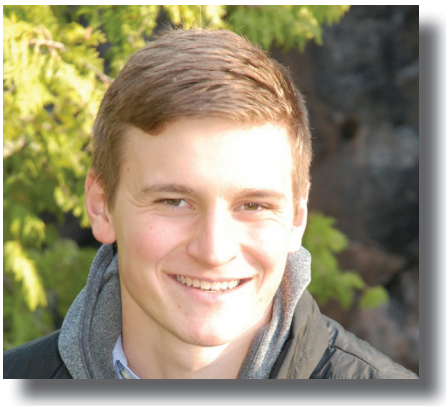
Albert Lea WWTP



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Organization Background

The Albert Lea Wastewater Treatment Plant (WWTP) is located in the City of Albert Lea in Freeborn County, MN. The plant serves a population of 18,203 along with industries such as food processing, metal plating, a biodiesel plant, an ethanol plant, and truck washing. In 2019, the facility treated a total of 9.5 million lbs. of Biological Oxygen Demand (BOD) (a quantitative measure of total organic matter), 123,000 lbs of ammonia nitrogen, and 132,000 lbs of phosphorus from these domestic and industrial sources.

"This summer I had the opportunity to learn about municipal wastewater treatment in a unique way. Being away from the facility pushed me to deepen my understanding of the processes in order to connect theoretical knowledge to experimental data. It was fun to collaborate from afar in order to learn the ins and outs of plant operations and obtain the data necessary to complete the project." ~ GP

Project Background

The plant was originally designed to treat for solids, organic matter, pathogens, organic nitrogen, and ammonia, and effectively treats for all these species at this time. More recently, other components of wastewater have been found to exert adverse effects on aquatic ecosystems, and the facility currently discharges these nutrients, particularly phosphate and nitrate, at concentrations in excess of 5 mg/L as P and 20 mg/L as N, respectively. Excess nitrogen and phosphorus in receiving waterbodies accelerates a process called eutrophication, which causes massive algal blooms, followed by the depletion of dissolved oxygen, and death of higher organisms such as fish. The objectives of this project were to explore methods by which the plant could reduce the concentrations of nitrogen and phosphorus in the effluent of the Albert Lea WWTP through Biological Nutrient Removal (BNR).

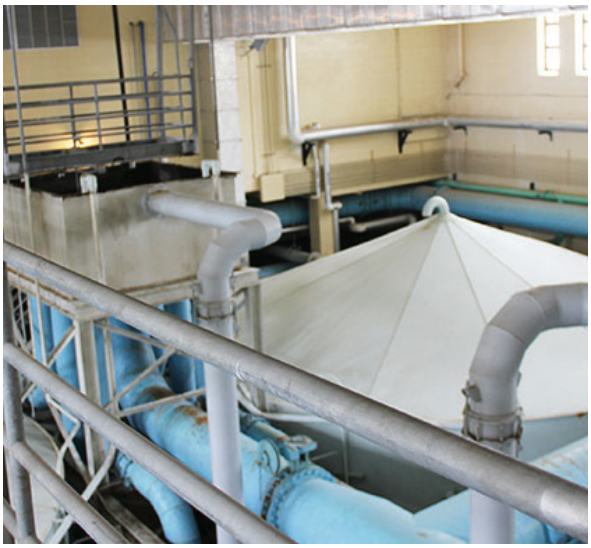
Incentives to Change

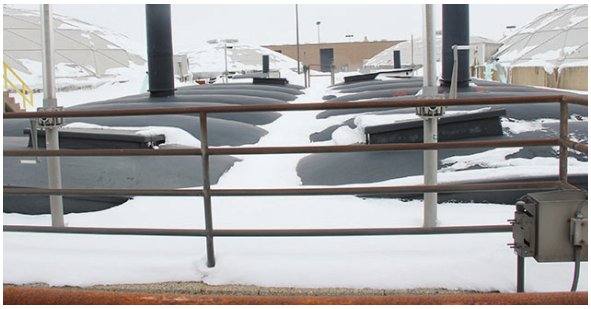
Investigating opportunities for Biological Nutrient Removal (BNR) at the Albert Lea WWTP offers an alternative to chemical addition that has the potential to not only save money on chemical purchases or plant upgrades, but also find savings due to reduced aeration requirements characteristic to BNR systems. In order to investigate these opportunities, a computer program called ASIM (Activated sludge SIMulation) was employed to model a variety of changes that could be implemented at the facility. The optimum changes with respect to impacts on the plant effluent as well as the feasibility of implementation were determined by analyzing results from ASIM. Evaluation of changes to facilitate BNR are timely, given that the plant is expected to receive a new permit imminently, which will most likely include a phosphorus limit of 1 mg/L. The plant is not currently equipped to treat phosphorus biologically down to this level, so either a multi-million dollar redesign or an annual addition of large amounts of ferric chloride or aluminum sulfate to chemically remove phosphorus would be required. The City estimates that a plant upgrade to achieve biological phosphorus removal would cost between $40-50 million dollars. Alternatively, the intern calculated that approximately $150,000 of ferric chloride would need to be applied annually in order to reduce phosphorus concentration in the effluent below 1 mg/L.

Solutions

Recommended Configuration Change

In order to facilitate biological nutrient removal, the current configuration of the tanks and clarifiers at the Albert Lea WWTP have to be re-arranged. The current secondary aeration basins must stop being aerated, and instead it is recommended that mechanical mixers be installed to provide the turbulence required to keep solids in suspension. This tank would function as an anaerobic/anoxic zone, allowing for the removal of nitrate and phosphorus. In addition, the current secondary clarifiers would also be equipped with mechanical mixers in order to keep solids in suspension. These clarifiers would then act as an extension of the anoxic/anaerobic zone formed in the proceeding tanks. The other tanks at the plant would be maintained as-is. The only other major modification would be the connection of the two return activated sludge lines to create one single-sludge system. Simulations of this configuration showed that two sequenced anoxic/anaerobic zones achieve 99% phosphorus and 90% nitrate removal from baseline simulations, all while keeping effluent ammonia concentrations under the most stringent permit limit of 1 mg/L.





The City of Albert Lea WWTP was pleased to have Gabriel as a MnTAP intern working with us this summer. This is our first year working with MnTAP and would participate again. He used computer modeling to help us better utilize nutrients. We hope to implement his suggestions to produce higher quality wastewater effluent by reducing phosphorus."

~ Brandon Huston, Plant Superintendent

Recommendation	Annual Reduction	Annual Savings	Status
Configuration Change	79,000 lbs of phosphorus 300,000 lbs of nitrogen 1,300,000 kWh	$98,000	Recommended

MnTAP Advisor: Josh Kirk, Associate Engineer