Bureau of Point and Non-Point Source Management
Technical Assistance Program

ENHANCED TECHNICAL ASSISTANCE EVALUATION

PA Department of Corrections
SCI Laurel Highlands Sewage Treatment Plant

Somerset Township, Somerset County

NPDES #PA0030406

The Pennsylvania Department of Environmental Protection (DEP) conducted an Enhanced Technical Assistance Evaluation (ETAE) of the Pennsylvania Department of Corrections-State Correctional Institution at Laurel Highlands (SCILH) wastewater treatment plant (WWTP) from December 2012 through February 2013. An ETAE 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 nutrients in the final effluent, with an overall goal of improving surface water quality. The ETAE was performed by staff of DEP's Bureau of Point and Non-Point Source Management (BPNSM), Technical Assistance Section.

At the onset of the project the Ammonia Nitrogen values in the effluent were very high and review of the systems compliance history over the previous six months showed the system had occasionally violated the NPDES permitted limits for Ammonia Nitrogen.. These issues along with a request from the DEP Regional office staff and the operators themselves prompted the decision to provide the assistance at the facility.

SCILH owns a sewage treatment plant (treatment plant) and collection system that serves the correctional institution, a contributing municipality, and the Mostoller Landfill under National Pollutant Discharge Elimination System (NPDES) Permit No. PA0030406.

The current treatment plant consists of three preliminary settling tanks, a trickling filter, two Sequencing Batch Reactor (SBR) units, two sludge digestors, and ultraviolet disinfection. The treatment plant has a current design flow limit of 0.50 MGD. The treatment plant discharges into an UNT to East Branch Coxes Creek.

The SCILH treatment plant is operated as an extended aeration, nitrification treatment facility. The Departments Technical Assistance Program was contacted to help address issues with Ammonia Nitrogen violations. Upon visiting the treatment facility and reviewing operational data, the decision was made to conduct an ETAE at the facility to address the ongoing violations and look at denitrification operations which often involve reductions in chemical usage and savings in electrical consumption.

The incoming ammonia levels were high at this facility, due to the leachate from the landfill, averaging approximately 100 mg/l. Upon achieving nitrification the resulting nitrate was approximately 80 mg/l. As SBRs often have the ability to nitrify and denitrify, the decision was made to modify the original cycle times to further manipulate the anoxic cycle, lengthening it, for improved nitrate reduction. It is imperative that the operators monitor the influent levels for ammonia and alkalinity to ensure enough are present. The high ammonia levels present in the raw leachate can provide some unique demands on the process. Having data on the process parameters will allow the operators to maintain the process, being proactive, and not reactive to changes in the influent. Inconsistent flows from the landfill will have an impact on operations at the SCILH plant. Large fluctuations in the flow rate or, at times, having no flow to the plant at all greatly complicate the job of the SCILH operator. These fluctuations will require additional process control testing to monitor the strength of the influent waste and ensure the quality of the effluent discharge. It will be essential to the successful operation of the SCILH plant for the landfill and plant operators to maintain open lines of communication. Information that should be routinely shared includes: anticipated changes in leachate flow rates, a stoppage of the leachate flow, a startup of leachate flow. This information should be shared ahead of time so the SCILH operator can process changes at the plant that will allow them to continue operating and meeting the NPDES permit limits. If the SCILH plant continues to experience challenges with meeting ammonia nitrogen limits and the ammonia levels continue from the landfill, then it may be necessary for SCILH to request the landfill to provide additional treatment, such as aeration, to assist in reducing ammonia levels prior to reaching the SCILH plant.

A person may not make a process control decision at a water or wastewater system unless that person is Board-certified with a valid certificate with the appropriate class and subclassifications for the size and treatment technologies of a water or wastewater system. 25 PA Code Chapter 302, fully explains all requirements of water and wastewater plant operators.

Over the course of the ETAE, the cycle times were modified to allow for complete nitrification to occur during on air periods and denitrification during off air periods. The nitrate levels fluctuated over the course of the project due to plant performance and changes in the influent characteristics; when the landfill is discharging into the system influent ammonia significantly increases while influent levels are much lower when the landfill was not. Though we achieved reductions in the nitrates through denitrification, the variability in influent ammonia, and the current constant speed blowers made it difficult to achieve optimal levels of removal. The operator, using the new available data and switching treatment units, was able to adjust the available oxygen, quickly resolving the ammonia effluent issues, bringing the treatment plant back into compliance.

Findings

1. The cause of the ammonia violations upon arrival at the site was an inadequate supply of oxygen in the SBR unit which did not allow complete nitrification to occur.
2. The operators at the facility are very knowledgeable and cooperated fully during the entire project. At several times they made instrumental decisions that improved treatment efficiency and effluent quality.
3. SCILH will need to increase the process control monitoring and testing to successfully comply with permit limits and account for fluctuations in the influent waste stream.
4. SCILH should consider having an additional certified operator available to assist in performing the operations and testing at the plant. Plants of similar size, with complex influent waste streams, often maintain at least two certified operators to conduct necessary operations and perform the amount of process control tests necessary to ensure compliance with NPDES permit limits.
5. SCILH should consider entering into a pretreatment agreement with the landfill to fully define operating parameters, influent quality, and conditions that are expected to be met on a routine basis.
6. SCILH should consider purchasing equipment to allow the operator to accurately monitor the treatment process for alkalinity, ammonia, and nitrate.
7. The air diffusers in the second SBR unit should be replaced in case the need arises to put it online quickly.
8. Consider the installation of additional process control equipment to closely monitor and optimize the nitrification treatment process. Utilization of online process monitoring equipment would allow the operators to see current conditions of the treatment process and take necessary actions prior to encountering treatment issues that could lead to effluent violations.

9. The Ammonia nitrogen spike occurring in late January further defined the limits to which the cycle times can be modified in the winter months.
10. The cycle times will need to be revised during the summer months along with the appropriate MLSS levels to maintain nitrification. Generally, a reduction in MLSS levels is necessary in warmer temperatures.
11. Flow meter readings for raw leachate were inaccurate at the onset of the ETAE and did not allow the operators to successfully plan for changes in influent characteristics. The flow meter was repaired during the ETAE.

Upon reviewing several weeks of Dissolved Oxygen continuous monitoring data, a decision was made to modify the times of the SBR cycles to ensure full nitrification and, to the extent possible, denitrification. Figure 2 depicts a typical chart used to identify cycles, aeration times, and the responding DO levels. These charts and cycle modifications were also used in an attempt to minimize DO levels which would also reduce electrical consumption; the constant speed blowers make electrical consumption reduction difficult. If online monitoring equipment, including DO probes, were utilized in conjunction with variable speed blowers then the process could be optimized, further improving effluent quality and reducing electrical consumption.

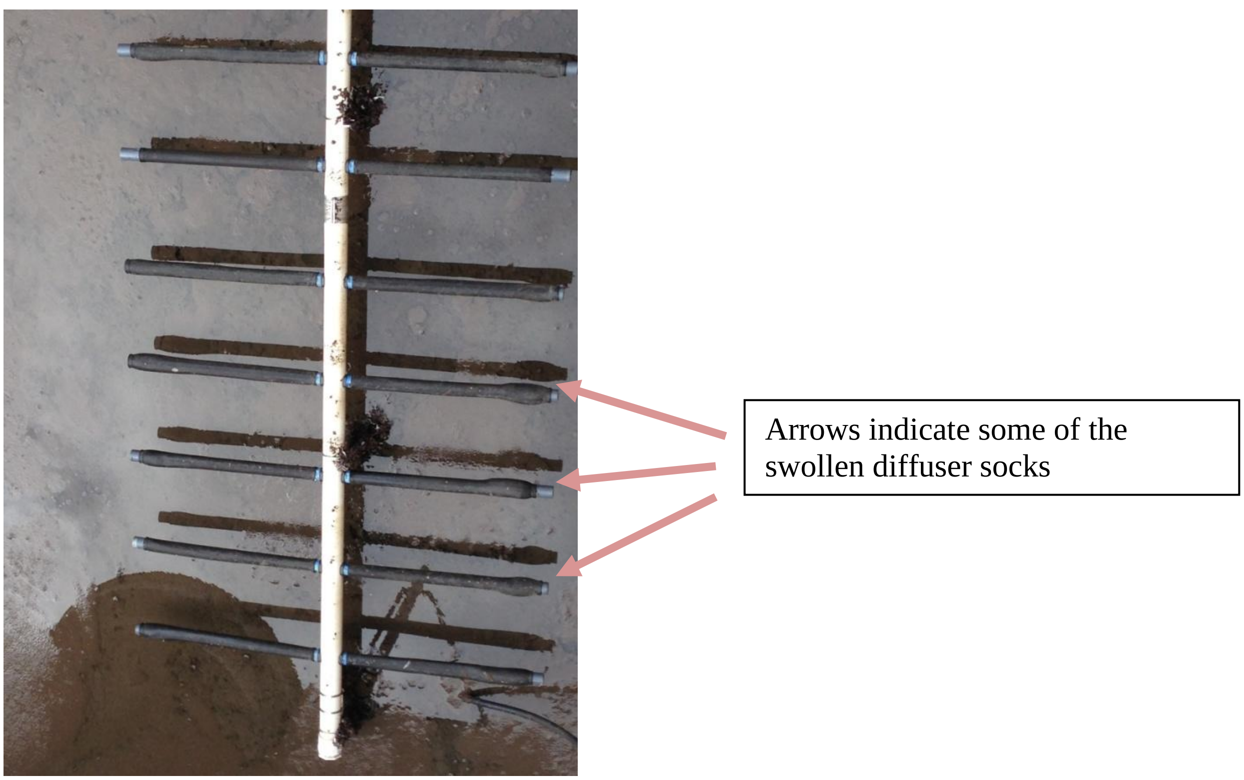

Figure 1: Diffuser socks in SBR 2. Note the enlarged ends that were partially blocked with solids which reduced the volume of air available for nitrification. The issue was resolved when the operator switched to the other SBR unit.

The nitrification process utilizes a significant amount of oxygen and can double oxygen requirements in wastewater treatment facilities when compared to those not nitrifying. The high ammonia levels in the influent at this facility necessitate a significant amount of available oxygen and alkalinity for nitrification to occur. Once the problem with insufficient oxygen was identified, the operator took the initiative to switch SBR units and found some diffuser socks in need of repair, as seen above. These socks were preventing a sufficient amount of oxygen from reaching the biomass resulting in elevated ammonia nitrogen levels in the effluent.

Performing denitrification operations at this facility would provide both oxygen and alkalinity for the nitrification process at no additional cost. The benefits of denitrification are improved effluent quality, reduced sludge production, reduced electrical consumption, and reduced supplemental alkalinity. Denitrification operations are best performed with online monitoring equipment that can more closely monitor the treatment process for additional parameters such as nitrate and oxygen reduction potential.

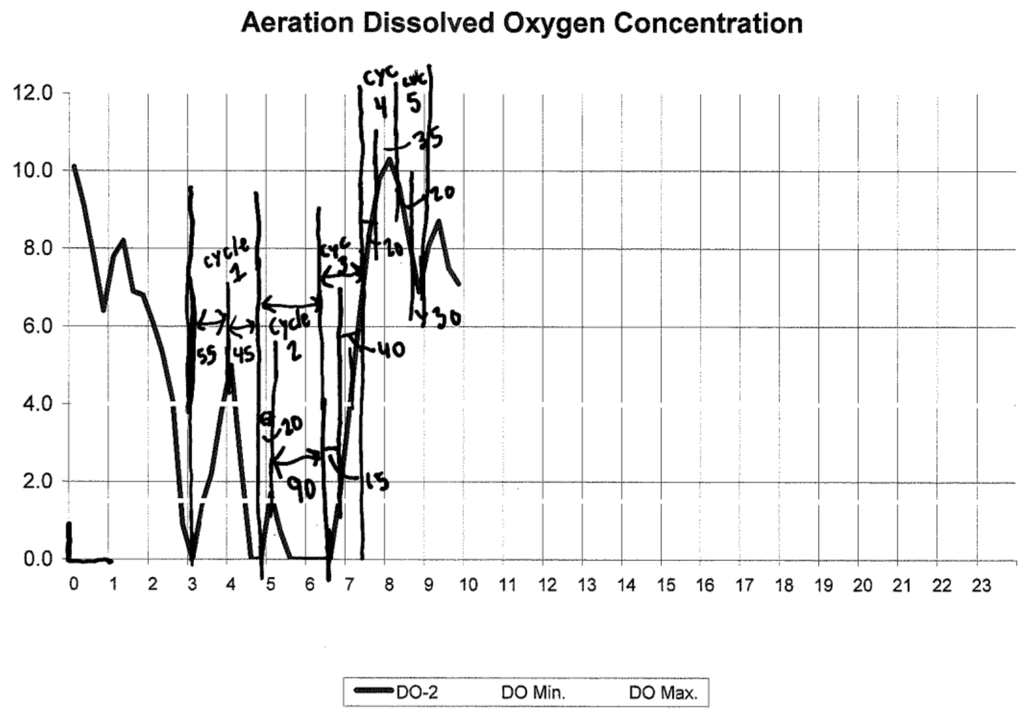

Figure 2: Detailed review of the SBR cycle times allowed modifications based on Dissolved Oxygen data collected with the on line monitoring equipment. This picture shows an overlay of the DO data with each of 5 cycles.

Figure 4: Decanter in SBR tank off line for maintenance

Figure 4: Mixer in SBR tank off line for maintenance

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, please contact the DEP regional office that supports your wastewater facility prior to making any modifications.

Attachment A— ETAE Team

SCILH Wastewater Treatment Plant

ETAE Team

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Attachment B— 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-LR, Ammonia-LR, Alkalinity, Digital Reactor Block, Phosphorus-Total-HR

Figure E.1 Locations of probe deployment within the SBR and at the discharge channel.

Attachment C— Sampling Data

Date	Infl BOD	Infl NH3	Effl NH3	Effl NO3
5-Dec	636	133.1	35.77	39.21
12-Dec	608	117.9	4.6	82.33
19-Dec	320	118.7	9.17	
2-Jan	303	87.8	1.336	80
9-Jan	271	142.7	0.1	88.82
16-Jan	381	78.6	0.1	28.06
23-Jan	383	20.5	0.1	52.7

Figure G.1: This figure shows influent and effluent data over the course of the ETAE project

Attachment D— Continuous Monitoring Charts

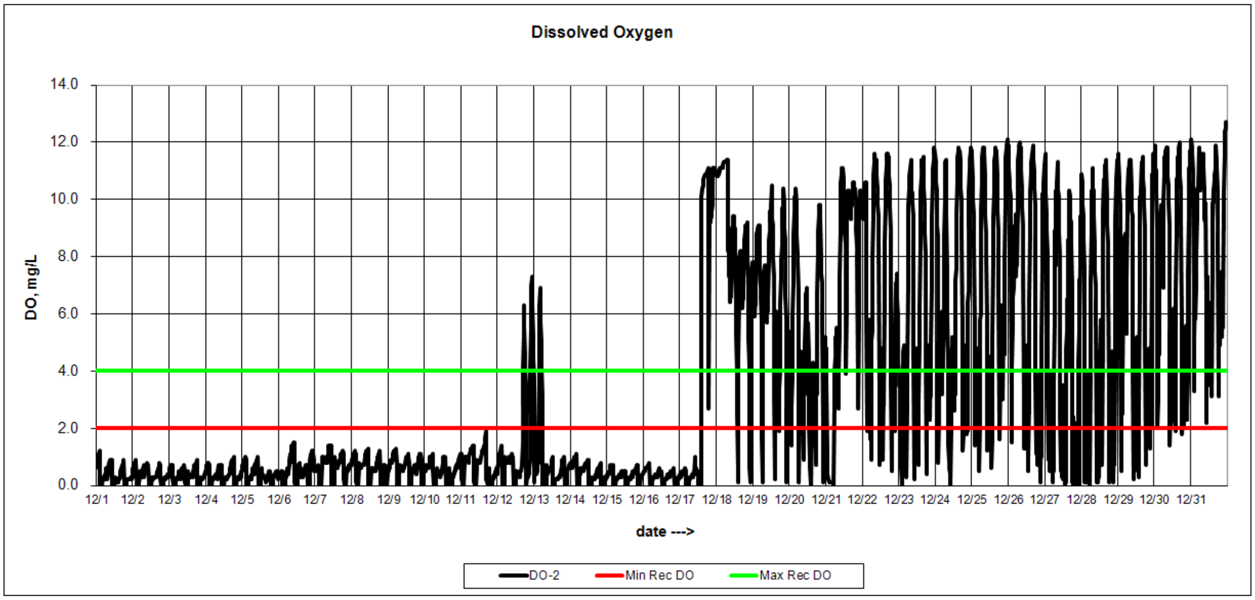

Figure G.1: This figure shows the Dissoloved Oxygen in the SBR units before and after changing the unit in operation. The original unit in use and faulty diffusers that will need replaced.

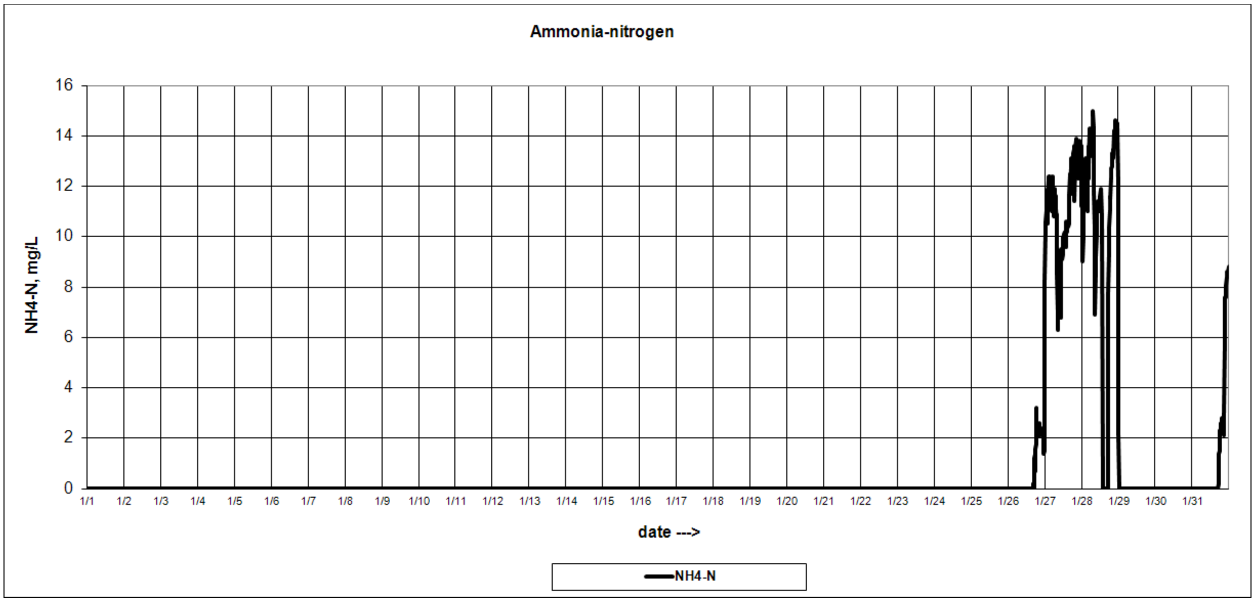

Figure G.1: This figure shows the improvements in the ammonia nitrogen levels after switching SBR tanks and modifying process times. The late spike in the ammonia levels defined the minimum requirements of the cycle times.

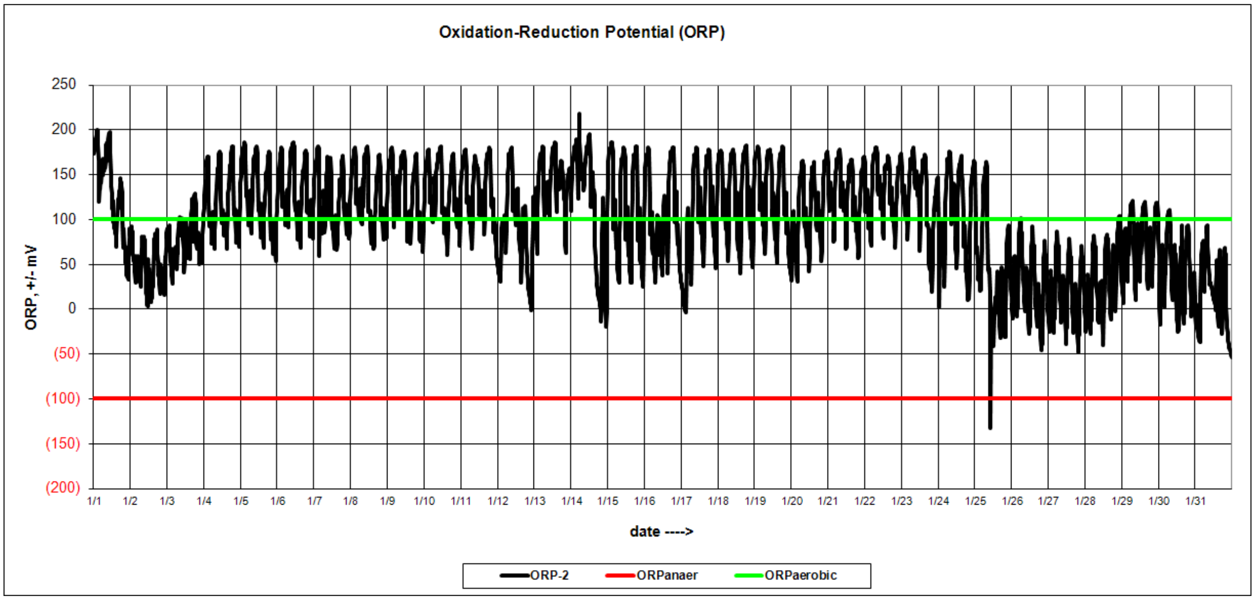

Figure G.1: A shift in the ORP values toward the end of the project coincided with some higher ammonia nitrogen values. The cycle times have to be maintained to keep ORP values elevated above 100 mV to ensure nitrification is possible.

Attachment E—Tables of SBR Cycle Time Mods

The following tables summarize original and modified SBR cycle times.

SCI Laurel Highlands

11/27 original settings	
react cycle time	air on time
45	30
45	35
45	30
45	15
45	20

cycle	minutes	
mix fill	30	
react fill	210	370 minutes (react fill + react)
react	160	
settle	45	
decant	35	
Total	480	

Original settings ran through the 45 minute cycels a total of 8.2 times in a 370 minute period providing 235 minutes of air

Changed react cycle times on 12/6

12/17 switched to SBR 1, found bad diffusers in SBR 2

Each cycle performs the air on time first then times out with no air

	6-Dec	10-Jan	14-Jan	18-Jan	22-Jan
react cycle time	air on time	air on time	air on time	air on time	air on time
100	65	65	55	55	55
110	60	45	20	20	25
55	35	25	15	10	5
55	35	25	20	10	5
50	40	30	20	20	15
Total min air	235	190	130	115	105

	24-Jan	1-Feb	13-Feb		
react cycle time	air on time	air on time	air on time	air on time	air on time
90	55	80	80		
80	25	30	30		
100	10	20	50		
50	5	5	25		
50	15	15	25		
Total min air	110	150	210		

Attachment F—NPDES Effluent Discharge Limits

SCILH Sewage Treatment Plant
NPDES PA0030406

Parameters	Mass (lb/day)		Concentration (mg/l)			
	Average Monthly	Weekly Average	Minimum	Average Monthly	Daily Maximum	Instant. Maximum
Flow (MGD)	0.50	Report Daily Max	XXX	XXX	XXX	XXX
pH (S.U.)	XXX	XXX	6.0	XXX	XXX	9.0
Dissolved Oxygen	XXX	XXX	5.0	XXX	XXX	XXX
CBOD5	104.2	158.4	XXX	25	38 Wkly Avg	50
Total Suspended Solids	125.2	187.8	XXX	30	45 Wkly Avg	60
Fecal Coliform (CFU/100 ml) May 1 - Sep 30	XXX	XXX	XXX	200 Geo Mean	XXX	1000
Fecal Coliform (CFU/100 ml) Oct 1 - Apr 30	XXX	XXX	XXX	2000 Geo Mean	XXX	10000
Ammonia-Nitrogen May 1 - Oct 31	8.3	12.5	XXX	2.0	3.0 Wkly Avg	4.0
Ammonia-Nitrogen Nov 1 - Apr 30	12.5	18.8	XXX	3.0	4.5 Wkly Avg	6.0
Total Copper	XXX	XXX	XXX	0.04	0.06	0.08
Total Iron	XXX	XXX	XXX	3.0	4.5	6.0
Total Manganese	XXX	XXX	XXX	3.5	5.2	7.0
Total Thallium	XXX	XXX	XXX	0.006	0.009	0.015
Phenol	XXX	XXX	XXX	0.015	0.026	0.037
a-Terpineol	XXX	XXX	XXX	0.016	0.033	0.040
Benzoic Acid	XXX	XXX	XXX	0.071	0.120	0.150
p-Cresol	XXX	XXX	XXX	0.014	0.025	0.035

Table M.1. SCILH- NPDES effluent limitations