pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

BUREAU OF POINT AND NON-POINT SOURCE MANAGEMENT

ENHANCED TECHNICAL ASSISTANCE EVALUATION

Big Run Area Municipal Authority

Sewage Treatment Plant

Henderson Township, Jefferson County

NPDES #PA0223107

The Pennsylvania Department of Environmental Protection (DEP) conducted an Enhanced Technical Assistance Evaluation (ETAE) of the Big Run Area Municipal Authority (Big Run) wastewater treatment plant (WWTP) from May through July 2012. An ETAE is an evaluation of existing operations and practices followed by small-scale operational changes meant to optimize effluent quality. This ETAE was requested by Big Run for the purpose of assisting the plant operators with optimizing operations and addressing long term odor issues at the facility. The ETAE was performed by staff of DEP's Bureau of Point and Non-Point Source Management (BPNSM), Technical Assistance Section.

Big Run owns a sewage treatment plant (treatment plant) and collection system that serves the Borough of Big Run under National Pollutant Discharge Elimination System (NPDES) Permit No. PA00223107. The treatment plant is located in Henderson Township, Jefferson County and serves a primarily residential service area.

The current treatment plant consists of a muffin monster and two, 0.055MGD, treatment trains, each consisting of: an anoxic tank, two aeration tanks, two clarifiers, and a sludge holding tank. The plant has a current design flow of 0.11 MGD and a design loading of 224 lbs/day of BOD. The treatment plant discharges into a Warm Water Fishery (WWF), Mahoning Creek. The collection system contains two pump stations, Mill Street and Main Pump Stations, which were not part of this evaluation.

Operational Strengths

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

- The operators have consistently reduced the concentration of contaminants in the treated effluent since the ETAE has occurred.
- The operators have reduced the usage of supplemental chemicals which had included: lime, deodorizers, and a polymer flocculant.
- Foul odor issues which have plagued the facility for some time, resulting in numerous complaints to the Department, appear to be mostly resolved.
- The operators are very conscientious and knowledgeable regarding wastewater treatment and invested many man hours over the course of the project to work at optimizing treatment plant operations.
- The operators collect process monitoring data including microscope work, MLSS, alkalinity, sludge judge use, centrifuge testing, and others allowing them to actively operate the plant as opposed to being in a reactive mode.

Focus Points for Improvement

The following items have been identified as focus points to assist in optimization efforts, and they are ranked "High," "Medium," and "Low" in terms of their importance to optimized functioning of the treatment facility. 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. The priority levels are defined as follows:

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

Medium- Minimal impact on plant performance on a repetitive basis

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

High:

- Continue to work with regional DEP staff to modify the Water Management Part II permit as necessary to address the need for increased sludge holding capability.

Medium:

- The lines returning sludge and skimmer waste to the anoxic tank should be routed below the surface of the unit so as to not introduce oxygen into the wastewater.
- The Authority plans to replace the grating over the treatment units of both trains to prevent the accumulation of debris in the tanks and for personnel safety.

Low:

- The operators plan to reroute some of the piping and electrical lines between the treatment trains for safety reasons.

Discussion

The Big Run plant is a sludge denitrification extended aeration treatment system. As such it is designed to reduce ammonia, nitrate, and phosphorus (using the BESST treatment technology), in addition to conventional operating parameters. The Department was requested by the permittee and operators to perform the ETAE due to routine problems with foul odors at the treatment facility plaguing neighbors and motorists passing by the plant. New operators were retained to manage the plant operations just prior to the start of the ETAE.

As part of the ETAE, Department staff reviewed the current operating data from the treatment plant and examined the treatment process, associated units, and available operating data. Operations prior to conducting the ETAE included the addition of lime in the aeration basins, polymer flocculant in the digestors, deodorizers to mask the odors generated at the plant, and possibly other chemicals. It should be noted that the process is not permitted for chemical addition.

The previous operators at the facility used polymer to thicken sludge on a routine basis. The current operators have discontinued the use of polymer due to complications with solids transfer, removal, and odor issues at the facility. Originally both sludge holding tanks, one for each treatment train, were in use as primary and secondary sludge holding tanks. In frequent

inspections conducted by Department staff the air to the digestors was always turned off. It is hypothesized that when the contents of the sludge holding tanks was aerated the odors were generated. Upon ceasing the usage of polymers and excessive thickening of the sludge, the odors dissipated. Another problem caused by the thickening of the sludge was reduced oxygen levels in the sludge holding tanks; the blowers could not provide enough air to the thickened sludge. The low DO conditions were favorable for filamentous bacteria to take hold, and they did; as a result clarifier operations were impacted.

The operators made additional modifications to the treatment process resulting in control of the odors that had previously resulted in complaints. Some of these include: modifying sludge wasting, increasing DO levels where necessary, and decreasing the use of chemicals. These modifications have greatly decreased chemical costs for treatment, reduced odors at the facility and offsite, and reduced the presence of filamentous bacteria resulting in improved clarifier operations.

Oxidation Reduction Potential **(**ORP), measures the ability of the wastewater to oxidize waste material. The ORP levels at Big Run ranged between -227 mv to 149 mv. The ORP values were in a range to effectively conduct both nitrification and denitrification as evidenced by the results. Denitrification is possible once nitrification has occurred in aerobic processes. Further optimization may be possible with additional modifications to the anoxic tank which include discharging the skimmer and sludge return lines at a point below the water surface to prevent air from being introduced in the tank. Further, the aerated wastewater in the equalization tank (anoxic tank #2) has the potential to be an oxygen source in the anoxic tank used for denitrification.

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

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 Enhanced Technical Assistance Evaluation is to optimize operations and reduce nutrients in wastewater plant discharges. This often times involves permittees achieving effluent quality above and beyond any permit requirements.

Attachment A— ETAE Team

Borough of Big Run Wastewater Treatment Plant

ETAE Team

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Attachment B— Plant Description and Treatment Schematic

Big Run currently operates a denitrification extended aeration treatment plant. The plant was designed with two treatment trains but high flows and inadequate sludge holding capacity require one of the treatment trains to be used for additional sludge holding capacity and influent equalization. Currently the aeration, anoxic, and settling units of one train appear to be effective in maintaining compliance with effluent limits. Train #1 is being used for treatment and Train #2 is used for equalization and sludge holding.

Operations—Big Run retains the services of a contract operator to maintain the treatment plant.

Headworks—The headworks include a muffin monster prior to influent equalization.

Influent Sampling—Influent composite samples are collected manually. While these can provide representative data, a composite sampler collecting 24 hour composite samples would be preferred.

Anoxic—There are two anoxic tanks; one is used as an anoxic tank (#1) and the other as an equalization tank (#2). Flows enter into the anoxic/equalization tank where they are aerated and pumped to the main anoxic tank based upon tank level which is controlled by floats. An airline was added to anoxic tank #2 in an attempt to keep the contents fresh.

Aeration—There are four aeration tanks, two in each treatment train. There are two units being utilized as aeration tanks during the ETAE. Of the other two units, one is empty and the other is used to hold excess sewage sludge. Air delivery can be controlled by timer and both motor run time and amperage are monitored with permanent gauges mounted on the control panels. There were minimal modifications to the timers as to maintain both nitrification and denitrification processes. Filamentous bacteria were present in the aeration basins and traced back to the sludge holding tanks. It is theorized that the low DO conditions in the sludge holding tanks, due to excessive solids content, encouraged the growth of the bacteria.

Possible future work in the aeration basins would be modifying blower run times to reduce electrical consumption while still maintaining nitrification.

Clarifiers—There are two clarifiers in each treatment train, upflow units with the wastewater entering the bottom, creating a sludge blanket to further filter the wastewater and discharging at the surface. The units of one treatment train are in use. There may be a leak in the piping under the clarifier furthest from the control building as evidenced by bubbles rising from the bottom of the unit. Early on in the project the clarifiers often had a scum on the surface which previous operators had skimmed continuously throughout the day. Current operations, addressing the filamentous issues, appear to have greatly reduced the surface scum.

Disinfection—The disinfection process is achieved utilizing ultraviolet light. This system appeared to be effective and was not evaluated further.

Discharge—Final effluent flows from the ultraviolet light disinfection tank and V notch weir to its discharge location at Mahoning Creek. The operator uses a 24hour composite sampler for collection of effluent samples.

Solids Handling—Solids are wasted from the clarifiers to a primary sludge holding tank in the #1 treatment train. Solids are decanted as necessary to thicken the sludge and then the contents are further pumped to the second sludge holding tank (in plant #2) and the #2 aeration tank to provide additional storage. The existing sludge holding tank (#1) is not large enough for the operator to utilize it effectively; hence the usage of the additional tankage. The Authority was working with DEP staff to permit the additional sludge holding tankage.

Current Performance—As of the completion of the ETAE, the facility is currently meeting all permitted effluent limits and reducing Total Nitrogen to approximately 5.0 mg/l. Several process modifications including the wasting, digestor operation, increased process monitoring, and operator diligence were key aspects of the plants operational improvements.

Both Total Suspended Solids and $CBOD_5$ have decreased in the months following the ETAE. Appendix D, Figures D.5 and D.6, graphically depict the reductions.

Attachment C— Equipment Deployed

Digital, Continuously Monitoring Probes

Laboratory Equipment On-Loan

Digital, Continuously Monitoring Probes:

1 – Laptop computer with signal converter, 2 – SC1000s, 2 – LDO probes, 1– pH probe,

2 – ORP probes, 1 – NH_4D, 1 – Nitrate Probe, 1 – Solitax probe

Laboratory Equipment On-loan:

1 – Hach HQ40d handheld pH and LDO meter, 1 – DR2800 spectrophotometer, TNTplus test vials for measuring Nitrate, Ammonia, and Alkalinity, Microscope

Figure C.1 Locations of ORP, DO, MLSS, and pH probes in the aeration tank

Figure C.2 Locations of ORP and DO probes in the anoxic tank

Figure C.3 Locations of Ammonia and Nitrate probes prior to the UV light in the effluent discharge

Attachment D— Continuous Digital Monitoring Charts

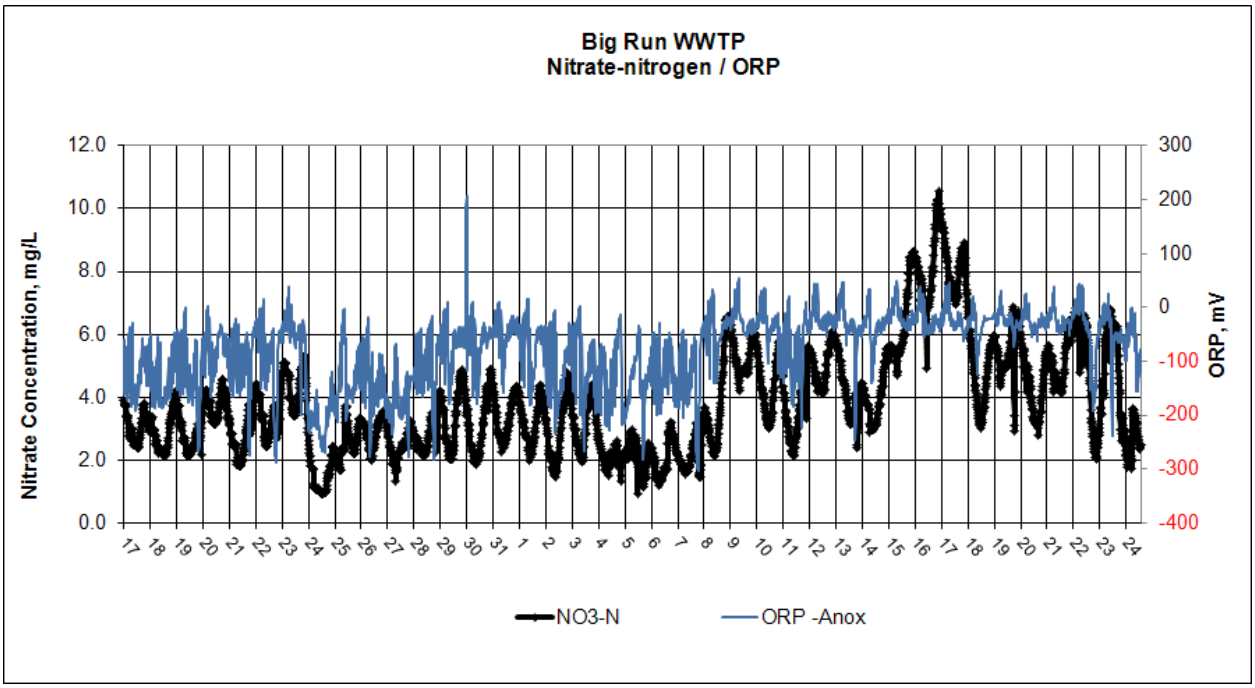

Figure D.1: This figure shows the relationship between the ORP and Nitrate concentration. ORP values should generally be -150 mV or less for effective denitrification. When ORP values increase the nitrate values increase as well.

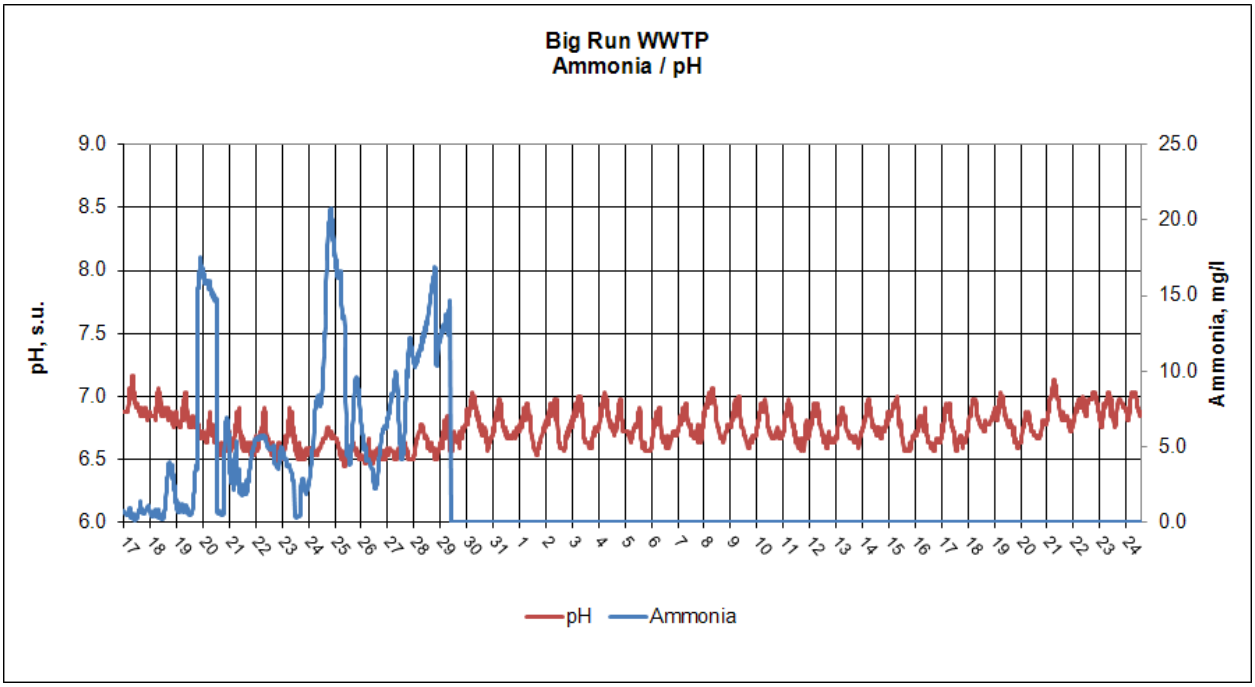

Figure D.2: This figure identifies the relationship between pH and Ammonia. The Ammonia probe is strictly a trending device and did malfunction after the 29th. Overall the trend to be noted here is that low pH values are associated with increased ammonia values. Sufficient alkalinity and a pH near 7.5 s.u. are ideal for maximizing nitrification.

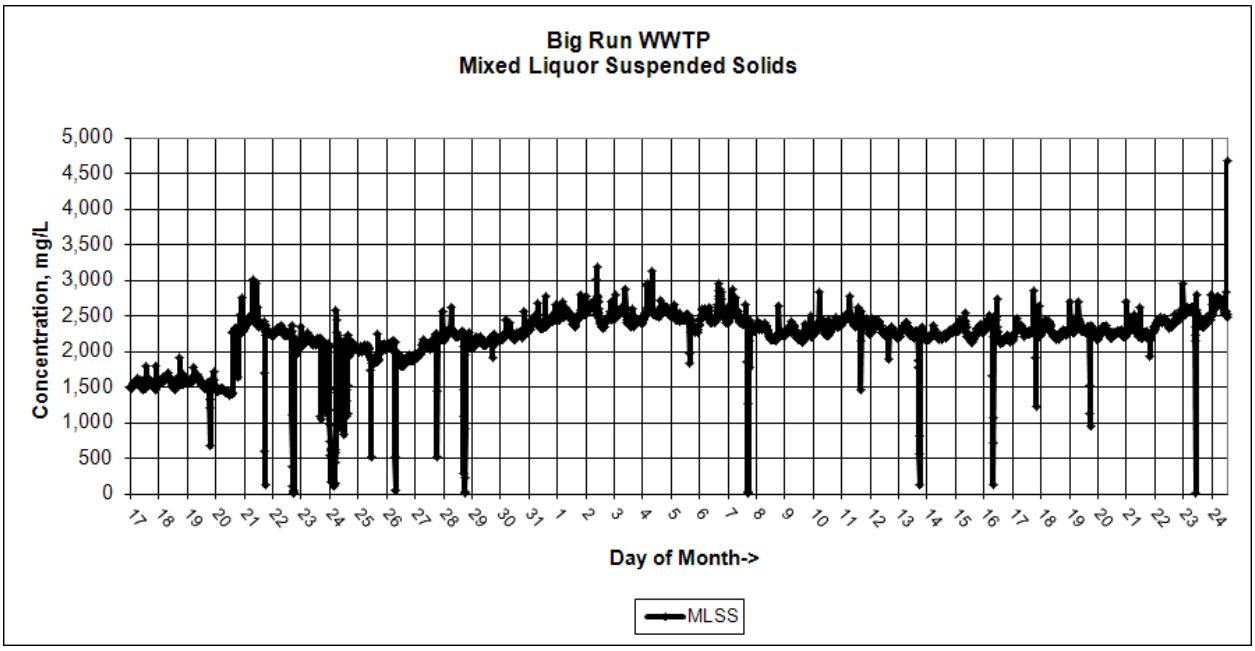

Figure D.3: The Mixed Liquor Suspended Solids levels were increased over the course of the evaluation due to very young mixed liquor at the beginning of the evaluation.

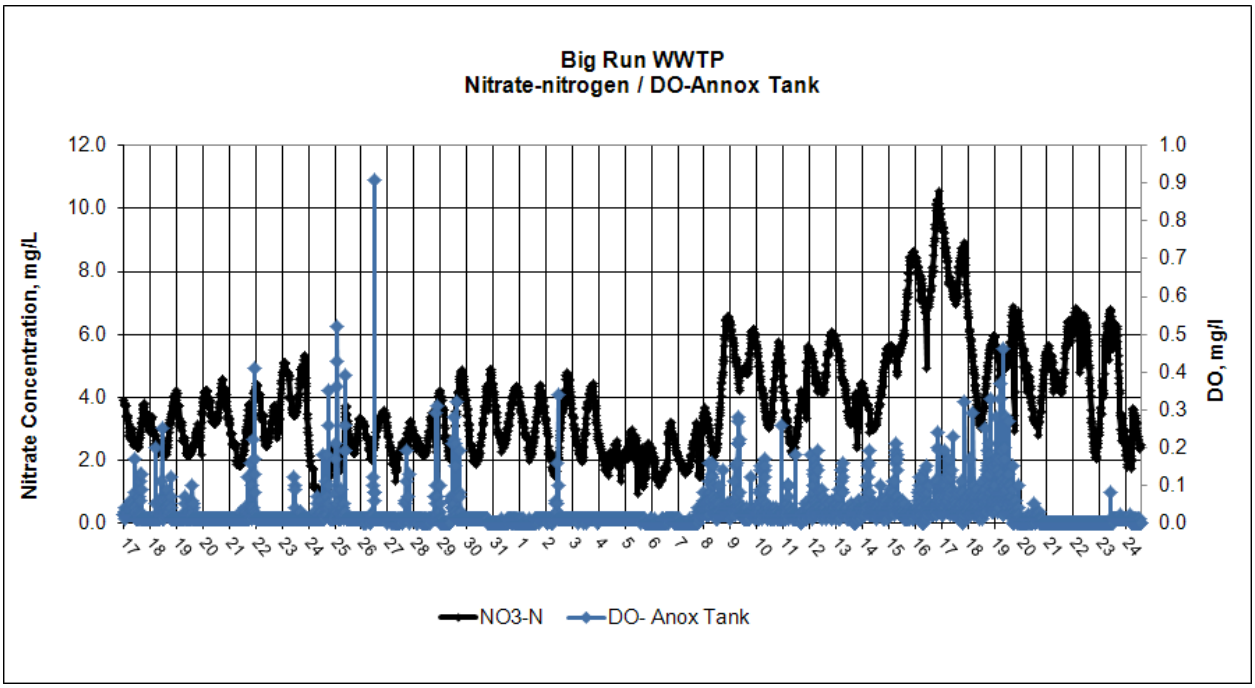

Figure D.4: The Dissolved Oxygen data shows that even very small amounts of oxygen in the Anoxic Tank have negative impacts on the denitrification process. The presence of oxygen correlates to spikes in the nitrate concentrations.

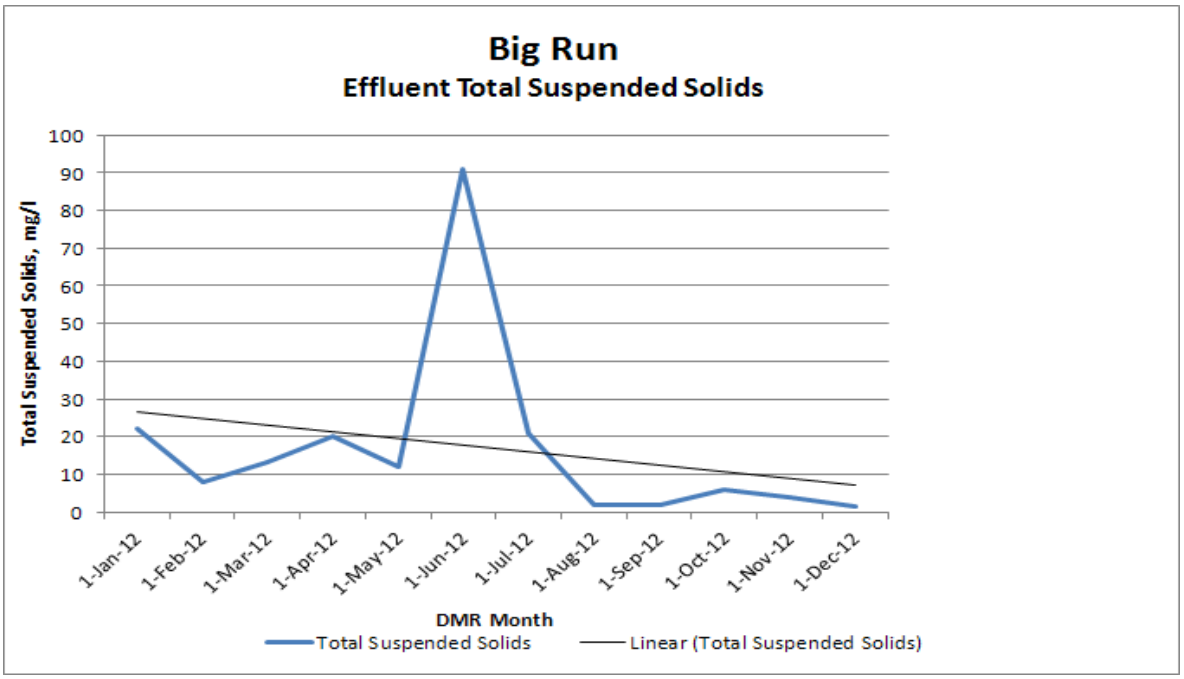

Figure D.5: The Effluent Suspended Solids steadily decreased after the ETAE.

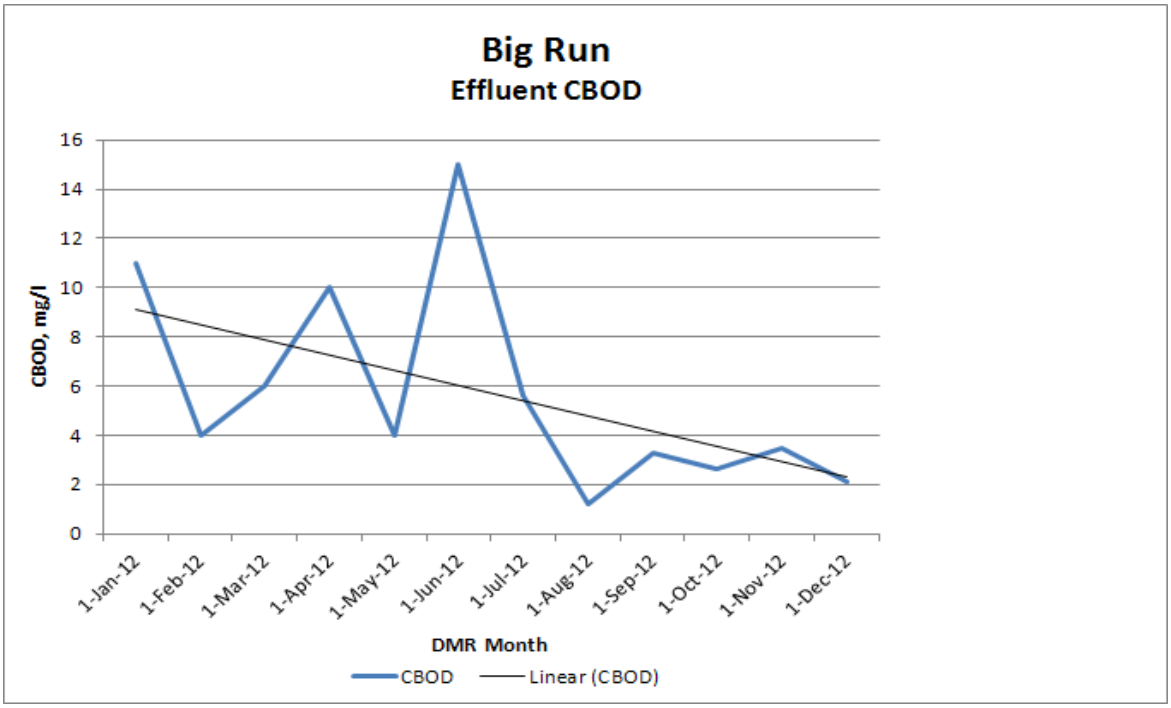

Figure D.6: The Effluent CBOD steadily decreased after the ETAE

Attachment E—NPDES Effluent Discharge Limits

Big Run Sewage Treatment Plant
NPDES PA0223107

Discharge Parameter	Effluent Limitations						Monitoring Requirements	
	Mass Units (lbs/day)		Concentrations (mg/L)					
	Average	Maximum	Minimum	Monthly Average	Weekly Average	Maximum	Minimum Measurement Frequency	Required Sample Type
$CBOD_5$	22.9	36.7		25	40	50	1/week	24-hr comp
Total Suspended Solids	27.5	41.3		30	45	60	1/week	24-hr comp
Dissolved Oxygen			3.0				1/week	Grab
pH			6.0			9.0	1/day	Grab
Fecal Coliform								
			200/100 ml as a geometric average, not greater than 1,000/100 ml in more than 10% of the samples tested				1/week	Grab
5/1 - 9/0 10/1 - 4/30			2000/100 ml as a geometric average				1/week	Grab

Table E.1. Big Run NPDES effluent limitations