ICWS 2022 LYON FRANCE

MAGNA ENGINEERING SERVICES INC.

Two-step hybrid wetlands as the low maintenance solution for communities in cold climates – approvals and implementation

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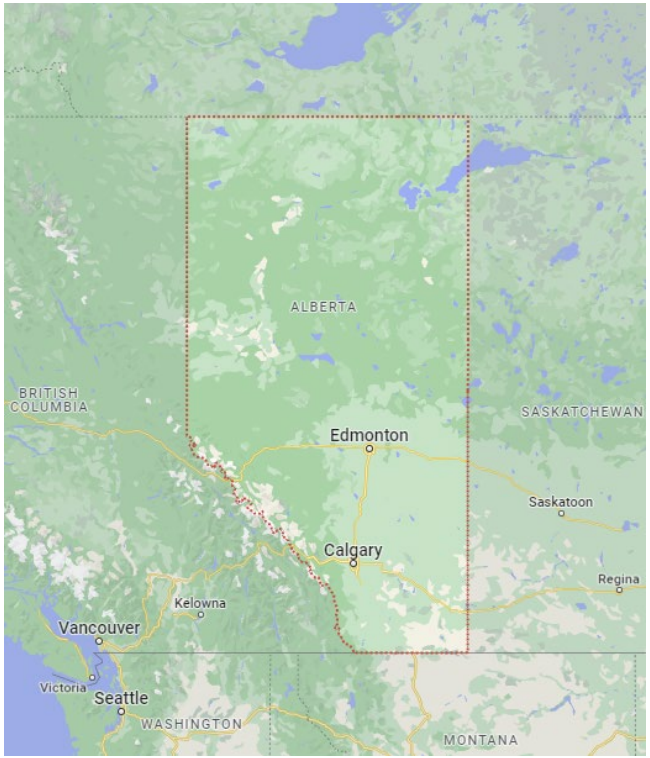
MAGNA Engineering Services Inc.

Introduction

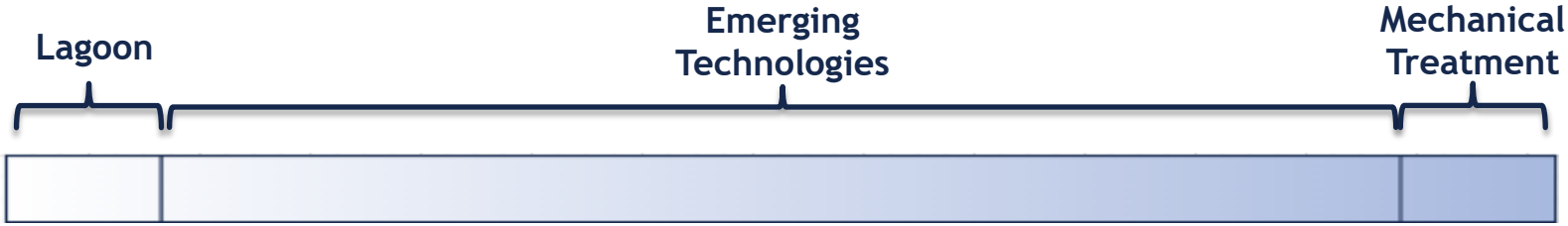
- **MAGNA Engineering Services Inc.** is a civil engineering consulting firm based in Alberta, Canada, dedicated to nature-based infrastructure solutions;
- Constructed wetlands offer unique benefits to small and medium-sized communities;
- There are challenges with implementation from both technical and regulatory perspectives;



Regulatory/Policy Perspective

- Small and medium-sized municipalities (under 20,000 people) are facing challenges with the existing wastewater treatment facilities;
- Many involve transitioning from wastewater lagoons to mechanical systems with unsustainable operations and maintenance costs;
- Regulatory framework is not set up to enable innovative solutions, including constructed wetlands;
- **Alberta Municipalities Wastewater Innovation Task Force** was created in 2021 to address key challenges and to advocate for changes to the regulatory pathways that would allow for innovative wastewater solutions.

THE SPECTRUM



Key Municipal Concerns

AGING INFRASTRUCTURE:

- Lagoons and associated collection systems are overwhelmed and/or underperforming;

LIMITING GROWTH:

- Current systems can't support new growth without substantial increase in costs;
- Balancing economic and environmental objectives.

TIGHTENING REGULATIONS:

- Lagoons assumed to remove BOD and TSS (not nutrients) as long as design aligns with code of practice;
- Nutrient removal (ammonia and phosphorus) are now required based on emerging environmental concerns;

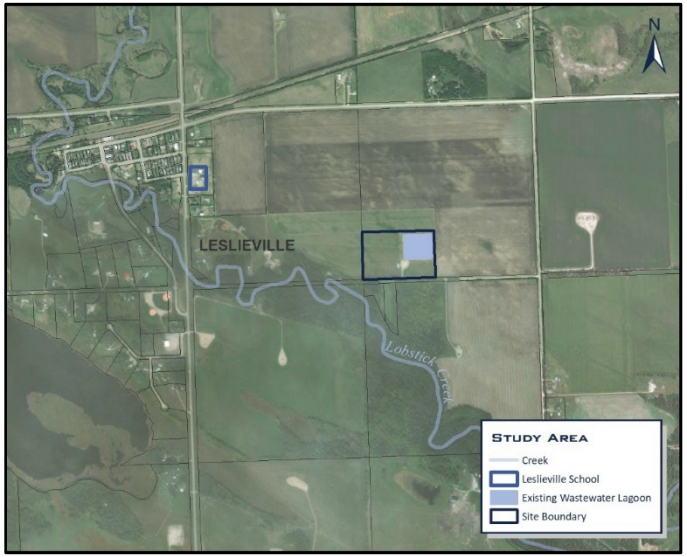
Opportunities For Innovation

- Working with the provincial regulatory bodies to develop approvals processes;
- Promote a standardized technical, managerial, and financial review of the community's resources to ensure sufficient internal capacity for any proposed technology;
- Develop a funding model to share financial risk between the municipality and the province to incentivize alternative wastewater treatment technologies.

… AND there are already shovel ready projects!

MBWS in Clearwater County

- MAGNA Biofilter-Wetland System - Full-Scale Pilot
- Hamlet of Leslieville located in west central Alberta;
- Service population of 300 design for growth for 2500;
- Existing lagoon receiving sewage;
- Ultimate solution to accommodate septage;
- Once a year discharge to nearby creek;
- Continuous discharge is desirable as the ultimate outcome.



Innovative Approvals Process - WQ

- Setting expectations for target effluent water quality was key:

Lagoon:

Contaminant	Target
BOD	25
TSS	25

Mechanical:

Contaminant	Target
BOD	20
TSS	20
Total Phosphorus	0.5-1.0
Total Ammonia	5-20
Unionized Ammonia	1.25

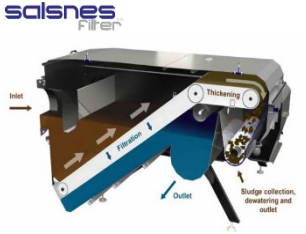
Negotiated:

Contaminant	Target
BOD	25
TSS	25
Total Ammonia	16
Unionized Ammonia	1.25

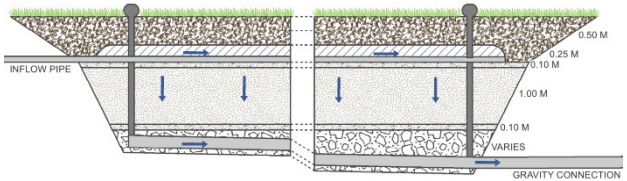
MAGNA Biofilter Wetland System - MBWS

- Two-step tandem treatment system:
  - **1st step** is a vertical flow biofilter (VFB);
  - **2nd step** is a horizontal subsurface flow biofilter-based wetland (HSSFBW);
- Primary treatment approach varies;
  - Rotating mesh filter (Salsnes Filter) was used for Clearwater County Pilot;

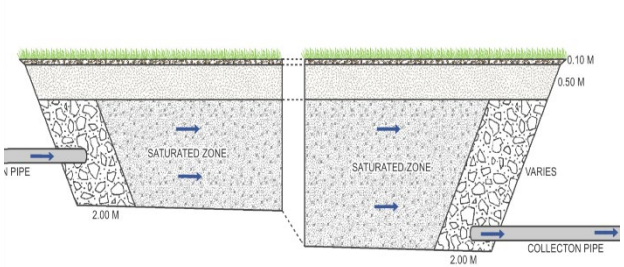
Primary Treatment



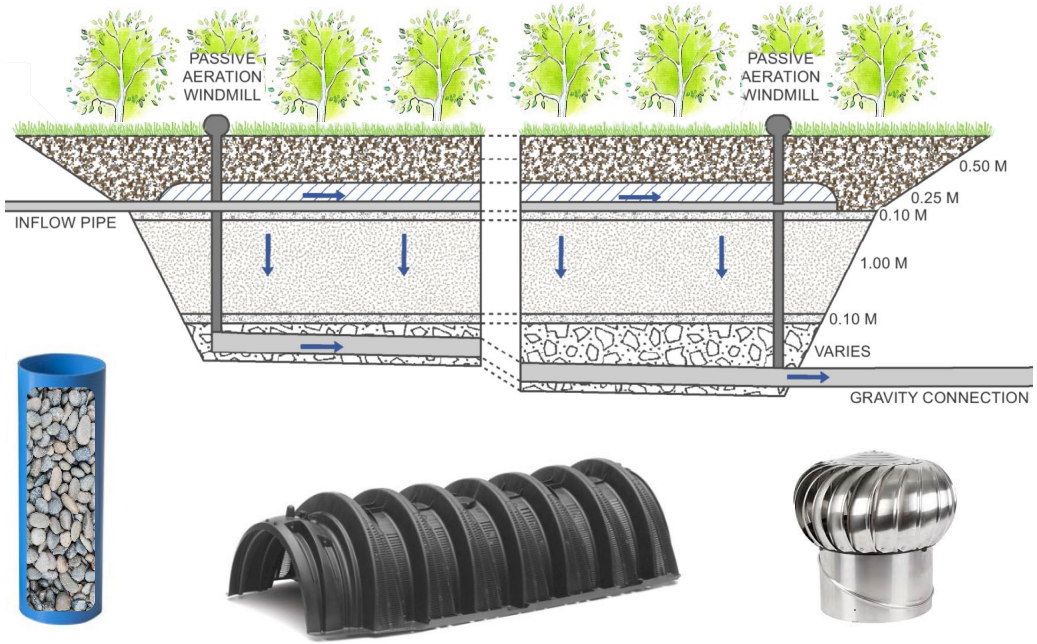
Stage 1



Stage 2



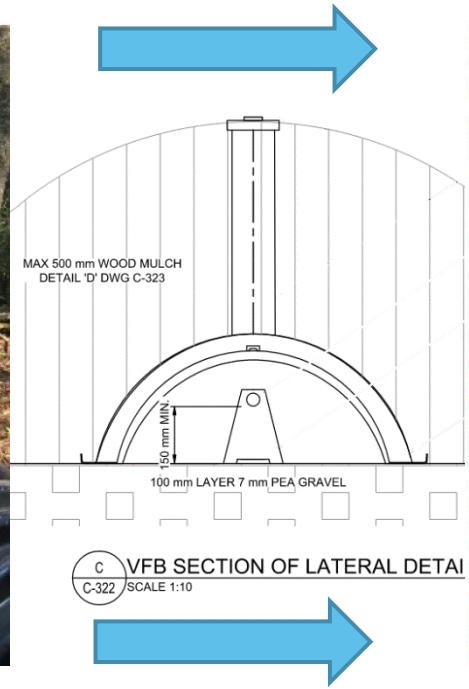
Vertical Flow Biofilter



- Deeper basin (~2.0 m) to prevent freezing
- Willows as vegetative cover
- Insulated effluent application similar to Alberta LFH (litter, fermented, humic) systems
- Dual hydraulic permeability media (as contingency)
- Passive windmills to assist in oxygen transfer (as contingency)

LFH At-Grade Systems

https://www.soilworx.ca/tanks-and-fields/



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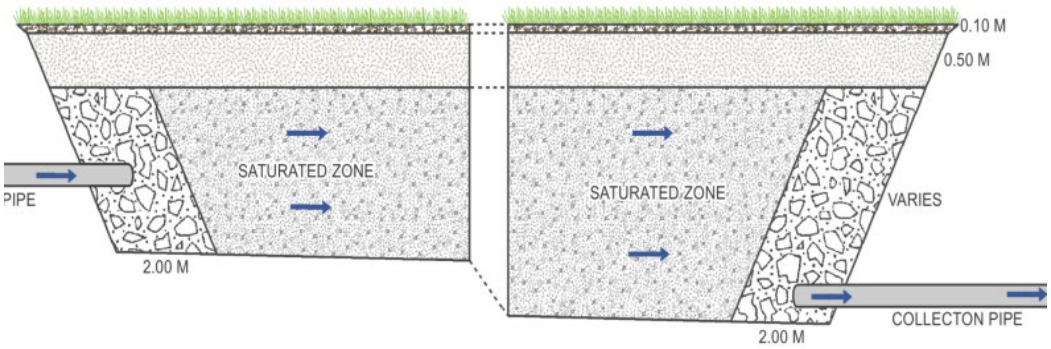
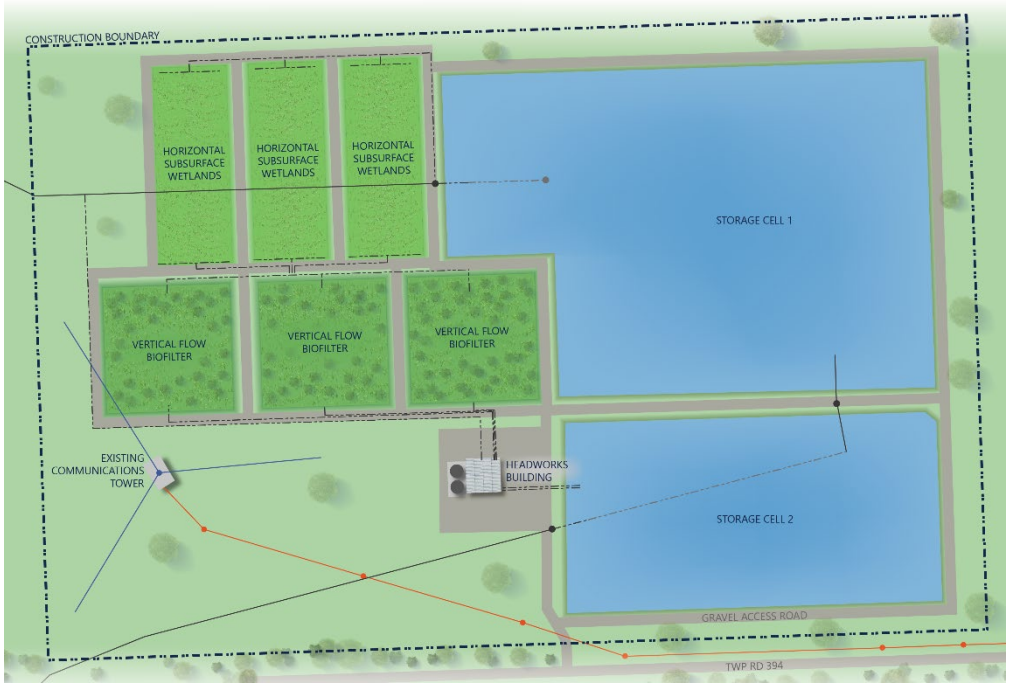
Horizontal Subsurface Flow Biofilter-Based Wetland

- Deeper basin (~2 m) to prevent freezing
- Flexible spill elevation for establishment optimization
- Polishing and denitrification
- Small-scale pilot utilized wood chips mixed in with the media, but organic leaching was observed.



MBWS Design - Proposed

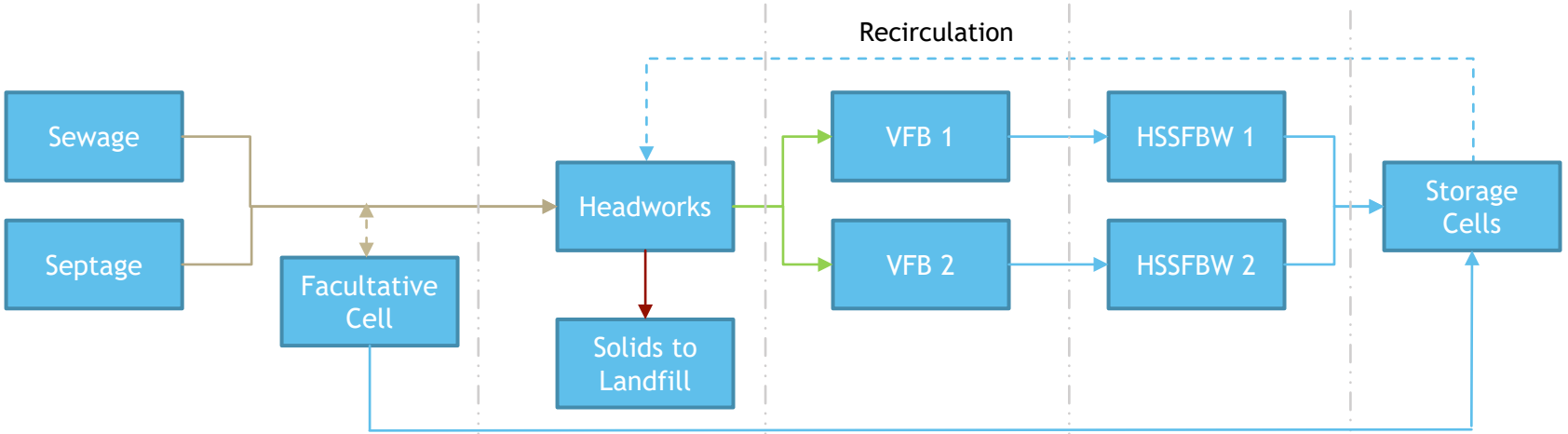
- Originally, proposed a three treatment train MBWS system designed for 25-year capacity;
- An expanded storage cell with 12 months storage capacity for 25 years of growth (designed as per current lagoon guidelines).



MBWS Design - Negotiated

- A combined MBWS + lagoon system;
- 2 treatment train MBWS;
- Parallel facultative lagoon to provide contingency;
- Each sized to accommodate 5-year design flows;
- Future expansion options.

Implementation - Design Details



Inflow

Incoming septage and sewage come to facultative cell to maintain lagoon functionality.

Filtering

Wastewater is filter through microfiltration unit

Solids sent to landfill.

Vertical Flow Biofilters

Subsurface biological treatment with no exposed standing water

Secondary treatment

Horizontal Subsurface Flow Biofilter Wetlands

Denitrification and additional polishing

Discharge

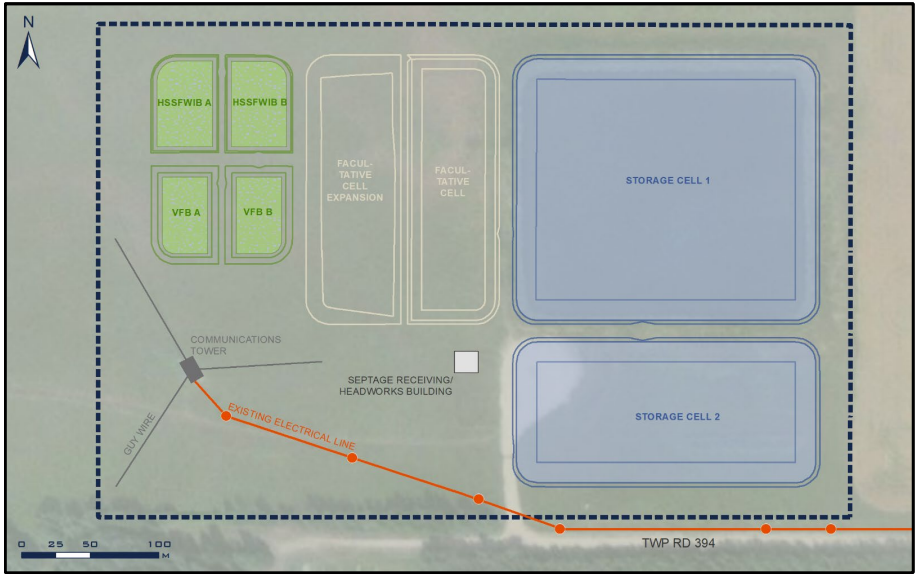
Effluent has optional recirculation.

Effluent held in storage cells to be discharge once annually.

Construction – to be completed in 2022!

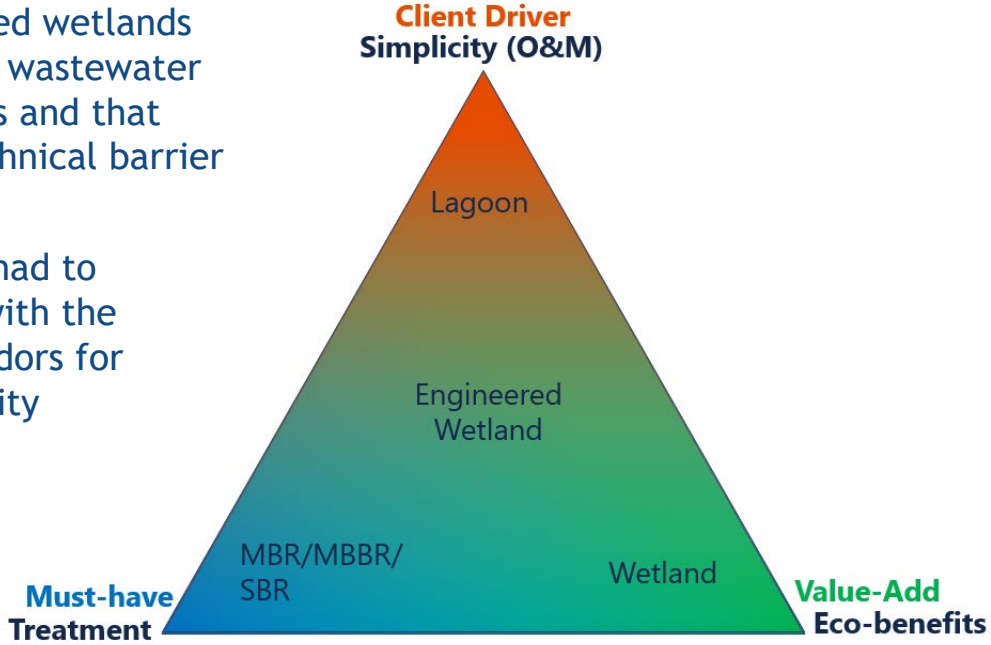
Expected Outcomes

- Weekly testing for one year immediately after construction completion with the intent to apply for full approval upon completion;
- Following approval, monthly testing for additional 2 years for validation and next steps:
  - **Option 1:** If targets are met, leave the system operating as is;
  - **Option 2:** If additional treatment is required, increase the size of the biofilter-wetland units.
  - **Option 3:** Increase the size of facultative cell and use the constructed wetland as additional treatment.



Conclusion

- This project demonstrates that constructed wetlands provide a much-needed low-maintenance wastewater treatment option for smaller communities and that cold climate challenges do not pose a technical barrier to implementation.
- To facilitate implementation, the design had to include specialized adaptations to align with the regulatory expectation of technology vendors for wastewater treatment to align with liability expectations;



Contact / Questions?

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Design Data

Characteristic	Description	Population
Current	Sewage: Leslieville OnlyExternal Hauling: None	Sewage: 134, 70, 80 External Hauling: 0
25 Year Growth Design Flow	Sewage: Alhambra, Withrow and Leslieville External Hauling: Allowed for the County	Sewage: 414 External Hauling: 2,176

Characteristic	Flow	BOD	TSS	TKN	TP
Sewage	44 m3/d	220 mg/L	220 mg/L	40 mg/L	6.5 mg/L
External hauling	48 m3/d	720 mg/L	450 mg/L	220 mg/L	22 mg/L
Combined	92 m3/d	481 mg/L	340 mg/L	134 mg/L	14.6 mg/L