Constructed Wetlands for Wastewater Treatment

NWCC - November 2024

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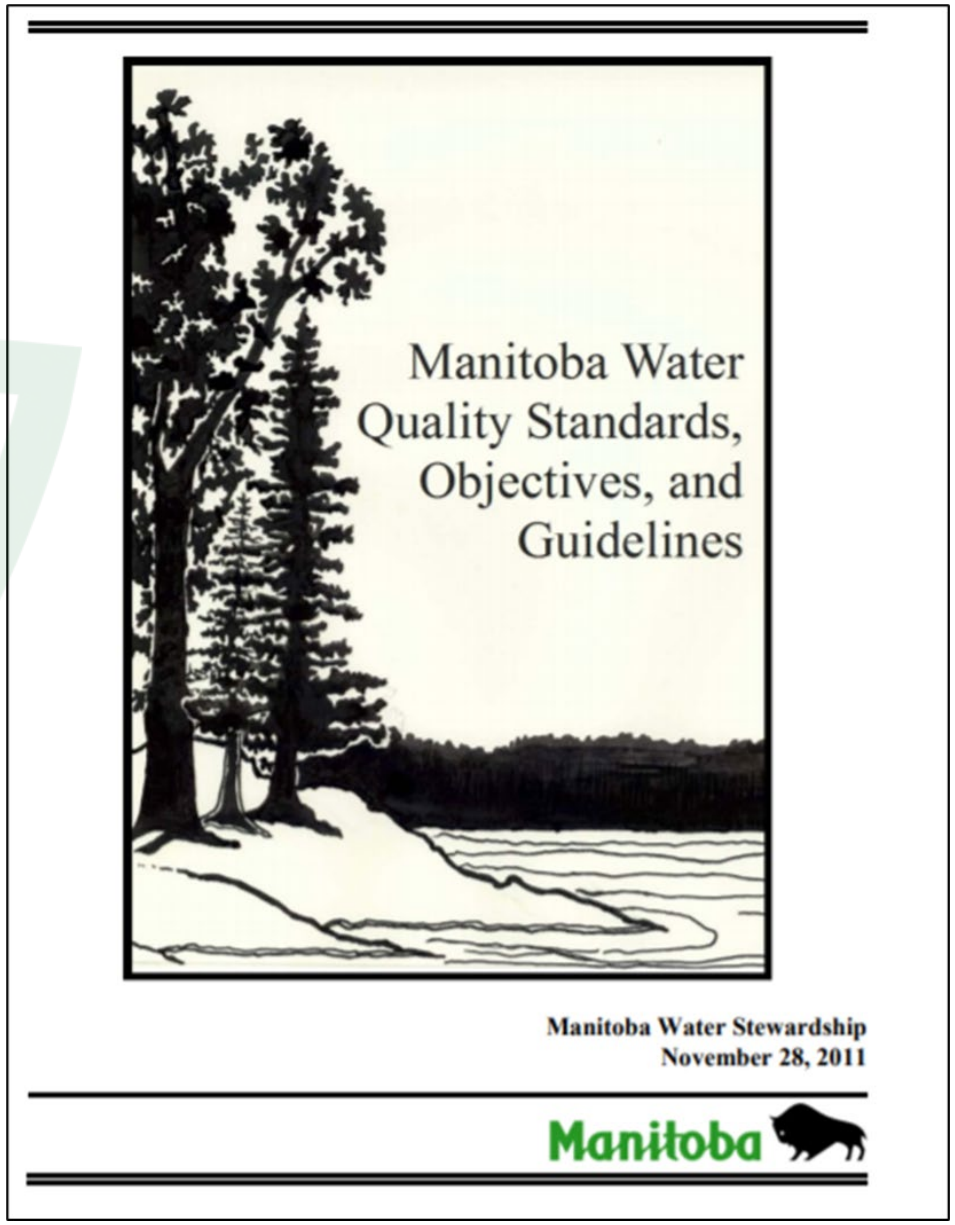
Native Plant Solutions

Creating natural and sustainable landscapes

Background

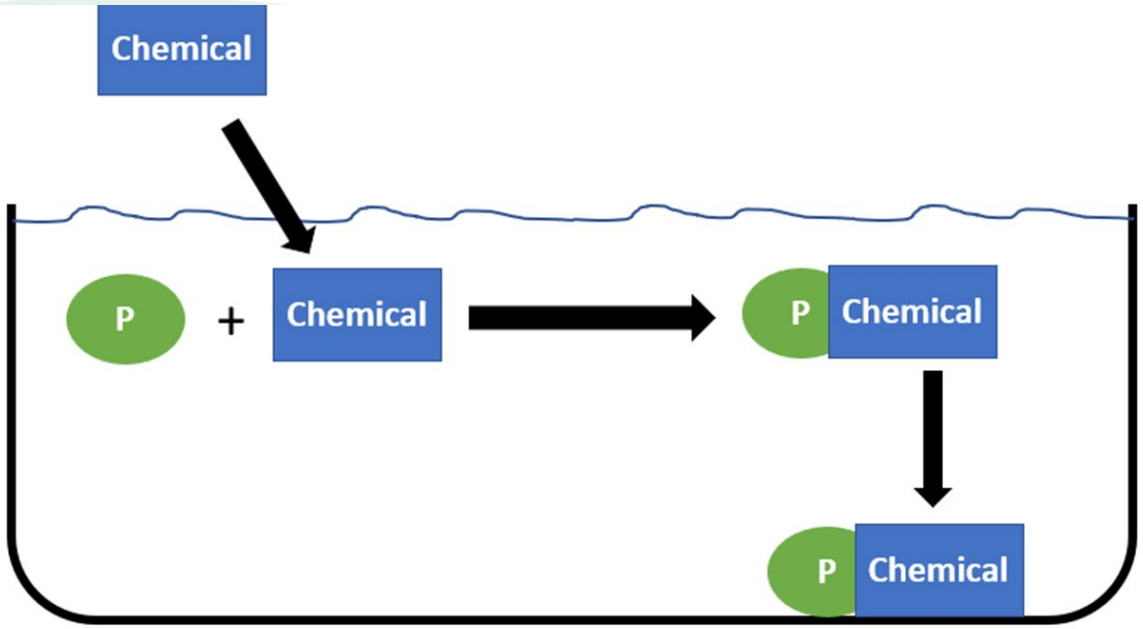
- Prairie aquatic environments susceptible to algal blooms due to phosphorus loading
- As of January 2016, wastewater facilities discharging > 820 kg TP/year must meet 1 mg/L TP limit.
- New and expanding facilities discharging < 820 kg TP/year must meet 1 mg/L limit or demonstrate their nutrient reduction strategy.
- Many small municipalities and First Nation comminutes in Manitoba use lagoons for wastewater treatment
- Phosphorus removal that happens naturally in municipal lagoons not sufficient to meet the 1 mg/L limit



https://www.gov.mb.ca/sd/pubs/water/lakes-beaches-rivers/mb_water_quality_standard_final.pdf

Conventional approach

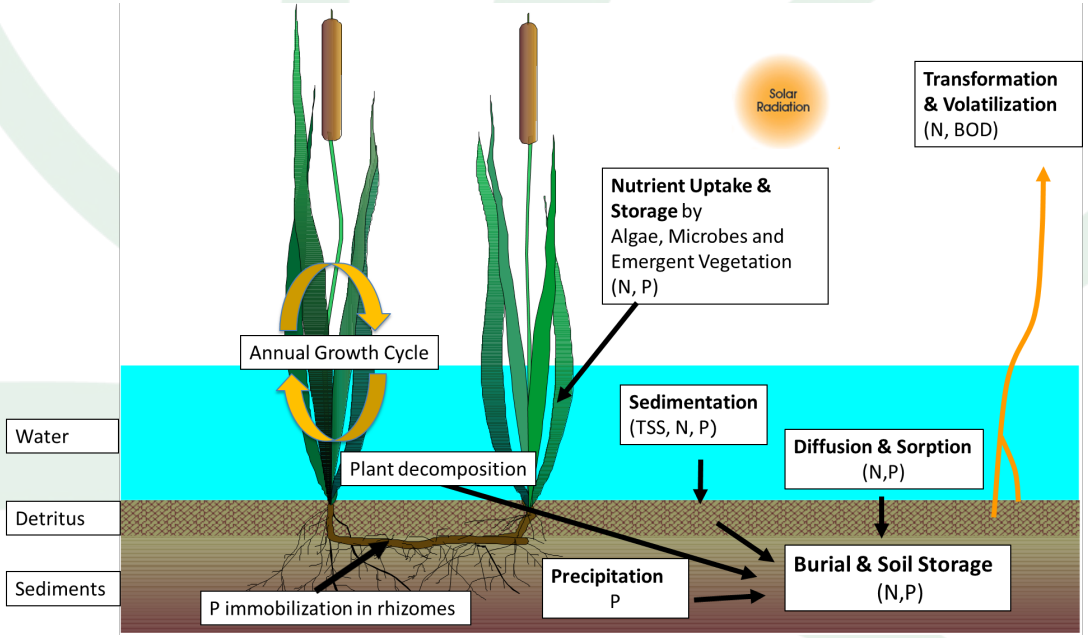
- Chemical coagulation is the most common approach in Manitoba
  - aluminium sulfate (alum) or ferric chloride



- Effective
- But…
  - On-going cost of chemical
  - Chemical application challenges
  - Sludge removal/disposal

Surface flow treatment wetlands

- Natural processes
- Eliminate the use of chemicals
- Can be a low-cost option
- Low maintenance
- Able to remediate multiple or mixed contaminants



Surface flow wetlands in Manitoba

RM of Ste. Anne wetland – 2.7 ha or 6.7 acres

- Lagoon Expansion
- No direct sewage lines – trucked hauled wastewater
- Operational year - 2024
- Sized to meet MB Provincial guideline (TP < 1 mg/L)

Surface flow wetlands in Manitoba

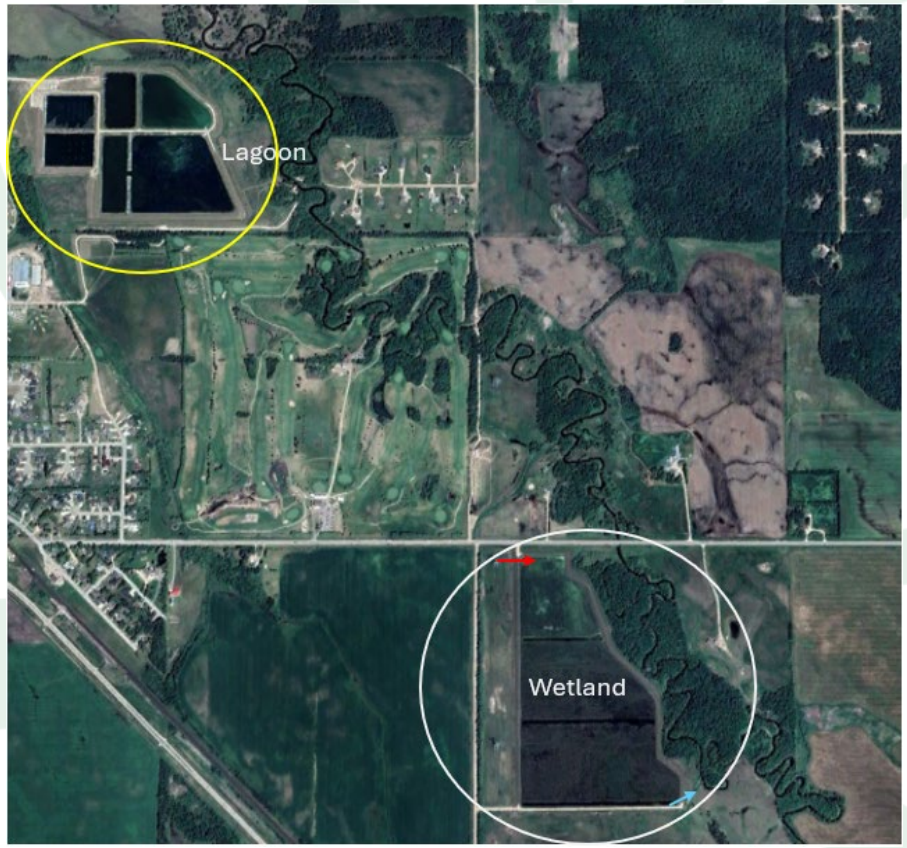
RM of Ste. Anne – 2.7 ha or 6.7 acres

2024 discharge period TP averages

- Secondary cells - 3 mg/L
- Wetland – 0.2 mg/L
- Upstream of receiving river – 0.1 mg/L

Surface flow wetlands in Manitoba

- Wetland size 17 ha or 42 acres
- Operational Year– 2021
- Sized to meet MB Provincial guideline (TP < 1 mg/L



Surface flow wetlands in Manitoba

Wasagamack First Nation Wetland – 0.5 ha

- Designed for treatment of landfill leachate
- Fully operational - 2023
- Designed to treat a wide range of contaminants e.g., metals, TSS, organic compounds such as hydrocarbons

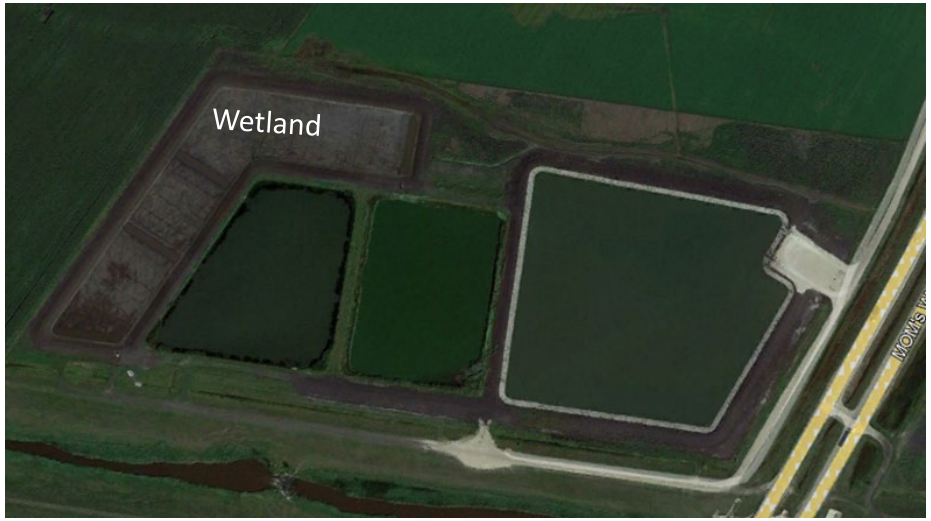
Example of surface flow wetlands outside Manitoba

Okanagan Falls Wetland, BC – 1.4 ha or 3.5 acres

- Designed for polishing effluent from a WWTP
- Designed to further reduce nutrients and other contaminants.

Design Requirements

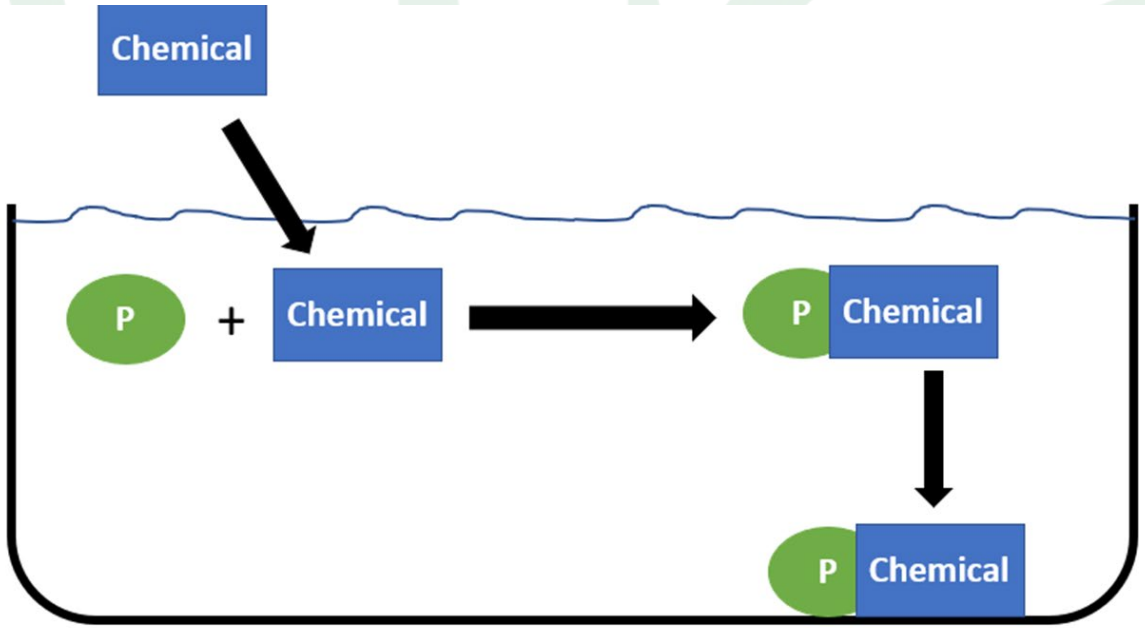
- Large footprint



Wetland design considerations

- Treatment and cost considerations:
  - Conventional versus treatment wetland

Chemical application



Treatment Wetland

Wetland treatment design considerations

- Hydraulic loading
- Storage
  - Including winter storage
- Population size
  - Forecast for the life of the system (e.g., 25 years)
- Additional inputs/flows
  - Septic tanks; industry; other
- Release type
  - Continuous vs. monthly
- Nutrients to be treated
  - Currently phosphorous drives design
  - Removal rates
- Residence time
- Site characteristics

Wetland design consideration

Substrate/topsoil for plant establishment

- Need to characterize local soils and determine how characteristics will impact cell design and plant establishment
- Require sufficient soil "barrier" to minimize vertical flow
- Require sufficient depth for plant root establishment

Wetland design considerations

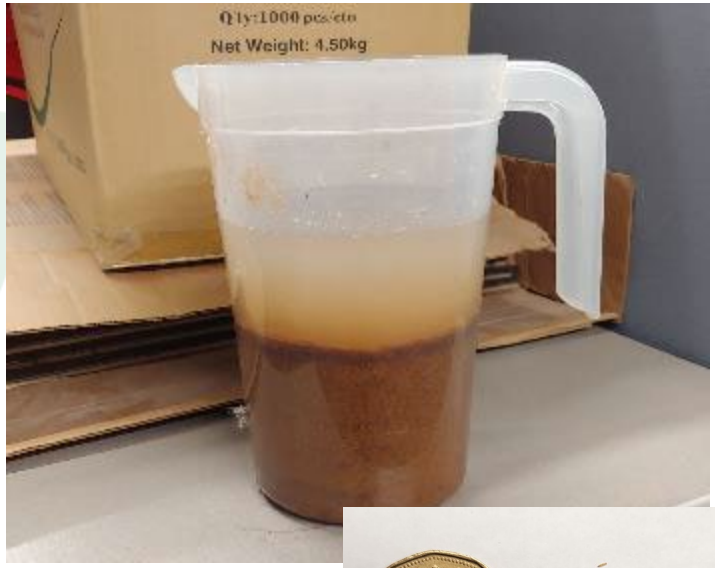
Plant selection

- Avoid non-native plants (e.g. Phragmites sp.)
- Cattail
  - "Workhorses" for treatment wetlands
  - Adapted for wetland conditions
  - Resilient to disturbances

Wetland establishment considerations

Wetland seed collection and processing

- Seed is not commercially available
- Hand collected and processed



Wetland commissioning

Wetland Establishment & Commissioning

- Seeding
- Water level management
- Weed control
- Vegetation & water quality monitoring

Wetland Establishment & Commissioning

- Wildlife concerns (geese, muskrat)
  - Fencing for geese in first few years
  - Potential issues with muskrat would be no different from any other lagoon
  - Cell is designed to be unattractive to wildlife, both wetland and dykes

Operation and Maintenance

- Infrastructure operation
  - Opening and closing valves
- Hydraulic operation
  - Water level and flow control
  - Adequate retention time
- Water quality monitoring
- Vegetation monitoring
- Annual reports

Water Quality Monitoring

Typical water quality monitoring licence requirements

Parameter	Secondary Cell	Wetland
CBOD	Monthly	N/A
TSS	Monthly	N/A
Fecal coliforms	Monthly	N/A
Unionized ammonia	Monthly	N/A
TP (mg/L)	N/A	Weekly (first summer of discharge) ***or*** Biweekly (subsequent summers of discharge)

Summary – Tertiary Treatment Wetlands

Key points

- Surface flow treatment wetlands can be effective for both small and large communities
- Wetland sediment provides long-term storage of P
- Surface flow wetlands have low maintenance and lower long-term costs as compared to conventional treatment
- P characterization/sampling should be started prior to design

Challenges

- May not be suitable for all communities depending on P treatment required and land availability
- Surface flow wetlands take time to commission (e.g., 2 – 3 years)
- In addition to more conventional approaches for design, success also requires understanding of wetland science and plant ecology

Questions?

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