Evaplant - Reducing Leachate Volumes with Willow Plantations

Our experience on Quebec Landfills

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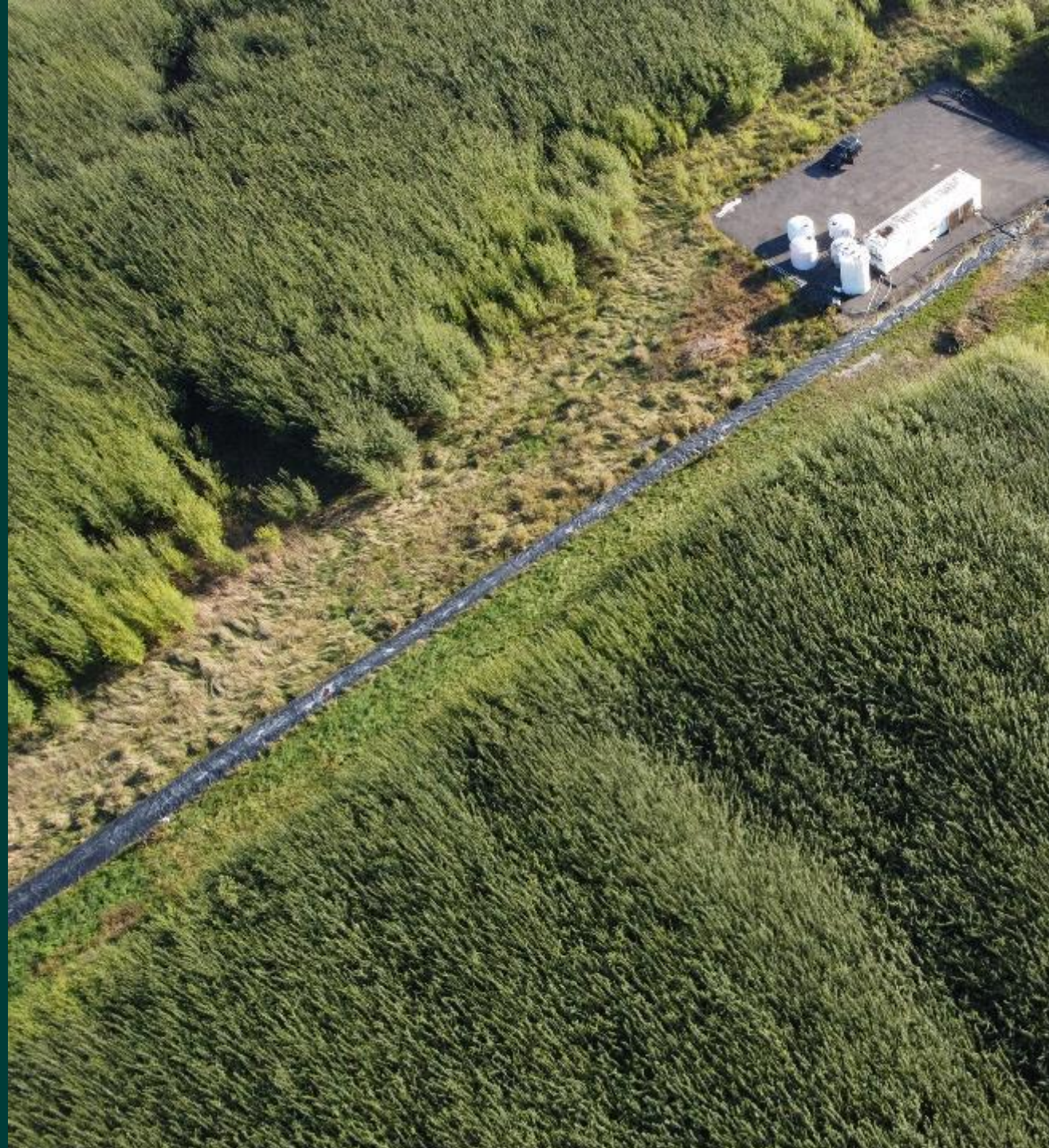
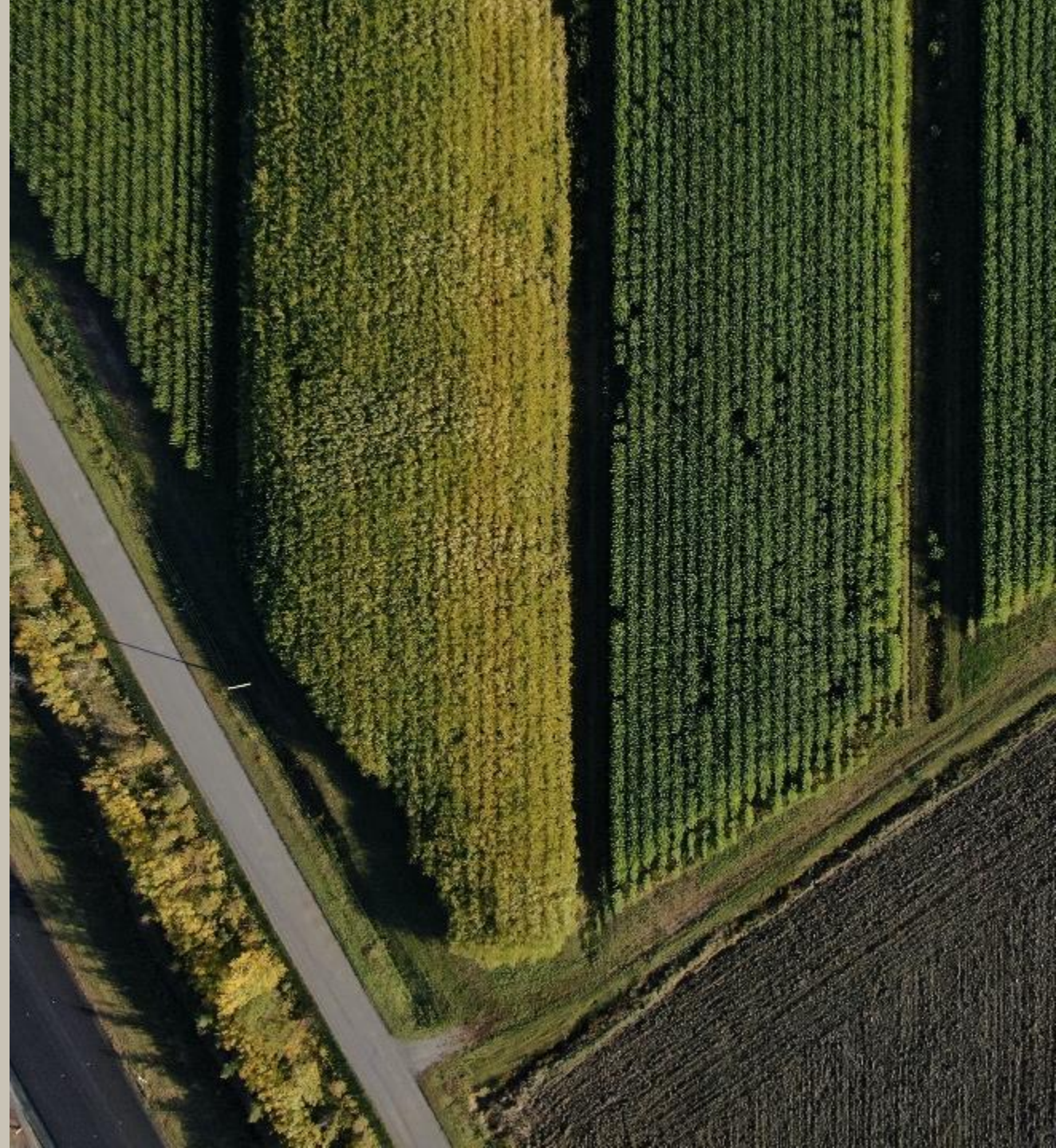


Presentation Outline

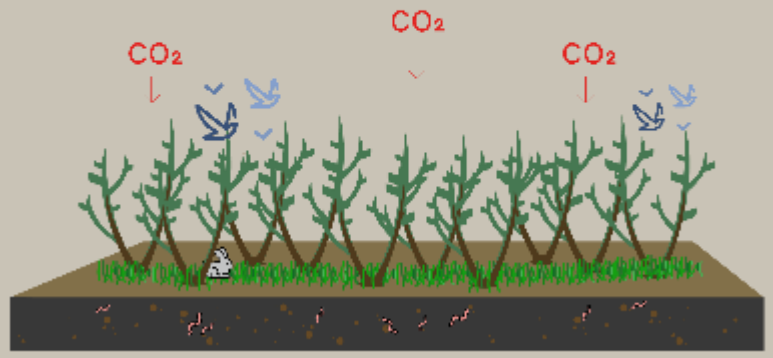
- Ramo, Our Roots
- Evaplant technology
- Projects & Lessons Learned
- Questions / Discussion



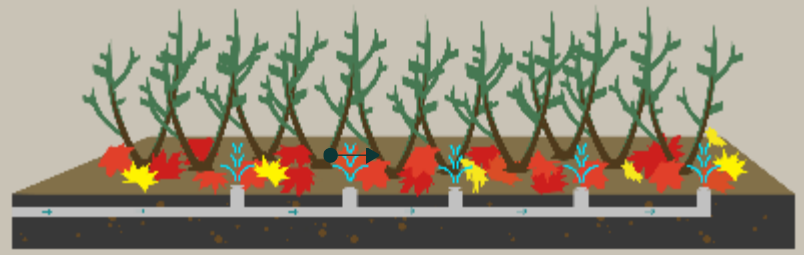
Our roots

- Expertise in willow cultivation since 2006
- North American leader in fast growing willow production
- Largest willow nursery in North America
  - 170 ha nursery
  - Managing 450ha of willow plantations
  - 60 million trees/year capacity in 2023
  - More than 50 genetics available (native, hybrids etc.)
- More than 70 employees with multidisciplinary expertise
- Ramo offers turnkey willow plantation services for: **Wastewater volume reduction, Land restoration, Soil amendment/organic matter, Carbon offset, Woodschip sources**

An ecosystem of nature-based solutions



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

Willow cultivation

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

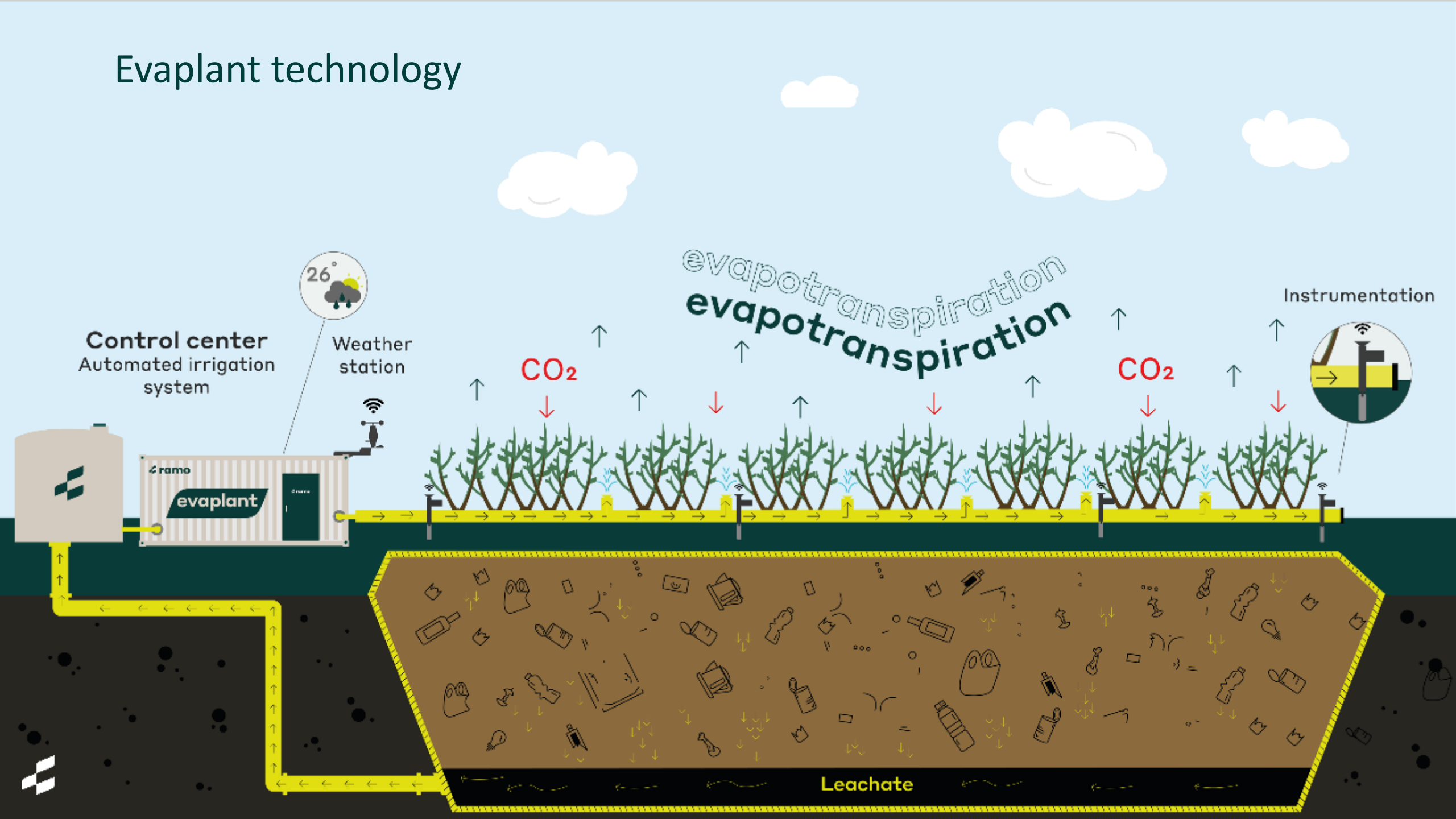
- 8-12 t DM/ha/yr in conventional cultivation
- 20-25 t DM/ha/yr in leachate irrigation context

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 technology



Evaplant technology

- Control Center for precision irrigation and **zero leachate discharge**
- Leachate Volume reduction **3,000-7,000 m3/ha/yr**
- Control of organic matter degradation and NH_4 nitrification
- Precise rationing of nutrient and metal concentrations for uptake in plant aerial biomass

Irrigation system

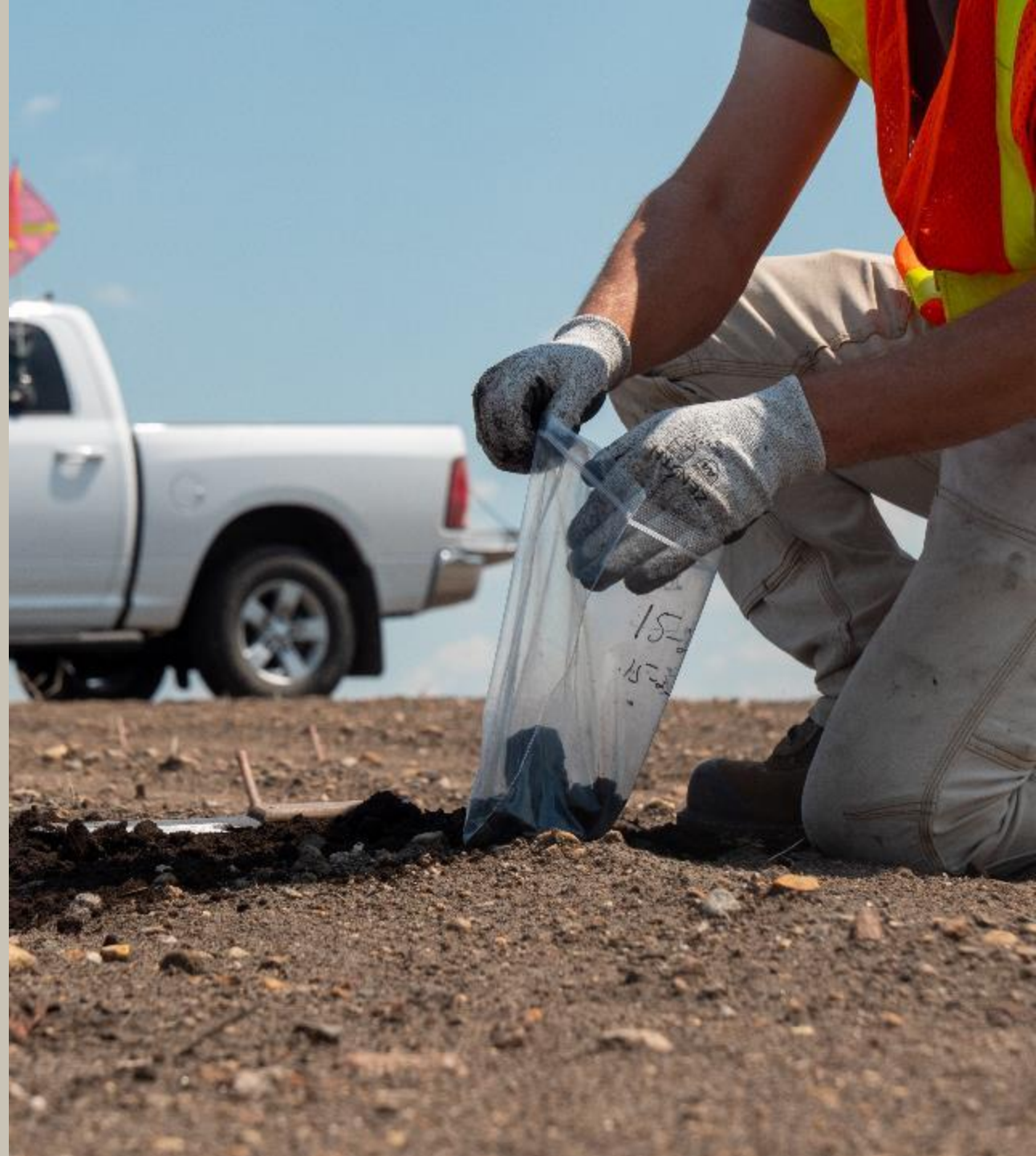
Specialized micro-sprinkler irrigation system design by Ramo to:

- Maximize soil evaporation and plant transpiration ie: **0 leachate discharge**
- Maximize soil biological processes
- Prevent equipment clogging
- Promote large droplet irrigation
- Allow full machinery movement
- Endure harsh industrial leachate and environmental conditions

Environmental monitoring

Nutrients and metal uptake in plant biomass

- Leachate quality over time
- Leaf and biomass composition
- Biomass yield calculations
- Soil Quality
- Lysimeter & tensiometers monitoring



Projects

Ste-Sophie, Québec

- Domestic Waste 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**	**4,1**	**15 600 - 23 400**	**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

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

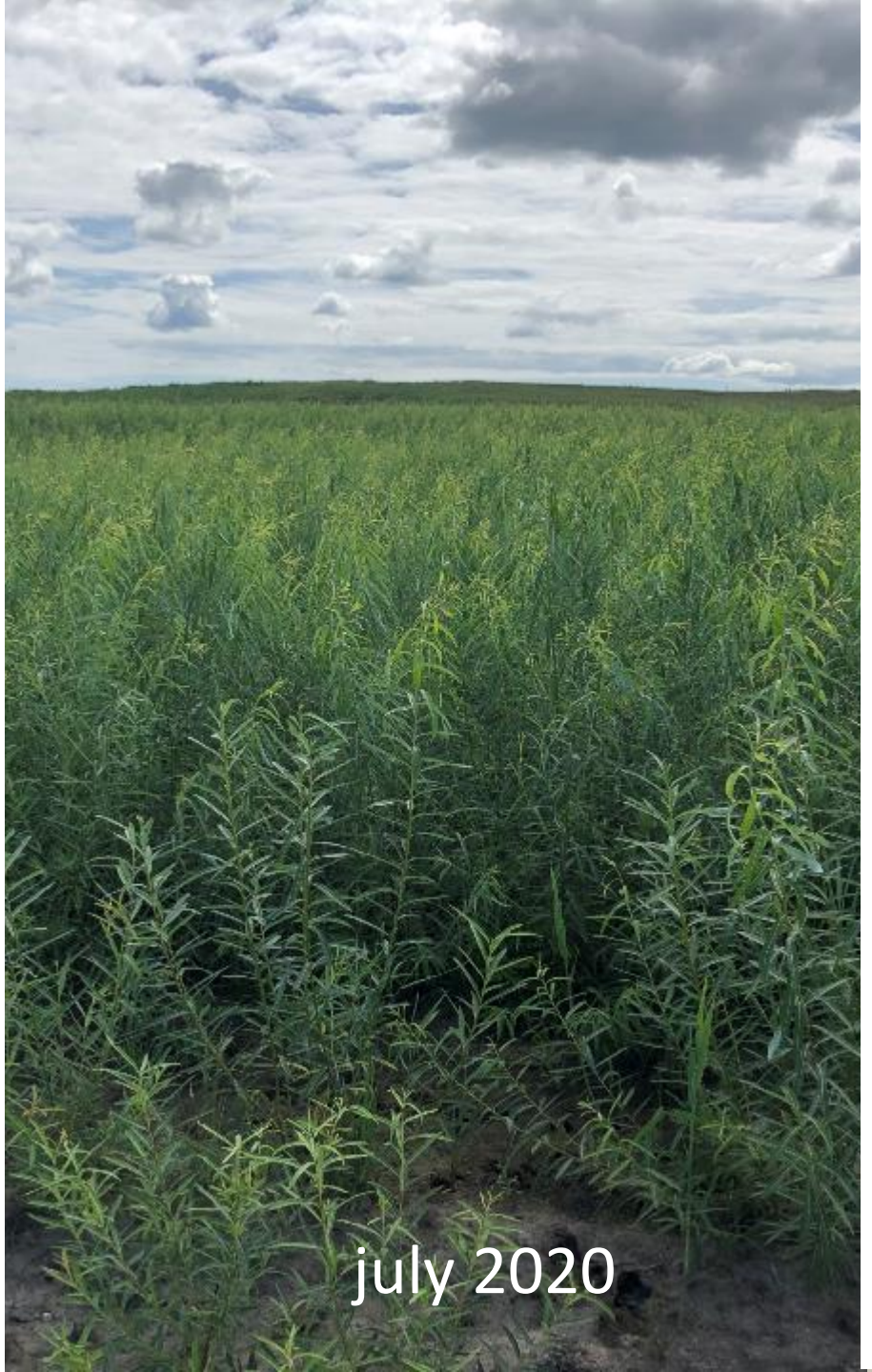

2018


2018


July 2019


September 2019


May 2020


july 2020


August 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 CO2 (CO_2 t.)
St-Nicéphore	2019	8,3	132 800	2020	1,6	413	2 021	8,3	176	322
				2021	1,6	7 401				
				2022	1,6	3 977	2 023	8,3	327	598
				2023	1,6	3 405				
				2024	**7,0**	**28 000 - 42 000**	**2025**	**8,3**	**327**	**598**
				2025	**7,0**	**28 000 - 42 000**				

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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.

Expansion Capacity

- Planted 8ha but only used 1,6ha for EvaPlant… making it really simple to expand system in future

- Obtain MECP approvals for entire project easier than obtaining them progressively.

Project Image

- High visibility projects with local communities
- Positive image for employees working onsite

The Evaplant system provides the added advantage of enhancing the landfills public image which goes above and beyond simply reducing leachate discharge volumes.

St-Lambert, Québec

- Domestic Waste Landfill
- Owned and Operated by the Regie Intermunicipale de Gestion des Déchets des Chutes-de-la Chaudière
- Evaplant of 1,7ha
- 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 eq. (CO_2 t.)
St-Lambert-de-Lauzon	2021	1,7	27 200	2022	1,1	3037	2023	1,7	68,3	125
				2023	1,1	1735				
				2024	**1,1**	**3 000 - 5 000**	**2025**	**1,7**	**68,3**	**125**
				2025	**1,1**	**3 000 - 5 000**				

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Lessons Learned

Available Federal & Municipal funding towards the implementation of an EvaPlant system is a great incentive for landfills (2BT, Tree Canada, Green Municipal Fund)

- 2BT & GMF helped us install St-Lambert system

Using onsite green waste as fertilizer for plantation is a no-brainer for landfills

- City was able to recycle/compost its collected leaves through the willow plantation

City of Neuville, Quebec

- Domestic Waste Landfill
- Owned and Operated by Regie Intermunicipal de Portneuf
- Evaplant of 3ha
- Irrigating with pre-treated new-cell Leachate

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.)
Neuville	2023	6,0	96 000	**2024**	**3,0**	**9 300 - 13 900**	**2025**	**6,0**	**264**	**483**
				Option 2025	**5,1**	**15 800 - 23 700**				

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Lessons Learned

- Willow Plantation can be started before Ministerial approvals are obtained
- Weather during plantation period (can be difficult)
  - Spring is synomymous with wet, muddy conditions.. Timing is crucial.
- Rooted cuttings vs. Cuttings
  - Depending on location, geography and project schedule, rooted cuttings or cuttings may be used.
- Using onsite residuals to fertilize plantation (in waiting for Evaplant approval)

Complexe Enviro Connexions, Quebec

- Domestic Waste Landfill
- Owned and Operated by Enviro Connexions
- Evaplant of 0,3ha
- Future objectives: Irrigating with pre-treated new-cell Leachate

ENVIRO CONNEXIONS

Lessons Learned

- Using onsite materials to build soil base is easy with landfills (contaminated soils, organic residuals)
    - Client had a site suitable for a plantation but was on a gravel base. Used onsite soils (destined for daily cover) & organic residuals to build a healthy soil base.

Summary

- A simple looking system is indeed quite complexe and requires constant maintenance and inspections … just like static treatment systems.
- Engineers get heartburn when discussing living systems
- Working with the landfill's consultants and utilizing the existing relationship with the regional MECP is a must.
- Remove all controllable sources of limiting factors (access to leachate, soil quality) as there are already many uncontrollable sources when dealing with living systems.
- Positive image of Evaplant is not to be overlooked for both surrounding communities and onsite employees

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