Stantec

Operations and Maintenance Plan

PCR Energy Solar Projects
Iowa and Illinois

August 12, 2022

Prepared for:

PCR Energy
1334 Brittmoore Rd. Suite 1327
Houston, TX 77043

Prepared by:

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2300 Swan Lake Boulevard, Suite 202
Independence, IA 50644

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1.0 INTRODUCTION

This Operations and Maintenance Plan (O&M Plan) is prepared for PCR Energy for the PCR Energy Solar Projects (Projects) in Iowa and Illinois. This O&M Plan describes soil erosion and sediment controls, ground cover and buffer areas, and general procedures for operation and maintenance of the facilities, including maintaining safe access and ongoing maintenance and repair.

The main text of this O&M Plan applies generally to the Projects in Iowa and Illinois. The appendices include project-specific information that addresses the specific design and location of one of the projects. A project-specific preliminary layout is provided in Appendix A.

2.0 SOIL EROSION AND SEDIMENT CONTROL

The Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) established by the Clean Water Act provides the framework of requirements for compliance to discharge stormwater from a construction site. Because the Projects will disturb more than 1 acre of land during construction, the Projects are required to have construction site stormwater runoff permit coverage.

For sites in Iowa, prior to construction, PCR or its contractors will prepare and submit a Notice of Intent (NOI) application to Iowa Department of Natural Resources (DNR) for coverage of construction site stormwater runoff under a NPDES General Permit No. 2, per Iowa requirements. The submittal will include a copy of the completed NOI application and a project-specific Stormwater Pollution Prevention Plan (SWPPP).

For sites in Illinois, prior to construction, PCR or its contractors will prepare and submit an NOI application for coverage of construction site stormwater runoff under the General NPDES Permit No. ILR10, per Illinois requirements. Applications must be filed with Illinois Environmental Protection Agency (IEPA). The submittal will include a copy of the completed NOI application and a project-specific SWPPP.

The SWPPP is for implementation by PCR or its contractors (specifically, the person or persons with either operational control of construction project plans and specifications, or day-to-day operational control of activities necessary to ensure compliance with storm water NPDES permit conditions) during all roadwork and site development work. The SWPPP describes how erosion and sedimentation on a project site will be managed to minimize sediment discharge offsite or to a water of the state. The SWPPP also addresses management of potential pollutant-generating activities during construction, such as refueling. The SWPPP will also address post-construction land use. The SWPPP will be prepared closer to the start of construction, to reflect final project design and once project disturbance limits are known for each project. Once prepared, the project-specific SWPPP will be added to Appendix B of this O&M Plan.

3.0 VEGETATION MANAGEMENT PLAN

The ground around and under the solar arrays and in the border areas within each the project fence line will be planted and maintained in perennial vegetated ground cover. A project-specific vegetation management plan has been prepared and is attached in Appendix C.

Topsoil will not be removed from the project's property boundaries during development (unless part of a remediation effort). Perennial vegetation will be planted and maintained in a density sufficient to prevent erosion, manage runoff, and build soil. The seed mix and see density is described in the attached plan. Monitoring and maintenance practices also are described in the attached plan.

4.0 OPERATIONS AND MAINTENANCE

The Owner anticipates that its facilities will be staffed with full-time technicians and that, accordingly, physical site monitoring will occur on a regular, ongoing basis. Visual and planned maintenance of the solar arrays, balance of plant, and substation, combined with ad hoc troubleshooting of inverters, solar arrays, substation, and other components will ensure that technicians are aware of the physical conditions on a regular basis. The table below describes the standard operations, maintenance, and monitoring activities for the Projects (Table 1). Maintenance shall include, but not be limited to, painting, structural repairs, and integrity of security measures. Depending on facility needs and industry best practices for operations and maintenance, the scheduled services may change in both frequency and scope over the facility's expected life of at least 30 years. Any retrofit, replacement or refurbishment of equipment shall adhere to all applicable local, state and federal requirements.

Table 1. Standard operations, maintenance, and monitoring activities for the PCR sites in Iowa and Illinois

Description	Frequency	Scope of Work
Administration, Planned Maintenance, Safety, & Monitoring		
Remote Monitoring and Site Dispatch	Ongoing	Remotely monitor Project 24/7/365. To include remote monitoring of inverters and substation vitals, interaction with ISO and off-taker, coordinate with onsite personnel for onsite reactive maintenance work and troubleshooting per OEM guidelines.
	Ongoing	Real time analysis of asset performance and interaction with site crew to remediate observed underperformance.
	As needed	Remotely dispatch facility setpoints based on ISO and off-taker scheduled outages, unscheduled outages, and curtailment events. Quantify impact of outages and events.
Facility Performance and Administrative Reporting	Monthly	Generate reports inclusive of site generation, resource adjusted generation, inverter and outage events, performance ratio calculations, warranty administration progress, NERC related events (if applicable), and balance of plant status (including vegetation, security, roads, fencing).
	As needed	Implement a Performance Analytics program to monitor and report any observed underperformance in real time or in a recurring report format. Assess soiling rates, DC health, inverter availability and efficiency, and other key metrics associated with site performance.
	Daily	Integrate facility with CMMS system to track and manage all site activities related to equipment maintenance.
	As needed	Implement a software system to manage equipment inventory inclusive of spare parts inventory, major equipment inventory (padmounts, substation equipment), inclusive of semi-annual inventory audits.
Site Management and Personnel	Ongoing	Site to be staffed with technicians to complete visual inspections, planned maintenance, and support reactive maintenance on an as-needed basis.
	As needed	Provide vehicles, safety equipment and tooling to onsite personnel.
General Operations	Per Manufacturer specifications and O&M Manual	Recurring inspections of facility and facility site, including the substation, breakers, padmount transformers, GSUs, capacitor banks (if applicable), all switches, SCADA System, electrical infrastructure, the modules, inverters, and trackers.

Description	Frequency	Scope of Work
	Per Manufacturer specifications and O&M Manual	Planned maintenance shall include racking system inspections, junction box, combiner box, perimeter fencing, roads, pest control, and erosion.
	Per Manufacturer specifications	Inspect and test all safety equipment
	Monthly; As needed	Monitor, troubleshoot, and review communications equipment, weather equipment and site control equipment.
	As needed	Manage, review, and contract Subcontractor work, completion and warranty administration, coordinate and oversee all scheduled outages and Subcontractor interventions onsite
	As needed	Paint operations and maintenance building.
	Ongoing	Compliance with Applicable Law.
Warranty Administration	As needed	Identify, assess, document, and submit warranty claims with O&M.
Road Maintenance	As needed	Repair roads to remediate excessive erosion, washout, and other damage.
Safety	Ongoing	Prepare and enforce a safety program, to include relevant signage, safety attire, and site security.
	Periodic; Per Manufacturer specifications	Perform periodic site audits and inspect safety equipment.
Administrative Responsibilities	As needed	Prepare and complete filings related to NERC, ISOs, off-takers, local/state/federal permits, insurance, wildlife and environmental, and any other compliance related items.
Preventative Maintenance and Balance of Plant[1]		
Vegetation Management	As needed	Comply with the vegetation management plan outlining the expected frequency of mowing and spraying, and consistent with site safety procedures.
Miscellaneous Balance of Plant Work	As needed	Coordinate and review of facility cleanliness.
	As needed	Coordinate and contract road repairs and grading as a result of site activities or weather. Maintain safe site access.
	As needed	Maintain internal and perimeter erosion control measures to ensure compliance with the project-specific SWPPP.

Key:
CMMS = computerized maintenance management system
DC = direct current
SWPPP = Stormwater Pollution Prevention Plan
GSU = generator step-up transformers
ISO = independent system operator
NERC = North American Electric Reliability Corporation
OEM = original equipment manufacturer
O&M = operations and maintenance
SCADA = supervisory control and data acquisition

Note:
[1] These items shall be performed according to O&M equipment manuals. Operator shall develop an O&M manual with recurring preventative maintenance activities. The O&M manual frequency of inspections and revisions will be at least as frequent as the O&M equipment manual requirements and include additional supplemental information.

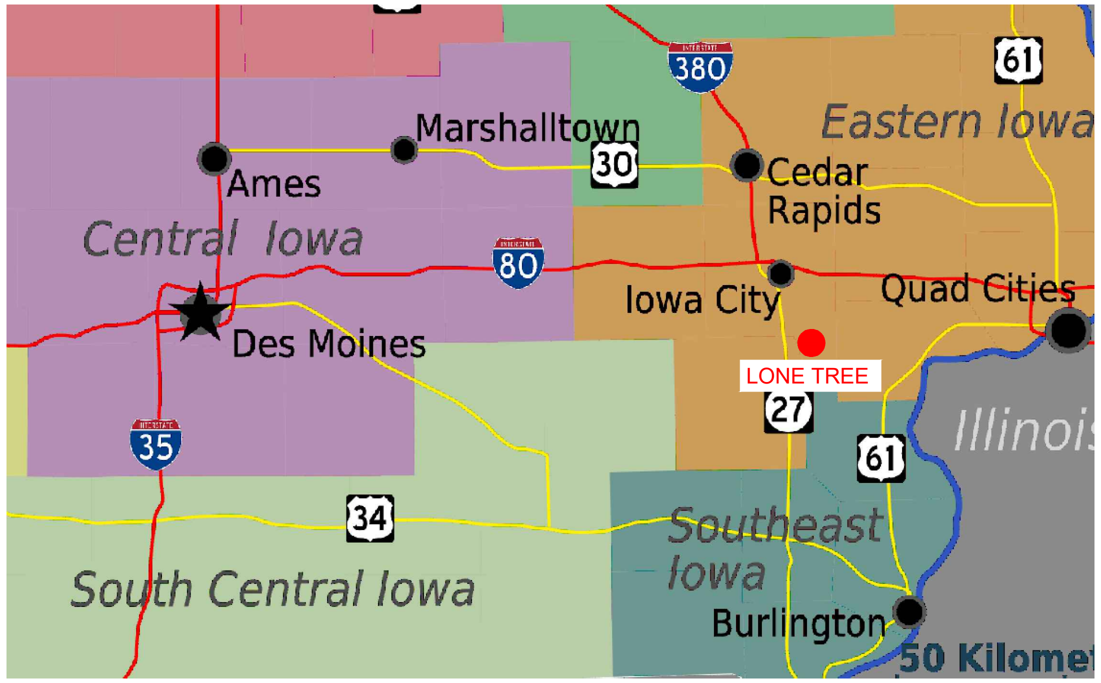
Appendix A PRELIMINARY SITE LAYOUT

LONE TREE PROJECT

Lone Tree, IOWA

SITE PLAN

Lone Tree Solar Project				
MW ac	MW dc	ratio	MWh/y	Acres
10,00	11,81	1,18	19988	50



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Cynthia Schuchner	Chief Construction and Engineering Officer	cschuchner@pcr.energy	PCR US Houston Office (832) 955 1979 – 1334 Brittmoore Rd, Suit 2407 Houston, TX 77043 – www.pcr.energy/en

Rev.	Date (MM/DD/YY)	COMMENTS
04	12/28/22	Wetlands buffer update
03	12/15/22	Access update
02	11/02/22	PVcase update
01	08/11/22	Georef update
00	06/14/22	Preliminary

REVISIONS

PCR

Project:	LONE TREE
Sector:	JOHNSON, IOWA, USA
Owner:	PCR INVESTMENTS SP2 LLC
Title:	SITE PLAN
Utility:	CIPCO
File:	Site Plan Lone Tree.dwg
Sheet:	01/07
Scale	
Rev:	

POINT	LAT	LONG
A	41,49670229	-91,48829677
B	41,49670967	-91,48362429
C	41,49698140	-91,48355875
D	41,50132142	-91,48348547
E	41,50131371	-91,48821947

Boundaries (aprox. 50ac)
1V54 Tracker
1V27 Tracker
MV Station
MV Underground cable 12.47 kV
Wetlands
Internal Roads

SOLAR PANEL	
Brand	ZNshine Solar
Model	ZXM7-SHLDD-144-550
Power	550 Wp - Bifacial
Dimensions (W x L x D)	1134 x 2278 x 30 mm
INVERTER	
Brand	SMA
Model	Sunny Highpower SHP125-US-20-PEAK3
Power	125 kW
Output Voltage	480 V
LV Cables (INV - TR)	
Model	EXZHELLENT COMPACT 1000V Prysmian
Type	0,6/1,1kV Cu 3x2/0AWG XLPE
Section	2/0 AWG
Rate Current	167 A
R	0,16 ohm/km
V/A km	0.34
MV Cables (TR - SW)	
Type*	12.5 kV Al 3x1x250MCM XLPE
Section*	250 MCM
Rate Current MVS 1|2|3|4	120| 240| 360| 480 A
R	0,568 ohm/km
X	0,194 ohm/km
B	0,156 mF/km
Length MV 1|2|3|4	444| 443| 400| 47 ft
COMPONENTS	
Total Inverters	84
Total Trackers 1V54 | 1V27	365 | 65
Total Modules	21465

*NOTE: MV Underground Cable Gauge TBD

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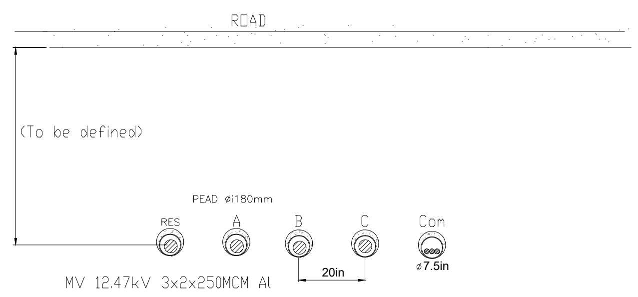
MV Cables (Interconnection)	
Type*	12.5kV Al 3x2x250MCM XLPE
Section*	250 MCM
Rate Current	480 A
R	0,211 ohm/km
X	0,175 ohm/km
B	0,212 mF/km
Length	0.18 miles
Power Factor @POI	**95%**

Boundaries Lone Tree CIPCO

MV Underground cable 12.47 kV

DETAIL - ROAD CROSS



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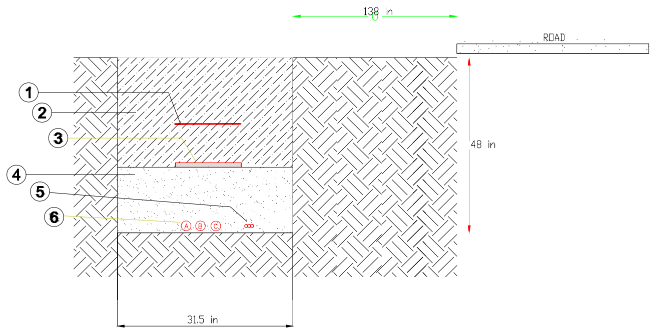

1. Warning sign
2. Filled with excavated land
3. Protection plate
4. Filled with excavated land
5. Tritube (FO)
6. MV 12.47kV Al 3x2x250MCM XLPE

*NOTE: MV Underground Cable Gauge TBD

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Utility:	CIPCO	Scale	Rev:
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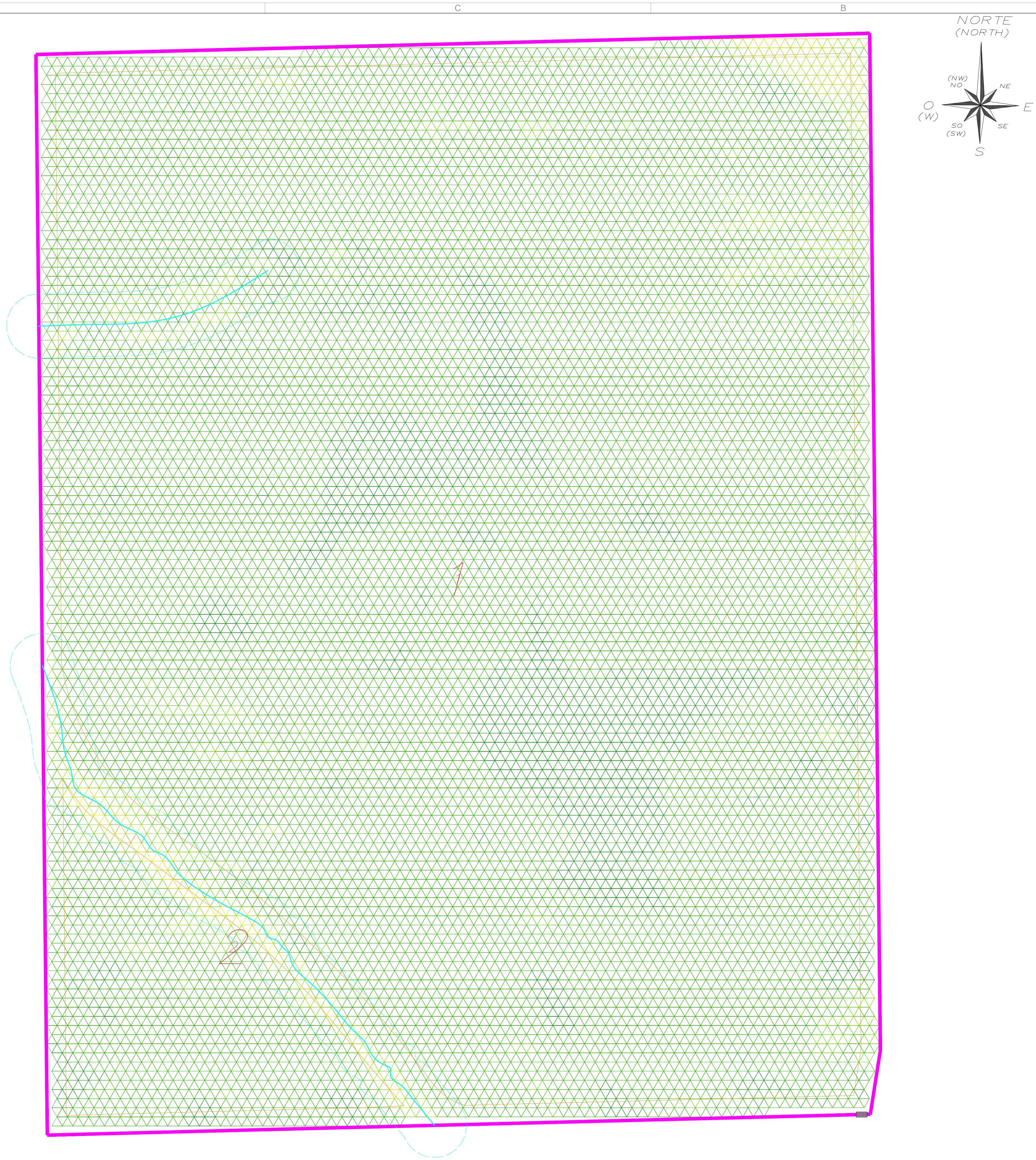

Pv Buildable Area

Angle min., °	Angle max., °	Distribution, %	Color
0.00	0.00	10.31	
0.00	1.75	84.08	
1.75	3.50	4.14	
3.50	5.25	0.99	
5.25	7.00	0.30	
7.00	8.75	0.11	
8.75	10.50	0.06	
10.50	12.25	0.02	
12.25	14.00	0.00	
14.00	55.00	0.00	

GCR	
PV Buildable Area1	32.61%
PV Buildable Area2	26.29%
Total	**29.45%**

PITCH	20.5 ft

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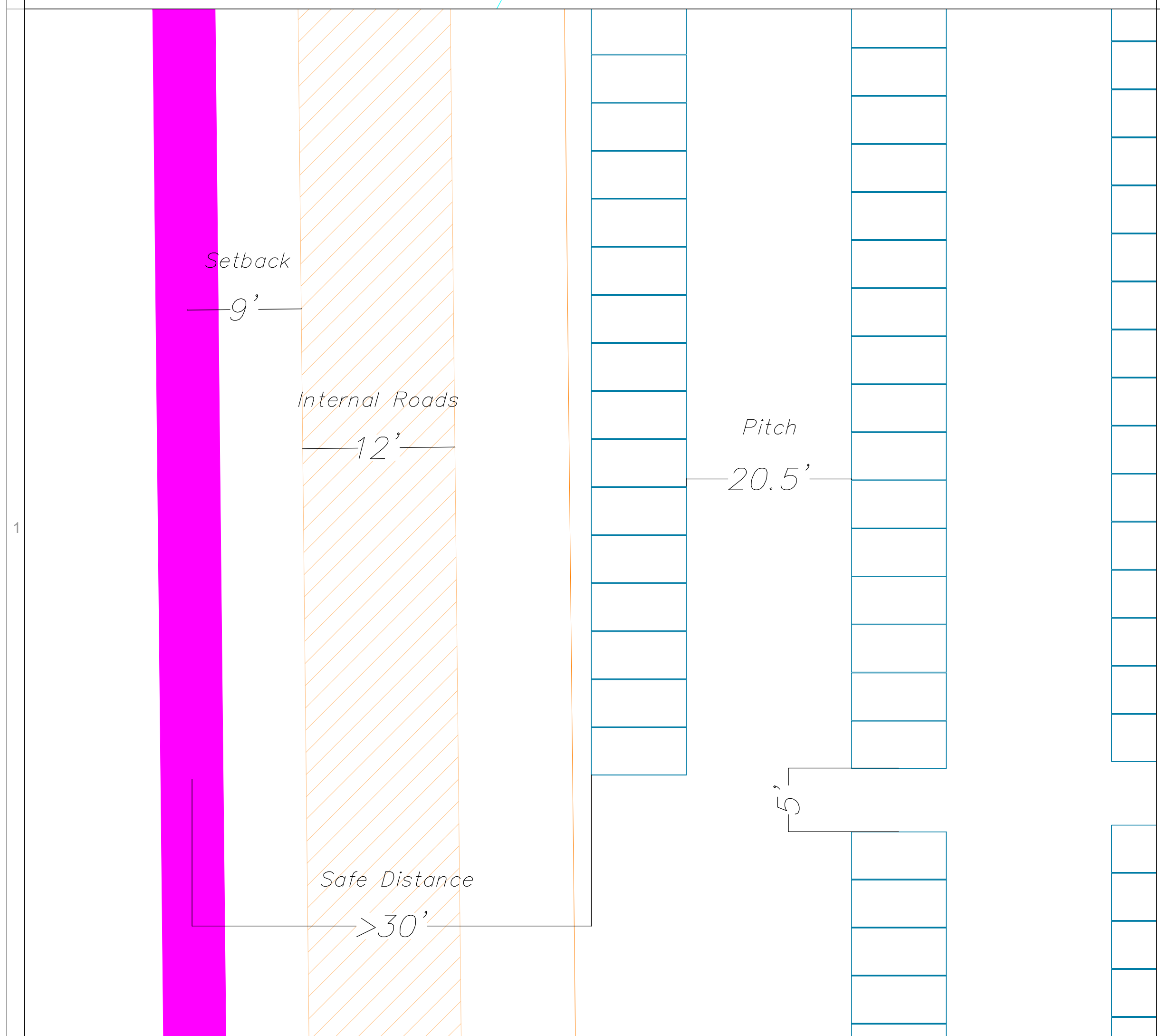
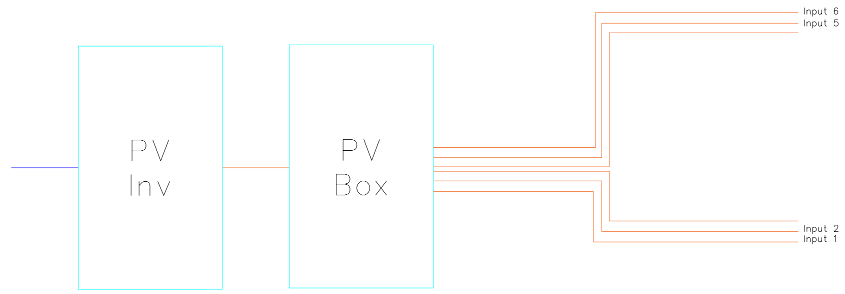


Voltage	
	AC 0,48kV
	DC 1500V
	AC 12.47kV

Inverter	
MPPT conected	1
Strings conected	10
Modules/String	27
Strings/Tracker	2



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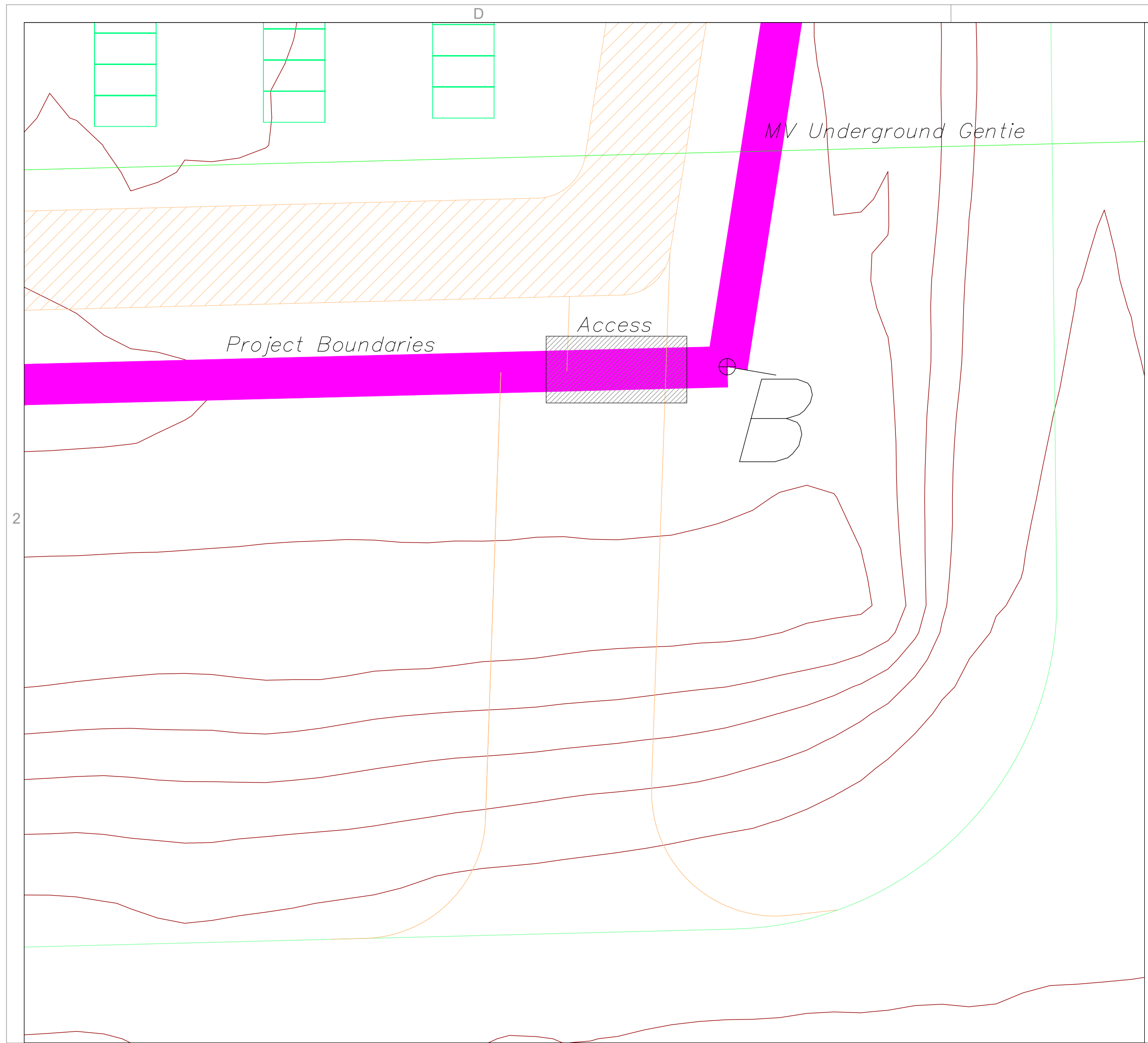
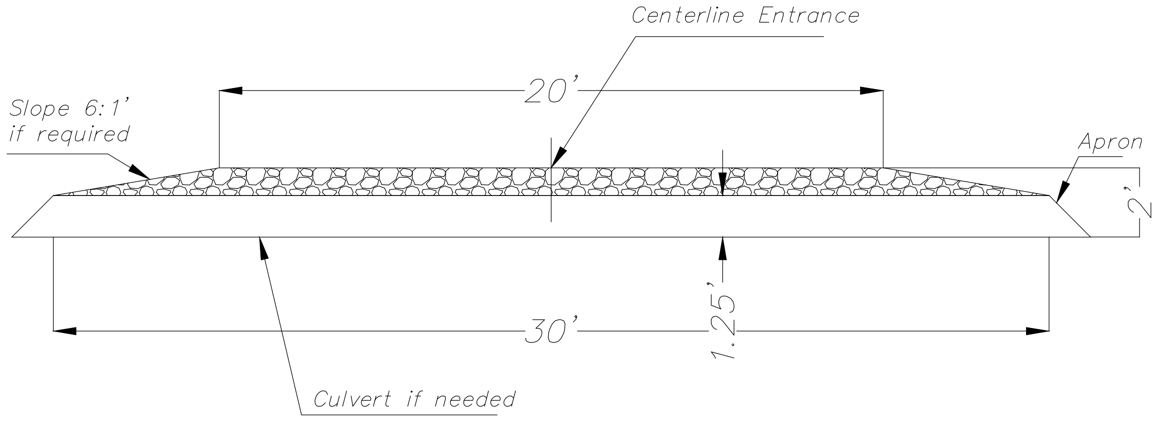
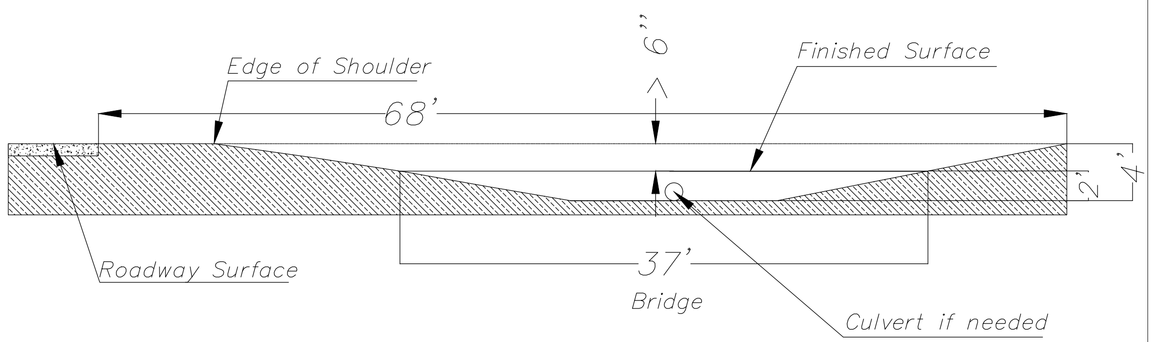


DETAIL - ACCESS FRONT VIEW



DETAIL - ACCESS CROSS VIEW



Heavy Loads:

- MVS ~ 10 tn
- PV 40ft Container ~ 7 tn

Contours Curves

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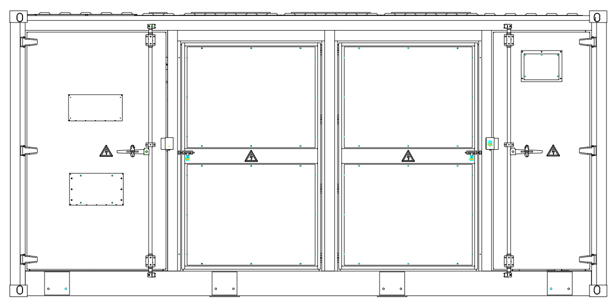
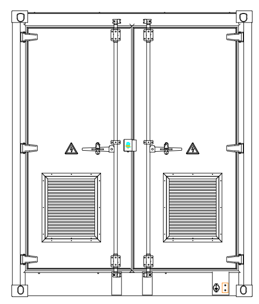
Rev:	

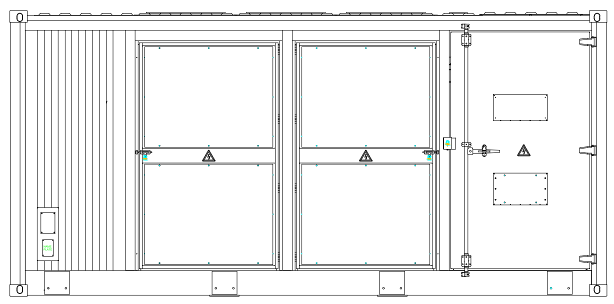
SW & CONTROL ROOM



Front View

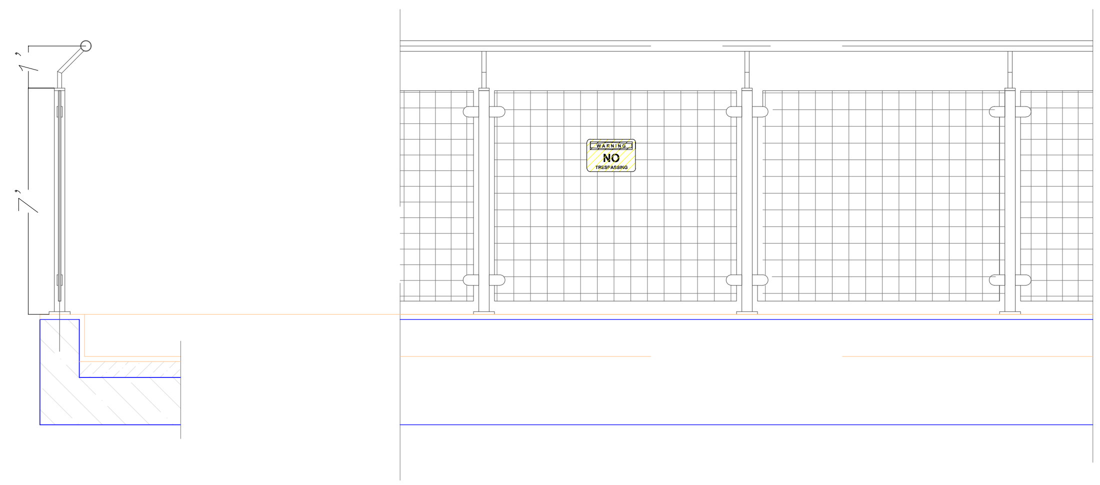


Right View

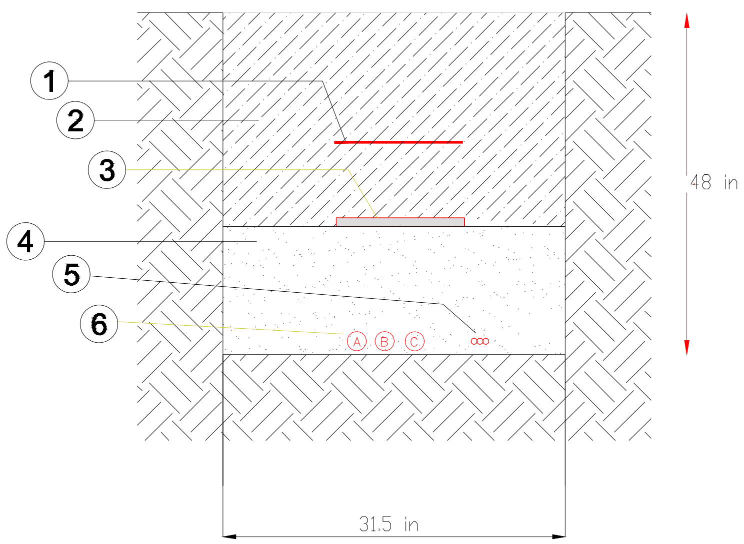


Back View

SITE BOUNDARY FENCE



DETAIL UNDERGROUND MV CABLE - INTERCONNECTION



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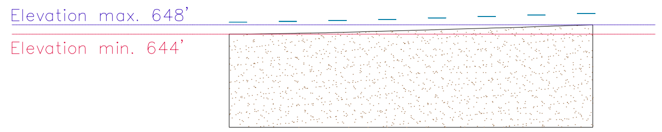
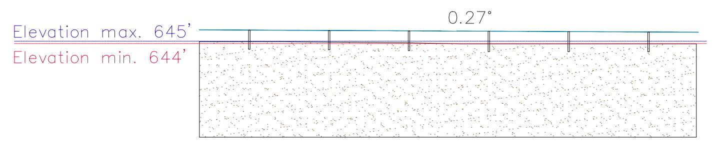
CROSS SECTION VIEW



FRONT VIEW



Frame parameters
- Framing type: single-axis trackers
- Module orientation: portrait
- Rows: 1
- Columns: 54
- Turning angle range, °: 52.00
- Horizontal gap between modules, ft: 0.066
- Vertical gap between modules, ft: 0.066
- Motor gap size, ft: 6.562
- Number of joint gaps : 0
- Joint gap size, ft: 1.640
- Overhang left, ft: 0.000
- Overhang right, ft: 0.000
- Pole reveal, ft: 4.914
- Reference height, ft: 1.969
- Frame height at highest point, ft: 7.919
- Frame power, kWp: 29.700

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Utility:	CIPCO	Scale	Rev:
File:	Site Plan Lone Tree.dwg		

Appendix B STORMWATER POLLUTION PREVENTION PLAN

Appendix C VEGETATION MANAGEMENT PLAN

Vegetation Management Plan

Lone Tree Solar Project

Lone Tree, Iowa Johnson County

Stantec Project No: 193709077

August 12, 2022

Prepared for:

PCR Investments SP2 LLC
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Houston, TX 77043

Prepared by:

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This document entitled Vegetation Management Plan, Lone Tree Solar Project was prepared by Stantec Consulting Services Inc. ("Stantec") for PCR Investments SP2 LLC ("PCR"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment considering the scope, schedule and other limitations stated in the document and in the contract between Stantec and the PCR. The opinions in the document are based on conditions and information existing at the time the document was published and do not consider any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others.

Prepared by ____

(signature)

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Reviewed by ____

(signature)

Chip DeAngelo, Restoration Project Manager

Reviewed by ____

(signature)

Stacey Parks, Senior Associate/Senior Scientist

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Executive Summary

PCR Investments SP2 LLC (PCR) is proposing to construct and operate the Lone Tree Solar Project (the "project") which is a 10-megawatt (MW) alternating current (AC) photovoltaic (PV) solar project in Lone Tree, Iowa in Johnson County. Proposed project developments, including ancillary facilities, will consist of solar panels and tracking systems, access roads, a project substation, underground collector cables, inverters, and junction boxes. All equipment will be Tier 1 quality.

This Vegetation Management Plan (VMP) is intended for use alongside an Erosion Control and Sediment Control Plan and Stormwater Management Plan (ECSCP) and (SMP) and provides further guidance on site seeding preparation, custom site-specific seed mixes, seed installation, and vegetation management activities over the 30-year lifespan of the facility. Site preparation typically consists of soil amendments, such as discing to reduce soil compaction from solar construction activities and create a seedbed to facilitates robust germination of compatible vegetation. Management of noxious and invasive plant species, if any, and other weedy species may also be conducted to reduce competition and improve establishment of permanent seed mixes. Temporary seed mixes consist of annual grasses for soil erosion control during or immediately after construction. Permanent seed mixes compatible with project vegetation objectives and suitable to local environmental conditions are installed after construction and site preparation, and include:

- Low growing graminoids (native and non-native grasses and grass-like plants) to be planted in the solar array areas and other areas outside fences and
- Pollinator-friendly vegetation to be planted in select but, as of yet undetermined buffer areas.

Following permanent seeding, ongoing management of regulated noxious and invasive plant species, and other weedy species may be required for compliance with local weed ordinances and to maintain project compatibility. Vegetation management activities typically consist of cutting (mowing) and targeted herbicide applications over the 30-year window. The custom designed seed mixes are also suitable for small ruminant grazing, (e.g., sheep), which is emerging as an alternative to mowing.

Photo 1. Vegetation management at solar sites can promote habitat for pollinators like the monarch butterfly.

1.0 PLAN GOALS

Specific goals of this Plan include the following:

- Compatibility, adaptability and compliance with the Project Erosion and Sediment Control Plan and Stormwater Management Plan once written;
- Compliance with post-construction re-vegetation requirements per Iowa and Johnson County Regulations
- Maintain soil health so that project lands may potentially be returned to productive agricultural land use after project decommissioning;
- Manage populations of existing noxious and invasive species within the project, as feasible;
- Develop and install permanent seed mixes that supports the following objectives:
  - Low growth, low maintenance, shade tolerant grasses for areas under panels and between panel rows,
  - Species adapted to site specific environmental parameters including soils, drainage, anticipated shade, and local climate,
  - Compatible with engineering objectives including height restrictions as well as capacity to form continuous, dense vegetation stands; and
  - Use of native species, including pollinator-friendly plantings, in select areas.
- Prepare seed beds and employ seed installation methods suitable for temporary and permanent seed; and
- Establish and maintain vegetation for the project through the anticipated 30-year life span of the facility.

Photo 2. Black-eyed Susan is a common species found in pollinator seed mixes.

2.0 PROJECT OVERVIEW

PCR is proposing the Lone Tree Solar Site in Lone Tree, Iowa near the intersection of Highway 22 and Sioux Ave. The project is a 10-megawatt (MW) alternating current (AC) solar project that includes solar array blocks containing PV panels attached to a single-axis tracking system mounted to steel piles. The PV panels will track the sun during the day. Direct current (DC) electricity from the PV panels will be routed underground through collection wiring to inverters located throughout the PV array areas. The PV array area will be fenced and have gated access at the road entrances. Constructed access roads will be gravel and approximately 12 to 20 feet wide. Construction is anticipated to begin Q1 of 2023 with the Commercial Operation Date (COD) projected in Q4 2023.

The Solar Facility portion of the project area is approximately 50 acres. Areas that are disturbed for project purposes will be re-vegetated per the Erosion Control and Sediment Control Plan and Stormwater Management Plan that will be prepared prior to construction once the project design is finalized. This Plan will supplement and does not replace the guidance provided in the ECSCP and SMP.

The typical minimum leading-edge height between the PV panels and the ground is 30 inches. Post-to-post spacing between rows is approximately 20 feet. Final spacing within the arrays will be determined once equipment selection is finalized and the detailed engineering plan is complete. The installation of low-growing plant species and performance of vegetation management practices within the PV panel areas will be conducted to minimize vegetation touching and overshadowing PV panels.

2.1 SITE CONDITIONS

2.1.1 Topography

Project area topography consists of relatively level uplands that slope down towards natural drainage channels. Most of the project area consists of 0% to 6% slopes. project area slope precents are as follows:

- Project Area at 0% - 6% slopes = 95%
- Project Area at 6% - 12% slopes = 5%

2.1.2 Soils

Project area soils, based on United States Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS) soil maps and interpretations, very deep, somewhat poorly drained soils formed in loess on uplands, fertile silt-loams conducive for vegetation establishment and cover and are mostly cultivated. Corn, soybeans, small grains, and meadow are the major crops, while some areas are used for pasture. Native vegetation was mixed prairie grass and hardwood trees. USDA-NRCS soil maps indicate 99% of project area soils consist of the soils identified in Table 1 below.

Table 1. Soil Types in Project Area

Map Unit Symbol	Map Unit Name	Hydric Rating	Percent of Project
121B	Tama silt loam, 2 to 5 percent slopes	7.4	15.70%
122	Sperry silt loam, depressional, 0 to 1 percent slopes	16.7	35.60%
160	Walford silt loam, 0 to 2 percent slopes	6.5	13.80%
175B	Dickinson fine sandy loam, 2 to 5 percent slopes	1.2	2.50%
291	Atterberry silt loam, 1 to 3 percent slopes	11.2	23.90%
M162B	Downs silt loam, till plain, 2 to 5 percent slopes	3.9	8.40%
M162C2	Downs silt loam, till plain, 5 to 9 percent slopes, eroded	0	0.10%

The primary soil hydrology associated with the project area constrains vegetation selection to species suitable for wet to medium mesic soils. Seed mixes ratios between moist and dry species will shift towards the drier spectrum. However, soil compaction during solar construction decreases drainage efficiency while increasing water holding capacity that favors species adapted to higher moisture conditions.

Soil matrices composed of primarily loams and silt increases the risk for erosion. All soil work, including grading and tilling, requires immediate soil stabilization to minimize the potential for soil erosion. Soil stabilization includes planting temporary cover crop, planting cover crop and permanent seed mixes, or covering bare soils with straw mulch. Severe erosion will compromise project construction efficiency and long-term maintenance.

2.1.3 Shade

Project area solar intensities at ground layer are currently in full sun. Solar array construction will create shade under the PV solar panels while full sun conditions will continue in areas outside PV panels. Hence, following construction, solar intensities at the ground layer will range between full sun, to partial shade, to full shade.

2.1.4 Current Vegetation

Project area vegetation is currently comprised of agricultural crops which could include corn (*Zea mays*), soybean (Glycine *max*), and alfalfa (*Medicago sativa*). Agricultural crop fields provide a good medium for planting solar project-compatible vegetation. However, agricultural crop field fertility has the potential to facilitate excessive weed growth. We have listed different preconstruction soil preparation strategies for each agricultural crop type in Section 3. Noxious weed management strategies and tactics are also described in Section 3.

3.0 SITE PREPARATION

3.1 PRE-CONSTRUCTION SOIL PREPARATION

3.1.1 Current Existing Vegetation / Site Preparation Considerations

Existing field crops, including corn (*Zea mays*), soybean (*Glycine max*), and alfalfa (*Medicago sativa*), require different preconstruction treatments prior to solar construction and temporary cover crop installation. These recommendations are meant to increase overall project construction and vegetation management. Soybean fields, small-grain fields (e.g., oat, wheat, cereal rye), and forage crop fields (e.g., alfalfa and corn silage) provide low crop residue soil surfaces and non-compacted soils conducive to both vegetation and construction objectives. Cornfields, grown for grain, can create excessive crop residue and compacted soils that impede both vegetation establishment, management, and solar construction. For these reasons, we advise working with current land managers to help determine final crops planted before solar construction begins. Our advice for final crops prior to solar construction are, from best to worst, soybeans, small grains, forage crops (e.g., hay, alfalfa, or corn silage), and in the least desirable case, grain-corn.

3.1.2 Temporary Cover Crop Consideration

The following information provides guidance for installing preconstruction temporary cover crops into existing crop fields conditions. Temporary cover crop types, and associated planting schedules are found in Appendix A, Tables. It is recommended that temporary cover crops should be installed if soils are idled for periods greater than 14 days or overwintered prior to solar construction. Idled agricultural fields, for extended periods of time, can be severely impacted by erosion and noxious weeds. Both soil erosion and noxious weeds will hinder vegetation establishment, management, and solar construction. The greatest potential for severe erosion in occurs in late winter / early spring when surface soils thaw while subsoils remain frozen, and rain occurs. Under these conditions, gully formation on associated unprotected soils and slopes, is rapid. Seeding cover crops into idled agriculture fields will help prevent erosion, maintain soil nutrients, provide competition against noxious weeds, reduce soil compaction, and help increase solar construction efficiency.

Existing field crops, such as soybeans, small grains, forage crops and corn, require different site preparation treatments prior to temporary cover crop installation. Excessive field crop residue and associated soil compaction will hinder cover crop installation, and ongoing vegetation and construction activities. The following information provides guidance for final field crop preparation that provide good conditions for cover crop installation and future vegetation management and solar construction.

3.1.3 Soybean Fields

Soybean fields are harvested in late-September through early-October. Harvested soybean fields provide good conditions for seeding temporary cover crops, permanent seed, and ongoing solar construction. Harvested soybean fields on sloping soils are susceptible to erosion that will impede ongoing vegetation management and solar construction. Therefore, it is not recommended soybean fields stand bare for long periods and should not go bare over winter. Harvested soybean fields, not scheduled for fall solar construction, should be stabilized seeded with temporary cover-crop before winter, preferably before mid-October.

Temporary cover crops, and when applicable permanent seed can be directly no-till drill seeded into soybean stubble. Temporary cover crop seed can also be broadcast seeded if followed by a packer (e.g., Brillion seeder, cultipacker or roller). Unharvested soybean fields should be mowed short or treated with an appropriate herbicide before seeding and solar construction.

3.1.4 Small Grain Fields (Oats, Wheat, Cereal Rye)

Small grains are harvested in mid-August. Harvested small grain crop fields can require surface residue reduction via straw baling to provide good conditions for seeding temporary cover crops, permanent seed, and ongoing solar construction activities. Without straw baling, excessive crop residue can impede seeding and solar construction. Small grain crop fields are more resilient to erosion and can stand bare for longer periods than soybean fields. However, small grain crop fields, not scheduled for fall solar construction, should be stabilized with temporary cover crops before winter, preferably before mid-October, to avoid severe spring erosion.

Following straw baling, temporary cover crops, and when applicable permanent seed can be directly no-till drill seeded into small grain stubble. Temporary cover crop seed can also be broadcast seeded, but this seeding method requires a shallow discing prior to broadcast seeding and a packing procedure following broadcast seeding. Unharvested small grain fields should be mowed short or treated with an appropriate herbicide before seeding and solar construction. Small grains, treated with herbicide, require biomass reduction, such as mowing before additional vegetation management of solar construction continues.

3.1.5 Forage Crop Fields

Forage crop fields, such as alfalfa-hay, are harvested throughout the year. Forage crop fields require some additional site preparation to provide good conditions for seeding temporary cover crops, permanent seed, and ongoing solar construction. Final site preparation includes a harvest (i.e., haying) to remove excess residue and a herbicide treatment to suppress existing vegetation and potential weeds. Herbicide application should occur approximately 20 – 30 days following haying, to allow remaining vegetation time to recover and regreen. Vegetation should reach 3 inches to 5 inches in height before herbicide is applied. Forage crop fields, prior to herbicide treatment, are resistant to erosion. Following herbicide treatment, soil erosion resistance decays, and forage crop fields should be seeded within 30 days following herbicide treatment.

Following herbicide treatment, and based on herbicide manufacturer's recommendations, temporary cover crops, and when applicable permanent seed, can be directly no-till drill seeded into forage crop stubble. Temporary cover crop seed can also be broadcast seeded, but this seeding method requires a shallow discing prior to broadcast seeding and a packing procedure following broadcast seeding.

3.1.6 Cornfields (Corn Silage and Grain Corn)

Regionally, corn is grown for either silage or grain. Corn harvested for silage provides good conditions for seeding temporary cover crops, permanent seed, and ongoing solar construction. Temporary cover crops, and when applicable permanent seed can be directly no-till drill seeded into corn silage stubble. Temporary cover crop seed can also be broadcast seeded, but this seeding method requires a shallow discing prior to broadcast seeding and a packing procedure following broadcast seeding.

Corn grown for grain produces excessive crop residue and severe soil compaction that makes ongoing site preparation and solar construction difficult. Excessive crop residue in combination with soil compaction decreases both evaporation and drainage, and in wet periods, ponding, mud, and rutting conditions persist. These conditions exacerbate vegetation management and solar construction. Adequate seedbed preparation for grain corn fields begins with mowing corn stubble, baling and removing plant residue, and/or discing soils prior to seeding.

Grain corn is the last regional crop to be harvested, usually in November, and often too late for cover crop germination. To avoid muddy compacted soils during solar construction, we advise grain cornfields be mowed and baled in the fall immediately following harvest. Unless solar construction begins immediately following harvest, we advise cover crops to be installed before winter freezes soils. Winter cover crops will germinate in early spring. Cover crops will help mitigate drainage and compaction issues associated with grain cornfields, plus provide protection against erosion and nutrient sloughing. Cover crop installation requires corn stubble to be mowed, residue baled and removed, and soils lightly disced prior to seeding.

Harvested grain corn fields are resistant to erosion; however, severe soil compaction prohibits water infiltration and therefore exacerbates downslope erosion.

3.1.7 Temporary Cover Crop Termination

Temporary cover crops can produce excessive crop residue that impede ongoing vegetation management and solar construction. Therefore, temporary cover crop installation requires planning for terminating cover crops before they produce excessive residue or how to deal with the excessive residue once its produced. Cover crops planted with permanent seed are terminated with regular ongoing management mowing.

If necessary, Fall installed temporary cover crops, consisting of winter wheat (*Triticum aestivum*) and annual rye grass (*Lolium multiflorum*) (Table A.1-A), can be treated with glyphosate or mowed short in the mid-spring before ongoing solar construction and vegetation management procedures proceed. Chemical and mowing cover crop termination should occur when cover crop has achieved 6 inches in height but is less than 12 inches tall.

If necessary, Spring installed temporary cover crops, consisting of oats (*Avena sativa*) and annual rye grass (*Lolium multiflorum*) (Table A.1-C), can be treated with glyphosate, or mowed short in the early-summer before ongoing solar construction and vegetation management procedures proceed. Chemical and mowing cover crop termination should occur when cover crop has achieved 6 inches in height but is less than 12 inches tall.

An alternative to mowing or treating cover crops with glyphosate is haying. Haying has the advantage of leaving behind a clean soil surface that is highly desirable to ongoing solar construction and vegetation management. Haying also has the advantage of reducing excess soil nitrogen; therefore, reducing the potential for noxious weed recruitment. The haying procedure allows the temporary cover crop to reach the beginning stages of flowering (boot stage). The cover crop is cut green and harvested for silage or hay. Green cover crops provide local farmers a quality forage crop.

3.2 POST-CONSTRUCTION SOIL PREPARATION

Most project soils will be impacted by solar construction and require post-construction soil preparation to develop a seedbed suitable for robust germination and compatible cover while providing a smooth surface for long-term vegetation management. Severe soil compaction caused by solar construction and tight spaces between panels makes post-construction seedbed preparation challenging. Soil preparation will require a minimum one deep tilling with an off-set disc, chisel plow or soil-ripper to fracture compacted soils. Following deep tillage, soils will require at least one pass with a drag harrow to create a smooth, firm, and friable seedbed that offers good germination and recruitment potentials. All seeded areas require a final packing to increase seed germination and reduce erosion potentials.

Table 2. Soil Preparation Procedures Based on Existing Vegetation and Project Construction Phase

Existing Conditions	Erosion Potential	Pre-seeding Preparation	Suitable for No-till Drill Seeding	Suitable for Broadcast seeding	Post-seeding Preparation Work
Harvested Soybean Field	High	None	Yes	Yes	Pack soils following seeding
Harvested Small Grain Field	Low	Reduce crop residue (e.g., bale straw) Shallow disc soils before broadcast seeding	Yes	Yes	Pack soils following seeding
Standing Forage Hay Field	Low	Final harvest to reduce biomass Herbicide treat forage Shallow disc soils before broadcast seeding	Yes	Yes	Pack soils following seeding
Harvested Corn Silage Field	Moderate	Shallow disc soils before broadcast seeding	Yes Disc soils prior to drilling seeding	Yes	Pack soils following seeding
Harvested Corn Grain Field	Moderate	Mow corn stubble. Bale corn residue Disc soils	No Disc soils prior to drilling seed	Yes	Pack soils following seeding
Post Solar Construction Bare Soils Within array field	High	Disc or chisel plow to reduce soil compaction (1-2 passes) Drag soils smooth firm Seed immediately	No Drill seeding not recommended in array field, inadequate seed coverage	Yes	Pack soils following seeding
Post Solar Construction Outside array field	Low	Disc or chisel plow to reduce soil compaction (1-2 passes) Drag soils smooth firm Seed immediately	Yes	Yes Increase seeding rates by 20%	Pack soils following seeding
Post Construction Noxious Weeds Within array field	Moderate	Treat weeds with appropriate herbicide Disc or chisel plow to reduce soil compaction (1-2 passes) Drag soils smooth firm Seed immediately	No Drill seeding not recommended in array field, inadequate seed coverage	Yes Follow herbicide label for seeding post herbicide treatment	Pack soils following seeding

Existing Conditions	Erosion Potential	Pre-seeding Preparation	Suitable for No-till Drill Seeding	Suitable for Broadcast seeding	Post-seeding Preparation Work
Post Construction Noxious Weeds Outside array field	Moderate	Treat weeds with appropriate herbicide Disc or chisel plow to reduce soil compaction (1-2 passes) Drag soils smooth firm Seed immediately	Yes Follow herbicide label for seeding post herbicide treatment	Yes Follow herbicide label for seeding post herbicide treatment	Pack soils following seeding

3.2.1 Soil Seedbed Preparation

A primary failure to establish compatible vegetation between and under PV panels is inadequate seedbed preparation. One reason is soil compaction that occurs during solar construction. Site preparation objectives seek to fracture soils to a minimum of 2.5 inches. This requires a minimum of one pass with either a heavy duty off-set disk or chisel plow (aka soil ripper / subsoiler). Following discing or chisel plowing, soils should be drag-harrowed to create smooth, firm, and friable soils suitable for seeding. Soil harrowing requires a minimum of one pass. Soil fracturing and harrowing is not possible completely under PV panels; however, seed rates and species selection can be designed to mitigate the lack of seed bed preparation in these areas.

3.2.2 Develop Contingencies for Erosion

Excessive post-construction soil compaction coupled to extensive PV panel dripline, creates the potential for rill and gully erosion during the soil preparation and early seed establishment phases. For these reasons, contractors and subcontractors should have in place plans and resources to correct. This might include filling in washouts, reworking soils to prepare an adequate seed bed, and over seeding impacted areas.

3.2.3 Invasive and Weed Species Management

Despite the clean appearance of recently harvested agricultural fields, several noxious weeds, such as Canada thistle (*Cirsium arvense*) and giant ragweed (*Ambrosia trifida*) can persist and thrive in abandon agriculture fields. When ceasing agricultural activities, noxious weeds are released and can quickly come to dominate large areas. These weeds can compromise project vegetation compatibility objectives and State and / or local Noxious weed laws. A list of noxious weeds in Iowa can be found on the USDA website here: https://plantsorig.sc.egov.usda.gov/java/noxious?rptType=State&statefips=19

For this plan, invasive and weed species are defined under the following two categories:

1. Compliance - includes species covered under State of Iowa Noxious Weed Law: Chapter 317. These species will be referred to as ‘noxious weeds.’
2. Compatibility – includes species that are not legally defined as noxious or ‘invasive’ but may interfere with the solar panels due to plant height, may interfere with ecological goals and the establishment of native species, or may pose vegetation management concerns. These species will be referred to as ‘weeds.’

Invasive and weed species management will be conducted as needed to:

- Minimize the spread of noxious weeds from existing populations, if present,
- Prepare the seeding areas for permanent vegetation to reduce competition and improve

establishment and success of the permanent seed mixes, and

- Reduce vegetation impacts to the PV panels and solar facility infrastructure. Flowering non-native species that are not considered noxious and do not have heights that interfere with the project operations will not be actively managed.

Noxious weed species management may consist of spot cutting, mowing, and herbicide treatments.

3.2.4 Cutting and Mowing

Vegetation cutting shall be appropriately timed to assist with control of invasive and weedy species (e.g., mow biennial species during flowering but prior to seed production) and to remove vegetation to assist with site seedbed preparation. Methods will be selected based on aerial extent of vegetation and site accessibility.

3.2.5 Herbicides

3.2.5.1 Purpose

Herbicide treatments are recommended for management of perennial noxious species, as mowing alone is not typically sufficient for adequate control. Ongoing management of invasive species may be required for compliance with existing invasive plant species regulations. Herbicides are also used to remove undesirable vegetation to prepare seeding areas for permanent seed installation.

3.2.5.2 Herbicide Types

There are three general types of herbicides that are applicable for use within the project: 1. Non-selective, 2. Broadleaf-selective, and 3. grass-selective.

Non-Selective Herbicides

Non-selective herbicides injure or kill all types of vegetation, including broadleaves, grasses, sedges, rushes, and woody plants. Glyphosate is commonly used to remove all vegetation to prepare areas for permanent seeding.

Broadleaf-Selective Herbicides

Broadleaf-selective herbicides are intended to injure or kill only broadleaf plants. There are many types of broadleaf herbicides. Two types commonly used in natural settings include 2,4-D and triclopyr. Both 2,4-D and triclopyr are used to remove broadleaf plants from grass-stands and turf lawns. Some broadleaf herbicides are highly selective, for example, the active ingredient clopyralid is very effective for controlling noxious Canada thistle (*Cirsium arvense*), giant ragweed (*Ambrosia trifida*) and weedy legumes (Fabaceae). These herbicides are all appropriate for controlling invasive broadleaf weeds within the PV panel arrays where only graminoid (grass and grass-like plants such as sedges and rushes) species will be installed. Extra caution should be taken to avoid injury to desirable graminoid species by waiting to apply herbicides after graminoid seedlings have matured for at least 90 days or have flowered at least once.

Grass-Selective Herbicides

Grass-selective herbicides are intended to injure or kill only grasses. The most common grass- selective herbicide is clethodim. It is used to selectively target undesirable grasses growing among desirable broadleaf plants. These herbicides may be appropriate for controlling certain invasive grasses in areas with pollinator-friendly vegetation.

3.2.5.3 Herbicide Application Methods and Timing

There are two primary methods to apply herbicides: low volume/spot applications and broadcast applications. Methods and timing should be based on a site-specific evaluation of target species, vegetation composition, and sensitivity of adjacent areas to herbicide applications.

Low Volume/Spot Applications

This method utilizes a hand-held sprayer mounted to small (3.5 to 25 gallon) tanks to selectively deliver herbicide to individual plants or small clumps of plants. Backpack sprayers are suitable for small areas while pistol sprayers mounted to an all-terrain vehicle or utility terrain vehicle (UTV) are suitable for larger areas or large clumps of vegetation. Wicks may also be used for ultra-low volume delivery of herbicide to undesirable plants growing in sensitive ecological areas. This method may be appropriate for managing discrete populations of weedy and invasive species before and during construction.

Broadcast Applications

This method utilizes a boom or boomless sprayer tanks mounted to a UTV or tractor to broadcast herbicide to large areas. This method is appropriate for large-scale site preparation to remove weedy and invasive vegetation from large areas using a non-selective herbicide.

3.2.5.4 Proposed Herbicides

The herbicides that may be used in the project are listed below in Table 1. These herbicides are frequently used in natural area settings to assist with management of species that would be expected to occur in the project area. These herbicides have a relatively short half-life and moderate to very unlikely potential to reach shallow groundwater.

Table 3. Environmental Information for Proposed Herbicides

Active Ingredient	Herbicide Type	Potential Uses	Rate (Ounces/ Acre)	Environmental Fate[1,2]			
				Water Solubility	Soil Half- life	Mineral Soil Sorption Coefficient KOC / FAO Mobility Classification 3	Groundwater Ubiquity Score (GUS)[4] / Potential to Reach Shallow Groundwater
Glyphosate	Non-selective systemic foliar	Non-selective treatment of grasses and broadleaf plants	64 - 96	Very soluble	3.6 days	33,025 in sandy soils / Hardly mobile	-0.29 in sandy soils / Very unlikely
2,4-D	Broadleaf systemic foliar	Selective treatment of weedy and invasive broadleaf plants	48 – 80	Moderately soluble	2.9 days	73 in sandy soils / Mobile	0.99 in sandy soils / Unlikely
Aminopyralid	Broadleaf selective foliar Species selective	Specific noxious and invasive weeds	5 - 9	Very soluble	81.5 days -	2.33 in	6.94 in
Clopyralid	Broadleaf selective foliar Species selective	Specific noxious and invasive weeds Asters and legumes	9 - 12	Very soluble	12.8 days	12.9 in sandy soils / Mobile[5]	3.96 in silt loam / Likely[5]
Clethodim	Grass-selective systemic foliar	Selective treatment of weedy and invasive grasses	12 - 16	Very soluble	3 days in unknown soil	137.5 in unknown soil / Moderately mobile	0.89 in unknown soil / Unlikely

[1] Information from Herbicide Properties Tool at the National Pesticide Information Center – Oregon State University. Accessed online on 10/28/2020 at http://npic.orst.edu/HPT/#.

[2] Reported for sandy soils unless otherwise stated in the Herbicide Properties Tool search results.

[3] Based on FAO Mobility Classification in *Guidance for Reporting on the Environmental Fate and Transport of the Stressor Concern in Problem Formulations*. Accessed online on 10/28/2020 at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-reporting-environmental-fate-and-transport#II_C.

[4] Potential to Reach Shallow Groundwater based on discussion in the Herbicide Properties Tool search results.

[5] Appropriate for low volume foliar herbicide applications targeting individual plants or clumps of plants.

3.2.5.5 Herbicide Adjuvants

Adjuvants are typically added to herbicide mixes to improve herbicide performance. Adjuvants typically used for natural areas management include hard water treatment additives, surfactants, and penetrants. Herbicide labels should be consulted for recommendations on the types of adjuvants to add to a mix. In general, aquatic-approved adjuvants should be used to minimize potential impacts on wildlife, including pollinators. Aquatic-approved adjuvants should always be used in and near areas of standing water.

3.2.5.6 Herbicide Standard Industry Practices

Herbicides are a valuable vegetation management tool when used according to manufacturer's instructions and following standard industry practices. The following practices are recommended when using herbicides to manage undesirable vegetation:

1. Vegetation managers should apply principles of integrated vegetation management. Herbicides will be used as one of several available 'tools in the toolbox' to manage vegetation and habitats in an ecologically sensitive manner, in addition to cutting, engineering controls, and cultural controls.
2. Herbicide labels and Safety Data Sheets should be read prior to mixing, loading, and application.
3. The appropriate volume of herbicides and adjuvants necessary to complete a vegetation management task should be utilized. This includes targeted application techniques when practicable and use of properly calibrated equipment to minimize environmental effects.
4. The appropriate concentrations of herbicides and adjuvants as recommended by product labels are used to achieve intended outcomes. Applying herbicide lower than recommended rates might result in herbicide resistance. Applying herbicides above recommended rates may result in "top-killing" the plant before the herbicide translocations through the root system killing the entire plant instead of only the above ground structure.
5. Selective herbicides are used to limit effects on non-target plants.
6. Persistent noxious weeds typically require several treatments, such as a spring, fall, spring treatment regime.
7. Herbicide applications should be conducted during favorable weather conditions to maximize herbicide efficiency and minimize off-site drift and run-off. These weather conditions include:
   a. Ambient air temperatures are below 78^0 degrees Fahrenheit (26^0 Celsius) and above 38^0 Fahrenheit (3^0 Celsius)
   b. Average weather conditions have prevailed for a minimum of two weeks prior to herbicide application (e.g., avoid herbicide application during persistent heat, drought, freezing or wet conditions).
8. Herbicide should be applied to plants when plants are most physiologically prone to injury by active ingredients. Plants are most prone to herbicide injury when they are actively growing. Plant life cycles targetable for herbicide application include the flower bud-stage and the cool season photosynthesizing rosette stage. Plants that have senesced following flowering or are inactive due to high heat or drought should not be treated.

Additional practices may be developed, as needed, based on project area conditions.

3.2.5.7 Herbicide Permitting

Herbicide treatments shall be performed by individuals with a current Commercial Pesticide Applicator certification and license issued through Iowa Department of Agriculture & Land Stewardship, and in accordance with all applicable laws, regulations, and herbicide label instructions.

4.0 VEGETATION INSTALLATION

4.1 SEEDING PLAN

Section 4 provides information on custom seed mixes and planting methods. Seed mix information covers both temporary and permanent seed mixes. Planting methods includes final seedbed preparation, seeding methods (e.g., drilled and broadcast seeded) and post seeding procedures (e.g., packing) for temporary and permanent seed mixes. This information is designed to increase compatible vegetation establishment, long-term vegetation management objectives, and overall project construction efficiency. All site seeding activities maintain compliance with the ECSCP and SMP. Many variables contribute to seed installation timing and this plan covers procedures for a wide variety of scenarios. Given the cost, performance and conditions arising from panel array construction, we recommend that all sites be seeded with the perennial final seed mix before construction begins.

4.1.1 General Seed Mix Information

Knowledge of site environmental constraints coupled to project vegetation compatible goals allows us to design custom site-specific mixes for both temporary and permanent seed. These seed mixes are customized to meet the environmental constraints that develop following PV panel installation. Seed mixes consist of fast to establish, low-growing species that thrive in mesic and moist-mesic soil conditions under a variety of sunlight levels This multi-species seed mix and corresponding seeding rates allows robust coverage and rapid establishment for a variety of site-specific environmental parameters throughout the project area.

Seed mix specifications for temporary cover crops are found in Appendix A, Table A.1-A – Table A.1-D. Seed mix specifications for permanent vegetation is found in Appendix A, Table A.2 – A.4. A list of regional seed mix vendors is found in Appendix B.

4.1.2 General Seed Installation (Seeding) Information

Seed installation for both preconstruction and post-construction project phases are described in this section. Preconstruction seeding primarily involves installation of temporary cover crops, and when appropriate, permanent seed mixes. Preconstruction seed installation methods are dependent upon preexisting conditions and timing. For example, some preexisting conditions, such as soybean fields, are suitable for direct no-till seeding. Other preexisting conditions, such as small grain crops (oats, wheat, rye, barley) corn silage, forage crops, and grain corn require additional site preparation prior to seeding. Site preparation for different preexisting conditions is detailed in Section 3 and summarized in Table 1.

There are two primary seed installation methods: drill seeding and broadcast seeding. Appendix C, Table 1.C provides a comparison summary of proposed seeding methods. Drill seeding requires less soil preparation and less seed. However, drill seeding is difficult in tight spaces and lacks the ability to spread seed under solar panels. Broadcast seeding requires greater soil preparation, increased seed amounts (e.g., >20%), and post-seeding packing to ensure adequate soil to seed contact and germination.

Differences between drill and broadcast seed installation dictates which method is preferable under pre-construction and post construction project phases. Drill seeding is the preferred method to install preconstruction temporary cover crops and, when applicable, permanent seed mixes, across the entire project area. Drill seeding is also the preferred method in larger post-construction areas (e.g., > 1 acre) outside the PV panel arrays, including designated perimeter, pollinator refuge, and buffer areas.

Broadcast seeding is the preferred method to install post-construction temporary and permanent seed mixes between PV panels. It is important to note, that while broadcast seeding covers more acres per hour, it requires two additional procedures, including pre-seeding soil tilling and post seeding packing to ensure adequate germination and establishment.

Packing soils following broadcast seeding is required to achieve good soil to seed contact. Although drill seeders do not require soil packing post seed installation, drilled seed still benefits from packing. In all cases, packing soils following seeding ensures good soil to seed contact, smoother soil surfaces, and reduction in potential erosion.

4.1.2.1 Seed Depth

Seed depth is another important general consideration. A primarily failure in seed recruitment is planting too deep. This is especially true when soils are shallow disced prior to seeding. The key term in shallow discing is shallow. In the best-case scenario, all seed should be incorporated into the soils between 1/16th and 1/4 inches deep. Large seed, such as cover crop seed can be seeded deeper, up to ½ inch deep. The permanent seed mixes are dominated by small-seed species that should be seeded between 1/16th and 1/4 inches deep. Some permanent seed species are very small and perform best when left on the surface. We have included very small seed species that are shade tolerant for under PV panels where soil preparation is impossible. The best way to ensure seed is not installed too deep is to drag-harrow or pack soils following soil fracturing and before seeding. Drag harrowing or packing soils prior to seeding creates a firm friable seedbed that prevents seed from being planted too deep.

4.1.2.2 Fertilizer

We recommend no fertilizer be applied to soils before, during or following seeding of both temporary cover crops and permanent seed mixes. Soils in the project area have been cropped with nitrogen fixing legumes, including soybeans and alfalfa, and augmented with nitrogen fertilizer for corn. Therefore, project soils provide adequate fertility to establish robust project compatible vegetation.

For sites developed on infertile soils, or on highly disturbed soils, the addition of legumes in cover crops can enhance fertility for permanent seed mixes. As such, legumes included in cover crops are not necessary for this project. Also, non-native legumes, including white clover (*Trifolium repens*) and red clover (*Trifolium pratense*) are included in the permanent seed mixes and native legumes are included in the permanent Pollinator Refuge seed mixes.

4.1.2.3 Seed Mix Vendors

Seed should be purchased from vendors that supply quality local sourced seed, or at a minimum, seed that has proven successful in local environmental parameters. All seed, including temporary cover crop and permanent seed mixes, require seed tags that indicate seed weight, pure live seed, region of origin, and noxious weed content. Native seed, used in Pollinator Refuge Areas, should require seed source tags that indicate genetic origin not greater than 250 miles from the project site. Stantec maintains an in-house native seed nursery capable of providing seed for this project. Prices available on request.

4.2 TEMPORARY COVER CROPS

Temporary seeding of cover crops is employed to stabilize soils following removal from agriculture production and soils disturbed by project construction that are not ready for permanent seed and will be idled for extended periods, over winter, or as otherwise specified in the ECSCP and SMP.

Temporary cover crops are replaced by permanent vegetation prior to or following installation of PV panels. Temporary cover crop seeding rates (e.g., seeds per square foot) are higher when permanent seed is not installed to provide adequate vegetative cover and protection from soil erosion. Cover crop seed mixes are designed to meet two primary objectives:

1. Compliance with the ECSCP and SMP and

2. Stabilization of soils to assist with establishment of permanent vegetation.

Cover crops are composed of annual grasses that establish quickly, provide erosion control, establish residue for later permanent seedings, build soil organic matter, maintain soil nutrients, reduce soil compaction, and assist with weed suppression. Three annual grasses – winter wheat (*Triticum aestivum*), seed oats (*Avena sativa*), and annual rye grass (*Lolium multiflorum*) are utilized, depending on installation timing. Each of these species is listed on the Iowa Construction Site Erosion Control Manual – Chapter 2. Vegetation and Soil Stabilization Control Measures and each species has a relatively wide tolerance of soil conditions.

Specific species and installation rates are selected based on installation timing, mechanism (drilled versus broadcast seeded), and whether cover crops are installed with or without permanent seed. Cover crop mixes, rates, and timings are provided in Tables A.1-A through A.1-D (Appendix A).

4.2.1.1 Solar Production Area

The solar production area is comprised of areas under and between the PV panel arrays. Temporary seeding in this area is completed in phases, starting concurrently with site preparation, and as follows:

- Phase 1 Fall (late-September to mid-November).: Temporary cover crop seeding occurs following final crop harvest. The temporary fall cover crop seed mix (Table A.1-A) is installed to establish vegetation cover that will overwinter and provide residue for additional temporary seeding in the 2022 growing season. Installation by drilling into exposed soils is the preferred method for seed establishment, but broadcast seeding is also acceptable method; however, broadcast seeding will increase the amount of seed needed by 20% and broadcasted seed needs to be incorporated into the soils via either a shallow drag-harrow or cultipacker.
- Phase 2 – Spring (mid-April-June). The temporary cover crop seeding occurs in early spring to early summer. Cover crops for this time period are listed in (Table A.1-C).
- Phase 3 – Spring-fall (mid-April-September). Aforementioned cover crop seed mixes (Tables A.1-A and A.1-C) will be installed, as needed, to revegetate areas disturbed by construction activities.

4.3 PERMANENT SEED

Two permanent seed mixes are proposed for the project area as follows:

1. Low Grow Native / Non-Native Graminoid Seed Mix for PV Panel and Perimeter Areas (Table A.2)
2. Pollinator Refuge Native Prairie Seed Mix – Select Perimeter Areas (Table A.3)

General descriptions of both seed mixes are described in greater detail below. Recommended species for both seed mixes are listed in Appendix A, Tables A.2 and A.3. Final seed mix design will occur when tentative seeding dates are known, and actual species composition and rates will be based on supply and cost just prior to seeding. An alternate Pollinator Refuge Native Wetland seed mix (Table A.4) is provided for low-lying buffer areas. Installation and maintenance for this mix is comparable to that of the Pollinator Refuge Native Prairie seed mix.

4.3.1 Low Grow Native / Non-Native Graminoid Seed Mix for PV Panel and Perimeter Areas (Table A.2)

This seed mix is intended to provide a cost-effective permanent low maintenance, low stature, ECSCP and WMP compliant, project compatible vegetation over a variety of environmental conditions throughout the project area. This mix blends both native and non-native graminoids with common low growing clovers. Non-native cool-season grass species in this mix, such as bluegrass (*Poa* spp.), bent grass, (*Agrostis* spp.), and fescue grass (*Festuca* spp.) act as surrogates for historic native cool season species, and are intended to provide competition against cool-season invasive and weedy species. Together, the proposed species ensemble is adapted to compacted soils, moist soils, well drained soils, wet and drought conditions, sun and shade, cool and warm seasons, and cold and hot weather. Once established, this mix will provide multiple ecosystem services. Immediate ecological benefits include reductions in soil erosion, run off, nutrient sloughing, and soil compaction. Long term benefits include increase in soil health, nutrient regulation, water infiltration, water purification, biodiversity, pollinator habitat, and wildlife habitat including nesting habitat for grassland birds. None of the species are considered invasive or noxious under State of Iowa Noxious Weeds law (Chapter 317).

4.3.2 Pollinator Refuge Native Prairie Seed Mix – Select Perimeter Areas (Table A.3)

This mix contains native grasses, sedges, rushes, and wildflowers. The mix is intended to promote a diversity of wildflowers, with flowering occurring over each of the three blooming periods (spring, summer, and fall), along with native grasses and sedges that provide benefits to pollinators and other wildlife. The seed mix is intended to be cost-effective, provide short to medium stature native plant cover and diversity, and improve long-term soil health. None of the species are considered invasive or noxious under State of Iowa Noxious Weed Law: Chapter 317.

The Pollinator Refuge Native Prairie Mix is designed to be installed in select portions of the perimeter areas. Areas intended for pollinator refuge mixes should be at least 0.5 acres in size and not to exceed 3:1 ratio between length and width to reduce surface area. Pollinator refuge areas also require occasional mowing and other management services, so these areas should be accessible by small tractors and skid-steers. More precise pollinator areas will be defined after the final site design is complete.

The two proposed custom permanent seed mixes are compared in Table 4 below.

Table 4. Permanent Seed Mix Comparison

Attributes	Low Grow Native / Non-Native Graminoid Mix (Table A.2)	Pollinator Refuge Native Prairie Mix (Table A.3)
Dominated by non-native species	**Yes**	**No**
Dominated by native species	**No**	**Yes**
Growth height below 30 inches	**Yes**	**Yes**
Wildflowers / multi-season blooms	**No**	**Yes**
Pollinator habitat	**Yes**	**Yes**
Wildlife habitat	**Yes**	**Yes**
For moderately to poorly drained soils	**Yes**	**Yes**
For well drained soils	**Yes**	**Yes**
Shade tolerant	**Yes**	**No**
Sun tolerant	**Yes**	**Yes**
ECSWMP Compliant	**Yes**	**Yes**

Attributes	Low Grow Native / Non-Native Graminoid Mix (Table A.2)	Pollinator Refuge Native Prairie Mix (Table A.3)
Project Compatible	**Yes**	**Yes**
Contributes to Soil Health	**Yes**	**Yes**

4.3.3 Permanent Seed Installation

Permanent seed will be installed either preconstruction or following construction and seedbed preparation. During solar construction, soils are frequently compacted, rutted, and soil erosion can occur. Therefore, prior to permanent seed installation, soils typically require additional soil preparation procedures as described in Section 3. Permanent seed installation should occur immediately following final soil preparation.

Seeding can be accomplished by either a drill seeder, broadcast seeder, or packer seeder (e.g., Brillion seeder). There are positives and negatives associated with each seeding method, as described earlier in Section 4, and summarized in Appendix C, Table 1.

Ultimately, based on the ability to install seed under PV panels and seed in tight spaces, all permanent seeding between PV panels will occur via broadcast seeding. All broadcast seeding should be followed by packing or at minimum a shallow drag-harrowing, to help increase germination rates, decrease soil erosion potentials, and provide a smooth level soil surface conducive to long term management.

Native plantings, such as Pollinator Refuge seed mixes, can be either drill-seeded or broadcast seeded. Drill seeding native mixes requires a specialized drill designed to plant native seed (e.g., Truax Drill). Native seed can also be seeded via broadcast seeding, but this method requires soils be shallow disced, followed by firming with a drag harrow or packer, and then seeded, and then finished by an additional packing or light drag-harrowing.

The most efficient method for seeding larger areas (> 1 acre) outside the solar array areas is by drill seeding. These areas might include buffer and perimeter areas and Pollinator Refuge areas.

Post-seeding packing by a cultipacker or roller benefits both drill and broadcast seeding. These benefits include: 1. Increase soil to seed contact, 2. Increase germination rates, 3. Decreases erosion potential, 4. Provides a finished soil surface conducive to on-going vegetation maintenance and management.

4.3.3.1 Timing

Permanent Low Grow Native / Non-Native Graminoid Seed Mixes for PV Panel and Perimeter Areas (Table A.2) can be seeded anytime between April 10th and September 30. There are preferred seeding dates within this contextual period, based on historic precipitation/evaporation ratios. The preferred dates for seeding permanent seed mixes are during the spring, between April 1 – June 15, and again in late summer between September 15 – October 15. Dormant season seeding in late fall through winter is not recommended for Permanent Low Grow Native / Non-Native PV Panel seed mixes. Associated compacted soils can encounter severe rill erosion during winter rains or rapid snow melt that can wash seed away. These areas can be difficult and expensive to re-seed and repair especially in between PV panels. For best results, seed should be planted during times that facilitates seed germination. The sooner the seed germinates, the less washing occurs, the more successful results. If dormant season seeding is the only option, permanent seed rates should be increased by 20%, a dormant season cover crop should be installed (Table A.1-B), and a contingency for over-seeding bare areas should be agreed upon between the contractor and service provider.

The Pollinator Refuge Seed Mix (Table A.3) is best installed in spring through early summer approximately between March 15 – June 15, and again in late summer between September 15 – October 15. Pollinator Refuge seed mixes can also be installed during the dormant season via frost seeding between November 30 to snow cover or during a period of light snow cover in the winter. Dormant season seeding seed rates should be increased by 20%. Areas with highly compacted soils should not be dormant season seeded to avoid washing.

Cover crop seed mixes should be installed with the permanent seed. If permanent seed is installed during fall through winter, the cover crop should consist of winter wheat and annual ryegrass (Table A.1-B). If permanent seeding occurs in the spring through early summer, the cover crop should consist of oats and annual ryegrass (Table A.1-D). Cover crop is installed at a lower rate when combined with permanent seed.

5.0 MONITORING AND MAINTENANCE PLAN

Section 5 provides information on post seed installation monitoring and maintenance that promotes the establishment of a desirable vegetation compatible with project objectives. Monitoring and maintenance activities seek to establish and maintain compliance with the ECSCP and SMP.

Per Johnson County Code of Ordinances all required vegetative cover will be monitored on an annual basis for 5 years following construction after which a request for reduced frequency will be submitted to the Zoning administrator. Any vegetative cover that fails to establish or dies during the life of the project will be replaced.

All areas will require ongoing maintenance to establish and maintain desirable vegetation that is compatible with PV panels, project objectives, and in compliance with noxious weed laws. Maintenance is expected to be most intensive in the establishment phase, or approximately the first two growing seasons following seeding as desirable species germinate, grow, and mature. In general, native species take longer to mature than non-native species. Vegetation cutting and herbicide applications are typical management activities as discussed below. Monitoring will occur to confirm compatibility of vegetation with project goals concurrently with routine vegetation maintenance activities.

5.1 VEGETATION CUTTING

Cutting, by mowing or hand-trimming, is the primary management tool used to aid in the establishment of desirable vegetation. Cutting is employed to reduce height, reduce flowering of undesirable vegetation, and maintain sunlight at the ground surface to encourage germination and growth of desirable species. Mowing using a deck mower is applicable in areas that are accessible with a small tractor and mower. Flail mowers are preferred but rotary mowers are acceptable if significant clumping of grass clippings is minimized. A 3-point side-mounted trimmer mower attached to a small tractor may also be used to cut vegetation around steel piles and under panels if areas are accessible with equipment.

5.1.1 Mowing Frequency and Timing

Establishment Phase
Frequent cutting is required in all seeding areas during the establishment phase (post-seeding years 1 and 2) to reduce fast-growing (annual and biennial) weeds, minimize vegetation height under the PV panels, and assist growth of desirable species. Following permanent seeding, anticipate establishment mowing to occur 4 weeks following seeding and about every 4-6 weeks thereafter from mid-spring to mid-fall. A minimum of three mowings should occur during the first establishment year and a minimum of 2 mowings should occur during the second establishment year.

Transition Phase
By the third growing season, desirable vegetation should be established. Years 3-5 represent a transition phase where desirable vegetation becomes increasingly established but remains susceptible to weed invasion. The frequency of cutting is reduced, and in the best-case scenario, mowing targets only specific areas of weed growth and to minimize vegetation height under the PV panels.

Long-Term Maintenance
Over the long-term (years 6-30), mowing should occur on an annual or biennial basis. Annual or biennial mows should occur during the dormant season late fall or early spring, or in mid-summer. The goal of annual / biennial mows is to reduce thatch, encourage lateral growth, encourage root development, and minimize the establishment of woody vegetation. Actual mowing frequency is dependent upon soil moisture; wet areas and wet weather requires more frequent mowing while dry areas and dry weather reduces mowing frequency.

5.1.2 Mowing Height

Specific recommendations for mowing height vary by seed mix.

Low Grow Native / Non-Native Graminoid Seed Mix for PV Panel and Perimeter Areas (Table A.2)
During the establishment phase (post-seeding years 1 and 2), areas seeded with this mix should be mowed when vegetation reaches a height of 8-12 inches and be cut back to a height of 4-6 inches. Expect to mow the vegetation three to four times during the first growing season, two times during the second growing season and once or twice per year thereafter. Installed species within this mix will likely stay below 18 inches in height (typically 8-12 inches) at maturity. Mowing this mix to the height of 4-6 inches will help invigorate the grasses and clover while discouraging weeds and trees.

Pollinator Refuge Native Prairie Seed Mix – Select Perimeter Areas (Table A.3)
In general, areas planted with the Pollinator Refuge Mix should be mowed when vegetation reaches a height of 8-12 inches, starting within 4-6 weeks post seeding and continuing at a 4–6-week interval throughout the first growing season, or whenever the vegetation reaches 8-12 inches in height. Taller vegetation will compete for sunlight and water and suppress desirable vegetation. Likewise, mowing taller vegetation creates excessive clumping that smothers desirable plants. Vegetation in Pollinator Refuge Mix plantings should be cut to a height of 6-8 inches during the first growing season.

During the second growing season, Pollinator Refuge plantings should be mowed two times, once in June and once in September–November. Mowing height should be 6-8 inches.

During the third growing season (Transition Phase), as native plants mature, mowing height should be raised to 10-12 inches and done selectively in June-July, to target tall and/or invasive and weedy species. A dormant season mowing at the end of the third growing season (October–November) offers spring emerging native species abundant sun to rapidly control state dynamics.

Long-term maintenance mowing should be conducted on an annual or biennial basis, during the dormant season, March-April, and September–November, and vegetation should be cut back to 6-8 inches. Summer mowing can be conducted to maintain project vegetation compatibility. Summer mowing should maintain 6–8-inch mower height, and not exceed one mowing per-growing season.

5.2 HERBICIDE APPLICATIONS

Herbicides may be used for long-term maintenance of areas planted with each seed mix. Herbicide type and method of application are highly dependent on target species and vegetation maintenance goals. Low volume / spot applications are appropriate for use in all areas during the establishment period (years 1 and 2) to spot treat invasive and incompatible species. Beyond the establishment period, this method is also appropriate for use in areas planted in pollinator-friendly seed mixes to minimize impacts on desirable vegetation and wildlife. Broadcast applications are generally not appropriate in areas planted with the native species and near PV panels. A combination of herbicides and application techniques is typically required to manage large areas. Herbicide use will be minimized to the extent practicable and will be conducted by trained and licensed personnel in accordance with label directions and standard industry practices.

6.0 PRELIMINARY SCHEDULE OF ACTIVITIES

The table below provides a preliminary schedule of activities that will occur up to permanent seed installation.

Table 5. Preliminary Schedule of Vegetation Management Activities

Activity	Timeframe[1]
Start of construction	Q1 2023
Initial permanent or temporary cover-crop seed installation following vegetation removal, grading, and as-needed seed bed preparation (Table A. 1-C)	Q2 2023
Initial temporary cover-crop seed installation following vegetation removal, grading, and as-needed seed bed preparation (Table A. 1-A)	Q3 - Q4 2023
As needed, install secondary temporary cover-crop seed for construction areas.	Q2 2024
Install permanent native seed mixes (Mixed Native & Non- Native Graminoid Seed Mix, and Upland Pollinator-friendly Seed Mix). Dormant season seeding rates should be increased by 20%. Dormant season cover crops are installed with permanent seed (Table A.1-B)	Q4 2022-Q2 2023
Install permanent native seed mixes (Mixed Native & Non- Native Graminoid Seed Mix, and Upland Pollinator-friendly Seed Mix). Cover crop for permanent seed and seeding during the growing season is found in (Table 1 A. 1-C).	Q2 2023 – Q3 2023
Project COD, start of 30-year facility life period	Q4 2023
Maintain permanent vegetation	Q2 2023 – Q3 2053

[1] Timing for vegetation management activities may be based on construction sequencing. Actual schedules for temporary seed installation, seed bed preparation, and permanent seeding may be based on construction timing within each array area.

7.0 SUMMARY

This plan was prepared to outline vegetation removal at the start of construction and revegetation tasks after construction of the project area. This plan also provides guidance to PCR on 30 years of maintenance following the installation of permanent vegetation at the Lone Tree Solar Project. The plan includes the installation of two permanent seed mixes:

1. Low Grow Native / Non-Native Graminoid Seed Mix for installation under and between the PV panels. This mix is anticipated to be compatible with minimum leading-edge height of 30 to 42 inches and shading from the panels, as well as provide low maintenance and hardy vegetative cover. This mix will also be planted in the bulk of the perimeter areas.
2. Pollinator Refuge Prairie Seed Mix in select portions of the perimeter areas, where feasible, that includes pollinator-friendly wildflowers, bunch grasses, and sedges.

The implementation and maintenance tasks provided in this plan will assist PCR in maintaining compliance with agency requirements for project revegetation. It is anticipated that the planting plan will result in improved plant species diversity and soil health compared to the pre-construction agricultural land use conditions.

APPENDIX A: SEED MIX TABLES

Table A.1-A – Table A.1-D. Temporary Cover Crop Seed Mixes*

Table A.1-A Temporary Fall (Late August – Early November) Project Area Cover Crop Seed Mix without Permanent Seed*	
Scientific Name	**Common Name**
Triticum aestivum	Winter Wheat
Lolium multiflorum	Annual Rye

Table A.1-B Temporary Fall (Late August – Early November) Project Area Cover Crop Seed Mix with Permanent Seed*	
Scientific Name	**Common Name**
Triticum aestivum	Winter Wheat
Lolium multiflorum	Annual Rye

Table A.1-C Temporary Spring-Summer (Mid-April – Mid-August) Project Area Cover Crop Seed Mix without Permanent Seed*	
Scientific Name	**Common Name**
Avena sativa	Seed Oats
Lolium multiflorum	Annual Rye

Table A.1-D Spring-Summer and Early Fall (Mid-April – Mid-August) Project Area Cover Crop Seed Mix with Permanent Seed*	
Scientific Name	**Common Name**
Avena sativa	Seed Oats
Lolium multiflorum	Annual Rye

* PCR anticipates further discussion regarding specifics of the seed mix and overall vegetation management plan during that construction planning period.

All seed mixes calculated at Pure Live Seed (PLS). Seeding rates are designed for drilling seed in spring through summer. Broadcasting seed and seeding during the dormant season will require 20% increase in PLS rates. Broadcast seed should be packed or harrowed into the soils.

Table A.2 Low Grow Native / Non-Native Graminoid Seed Mix for PV Panel and Perimeter Area*

Scientific Name	Common Name
Agropyron smithii (Pascopyrum smithii)	Western Wheat Grass
Agrostis gigantea	Red Top
Agrostis perennans	Upland bent
Bouteloua curtipendula	Side-oats Grama
Carex bicknellii	Copper Sedge
Carex brevior	Plains Sedge
Carex vulpinoidea	Brown Fox Sedge
Danthonia spicata	Poverty Oat Grass
Deschampsia cespitosa	Tufted Hair Grass
Elymus trachycaulus	Slender Wheat Grass
Elymus villosus	Silky Wildrye
Eragrostis spectabilis	Sand Love Grass
Festuca brevipila	Hard Fescue
Festuca ovina	Sheep's Fescue
Festuca rubra	Red Fescue
Festuca subverticillata	Nodding Fescue
Hordeum jubatum	Squirrel Tail Grass
Koeleria macrantha	June Grass
Muhlenbergia mexicana	Upland Timothy
Poa palustris	Meadow Bluegrass
Poa pratensis	Kentucky Bluegrass (var. Park)
Poa supina	Supina Bluegrass
Poa trivialis	Woodland Bluegrass
Schizachyrium scoparium	Little Bluestem
Sporobolus compositus	Rough Dropseed

*PCR anticipates further discussion regarding specifics of the seed mix and overall vegetation management plan during that construction planning period.

Table A.3 Pollinator Refuge Prairie Seed Mix – Select Perimeter Areas*

Scientific Name	Common Name
Grasses and Sedges	
Agropyron smithiii	Western Wheat Grass
Bouteloua curtipendula	Side oats Grama
Bouteloua gracilis	Blue Grama Grass
Bromus kalmii	Prairie Brome
Calamagrostis canadensis	Blue Joint Grass
Carex annectens	Yellow-headed Fox Sedge
Carex bicknellii	Copper Sedge
Carex brevior	Plains Oval Sedge
Danthonia spicata	Poverty Oat Grass
Deschampsia cespitosa	Tufted Hair Grass
Elymus canadensis	Canada Wild Rye
Elymus trachycaulus	Slender Wheat Grass
Festuca rubra	Red Fescue
Festuca subverticillata	Nodding Fescue
Poa compressa	Canada Bluegrass
Poa pratensis	Kentucky Bluegrass (var. Park)
Schizachyrium scoparium	Little Bluestem
Sorghastrum nutans	Golden Grass
Sporobolus compositus	Rough Dropseed
Sporobolus heterolepis	Prairie Dropseed
Forbs	
Agastache foeniculum	Blue Hyssops
Allium cernuum	Nodding Onion
Amorpha canescens	Lead Plant
Anaphalis margaritacea	Everlasting
Anemone cylindrica	Thimbleweed
Artemisia ludoviciana	Sage
Asclepias tuberosa	Butterfly Milkweed
Asclepias syriaca	Common Milkweed
Asclepias verticillata	Whorled Milkweed
Astragalus canadensis	Canadian Milk Vetch

Table A.3 (cont.) Pollinator Refuge Prairie Seed Mix – Select Perimeter Areas*

Scientific Name	Common Name
Forbs	
Baptisia alba	White Wild Indigo
Chamaecrista fasciculata	Partridge Pea
Coreopsis lanceolata	Lanceleaf Coreopsis
Coreopsis palmata	Prairie Coreopsis
Dalea candida	White Prairie Clover
Dalea purpurea	Purple Prairie Clover
Drymocallis arguta	Prairie Cinquefoil
Echinacea pallida	Pale Purple Coneflower
Echinacea purpurea	Purple Coneflower
Geum aleppicum	Yellow Avens
Lespedeza capitata	Prairie Bush Clover
Liatris aspera	Rough Blazing Star
Lupinus perennis	Wild Lupine
Monarda punctata	Spotted Beebalm
Oenothera rhombipetala	Sand Primrose
Oligoneuron rigidum	Stiff Goldenrod
Penstemon digitalis	Foxglove Beardtongue
Penstemon grandiflorus	Large Flowered Penstemon
Ratibida pinnata	Yellow Coneflower
Rosa arkansana	Prairie Rose
Rosa blanda	Meadow Rose
Rudbeckia hirta	Black-eyed Susan
Solidago juncea	Early Goldenrod
Solidago rigida	Stiff Goldenrod
Symphyotrichum ericoides	Heath Aster
Symphyotrichum laeve	Smooth Blue Aster
Symphyotrichum oolentangiense	Sky Blue Aster
Teucrium canadense	Germander
Tradescantia ohiensis	Ohio Spiderwort
Verbena stricta	Hoary Verbena
Zizia aptera	Heart Golden Alexandria

*PCR anticipates further discussion regarding specifics of the seed mix and overall vegetation management plan during that construction planning period.

Table A.4 Pollinator Refuge Wetland Seed Mix – Wetland Buffer Areas*

Scientific Name	Common Name
Grasses and Sedges	
Agropyron smithiii	Western Wheat Grass
Agrostis gigantea	Red Top
Beckmannia syzigachne	Slough Grass
Calamagrostis canadensis	Blue Joint Grass
Carex scoparia	Lance-fruited Oval Sedge
Carex stipata	Common Fox Sedge
Carex vulpinoidea	Brown Fox Sedge
Deschampsia cespitosa	Tufted Hair Grass
Eleocharis obtusa	Bald Spikerush
Festuca rubra	Red Fescue
Glyceria striata	Fowl Manna Grass
Juncus dudleyi	Dudley's Rush
Poa palustris	Meadow Bluegrass
Poa pratensis	Kentucky Bluegrass (var. Park)
Forbs	
Asclepias incarnata	Marsh Milkweed
Asclepias syriaca	Common Milkweed
Astragalus canadensis	Canadian Milk Vetch
Bidens cernua	Nodding Bur Marigold
Bidens frondosa	Common Beggar's Ticks
Boltonia asteroides	False Aster
Coreopsis lanceolata	Lanceleaf Coreopsis
Coreopsis palmata	Prairie Coreopsis
Eupatorium perfoliatum	Boneset
Geum aleppicum	Yellow Avens
Helenium autumnale	Sneezeweed
Liatris spicata	Marsh Blazing Star
Lobelia siphilitica	Blue Lobelia
Monarda fistulosa	Wild Bergamot
Penstemon digitalis	Foxglove Beardtongue
Penthorum sedoides	Ditch Stonecrop
Persicaria pensylvanica	Pinkweed
Pycnanthemum virginianum	Mountain Mint

Scientific Name	Common Name
Forbs	
Rudbeckia hirta	Black-eyed Susan
Zizia aurea	Golden Alexanders

* PCR anticipates further discussion regarding specifics of the seed mix and overall vegetation management plan during that construction planning period

APPENDIX B: COMPARISON OF SEEDING METHODS

Table B.1 Comparison Summary Between Drill and Broadcast Seeding Methods

Circumstance	Drill Seeding	Broadcast Seeding	Post Seeding Packing
Soil to Seed Contact	High	Low	Increase soil seed contact
Germination Efficiency	High	Low	Increase germination rates
Extra Seed Required to Achieve Compatibility	No	≥ 20%	No extra seed required
Seedbed Preparation	Low	High	Decreases soil preparation
Soil Finishing (packing or rolling)	Low	High	N.A.
Efficiency in Tight Spaces	Low	High	Low
Ability to Seed Under PV Panels	No	High	No
Impact on Erosion Potential	Decrease	Increase	Decreases erosion potentials
Harvested Soybean Field	Yes	Yes	Increase germination rates
Harvested Corn Field (followed by mowing, baling, and light discing)	Yes	Yes	Increase germination rates
Harvested Forage (hay or silage) Field	Yes	Yes	Increase germination rates
Post-construction Seeding Within Array Field	Not advised	Advised	Advised
Potential for Second Seeding Event	Low	High	Decreases