



MINNESOTA POLLUTION CONTROL AGENCY



Optimizing Nutrient Treatment Wastewater Ponds: Gaylord, M N





Making Water Cleaner

Wastewater nutrient optimization is a challenge faced by pond treatment systems throughout Minnesota. In the case of Gaylord MN, wastewater treatment has been enhanced significantly thanks to the collaboration between Gaylord's plant operator, Robert Kloeckl and the LCCMR wastewater nutrient optimization team. Achieving effective wastewater treatment starts with the people who operate the facility, and Robert has been more than willing to explore new ways to attain the best possible treatment. Together with the field and technical support of Tim Hagemeier and Frank Stuemke with the Minnesota Rural Water Association, Gaylord's treatment is better than ever. As of fall 2019 Gaylord is

achieving excellent phosphorus treatment with a most recent effluent sample of .285 mg/L and average effluent of .52 mg/L since October 2019. Gaylord's approach to wastewater treatment involves strategies that the project team have found to be best practices in ponds throughout Minnesota with great success at achieving better nutrient removal.

IMPROVEMENTS

Phosphorus 1.0 \longrightarrow 0.52 mg/L Nitrogen 4.7 \longrightarrow 3.1 mg/L Coontail Growth +45%

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Approach

To understand how Gaylord achieved effluent phosphorus down to 0.285 mg/L, MnTAP's wastewater team investigated previous operational strategies taken by the pond operator. The timeline below shows the various stages of operation within the past few years, along with a table showing nutrient treatment.

Timeline of Gaylord's Operation and Phosphorus Effluents



Table: Improvements of Nutrient Effluents

Type of Operation ->	Parallel Flow and Reduced Plant Life (Oct 2016-Jun 2019)	Flow Through and Proliferating Plant Life (Sept 2019-Nov 2020)
Phosphorus Effluent AVG.	1.0 mg/L	0.522 mg/L
Phosphorus Removal	69%	81%
Nitrogen Effluent AVG.	4.6 mg/L	3.1 mg/L
Most Recent Phosphorus Effluent:	<u>Oct 2020</u>	<u>Nov 2020</u>
	0.325 mg/L	0.285 mg/L

• 2016- 'Flow Through' Pond Operation

Prior to 2016, Robert has commonly stuck to one operation. MnTAP refers to this strategy as the 'Flow Through' pond operation. Robert has been taking advantage of this strategy even before MnTAP recommended it to Gaylord. The 'Flow Through' operational strategy serves to increase pond hydraulic retention time while maintaining steady treatment conditions in a deep first pond (method described below).

- 2017- A Test to Parallel Flow ightarrow Giving Way to a Plant Life Catastrophe

During the winter of 2016 and early spring of 2017, Robert decided to try switching his operation by testing parallel flow into both Ponds 1 and 2. When Robert tried parallel flow, all plant life in Ponds 2 and 3 went down significantly, and treatment of parameters, such as phosphorus, TSS, and BOD were above average. Robert observed this reduction of plant life, and quickly switched the operation back to a 'Flow Through' operation in series.

2018 to 2020- Switching Back to a 'Flow through' Method

Since 2018 Robert has kept his ponds operational utilizing the 'Flow Through' method. After testing parallel flow, plant life primarily consisting of coontail died off



Aerial View of the Ponds

and did not make a comeback until late summer of 2019. Surprisingly, by the summer of 2020, plant life made a full recovery and even grew into Gaylord's Pond 3 where it did not grow previously. Now Gaylord is receiving far better treatment for phosphorus than it ever has in the past.

How did Gaylord Attain Low Effluent Nutrients?

Utilizing Full Pond System Volume

By using the full volume of Pond 1 and the majority of Pond 2, Robert was able to maximize the HRT of his ponds while slowly transferring water.

Here's the method:

- 1. Keep Pond 1 as deep as possible.
- 2. Allow water to flow into Pond 1, while water continuously flows out to fill Pond 2 at a very slow rate.
 - a. This is most easily accomplished with a slide gate that will maintain a full depth in Pond 1.
- 3. When Pond 2 is full, discharge Pond 3 and transfer water from Pond 2 to Pond 3.
- 4. Repeat

This method keeps all ponds relatively full for the majority of the year. Influent water flowing into Pond 1 creates an ecosystem with a steady supply of carbon and nutrients which it will adapt to treat within Pond 1.

In Gaylord specifically, Robert held their large Pond 1 at 6' depth using a slide gate. Water was then allowed to cascade over the slide gate to fill Pond 2. Additionally, Robert had a second 'Flow Through' slide gate from Pond 2 to Pond 3 where water in Pond 2 was held at 4' before spilling over into Pond 3.

Gaylord's ponds can run the 'Flow Through' method year-round creating a deepwater environment in the ponds for most of the year. MnTAP's wastewater team believes that this 'Flow Through' operational strategy is the best general operational change that ponds can make to boost pond treatment efficiency.

Allowing Coontail Growth

Coontail is an aquatic plant that naturally grows in many Minnesota wastewater pond systems. It is known to uptake nutrients as it grows and can therefore be a useful tool in achieving better treatment in pond systems. In Gaylord, the switch to parallel flow in 2017 most likely disrupted growing conditions and killed off any coontail. As seen in the charts below, after two years of switching back to the recommended 'Flow Through' method, coontail made more than a full comeback and is now flourishing in ponds where there was previously no growth. Providing conditions for coontail growth was another factor contributing to better nutrient treatment.



<u>"Coontail, Susquehanna</u> <u>Flats"</u> by <u>chesbayprogram</u> is licensed



Reduced Inflow and Infiltration

Reducing inflow and infiltration effectively increases the hydraulic retention time of the wastewater that needs to be treated. Sure, incoming clean rainwater does dilute the waste stream, but it hurts the overall treatment by reducing the treatment time available to clean the water that is dirty. Even if I&I has an immediate impact of slightly reducing nutrient concentrations, it does not reduce the total mass of phosphorus in the system. The City of Gaylord was able to repair 6 blocks of downtown Gaylord, by relining the storm water pipes, as well as resealing leaky manhole covers. These improvements helped to reduce the amount of storm water in the pond, and therefore led to more treatment time

allowing for improved nutrient removal.