Technical Assessment - Site Observations

Colonial Beach /Permit Number: VA0026409
December 9, 2023
Time of Site Visit: 0900 to 1530

Report completed by:
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Bethesda, MD 20816

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SITE VISIT DETAILS

Moonshot Missions visited the Town of Colonial Beach, Virginia's collection system and wastewater treatment facility on December 8, 2023. Moonshot staff included on this visit were Managing Director Andy Koester, Senior Utility Advisor Shannon Gority, and Senior Utility Advisor Nathan Coey. The following representatives for Colonial Beach were present: Diane Beyer (Director of Public Works), Chris Ruchty (Assistant Director of Public Works), and Harry Kowalski (Wastewater Treatment Superintendent).

The Moonshot team arrived on site by 0900 with introductions and general conversations about the intent of the site visit and a better understanding of the utility. Chris Ruchty provided a thorough collection system tour with visits to the lift stations. The collection system tour provided an opportunity to observe the condition of major system assets. Harry Kowalski provided a walk-through tour of the wastewater treatment facility to observe operations.

SYSTEM DESCRIPTION

System Name: Town of Colonial Beach Wastewater Treatment Plant and Collection System
Address: 2301 McKinney Blvd, Colonial Beach, VA 22443
Permit Number: VA0026409
Permit Effective Date:
Permit Expiration Date: October 31, 2025 (Permit Renewal Deadline: May 4, 2025)
Design Capacity: Average daily flow facility design of 2 million gallons per day (MGD), max daily flow 4 MGD, with peaks to 6 MGD.

I. System Ownership & Governance

The Town of Colonial Beach owns and operates the facility and components. The system's operation is funded through user charges through the current utility rate structure.

II. Brief System Description

The Town of Colonial Beach collection system has a mainline inventory ranging from 4 to 18 inches in diameter. The construction of the pipeline inventory consists mainly of PVC, vitrified clay pipe, and Orangeburg (fiber pipe) style pipe. The total pipeline feet are estimated at 210,000, totaling 450 manholes. A recent request for bids document indicated information regarding pump station sanitary sewer drainage districts within the system as the most probable areas with inflow and infiltration issues. The five drainage areas, Horton Street (PS), Monroe Street (PS8), Billingsley Street (PS9), Rescue Squad (PS10), and 12th Street (PS19),

consist of 14,190 feet of gravity main, 2,186 feet of force main, and 49 manholes. The heartbeat of the collection system is the 19 lift stations throughout the service area. The stations vary in size, pumping capacity, age, and remaining useful life. The estimated 2.9 square mile wastewater service area collection system terminates at the wastewater treatment facility.

The treatment facility site was established in the late 1990s with drawings that indicate upgrades in 2008. The essential components of the facility include influent headworks with screening, compactor, and grit removal, influent flow metering, influent pumping, a complete mix activated sludge process as a Modified Ludzack Ettinger process, clarification, filtration, ultraviolet disinfection, coagulation basin, effluent discharge and monitoring, lime silos for pH adjustment, liquid waste holing, a belt filter press for landfill disposal. The facility is designed to treat an average permitted flow of 2 million gallons per day (MGD), with a maximum daily average of 4 and peak flow of 6 MGD.

Influent flow can be pumped to the two Flow Equalization Basins (FEB), anoxic reactors. Four 60-horsepower pumps indicate a flow rate of 4 million gallons each. The mixture of influent and return flows is incorporated in this tank to encourage the anoxic feature of the nutrient removal process. The return flows are applied via gravity lines with an expected flow average twice the daily flow average. The tanks are referred to in the operation as tanks 1A and 1B, with a maximum capacity of 1.3 million gallons. Average design operating conditions indicate a 0.34-to-0.68-million-gallon capacity with a surge capacity of 0.6 million gallons each. A mixing system is provided to ensure suspension with the addition of free oxygen. The tanks are equipped with a diffuser system if needed.

The FEB pump station flows to the Nitrification Reactors or tanks 2A and 2B. The aeration process occurs in these basins to provide biological nutrient removal. Depending on the operational optimization requirements, the tanks can be operated in series or parallel. Each tank has a capacity of 1.55 million gallons at a typical operating control depth of 21.5 feet. Return flows can enter either FEB or the complete mix aeration process in 2A and 2B, providing flexibility in the biological removal process. A combination system of jet mixers and aeration is provided through blowers for the system. The discharge from the biological process can flow to a diversion and flocculation chamber before flowing to the clarifiers. The tank has a capacity of 25,000 gallons, with a mixer for adding coagulants.

The two clarifiers are 78 feet in diameter with a 17 feet normal operating depth and a capacity of 0.6 million gallons each. The design is for an MLSS concentration of 3,000 mg/l with a detention time of over 7 hours and a 100% return rate at an average design flow of 2 MGD. Return flow pumps are provided to draw off the clarifiers and return to the biological process or waste from the system. Two aerobic digesters are offered on-site with the ability to decant supernatant before press operations with an estimated capacity of 0.5 million gallons. A 1.2-meter belt filter press is used for dewatering solids before landfill disposal.

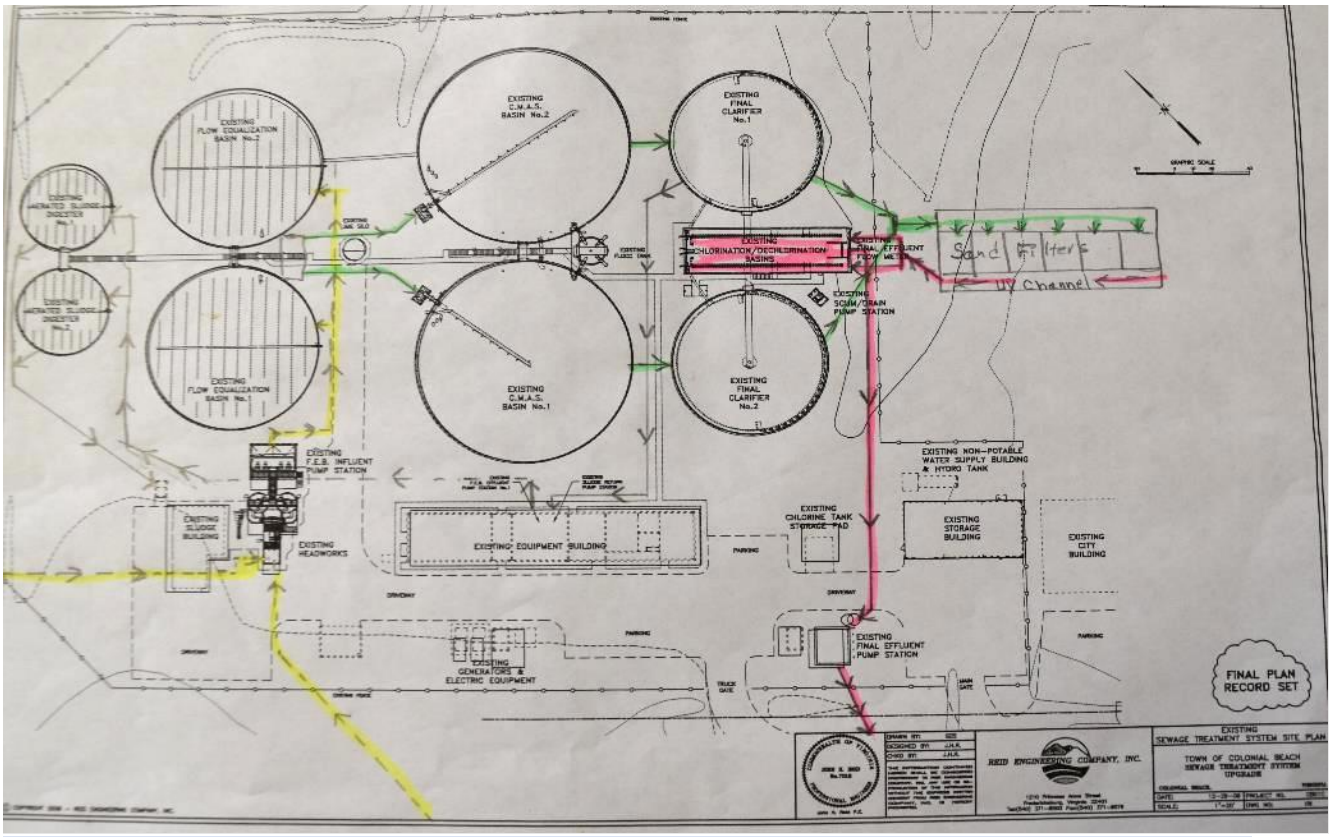
The facility is equipped with a hydrated lime silo for pH control related to the biological process with slaked lime slurry options for flow to the FEB portion of the system. Magnesium hydroxide is available for alkalinity control in the RAS system. A carbon source can be used in the activated sludge portion of the process to provide additional food downstream from the FEB tanks in the aeration process. The carbon source is also used in the filter house building for denitrification across the filters.

The settled effluent flow is diverted to the Nitrification Filters for nitrate and total nitrogen reduction. A total of 18 filters are available - six modules with three filters each - designed for a maximum daily flow of 4 and a peak flow of 6 MGD. By design, each filter cell has 7.08 square feet of surface area, 80 inches of filter media depth, and a 3.7 gallons per square foot loading rate. The up-flow filters include weirs and pipes for effluent trough collection. The filters are designed for continuous backwash at a rate of 7 to 14 GPM per filter in service, with flow intended to return to the aeration process, possibly due to the potential for free oxygen. A methanol carbon source is added to aid in the denitrification process. Ultraviolet lamps disinfect the post-filter effluent. One hundred eight lamps are in the system, with three banks, six modules (racks), and six lamps on each rack. A post-aeration method is included to increase the effluent dissolved oxygen level before environmental discharge. The effluent system includes flow monitoring, composite sampling, and pumping for the discharge point through a 20-inch force main to Monroe Bay.

III. System Flow/Schematic

Collection System Overview

Treatment Facility Overview



EXECUTIVE SUMMARY

I. Summary of Observations

- The staff is working diligently to rectify areas of deficiency. It is important to note that the team is keenly aware of the difference between where they want to be and their status.
- The Colonial Beach Public Works Department is a lean and mighty crew. They provide service to the community in many forms, including streets, refuse, storms, water, and sewers. The aggressive nature of their work tends to be reactionary due to the limited staff. Staffing limitations are noted across the United States as many communities seek more qualified individuals to operate and maintain the most precious water resources.
- It was observed there is a healthy top-down model in place. The staff at the top of the Public Works division have an excellent attitude as stewards. They exhibit caution and care towards their roles as overseers. The empowerment of the staff provides ownership to those in trusted care.
- The collection system shows age-related deficiencies along with inflow and infiltration issues. The proximity to the bay and high-water table can cause instances of overwhelming the collection systems.
- The lift stations indicate significant amounts of fat, oil, and grease (FOG) in the collection system. Staff indicated they know trouble areas and no administrative or building code regulations.
- The lift stations are inspected daily, which is a commitment to service exemplified by the staff. The operator that handles the daily inspections uses a tablet to record data and findings at each station.
- The town owns a crane hoist service truck for lift station submersible pump maintenance.
- Several stations have been updated in recent years. Several require reinvestment to ensure reliable service. Pumps have been replaced in several of the stations. There is a station that requires weekly cleaning due to debris.
- The town owns a Vac-Con combination sewer cleaning truck used frequently in the system.
- The wastewater facility indicates the need for additional housekeeping duties. While the staff is limited and busy, there are signs of a need to focus on housekeeping. The reference point is the overall presentation of rusted or delaminated pipework components and the need for a general washdown of tanks internally and externally. The influent headworks area indicates the need for cleaning due to the fine screen and grit system being out of service. Lime dosing straight from bags displays residual buildup. The components around the headworks and plant indicate corrosion. The tanks indicate an abundance of vegetation that has accumulated over the years. The facility building that houses the laboratory and offices requires attention to cleanliness.

- Observations indicate a lack of process control methods to ensure consistent treatment levels. The observation suggests establishing treatment goals to ensure consistent operation with all operators.
- Observations indicate that standards for treatment operations and enhancements are needed. The treatment process seems to have some flexibility related to optimization that needs to be explored to ensure consistent treatment goals.
- The opacity of the effluent on the day of the visit was not as transparent as expected, given the filters. The media for the filters are expected to be original and require inspection for media health and quantity.
- Several components were out of service and needed maintenance to reinstate. The fine screen was off due to a compactor motor failure. The grit system was offline due to equipment failure. The belt filter press is out of service due to an air system leak. The scum and filter backwash pump station is offline due to pump failure, and stand-by pumps are in use to prevent overflow. A septic receiving station is near the influent structure, and maintenance is required to avoid spills during offloading procedures. RAS pump was noted as being out of service. The polymer feed lines to the flocculation chamber have failed and are currently being replaced with garden hoses.
- The aeration and mixing components of the treatment process were observed as sufficient.

II. Recommendations and Opportunities

- Implement a department-wide work management program. Utilize a system similar to that currently being used in the collection system in the treatment plant and for other service duties to document activities. Tracking service-related data is recommended to ensure diligence and ability to gauge needs versus resource allocation. Focus on predictive (capital replacement), preventive, and repair maintenance tracking of assets.
- With a work management program, evaluate staffing levels versus service commitments.
- Optimize the GIS program to provide relevant data regarding the system assets. Evaluate if that program can be utilized to track treatment components.
- Reinvest in the collection system. It is recommended to prioritize mainlines that are ideal for relining or replacement and manholes subject to inflow and infiltration that could be sealed.
- Implement a rehabilitation program for the lift stations, including updating pumps, controls, and structures. Create a priority list of wet wells subject to inflow and seal for remediation. Ensuring sufficient notification and remote controls for the stations and emergency pump or generator connections is recommended. One station has a pump

vault in the roadway, subject to surface runoff and access issues. Evaluate the operations to eliminate or relocate.
    - The age and construction of the collection system require significant investment to reduce the likelihood of capacity issues that result in bypass or overflows. The nature of the community and proximity to the protected bay results in the need to eliminate environmental impacts.
- It is recommended to establish a FOG (Fat, Oil, and Grease) program within the Colonial Beach service area. The effort requires minimum inspections to determine where the grease loadings occur and increase maintenance methods to eliminate costly backups. It is also recommended that lift stations be cleaned more frequently to remove the grease from getting pumped around the system. Regulations must be established to ensure food service entities have the proper grease separators to eliminate the burden on the town. Universal plumbing and building standard codes can provide this, along with a program for compliance that results in surcharges when users do not meet standard regulations.
- Housekeeping at the treatment facility is needed. While the staff is busy, an attitude of stewardship is recommended to ensure presentation at any time. The vegetation must be removed from the tanks – this may require completely removing the tanks from service to allow for ample cleaning as soon as possible. Cleaning of the structures ensures positive presentation.
    - Rusted pipes and structures should be a focal point to ensure service life.
    - The laboratory should be cleaned routinely to not interfere with testing.
    - Any offices and rooms should be cleaned frequently.
    - A clean plant sends a message, and commitment to cleanliness ensures expectations with the staff.
- Observed corrosion to open air and enclosure indicates elevated levels of hydrogen sulfide, likely from the septic conditions of the sewage. Considerations for air handlers for enclosures. Consideration for liquid pretreatment of the influent as it comes into the headworks structure. Analyzing the raw sewage's condition and understanding the chemistry related to the observed corrosion is recommended.
- Repair and reestablish all offline components to improve the treatment process. The recommended equipment is the screen system, grit removal, belt filter press, decant station pumps, RAS pump, and replacement chemical feed lines where garden hoses were installed. It may be ideal to purchase a 0.5-inch water service line in increments with as few couplings as possible. Once all equipment is entirely online, a testing program for process control would provide an excellent return.
- The Vac-Con dump station is undersized for the demand. It does not have enough capacity and containment to dump the debris bed on the truck effectively.
- Operational goals need to be established along with consistent process control methods. The Spins Process Control method is recommended for this facility.
- Standard Operating Procedures are recommended to document operational directions and facilitate staff training. The process would allow the staff to compare how the plant

operates regarding design. The effort is to ensure the team is on the same page and to establish methods related to facility optimization.

- A sampling schedule/checklist should be documented to ensure compliance testing is completed per permit. The sampling program should include related process control efforts to ensure consistency.
- Chemical dosing needs to be tracked and regularly reviewed to ensure that it is being used to benefit the operation. Evaluation of whether the doses are correct and beneficial for the process. If the facility is dialed in with process control, costly chemical use could be eliminated. While the components were installed as designed, an evaluation of what is currently needed should be reviewed and acted upon. The focus of the review should be: (1) which chemicals are used, (2) why are they used, and (3) how much is used. The evaluation of chemical use is combined with understanding the influent chemistry characteristics.
- Consider premade polymer already in solution, which would provide proper concentration for dosing out of barrels to coagulate the MLSS and the belt filter press. Proper concentration will save money and staff time, improve performance consistency, and ensure that the proper dose is applied.
- The post-filter effluent opacity indicates that the filters may not perform per design. The media health and quantity need to be evaluated. The water quality means that the filters are not operating as a benefit for the facility at the time of observation. There could also be a chemistry issue that needs to be evaluated. It could be chemical doses are wrong or not required, or due to lack of process control. The biological system is robust and, with process control and optimization,should meet the conversion and separation needs at the facility with only minor chemical enhancement.
- The blower and air scour system for the filters seems to be undersized or have the wrong application as evidenced by heat generation issues. New units in conjunction with new media should be considered. It may be practical to convert these units to high-rate filters with less media and intentional backwash cycles. There seem to be inefficiencies in expected reject water for every gallon across the filters.

PHOTO LOG

.   	**Description:** Manhole before a major lift station **Observations:** An example of a manhole that would benefit from grout and resealing. From the view of the picture, a cable was bored through the joints in the structure. For example, the location is off the road and subject to surface water runoff.
	Description:

	Lift station wet well **Observations:** Example of the town's efforts - rehabilitation of the pipework and station controls.
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	**Description:** Lift station grease ball formations **Observations:** A typical station observation is to see the grease in a ball form. Other pictures indicate stations with grease mat that may depend on the location in the system and the type of velocities in the pipes.

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Residential lift station location</td>
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	**Observations:** An example of one of the stations that have been recently updated
	**Description:** Residential area lift station **Observations:** Example of a station in residential area.
	**Description:** The original treatment plant site **Observations:** Tanks converted to a lift station

	
	**Description:** An example of a newer station **Observations:** The station is near the public beach access area.
	**Description:** Field Tablet **Observations:** The Collection System Operator uses the tablet for station daily rounds. The information is collected in real time, and the sheets are updated. Recommend this approach for treatment plant and service duties.

	**Description:** Lift Station in Right of Way **Observations:** The pump wet well for this station is in the roadway adding complexity for service. Consideration of relocation or, elimination if possible, in conjunction when new developments come online.
	**Description:** Vac-Con Truck **Observations:** An example of service commitment by Colonial Beach is using this truck frequently.

 	**Description:** Influent Flow Channel **Observations:** Typical influent flow to the facility indicates septic conditions. Septic receiving station at headworks.
	Description: Headworks - Influent Flow Screen, Grit System, and Vac-Con Dump Station **Observations:** The influent screen is out of service due to a failed compactor motor. In this area, bags of hydrated lime are added periodically to the influent. Recommend fixing the motor to use the screen and creating a water and lime slurry to slow-feed into the flow to ensure proper dispersion. The grit removal system is offline and must be returned to service. The debris

 	needs to be removed to ensure proper operation. Note the amount of corrosion at the influent structure while in open-air conditions. This is an indication of septic conditions and high hydrogen sulfide concentrations. The dump station is undersized for utility needs and needs to be expanded.

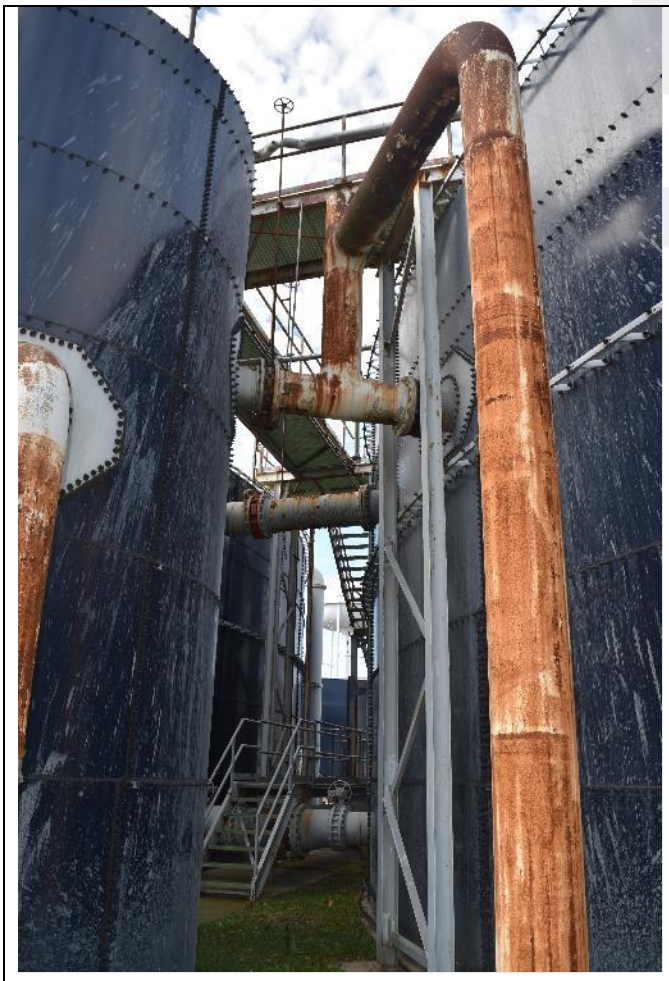
Description:

Flow Equalization Basin (FEB)/Anoxic Reactor 1A and 1B

Observations:

Vegetation growth in tanks 1A and 1B requires removal as soon as possible as it is robbing tank capacity and causing component fouling.

	
	**Description:** Lime Silo view from Anoxic to Nitrification **Observations:** Example of coatings failing on the lime silo and exposed pipe. These need attention to protect the integrity of the metal and improve its appearance (a good appearance is critical for instilling a sense of pride in the operations staff). An example of coatings failing on handrails and walkway structures – a potential safety concern.



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Nitrification Reactors 2A and 2B

Observations:

Vegetation growth and carry-over to this point in the process. Removal should be expedited to prevent treatment issues and overflows as it robs tank capacity and contributes to component fouling.

Examples of exposed pipe that is losing coatings.</td>
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	**Description:** Flocculation Diversion Tank **Observations:** On the day of the site visit, a polymer solution derived from a dry mix was flowing into the tank. There was evidence of insufficient residual polymer to create good floc to help with chemical settling. Due to pipe failure from the feed building, garden hoses are being used to transport the polymer solution.
	**Description:** Belt Filter Press **Observations:** The belt filter press is out of service due to an airline failure. The air filter or regulator has duct tape around it, indicating it may leak; recommend evaluating replacement. Note the corrosion to the metal portions of the support beams.


WARNING
ROTATING EQUIPMENT
ELECTRICAL HAZARD

Description:

Clarifiers, Post Aeration, and Scum/Backwash Station

Observations:

Example of a clarifier in service with vegetation in the launder. Efforts have been made to remove the vegetation.

Example of a clarifier out of service.

Algae and vegetation growth in the post-aeration tanks. Notice the handrail and metal corrosion.

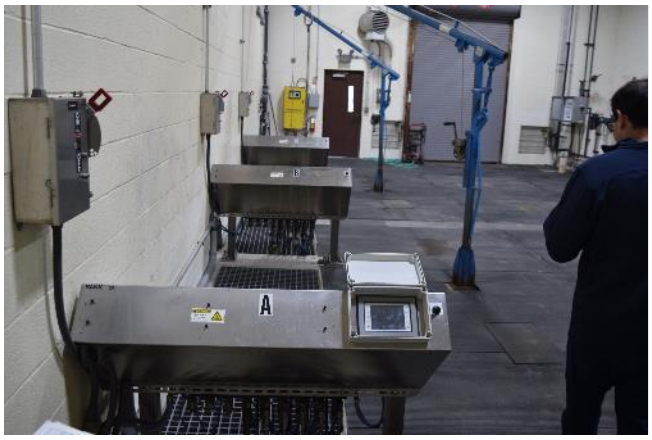
Scum and filter backwash station flow and standby pump set up with automatic float control.

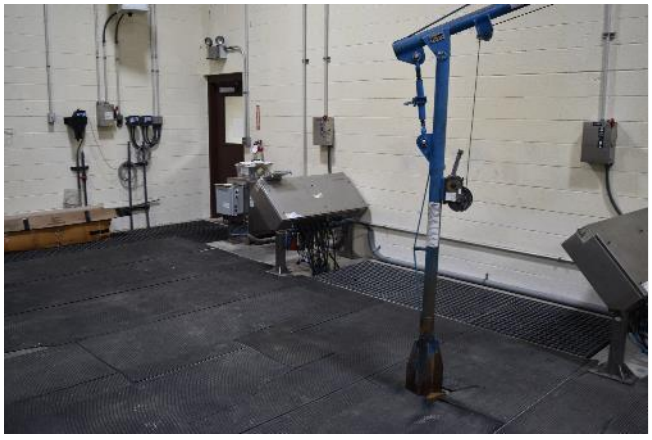
Description:

Denitrification Effluent Filter Air System

Observations:

The units may be improperly sized for the application indicated by a constant run time that affects temperature. Evaluate replacement options when evaluating media replacement.





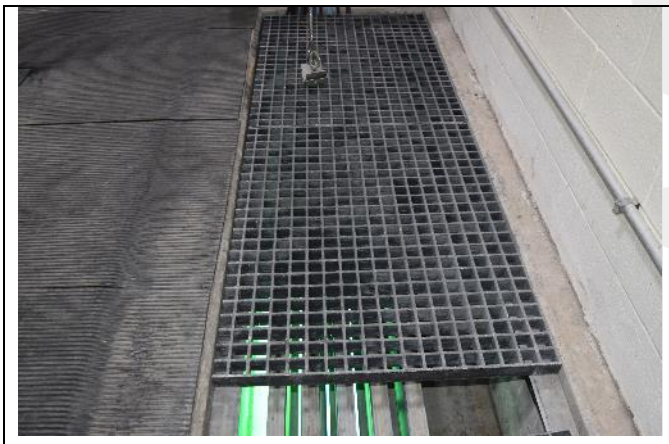
Description:

UV System and Filter Building

Observations:

The banks of modules for disinfection.

The quantity and health of the media are unknown, but the comparison in pre- and post-filter indicated little change in water quality to the naked eye.



Description:

Effluent Discharge Structures

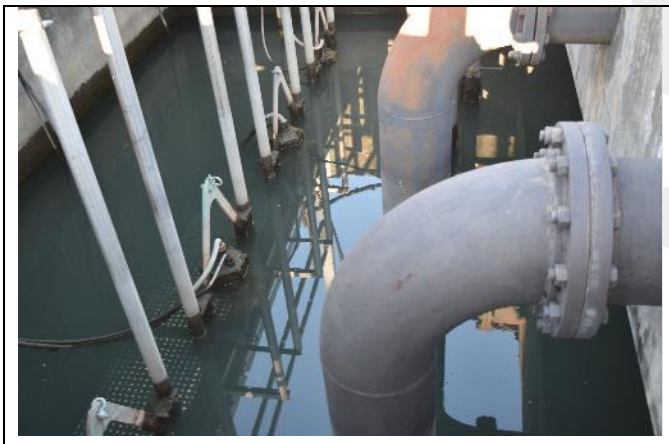
Observations:

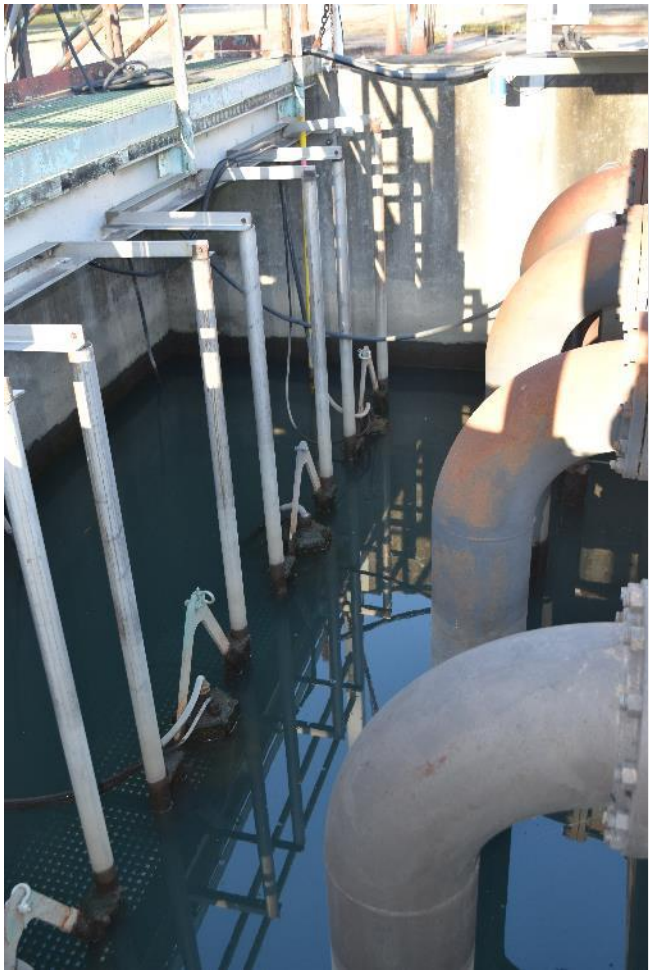
The post-aeration basin before delivery to the effluent pump station.

The effluent quality on the day of the visit lacked the transparency expected with a filtered product. The dissolved solids content may be high, or the chemistry is out of balance, which in a filter process would indicate high water reject flows.

Effluent sampling station before pumping to the bay.

Cloudy effluent at the discharge pump station. The effluent expectation would be higher quality post-filtration. Again, this indicates that the media is at the end of its useful life or the plant's chemistry is off.





Description:

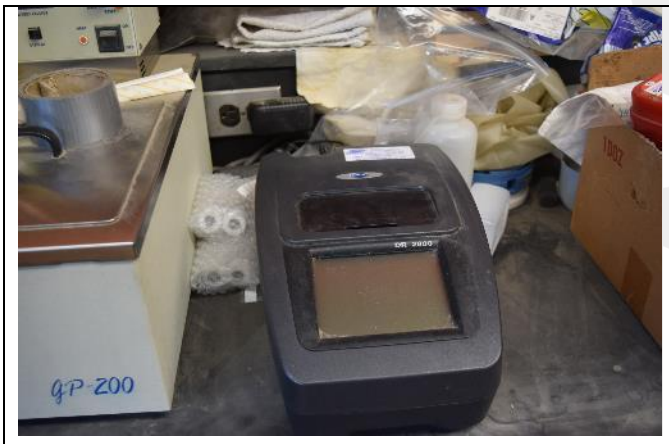
Laboratory

Observations:

The laboratory indicates a lack of organization and overall cleanliness expected for (at a minimum) process sampling at a facility of this nature.

Verify what analytics are conducted in-house and what clutter could be removed. A good lab is a clean lab, even if it is only used for process control.

The facility logbook was noted, and information was recorded.


GP-200


HACH
COD REACTOR
HEATING
POWER
TIMER
150°C