

Niverville Lagoon Bioremediation Project

Spring 2014 Newsletter

This newsletter, written by Native Plant Solutions, provides a brief update on the construction, communications, funding and research activities of the Niverville Lagoon Bioremediation Project from spring 2013 to spring 2014.



Wetland Cell 1, summer 2013 (photo courtesy of N. Jeke).

Construction Update

In spring 2013, Cell 1 (wetland cell) was flooded to the normal water level, then drawn down one month following, to support the wetland plants in their first growing season. Fencing was also placed around the newly planted wetland plants in Cell 1 to keep Canada Geese from grazing on the vegetation. Once the plants are fully established, the fencing will be removed. Throughout 2013, wetland plants responded very well, showing growth and spreading in Cell 1 for their first growing season. Due to this success, no additional plantings were required in summer 2013 to supplement what had been planted in fall of 2012, and water levels were drawn up to normal in Cell 1 in August 2013. As wetland plant growth was sufficient and robust enough to withstand deeper water levels in 2014, Cell 1 was pumped to the normal water level in early May 2014.

Communications Update

The success of the Niverville Lagoon Bioremediation Project was well received by the public, and in media/publications, in 2013/2014. In May 2013, Niverville Collegiate students from the Sustainability Group, along with their teacher Mr. Hank Dueck, received a tour of the University of Manitoba Soil Science Department's research facilities from Dr. Francis Zvomuya, and Niverville graduate students Ms. Adenike Hassan and Mr. Nicholson Jeke. The Sustainability Group then shared their research information with their Grade 10 Ecology class.

Although a site tour was not able to be coordinated in 2013, the hope is to tour the bioremediation project site in June of 2014.



Niverville Collegiate students tour research at the University of Manitoba Soil Science Department (May 2013).

A new project sign was placed on site in the spring of 2013 and in September 2013, Town Council members and Native Plant Solutions highlighted the lagoon bioremediation project at a community open house, presenting the project to over 200 residents that visited. These steps help to support the Town's intention for development of the site as an interpretive area. A selection of photos showing the progress of the project has also been compiled for the Town of Niverville's website www.whereyoubelong.ca.

Ms. Hassan presented her initial research results at the Canadian Soil Science Conference held in Winnipeg in July 2013, and Mr. Jeke presented his first year research results at the Manitoba Soil Science Conference in Winnipeg in February 2014.

The Niverville Lagoon Bioremediation project was also highlighted in the 75th anniversary edition of Ducks Unlimited Canada's national Conservator magazine, as well as the national Canadian Reclamation magazine's spring/summer 2014 edition.

Funding Update



Federal funding announcement for the Lake Winnipeg Basin Stewardship Fund (June 2013).

In June 2013 Niverville was informed they were one of a few successful recipients to receive funding support, totaling \$150,000, from the Lake Winnipeg Basin Stewardship Fund. These funds will help Niverville support ongoing research activities, as well as site enhancements in 2013/2014, 2014/2015 and 2015/2016. Niverville Town Council members, Dr. Francis Zvomuya and NPS staff met former Provencher MP Vic Toews on site for the official funding announcement in June 2013. In September 2013, the Town of Niverville and NPS had the opportunity to provide a site tour to Environment Canada program advisors on the

progress being made on the bioremediation project. With the submission of the annual report to Environment Canada for FY2013/2014, additional funding was requested and is pending approval for construction of an all-season access road, redesigning dike slopes to address safety concerns for mobilizing equipment for site maintenance and interpretive signage to explain and invite the general public to examine the project. Round 8 of the Lake Winnipeg Basin Stewardship Fund application process begins in October 2014. The opportunity exists to request additional funding to support research into biomass harvesting on site (i.e., for nutrient recapture and/or biofuel purposes) and/or development of the site as an interpretive area. In addition to 2013/2014 quarterly updates to Environment Canada, a final report was submitted to the Province of Manitoba for the Water Stewardship Fund (\$25,000 in 2012/2013), as well as an update to the province in support of the Environment Act License (January 30th, 2014).

Research Update

Objective: Examine the efficacy of two alternative in-situ remediation approaches – a constructed wetland system and a traditional phytoremediation system – as alternative approaches for the decommissioning of municipal lagoons.

Investigators: Dr. Francis Zvomuya (University of Manitoba), Lisette Ross (Native Plant Solutions), Dr. Pascal Badiou (Institute for Wetland and Waterfowl Research, Ducks Unlimited Canada), Dr. Nazim Cicek (University of Manitoba), Dr. Tee Boon Goh (University of Manitoba)

In 2012, two graduate students began their research programs under the supervision of Dr. Francis Zvomuya, soil scientist at the University of Manitoba. Ms. Adenike Hassan began her Master's project in January 2012, undertaking laboratory and growth room research (Phase I, growth room research component) to support the bioremediation project, and is hoping to defend her thesis in summer 2014. Mr. Nicholson Jeke began his Master's project in September 2012, undertaking the fieldwork component (Phase II, field research component) of the bioremediation project, and will be conducting his second year of field research in summer 2014.

Remediation Research Lingo

Phytoremediation. *the use of a plant for the treatment of an environmental problem*

Biomass. *is the biological material that makes up living, or recently living organisms*

Trace elements. *a chemical present only in minute amounts, and required minimally by living organisms for normal growth. For example: cadmium*

Biosolids. *the sewage sludge that has settled, as part of wastewater treatment*

2013 marked the second year of research for the Niverville bioremediation project, and the first growth season for the field research component of the project. For Phase I, results are showing that biosolids can support the growth of plants, without the need for soil amendment, and that repeated harvesting of the plant biomass significantly improves nutrient uptake. For Phase II, the peak day into the growing season has been targeted in order to optimize nutrient removal for harvesting purposes. In addition, results are showing that nutrients and trace elements are being taken up by the cattail as they grow. In terms of efficacy of removal, initial results show a decline in nutrient and trace elements biosolids concentrations in 2013, as compared to 2011; however, this decline may be related to biosolid dilution with soil in the construction process, rather than plant uptake. Continued monitoring at research plots established in 2014 will allow for better evaluation of efficacy of removal, without the bias of construction activities. A summary of Phase I and Phase II research, and preliminary results, is given below.

Phase 1: Growth Room Experiments (Student: Adenike Hassan; Started winter 2011)

Research objective and questions

- Growth room (i.e., greenhouse/laboratory) study to examine the removal ability of two alternative on-site remediation approaches – a constructed wetland system and a traditional phytoremediation system – as alternative approaches for the decommissioning of municipal lagoons.
- Switchgrass was the focus species for the phytoremediation component, while cattail was the focus species for the wetland bioremediation component.
- Growth room experiments were carried out to mimic both a wetland system (for bioremediation using cattail) and a dryland system (for phytoremediation using both cattail and switchgrass).



*Growth room trials at the University of Manitoba
(photo courtesy of A. Hassan).*

- Biosolids from both the primary cell and secondary cell were compared, as well as a soil/biosolid mixture, to compare their effectiveness for phytoremediation.
- Single and multiple harvests, in order to recapture nutrients and metals sequestered during plant growth, were tested to examine the effects of harvest on plant growth and nutrient removal.

Preliminary results and key messages:

- Biosolids can support a healthy plant population without the need for dilution with soil.
- Repeated harvesting increased biomass yield for both switchgrass and cattail, and significantly improved uptake.
- Preliminary results show cattail are removing up to 10% of nutrients in biosolids after a single growth cycle.

Phase 2: Field, Laboratory and growth room studies (Student: Nicholson Jeke; Started Fall 2012)

Research objectives and questions

- Field study to evaluate in-situ wetland and traditional phytoremediation approaches as alternatives to traditional lagoon decommissioning options.

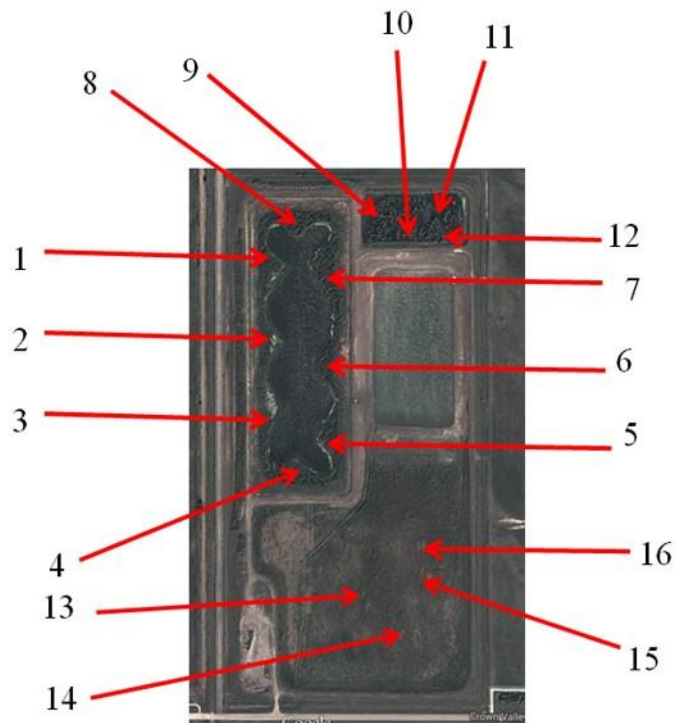
- Study removal efficiencies of nutrients and trace elements in a wetland and non-wetland system using cattail and switchgrass. Biomass accumulation, availability and uptake of nutrients and trace elements, and their distribution in aboveground and belowground biomass, will be studied.

- In the wetland cell (former lagoon Cell 1), six research plots were established in 2013. Two harvest frequencies (1 versus 2 harvests per growing season) were tested to examine effectiveness of wetland bioremediation. In the wetland cell, cattail are the focal species.

- In the dryland cell (former lagoon Cell 2), four

research plots were established in 2013. Two harvest frequencies (1 and 2 harvests per growing season) were tested in 2013 to examine effectiveness of phytoremediation. Both cattail and switchgrass are focal species.

- For effective plant removal, contaminants have to be moved in the plant from belowground to aboveground parts, to allow for removal through harvest. Additional laboratory tests focused on this question.



Sampling locations for the Niverville lagoon bioremediation project (site image - Google Earth).

Preliminary results and key messages

- The optimal date of maximum plant growth of aboveground parts for cattail and switchgrass was determined. This will help to select the best day to harvest for nutrient and contaminant removal.
- Preliminary results show a general decline in mean biosolids concentration of nutrients and trace elements in the wetland cell in 2013, compared to 2011; however, this decline may be partly due to the dilution of Cell 1 biosolids with soil during construction in 2012, rather than plant uptake. Continued research in 2014 will help to follow reduction outside of construction.
- Significant changes in nutrient and trace element reduction in the dryland cell (Cell 2) were not observed in 2013; however, a decrease was not expected, as harvesting of plant material was not conducted outside of the research plots.

- Uptake of nutrients, and select trace elements, into both belowground (roots) aboveground (shoots) plant parts was observed, indicating the potential to recapture nutrients with harvest; however, cattail aboveground parts incorporated lower trace element concentrations than belowground parts.

Next Steps

A number of exciting activities related to the Niverville lagoon bioremediation project are planned for the 2014-2015 season:

- Field research will continue into its second year on the Niverville bioremediation project site.
- On site plant harvesting will commence, in order to recapture some of the nutrients and trace elements extracted on site. The opportunity to use this material as biofuel exists.
- Communications opportunities, including publications and open houses, will continue to be pursued, in order to share the success of this innovative project. Involvement of the local high school will continue to be supported.
- Next research steps, including a focus on on-site plant harvest of the bioremediation site, will be explored, including supporting funding opportunities.
- Graduate students Adenike Hassan and Nicholson Jeke are estimated to have both defended by spring 2015. Their research will support demonstration of the success of this project for on-site lagoon decommissioning using bioremediation techniques.
- Opportunities for lagoon site development for interpretive purposes will be explored, including intention to open the area for public use, incorporating site signage, pathways and area naturalization.



*Experimental harvest in the wetland cell, summer 2013
(image courtesy of N. Jeke).*

Contact

If you have any questions regarding activities of the Niverville bioremediation project, please do not hesitate to contact:

Lisette Ross

Native Plant Solutions / Ducks Unlimited Canada
Unit A, 1238 Chevrier Blvd., Winnipeg, MB R3T 1Y3
Ph: 204-953-8205; E-mail: l_ross@ducks.ca