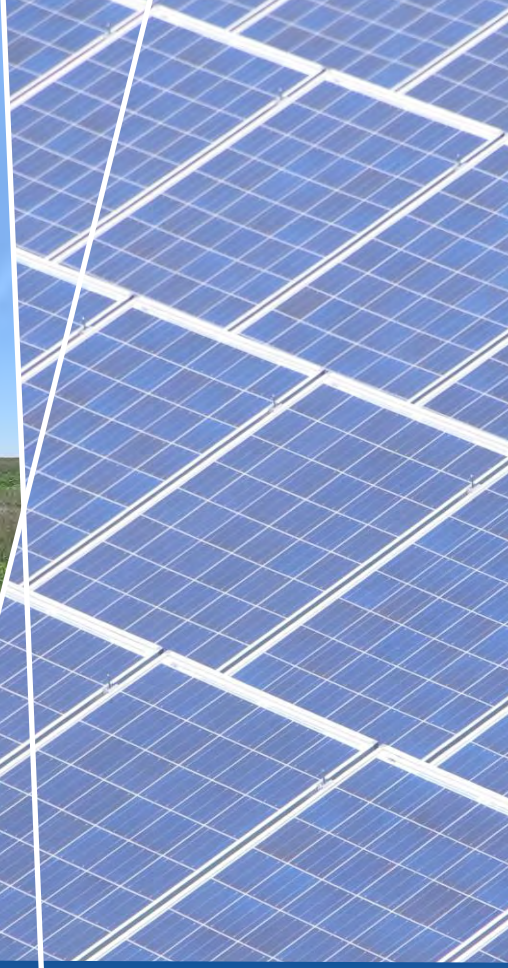
APPENDIX L:
Vegetation Management Plan



Vegetation and Soil Management Plan

Lake Wilson Solar Project

February 2023

Confidential Business Information

Stantec

Table of Contents

Executive Summary ..... **v**
Introduction v
1 Vegetation Management Goals and Objectives **1-1**
1.1 Introduction 1-1
1.2 Goals and Objectives for Vegetation Establishment and Management 1-1
2 Site Description **2-3**
2.1 Project Location 2-3
2.2 Project Size and Boundary Description 2-4
2.3 Historic and Current Vegetation and Land Use 2-5
2.4 Soils 2-9
2.5 Topography 2-12
3 Vegetation Management Units **3-14**
3.1 Vegetation Management Unit Background 3-14
3.2 Vegetation Management Unit Descriptions 3-19
3.3 Vegetation Management Unit Objectives 3-24
4 Vegetation Establishment and Management Prescriptions **4-27**
4.1 Site Preparation 4-27
4.2 Temporary Vegetation 4-33
4.3 Perennial Vegetation Seeding and Planting 4-33
4.4 Pre-Construction and Construction Phase Practices (Prior to Year 0) 4-35
4.5 Short-Term Establishment Practices (Years 0 – 5) 4-36
4.6 Long-Term Maintenance Practices (Years 6+) 4-40
5 Vegetation Monitoring and Adaptive Management **5-42**
5.1 During Construction 5-42
5.2 Post-Construction 5-42
5.3 Adaptive Management 5-43
6 References **6-43**

Figures

Figure 1. Site Location for Lake Wilson Solar Project. 2-4
Figure 2. Project Overview. 2-5
Figure 3. Historical Aerial from 1938. 2-6
Figure 4. Current Land Cover based on 2019 National Land Cover Dataset. 2-7
Figure 5. Current Land Use 2-8
Figure 6. Potential Areas of Ecological Importance. 2-9
Figure 7. Mapped Soil Units. 2-10
Figure 8. Soil Drainage Classification. 2-11

Figure 9. Soil Hydric Rating. 2-12
Figure 10. Murray County Public Drain Tiles within the Project Area. 2-13
Figure 11. Overview of Vegetation Management Block and Unit Boundaries. 3-14
Figure 12. VMUs A1 and A2. 3-20
Figure 13. VMUs B1 through B4. 3-22
Figure 14. VMU C1. 3-23
Figure 15. VMU D1. 3-24

Tables

Table 1. Descriptions and distances for key reference points regarding the boundary description of LWS project area. 2-5
Table 2. Land cover types within the LWS project area based on National Land Cover Data from 2019. 2-7
Table 3. Dry mesic low growing regionally appropriate grass-dominated mix. 3-15
Table 4. Wet mesic low growing regionally appropriate grass-dominated mix. 3-16
Table 5. Preliminary perennial seed mix totals for the LWS project area. 3-18
Table 6. Proposed land use by vegetation management unit block following construction. 3-18
Table 7. Summary of performance criteria for components of vegetation cover during reference points during establishment and maintenance phases of LWS facility operation. 3-26
Table 8. Site preparation sequence and activities based on construction start period. 4-27
Table 9. Seedbed preparation activities based on seedbed conditions prior to seeding. 4-29
Table 10. MDA-listed Noxious Weeds 4-31
Table 11. Non-native Terrestrial Plants Considered by MNDNR to be Potentially Invasive in Natural Areas. 4-32
Table 12. Temporary seed mixes proposed for areas where perennial vegetation is not immediately available (See Attachment E for detailed seed mix information). 4-33
Table 13. Potential mowing conditions and specifications during the short-term establishment period for vegetation management. 4-37
Table 14. Commonly used herbicide for vegetation management of non-turf and non-agricultural areas. Note, none listed are neonicotinoids, which should not be used for vegetation management within solar seedings. 4-38
Table 15. Guidelines for mowing during the maintenance period. 4-40

Attachments

Attachment A BSWR Habitat Friendly Program Scorecard planning phase
Attachment B Soil charcteristics of mapped soil units
Attachment C Soil sampling results
Attachment D Civil design for Lake Wilson Solar project (**Submitted under Separate Cover**)

Attachment E Seed mixes

Attachment F Planting plan figures

Executive Summary

Introduction

Lake Wilson Solar Energy LLC is developing the Lake Wilson Solar (LWS) project in Murray County, Minnesota. The proposed project area is approximately 2,621 acres. Of the 2,621 acres, approximately 1,526 acres are currently designated as a possibility to host proposed project facilities which includes approximately 1,196 acres of solar arrays (Figure 1). Lake Wilson Solar Energy LLC has developed a Vegetation and Soil Management Plan (VSMP) to guide vegetation and soil management for the project area from the pre-construction phase through post-construction operation. If approved, the facility would operate under a site permit issued by the Minnesota Public Utilities Commission. The VSMP covers site preparation, installation of seed materials, management activities during the vegetation establishment and maintenance phases along with annual monitoring.

Land use within the proposed project area is primarily row-crop agriculture. As a result of the construction of the LWS project, based off of the preliminary design, more than 1,469 acres will be converted and/or managed for perennial, regionally appropriate vegetation for the course of the permit lifetime (approximately 35 years). Areas to be converted to perennial vegetation include all areas within facility fence lines including underneath and between panels and a buffer along the outside perimeter of the facility fence lines, excluding areas that already consist of perennial vegetation and are not under or between arrays. The LWS project vegetation management program is eligible for the Minnesota Board of Soil and Water Resource's (BWSR's) Habitat Friendly Solar Program. The LWS project meets the minimum habitat friendly standards when scored using the Habitat Friendly Solar Site Assessment Form for Project Planning (Attachment A).

For the purpose of this VSMP, "regionally appropriate" was defined as having one or more of the following characteristics:

- Native to the region and the state prior to large scale agricultural development.
- Commonly occurs within the landscape of the project area and is not considered to have invasive plant species characteristics that can negatively impact existing plant communities. For example, common pasture and forage species such as red clover (*Trifolium pratense*) and orchard grass *(Dactylis glomerata*) are commonly found within the region and have characteristics that allow them to persist in the environment.
- Not listed by the Minnesota Department of Agriculture as a Noxious Weed.

The VSMP sets vegetation goals and provides guidance on steps recommended and required to achieve goals in a manner that are consistent with regulatory standards, economic and operationally feasible, and provides environmental benefits. The VSMP will be used for internal communication between teams and contractors as a guide and reference document to successfully achieve the vegetation goals for the LWS project.

The site has three goals for vegetation including 1) establishing low-growing, regionally appropriate grasses within the arrays and associated buffers, 2) minimizing the presence of noxious weeds and 3) protecting adjacent natural areas from impacts during construction and operation of the LWS facility.

1 Vegetation Management Goals and Objectives

1.1 Introduction

Lake Wilson Solar Energy LLC has developed the VSMP to establish and maintain vegetation at the LWS project in a manner that allows for safe and reliable solar energy generation while providing environmental benefits during operation of the project. The purpose of the VSMP is to provide goals and guidelines for successfully establishing and maintaining vegetation for the life of the permit.

The VSMP was developed during the project planning phase for the LWS project using the most current information available. The VSMP is intended to be a living document that is updated as needed to reflect changes in on-site conditions, clarifications of previous assumptions, and incorporation of gained knowledge that provides for better management of the project's vegetation. Upon completion of final construction, the VSMP will be reviewed and updated to reflect final construction conditions.

1.2 Goals and Objectives for Vegetation Establishment and Management

The following are goals and objectives for vegetation establishment and management associated with the LWS project:

Goal 1: Perennial Vegetation within Arrays and Associated Buffers

Establish and maintain low-growing regionally appropriate grass-dominated vegetation within the array fields and along the buffer to stabilize the soil.

Objective(s)

- Establish and maintain low-growing regionally appropriate grass-dominated vegetation within the array field and along buffers to meet or exceed requirements of the project National Pollutant Discharge Elimination System (NPDES) permit. Short-term and long-term vegetation management will be guided by performance standards outlined in the Lake Wilson VSMP.
- Use maintenance practices that are consistent with typical industry standard practices including periodic mowing and spot herbicide treatment.
- Establish as many acres of perennial vegetation as possible during the pre-construction and construction phases of the project to provide soil stabilization, meet NPDES and the project-specific Stormwater Pollution Prevention Plan (SWPPP) requirements, and minimize post-construction re-vegetation efforts.

Goal 2: Noxious and Invasive Plant Species

Minimize the presence and abundance of plant species listed on the Minnesota Department of Agriculture's (MDA's) Noxious Weeds List.

Objective(s)

- Use Integrated Vegetation Management to reduce and eliminate MDA Noxious Weed-listed species.
- In areas within the project boundary not developed for energy generation (i.e. outside of most fence lines and substations), maintain agricultural and other land uses.

Goal 3: Natural Areas Within and Adjacent to Perimeter Fencing

Protect existing natural areas within and adjacent to the perimeter fence including streams, drainages, wetlands, and native plant communities through site evaluation and mapping, implementation of best

practices during construction, revegetation in accordance with practices outlined in the Lake Wilson VSMP and Minnesota Department of Natural Resource (MNDNR 2020) *Prairie Establishment and Maintenance Technical Guidance for Solar Projects.*

Objectives(s)

- Evaluate and map existing natural areas within and adjacent to perimeter fencing to establish baseline conditions. Periodically update information during inspection and/or monitoring activities so current conditions can be compared against baseline conditions.
- Avoid disturbance to any areas outside of the perimeter fence buffers during construction using flagging and signage as shown on the civil site plans in Attachment D, contractor education, and erosion and sediment controls.
    - Wetlands within and adjacent to the perimeter fence will be protected from unauthorized fill and sediment during construction and operation of LWS in accordance with the SWPPP developed for the project.
- Establish and maintain vegetation within the project area that meets the desired conditions outlined in the VSMP, which uses pre-dominantly regionally appropriate grasses to achieve permanent cover while minimizing the percent cover of MDA-listed noxious weeds and invasive species.
- Select regionally appropriate seed mixes based on local site conditions including hydrology and soil type.
- Protect adjacent native plant communities and wetlands from impacts due to facility construction and operation.
    - Avoid disturbance to all native plant communities and wetlands outside of the perimeter fence.
    - Apply herbicides within the perimeter fence and vegetated buffer in the appropriate manner that minimizes drift to adjacent plant and wildlife habitats as described in Section 4.5.
    - Prioritize invasive species control in management units adjacent to native prairie and other natural communities through seasonal inspections, Early Detection Rapid Response, and collaborating with landowners adjacent to natural areas.

Habitat Friendly Solar Program

The LWS project will qualify to participate in BWSR's Habitat Friendly Solar Program by meeting the minimum standards when scored using the Habitat Friendly Solar Site Assessment Form for Project Planning (Attachment A). Lake Wilson Solar Energy LLC is developing the LWS project, and while not planned at this time, still reserves the right to sell or assign the Project to another qualified entity at any time before, during or after the Project is constructed. The project owner/operator will be responsible for participation in the Habitat Friendly Solar Program, if they choose. For purposes of this VMSP, Lake Wilson Solar Energy LLC will not be participating.

Monitoring and Implementation Technical Expertise

The implementation of the VSMP including pre-construction through monitoring and maintenance period activities will be completed by qualified vegetation management professionals. For the purposes of the VSMP and the Lake Wilson project, a qualified vegetation management professional includes individuals or contractors that have one or more of the following qualifications:

- Five or more years implementing and management natural vegetation with specific experience in applying techniques to establish and maintain regionally appropriate grassland communities and vegetation.
- Knowledge of plant identification with an emphasis on regionally appropriate vegetation.
- Individuals and/or staff with post-secondary education or training in the field of natural resources such as degrees, course work, or certification programs.
- Applicable state certifications such as pesticide applicator, erosion control inspector, or erosion control installer.
- Uses specialized equipment characteristic of the tools of the trade for natural resource management.

Qualified vegetation management professionals may be internal staff from Lake Wilson Solar Energy LLC, future facility owners, facility operators, or hired contractors. Likely over the course of the lifetime of the project, it will be a combination of multiple entities implementing one or more portions of the VSMP. The role of the VSMP and its associated programs such as adaptive management and monitoring will be to provide a consistent basis for how vegetation will be managed for the lifetime of the project.

2 Site Description

2.1 Project Location

The western boundary of the proposed LWS project is located approximately 0.5 miles southeast of the City of Lake Wilson in Murray County and extends approximately 1.1 miles to the south and approximately 4 miles to the east (Figure 1). The project is located in Sections 15, 16, 17, 20, 21, 22, and 27 T106N, R42W (Leeds Township).

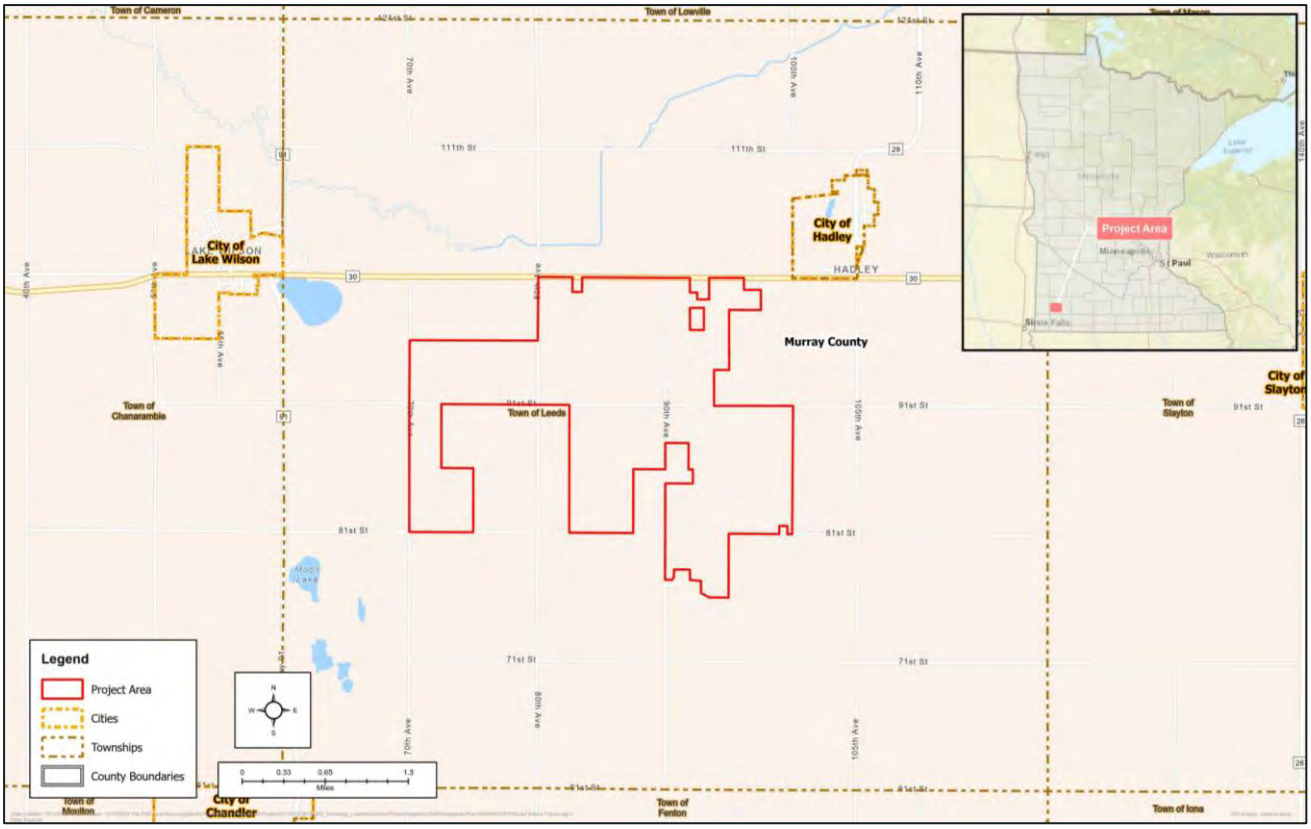


Figure 1. Site Location for Lake Wilson Solar Project.

2.2 Project Size and Boundary Description

The entire LWS project area includes approximately 2,621 acres that are divided into four blocks with eight management units (Figure 2). General dimensions based on a point of beginning at the northwest corner of the LWS project area (vegetation management unit A1) are described in Table 1. The current LWS project has approximately 1,196 acres of solar arrays throughout the project area.

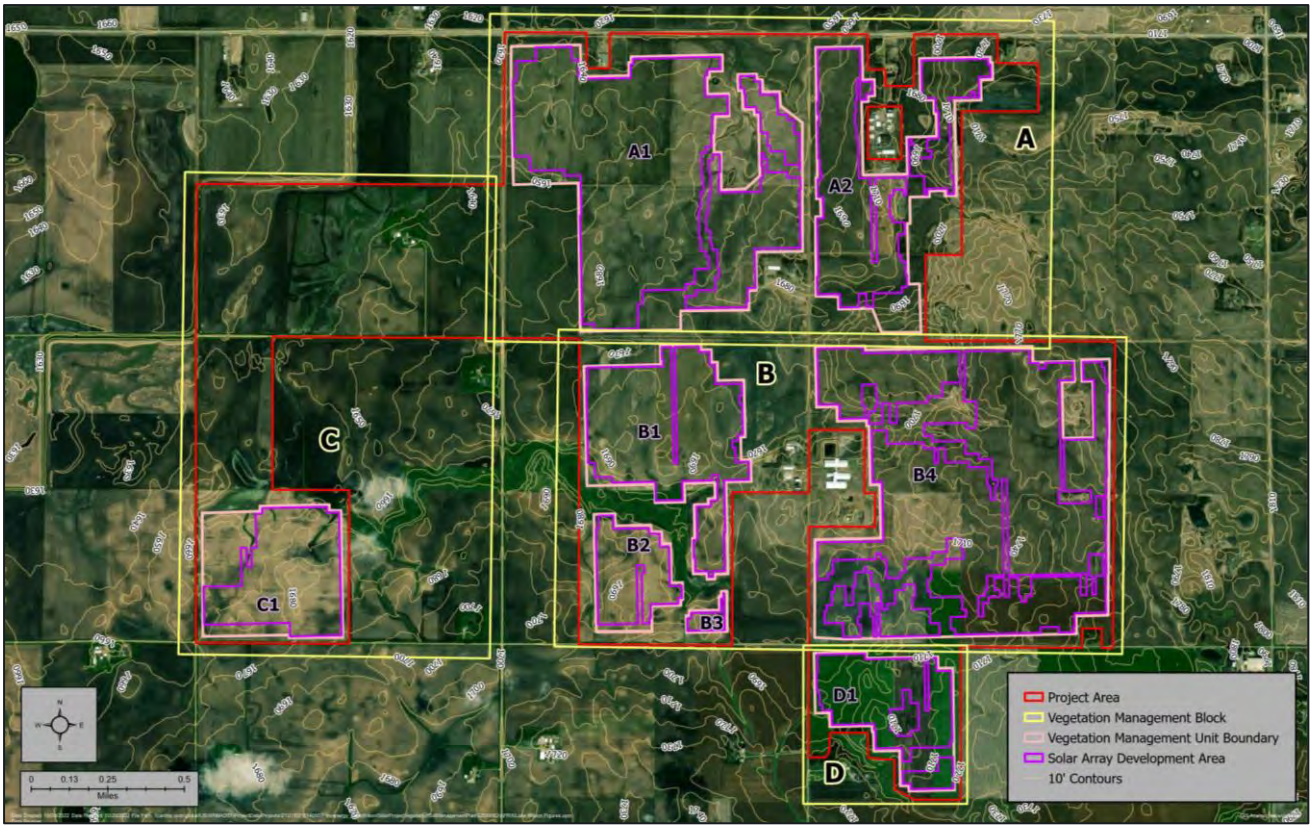


Figure 2. Project Overview.

Table 1. Descriptions and distances for key reference points regarding the boundary description of LWS project area.

Unit Name	Description for Measurement	Length (ft)
Management Unit Block A	Northwest corner to the southwest boundary.	11,600
	Northwest corner to eastern-most boundary.	10,800
	Northwest corner to the southeastern boundary.	14,900

2.3 Historic and Current Vegetation and Land Use

Historic Vegetation and Land Use

The project area falls within the historical Prairie Pothole region of Minnesota. Pre-settlement vegetation consisted primarily of regionally appropriate grasses and forbs with scattered trees (Oslund et al. 2010). Wetlands were extensive and scattered throughout the landscape. Plant communities were maintained through large herbivore grazing and fire. Following settlement, much of the landscape was converted to agricultural land uses. Wetlands were drained or altered. Most of the native prairie was broken for either row-crop agriculture or cool season grass production (pasture or hay land). Aerial photography from 1938 indicates that most of the project area was being used for some form of agricultural production (Figure 3).

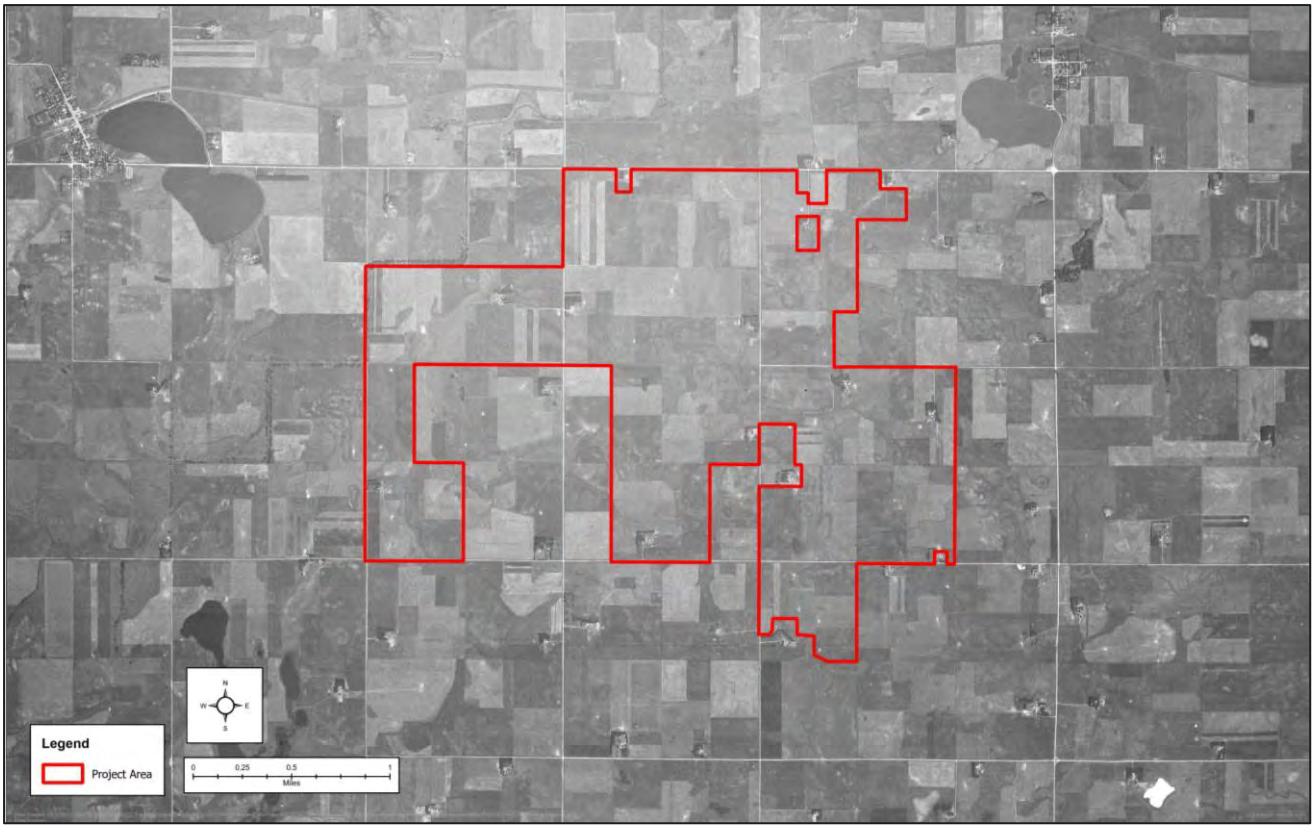


Figure 3. Historical Aerial from 1938.

Current Vegetation and Land Use

National Land Cover Data from 2019 indicates that approximately 95% of the vegetation and land cover is cultivated crops, primarily corn and soybeans (Table 2 and Figure 4). The remaining land cover is primarily scattered developed open space (2.6%), and grassland/herbaceous (1.6%) with limited other land cover types.

Existing vegetation adjacent to the project area and within the local region is primarily cultivated crops. Adjacent to the project area boundary are several locations of MNDNR Protected Areas including along the eastern border and along the southwestern border. These are a mix of grassland and wetland communities (Figure 5). Westwood Professional Services completed a detailed desktop review and field survey of potential native prairie areas within the project area from 2017 through August 2022 as part of the Site Permit Application (SPA). Results of this review/survey indicate none of the potential native prairie locations within the project area meet the definition native prairie (Westwood 2022). Two native prairies were determined to be present adjacent to the project area but will not be impacted due to the development of Lake Wilson Solar.

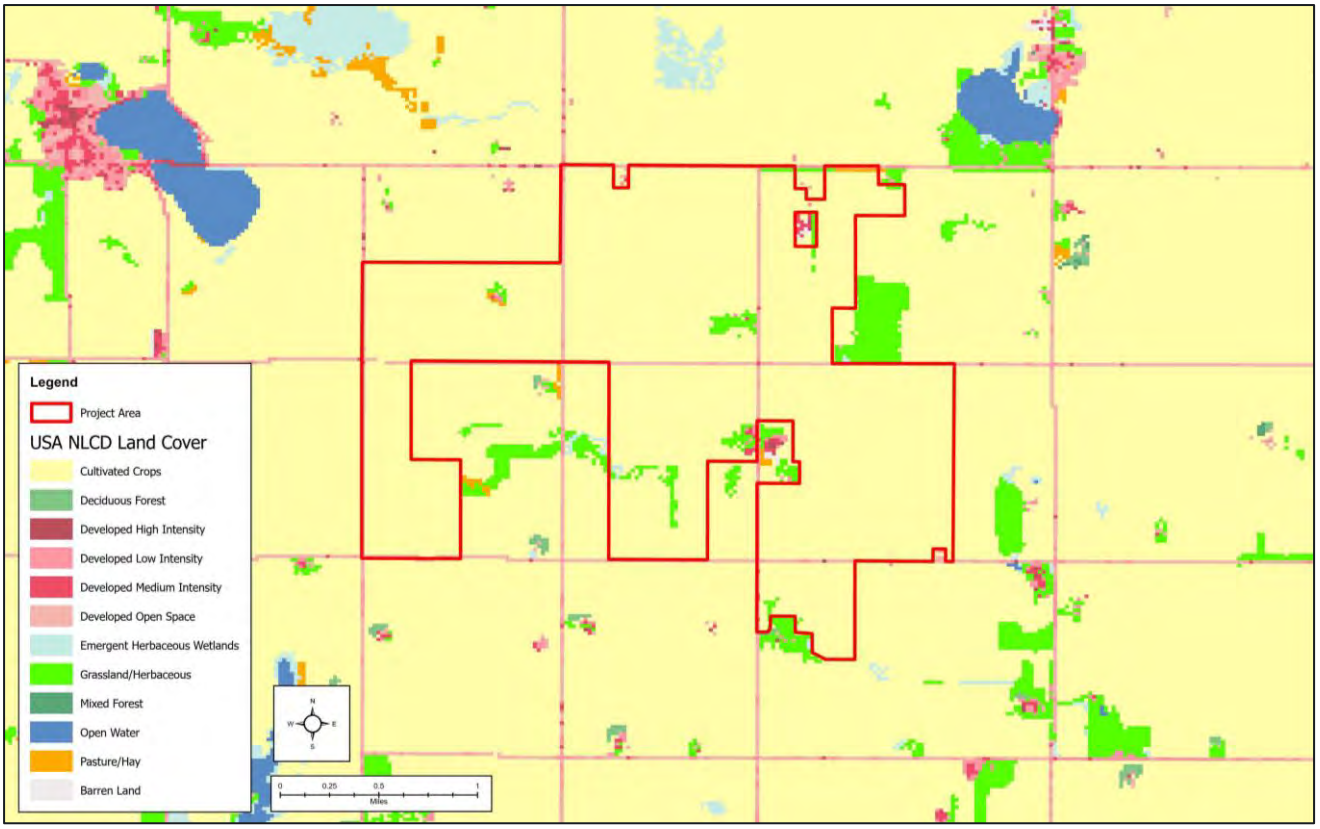


Figure 4. Current Land Cover based on 2019 National Land Cover Dataset.

Table 2. Land cover types within the LWS project area based on National Land Cover Data from 2019.

Land Cover Type	Proposed Project Area	
	Area (Acres)	Percent of Total (%)
Cultivated Crops	2,491.1	95.0%
Developed Open Space	67.3	2.6%
Grassland/Herbaceous	42.6	1.6%
Developed (Low/Medium/High Intensity)	13.6	0.5%
Pasture/Hay	4.4	0.2%
Emergent Herbaceous Wetlands	1.6	<0.1%
Deciduous Forest	0.2	<0.1%
Total	**2,620.8**	**100.0%**

Based upon a desktop review of US Geological Survey's (USGS) National Land Cover Data from 2019, land use within the project area is primarily agriculture. 43% of the project area is classified as prime farmland, while an additional 37% of the project area is classified as prime farmland if drained or protected from flooding during the growing season (Figure 5).

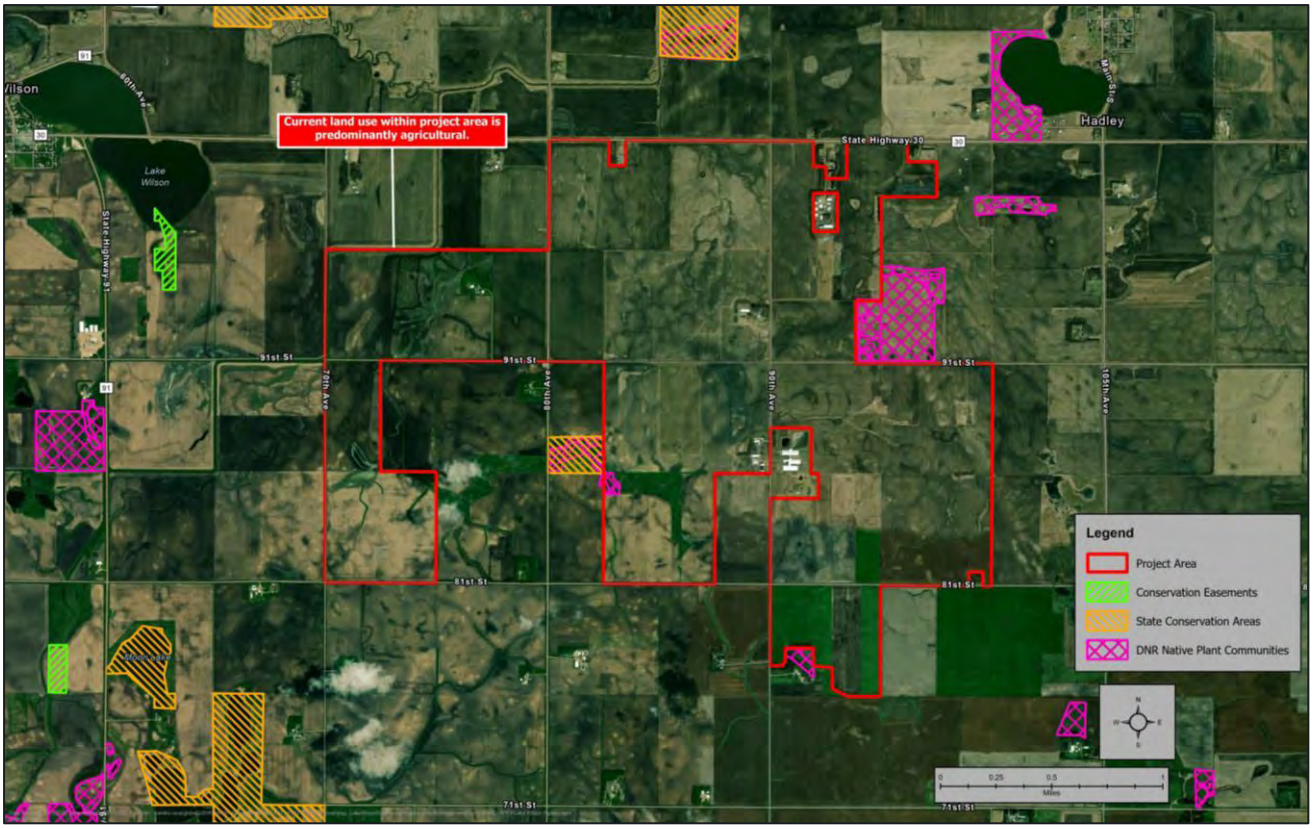


Figure 5. Current Land Use.

Figure 6 provides an overview of data maintained by MNDNR indicating areas within and adjacent to the project boundary that are identified as either having important ecological characteristics (native plant community, a Minnesota Biological Survey (MBS) site of biological significance, or potentially undisturbed lands) or protected status such as a conservation easement or designated state conservation area. Environmental investigations completed as part of the SPA process indicate that one MBS site of moderate biodiversity was mapped partially within the project area and field reconnaissance determined the site to be dominated by non-native species (Westwood 2022a). A second MBS site classified as below biodiversity significance was mapped within the project area and field reconnaissance determined the site to be partially cropped.

Nine potential native prairie locations within and adjacent to the site were identified during a desktop analysis for the SPA (Westwood 2022c). Field reconnaissance determined that no native prairie areas are present within the project area. One area adjacent to the project area along the eastern border qualifies as native prairie by Minnesota state statutes. Along the west central boundary, MNDNR manages the Carlson Wildlife Management Area (WMA), a 26-acre prairie containing a mix of high-quality remnant prairie, seeded prairie, and woody cover plantings (Westwood 2022c). Due to the location of both the Carlson WMA and the qualifying native prairie area being outside of the project area, no impacts due to construction of Lake Wilson Solar are anticipated. Both short-term and long-term management of noxious and invasive weeds along with preventing pesticide drift on adjacent vegetation at LWS should further prevent impacts to existing native plant communities outside of the project area.

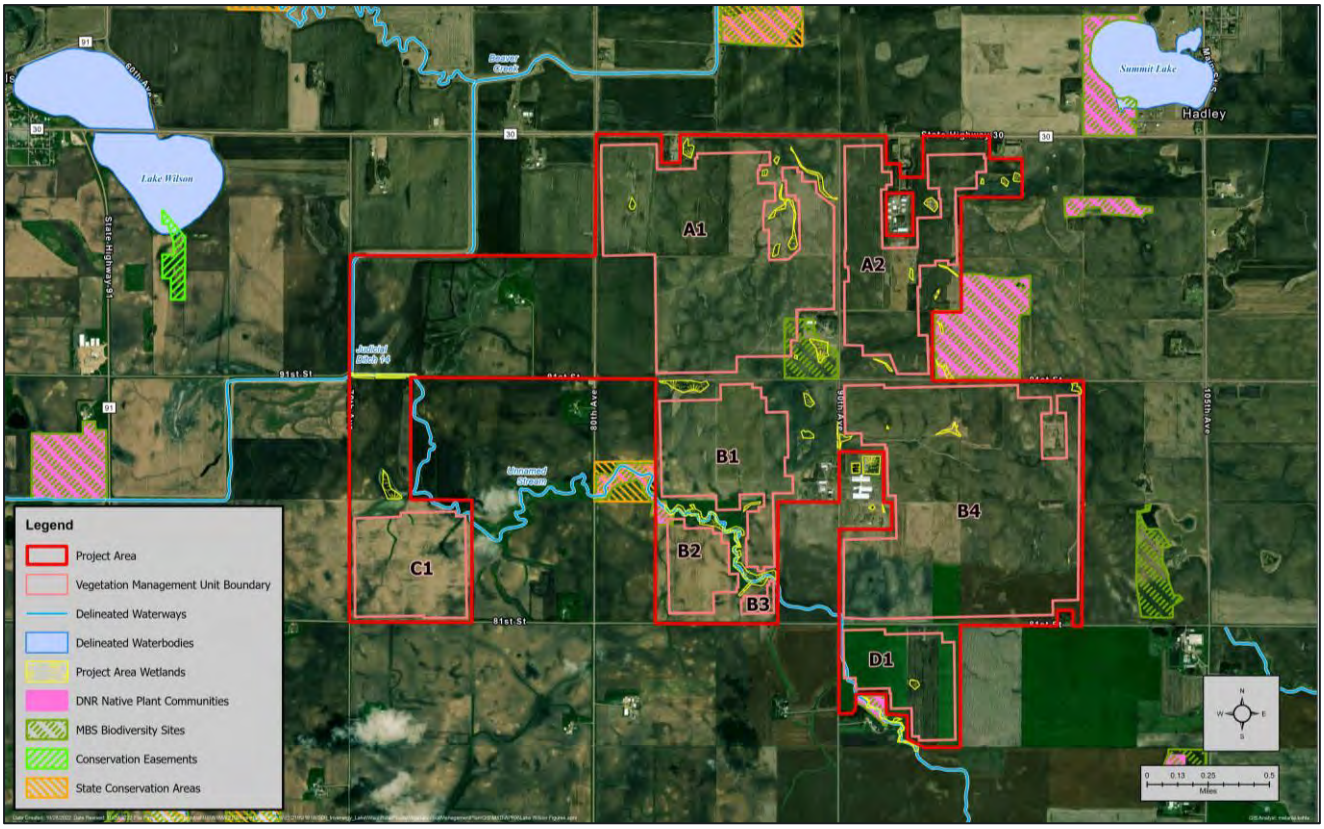


Figure 6. Potential Areas of Ecological Importance.

2.4 Soils

Information about the soils within the project area was obtained from both a desktop review through the NRCS's online soil mapping tool, Web Soil Survey (WSS) and from soil samples collected on-site. WSS is the online mapping tool using Soil Survey Geographic database (SSURGO). Thirty different soil units are present within the project area and distributed as a complex mosaic typical of the geologic history of the Prairie Pothole Region (Figure 7). Barnes-Buse-Svea complex is the most abundant soil unit at 16.4% and the rest range between 0.1 to 15.1% (Attachment B).

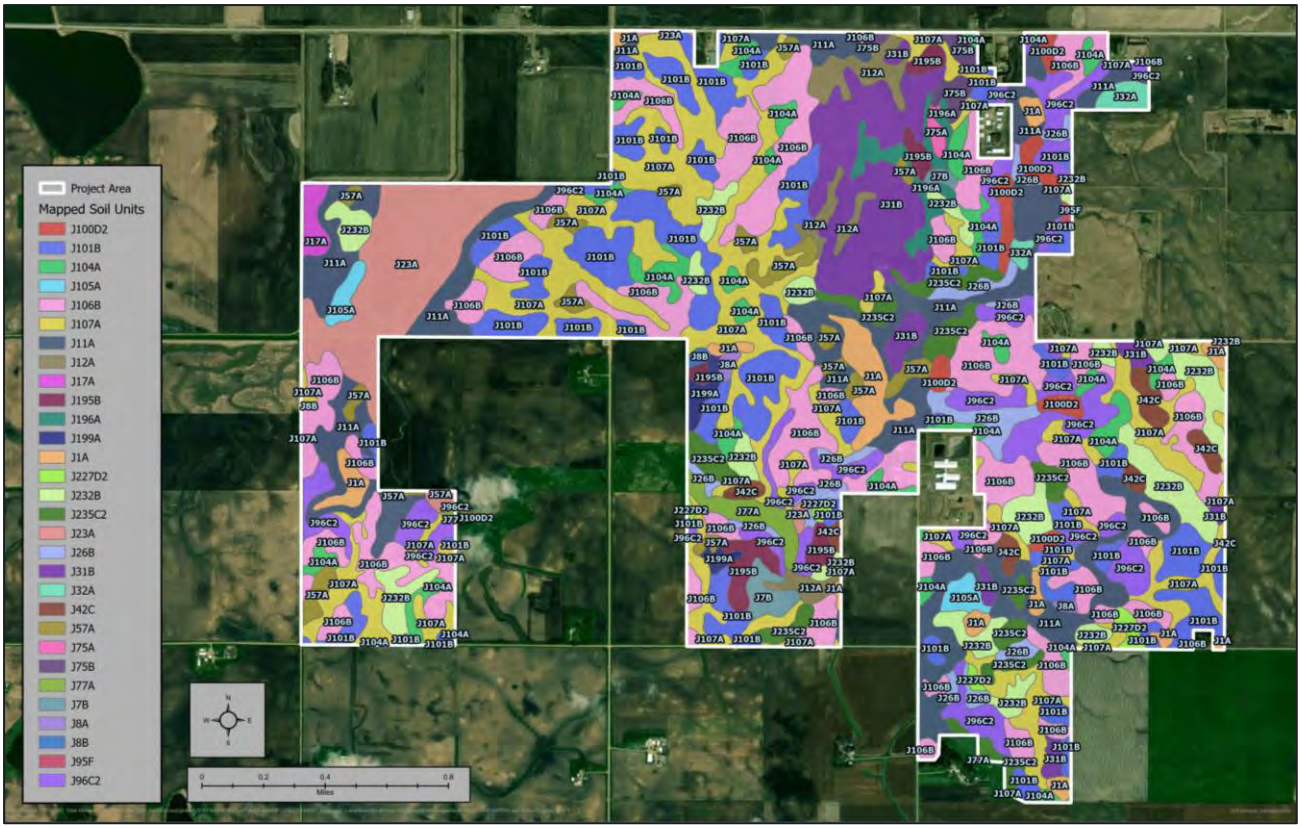


Figure 7. Mapped Soil Units.

According to SSURGO data, approximately 35% of the project area is classified as being moderately well drained. Poorly drained and well drained soils each make up approximately 20% of the project area and are distributed throughout the project area (Figure 8). Approximately 62% of the project area is classified as being either non-hydric or predominately non-hydric soils (SSURGO data; Figure 9). Predominately hydric soils make up approximately 35% of the project area while all hydric soils represent only 3%.

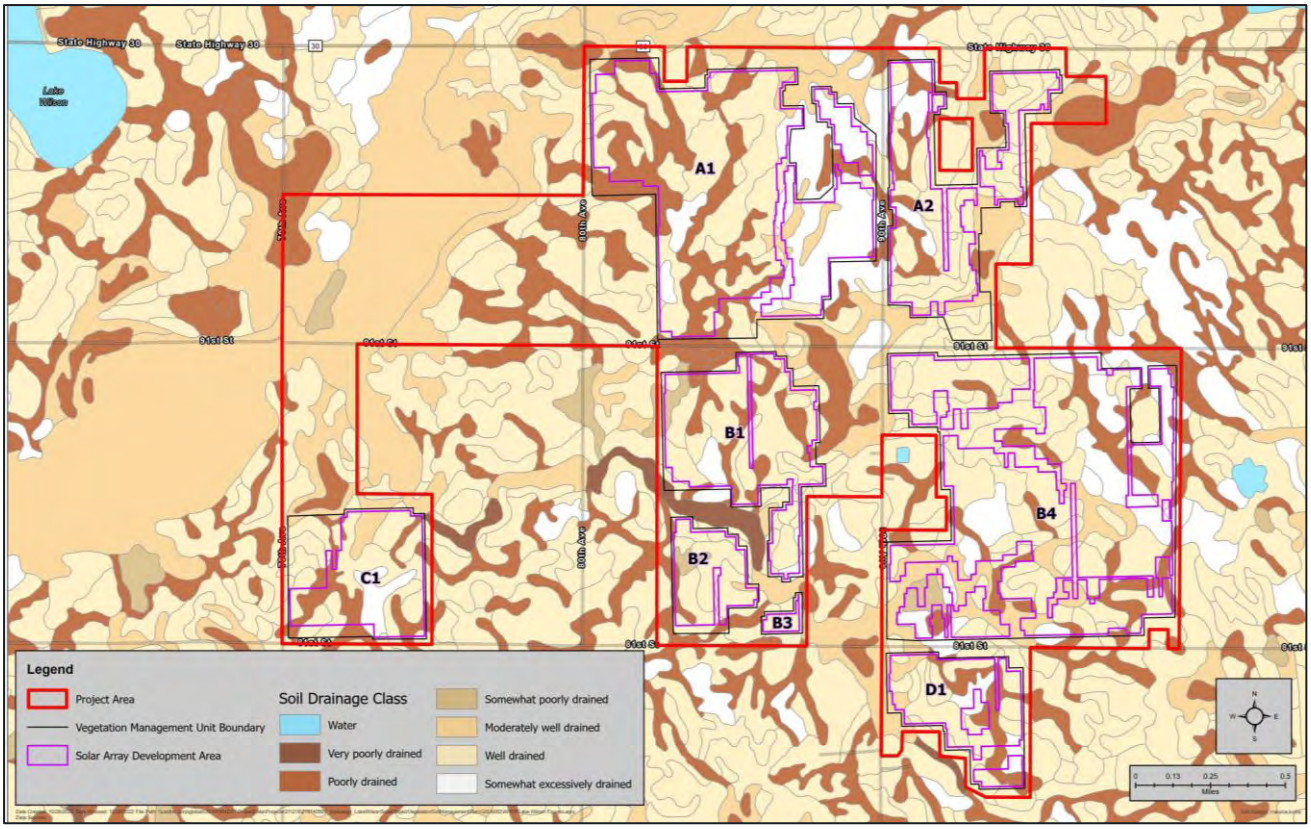


Figure 8. Soil Drainage Classification.

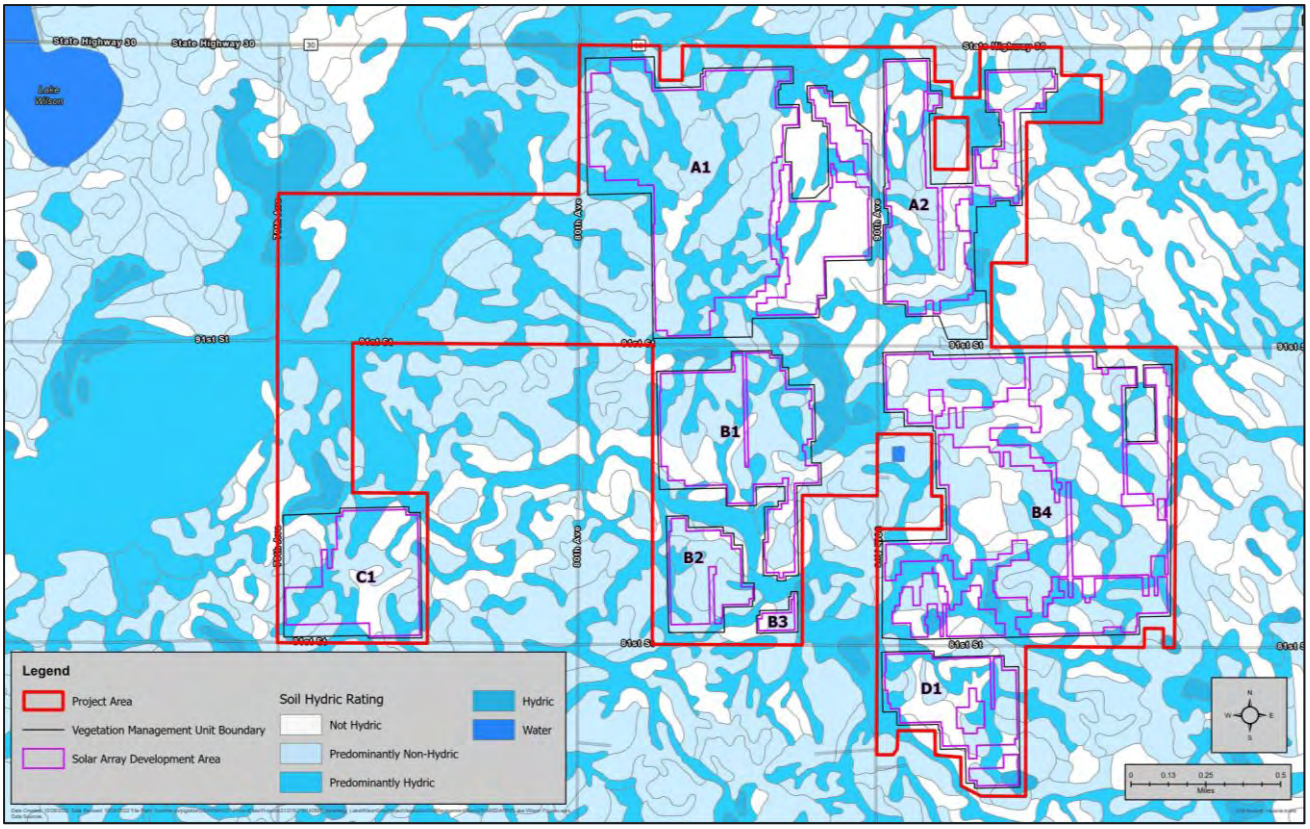


Figure 9. Soil Hydric Rating.

There is a mosaic of soil units throughout the project area. Soil characteristics can generally be described as having components that are non-hydric and well-drained or poorly drained. There are pockets of soil units that are more hydric and less drained scattered within the proposed arrays. Due to the mosaic soil conditions, regionally appropriate seed mixes that are comprised of species that can exist along a gradient of dry to mesic to wet conditions will be required. For example, in areas where more hydric soils i.e. wetter conditions, are present, a regionally appropriate seed mix comprised of a greater percentage of wet mesic species are proposed. Greater detail on site hydrology and regionally appropriate seed mixes are discussed below in separate sections.

Representative soil samples were collected in October 2021 within the proposed project area and analyzed by the Soil Testing Laboratory at the University of Minnesota using standard soil sampling techniques. At each sampling location, soils were collected from a profile sample to a depth of 10 inches below the ground surface. Material from each distinguishable soil horizon were collected and compiled into one composite sample for each point. Samples were analyzed for the laboratory's Regular Series parameters, which include phosphorus, potassium, pH and lime requirement, percent organic matter, and estimated texture category. This information was used to guide the appropriate seed mix selection. Attachment C provides a summary of the soil characteristics.

2.5 Topography

The LWS project is located within the Loess Prairies and Des Moines Lobe regions of the Western Corn Belt Plains Ecoregion (USEPA 2015). Topography within the LWS project area generally consists of gently rolling hills, particularly in the eastern portion of the project area (Westwood 2020a) and average ground slope decreases to the west. Elevation within the project area ranges from 1,620 to 1,784 feet above mean sea level (amsl; Figure 2).

The project area is within the Prairie Pothole Region of Minnesota, an area characterized by a landscape mosaic of wetland and grassland complexes with limited surface drainages. Wetlands periodically become inundated and dewater based on seasonal and annual climatic conditions. During the agricultural development of the region, it was and currently is a common practice to install and maintain subsurface drain tiles to facilitate soil drainage and promote conditions that allow crop production in former wetland basins and other areas with seasonally wet conditions. A review of an online GIS maintained by Murray County indicates an extensive network of County-owned tiles throughout the project area that appear to drain towards the north; these tiles are avoided by project design (Figure 10).

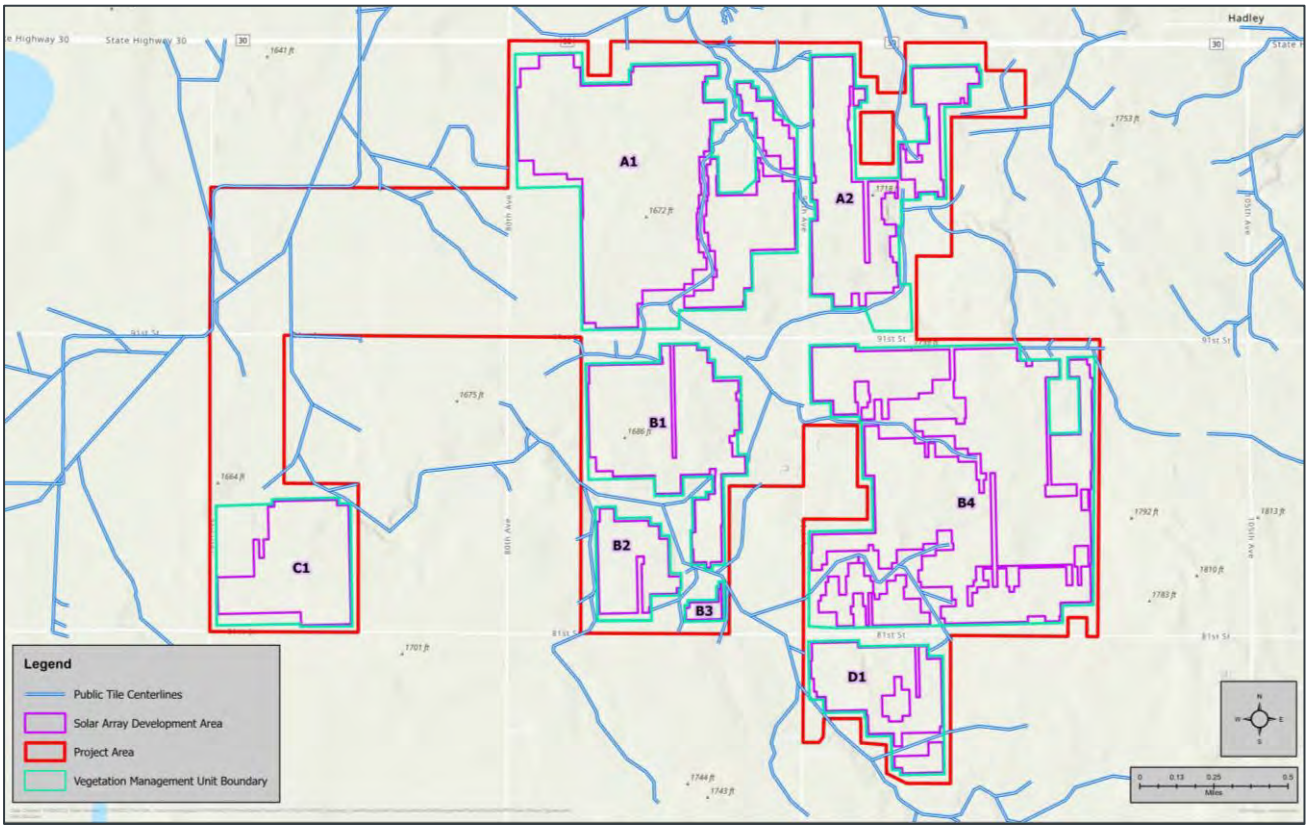


Figure 10. Murray County Public Drain Tiles within the Project Area.

The presence of wetlands and other surface water features within the project area was determined by a review of public environmental data sets and an on-site review in 2017, 2021, and 2022 (Westwood 2022b). Thirty-six wetland basins totaling 38.25 acres were delineated within the project area. Six watercourses were field delineated within the project area footprint including Judicial Ditch 14 (Westwood 2022b).

Protection of public waters and wetlands will be a priority for the Lake Wilson project during construction and post-construction periods. A combination of practices will be used to prevent or reduce the potential for direct or indirect impact to public waters. Practices include:

- Following practices outlined in the SWPPP such as using erosion control devices and accepted Best Management Practices for construction.
- Stabilizing row-crop agricultural land with either temporary or perennial vegetation prior to construction.

During construction, contractors will be required to adhere to existing environmental compliance guidelines to minimize the potential for negative impacts to the environment (Invenergy 2022). Environmental compliance will remain a requirement through the operation and maintenance of the facility.

3 Vegetation Management Units

3.1 Vegetation Management Unit Background

Attachment D provides the current civil site plans including facility layout and grading plans.

The current LWS project has eight proposed fenced array areas totaling approximately 1,196 acres ranging from approximately 5 to 389 acres in size spread across eight vegetation management units (VMU), which are grouped into four vegetation management blocks (Figure 11). Vegetation management blocks are for organizational purposes only and provide context where a management unit is located within the context of the larger project area. Seed mix selection, planting plans, and vegetation management within each VMU are described in Section 3.2. Seed mix planting areas within each VMU are shown in Figures 12, 13, 14, and 15. A VMU includes the solar facility features such as arrays, inverter, fence lines, access roads, collection cables, substation, and battery storage, and associated vegetated buffers within that unit. Participating property owners adjacent to a VMU are assumed to continue with the current land use, primarily row-crop agriculture, during the life of the permit. If a property owner opts to not continue row-crop agriculture, future land management will be determined by LWS and the property owner.

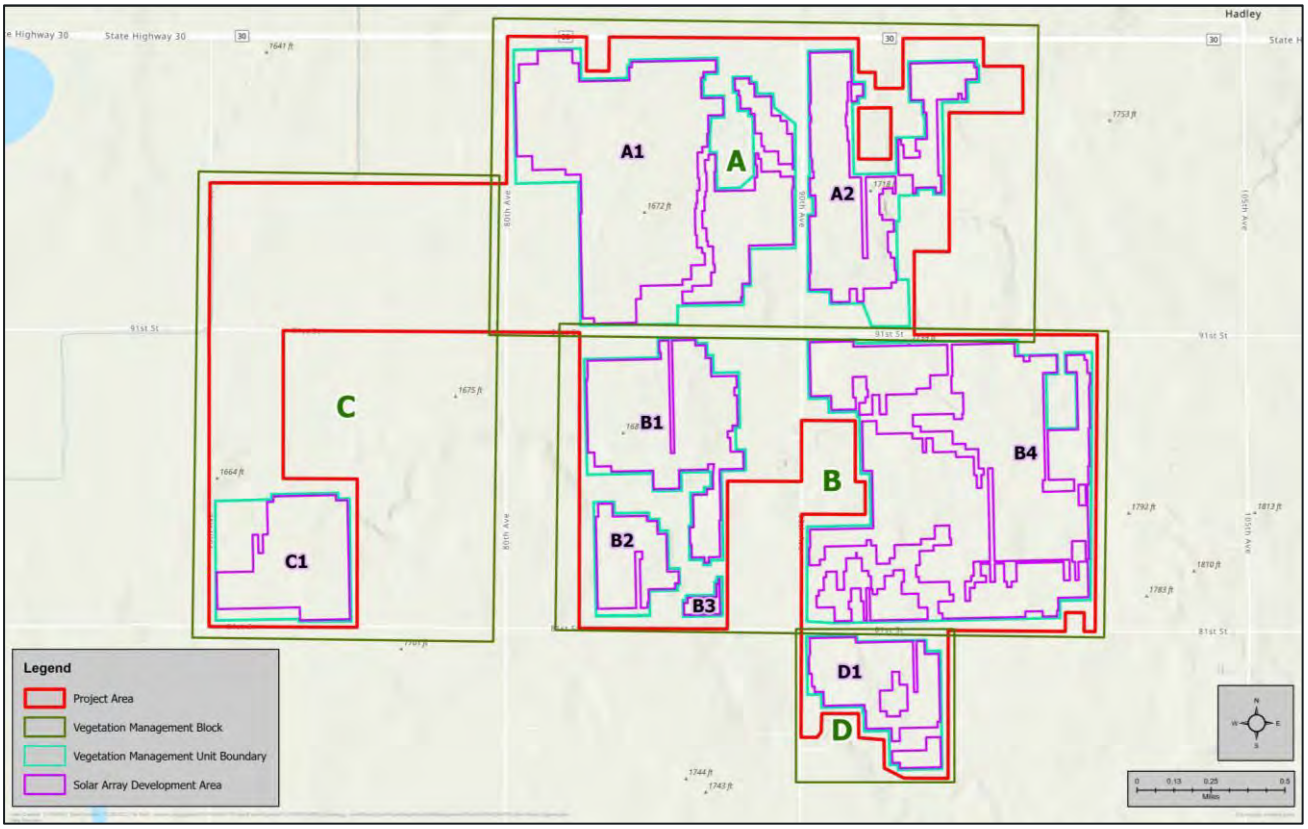


Figure 11. Overview of Vegetation Management Block and Unit Boundaries.

The area inside the fence line for each array area will be seeded using one or more of the low-growing regionally appropriate grass-dominated seed mixes provided in (Tables 3 and 4; Attachment E). These mixes are herein referred to as the Dry Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix and the Wet Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix. Attachment E contains other seed mixes that could be used as final site plans are determined such as seeding around stormwater basins and temporary seed mixes. Outside the fence line, a buffer of perennial vegetation will be established around the perimeter fence. Approximately 54 acres of buffer outside of the array fence line will be seeded to perennial vegetation using the low-growing array mixes provided in Tables 3 and 4.

Table 3. Dry mesic low growing regionally appropriate grass-dominated mix[*].

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (by Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)	Wetland Indicator
Grasses						
Bouteloua curtipendula	Side-oats Grama	1.54	5.2%	3.4	6.2%	NI
Bouteloua gracilis	Blue Grama	0.50	1.7%	7.4	13.5%	NI
Bromus kalmii	Kalm's Brome	0.5	1.7%	1.5	2.7%	FAC
Elymus canadensis	Canada Wild Rye	1.05	3.6%	1.6	2.9%	FACW
Elymus riparius	Riverbank Wild Rye	0.9	3.1%	1.0	1.7%	FACW
Koeleria macrantha	Junegrass	0.14	0.5%	9.2	16.7%	NI
Pascopyrum smithii	Western Wheatgrass	0.5	1.7%	1.3	2.3%	FACU
Schizachyrium scoparium	Little Bluestem	2	6.8%	11.0	20.0%	FACU-
Sporobolus heterolepis	Prairie Dropseed	0.19	0.6%	1.1	1.9%	FACU-
	Subtotal	7.32	24.9%	37.4	68.0%	
Sedges						
Carex bicknellii	Bicknell's Sedge	0.24	0.8%	1.6	2.8%	FAC-

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (by Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)	Wetland Indicator
Carex brevior	Plains Oval Sedge	0.18	0.6%	1.9	3.5%	FAC
Carex molesta	Field Oval Sedge	0.22	0.7%	2.0	3.6%	FAC
	Subtotal	0.64	2.2%	5.5	9.9%	
Legumes						
Trifolium pratense	Red clover	0.5	1.7%	1.6	2.9%	FACU
Trifolium repens	White clover	0.5	1.7%	4.6	8.3%	FACU
	Subtotal	1.00	3.4%	6.2	11.2%	
Cover Crop						
Avena sativa	Oats	20.42	69.5%	6.0	10.9%	
Subtotal		20.42	69.5%	6.0	10.9%	
	Total	29.38	100.0%	55.0	100.0%	

*See figures 12, 13, 14, and 15 for location where this mix is planned to be installed.

*Table 4. Wet mesic low growing regionally appropriate grass-dominated mix.**

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (by Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)	Wetland Indicator
Grasses						
Bromus kalmii	Kalm's Brome	0.5	1.2%	1.5	1.8%	FAC
Elymus virginicus	Virginia Wild Rye	1.71	4.1%	2.6	3.2%	FACW-
Glyceria canadensis	Rattlesnake Grass	0.19	0.5%	5.2	6.3%	OBL
Glyceria striata	Fowl Manna Grass	0.10	0.2%	3.3	4.0%	OBL

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (by Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)	Wetland Indicator
Muhlenbergia mexicana	Leafy Satin Grass	0.10	0.2%	6.4	7.8%	FACW
Poa palustris	Fowl Bluegrass	0.42	1.0%	20.1	24.4%	FACW+
Sporobolus heterolepis	Prairie Dropseed	0.19	0.5%	1.1	1.4%	FACU-
	Subtotal	3.21	7.6%	40.2	48.8%	
Sedges/Rushes						
Carex scoparia	Lance-fruited Oval sedge	0.07	0.2%	2.2	2.6%	FACW
Carex stipata	Common Fox Sedge	0.17	0.4%	2.1	2.6%	OBL
Carex vulpinoidea	Brown Fox Sedge	0.11	0.3%	2.1	2.6%	OBL
Juncus tenuis	Path Rush	0.05	0.1%	18.4	22.3%	FAC
	Subtotal	0.40	1.0%	24.8	30.1%	
Legumes						
Trifolium pratense	Red clover	0.25	0.6%	1.6	1.9%	FACU
Trifolium repens	White clover	0.25	0.6%	4.6	5.6%	FACU
	Subtotal	0.50	1.2%	6.2	7.5%	
Cover Crop						
Avena sativa	Oats	37.88	90.2%	11.1	13.5%	
	Subtotal	37.88	90.2%	11.1	13.5%	
	Total	41.99	100.0%	82.3	100.0%	

*See figures 12, 13, 14, and 15 for location where this mix is planned to be installed.

Collection Cables

Solar energy generation begins with the installed solar modules converting energy from sunlight into direct current (DC) electrical power. Power blocks of tracker rows, on which the modules are installed, are electrically connected in series by DC cabling, which terminate at an inverter. The DC collection cabling will be installed either underground or hung beneath the solar modules and racking. Inverters convert the DC power from the modules to AC power. AC electrical collection cables will be underground and connect the inverters to the Project Substation. Underground collection lines will be buried approximately 3 – 5 feet below ground. During construction, disturbed areas along collection lines will be re-vegetated using temporary seed mixes to maintain soil stability as discussed below in Section 4. Upon the completion of collection line installation, the ground surface will be restored to previous conditions and control of land use activities will revert to the landowner.

Planting Plan

Seed mix selection within the array fence lines and vegetated buffers initially assigned based on soil unit drainage and hydric classes. Seeding polygons were further refined to create simple seed mix polygons to facilitate installation, establishment, and maintenance activities. Seed mixes were developed for dry mesic and wet mesic conditions for both regionally appropriate grass-dominated. Table 5 provides a preliminary breakdown of perennial seed mix type across the entire project area. Vegetation management unit descriptions are provided in Section 3.2.

Table 5. Preliminary perennial seed mix totals for the LWS project area.

Vegetation Management Unit	Seed Mix (Acres)	
	Dry Mesic Low Growing Regionally Appropriate Grass-Dominated	Wet Mesic Low Growing Regionally Appropriate Grass-Dominated
VMU A1	226.8	173.1
VMU A2	181.3	--
VMU B1	130.9	27.8
VMU B2	55.1	--
VMU B3	7.6	--
VMU B4	460.5	51.1
VMU C1	92.8	31.0
VMU D1	66.1	28.4
Total	1,221.0	311.4

Table 6 provides a breakdown of acreage of non-row crop land use by block following the completion of construction activities. During construction, areas within the solar facility fence lines that are currently vegetated with perennial species that do not pose a threat to vegetation management objectives and that are not under and between arrays will be left undisturbed and managed in a manner consistent establishment and maintenance practices. An example would be existing vegetated drainages, pastures, or hayfields. Substations, battery storage facility, and switchyards will not be vegetated following construction. Those areas will be maintained as a combination of gravel and concrete surfaces.

Table 6. Proposed land use by vegetation management unit block following construction.

Management Unit Block	Array Facility (Acres)	Arrays – Under and Between Panels (Acres)	Arrays – Open Areas Between Arrays and Fence Lines (Acres)	Buffer – Outside Perimeter Fence Lines (Acres)*	Other Facility – Substation, Battery Storage (Acres)
A	559.4	463.8	95.6	21.8	0
B	709.3	573.9	135.4	23.7	0
C	119.5	86.9	23.4	4.3	9.2
D	90.2	71.6	18.6	4.4	---
Grand Total	**1,478.4**	**1,196.1**	**273.0**	**54.2**	**9.2**
Perennial Vegetation Total		**1,523.4**			**N/A**

*Buffer acreage calculated using a preliminary 20 ft-wide buffer outside of the perimeter fence. Actual width of buffer may vary based on final design, construction, and discussions with participating property owners.

3.2 Vegetation Management Unit Descriptions

Descriptions of each VMU is provided below along with a corresponding figure (Figures 12 -15, Attachment F). For demonstration purposes only in each figure, the VMU boundary shown as being offset from the perimeter fence line boundary by 50 feet. The perimeter fence lines surrounding the arrays define the physical boundary in the field. The vegetated perimeter buffer extends outward from the edge of the perimeter fence. During construction, there is potential for temporary disturbance within the vegetated buffer. Natural areas adjacent to the vegetated buffer will be avoided and protected through implementation of the practices outlined in the construction environmental practices manual (Invenergy 2022). In most cases, row-crop agriculture is anticipated to continue during the life of the permit for participating property outside of the fenced array areas. If a landowner opts to not continue row-crop agriculture, the land use management will be determined between LWS and the landowner, and any areas maintained by LWS will consist of regionally appropriate grass-dominated vegetation.

Vegetation Management Block A

Vegetation Management Unit (VMU) A1

VMU A1 is located along the northwestern corner of the project area (Figure 12). The management unit includes approximately 333 acres of solar arrays and 12 acres of vegetated buffer along the outside perimeter of the fence lines. Fifty-four acres of open space within the fence lines not under or between arrays will be vegetated. Approximately 227 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix and 173 acres will be seeded with the wet mesic low growing regionally appropriate grass-dominated mix. One delineated farmed wetland with no wetland vegetation is located within VMU A1. No arrays are proposed within the wetland boundary and will not be impacted by construction activities. The wetland will be re-vegetated with the wet mesic grass-dominated regionally appropriate seed mix. Eight field-delineated wetlands are adjacent or within proximity to VMU A1. These wetlands are outside the vegetated perimeter buffer and will not be managed as part of the facility operations. The wetlands are a combination of farmed wetlands and degraded wetland composed of invasive cool season grasses or low quality native vegetation such as horsetail. The MBS site partially within and adjacent to VMU A1 in the southeast corner of the unit was determined in the field to be currently tilled (Westwood 2022b). The delineated wetlands within the MBS are dominated by reed canary grass and nonnative narrowleaf cattail or partially cropped with cattail and barnyard grass.

VMU A2

VMU A2 is located along the northeastern corner of the project area (Figure 12). The management unit includes approximately 130 acres of solar arrays and 10 acres of vegetated buffer along the outside

perimeter of the fence lines. Forty-one acres of open space within the fence lines not under or between arrays will be vegetated. The entirety of the VMU (approximately 181 acres) will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix. One delineated wetland that is mostly unvegetated with minimal coverage of sedges and horsetail is located within VMU A2. No arrays are proposed within the wetland boundary and will not be impacted by construction activities. The wetland will be seeded with the dry mesic regionally appropriate grass-dominated seed mix. Along the southeast border of the project area and outside of the vegetated perimeter buffer of VMU A2 is a mapped Minnesota Native Plant Community that was confirmed based on field observations to meet the criteria for native prairie (Westwood 2022b). The native prairie community is invaded by smooth brome; however, a mix of native forb species are present. This area of native prairie is outside of the proposed vegetation management and project area boundaries for LWS. Preventing pesticide drift through practices described in Section 4.3, as applicable, and managing invasive species within the VMU are the best ways for LWS to protect the native prairie from impacts due to the construction and operation of the facility.

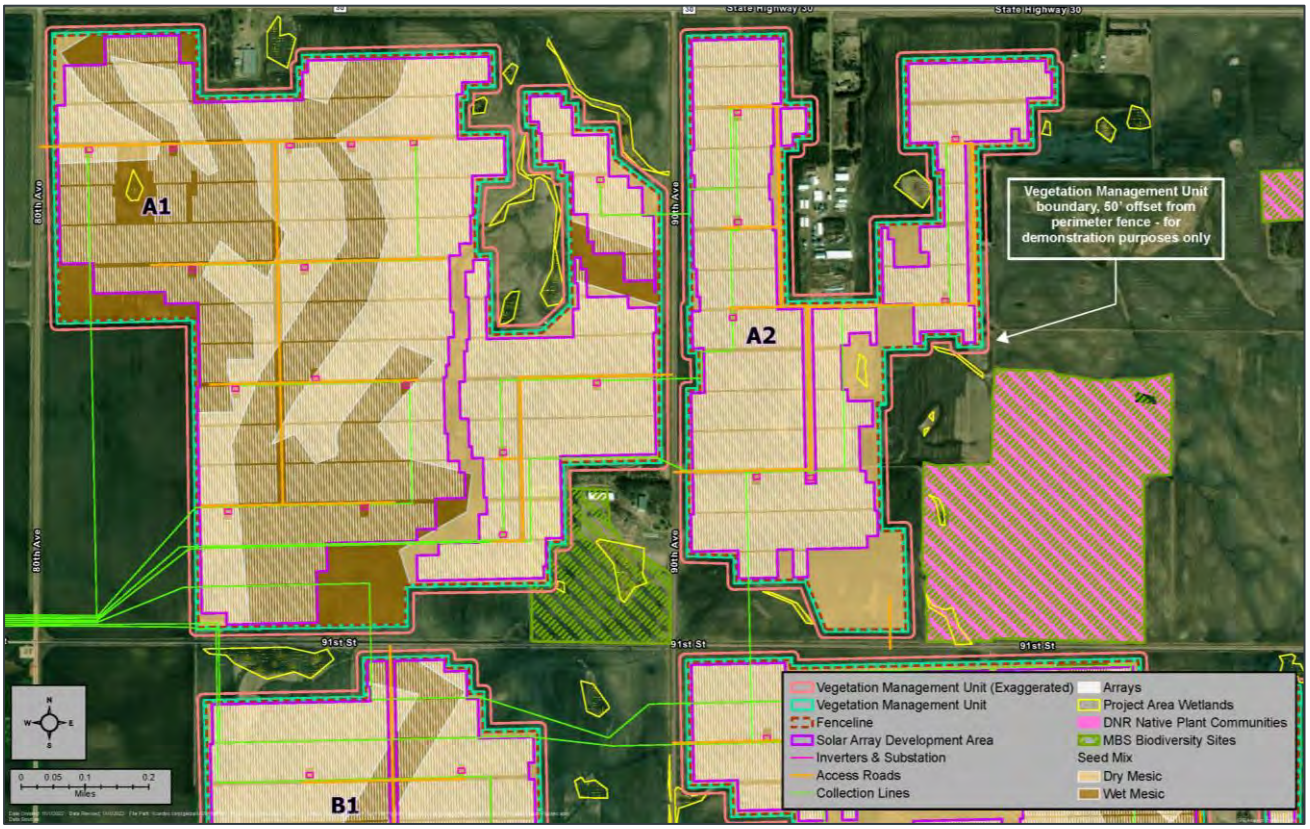


Figure 12. VMUs A1 and A2.

Vegetation Management Unit Block B

VMU B1

VMU B1 is in the central portion of the project area (Figure 13). The management unit includes approximately 137 acres of solar arrays and 7 acres of vegetated buffer along the outside perimeter of the fence lines. Fifteen acres of open space within the fence lines not under or between arrays will be vegetated. Approximately 131 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix and 28 acres will be seeded with the wet mesic low growing regionally appropriate grass-dominated mix. No delineated wetlands are located within VMU B1. Wetlands to north, east, and south of VMU B1 range from a farmed wetland to basins partially cropped or dominated by cool season invasive species. Murray County Judicial Ditch 14 and an associated reed canary grass-

dominated wetland complex is present south of VMU B1. The ditch and the wetland are outside of the vegetated perimeter buffer and will not be impacted by construction activities. The southwest corner of VMU B1 borders Carlson WMA, which is managed by MNDNR. The 26-acre property is a mix of seeded prairie, woody plantings, and a small remnant prairie. This area of native prairie is outside of the project area and proposed vegetation management boundaries for LWS. Preventing pesticide drift through practices described in Section 4.3, as applicable, and managing invasive species within the VMU are the best ways for LWS to protect the native prairie from impacts due to the construction and operation of the facility.

VMU B2

VMU B2 is in the south central portion of the project area (Figure 13). The management unit includes approximately 44 acres of solar arrays and 4 acres of vegetated buffer along the outside perimeter of the fence lines. Eight acres of open space within the fence lines not under or between arrays will be vegetated. Approximately 55 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix. No delineated wetlands are located within VMU B2. Murray County Judicial Ditch 14 and an associated reed canary grass-dominated wetland complex is present north and east of VMU B2. The ditch and the wetland are outside of the vegetated perimeter buffer and will not be impacted by construction activities.

VMU B3

VMU B3 is located on the south central boundary of the project area (Figure 13). The management unit includes approximately 5 acres of solar arrays and 1 acre of vegetated buffer along the outside perimeter of the fence lines. One acre of open space within the fence lines not under or between arrays will be vegetated. Approximately 8 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix. No delineated wetlands are located within VMU B3. Murray County Judicial Ditch 14 and an associated reed canary grass-dominated wetland complex is present north and west of VMU B3. The ditch and the wetland are outside of the vegetated perimeter buffer and will not be impacted by construction activities.

VMU B4

VMU B4 is located along the southeastern boundary of the project area (Figure 13). The management unit includes approximately 389 acres of solar arrays and 12 acres of vegetated buffer along the outside perimeter of the fence lines. One hundred eleven acres of open space within the fence lines not under or between arrays will be vegetated. Approximately 461 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix and 51 acres will be seeded with the wet mesic low growing regionally appropriate grass-dominated mix. Two delineated wetlands are located within VMU B4. One wetland is a farmed wetland and the other is a reed canary grass-dominated wetland. Both wetlands will be seeded with the dry mesic regionally appropriate grass-dominated mix after the appropriate site preparation such as an application of glyphosate during the growing season. No arrays are proposed within the wetland boundaries and will not be impacted by construction activities. Four additional wetlands are adjacent to the west and east of VMU B4. All four wetlands are outside of the vegetated perimeter buffer and are either farmed or contain reed canary grass. The wetland in the northeast corner of VMU B4 was identified as having amaranth present, which is classified as an MDA-listed noxious weed with the designation of Eradicate. Working with the landowner to eliminating the existing population prior to construction and inspecting VMU B4 for amaranth seedlings will be important to prevent the establishment and spread of an MDA-listed species.

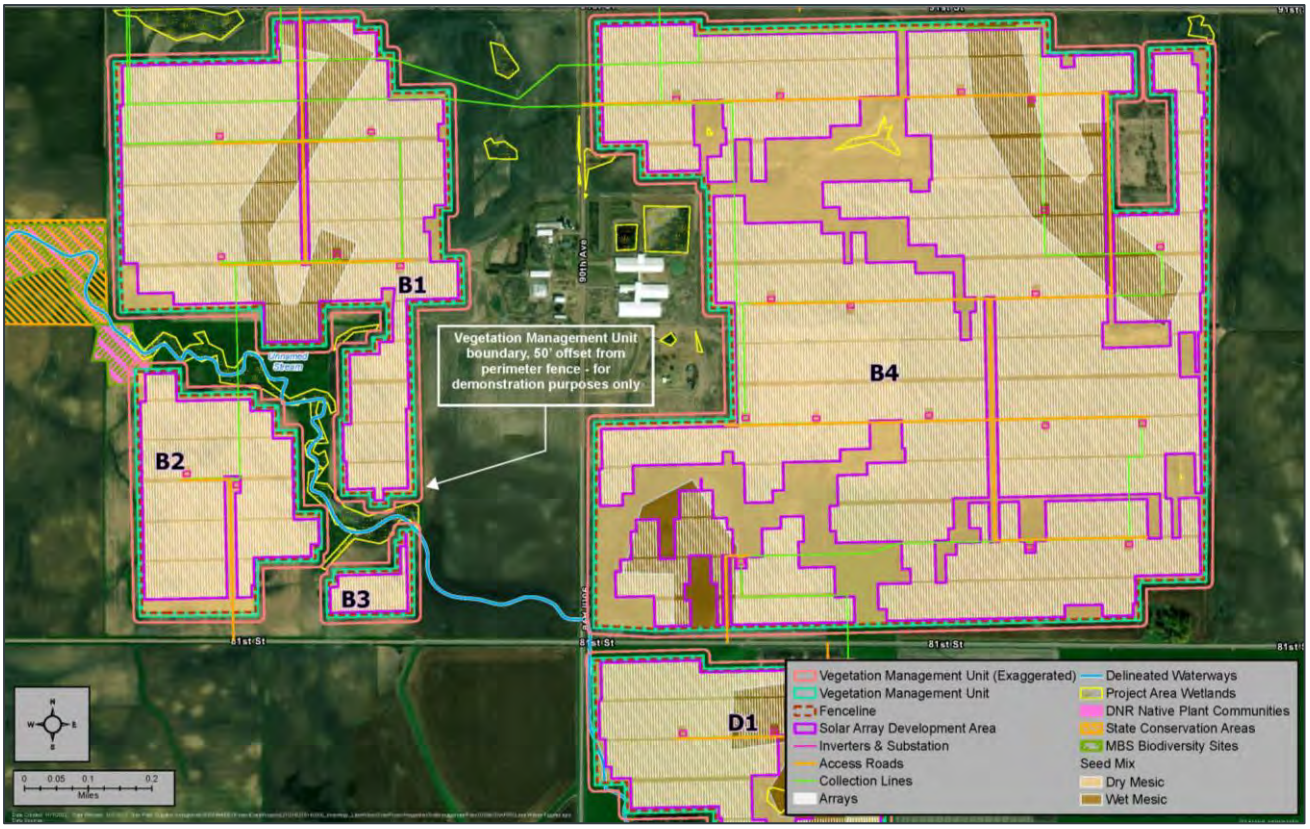


Figure 13. VMUs B1 through B4.

Vegetation Management Unit Block C

VMU C1

VMU C2 is located in the southwestern corner of the project area (Figure 14). The management unit block includes approximately 87 acres of solar arrays and 4 acres of vegetated buffer along the outside perimeter of the fence lines. Thirty-three acres of open space within the fence lines not under or between arrays will be vegetated. Approximately 93 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix and 31 acres will be seeded with the wet mesic low growing regionally appropriate grass-dominated mix. No delineated wetlands are located within VMU C1. There is one delineated farmed wetland to the north of VMU C2 adjacent to proposed collection lines.

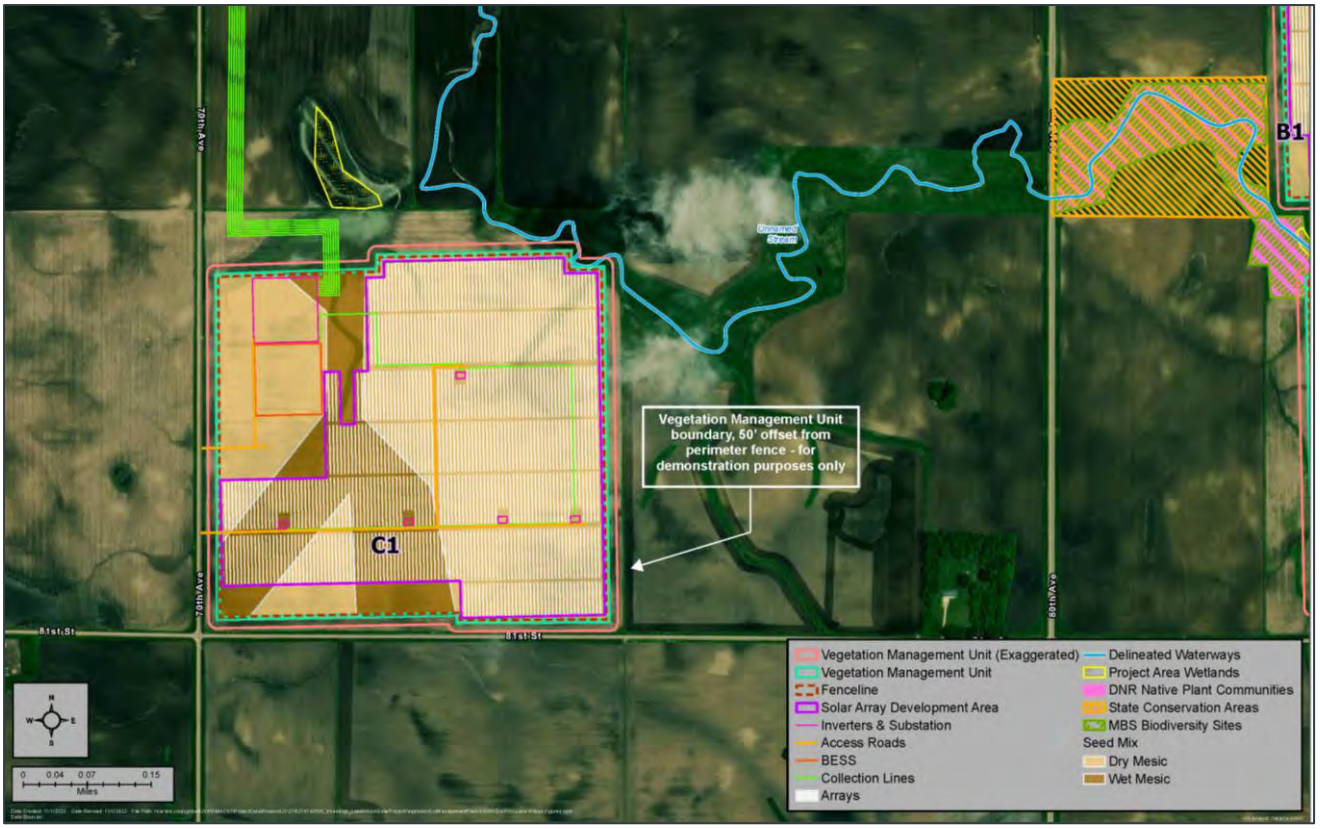


Figure 14. VMU C1.

Vegetation Management Unit Block D

VMU D1

VMU D1 is located in the southern-most boundary the project area (Figure 15). The management unit includes approximately 72 acres of solar arrays and 4 acres of vegetated buffer along the outside perimeter of the fence lines. Nineteen acres of open space within the fence lines not under or between arrays will be vegetated. Approximately 66 acres of the VMU will be seeded with the dry mesic low growing regionally appropriate grass-dominated mix and 28 acres will be seeded with the wet mesic low growing regionally appropriate grass-dominated mix. One delineated wetland consisting of nut sedge and cattails was identified within the boundary of VMU D1. The wetland will be seeded with the wet mesic regionally appropriate grass-dominated mix after the appropriate site preparation such as an application of glyphosate during the growing season. No arrays are proposed within the wetland boundary and will not be impacted by construction activities. A Minnesota Native Plant Community was mapped; however, a field review determined that it did not qualify as native prairie because it was heavily invaded by Kentucky bluegrass and smooth brome (Westwood 2022b). There were native forbs such as Canada goldenrod and common milkweed present. Preventing pesticide drift through practices described in Section 4.3, as applicable, and managing invasive species in the VMU are the best ways for LWS to protect this natural area from impacts due to the construction and operation of the facility.

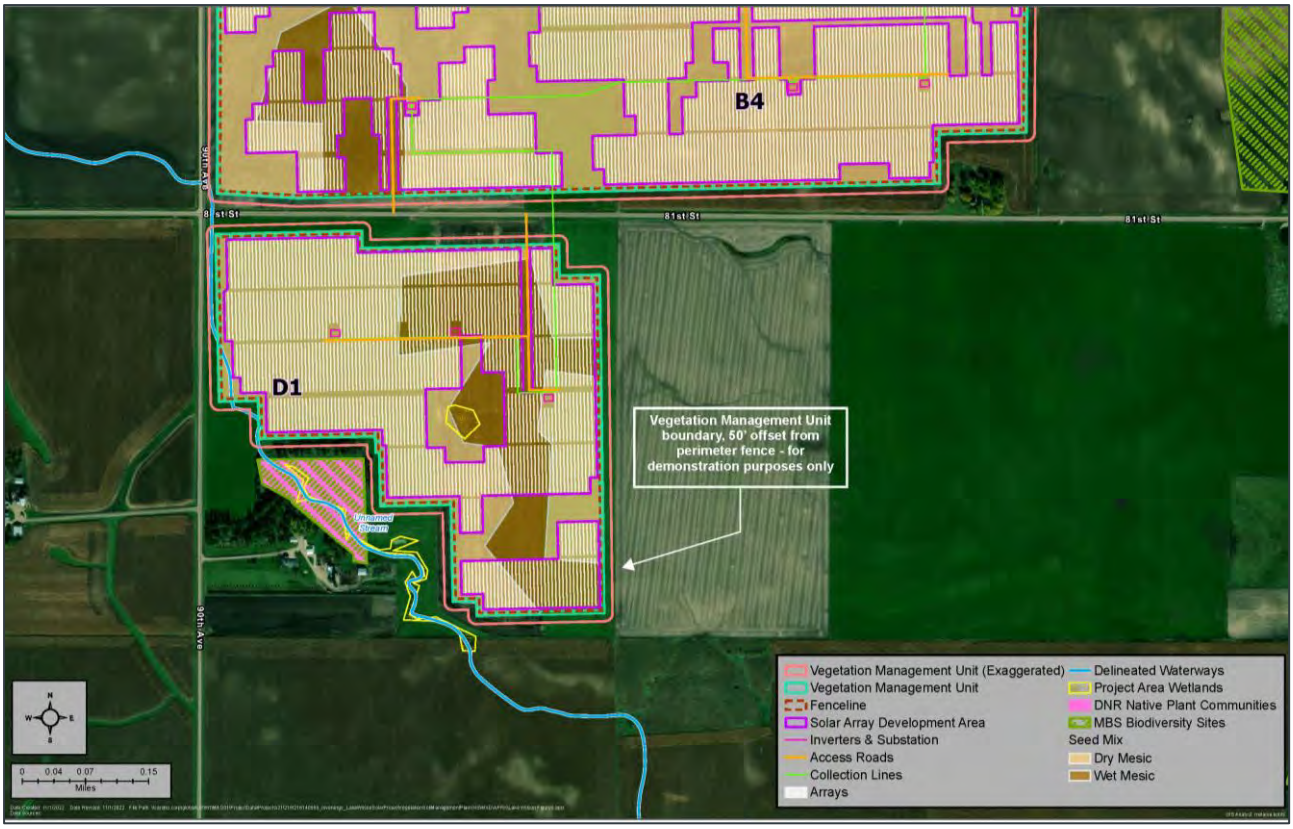


Figure 15. VMU D1.

3.3 Vegetation Management Unit Objectives

All vegetation management units have the same pre-construction/construction phase, short-term establishment and long-term management objectives.

Pre-construction/Construction Phase Objectives

Pre-construction is defined as the period that begins when Lake Wilson Solar Energy LLC assumes control of parcels within the proposed project area to the initialization of construction activities associated with the solar facility. Construction is the period when the solar facility infrastructure is being installed. Construction activities can include, but not limited to, access road construction, array and collection cable installation, and fencing. At this time, construction is anticipated to begin for the Lake Wilson Solar project in the second quarter of 2024 with expected completion by the end of 2025.

The following are the objectives for vegetation and soil management during the pre-construction phase prior to the installation of any solar facility assets or land disturbing activities:

- In areas where no civil construction (grading) is required as part of the construction activities, establish the designated Dry Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix or the Wet Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix to initiate long-term perennial vegetation during the soonest available optimal seeding window to increase the probability of successful vegetation establishment.

Construction schedule and sequencing will be an important driver for the seed mixes used to meet pre-construction/construction objectives. For example, in areas where no civil construction is required and the pre-construction period allows for the establishment of perennial vegetation prior to construction, final low-

growing regionally appropriate seed mixes (Dry Mesic – Array and Vegetated Buffer Regionally Appropriate Grass – Dominated Seed Mix or the Wet Mesic – Array and Vegetated Buffer Regionally Appropriate Grass – Dominated Seed Mix) will be used. In areas where no civil construction is required and the pre-construction period does not allow for adequate perennial vegetation establishment prior to construction, temporary seed mixes would be used until the completion of construction in that area. Section 4.1 provides greater detail on the use of temporary seed mixes for soil and erosion control throughout the construction phase of the project.

Perennial seed mixes were developed by referencing the guidelines outlined in MNDNR (2020) *Prairie Establishment and Maintenance Technical Guidance for Solar Projects* and multiple MN BWSR seed mixes including low-growing array mixes and seed mixes developed by native plant nurseries within the state for similar site conditions and proposed plant communities.

Each low-growing grass-dominated seed mix has the following characteristics:

  - A minimum seeding rate of 40 seeds/sqft
  - Seven or more grass/sedge species with at least 2 species of bunchgrass
  - Provides a combination of cool season grasses, warm season grasses, sedges/rushes that have a component of species that are shade tolerant.

- In areas where civil construction (grading) is required as part of the construction activities, establish and maintain a designated temporary seed mix until grading is complete to provide soil stabilization and compliance with SWPPP conditions. If construction activities extend beyond the life cycle of a temporary seed mix, consider re-seeding areas, as necessary.

The following are the objectives for vegetation and soil management during the construction phase:

- In areas where perennial vegetation was established during the pre-construction phase, manage vegetation in a manner that supports remaining compliant with SWPPP conditions including mowing, herbicide applications, and re-seeding areas disturbed by construction activities.
- In areas where civil construction requires grading or land disturbance, establish the designated Dry Mesic or the Wet Mesic Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix following the completion of grading activities and prior to the installation of solar facility assets such as arrays, collection cables, or fences. Use typical vegetation management practices such as mowing, spot spraying, and re-seeding to minimize establishment of MDA-listed noxious weeds.
- In areas where establishing the Dry Mesic or the Wet Mesic Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix immediately following the construction phase is not possible, use a temporary seed mix to remain compliant with SWPPP conditions and then establish permanent regionally appropriate grass-dominated vegetation during the soonest available optimal seeding window to increase the probability of successful vegetation establishment. Use typical vegetation management practices such as mowing, spot spraying, and re-seeding to minimize establishment of MDA-listed noxious weeds.

Post Construction Phase Objectives

Establishment and maintenance phases occur over the course of years. Demonstrating incremental progress towards a desired objective is important. Table 7 provides a summary of performance criteria for the components of vegetation cover for both short-term and long-term objectives. Phase year benchmarks are included as a reference to measure during monitoring and to demonstrate trends or progress towards meeting and maintaining the long-term management objectives. Actual vegetation performance against reference year benchmarks will be used as indicator of the success of current vegetation management or the need for additional management or resources.

Table 7. Summary of performance criteria for components of vegetation cover during reference points during establishment and maintenance phases of LWS facility operation.

Phase	End of Growing Season Reference Year	Perennial Cover (Overall)	Perennial Cover (Regionally appropriate Species)	MDA-listed Noxious Weed Cover	Invasive Weedy Species Cover
Establishment	Year 2	>30%	>20%	<10%	<50%
	Year 4	>50%	>40%	<5%	<30%
	Year 5	>70%	>50%	<5%	<15%
Maintenance	Year 6+	>90%	>70%	<5%	<15%

Short-term Establishment Objectives

Short-term establishment objectives are defined as the desired conditions for vegetation management units in Years 0 to 5 immediately following construction activities and focus on establishing perennial regionally appropriate vegetation. Specifically, short-term establishment objectives include:

- Establish or maintain a temporary seed mix with greater than 70% vegetation cover during the seasonal periods each year when conditions are not conducive to establishing perennial vegetation to meet or exceed requirements of the project NDPES permit. This primarily includes areas that have not undergone initial perennial re-vegetation during pre-construction or construction phases
- In areas that have not been re-vegetated with a perennial seed mix during the pre-construction or construction phase, install the designated regionally appropriate seed mix within the first 6 months following construction during the soonest available optimal seeding window to increase the probability of successful vegetation establishment.
- During Years 1 and 2, use mowing to reduce annual weed competition, minimize MDA-listed noxious weed species to less than 10% cover, minimize weedy species (See Table 9 in Section 4.1 for a list of invasive species) to less than 50% cover and establish 30% or greater perennial vegetation cover.
- During Years 1 and 2, use seasonal inspections and annual monitoring to identify areas where re-seeding may be required. Consider modifying or supplementing seed mixes to match local-scale conditions as additional information about the site is obtained. For example, supplemental re-seed areas with the low-growing wet mesic seed mix in areas that end up being wetter than planned.
- By Year 4, establish 50% or greater perennial vegetation cover with less than 5% MDA-listed noxious weed species and less than 30% weedy species cover.

- Use spot-spraying with the appropriate herbicides to reduce and control weed species that cannot be controlled through mowing practices to less than 20% total cover.
- By the end of Year 5, perennial vegetation cover will be 70% or greater with 50% or greater cover from regionally appropriate species. MDA-listed species will be 5% or less of total cover and weedy species will be 15% or less of total cover.
- By the end of Year 5, reduce the number and need for mowing and herbicide treatments as a form of weed control, if possible, because each vegetation management unit has well-established low-growing regionally appropriate grass sod (or regionally appropriate grasses and forbs, where planned).

Long-term Management Objective

Long-term management objectives are defined as the desired conditions for vegetation management units in Year 6 to the end of the permit and will focus on maintaining regionally appropriate, perennial vegetation. Specifically, long-term management objectives include:

- Maintain 90% or greater perennial vegetation cover including 70% or greater regionally appropriate grass-dominated vegetation cover or regionally appropriate grasses and forbs, where planned within each vegetation management unit as mapped using prescribed mowing, spot-spraying, and supplemental seeding to minimize MDA-listed noxious weed species. MDA-listed species will be 5% or less of total cover and weedy species will be 15% or less of total cover.
- Initiate vegetation management activities if invasive weedy species cover becomes 20% or greater and/or MDA-listed noxious weed cover becomes 10% or greater to maintain meeting long-term management objectives.

4 Vegetation Establishment and Management Prescriptions

4.1 Site Preparation

Site Preparation Sequence

Most of the area within each vegetation management unit is row-crop agriculture, either corn or soybeans. Depending on construction timing, row-crops may be harvested prior to construction, mowed down to remove vegetation, or not planted, if construction occurs between fall and late spring. In agricultural settings, annual weed species are typically the most common problem prior to initiating re-vegetation efforts. Site preparation and the sequence of activities will ultimately be determined when construction starts. Temporary and perennial vegetation seed mixes, herbicide treatments, and mowing will be used in combination to prepare the site for re-vegetation while keeping soil stabilized during construction and reducing the establishment of noxious or invasive species that will be detrimental to both short-term and long-term vegetation establishment and maintenance. Table 8 provides guidance for a planned schedule and sequence of site preparation activities under different construction start scenarios. This table along with consultation from a qualified vegetation management professional will be used to develop the appropriate prescription based on the final project schedule. Table 12 and Section 4.3 provide additional information about preferred annual seeding time periods for temporary and perennial seeding, respectively.

Table 8. Site preparation sequence and activities based on construction start period.

Pre-construction Period	Pre-construction Site Conditions – Seeding Preparation	Pre-construction Seeding	Construction Start
Spring	Previous row-crop – None Winter crop - Harvest winter crop	Perennial seed mix in optimal seeding window – Areas that will not be graded (April 1 – June 30) Temporary seed mix (spring/fall seed mix) – Areas to be graded (April 1 – June 1)	Summer
Summer	Terminate row-crop – Mow, disk or herbicide application	Perennial seed mix in optimal seeding window – Areas that will not be graded (June 30 – August 1 Not recommended – Assess current seasonal weather trends; Monitor and prepare for supplemental seeding) Temporary seed mix (summer seed mix) – Areas to be graded (May 1 – August 15)	Fall
Fall	Harvest row-crop	Perennial seed mix in optimal seeding window – Areas that will not be graded (September 10 – October 31, less than ideal; November 1 – Frozen conditions; when soil temperature is 40°F or less) Temporary seed mix (spring/fall seed mix) – Areas to be graded (August 1 – September 15)	Winter or spring
Winter	Previous row crop - None	Perennial seed mix in optimal seeding window – Areas that will not be graded (February 15 – April 7 – Frost Seeding; Complete when snow depth is 1 ft or less) Temporary seed mix (winter mix) – Areas to be graded	Spring

Pre-construction Period	Pre-construction Site Conditions – Seeding Preparation	Pre-construction Seeding	Construction Start
		(September 1 – November 15)	

Soil Handling

Within a vegetation management unit, grading may be required to provide flat surfaces for the installation of arrays (Attachment D). Grading contractors will be responsible for segregating and stockpiling topsoil and grading spoils, the excess material generated from construction activities, by soil layer. Excess material will be placed in a manner that preserves soil health and integrity. Typically, this will entail spreading subsoils first and then placing topsoil material over subsoils. Excavation and grading requiring trenching (temporary disturbance of the ground to bury facility infrastructure) will segregate soil material by layer and re-fill trenches in the reverse order the soil layer was encountered so that topsoil layer is placed at the surface and depth of topsoil is maintained as much as possible.

Mitigation of Soil Compaction Prior to Seeding

To minimize soil compaction, grading and facility contractors will use areas proposed as access roads as much as possible for travel. Following construction activities and prior to the installation of regionally appropriate seed mixes, areas of heavy use such as the laydown yard may be tilled or ripped to alleviate soil compaction and then disked to provide a uniform surface. Depending on a combination of soil conditions, the time elapsed between disking and seeding, and methods used for seeding, rolling the seedbed with a cultipacker may be necessary. A qualified vegetation management professional will be consulted for recommended techniques for each vegetation management unit prior to seeding.

Wet areas such as in hydric soil units will be avoided to the extent practicable to minimize compaction and de-compaction activities. The AIMP provides greater detail about activities to alleviate compacted soils.

Seedbed Preparation

Potential steps for seedbed preparation are ultimately determined by the timing of the end of construction and the installation of the regionally appropriate seed mix. Prior to seeding, a survey of pesticide use by the previous farm operators should be completed to determine if potential pesticide carryover will be an issue that prevents or impacts regionally appropriate seed germination rates. In locations where carryover may be a potential, the extended use of temporary cover crops or other carryover resistant vegetation may be required until the residual effect potential has decreased. A qualified vegetation management professional should be consulted to determine the potential for pesticide carryover. Table 9 provides potential seedbed preparation activities based on the timing and conditions of the vegetation management units post-construction.

Table 9. Seedbed preparation activities based on seedbed conditions prior to seeding.

Pre-Seeding Seedbed Conditions	Potential Seedbed Activities
Not compacted, bare ground (Typical tilled row-crop field)	• Cultipacking to firm seed bed, depending on seed installation technique and equipment.
Harvested row-crop field	• Soybeans – None.

Pre-Seeding Seedbed Conditions	Potential Seedbed Activities
	• Corn – Mowing stalks to mulch corn stover or raking and baling to remove corn stover.
De-compacted, no existing vegetation (Areas where grading occurred)	• Disk to provide uniform surface when post-grading surface would impact seed installation or growth. • Cultipacking to firm seed bed, depending on seed installation technique and equipment.
Not compacted, temporary seed mix present, no large areas of annual or perennial weeds	• Spot spray areas of annual or perennial weeds to reduce competition and prevent weed establishment. • Depending on life stage and density of temporary seed mix, consider spraying, mowing, or rolling prior to or immediately after seeding to terminate crop, reduce competition and provide mulch layer for regionally appropriate seeding.
Not compacted, sparse to no temporary seed mix present, extensive areas of annual or perennial weeds	• Broadcast spray with a non-selective, non-residual herbicide such as glyphosate to reduce weed competition.
Existing vegetation is temporary cover crop that includes species such as winter wheat.	• Broadcast spray with a non-selective, non-residual herbicide such as glyphosate to terminate crop either prior to or immediately after seeding.
Existing vegetation is pasture/hayland, but **NOT** native sod	• Broadcast spray with a non-selective, non-residual herbicide such as glyphosate to reduce vegetation competition.
Wet areas with existing invasive vegetation or bare ground.	• Broadcast spray within a non-selective, non-residual herbicide such as glyphosate. Consult a qualified vegetation management professional to determine if a wetland-approved formulation is required based on site conditions.
Existing vegetation is NATIVE sod	• Do not impact the sod and consult a qualified vegetation management professional.

Invasive Species Prevention

Invasive plant species, including MDA-listed noxious weeds and other weedy species such as reed canary grass, can negatively impact desired vegetation establishment and management for extended periods of time and prevent accomplishing vegetation management goals and objectives. MDA-listed noxious weeds (Table 10) are plant species designated under state law that require some form of control or eradication by landowners, if present and requested by state or local officials. Failure to comply with a formal request to control or eradicate can result in the landowner being responsible for the financial cost of work performed by others at the request of the inspecting governmental unit.

Table 10. MDA-listed Noxious Weeds

MDA-listed Noxious Weed Species			
Eradicate – Not currently known to be present or widely distributed in the state. If found, all above and belowground parts must be destroyed. Transportation, propagation, or sale is prohibited by law.			
Black swallow-wort	Dalmatian toadflax	Japanese honeysuckle	Palmer amaranth
Brown knapweed	Diffuse knapweed	Japanese hops	Poison hemlock
Common teasel	Giant hogweed	Meadow knapweed	Tree of heaven
Cutleaf teasel	Grecian foxglove	Oriental bittersweet	Yellow starthistle
Control – Established throughout or in regions of the state. If found, control efforts shall focus on preventing the spread, maturation, and dispersal of propagating parts such as seeds, rhizomes, and root parts. Herbicide applications that reduces the local abundance or mowing that prevents seed formation would be control techniques. Transportation, propagation, or sale is prohibited by law.			
Bohemian knotweed	Giant knotweed	Non-native phragmites	Wild parsnip
Canada thistle	Japanese knotweed	Plumeless thistle	
Common barberry	Leafy spurge	Purple loosestrife	
Common tansy	Narrowleaf bittercress	Spotted knapweed	
Restricted – Widely distributed in the state and is detrimental to human and animal health or the environment, but feasible control is limited to prohibiting importation, sale and transportation. **(Presence of restricted-listed species on-site will not require management action by law; however, due to the widespread distribution and negative impact to natural communities, control or management actions for these species is highly recommended to achieve the desired vegetation conditions for the Project.)*			
Amur honeysuckle	Crown vetch	Japanese barberry cultivars	Siberian peashrub
Bell's honeysuckle	European alder	Morrow's honeysuckle	Tatarian honeysuckle
Black locust	Garlic mustard	Multiflora rose	Wild carrot/Queen Anne's lace

MDA-listed Noxious Weed Species			
Common or European buckthorn	Glossy buckthorn	Porcelain berry	

Invasive plant species are primarily non-native, but sometimes native plant species that can be aggressive and outcompete other plant species. Table 11 provides a list of plant terrestrial plant species that MNDNR considers to be invasive to natural areas (https://www.dnr.state.mn.us/invasives/terrestrialplants/index.html#text-1-4).

Table 11. Non-native Terrestrial Plants Considered by MNDNR to be Potentially Invasive in Natural Areas.

Flowering plants			
Birdsfoot trefoil	Cow vetch and hairy vetch	Hoary alyssum	Poison hemlock
Bull thistle	Creeping Charlie	Leafy spurge*	Queen Anne's lace*
Butter and eggs	Crown vetch or axseed*	Musk or nodding thistle	Spotted knapweed*
Canada thistle*	Erect hedgeparsley	Orange hawkweed	White and yellow sweet clover
Common tansy*	Garlic mustard*	Oxeye daisy	Wild parsnip*
Grasses			
Amur silver grass	Reed canary grass	Smooth brome grass	
Trees and shrubs			
Amur cork tree	Buckthorn*	Non-native knotweeds	Siberian pea shrub
Amur maple*	Japanese barberry*	Norway maple*	Winged burning bush*
Autumn olive	Multiflora rose*	Russian olive	
Black locust	Non-native bush honeysuckles*	Siberian elm	

*Denotes species is also an MDA-listed noxious weed, but not required to be eradicated, if found.

The best strategy is to make prevention and control from the start of construction activities a priority. Strategies to reduce invasive (weedy) species during construction include:

- Require construction equipment comes to the construction site free of soil and existing vegetation and leaves the site free of soil and existing vegetation.
    - Have contractors self-inspect all equipment arriving and departing from the site and prepared to provide proof of inspection upon request.
    - Designate wash stations for cleaning equipment and monitor cleaning areas for invasive species.
- Survey construction areas and adjacent lands prior to construction to determine the presence of MDA-listed noxious weeds, other invasive plants species, and native vegetation. Identify in project maps and with signage areas where noxious weeds or native vegetation is located to prevent equipment from picking up and spreading seed and plant parts or disturbing native vegetation to make it more susceptible to invasive species establishment.
- Monitor the site on a seasonal basis to identify, map and treat areas where invasive species are present.
    - In areas of known invasive species, make herbicide treatment a priority before regionally appropriate seed is installed.

When vegetating areas with a history of row-cropping, both annual and perennial noxious weeds and invasive plant species will be a primary threat to successfully establishing vegetation due to existing seedbanks and the potential for seed sources in adjacent row-crop areas. Mowing and herbicide treatments that are completed prior to seed development are effective means to control annual weed species and reduce the spread of perennial weed species. Well-established regionally appropriate grass-dominated vegetation (years 6+) may be less susceptible to invasive species establishment; however, it is anticipated that invasive species management will be an on-going priority for vegetation management throughout the lifetime of the project. Within the LWS project area, the period between construction and vegetation maintenance is when the vegetation management units will be most vulnerable to invasive species establishment.

4.2 Temporary Vegetation

Temporary seed mixes are likely to be used extensively during the pre-construction, construction, and post-construction phases when conditions or timing does not allow for the installation and establishment of perennial vegetation. Temporary seed mixes serve multiple purposes such as soil stabilization, reduce weed pressure, and provide a nurse crop/mulch to regionally appropriate seedings. Temporary seed mixes were developed that include multiple species to increase the likelihood that temporary vegetation will grow on a variety of site and seasonal conditions (Table 12 and Attachment E). MN BWSR 2019 *Native Vegetation Establishment and Enhancement Guidelines*, Minnesota NRCS guidance (USDA 2018), and resources available through the University of Minnesota Extension were referenced when developing temporary seed mixes. The success of seedings that occur between October 15 and April 1 (fall to dormant season seeding) will ultimately be dependent on seasonal weather conditions that influence soil temperature and soil moisture. Fall and dormant season temporary seed mix seedings may need to be monitored the following spring to determine germination rate and winter kill. Areas may be re-seeded, as necessary. Seeding rates should be increased by 50% when broadcast seeding is used and/or cultipacking or dragging is not used to incorporate the seed into the soil.

Table 12. Temporary seed mixes proposed for areas where perennial vegetation is not immediately available (See Attachment E for detailed seed mix information).

Seed Mix	General Recommended Seeding Dates*
Spring-Fall Season	April 1 – June 1 August 1 – September 15
Summer Season	May 1 – August 15
Winter Season	September 1 – November 15

*Determine appropriate mix based on seasonal trends and conditions.

To reduce competition from temporary cover crops to perennial vegetation germination, cover crops should be terminated with a non-selective, non-residual herbicide such as glyphosate prior to seed installation or immediately after installation.

4.3 Perennial Vegetation Seeding and Planting

Two factors that are important to a successful seeding is the timing of the seeding and the equipment used. Based on the Dry Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix and the Wet Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix proposed for each vegetation management unit, MN BWSR recommends the following dates:

- February 15 to April 7, when broadcast frost seeding
- April 1 to June 30, after soil temperature is above 60^{O} F
- After November 1, in particular when soil temperatures are below 60^{O} F

In areas not stabilized with perennial vegetation during the pre-construction or construction phases, temporary seed mixes are likely to be used to vegetate or maintain vegetated management units vegetated until a regionally appropriate seeding window is available.

Regionally appropriate seeding can be completed through either drill-seeding or broadcast seeding. Likely, there may be a combination of techniques used given the size of the project area, timing of seeding, and effectiveness of equipment around arrays. Contractors may use no-till drills that are specialized for installing regionally appropriate seed to increase the probability of a successful seeding. Example manufacturers include Truax or Great Plains. Regionally appropriate seed may be broadcast using a Vicon or equivalent spreader. It is recommended that areas broadcast seeded are rolled with a cultipacker to improve seed-to-soil contact. Seed rates (PLS lbs/acre) listed in Tables 3 and 4 and Attachment E should be increased by 1.5 times the rate when seed is installed via broadcast seeding and/or cultipacking is not an option (USDA 2016).

Seed availability through commercial vendors can vary year to year based on market demand, previous year's growing conditions, and individual species seed production. For the Lake Wilson Solar project, seed for designated mixes will be required over several years and include the pre-construction, construction, and vegetation establishment phases. Species substitutions based on limited availability will likely be necessary. When selecting substitutions for designated mixes, it is important to consider the plant functional group that a species belongs to and select species from same group. For example, if a warm season grass species is unavailable, a different warm season grass species with a similar plant height should be selected and not a cool season grass.

MN BWSR and Minnesota Department of Transportation (MNDOT) maintain and annually update an approved seed substitution list for many regionally appropriate species based on querying approved seed vendors. If one or more species are not available or are available at limited quantities, these lists should be referenced to select appropriate substitutions. Using the MN BWSR and MNDOT substitution lists helps to ensure that plant species substitutions are made within the same functional groups. Nurseries specializing in native plants can also provide recommendations for substitutions. Proposed substitutions will need to be approved by LWS Solar Energy LLC staff prior to installation.

Array and Vegetated Buffer Planting

One of the objectives for seeding within the array and buffer areas is to install a regionally appropriate grass-dominated seed mix that is influenced by the guidelines outlined in the Minnesota Department of Natural Resources (2020) *Prairie Establishment and Maintenance Technical Guidance for Solar Projects.* To accomplish this, Lake Wilson Solar Energy LLC is proposing to establish low-growing, regionally appropriate grass-dominated seed mixes with the following characteristics, which were informed by the 2020 MNDNR guide:

- A minimum seeding rate of 40 seeds/sqft
- Seven or more grass/sedge species with at least 2 species of bunchgrass
- Provides a combination of cool season grasses, warm season grasses, sedges/rushes that have a component of species that are shade tolerant

Tables 3 and 4 and Attachment E provides detailed tables on the proposed seed mixes including species name, seeding rate, and seeds/sqft. Seed mixes were developed from consulting MN BWSR's Low Growing Solar Array Mix – Southwest seed mix and Low Growing Solar Array Moist Soils-South and various other regionally available regionally-appropriate seed mixes. Figures 12 through 15 generally

delineate where the two different seed mixes should be used throughout the proposed re-vegetation areas based on the current facility design.

As part of the Adaptive Management program (See Section 5.3), modifications to seed mixes, especially during the establishment phase, may be required based on greater understanding of local or micro-scale site conditions, climatic trends, individual species performance, and market availability. Decisions about potential species substitutions, additions, or subtractions will be based on a combination of the following:

- Maintaining a minimum seeding rate that has shown to be effective in establishing vegetative cover on recently disturbed surfaces.
- Maintaining species functional group composition when substitutions are required.
- Referencing recognized sources of information for acceptable substitutions and seed mix design such as MNDNR and MN BWSR.
- Integrating lessons learned about vegetation management from others within solar energy industry.

Stormwater Detention Area Planting

In areas designated as stormwater detention areas within each vegetation management unit, MN BWSR's Stormwater South and West will be used (Attachment E). Vegetation management around stormwater detention areas will be similar to other vegetation management techniques; however, due to the potential for ponded water or wet conditions, equipment access may be limited with more work being conducted by hand. Qualified vegetation management professionals should have the equipment and expertise to address the needs of these areas to establish and maintain the regionally appropriate plant community.

Pesticide Drift

The project area is located within an intense agricultural landscape. There is the potential for landowner use of pesticides outside of vegetation management units. Impacts due to pesticide drift to the vegetation within the arrays are reduced using the following practices:

- Establish and maintain a buffer composed regionally appropriate low growing grass-dominated buffers along the outside perimeter of the fence lines.
- Adjacent landowners will be annually notified of the importance of avoiding pesticide drift. Impacts due to pesticide drift will be recorded during seasonal inspections and annual monitoring. Landowners will be notified that repeated impacts to LWS vegetation due to pesticide drift will result in the landowner paying for re-seeding and establishment costs.

4.4 Pre-Construction and Construction Phase Practices (Prior to Year 0)

As previously discussed, construction may take one or more years before it is complete. However, one of the goals and objectives for the overall project is to vegetate as many acres as possible to a perennial low-growing regionally appropriate cover type by establishing the Dry Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix and the Wet Mesic - Array and Vegetated Buffer Regionally Appropriate Grass - Dominated Seed Mix during the pre-construction phase. To accomplish this, re-vegetation will focus on areas that do not require grading prior to installing facility infrastructure. Vegetation management within areas of management units that have been seeded with a perennial seed mix during the pre-construction phase will be managed in a similar fashion to short-term establishment practices described in Section 4.5. Mowing, spot spraying, and re-seeding disturbed areas are the likely main tools that will be used. Construction activities such as running over vegetation with equipment, localized excavation to install posts for arrays, or burying collection lines may cause limited disturbance that may require additional re-seeding. The need to re-seed will be managed on a case-by-case basis.

Temporary seed mixes will be used to stabilize soil and remain compliant with SWPPP conditions in areas that require grading prior to installing facility infrastructure. The need to re-seed areas with temporary seed mixes during the construction phase is anticipated when the temporary seed mix is at the end of its life cycle and/or when ground disturbing activities occur, but the next optimal seeding window for perennial vegetation does not occur for several months.

It may be the case where within a management unit block is a mosaic of perennial vegetation, temporary seed mixes, and areas under active construction. Each vegetation type will be managed in the appropriate manner until the entire management unit can be transitioned into the short-term establishment period (Year 0).

4.5 Short-Term Establishment Practices (Years 0 – 5)

The period between regionally appropriate seed and plant installation (Year 0) through the fourth or fifth growing season (Year 5) is typically defined as the establishment period. The key priorities for establishment during this time period include:

- Reducing competition from annual weeds that shade out or smother regionally appropriate plant seedlings.
- Preventing the establishment of perennial invasive or noxious species.
- Re-seeding in areas where vegetation is not establishing or is impacted by herbicide applications necessary to control invasive species.

Understanding the expectations for vegetation during the establishment period is an important factor in success and determine vegetation management actions. Many plant species native to this area are deep-rooted to access moisture during hot, dry summer months and to store energy during the winter months. Typically, the first growing season or two, seedlings invest a lot of energy in root growth while maintaining sparse above ground vegetation. In Years 2 and 3, there is a marked increase in above ground vegetation density and abundance increases to the point that it can shade out annual plant species and more easily compete with invasive species.

Mowing

Mowing during the establishment period is typically the most common and cost-effective strategy for controlling weed species. Table 13 provides mowing guidelines for both timing and maintaining vegetation heights. It is important to adjust the timing of mowing based on an individual year. Spring and summer weather conditions ultimately determine when mowing should occur. Mowing too frequently or too low of a height can negatively impact regionally appropriate vegetation and make establishment more difficult. However, mowing after annual and perennial weed species have set seed is counterproductive for long-term vegetation management. The finished mowing height for each mowing event during the establishment period should be determined prior to mowing and should consider the life cycle and percent cover of weedy species present. In other words, finished mowing height should be driven by current vegetation performance. Feedback from seasonal inspections and annual monitoring will help to determine finished mowing heights during the establishment period.

A qualified vegetation contractor will have the experience and the equipment to correctly mow regionally appropriate plantings. Using a mower that does not windrow thatch that can smother regionally appropriate seedlings or can be set at the appropriate height such as a flail or rear-discharge mower is key. In the event of a build-up of thatch, raking and haying may be considered.

During the short-term establishment period, areas under the arrays will be mowed once annually at a minimum. Mowing frequency after the second growing season for areas outside of the arrays will be based on vegetation conditions and quality. Either seed mix areas may be mowed when the vegetation is

at the appropriate height and mowed down to the appropriate level. In stormwater detention areas, hand trimming or low ground pressure equipment may be used to prevent rutting and ground disturbance.

Specialized mowing equipment may be used around and under arrays. Additionally, hand work using brush cutters and strip trimmers may be necessary to access difficult areas around arrays and in wet areas where equipment would cause vegetation disturbance.

During the establishment phase, mowing typically occurs throughout the entire site. Within a vegetation management unit, it may be possible that some areas require spot mowing on a more frequent basis because of the presence of fast-growing weed species. Conversely, there may areas that require less mowing due to both sparse and weedy vegetation or that desired vegetation quickly develops and becomes well-established. The vegetation will be inspected during the growing season to inform appropriate mowing and herbicide management. Frequent mowing required to manage weedy plant species in particular areas during and after the third growing will be a potential trigger to determine if supplemental seeding is required due to a lack of regionally appropriate vegetation establishment.

Table 13. Potential mowing conditions and specifications during the short-term establishment period for vegetation management.

Initial Mowing	Mowing Height	Mowing Period	Mowing Triggers
Late spring/early summer when vegetation reaches a height of 12 – 18 inches	Finished height of 4 – 6 inches during first growing season. Continue mowing to finished height of 4 – 6 inches in Years 1 – 4, as necessary based on weed pressure. Finished height of 8 – 12 inches during Year 5, if not sooner based on weed pressure.	May – November, typically two events per growing season	Flowering annual weeds Dense annual vegetation with a height of 12 – 18 inches.

Herbicide Application

Herbicide application following seed installation and during the establishment period is likely to primarily be spot spraying to prevent large areas devoid of vegetation being created. Spot spraying consists of using low volume equipment applied manually through either backpack sprayers or equipment mounted hand sprayers. Localized broadcast spraying can occur in instances when weeds and invasive species are present in patches large enough or dense enough that off-target damage to regionally appropriate vegetation can be justified given the benefit to long-term management. Areas treated with herbicide may be mapped and accessed to determine if supplemental seeding is required.

Two important considerations to herbicide applications include herbicide selection and herbicide timing. Table 14 provides a list of preferred herbicides to use during vegetation establishment and maintenance periods. Herbicide formulations and labeled uses are constantly being updated so Table 14 should not be considered a comprehensive list. Herbicide applicators should read and understand the herbicide label and apply at labeled rates to labeled species. Additionally, the use of herbicides that have a residual

effect should be avoided to prevent unintended impacts to perennial seed germination and persistence. None of the herbicides listed in Table 12 are classified as neonicotinoids, a class of insecticide that is believed to have a negative impact on pollinating insects.

Table 14. Commonly used herbicide for vegetation management of non-turf and non-agricultural areas. Note, none listed are neonicotinoids, which should not be used for vegetation management within solar seedings.

Herbicide – Active Ingredient (Common Trade Names)	Description	Potential Uses and Notes
Glyphosate (Round-up, Rodeo, Accord, AquaNeat, Touchdown)	Non-selective herbicide effective against both grasses and broadleaf plants	Used to chemically burn down a site or spot spray weeds Misuse or overuse on vegetated areas can lead to the need to re-seed because it is non-selective Limited to no soil residual activity that impacts future growth of plants Available in aquatic-approved formulations that can be used over or near standing water
Aminopyralid (Milestone)	Selective herbicide effective against many invasive broadleaf and brush species	Limited impacts to grass species Limited impacts to native broadleaf species
Clopyralid (Transline, Stinger)	Selective herbicide used to control many broadleaf weeds and some woody species in grass-dominated plantings	Limited impacts to grass species, but does impact legumes such as clover Residual activity that impacts future plant growth Average cost for herbicide is lower than aminopyralid (Milestone) Can be less effective than other similar herbicides; however commonly used Should not be used in regionally appropriate grass and forb seeding areas OR adjacent to native plant communities within the project area and adjacent to the project area.

Herbicide – Active Ingredient (Common Trade Names)	Description	Potential Uses and Notes
Triclopyr (Vaslan, Garlon 3a, Garlon 4)	Selective herbicide used to control brush and other broadleaf weeds	Limited impacts to grass species No residual soil activity that impacts future plant growth Available in aquatic-approved formulations (amine formulation – Garlon 3a) that can be used over or near standing water Ester formulation (Garlon 4a) can be mixed with basal oil for basal bark or cut stump treatment
Imazapyr (Habitat, Arsenal, Chopper)	Non-selective herbicide used for control of broad range of grasses and broadleaf plants	Residual activity in the soil that prevent growth of plants for limited time Do not apply anywhere within drip line of any desirable trees and shrubs Use on a case-by-case basis based on vegetation management activity objectives

Since the majority of the vegetation management units will be seeded to a regionally appropriate grass-dominated seed mix, the use of broadleaf-specific herbicides will be effective against many noxious and invasive plant species while minimizing the opportunity to off-target damage to regionally appropriate grass vegetation. Herbicide applications will be timed when the plants are actively growing and with enough time prior to a precipitation event so that the herbicide can be absorbed or become rainfast. Seasonally, herbicide applications can be timed to occur early in the growing season before many regionally appropriate grass species have started to grow or after the growing season has ended for many warm season species, but while many cool season species such as reed canary grass are still actively growing. This seasonal timing helps to minimize off-target damage.

Supplemental Seeding

When perennial vegetation establishment has not reach at least 70% coverage, supplemental seeding will be required. Vegetation monitoring detailed in Section 5 will determine if and/or where supplemental seeding is required. The necessity for supplemental seeding does not indicate that the initial seeding was a failure. Supplemental seeding will occur during the same seeding windows as described in Table 10. Potential areas that are candidates for supplemental seeding include:

- Areas where localized broadcast herbicide application occurred
- Areas with observed hydrology requiring either wetter or drier species

During monthly inspections and annual monitoring, areas where supplemental seeding will be required will be mapped and considered during the annual review of the adaptive management program. Repeated supplemental seedings in the same general vicinity may indicate that a change in management techniques, soil amendments, or seed mix may be required.

4.6 Long-Term Maintenance Practices (Years 6+)

In Year 6, a well-managed regionally appropriate seeding typically transitions from establishment to maintenance. The transition from the establishment phase to maintenance phase will be marked by having 70% or greater perennial vegetation established throughout the site. The key feature of the transition is a decrease in the amount of time and resources dedicated to working towards achieving the desired vegetation management outcomes. By Year 6, vegetation should be positively trending towards meeting the objective set in the VSMP. For the LWS project area, this means:

- Desired vegetation succeeding in the appropriate locations throughout the project area.
- Meeting or exceeding vegetation standards outlined in the long-term vegetation objectives.
- Using inspections and monitoring to trigger proactive management actions that keeps the facility's vegetation meeting the management objectives.

Year 6 through the end of the permit period is referred to as the maintenance period because regionally appropriate plant species have evolved to persist in the environment through a wide range of conditions. However, maintenance does not infer maintenance-free. Regionally appropriate vegetation in the project area represents a grass-dominated or prairie conditions. Grass-dominated plant communities and prairies are disturbance-dependent and help to maintain plant community health. Disturbances were historically provided by both wild and human-set fires, drought, and grazing herds of large herbivores. Mowing within the vegetation management units will likely be the main form of disturbance.

Mowing

Mowing during the long-term maintenance period varies from the establishment period in frequency and desired outcome. The desired outcome for establishment period mowing is to reduce competition. During the maintenance period it is to simulate disturbance. Table 15 provides guidelines for mowing during the maintenance period. The mowing frequency is reduced during the maintenance period when compared to the establishment period; however, the number of mowing events in the maintenance period may increase if vegetation grows to a height that impacts solar energy capture by the arrays. Mowing that generates thatch that may be detrimental to vegetation growth will be collected as part of the mowing activity or addressed by using equipment that minimizes thatch accumulation.

Table 15. Guidelines for mowing during the maintenance period.

Mowing Period	Mowing Height	Frequency	Mowing Triggers
Prior to May 31 and after August 1 to minimize impacts to grassland nesting birds	Finished height of 4 – 6 inches	Annually to once every 2 – 3 years	• Vegetation exceeds 18 inches, which has the potential to shade panels • Presence of woody vegetation seedlings • Accumulation of thatch and dead stems that represent a fire hazard • Vegetation that does not look healthy or vigorous. • Desired perennial vegetation cover is less than 70% of total vegetation cover. • Weedy or annual species compromise greater than 40% of the total vegetation cover.

Mowing one-third of a vegetation management unit every year on a rotational basis and avoiding mowing in the same area in consecutive years provides refugia for pollinator species using the thatch layers for overwintering, nesting, or egg laying while also providing habitat for grassland birds that prefer a range of cover densities and thatch thickness. Mowing only one-third of a management unit every year also reduces the overall maintenance budget.

The feasibility of setting a rotation mowing program that results in up to two-thirds of the perennially vegetated areas mowed once every three years to create refugia for pollinators and grassland birds will be evaluated several years into the maintenance period (potentially Year 7 or 8) after observations have been obtained on the typical growth height within the given site conditions. Ultimately, the potential to create refuges will depend on the annual growth rate, height of the vegetation, the potential to impact solar energy captured by the arrays, or the creation of unsafe working conditions for the operations personnel.

Currently grazing by livestock and haying are not proposed management activities. In the event that either is considered in the future, Lake Wilson Solar Energy LLC will assess the current state of knowledge to determine their suitable and best management practices before implementation.

Woody Vegetation Control

The establishment of woody vegetation within the arrays and along fence line perimeter borders when not used for visual screening is a potential negative impact to facility infrastructure through shading of both the solar panels and the regionally appropriate grass vegetation.

Mowing will likely control most woody vegetation seedlings, if conducted annually during the establishment phase and every two to three years during the maintenance phase. Additional woody vegetation control techniques include:

- Hand cutting with brush saws and chainsaws around arrays and fence lines where mowing does not do an effective job and trees and shrubs are reaching waist height or greater. Many tree species will continue to re-sprout so herbicide may be applied to the cu stump.
- Applying a foliar herbicide to the leaves using a spot spray treatment technique during the growing season. This is typically an effective treatment for dense stands of small saplings that are difficult to mow and hand cut. Care will be taken to avoid overspray and off target damage to existing vegetation.

Herbicide Application

Similar to the establishment period, herbicide applications during the maintenance period are likely to primarily be spot spraying using low volume backpack sprayers and equipment-mounted hand sprayers. Herbicide selection and timing are similar between establishment and maintenance period. Regular inspections throughout each entire vegetation management unit will identify areas for treatment. Completing multiple inspections throughout the growing season will identify species and areas needing treatment that may not have been an issue earlier in the year.

Supplemental Seeding

Ideally, supplemental seeding will be minimal during the maintenance phase because the vegetation should be well-established; however, annually, it is likely that due to herbicide applications, operation, and maintenance activities, or changing conditions, that a small amount of supplemental seeding may be required. It is important to be prepared to supplemental seed to avoid allowing invasive species to get established in bare ground or sparsely vegetated areas.

Agricultural Areas included in Project Area and Planned for Future Facility Expansion

As previously discussed, areas outside of fenced array areas and the designated vegetated buffers will likely remain in agricultural production. Lake Wilson Solar Energy LLC will inform landowners of the importance of preventing pesticide drift onto regionally appropriate vegetation, implementing practices that protect soil health, and managing noxious and invasive plant species.

5 Vegetation Monitoring and Adaptive Management

5.1 During Construction

Qualified vegetation management professionals will monitor construction practices that maintain soil health including reducing impacts due to construction such as compaction, soil erosion, soil separation and storage, and stormwater runoff. Qualified vegetation management professionals will also be able to identify, and report weed establishment and proliferation as part of monitoring events, which will be important to avoid weed problems that negatively impact vegetation conditions outlined in the objectives section.

5.2 Post-Construction

Post-construction will focus on collecting data that indicates when the NPDES permit may be closed out and on informing establishment management activities. Specifically, the monitoring program will focus on collecting data on percent cover represented by regionally appropriate species (both seeded and volunteer), annual species, perennial species, and noxious/invasive species. The highest priority for vegetation management is to achieve and maintain 70% or greater perennial vegetation coverage to terminate the NPDES permit (Goal 1). Understanding the development of perennial cover over time and the species that comprise the vegetation cover will inform annual management activities such as re-seeding, mowing, or spot herbicide applications.

The monitoring program will include two components: multiple inspections and annual monitoring. During the growing season, multiple inspections will occur throughout the project area. Inspections will be completed by a qualified vegetation management professional with the intent to determine the current state of vegetation and confirm/update vegetation management activities for the current growing season. Inspections will be a combination of meander surveys through management units and as needed, observations to address troublesome areas. Inspection reports will be developed that include areas inspected, representative photos, outcomes of previous management activities, and prescriptions for future management activities. Inspection reports will be kept internally within the LWS project team; however, inspection reports will be summarized in the annual monitoring report.

Annual monitoring will consist of a timed meander survey through each vegetation management unit. The meander survey will be modified based on procedures in Bohnen and Galatowitch (2016). During the time meander survey, species observed along with an estimate of cover class will be recorded. Representative photos during each meander survey will be taken and spatially linked. Each timed meander survey route will be at least 30 minutes long. The number of routes will vary based on the size of the vegetation management unit, but will follow guidelines in Bohnen and Galatowitch (2016):

- One route for each management unit 5 acres or less.
- Two routes for each management unit between 5 and 59 acres in size.
- One route for every 30 acres in management units between 60 and 300 acres in size.
- Ten or more routes in management units 300 acres in size.

Monitoring will occur late in the growing season annually in the first five years and continue on an annual basis through the remaining period of the permit. Monitoring late in the growing season allows for an understanding of the effects of the previous and current management activities while setting the basis for the following year's work. A monitoring report will be developed by January 31 of the following year.

As part of the adaptive management program, monitoring data and monitoring protocols will be evaluated every 3 to 5 years to determine if the monitoring program needs to be updated. Rationale for updating the protocol could include:

- Changes to reporting requirements for permit compliance and/or participation in voluntary programs such as Habitat Friendly Solar.
- Need for different information to effectively inform management decisions.
- New developments in technology or data analysis such as unmanned aerial vehicles, artificial intelligence, and data cloud processing.

5.3 Adaptive Management

Adaptive management is the process of collecting data about the response to management actions and incorporating new information to make future decisions. An adaptive management program will consist of the following elements:

- Following annual monitoring in the first six years, if a vegetation management unit is not meeting its objectives, developing a work plan for a vegetation management unit block that includes proposed management actions to achieve the project objectives. This could be as simple as a one to two page worksheet.
- Recording management actions completed during the growing season, environmental conditions such as temperatures and rainfall, and activities that impacted vegetation.
- Incorporating changed management actions into vegetation management unit work plans in response to new information and/or techniques.

Adaptive management decisions will be informed by a qualified vegetation management professional. The impact of using an adaptive management approach will be observed based on the description of the existing site conditions in the post-construction long-term management phase.

6 References

Bohnen, J, and S Galatowitsch. "Restoration Evaluation Project vegetation Monitoring Tool University of Minnesota"..https://www.lccmr.leg.mn/pm_info/restoration_evaluations/Restoration_Evaluation_Project_Vegetation_Monitoring_Tool.pdf.

Invenergy 2022. Construction environmental plan for utility-scale solar facilities.

Minnesota Department of Commerce. 2021. Guidance for developing a vegetation establishment and management plan for solar facilities. https://mn.gov/eera/web/project-file/11702/.

Minnesota Department of Natural Resources. 2020. Prairie establishment and maintenance technical guidance for solar projects. https://files.dnr.state.mn.us/publications/ewr/prairie_solar_tech_guidance.pdf

Oslund FT, Johnson RR, Hertel DR. 2010. Assessing wetland changes in the Prairie Pothole Region of Minnesota from 1980 to 2007. Journal of Fish and Wildlife Management 1(2):131–135; e1944-687X. doi: 10.3996/122009- JFWM-027.

USDA NRCS. 2018. Minnesota Agronomy Technical Note No. 33 Cover crop seeding guide. https://efotg.sc.egov.usda.gov/api/CPSFile/392/340_MN_GD_Agronomy_Technical_Note_2018

USDA NRCS. 2016. Minnesota Agronomy Technical Note No. 31 Herbaceous vegetation establishment guide. https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd1294635&ext=pdf

Westwood Professional Services (Westwood). 2022a. Site characterization study Lake Wilson Solar Project. Prepared for Lake Wilson Solar Energy LLC.

Westwood Professional Services (Westwood). 2022b. Native prairie desktop assessment and field survey Lake Wilson Solar Project, Murray County, Minnesota. Prepared for Lake Wilson Solar Energy LLC.

Westwood Professional Services (Westwood). 2022c. Wetland and waterway delineation report Lake Wilson Solar Project Murray County, Minnesota. Prepared for Large Lake Wilson Solar Energy LLC.

Lake Wilson Solar Project

ATTACHMENT A

HABITAT FRIENDLY PROGRAM SCORECARD PLANNING PHASE

BWSR

Habitat Friendly Solar Site Assessment Form for Project Planning

For solar companies and local governments to meet Habitat Friendly standards
5-26-2020

1) PLANNED % OF SITE DOMINATED BY NATIVE SPECIES COVER (wildflowers, grasses, sedges, shrubs, trees)

- ☐ 26-50% +5 points
- ☐ 51-75% +10 points
- ☒ 76% and above +15 points

Total points 15

2) PERCENT OF PROPOSED SITE VEGETATION COVER TO BE DOMINATED BY WILDFLOWERS (not grasses and sedges)

- ☒ 10-20 % +5 points
- ☐ 21-30 % +10 points
- ☐ 31% and above +15 points

Total points 5

Note: Projects may have "array" mixes and diverse border mixes; forb dominance should be averaged across the entire site. The dominance should be calculated from total numbers of forb seeds vs. grass seeds based on seeds per square foot(from all seed mixes to be planted).

3) PLANNED COVER DIVERSITY (# of species in seed mixes; numbers from upland and wetland mixes can be combined)

- ☐ 10-19 species +5 points
- ☒ 20-25 species +10 points
- ☐ 26 or more species +15 points

Total points 10

4) PLANNED SEASONS WITH AT LEAST 3 BLOOMING SPECIES PRESENT (check/add all that apply)

- ☐ Spring (April - May) +10 points
- ☐ Summer (June - August) +5 points
- ☐ Fall (September - October) +5 points

Total points 0

See BWSR Pollinator Toolbox about bloom season.

5) AVAILABLE HABITAT COMPONENTS WITHIN SITE OR WITHIN .25 MILES (check/add all that apply)

- ☒ Native bunch grasses for nesting +3 points
- ☐ Native flowering shrubs +4 points
- ☒ Clean, perennial water sources +3 points
- ☐ Created nesting feature/s (bee blocks, etc.) +4points

Total points 6

6) SITE PLANNING AND MANAGEMENT

- ☒ Detailed establishment and management plan (see notes) developed with funding/ contract to implement. +15 points
- ☒ Signage legible at forty or more feet stating pollinator friendly solar habitat (see notes for number of signs). +5 points

Total points 20

7) SEED MIXES

- ☒ Mixes are composed of at least 40 seeds per square foot. +5 points
- ☒ All seed genetic origin within 175 of site (see notes). +8 points
- ☐ At least 1% milkweed cover to be established from seed/plants. +10 points

Total points 13

8) INSECTICIDE RISK

- ☐ Planned on-site insecticide use or pre-planting seed/plant treatment (excluding buildings/electrical boxes, etc.). -40 points
- ☒ Communication with local chemical applicators/neighbors about need to prevent drift from adjacent areas (see notes). +10 points

Total points 10

Grand Total 79

Gold Standard - Provides Exceptional Habitat 85+

Meets Pollinator Standards 70

Project Name: Lake Wilson Solar
Vegetation Consultant: Mark Pranckus, Cardno
Project County: Murray
Project Size: 1,533 acres
Projected Seeding Date: TBD

See notes related to the question on the back side of this form.

Lake Wilson Solar Project

ATTACHMENT B

SOIL CHARACTERISTICS OF MAPPED SOIL UNITS

Summary of SSURGO data provided by NRCS Web Soil Survey, accessed September 2022.

Map unit symbol	Map unit name	Acres in AOI	Percent of AOI	Drainage Class Rating	Farmland Classification	Flooding Frequency	Erodibility	Hydric Class
J106B	Barnes-Buse-Svea complex, 1 to 6 percent slopes	429.60	16.4%	Well drained	All areas are prime farmland	None	Moderate	Predominantly Non-Hydric
J107A	Lakepark-Roliss-Parnell, depressional, complex, 0 to 3 percent slopes	395.74	15.1%	Poorly drained	Prime farmland if drained	None	Slight	Predominantly Hydric
J101B	Hokans-Svea complex, 1 to 4 percent slopes	310.82	11.9%	Well drained	All areas are prime farmland	None	Moderate	Predominantly Non-Hydric
J11A	Vallers clay loam, 0 to 2 percent slopes	280.67	10.7%	Poorly drained	Prime farmland if drained	None	Slight	Predominantly Hydric
J96C2	Barnes-Buse complex, 6 to 12 percent slopes, moderately eroded	164.06	6.3%	Well drained	Farmland of statewide importance	None	Severe	Not Hydric
J31B	Arvilla-Sandberg complex, 2 to 6 percent slopes	150.33	5.7%	Somewhat excessively drained	Not prime farmland	None	Slight	Not Hydric
J232B	Barnes-Buse-Arvilla complex, 2 to 6 percent slopes	137.72	5.3%	Well drained	All areas are prime farmland	None	Moderate	Not Hydric
J23A	Lamoure silty clay loam, 0 to 2 percent slopes,	135.16	5.2%	Poorly drained	Prime farmland if protected from flooding or	Occasional	Slight	Predominantly Hydric

Map unit symbol	Map unit name	Acres in AOI	Percent of AOI	Drainage Class Rating	Farmland Classification	Flooding Frequency	Erodibility	Hydric Class
	occasionally flooded				not frequently flooded during the growing season			
J104A	Svea loam, 1 to 3 percent slopes	93.29	3.6%	Moderately well drained	All areas are prime farmland	None	Slight	Predominantly Non-Hydric
J235C2	Buse-Barnes-Arvilla complex, 6 to 12 percent slopes, moderately eroded	70.16	2.7%	Well drained	Farmland of statewide importance	None	Severe	Not Hydric
J1A	Parnell silty clay loam, depressional, 0 to 1 percent slopes	61.77	2.4%	Very poorly drained	Prime farmland if drained	None	Slight	Hydric
J26B	Darnen loam, 2 to 6 percent slopes	54.64	2.1%	Well drained	All areas are prime farmland	None	Moderate	Predominantly Non-Hydric
J57A	Balaton loam, 1 to 3 percent slopes	53.26	2.0%	Moderately well drained	All areas are prime farmland	None	Slight	Predominantly Non-Hydric
J12A	Marysland loam, 0 to 2 percent slopes	41.06	1.6%	Poorly drained	Prime farmland if drained	None	Slight	Predominantly Hydric
J195B	Poinsett-Waubay silty clay loams, 1 to 6 percent slopes	33.07	1.3%	Well drained	All areas are prime farmland	None	Moderate	Predominantly Non-Hydric
J100D2	Buse, eroded-Wilno complex, 12	31.80	1.2%	Well drained	Not prime farmland	None	Severe	Not Hydric

Map unit symbol	Map unit name	Acres in AOI	Percent of AOI	Drainage Class Rating	Farmland Classification	Flooding Frequency	Erodibility	Hydric Class
	to 18 percent slopes							
J42C	Sandberg-Arvilla complex, 6 to 12 percent slopes	27.01	1.0%	Excessively drained	Not prime farmland	None	Moderate	Not Hydric
J196A	Forada loam, 0 to 2 percent slopes	24.25	0.9%	Poorly drained	Prime farmland if drained	None	Slight	Predominantly Hydric
J77A	Lamoure silty clay loam, 0 to 2 percent slopes, frequently flooded	19.86	0.8%	Poorly drained	Not prime farmland	Occasional	Slight	Predominantly Hydric
J105A	Arvilla sandy loam, Till Prairie, 0 to 2 percent slopes	16.73	0.6%	Somewhat excessively drained	Farmland of statewide importance	None	Slight	Predominantly Non-Hydric
J7B	Sverdrup sandy loam, 2 to 6 percent slopes	15.49	0.6%	Well drained	Farmland of statewide importance	None	Slight	Predominantly Non-Hydric
J75B	Renshaw-Fordville loams, coteau, 2 to 6 percent slopes	15.21	0.6%	Somewhat excessively drained	All areas are prime farmland	None	Slight	Not Hydric
J32A	Bigstone silty clay loam, depressional, 0 to 1 percent slopes	12.43	0.5%	Very poorly drained	Prime farmland if drained	None	Slight	Hydric
J199A	Fulda silty clay, 0 to 2 percent slopes	12.13	0.5%	Poorly drained	Prime farmland if drained	None	Slight	Predominantly Hydric
J17A	Quam silty clay loam,	11.27	0.4%	Very poorly drained	Prime farmland if drained	None	Slight	Hydric

Lake Wilson Solar Project

ATTACHMENT C

SOIL SAMPLING RESULTS

Map unit symbol	Map unit name	Acres in AOI	Percent of AOI	Drainage Class Rating	Farmland Classification	Flooding Frequency	Erodibility	Hydric Class
	depressional, 0 to 1 percent slopes							
J227D2	Buse, moderately eroded-Sandberg complex, 12 to 18 percent slopes	10.44	0.4%	Well drained	Not prime farmland	None	Severe	Not Hydric
J8A	Egeland sandy loam, 0 to 2 percent slopes	4.72	0.2%	Well drained	All areas are prime farmland	None	Slight	Predominantly Non-Hydric
J75A	Fordville loam, coteau, 0 to 2 percent slopes	4.16	0.2%	Well drained	All areas are prime farmland	None	Slight	Not Hydric
J8B	Egeland sandy loam, 2 to 6 percent slopes	2.55	0.1%	Well drained	All areas are prime farmland	None	Slight	Not Hydric
J95F	Buse, stony-Wilno complex, 25 to 40 percent slopes	1.35	0.1%	Well drained	Not prime farmland	None	Severe	Not Hydric
Totals for Area of Interest		**2620.8**	**100.0%**					

Results from soil samples collected throughout the project area.

Sample No.	Estimated Soil Texture	Organic Matter (%)	pH	Phosphorus (ppm)	Potassium (ppm)	Zinc (ppm)	Iron (ppm)	Manganese (ppm)	Copper (ppm)
SS-01	Coarse	4.5	8.0	7.0	135.0	1.4	12.6	4.0	0.9
SS-02	Coarse	2.7	8.2	8.0	97.0	1.5	9.3	3.3	0.5
SS-03	Coarse	4.5	6.3	14.0	78.0	1.3	66.4	14.4	0.9
SS-04	Coarse	3.5	7.4	21.0	105.0	1.0	16.7	7.3	0.6
SS-05	Coarse	6.0	7.7	3.0	76.0	1.2	10.4	2.3	0.8
SS-06	Coarse	4.1	6.9	2.0	80.0	1.2	41.8	12.1	1.0
SS-07	Medium	5.4	6.6	26.0	119.0	2.7	94.6	8.8	0.9
SS-08	Medium	3.8	5.9	32.0	116.0	1.5	70.1	16.5	0.9
SS-09	Coarse	2.3	8.2	4.0	76.0	1.0	6.5	2.2	0.4
SS-10	Coarse	3.3	8.1	6.0	68.0	0.5	5.9	2.1	0.4
SS-11	Medium	8.6	7.9	10.0	95.0	2.4	21.4	2.8	0.8
SS-12	Coarse	3.9	8.3	16.0	60.0	0.5	26.6	2.8	0.4

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page	**1**
Report No.	**80431**
Laboratory No.	**159684**
Date Received	**10/20/21**
Date Reported	**10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:
C (coarse): sand, loamy sand, sandy loam
M (medium): loam, silt loam
F (fine): clay loam, silty clay loam, silty clay

Scale	Organic Matter	Soluble Salts	pH	Olsen P	Bray 1 P	K	Zn	Fe	Mn	Cu
Very High								F		
								F		
	O					K	Z	F		
	O		H			K	Z	F		
	O		H			K	Z	F	M	
	O		H			K	Z	F	M	
	O		H	P		K	Z	F	M	
	O		H	P		K	Z	F	M	
	O		H	P		K	Z	F	M	C
Very Low	O		H	P	P	K	Z	F	M	C

(Organic matter scale: HIGH / MED / LOW; Soluble salts scale: PROBLEM / EXCESSIVE / OK; pH scale: 9, 8, 7, 6, 5, ALKALINE / ACID)

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
1	**Coarse**	**4.5**		**8.0**			**7**	**1**	**135**		**1.7**	**12.6**	**4.0**	**0.9**			

RECOMMENDATIONS **Crop Before Last: Corn, Silage; Last Crop: Corn, Silage**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**40**	**10**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **2**
Report No. **80431**
Laboratory No. **159685**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:
C (coarse): sand, loamy sand, sandy loam
M (medium): loam, silt loam
F (fine): clay loam, silty clay loam, silty clay

Item	Interpretation level
Organic Matter	O (Low)
Soluble Salts	
pH	H (8+, Alkaline)
Olsen Phosphorus	P (5 bars)
Bray 1 Phosphorus	P (1 bar)
Potassium	K (6 bars)
Zinc	Z (8 bars)
Iron	F (10 bars)
Manganese	M (5 bars)
Copper	C (1 bar, Very Low)

SOIL TEST RESULTS

Sample/Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
2	Coarse	2.7		8.2			8	1	97		1.5	9.3	3.3	0.5			

RECOMMENDATIONS **Crop Before Last: Corn, Silage; Last Crop: Corn, Silage**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	0	50	30	40		0	0	0	0			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT

Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page	**3**
Report No.	**80431**
Laboratory No.	**159686**
Date Received	**10/20/21**
Date Reported	**10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:
C (coarse): sand, loamy sand, sandy loam
M (medium): loam, silt loam
F (fine): clay loam, silty clay loam, silty clay

Level	Organic Matter	Soluble Salts	pH	Bray 1 P	K	Zn	Fe	Mn	Cu
HIGH / PROBLEM / EXCESSIVE / 9 / ALKALINE / Very High							F	M	
							F	M	
8	O						F	M	
	O			P		Z	F	M	
MED	O			P		Z	F	M	
7	O			P	K	Z	F	M	
	O		H	P	K	Z	F	M	
6 / ACID	O		H	P	K	Z	F	M	
LOW / OK	O		H	P	K	Z	F	M	C
5 / Very Low	O		H	P	K	Z	F	M	C

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
3	**Coarse**	**4.5**		**6.3**				**14**	**78**		**1.3**	**66.4**	**14.4**	**0.9**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**30**	**70**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **4**
Report No. **80431**
Laboratory No. **159687**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH		PROBLEM	EXCESSIVE	9		ALKALINE						F	Very High	M			
C (coarse):										P			F		M			
sand, loamy sand, sandy loam					8					P			F		M			
M (medium):										P	K		F		M			
loam, silt loam	MED	O			7	H				P	K		F		M			
F (fine):		O				H				P	K	Z	F		M			
clay loam, silty clay loam, silty clay		O				H				P	K	Z	F		M			
		O			6	H		ACID		P	K	Z	F		M			
		O				H				P	K	Z	F		M	C		
	LOW	O	OK		5	H				P	K	Z	F	Very Low	M	C		

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
4	**Coarse**	**3.5**		**7.4**				**21**	**105**		**1.0**	**16.7**	**7.3**	**0.6**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**0**	**40**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

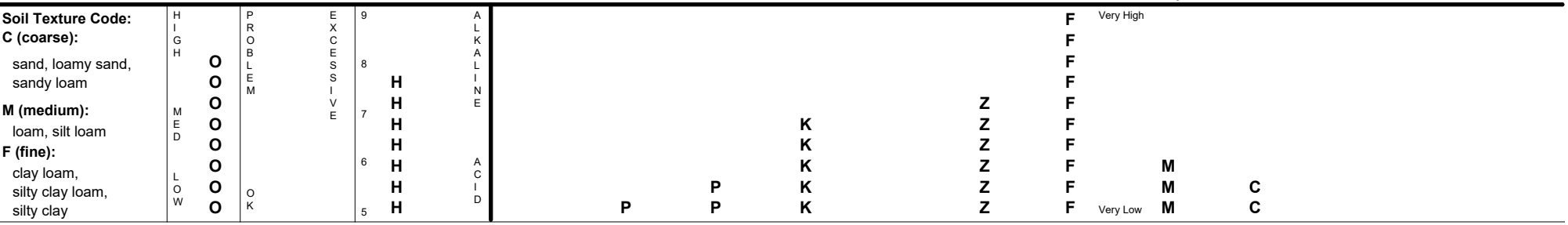
Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **5**
Report No. **80431**
Laboratory No. **159688**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS



SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
5	**Coarse**	**6.0**		**7.7**			**1**	**3**	**76**		**1.2**	**10.4**	**2.3**	**0.8**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**50**	**70**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **6**
Report No. **80431**
Laboratory No. **159689**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH	PROBLEM	EXCESSIVE	9	ALKALINE									
C (coarse):											F	Very High	M	
sand, loamy sand, sandy loam	**O**										F		M	
M (medium):	**O**			8							F		M	
loam, silt loam	**O**										F		M	
F (fine):	**O**			7						Z	F		M	
clay loam, silty clay loam, silty clay	**O**				**H**			K		Z	F		M	
	O				**H**			K		Z	F		M	
	O			6	**H**			K		Z	F		M	
	O				**H**			K		Z	F		M	C
	O	OK		5	**H**	ACID	P	K		Z	F	Very Low	M	C
	MED													
	LOW													

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
6	**Coarse**	**4.1**		**6.9**				**2**	**80**		**1.2**	**41.8**	**12.1**	**1.0**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**50**	**70**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page	**7**
Report No.	**80431**
Laboratory No.	**159690**
Date Received	**10/20/21**
Date Reported	**10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH	MED	LOW	PROBLEM	EXCESSIVE	9	8	7	6	5	ALKALINE	ACID	P	K	Z	F	M	C
C (coarse): sand, loamy sand, sandy loam	O												P		Z	F	Very High M	
	O												P		Z	F	M	
	O												P		Z	F	M	
M (medium): loam, silt loam	O												P	K	Z	F	M	
	O												P	K	Z	F	M	
F (fine): clay loam, silty clay loam, silty clay	O							H					P	K	Z	F	M	
	O							H					P	K	Z	F	M	
	O							H	H				P	K	Z	F	M	
	O							H	H	H			P	K	Z	F	M	C
	O			OK				H	H	H			P	K	Z	F	Very Low M	C

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
7	**Medium**	**5.4**		**6.6**				**26**	**119**		**2.7**	**94.6**	**8.8**	**0.9**			

RECOMMENDATIONS **Crop Before Last: Corn, Silage; Last Crop: Corn, Grain**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**0**	**0**	**40**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **8**
Report No. **80431**
Laboratory No. **159691**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH	PROBLEM	EXCESSIVE	9	ALKALINE	P			F	Very High	M	
C (coarse):						P			F		M	
sand, loamy sand, sandy loam	**O**			8		P		Z	F		M	
M (medium):	**O**					P	K	Z	F		M	
loam, silt loam	**O**			7	**B**	P	K	Z	F		M	
F (fine):	**O**				**B**	P	K	Z	F		M	
clay loam, silty clay loam, silty clay	**O**			6	**H** **B**	P	K	Z	F		M	
	O				**H** **B**	P	K	Z	F		M	**C**
	O			5	**H** **B**	P	K	Z	F	Very Low	M	**C**
	MED	OK			ACID							
	LOW											

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
8	**Medium**	**3.8**		**5.9**	**6.8**			**32**	**116**		**1.5**	**70.1**	**16.5**	**0.9**			

RECOMMENDATIONS **Crop Before Last: Corn, Silage; Last Crop: Corn, Grain**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**0**	**0**	**40**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **9**
Report No. **80431**
Laboratory No. **159692**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH	PROBLEM	EXCESSIVE	9	ALKALINE												
C (coarse):														**F**	Very High		
sand, loamy sand, sandy loam				8	**H**									**F**			
					H									**F**			
M (medium):	MED				**H**									**F**			
loam, silt loam				7	**H**					**K**		**Z**		**F**			
F (fine):					**H**					**K**		**Z**		**F**			
clay loam,	LOW **O**			6	**H**		**P**			**K**		**Z**		**F**		**M**	
silty clay loam,	**O**	OK			**H**		**P**			**K**		**Z**		**F**		**M**	
silty clay	**O**			5	**H**		**P**		**P**	**K**		**Z**		**F**	Very Low	**M**	**C**

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
9	**Coarse**	**2.3**		**8.2**			**4**	**1**	**76**		**1.0**	**6.5**	**2.2**	**0.4**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**40**	**70**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **10**
Report No. **80431**
Laboratory No. **159693**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH / MED / LOW	PROBLEM / OK	EXCESSIVE	9 / 8 / 7 / 6 / 5	ALKALINE / ACID											
C (coarse): sand, loamy sand, sandy loam				**H**								**F**	Very High			
M (medium): loam, silt loam				**H**								**F**				
F (fine): clay loam, silty clay loam, silty clay	**O**			**H**					**K**			**F**				
	O			**H**			**P**		**K**			**F**				
	O			**H**			**P**		**K**		**Z**	**F**		**M**		
	O			**H**			**P**		**K**		**Z**	**F**		**M**		
	O			**H**		**P**	**P**		**K**		**Z**	**F**	Very Low	**M**	**C**	

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
10	**Coarse**	**3.3**		**8.1**			**1**	**6**	**68**		**0.5**	**5.9**	**2.1**	**0.4**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**50**	**70**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page	**11**
Report No.	**80431**
Laboratory No.	**159694**
Date Received	**10/20/21**
Date Reported	**10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH	MED	LOW	PROBLEM	EXCESSIVE	pH	ALKALINE / ACID								
C (coarse): sand, loamy sand, sandy loam	O	O	O			9						Z	F	Very High	
M (medium): loam, silt loam	O	O	O			8						Z	F		
F (fine): clay loam, silty clay loam, silty clay	O	O	O				H					Z	F		
	O	O	O			7	H			K		Z	F		
	O	O	O				H	P		K		Z	F		
	O	O	O				H	P		K		Z	F	M	
	O	O	O			6	H	P		K		Z	F	M	
	O	O	O		OK		H	P		K		Z	F	M	C
	O	O	O			5	H	P	P	K		Z	F	Very Low M	C

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
11	**Medium**	**8.6**		**7.9**			**10**	**1**	**95**		**2.4**	**21.4**	**2.8**	**0.8**			

RECOMMENDATIONS **Crop Before Last: Soybeans; Last Crop: Soybeans**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**0**	**30**	**40**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

University of Minnesota
Soil Testing Laboratory

SOIL TEST REPORT
Farm and Field

Client Copy

Department of Soil, Water, and Climate
Minnesota Extension Service
Agricultural Experiment Station

TERANCE RUANE
1301 CORPORATE CENTER DR
EAGAN MN 55121

Page **12**
Report No. **80431**
Laboratory No. **159695**
Date Received **10/20/21**
Date Reported **10/29/21**

INTERPRETATION OF SOIL TEST RESULTS

Soil Texture Code:	HIGH	PROBLEM	EXCESSIVE	9	ALKALINE										
C (coarse):												**F**	Very High		
sand, loamy sand, sandy loam	**O**											**F**			
M (medium):				8	**H**			**P**				**F**			
loam, silt loam	**O**				**H**			**P**				**F**			
F (fine):	**O**			7	**H**			**P**				**F**			
clay loam, silty clay loam, silty clay	**O**				**H**		**P**	**P**				**F**			
	O				**H**		**P**	**P**	**K**			**F**		**M**	
	O			6	**H**		**P**	**P**	**K**		**Z**	**F**		**M**	
	O				**H**		**P**	**P**	**K**		**Z**	**F**		**M**	
	O	MED	OK	5	**H**	ACID	**P**	**P**	**K**		**Z**	**F**	Very Low	**M**	**C**
	LOW														

SOIL TEST RESULTS

Sample/ Field Number	Estimated Soil Texture	Organic Matter %	Soluble Salts mmhos/cm	pH	Buffer Index	Nitrate NO3-N ppm	Olsen Phosphorus ppm P	Bray 1 Phosphorus ppm P	Potassium ppm K	Sulfur SO4 -S ppm	Zinc ppm	Iron ppm	Manganese ppm	Copper ppm	Boron ppm	Calcium ppm	Magnesium ppm
12	**Coarse**	**3.9**		**8.3**			**10**	**16**	**60**		**0.5**	**26.6**	**2.8**	**0.4**			

RECOMMENDATIONS **Crop Before Last: Corn, Silage; Last Crop: Corn, Silage**

Crop and Yield Goal	Method	Lime #ENP/A	N lb/A	P2O5 lb/A	K2O lb/A	S lb/A	Zn lb/A	Fe lb/A	Mn lb/A	Cu lb/A	B lb/A	Ca lb/A	Mg lb/A
Native Grasses	Broadcast	**0**	**50**	**30**	**70**		**0**	**0**	**0**	**0**			
3 tons/acre	Row/Drill												

Comments: 4,5,16,18

County: MURRAY. For additional information, contact the soil extension specialist: DANIEL KAISER 612-624-3482 Website: http://soiltest.cfans.umn.edu

Comments

1. The recommended rates of P2O5 and/or K2O are to be broadcast and incorporated before seeding and top-dressed after the 1st cutting of the 1st year in production. Re-test field before the 2nd production year. If oats are seeded as a nurse crop, apply 30 lb. N/acre.

2. The recommended rates of P2O5 and/or K2O are to be top-dressed to the establised stand. Re-test in two years.

3. For best results, the recommended rate of lime should be broadcast and incorporated from 6 to 12 months before seeding.

4. If only phosphorus is recommended for any agronomic crop and the recommendation is 30 lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

5. If only potash is recommended for any agronomic crop and the recommendation is 40lb./A or less, it may not be practical to broadcast this low rate. An alternative would be to double this suggested rate and broadcast on alternate years.

6. Broadcast phosphate will not increase yield at this P level. Use 10-15 lb. P205/acre in a starter.

7. No phosphate fertilizer is recommended, but, if the soil temperature is low and soils are wet, use 10-15 lb. P2O5/acre in a starter for corn.

8. This P level is very low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

9. This K level is low. Use a combination of starter (drill applied for small grain) and broadcast applications. Subtract the rate for starter (drill) from the suggested broadcast rate. Use the starter (drill) rate and broadcast the remainder.

10. No broadcast potash is recommended. Suggested rate is 10-15 lb. K2O/acre in a starter fertilizer.

11. Use of a starter fertilizer (fertilize with the drill for small grains) is a good way to apply fertilizer at soil test levels where phosphate and/or potash are needed. Do no apply urea, thiosulfate, or boron in contact with the seed. Do not use more than 10-15 lb./acre of N + K2O in contact with the seed for small grain, or 8 lb./acre of N + K2O in contact with the seed for corn production.

12. The soil test for sulfur is appropriate only for coarse textured (sands, loamy sand, sandy loams) soils. Sulfur recommendations are made for sandy soils only. Use an annual application of 25 lb. S/acre for alfalfa and red clover. For corn and small grains use either a broadcast application of 25 lb. S/acre or a band application of 10-15 lb. S/acre. Use this recommendation if there was no soil test for S.

13. In Minnesota, research with agronomic crops has shown that boron (B) use has only been beneficial for alfalfa production on limited soils. Therefore, B is not recommended for other agronomic crops.

14. In Minnesota, use of iron (Fe), manganese (Mn), and copper (Cu) has not increased yield of this crop. Therefore, none is recommended. Use of zinc (Zn), where needed, may increase yield at the recommended rate listed.

15. Although no fertilizer N is recommended on this field, as based on the test result for nitrogen, a small amount of N applied in a starter fertilizer at planting is encouraged.

16. Research trials in Minnesota show that this crop will not respond to the use of micronutrients (Zn, Fe, Mn, Cu, B). Therefore, none are recommended.

17. If the small grain crop follows soybeans, subtact 20 lb. N/acre from the N recommendation listed.

18. Manure applications result in nutrient credits that should be subtracted from fertilizer needs. Proper nutrient crediting is discussed in bulletins: AG-FO-5879C, 5880C, 5881C, 5882C and 5883C available at your County Extension Office.

19. Do not place any fertilizer in contact with the soybean seed.

20. Do not apply more than 5.5 lb./acre of N + K20 in direct contact with the seed.

21. Subtract the NO3-N test result for the top 2 feet from the recommendation value to determine the amount of fertilizer N (lb./acre) to apply.

22. The soil ntitrate test can be used to predict fertilizer N needs in your area if samples are taken before planting in the spring. If the sample was collected at another time, the N recommendation listed is based on yield goal, previous crop, and organic matter content. See Bulletin 3790 B (revised) for more details.

23. The recommended N rate shown should be used if barley is grown for malting purposes. If barley is used for feed, increase rate by 10 percent (multiply by 1.1).

24. Lime recommendations are reported as lbs. of ENP per acre (Effective Neutralizing Power). To determine the tons of lime needed to be applied per acre, divide the ENP recommendation by the "ENP PER TON" value provided by your liming material dealer.

25. No nitrogen is recommended because of NO3-N carryover.

ATTACHMENT D

CIVIL DESIGN FOR LAKE WILSON SOLAR PROJECT

Lake Wilson Solar Project

ATTACHMENT E

SEED MIXES

Dry Mesic – Array and Vegetated Buffer Regionally Appropriate Grass-Dominated Seed Mix

Uses: Within array and along vegetated buffers associated with solar facility infrastructure in excessively drained to moderately well drained soils as a perennial vegetation cover.

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (By Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)
Grasses					
Bouteloua curtipendula	Side-oats Grama	1.54	5.2%	3.4	6.2%
Bouteloua gracilis	Blue Grama	0.50	1.7%	7.4	13.5%
Bromus kalmii	Kalm's Brome	0.5	1.7%	1.5	2.7%
Elymus canadensis	Canada Wild Rye	1.05	3.6%	1.6	2.9%
Elymus riparius	Riverbank Wild Rye	0.9	3.1%	1.0	1.7%
Koeleria macrantha	Junegrass	0.14	0.5%	9.2	16.7%
Pascopyrum smithii	Western Wheatgrass	0.5	1.7%	1.3	2.3%
Schizachyrium scoparium	Little Bluestem	2	6.8%	11.0	20.0%
Sporobolus heterolepis	Prairie Dropseed	0.19	0.6%	1.1	1.9%
	Subtotal	7.32	24.9%	37.4	68.0%
Sedges					
Carex bicknellii	Bicknell's Sedge	0.24	0.8%	1.6	2.8%
Carex brevior	Plains Oval Sedge	0.18	0.6%	1.9	3.5%
Carex molesta	Field Oval Sedge	0.22	0.7%	2.0	3.6%
	Subtotal	0.64	2.2%	5.5	9.9%
Legumes					
Trifolium pratense	Red clover	0.5	1.7%	1.6	2.9%
Trifolium repens	White clover	0.5	1.7%	4.6	8.3%
	Subtotal	1.00	3.4%	6.2	11.2%
Cover Crop					
Avena sativa	Oats* (See Cover crop note)	20.42	69.5%	6.0	10.9%
	Subtotal	20.42	69.5%	6.0	10.9%
	Total	29.38	100.0%	55.0	100.0%

Wet Mesic – Array and Vegetated Buffer Regionally Appropriate Grass Dominated Seed Mix

Uses: Within array and along vegetated buffers associated with solar facility infrastructure in somewhat poorly drained to very poorly drained soils as a perennial vegetation cover.

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (By Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)
Grasses					
Bromus kalmii	Kalm's Brome	0.5	1.2%	1.5	1.8%
Elymus virginicus	Virginia Wild Rye	1.71	4.1%	2.6	3.2%
Glyceria canadensis	Rattlesnake Grass	0.19	0.5%	5.2	6.3%
Glyceria striata	Fowl Manna Grass	0.10	0.2%	3.3	4.0%
Muhlenbergia mexicana	Leafy Satin Grass	0.10	0.2%	6.4	7.8%
Poa palustris	Fowl Bluegrass	0.42	1.0%	20.1	24.4%
Sporobolus heterolepis	Prairie Dropseed	0.19	0.5%	1.1	1.4%
	Subtotal	3.21	7.6%	40.2	48.8%
Sedges/Rushes					
Carex scoparia	Lance-fruited Oval Sedge	0.07	0.2%	2.2	2.6%
Carex stipata	Common Fox Sedge	0.17	0.4%	2.1	2.6%
Carex vulpinoidea	Brown Fox Sedge	0.11	0.3%	2.1	2.6%
Juncus tenuis	Path Rush	0.05	0.1%	18.4	22.3%
	Subtotal	0.40	1.0%	24.8	30.1%
Legumes					
Trifolium pratense	Red clover	0.25	0.6%	1.6	1.9%
Trifolium repens	White clover	0.25	0.6%	4.6	5.6%
	Subtotal	0.50	1.2%	6.2	7.5%
Cover Crop					
Avena sativa	Oats	37.88	90.2%	11.1	13.5%
	Subtotal	37.88	90.2%	11.1	13.5%
	Total	41.99	100.0%	82.3	100.0%

Stormwater and Detention Pond Seed Mix

Uses: Areas designated as stormwater pond edges, temporarily flooded dry ponds, and temporarily flooded ditch bottoms to act as a perennial vegetation cover.

Note: Seed mix is derived from Minnesota State Seed Mix 33-261 Stormwater South and West

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (By Wt)	Seeds/sqft	Pct of Mix (Seeds/sqft)
Grasses					
Andropogon gerardii	Big Bluestem	2.00	5.7%	7.35	4.1%
Bromus ciliatus	Fringed Brome	2.00	5.7%	8.10	4.5%
Calamagrostis canadensis	Bluejoint	0.06	0.2%	6.40	3.5%
Elymus trachycaulus	Slender Wheatgrass	1.00	2.9%	2.53	1.4%
Elymus virginicus	Virginia Wild Rye	1.50	4.3%	2.31	1.3%
Panicum virgatum	Switchgrass	0.38	1.1%	1.93	1.1%
Poa palustris	Fowl Bluegrass	1.06	3.0%	50.70	28.0%
Sorghastrum nutans	Indian Grass	0.12	0.3%	0.55	0.3%
Spartina pectinata	Prairie Cordgrass	0.38	1.1%	0.91	0.5%
	Subtotal	8.50	24.3%	80.78	44.7%
Sedges					
Carex stipata	Awl-fruited Sedge	0.25	0.7%	3.10	1.7%
Scirpus atrovirens	Dark Green Bulrush	0.19	0.5%	31.70	17.5%
Scirpus cyperinus	Woolgrass	0.06	0.2%	39.00	21.6%
	Subtotal	0.50	1.4%	73.80	40.8%
Forbs					
Anemone canadensis	Canada Anemone	0.07	0.2%	0.20	0.1%
Asclepias incarnata	Marsh Milkweed	0.11	0.3%	0.20	0.1%
Bidens frondosa	Leafy Beggarticks	0.11	0.3%	0.20	0.1%
Doellingeria umbellata	Flat-topped Aster	0.06	0.2%	1.50	0.8%
Eutrochium maculatum	Spotted Joe Pye Weed	0.06	0.2%	2.19	1.2%
Helenium autumnale	Autumn Sneezeweed	0.13	0.4%	5.97	3.3%
Physostegia virginiana	Obedient Plant	0.07	0.2%	0.30	0.2%
Rudbeckia laciniata	Tall Coneflower	0.07	0.2%	0.37	0.2%
Symphyotrichum novae-angliae	New England Aster	0.07	0.2%	1.56	0.9%
Verbena hastata	Blue Vervain	0.05	0.1%	1.85	1.0%
Zizia aurea	Golden Alexanders	0.20	0.6%	0.79	0.4%
	Subtotal	1.00	2.9%	15.13	8.4%
Cover Crop					
Avena sativa	Oats	25.00	71.4%	11.14	6.2%
	Subtotal	25.00	71.4%	11.14	6.2%
	Total	35.00	100.0%	180.85	100.0%

Temporary Seed Mixes

Uses: Provide temporary vegetation in areas where land disturbance has or will occur or to bridge the gap between disturbance and the next optimal perennial seeding window. Acts to stabilize soil and meet erosion and sediment control permit conditions.

Note: Select seed mix based on when seeding occurs and seasonal trends. Increase rate by 50% when broadcast seeding is the installation method.

Spring/Fall Seed Mix (April 1 – June 1; August 1 – September 15)

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (By Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)
Grasses					
Avena sativa	Oats	12.00	26.7%	5.40	16.8%
Hordeum vulgare	Spring Barley	15.00	33.3%	4.68	14.6%
Lolium multiflorum	Annual Ryegrass	3.00	6.7%	13.10	40.7%
	Subtotal	30.00	66.7%	23.19	72.0%
Legumes					
Trifolium repens	White clover	0.50	1.1%	9.00	28.0%
	Subtotal	0.50	1.1%	9.00	28.0%
	Total	30.50	67.8%	32.19	100.0%

Summer Seed Mix (April 1 – June 1; August 1 – September 15)

Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (By Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)
Grasses					
Fagopyrum esculentum	Buckwheat	18.00	40.0%	8.43	18.9%
Lolium multiflorum	Annual Ryegrass	4.50	10.0%	19.66	44.0%
Pennisetum glaucum	Pearl Millet	4.00	8.9%	7.56	16.9%
	Subtotal	26.50	58.9%	35.65	79.8%
Legumes					
Trifolium repens	White clover	0.50	1.1%	9.00	20.2%
	Subtotal	0.50	1.1%	9.00	20.2%
	Total	27.00	60.0%	44.65	100.0%

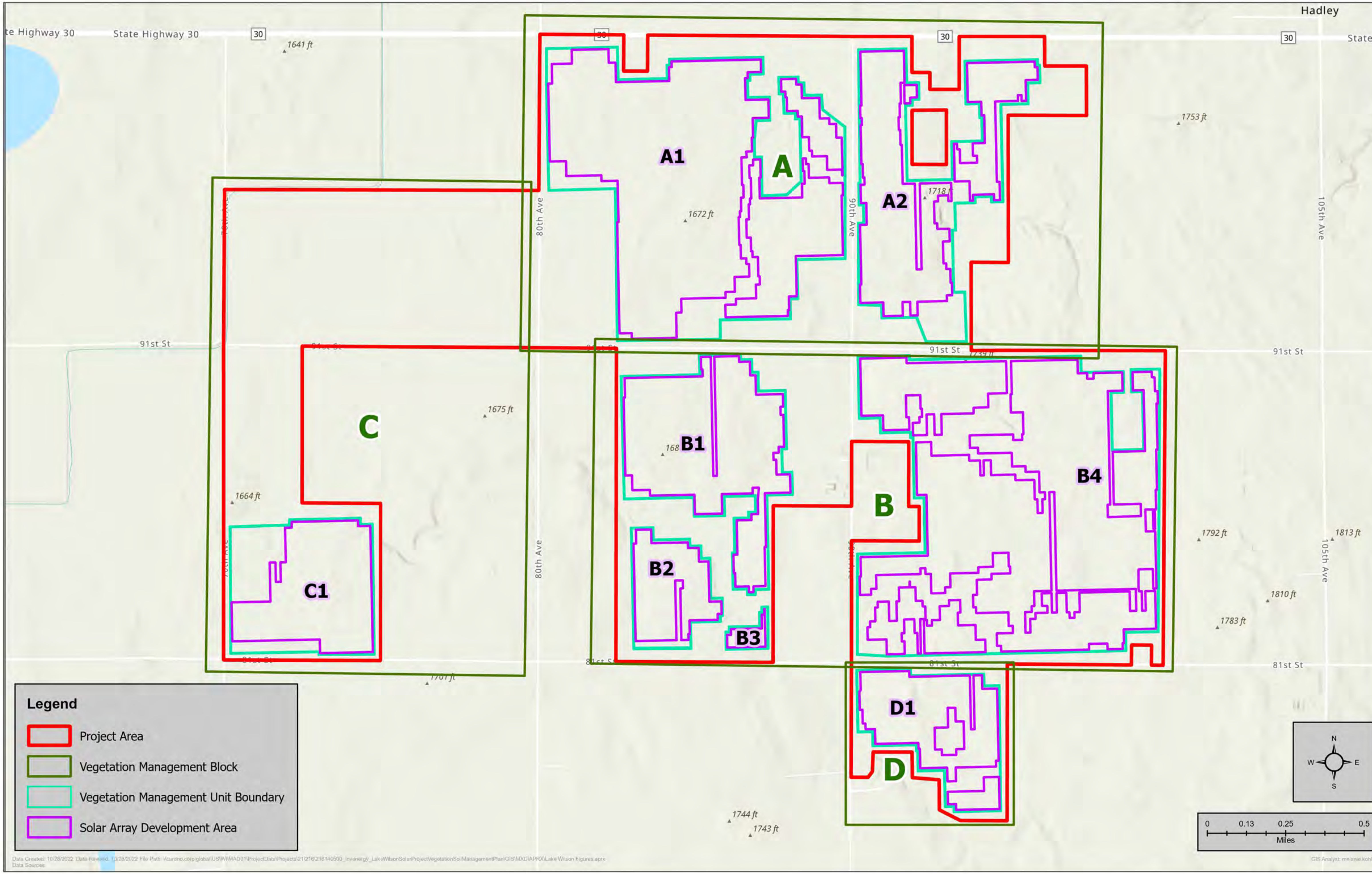
Winter Seed Mix (April 1 – June 1; August 1 – September 15)

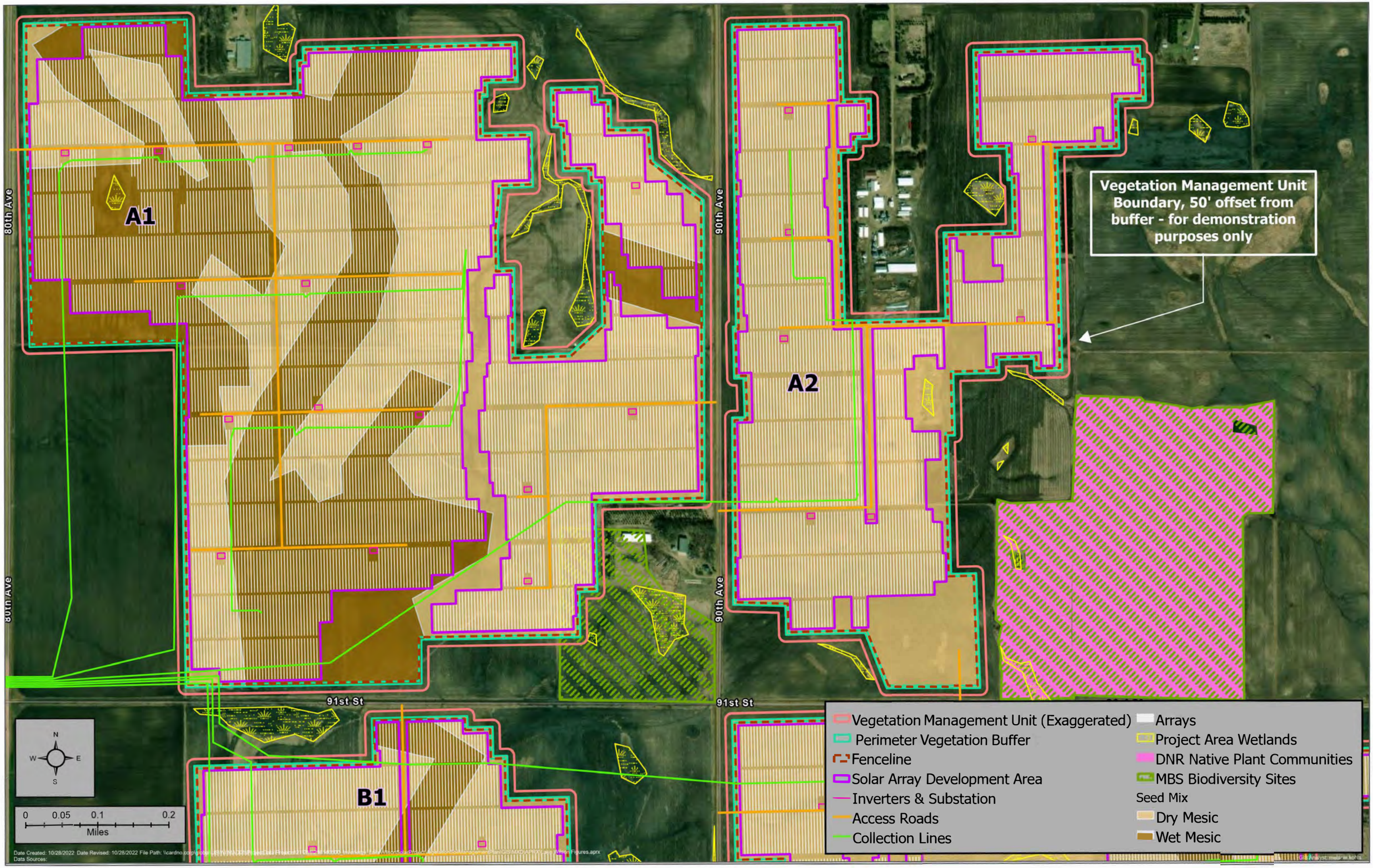
Scientific Name	Common Name	Rate (lb/ac)	Pct of Mix (By Wt)	Seed/sqft	Pct of Mix (Seeds/sqft)
Grasses					
Triticum aestivum	Winter Wheat	10.00	22.2%	3.44	19.9%
Secale cereale	Winter Rye	20.00	44.4%	9.14	52.9%
Hordeum vulgare	Winter Barley	15.00	33.3%	4.68	27.1%
xTriticosecale	Winter Triticale	5.00	11.1%	2.61	15.1%
	Subtotal	45.00	100.0%	17.26	100.0%
	Total	45.00	100.0%	17.26	100.0%

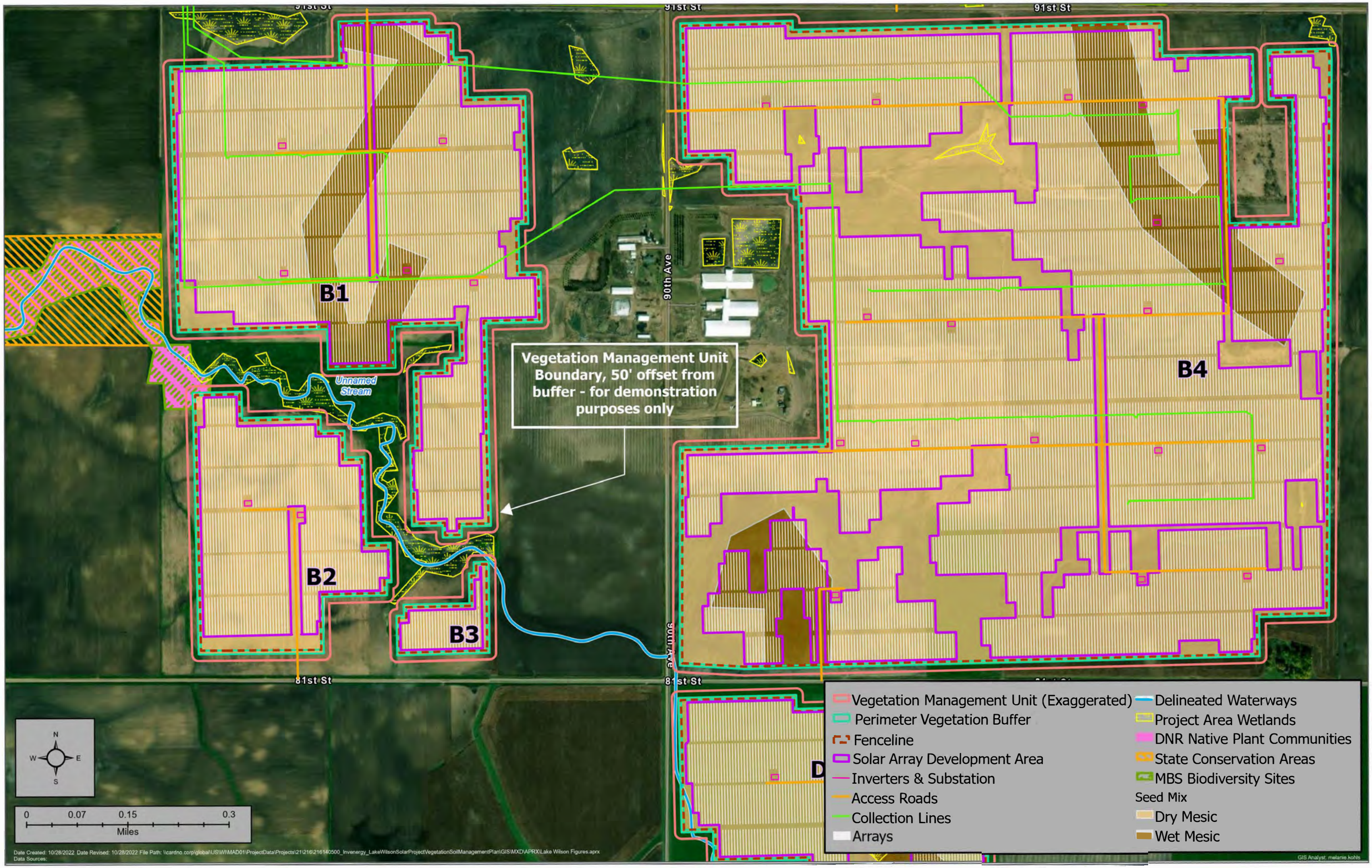
Lake Wilson Solar Project

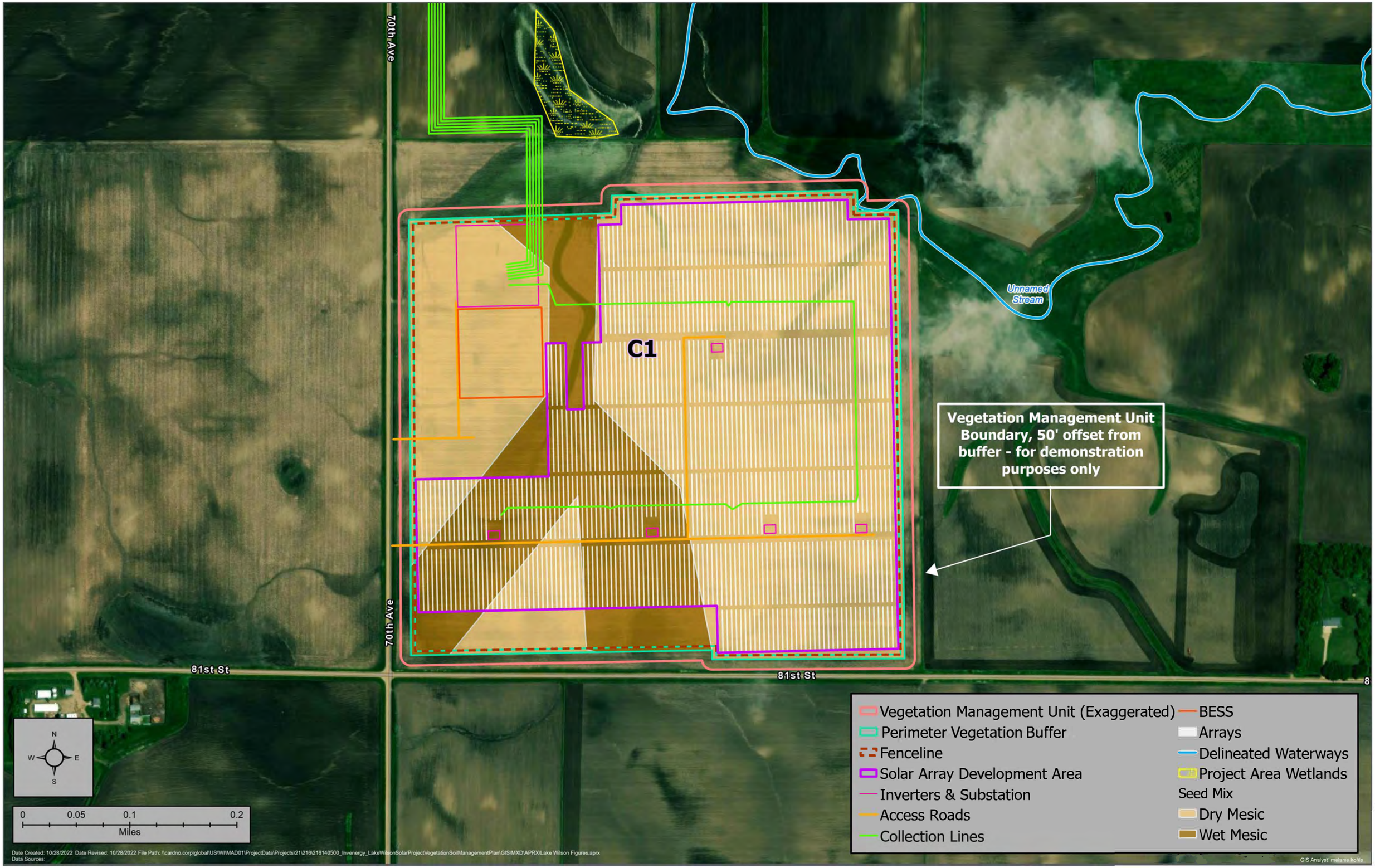
ATTACHMENT F

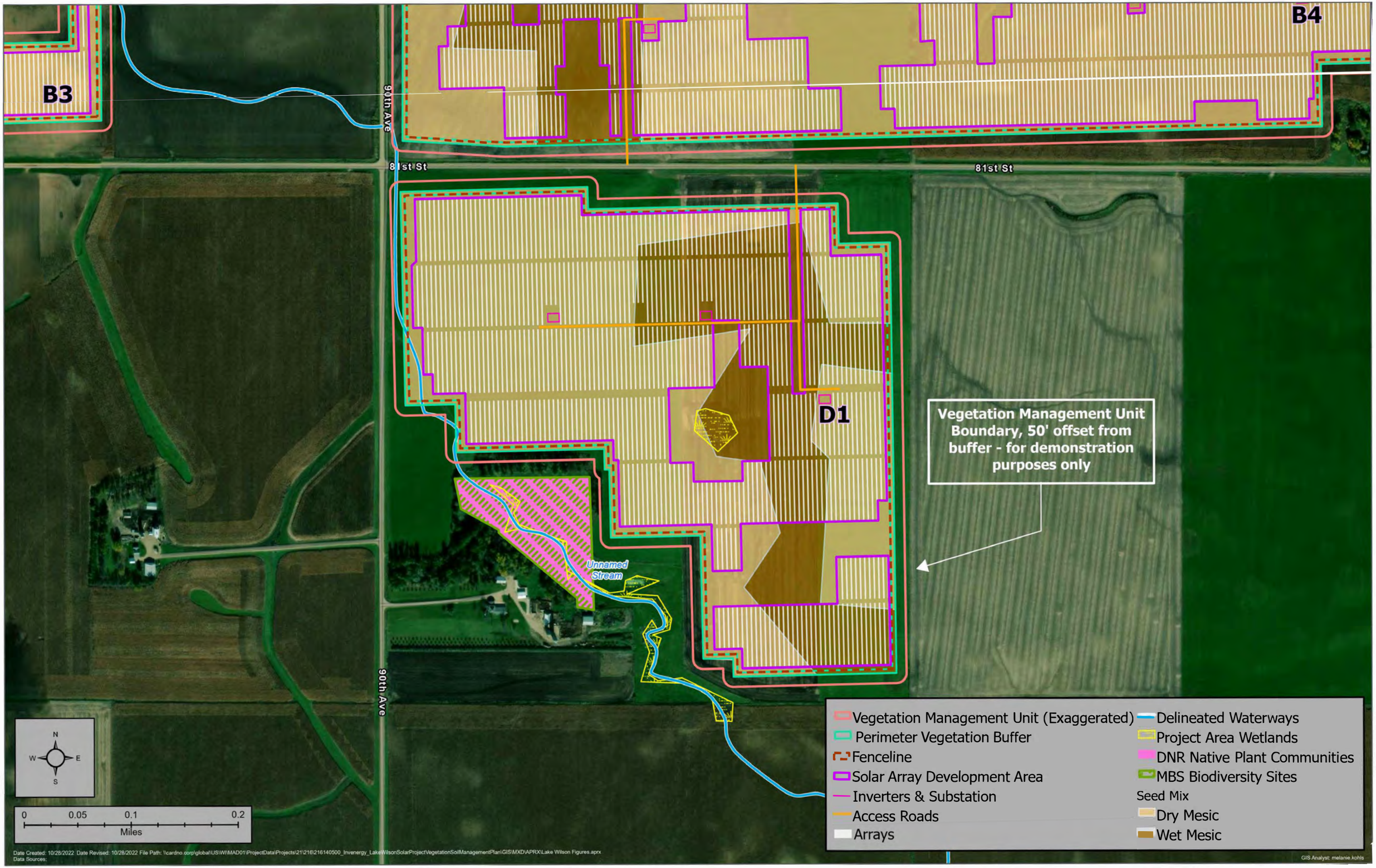
PLANTING PLAN FIGURES


Hadley
State Highway 30
30
1641 ft
1753 ft
A1
A
A2
1718 ft
1672 ft
80th Ave
90th Ave
105th Ave
91st St
1675 ft
C
B1
B4
B
1664 ft
C1
B2
B3
1792 ft
1813 ft
1810 ft
1783 ft
81st St
1701 ft
D1
D
1744 ft
1743 ft
Legend
Project Area
Vegetation Management Block
Vegetation Management Unit Boundary
Solar Array Development Area
N
W
E
S
0
0.13
0.25
0.5
Miles


A1
A2
B1
80th Ave
90th Ave
91st St
Vegetation Management Unit Boundary, 50' offset from buffer - for demonstration purposes only
N
W
E
S
0
0.05
0.1
0.2
Miles
Vegetation Management Unit (Exaggerated)
Perimeter Vegetation Buffer
Fenceline
Solar Array Development Area
Inverters & Substation
Access Roads
Collection Lines
Arrays
Project Area Wetlands
DNR Native Plant Communities
MBS Biodiversity Sites
Seed Mix
Dry Mesic
Wet Mesic


91st St
91st St
91st St
90th Ave
B1
B2
B3
B4
Unnamed Stream
Vegetation Management Unit Boundary, 50' offset from buffer - for demonstration purposes only
81st St
81st St
90th Ave
N
W
E
S
0
0.07
0.15
0.3
Miles
Vegetation Management Unit (Exaggerated)
Perimeter Vegetation Buffer
Fenceline
Solar Array Development Area
Inverters & Substation
Access Roads
Collection Lines
Arrays
Delineated Waterways
Project Area Wetlands
DNR Native Plant Communities
State Conservation Areas
MBS Biodiversity Sites
Seed Mix
Dry Mesic
Wet Mesic
Date Created: 10/28/2022 Date Revised: 10/28/2022 File Path: \\cardno.corp\global\US\WI\MAD01\ProjectData\Projects\21\216\216140500_Invenergy_LakeWilsonSolarProjectVegetationSoilManagementPlan\GIS\MXD\APRX\Lake Wilson Figures.aprx
Data Sources:
GIS Analyst: melanie.kohls


70th Ave
C1
Unnamed Stream
Vegetation Management Unit Boundary, 50' offset from buffer - for demonstration purposes only
70th Ave
81st St
81st St
8
N
W
E
S
0
0.05
0.1
0.2
Miles
Vegetation Management Unit (Exaggerated)
Perimeter Vegetation Buffer
Fenceline
Solar Array Development Area
Inverters & Substation
Access Roads
Collection Lines
BESS
Arrays
Delineated Waterways
Project Area Wetlands
Seed Mix
Dry Mesic
Wet Mesic
Date Created: 10/28/2022 Date Revised: 10/28/2022 File Path: \\cardno.corp\global\US\WI\MAD01\ProjectData\Projects\21\216\216140500_Invenergy_LakeWilsonSolarProject\VegetationSoilManagementPlan\GIS\MXD\APRX\Lake Wilson Figures.aprx
Data Sources:
GIS Analyst: melanie.kohls


B3
B4
90th Ave
81st St
81st St
D1
Unnamed Stream
90th Ave
Vegetation Management Unit Boundary, 50' offset from buffer - for demonstration purposes only
N
W
E
S
0
0.05
0.1
0.2
Miles
Vegetation Management Unit (Exaggerated)
Perimeter Vegetation Buffer
Fenceline
Solar Array Development Area
Inverters & Substation
Access Roads
Arrays
Delineated Waterways
Project Area Wetlands
DNR Native Plant Communities
MBS Biodiversity Sites
Seed Mix
Dry Mesic
Wet Mesic
Date Created: 10/28/2022 Date Revised: 10/28/2022 File Path: \\cardno.corp\global\US\WI\MAD01\ProjectData\Projects\21\216\216140500_Invenergy_LakeWilsonSolarProjectVegetationSoilManagementPlan\GIS\MXD\APRX\Lake Wilson Figures.aprx
Data Sources:
GIS Analyst: melanie.kohls