The Alexandria Lake Area Sanitary District, MN

BACKGROUND

The Alexandria Lake Area Sanitary District (ALASD) is located in the central lakes region of Minnesota, about halfway between the Twin Cities and the Fargo/Moorhead area. Created in 1971, ALASD was the third sanitary district established in Minnesota, following the sanitary districts in the Twin Cities and Duluth. ALASD was established to convey and treat wastewater from the city of Alexandria and the adjacent townships of Carlos, Hudson, and LaGrand. Ida township and Lake Mary township have subsequently been added to the service area and ALASD additionally provides contract services to the cities of Nelson, Forada, Carlos State Park, Leaf Valley Township, and two interstate rest areas. ALASD currently has a service area of about 100 square miles with more than 10,000 customer accounts, serving a population of more than 24,000.

COLLECTION SYSTEM

The service area is spread between and around the many lakes within the service area boundaries. As a result, the sanitary district operates and maintains 119 lift stations, 48 grinder stations, 124 residential grinders, and more than 270 miles of sanitary sewer and forcemain from residential, commercial, and light industrial customers. ALASD staff perform all of the maintenance of the collection system, including preventative maintenance of the pumps in the lift stations, inspection and testing of the lift station control panels, jetting of the sewer pipes, regular inspection, cleaning, and preventative maintenance of the many air release valves throughout the collection system. ALASD also performs all pump rebuilding in-house.

ALASD has a fully integrated supervisory control and data acquisition (SCADA) system to monitor equipment and processes in both the collection system and at the wastewater treatment facility. Operating data from the major lift stations is relayed to the wastewater treatment facility for monitoring by staff. Field crews can be directed to problems in the collection system as soon as they arise. The collection system conveys wastewater to the ALASD wastewater treatment plant (WWTP) which is rated to treat average wet weather flow of 4.7 million gallons per day (mgd). The current average annual wastewater flow to the WWTP is 2.9 mgd.

WASTEWATER TREATMENT FACILITY

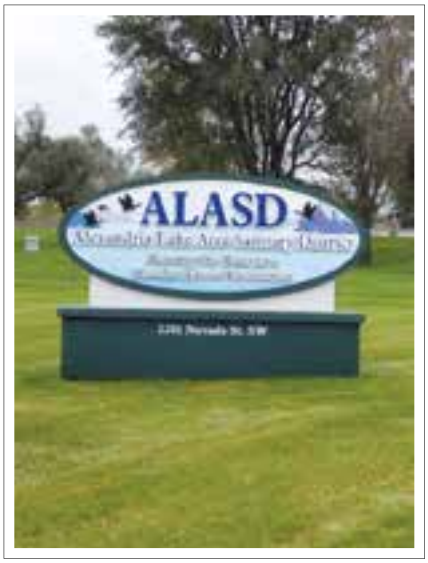
The ALASD wastewater treatment facility was initially constructed in 1977 as an advanced secondary treatment facility. The facility included raw sewage screening and grit removal, primary clarification, aeration basins, secondary clarification, solids contact clarifier and tertiary filtration, and disinfection. Solids-handling improvements were completed in 1998 to add a third aerobic digester and the tertiary filters were renovated in 2000. An expansion project was completed in 2008 that included an all-new headworks building and grit removal, a third aeration basin, conversion of the solids contact clarifier into a secondary clarifier, replacement of the tertiary filters with cloth disk filtration units, and upgrades to the solids processing. A fourth aerobic digester and miscellaneous improvements to the solids processing facilities were completed in 2014.

The wastewater treatment facility is equipped with a PLC-based distributed control system (DCS) to monitor process performance, record operational data, and provide for remote control of unit processes. The control screens can be monitored by staff from any PLC panel in the facility and from computers, whether at the site or located remotely. The DCS also provides access to the facility electronic operations and maintenance (O&M) manual.

PRELIMINARY AND PRIMARY TREATMENT

Wastewater enters the facility via the main pump station. Solids handling centrifugal pumps convey influent raw sewage to the headworks building, which then flows by gravity through the remainder of the treatment facility.

The headworks building houses the raw sewage screening and grit removal facilities. Two ¼ inch perforated stainless steel plate, rotating mechanical filter screens, each rated for a peak hourly flow of 6.9 mgd, remove rags and debris from the raw wastewater. Screenings collected from each filter screen are discharged to a dedicated screenings washer and compactor, each



with a capacity of 35 cubic-feet per hour. Screened wastewater flows through vortex grit removal prior to primary clarification. Grit slurry from the vortex grit tank is pumped to a cyclone classifier and grit washer. Cleaned screenings and grit discharge to a common roll-off box located in an adjacent room to help minimize odors in the headworks building. The headworks building has been designed to accommodate the addition of a third filter screen and a second vortex grit tank for future additional preliminary treatment capacity.

Screened and degritted wastewater flows to primary sedimentation. The WWTF has two 45-foot diameter primary clarifiers to remove settleable material from the wastewater. Each primary clarifier is equipped with a plow type collector mechanism, which directs solids collected on the tank bottom to a hopper for removal. Primary sludge and scum are conveyed to the digesters for further treatment.

SECONDARY TREATMENT

Primary effluent flows to the aeration tank head box where it is split between three aeration basins, each with a volume of 0.38 million gallons. The aeration basins are equipped with nine-inch diameter ceramic fine pore diffusers. Dissolved oxygen levels, pH, and temperature are monitored in each tank. Solids retention times are typically maintained between six and 10 days to achieve nitrification and ferric sulfate is added to the end of the aeration basin for phosphorus removal.

Aeration air is provided by dual vane single stage centrifugal aeration blowers. Aeration blower guide vane positions are adjusted automatically to maintain an operator set air header pressure and a set dissolved oxygen setpoint in the aeration tanks.

Mixed liquor from the aeration basins is split between three secondary clarifiers through a weir box. Secondary Clarifiers one and two are 55-foot diameter center feed clarifiers and Secondary Clarifier three is a 75-foot diameter center feed clarifier. Flow is distributed to the three clarifiers through a mixed liquor splitter box to achieve proportional hydraulic and solids loadings.

Each clarifier is equipped with an energy dissipating inlet structure, flocculation well, and hydraulic suction sludge removal collectors. Secondary effluent is collected by peripheral weirs located around the perimeter of each clarifier and is conveyed by gravity to the effluent filters.

The return activated sludge (RAS) is withdrawn from the secondary clarifiers by non-clog centrifugal pumps. A total of six variable speed RAS pumps are installed, two for each clarifier. A sludge blanket monitor is located in each clarifier and RAS pump speed is controlled to maintain a constant sludge blanket level in each clarifier. The pumps discharge to a common header that returns RAS flow back to the aeration tank head box where it mixes with primary effluent to be split among the three aeration basins.

EFFLUENT FILTRATION

Secondary effluent is conveyed to three cloth media filters to remove particulate material from the secondary effluent prior to disinfection. Each filter is rated for 6.1 mgd and consists of a stainless-steel tank, drive assembly, center tube assembly, 12 cloth disk assemblies, and two backwash pumps with associated piping and valves. The disks are cleaned by backwashing and accumulated sludge in the bottom of the filter tank is removed by a waste sludge cycle. Backwash is initiated auto-

matically when the water level above the cloth disk assembly exceeds the set point. Typically, only two filter units are operated at any given time.

DISINFECTION

ALASD uses gaseous chlorine from one-ton cylinders for disinfection of the final effluent from chlorine gas regulators and vacuum type chlorinators. Filtered secondary effluent and chlorine solution flow to two contact tanks that provide a minimum of 15 minutes of detention time at peak hourly flow conditions. The chlorine contact tanks are located under the filter and control building slab, directly under the cloth disk filter units, allowing flow by gravity from tertiary filtration to disinfection. Sodium bisulfite is injected at the end of the chlorine contact tanks for dechlorination prior to discharge.

SOLIDS HANDLING

Sludge is pumped from the primary clarifiers on a timed basis to maintain low sludge inventories in the tanks and to provide a more consistent load to the aerobic digesters.

Waste activated sludge (WAS) is withdrawn from the common RAS header by variable speed progressing cavity pumps. WAS is pumped continuously to a dissolved air flotation thickener (DAFT) where it is thickened from about 0.8% total solids (TS) to 2-3% TS.

Aerobic digester cells stabilize primary and thickened waste activated sludge. Each digester cell is equipped with nine-inch diameter flexible membrane fine pore diffusers. Due to oxygen demand and limitations in oxygen transfer capacity, raw sludge is split between digesters one and two to distribute the load for better-dissolved oxygen (DO) level control. The effluent from Digester Cells one and two combine at the downstream end and flow through cell three and cell four in series. Dissolved oxygen levels, pH, and temperature are monitored in each cell. Air is provided to the aerobic digesters by two 250 HP dual vane single stage centrifugal aeration blowers rated for 4,500 scfm at 8.4 pound-force per square inch (psig) each. Blower guide vane positions are adjusted to maintain an operator set air header pressure in the main serving the digesters. Airflow to each digester cell is adjusted based upon operating DO and pH.

Due to auto-heating of the sludge during the digestion process, it is sometimes necessary to cool the digesters to maintain sludge temperatures below 32 deg C. A mechanical chiller was installed in 2008 to provide chilled water glycol solution to cool the sludge. Two tube-in-tube type heat exchangers were installed when the fourth digester cell was constructed to allow cooling of each primary digester cell. Chopper pumps circulate digested sludge from cells one and two through the heat exchangers as needed to maintain the temperature set point.

Digested sludge is withdrawn from digester cell four by variable speed progressing cavity pumps and conveyed to a high- solids dewatering centrifuge. Dewatering operations are typically conducted daily, Monday through Friday, for four to six hours per day and produce a cake of up to 24% TS with 14 pounds of polymer per dry ton.

The solids processing at ALASD produces a Class B biosolids product that is hauled by ALASD operations to area fields for land application. ALASD generates about 800 dry tons of biosolids per year.

Click HERE to return to Table of Contents






FACILITY PERFORMANCE AND EFFLUENT QUALITY

ALASD is equipped with an on-site laboratory that is certified by the State of Minnesota for compliance testing, so testing is conducted in house under the guidance of a full-time laboratory manager. ALASD partners with the industrial dischargers, which include food processing and metals fabrication and finishing facilities, in performance of a pretreatment program and conducts regular sampling and analysis of the industrial discharges. The pretreatment program has been successful in assisting industry manage their discharges while improving overall plant performance.

The ALASD WWTP discharges into Lake Winona, which is connected to a chain of lakes that ultimately discharges to the Long Prairie River. The chain of lakes is popular for both vacationers and year-round residents for the recreational and sport opportunities they provide. Because of this close connection with the community, ALASD has always strived to achieve the highest level of effluent quality. ALASD staff conducts water quality testing on 13 separate lakes in the chain from June through September to monitor for any impacts related to WWTP discharges.

The key National Pollution Discharge Elimination System (NPDES) permit limits are summarized in Table 1.

Parameter	Limit	Notes
cBOD5	25 mg/L	Monthly Average
TSS	30 mg/L	Monthly Average
Total Phosphorus	0.3 mg/L	Monthly Average

Table 1: NPDES Discharge Limits for the ALASD WWTF

ALASD anticipates that the total phosphorus discharge concentration limit will be reduced to 0.157 mg/L in future permits. It is also anticipated that a chloride limit will be added to the NPDES permit at some point in the future, as this has been an emerging concern with the state regulatory agency.

The WWTP effluent averages about one mg/L for both cBOD5 and TSS on an average annual basis. ALASD utilizes a chemical phosphorus removal process through addition of ferric sulfate to the mixed liquor stream, which is effective for removal of soluble phosphorus. Particulate phosphorus is captured through the cloth disk filters. Operations has been able to optimize the chemical addition and filter operation to achieve a total phosphorus concentration of less than 0.13 mg/L on an average monthly basis, with monthly discharges as low as 0.08 mg/L. Although the district has demonstrated the ability to meet the anticipated future total phosphorus limit of 0.157 mg/L, additional improvements to secondary clarification or tertiary filtration are likely needed in the future to ensure permit compliance under all operating conditions. ALASD commissioned a study to evaluate pathways to achieve a future permit limit on chloride. ALASD, like many other public utilities in Minnesota, will continue to discuss the emerging concern over chloride discharges with the state regulatory agency and other regional stakeholders to work toward a solution.

Since its inception, ALASD has sought to be a responsible steward of the public interest and the natural environment. ALASD has always sought to operate the wastewater collection and treatment systems to the best of their ability, not simply to meet permit requirements. In demonstration of this goal, the district has never had a discharge permit violation in its history. Because of the diligent work of the ALASD staff and continual support of the ALASD Board of Directors, ALASD looks to the future to uphold the dedication to the outstanding performance of its past. CS