AECOM

2018 Woody Crops International Conference
Post-Conference Field Tour
Great Lakes Restoration Initiative Landfill Phytoremediation Project
Manitowoc, WI
July 26, 2018 8:30 am


I.   Welcome (Mayor Justin Nickels, City of Manitowoc)

II. Introduction (AECOM)
   a. Forest Service staff & visitors, Conference attendees, City staff, AECOM staff
   b. Health & Safety Briefing
   c. What to Expect

III. Project Overview (AECOM)
   a. Environmental Impacts
   b. Remedial Activities

IV. Landfill Phytoremediation Project and Site Tour (USDA Forest Service)

MANITOWOC
CITY OF MANITOWOC
WISCONSIN, USA

2018 Woody Crops International Conference
Post-Conference Field Tour
Great Lakes Restoration Initiative Landfill Phytoremediation Project
Manitowoc, WI

AECOM
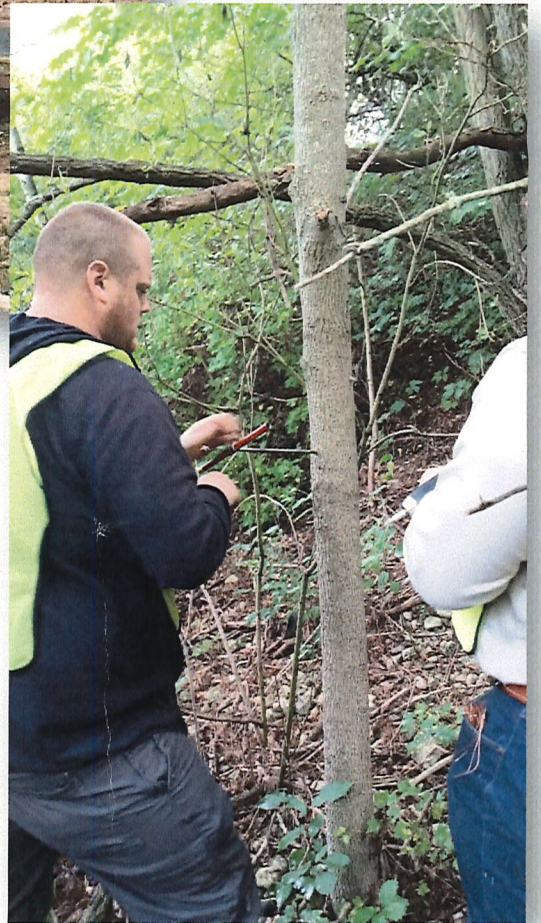
Received 7/26/18

2018 Woody Crops International Conference

July 22-27, 2018; Nicolet College; Rhinelander, Wisconsin, USA

Post-Conference Field Tour Guide

Hosted by:
Short Rotation Woody Crops Operations Working Group
Poplar and Willow Council of Canada
IUFRO Working Party 2.08.04 (Physiology and Genetics of Poplars and Willows)
IUFRO Working Party 1.03.00 (Short Rotation Forestry)
International Energy Agency Task 43 (Biomass Feedstocks for Energy Markets)
International Poplar Commission Environmental and Ecosystem Services Working Party

Many thanks to our sponsors!

AECOM

Great Lakes
RESTORATION

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Great Lakes Restoration Initiative
Action Plan II

Great Lakes RESTORATION

The Great Lakes Restoration Initiative was launched in 2010 to accelerate efforts to protect and restore the largest system of fresh surface water in the world — to provide additional resources to make progress toward the most critical long-term goals for this important ecosystem.

The Great Lakes Restoration Initiative has been a catalyst for unprecedented federal agency coordination — through the Interagency Task Force and the Regional Working Group, which are led by EPA. This coordination has produced unprecedented results. Great Lakes Restoration Initiative resources have supplemented agency base budgets to fund the cleanup actions required to delist five Great Lakes Areas of Concern and to formally delist the Presque Isle Bay Area of Concern — a major change from the 25 years before the Initiative, during which only one Area of Concern was cleaned up and delisted. Great Lakes Restoration Initiative resources have also been used to double the acreage enrolled in agricultural conservation programs in watersheds where phosphorus runoff contributes to harmful algal blooms in western Lake Erie, Saginaw Bay and Green Bay. So far, Great Lakes Restoration Initiative resources have been used to fund over 2,000 projects to improve water quality, to protect and restore native habitat and species, to prevent and control invasive species and to address other Great Lakes environmental problems.

During the next five years, federal agencies plan to continue to use Great Lakes Restoration Initiative resources to strategically target the biggest threats to the Great Lakes ecosystem and to accelerate progress toward long term goals — by combining Great Lakes Restoration Initiative resources with agency base budgets and by using these resources to work with nonfederal partners to implement protection and restoration projects. To guide this work, federal agencies have drafted GLRI Action Plan II, which summarizes the actions that federal agencies plan to implement during FY15-19 using Great Lakes Restoration Initiative funding. GLRI Action Plan II outlines the next phase of work on Great Lakes environmental problems and associated human health issues — many of which will take decades to resolve. GLRI Action Plan II lays out the necessary next steps to get us closer to the day when we will be able to achieve our long-term goals for the Great Lakes and our commitments under the U.S.-Canada Great Lakes Water Quality Agreement.

The Great Lakes Restoration Initiative is Accelerating Great Lakes Protection and Restoration

2010: GLRI Action Plan I	2014: GLRI Action Plan II	2019

Cleaning up Great Lakes Areas of Concern

Preventing and Controlling Invasive Species

Reducing Runoff that Contributes to Algal Blooms

Restoring Habitat to Protect Native Species

Science-Based Adaptive Management

GLRI Action Plan II

GLRI Action Plan II summarizes the actions that federal agencies plan to implement during FY15-19 using Great Lakes Restoration Initiative funding — actions to protect and restore the largest fresh surface water system in the world. These actions will build on restoration and protection work carried out under the first GLRI Action Plan, with a major focus on:

- Cleaning up Great Lakes Areas of Concern
- Preventing and controlling invasive species
- Reducing nutrient runoff that contributes to harmful/nuisance algal blooms
- Restoring habitat to protect native species

GLRI Action Plan II incorporates a science-based adaptive management framework that will be used to prioritize ecosystem problems to be targeted with GLRI resources, to select projects to address those problems and to assess the effectiveness of GLRI projects (see pages 28-29). Measures of Progress have been developed to track all actions implemented under GLRI Action Plan II. These Measures of Progress focus on outputs and/or outcomes that can be measured over the five year period covered by this Action Plan, rather than the longer term ecological benefits that will be produced by GLRI-funded projects and will take years to document in an ecosystem as large and complex as the Great Lakes. There are ten Measures of Progress with annual targets and other Measures of Progress that will be reported annually to track progress toward long term goals (see below) that will take more than five years to reach.

GLRI Action Plan II commits agencies to develop and incorporate climate resiliency criteria in project selection processes. Agencies will develop standard criteria to ensure climate resiliency of GLRI-funded projects (see pages 24-25).

GLRI Action Plan II includes many ideas developed during the first five years of the Great Lakes Restoration Initiative that were contributed by the Great Lakes Advisory Board, the U.S. EPA Science Advisory Board, the U.S. Government Accountability Office, the Congressional Research Service, states, tribes, municipalities and the general public. All of the federal agencies involved in the Great Lakes Restoration Initiative are grateful for these recommendations and will be actively seeking additional input as part of the science-based adaptive management cycle — as we implement and improve the Great Lakes Restoration Initiative and as we work with our many partners to protect and restore the Great Lakes.

Long Term Goals for the Great Lakes Ecosystem

Fish safe to eat

Water safe for recreation

Safe source of drinking water

All Areas of Concern delisted

Harmful/nuisance algal blooms eliminated

No new self-sustaining invasive species

Existing invasive species controlled

Native habitat protected and restored to sustain native species

FY15-19 Great Lakes Restoration Initiative Action Plan Summary*

Focus Areas	Objectives	Commitments
Toxic Substances and Areas of Concern	Remediate, restore and delist Areas of Concern	• Implement management actions necessary to remove Beneficial Use Impairments and delist Areas of Concern
	Increase knowledge about contaminants in Great Lakes fish and wildlife	• Reduce human exposure to contaminants from Great Lakes fish consumption • Identify emerging contaminants and assess impacts on Great Lakes fish and wildlife
Invasive Species	Prevent new introductions of invasive species	• Block pathways through which aquatic invasive species can be introduced to the Great Lakes ecosystem • Conduct early detection monitoring activities • Work with Great Lakes states to conduct rapid response actions or exercises
	Control established invasive species	• Implement control projects for GLRI-targeted invasive species
	Develop invasive species control technologies and refine management techniques	• Develop/enhance technologies and methods to prevent the introduction and to control the spread of invasive species • Develop/enhance invasive species specific collaboratives to support rapid responses and communicate the latest control and management techniques
Nonpoint Source Pollution Impacts on Nearshore Health	Reduce nutrient loads from agricultural watersheds	• Implement agricultural practices or other nutrient reduction practices in GLRI targeted watersheds.
	Reduce untreated runoff from urban watersheds	• Implement watershed management projects in urban areas that have adopted a watershed strategy
Habitats and Species	Protect, restore and enhance habitats to help sustain healthy populations of native species	• Remove or bypass barriers on Great Lakes tributaries to facilitate fish passage • Protect, restore and enhance Great Lakes coastal wetlands • Protect, restore and enhance GLRI-targeted habitats in the Great Lakes basin
	Maintain, restore and enhance populations of native species	• Promote the recovery of priority federally-listed endangered, threatened and candidate species • Promote self-sustaining populations of GLRI-targeted native non-threatened and non-endangered species
Foundations for Future Restoration Actions	Ensure climate resiliency of GLRI-funded projects	• Develop and incorporate climate resiliency criteria in project selection processes
	Educate the next generation about the Great Lakes ecosystem	• Promote Great Lakes-based ecosystem education and stewardship, with a focus on educator training
	Implement a science-based adaptive management approach for GLRI	• Evaluate the effectiveness of GLRI-funded projects • Assess the overall health of the Great Lakes ecosystem and identify the most significant remaining problems • Identify watersheds, habitats, and species to be targeted by the GLRI • Report on GLRI progress and Great Lakes ecosystem health

Objectives and targets in this plan may be adjusted annually based on appropriations and performance.

Measures of Progress**

- Areas of Concern where all management actions necessary for delisting have been implemented
- Area of Concern Beneficial Use Impairments Removed

- Number of people provided information on the risks and benefits of Great Lakes fish consumption by GLRI-funded projects
- Number of GLRI-funded projects that identify and/or assess impacts of emerging contaminants on Great Lakes fish and wildlife

- Number of GLRI-funded projects that block pathways through which aquatic invasive species can be introduced to the Great Lakes ecosystem
- Number of GLRI-funded early detection monitoring activities conducted
- Number of GLRI-funded Great Lakes rapid responses or exercises conducted

- Number of acres controlled by GLRI-funded projects
- Number of tributary miles protected by GLRI-funded projects

- Number of technologies and methods field tested by GLRI-funded projects
- Number of collaboratives developed/enhanced with GLRI funding

- Number of GLRI-funded nutrient and sediment reduction projects in targeted watersheds (measured in acres)
- Projected phosphorus reductions from GLRI-funded projects in targeted watersheds (measured in pounds)
- Measured nutrient and sediment reductions from monitored GLRI-funded projects in targeted watersheds (measured in pounds)

- Number of GLRI-funded projects implemented to reduce the impacts of untreated urban runoff on the Great Lakes
- Projected volume of untreated urban runoff captured or treated by GLRI-funded projects
- Measured volume of untreated urban runoff captured or treated by monitored GLRI-funded projects

- Number of miles of Great Lakes tributaries reopened by GLRI-funded projects
- Number of miles of Great Lakes shoreline and riparian corridors protected, restored and enhanced by GLRI-funded projects
- Number of acres of Great Lakes coastal wetlands protected, restored and enhanced by GLRI-funded projects
- Number of acres of other habitats in the Great Lakes basin protected, restored and enhanced by GLRI-funded projects

- Number of GLRI-funded projects that promote recovery of federally-listed endangered, threatened, and candidate species
- Number of GLRI-funded projects that promote populations of native non-threatened and non-endangered species self-sustaining in the wild

- By 2016, a standardized set of climate resiliency criteria will be developed for GLRI-projects
- Starting in 2017, projects will include climate resiliency criteria in planning and implementation

- Number of educators trained through GLRI-funded projects
- Number of people educated on the Great Lakes ecosystem through GLRI-funded place-based experiential learning activities

- Project evaluations completed and used to prioritize GLRI funding decisions each year
- Annual Great Lakes monitoring conducted and used to prioritize GLRI funding decisions each year
- GLRI-targeted watersheds, habitats and species identified and used to prioritize GLRI funding decisions
- Issue annual GLRI Reports to Congress and the President
- Issue Great Lakes Water Quality Agreement Triennial Progress Reports of the Parties
- Issue triennial State of the Lakes reports
- Periodically update publicly available online information about the GLRI

**Most GLRI Action Plan II Measures of Progress track outputs and/or outcomes produced solely by GLRI-funded projects. AOC-related measures track results produced using GLRI funding and, in some cases, using other sources of funding, as well. Many GLRI-funded projects supplement other Great Lakes restoration activities that are funded by agency base budgets and are reported independently by agencies. Action Plan II Measures of Progress include: several Action Plan I Measures of Progress; several Action Plan I Measures of Progress that have been modified to accurately track actions funded by GLRI; and a number of new Measures of Progress.

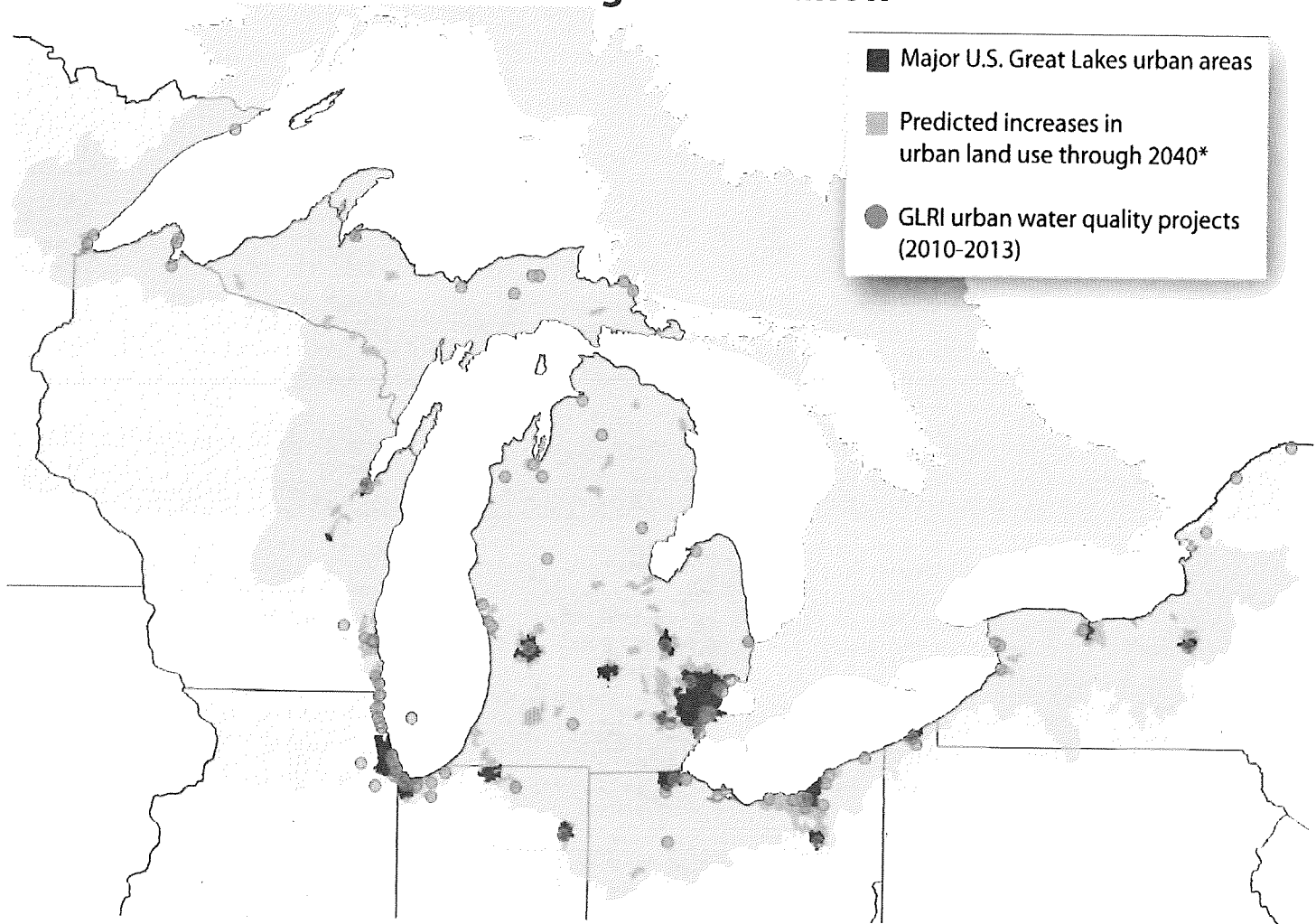# Nonpoint Source Pollution Impacts on Nearshore Health

Objective

Reduce untreated runoff from urban watersheds

Commitment

• Implement watershed management projects in urban areas that have adopted a watershed strategy

Reducing Urban Runoff

Legend:
- Major U.S. Great Lakes urban areas
- Predicted increases in urban land use through 2040*
- GLRI urban water quality projects (2010-2013)

GLRI Action Plan I projects in urban areas reduced polluted runoff to Great Lakes tributaries and nearshore waters. GLRI Action Plan II projects implemented under this prinicipal initiative will focus on major urban areas and on areas where urbanization is expected to increase in the near future.

During the first five years of the Great Lakes Restoration Initiative, federal agencies and their partners implemented projects in urban areas to reduce sediment, nutrient, toxic contaminant and pathogen loadings to Great Lakes tributaries and nearshore waters. The GLRI funded green infrastructure projects in Great Lakes shoreline cities to reduce untreated stormwater runoff and to improve nearshore water quality. These green infrastructure projects reduce flooding, increase greenspace in urban areas and return vacant properties to productive use. Watershed management projects were also implemented to stabilize stream banks, increase forest cover, restore wetlands and improve water quality at beaches in urban areas.

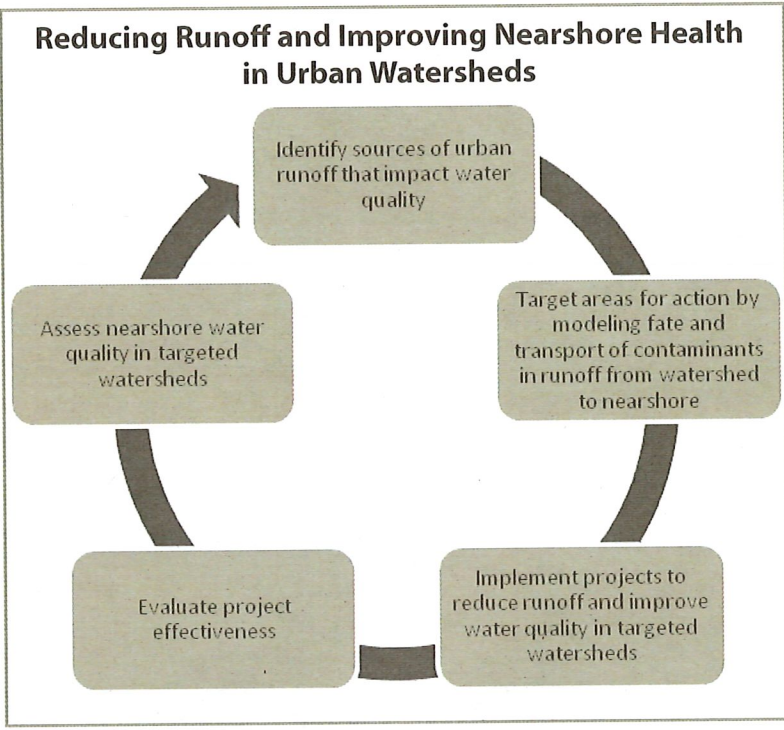*Urban land use predictions generated through the USGS Climate Change Impacts Program and provided by Dr. Bryan C. Pijanowski, Purdue University (http://ltm.agriculture.purdue.edu/)*

Great Lakes Restoration Initiative Action Plan II

Measure of Progress with Annual Targets	Baseline/ Universe	2015 Target	2016 Target	2017 Target	2018 Target	2019 Target
• Projected volume of untreated urban runoff captured or treated by GLRI-funded projects (measured in millions of gallons)	Baseline: 0 Universe: N/A	30	70	120	185	250

Additional Measures of Progress

• Number of GLRI-funded projects implemented to reduce the impacts of untreated urban runoff on the Great Lakes
• Measured volume of untreated urban runoff captured or treated by monitored GLRI-funded projects

Under GLRI Action Plan II, federal agencies and their partners will continue to implement watershed management and green infrastructure projects to reduce the impacts of polluted urban runoff on nearshore water quality at beaches and in other coastal areas. These projects will capture or slow the flow of untreated runoff and filter out sediment, nutrients, toxic contaminants, pathogens and other pollutants prior to entering Great Lakes tributaries and nearshore waters.

Federal agencies and their partners will build green infrastructure, install tributary buffers, restore coastal wetlands, and re-vegetate and re-forest areas near Great Lakes coasts and tributaries.

These and other actions to reduce untreated runoff will be implemented in urban areas that have adopted watershed management strategies. Urban runoff reduction projects will be evaluated to determine their effectiveness. This information along with the assessment of water quality will be used to target future actions.

Reducing Runoff and Improving Nearshore Health in Urban Watersheds

Identify sources of urban runoff that impact water quality

Target areas for action by modeling fate and transport of contaminants in runoff from watershed to nearshore

Implement projects to reduce runoff and improve water quality in targeted watersheds

Evaluate project effectiveness

Assess nearshore water quality in targeted watersheds

Green Infrastructure Captures and Filters Urban Runoff

Bioswale planter

Pervious parking lane and bike lane with detention area for up to 2 year storm event using recycled content

Image courtesy of Chicago Department of Transportation

Great Lakes Interagency Task Force

Great Lakes RESTORATION

Science Brief for Resource Managers

Enhancing Nearshore Health in the Great Lakes Basin

Increasing human population growth and associated industrial development in the last 50 years have greatly impacted water quality in the Great Lakes and their watersheds. Closed landfills, dumps, and similar sites contribute to nonpoint source pollution of nearshore health, especially given potential impacts of their runoff and leakage. Short rotation woody crops such as poplars and willows are ideal for phytoremediation (i.e., the direct use of plants to clean up contaminated soil, sediment, sludge, or groundwater) because they grow quickly, have extensive root systems and hydraulic control potential, all of which serve as biological systems that remediate such pollution. Forest Service researchers have developed *phyto-recurrent selection*, a tool for choosing generalist plant varieties that remediate a broad range of contaminants, or specialist plants that are matched to specific pollutants. The ability to select varieties across contaminants allows for broad applicability of these phytoremediation systems.

While the science of phytoremediation has undergone rapid growth in the last two decades, there is some uncertainty about the efficacy of using existing forests to remediate liability sites. However, the recent development and patenting of *phytoforensic* technologies helps to use plants as not only remediation, but also as site delineation for non-point source pollutants and as monitoring tools of remediation. Phytoforensics is the use of plant sampling as a way to detect and quantify pollutants in the environment around the plants.

In this project, phytoremediation buffer systems are being developed to reduce untreated runoff from sites in the Great Lakes Basin and, ultimately, to mitigate nonpoint source pollution impacts on nearshore health.

Management Implications

- This project reduces uncertainty about the efficacy of using trees to remediate landfills, dumps, and similar sites.
- The volume of untreated urban runoff captured or treated at the installations will be projected and measured.
- Potential landfill leachate leakage plumes will be delineated and phytoremediation potential assessed.
- Health assessments of mature and planted trees will be conducted to evaluate methods for reducing runoff before it reaches Lakes Michigan and Superior.
- Superior poplar and willow varieties have been tested and matched to soils and climate at fifteen landfills in Wisconsin and Michigan.
- These poplar and willow phyto-buffers are being established to: improve water quality, stabilize stream banks, increase forest cover, and restore ecosystems.
- A "green tool" integrating existing vegetation with phyto buffers is being developed to provide site managers with a biological treatment option.

Point of Contact

Ronald S. Zalesny Jr.
Supervisory Research Plant Geneticist
USDA Forest Service
Northern Research Station
Institute for Applied Ecosystem Studies
5985 Highway K
Rhinelander, WI
rzalesny@fs.fed.us
(715) 362-1132
http://www.nrs.fs.fed.us/people/Zalesny

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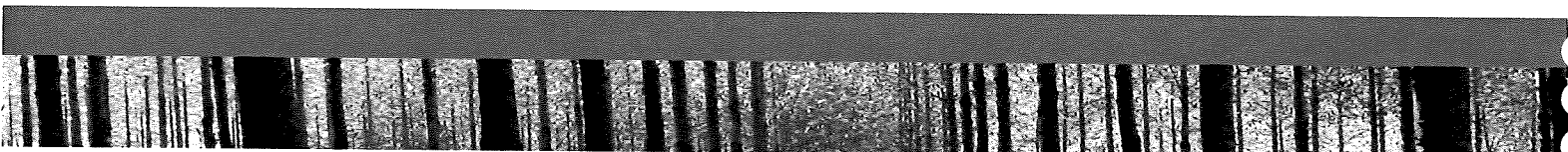
2018 Woody Crops International Conference

Nicolet College

Rhinelander, Wisconsin, USA

July 22-27, 2018

2018

WOODY CROPS

INTERNATIONAL CONFERENCE

RHINELANDER, WI, USA

2018 Woody Crops International Conference

A Joint Meeting of the:

Short Rotation Woody Crops Operations Working Group

Poplar and Willow Council of Canada

IUFRO Working Party 2.08.04 (Physiology and Genetics of Poplars and Willows)

IUFRO Working Party 1.03.00 (Short Rotation Forestry)

IEA Task 43 (Biomass Feedstocks for Energy Markets)

IPC Environmental and Ecosystem Services Working Party

Short Rotation Woody Crops Operations Working Group

POPLARS & WILLOWS CANADA PEUPLIERS & SAULES

Poplar and Willow Council of Canada
Conseil canadien des peupliers et des saules

IUFRO)) Short Rotation Forestry 1.03.00

IUFRO)) Poplar and Willow Genetics 2.08.04

IEA Bioenergy
Task 43

IPC INTERNATIONAL POPLAR COMMISSION
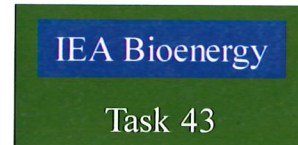
Contents

Welcome from the Conference Chairs

We are pleased to present the proceedings of the 2018 Woody Crops International Conference held throughout Minnesota and Wisconsin, USA during July 22-27, 2018. In particular, the event consisted of an optional pre-conference tour showcasing poplar tree improvement in Minnesota, USA held July 22-23, 2018, a technical program showcasing state-of-the-art techno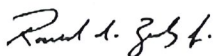logies held 23-25, 2018 in Rhinelander, Wisconsin, USA, and an optional post-conference tour highlighting phytotechnologies in Wisconsin, USA held July 25-27, 2018.
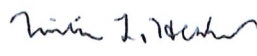
Historically, international efforts for the development of short rotation woody crops (SRWCs) focused on the production of biomass for bioenergy, biofuels, and bioproducts, while research and deployment over the past decade has expanded to include broader objectives of achieving multiple ecosystem services. In particular, silvicultural prescriptions developed for SRWCs have been refined to include woody crop production systems for environmental benefits such as carbon sequestration, water quality and quantity, and soil health. In addition, current systems have been expanded beyond traditional fiber production to other environmental technologies that incorporate SRWCs as vital components for phytotechnologies (e.g., phytoremediation), urban afforestation, ecological restoration, and mine reclamation.

To address the need for such information, our conference goal was to unite six of the world's leading SRWC organizations to enhance information exchange and provide a platform for developing future collaboration around SRWC production systems. We hope these efforts will enhance future discussions among scientists, academicians, regulators, and the general public. We encourage you to contact conference participants and presenters to initiate such conversations.

We are grateful to the professional and efficient international team of conference organizers who helped to make this conference possible. In addition, we thank our sponsors for supporting these efforts. Erik Schilling, Tracy Stubbs, and Tammerah Garren from NCASI deserve special recognition for their unwavering commitment to conference planning, along with Tammy Booth who developed our logo. Likewise, we thank Bernie McMahon for developing a world-class pre-conference tour and Emile Gardiner for selflessly leading efforts for abstract reviews. Also, we are grateful to Judy Heikkinen, Chad Lashua, and Hakim Salaam for assistance with hosting the conference at Nicolet College. Lastly, we thank the presenters and participants for contributing to the networking and technology transfer during the field tours and technical sessions.

Ronald S. Zalesny Jr.
USDA Forest Service,
Northern Research Station
rzalesny@fs.fed.us

William L. Headlee
University of Arkansas
at Monticello
headlee@uamont.edu

Raju Soolanayakanahally
Agriculture and Agri-Food
Canada
raju.soolanayakanahally@agr.gc.ca

Jim Richardson
Poplar and Willow
Council of Canada
jrichardson@on.aibn.com

Conference Organizers

Chairs

Bill Headlee	University of Arkansas at Monticello
Jim Richardson	Poplar and Willow Council of Canada
Raju Soolanayakanahally	Agriculture and Agri-Food Canada
Ron Zalesny	USDA Forest Service, Northern Research Station

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Solomon Ghezehei	North Carolina State University
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Dana Mitchell	USDA Forest Service, Southern Research Station
Tim Rials	University of Tennessee
Randy Rousseau	Mississippi State University
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Brian Stanton	GreenWood Resources
Bryce Stokes	Navarro Engineering
Tim Volk	State University of New York, College of Environmental Science & Forestry (ESF)

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Solomon Ghezehei	North Carolina State University
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Jim Richardson	Poplar and Willow Council of Canada
Raju Soolanayakanahally	Agriculture and Agri-Food Canada
Brian Stanton	GreenWood Resources
Ron Zalesny	USDA Forest Service, Northern Research Station

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Brent DeBauche	Missouri University of Science and Technology
Pedro Munoz	Technical University of Madrid
Liz Rogers	USDA Forest Service, Northern Research Station
Adam Wiese	USDA Forest Service, Northern Research Station
Ron Zalesny	USDA Forest Service, Northern Research Station

Resource Coordinators

Brent DeBauche	Missouri University of Science and Technology
Amanda Foust	University of Arkansas at Monticello
Pedro Munoz	Technical University of Madrid
Liz Rogers	USDA Forest Service, Northern Research Station

Registration and Finances

Tammerah Garren	National Council for Air and Stream Improvement (NCASI)
Erik Schilling	National Council for Air and Stream Improvement (NCASI)
Tracy Stubbs	National Council for Air and Stream Improvement (NCASI)

Field Tours

Ed Bauer	USDA Forest Service, Northern Research Station
Larry Buechel	Waste Management of Wisconsin, Inc.
Brent DeBauche	Missouri University of Science and Technology
Karen Dorow	City of Manitowoc, Wisconsin
Rich Hallett	USDA Forest Service, Northern Research Station
Dave Henderson	AECOM
Bernie McMahon	University of Minnesota – Natural Resources Research Institute
Ted O'Connell	TRC
Mike Peterson	Waste Management of Wisconsin, Inc.
John Rice	TRC
Liz Rogers	USDA Forest Service, Northern Research Station
Erik Schilling	National Council for Air and Stream Improvement (NCASI)
Ray Seegers	Waste Management of Wisconsin, Inc.
Bart Sexton	Sand Creek Consultants
Ron Zalesny	USDA Forest Service, Northern Research Station

2018 Woody Crops International Conference

Great Lakes Restoration Initiative

2018 Woody Crops International Conference

Stop 3: Manitowoc

Great Lakes Restoration Initiative Phyto Buffer Project

City of Manitowoc Gravel Pit
Manitowoc, WI

Objectives
- Runoff Reduction
- Phytoremediation
- Phytovolatilization

Objectives
- Runoff Reduction
- Phytoremediation
- Phytovolatilization
- Stormwater Management

Types of Plantings
- Phyto-Recurrent Selection
- Yield Blocks
- Demonstration

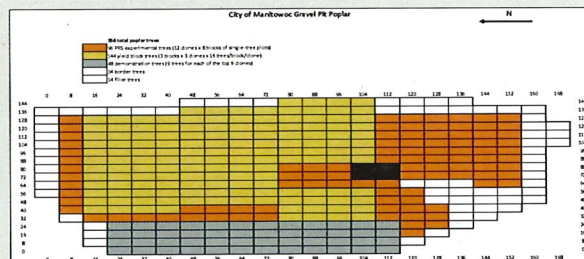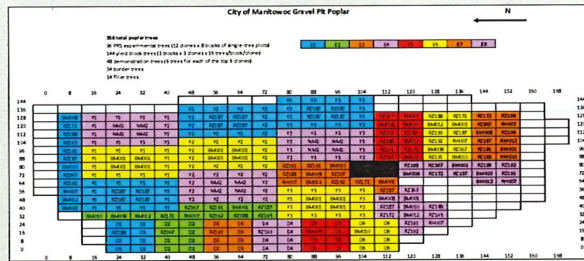**Types of Plantings**
- Phyto-Recurrent Selection
- Yield Blocks
- Demonstration

Number of Trees
- 348 Poplar (est. 2018)

Number of Trees
- 2,748 Willow (est. 2018)

City of Manitowoc Gravel Pit Poplar

City of Manitowoc Gravel Pit Poplar

City of Manitowoc Gravel Pit Poplar

N ←

356 total poplar trees
96 PRS experimental trees (12 clones x 8 blocks of single-tree plots)
144 yield block trees (3 blocks x 3 clones x 16 trees/block/clone)
48 demonstration trees (9 trees for each of the top 6 clones)
54 border trees
14 filler trees

Legend: | E1 | E2 | E3 | E4 | E5 | E6 | E7 | E8 |

Y \ X	0	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144	152
144											Y3	Y3	Y3	Y3						
136							Y2	Y2	Y2	Y2	Y3	RZ187	RZ187	Y3						
128	BM008	Y1	Y1	Y1	Y1		Y2	RZ187	RZ187	Y2	Y3	RZ187	RZ187	Y3	RZ367	RH007	RZ188	RZ172	RZ172	RZ188
120	RZ172	Y1	NM2	NM2	Y1		Y2	RZ187	RZ187	Y2	Y3	Y3	Y3	Y3	BM008	BM010	BM012	BM001	RZ367	RH007
112	RZ188	Y1	NM2	NM2	Y1		Y2	Y2	Y2	Y2	Y3	Y3	Y3	Y3	RZ192	RZ187	RZ193	RZ187	BM008	RZ193
104	RZ193	Y1	Y1	Y1	Y1		Y2	Y2	Y2	Y2	Y3	NM2	NM2	Y3	RZ188	BM012	RZ192	RH007	RZ187	BM012
96	RZ191	Y1	Y1	Y1	Y1		Y2	BM001	BM001	Y2	Y3	NM2	NM2	Y3	RZ191	RZ172	BM008	RZ367	RZ191	BM001
88	RZ187	Y1	BM001	BM001	Y1		Y2	BM001	BM001	Y2	Y3	Y3	Y3	Y3	RZ193	BM001	RZ191	BM010	RZ192	BM010
80	BM010	Y1	BM001	BM001	Y1		Y2	Y2	Y2	Y2	RZ191	RZ193	BM010	[black]	RZ193	RZ367	BM001	RZ188	RZ192	
72	RZ367	Y1	Y1	Y1	Y1		Y2	Y2	Y2	Y2	RZ188	BM008	RZ367	[black]	BM008	RZ172	RZ187	BM010	RZ191	
64	RZ192	Y1	Y1	Y1	Y1		Y2	NM2	NM2	Y2	RH007	BM012	RZ192	RZ172	BM001				BM012	RH007
56	RH007	Y1	RZ187	RZ187	Y1		Y2	NM2	NM2	Y2	Y3	Y3	Y3	Y3	RZ187	RZ367				
48	BM012	Y1	RZ187	RZ187	Y1		Y2	Y2	Y2	Y2	Y3	BM001	BM001	Y3	BM008	BM001				
40	BM001	Y1	Y1	Y1	Y1		RZ367	RZ191	BM001	RZ187	Y3	BM001	BM001	Y3	RZ187	BM010	RZ188			
32			BM010	BM008	BM012	RZ172	RH007	RZ192	RZ188	RZ193	Y3	Y3	Y3	Y3	RZ172	BM012	RZ193			
24				D1	D1	D2	D2	D3	D3	D4	D4	D5	D5	D6	D6	RZ191	RH007			
16				RZ188	D1	RZ367	D2	RZ191	D3	RZ193	D4	BM008	D5	BM010	D6	RZ192				
8				D1	D1	D2	D2	D3	D3	D4	D4	D5	D5	D6	D6					
0				D1	D1	D2	D2	D3	D3	D4	D4	D5	D5	D6	D6					