

**A PROJECT PROPOSAL TO DEMONSTRATE AND EVALUATE  
NONMETALLIC RECLAMATION USING TEST PLOT TRIALS  
AT REPRESENTATIVE SITES IN CHIPPEWA COUNTY, WISCONSIN**

**Introduction**

The natural resource base of western Wisconsin supports a diverse mix of productive working lands. These working lands provide the foundation of a balanced economy.

At present, the land is managed to support a number of resource-based industries, including agriculture, forestry, nonmetallic mining, and tourism.

The individual producers who contribute to these industries are responsible for applying conservation measures that assure that the land base is adequately managed to sustain production. In circumstances where the land is mined, it is the responsibility of the landowner and mine operator to assure that a mine site is reclaimed to a productive post-mining land use.

Nonmetallic mining and processing are important sectors of the regional economy.

In glaciated areas of the region, most nonmetallic mining has been conducted to extract sand and gravel aggregate from glacial outwash deposits. This material is used locally to produce concrete and aggregate products critical to infrastructure development and maintenance.

In recent years, there has been a newfound demand for industrial sand in the region. This demand has resulted in the development of a growing number of industrial sand mines that are being operated to extract sand and sandstone from geologic deposits associated with the Jordan and Wonoewoc formations, common to western Wisconsin. Much of this industrial sand is now being exported from the region as “frac sand” to be used in the hydraulic fracturing process, as now applied in oil and natural gas production.

Wis. Stat., Chapter 295, and Administrative Code NR 135, establish the legal framework and requirements for nonmetallic mine reclamation in Wisconsin. Under the state’s regulatory approach, mine operators are required to reclaim mine sites to state standards, and are encouraged to use a process of “contemporaneous reclamation” whereby mined areas are systematically planned and reclaimed as part of ongoing operations.

To meet state requirements for mine reclamation, the Chippewa County Department of Land Conservation & Forest Management (LCFM) administers a county nonmetallic mine reclamation ordinance and associated mine reclamation program.

At present, there are currently eighty-three (83) nonmetallic mines permitted under this ordinance. Of these, seventy-three (73) are sand and gravel operations and ten (10) are industrial sand mine operations. A map showing the location of these nonmetallic mines is provided as Figure 1.

Recent expansion of the aggregate and industrial sand industries in Chippewa County has resulted in a growing number of surface mined areas that are permitted, disturbed, and not yet reclaimed. At present, there are now approximately 5,200 acres that have been permitted for mining, with approximately 1,770 acres currently disturbed and subject to reclamation.

The rate at which mine reclamation occurs is unique to each mine site and is directly related to product demand and the rate of mine operations.

Since the onset of the Chippewa County reclamation ordinance in 2001, approximately 285 acres have been reclaimed and certified as meeting state reclamation standards, with five (5) mine sites having been fully reclaimed and released from the permit requirements of the ordinance.

A graph showing the number of nonmetallic mine acres that have been permitted in comparison to the number of mine acres that have been disturbed and reclaimed over time is provided as Figure 2.

To meet the growing need for mine reclamation, this project initiative has been developed to demonstrate reclamation procedures and treatments that can be used by mine operators to achieve the proposed post- mining land use(s) that have been planned for individual mine sites.

Under the project approach, a number of reclamation test plots with customized treatments will be designed, implemented, and evaluated at representative mine sites.

Recognizing the scientific and technical challenges associated with land reclamation, this project is being advanced as a multi-year effort between the Chippewa County Dept. of Land Conservation & Forest Management (LCFM), the UW-River Falls, the UW Nutrient and Pest Management Program (NPM), and participating mining companies.

The general roles and responsibilities of the project participants during the test plot planning and implementation phases of the project are outlined in Figure 3.

## **Objectives**

This project has been developed to systematically demonstrate and evaluate methods that can be used to reclaim surface mined lands.

Through it's implementation, the project will serve as a catalyst to accelerate the rate of reclamation in Chippewa County. It will also allow the project participants to determine the type, extent, and quality of reclamation that can actually be achieved.

The technical and scientific objectives of this project are to:

1. Record the existing physical and biological characteristics of unmined soils at representative mine sites, as needed to assess the biodiversity, soil health, site functions, and land use capabilities before mining begins.
2. Document the best management practices that are used by mine operators to re-establish post mine contours and to reapply soil materials as part of contemptuous reclamation.
3. Using soil test plots, evaluate the benefits of soil amendments and biological conditioning, as used to reestablish soil properties, site functions, and site capabilities.
4. Using soil test plots, record and monitor the changes in test plot vegetation and soil properties and functions as a measure of reclamation success and performance.

5. Systematically compile, interpret, and summarize test plot results and disseminate this information to project stakeholders, public agencies, and the general public to advance mine reclamation efforts.

In pursuing the scientific aspects of the project, the research design will focus on soil physical properties and functions, including soil infiltration, soil pore water interactions, soil chemistry and fertility, and soil health and biologic diversity.

To characterize the success of site reclamation, the research effort will be applied to evaluate plant species suitability and diversity, plant growth and root development, vegetative succession, and weed and pest pressure.

For wooded mine sites with shallow soils that have not been cropped, initial research efforts will focus on the potential of reclaiming sites to permanent forest cover or other wildlife habitat, or to a condition that will support and sustain grass-based forage production, pasture-based grazing systems, or the sustainable growth of biomass for energy production.

For agricultural mine sites with deeper soils that have been previously cropped, research efforts will focus on the potential of reclaiming sites to sustainable forage or row crop based cropping systems.

### **Project Outline & Timeframe**

The project objectives will be met by completing eight (8) tasks. These tasks fall within two (2) project components which will proceed in parallel over the course of the project.

#### **Technical Investigation and Monitoring Component:**

1. Pre-Mine Soil Benchmarking.
2. Reclamation Test Plot and Treatment Design.
3. Test Plot Establishment.
4. Test Plot Monitoring and Data Collection.
5. Data Compilation and Comparative Results Analysis.

#### **Public Outreach and Reporting Component:**

1. Fact sheet development.
2. Stakeholder meetings.
3. Reporting and public presentations.

These project tasks will be performed over a five (5) year project period extending from January 1, 2014, through January 1, 2019.

## **Project Participation, Management & Oversight**

This project will be administered by the Chippewa County Dept. of Land Conservation & Forest Management (LCFM), and will be managed as a contributing component of the County's nonmetallic mine reclamation program.

To meet project objectives, major mining companies will be invited to participate by sponsoring test plot sites on a voluntary basis. All test plot sponsors will be asked to share general information and test plot data for the purpose of advancing the general objectives of the project.

Technical and outreach components of the project will be conducted under service contracts developed between Chippewa County, the UWRF Dept. of Plant and Soil Science, and the University of Wisconsin, Nutrient and Pest Management Program.

Project oversight and coordination will be provided through use of a Project Stakeholders Group (P.S.G.) composed of project stakeholders. Members will include state and county agency representatives, university researchers, and participating mine operators and landowners.

An outline of the stakeholders group charge and scope of responsibility is provided as Appendix A.

## **Project Financing, Budget, and Fiscal Accountability**

The project will be financed using a combination of public and private funding sources, including County tax levy, nonmetallic mine fee fund balances, state and federal research grants, and public and corporate donations.

A core five (5) year project budget has been prepared to itemize the general project costs and anticipated revenues. This multi-year project budget is provided as Appendix B. This core project budget may be expanded contingent upon interest by the participating parties, and upon the availability of additional funding.

An annual project operating budget will be prepared by the LCFM, working in association with UWRF researchers. This annual budget will be structured to account for the planned expenditures that may be incurred under each of the two (2) designated project components, and the revenues that will be used to offset those expenditures.

This annual budget will be updated annually through the County budget process and will be subject to an annual state audit, commissioned by Chippewa County following standard accounting procedures.

Reimbursement for technical services, provided through service contracts, will occur routinely throughout the period of the project using a method and schedule specified in the service contract.

## **Project Performance, Tracking, and Accountability**

A table of planned activities has been developed and will be used to schedule project tasks and guide project workflow at multiple sites. This table is provided as Appendix C.

It is recognized that the actual rate and schedule of project implementation will depend largely upon the availability of reclamation sites, as sponsored by the participating mine operators.

To assure accountability and provide opportunity for refinement, the project will be evaluated annually. Project performance will be systematically measured using the project schedule and timely completion of product deliverables.

An annual project report will be prepared by the LCFM using information and product deliverables provided by UWRP. This annual report will be used to outline the status of planned activities, present product deliverables, and summarize preliminary findings and experiences that may be of benefit to project participants.

A benchmark evaluation of project performance will be conducted by the LCFM at the end of Year 3. This evaluation will be conducted to assess the need for continued research and monitoring that may extend beyond the initial five (5) year project period. The outcome of this evaluation will be summarized in a mid-term project report to be prepared by the LCFM.

## **Project Tasks, Schedule, and Deliverables**

### **Component 1 – Technical Investigation and Monitoring**

#### **Task 1 – Pre-Mine Soil Benchmarking**

Site specific soils and vegetative data will be collected at each participating mine site using control plots or transects to characterize the land use, physical properties, site functions, and site productivity that exist at each site under existing (pre-mining) conditions.

This data will provide the benchmark control that will be used to compare similar data generated using reclamation test plots to be established at each mine site.

The control plot data will be initially collected using a combination of soil test pits and vegetative transects. Control plots will be monitored periodically through the course of the project to provide an ongoing benchmark for comparison.

A general description of the methods to be used and the parameters to be sampled in conducting the pre-mine soil benchmark are provided in Attachment D.

This methodology will be further defined and documented during Year 1 of the project, as the characteristics of benchmark sites are actually evaluated and measured.

This methodology will then be applied uniformly to characterize the baseline conditions of all mine sites that may subsequently participate in the project.

#### **Deliverables:**

Data from each control plot or transect will be compiled in a standardized format shortly after data collection.

The collected data and an associated interpretation of site characteristics, functions, capabilities, and limitations for each control site will be compiled in an individual site report.

#### **Timeframe:**

It is anticipated that the data collection component of this phase will be conducted for all participating mines during the spring and summer months of Project Years 1 and 2.

Individual site reports will be prepared as the soil benchmark site studies are completed. These site reports will be submitted annually, as they are completed, as contributing components of the annual project performance report.

### **Task 2 – Reclamation Test Plot and Treatment Design**

Reclamation test plots will be planned, established, and monitored to evaluate post mining soil treatments conducted to achieve the unique mine reclamation objectives and target post-mining land use as planned at each mine site.

Test plot treatments will focus on:

- A. The use of vegetative bio-conditioning conducted to alleviate compaction and to re-establish soil physical properties and functions.
- B. The potential need for, and benefits of, soil amendments to improve soil conditions. At a minimum, soil amendments to be evaluated shall include processing fines from mine wash plant operations, forestry or wood processing residues or bi-products, and materials that may be available from local agricultural operations, including manure, hay, and stover.
- C. The physical characteristics and capabilities of reclaimed sites, with a focus on plant species suitability, rate of plant growth, vegetative succession, and weed and insect pest management.

#### **Deliverables:**

A detailed test plot design outline will be prepared for each test plot trial site. The design outline will include a test plot graphic showing the location of the test plot, the anticipated restored land contours, the layout of planned plantings and treatments, and any proposed site transects, sampling points, and instrumentation to be used in site monitoring.

The design outline will also include a corresponding test plot summary that describes the purpose of the test plot as well as the methods and materials to be used to establish and collect data from the plot site. The outline will also include a recommended budget, timetable, hourly staffing allocation, and activity schedule to establish the test plot.

#### **Timeframe:**

It is anticipated that the reclamation test plot and treatment designs will be completed for all participating mines during Project Years 1, 2, and 3 in preparation for test plot establishment and instrumentation.

### **Task 3 – Test Plot Establishment**

Reclamation test lots will be established and instrumented by implementing the individual test plot and treatment design(s) that have been prepared for each participating mine site.

#### **Deliverables:**

An “as built” test plot drawing and air photo site map will be prepared for each test plot. This “as built” drawing and site map will be drawn to scale and will be prepared on an airphoto backdrop. The site map will show the location, contour elevation, and layout of the test plot and associated treatments, as planted and instrumented. The drawing and site map shall be provided in a digital format and shall be supported by survey grade GPS coordinates that delineate the boundaries of each test plot and test plot treatment.

A test plot implementation plan treatment summary will be prepared for each site. The test plot treatment summary shall describe the purpose of the test plot, the methods and materials used to establish the test plot treatments, and the baseline soil conditions and properties at the time the test plot is established.

The summary shall also describe the purpose and type of any site instrumentation installed, and the methodology and schedule to be used in site monitoring and data collection.

*Timeframe:*

It is anticipated that test plots will be established and instrumented during Qt. 1 and Qt. 2, Project Years 1, 2 and 3.

The rate and schedule of test plot establishment will be dependent upon the availability of test plot sites. Test plot sites will be established as soon as possible at each participating mine upon completion of final rough grading and re-application of stockpiled overburden and soil materials.

**Task 4 – Test Plot Data Collection**

Test plot data will be systematically collected and recorded using the methodology prescribed in the test plot implementation plan and treatment summary.

*Deliverables:*

Individual data sets or data set summaries will be compiled for each test plot in a format to be determined by the researcher. These data set summaries will be prepared annually and will be submitted as a contributing component of the annual project performance report.

*Timeframe:*

It is anticipated that the data from each established test plot will be collected commencing the year the test plot is established.

Data will be collected continuously during each subsequent growing season using the methods and schedule for data collection outlined in the test plot design and treatment summary.

**Task 5 – Data Compilation and Comparative Results Analysis**

Data from each test plot and associated benchmarking control sites will be compiled and evaluated annually.

A comparative analysis will be conducted once every two (2) years at each site to evaluate changes in site conditions, as measured and documented between the benchmark control sites and the reclamation test plot sites at each participating mine.

*Deliverables:*

A reclamation site conditions report will be prepared for each test plot site. The conditions report will summarize the purpose, methods, and preliminary results of each test plot and test plot treatment conducted at each participating mine.

These comparative site conditions reports will be prepared and delivered for each mine site at the completion of the second and fifth years of site monitoring and data collection.

*Timeframe:*

**Component 2 – Public Outreach and Reporting**

**Task 1 – Fact Sheet Development**

A four (4) page fact sheet will be developed by the UWRF to describe and explain the project to project stakeholders and the general public.

The fact sheet will provide an overview of the purpose of the project and will explain the methods to be used to accomplish the technical investigation and the public outreach components of the project.

The fact sheet will be posted on the Chippewa County and UWRF websites, and will be used through the course of the project.

**Deliverables:**

A digital (pdf) copy of the fact sheet will be prepared and provided to support electronic distribution and the creation of hard copies.

**Timeframe:**

It is anticipated that the fact sheet will be developed during Qt. 2 and Qt. 3 of project Year 1.

**Task 2 – Stakeholder Meetings**

A series of project stakeholders meetings will be held to introduce the project, disseminate results, and solicit feedback from project participants.

**Deliverables:**

A project orientation meeting will be planned by the LCFM and UWRF to introduce the project to participating mine operators, public agencies, and elected officials.

An annual project stakeholders meeting will be held each year during the project. The annual project stakeholders meeting will be used to present information and reports generated through the project and to gain feedback to be used to adjust and refine the project.

**Timeframe:**

The project orientation meeting will be planned and conducted at the onset of the project to introduce the project to interested mine operators, public agencies, and elected officials. This meeting will be scheduled during Qtr. 3 or Qtr. 4 of Project Year 1.

An annual project stakeholders meeting will be held each year during the project. This annual meeting will be used to present information and reports generated through the project and to gain feedback to be used to adjust and refine the project.

These annual project stakeholders meetings will be scheduled during Qtr. 1 or Qtr. 2 of each year.

### **Task 3 - Reporting and Public Presentations**

A set of scheduled reports and associated Power Point summaries will be prepared by the UWRF to systematically present project results.

This set of reports shall include an annual end-of-year technical report for each mine test plot, an annual project performance report that summarizes all project related activity, a scheduled mid-term project summary report, and a final project summary report.

A series of public presentations will be conducted in conjunction with the completion of scheduled project reports and scheduled annual stakeholders meetings.

These meetings will be used to summarize the status of project activities and test plot trial results.

#### **Deliverables:**

The UWRF shall provide a hard and digital copy of each required report and Power Point summary.

The LCFM will establish and maintain a project website that will be used to routinely post information generated through the project.

Project information to be posted will include all stakeholders and public meeting notices, agendas, and minutes, and all scheduled project reports, and associated Power Point summaries.

#### **Timeframe:**

The scheduled reports and presentations will be routinely prepared and delivered through the course of the project following the project schedule provided in Appendix C.

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## **APPENDIX A**

### **Project Stakeholders Group Charge**

The Project Stakeholders Group is advisory to the Chippewa County Department of Land Conservation & Forest Management (LCFM).

The group has been established to assist Chippewa County LCFM and the UW River Falls Plant and Soil Department to conduct a multi-year non-metallic mine reclamation demonstration project in Chippewa County, Wisconsin.

#### **Project Objectives**

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The technical and scientific objectives of this project are to:

1. Record the existing physical and biological characteristics of unmined soils at representative mine sites, as needed to assess the biodiversity, soil health, site functions, and land use capabilities before mining begins.
2. Document the best management practices that are used by mine operators to re-establish post mine contours and to reapply soil materials as part of contemptuous reclamation.
3. Using soil test plots, evaluate the benefits of soil amendments and biological conditioning, as used to reestablish soil properties, site functions, and site capabilities.
4. Using soil test plots, record and monitor the changes in test plot vegetation and soil properties and functions as a measure of reclamation success and performance.
5. Systematically compile, interpret, and summarize test plot results and disseminate this information to project stakeholders, public agencies, and the general public to advance mine reclamation efforts.

#### **Duties and Responsibilities**

The Project Stakeholders Group (PSG) members will:

1. Assure structured communication between the public agencies, who are conducting the study, and stakeholder interests who are participating in the study.
2. Serve as representatives and express the interests of their respective public and private sector organizations.

3. Actively participate in project meetings and pursue opportunities to collaborate on project tasks related to the technical investigation and outreach components of the modeling study.
4. Systematically review project status and provide feedback to support the successful completion of project tasks related to the technical investigation and outreach components of the modeling study.

Specific duties and assigned tasks are as follows:

1. Participate in annual project review and planning meetings, conducted by the County to track progress, solicit feedback, and seek input on planned project tasks.
2. Review and provide comments on scheduled technical and performance reports completed by the UWRP and Chippewa County LCFM.
3. Assist in the dissemination of information generated through the project.

**Term of Ad Hoc Committee, Reimbursement, and Anticipated Meetings**

The stakeholders group will serve during the full implementation phase of the study.

**Stakeholder Group Representation**

**Non-Metallic Mine Interests**

- Superior Silica Sand/Fred Webber
- Mathy Construction
- Other mining companies that sponsor reclamation demonstration sites

**Agricultural Interests**

- Wisconsin Farmers Union

**Environmental Interests**

- The Nature Conservancy

**Agency Interests**

- DNR – Wildlife
- Chippewa Co. Extension
- USDA NRCS

**Citizen Interests**

- (Citizen Representative)
- Landowner(s)

**Staff Support**

- D. Masterpole, LCFM
- S. Ebel, LCFM Project Engineer



APPENDIX C

GENERAL ROLES AND RESPONSIBILITIES TO INSTALL AND MONITOR RECLAMATION TEST PLOTS AT NON-METALLIC MINES

Reclamation Project Planning	2014				2015				2016				2017				2018			
	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.	1st qtr.	2nd qtr.	3rd qtr.	4th qtr.
Develop reclamation plan. Determine post mine landuse(s)	1, 2, 3																			
Define reclamation cell objective/test plot purpose(s)	1, 2, 3																			
Determine test plot and control site location(s)	1, 2, 3																			
Determine schedule for test plot implementation	1, 2, 3																			
Determine Location of Pre-Mine Soil Benchmarking		1, 2, 3*																		
Establish/instrument benchmark control sites		1, 2, 3*	2, 3*	2, 3*																
Collect data to characterize undisturbed site condition*		1, 2, 3*	2, 3*	2, 3*																
<b>Test Plot Treatment Design</b>																				
Prepare sketch plan of restoration cell topography/drainage	1, 2	3																		
Develop proposed test plot treatments & layouts	1, 2	3																		
Confirm final restoration cell contours & treatment design	1, 2, 3																			
<b>Test Plot Establishment</b>																				
Replace overburden & complete rough grading to establish post mine drainage & surface contours		1, 2				3														
Place mine subsoil, topsoil, & primary soil amendments		1, 2				3														
Install instrumentation			2			3														
Secure & pay for planting stocking			1, 2	3																
Prepare seedbed & soil test			1, 2	1, 2		3														
Fertilize & plant site			1, 2	1, 2		3														
Apply post plant fertilizer/pest treatments			1, 2	1, 2																
<b>Test Plot Monitoring and Data Collection</b>																				
Train research staff & get MSHA certifications	1, 2, 3	1, 2, 3																		
Record & monitor soil properties/functions			1, 2	1, 2		1, 2, 3	1, 2, 3	1, 2, 3												
Record & monitor plant growth			1, 2	1, 2		1, 2, 3	1, 2, 3	1, 2, 3												
Take plant & soil & water samples			2	2		2, 3	2, 3	2, 3												
Conduct lab analysis			2	2		2, 3	2, 3	2, 3												
<b>Data Compilation &amp; Report</b>																				
Compile data sets				1, 2, 2*, 3*																
Prepare & post individual test plot reports (annual)				1, 2																
Prepare & post comparative test plot analysis reports (i.e. baseline sites- vs- test plot sites) - (biannual)																				
Prepare end-of-year performance reports				1, 2, 3*																
Prepare mid-term & final project reports																			1, 2, 3	

Note A - The quarters referenced are estimates and will be determined through annual work planning conducted by UWRP & LCFM staff.  
 Note B - \*Asterisk (\*) references installation of instrumentation and data collection at benchmark sites. The extent, frequency, and duration of data collection will be determined by the UWRP & LCFM staff.  
 Note C - It is anticipated that Cell 1 at the SSS site will be a general demonstration site. This cell will not be instrumented, nor will detailed research data be collected to document soil conditions, plant survival, & plant growth.  
 Note D - Additional reclamation projects are anticipated and may be planned and implemented in 2015-2018.

## **APPENDIX D**

### **An Overview of the General Methods to be Used and the Parameters to be Sampled in Conducting Pre-Mine Soil Benchmarking**

Site specific soils and vegetative data will be collected at benchmark sites using control plots or transects to characterize the land use, physical properties, site functions, and site productivity that exist at each mine site under existing (pre-mining) conditions.

This data will provide the benchmark control that will be used to compare pre-mining and post-mining (reclaimed) conditions at each mine site.

Control plots will be monitored periodically through the course of the project to provide an ongoing benchmark for comparison.

Benchmark sites will be selected to be physically representative of the site to be mined. If possible, the benchmark site will be approximately the same size of the test plot site to be evaluated and will be located adjacent or in close proximity to it.

Most ideally, these benchmark sites will be sites that will be sequentially mined and reclaimed in the near term, to provide a basis for a direct comparison between pre-mine conditions and reclaimed mine conditions during the same period when the test plot treatments are being conducted.

The physical and biological properties of the benchmark sites will be characterized using sampling methods that will be selected by the researcher to account for the physical characteristics of the site, as needed to limit natural variability.

Soil properties and functions of the benchmark sites will be measured to document soil morphology and physical properties, hydrologic conductivity and infiltration, soil water chemistry, and soil biologic activity using CO<sub>2</sub> flux.

Biologic properties of the benchmark sites will be measured using vegetative composition surveys that measure species type, density, and diversity.

This methodology will be further defined and documented during Year 1 of the project, as the characteristics of benchmark sites are actually evaluated and measured.

This methodology will then be applied uniformly to characterize the baseline conditions of all mine sites that may subsequently participate in the project.