# NW MN Wastewater Ponds

**Ella Carlson**
Bioproducts and Biosystems Engineering
University of Minnesota Twin Cities

## Organization Background

Founded in 1978, the Minnesota Rural Water Association (MRWA) is a non-profit organization that provides technical assistance to and trains personnel at small municipal and non-municipal systems, rural water districts, and wastewater districts with populations less than 10,000. They offer professional services in several areas, including state and federal regulations, fiscal management, system operation and maintenance, source water protections, and more. The Minnesota Pollution Control Agency (MPCA) is the leading organization that monitors environmental quality and enforces environment regulations in the state of Minnesota. Both MRWA and MPCA are partnered with MnTAP to identify nutrient removal solutions for wastewater ponds across Minnesota.

**Jerald Lim**
Chemical Engineering
University of Minnesota Twin Cities

## Project Background

Funded through a grant by the Legislative Citizen Commission on Minnesota Resources (LCCMR), the goal of the partnership of MnTAP, MRWA, and MPCA is to work with cities in optimizing the removal of nitrogen and phosphorus from their wastewater. Doing so involves analyzing current operations of their wastewater pond systems, researching best practices, calculating potential improvements, suggesting operational changes, and promoting the implementation of these low-cost solutions. The scope of this project encompasses the wastewater treatment ponds in the cities of Roseau, Warroad, Breckenridge, and Karlstad. Ella Carlson and Jerald Lim were the MnTAP interns leading the analysis with these pond sites. Ella took lead on the Breckenridge and Karlstad assessments while Jerald led the projects with Roseau and Warroad.

## Incentives To Change

Nutrients in water, namely nitrogen and phosphorus, which come from agriculture, industry, or domestic households pose a serious threat to the health of aquatic environments. With an overabundance of these nutrients, algae are able to grow rapidly in local and international bodies of water. The excessive algal biomass consumes most of the oxygen in the water, leading to the depletion of oxygen and the subsequent death of aquatic animal and plant life in these ecosystems. In order to prevent these negative effects from occurring, the MPCA has placed limits on the phosphorus discharge in the effluents of wastewater ponds.

# Solutions

## Flow Pattern

Altering the way water flows through a wastewater pond can help immensely in increasing the hydraulic retention time (HRT) and maximizing the depth of water. As the amount of time water stays in the pond system increases, the treatment time increases, leading to better nutrient removal and cleaner discharge water. The overall goal is to keep the wastewater ponds as full as possible over the course of the year, ensuring that as much of the total pond volume as possible is actually being used for treatment time.

## Inflow and Infiltration

Inflow and infiltration (I&I) refers to the unintentional flow of storm water into the sanitary sewer system. It leads to ineffective use of the available volume in a pond, since storm water does not need to be treated but still takes up space, and reduces overall treatment time. Reducing inflow and infiltration by performing dye tests, resealing manhole covers, and inspecting private properties would serve to improve system hydraulic retention time.

## Waterfowl Prevention

Waterfowl, such as geese, contribute heavily to nutrient levels in these ponds in the form of fecal loading. Because waterfowl migration periods tend to align with wastewater pond discharge windows, and waterfowl like to use secondary, polishing ponds, slug loads of nutrients from waterfowl may have adverse impacts on effluent nutrient concentrations. Deterring geese from landing on the ponds during migration periods and deterring nesting at the ponds can lead to a direct decrease in nutrient levels. The use coyote cutouts and other decoys are suggested as options worth testing to reduce direct waterfowl nutrient loading into the ponds.

## Chemical Phosphorus Removal

Chemical addition is a common method of addressing phosphorus and is recommended only if lower effluent levels cannot be achieved using the other solutions provided in this report. A cost analysis for four chemicals, ferric chloride, aluminum sulfate, Phoslock, and RE300, was compiled. From this, both ferric chloride and aluminum sulfate were found to be the most cost effective options at this time. In order to reduce costs associated with the use of a boat or mixer to add chemicals, gravitational addition of ferric chloride solution to the transfer structures between the primary and secondary ponds as water is being transferred was identified as a lower cost option, utilizing the natural mixing of the transfer process to distribute the chemical into the water.

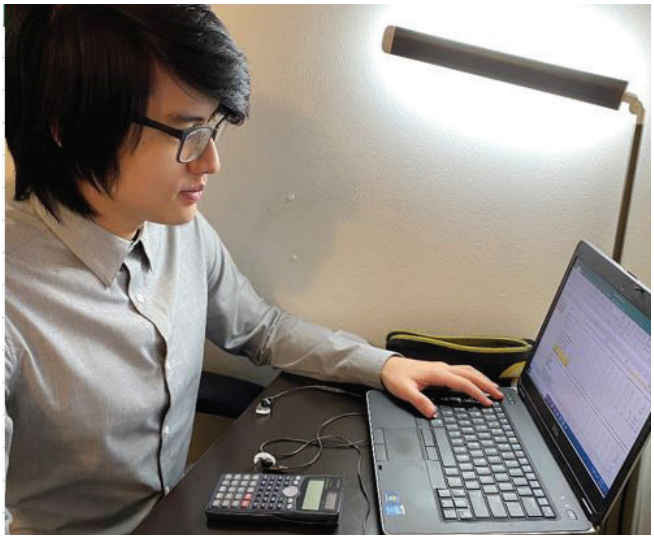
> "It has been great working with such talented professional and educated interns with the U of M MnTAP. The perspective and talents of the Interns brings confidence and success to the LCCMR wastewater pond optimization project"
>
> *~ Frank Stuemke, Minnesota Rural Water Association*

> "MnTAP interns provide site specific recommendations to operators for nutrient reduction at their wastewater facility."
>
> *~ Tim Hagemeier, Minnesota Rural Water Association*

# NW MN Wastewater Ponds

### Table 1: Roseau Opportunities

| Recommendation | Annual Reduction | Annual Savings | Status |
|---|---|---|---|
| Increase Hydraulic Retention Time | 160 lbs P | $0 | Recommended |
| Use Coyote Decoys or Similar to Reduce Waterfowl Loading | 1550 lbs P<br>5700 lbs N | $0 | Recommended |
| Add Ferric Chloride as Chemical Phosphorus Treatment | 600 lbs P | $0 | Recommended |
| Increase Hydraulic Retention Time by Reducing Inflow and Infiltration | 180 lbs P | $0 | Recommended |



*"I think the biggest thing that I gained is the idea of a client-centered approach. We are always thinking about how to best present information that is relevant to the client, what recommendations make sense for their site, what concerns could they potentially have. My ultimate hope is that I've provided some value to all stakeholders involved in my project. This includes the MnTAP wastewater team, any future interns that may be working on similar projects, the MPCA, and of course my project sites. And finally, I really see myself continuing to work in sustainability for the long term." ~ JL*

### Table 2: Warroad Opportunities

| Recommendation | Annual Reduction | Annual Savings | Status |
|---|---|---|---|
| Increase Hydraulic Retention Time | 280 lbs P | $0 | Recommended |
| Use Coyote Decoys or Similar to Reduce Waterfowl Loading | 1400 lbs P<br>5000 lbs N | $0 | Recommended |
| Add Ferric Chloride as Chemical Phosphorus Treatment | 2600 lbs P | $0 | Recommended |
| Increase Hydraulic Retention Time by Reducing Inflow and Infiltration | 370 lbs P | $0 | Recommended |

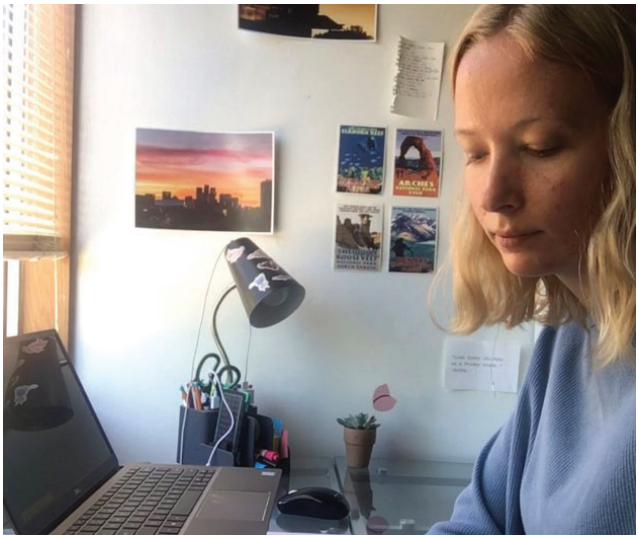
**MnTAP Advisor:** Jon Vanyo, Engineer

# Solutions

### Table 3: Karlstad Opportunities

| Recommendation | Annual Reduction | Annual Savings | Status |
|---|---|---|---|
| Increase Hydraulic Retention Time | 100 lbs P | $0 | Recommended |
| Use Coyote Decoys or Similar to Reduce Waterfowl Loading | 100 lbs P<br>350 lbs N | $0 | Recommended |
| Add Aluminum Sulfate as Chemical Phosphorus Treatment | 70 lbs P | $0 | Recommended |
| Increase Hydraulic Retention Time by Reducing Inflow and Infiltration | 75 lbs P | $0 | Recommended |

*My experience working with the Breckenridge and Karlstad Wastewater Treatment Ponds this summer was very beneficial to me as an engineering student with a concentration in the environment and sustainability. When I started this internship, I didn't know much about wastewater treatment but was very excited to be introduced to the field, and I learned so much by just jumping right into my project. Though I had to complete this internship remotely, I still gained valuable insight into how to complete an industry project and truly enjoyed my experience ~ EC*



### Table 4: Breckenridge Opportunities

| Recommendation | Annual Reduction | Annual Savings | Status |
|---|---|---|---|
| Increase Hydraulic Retention Time | 560 lbs P | $0 | Recommended |
| Use Coyote Decoys or Similar to Reduce Waterfowl Loading | 250 lbs P<br>940 lbs N | $0 | Recommended |
| Add Aluminum Sulfate as Chemical Phosphorus Treatment | 270 lbs P | $0 | Recommended |
| Increase Hydraulic Retention Time by Reducing Inflow and Infiltration | 1900 lbs P | $0 | Recommended |

**MnTAP Advisor:** Jon Vanyo, Engineer