WASTEWATER PLANT PERFORMANCE EVALUATION

August 10, 2010 – October 13, 2010

Elkland Borough Authority STP

Water Pollution Control Facility

NPDES #PA0113298

Bureau of Water Standards & Facility Regulation
POTW Optimization Program

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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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. Executive Summary

The Pennsylvania Department of Environmental Protection (DEP) conducted a Wastewater Plant Performance Evaluation (WPPE) of the Elkland Borough Authority's (EBA) wastewater treatment plant (WWTP) from August through October 2010. A WPPE is an evaluation of existing operations and practices followed by small-scale operational changes meant to optimize effluent quality. The purpose for optimizing effluent quality is to reduce pathogens and nutrients at drinking water intakes directly downstream of the subject facility, with an overall goal of improving surface water quality.

The WPPE was performed by staff of DEP's Operations Monitoring and Training Division, Bureau of Water Standards and Facility Regulation (BWSFR). The WPPE program is conducted under terms of a federal grant administered by the United States Environmental Protection Agency (USEPA). The primary objective of the site study is to determine if wastewater treatment plant optimization through process control is sufficient to reduce the number of parasitic wastewater pathogens Cryptosporidium oocysts and Giardia lamblia cyst in the finished effluent. This is of concern because a water works is located 2.7 miles downstream on the Cowanesque River in Nelson Township.

Operational Strengths

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

- The operator's dedication to plant operations and optimization as part of his daily activities and as part of this WPPE was abundantly obvious
- The operator performs a significant number of process control tests at the facility which have established a good baseline upon which operational decisions can be made. Continue to record and trend data to troubleshoot periods of reduced performance.
- The EBA wastewater plant consistently produces a treated effluent that exceeds the requirements of its NPDES permit
- Plant operations appear be optimal with solids levels at approximately 1300 mg/l during the summer months. As the temperatures decrease, it may be necessary to increase solids levels to maintain nitrification and, ultimately, denitrification.
- Microscopic evaluation of the mixed liquor confirmed a good combination of bacteria in the biomass including large amounts of stalked ciliates, usually indicative of good settling.
- There were 2 significant rain events (over 1") during the course of the WPPE which contributed to a temporary significant increase of influent flow. September's end of month 3 inch rainfall also upset plant operations for several days. The Borough continues to work on its wastewater collection system and has made significant progress in removing excess inflow and infiltration (I&I) from its collection system.
- The operator monitors the influent quality and mixed liquor health and uses the information to adjust molasses flow as necessary. The molasses is used to augment the existing low influent BOD levels (strength of the wastewater). The continued I&I work should continue to increase influent BOD levels to the point where molasses augmentation will be unnecessary.

Focus Points

The following items have been identified as focus points to assist in optimization efforts. 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 are expected to be favorable by improving the plants discharge quality and thereby improving downstream water quality. Focus points are listed in order of importance.

- Information regarding the as built size of the Aeration Lagoons 1A and 1B was not readily available. Water Management Permit documents indicate the lagoons were permitted at 0.915 MG each. Design documents provided by the manufacturer refer to volumes of 0.6 MG for each lagoon. The operator requested information from its engineer but apparently was unsuccessful in gathering the relevant information. This information could greatly alter operational set points and target values for various parameters; along with the available overall treatment capacity.
- Consider rerouting the ferric chloride feed to a point before the clarifiers, end of aeration, to provide adequate mixing and reaction time for the ferric prior to filtration; EBA was investigating this option at the end of the WPPE
- Repairs should be made of Lagoon 1B clarifier so it may be utilized for treatment when necessary. During the WPPE, there were some minor issues with leakage at the clarifier discharge trough piping.
- The operator spends time cleaning the solids materials from the auger system at the headworks. This system, if operating properly, should deposit the solids in a waste container. Apparently, the system has not operated correctly since relocated to the new headworks building. This would also prevent solids from bypassing these systems and potentially effecting downstream pumps and other treatment processes.
- Clarifier skimmers are somewhat ineffective at removing surface solids accumulations; they appear to be not centered in the tank between the walls and discharge weirs. This also requires a significant amount of operator time manually removing solids from the surface of the clarifiers. They may not be a fix for this due to the design of the solids removal mechanism and surface layout.
- Solids control is very important to the extended aeration process. Without a return sludge flow meter, frequent solids inventory testing will greatly assist operator in making process control decisions. Consider purchasing a centrifuge for conducting percent solids testing. This will provide results within approximately 15 minutes and, once the values are validated through mixed liquor solids analysis, can be used as a process monitoring tool to control solids throughout the plant. While current practices include weekly mixed liquor solids testing additional testing for % solids using a centrifuge can provide a quick and representative snapshot of current solids levels in the mixed liquor and return activated sludge streams.
- If the Elkland WWTP purchased additional testing equipment to monitor nitrate, ammonia, and phosphorus; the operator would have more tools to operate the plant most efficiently. While there may be some older equipment on hand to perform some testing, there is some newer laboratory analysis equipment available that provides results very quickly. This data should be trended; then used to identify and troubleshoot periods of reduced performance. In addition, some testing, such as Ammonia Nitrogen, could be

performed in house with the same equipment used for this process control testing resulting in an overall cost savings. This testing, used for DMR reporting, would need to be accredited by the Department's Laboratory Accreditation Program and would require additional operator laboratory time.

- Lagoon 2, solids holding lagoon, decant assembly should pull from below the surface of the lagoon which would help prevent excessive duckweed and other algal materials from accumulating in process units. This accumulation again takes operator time to manually remove from the system.
- It may be advantageous to purchase an updated DO meter. Some DO sensors utilize luminescent measurement of DO instead of membrane sensors which are prone to fouling when utilized in the mixed liquor. On-line DO monitors, if connected to a controller for the blower motors could further maximize treatment and minimize power consumption. Since the Borough currently has on-line DO monitors, and the capability to operate the blowers based on their readings, it may prove valuable for the operator to spend some time utilizing the DO monitors to operate the treatment process. This will take some time to adjust the blower settings to optimal conditions for nitrification and denitrification but the system appears to be designed to operate in that process mode.
- While using the DO probe at the end of the north aeration basin and maintaining DO levels below 1.5 mg/L, the resulting nitrate levels were the lowest of the entire WPPE evaluation. The existing on-line DO meter should provide the operator with necessary information to help maintain the treatment process at its maximum efficiency.
- There are no return sludge flow meters or any way to accurately measure return sludge/waste sludge flow. There are in line flow meters available that would allow the operator to accurately monitor return sludge/waste sludge flows which would provide another tool to ensure the entire biological treatment process stays in balance.
- With only one operator to operate and maintain several of the Borough's utilities, the facility could benefit from the installation of on-line processing equipment to monitor Total Suspended Solids (TSS). This would allow the operator to quickly make adjustments in the treatment process and identify times when solids removal is necessary.
- Purchasing a meter capable of monitoring Oxidation Reduction Potential (ORP) would allow the operator to more closely monitor the denitrification process. ORP monitoring is essential for maximizing the efficiency of the denitrification process.
- The clarifier skimmers troughs are connected to additional piping with a large coupling which appears to be the wrong fitting at that junction. A rotating coupler that is intended to move back and forth, as when utilizing the skimmer trough, would provide easier operation of the gearing and not lead to fatigue and possible premature failure of the assembly parts. Currently the coupling loosens or tightens as the skimmer trough is operated; loosening the coupling could allow excess clarifier water to escape through the attached flexible piping. Replacing the existing coupling with a rotating coupling designed for that application may prevent an equipment failure that would take the entire clarifier out of operation.
- Continue monitoring Mixed Liquor Suspended Solids (MLSS) along with settleability testing to identify when solids removal is necessary. In addition, monitoring the mixed liquor for % solids would add a quick and accurate measurement of solids inventory on those days when the total solids tests is not performed. These tests should be conducted at least twice per week.

2. Background

The Pennsylvania Department of Environmental Protection (DEP) has recently undertaken a project in its Bureau of Water Standards and Facility Regulation (BWSFR) to improve the quality of surface waters used for drinking water by optimizing wastewater treatment plant operations to reduce pathogens and nutrients in the effluent from the WWTP. BWSFR's optimization program is called the Wastewater Plant Performance Evaluation (WPPE) and is modeled on the successful program for drinking water filtration plants that has been operating for the past twenty plus years, the Filter Plant Performance Evaluation (FPPE) program. The WPPE program is fully explained in Attachment A.

The EBA WWTP, National Pollutant Discharge Elimination System (NPDES) Permit Number PA0113298, is a lagoon system utilizing the Biolac process. The system is designed as an extended aeration treatment facility employing two treatment trains, each rated at 0.350 MGD. The facility discharges to the Cowanesque River, a warm water fishery and potable water supply. The nearest withdrawal point for potable water use is the Nelson Township Municipal Authority Public Water supply, located approximately 2.7 miles downstream of the Elkland WWTP point source discharge. Due to the proximity of the discharge and intake this wastewater plant was selected to participate in a Wastewater Plant Performance Evaluation.

The EBA WWTP has a design flow of 0.7 MGD average daily flow and an organic design capacity of 600 pounds per day of BOD. For the past year, the average daily flow was 0.374 MGD with a range of 0.242 to 0.513 MGD. Organic loading in 2009 averaged 287.7 pounds of BOD per day with a maximum daily load of 675 pounds. These flows and, generally, the loadings are well within the design parameters of the facility and no overloading is projected for several years per the facility 2009 Wasteload Management Report. The loadings are usually quite low for domestic sewage and are supplemented with molasses to assist in providing soluble BOD for the nitration/denitrification process. During July 2009, during switch over to the new outfall there were three days, the 20th, 22nd, and 27th, where BOD_5 was quite high. In fact the BOD loading on those three days averaged 1,150 lbs/day. Since that event there has not been any recurrence of incidents such as these.

EBA's treatment train is depicted in Figure 2.1, below, showing the Biolac treatment lagoons, an extended aeration treatment process. Plant headworks include a channel monster, manual bar screen channel, and auger grit removal. According to the EBA permit application and associated documents, two lagoons provide for 915,000 gallons of capacity, each. Secondary settling is provided in two clarifiers. The clarifiers have a 1000 sq ft surface area and 51,000 gallon capacity. The disinfection processes utilizes two chlorine contact tanks with sodium hypochlorite disinfection to destroy pathogens prior to discharge to the receiving stream. Solids removal is provided by Lagoon 2 with a 2,000,000 gallon capacity. Additional chemicals used at this facility include molasses added to the influent as a BOD supplement and ferric chloride added just prior to the upflow filters for phosphorus reduction. EBA discharges final effluent through outfall 001 into the Cowanesque River.

Waste sludge has not been removed for several years and, according to the operator, should not have to be removed for several more years due to the excess capacity in Lagoon 2.

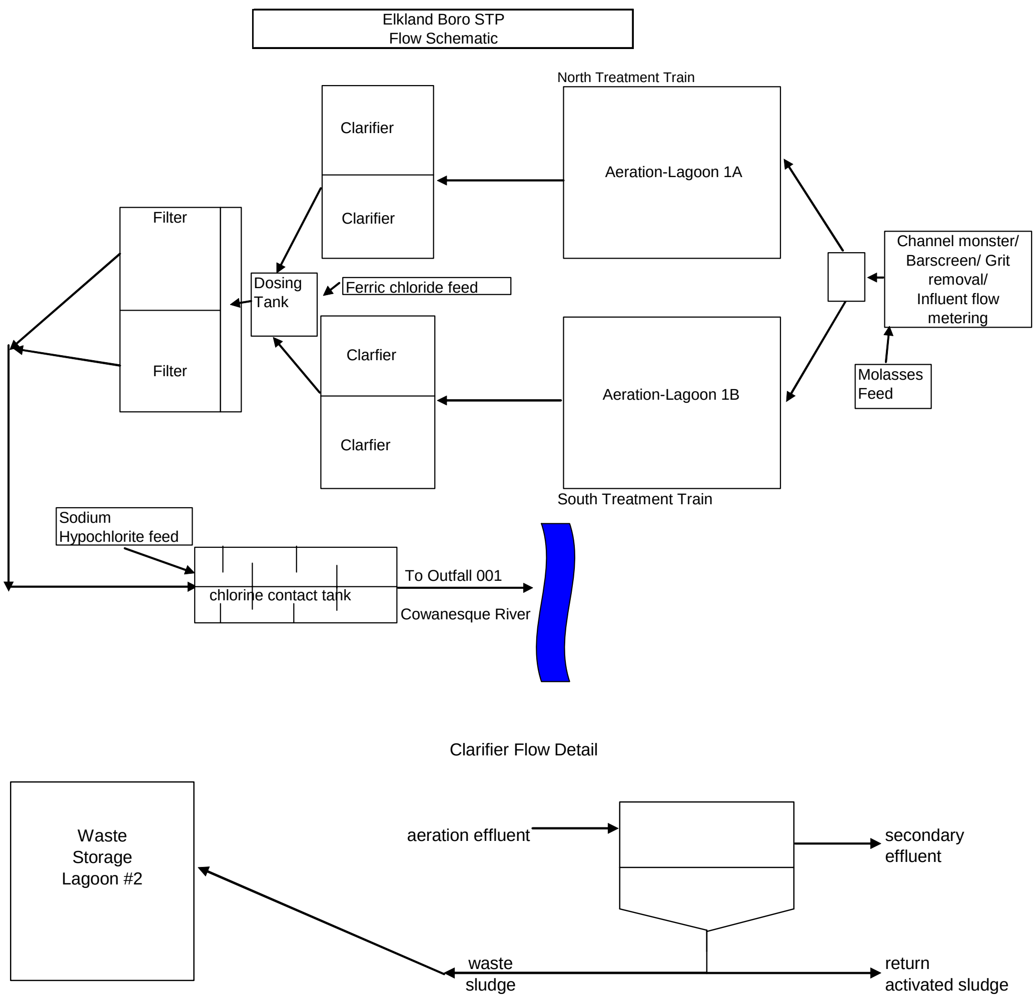

Figure 2.1 Elkland wastewater treatment plant process flow schematic

Elkland's NPDES permit limits concentration and loading limits for the waste discharge. Nutrient loading limits have been established for the Elkland WWTP because of the Chesapeake Bay Initiative that requires point source discharges within the Bays drainage area to manage nutrient releases. Elkland is required to discharge no more than 10,277 pounds of Total Nitrogen (TN) and 1,285 pounds of Total Phosphorus (TP) to the Cowanesque River, a tributary to the Susquehanna River and part of the larger Chesapeake Bay drainage basin. Table 2.1, below, lists the NPDES effluent discharge concentration and Chesapeake loading limits for the Elkland WWTP:

Discharge Parameter	Effluent Limitations				
	Mass Units (lbs/day)		Concentrations (mg/L)		
	Monthly Average	Weekly Average	Average Monthly	Average Weekly	Instantaneous Maximum
$CBOD_5$					
6/1 - 10/31	44	64	25	40	50
11/1 - 5/31	115	183	30	45	50
Total Suspended Solids	138	206	30	45	50
NH_3-N					
6/1 - 10/31	13	20	2.9	4.4	5.8
11/1 - 5/31	40	60	8.7	13	17
Total Residual Chlorine			0.44		1.5
Total Phosphorus	9.2		2		4
Dissolved Oxygen					
pH	From 6.0 to 9.0 inclusive				
Fecal Coliform					
5/1 - 9/30	200/100 ml as a geometric average, not greater than 1,000/100 ml in more than 10% of the samples tested				
10/1 - 4/30	2000/100 ml as a geometric average				

Chesapeake Bay Requirements			
	Concentration (mg/L)	Mass (lbs)	
	Monthly Average	Monthly	Annual
Ammonia-N	Report	Report	Report
Kjeldahl-N	Report	Report	XXX
Nitrate-Nitrite as N	Report	Report	XXX
Total Nitrogen	Report	Report	Report
Total Phosphorus	Report	Report	Report
Net Total Nitrogen	XXX	Report	10,277
Net Total Phosphorus	XXX	Report	1,285

Table 2.1. Elkland Borough Authority NPDES effluent limitations

The EBA WWTP has been recently renovated and upgraded over the last two years and its current overall operating efficiency appears to be good with few violations of its operating permit. The operator, Mr. Roy Perry, at this facility is a very dedicated individual who has a good grasp on the requirements for operating this facility. The operator performs many process control tests and has a strong understating for the conditions that are necessary to maintain the facility in maximum operating efficiency. He was very helpful during the WPPE and was willing to try process modifications to attempt improvements in plant operations which appear to have made some positive impacts on effluent quality.

DEP contacted EBA with a request to deploy and operate its instrumentation at their WWTP located in Elkland Borough, Tioga County, for a period of up to two months in order to assess current plant operations and provide the operator with process monitoring data to make process modifications improving effluent quality and downstream surface water quality at the NT drinking water intake.

DEP utilized on-line probes installed within the secondary treatment processes. In addition, DEP brought, to the facility's laboratory, instruments and test kits that were used during the evaluation and available for the plant operators' use. This equipment supplements the on-line continuous monitoring and provides operators with the opportunity to utilize test equipment used in making process control adjustments. The goal is to familiarize operators with process control testing that can be performed to trend their plant data which will assist them in making decisions to optimize their treatment process. A list of all the equipment employed during this WPPE is included in Attachment F.

The Department recommends that the Authority review the report and the plant operator continue to maintain and improve plant performance through the use of regular process monitoring and control and data trending to ensure the facility is capable of producing effluent water quality that exceeds current and planned future concentration and loading limits. On-line monitoring equipment for DO is currently in use to monitor oxygen levels in the aeration basin but the equipment is not used to operate the process blowers. If the blower motors were utilized based on an oxygen demand basis there could be periods of reduced usage over the evening hours and associated electrical cost savings that may provide a payback period desirable to the EBA. This issue could prove more important as rate caps expire and the cost of electrical usage increases.

In conducting this WPPE, DEP made no recommendation for or endorsement of any particular brand or model of equipment or testing methodology. DEP encourages those who review this report to survey the market and contact any of several companies manufacturing or selling this technology that can be used for improving monitoring and operations, before they acquire any particular technology.

In addition, this WPPE has been provided as a *gratis* service to the client as part of a research project funded by the federal and state government. The services offered during the WPPE are part of an effort to enhance surface water quality throughout the Commonwealth and are not meant to compete with private-sector services aimed at improving a client facility's operations or upgrading its capabilities. Oftentimes, POTW Optimization requires the client facility to achieve effluent quality above and beyond NPDES permit requirements in order to obtain improved drinking water quality downstream. Clients are encouraged to contact their consulting engineers when contemplating any process changes to a facility where engineering or design services may be necessary. Furthermore, any process or procedural changes may be subject to regulatory reporting and permitting processes through PADEP or the US Environmental Protection Agency (USEPA.)

Attachment B lists the WPPE team and participating members of the EBA.

The Elkland sewer collection system is shown below in Figure 2.1.

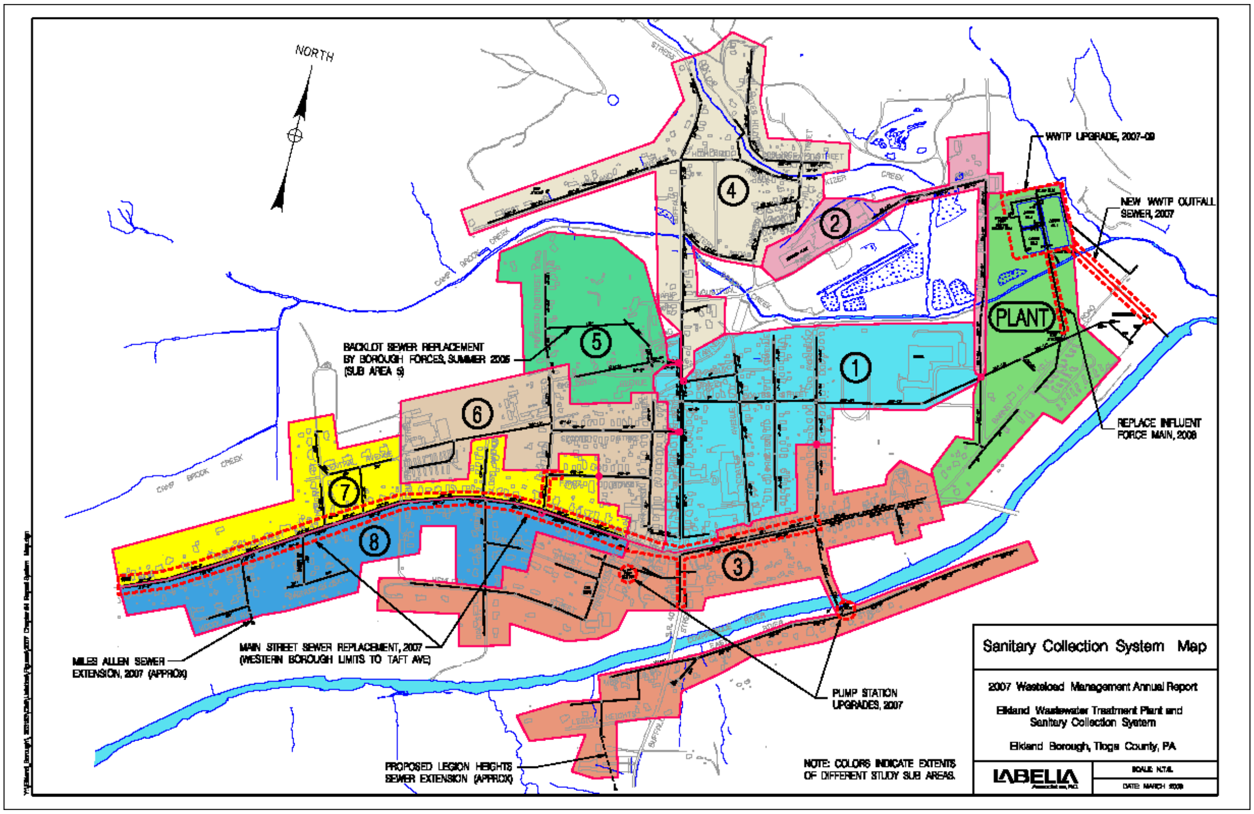

Figure 2.2 Elkland sewer collection system

The sanitary sewer collection system and service area encompasses Elkland Borough and has seen very limited growth in the form of new connections to the wastewater plant and few are projected.

3. Initial Observations

Plant Description

The EBA plant is located on Ellison Rd in Elkland Borough, Tioga County, Pennsylvania approximately ½ mile south of the New York state border. It treats domestic sewage generated within Elkland Borough and has one industrial user but does not require participation in USEPA's Industrial Pretreatment Program.

Treatment is achieved utilizing the Biolac treatment process. This is a lagoon treatment system based on extended aeration with longer MCRTs for nitrification and on/off aeration to create anoxic zones for denitrification. There are two treatment trains; only one is utilized at a time due to low influent flows and loadings.

The facility operates under the requirements of NPDES Permit No. PA0113298 which establishes the operations and monitoring requirements for treated sewage at the facility. The EBA WWTP discharges treated effluent to the Cowanesque River which is designated as a warm water fishery. The Cowanesque River is in the Susquehanna River Basin, Subbasin 4- Watershed A, Tioga-Cowanesque Rivers. These receiving water are tributary to the Chesapeake Bay. The NT water intake is on the Cowanesque River approximately 2.7 miles below the Elkland discharge.

The in stream waste concentration (IWC) is based on plant design flow and the Q7-10 flow of the Cowanesque River at the discharge location. The Q7-10 flow, 1.73 cfs, is the lowest average, consecutive 7-day flow that would occur with a frequency or recurrence interval of one in ten years (from SRBC website). The Q7-10 flow and IWC are used in the Department's NPDES permitting process. The IWC for Elkland is 38.5%, indicating that during relatively dry conditions the EBA discharge flow would represent 38.5% of the river flow. The stream flow of the Cowanesque River was not measured during the WPPE, but from USGS records over the period of the WPPE, it was shown that the river flow just upriver of the plant discharge was 102.4 cubic feet per second (cfs) with 9.15 inches of rainfall occurring over the same time period. During the WPPE, based on the USGS gage station readings and EBA reported influent flows, the EBA plant actually contributed 0.4 % of the total river flow downstream.

According to information obtained from the facility there are approximately 714 sewer connections and 1,786 persons connected to the municipal sewer system. Theoretically, this should generate approximately 304 pounds of BOD loading at the WWTP. Over the past few years the BOD loading at the plant was significantly lower than this estimated value, which is approximately ½ of the design load of 600 pounds of BOD. The BOD loads at the plant have increased steadily with Elkland's work on reducing inflow and infiltration (I&I) in the collection system. Molasses is currently added to the raw wastewater to supplement the low BOD loadings at the plant.

This site was chosen for the WPPE because of its proximity to the NT DW plant, PWSID 2590051, intake which is located approximately 2.7 miles directly downstream of Elkland's outfall. The NT water works serves a population of 300 people and employs a conventional filtration process.

Elkland's overall operating efficiency appears to be very good with no recent violations of its operating permit. Following deployment of the WPPE equipment, the instrumentation was used to collect data that supplemented existing operations by providing the operator with additional process data used when making decisions on modifying treatment plant control with the ultimate goal of improving effluent quality.

Background samples were collected on August 11, 2010, and process samples were taken every week during the WPPE and analyzed by the DEP's Bureau of Laboratories facility in Susquehanna Township, Dauphin County. A summary of the results for all sampling is listed in Attachment D.

Figure 3.1, below plots Elkland's treatment plant and outfall to the Cowanesque River along with the NT water works drinking water intake.

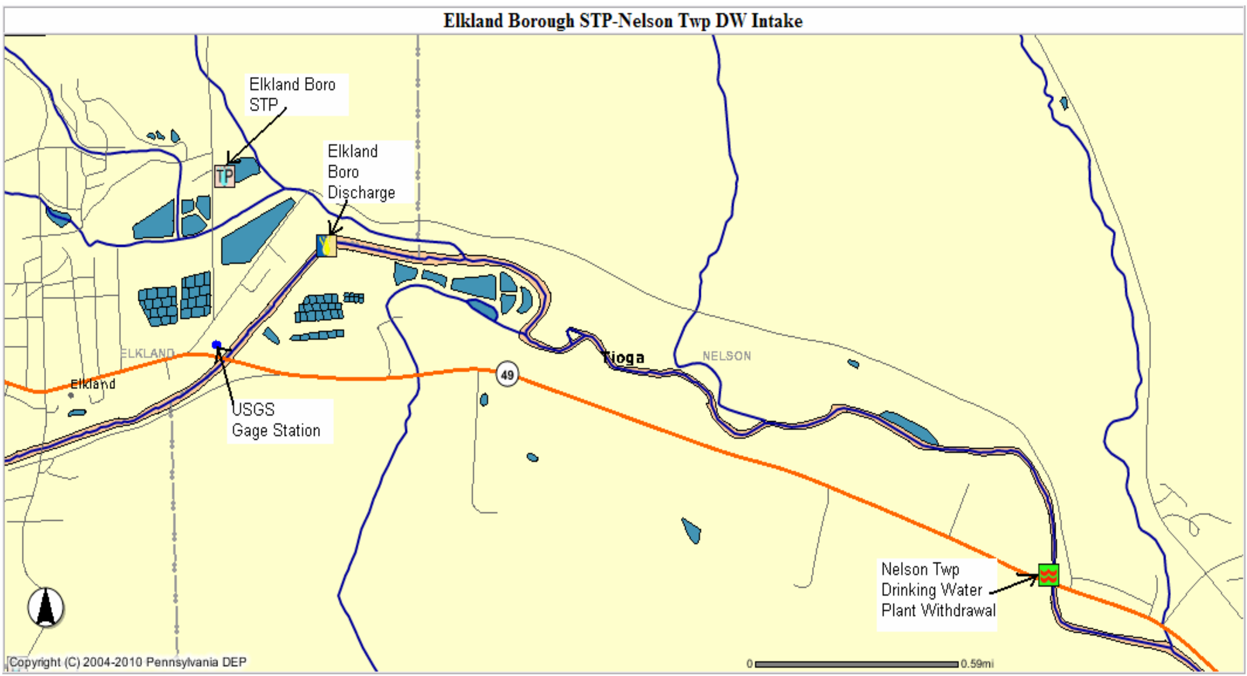

Figure 3.1. Elkland WWTP and NT drinking water intake

Past Performance

During file review, the Department reviewed the facility's NPDES Permit, its Part II Permit, Water Quality Protection Report, monthly Discharge Monitoring Reports (DMR), Chapter 94 Report, as-built drawings, and available daily process monitoring records.

DMRs for all of 2009 through September 2010 were reviewed in order to develop an understanding of the facility's daily operating ranges. For 2009, the annual average flow was 0.374 MGD and the peak monthly average flows of 0.513 MGD was recorded in March 2009. For 2010 (January through September), the average flow was 0.356 MGD and the peak monthly average flow of 0.575 MGD occurred in March 2010. These records, when thoroughly reviewed, indicate that the collection system is impacted by inflow/infiltration during wet weather events. Rainfall tends to increase flows at the plant rather quickly indicating sources of inflow within the collection system. The Wasteload Management Reports contribute the excess flows to some sections of the collection system that are constructed of older vitrified clay pipe. The Borough is currently reviewing proposals for improvements to the River Street area of the collection system.

The EBA WWTP appears to consistently produce effluent of a good quality and the results of this project along with the review of DMRs for calendar years 2009 and 2010 supported this conclusion, see Tables 3.1 and 3.2 below.

Elkland Boro STP
2009 DMR Data

Date	Flow Avg. Mon	Flow Max Daily	Eff pH min	Eff pH max	Eff Fecal Avg Mon	Influent BOD-load Avg Mon	Influent BOD-conc Avg Mon	Eff TSS Avg Mon	Eff TSS Avg Wkly	Ammonia Nitrogen Avg Mon	Ammonia Nitrogen Avg Wkly	Effluent CBOD-5 Avg Mon	Effluent CBOD-5 Avg Wkly	Eff TRC Avg Mon	Eff TRC Inst Max	Eff Total Phos
Jan	0.340	0.554	7.6	7.7	32	275.5	98.5	5.5	7	11		8	10	0.55	0.58	1.1
Feb	0.396	0.695	7.2	7.7	76	324	105	9	16	12		6.5	7	0.53	0.58	2
Mar	0.513	0.835	7.2	7.7	44	265	68	6	8	9.8		7	10	0.54	0.58	1.57
Apr	0.330	0.563	7.2	7.5	39	254	77	10	15	11		6	26	0.34	0.58	2.06
May	0.354	0.544	7.2	7.4	16	286	102	9	18	13		6	6	0.55	0.58	2
Jun	0.457	0.899	6.8	7.3	3	231	60	7	13	2		6	6	0.55	0.58	1
Jul	0.440	0.644	7.1	7.4	2	675	202	5	5	0.9		6	6	0.43	0.58	0.96
Aug	0.407	0.561	6.9	7.7	2	254	80	5	5	0.1	0.1	6	6	0.26	0.4	1.2
Sep	0.341	0.385	7.4	7.8	2	244	108	5	5	0.1	0.1	6	6	0.31	0.38	1.59
Oct	0.313	0.459	7.2	7.6	3	247	116	5	5	0.15	0.3	6	6	0.26	0.36	0.95
Nov	0.242	0.371	7.4	7.7	13	178	68	5	5	0.1	0.1	6	6	0.34	0.48	1
Dec	0.351	0.607	7.5	7.8	17	219	79	7	14	0.1	0.1	6	6	0.35	0.49	1.27
Min	0.242	0.371	6.8	7.3	2	178	60	5	5	0.1	0.1	6	6	0.26	0.36	0.95
Max	0.513	0.899	7.6	7.8	76	675	202	10	18	13	0.3	8	26	0.55	0.58	2.06
Avg	0.374		7.2	7.608333	21	287.7	97.0	6.5	9.7	5.0	0.1	6.3	8.4	0.4	0.5	1.4

Table 3.1. Elkland WWTP 2009 DMR data summary

Elkland Boro STP
2010 DMR Data

Date	Flow Avg. Mon	Flow Max Daily	Eff pH min	Eff pH max	Eff Fecal Avg Mon	Influent BOD-load Avg Mon	Influent BOD-conc Avg Mon	Eff TSS Avg Mon	Eff TSS Avg Wkly	Ammonia Nitrogen Avg Mon	Ammonia Nitrogen Avg Wkly	Effluent CBOD-5 Avg Mon	Effluent CBOD-5 Avg Wkly	Eff TRC Avg Mon	Eff TRC Inst Max	Eff Total Phos	Rainfall Inches
Jan	0.442	0.672	7.2	7.7	10	274	67	9	13	0.2	0.5	6	6	0.39	0.83	0.65	3.5
Feb	0.377	0.549	7.2	7.5	16	220	70	6	10	1.4	2.8	6	6	0.33	0.58	1.02	0.83
Mar	0.575	0.953	7.2	7.5	30	232	54	5	5	1.63	4.09	6	6	0.27	0.45	0.78	3.54
Apr	0.398	0.574	7.1	7.4	12	217	61	5	5	0.5	1.3	6	6	0.3	0.44	1.03	2.41
May	0.376	0.449	7.1	7.3	10	247	82	5	5	0.1	0.1	6	6	0.28	0.48	0.9	4.14
Jun	0.381	0.526	7	7.2	10	271	89	5	5	0.1	0.1	6	6	0.28	0.41	1.12	3.01
Jul	0.288	0.37	7	7.3	10	234	103	5	5	0.1	0.1	6	6	0.26	0.35	1.16	7
Aug	0.243	0.345	7	7.3	17	238	118	5	5	0.1	0.1	6	6	0.22	0.31	1.01	2.41
Sep	0.212	0.571	7	7.3	22	169	104	5	5	0.25	0.9	6	6	0.28	0.64	1.11	4.12
Oct	0.409	0.721	7	7.3	10	228	75	5	5	0.1	0.1	4	7	0.28	0.5	0.78	
Nov																	
Dec																	
Min	0.212	0.345	7	7.2	10	169	54	5	5	0.1	0.1	4	6	0.22	0.31	0.65	0.83
Max	0.575	0.953	7.2	7.7	30	274	118	9	13	1.63	4.09	6	7	0.39	0.83	1.16	7
Avg	0.366		7.1	7.38	15	233.0	82.3	5.5	6.3	0.4	1.0	5.8	6.1	0.3	0.5	1.0	3.4

Table 3.2 Elkland WWTP 2010 DMR data summary

Current Performance

During the period of the evaluation, the Department observed that the facility was operating satisfactorily with nitrification occurring within both aeration basins. There was ample alkalinity and pH in the plant effluent, 142.8 mg/L and 7.9 s.u. respectively, indicating that a sufficient amount of alkalinity for nitrification. Targets values for alkalinity and pH are at least 50mg/L alkalinity in the effluent and a pH of 7.5 s.u. in the aeration basins.

Flow into the treatment facility averaged 0.264 MGD and BOD concentrations averaged 211.1 mg/L over the course of the WPPE. The calculated average BOD loading using daily BOD and daily flow was 465 lbs/day. The flows were approximately 38% of the design flow and approximately 78% of the permitted organic loadings that the plant is designed to treat. Influent sample data is included in Attachment D and is based on grab sample events, except the 9/8 effluent sample which was a split composite.

At the start of the WPPE on August 26th the following data was collected:

Parameter	North Tank	Anticipated Values*
F/M ratio	0.07	0.03-0.10
Hydraulic Retention Time	86 hrs	24-48 hrs
Sludge Age	27 days	50-70 days
Sludge Volume Index (SVI)	198	75-125

* Anticipated values were gathered from the Biolac Treatment System, Aeration System Description

The F/M ratio was in the middle of the range set forth in the design manual for the Biolac system. While the influent BOD levels are generally on the low side, the MLSS is also on the low side which works together and provides a consistent F/M ratio. Throughout the WPPE project, the operator increased MLSS values which corresponded to increases in influent BOD values while the flow levels were low. At the end of September and beginning of October when flows jumped due to rainfall, the F/M ratio dropped with the dilution of influent BOD as expected. Overall the F/M ratio remains within the design criteria, but the solids levels were low and influent BOD remains low. The F/M ratio averaged 0.06, with a maximum of 0.07 and a minimum of 0.04. If the solids levels in the aeration basins were increased, while maintaining settleability in the ½ hour settleability tests, the resulting SVI values would be in the anticipated range. Decreasing wasting within the plant would decrease the F/M ratio, the SVI, and increase the Sludge Age but could lead to pop ups on the clarifier surface and increased manual labor cleaning the clarifiers. It will take the operators expertise and experience to determine the exact set points for maximum performance.

Figure 3.2 Elkland headworks auger system

Headworks

The facility headworks consist of a channel monster device to shred solids and inert materials and an auger device to remove the solids form the system. Since being moved from its previous location the auger system does not operate properly. The operator has attempted to work with the manufacturer and equipment installer for repairs with limited success. If this device were operable as designed there would be much less solids materials continuing on throughout the plant which will impair pumps and more importantly take a significant amount of the operators time to remove the accumulated solids at various locations throughout the plant including the bar screens after return activated sludge pumps and the surface of clarifiers.

According to the facility's most recent Chapter 94 reports, the facility is not projected to exceed its hydraulic and organic operating capacity. However, the influent loading concentrations appeared rather low. After reviewing previous Chapter 94 reports it was apparent that organic loading levels had been much lower previously but appear to consistently improve with the removal of I/I from the collection system. If these successes were indicative of future efforts then the continued removal of I/I should result in the cessation of molasses addition, additional cost savings.

Figures 3.3 and 3.4 depict the monthly average hydraulic loadings from 2009 and 2010.

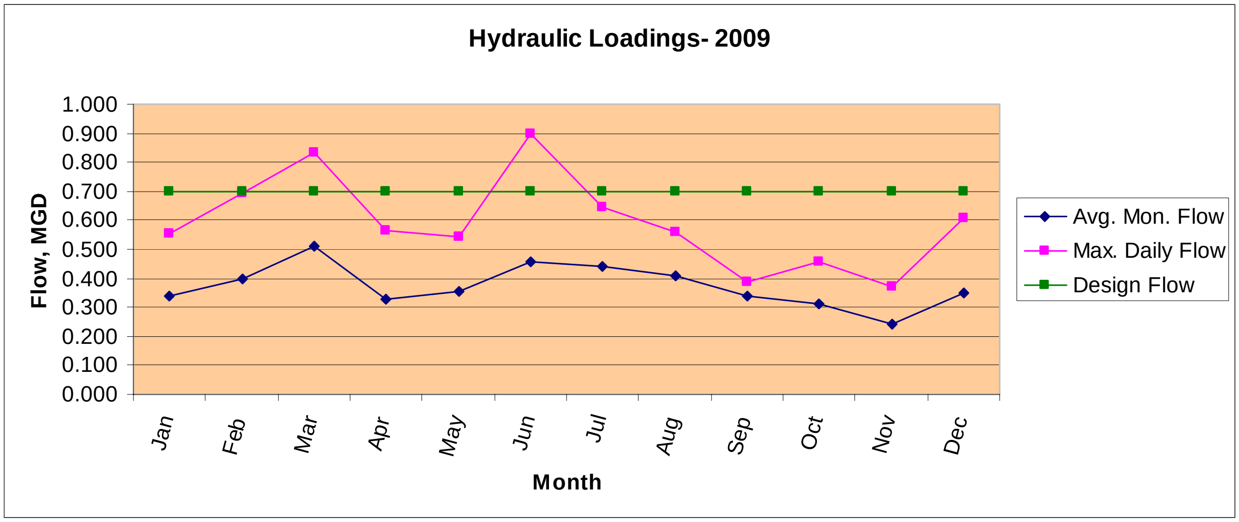

Figure 3.3 Elkland 2009 hydraulic loadings

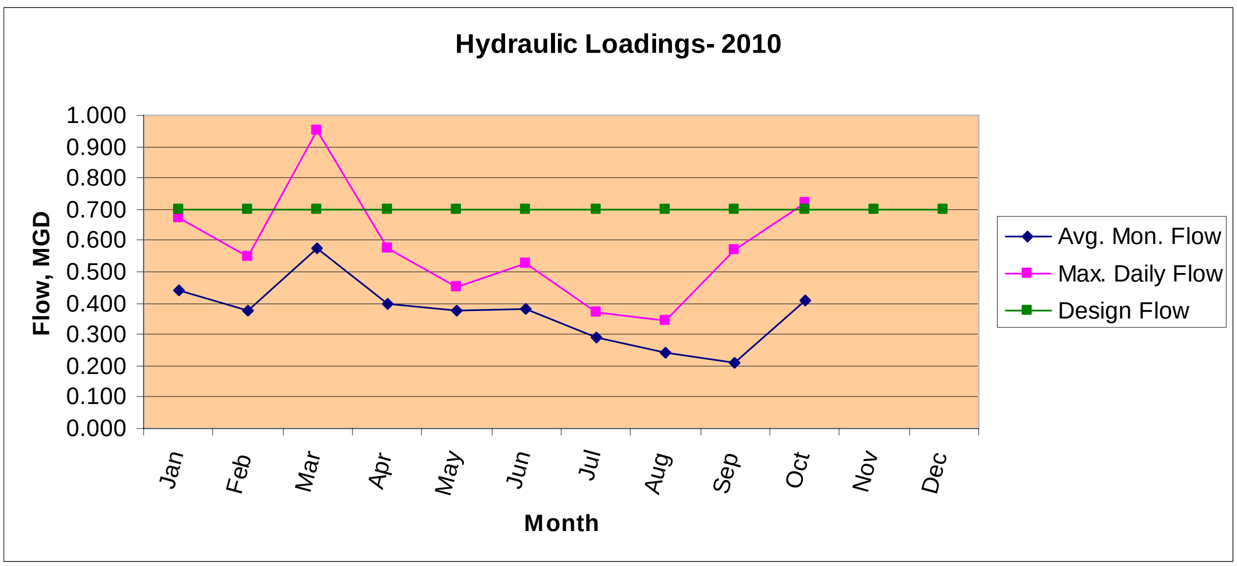

Figure 3.4 Elkland 2010 hydraulic loadings

Figure 3.5, shows the daily flow readings over the course of the WPPE. A summary of daily flow measurements for August through October 2010 is listed in Attachment E.

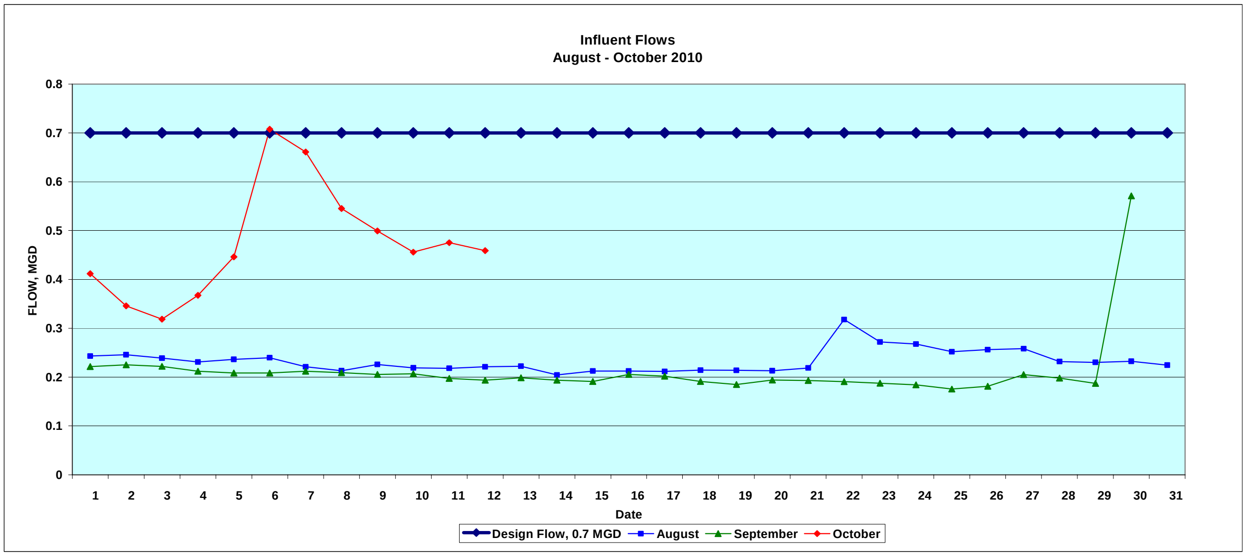

Figure 3.5. Daily flow readings over WPPE

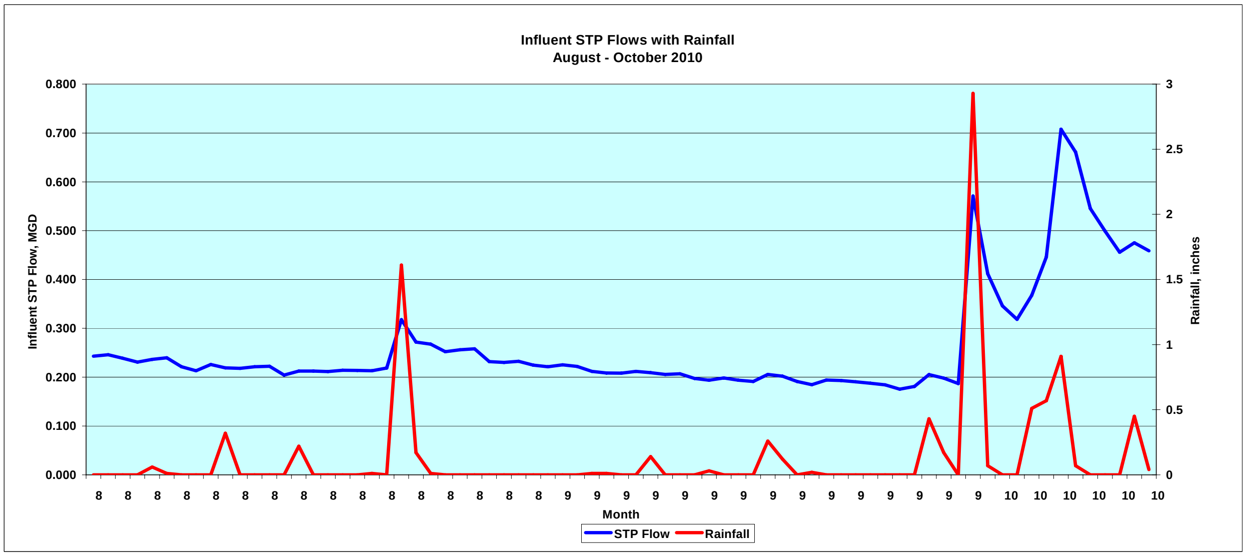

Figure 3.6 Daily rainfall versus flow

Figure 3.6, above, depicts rainfall versus influent flow at the plant. By reviewing the data, it appears that it takes a rainfall of approximately 1 inch within 24 hours to have a measurable impact on influent flows. At the same time, the influence is rather significant. Elkland continues work on the River Street section of its collection system since there is significant I&I in that area.

Organic loadings, which are generally less than half of design loadings, are depicted below in Figures 3.7 and 3.8. The surge in loadings during July 2009 coincides with plant startup. The EBA was seeded with 8000 gal of sludge from a local wastewater plant during April 2009.

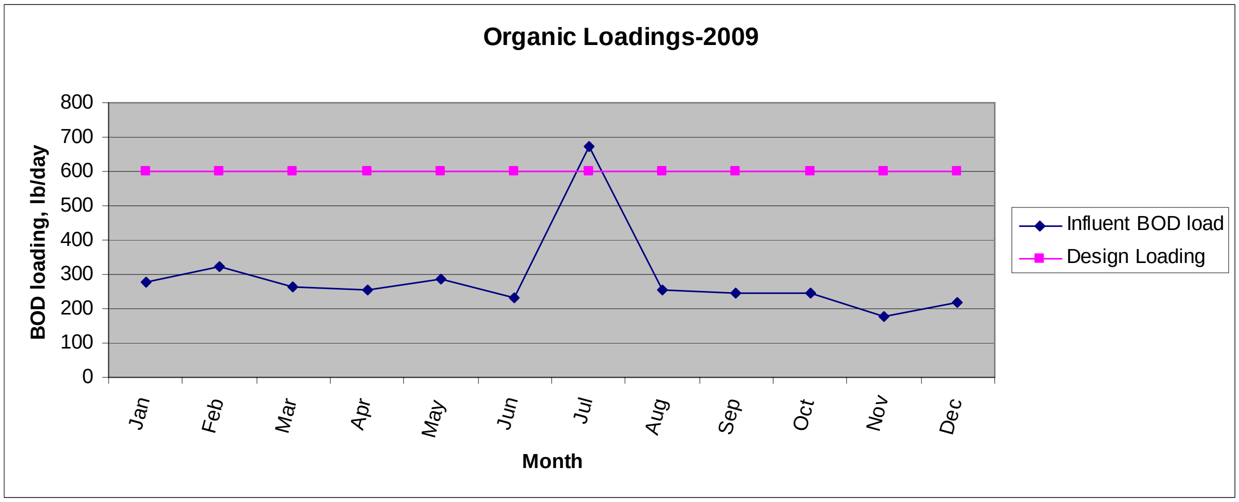

Figure 3.7 2009 Organic loadings

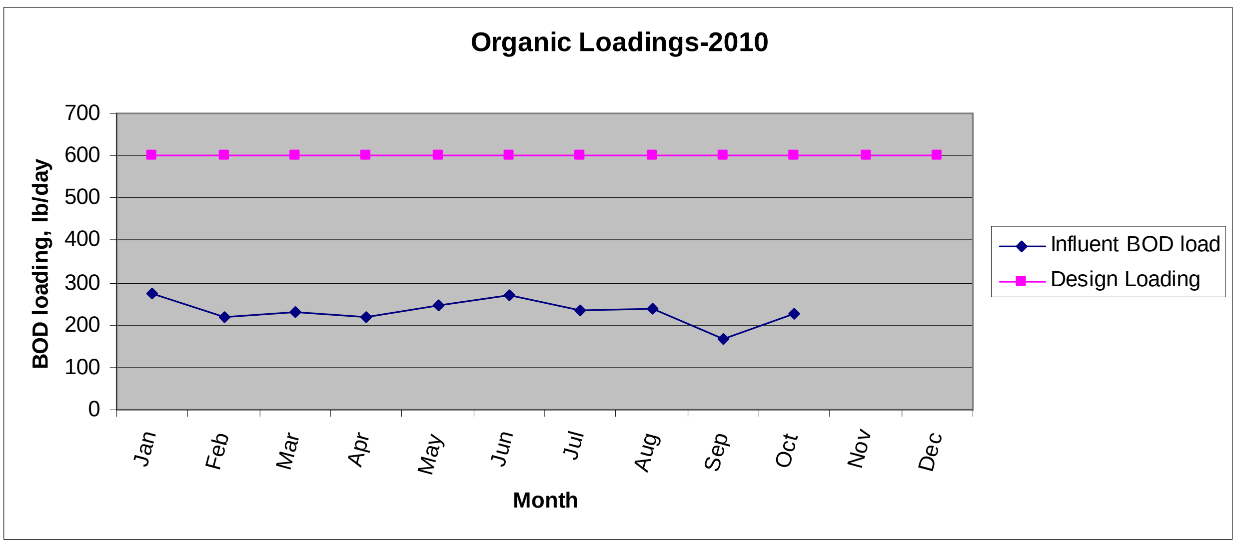

Figure 3.8 2010 Organic loadings

Aeration

Two secondary aeration lagoons each having a capacity of 915,000 gallons provide the bulk of treatment at the facility. Only one lagoon is utilized due to generally low flows and influent BOD loadings. A computerized system controls the each of five rows of aerators turning them on and off in certain sequences to operate the section in either aerated mode or an anoxic state depending whether nitrification or denitrification is the intended operating mode. Fine bubble diffusers are used for air distribution in both units. For the WPPE, the Department installed instruments in the north lagoon, Lagoon 1A, which is utilized for treatment at the facility. Aeration within the north lagoon was rather consistent; this is explained further in the section on DO Profile. The WPPE confirmed that nitrification and denitrification are occurring in the north lagoon and on/off times were adjusted to attempt maximizing denitrification resulting in the lowest nitrate results possible. At times during the WPPE, the ammonia probe provided false elevated values. The overall rise in ammonia levels was accurate but the exact extent was exaggerated by the on-line ammonia probe. Bench tests confirmed the lagoon was maintaining nitrification, as did the fact that denitrification was able to occur. Some large rainfall events occurring after aeration time adjustments were made, along with emptying Lagoon 3 into Lagoon 2 which then decants to Lagoon 1A, impacted the clarity of the results showing the benefits in nitrate reduction.

Secondary Settling

Each lagoon discharges to two attached clarifiers. Here, activated sludge solids settle by gravity and are withdrawn using air lift return sludge pumps, for reintroduction to the lagoons. Both settling tanks have an approximate capacity of 51,000 gallons each. The return sludge pumps can be roughly adjusted as desired to maintain optimal conditions in the settling tanks and aeration basins. The aeration tank blowers also provide the air to the return sludge pumps.

Typically, the clarifiers operate with sludge blankets in the 2.5 foot range. The operator measures the blankets daily as part of his testing regimen and uses the results to modify wasting schedules. While the Sonatax probe measures the solids blanket in the clarifier its output can be influenced by changes in wasting rates and or clarity of the clarifier contents. Overall, throughout the project the clarifier operated well with a steady sludge blanket around 2.5 ft. Sludge wasting occurs every 82.5 minutes for 7.5 minute duration, 16 times daily.

Figure 3.9 Surface skimmer in west clarifier

The Sonatax probe measured the blanket near the center of the tank where the solids collection mechanism operates due to restrictions on where its mounting bracket could be located. The operators solids blanket measurements were taken from the flat floor area of the clarifier to the north side of the solids collection mechanism. The difference in depth between the two locations was approximately 1.5 feet which correlates to the readings measured with the Sonatax probe.

Figure 3.10 Surface skimmer coupling in west clarifier

The surface skimmers are rather ineffective as shown in Figure 3.9, above. The floating skimmer is too short to cover the entire width between the wall of the clarifier and the overflow weir. As a result, floating solids move around the end of the float instead of being pushed into the skimmer discharge trough. Also, the surface skimmer discharge trough is attached to its associated piping with a pipe coupling which does not allow it to turn freely, see Figure 3.10, left. As you turn the skimmer to skim solids the coupling loosens, which could allow excess flow to enter the attached discharge pipe, and as the skimmer is closed the coupler is tightened. A coupler designed to rotate in the middle would allow the device to turn much more freely reducing stresses on the component rotating the skimmer trough, some of which appear to be made of plastic. The pipe coupling is constructed of white PVC.

Bio-solids removal

The EBA plant has 1 entire lagoon, Lagoon 2, for solids holding, Figure 3.11 below. It is constructed similar to the existing Lagoons 1A and 1B but its sole purpose is as an aerobic digester. It has a 2,000,000 gallon capacity and solids have not been removed in several years and, while the operator maintains observations of solids accumulation in the lagoon, no solids removal is scheduled in the near future. It will be important to maintain an accurate inventory of solids since waste sludge will need to be removed some day, regardless of the size of the holding tank. And, of course, the larger the tank the more solids will accumulate and the more solids that will need removed, increasing costs significantly. The levels of solids accumulation in Lagoon 2 must be closely monitored to ensure the automatic decant mechanism does not transfer solids back to the influent. Solids are wasted to the holding lagoon automatically for 7 ½ minutes every 82 ½ minutes each day based on MLSS solids levels in Lagoon 1A. This equates to 2 hours of wasting each day. The operator is very consistent with testing the solids levels throughout the plant daily to identify trends. Adding a centrifuge to the operator's laboratory would provide more accurate on solids levels throughout the treatment process and much more quickly.

Figure 3.11 Lagoon 2, solids holding lagoon

Disinfection

The EBA facility utilizes sodium hypochlorite for disinfection of the treated wastewater. There are two chlorine contact tanks, each approximately 10,300 gallons. Following chlorine injection, the effluent flows through the chlorine contact tanks and finally to the outfall on the Cowanesque River approximately 1100 feet away.

Figure 3.12 below shows the sodium hypochlorite storage area and Figure 3.13 shows the chlorine contact tank discharge.

Figure 3.12 Sodium hypochlorite storage area

Figure 3.13 Chlorine contact tank discharge

4. Equipment Installation & Calibration

On August 10, 2010, DEP staff arrived at EBA to diagram the instrument layout and install the on-line probes and associated communication lines between probes and SC1000 control unit.

The on-line monitoring equipment is described as having microprocessor technology built into each probe. Each probe has sufficient memory to retain several days' worth of readings. The SC1000 base units are microprocessor-driven routing and transit units, working in conjunction with detachable display units. The display units are used to calibrate the attached instruments, in addition to relaying information to other microprocessors. The technology allows plant operators to observe and track operational trends that can be interpreted using readily available literature, reinforcing an operator's process control decisions and showing him/her, in real time, the results of process changes that affect plant performance. The entire system is capable of being combined with a Supervisory Control and Data Acquisition (SCADA) operations and monitoring system.

The equipment utilized in this WPPE contains a portable notebook computer for displaying the continuous signals from the digital probes. This is an enhancement, as the SC1000 units installed also support displays that provide graphical depiction of trends collated from the data recorded by the probes.

This WPPE utilized a sufficient number of probes to allow for monitoring equipment to be installed in one aeration tank. The south tank was chosen because it receives slightly more flow than the north tank.

The installations were:

- 1 Hach SC1000 base unit
- DO, ORP, Total Suspended Solids, Solids Blanket Level, Nitrate, and Ammonia sensors in the north treatment train

Attachment F shows a diagram of where the continuous monitoring probes were installed.

Continuous Digital Monitoring

The installation at this facility was set to log all measured parameters at 15 minute intervals. Data collected from the probes is transferred via digital signal to a SC1000 base unit which then transferred the data to a laptop computer to log the values in spreadsheet format. A summation of all logged data is provided in electronic format on a CD provided along with this report. The continuous logging function allowed the operator to view live data representing the current operating conditions of the WWTP. With this data the operators were able to review real-time data and make on the spot adjustments to the treatment process as desired. The continuous monitoring digital probes provide the plant operators with graphical output that allows them to see how the tested parameters fluctuate during a variety of conditions.

Laboratory Equipment

As part of the WPPE program, the continuous monitoring digital probes provide the plant operators with graphical output that allows them to see how the tested parameters fluctuate over time. However, the optimization program supplements their use by making available portable laboratory equipment at no cost to the facility, to be used for obtaining process monitoring "snapshots" of plant conditions using relatively simple test methods . This equipment was also utilized to verify the quality of data being collected with the digital probes. The process monitoring equipment may be purchased at modest cost from a variety of vendors and included:

-
- Raven Products centrifuge, settleometers, and clarifier core-taker for sampling and testing according to sludge inventory methods developed by Al West and cited in Activated Sludge Manual of Practice No. OM-9
- Microscope with digital recording camera and computer interface
- Portable spectrophotometer and packaged wastewater lab, for colorimetric analyses of water and wastewater parameters
- Chemical Oxygen Demand (COD) heater block and test kit
- Hach portable HQ40d microprocessor with LDO, pH, and BOD probes adapted to rough service.

Figure 4.1 Lab equipment setup during Elkland WPPE

The purpose of this equipment is to supplement the digital recording probes with a variety of lab tests that can be performed by plant operators to track solids inventory, health and condition of the biomass, and relative strength of incoming wastewater. A small lab set such as this can be used in lieu of digital equipment, long after the WPPE has finished. Figure 4.1 at left is the laboratory equipment arrangement at Elkland as part of the WPPE.

The additional testing is intended to provide an operator with data needed to develop Mean Cell Residence Time (MCRT), Food to Mass Ratio (F/M), or Sludge Age (AGE) methods of managing activated sludge treatment facilities.

The EBA operator performs a large amount of process control testing including: settleability and total solids testing on the mixed liquor, pH and DO at various locations throughout the process, and monitors alkalinity to ensure effective nitrification conditions. The operator is seeking to acquire additional equipment to allow him to more closely monitor nitrification, denitrification, and additional parameters. The Department encourages facilities to conduct process control testing such as this to ensure maximum efficiency in the treatment processes. Since the facility is regulated on the amount of Total Nitrogen that it discharges, additional testing equipment for analysis of nitrate, ammonia, and phosphorus would greatly assist the operator. The operator performs pH and Total Residual Chlorine testing for effluent testing as required.

There were a significant number of process control tests performed during the WPPE, some representative spreadsheets of the output data are included at Attachment G. All process control test results are included in electronic format on the included CD Rom.

Sampling & Tests Ordered

Sampling and testing for facility operating and effluent conditions, as well as those of the background receiving stream and at the downstream water works, varied during our attempts to refine program requirements. Typically, water and wastewater samples were tested according to standardized suites of analyses used in testing compliance samples.

Our water chemistry sample locations were:

- INF: Influent Wastewater—sampled prior to the channel monster, to assay the waste stream entering the Biolac process;
- EFF: Final Effluent—sampled at chlorine contact tank discharge
- UPS: Upstream of Outfall 001—sample background conditions of the receiving stream at least 100 meters upstream of the outfall so as to avoid influence of plant discharge;
- DWS: Downstream of Outfall 001—sampled at the raw water tap of the Nelson Township water filtration facility to determine the effect of plant effluent on receiving water quality and its impact on raw water for the PWS filtration system;
- MLSS: Lagoon 1A Mixed Liquor Suspended Solids—sample at the south (discharge) end of the lagoon, near where the instruments had been placed;
- RAS: Return Activated Sludge--sampled at point where both sludge return are combined before mixing with the influent and returning to Lagoon 1A

A typical analysis suite included tests for BOD_5, pH, TSS, VSS, NH-N, NO2-N, NO3-N, TKN, (TN by calculation,) TP, Alkalinity, and Chlorides. Fecal Coliform was also tested on Upstream, Effluent, and Downstream samples. Additional testing may have been added to clarify specific issues or as part of the evaluation.

Of special interest to the project were the Method 1623 Pathogen Assays employing antibody markers, analyses performed at DEP Bureau of Laboratories. The program required three pathogen assays for the project: Initial, Intermediate, and Final conditions.

A summary of all the Bureau of Laboratories test results is located in Attachment D with copies of the lab reports.

5. Process Monitoring

Interpretation of Data

Beginning on August 10, 2010 and lasting until October 13, 2010 the Department continuously obtained digital data from the on-line probes installed at EBA.

Attachments I and J include graphs of monthly and daily data, respectively, collected by the digital probes.

During the project, the operator adjusted aeration times via the Waveox controller. The first adjustments were made on September 8th, see Figure 5.1 below. These included turning off the 5th row of diffusers nearest the influent end of the lagoon and leaving rows 2 and 3 start and stop together at 60 minute intervals. When rows 2 and 3 were not operating, row 4 would initiate for 60 minutes. Vice versa, when row 4 was off, rows 2 and 3 were on. The 1st row of aerators always remains in operation and cannot be shut down via the Waveox. According to the operator, Elkland's control of the Waveox computer system is very limited and aeration times cannot be adjusted to intervals longer than 60 minutes. The results of these adjustments appeared very promising as viewed below.

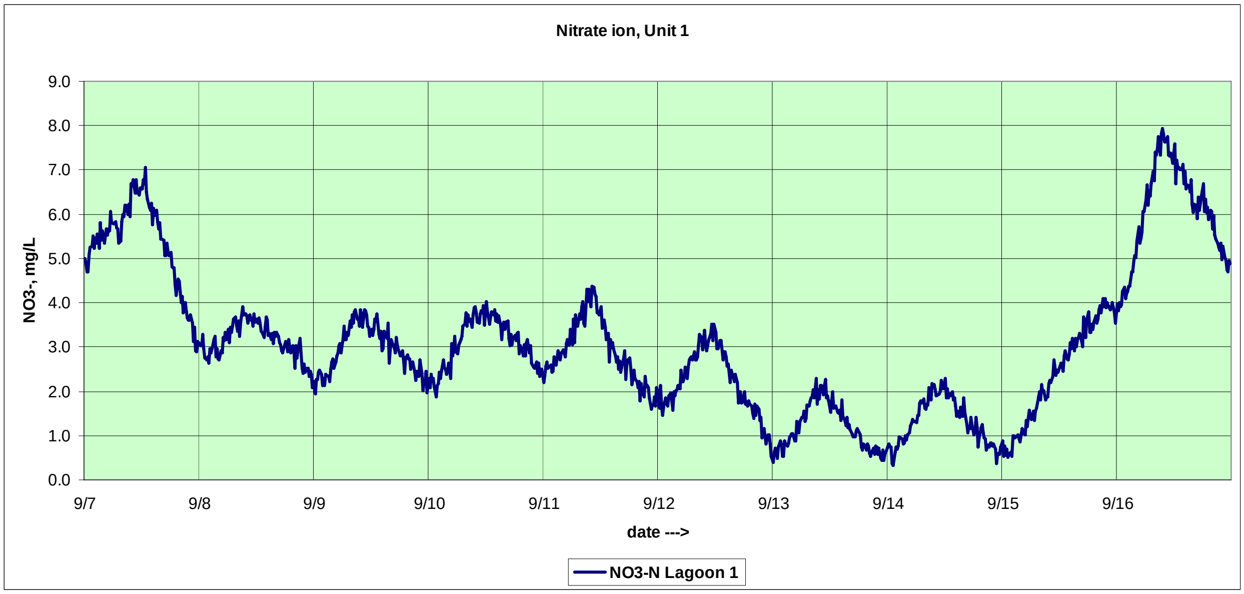

Figure 5.1 Nitrate-N data for Lagoon 1A, 9/7 through 9/16

Further adjustments made on September 15 included leaving rows 2 and 3 always on. While the ammonia trended downward the nitrate levels increased. Again, the ammonia readings were abnormally high due to problems with the probe but it was trending accurately; the device is intended to be used for trending and not a measurement device. Since this change was not beneficial to the denitrification process, the Waveox system was adjusted back to the modification made on September 8th. It took some time for the system to return to its initial conditions.

Figures 5.2 and 5.3, below, show the effects of DO on the nitrate levels in Lagoon 1A. The lower DO values, as measured at the south end of the lagoon near discharge to the clarifier, are associated with lower nitrate values.

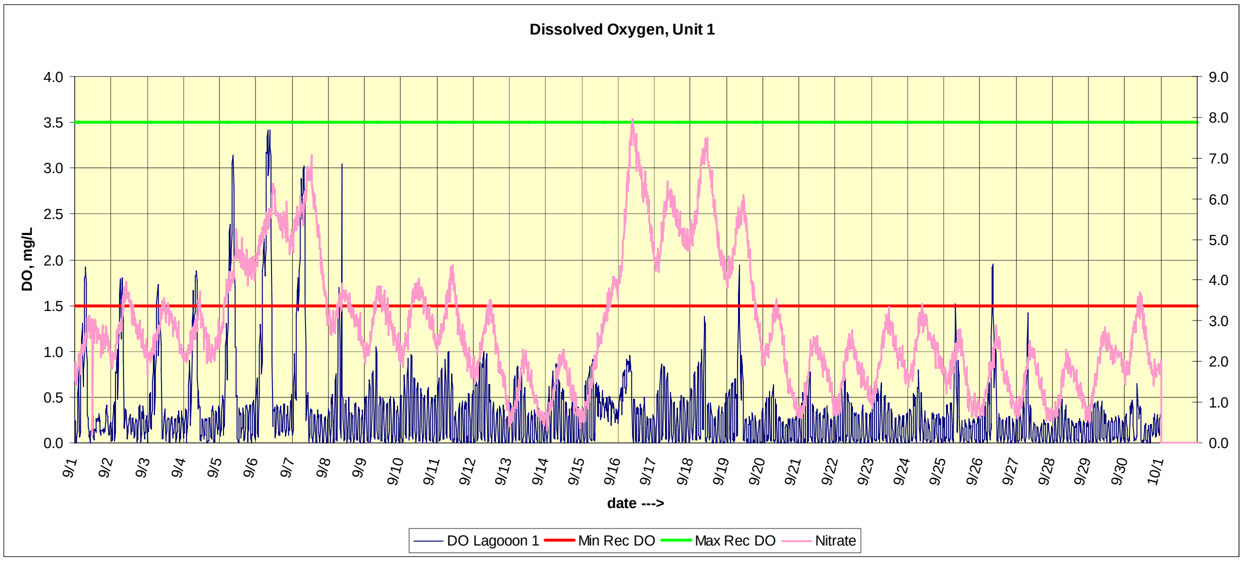

Figure 5.2 Effects of DO on nitrate levels in Lagoon 1A, September

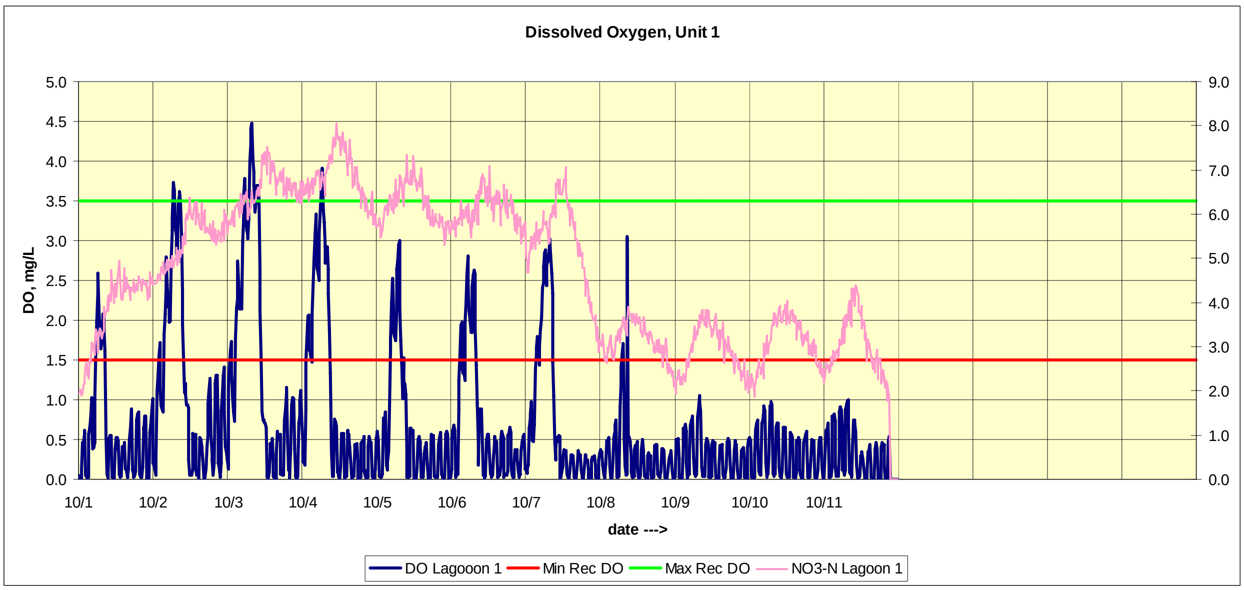

Figure 5.3 Effects of DO on nitrate levels in Lagoon 1A, October

As one would expect, there was variability in the process data which is attributed to it being a biological process under influence from varied influent loadings due to I/I issues in the sewage collection system.

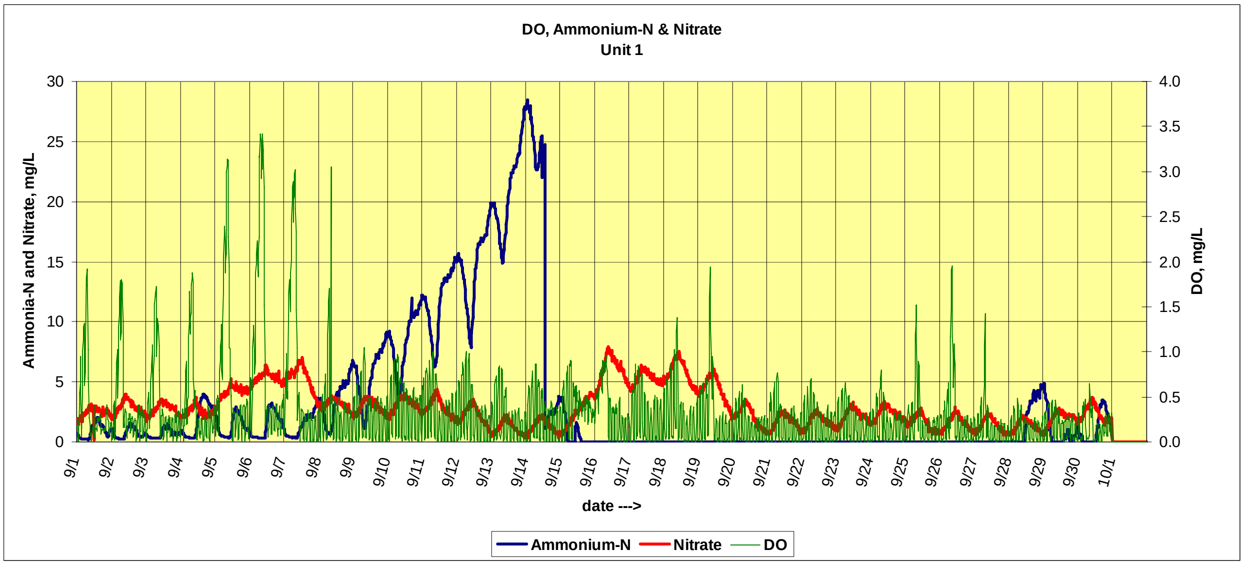

Figure 5.4 Effects of DO on ammonium levels in Lagoon 1A, September

Figure 5.4 shows the effects of DO on Ammonia levels in Lagoon 1A. The Ammonia probe is intended to be used as a trending device unlike the Nitrate probe that provides very accurate data. The Ammonia levels above rise quite high, while in reality, the actual levels were measured in the lab at 0.898 on September 14th.

It is vital for plant operators to perform regular process monitoring tests to assay the condition of their facility and to look for trends that both support process control decision-making as well as predict future plant performance under changing conditions. Process monitoring equipment manufacturers and regulatory personnel generally suggest that equipment such as centrifuge equipment, sludge settleometers, and core-takers, to name a few, be employed on a daily basis in order to monitor the health of the facility. Likewise, use of the digital spectrophotometer and accompanying portable wastewater lab chemical test kits will allow an operator to assay any number of chemical parameters for process monitoring and control purposes. Even those facilities who employ an independent contractor for operations and/or compliance reporting do need to regularly conduct process monitoring tests of their facility systems. Once this data is collected it should be trended to identify the optimal set points for various parameters including DO, MLSS, waste rates and pH to name a few. When future situations arise the operator can refer to the trending data to identify the conditions during a previous similar situation and see what remedial actions were taken to rectify the issue. Without having trending data, an operator is starting at square one for each occasion where the plant experiences an abnormal condition. Trending is also very important when more than one operator runs a treatment plant or even more importantly when a secondary operator only occasionally operates the plant.

Shown below in Figure 5.5 is a graphical representation of DO versus time in the North lagoon for October 10, 2010. The blowers at this facility are computer controlled. There are 5 rows of aerators set to turn on and off at various times based on preset conditions within the Waveox computer controller. Currently, the settings for the 2nd and 3rd rows of aerators are set at 60 minutes on and 60 off. The row of aerators nearest the clarifier where the probes were placed is constantly on. As seen in the figure below, the DO readings recorded by the on-line probe reflect the 60 minute on-off cycles. Generally the target DO range is between 1.5 to 3.0 mg/L within an aeration basin for enough free oxygen to be present for nitrification to occur. Because the Biolac system utilizes a lagoon with sections that are either aerobic or anoxic based on Waveox settings and the amount of oxygen provided to the particular section, this generality does not apply to the results gathered by the online monitoring probe. What is significant is that based on the project findings, when monitoring DO near the entrance to the clarifier, where Elkland monitors DO, the most effective results for nitrate reduction occurred when DO levels were below 1.0 mg/L as measured where effluent enters the clarifier.

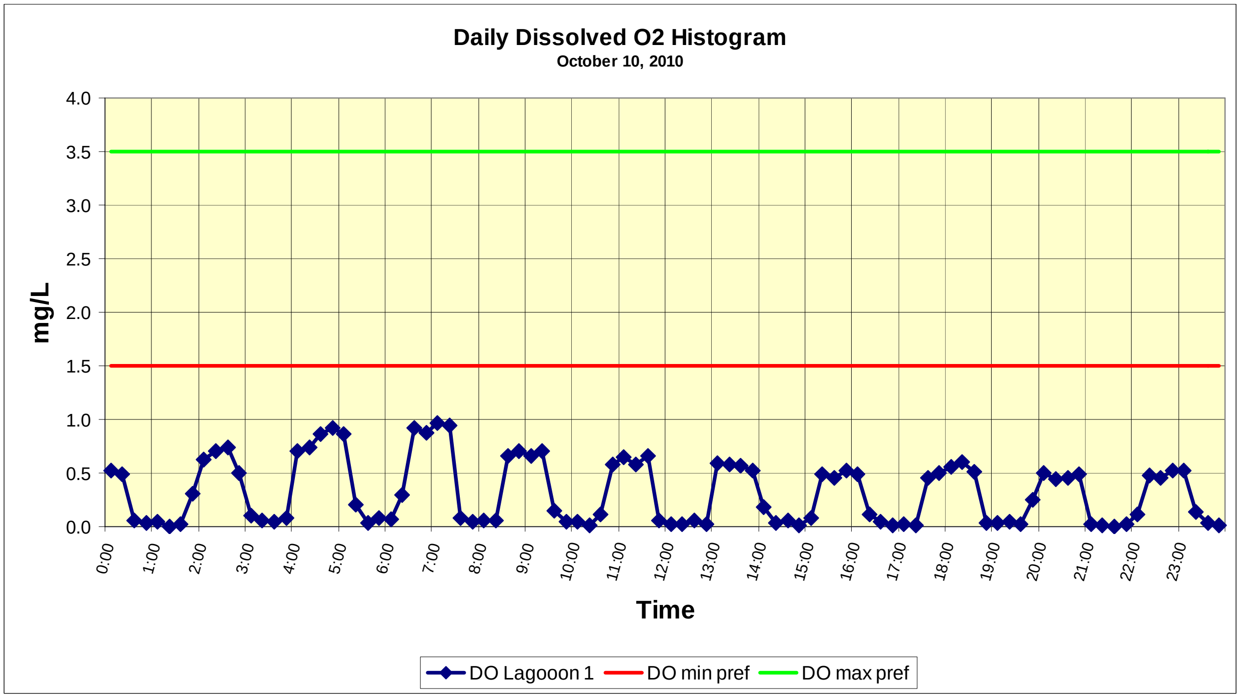

Figure 5.5 DO vs. time, October 10, 2010

As shown below in Figure 5.6, lower ORP trends were associated with lower nitrate levels in the aeration lagoon discharge. ORP levels need to be below 100 millivolts before denitrification can begin to occur. Generally, ORP levels near 0 mV identify anoxic conditions in the wastewater where the nitrate in the wastewater is utilized in lieu of free oxygen result in conversion back to nitrite and Nitrogen gas is further released. The ammonia sensor is designed as a trending device, and trended correctly during the WPPE, but at times provided resultant data that was incorrect.

Figure 5.7 again shows the lower ORP levels resulting in lower nitrate levels in Lagoon 1A during October.

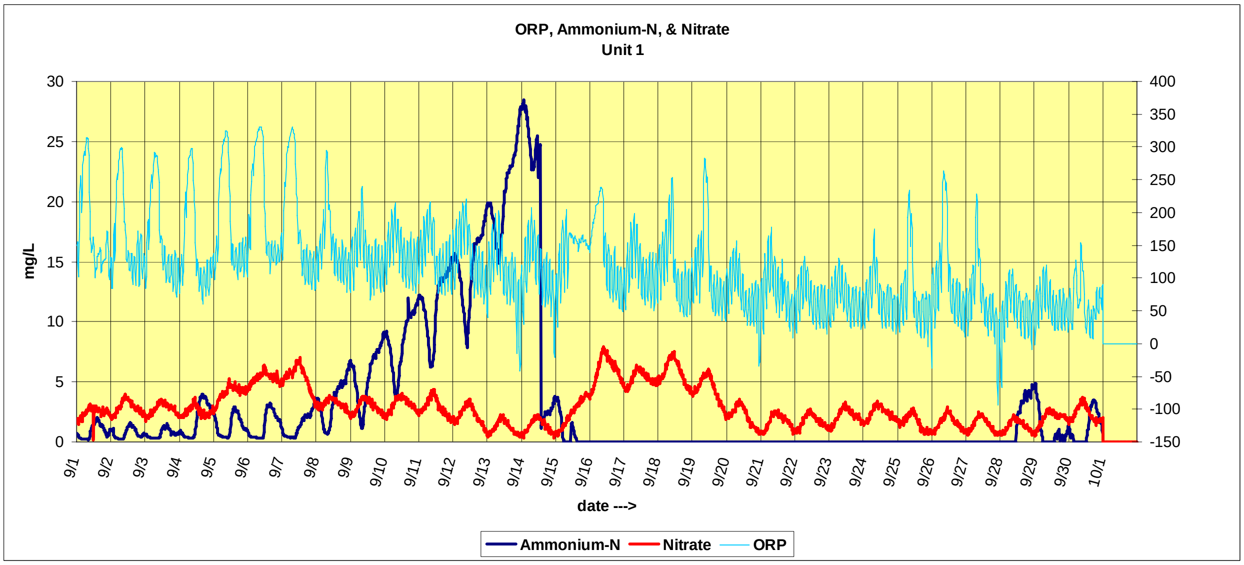

Figure 5.6 ORP, nitrate, and ammonia, September

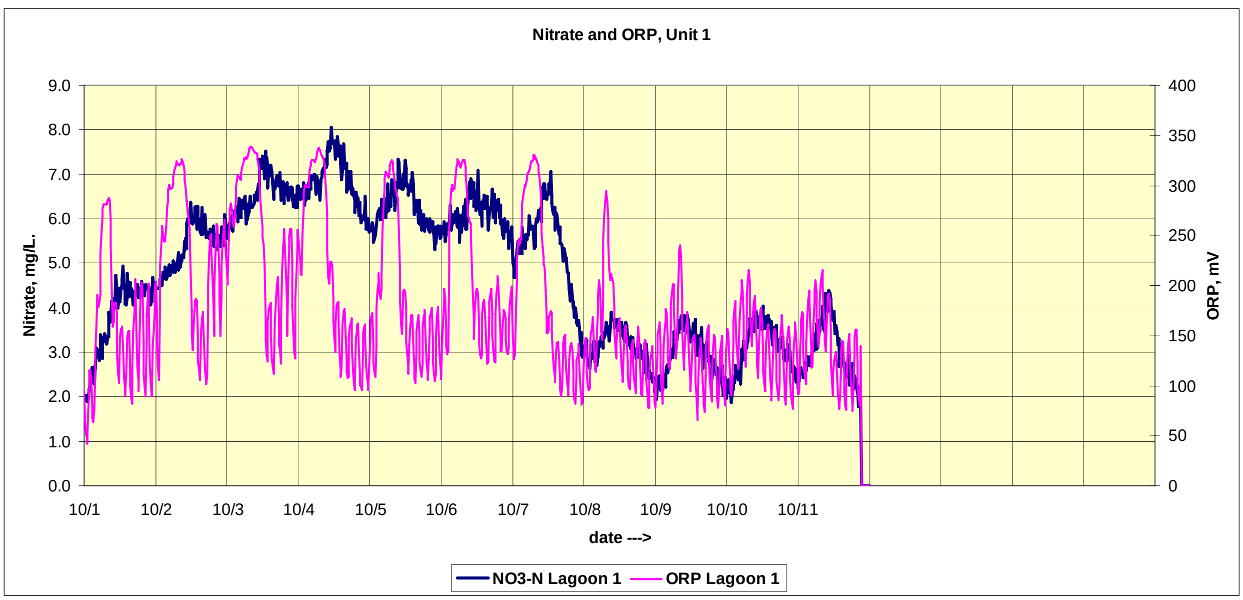

Figure 5.7 ORP and nitrate, October

Oftentimes during the late spring when water temperature rises, the concentration of MLSS needs to be lowered from the levels that sustained the plant through cold weather. Treatment efficiency rises as a function of temperature, and fewer MLSS are needed to accomplish the same amount of waste treatment as may be necessary during winter months. Regular sludge wasting is a vital part of maintaining a healthy biomass. The operator at EBA bases the need to waste on ½ hour settleability, clarifier core samples, gravimetric results on occasion, and visual observations collected at the WWTP. The levels of the various tests resulting in the maximum system performance generally change with seasonal variations which reinforces the need to trend the data and keep records of the results. While these methods are effective in identifying when to adjust the levels of biomass, the solids removal operations allow for the actual changes in the MLSS levels.

In order to maintain a healthy biomass and an optimally performing treatment system, sludge wasting is usually performed daily or several times per week. If solids are wasted from the process less frequently and in large volume then large amounts of nitrifying bacteria will be removed from the process all at once. Through the use of gravimetric MLSS tests, centrifuge testing, and other laboratory tests an operator can adjust the solids levels in the aeration basins to anticipate the changes in operating conditions as the weather changes from warmer to colder and vice versa. Instead of wasting solids over a few days to transition the operation from winter to spring conditions, an operator would be better to withdraw waste solids to establish a desired MCRT, gradually reaching a solids concentration where biomass growth rate is nearing the peak of log growth, where treatment efficiency is optimal, and the potential for negative indicators such as filamentous organisms are reduced.

It is generally best to maintain a consistent solids management plan that includes wasting solids based on process control testing that includes monitoring the food to mass ratios (F/M), mean cell residence time (MCRT), sludge volume index (SVI), and mixed liquor suspended solids (MLSS). Generally, choosing a method such as a targeted F/M or MCRT and sticking with it produces the most consistent effluent quality.

Figure 5.8, below, depicts the MLSS and MLVSS levels in the north lagoon over the course of the project. The solids levels increased over the course of the project; design parameters for MLSS indicate optimum levels at 2300 mg/L at design flow. Flows to the plant generally average less than ½ of design so solids levels are reduced accordingly. The operators target range for the MLSS is 1300 mg/L with the current flows, loadings, and ½ of the plant in use.

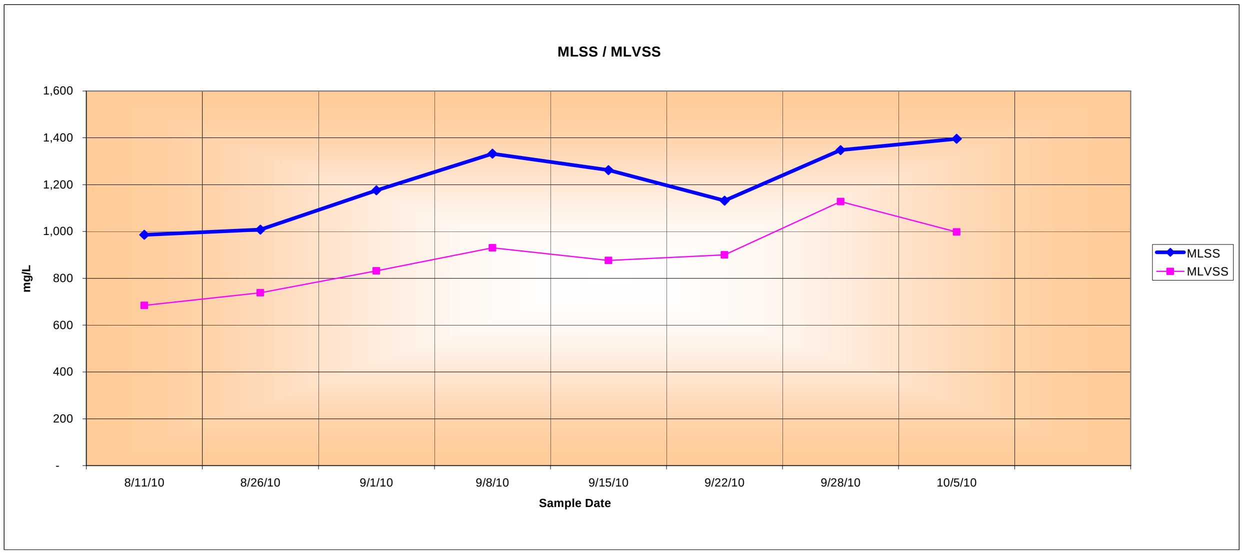

Figure 5.8 Mixed liquor suspended solids, mixed liquor volatile suspended solids, Lagoon 1A

The resulting effluent samples analyzed by the Bureau of Labs confirmed the results. Reductions in effluent nutrient levels are graphically depicted on Figure 5.9, below. While there were some spikes in the effluent data, the overall trend was a reduction in both nitrate and phosphorus. On September 30, a 3 inch rainfall effected plant operations and reduced treatment efficiency. Further rainfall the next several days compounded the situation. The results of the rainfall, excessive flow to the plant, and minimal BOD loading were reduced ability of the system to denitrify and increased Nitrate/ Total Nitrogen in the wastewater. Analytical results reported on the chart are from samples collected of the plant effluent and tested at the Department's Bureau of Laboratories.

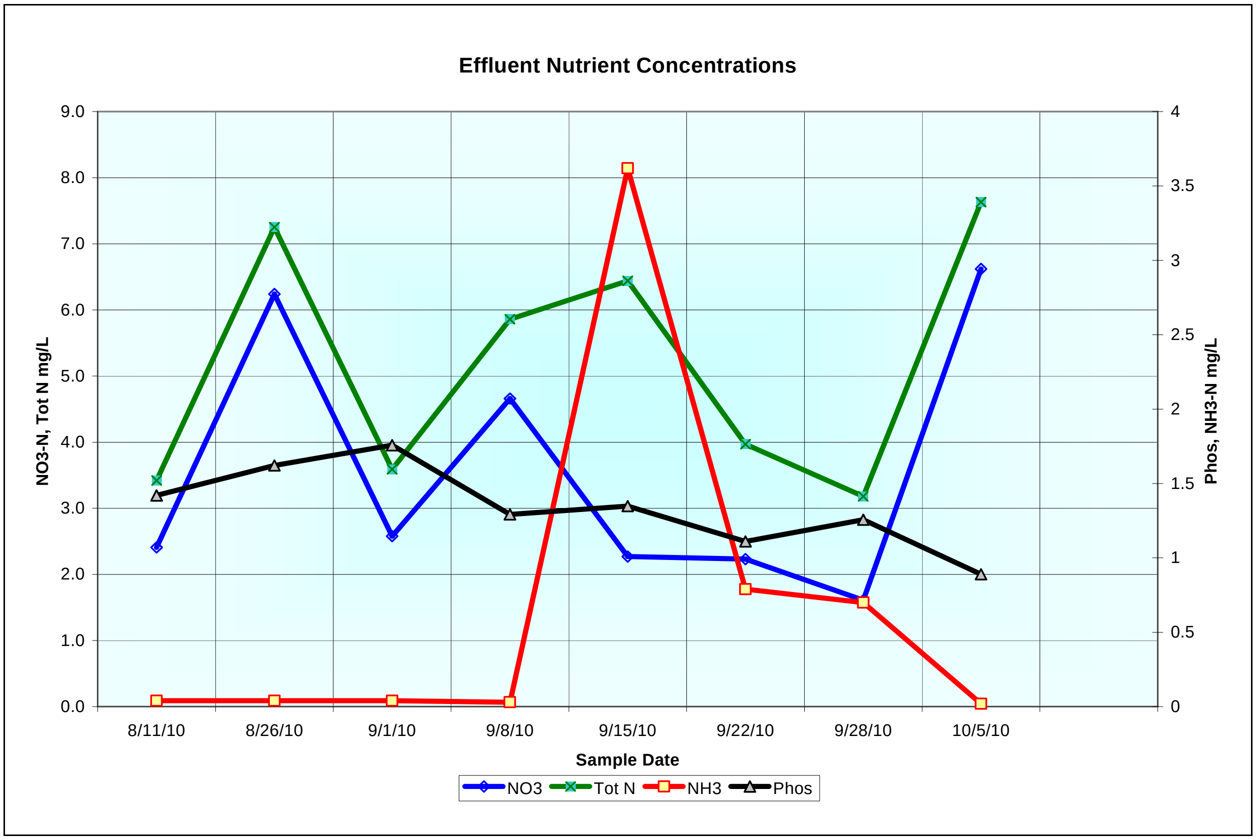

Figure 5.9 Effluent nutrient reduction over the course of the WPPE

Figures 5.10 through 5.11 identify the sampling results for nutrient testing over the course of the WPPE. There were changes made to the aeration cycles in attempts to optimize nutrient treatment efficiency thereby reducing levels of nutrients of concern. Generally, the influent nutrients increased over the course of the WPPE, excluding a reduction in the last sample due to heavy rainfall which greatly diluted influent concentrations. Despite the increases in influent concentrations, the operator was able to modify process operations to maintain or reduce effluent concentrations for the same parameters.

Often during the WPPE projects, operators pay more attention to the treatment process and positive outcomes are documented even while minor adjustments are made throughout various phases of the treatment process. This is another reason to stress the importance of trending data and documenting daily activities so operators may reproduce favorable results in the treatment process after the WPPE equipment has been removed from the site.

Trending of the available data shows both influent and effluent data to address concerns of lower influent concentrations resulting in lower effluent concentrations.

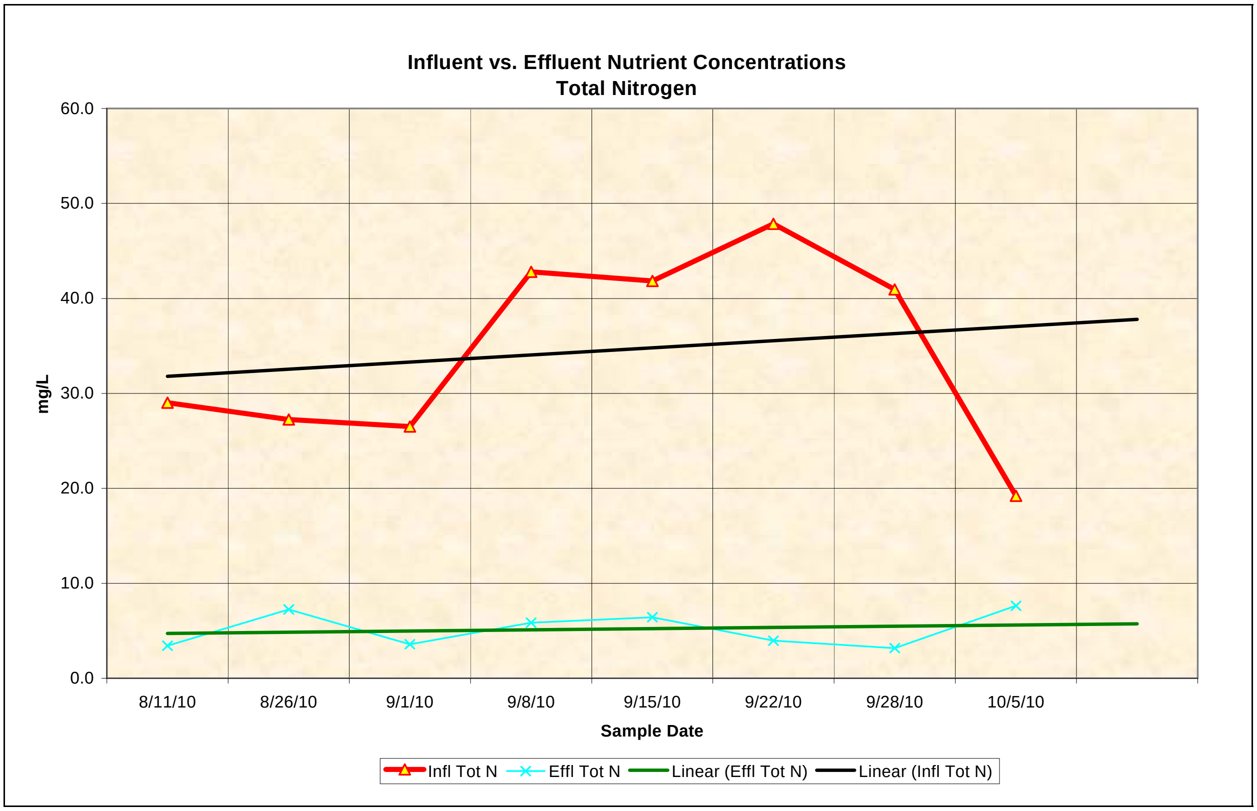

Figure 5.10 Influent vs. Effluent Total Nitrogen concentrations

The phosphorus results show that while the influent phosphorus trended upward, discounting the October 5th sample that was diluted due to excessive rainfall, there was an overall reduction in effluent phosphorus. With the relocation of the ferric chloride feed to a location near where the wastewater enters the clarifiers, it is expected to further reduce phosphorus levels. While the ferric chloride feed line was not relocated during the WPPE, there is no direct source for the reduction in Phosphorous levels as depicted in the associated graph. The reductions while small are significant considering the starting concentrations were less than 1.5mg/L. EBA is currently working with its engineer to relocate the ferric chloride feed line to the clarifier inlet which should improve phosphorus removal even further.

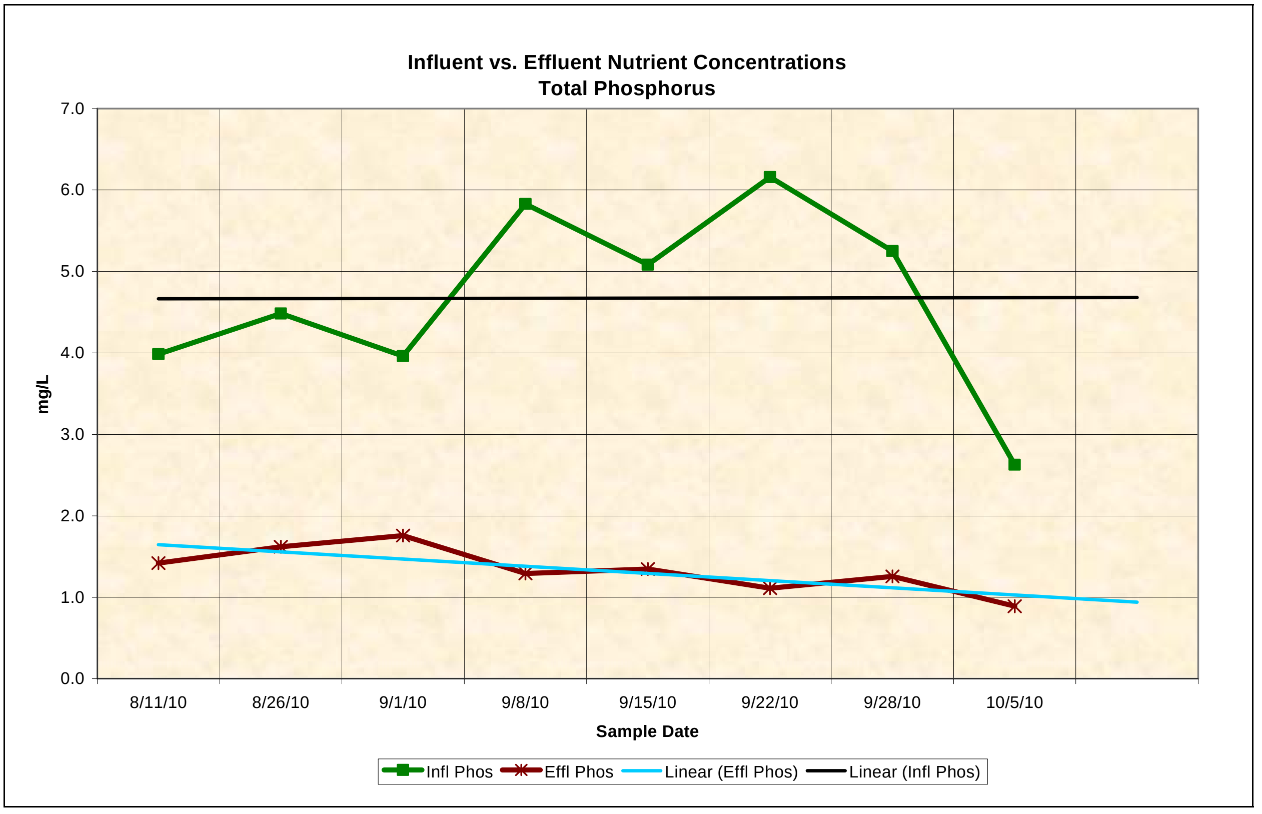

Figure 5.11 Influent vs. Effluent Total Phosphorus concentrations

The EBA plant consistently nitrifies the wastewater to reduce ammonia to negligible levels. As shown in Figure 5.12, below, there was a spike on September 15th while attempting to modify the aeration settings. Quick action by the operator brought the plant back into expected operational confines.

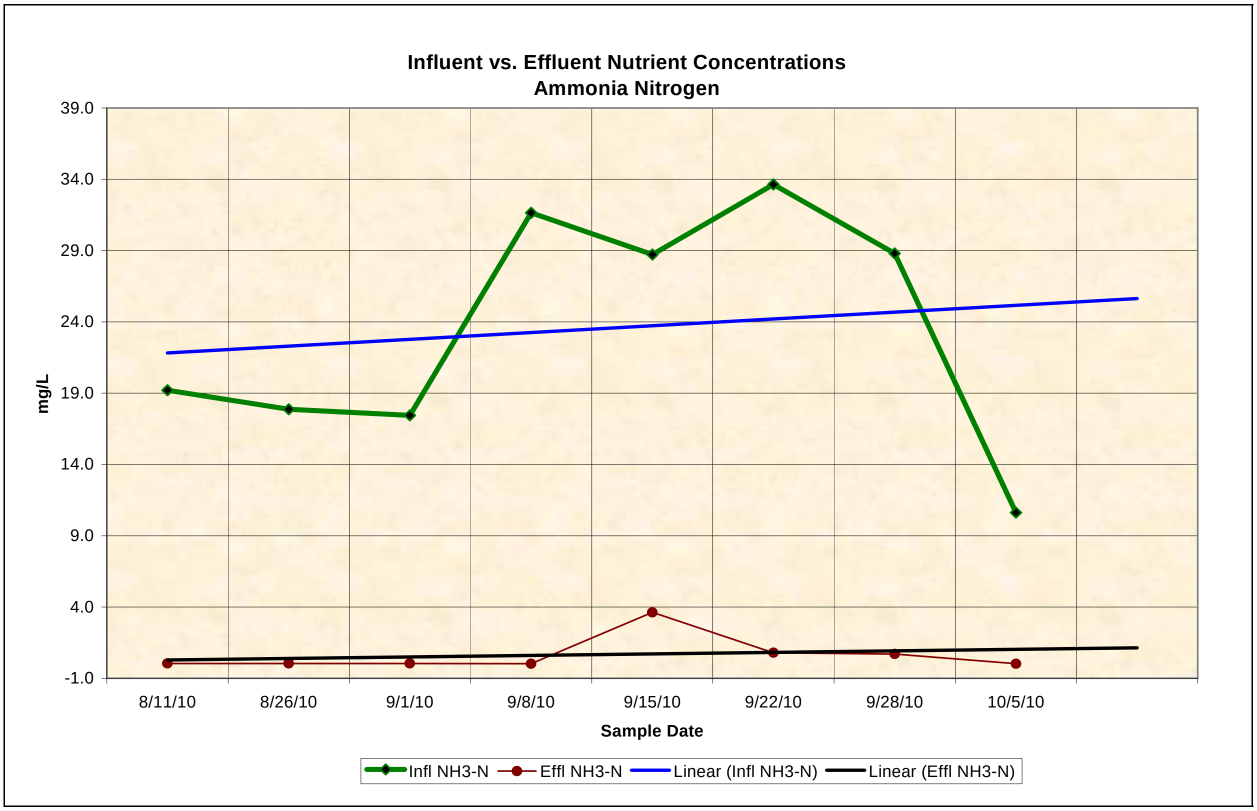

Figure 5.12 Influent vs. Effluent Ammonia Nitrogen concentrations

Figures 5.13 and 5.14, below, depict the upstream and downstream nutrient concentrations measured during the WPPE.

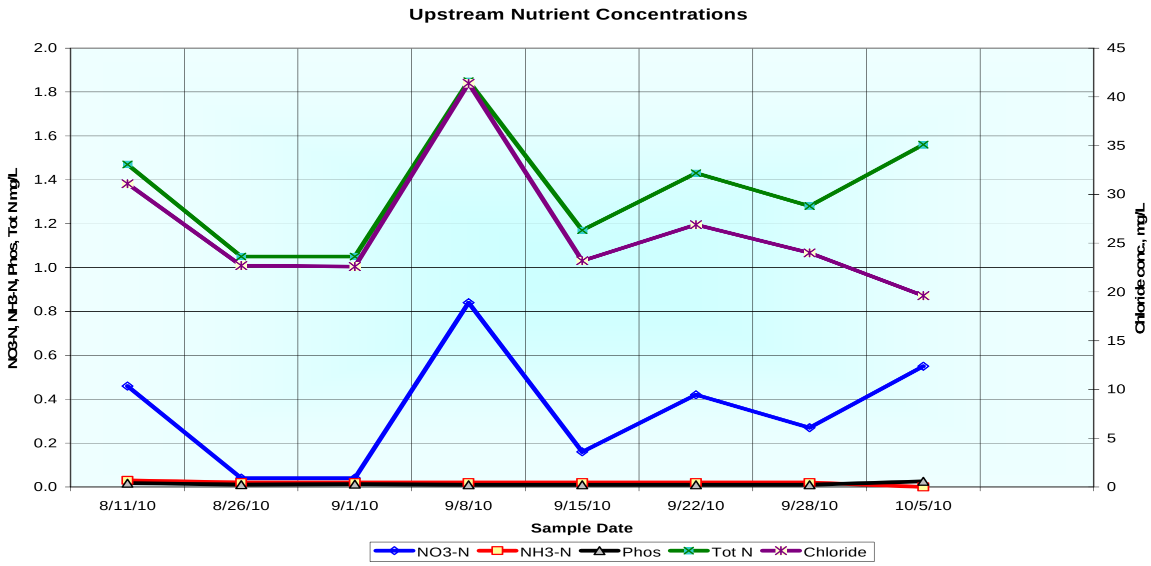

Figure 5.13 Upstream nutrient concentrations

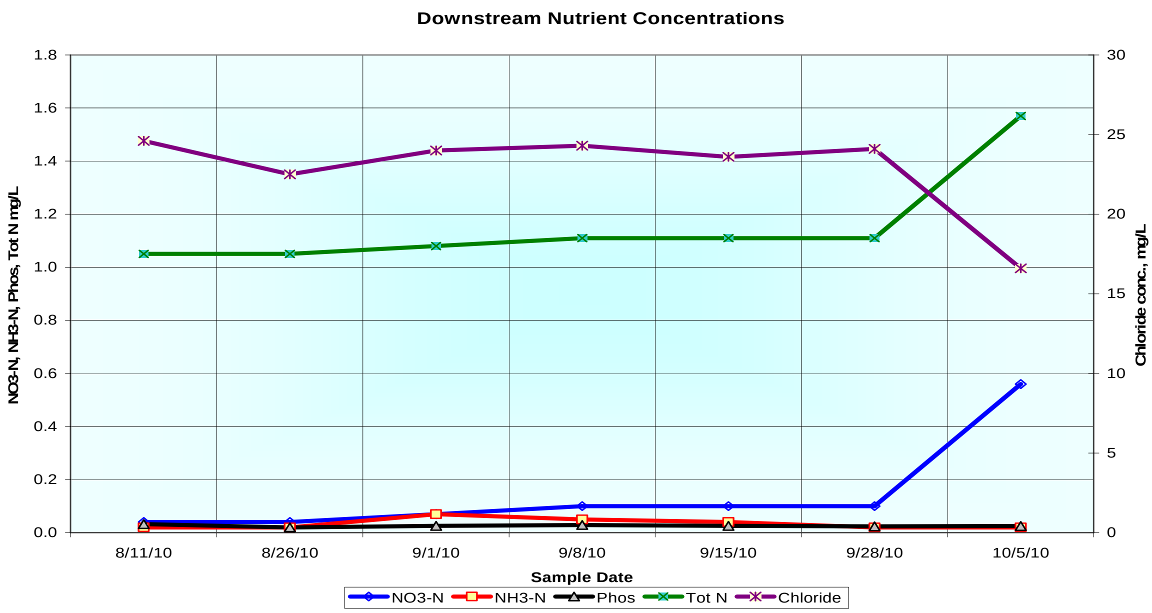

Figure 5.14 Downstream nutrient concentrations

Figure 5.15, below, shows the *Cryptosporidium* oocysts levels in nine samples taken during three sampling events over eight weeks. Two of the upstream sample results had hits for *Cryptosporidium* oocysts while the effluent and downstream samples were void of any positive results. The October 5 upstream sample may have been void of positive results due to high river levels. The river flow average 209 cfs that day while the averages on the two previous sample days were 7.3 and 6.0 cfs, respectively.

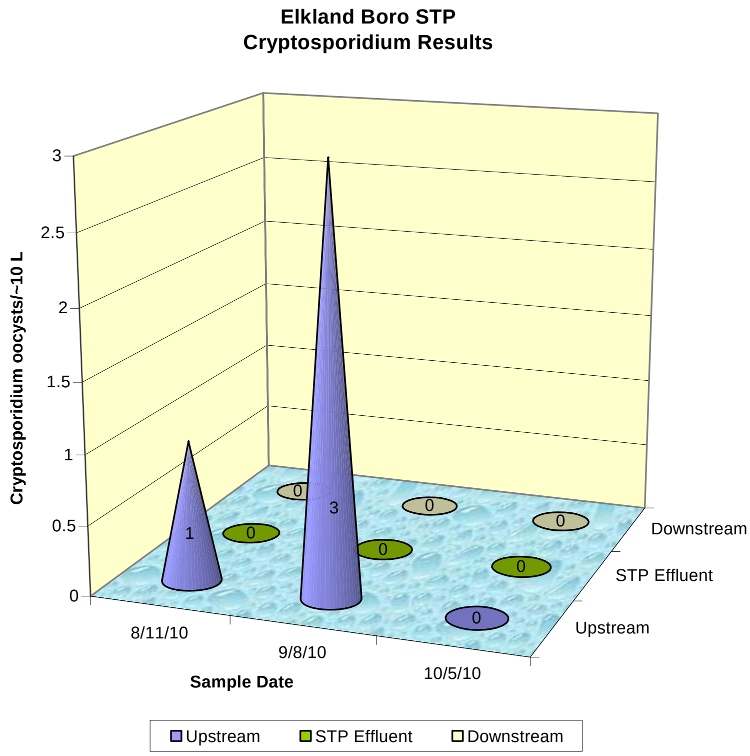

Figure 5.15 ***Cryptosporidium oocyst*** **levels**

The levels of *Giardia lamblia* cysts found in 10L samples are shown in Figure 5.16. In this illustration, the treatment plant produced a higher quantity of giardia cyst than was present in the upstream and downstream samples. The high number of giardia does not indicate that the disease causing organism is endemic in the population of the service area; neither does the test indicate whether or not the organisms have been inactivated by disinfection methods.

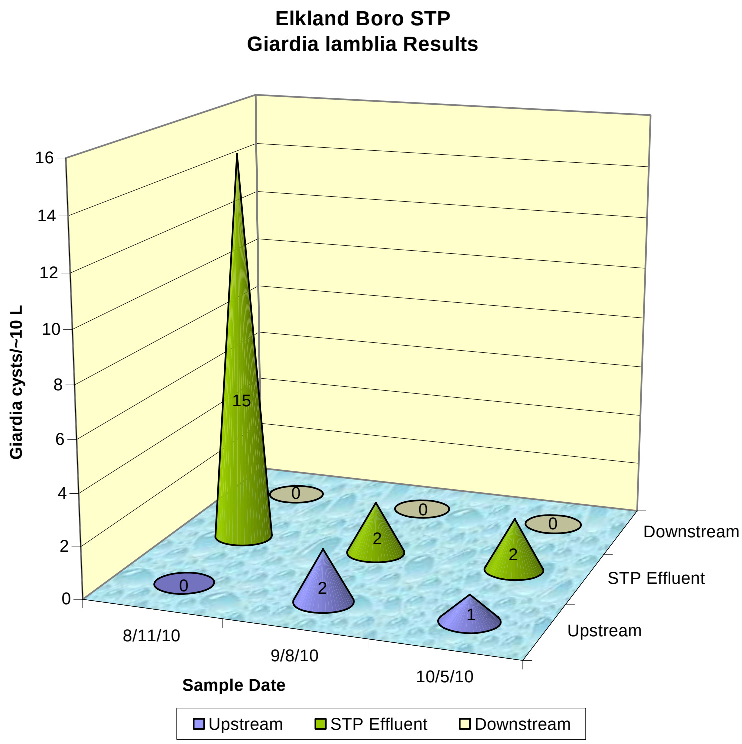

Figure 5.16 ***Giardia lamblia*** **cyst levels**

Figures 5.17 and 5.18 compare effluent *Giardia lamblia* levels to those of effluent TSS and effluent flow. While previous WPPEs have shown a correlation to wastewater plant flow and effluent *Giardia lamblia* levels, that is not the case here. Nonetheless, due to data provided by the previous WPPEs, the NT drinking water intake should maintain heightened awareness of pathogen levels during rain events which generally tend to raise flows at the WWTP and could contribute to elevated *Giardia lamblia* levels in the downstream raw water.

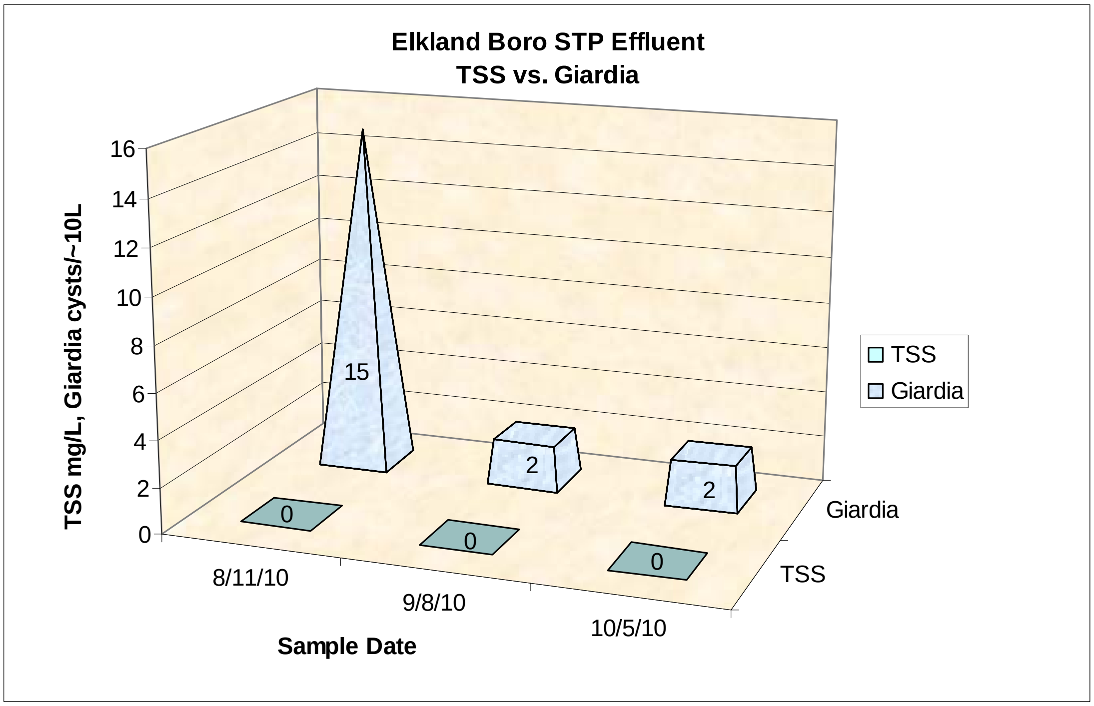

Figure 5.17 ***Giardia lamblia/*****TSS comparison**

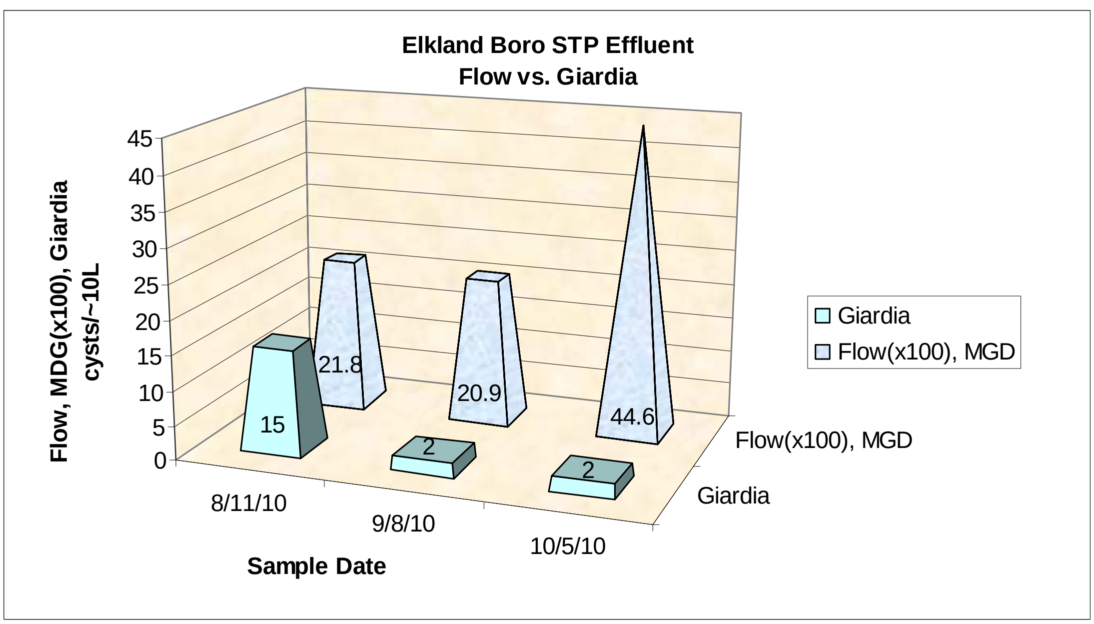

Figure 5.18 ***Giardia lamblia/*****Flow comparison**

In order to more effectively assess the level of pathogens, and the effect of annual weather patterns on them, an effective statistical population would necessarily include many samples per location, taken over the course of the entire year. The study would have to account for temperature and weather variability, wastewater plant flows, seasonal activity of host wildlife in the area, changes in stream flow and chemistry, and other factors.

Microscopy with Digital Photography

A microscope is a beneficial addition to any wastewater laboratory. DEP provides temporary use of a microscope during the WPPE so that operators become familiar with the organisms of the activated sludge process, including indicator organisms that may be used to predict the relative health of the biomass and the operating condition of the facility. The Elkland operator does have access to a microscope and does use it to evaluate the quality of the biomass on occasions when treatment issues arise.

Following are some example photographs of the EBA activated sludge samples taken during September.

A microscopic evaluation of the biomass in the North Lagoon 1A on September 7, 2010 identified few nematodes, many stalked ciliates, and some free swimming ciliates with few rotifers observed. The evaluation on this day indicated a biomass with good settling characteristics as suggested by the large amount of stalked ciliates present throughout the sample. Generally these microorganisms would also indicate an average Sludge Volume Index (SVI) and Food to Mass (F/M) ratio.

Figures 5.19 and 5.20, below, shows stalked ciliates, rotifers, and other protozoa in mixed liquor samples of the north lagoon 1A. Stalked ciliates can be indicators of a good settling sludge when present with free swimming ciliates and some rotifers.

Figure 5.19: Stalked ciliates, Lagoon 1A – 9/7/10

Figure 5-20: Rotifer, Lagoon 1A – 9/7/10

Field Sampling

Initial background samples were collected on August 11, 2010:

Location	Sample Number	Analyses
Upstream of Outfall 001 on the Cowanesque River	0331947	Conventional Pollutants
Outfall 001 at Cowanesque River	0331948	Conventional Pollutants
Downstream of Outfall 001 at Nelson Township Drinking Water Facility, raw water intake	0331949	Conventional Pollutants

Table 5.1. Initial sampling locations and analyses

As indicated in Table 5.1 above, on several occasions, grab samples were collected for Method 1623 pathogens (*Cryptosporidium* and *Giardia lamblia*) from the WWTP effluent at the outfall, upstream on the Cowanesque River, and downstream at the drinking water intake for NT.

At various times during the WPPE, samples were collected of the WWTP and receiving stream; these samples were submitted to the Department's Bureau of Laboratories for analysis. The mixed liquor was sampled for suspended solids, and volatile solids. The influent, effluent, upstream, and downstream samples were checked for conventional sewage pollutants and chlorides. The effluent, upstream, and downstream were also sampled for *Cryptosporidium* and *Giardia lamblia*.

A summary of these results is fully listed in Attachment D. In addition, the laboratory results for all samples collected during the WPPE have been provided separately on a CD-ROM disc that accompanies this report.

6. Process Control

Permit Modifications

Any modifications to the permitted treatment process may require an amendment to the Water Management Permit. If you are unsure whether a permit modification is necessary contact the DEP regional office that supports your wastewater facility prior to making any modifications.

General

The objective of Process Monitoring and Testing is to develop regular monitoring procedures for the individual treatment facility. Typically, an operator chooses to maintain a facility according to mean cell residence time (MCRT) or food-to-mass (F/M) ratio. The objective of these broad parameters is to find a level where plant performance is optimal for the current conditions (including season, amount of precipitation, loading variations, industrial or commercial contributors) and then adjust the treatment processes in order to maintain a steady-state. For example, if an operator runs a facility according to constant Food to Mass ratio of 0.07, and plant loading (the "food" value) is either naturally constant (based on collection system) or can be sufficiently buffered (using flow equalization tanks), then their objective in maintaining constant F/M is to assure that the biomass (the "mass" value, or the amount of Mixed Liquor Volatile Suspended Solids (MLVSS) in the system) can be adjusted through wasting in order to keep the ratio at or near a constant 0.07.

Mean Cell Residence Time is a method by which the operator adjusts solids retention to achieve a steady sludge age. MCRT incorporates a regularly tested solids inventory with adjustments to the wasting rates and an accounting for the expected growth rate due to plant loading. The end result of such operation is an MCRT of X-number days, usually in the range of 10-13 days for nitrifying wastewater plants.

Guidance manuals generally suggest that an operator choose a parameter and then operate the facility accordingly. Operators have found that doing so maintains conditions in an optimized state whereby the chance of plant upsets is mitigated or controlled.

Solids Tracking

At present, the Elkland facility tracks sludge solids in Lagoon 1A by performing ½ hour settleability total solids testing. Total Solids tests are performed once per week on each treatment train. Solids levels increased over the course of the WPPE and were scheduled for removal upon reaching approximately 2500 mg/L. When solids have accumulated in the chlorine contact tank/disinfection tank they will denitrify over time causing the solids to rise to the surface and be washed out with the treated effluent having negative effects on effluent quality. At EBA, the chlorine contact tanks are drained and cleaned as necessary to prevent an accumulation of solids and the potential discharge of said solids. There was no accumulation of solids noted in the chlorine contact tank during the WPPE.

The Biolac design and operation manual suggests operating the plant using one of three commonly suggested practices: maintaining constant MLVSS, constant F/M ratio, or constant sludge age. Overall the operator was successful at maintaining a rather constant F/M ratio of 0.06 during the WPPE. The design manual suggests a 0.04 F/M ratio at design loading, which they have not met yet.

To develop and maintain a complete solids inventory, the clarifier solids needs be regularly assayed in a consistent method. During a WPPE, DEP provides, on loan, a clarifier core-taker sampler that is used to determine the level of the sludge blanket and which can be used to sample the entire clarifier for a percent solids number that, with measurements of the return and waste sludge values, may be used to determine an operational MCRT. This method only involves the core taker and a centrifuge to spin the solids samples. A centrifuge spin cycle that runs six samples, or three with duplicates, takes approximately 15 minutes to complete.

The MCRT method is described in earlier versions of WPCF's Activated Sludge Manual of Practice No. OM-9 and in other sources. Calculation of a sludge inventory using undefined sludge units allows an operator to derive an MCRT value for his/her facility, and this can be done on a daily, semi-weekly, or weekly basis.

The Department utilized gravimetric solids tests, ½ hour settleability tests, and centrifuge tests to track changes in the mixed liquor suspended solids.

Solids monitoring is very important in a wastewater treatment plant. If the MLSS concentrations are too low then there won't be enough nitrifying bacteria present for nitrification to occur and MLSS concentrations to high can cause problems with clarifier operations and suspended solids levels in the effluent. MLSS target levels are usually adjusted seasonally as the temperature plays an important part in nitrification.

ORP

ORP can be used by the operators to control periods of anoxic or aerobic treatment conditions, as described earlier, for the removal of nitrates. Generally, ORP probes are most useful in the denitrification process but are also good indicators of biological activity in the nitrification process. The following table depicts general ORP values at which denitrification occurs; the operators may wish to pursue the use of timed intervals as a method to optimize nitrate removal, even in the absence of dedicated treatment units where denitrification would occur.

General values for ORP used to determine which biological condition exists within a particular treatment unit:

ORP (mV)	Process	Electron Acceptors	Condition
> +100	1	O2	Aerobic
≤ +100	2	NO3	Anoxic
≥ -100	2	NO3	Anoxic
< -100	3	SO4	Anaerobic

1= Nitrification

2= De-Nitrification

3= Methane Formation

Table 6.1 ORP Chart

ORP readings are typically used in conjunction with the DO readings to identify the effectiveness of a given biological treatment process and the condition of each zone. At times during the evaluation the DO levels reached near 0 mg/L.

DO findings

The DO readings at this facility follow a typical diurnal pattern with peaks occurring in the morning hours prior to the facility receiving an increase in flows due to residents starting their day. The flows then decrease over the daytime hours and begin to creep up in the evening until starting the cycle over the next day. Optimal DO range for activated sludge plants is usually between 1.5 mg/L and 3.5 mg/L. Any DO over 3.5 mg/L usually represents wasted energy, because the biomass functions adequately within this prescribed range.

It may be advantageous to purchase an updated DO meter. Some DO sensors utilize luminescent measurement of DO instead of membrane sensors which are prone to fouling when utilized in the mixed liquor. The on-line DO monitors, currently in use at Elkland, has the capability to operate the blowers but is not utilized due to over aeration of the biomass when recovering from periods of low DO. Possibly some reprogramming of the standby time, from when the sensors read the low DO readings to when blowers engage, may reduce such lags and resulting over aeration.

During the course of the study, DO grab samples were collected at various locations in the aeration tanks for process control purposes and to validate on-line monitoring equipment. These samples were also used to perform OUR and Specific Oxygen Uptake Rate (SOUR) testing on both basins to analyze biomass health and food supply.

After the on-line monitoring equipment has been removed the DO within the aeration tanks can be tracked and trended using this same grab sample method to ensure sufficient oxygen is available for nitrification to occur.

DO Profile

A DO profile, shown in Figure 6.1 below, was developed in September to characterize mixing in the north Lagoon 1A. For this, a Hach 40d digital meter and LDO portable probe were used. DO was recorded at several locations in the lagoon, at varying depths. Recordings were made at 3 locations along the outside edges of the lagoon at three depths: 1 ft, 7ft, and 11ft.

Results of this analysis show that, for the most part, mixing within the east tank is complete and DO remains fairly consistent throughout the process. There are fluctuations in the profile but are attributed to sections of the tank changing modes during the testing. One section may be in a aerobic mode but then change to an anoxic zone later which effects nearby readings.

Generally, operators find that performing a DO profile on a regular basis helps to characterize weak spots in the aeration grid and identify dead zones that may be caused by occluded diffuser outlets or by faulty baffling. Performing a DO profile every six months at this facility should be sufficient. Studying the DO profile over time also allows the operator to see the effects of loading on the tanks, and data may be used to identify the need for aeration balancing and/or the need for cleaning of diffusers.

Note: shape of tank in figure 6.1 is not of exact shape as actual tank only for ease of illustration

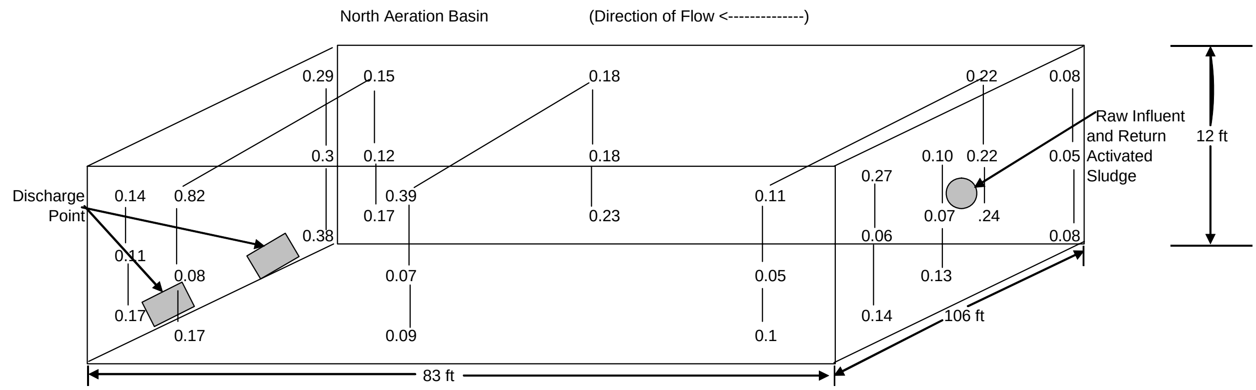

Figure 6.1 DO Profile of the Elkland north lagoon 1A

Nitrate and Ammonia Nitrogen

Use of the nitrate and ammonium ion probes at the EBA plant showed relatively low ammonia and low nitrate concentrations throughout the WPPE. Generally, for low effluent ammonia levels in wastewater there must be conditions present for nitrification to occur, this includes BOD removal. Bench tests and laboratory tests confirmed both BOD and ammonia removal. This system is also capable of denitrification with the Bioloc's Waveox computer system and the design of the lagoon itself, i.e. where flow enters, rows of aerators and capability of DO controlled blowers. The Waveox system allows for some adjustment of time sequencing for phasing blowers on and off. This part of the system, manipulating rows of aerators and the on/off set points, was the target for the process modifications. Since the on-line equipment was there to monitor multiple parameters at once, it was a control, that would give the operator some encouragement in making said process modifications to see results immediately and as they occur.

From the start of the project through September 7th, the Department collected background data. Then beginning on the 8th through the 15th, the process modifications occurred. The first process modification occurring on the 8th involved leaving the aerators off at the influent end of Lagoon 1A(row 5), row 4 -on 60minutes then off 60minutes, rows 3 and 2- on 60 minutes then off 60 minutes (opposite times of row 4), and row 1 nearest the clarifier -on all the time. This methodology seemed to provide a reduction in nitrate levels and ultimately was the most favorable methodology developed and was utilized after the completion of the WPPE.

On September 15th the aerators were further modified to leave aerators off at influent end of Lagoon 1A(row 5), row 4 -on 60min then off 60min, rows 3 and 2 -on full time, and row 1 nearest the clarifier- on all the time. This methodology did not provide favorable results and led to a temporary spike in ammonia levels. The operater identified this, with the SC1000 and associated on-line probes, and made adjustments to reduce ammonia levels by switching back to the aeration timing developed on September 8th.

pH, Temperature

The plant influent pH averaged 7.3 s.u. and the mixed liquor was pH was very consistent to that of the influent. For that reason, and that our SC1000 is configured to measure 6 parameters, we removed the mixed liquor pH monitoring for totals suspended solids monitoring. The pH range average range of 7.3 to 7.5 is at the lower end of the spectrum as far as book pH values to achieve nitrification. But, with the denitrification that is occurring within the plant and the associated alkalinity recovery that occurs as part of that process, the pH levels appear to be those at which the plant will optimally perform. The operator should continue to monitor the pH in the influent and aeration basins on a daily basis; often times a pH measurement can be the first signal of a treatment plant upset due to a toxic load or loss of nitrification.

Temperature readings were consistent and inline with values expected for optimum nitrification to occur. At the start of the project the temperatures were approximately 70 degrees Fahrenheit and were in the low to mid 60's during September and October.

Flow Measurement

The EBA totalizer readings were utilized for flow readings during the WPPE. During the evaluation period from August 10 through October 13, 2010, the average daily flow was 0.264 MGD and the maximum average daily flow was 0.708 MGD. The minimum flow occurring during the WPPE was 0.176 MGD. During the WPPE, there were 2 rain events over 1 inch and one event of nearly 3 inches, with approximately 9.08 inches of rain falling over the course of the WPPE.

Laboratory Tests

A significant part of the WPPE includes sampling on-site using a centrifuge, pH and DO meters, LBOD probe, and a spectrophotometer, and heater block. Also, the clarifier sludge blankets are monitored to define the blanket depth and clarity.

A centrifuge was utilized for developing quick information on solids inventory and biomass condition. This equipment includes settleometers, which mimic clarifier performance, and a core-taker that is used to determine both clarifier sludge blanket level and percent solids of a representative sample, used in determining total plant inventory. According to supplemental information provided by the core taker manufacturer, it is possible to determine a sludge age, similar to use of MCRT, for tracking overall plant performance. Doing so includes maintaining a running sludge solids inventory of all processes and tanks, including aeration, clarifiers, return and waste sludge volumes, and inflow and effluent solids. It is also recommended that the sludge solids by percent volume be calibrated to sludge solids by gravimetric analysis.

During the evaluation period, the Department also provided a hand-held DO probe and pH probe for use in field testing of the aeration tank mixed liquor. The preferred method of determining process DO is to immerse the DO probe into the aeration tank or effluent stream and to read the DO after the meter stabilizes.

To verify the accuracy of the digital probes, a field spectrophotometer kit was provided that included test materials for several water quality parameters. During the WPPE, this kit was used to determine nitrate and ammonia nitrogen levels throughout the plant and verify the on-line process monitoring equipment. The heater block was used for analysis of COD and Total Phosphorus.

Attachment G contains examples of the Process Control Testing worksheets prepared during the WPPE.

eDMR

EBA is currently participating in DEP's electronic reporting system, eDMR (electronic discharge monitoring reports), for the reporting of NPDES effluent data.
This program is accessed over the Internet and allows a facility to send its monthly reports to the regulators without employing paper forms. eDMR adds each monthly report to a database that allows for quick retrieval of the historical record for export to other programs, making work with the records easier. Another advantage of this is that the chance for reporting errors may be reduced, because numbers do not have to be repeatedly copied from one form to another.

Power Consumption

Electrical usage is commonly the highest expense when operating a wastewater treatment facility. EBA presently employs a dissolved oxygen probe as part of its Waveox control of the treatment process. While the probe does not control aerator run times, it has the capability to do so. The problems encountered when operating the aeration system based on the DO probe input involve times when the DO drops to a bottom setpoint; both blowers would come on to raise the DO but it would often be over aerated causing floc and settling issues. This project has identified DO levels where nitrate removal is optimum; it may be valuable to investigate modifying the software setpoints to run the blowers via dissolved oxygen control or via oxidation reduction potential probe control. The use of additional probes such as those for nitrate and ammonium may also help secure the optimal efficiency of the treatment process, reducing power demands. The use of variable frequency drives would allow for additional options with blower operations.

EBA currently has updated motors that were provided with the plant upgrade. When it is necessary to replace a damaged or failed motor, a very useful tool for motor replacement guide is the US-EPA's free computer program "Motor Master+ 4.0" which allows plant supervisors to assess motor efficiency and determine costs of replacements. This program is available from EPA's website, at
http://www1.eere.energy.gov/industry/bestpractices/software.html

Typically, with motor rewinds, we note the following:

- Traditional fast cheap motor rewinds have an average loss of 20% efficiency each time the coil is repaired.
- Even with reliable repair shops, using OEM or OEM-equivalent materials, the efficiency loss is 1% or 2% each instance.
- We recommend evaluating the motors if:
  - Motor of any age has a rating less than 40 hp (assuming not an energy efficient motor currently);
  - The cost of the rewind exceeds 65% of the price of a new energy efficient motor;
  - The motor was rewound before 1980.

During the WPPE, we did not evaluate the facility's emergency power generator, although we did note that the operators run the generator according to the manufacturer's specifications.

Method 1623 Pathogen Test Results:

Date	Sample Location	Sample Number	*Giardia lamblia* cysts/~10 L	*Cryptosporidium* oocyst/~10 L
8/11/10	Upstream on the Cowanesque River	0331948	0	1
8/11/10	Effluent	0331947	15	0
8/11/10	Downstream at Nelson Township DW Intake	0331949	0	0
9/8/10	Upstream on the Cowanesque River	0331966	2	3
9/8/10	Effluent	0331965	2	0
9/8/10	Downstream at Nelson Township DW Intake	0331967	0	0
10/5/10	Upstream on the Cowanesque River	0331991	1	0
10/5/10	Effluent	0331990	2	0
10/5/10	Downstream at Nelson Township DW Intake	0331992	0	0

Table 6.2 Method 1623 test results

Table 6.2, above shows the pathogen test results for *Giardia lamblia* and *Cryptosporidium*. The effluent samples from the plant consistently indicate the presence of *Giardia lamblia* cysts and *Cryptosporidium* oocysts in the effluent.

Specific Oxygen Uptake Rate

Several SOUR tests were conducted over the course of the WPPE to evaluate the health of the biomass. An example of the resultant data can be seen in Appendix H. The SOUR test can be used to quickly measure the influent organic load and its ability to be biological degraded. It can also be used to identify toxic conditions within the facility. As with other treatment parameters, an operator must conduct several tests to establish baseline readings for their facility. SOUR rates are measured in (mg/g)/h. Values can vary from plant to plant but the following can be used as a general guideline:

>20	High	This may indicate that there aren't enough solids for the BOD loading present
12-20	Normal	This range indicates good BOD removal and a well settling sludge
<12	Low	This may indicate there are not enough solids or there has been a toxic event

The results from the testing at Elkland were all within the 12-20 range. There were two occasions when the BOD was at its highest that the SOUR levels neared 20. As the BOD values dropped to normal levels, the SOUR rates returned to the average of 16.8. The results are fully listed in Table 6.3, below.

Date	SOUR	Influent BOD	MLVSS
9/2/2010	16.66	217	832
9/8/2010	19.29	249	930
9/21/2010	18.8	254	900
9/22/2010	16.27	254	900
9/28/2010	13.14	202	1128

Table 6.3 Specific Oxygen Uptake Rates

7. Nelson Township Drinking Water Plant

The nearest downstream surface water filtration facility from the EBA WWTP is the Nelson Township (NT) Drinking water plant, PWS #2590051. The raw water intake is approximately 2.7 stream miles downstream on the Cowanesque River

Plant Description

The following information was gathered from the most recent NT Filter Plant Performance Evaluation report. Samples collected during the FPPE indicated no *Giardia* cysts and no presumptive *Cryptosporidium* oocysts in the source water sample collected during the evaluation.

The Nelson Township Municipal Authority Treatment Plant obtains raw water from the Cowanesque River in Tioga County. Constructed in 2007, the filter plant serves the community of Nelson and surrounding homes. The Nelson Township Municipal Authority provides water to about 300 consumers through metered service connections. Treatment currently consists of a PAC for coagulation, Wagner Fluid Systems Model 30-D which includes flocculation, sedimentation, and multi-media filters, and disinfection.

At the Nelson Township plant, the raw water sources include the Cowanesque River and well #3. The watershed is around 160,000 acres. Potential pollution threats include concentrated livestock, roads, communities with sewage treatment plants, residential areas with on-lot sewage systems, and other activities that impact water quality characteristics. Raw water turbidity levels fluctuate widely and rapidly and usually range from 1 to 20 NTU with occasional spikes above 20 NTU. The raw water quality also includes high alkalinity, a fairly stable pH and occasional algae problems in the summer.

The EBA WWTP discharge is located approximately 2.7 miles upstream of the drinking water intake. This is a new discharge as the discharge was previously located downstream of the NT drinking water intake.

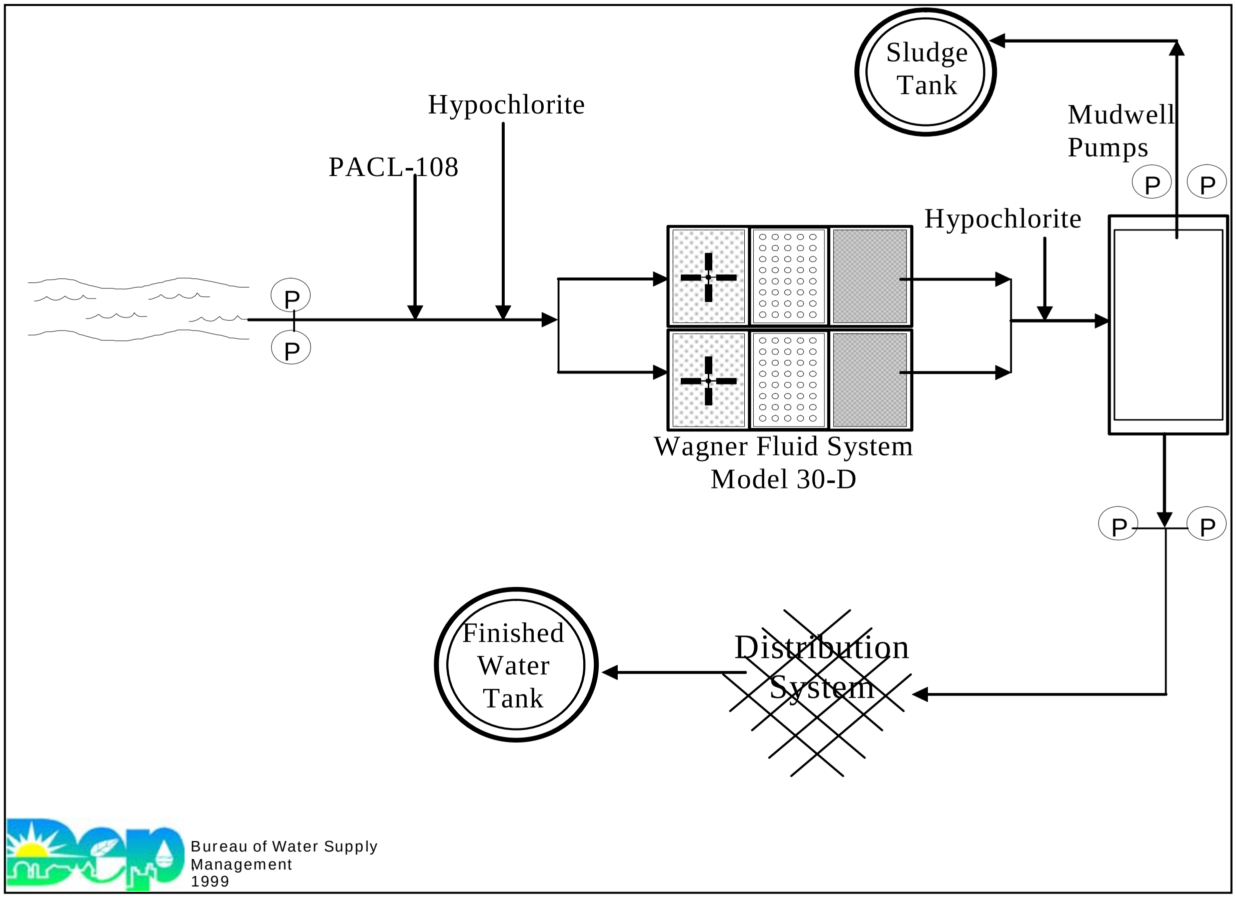

Figure 7.1 Nelson Township water treatment plant schematic

Raw Water Sampling Results

During the WPPE, we sampled our downstream (impacted) water samples from the raw water tap in the control building at the drinking water plant. The sampling protocol for the WPPE required that, for every WWTP effluent sample collected for analysis, samples of surface water source background (Cowanesque River-Upstream) and effluent impacted (Cowanesque River-Downstream) would be sampled and tested for the same parameters. The only difference is in the BOD-5 test: effluent tests employed inhibition of the nitrification process while the upstream and downstream samples did not. The results of all tests conducted for the WPPE were analyzed by the DEP Bureau of Laboratories and are summarized in Attachment D.

Figure 1.x shows a map of the immediate watershed surrounding the intake to the water works. Not much development is occurring in the watershed other than the development of natural gas wells since the facility lies within the Marcellus Shale formation.

Figures 7.2 and 7.3 graphically depict the sample results collected downstream of the EBA WWTP discharge at the NT drinking water intake. All downstream samples were collected from the raw water tap at the drinking water plant before any chemical treatment had occurred.

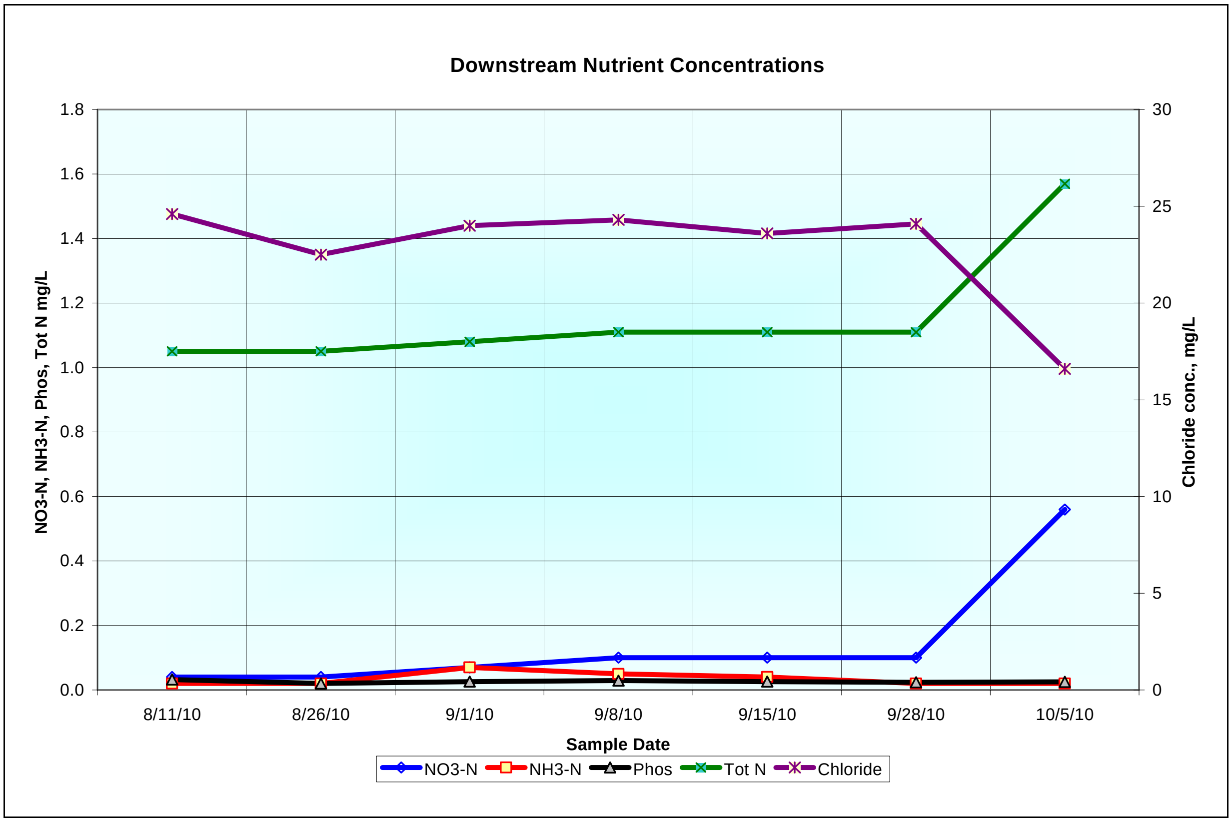

Figure 7.2 NT water treatment plant raw water nutrient sampling results

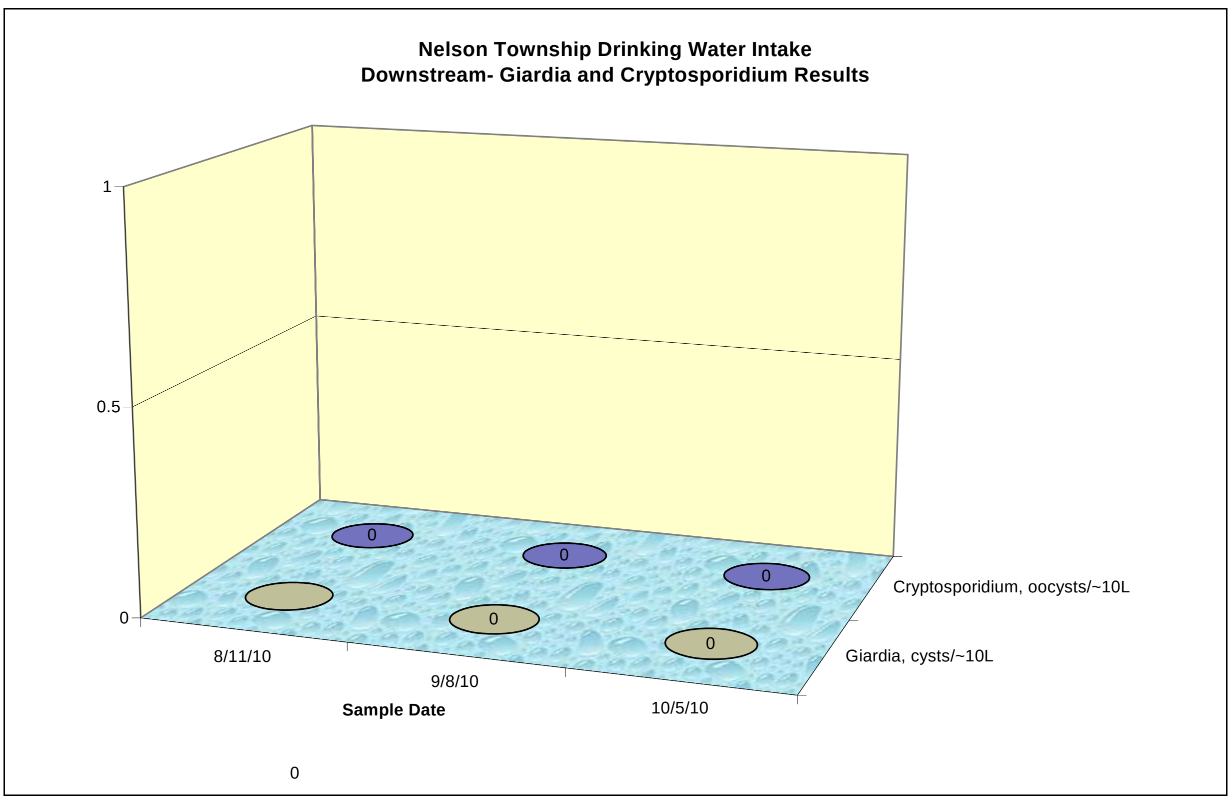

Figure 7.3 NT water treatment plant raw water *Giardia lamblia/Cryptosporidium* results

There is no historical raw water sampling for *Cryptosporidium* and *Giardia* for the NT drinking water plant since the facility was recently constructed in 2007.

Discussion

The distance between the EBA STP discharge and the NT drinking water plant raw water intake is approximately 2.7 miles. While the raw water sampling results did not provide any direct correlation to the optimization results at the Elkland STP, the dilution factor of the Cowanesque River and influences from groundwater recharge at the source water are believed to have a direct impact on the raw water results at the drinking water intake. In addition, there may be some vertical and horizontal stratification because of temperature and side stream influence. Nevertheless, the optimization efforts at the EBA WWTP provided information relevant to optimizing wastewater operations at the plant which does contribute to the raw water utilized by the NT drinking water plant. These results are further discussed in the Process Control section.

8. Conclusions

Considerations for Operational Modifications

The following are possible modifications that could be made at the WWTP and are based on the data collected during this study and current operating practices commonly utilized at other WWTP's across the Commonwealth. These modifications are presented for the operators benefit but should only be instituted while cautiously observing the effects on the overall treatment efficiency. Since the WWTP process is a biological process, changes made on a particular day may not be visible until at least 24-48 hours later, or more. The responsibility for instituting changes and their outcomes remains with the Operator in Responsible Charge at the WWTP where the changes are made.

DO control

Currently, the plant has limited ability to modify DO levels in the aeration tank without manually starting and stopping blower motors controlling air flow to the aeration and settling tanks. Future modifications to the plant could include separation of air lines to make it possible to more accurately control DO levels in the aeration units while maintaining an air supply to the return sludge pumps. At EBA, the facility could benefit from analyzing the current blower performance, along with current BOD loadings, and resulting air supply needs to determine if it's necessary to replace the current blowers. Current DO data suggests that the blowers cannot provide enough air to the treatment process. The exact cause for this was not determined but could include increased influent loadings and/or diminished capacity of the blowers themselves. If the blowers were replaced it would be most beneficial to install units capable of being operated with Variable Frequency Drives to ensure the most efficiency. At that point if the air lines to the clarifiers were separated then the blower motors could be controlled through on-line process monitoring equipment such as a DO monitor. If the data were used to control the blower motors with combined with soft-start and variable-speed drive capability then utilizing a feedback loop between the motor starters and on-line DO probes, the operator could efficiently regulate aeration capacity to support nitrification. These efforts could save money over the long term on electric energy costs. EBA's engineer may be able to develop a depreciation and payback term for such equipment changes.

Optimum Levels for Nitrification

Nitrifying bacteria (autotrophic aerobes) convert NH3 to NO3 consuming inorganic carbon, DO, and alkalinity.

Optimal conditions for nitrification are:

MCRT:	10 to 13 days
Wastewater Temperature:	60 - 95°F
MLSS:	2,000 to 3,500 mg/L (colder temperatures may require increased MLSS levels)
DO level:	> 1.5 mg/L (4.6 lbs per lb of NH3 converted to NO3)
pH:	7.5 to 8.5 s.u.
Sufficient Alkalinity to provide 7.2 lbs per pound of NH3 converted to NO3	

Table 8.1 Optimum nitrification indicators

Unfortunately, all plants have their individual characteristics based on influent flow, plant design, and operating procedures. While these levels are generally used in the nitrification process, individual plants may find necessary to deviate from these general values.

Pathogen control

Disinfection for fecal coliform reduction is currently performed utilizing gas chlorination. Sodium hypochlorite tablets are used to supplement the gas system when necessary, as a backup means of chlorination and for chlorinating sludge returns to treatment for filamentous bacteria. No solids accumulation was identified in the disinfection tank during the course of the WPPE. Ultraviolet disinfection (UVD) is being considered for implementation at this facility. UVD is generally much safer for the operators and the public and can provide excellent disinfection when used in the correct applications. In addition, UVD is more effective at inactivating *Giardia lamblia cysts* and *Cryptosporidium oocysts*.

Laboratory methods

Mixed liquor suspended solids tests are usually conducted once weekly. Generally this practice would be acceptable for monitoring the biomass. During spring and fall times of year when the temperatures are changing it may be beneficial to monitor the MLSS more frequently, at least twice weekly. Also, once the MLSS test is complete, volatilizing any remaining solids utilizing a muffle furnace will provide data on MLVSS, which allows for the calculation of the mean cell residence time (MCRT) and F/M ratios. For this facility, the design F/M ratios are 0.03 to 0.1MCRTs in the 10 - 13 day range allow for optimum nitrification of the wastewater. For this facility,

Use of the centrifuge, settleometers, and core-taker would allow the operators to develop a sludge inventory based on sludge units (SLU), which is a product of both solids-by-volume percent and process volume or total flow. Developing such a sludge inventory also allows the operators to determine a sludge age (AGE) for the process, which on a daily basis is used similar to the MCRT as an operational guideline.

In either case, whether using AGE or MCRT, it is beneficial to plant operators to find an ideal operational setpoint and then adjust the process to maintain the plant at or near that setpoint. It is somewhat like flying by instruments instead of using visual flight rules. Intuition, experience, and visual observations do help, but they only go so far.

Inflow/Infiltration

As are many POTWs in the Commonwealth, the Elkland collection system is impacted by inflow and infiltration. A maximum daily flow of 0.585 MGD indicates that some I/I does exist and could adversely affect operations. EBA should continue to evaluate its collection system and prioritize areas for repair and/or replacement based on the excess flow generated in that particular section.

Solids Management and Inventory Control

The solids management and inventory control program is based primarily on ½ hour settleability tests and centrifuge testing performed on mixed liquor samples. Additionally, gravimetric tests should be performed at least once per week to correlate the settleability and centrifuge tests to actual suspended solids analysis. With these three pieces of information the operator can quickly identify the loadings on the treatment units allowing them to waste solids at the most opportune times.

The current practices include wasting solids after they are allowed to settle in the clarifiers for several hours. While the operators make this practice work for the current plant setup it would be more operator friendly and easier to operate if a larger sludge digester were present for solids disposal.

MLSS vs. Centrifuge Solids comparison charts were prepared for the operators use should they acquire a centrifuge, which is encouraged. Operators can use the attached charts to estimate MLSS levels after performing a % solids test which should give a good indication of solids levels and help with deciding when to waste solids. These charts would need to be updated regularly to ensure changes in plant conditions are considered, especially seasonal considerations.

Figures 8.1 and 8.2, below, depict the mixed liquor suspended solids (MLSS) and Return Activated Sludge (RAS) levels at EBA in relation to the respective centrifuge solids reading. By plotting the data and inserting a best fit line, one can use a centrifuge solids reading to effectively estimate the MLSS reading. To utilize the chart, find the % solids result along the x axis and draw a line vertically to the black line to find the approximate MLSS result.

The MLSS results were consistent and good for projections of MLSS levels based on centrifuge test results. Using the chart below, the average of the centrifuge multiplier values is 794. Therefore, when performing MLSS centrifuge tests, multiplying the resultant % solids value by 794 will give a good approximation of the actual MLSS value for that sample. This chart will need to be updated seasonally and will not be accurate should treatment be impacted.

The chart for RAS is utilized the same way. The calculated multiplier for the RAS value is 835.

	8/26/10	8/27/10	9/15/10	9/1/10	9/22/10	10/5/10	9/8/10	9/28/10	
MLSS- N - Sample #									
MLSS-BOL	1008	1018	1262	1176	1132	1396	1332	1348	
Centrifuge	1.2	1.2	1.5	1.6	1.6	1.65	1.7	1.8	Avg.
MLSS/Cent solids ratio:	99.88%	99.88%	99.88%	99.86%	99.86%	99.88%	99.87%	99.87%	99.873%
Centrifuge # multiplier	840	848	841	735	708	846	784	749	794

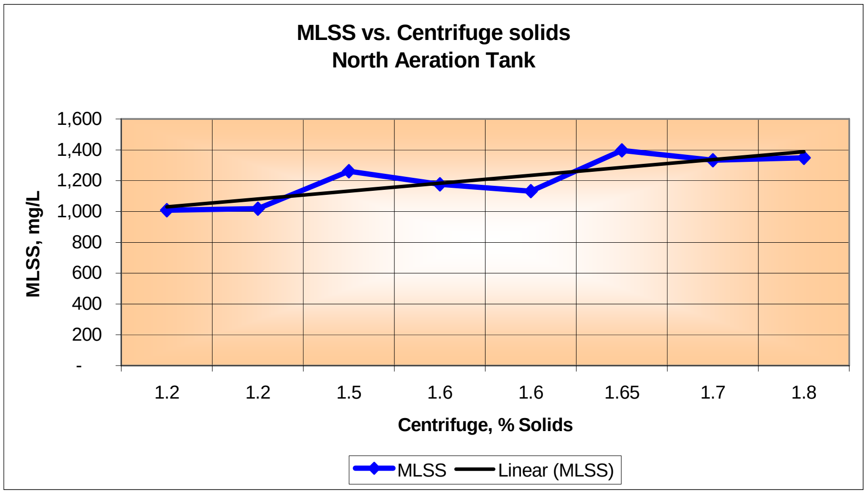

Figure 8.1 MLSS vs. Centrifuge solids comparison chart for the north lagoon 1A

	9/1/10	9/8/10	9/15/10	9/22/10	9/28/10	
RAS- N - Sample #						
RAS-BOL	3204	3144	3144	3192	3124	
Centrifuge	3.4	3.8	3.9	3.9	4	Avg.
RAS/Cent solids ratio:	99.89%	99.88%	99.88%	99.88%	99.87%	99.880%
Centrifuge # multiplier	942	827	806	818	781	835

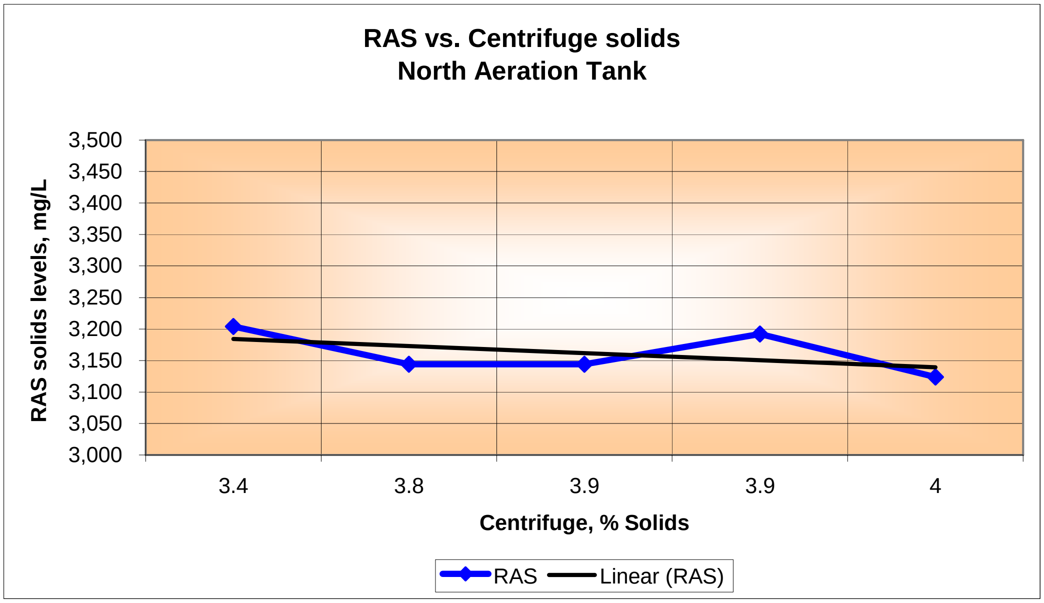

Figure 8.2 RAS vs. Centrifuge solids comparison chart for the north lagoon 1A

9. WPPE Rating

The WPPE program is a new program. As such, DEP is in the process of establishing criteria for rating each facility where a WPPE is performed, analogous to the ratings given to the drinking water systems.

Based on the observations made during this WPPE, the Elkland Borough Authority, Wastewater Treatment Facility merits a "**Satisfactory**" rating.

Performance Rating System Defined

WPPE staff will use the following categories to rate each plant. The ratings are based on the plant's ability and operators' skill level to maintain optimal performance over the long-term. Please note that while WPPEs may discover major treatment problems or identify and record violations of regulations, the rating system is not based on regulatory compliance.

"Commendable"
Department staff identified only minor operational, equipment, and/or performance problems that affect the facility's ability to maintain optimized performance. Plant personnel have already taken steps to improve overall water pollution control performance and maintain the long-term reliability of the facility.

"Satisfactory"
Department staff identified operational, equipment, and/or performance problems that may affect the facility's ability to maintain optimized performance. Plant personnel appear willing and capable of improving overall water pollution control performance. However, one or more of the treatment processes showed areas of weakness in operational, equipment, and/or performance that, if corrected, will improve performance and maintain the long-term reliability of the plant.

"Needs Improvement"
Department staff 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 water pollution control performance. Areas of weakness affect the capability and dependability of the facility in producing a quality effluent that meets the facility's permit requirements.

Attachment A— Program Description

POTW Optimization Program

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 reduce pathogen, nutrient, and emerging contaminant loadings to downstream drinking water facility intakes. The initial focus will be to work with wastewater treatment facilities within five miles upstream of these 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.

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.

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, on-line monitoring for pH, Oxidation-Reduction Potential, Ammonia, Nitrates, DO, 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. Process modification will be discussed to explain how operators 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.

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.

Attachment B— WPPE Team

Elkland Borough Authority-Wastewater Treatment Plant

WPPE Team

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Attachment C— Suggested Sampling Frequencies

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 C.1. Suggested sampling frequencies

These parameters and frequencies are the minimum for facilities with flows rated less than 1.0 MGD. Operators are encouraged to sample more frequently as necessary to gather enough data to effectively make informed process control decisions. Depending on the chemical makeup of the wastewater, additional analyses may need to be performed to provide adequate treatment. This sampling may coincide with some sampling required by the NPDES permit but does not reduce the sampling required by said permit.

Attachment D— Laboratory Sampling Results

Municipal Authority of Elkland Laboratory Sample Results

Upstream, Downstream, Effluent, Mixed Liquor Suspended Solids

The following pages represent the samples collected by Department personnel over the project period. These samples are for informational use in identifying trends and effects of process modifications where applicable. These samples were not collected with the intentions of being used for compliance purposes.

Municipal Authority of Elkland, DEP Laboratory sample results

Effluent, Upstream, and Downstream

Lab Resutls-Elkland WWTP

	8/11/10	8/26/10	9/1/10	9/8/10	9/15/10	9/22/10	9/28/10	10/5/10		Avg.
Effluent-Sample #	0331947	0331953	0331959	0331965	0331971	0331977	0331984	0331990		
CBOD	0.4	0.5	0.7	2.5	3	0.2	0.6	1.4		1.2
TSS	5	5	5	5	5	5	5	5		5
Alkalinity	142.8	129.8	140.2	139.6	167.4	155.8	155.4	116.6		143.5
NO2-N	0.01	0.01	0.01	0.01	0.04	0.04	0.03	0.01		0.02
NO3-N	2.41	6.24	2.58	4.66	2.27	2.23	1.61	6.62		3.58
NH3-N	0.04	0.04	0.04	0.03	3.62	0.79	0.7	0.02		0.66
TKN	1	1	1	1.19	4.13	1.7	1.54	1		1.6
Phos	1.42	1.621	1.757	1.292	1.348	1.11	1.256	0.89		1.34
TOT N(TKN+NO3+NO2)	3.42	7.25	3.59	5.86	6.44	3.97	3.18	7.63		5.17
Fecal Coliform	140	900	100	20	20	20	20	20		155
Chloride	117.5	106.4	105.8	98.1	110.9	121.2	106.2	83.2		106.2
pH	7.9	8.1	8.1	8.2	8.1	7.6	7.4	7.8		7.9
Crypto	0			0				0		0
Giardia	15			2				2		6
STP Flow, MGD	0.218	0.256	0.2214	0.209	0.191	0.191	0.198	0.446		0.241
TDS		492	400	426	438	468	440	390		436
Iron, ug/L			77							77
Specific Conductivity		725	721	709	763	758	758	625		723
Sulfate		35.1	37	38.2	38.2	38.3	38.28	34.99		37.2
STP Flow x 100	21.8			20.9				44.59		

Upstream-Sample #	0331948	0331954	0331960	0331966	0331972	0331978	0331985	0331991		Avg.
BOD		0.8	1.3	0.9	0.6	1	1.7	0.8		1.0
TSS	5	5	5	5	5	5	5	5		5
Alkalinity	94.4	78.2	75.6	131.8	86.4	96.6	90.2	65		89.8
NO2-N	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.01
NO3-N	0.46	0.04	0.04	0.84	0.16	0.42	0.27	0.55		0.35
NH3-N	0.03	0.02	0.02	0.02	0.02	0.02	0.02	<.02		0.02
TKN	1	1	1	1	1	1	1	1		1
Phos	0.017	0.011	0.013	0.01	0.01	0.01	0.01	0.026		0.01
TOT N(TKN+NO3+NO2)	1.47	1.05	1.05	1.85	1.17	1.43	1.28	1.56		1.36
Fecal Coliform	260	150	10	130	30	40	250	480		169
Chloride	31.1	22.7	22.6	41.4	23.2	26.9	24	19.6		26.4
pH	7.7	8.9	8.3	8.1	8.3	8	8.1	7.9		8.2
Crypto	1			3				0		1
Giardia	0			2				1		1
Specific Conductivity		257	252	460	291	317	296	232		301
Sulfate		14.4	14.8	33.2	17.1	21.5	18.8	15.07		19.3
TDS	788	136	144	272	172	204	182	158		257

Downstream-Sample #	0331949	0331955	0331961	0331967	0331973	0331979	0331986	0331992		Avg.
BOD		0.6	0.5	0.6	1.2	no	0.6	0.9		0.7
TSS	5	5	5	5	5	sample	5	5		5
Alkalinity	85.2	85.4	97.6	120	103.6		120.4	93.2		100.8
NO2-N	0.01	0.01	0.01	0.01	0.01		0.01	0.01		0.01
NO3-N	0.04	0.04	0.07	0.1	0.1		0.1	0.56		0.14
NH3-N	0.02	0.02	0.07	0.05	0.04		0.02	0.02		0.03
TKN	1	1	1	1	1		1	1		1
Phos	0.032	0.02	0.026	0.029	0.026		0.024	0.025		0.026
TOT N(TKN+NO3+NO2)	1.05	1.05	1.08	1.11	1.11		1.11	1.57		1.15
Fecal Coliform	20	70	10	20	10		10	100		34
Chloride	24.6	22.5	24	24.3	23.6		24.1	16.6		22.8
pH	8.4	8.5	8.2	8.2	8.2		8	7.9		8.2
Crypto	0			0				0		0
Giardia	0			0				0		0
Specific Conductivity		273	305	350	323		347	281		313
Sulfate		14.7	15.4	19.6	18.3		20.4	19.1		17.9
TDS	736	160	176	204	192		196	204		267

Red values are "Less than", meaning belowing detection limit or method limit

Table D.1 Elkland sample data

Municipal Authority of Elkland, DEP Laboratory sample results

Mixed Liquor Suspended Solids, Return Activated Sludge, and Influent

Lab Resutls-Elkland WWTP

	8/11/10	8/26/10	9/1/10	9/8/10	9/15/10	9/22/10	9/28/10	10/5/10		
MLSS- North - Sample #	0331950	0331956	0331962	0331968	0331974	0331980	0331987	0331993		Avg.
MLSS	986	1008	1176	1332	1262	1132	1348	1396		1205
MLVSS	684	738	832	930	876	900	1128	998		886
MLSS/MLVSS ratio:	69.4%	73.2%	70.7%	69.8%	69.4%	70.0%	83.7%	71.5%		72.2%
Alkalinity	178.2	172.2	186.4	193.8	197.4	203.4	187.4	151		183.7
RAS- North- Sample #	0331951	0331957	0331963	0331969	0331975	0331981	0331988	0331994		Avg.
MLSS	2316	3174	3204	3144	3144	3192	3124	3324		3078
MLVSS	1696	2284	2206	2134	2224	2356	2496	2476		2234
MLSS/MLVSS ratio:	73.2%	72.0%	68.9%	67.9%	70.7%	73.8%	79.9%	74.5%		72.6%
Influent -Sample #	0331946	0331952	0331958	0331964	0331970	0331976	0331983	0331989		Avg.
BOD	116	183	217	249	231	254	202	142		199
COD	128.2	382.8	313.7	230.5	378.9	326.2	327			298.2
BOD/COD ratio:	111%	209%	145%	93%	164%	128%	162%	0%		1
TSS	110	136	148	344	164	234	162	105		175
Alkalinity	243.2	254	222.8	294	312	311.8	270	196		263.0
NO2-N	0.01	0.12	0.07	0.01	0.01	0.01	0.01	0.24		0.06
NO3-N	0.04	0.04	0.4	0.04	0.04	0.04	0.04	0.16		0.10
NH3-N	19.21	17.87	17.44	31.65	28.72	33.63	28.8	10.63		23.49
TKN	28.96	27.07	26.03	42.75	41.79	47.8	40.9	18.8		34.3
Phos	3.986	4.485	3.963	5.83	5.085	6.158	5.249	2.627		4.673
TOT N	29.01	27.23	26.5	42.8	41.84	47.85	40.95	19.2		34.4
Chloride	87.4	80.1	76.7	116.3	91.7	92.4	83.4	63.1		86.4
pH	7.3	7	7.5	7.3	7.4	7.3	7.3	7.2		7.3
STP Flow, MGD	0.218	0.256	0.2214	0.209	0.191	0.191	0.198	0.4459		0.241
TDS	310									310
Iron, ug/L			891							891
BOD-after molasses add						286				286

Red values are "Less than", meaning belowing detection limit or method limit

Table D.2 Elkland sample data

Attachment E— 2010 Flow Data, August through October

Elkland Boro STP, Influent Flow Readings Rainfall/Streamflow Data for Elkland, PA from USGS gage station

August	**2010**		Daily Avg	**September**	**2010**		Daily Avg	**October**	**2010**		Daily Avg
Day	**MGD**	**Rainfall**	**Streamflow**	**Day**	**MGD**	**Rainfall**	**Streamflow**	**Day**	**MGD**	**Rainfall**	**Streamflow**
1	0.243	0	19.5	1	0.221	0	9.7	1	0.412	0.07	1129.1
2	0.246	0	21.3	2	0.225	0	8.4	2	0.346	0	253.4
3	0.239	0	18.7	3	0.222	0	7.4	3	0.318	0	162.2
4	0.231	0	15.1	4	0.212	0.01	6.4	4	0.368	0.51	125
5	0.236	0.06	13.4	5	0.209	0.01	6.1	5	0.446	0.57	209
6	0.240	0.01	12.2	6	0.208	0	5.8	6	0.708	0.91	1252.1
7	0.221	0	11.2	7	0.212	0	5.5	7	0.661	0.07	867.3
8	0.213	0	9.3	8	0.209	0.14	6.0	8	0.545	0	380.4
9	0.226	0	7.7	9	0.205	0	6.2	9	0.499	0	263.9
10	0.219	0.32	7.8	10	0.207	0	6.9	10	0.456	0	201.8
11	0.218	0	7.3	11	0.197	0	6.6	11	0.475	0.45	168.1
12	0.221	0	7.5	12	0.194	0.03	6.3	12	0.459	0.04	406.2
13	0.222	0	7.2	13	0.199	0	6.6	13			
14	0.204	0	6.6	14	0.194	0	5.9	14			
15	0.213	0.22	7.1	15	0.191	0	5.5	15			
16	0.213	0	9.5	16	0.206	0.26	5.9	16			
17	0.212	0	10.7	17	0.202	0.12	8.4	17			
18	0.214	0	7.8	18	0.191	0	12.6	18			
19	0.214	0	5.9	19	0.185	0.02	11.3	19			
20	0.213	0.01	4.9	20	0.194	0	9.2	20			
21	0.219	0	4.2	21	0.193	0	8.4	21			
22	0.318	1.61	143.4	22	0.191	0	7.8	22			
23	0.272	0.17	120.8	23	0.188	0	6.5	23			
24	0.268	0.01	62.1	24	0.184	0	5.3	24			
25	0.252	0	46.9	25	0.176	0	5.2	25			
26	0.256	0	34.0	26	0.181	0	4.5	26			
27	0.258	0	24.4	27	0.205	0.43	5.2	27			
28	0.232	0	18.9	28	0.198	0.17	10.4	28			
29	0.230	0	15.3	29	0.187	0	15.4	29			
30	0.232	0	12.8	30	0.571	2.93	1133.2	30			
31	0.2246	0	11.5					31			
Average	**0.233**	**0.078**	**22.7**	**Average**	**0.212**	**0.137**	**45.0**	**Average**	**0.474**	**0.218**	**451.5**
Max	0.318	1.61	143.4	**Max**	0.571	2.93	1133.2	**Max**	0.708	0.91	1252.1
Min	0.204	0.00	4.2	**Min**	0.176	0.00	4.5	**Min**	0.318	0.00	125.0
Total		2.41		**Total**		4.12		**Total**		2.62	

Average flow over the project= 0.264 MGD

Table E.1 Elkland wastewater treatment plant flow data

Attachment F—Equipment Deployed

Continuous monitoring

Table of equipment

1 – Laptop computer with 485 to 232 signal converter
1 – SC1000
1 – LDO probe
1 – pH probe
1 – ORP probe
1 – NH_4D probe
1 – Nitratax probe
1 – Sonatax probe
1 – Solitax probe

Laboratory

Table of equipment

1 – Hach HQ40d handheld pH and LDO meter
1 – LBOD probe
1 – DR2800 spectrophotometer
1 – Raven centrifuge
1 – Raven Core Taker sampler
2 – Raven settleometers
1 – COD Heater Block
1 – Microscope with photographic/video capability

.

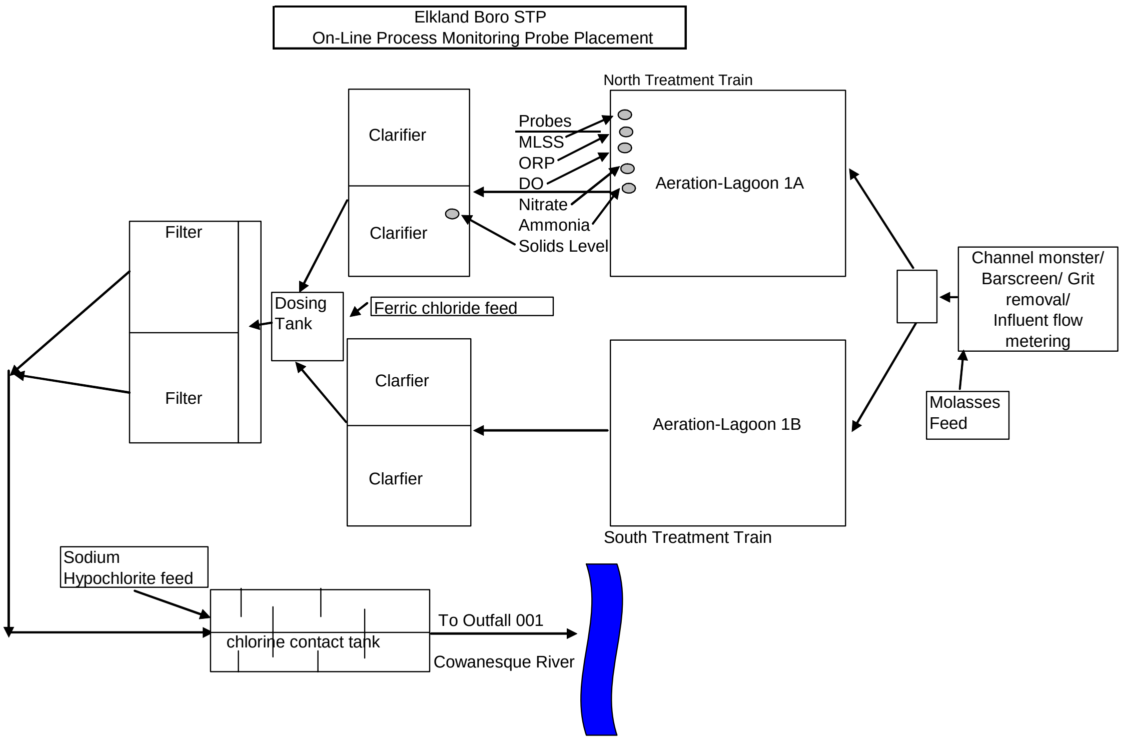


Figure F.1 Locations of on-line process monitoring equipment

Attachment G— Process Control Test Results

Elkland Boro STP
Bench Sheet

Date: 9/28/2010 **Time:**

Lab Tech: DiGilarmo

Raw Wastewater (INF)		
COD		mg/L
Influent Flow	0.198	MGD
Influent TSS	162.00	mg/L
Influent BOD	202.00	mg/L

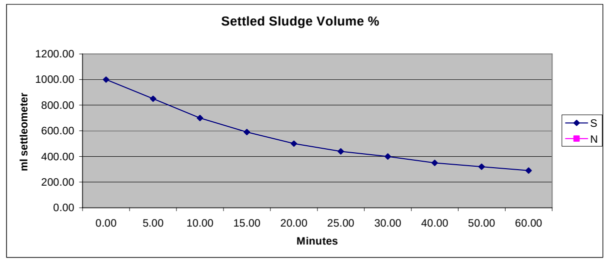
Loc	N-Aer	N clar	N RAS	N WAS				
Spin Solids	1.80		4.00					
Tank vol. (MGD)	0.915	0.102						

Location	N-Aer	N-Aer		
Time	SSV	SSC		
0.00	1000.00	1.80		
5.00	850.00	2.12		
10.00	700.00	2.57		
15.00	590.00	3.05		
20.00	500.00	3.60		
25.00	440.00	4.09		
30.00	400.00	4.50		
40.00	350.00	5.14		
50.00	320.00	5.63		
60.00	290.00	6.21		

SSC=[(Spin%) x 1000] ÷ SSV

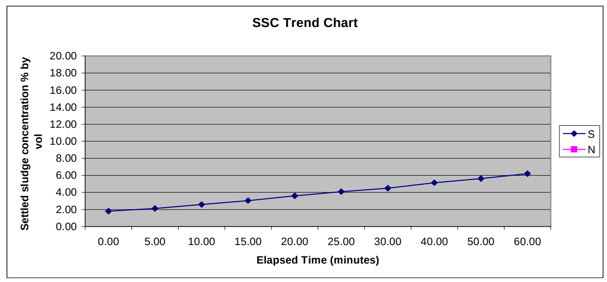
WCR=TSS ÷ Spin%

	N- Aer	
TSS	1348.00	
WCR	748.89	
MLVSS	1128.00	
RAS solids	3124.00	



	N-Aer			
SVI	296.74			
Sludge Age	38.45	days		
HRT	110.91	hours		
F/M Ratio	0.04			

	N-Clar		
Surface overflow rate	188		gpd/sf
Loading rate			lbs/day/sf
HRT	12.36		hours



Bench Tests	INF	N- Aer	N-Aer	N Clar	N Clar	Effl	SC1000	Effl Comp
Nitrate		1.82				1.67	1.90	
Phosphate-P								
Ammonia-N		0.700				0.420	0.000	
COD								
pH	7.00	7.00		7.10		7.20		
DO	3.48	1.57				6.55		
TRC						0.71		
Alkalinity								
Blanket Depth					2.00		1.53	
Temp°C	18.20	19.10				19.20		
COD-Hg Free								
MLSS							1750	

Notes:

clarifier surface area = 21.09W x 25L x 2 clarifiers
= 1054.50 sq ft.

Table G.1 Elkland bench sheet

Elkland Boro STP
Bench Sheet

Date: 9/28/2010 **Time:**

Lab Tech: DiGilarmo

OUR Testing

Location: N- Aer

OUR = slope x 60

slope = 2.47 / 10

OUR = 2.47 / 10 x 60

OUR = 14.82 mg O2/L-h

RR= (1000 x OUR) ÷ VSS

= 1000 / 1128.00 x 14.82

RR = 13.14 mg O2/g-MLVSS-h

Time	D.O.
0	8.7
1	8.21
2	7.99
3	7.78
4	7.55
5	7.32
6	7.11
7	6.89
8	6.66
9	6.44
10	6.23

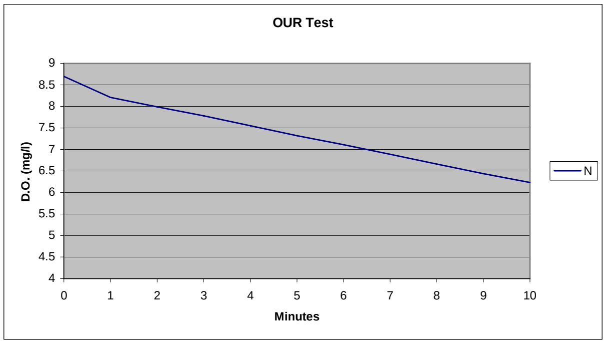


Table G.2 Elkland bench sheet

Attachment H—Graphs: Monthly Monitoring Examples

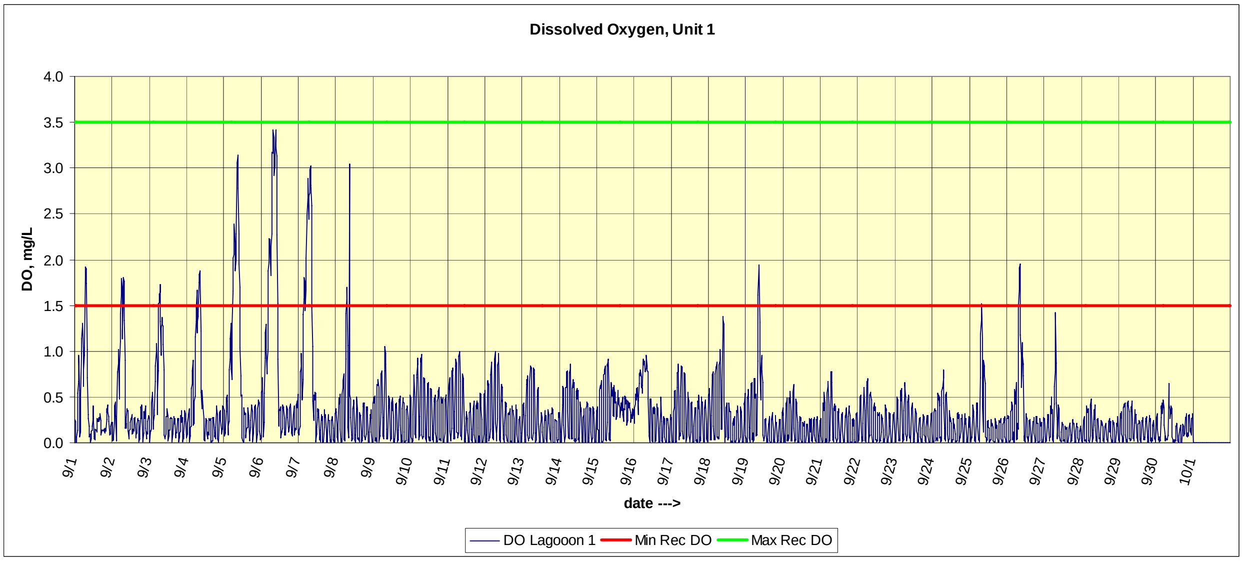


Figure H.1 DO values during the month of September 2010

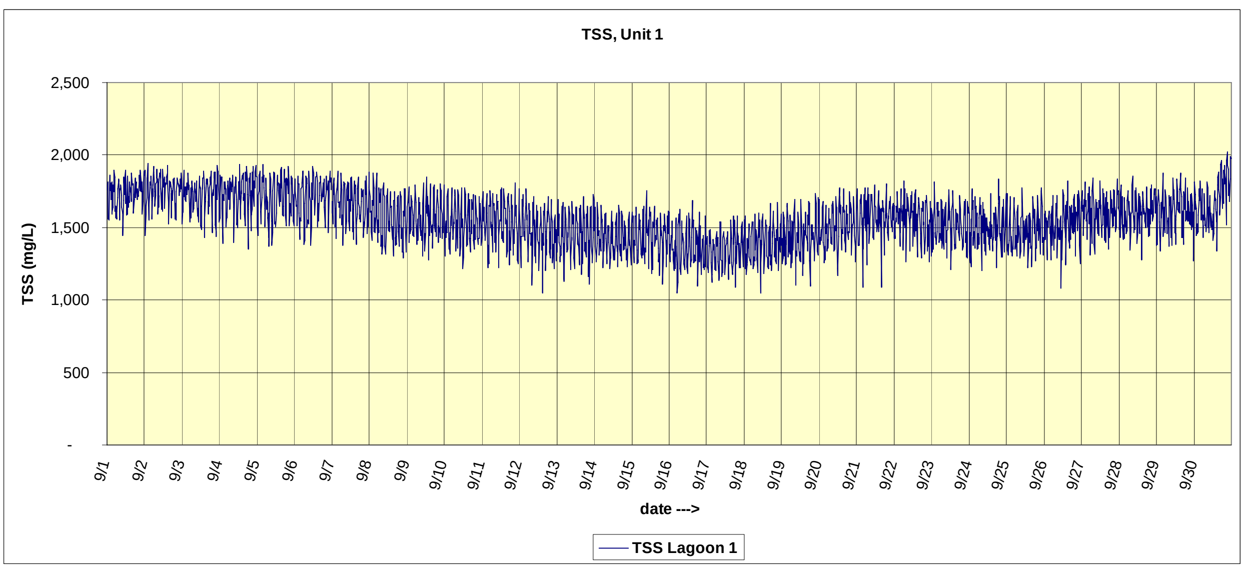


Figure H.2 MLSS values during the month of September 2010

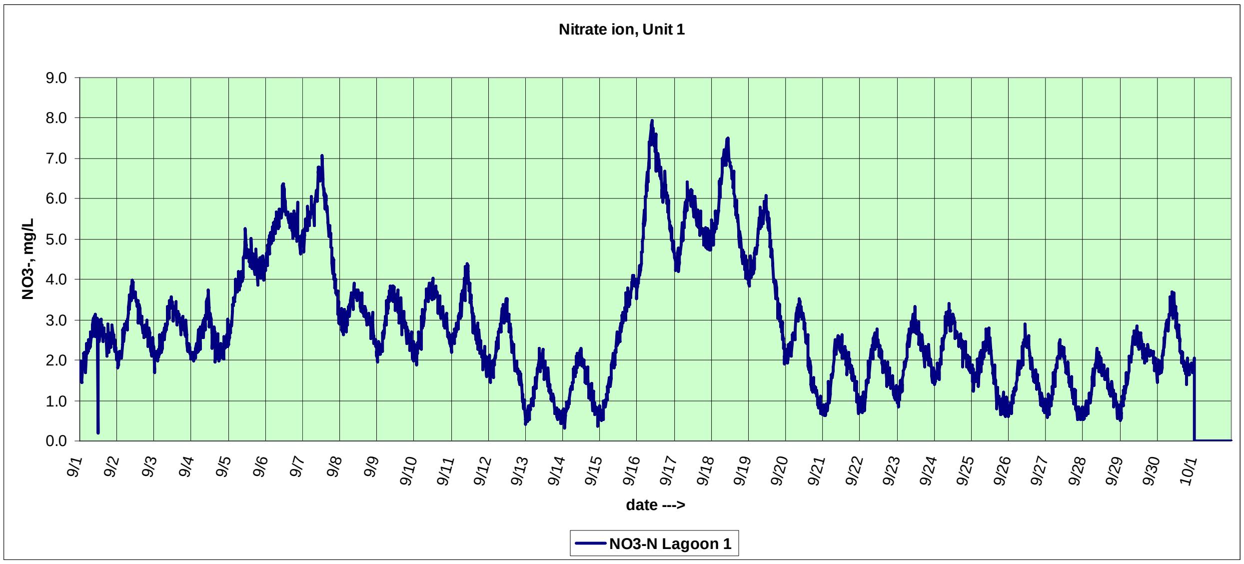


Figure H.3 Nitrate Values for the month of September 2010

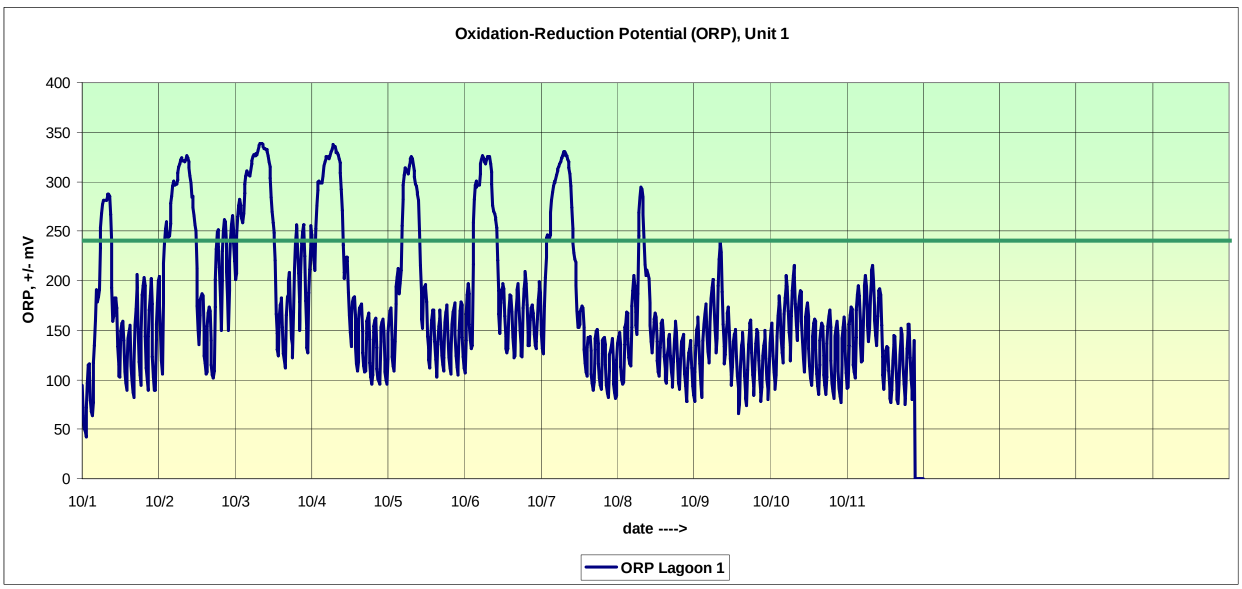


Figure H.4 ORP values for the month of October 2010

Attachment I—Graphs: Daily Monitoring Examples

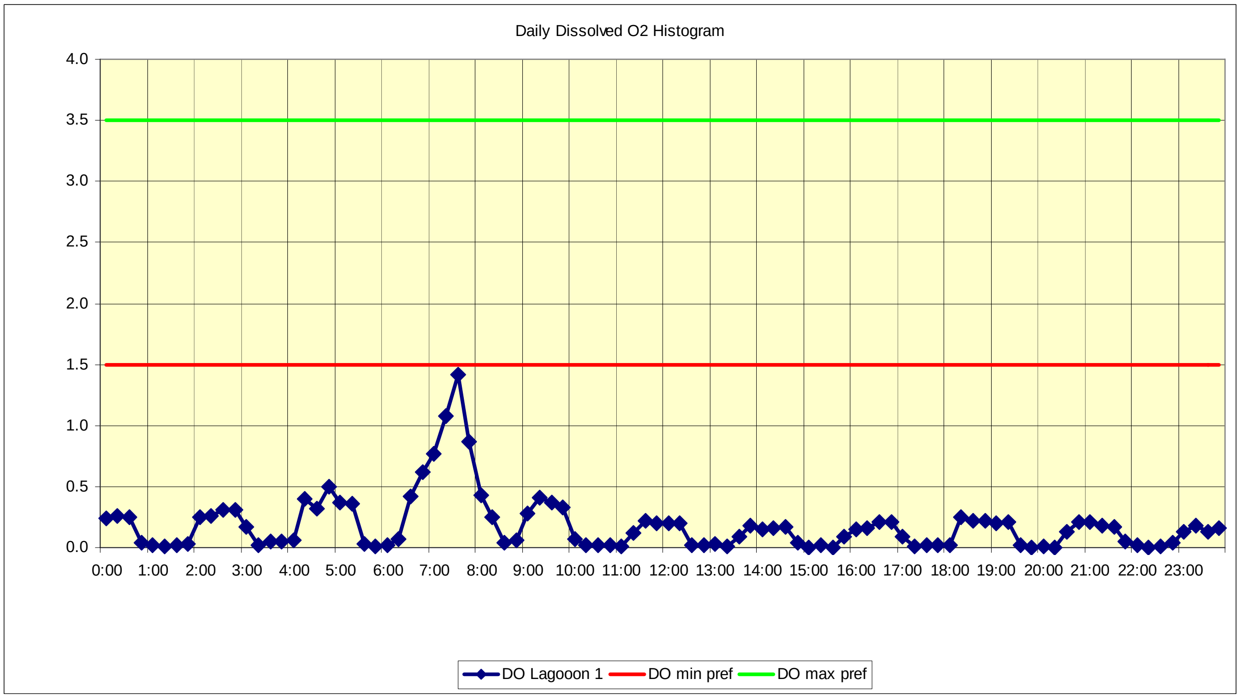


Figure I.1 DO values, September 27, 2010

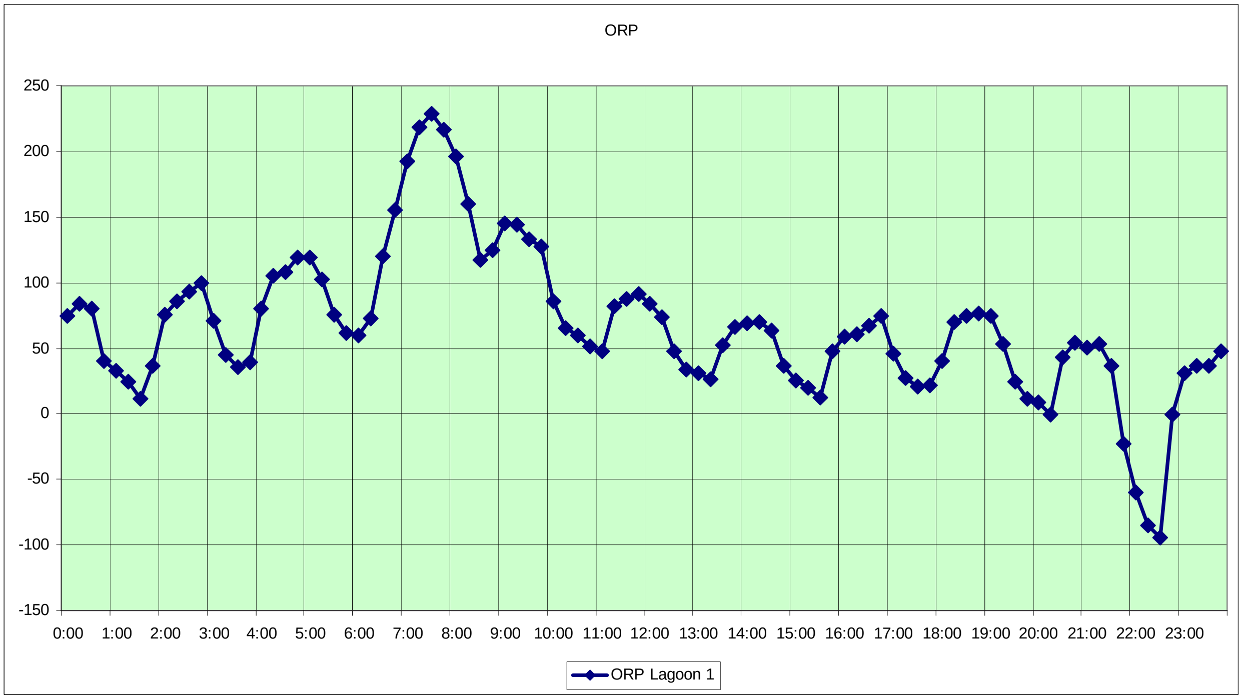


Figure I.2 ORP values, September 27, 2010

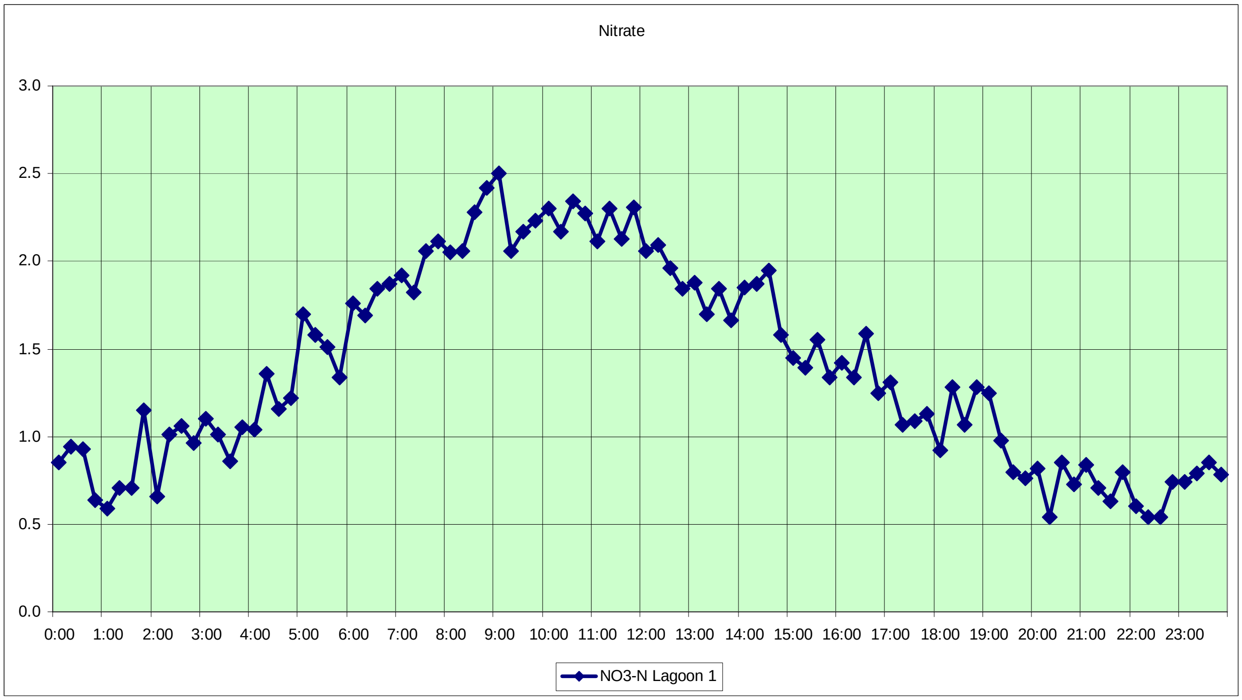


Figure I.3 Nitrate values, September 27, 2010

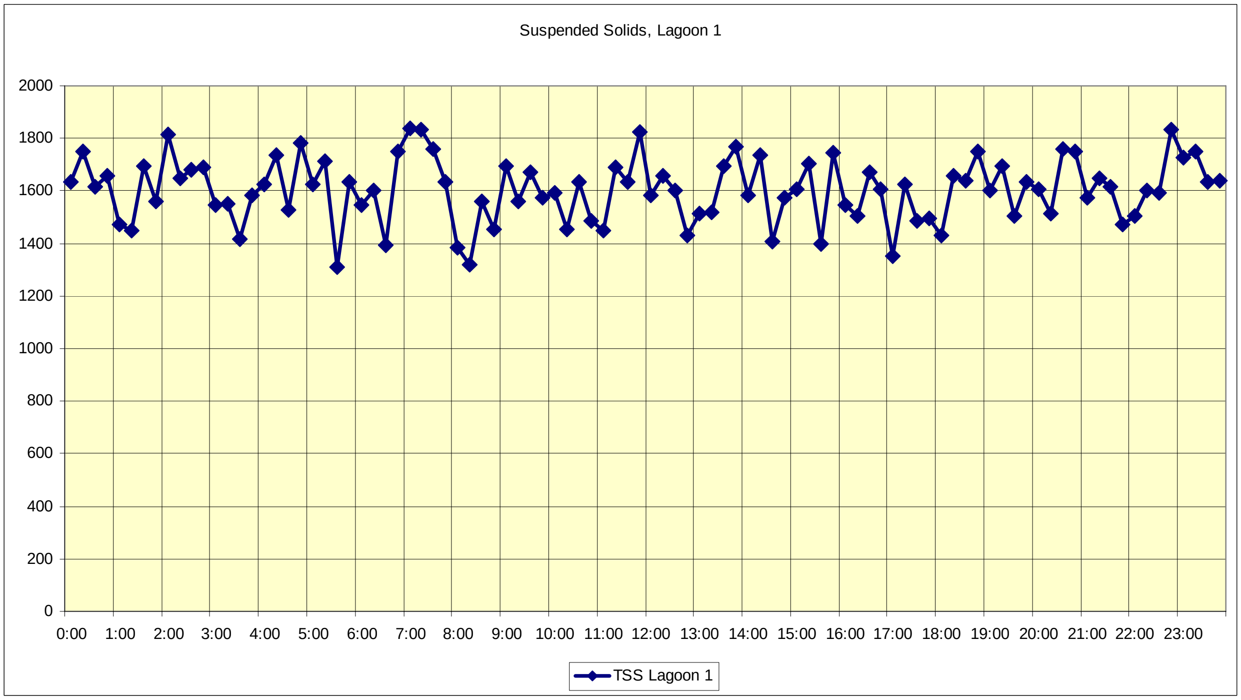


Figure I.4 Suspended Solids values, September 27, 2010

Attachment J—WPPE Photographs

Elkland Borough Authority STP

Figure J.1 DO, ORP, Ammonium, Nitrate, and TSS probes installed in north lagoon 1A

Figure J.2 Sonatax probe installed in west clarifier

Figure J.3 Solids holding lagoon 2

Figure J.4 Laboratory testing area

Figure J.5 Chlorine contact tank discharge