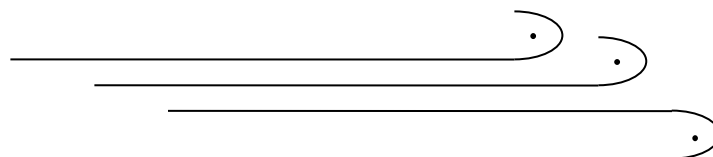
- Continuing-Education for Personnel: Licensed wastewater operators are required by the Department to maintain certification through continual education offered from a variety of sources. These courses are important in helping operators remain abreast of changes in technology and regulation, as well as assuring they maintain basic competencies. One course that is required for all operators during the current licensing cycle is a Security and Intrusion Awareness course with the Department offers through on-line and classroom training. This course or a similar course offered by others must be completed by every licensed operator.
- Site Security: Atglen personnel routinely secure the Wastewater plant when not on the premises. The presence of a guard dog tends to deter the casual trespasser. It is further recommended that all wet well covers remain secure throughout the day, with the access handles or keys kept in a secure location. The locksets for the door to the control building are obsolete and can be easily picked by raking the worn tumblers; it is recommend that they be replaced with more secure, modern locksets. Other enhancements might include installation of wireless perimeter security and motion detectors inside buildings.
- Energy Consumption: An energy audit of the facility should be performed to optimize electric power consumption. While most attention needs be paid to the blower system, other systems such as pumps, headworks, and support services should be evaluated for energy efficiency, including heating and lighting systems. No plant upgrade should proceed without a careful analysis and inclusion of methods for conserving energy and reducing electrical consumption. Many wastewater plants automatically pace aeration blows based on a DO or ORP probe. This strategy can be used to optimize treatment performance and reduce energy consumption at the same time.

1.3 WPPE Rating:

Background of the rating system for WPPE is described in Attachment A. As a result of the evaluation and on-site interaction with the plant operators, the Department has assigned a facility rating of **Needs Improvement**.

1.4 Re-evaluation:

Presently, there are no plans to re-evaluate the facility for the WPPE Program, although future program goals include re-evaluation of WPPE facilities. The Department would like to revisit the facility within three-year's time to see if the facility status has changed.



2 Downstream Water Treatment

Valley Creek is a tributary of East Branch Octoraro Creek, itself part of the larger Octoraro Creek watershed. The Octoraro Creek eventually flows to the Susquehanna River, near Maryland. Of the major watersheds draining western Chester County, only the Octoraro flows southwest, away from the Schuylkill and Delaware River Basins. It was for that reason, sixty years ago, that the Chester Water Authority decided to build a water filtration plant in this watershed and forty miles of pipeline away from its service area. In 1951, CWA considered the Delaware River basin to be increasingly degraded and opted for the Susquehanna instead. More than half a century later, the idea doesn't seem as good, as the Susquehanna watershed now rivals the Delaware in degraded water quality.

The Chester Water Authority Filtration Plant (PWSID 1230004) is approximately 11 stream miles downstream of Atglen Borough's outfall on Valley Creek. The Atglen effluent does not appear to adversely affect water quality of the Chester Water Authority's facility. Pathogen tests included one Method 1623 sampling event at Outfall 001 of the Atglen plant and at the nearest crossroad to the water plant, in the Octoraro Creek watershed. This downstream location closer to the outfall had been chosen because the effects of the treatment plant on the immediate watershed were assumed to be greater than they would be on the reservoir for the water plant, which collects from many small watersheds contributing to the Chester City Authority facility. This reasoning was based on pathogen tests performed previously for the drinking water programs. The most immediate sewage plant outfall in proximity to the Chester City Authority's water treatment plant is the Borough of Delta Municipal Authority's, although it is located along another creek feeding the reservoir.

2.1 FPPE Review—

The Chester Water Authority water system serves 37 municipalities located in Northern & Western Delaware counties along with Southern Chester County and Lancaster County. The Chester Water Authority provides water to about 200,000 consumers and has 100% metered service connections. Treatment currently consists of alum for coagulation, flocculation, and sedimentation with plate settlers, 12 two sided multi-media filters, and disinfection. It withdraws up to 0.900 MGD from the Octoraro Creek. The Chester water plant began operation in 1994 using two Roberts package units employing adsorption clarifiers and mixed-media filters. Storage capacity for the clear well is 40,800 gallons, and a ca. 33 ft. diameter, 48 ft. high water tank with a 300,000 gallon capacity is nearby with a maximum working storage capacity of 262,500 gallons. A 2009 FPPE report notes that three back-up wells can provide approximately 0.703 MGD of capacity should the 14.5 acre reservoir be out of service.

DEP conducted a Filter Plant Performance Evaluation (FPPE) at Chester City in May 2009. Settled water turbidities are consistently below the optimization goals of 1.0 NTU; filtered water turbidities, below 0.10 NTU. Particle counts on the operating filters remained below thresholds of 25 particles per milliliter for *Giardia*-sized particles (>2.0 µm/ml) except during brief periods following filter backwashes, when water was diverted

during filter recovery periods. Actual assays for Method 1623 pathogens performed on samples taken during the FPPE showed there were no pathogens present in either the raw or finished water samples. The facility received a "satisfactory" rating during its latest evaluation.

Figure 2.1, below, is a schematic of the Chester City Authority Water Filtration Plant.

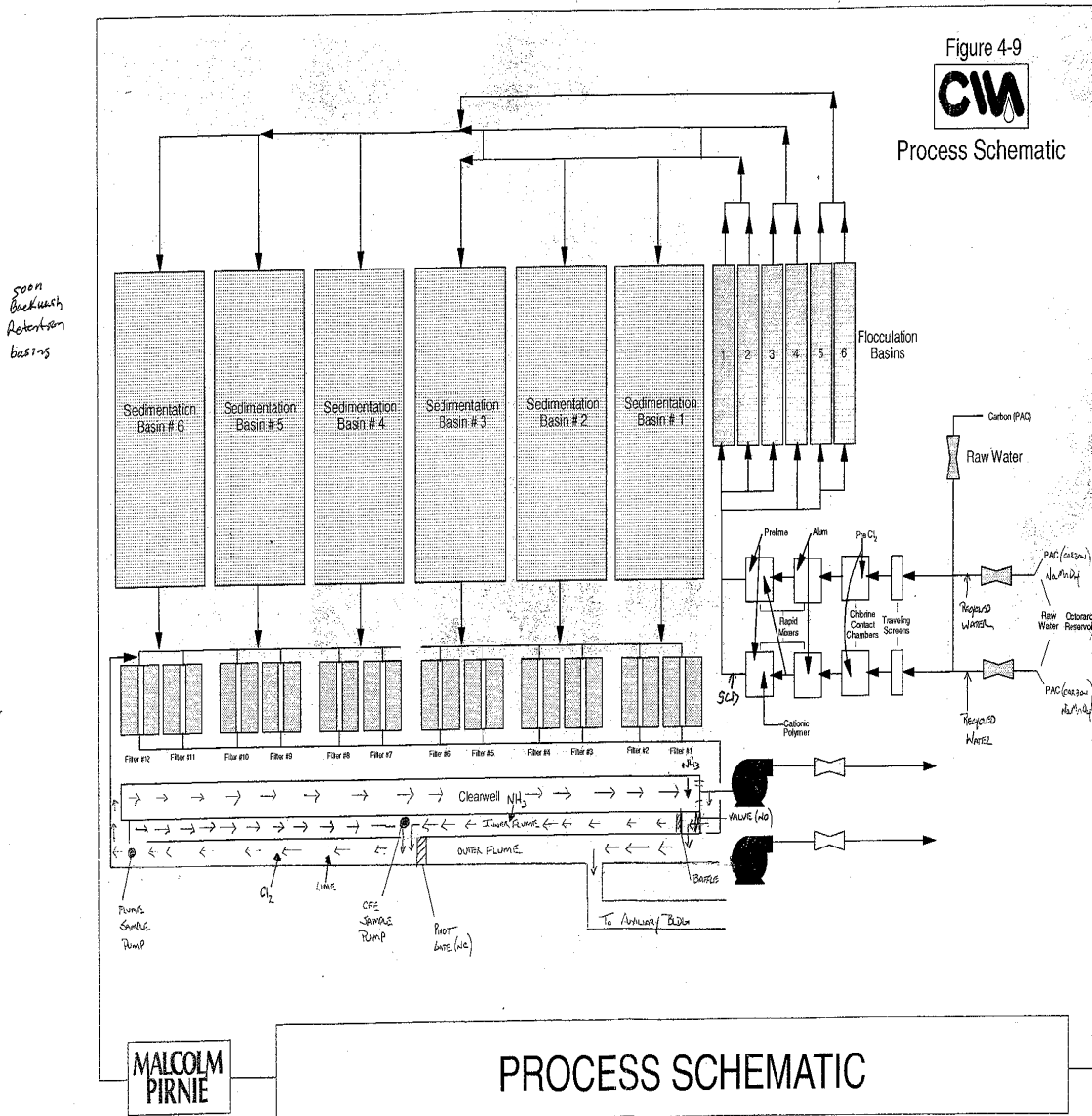


Figure 2.1: Flow Schematic for Chester City Authority Water Filtration Plant

Plant Production

- Current daily production: 34.1 MGD (23680 gpm)
- Time of operation: 24 hours/day, 7 days/week
- Design capacity: 60 MGD (41666 gpm)
- Filtration rate: 4 gpm/sq.ft
- Permitted Capacity: 60 MGD

Equipment:

- Pumps: 3- vertical 4-stage turbine raw water pumps
 - 4- 2-stage & 3 single stage centrifugal finished water pumps
 - 1-centrifugal backwash water pump is used to fill the backwash water tank.
- Backwash water flow is by gravity from the backwash tank.

2.2 Water Chemistry—

At the Chester Water plant, the raw water sources are the Susquehanna River and the Octoraro Reservoir. The drainage area of the of the Susquehanna River Basin totals around 27,510 square miles, and includes parts of New York, Pennsylvania and Maryland. Land use in the basin is about 55 percent agricultural, 36 percent wooded and 6 percent developed. Potential pollution threats include concentrated livestock, agricultural and land development runoff from industry and communities with sewage treatment plants along with residential on-lot sewage systems. Raw water turbidity levels fluctuate widely and rapidly and usually range from 10 to 40 NTU with occasional spikes above 100 NTU (Figure 3). The raw water quality also includes low alkalinity, a fairly stable pH and occasional algae problems in the summer.

The Octoraro Reservoir which is the primary water source for this plant is located within the Lower Susquehanna watershed and supplies about 70% of the raw water to the plant. The water from this source usually has higher levels of nitrates, bacteria and algae growth due to the surrounding activities of the agricultural community. Thus the water from the Susquehanna is very vital in reducing the higher contaminations of the Octoraro. Figure 3 shows the average of the two sources combined over a one year period.

Sample #	69	82	97	111	141	164
Date	8/19/09	8/26/09	9/8/09	9/14/09	9/23/09	10/5/09
Time	12:57	11:30	15:45	15:08	13:48	11:45
Locus	DWS	DWS	DWS	DWS	DWS	DWS
BOD	0.80	0.04	0.20	1.30	0.60	0.80
pH	7.8	7.8	8.0	7.8	8.1	8.0
ALK	67.6	72.2	68.4	74.0	72.4	71.2
TSS	5	5	5	5	5	5
VSS						8
NH3-N	0.13	0.04	0.03	0.05	0.03	0.05
NO2-N	0.03	0.02	0.04	0.03	0.02	0.02
NO3-N	6.96	7.97	8.37	7.16	8.25	7.91
TKN	1	1	1	1	1	1
NO2 + NO3	6.99	7.99	8.41	7.19	8.27	7.93
TN	8.12	9.03	9.44	8.24	9.30	8.98
TP	0.159	0.119	0.123	0.138	0.121	0.120
Chloride	27.1	28.0	28.3	27.9	27.9	28.0

Table 2.1: Valley Creek Sample Test Results

Despite the obvious impacts of the Atglen effluent approximately 200m downstream of the outfall, the level of pollution remains below MCL for nitrate, although it is close. Both total suspended solids and total Kjeldahl nitrogen parameters were undetectable.

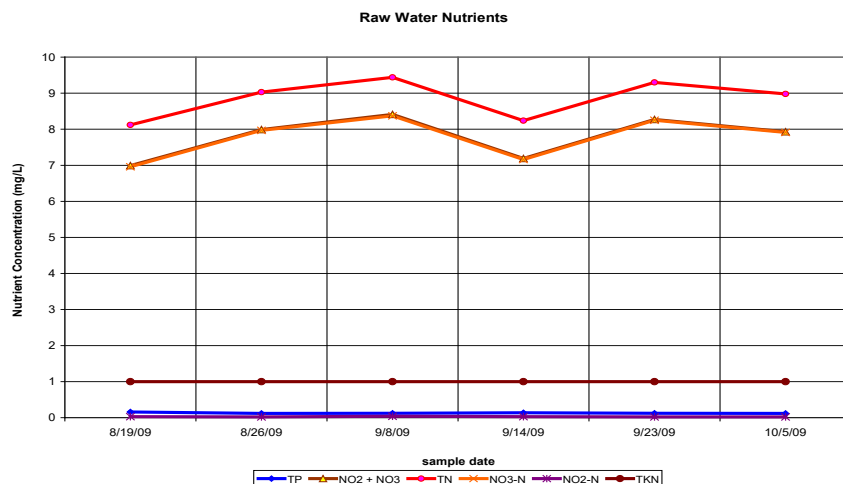


Figure 2.2: Histogram of Downstream Water Nutrient Concentrations (TKN undetected but reported as detect limit.)

2.3 Waterborne Pathogen Discussion—

One Method 1623 Sampling was performed during early-September. The testing was not repeated due to cost considerations and because effluent quality had not appreciably improved as a result of the process modifications on September 15, which covered only one of two aeration systems. The samples resulted in the general observation that *Giardia* and *Cryptosporidium* were endemic to the waste stream but were not readily evident in the background sample, and that pathogen concentration downstream at the CWA filtration facility could not be reliably tied to the Atglen effluent, because there are other, closer intervening dischargers near to the Octoraro Reservoir. Previous tests conducted by DEP inspectors in September 2008 found no pathogens in raw water samples from the Octoraro Reservoir, although a water sample from the Susquehanna River source had one *Giardia* cyst in 10 liters. It is evident that the relatively high concentrations of these pathogens found in Valley Creek, shown in the table below, did not impact the raw water source of the larger watershed eleven miles downstream.

Sample #	Date	Upstream		Effluent		Downstream	
		Giardia	Crypto	Giardia	Crypto	Giardia	Crypto
0907095--097	9/8/2009	1	0	1237	163	226	14

Figure 2.3: Waterborne pathogen test results for Valley Creek and Outfall 001 for Atglen Borough

Because the Atglen facility was discharging an effluent higher in suspended solids than more modern and extensive facilities, it is theorized that the high pathogen concentrations correlated to high suspended solids that provide shelter for the organism from the toxic effects of the disinfection process, whatever little detention time had been available. This hypothesis could not be fully investigated; because testing at some other facilities showed the presence of pathogens where effluent suspended solids were not detectable to a detection limit of 5 mg/L. There is insufficient statistical population of test events to justify a correlation between ESS and the pathogens.

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3 Attachment A—Program Description

3.1 Description and Goals:

As part of an EPA-sponsored grant, the DEP has created a Wastewater Optimization Program to enhance surface water quality by improving sewage treatment plant performance beyond that expected by existing limits of the plants' National Pollutant Discharge Elimination System (NPDES) Permits.

The goal of this program is to encourage wastewater treatment facilities to voluntarily produce higher-quality effluent than mandated by the limits set in their NPDES permits and to optimize treatment in such a way that reduces contaminants and pathogens in surface waters that are consumed for drinking water following filtration at facilities downstream.

The initial focus will be to work with wastewater treatment facilities within ten miles upstream of these drinking water filter plant intakes. DEP will conduct Wastewater Plant Performance Evaluations (WPPEs) to assist municipal wastewater systems in optimizing their wastewater treatment plant processes as part of the Wastewater Optimization Program. Each evaluation is expected to last up to 2 months.

3.2 Process Optimization:

- Purpose of Optimization: Set production goals as if running the process were an industry that makes a product: clean water and biomass.
- Goal-Setting: Voluntary meeting of limits that are better than the minimum required limits in the permit in order to reduce pathogen, nutrient, and emerging contaminant loadings to downstream drinking water facility intakes.
- Action Items: Break down optimization tasks into various activities or adjustments that should be done to improve routine operation.

This new program is modeled after DEP's Filter Plant Performance Evaluations (FPPEs) conducted at Drinking Water facilities.

This program is not part of the Field Operations, Monitoring and Compliance Section. Sample collection methods utilized during this evaluation generally do not conform with 40 CFR Part 136, therefore the data collected will not be used, and in some cases is not permitted to be used for determining compliance with a facility's effluent limits established in its NPDES permit.

3.3 Wastewater Plant Performance Evaluation:

- Department staff will consult with the plant operators to explain the program, the goals, the equipment used, and the expectations for participation.
- Upon arrival at the wastewater plant, Department staff will set up equipment, including meters capable of continuous, in-line monitoring for pH, Oxidation-Reduction Potential, Ammonia, Nitrates, Dissolved Oxygen, and other parameters.
- The Department will utilize the equipment to gather data on system performance, show the operator how to gather similar data, and explain the value of gathering the data. Data will be presented to operators to show how they could choose to modify their treatment processes based on interpretation of the data collected.

- Although the Department may show operators how to achieve effective process control by using these process monitoring tools, the operators will continue to make all process control decisions, in conformance to their licensing requirements, and retain responsibility for those changes.
- The Department will also lend the facility additional laboratory equipment which will remain on site during the WPPE to assist in data collection and interpretation.
- During this time, the operator may need to spend more time performing routine testing at the treatment plant than was done previously. This will allow correlations to be made between process modifications and the process response.
- One major goal of the program is to provide the operator with the process monitoring knowledge and experience necessary to gather useful data and utilize it to make beneficial changes in the treatment process and the receiving stream long after the Department and its equipment have been removed.
- There is no charge for the Department's review of the treatment process, setup of all equipment, the process control monitoring that will take place, lending meters to the plant during the WPPE, data collection and explanation of potential effects that process modifications can have on the treatment process.
- The municipality will be responsible for providing laboratory bench space and 120 VAC power for the instrumentation. Any costs associated with process modifications (such as equipment upgrades, chemical purchases, etc.) that the municipality deems appropriate and beneficial as a result of the WPPE remain the responsibility of the municipality. The municipality reserves the right to cease participation in the WPPE at any time.
- Following the equipment set-up, the Department will observe the facilities and review operational practices, treatment processes, chemical treatment, operational data currently collected, and overall system performance.
- During the evaluation, the Department will review monitoring records, laboratory sheets, operations log sheets, and any drawings and specifications for the treatment facility. Also of interest is data currently collected and how it is utilized for daily process modifications. This information is usually available from existing reports.

Program evaluation team will consist of 1 to 2 people: Wastewater Optimization Program Specialists, PA licensed as a wastewater plant operators with operations and compliance assistance experience.

3.4 Potential Benefits:

- Use of online process control monitoring equipment during the WPPE, use of hand held meters and portable lab equipment during the WPPE, and furthering the operators' knowledge of process control strategies and monitoring techniques,
- Producing a cleaner effluent discharge which minimizes impacts to the environment and downstream water users, and possible identification of process modifications that could result in real cost savings.
- Where the optimization goals may be more stringent than current requirements of your NPDES permit, they are completely voluntary. The WPPE objective is to optimize wastewater treatment plant performance in order to enhance surface water quality, minimizing the effects of pathogen and nutrient loading to downstream drinking water plant intakes.

- Furthermore, pursuit of a good rating in the WPPE program may place the wastewater system in a better position to meet more stringent regulatory requirements in the future, should they occur. For example, regulatory changes over the last ten years have reduced the final effluent Total Chlorine Residual limits requiring dechlorination or optimization of treatment processes to reduce the levels of chlorine added to the process for disinfection. Facilities who have voluntarily maintained lower residuals than listed in their permit have found it easier to comply with the updated regulations.

3.5 Potential Obstructions to Success

Many factors may present obstructions to a successful plant optimization. Some of these are listed below:

- Inadequate use or interpretation of regular process monitoring test results
- Inadequate funding of facility operating expenses, including staff training, chemical and energy usage, equipment maintenance
- Miscommunication as to program goals and methodologies
- Obsolete, inadequate, or out-dated treatment equipment and methods

3.6 WPPE Rating System

WPPE Staff use the following categories to rate each facility, based on observations and data developed during the evaluation. The ratings are based on the facility's capabilities and the operators' skill levels to maintain optimal performance over the long term. Please note that while WPPEs may discover treatment problems or identify potential or actual violations of regulations, the rating system is not based upon regulatory compliance.

- **“Commendable”**
Department staff have identified only minor operational, equipment, and / or performance problems that affect the plant's ability to maintain optimized performance. Plant personnel have already taken steps to improve overall facility performance, maintain high effluent quality, and consistently preserve the long-term reliability of the facility.
- **“Satisfactory”**
Department staff have identified operational, equipment, engineering, and / or performance problems that may affect the facility's ability to maintain optimized performance. Facility personnel appear willing and capable of improving overall performance; however, one or more treatment processes showed areas of weakness in operational, equipment, and/or performance that, if corrected, will improve treatment performance and maintain the long-term reliability of the facility.
- **“Needs Improvement”**
Department staff have identified considerable operational, equipment, and/or performance problems that are affecting the facility's ability to maintain optimized performance. Limitations are apparent that hinder improvement of overall filter plant performance. Areas of weakness affect the capability and dependability of the plant in producing a quality final effluent, increasing the potential for degradation of the receiving stream through increased nutrient and/or pathogen loading.

4 Attachment B—Borough of Atglen WPPE Team

WPPE Team

Marc Neville, Water Program Specialist
DEP- RCSOB
400 Market St
Harrisburg, PA 17105
717-772-4019
eml: mneville@state.pa.us

Robert DiGilarmo, Water Program Specialist
DEP – Cambria Office
286 Industrial Park Rd
Ebensburg, PA 15931
814-472-1819
eml: rdigilarmo@state.pa.us

Borough of Atglen Wastewater Treatment Plant Representatives

Bryan Umble, Chief Operator
Borough of Atglen WWTP
41 South Main Street
Atglen, PA
610-864-5459
eml: bryan@atglen.org
web: <http://www.atglen.org>

Bill Hunter, Operator
Borough of Atglen WWTP
41 South Main Street
Atglen, PA
610-864-5460

5 Attachment C—Plant Description and Treatment Schematic

The Borough of Atglen WWTP is a Contact-Stabilization type activated sludge treatment facility that uses compressed air for supporting biological oxidation of organic wastes in domestic sewage originating in the Borough’s collection system. There are presently two sets of contact-stabilization tanks, constructed before 1975, with some more recent additions including an influent flow equalization tank and modern submersible wet-well pumping station, although the facility lacks a robust headworks and biosolids handling system. The sludge drying beds have not been used for many years.

Flow was originally set for 75,000 gpd average daily flow, with peak flow of 90,000 gpd. In 2009, the facility was re-rated for an ADF of 90,000 gpd. A re-rate amendment was filed in February 2005 to increase flow to 140,000 gpd contingent upon construction of a pair of sequencing batch reactors and employing the old tanks as effluent flow equalization and sludge storage and holding tanks. Negotiations to find an alternative to this expensive capital project proposed a flow of 108,500 gpd, but the conclusion of the regional office was that the clarifiers would not accommodate the flow, so the latest permit issuance maintained the ADF of 90,000 gpd, pending capital upgrades.

A schematic of the facility follows, showing probe placement for the WPPE study.

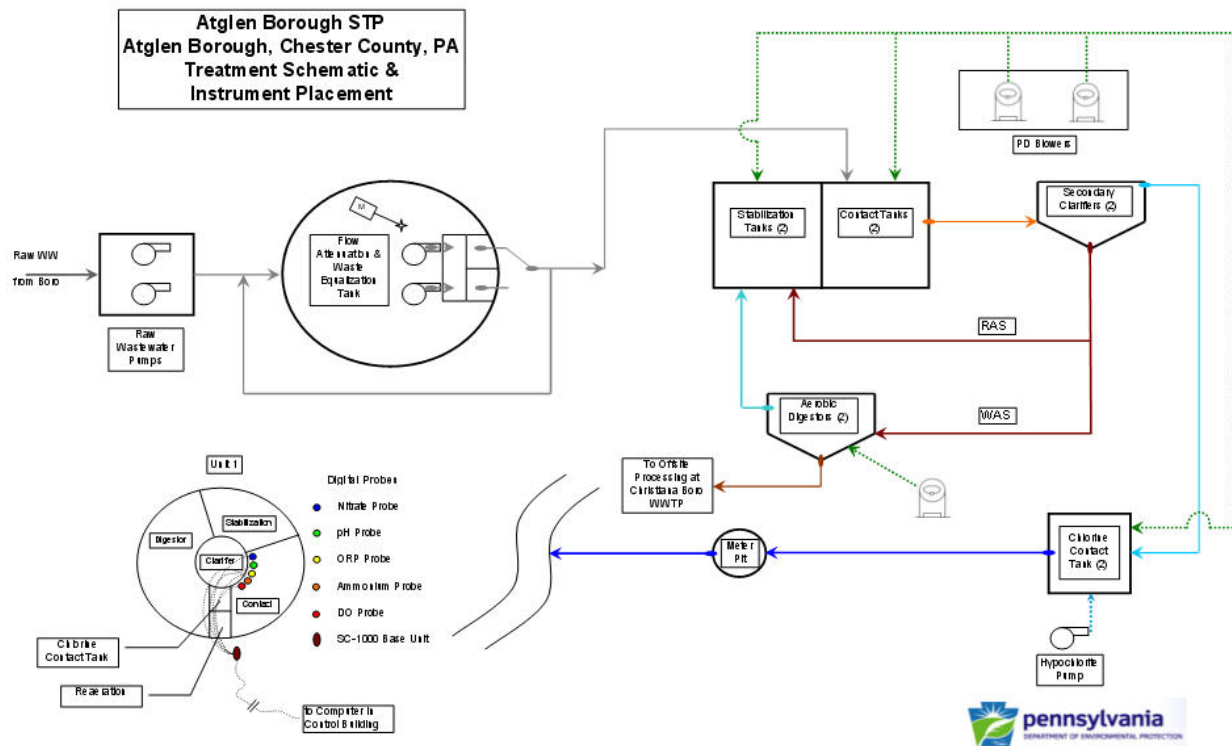


Figure C-1: Schematic for Atglen Borough WWTP in September 2009.

6 Attachment D—On-site Process Monitoring and Control

The Atglen Borough Sewer Authority owns and operates a small-flow contact-stabilization wastewater treatment plant servicing the Borough of Atglen in Chester County, near the Lancaster County line and almost adjacent to the Borough of Christiana. The facility is currently rated for 0.900 MGD and has been running at or slightly over capacity for several years.

Atglen discharges to Valley Creek, a small tributary of the East Branch Octoraro Creek that supplies a downstream impoundment used by the Chester Water Authority for its filtration plant serving connections in and around City of Chester. Downstream of the lake, Octoraro Creek meets Susquehanna River and, subsequently, the Chesapeake Bay. Total maximum daily load (TMDL) issues regarding this watershed include sediment and nutrients. Many old-order Amish farms do not practice modern ecological conservation as regards riparian buffers or surface water protection. While nutrient contamination is a principal concern in the proposed TMDL study of Octoraro Creek, another consideration is the presence of Chlorides. A TMDL for the Octoraro is currently in the proposal phase.

An engineering study performed in 2008 by Stearns & Wheler LLC recommended replacing the existing processes with sequencing batch reactor (SBR) technology with improved disinfection and nutrient control as part of a strategy that would enable the Authority to obtain higher flow and loading capacity in order to accommodate growth in the borough and the surrounding Sadford Township. The proposed average daily flow would have been 0.178 MGD. Finance issues combined with a severe downturn in the economy to render the \$4.5 M project unfeasible; however, the Authority still had to deal with capacity issues as well as the imminent publication of effluent nutrient limits pursuant to the Chesapeake Bay Tributary Initiative. A proposed joint project with Christiana Borough did not advance, and Atglen decided to apply for a hydraulic capacity re-rate while maintaining current loading capacity.

After the SBR development proposal fell through, borough staff proposed modifying the existing facility and adding tankage that would support an increase of ADF from 0.090 MGD to 0.1085 MGD, with a maximum daily flow of 0.140 MGD. DEP staff conducted this on-site evaluation of the contact-stabilization plant and proposed changing the treatment technology to extended aeration in order to improve nitrification and reduce the high ammonia-nitrogen content. However, modification of the existing treatment units would not provide sufficient treatment capacity and detention time to accommodate higher hydraulic loading while maintaining existing organic load, neither would it allow the borough to meet the nutrient limits required by the Chesapeake Bay Tributary Strategy.

Atglen staff suggested constructing an additional tank for use as an aerobic digester, allowing more capacity in the existing tanks to be used for extended aeration; however, it was determined that any increases in hydraulic capacity through the existing tanks would be limited by the integral, internal clarifiers, which were considered too small to handle the proposed maximum flows and having trouble meeting the current needs.

Subsequently, the regional office reissued the permit using established permitted flows without any of the proposed increases, with notice that nutrient control would eventually be required.

6.1 Performance Evaluation:

In late August 2009, DEP staff Marc Neville and Paul Handke of the Filter Plants Program arrived on site and set up equipment for continuous monitoring of various qualities of the mixed liquor in one of the two unitized treatment tanks. Probes were placed in the Contact Tank of Unit 1 and included the materials listed in Attachment E. The data generated by those probes is provided on an accompanying CD-rom disk and also graphically represented in Attachment G.

A portable wastewater lab was established inside the control room that sits atop the facility's drywell pumping station and motor control center. This lab equipment was lent to the facility's operators for their use during the on-site activities period and was also used by DEP staff to calibrate the on-line probes and supplement data to characterize the facility's operations and efficiency. Examples of bench testing data are included in Attachment I, with the remainder of this data on the CD-rom disk.

Four standard sample points are established for the overall WPPE program: Raw Wastewater (INF) as it enters the facility for treatment, Final Effluent (EFF) as discharged to the plant outfall, Background Receiving Stream (UPS), and Impacted Receiving Stream (DWS.) Additional internal sampling points included Mixed Liquor from the Contact and Stabilization treatment tanks, the Return/Waste Sludge from the clarifier floor, and the Clarifier Supernatant, taken prior to disinfection. Test data from these sampling points provided a baseline operational diagnosis and then also assessed any improvements due to minor process changes and adjustments. Test data for samples analyzed at the DEP Bureau of Laboratories is presented in tabular and graphic forms in Attachments J and K.

6.2 On-Site Experiences:

The initial testing demonstrated wide swings of ammonia-nitrogen concentration in the mixed liquor and that both tanks produced inadequate nitrification (oxidation of ammonia-nitrogen to nitrate.) Because of the treatment configuration, there is no possibility for biological nutrient removal (denitrification and biological phosphorus removal.) An initial option presented to operators was to change one tank from contact-stabilization to step-feed extended-aeration treatment, whereby raw wastewater is introduced to mixed liquor at multiple points (in this case, two,) along the treatment train and where all return activated sludge (RAS) is introduced at the head of the treatment train with some of the raw wastewater. This produced instantaneous control of the ammonia-nitrogen swings observed during the first phase of the WPPE. The extended aeration process effectively nitrified all of the ammonia waste.

DEP staff conducted a weekly assessment of the operation using routine process monitoring tests. An example worksheet is depicted in Attachment I, showing the results of Settability, OUR, %Solids by Volume, and colorimetric nutrient tests for a representative day. A full set of process monitoring tests may take three to four hours for one person to complete, record, and interpret.

6.3 Process Monitoring & Control Tests:

The Atglen facility is a small discharger and contracts with an environmental laboratory for most of its analyses. Plant staff obtains samples in vendor-provided, preserved jars, and the laboratory conducts the tests. This approach is taken by many small treatment plants in light of the costs associated with certifying and maintaining an on-site lab. One of the purposes of the WPPE program, though, is to reacquaint plant operators with the need for routine process monitoring and control tests. For that reason, DEP lends client facilities sufficient lab equipment to conduct qualitative and some quantitative tests of the relative condition of the treatment system, the raw wastewater strength, and the effluent quality. A listing of this equipment follows in Attachment E. In the following paragraphs, a short discussion of the minimum recommended process monitoring testing is provided. Attachment L summarizes the recommended minimum tests required for facilities discharging under 1.0 MGD. A general recommendation is more frequent sampling and analyses than listed in the table there, because the facility is being operated at or above capacity and is thus at risk for more frequent plant upsets.

6.4 On-site Process Test Results:

A variety of analyses conducted during the WPPE were used to characterize the facility. A sample bench sheet with actual process monitoring results is found as Attachment I, with graphs of test results shown in Attachment J, and the results of lab testing are included in Attachment K.

Some values that stand out in the routine analyses follow:

Mixed Liquor Suspended Solids tended to be higher than the design value of 3,500 mg/L during the summer months for the north reactor, which was being operated in conventional step-feed or in extended aeration, step-feed mode on a temporary basis. For the samples tested, north contact tank averaged 4,600 mg/L with a maximum of 5,200 mg/L. The average ratio of volatile to total solids was 84%, which would indicate “young” sludge conditions under normal circumstances.¹ For contact/stabilization facilities, one would expect that the stabilization suspended solids would tend to be closer in number to the return sludge value, and the contact tank would have lower MLSS values, indicating dilution of the biomass by a greater volume of raw wastewater. This holds true for Atglen’s south reactor, where MLSS averaged 3,100 mg/L with a closer maximum value of 3,300 mg/L.

Return and waste sludge concentrations tended to hold in the 6,000 to 9,000 mg/L range. As a rule, return sludge concentration should be three to four times the concentration of the biomass in the aeration tanks. This is difficult to maintain at the Atglen plant, most likely because the air-lift pump technology does not afford the level of fine-tuning that is found in plants employing more modern equipment. RAS concentrations could be maintained at higher values, but operators would be required to spend more time adjusting the pumps and monitoring

¹ In young sludge, free swimming flagellates and ciliates tend to dominate, and the bacteria are in the log phase of growth and reproduction. High-rate plants tend to operate better under these conditions, but conventional or extended aeration usually run better when the biomass is at the top of the growth curve or in the endogenous stage of growth. Ratios for endogenous stage would be closer to 70% to 75% VSS of TSS. For reactors operating in the low 80% range, one would expect to see high F/M ratio, high respiration rate, and low MCRT. The opposite is true for facilities operating in the 70% VSS/TSS range.

concentrations. In addition, the integral clarifiers would be at greater risk of bulking or solids washout if sludge concentrated there too long.

As regards the raw wastewater, the average influent BOD grab samples taken from the Equalization tank between 11 AM and 2 PM was 187 mg/L, +/- 30 mg/L. BOD to COD ratio varied widely among the samples, averaging 135% but as low as 67% and as high as 212% on occasion. This variability would make it difficult for operators to reliably substitute COD testing for BOD testing when determining feed rates for raw wastewater. Despite this, it may be practical for operators to continue COD testing as it can be a practical indicator of relative wastewater strength, and it is useful because of its 2-hour digestion time as opposed to a 5-day incubation period for the BOD test. The operators could continue performing comparison testing using the BOD and COD tests, at least once per week, in order to obtain a rolling average to use on the daily COD results.

In comparison to the engineering study, the WPPE BOD values were consistently below the average BOD of 221 pounds per day (ppd) determined through a multi-year review of the plant records, averaging 146 ppd. This could be attributed to seasonal variation or even to daily variation, although the equalization tank does provide some attenuation of concentration and load.

Waste nutrient values averaged 77 mg/L for Total Nitrogen and 6.4 mg/L for Total Phosphorus, with ammonia-nitrogen averaging 32 mg/L and Total Kjeldahl nitrogen, a measure of ammonia and organic nitrogen, averaging 45 mg/L. Intermediate forms of oxidized nitrogen, of course, were non-detectable. Alkalinity averaged 260 mg/L, an pH was consistent at 7.5 s.u. Total Suspended Solids averaged 270 mg/L, with loadings averaging 211 ppd, similar to the values determined in the S&W evaluation that covered three years from 2004 to 2008. Two-thirds of the samples fell within a +/- 11 pound range.

Effluent water chemistry during the WPPE generally confirmed historical data reported in the facility's compliance testing and reporting, based on environmental laboratory results and the DMR record. The effluent tended to have higher total suspended solids than most other plants assessed in the WPPE program, averaging 33 mg/L for instantaneous max samples and exceeding the imax values on one occasion, for the sample taken on 9/23/09, where the result was over 163% of the imax value. Although CBOD values averaged 12.3 mg/L +/- 2.3, for the study, the high TSS values of themselves confirmed doubts about the secondary clarifiers being able to withstand the higher flows proposed in the re-rate letter.

Effluent alkalinity averaged 56 mg/L, and pH averaged 7.1. Total nitrogen averaged 40 mg/L, composed mostly of nitrate-nitrogen, which averaged 32 mg/L, and total phosphorus averaged 5.5 mg/L, with a maximum concentration of 6.6 mg/L. These nutrient values are important, because the re-rated facility would have to maintain concentrations of 22 mg/L and 2.95 mg/L for TN and TP, respectively, in order to maintain compliance with proposed annualized Chesapeake loading limits of 7,306 lb. of TN and 974 lb. of TP, to say nothing of being able to meet the annualized limits at the current permitted hydraulic load.

Fecal Coliform testing showed much higher results during the WPPE than those seen in the historical record. The effluent samples for the September 2009 by themselves averaged 4,160 mpn/100 ml, a greater-than-3-log increase over the same parameter tested in the previous year.

During the WPPE, approximately 1/3 of the reported ADF was at or over the design flow of 0.090 MGD. Total chlorine residual for the month averaged 0.35 mg/L +/- 0.14 mg/L. This evidence suggests that the existing chlorine contact volume may be insufficient for killing the Fecal Coliforms.²

During late summer of 2009, the WPPE program was tasked to begin monitoring receiving streams and plant effluent for chlorides, as this pollutant is a rising concern in states that employ halides to depress freezing temperature of water on highways. The maximum concentration limit (MCL) for chlorides in drinking water is 250 mg/L, the point at which water acquires a “salty” taste. In samples of the Atglen effluent, the chloride content never exceeded 109 mg/L, averaging 69 mg/L. By way of comparison, the Valley Creek background sample averaged 26.9 mg/L and the impacted sample, taken 100 meters downstream of the outfall, averaged 27.9 mg/L. This lack of environmental impact with regard to the treated effluent in late summer supports suspicions that chlorides in surface waters are more of a road maintenance winter materials issue than a wastewater treatment one.

² The Department did not independently test for TRC during the WPPE, relying instead on the test results generated by the operators who performed their tests in accordance with permit requirements and manufacturer instructions.

7 Attachment E—Equipment Deployed

DEP staff visited the site on Monday, August 17, and Tuesday, August 18, 2009 to set up equipment. Marc Neville was assisted by David Hissner of the Filter Plant Program section at DEP's Bureau of Water Standards' Operations Monitoring and Training Division. Equipment was staged at the North treatment unit, using electricity tapped from the blower building's convenience circuits. Use of dedicated GFIC receptacles was abandoned due to frequent opening of the circuits, probably due to the proximity to blower motors.

Digital, Continuously Monitoring Probes:

- 1 – Laptop computer with signal converter
- 1 – SC1000 SCADA Base Unit
- 1 – LDO probe
- 1 – pH probe
- 1 – ORP probe
- 1 – NH₄D probe w/Cleaning System
- 1 – Nitratax probes
- 1 – Solitax probes

Laboratory Equipment On-loan:

- 1 – Hach HQ40d handheld pH and LDO meter
- 1 – LBOD probe
- 1 – DR2800 spectrophotometer
- 1 – Wastewater Field Test Kit
- 1 – Raven centrifuge with 6 sample tubes
- 1 – Raven Core Taker sampler
- 3 – Raven settleometers
- 1 – COD Heater Block
- 1 – Microscope with electronic photographic/video capability

8 Attachment F—Equipment Placement Photos

WPPE at Borough of Atglen Contact-Stabilization Wastewater Treatment Plant



Figure F-1: Nitrate, Ammonium, TSS, DO, and pH probes installed in Contact Tank 1



Figure F-2: SC-1000 SCADA Unit with Sunshield on Railing near Contact Tank 1



Figure F-3: NH3-N Cleaning Compressor



Figure F-4: Location of SC-1000



Figure F-5: Probe Poles Adjusted for Depth



Figure F-6: Five Probes inserted at angle into Contact Tank 1



Figure F-7: Notebook Computer installed in Control Room and connected to SC-1000 Computer



Figure F-8: Portable Lab Equipment Organized in Control Room

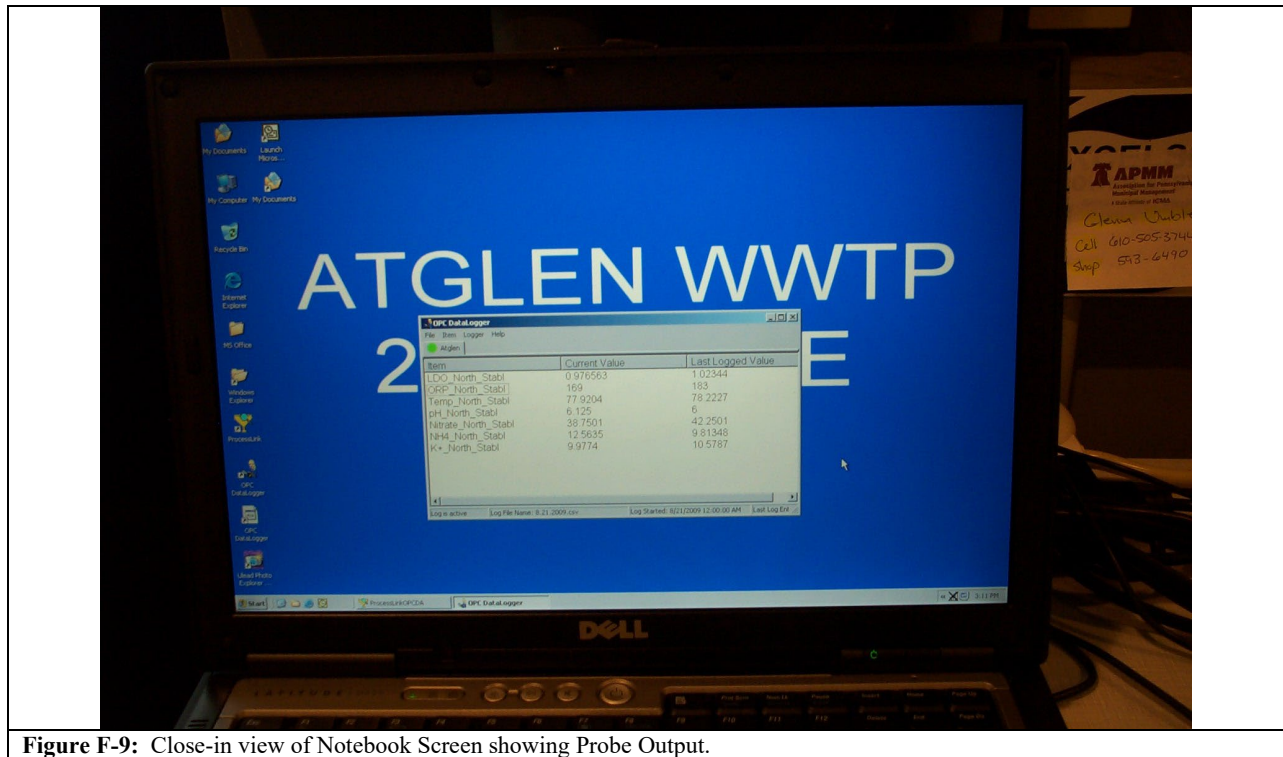


Figure F-9: Close-in view of Notebook Screen showing Probe Output.

9 Attachment G—Continuous Digital Monitoring Charts, Examples

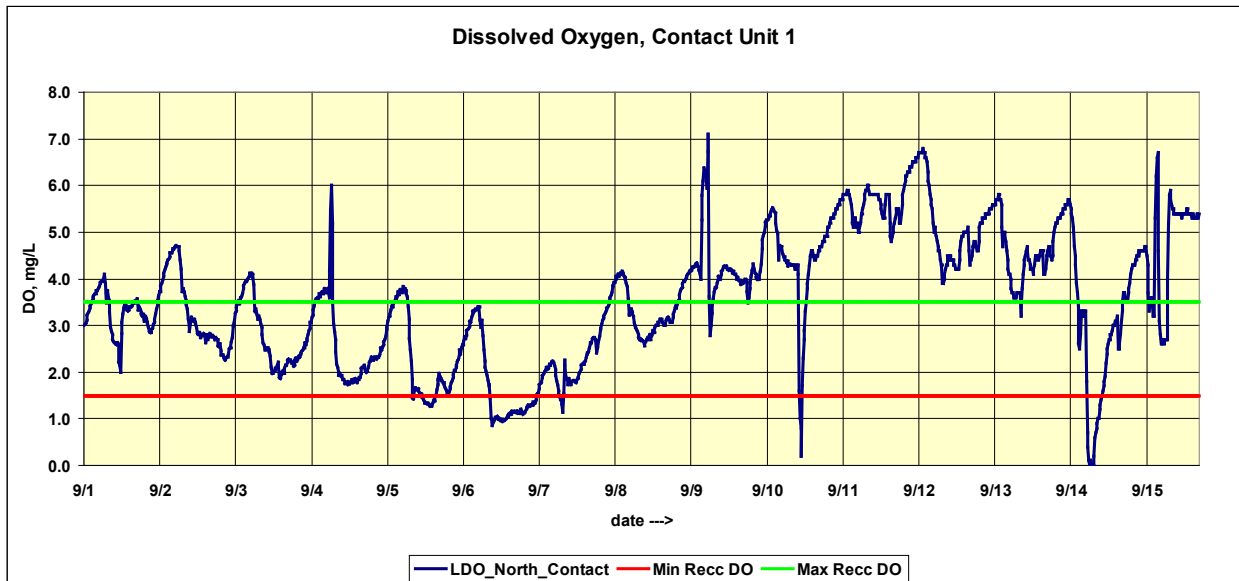


Figure G-1: Unit 1 Dissolved Oxygen Histogram, Sept. 1-15, 2009: DO above 3.5 represents wasted energy due to unnecessary over-aeration. This can be controlled by connecting a vsd blower motor control to a DO probe and using internal setpoints to manage motor speed.

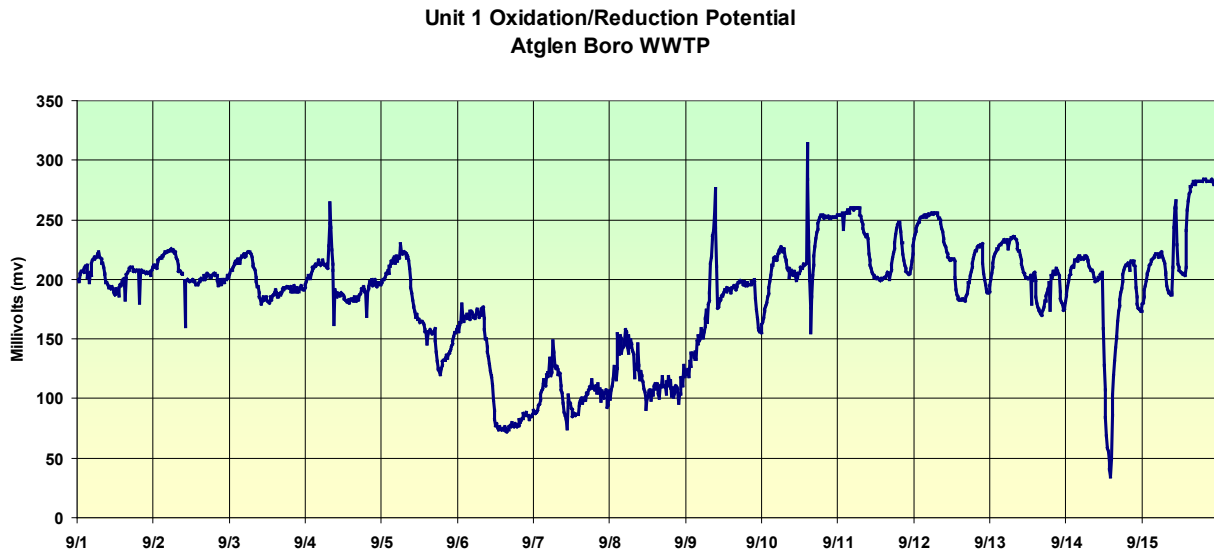


Figure G-2: Oxidation/Reduction Potential, Unit 1, Atglen Boro WWTP

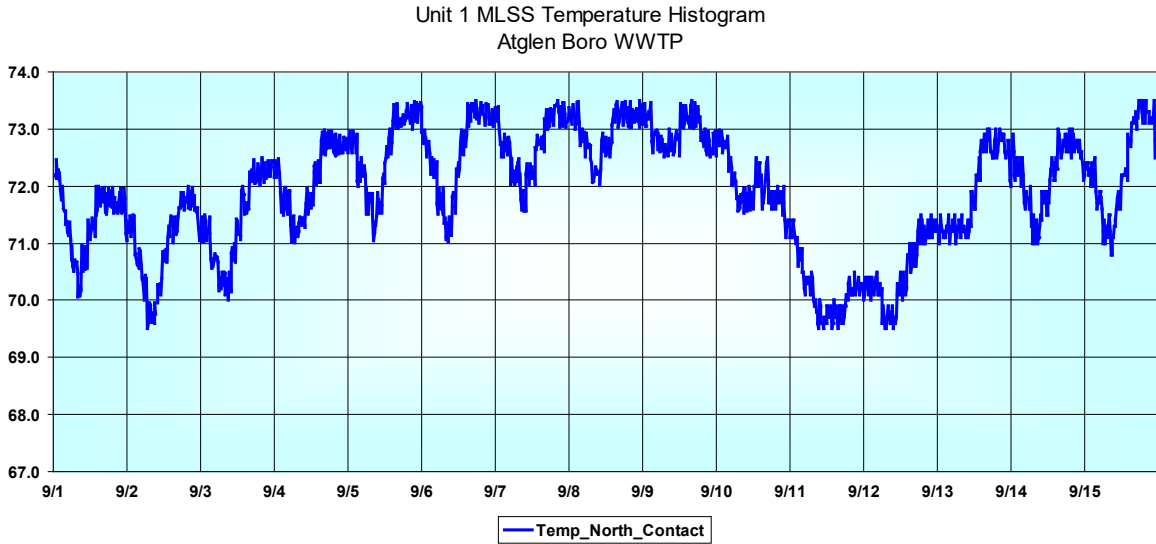


Figure G-3: Aeration Tank Temperature Histogram, Sept. 1-15, 2009, Unit 1, Atglen Boro WWTP

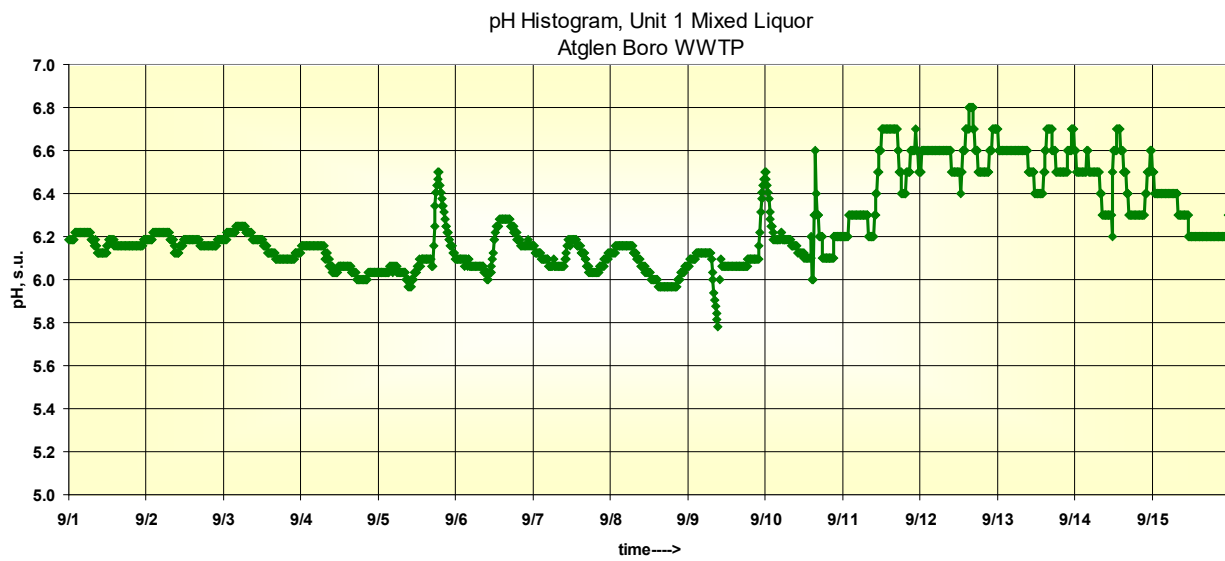


Figure G-4: Mixed Liquor pH Histogram, Unit 1, Sept. 1-15, 2009, Atglen Boro WWTP

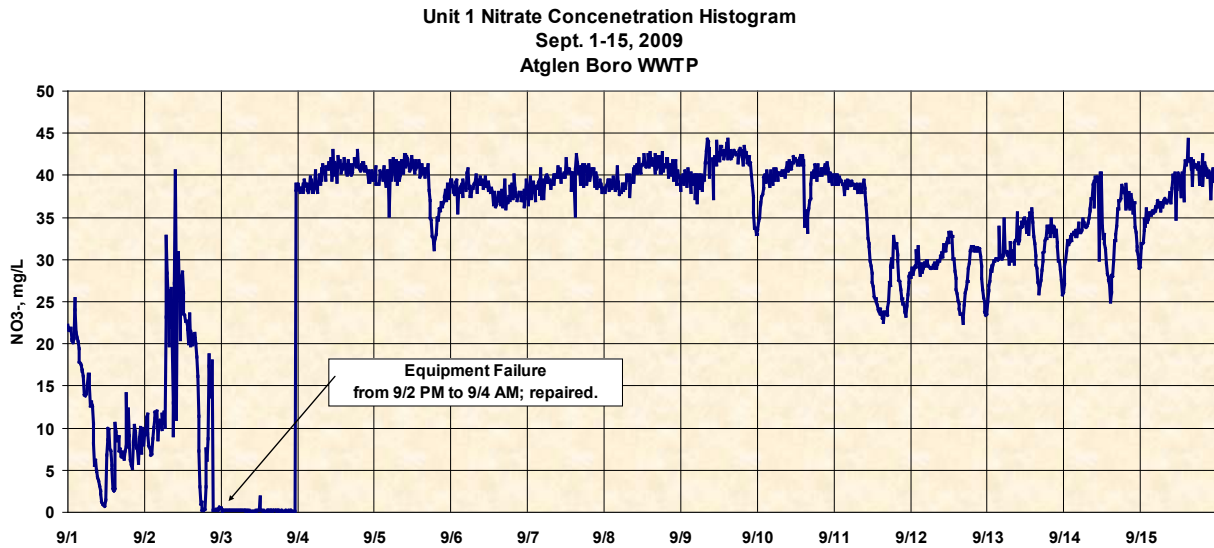


Figure G-5: Mixed Liquor Nitrate-Nitrogen Histogram, Unit 1, 9-1 through 9-15, Atglen Boro WWTP

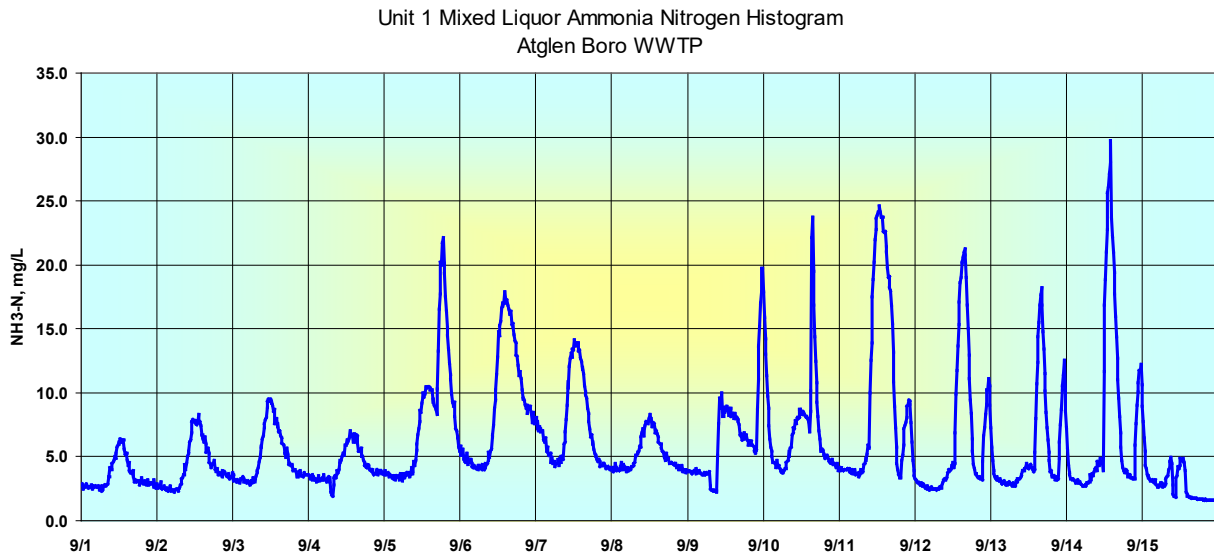


Figure G-6: Ammonia-nitrogen Histogram: Unit 1 Mixed Liquor, Sept 1-15, 2009, Atglen Boro WWTP

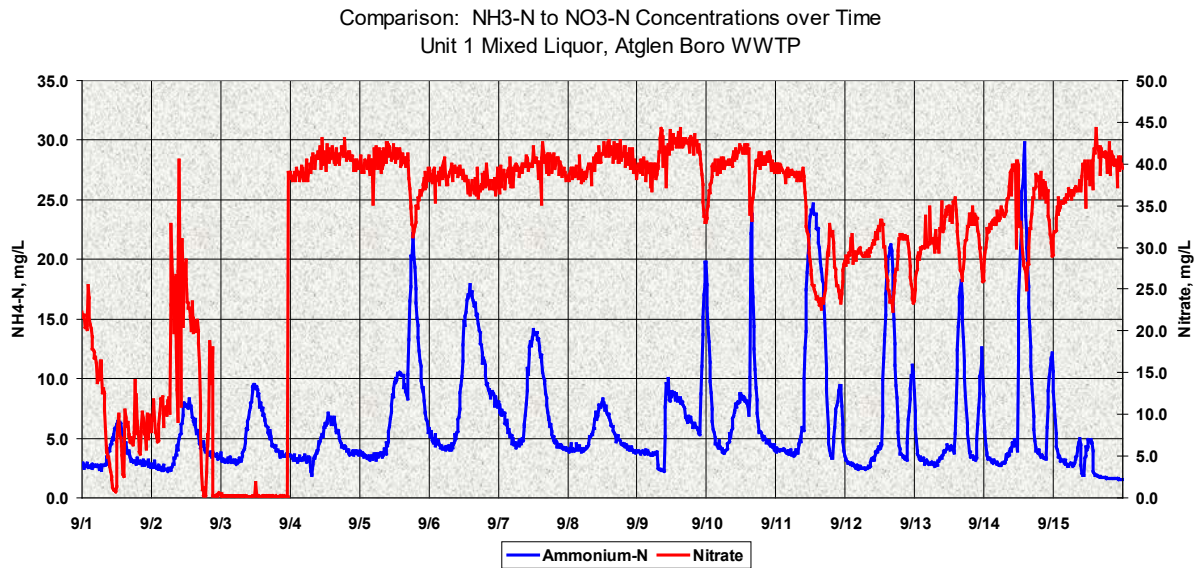


Figure G-7: Comparison of NO₃-N to NH₃-N Concentrations

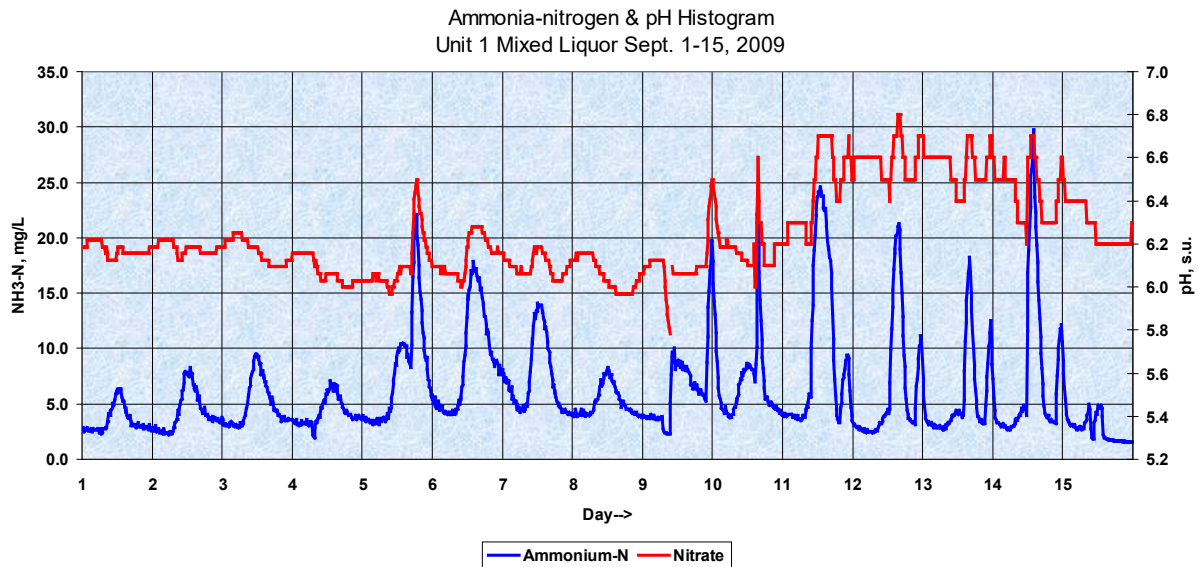


Figure G-8: Comparison of NH₃-N to pH in Unit 1 Contact Tank, Sept. 1-15, 2009, Atglen Boro WWTP

The following three graphs depict ammonium ion concentration of the mixed liquor in the north reactor process over a period where the operators erected a temporary influent feed line to the stabilization tank, effectively converting the operation to a step-feed conventional system.

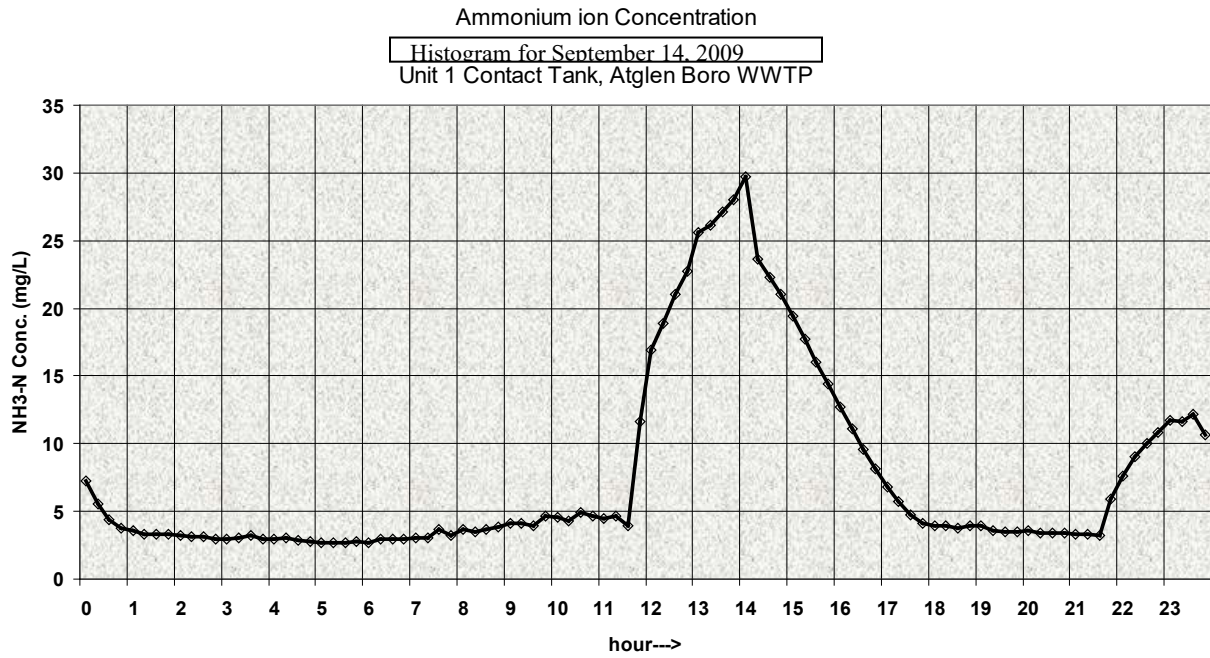


Figure G-9: Example DO Histogram, Atglen Boro Unit 1 CT, Sept. 14, 2009

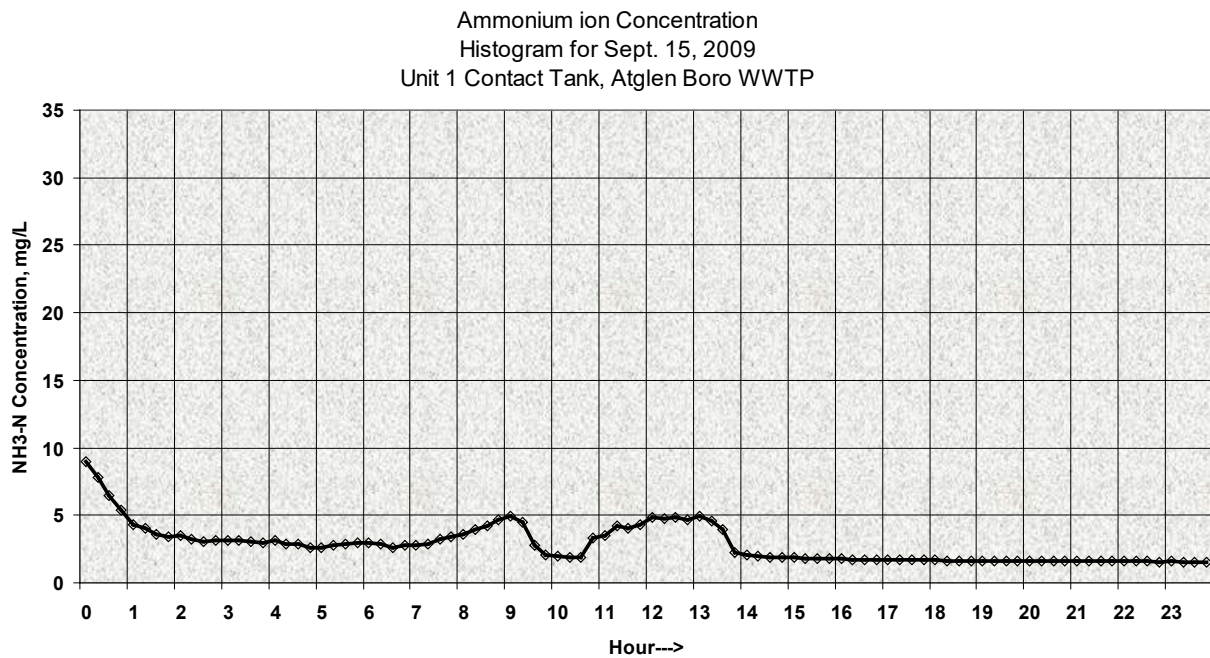


Figure G-10: Example DO Histogram, Atglen Boro Unit 1 CT, Sept. 15, 2009

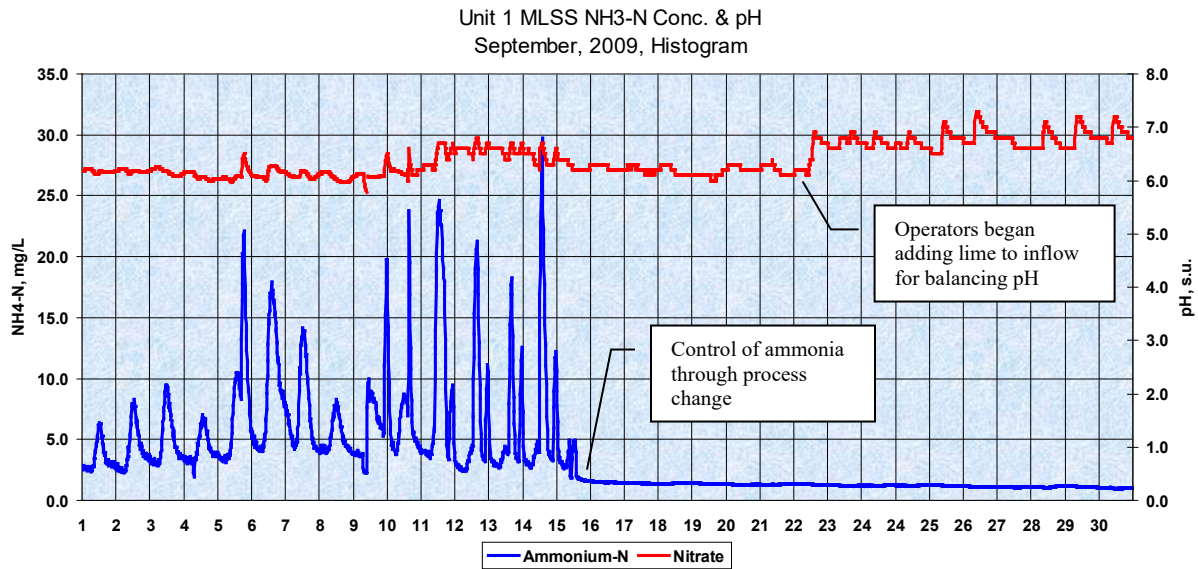


Figure G-12: NH₃-N drop following conversion from contact stabilization mode to extended aeration mode
Graph showing the cessation of toxic ammonia accumulation in the biomass on a diurnal basis. When the tanks were converted to extended aeration/step feed mode on Sept. 16, all of the ammonia-nitrogen was converted rapidly to nitrates.

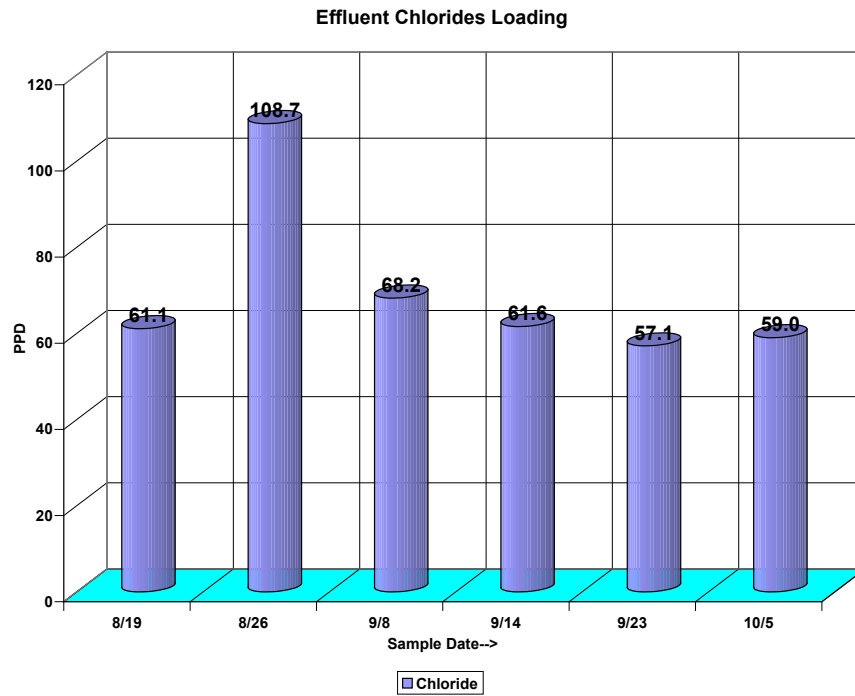


Figure G-13: Effluent Chloride Concentration

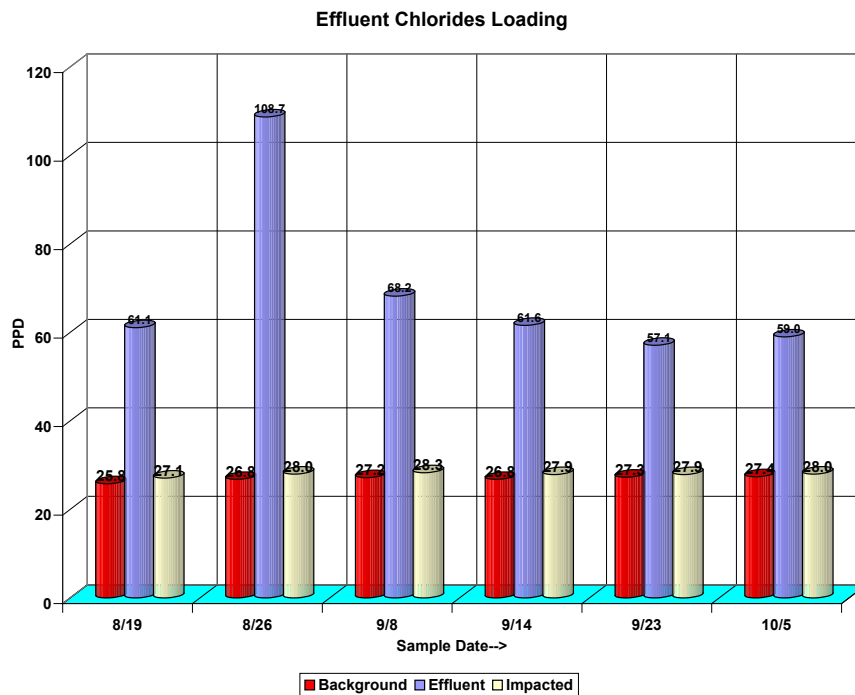


Figure G-14: Chloride Comparison: Background, Effluent, Impacted

Comment: Chlorides have been implicated as one of the pollutants increasingly degrading the quality of the Octoraro Creek Watershed. It is believed that most of these chlorides come from the use of road salt, but the EPA asked us to evaluate the wastewater treatment impact of chlorides as part of the study. The graph above shows that chloride concentration increased only 3.7% on average downstream.

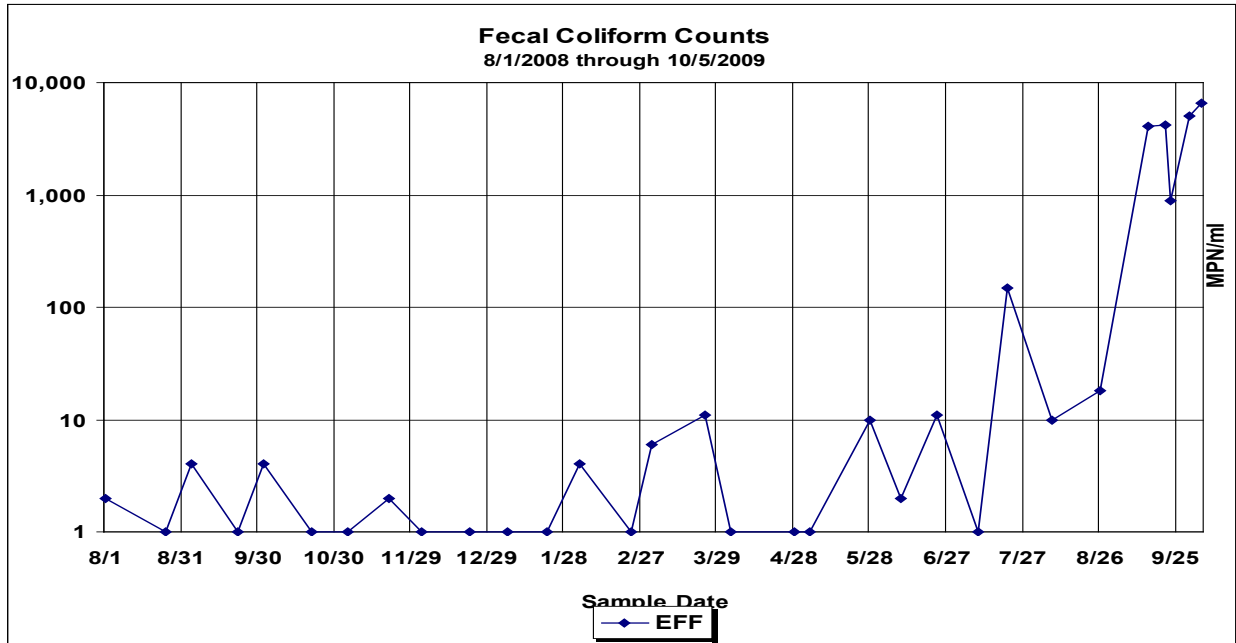


Figure G-15: Fecal Coliform Counts over 14-month period

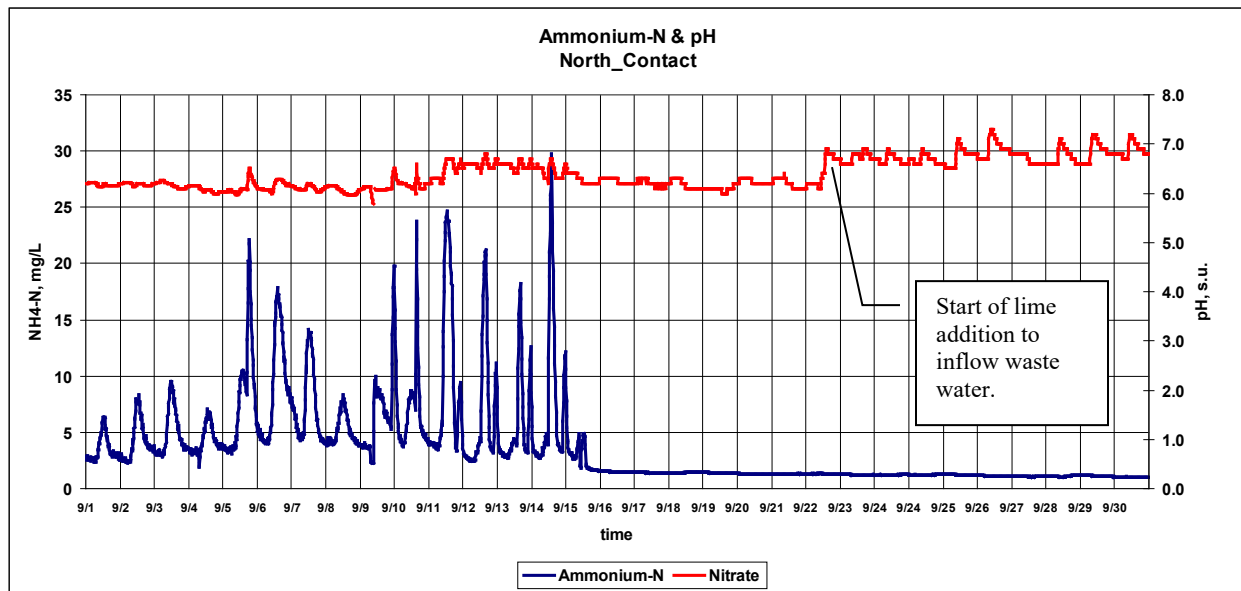


Figure G-16: Ammonium and pH Comparison

Comment: This graph compared the oxidation of ammonia-nitrogen to the mixed liquor pH, as nitrification consumes alkalinity during the production of acid byproduct. On 9/23, operators began adding lime to increase alkalinity and maintain the raw wastewater pH above 6.0 s.u.

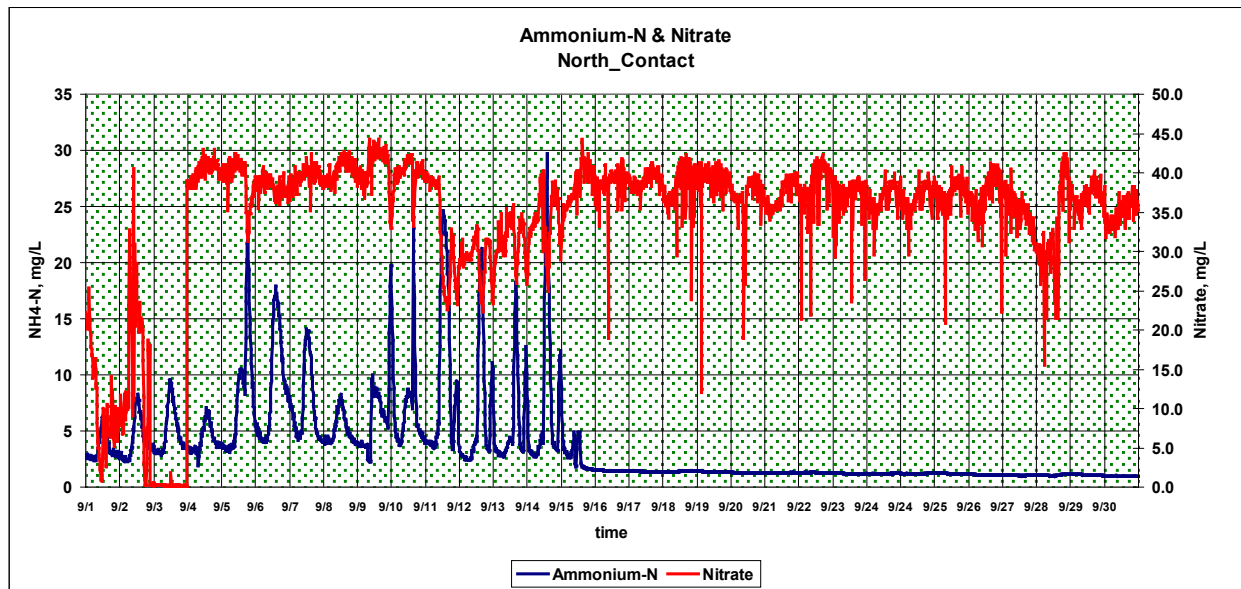


Figure G-17: Ammonium and Nitrate Comparison

Comment: In this graph, ammonia-nitrogen and nitrate-nitrogen are compared as a function of time. Complete oxidation of ammonia-nitrogen did not appear to cause a related uptick in concentration of nitrates; neither did the addition of lime to the raw wastewater as a way to preserve alkalinity and control pH.

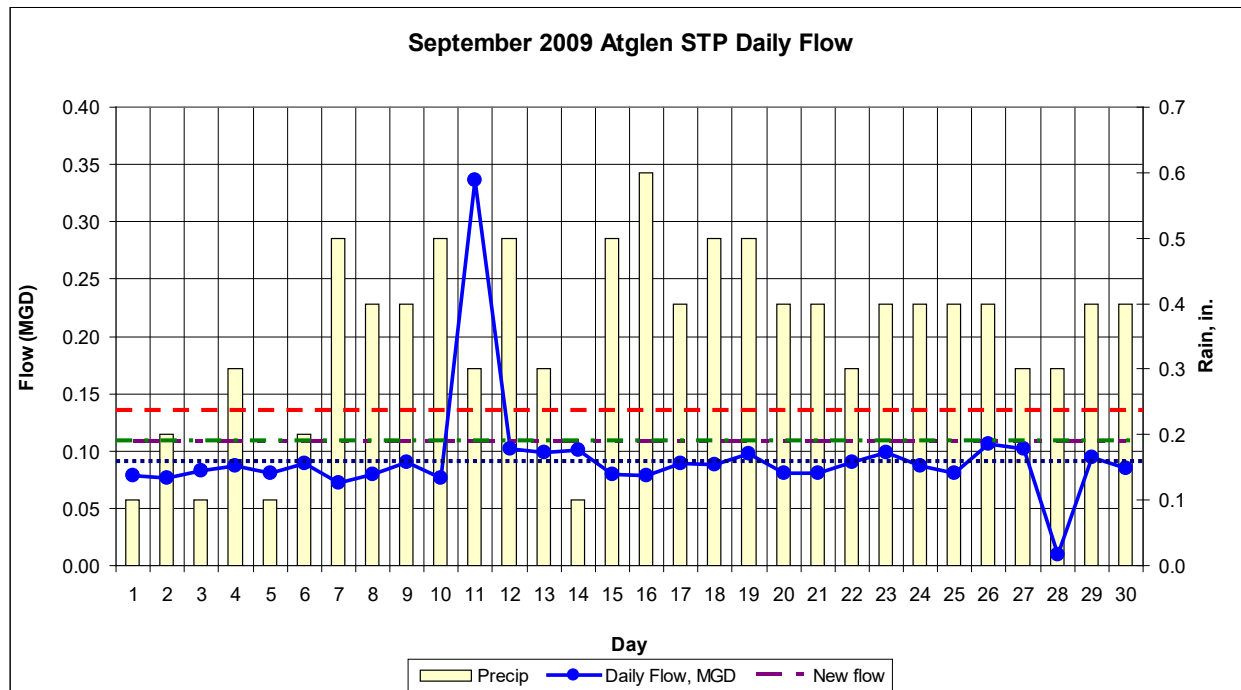


Figure G-18: September 2009 Flow Histogram, showing peak flow.

The September 2009 flow histogram showed a peak daily flow of 0.34 MGD. This is close to the peak flow of 0.29 MGD used in the Stearns & Wheler report. The graph below, depicting the Chapter 94 hydraulic loading from 2004 through 2009, shows that average monthly flows tended to occur during the winter months:

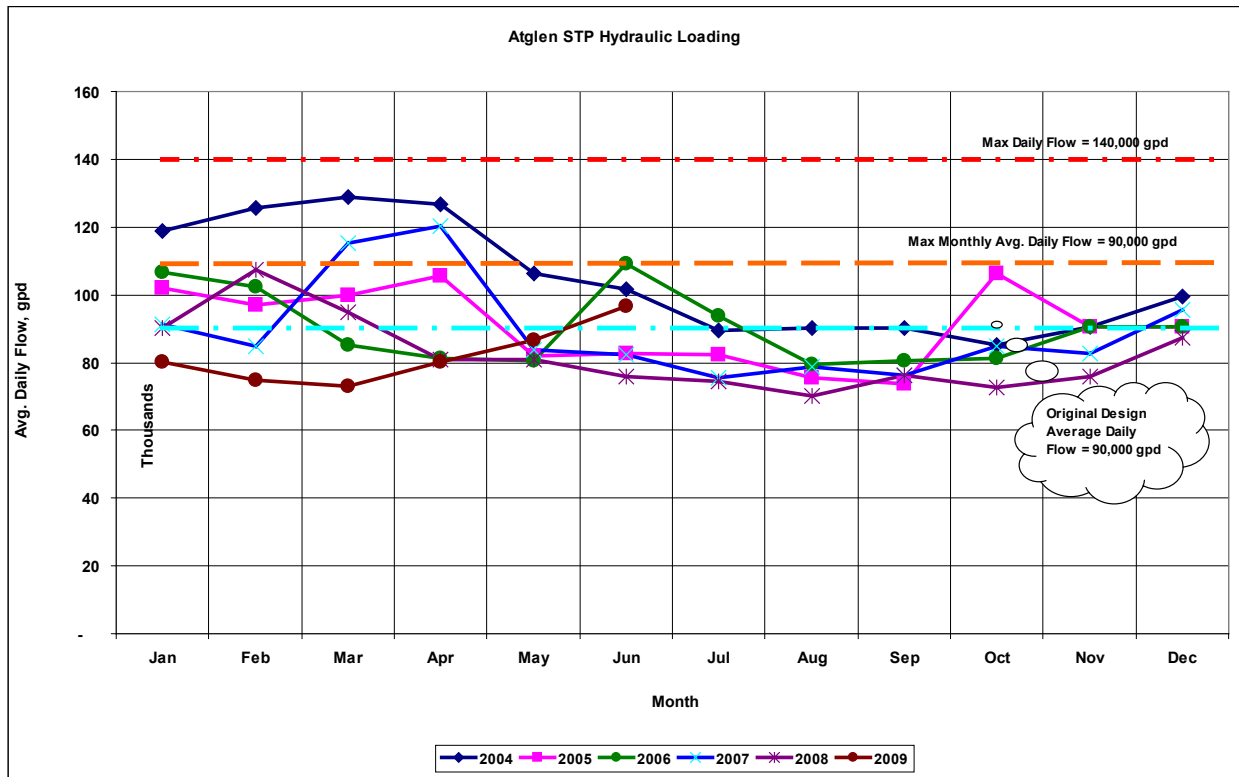


Figure G-19: Chapter 94 Hydraulic Loading, 2004-2009.

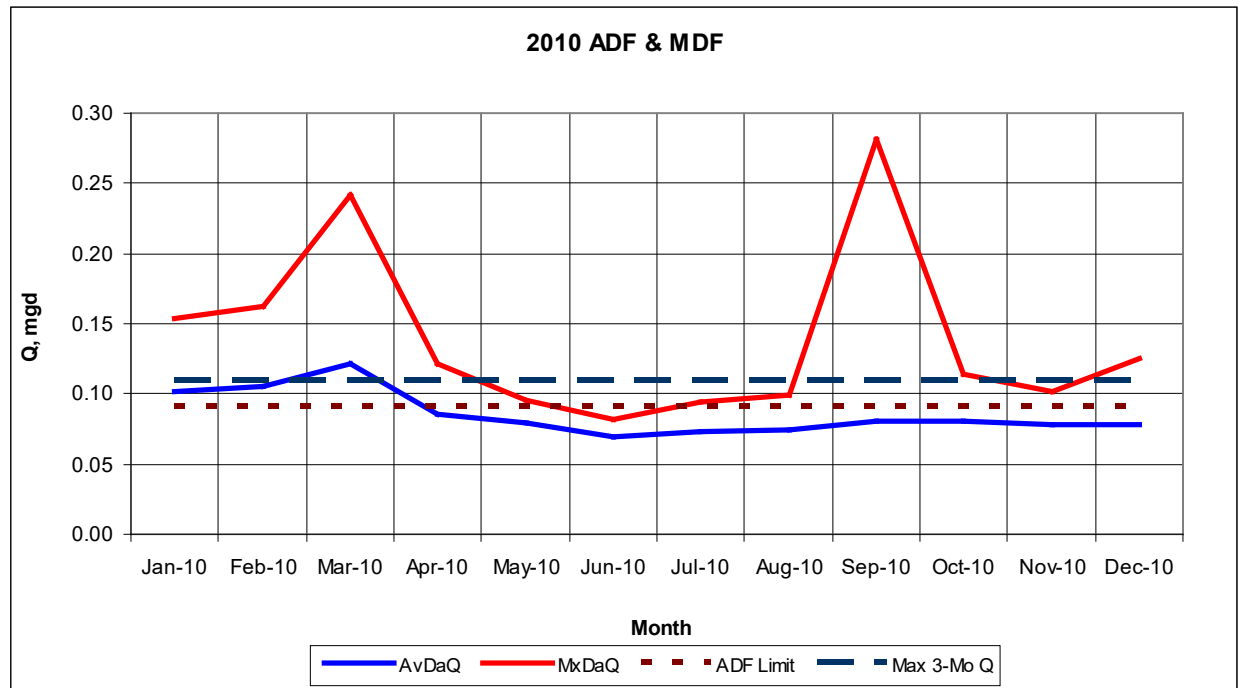
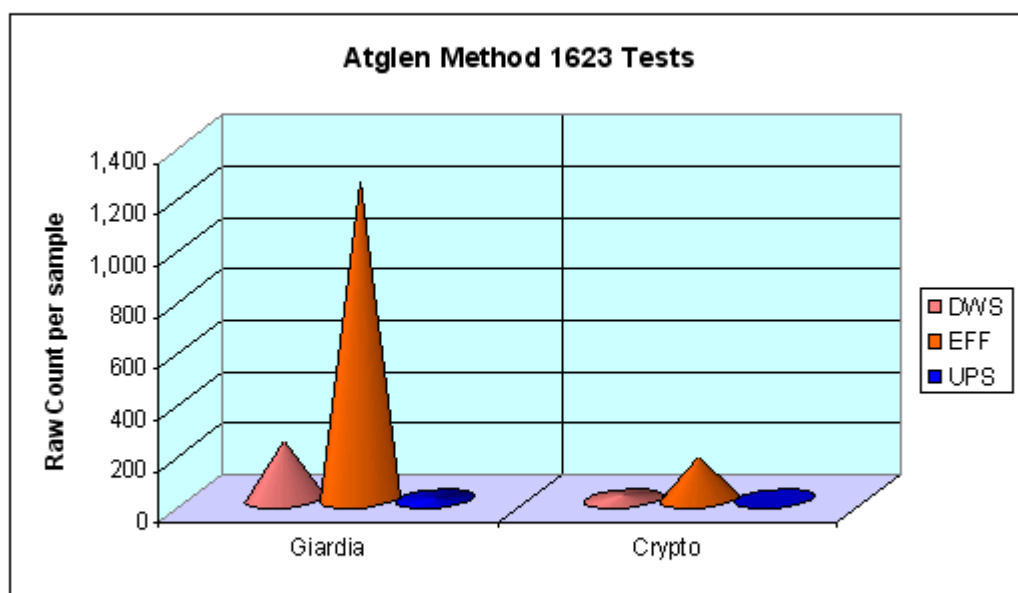


Figure G-20: Peak Loading Days in 2010.

10 Attachment H—Pathogen Test Results (Method 1623 for *Cryptosporidium* and *Giardia*)

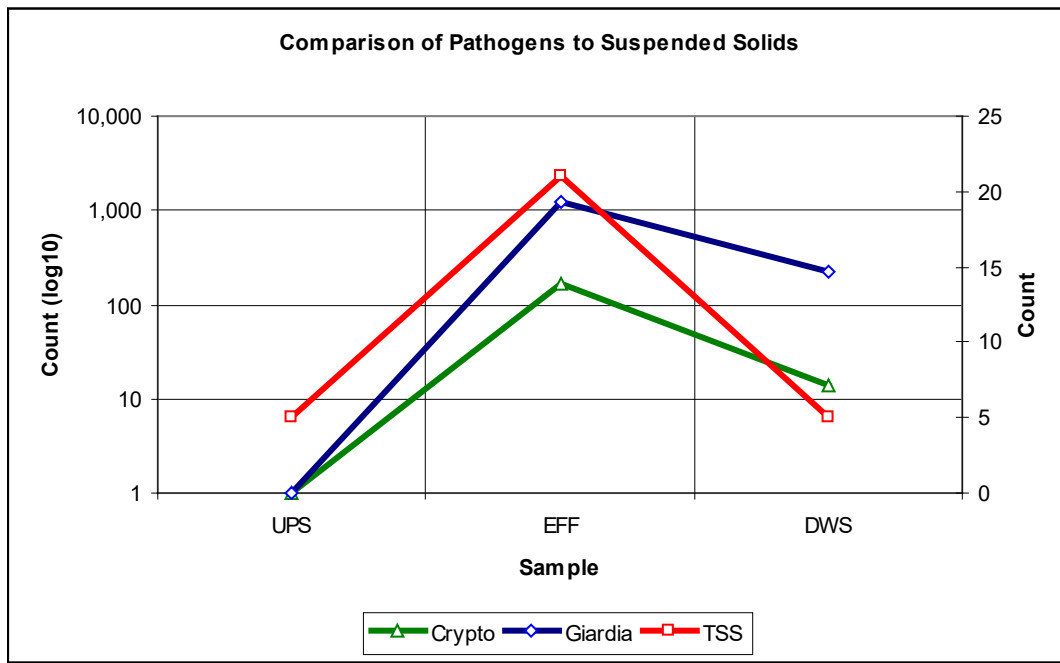
The Atglen study was considered a “mini” WPPE, specifically looking at the question of whether the facility could find an alternative to a proposed \$3.5M replacement with SBR technology. Therefore, the full battery of Method 1623 tests were not performed, as the system modifications would be in the form of proposals rather than actually implemented during time on site. One screening sampling was performed:

**Borough of Atglen WWTP
Waterborne Pathogen Tests
September 8, 2009**



Sample #	Date	Upstream		Effluent		Downstream	
		Giardia	Crypto	Giardia	Crypto	Giardia	Crypto
0907095--097	9/8/2009	1	0	1237	163	226	14

The screening showed that the facility effluent had high Giardia and Crypto content, possibly due to accumulation in the collection system, which correlated directly with the relatively high content of suspended solids in the plant effluent. The graph, following, compares the pathogen count to the total suspended solids:



In the above graph, the pathogen counts were shown on a logarithmic scale, compared to the Effluent Suspended Solids counts, shown on the base 10 scale to the right. This was the study’s first correlation of Method 1623 pathogens to suspended solids.

11 Attachment I—Example Process Monitoring Tests

Example WPPE Daily / Weekly Bench Data

Following are examples of the Example Bench Test Reports for Daily or Weekly Process Monitoring tests. The testing conducted while on-site during the WPPE consisted of three basic activated sludge test protocols, plus any other testing that was specific to the contact-stabilization mode of wastewater treatment.

Borough of Atglen Sewer Authority STP Process Monitoring Data for
Thursday, October 01, 2009

Raw WWV 448 mg/L COD - lb/day BOD5 Analog = 340 mg/L = - lb/day
Flow at noon: MGD
OUR

Settleability:

	Unit 1	Unit 2
0	1000	1000
5	360	250
10	250	180
15	230	160
20	210	150
25	200	150
30	200	140
35	200	140
40	200	140
45	195	140
50	190	140
55	185	140
60	180	140

Time	Unit 1 reading	Unit 2 reading
0	8.6	8.6
30	8.3	8.3
60	8.1	7.9
90	7.8	7.7
120	7.6	7.6
150	7.4	7.4
180	7.2	7.3
210	7.0	
240	6.7	7.0
270	6.5	
300	6.2	6.7
330		
360		6.4

pH checks

1 Contact	1 Stab	1 RAS	INF
7.4			

pH checks

2 Contact	2 Stab	2 RAS	EFF
7.0			

OUR

Slope	0.48	0.38
OUR	28.8	22.8
Slope2		

Parameter	Unit 1	Unit 2	Effluent	Digester
DO	2.7	1.8	4.2	
pH	7.3	7.2	6.9	
Temp	18.8	18.6	18.2	
SSV-30	200	140		
MLSS	5,371	3,148		
SVI	33	44		

Centrifuge solids by volume

INF	Contact1	Stab1	RAS1	2 Contact	2 Stab	2 RAS	EFF
	4.0	3.5	7.0	2.8	5.7	6.5	

Settled Sludge Concentration

Time	Unit 1	Unit 2
0	4.0	2.8
5	11.1	11.0
10	16.0	15.3
15	17.4	17.2
20	19.0	18.3
25	20.0	18.3
30	20.0	19.6
35	20.0	19.6
40	20.0	19.6
45	20.5	19.6
50	21.1	19.6
55	21.6	19.6
60	22.2	19.6

Unit 1 Process Nutrients:

Parameter	Value	Unit	Dilution	Tube	Under/Over
PO4-P	45.2	mg/L P	No dilution	HR	-
NH4-N	2.52	mg/L N	No dilution	LR	-
NO3-N	36.11	mg/L N	No dilution	HR	-

Unit 2 Process Nutrients:

Parameter	Value	Unit	Dilution	Tube	Under/Over
PO4-P	37.2	mg/L P	No dilution	HR	-
NH4-N	1.71	mg/L N	No dilution	LR	-
NO3-N	39.6	mg/L N	No dilution	LR	-

Effluent Nutrients:

Parameter	Value	Unit	Dilution	Tube	Under/Over
PO4-P	4.80	mg/L P	No dilution	HR	-
NH4-N	0.17	mg/L N	No dilution	ULR	-
NO3-N	34.7	mg/L N	No dilution	LR	-

Notes:

Blue numbers are entered
Red numbers are calculated

Comment: Bench testing generally showed the rapid settling of an older, oxidized sludge, where the bulk of solids falls rapidly and leaves straggler floc in its wake. The Atglen effluent generally showed visible presence of suspended solids, sometimes comparable to the primary effluent of other treatment plants.

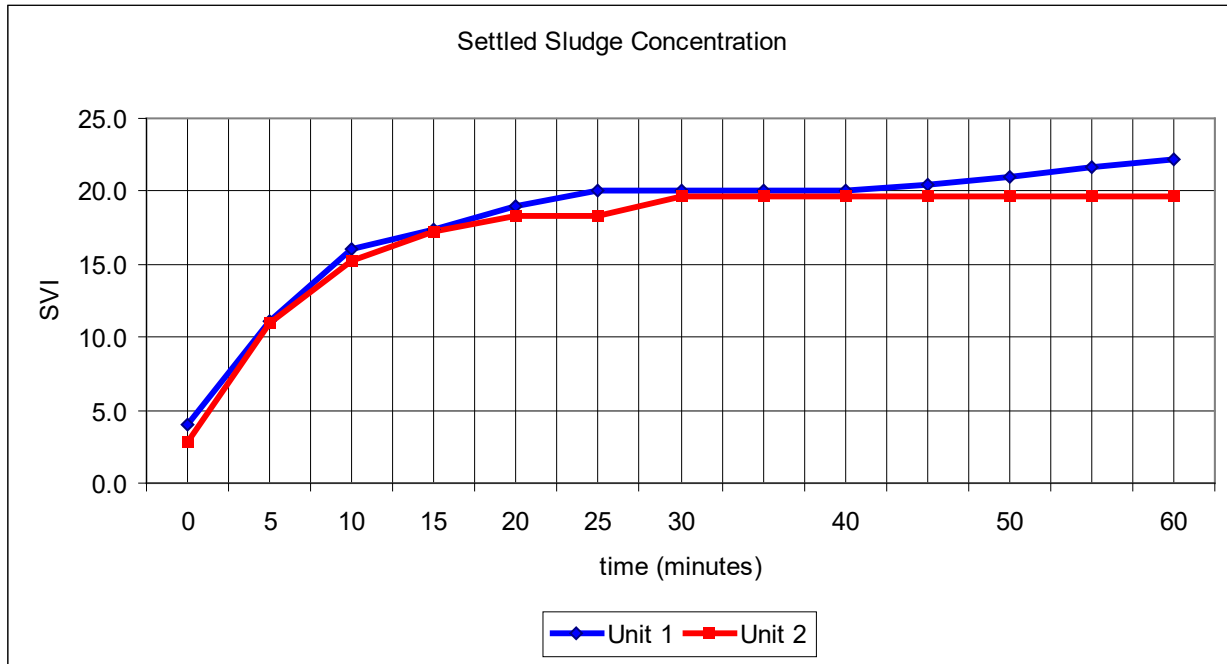


Figure I-2: Settled Sludge Concentration for October 1, 2009, Mixed Liquor Samples
 Comment: The settled sludge rapidly approached its maximum concentration, as shown in this graph which accounts for the increasing density of the activated sludge mass as it settles. Generally, with this type of sludge, clarifier holding times are reduced to prevent unwanted denitrification from causing the settled solids to float.

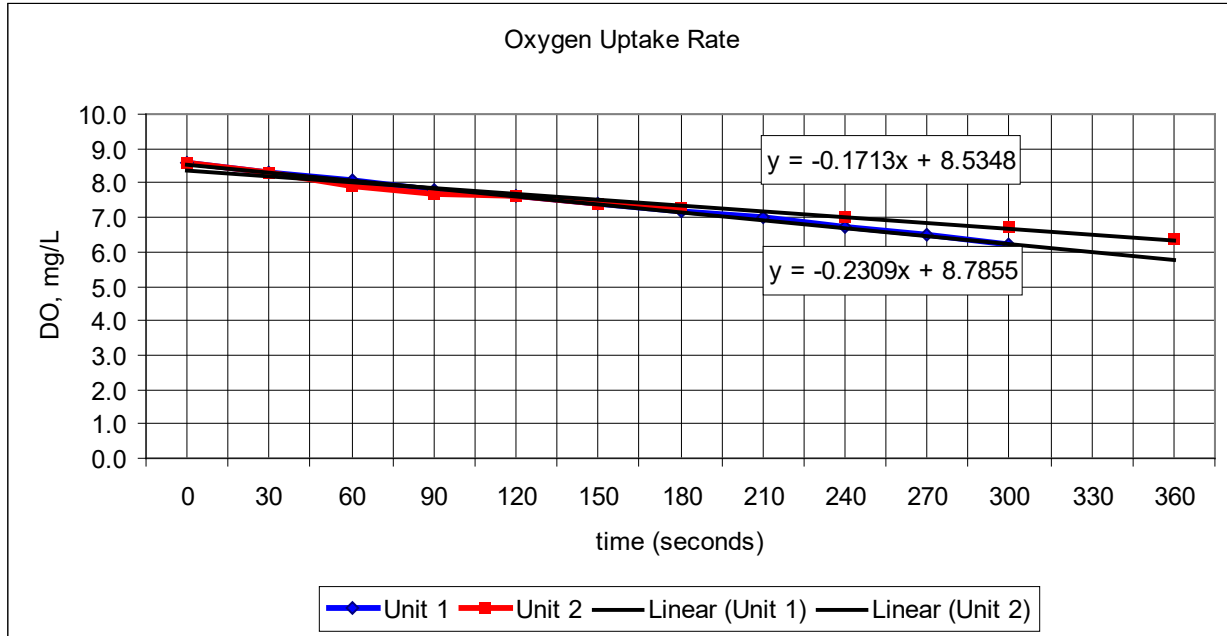


Figure I-3: Settled Sludge Concentration for October 1, 2009, Mixed Liquor Samples
 Comment: OUR was somewhat flat, averaging a decline of only -2 mg O₂ per minute. Indications were that BOD₅ was low for the biomass under aeration at the time.

12 Attachment J—Tables of Sample Data from Bureau of Labs Testing

Borough of Atglen WWTP Sampling Data

(All samples are "grab samples" unless otherwise noted.)

Raw Wastewater							Average	Max	Min	Std. Dev.
Sample #	66	79	93	105	139	161				
Date	8/19/2009	8/26/2009	9/8/2009	9/14/2009	9/23/2009	10/5/2009				
Time	11:20	10:06	10:06	14:27	13:15	11:27				
Locus	INF	INF	INF	INF	INF	INF				
Lab#	2009029967	2009029947	2009031978	2009032519	2009033568	2009034947				
BOD	208.00	141.00	198.00	215.00	164.00	196.00	187.00	215.00	141.00	28.54
COD	164.6	210.0	141.3	101.5	84.5	273.4	162.55	273.40	84.50	70.45
pH	7.4	7.4	7.4	7.4	7.6	7.6	7.47	7.60	7.40	0.10
ALK	264.0	276.2	254.2	244.0	262.6	262.2	260.53	276.20	244.00	10.75
TSS	244	268	274.0	278.0	226.0	336	271	336	226	38
VSS						294				
NH3-N	35.1	28.4	37.2	33.6	27.3	30.0	31.93	37.20	27.31	3.94
NO2-N	<0.01	<0.01	<0.04	0.01	<0.01	<0.01				
NO3-N	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04				
TKN	49.3	44.7	46.6	40.9	42.8	47.3	45.26	49.27	40.85	3.09
NO2 + NO3	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.00
TN	84.34	73.17	83.78	74.43	70.11	77.29	77.19	84.34	70.11	5.80
TP	6.871	6.133	6.363	6.163	5.338	7.436	6.38	7.44	5.34	0.71
Chloride	52.2	112.4	58.0	50.5	49.1	48.5	61.78	112.40	48.50	25.03

Plant Effluent							Average	Max	Min	Std. Dev.
Sample #	67	80	95	106	134	162				
Date	8/19/09	8/26/09	9/8/09	9/14/09	9/23/09	10/5/09				
Time	11:28	10:14	13:50	14:22	13:11	11:30				
Locus	EFF	EFF	EFF	EFF	EFF	EFF				
Lab#	2009029968	2009029948	2009031978	2009031978	2009033563	2009034948				
CBOD	14.60	14.60	10.30	13.20	9.10	12.10	12.32	14.60	9.10	2.27
pH	6.9	7.2	6.9	7.0	7.6	7.2	7.13	7.60	6.90	0.27
ALK	56.6	58.4	26.0	48.4	98.0	49.6	56.17	98.00	26.00	23.53
TSS	51	37	21.0	24.0	31.0	35	33	51	21	11
VSS						32				
NH3-N	7.58	1.39	0.65	0.97	0.17	0.52	1.88	7.58	0.17	2.82
NO2-N	0.89	0.72	0.79	1.10	0.22	0.61	0.72	1.10	0.22	0.30
NO3-N	29.84	28.46	35.20	31.60	34.67	34.64	32.40	35.20	28.46	2.85
TKN	11.34	5.43	4.10	5.11	4.10	4.10	5.70	11.34	4.10	2.83
NO2 + NO3	30.73	29.18	35.99	32.70	34.89	35.25	33.12	35.99	29.18	2.73
TN	49.65	36.00	40.74	38.78	39.16	39.87	40.70	49.65	36.00	4.67
TP	6.626	4.889	4.675	5.974	4.841	6.148	5.53	6.63	4.68	0.82
Chloride	61.1	108.7	68.2	61.6	57.1	59.0	69.28	108.70	57.10	19.67

Upstream/Background							Average	Max	Min	Std. Dev.
Sample #	68	81	96	110	140	163				
Date	8/19/2009	8/26/2009	9/8/2009	9/14/2009	9/23/2009	10/5/2009				
Time	13:08	11:22	14:40	14:57	13:42	11:38				
Locus	UPS	UPS	UPS	UPS	UPS	UPS				
Lab#	2009029969	2009029949	2009031979	2009031979	2009033569	2009034949				
BOD	0.30	<0.20	<0.02	1.00	0.50	0.60	0.60	1.00	0.30	0.29
pH	7.9	7.8	8.0	7.9	8.1	8.0	8.0	8.1	7.8	0.1
ALK	68.2	73.2	71.2	74.0	71.0	70.8	71.4	74.0	68.2	2.0
TSS	5	<5	<5	<5	<5	<5	5	5	5	
VSS										
NH3-N	0.03	0.02	0.02	0.04	<0.02	0.0	0.03	0.04	0.02	0.01
NO2-N	0.01	0.01	<0.04	0.01	0.02	0.01	0.01	0.02	0.01	0.00
NO3-N	6.78	7.43	7.99	7.32	8.00	7.67	7.53	8.00	6.78	0.46
TKN	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00				
NO2 + NO3	6.79	7.44	8.03	7.33	8.02	7.68	7.55	8.03	6.79	0.47
TN	6.82	7.46	8.01	7.37	8.02	7.72	7.57	8.02	6.82	0.45
TP	0.052	0.047	0.035	0.051	0.032	0.028	0.041	0.052	0.028	0.010
Chloride	25.8	26.8	27.2	26.8	27.3	27.4	26.9	27.4	25.8	0.6

Downstream/Impacted							Average	Max	Min	Std. Dev.
Sample #	69	82	97	111	141	164				
Date	8/19/09	8/26/09	9/8/09	9/14/09	9/23/09	10/5/09				
Time	12:57	11:30	15:45	15:08	13:48	11:45				
Locus	DWS	DWS	DWS	DWS	DWS	DWS				
Lab#	2009029970	2009029950	2009031980	2009031980	2009033570	2009034950				
BOD	0.8	0.04	0.20	1.30	0.60	0.80	0.62	1.30	0.04	0.46
pH	7.8	7.8	8.0	7.8	8.1	8.0	7.92	8.10	7.80	0.13
ALK	67.6	72.2	68.4	74.0	72.4	71.2	70.97	74.00	67.60	2.48
TSS	<5	<5	<5	<5	<5	<5				
VSS						6				
NH3-N	0.13	0.04	0.03	0.05	0.03	0.05	0.06	0.13	0.03	0.04
NO2-N	0.03	0.02	<0.04	0.03	0.02	0.02	0.02	0.03	0.02	0.01
NO3-N	6.96	7.97	8.37	7.16	8.25	7.91	7.77	8.37	6.96	0.58
TKN	<1.00	<1.00	<1.00	<1.00	<1.00	<1.00				
NO2 + NO3	6.99	7.99	8.41	7.19	8.27	7.93	7.80	8.41	6.99	0.58
TN	8.12	9.03	9.40	8.24	9.30	8.98	8.85	9.40	8.12	0.54
TP	0.159	0.119	0.123	0.138	0.121	0.120	0.13	0.16	0.12	0.02
Chloride	27.1	28.0	28.3	27.9	27.9	28.0	27.87	28.30	27.10	0.40

Items in Red signify quantities determined at or below their detection limits.

Borough of Atglen WWTP Sampling Data

(All samples are "grab samples" unless otherwise noted.)

North Contact Tank

Sample #	70	94	122	133	165				
Date	8/19	9/8	9/16	9/23	10/5				
Time	11:32	12:00	17:56	13:20	11:57				
Locus	NCT	NCT	NCT	NCT	NCT				
Lab#	I2009029971	I2009031977	2009032925	2009033562	2009034951	Average	Max	Min	Std. Dev.
BOD				1675.00	1,754.00	1714.50	1754.00	1675.00	55.86
pH				7.1	7.4	7.25	7.40	7.10	0.21
ALK	132.4	118.8	90.0	245.0	307.6	178.76	307.60	90.00	93.02
TSS	5,156	4,440	4,962	4,072	4,224	4,571	5,156	4,072	469
VSS	4,338	2,990	4,228	3,764	3,952	3,854	4,338	2,990	533
%VSS/TSS	84%	67%	85%	92%	94%	85%	94%	67%	10%
NH3-N	5.2			0.6	0.6	2.11	5.15	0.58	2.63
NO2-N	1.9			3.83	3.15	2.95	3.83	1.86	1.00
NO3-N	17.0			14.84	20.00	17.27	20.00	14.84	2.59
TKN	183.8			223.1	226.8	211.20	226.78	183.75	23.84
NO2 + NO3	18.83			18.7	23.2	20.22	23.15	18.67	2.54
TN	207.73			242.3	250.5	233.52	250.53	207.73	22.71
TP	36.620			25.350	48.861	36.94	48.86	25.35	11.76
Chloride				51.0	57.6	54.30	57.60	51.00	4.67

North Stabilization Tank

Sample #	123	137	166						
Date	9/16	9/23	10/5						
Time	18:03	13:26	12:00						
Locus	NST	NST	NST						
Lab#	I2009032926	I2009033566	2009034953	Average	Max	Min	Std. Dev.	Lab#	I2009029973
BOD			2,102.00					BOD	17.4
pH			7.4					pH	6.2
ALK	111.0	245.5	306.8	221.13	306.80	111.00	100.17	ALK	27.8
TSS	5,166	8,216	4,532	5,971	8,216	4,532	1,970	TSS	12
VSS	4,270	3,532	3,690	3,831	4,270	3,532	389	VSS	14
%VSS/TSS	83%	43%	81%	69%	83%	43%	23%	%VSS/TSS	117%
NH3-N			0.5					NH3-N	2.52
NO2-N			3.47					NO2-N	0.70
NO3-N			19.60					NO3-N	36.09
TKN			220.2					TKN	5.9
NO2 + NO3			23.1					NO2 + NO3	36.79
TN			243.8					TN	45.18
TP			44.060					TP	5.947
Chloride			57.8					Chloride	57.0

North Clarifier

North Return Sludge

Sample #	71	135	167				
Date	8/20	9/23	10/5				
Time	11:32	13:23	12:03				
Locus	NRS	NRS	NRS				
Lab#	I2009029972	I2009033564	2009034953	Average	Max	Min	Std. Dev.
TSS	9,748	8,356	8,048	8,717	9,748	8,048	906
VSS	8,028	4,308	6,650	6,329	8,028	4,308	1,881
%VSS/TSS	82%	52%	83%	72%	83%	52%	18%

Borough of Atglen WWTP Sampling Data

(All samples are "grab samples" unless otherwise noted.)

South Contact Tank

Sample #	132	168				
Date	9/23/09	10/5/09				
Time	13:31	12:06				
Locus	SCT	SCT				
Lab#	i2009033561	i2009034954	Average	Max	Min	Std. Dev.
BOD	1389.00	1,352	1380.50	1389.00	1352.00	12.02
pH	7.0	6.9	6.95	7.00	6.90	0.07
ALK	189.2	126.8	158.00	189.20	126.80	44.12
TSS	3,340	3,090	3,215	3,340	3,090	177
VSS	2,956	2,956	2,956	2,956	2,956	0
%VSS/TSS	89%	96%	92%	96%	89%	5%
NH3-N	0.67	2.59	1.63	2.59	0.67	1.36
NO2-N	1.68	1.90	1.79	1.90	1.68	0.16
NO3-N	24.58	23.14	23.86	24.58	23.14	1.02
TKN	200.35	169.0	184.70	200.35	169.04	22.14
NO2 + NO3	26.26	25.04	25.65	26.26	25.04	0.86
TN	227.28	196.67	211.98	227.28	196.67	21.64
TP	21.885	38.123	29.99	38.12	21.87	11.50
Chloride	57.4	58.9	57.15	57.40	58.90	0.35

South Stabilization Tank

Sample #	138	169				
Date	9/23/09	10/5/09				
Time	13:38	12:10				
Locus	SST	SST				
Lab#	i2009033567	i2009034955	Average	Max	Min	Std. Dev.
BOD		2,402	2402.00	2402.00	2402.00	
pH		6.8	6.80	6.80	6.80	
ALK	250.4	162.2	206.30	250.40	162.20	62.37
TSS	6,220	6,448	6,334	6,448	6,220	161
VSS	4,292	5,010	4,651	5,010	4,292	508
%VSS/TSS	69%	78%	73%	78%	69%	6%
NH3-N		0.66	0.66	0.66	0.66	
NO2-N		1.12	1.12	1.12	1.12	
NO3-N		25.14	25.14	25.14	25.14	
TKN		348.6	348.61	348.61	348.61	
NO2 + NO3		26.3				
TN		375.5				
TP		51.954	51.95	51.95	51.95	
Chloride		62.4	62.40	62.40	62.40	

South Return Sludge

Sample #	136	170				
Date	9/23/09	10/5/09				
Time	13:35	12:14				
Locus	SRS	SRS				
Lab#	i2009033565	i2009034956	Average	Max	Min	Std. Dev.
TSS	6,992	5,176	6,084	6,992	5,176	1,284
VSS	3,094	4,485	3,790	4,485	3,094	984
%VSS/TSS	44%	87%	65%	87%	44%	30%

Items in Red signify quantities determined at or below their detection limits.

13 Attachment K—Power Consumption Charts

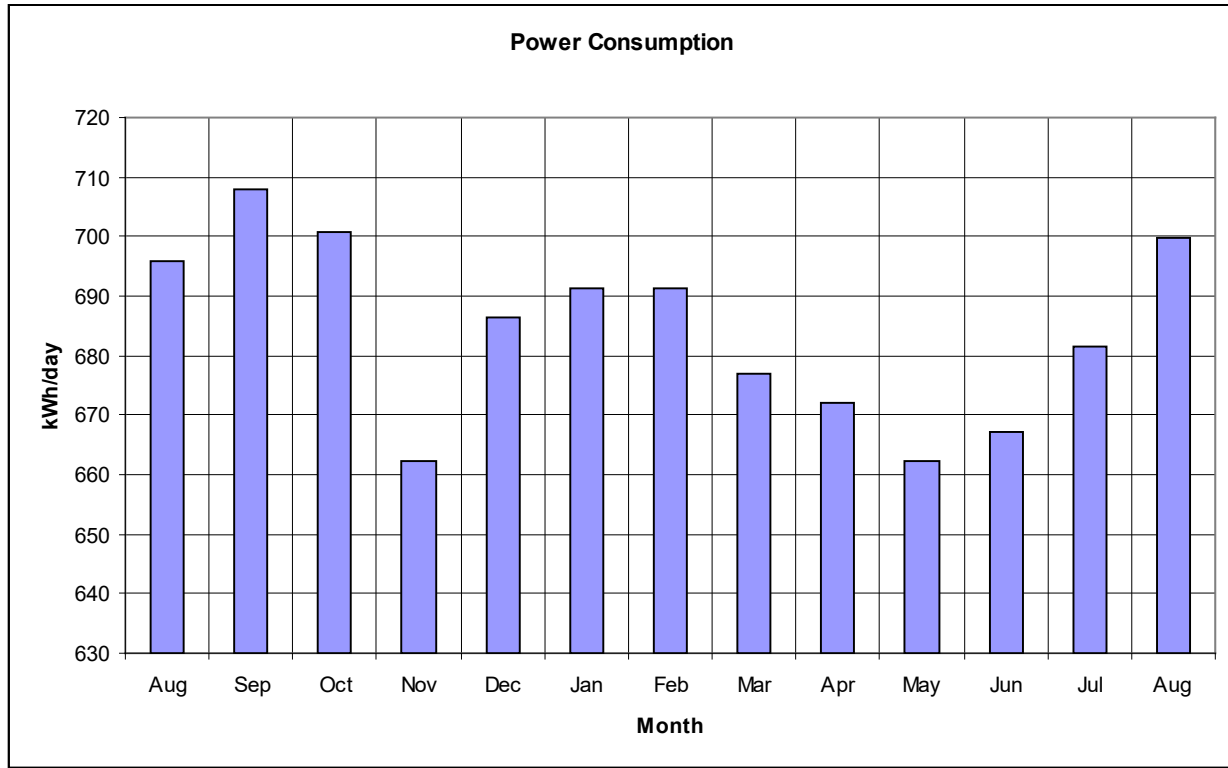


Figure D-12: Power Consumption: July 2008 through August 2009

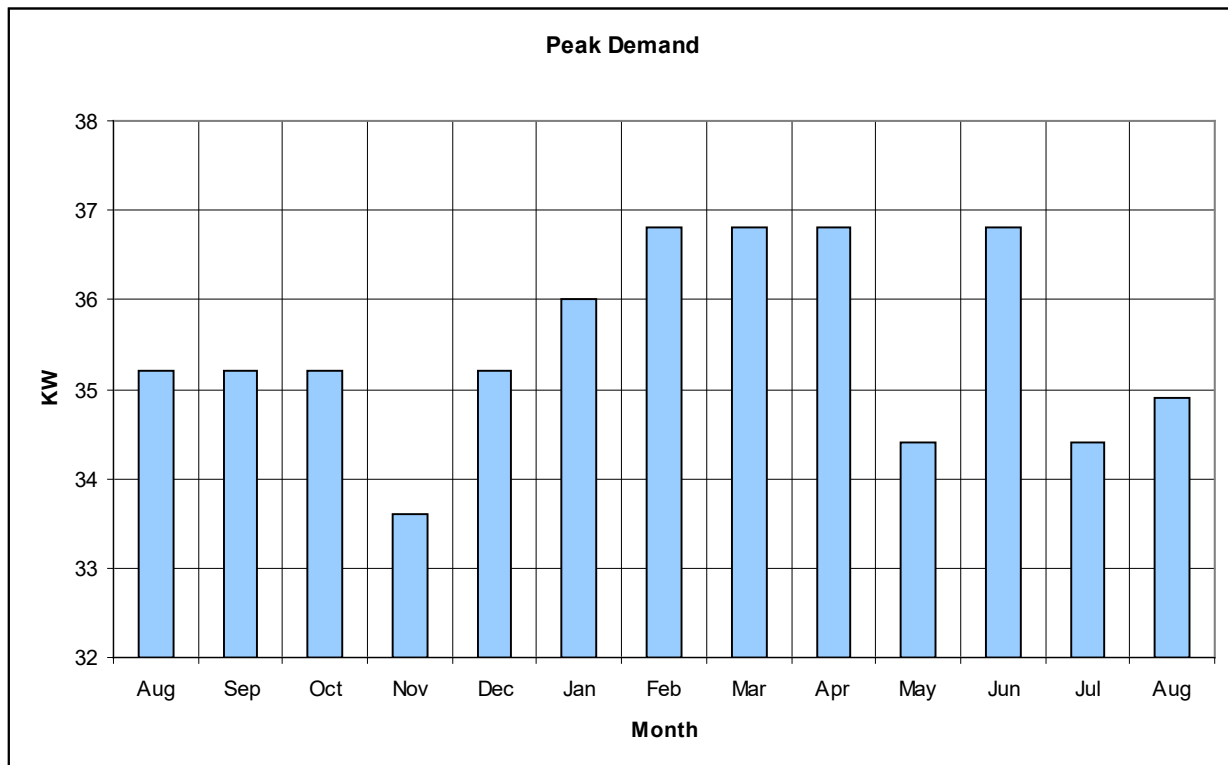


Figure D-13: Power consumption: Peak Demand: July 2008 through August 2009

14 Attachment L—Recommended Process Control Tests, Observations, and Calculations

Operator Sample collection guidelines			Plant Flow: Less than 1.0 MGD		
Sample Parameter	Sample Location	Sample Type	3/Week	1/Week	2/Month
Raw Influent *					
BOD5 and TSS	Influent	Grab			x
Alkalinity	Influent	Grab			x
COD	Influent	Grab			x
NH3-N	Influent	Grab			x
pH	Influent	Grab		x	
Flow	As permitted	Totalizer	Daily		
* Frequency of sampling may need to be increased or decreased depending on plant size or conditions					
Aeration Basin					
MLSS / MLVSS	Aeration Tank	Grab			x
Centrifuge Testing	Aeration Tank	Grab		x	
Dissolved Oxygen	Aeration Tank	In Situ		x	
Settleability (SV30)	Aeration Tank	Grab	x		
pH	Aeration Tank	Grab		x	
Microscopic Evaluation	Aeration Tank	Grab			x
Return Activated Sludge, SS	RAS line	Grab			x
Computation of SVI, F/M, sludge age, and/or MCRT	-	-	As data collected		
Secondary Clarifier					
Sludge blanket depth	As appropriate	In situ		x	
Waste Activated Sludge, SS and VSS	Waste Line	Grab			X
Final Effluent					
Alkalinity	Effluent	Grab			x
Parameters, sample types, and frequencies required by permit					
Modified from its original version					
Reference: Texas Commission on Environmental Quality, Guidance Document RG-002(Revised), October 2002					

Table M-1: Suggested sampling frequencies

14.1 Discussion of Process Monitoring and Control:

For this size of a treatment plant, though, it is suggested that the battery of process monitoring tests be performed more frequently than once per week. Ideally, tests are done three times per week (Settleometry, Centrifuge, Water Chemistry, and Microscopy) at least until the operators have 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, it is recommend that more frequent process monitoring and control testing be performed by the operators.

This testing is not the same as those performed by contract laboratories. Those tests are considered “compliance testing” and refer only to the need for the facility to report 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 and where and what are the qualities of the treatment solids (quality and quantity of “bugs.”)

Thus, the operators should consider adopting the process monitoring tests recommended by US-EPA and the professional trade organization, Water Environment Federation (WEF.) These tests include the following:

Solids Inventory:

- 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.
- 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 WPPE consists of materials for conducting various colorimetric analyses for nutrients such as ammonia-nitrogen, nitrite, nitrate, Kjeldahl nitrogen, phosphorus, etc. to determine whether the facility is removing or treating nutrients.
- 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 there exist sufficient data, operators should develop a cogent understanding of how the facility responds 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.

More complete understanding of the Process Monitoring and Control tests may be found in Activated Sludge Manual of Practice OM-9, Water Pollution Control Federation 1986 or in the freely downloadable (from EPA) Albert West series “Operational Control for the Activated Sludge Process,” Parts I through V. These publications, while dated, broadly cover the basic process monitoring tests and calculations required for determining operational set-points.

15 Attachment M— Expansion Issues: Design-Limiting Factors

15.1 Comparisons of Proposed Money-saving Upgrade Compromise to Original Engineering Report's Proposals:

One of the proposed benefits of performing the WPPE is to study ways for a facility to employ modest operational changes to improve effluent quality. Typically, this brief does not include proposals for additional tankage or treatment processes, which are best left to the Authority's consulting engineers. However, the question presented was whether the facility could be re-rated to 108,500 gpd provided that organic loading remained constant and some additional tankage was constructed in-house to accommodate nutrient control. The 2008 Stearns & Wheeler engineering study proposed replacing the existing reactor units with a pair of sequencing batch reactors and associated upgrades.

Proposed alternative additions to the existing facility might include a new clarifier to supplement the existing two that are integral to the contact/stabilization reactors, expanded aeration capacity by constructing a larger aerobic digester and converting existing digester volume to aeration, and perhaps also including some screening facilities at the headworks to reduce the organic and solids loading on secondary treatment and reduce wear on downstream pumps and equipment.

Field observations generally confirmed that the present facility is hydraulically overloaded. The effluent on some days appeared to have evidence of clarifier washout, although 24-hour composite samples and instantaneous grab samples of the effluent did not exceed the permit limits of 30 and 60 mg/L, respectively.³

The existing facility could not be modified for biological nutrient removal without addition of tanks and processes, entailing complicated capital upgrades. Small facilities might achieve some denitrification using simple on/off aeration schemes, but this would not work very well at the Atglen plant's contact/stabilization reactors where air lift pumps are employed for return and waste sludge transfer.

The best operational change that Atglen could make would be to abandon contact/stabilization in favor of step-feed conventional or extended aeration, done by splitting the raw wastewater influent flow between both the stabilization and contact portions of the reactors. This was done with one of the reactors.

Based on observations, if the entire facility were modified to be operated in this way, it is still limited by the capacity of its integral secondary clarifiers. The existing clarifiers occupy the inner ring of each reactor unit, with 12 ft. diameter and side wall depth of 11 ft. The clarifiers are rated for a solids loading rate (SLR) of 18.2 lb/day/sf at a flow rate of 94,000 gal. with a return sludge rate of 47,000 gal. and solids are 3,500 mg/L. The peak SLR is 45.0 lb/day/sf at a design peak flow of 271,000 gpd. The average surface overflow rate (SOR) is 400 gpd/sf; the peak hourly, 1,200 gpd/sf. Sludge flow rates could not be confirmed in the field, although the air lift pumps for return and waste sludge were reported to be capable of 0.173 mgd each.

³ For comparison, effluent TSS from other facilities where WPPEs were performed more often were non-detectible at a limit of 5 mg/L.

As listed in the 10 States' Standards Wastewater Manual, the minimum side wall depth for secondary clarifiers is twelve feet⁴. It isn't possible to alter the height of these units.

Reviewing eDMR data for 2010, it was noted that very high daily flow at the facility occurred twice that year, in March and September, and that the reported average daily flows were over 100,000 gallons for three months that year, occurring during winter. The actual observed maximum daily flow during September 2009 was 0.3367 MGD, close to the peaking factor of four.⁵

Using the desired hydraulic upgrade flows of 108,500 gpd, the clarifiers would continue to be undersized at the peak hourly flow rate, and with effluent TSS samples averaging 31 mg/L and a maximum of 51 mg/L, it is evident that additional clarifier capacity would have to be constructed.

Alternatively, if the Borough decided to convert their two reactors from the existing contact-stabilization tanks to SBRs, by opening the three compartments to one another and converting the clarifier space to disinfection contact tanks, they would then have total treatment capacity of 78,276 gallons of aerated space, but this is below the recommended volume of 130,000 gallons for an SBR that will achieve denitrification under winter conditions. Also, batch discharges from the SBR may exceed the operating flow rate required by the disinfection process, requiring an effluent flow equalization tank.

If the current digesters are used for aeration space, a new digester with sufficient capacity will have to be constructed.

15.2 Summary of Ineffectiveness of Short-term Fixes:

It appears that the existing facility cannot be modified economically any longer and should be upgraded significantly to meet existing and future hydraulic and organic loads imposed by current and future zoning and development.

- Re-rating the existing facility is not possible because the existing secondary clarifiers are limiting.
- Replacement of clarifiers with new clarifiers is not economically justifiable if it increases hydraulic loading a mere 18,500 gpd while limiting future development inside and adjacent to borough boundaries.
- Replacement of existing aerobic digesters to buy more aeration space in the existing reactors is not economically justifiable if it still does not provide enough aeration

⁴ The 4th Edition of Wastewater Engineering by Metcalf + Eddy design manual recommends SWD at 13 ft. for clarifiers under 50 ft. diameter.

⁵ The following table depicts the surface overflow rates at the current design ADF and proposed ADF and MMF, along with the maximum daily flow recorded on September 11, 2009⁵:

Flow Rate	Weir Overflow Rate	Surface Settling Rate	Solids Loading Rate
90,000 GPD (current)	651 gpd/ft	398 gpd/sf	11.6 lb./d/sf
108,500 GPD (Umble)	785	480	14.0
140,000 GPD (Umble)	1,013	619	18.1
336,700 GPD MaxDaily Q	2,440	1,490	43.5

capacity to treat existing and future organic loads when compared to the cost of building a new digester.

- Construction of new headworks may relieve some organic loading on the existing facility, but it will not help with the hydraulic overload.
- Addition of alum to remove phosphorus treats only half of the nutrient problem and imposes additional requirements for digester capacity.
- The future imposition of nitrogen limits to 6.4 mg/L at all times requires effective BNR or ENR facilities be constructed. The proposed temporary modifications at best improve only nitrification whilst completely ignoring the space and methodology required for effective denitrification.
- Effective BNR requires considerable automated instrumentation for process monitoring and control; none of the intermediate proposals considered the addition of an effective SCADA, much less one that could handle BNR.

16 Attachment N—NPDES Permitted Effluent Discharge Limits

PA0024651, Sewage, Atglen Borough Sewer Authority, 120 West Main Street, P. O. Box 250, Atglen, PA 19310.

This existing facility is located in Atglen Borough, Chester County.

Description of Proposed Activity: This is the proposed renewal of the National Pollutant Discharge Elimination System (NPDES) permit for the discharge of 0.09 mgd of treated sewage from the Atglen Borough sewage treatment plant.

The receiving stream, Valley Creek, is in the State Water Plan watershed 7K and is classified for: TSF, MF. It is a tributary to East Branch Octoraro Creek.

The effluent limits for Outfall 001 are based on a design flow of 0.09 mgd.

Atglen Borough Sewer Authority, Chester County, PA: 2011-2016 Continuation of Permit:

NPDES Permit # PA0024651 Parameters	Mass (lb/day)		Concentration (mg/l)		Instantaneous Maximum (mg/l)
	Monthly Average	Weekly Average	Monthly Average	Weekly Average	
CBOD₅	19	30	25	40	50
Total Suspended Solids	23	34	30	45	60
Ammonia as N			Report		
Fecal Coliform (05/01 to 09/30) (10/01 to 04/30)			200/100 ml 26,000/100 ml		1,000/100 ml
Dissolved Oxygen			3.0 (min.)		
pH (Std. Units)			6.0 (min.)		9.0
Total Residual Chlorine			0.5		1.2
Total Nitrogen (first 2 years)	Report	Report Annual Average	Report		
Nitrate as N (first 2 years)			Report		
Nitrite as N (first 2 years)			Report		
Total Kjeldahl Nitrogen (first 2 years)			Report		
Phosphorus as P (first 2 years)	Report	Report Annual Average	Report		

In addition to the effluent limits, the permit contains the following major special conditions:

- A. Notification of Designation of Operator
- B. Average Weekly Definition

- C. Remedial Measures if Unsatisfactory Effluent
- D. No Stormwater
- E. Acquire Necessary Property Rights
- F. Small Stream Discharge
- G. Change in Ownership
- H. Total Residual Chlorine Requirement
- I. Proper Sludge Disposal
- J. TMDL Data
- K. Certified Operator
- L. I-Max Requirements
- M. 2/Month Monitoring Requirements
- N. Laboratory Certification
- O. Fecal Coliform I-Max Reporting

From: PA Bulletin, Doc. No. 11-257

17 Attachment O—Biosolids Production Worksheet

Borough of Atglen Sewer Authority WWTP

Date: **2006 Records**

Plant Name: **Atglen**

Design Flow:	0.09
Design Loading:	220
Avg Daily Flow	0.094
Months	Actual Sludge Disposed
Jan	1.5
Feb	1.5
Mar	1.5
Apr	1.5
May	1.5
Jun	1.5
Jul	1.5
Aug	1.5
Sep	1.5
Oct	1.5
Nov	1.5
Dec	1.5
12	18

BOD mass removed by STP

influent pounds BOD/day = **162** lbs/day (as reported in Chapter 94 Report)

effluent pounds BOD/day = **19** lbs/day (use monthly avg loading value from permit)

BOD mass removed by STP = **143** lbs/day (from DMRs)

pre-digestion sludge mass produced by STP

BOD mass removed by STP = **143** lbs/day

sludge production factor * x **1**

pre-digested sludge mass = **143** lbs/day

post-digestion sludge mass produced by STP **

**calculate only if plant has a digester

pre-digestion sludge mass = **143** lbs/day

% of pre-digestion solids remaining x **0.65**

post-digested sludge mass = **93** lbs/day

estimated amount of sludge to be removed

sludge mass (pre or post) = **93** lbs/day

days per year x **365** days/yr

estimated sludge mass for disposal = **33,927** lbs/yr

percentage of sludge mass for disposal

actual **36,000** lbs

estimated **33,927** lbs

$\frac{36,000}{33,927} = 1.0611096$

x **100** %

106.111 % Sludge Removal Percentage

Typical Range: 100% ± 15%

* sludge production factors

extended aeration = .65

oxidation ditches = .65

conventional activated sludge = .85

contact stabilization = 1.0

solids reduction in digestors

0 days (no digester) = 1

10 days = .9

15 days = .8 **default value**

20 days = .7

>30 days = .65

18 Attachment P—Example Chesapeake Nutrient Reduction Worksheet

To review the calculation of annualized nutrient loading reports for the Chesapeake Bay Strategy Initiative, the following sample worksheet for calculating the total nitrogen and total phosphorus loadings is attached. These loadings are calculated based on a summation of each month's *monthly mass load* (MML) where the average loading is multiplied by the number of days in the month to obtain the total load for each month. At the end of the reporting period, usually in November, the month sums are added to obtain the annualized load. Additional worksheets provided on the accompanying CD/DVD include sheets for deducting nutrient credits traded with other entities.

Example: The facility collected 10 flow-proportional or timed-interval compliance samples but ran only 5 TKN tests in December 2009; therefore, there are only 5 results for Total Nitrogen (TN). For each day where TN was calculated, multiply the TN concentration by the MGD flow for the sample date. Then average all 5 TN loadings. Multiply the product of this calculation by 31, the total number of days in the month. This value will then be added with the similar MML for the other 11 months to obtain the total nitrogen load emanating from the facility effluent.

(a) $1.51 \text{ lb/day} \times 31 \text{ day} = 47 \text{ lb TN}$

(b) For the reporting year: $\sum \text{MML}_{\text{TN}} = \leq 7,306 \text{ lb. TN}$, $\sum \text{MML}_{\text{TP}} = \leq 974 \text{ lb. TP}$

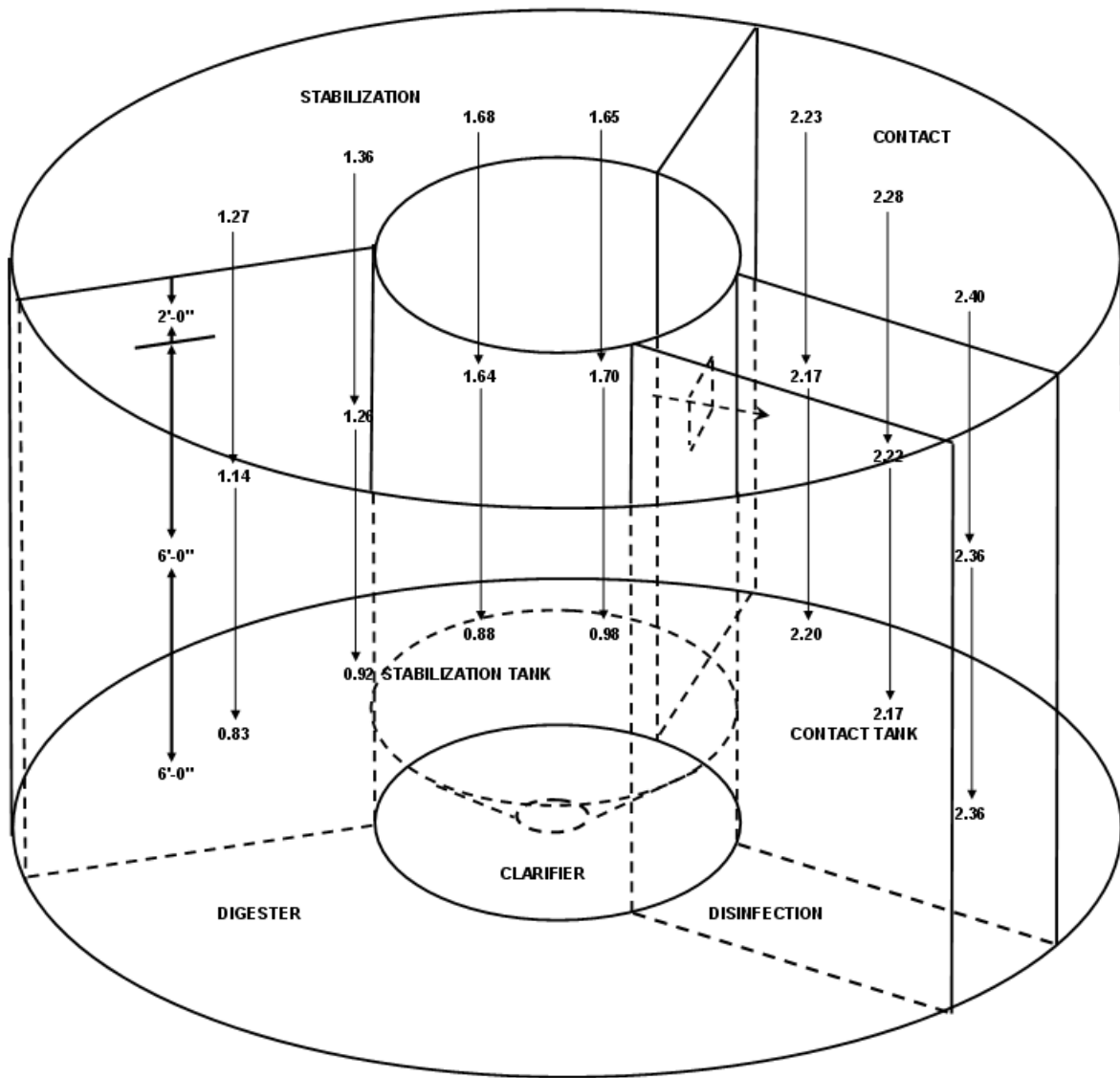
800-FM-WSP R0444 72008													
CHESAPEAKE BAY SUPPLEMENTAL REPORT													
NUTRIENT MONITORING													
Facility Name:		Wilson Twp. STP				Month:		12 (Select number)		Year:		2009	
Municipality:		Wilson Township				County:		Hartranft		NPDES Permit No.:		Outfall: 001	
Watershed:		7-F				Renewal application due		180 days		prior to expiration.		This permit will expire on:	
DAY	FLOW MGD	Total P		NH ₃ -N		TKN		NO ₂ +NO ₃ as N		Total N			
		mg/l	lbs/day	mg/l	lbs/day	mg/l	lbs/day	mg/l	lbs/day	mg/l	lbs/day		
1	0.079	0.4	0.26	0.2	0.13	1.2	0.79	1.0	0.66	2.20	1.45		
2	0.072	0.1	0.06	0.1	0.06			0.5	0.30				
3	0.052												
4	0.087												
5	0.075												
6	0.082												
7	0.086												
8	0.078	0.5	0.33	0.2	0.13	1.0	0.65	0.8	0.52	1.80	1.17		
9	0.067	0.1	0.06	0.4	0.22			0.5	0.28				
10	0.066												
11	0.064												
12	0.08												
13	0.077												
14	0.077												
15	0.079	0.1	0.07	0.1	0.07	1.0	0.66	0.7	0.46	1.70	1.12		
16	0.069	0.4	0.23	0.3	0.17			1.9	1.09				
17	0.066												
18	0.067												
19	0.069												
20	0.068												
21	0.093	0.4	0.31	0.1	0.08	1.0	0.78	1.3	1.01	2.30	1.78		
22	0.114	0.5	0.48	0.1	0.10			1.8	1.52				
23	0.102												
24	0.088												
25	0.097												
26	0.084												
27	0.077												
28	0.075												
29	0.078	0.3	0.2	0.2	0.13	1.0	0.65	2.1	1.37	3.10	2.02		
30	0.077	0.1	0.06	0.3	0.19			0.5	0.32				
31	0.086												
Avg	0.0784	0.29	0.20	0.20	0.13	1.04	0.71	1.09	0.75	2.22	1.51		
Monthly Total Loads (lbs):		6		4		22		23		47			

I certify under penalty of law that this document was prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations. See 18 Pa. C.S. § 4904 (relating to witness falsification).

Prepared By: _____ License No.: _____
 Title: Operator Date: _____

19 Attachment Q—DO Profile for Atglen Contact/Stabilization Tank

Figure Q-1, below, depicts a Dissolved Oxygen profile for the North tank, prior to modification to step-feed, extended aeration mode:



20 Attachment R—Process Modifications Photos



Figure M-1: Raw Wastewater Shunt to Stabilization Tank 1.



Figure F-11: Raw Shunt Connection at EQT Lift Pump Relief Line



Figure 35: View of Temporary Raw Line & Support



Figure 35: Another View of Raw Wastewater Shunt

Comment: The temporary modification to the inflow of the North reactor unit allowed wastewater to enter the stabilization tank as well as the established flow to the contact tank. This created a step-feed mode and converted the tank to a form of conventional or extended aeration scheme. The Authority should consider that this redistribution of influent wastewater be made as a permanent change in order to reduce toxic ammonia-nitrogen spikes.