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Tracey Braun, Director
Environmental Approvals
Manitoba Conservation and Water Stewardship
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Nicole Armstrong, Director
Water Science and Management Branch
Manitoba Conservation and Water Stewardship
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August 30, 2016

Dear Ms. Braun and Ms. Armstrong,

The Rural Municipality of Hanover in partnership with Eco-West would like to jointly make the request for the notice of alteration at the New Bothell Wastewater Treatment lagoon. This facility currently operates under Licence # 1524r which addressed phosphorous removal limits prior to this year's January mandate but along with the above mentioned partnership with Eco-West we would like to see this limit suspended on one of our secondary cells. Attached you will find the pilot project proposed and the reasoning for this temporary limit suspension.

We thank you in advance for your consideration.

Sincerely,

A handwritten signature in blue ink, appearing to read "Rob Driedger".

Rob Driedger, C.E.T.
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Floating Cattail Bio-platform Harvesting System (Pilot Project)



Notice of Alteration

Presented to:

Manitoba Conservation and Water Stewardship

August 2016



1) Project Overview

It is anticipated that the Cattail Bioplatfrom Harvesting System™ as designed by Winnipeg's Curry Industries Ltd. will be installed in the secondary treatment cells of three municipal wastewater stabifization ponds (lagoons) – RMs of Ste. Anne, Taché and Hanover - in the spring of 2017. Each of the installations will consist of 250 square meters of grow trays in rectangle floating trays for establishing root growth during the first season.

The purpose of this pilot project will be to field-test a prototype design of floating cattail bio-platforms in a wastewater environment - i.e., municipal lagoon - to study their performance characteristics for growing cattails and sequestering nutrients, to determine the feasibility of using cattails shreddings as biofuel or feedstock, and to evaluate and refine the design for biomass harvesting and nutrient recapture.

The Cattail Bio-platfrom Harvesting System™ is a structured growing bed for cattails to treat wastewaters passively in sewage lagoons prior to subsequent release into surface waters. The system - invented by Mike Curry of Curry Industries in Winnipeg, MB - has been designed to harvest the cattails when the plant is richest in phosphorous and nitrogen. The cuttings are subsequently shredded by a forage cutter and deposited into a storage bin on the shoreline for further use, and the options for biomass harvesting that are being explored include , in addition to its potential as a biofuel or feedstock, as biomass that can also be used to create heat/electricity or act as a carbon source for composting. One of the advantages of using the harvested cattails as compost is that nitrogen and phosphates are retained for added value, which also means that they can be used as mulch for fertilizing purposes in the agricultural sector.

The use a wastewater site (lagoon) was chosen to allow for the designing of prototype grow beds and processing equipment for harvesting an actual site, and also to assess the technology's potential using cattail platforms that could eventually be scaled for commercial applications in various bodies of water and ecosystems.

The bio-platforms could also provide the following, additional benefits: 1) They may help to dissipate waves and help to promote long-term sediment accretion that would enable natural vegetation to grow and 2) They may provide a restored habitat for wildlife and fish.

This project thus proposes the testing of an innovative technology to reduce nutrient loading in wastewater systems, with potentially wider commercial applications. With the ongoing implementation of stricter provincial guidelines (i.e., total phosphorus at the discharge point) concerning the management of municipal wastewater, this alternative treatment process will be studied to determine its efficacy at removing nutrients from wastewater in a rural, prairie context.

2) Odour nuisance; Is there any plan in place to monitor dissolved oxygen in the lagoon cell?

During initial trials of the cattail bio-platfrom system that was deployed at Fort Whyte Alive, no unusual odours were detected. Therefore, under normal operating conditions the proposed pilot project should create no unforeseen odour nuisances. Nevertheless, the

dissolved oxygen will be monitored on a regular basis (weekly) by the lead researcher from the University of Manitoba as well as lagoon operators.

3) Pilot Project Timelines

The Cattail Bio-platform harvesting project will run over a 2 1/2 year period from the spring of 2017 to fall of 2019. The following are the milestones expected to be completed throughout the duration of the project:

2017 - Spring – Initial deployment of bio-platforms with rhizomes planted in cells for establishing roots system

2018 - August – First harvest using amphibious harvester

2019 - August – Second harvest with adaptations if needed for plant and harvesting technique improvements

2017 (Initial Deployment)

- Final development and construction of aquatic harvesting system will commence employing Curry design system and engineering services
- Install prototype cattail bio-platforms in rural wastewater treatment ponds for testing system as to its capability of removing phosphorus (P) and nitrogen (N)
- Bio-platforms will contain rhizome in soil mixture establishing roots for first year growth
- Bio-platforms will be housed in netted hooped shelters with side barriers to prevent avian and muskrat intrusion
- Sampling of cattail growth, soil and water at different stages of growth for lab testing
- The bio-platforms will remain in the water during the winter months for renewed growth the following spring (year 2)

2018 (First Harvest Season)

- The harvester is designed to cut, shred and deposit cattail into bin on the shore
- The cattail will be harvested in August when plant is richest in phosphorus and nitrogen
- Regular sampling of cattail growth, soil and water at harvest time for lab testing
- Shredded cattail will be tested as a compost on agricultural land as alternative fertilizer
- Agricultural field will be monitored as to the potential value of this new type of fertilizer
- Evaluate complete system of harvesting and modify design if needed
- The bio-platforms will continue to be deployed for year 3

2019 (Second Harvest Season)

- Identify cattail cell requirements for intake results
- Sampling of cattail growth, soil and water for lab testing
- Monitor results of agricultural field results for crop growth
- Harvest in year three and identify modifications for complete system
- Streamline any procedures within system related to handling of equipment

- Modify any parts of system for maximum efficiency
- Compile laboratory data to identify nutrient intake (translocation) of cattail shoots
- Evaluate opportunities using cattail for wastewater stabilization and subsequent use of shredded plant as compost fertilizer
- Determine ROI of harvesting system based on intakes of P & N for value proposition
- Begin commercialization & marketing phase / sale of biomass product

4) Operations for the pilot project, maintenance & harvesting

The pilot project will be operated by Curry Industries Ltd with additional staff to manage sites and conduct harvesting in collaboration with participating municipal wastewater managers throughout duration of the project. The management team will supervise installation of the system, maintain and monitor bio-platform performance throughout the development cycle. Water sampling and analysis of cattail shredding will be conducted by Dr. Qiuyan Yuan, PEng., Department of Civil Engineering, University of Manitoba.

5) Anchoring of bio-platforms in the lagoon and potential impact of anchoring cattails on lagoon liner integrity

It is proposed to use circular cement blocks with embedded steel loop in center to anchor the bio-platforms in the lagoon(s). These anchors will be positioned on bottom for attaching bio-platform floatation to prevent drifting. The weight of the cement will be design to accepted anchoring techniques currently being employed in wastewater ponds without degrading the integrity of the lagoon liner.

6) Subsequent use of harvested cattails

The system has been designed to harvest the cattails when the plant is richest in phosphorous and nitrogen. The cuttings are subsequently shredded by a forage cutter and deposited into a storage bin on the shoreline for further use. Options for biomass harvesting that are being explored include, in addition to its potential as a biofuel or feedstock, as biomass that can also be used to create heat/electricity or act as a carbon source for composting. One of the advantages of using the harvested cattails as compost is that nitrogen and phosphates are retained for these added-value purposes.

7) Influence of harvesting period on the nutrient removal rate and expected nutrient removal amount.

Macrophytes (cattails) play a crucial role in an aquatic ecosystem; they supply food and nutrients to native species that populate the habitat. Some macrophytes have unique absorptive qualities that allow them to remove nutrients from the water column. Cattails (*Typha* spp.) are a common macrophyte found in lagoons, wetlands and other bodies of water and have excellent absorptive qualities for phosphorus (P) and nitrogen (N).

By holding cattails within their structure, the bio-platforms have been designed to increase vegetative cover, while reducing levels of eutrophication through the sequestration of nutrients such as phosphorus and nitrogen, thereby preventing their release into the water column.

Using floating cattail bio-platforms, samples of water, in addition to above-ground and below-ground cattail tissue from the bio-platforms, can be taken and analyzed at regular intervals to be tested for change in total phosphorus concentration. This will enable the project team to observe the translocation of phosphorus throughout the cattail tissue, and to determine the mean total phosphorus before, during and after the growing season. This knowledge will lead to a better understanding of how harvesting cattail can be used to remove phosphorus and other nutrients from the water in order to mitigate eutrophic conditions.

In late summer and early fall, cattail above-ground shoots begin to die off and decompose in the water column, releasing their nutrients back into the water column. Cattails are perennial aquatic macrophytes and must have adaptations to survive harsh winter conditions. Prior to senescence, the shoots translocate the nutrients, such as nitrogen and phosphorus to the below-ground/root tissue to survive freezing and allow re-establishment the following spring.

Towards the end of the month of August, then, is when the cattail reaches its maximum growth and is richest in absorbed nutrients. It is at this time that harvesting will take place, thereby maximizing the load of the plant before the nutrients are allowed to migrate back down into the roots and water (beneath the floating platform) for the duration of the hibernation cycle. Once the cattails have been harvested, the absorbed nutrients will be completely removed from the water column.

Since this is the first study of bio-platform application in a **wastewater lagoon environment**, there is currently no data available on its nutrient removal efficiency. However, a research collaboration has been created with the researchers at the University of Manitoba. We will work closely on monitoring the nutrient dynamic of the lagoon through the year. At the end of each harvest, we will be able to calculate the nutrient removal amount. This information will be included in the annual progress report submitted to Manitoba Conservation and Water Stewardship.

8) Impact of ice thaw on the project

The lingering effects of the winter season did not have any impact on growing beds or bio-platform integrity at Fort Whyte. During the spring, the ice melts faster surrounding the bio-platforms. The thaw is a natural process that assists the plant in absorbing nutrients sooner than cattails that grow naturally in drainage ditches. A senior wetlands/uplands specialist at Native Plant Solutions indicated that climate is not an issue with lagoons generally across the province. Cold or extreme weather does not affect (kill) plants, but rather water that is too deep. A wastewater stabilization pond is a controlled environment with a relatively shallow

water depth that is stable (i.e., controlled levels until time of discharge), and so it is not subject to unforeseen fluctuations (i.e., floods) as is the external, natural environment.

9) Contingency plans / risk management

The probability of success for this pilot project is high given the results that were obtained from the cattail harvesting system pilot project at Fort Whyte Alive, a project in which Curry Industries was also involved as the company began to explore design possibilities for floating cattail bio-platforms and their eventual deployment in municipal lagoons. Of course, there is the distinct possibility that the project could be affected by extreme Acts of God. In this case, the practical approach would be to assess the catastrophic event and consult with stakeholders for potential solutions as well as for implementing adaptations to the project plan if necessary. This type of incident would be recorded and also placed on the agenda for evaluation of incidence on business opportunities in year 3.

10) Planned water sampling to demonstrate the impact of the cattails – frequency, parameters, etc.

The water sampling frequency will be as follows: April - October, weekly. November-March, monthly. The water sample parameters for analysis includes: BOD, pH, DO, temperature, total suspended solids, Nitrogen (ammonia and total nitrogen), Phosphorus (ortho-phosphate and total phosphorus), and *E.Coli*.

11) Proposed reporting to the department – when, what would be included in the report, etc.

At the end of each term agreed by the department and stakeholders the company will provide a update on all aspects of the system. This will include timelines on each project phase, targets met, improvement if needed and overall performance of system.

12) Current reduction Strategy

The R.M. of Hanover is currently applying Aluminum Sulphate by way of a pontoon boat and spreader into our secondary ponds prior to discharge of effluent. This application process is done on a daily basis for upwards of 5 weeks to bring phosphorous levels within the required limit. Costs for this application per session can range from \$10,000-\$15,000 per holding pond.