



# Wastewater Nutrient Removal Optimization

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**Driven to Discover<sup>SM</sup>**

# Background

## Project background

- Partnered with MRWA and MPCA
- Remove phosphorus and nitrogen

## Incentives for change

- Combat eutrophication
- Meet/inform permit limits

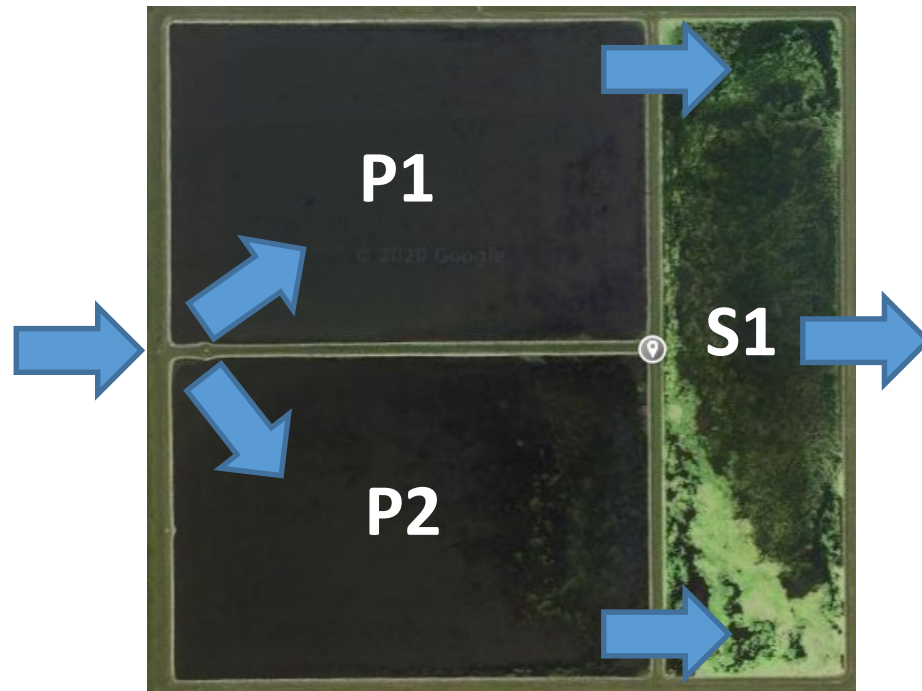
## Roseau and Warroad

- Small cities in northern Minnesota
- Red River >>> Lake Winnipeg

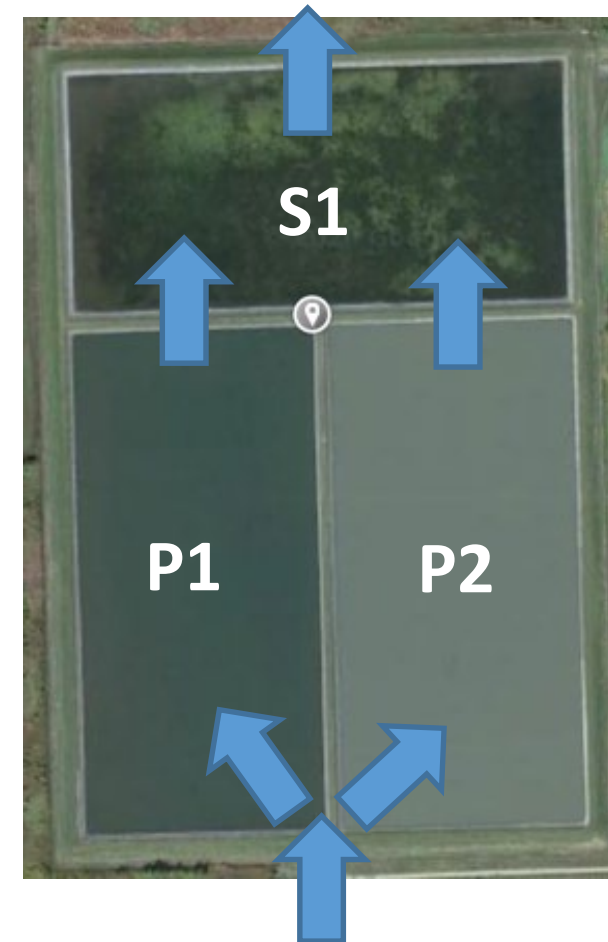


Karl Musser, 2007. 500 x 499. Creative Commons, <https://commons.wikimedia.org/wiki/File:Redriversnorthmap.png>

# Wastewater Ponds



Satellite View of Roseau Ponds  
110 acres (80+ football fields)



Satellite View of Warroad Ponds  
50 acres (35+ football fields)

Images retrieved from Google Maps with modification

# Solutions

## **Modify flow scheme to achieve better HRT**

- Covered earlier

## **Address and fix inflow and infiltration (I&I)**

- Rainfall, groundwater, snow melt

## **Prevent waterfowl**

- Topic of this presentation

## **Add chemical for phosphorus removal**

- Ferric chloride



# Waterfowl

## Presence on ponds

- Nesting and migration
- Thousands of geese

## Attraction

- Water = habitat
- Large open area = safety
- Grass = food

## Downside

- Fecal loading



5531 x 4000. Creative Commons,  
<https://www.pxfuel.com/en/free-photo-xdjef>

# Waterfowl Loading

## Fecal matter

- 2 lb per goose daily

## Complications

- Contribute extra nutrients to water column
  - 2,000 lb phosphorus and 8,000 lb nitrogen annually
- Levels not captured by influent water testing
- Spike during discharge window



Yellowstone National Park, 2018. 7266 x 4844. Creative Commons,  
<https://www.flickr.com/photos/yellowstonenps/43176249261>

# Waterfowl Prevention

## Goals

- Create an uncomfortable environment
- Condition fear upon landing

## Common solutions

- Decoy coyote figures
- Sound cannons
- Chemical repellent

## Habituation

- Geese get used to scare tactic



Mississippi Watershed Management Organization, 2020. 7952 x 5304. Creative Commons, <https://www.flickr.com/photos/134605195@N07/49943309947/>



# Mylar Flags

## Description

- Shiny and reflective (visual)
- Sway in the wind (audio and visual)
- Attached to wooden posts

## Benefits

- 86% success rate in literature
- Ease of implementation
- Inexpensive (one time cost ~\$100)

## Combat habituation

- Move around or use in conjunction with other methods



Petr Kratochvil. 1280 x 853. Creative Commons,  
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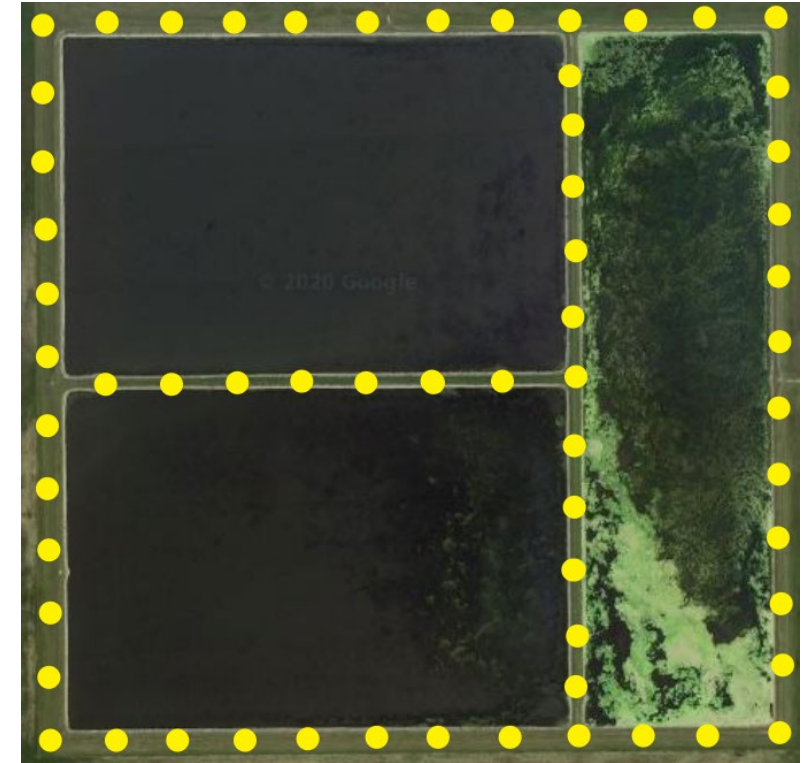
# Savings

## Implementation

- 200 ft apart around perimeter
- 50% deterrence success rate
- 1,000 lb phosphorus and 4,000 lb nitrogen savings annually
  - Compared to 4,000 – 7,000 lb phosphorus entering annually

## Cost analysis

- \$0.10 per lb phosphorus for mylar flags  
ONE TIME
- \$15-20 per lb phosphorus for ferric chloride  
ANNUALLY



**Satellite View of Roseau Ponds  
Mylar Flag Placement**

Image retrieved from Google Maps with modification

# Next Steps

## Waterfowl Prevention

- Approval from MPCA and DNR
- Purchase equipment
- Set up equipment

## Status

- Warroad: purchased, test in fall
- Roseau: planning

# Summary of Recommendations: Roseau

Recommendation	Change Type	Annual Reduction [lb/year]	Implementation Cost [\$ /year]	Cost Effectiveness [\$ /lb]	Cost Savings [\$ /year]	Payback Period	Status
Modify Flow Scheme	Procedure	160 P	0	0	2,800	N/A	Recommended
Address I&I	Process and Equipment	180 P	N/A	N/A	3,200	N/A	Recommended
Install Mylar Flags	Product Addition	1,500 P 5,500 N	160	0.11 P 0.03 N	10,500	N/A	Planning
Add Ferric Chloride	Product Addition	600 P	13,200	21 P	0	N/A	Recommended



# Summary of Recommendations: Warroad

Recommendation	Change Type	Annual Reduction [lb/year]	Implementation Cost [\$ /year]	Cost Effectiveness [\$ /lb]	Cost Savings [\$ /year]	Payback Period	Status
Modify Flow Scheme	Procedure	280 P	0	0	4,300	N/A	Recommended
Address I&I	Process and Equipment	370 P	N/A	N/A	5,600	N/A	Recommended
Install Mylar Flags	Product Addition	1,500 P 5,000 N	110	0.10 P 0.03 N	23,000	N/A	Implementing
Add Ferric Chloride	Product Addition	2,600 P	39,500	15 P	0	N/A	Recommended

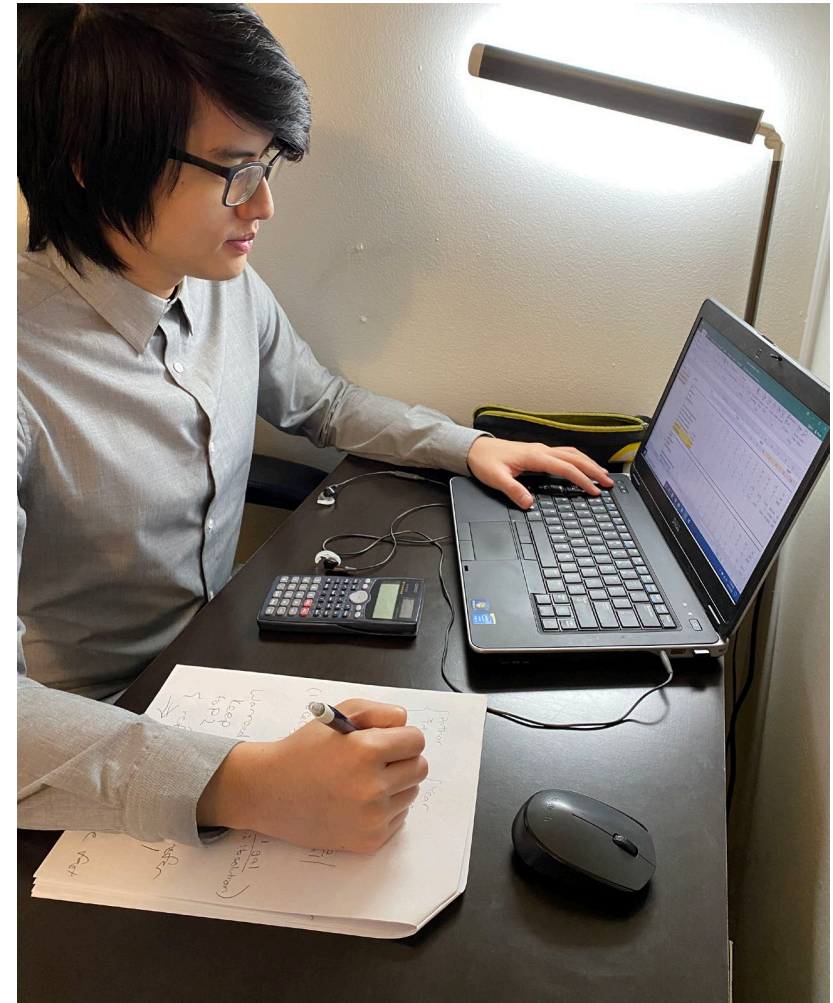
# Reflection

## Lessons

- Client-centered approach
- Taking action

## Aspirations

- Provided value to all stakeholders
- Continue career in sustainability





Alan, 2011. 2304 x 3072. Creative Commons,  
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