Green Solutions for Landfill Leachate: Willow Plantations as Effluent Reduction Systems

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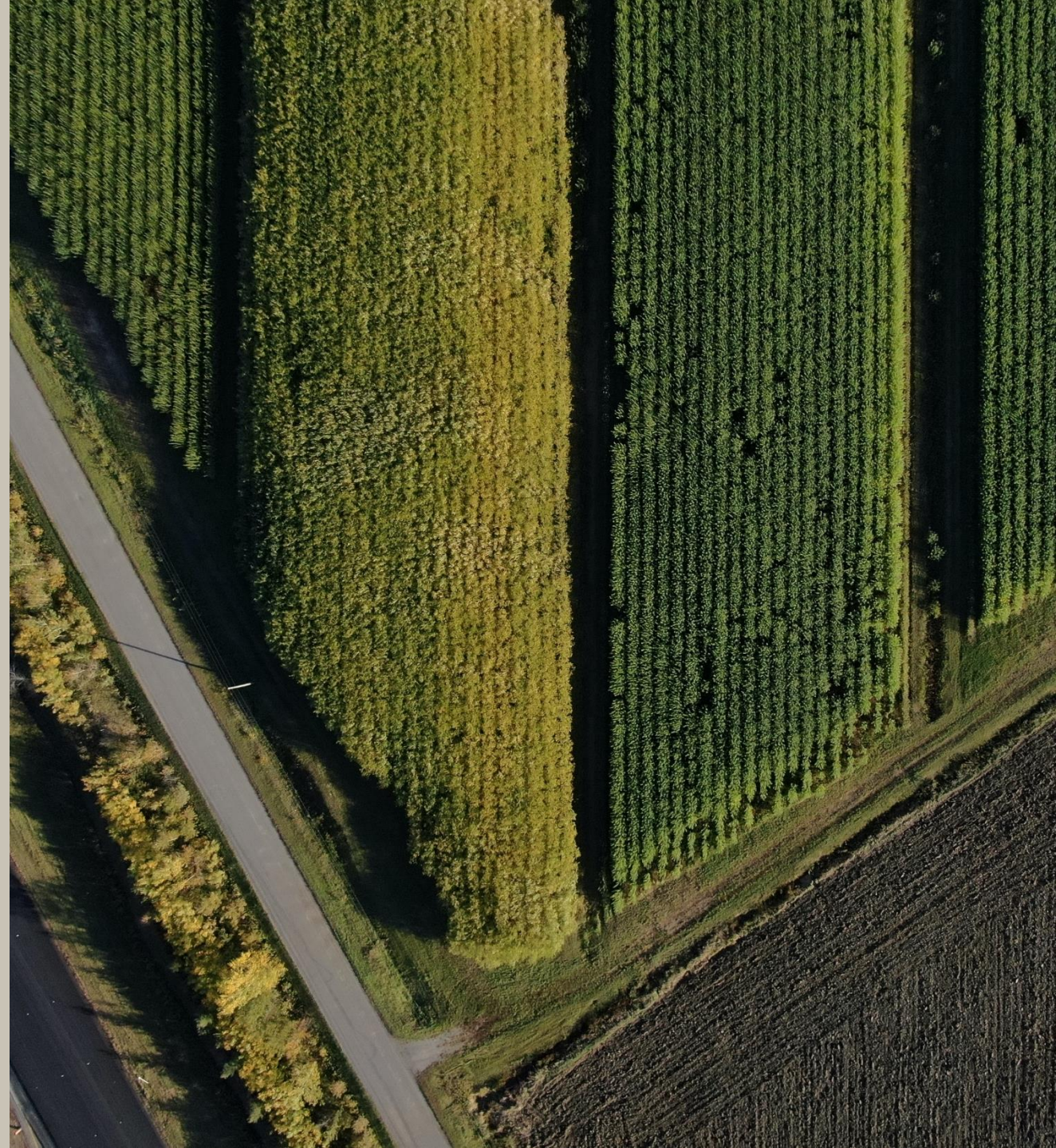
Presentation Outline

- Ramo, Our Roots
- Why Willows
- Evaplant technology
- Projects & Lessons Learned
- Questions / Discussion



Our roots

- Expertise in willow cultivation since 2006
- A fourth-generation agricultural farm transformed into headquarters, operations center, and willow nursery.

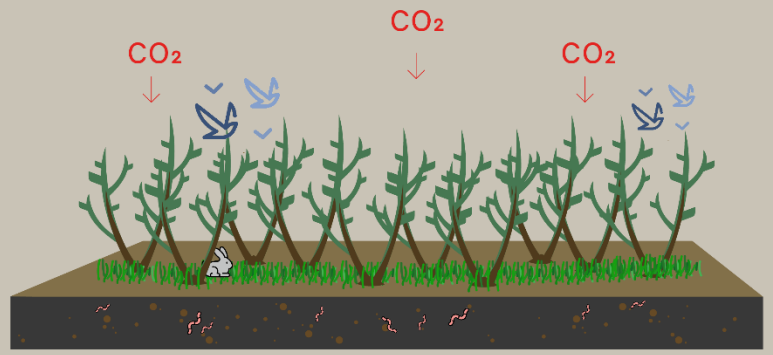
- 9 million invested in R&D over 17 years.

- Largest willow nursery in North America
  - 170 ha nursery
  - Managing 900ha of willow plantations
  - 30 million trees/year capacity in 2024
  - More than 70 genetics available (native, hybrids etc.)

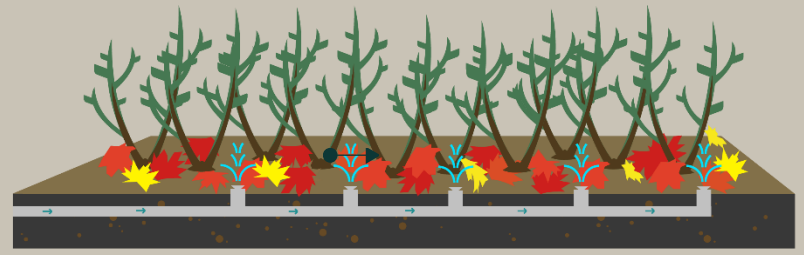
- 80 employees forming a multidisciplinary team: Engineers, agronomists, technicians, professionals.

ESF
State University of New York
College of Environmental Science and Forestry

Circular Resource Management

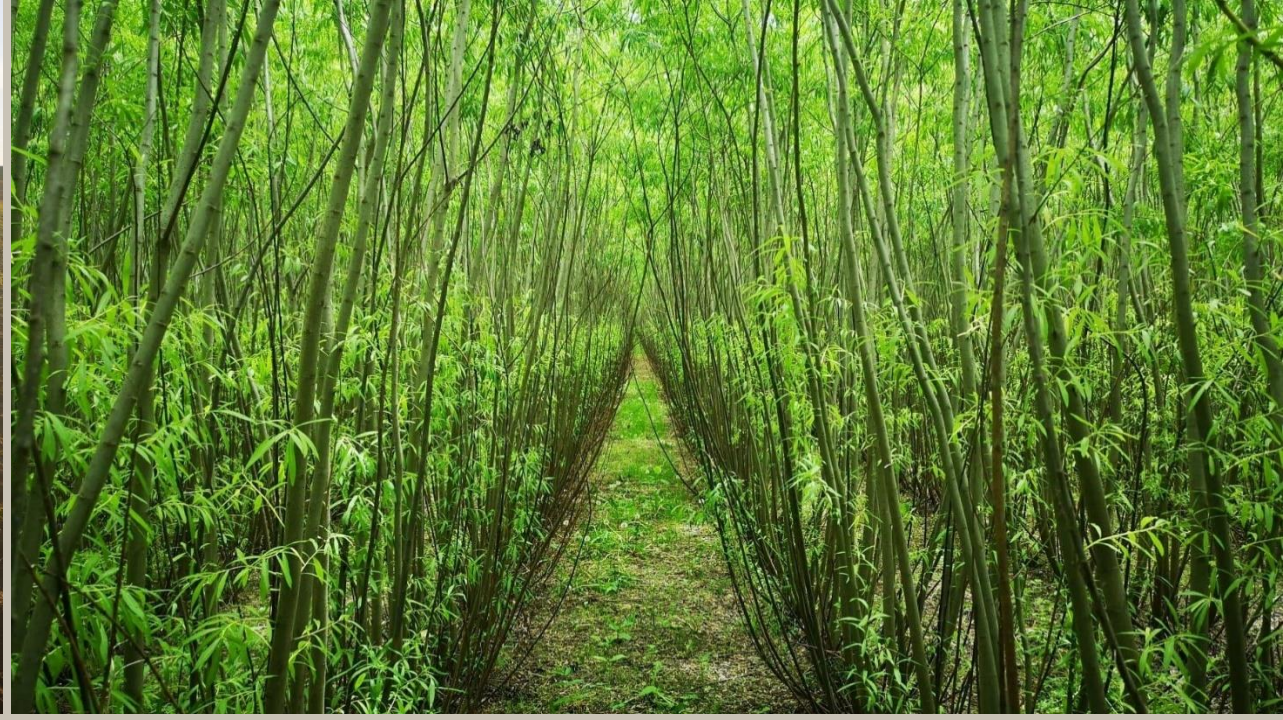


Planting willows on degraded and marginal land for rapid CO2 capture



Reuse of wastewater and organic residuals in willow plantations

Production of renewable wood fibers for soil remediation and the manufacture of bio-sourced materials

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Why willows?

High water uptake rate

- Up to 1,500 mm per season

Shallow root depth

- Lateral root system concentrated on the surface (CEAEQ, 2017)
- Roots in the first 30 cm of soil (Jerbi et al. 2015)

High biomass yield

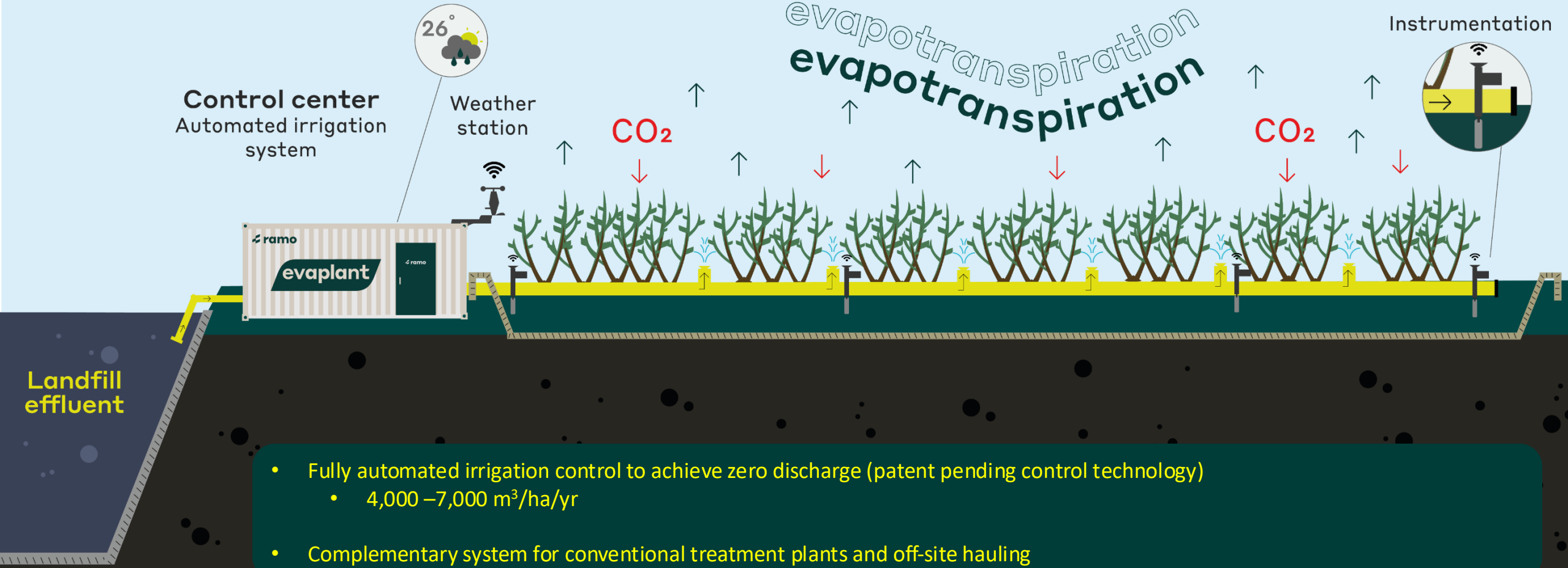
- 8-12 t DM/ha/yr in conventional cultivation
- 20-25 t DM/ha/yr in leachate irrigation context

Why willows?

- Willow are very cross-compatible ie: wide choice to choose from depending on technical characteristics desired.
- Willow plantations have a high nutrient demand, specifically to compensate the removal of stem biomass at harvest

Evaplant: how it works

Evaplant



- Fully automated irrigation control to achieve zero discharge (patent pending control technology)
  - 4,000 –7,000 m^3/ha/yr
- Complementary system for conventional treatment plants and off-site hauling

Projects

Ste-Sophie, Québec

- MSW Landfill
- Owned and Operated by WM
- Evaplant of 1,2ha
- Irrigating with “raw” old cell leachate


2018

1 ha

2018

First year of growth

2nd & 3rd Year of Growth

Mature Plantation

Site	Plantation			Evaplant Operation			Harvest			
	Year Planted	Planted Area (ha)	No. Willows Planted	Year of Operation	Irrigated Surface (ha)	Volume of Leachate Irrigated (m3)	Harvest Year	Harvested Area (ha)	Produced Biomass (Dry tons)	Captured CO2 (CO_2 t.)
Ste-Sophie	2018	1,1	17 600	2019	0,7	1 829	2021	1,1	48,4	88,6
				2020	0,7	2 845				
				2021	0,9	2 602				
	2022	2,0	32 000	2022	0,9	1 119	2023	1,1	49,3	90,2
	2023	9,7	155 200	2023	0,9	2 910				
	Total	*12,8*	*204 800*	2024	0,9	3960	**2025**	**12,8**	**573**	**1049**
				2025	**9,7**	**36 900 - 55 300**				

Soil Quality Considerations

- Challenges faced with trying to establish a willow plantation on industrialized non-homogeneus sites.
  - Considerations need to be taken into account to balance soil quality with irrigation efficiency (leveling of soil)

- Planting directly into soil is an option to be considered based on site, location and time of year

Harvesting

- Harvesting is essential for efficient leachate consumption.
    - Limits over-competition, mortality, diseases etc..
- Harvest schedules need to be strict with fast growing willows.
- Regular site visit and site assessments are critical to confirm speed of growth of plantation : re-adjust harvest if needed.


2021


2022

St Nicéphore, Québec

- MSW Landfill
- Owned and Operated by WM
- Evaplant of 1,6ha
- Irrigating with “raw” old cell leachate


2018


2019


July 2019


September 2019


May 2020


July 2020


September 2020


2021

Site	Plantation			Evaplant Operation			Harvest			
	Year Planted	Planted Area (ha)	No. Willows Planted	Year of Operation	Irrigated Surface (ha)	Volume of Leachate Irrigated (m3)	Harvest Year	Harvested Area (ha)	Produced Biomass (Dry tons)	Captured CO_2 (CO_2 t.)
St-Nicéphore	2019	8,3	132 800	2020	1,6	**413**	2021	8,3	176	322
				2021	1,6	**7 401**				
				2022	1,6	**3 977**	2023	8,3	327	598
				2023	1,6	3 405				
				2024	1,6	4 670	**2025**	**8,3**	**327**	**598**
				2025	**7,0**	**28 000 - 42 000**				

ramo

Leachate Availability

Direct access to readily available leachate

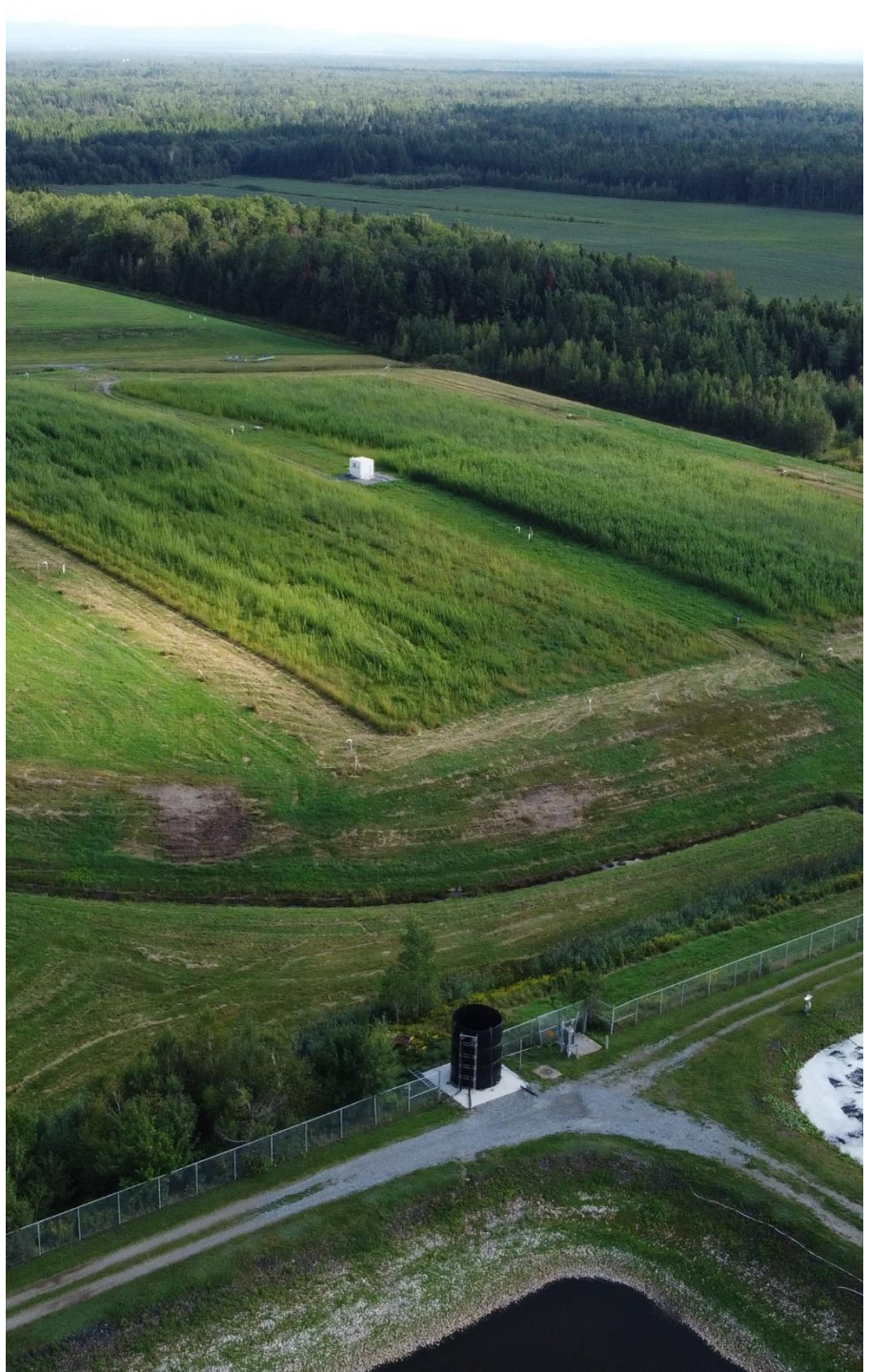
- Installed initial system with leachate storage tanks for irrigation… became bottleneck for efficient irrigation (lack of available leachate)
- Future installation to pump leachate directly from storage lagoons or onsite treatment plant.

St-Lambert, Québec

- Domestic Waste Landfill
- Owned and Operated by Municipality of St-Lambert de Lauzon
- Evaplant of 2ha
- Irrigating with pre-treated new-cell Leachate


2021


2022



Site	Plantation			Evaplant Operation			Harvest			
	Year Planted	Planted Area (ha)	No. Willows Planted	Year of Operation	Irrigated Surface (ha)	Volume of Leachate Irrigated (m3)	Harvest Year	Harvested Area (ha)	Produced Biomass (Dry tons)	Captured CO2 (C02 t.)
St-Lambert-de-Lauzon	2021	1,7	27 200	2022	1,1	3 037	2023	1,7	68,3	125
				2023	1,1	1 735				
				2024	1,1	2 353	2025	1,7	68,3	125
				2025	1,1	3 000 - 5 000				

Lessons Learned

- Weather during plantation period (can be difficult)
  - Spring is synomymous with wet, muddy conditions.. Timing is crucial.

- Available Federal, State and Municipal funding towards the implementation of an EvaPlant system is a great incentive for landfills (NHDES Waste Remediation Grants, PFAS Remediation Loan Fund, CWSRF Emerging Contaminants funding etc..)

Summary

- Natural leachate management systems are not only found on student posters… Depending on the purpose, they can be equivalent if not better than traditional treatment systems

- Remove all controllable sources of limiting factors (access to leachate, soil quality) as there are already many uncontrollable sources when dealing with living systems.

- Timing is everything (Flexible timelines vs. hard stops)

- A simple looking system is indeed quite complexe and requires constant maintenance and inspections … just like static treatment systems.

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