

TECHNICAL REVIEWERS' COMMENTS

LRC-LXXX-D: "Management practices to improve soil and vegetation perimeters of reclaimed North Dakota Coal Mine Lands"

Submitted by: Department of Soil Science - School of Natural Resource Sciences (NDSU)

Principal Investigator: Ryan Limb

Project Duration: 5 years

Request for: \$578,187; Total Project Costs: \$1,156,374

1. **OBJECTIVES**

The objectives or goals of the proposed project with respect to clarity and consistency with North Dakota Industrial Commission/Lignite Research Council goals are: 1 - very unclear; 2 - unclear; 3 - clear; 4 - very clear; or 5 - exceptionally clear.

Reviewer 17-10 (Rating: 4)

This project is solidly in line with NDIC/LEC Goals.

Reviewer 17-11 (Rating: 4)

The objectives of this proposal and 1) improve H2O movement between boundaries, 2) decrease shallow and deep soil compaction, 3) increase root abundance and depth, and 4) reduce exotic grass abundance. These objectives are consistent with the NDIC LRC priority to reclaim surface mined land to original or better productivity.

Reviewer 17-12 (Rating: 4)

The objectives are clear and achievable.

2. **ACHIEVABILITY**

With the approach suggested and time and budget available, the objectives are: 1 - not achievable; 2 - possibly achievable; 3 - likely achievable; 4 - most likely achievable; or 5 - certainly achievable.

Reviewer 17-10 (Rating: 4)

Based on the objectives as written it seems likely the objectives will be met.

Reviewer 17-11 (Rating: 4)

Given the approach, time and budget the objectives are most likely achievable. The deliverables are specific and can be monitored. The challenge may be on accepting the practice by PSC and adoptions as a best management practice.

Reviewer 17-12 (Rating: 4)

The result will most likely be achievable.

3. **METHODOLOGY**

The quality of the methodology displayed in the proposal is: 1 - well below average; 2 - below average; 3 - average; 4 - above average; or 5 - well above average.

Reviewer 17-10 (Rating: 3)

The general concept is relayed but more clarity as to what the test techniques yield and what they will indicate are lacking. What is the polymer mentioned in the text? What is the abundance of exotic species on other land types and how does it compare to reclaimed land? Does the timeframe of the work compare to land reclaimed 30 years ago and what is the relationship formed with the data collected?

Reviewer 17-11 (Rating: 4)

The methodology displayed in the proposal is above average.

Reviewer 17-12 (Rating: 4)

The methodology is good, but the proposal lacks specifics like the location of sites and the number of sites.

4. **CONTRIBUTION**

The scientific and/or technical contribution of the proposed work to specifically address North Dakota Industrial Commission/LRC goals will likely be: 1 - extremely small; 2 - small; 3 - significant; 4 - very significant; or 5 - extremely significant.

Reviewer 17-10 (Rating: 3)

Reviewer 17-11 (Rating: 5)

The contribution of the proposed work could be significant in addressing NDIC priorities.

Reviewer 17-12 (Rating: 3)

The contribution will be significant if successful, but the proposals claim of “Reclamation strategies developed by this project for the surface coal industry will be directly transferrable to other industries to increase reclamation success across North Dakota” may not necessarily be true. I do not think we can say for sure that what is good for mining is also good for oil wells or any other industry.

5. **AWARENESS**

The principal investigator's awareness of current research activity and published literature as evidenced by literature referenced and its interpretation and by the reference to unpublished research related to the proposal is: 1 - very limited; 2 - limited; 3 - adequate; 4 - better than average; or 5 - exceptional.

Reviewer 17-10 (Rating: 3)

Reviewer 17-11 (Rating: 5)

The PI and staff have impressive backgrounds and knowledge in this area.

Reviewer 17-12 (Rating: 3)

The whole idea of the proposal is based on Figure 1, but there is no reference for Figure 1. The references site is not clear whether or not it is the same land before mining or if it is different land. If

a different land, how can we say for sure that the two plots are equivalent? Figure 1 also does not show a significant inverse relationship between rooting depth and biomass constant as claimed by the proposers. The other figures included in the proposal to justify what they are proposing may not be applicable for the conditions in North Dakota and most of them are also dated.

6. **BACKGROUND**

The background of the investigator(s) as related to the proposed work is: 1 - very limited; 2 - limited; 3 - adequate; 4 - better than average; or 5 - exceptional.

Reviewer 17-10 (Rating: 3)

Reviewer 17-11 (Rating: 5)

The PI and staff have impressive backgrounds and knowledge in this area.

Reviewer 17-12 (Rating: 4)

The proposers have the experience and expertise to do the work they proposed to do.

7. **PROJECT MANAGEMENT**

The project management plan, including a well-defined milestone chart, schedule, financial plan, and plan for communications among the investigators and subcontractors, if any is: 1 - very inadequate; 2 - inadequate; 3 - adequate; 4 very good; or 5 - exceptionally good.

Reviewer 17-10 (Rating: 2)

More description of milestones are needed along with a discussion of alternative measures. How are natural weather phenomena going to affect the work and how will it be addressed? For a five year study it would seem advisable to have annual presentations of progress to the project team.

Reviewer 17-11 (Rating: 3)

The PI and staff have impressive backgrounds and knowledge in this area.

Reviewer 17-12 (Rating: 4)

The project management plan is very good.

8. **EQUIPMENT PURCHASE**

The proposed purchase of equipment is: 1 – extremely poorly justified; 2 – poorly justified; 3 – justified; 4 – well justified; or 5 – extremely well justified. (Circle 5 if no equipment is to be purchased.)

Reviewer 17-10 (Rating: 2)

Equipment is not discussed well. More detail on the work to be performed might have clarified this. A discussion on the length of fieldwork would better clarify the justification of travel trailers.

Reviewer 17-11 (Rating: 5)

Reviewer 17-12 (Rating: 3)

Purchase of equipment is justified.

9. **FACILITIES**

The facilities and equipment available and to be purchased for the proposed research are: 1 – very inadequate; 2 – inadequate; 3 – adequate; 4 – notably good; or 5 – exceptionally good.

Reviewer 17-10 (Rating: 3)

They appear to satisfy the work to the level described in the proposal.

Reviewer 17-11 (Rating: 5)

Reviewer 17-12 (Rating: 4)

Proposed equipment could be enough to do the job, but I am wondering how the proposers do not have some of the equipment, like the one to determine organic content if they have experience in similar projects in the past.

10. **BUDGET**

The proposed budget "value"¹ relative to the outlined work and the financial commitment from other sources² is of: 1 - very low value; 2 - low value; 3 - average value; 4 - high value; or 5- very high value.

Reviewer 17-10 (Rating: 4)

Reviewer 17-11 (Rating: 3)

The proposed budget is of average value \$1 matching \$1.

Reviewer 17-12 (Rating: 2)

The criterion is to "Attract matching private industry investment equal to at least 50% or more of the total cost," but the proposers included matching funds from NDSU to make it 50%. As far as I understand, matching fund from NDSU does not qualify as a private industry investment since it is a state owned university.

¹ "Value" – The value of the projected work and technical outcome for the budgeted amount of the project, based on your estimate of what the work might cost in research settings with which you are familiar.

² Financial commitment from other sources – A minimum of 50% of the total project must come from other than Industrial Commission sources to meet the program guidelines. Support greater than 50% from Industrial Commission sources should be evaluated as favorable to the application.

OVERALL COMMENTS AND RECOMMENDATION:

Please comment in a general way about the merits and flaws of the proposed project and make a recommendation whether or not to fund.

Reviewer 17-10 (Rating: FUNDING MAY BE CONSIDERED)

Overall the proposed work has been argued positively for need. Detail on expected results from data to be collected is lacking. Additional discussion on relationship to other land use types would have been beneficial as well as more in depth discussion on the use of equipment.

Reviewer 17-11 (Rating: FUND)

The proposed work is a joint project of the four mining companies and is focused on a long-term project to improve soil properties and native vegetation. The projects has the combined strength of practical mine land reclamation expertise and academic experience. The flaw in this project may be how the practice can be implemented given regulatory practices.

Reviewer 17-12 (Rating: FUNDING MAY BE CONSIDERED)

I have reservations about the background information used to justify the study and matching fund for the project. The project may be considered for funding if there is money available and the matching criterion is not an issue.

LRC-LXXX-D: "Management practices to improve soil and vegetation perimeters of reclaimed North Dakota Coal Mine Lands"

Submitted by: Department of Soil Science - School of Natural Resource Sciences (NDSU)

Principal Investigator: Ryan Limb

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Response to Technical Reviewers' Comments

2. Achievability

Reviewer 17-11 (Rating: 4)

Given the approach, time and budget the objectives are most likely achievable. The deliverables are specific and can be monitored. The challenge may be on accepting the practice by PSC and adoptions as a best management practice.

-Project partners at each of the four participating mines recognize that research treatments in this project are outside of the current PSC best management practices. The respective Environmental Specialist/Manager for each mine is prepared to submit a variance request to the PSC for research purposes.

3. Methodology

Reviewer 17-10 (Rating 3)

The general concept is relayed but more clarity as to what the test techniques yield and what they will indicate are lacking. What is the polymer mentioned in the text? What is the abundance of exotic species on other land types and how does it compare to reclaimed land? Does the timeframe of the work compare to land reclaimed 30 years ago and what is the relationship formed with the data collected?

-Soil compaction has been problematic and limiting in surface coal reclamation and continues with current reclamation practices. Our overall goal with each of our treatments is to test various methods/combinations to facilitate vertical water movement throughout the soil profile. Water movement throughout the soil profile will initiate freeze/thaw cycles that will decrease soil compaction over time, and facilitate plant root growth which will also decrease soil compaction over time. Our treatments, and corresponding soil measurements, will reveal the depth and degree of soil compaction and any changes. The soil water measurements will reveal if our treatments are successfully facilitating soil water movement throughout the profile. Soil cores will reveal the depth that plant roots can penetrate.

-The Super-absorbent Polymer (Super-Slurper®) is a stacked polymer commonly used in potato production (and other industrial/cosmetic applications) where water is seasonally

limited. The polymer's chemical structure absorbs water and holds it between the polymer chains. The polymer chains expand as additional water is absorbed similar to the billows in an accordion. The water is not tightly bound and remains plant-available, but the water is retained within the soil profile. Holding water in place within the soil profile prior to the onset of winter will facilitate the freeze-thaw cycle and reduce soil compaction.

-Exotic species are present throughout North Dakota and not limited to reclaimed coal land. Kentucky bluegrass (the primary species limiting soil development) is found on native rangelands ranging between 25% and 60% of the plant community (data collected from NDSU Range Scientists), depending on management history and site characteristics. The most recent data collected in 2014, with a partnership between NDSU and BNI Energy, indicates that Kentucky bluegrass abundance on reclaimed land at ranged between 26% and 93% with an average cover of 51%. Compacted soils on reclaimed lands promote the establishment and spread of Kentucky bluegrass faster and more uniform than on virgin rangelands without soil compaction issues. Therefore Kentucky bluegrass abundance on reclaimed land is more problematic than on virgin rangelands.

-Our proposed treatments on previously vegetated sites will incorporate lands recently reclaimed in addition to lands reclaimed 30-40+ years ago. Previous data indicates that soils reclaimed 10 years ago are structurally similar to soils reclaimed in the 1970's. By working across both young and relatively old landscapes we can better understand how to improve reclamation moving forward as well as amend soils previously reclaimed.

Reviewer 17-12 (Rating 4)

The methodology is good, but the proposal lacks specifics like the location of sites and the number of sites.

-The specific location of each treatment site is will be dependent on available land at each mine. Within each treatment block, at least two 100-m transects will be established with sampling seven sampling points distributed along this transect. Multiple samples will be collected at each of the seven locations and combined into a single composite sample. Treatments will be replicated at least three times at a given mine and implemented on at least two mines. However, while each mine will have a component of the three phases of the project, all phases of the project will not be represented on each of the four mines.

5. Awareness

Reviewer 17-12 (Rating: 3)

The whole idea of the proposal is based on Figure 1, but there is no reference for Figure 1. The references site is not clear whether or not it is the same land before mining or if it is different land. If a different land, how can we say for sure that the two plots are equivalent? Figure 1 also does not show a significant inverse relationship between rooting depth and biomass constant as claimed by the proposers. The other figures included in the proposal to justify what they are proposing may not be applicable for the conditions in North Dakota and most of them are also dated.

-We disagree with the reviewer's opinion. The data presented in figure 1 was reviewed by four NDSU scientists and found to be statistically valid and interpreted correctly.

7. Project Management

Reviewer 17-10 (Rating 2)

More description of milestones are needed along with a discussion of alternative measures. How are natural weather phenomena going to affect the work and how will it be addressed? For a five year study it would seem advisable to have annual presentations of progress to the project team.

-The recently formed Environmental Taskforce, chaired by members from each of the four mines, are critical partners on this research project. Semiannual project meetings among both the NDSU research team and the Environmental Taskforce members are planned to discuss project accomplishments, treatment implementation, data collection and preliminary results. Additionally, graduate student annual progress reports and final theses will be prepared throughout the 5-year project and distributed to the Taskforce. Further, our travel budget was developed to allow for attendance at multiple meetings throughout the year and present our findings.

8. Equipment Purchase

Reviewer 17-10 (Rating: 2)

Equipment is not discussed well. More detail on the work to be performed might have clarified this. A discussion on the length of fieldwork would better clarify the justification of travel trailers.

-Our largest equipment purchase is a hydraulic soil penetrometer and is intended to reduce sampling time and increase sample accuracy. Recent soil compaction data collected in 2015 with a partnership between NDSU and BNI Energy, required a graduate student to drop a 15 lb weight nearly 45,000 times and took nearly 28 field days to complete, with numerous weather delays. The number of sample locations were slightly more than 10% of what is proposed in this study. We are planning on multiple samples at each of seven locations along two transects within each unique treatment. With each treatment replicated three times at two mines, the number of individual samples becomes overwhelming and cost-prohibitive if hand manual measurements are used. Additionally, samples will be collected throughout each summer field season requiring technicians and graduate students be present for weeks at a time. Hotel accommodations are limited in this region and not consistently available. Travel trailers provide consistent living accommodations and limit vehicle mileage to and from research locations.

9. Facilities

Reviewer 17-12 (Rating: 4)

Proposed equipment could be enough to do the job, but I am wondering how the proposers do not have some of the equipment, like the one to determine organic content if they have experience in similar projects in the past.

The NDSU research team has much of the equipment to conduct the study within our respective labs, or within shared labs. Organic matter, and other soil tests are processed by the NDSU Soil Testing Lab with shared equipment and billed on an individual sample basis. Using the Soil Testing Lab services reduces overall project costs and decreases processing time.

10. Budget

Reviewer17-12 (Rating: 2)

The criterion is to “Attract matching private industry investment equal to at least 50% or more of the total cost,” but the proposers included matching funds from NDSU to make it 50%. As far as I understand, matching fund from NDSU does not qualify as a private industry investment since it is a state owned university.

Contracts for Land Reclamation Research and Research, Development, and Marketing of Lignite Products Derived from Lignite

<http://www.legis.nd.gov/information/acdata/html/43-03.html>

43-03-03-02. Matching funds. A grant may not exceed fifty percent of the total project cost. Documentation demonstrating the matching funds, including letters of commitment from other funding sources, must be submitted to the commission within sixty days of the approval of an application by the commission, or within any additional time granted by the commission. The commission's approval is contingent upon receiving this documentation. If it is not received, the approval lapses and no grant may be made. **Indirect costs (contributed equipment, materials, or services) may be used by any applicant to supply the required funding match or contribution.**

NDCC 57-61-01.5, 54-17.5-03, 54-17.5-04, 57-61-01.5

-Matching funds for this project are comprised of cash from BNI Energy, Coteau Properties Company, Coyote Creek Mining Company, and Falkirk Mining Company (\$420,000 – 36.3%). Additionally, NDSU is contributing cash and indirect funds (\$158,000 – 13.7%).