September 12, 2025

Mr. Peter Lance
Sheridan Charter Township Supervisor and Zoning Administrator
6525 W 64th Street
Fremont, MI 49412

Re: Sylvan Solar Application for a Special Land Use Permit from the Fremont Community Joint Planning Commission

Dear Mr. Lance,

Sylvan Solar, LLC (Sylvan Solar), an affiliate of AES Clean Energy Development, LLC, is pleased to submit the enclosed application for a Special Land Use Permit and Site Plan approval for the 220-MW Sylvan Solar Project (Project), approximately 76-MW of which will be located in Sheridan Charter Township, Newaygo County, Michigan. Sylvan Solar is proposing to construct, own, operate, and decommission the Project.

Sylvan Solar prepared the enclosed application to meet the Fremont Community Joint Planning Commission's (FCJPC) Special Land Use requirements for Commercial Solar Energy Systems (SES) as described in Section 3.26 (II)(D) of the SES amendment to the Fremont Community Joint Zoning Ordinance

We look forward to working with you and the FCJPC to answer questions as you complete your review and this Project moves forward to the Joint Planning Commission for consideration.

If you have any questions or require more information, please contact Dana Schultz, Development Manager at 720-416-4524 or Lauren Colwell, Permitting Project Manager at 763-269-5892.

Sincerely,

Frank Krawczel

Sylvan Solar, LLC
Frank Krawczel
Director of Development
540-420-4460
frank.krawczel@aes.com

Special Land Use Application for Utility-Scale Solar Energy Generation Facility

Sylvan Solar Project

Sheridan Charter Township, Newaygo County, Michigan

Prepared for
Sylvan Solar, LLC

Prepared by
Barr Engineering Michigan LLC

September 2025

2180 S 1300 E #500
Salt Lake City, UT 84106

Special Land Use Permit Application

September 2025

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barr.com

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Attachments

Abbreviations

AC	alternating current
AES	AES Clean Energy Development, LLC
AG	agricultural
Applicant	Sylvan Solar, LLC
Application	permit application
Barr	Barr Engineering Michigan LLC
BMPs	Best Management Practices
C SES	commercial solar energy system
dBA	A-weighted decibels
DC	direct current
DNR	Department of Natural Resources
EGLE	Michigan Department of Energy, Great Lakes, and the Environment
EPC	Engineering, Procurement, and Construction
EMR	Eastern Massasauga Rattlesnake
FAA	Federal Aviation Administration
FCJPC	Fremont Community Joint Planning Commission
FEMA	Federal Emergency Management Agency
gen-tie	generation tie line
GWs	gigawatts
HV	high voltage
kV	kilovolt
MDARD	Michigan Department of Agriculture and Rural Development
MDOT	Michigan Department of Transportation
MISO	Midcontinent Independent System Operator
MPSC	Michigan Public Service Commission
MV	medium voltage
MW	megawatt
NCDC	Newaygo County Drain Commission
NCRC	Newaygo County Road Commission
NEC	National Electric Code
NESC	National Electrical Safety Code
NLEB	Northern Long-eared Bat
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Science
NREL	National Renewable Energy Laboratory
NREPA	Natural Resources and Environmental Protection Act
O&M	operations & maintenance
Project	Sylvan Solar Project
PV	photovoltaic
QHA	qualitative habitat assessment
SCADA	supervisory control and data acquisition
SES	solar energy systems
SWPPP	Stormwater Pollution Prevention Plan
SLU	special land use
SPCC	spill prevention, control, and countermeasures

Sylvan Solar	Sylvan Solar, LLC
T&E	threatened and endangered species
TIS	Traffic Impact Statement
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VMP	Vegetation Management Plan

1 Introduction

This Special Land Use (SLU) Permit application for the Sylvan Solar Project (Project) in Sheridan Charter Township, Newaygo County, Michigan is submitted by Sylvan Solar, LLC (Sylvan Solar, Applicant), an affiliate of AES Clean Energy Development, LLC (AES). AES is a subsidiary of The AES Corporation based in the United States that owns and operates solar, wind, battery, and green hydrogen projects across the United States, grossing 9.1 gigawatts (GWs) in operation at the end of 2024. Sylvan Solar, a Delaware limited liability company, is an independent power producer that is qualified to do business in Michigan.

Sylvan Solar is proposing to construct, own, operate, and decommission the 220-megawatt (MWac) Sylvan Solar Project (Project), which spans both Sheridan Charter and Garfield Townships. The Project is expected to generate an annual average of approximately 445,000 MW hours of renewable energy over its anticipated 35-year life span, which is enough electricity to power the equivalent of approximately 55,000 Michigan homes per year. The Project represents a significant private investment in Newaygo County which will contribute to the local labor income and tax base with no local incentives or long-term strain on township and county services. Additionally, the Project incorporates a well-sited design and will provide direct and indirect social and economic benefits to the townships and county.

The Applicant respectfully requests approval for a SLU Permit for the construction and installation of approximately 76 MWs of the Project, and accompanying facilities and infrastructure, situated in Sheridan Charter Township (a separate permit application was submitted to Garfield Township for the Project components located in Garfield Township). If approved, the Project will be the first utility-scale solar project in Sheridan Charter Township.

This SLU Permit application (Application) was written in accordance with the Fremont Community Joint Planning Commission (FCJPC) Zoning Ordinance and Solar Energy Systems (SES) Amendment, for submittal to the FCJPC. A detailed analysis of how the Project meets each of the requirements of the SLU and SES Amendment is included in Section 3 of this Application.

2 Project Information

2.1 Project Description

The proposed Project is a 220-MW photovoltaic (PV) solar generation facility within a 2,166-acre Project area on land within Sheridan Charter and Garfield Townships, Newaygo County, Michigan (Figure 1). The Project is approximately 4.5 miles southeast of Fremont, Michigan. The Project is generally north of North River Drive, west of Bingham Avenue, south of Michigan Highway 82, and east of South Osborn Avenue. The Project will connect to the electrical grid via a Project substation and utility-owned switchyard that will be located in Garfield Township.

The Project boundary and surrounding area primarily consists of agricultural fields, wooded areas, agricultural ditches, and Newaygo County designated drains. The Muskegon River is approximately 900 feet south of the Project at its closest point.

Of the total 2,166 acres leased for the Project, approximately 1,250 acres of the Project area will consist of the solar energy facility and generation tie line (gen-tie). Buried medium voltage (MV) collection lines will be installed within and outside the fenced area to connect the blocks of solar panels in the Project area.

Of the approximate 1,250 acres of the Project area that will be within the fence line (referred to as the Development Area), approximately 420 acres are within Sheridan Charter Township. A Vicinity Map is included on Sheet PV-G.00.01 of the attached Site Plan (Attachment 1). The participating parcels (Attachment 2, Figure 2) are zoned as AG-2. Table 2-1 summarizes the estimated metrics for the Project:

Table 2-1 Project Quantities

Project Details	Sheridan Charter Township
Megawatts (MW)	76 MW
Total acres (including easements)	783 acres
Fenced area (Development Area)	420 acres
Project Substation and Utility-owned Switchyard (Garfield Township only)	N/A
High Voltage (HV) Gen-tie Line (Garfield Township only)	N/A

On-site construction of the Project is anticipated to commence in mid-2027, and the solar energy facility is currently expected to be operational in late 2028. Prior to commencing on-site construction, Sylvan Solar will make significant investments (excess of $10,000) to advance the Project, including purchasing the generator step-up transformer for the Project substation, executing the Generator Interconnection Agreement or Power Purchase Agreement, or contracting the initial civil work at the site.

2.2 General Facility Description

The facility will include multiple rows of PV solar panels oriented north-south on single-axis tracking structures, inverters that convert direct current (DC) to alternating current (AC), transformers, primarily underground 34.5-kV MV collection lines, meteorological stations, a stormwater management system, and a 345-kV Project substation. The MV collection lines will transport electricity from the PV solar arrays to the proposed Project substation in Garfield Township.

The Development Area (420 acres) includes the following Project components (Site Plan, Attachment 1):

- PV solar arrays,
- inverter skids that will house inverters and MV step-up transformers,
- underground MV collection lines,
- gravel access roads,
- meteorological stations,
- security fencing and gates,
- temporary construction laydown areas, and
- stormwater management system.

In addition, the potential exists that the Operations and Maintenance (O&M) building may utilize an existing building (if available) or a laydown area within the Project area in Sheridan Charter Township.

The Development Area represents Sylvan Solar's anticipated maximum number of developed acres within the Project boundary in Sheridan Charter Township. As the Project approaches construction, additional engineering studies will be completed that may further refine the design shown on the attached Site Plan (Attachment 1). Typical changes include shifting equipment within the Development Area and a potential reduction of the area within the perimeter fence line. These changes will be minimal, will occur within the proposed fence line (i.e., no new areas will be needed), result in the same or less environmental and social impacts, and are typical of solar project development. Sylvan Solar will submit the final Site Plan prior to construction.

During construction, temporary laydown areas, construction trailers, and parking areas will be located within the Project area. Fencing, lighting at the Project substation and O&M building, and electronic security systems will secure the Project facilities. The perimeter fence in Sheridan Charter Township will be an approximate 7-foot-high woven wire fence. Security fencing around the Project substation and utility-owned switchyard, located in Garfield Township, will consist of a 7-foot-tall chain link fence topped with 1-foot barbed wire per the National Electrical Safety Code (NESC).

During operation of the Project, downlit, dark-sky friendly security lighting will be installed at the O&M building and Project substation. The Project's O&M building will be located either within a laydown area near the Project substation or in an existing building within the Project area (potentially in Sheridan Charter Township), and will include maintenance facilities, restrooms, and ancillary support systems such as component storage.

2.3 Contact Information for Applicant

The contact information for the applicant is provided below.

Mr. Frank Krawczel
Director of Development - MISO
AES Clean Energy, The AES Corporation
2180 South 1300 East, Suite 500
Salt Lake City, Utah 84106
Office: 540-420-4460
Email: frank.krawczel@AES.COM
Website: www.aes.com/sylvan-solar

2.4 Project Construction

On-site construction of the Project is anticipated to commence in mid-2027 with commercial operations expected to begin in late 2028. Sylvan Solar anticipates that construction will likely take 19 months to complete.

Mobilization activities may include but are not limited to:

- Locating and marking existing utilities;
- Delineating the limits of construction disturbance areas by surveying, flagging, and staking;
- Installing stabilized construction entrances and sediment control Best Management Practices (BMPs);
- Installing any necessary temporary security fencing;
- Adding gravel and grading the temporary laydown areas for office trailers, storage of construction materials and shipped equipment containers, receiving construction deliveries, and temporary parking for Project-related vehicles;
- Mobilizing office trailers and construction equipment;
- Receiving material deliveries; and
- Surveying and marking the locations of access roads, solar arrays, collection system, and gen-tie line alignment.

Construction activities may include but are not limited to:

- Installing erosion and sediment control BMPs per applicable permit requirements;
- Recontouring and grading land where necessary within the solar arrays and Project substation;
- Constructing access roads;
- Installing fencing, inverters, and transformer pads;

- Pile driving and installation;
- Installing the racking system and solar modules;
- Installing inverters;
- Installing collection system and communication lines;
- Installing the communications shelter; and
- Installing the gen-tie line (right-of-way preparation, foundation installation, tower installation, attaching cross-arms or davit arms and insulators, and conductor stringing onto the structures) and constructing the Project substation.

Sylvan Solar anticipates the Project to generate approximately 530 temporary construction jobs on-site at the peak of the construction of the Project, which account for half of the anticipated average annual 1,085 total net jobs supported during construction as described in Section 3.2 of this Application. Generally, the number of construction workers on-site will be lower in the initial stages of pre-construction activities, approximately several dozen, and will peak during the concurrent and phased installation of Project components. As construction of the Project components ends and commissioning and restoration activities begin, the number of workers on-site will decrease.

Sylvan Solar estimates that semi-trucks will be used for bulk load equipment delivery during construction. Higher volumes of semi-truck traffic will occur for delivery of piles, trackers and modules at the peak of construction. Light duty trucks and/or passenger vehicles will also be used to transport construction workers to and from the site daily. The workers may be responsible for their own transportation and/or the Engineering, Procurement, and Construction (EPC) contractor may transport groups of workers to the site. Traffic impacts from construction and operation of the Project are described in the Traffic Impact Statement (Attachment 3).

The Project area will be seeded prior to the start of construction to minimize dust and erosion during construction. As portions of the Project near completion, demobilization of equipment and restoration of the temporary laydown yards and other temporary disturbance areas will occur. This includes final grading, decompacting soils, and establishing vegetation in accordance with the Project’s Vegetation Management Plan (VMP, Attachment 4). The VMP includes guidelines and recommendations regarding site preparation, seed mixes, management of invasive species and noxious weeds, and ongoing management and monitoring after construction. Note that the VMP will be updated in accordance with FCJPC Zoning Ordinance and SES Amendment after ongoing consultation with appropriate stakeholders and review by Sylvan Solar’s construction contractors.

2.5 Project Operation

Once operational, power production for the Project will be remotely operated and monitored 24 hours per day via the Supervisory Control and Data Acquisition (SCADA) system housed in the control room at the Project substation located in Garfield Township. Additionally, the Project is projected to support four full-time on-site O&M employees, which are included as part of the net 10 full-time jobs expected to be generated during Project operations as described in Section 3.2 of this Application. O&M employees will be on-site business days, and as necessary to complete maintenance and operational activities. As described in the Traffic Impact Statement (Attachment 3), O&M employees are anticipated to visit each site entrance approximately five times per day in light duty trucks. This level of traffic is compatible with existing traffic patterns and is not expected to have an adverse impact on daily traffic.

2.6 Decommissioning

The Project lifespan is currently expected to be 35 years. At the end of the Project lifespan, the Project will be re-powered or will be decommissioned as outlined in landowner lease agreements and the Decommissioning Plan (Attachment 5). Decommissioning involves removing above- and below-ground Project equipment and restoring the land to pre-construction conditions to the extent possible. Per Section 3.26 (II)(D)(4) of the SES Amendment to the FCJPC Zoning Ordinance, the Applicant will post financial assurance at the start of construction that covers the net cost of decommissioning equipment. To provide for an accurate financial assurance amount at the time of construction, the Applicant will hire an independent, third-party registered engineer to update the net decommissioning cost estimate and provide to Sheridan Charter Township prior to construction, after final equipment has been identified. Refer to Section 3.18 and Attachment 5 of this Application for additional details on the decommissioning phase of the Project.

3 Sheridan Township Special Land Use Requirements

Sylvan Solar requests a SLU classification for the Project area to install a commercial solar energy system (C SES), in accordance with Section 3.26(II) of the SES Amendment to the FCJPC Zoning Ordinance. A C SES is defined as a solar energy system with the primary purpose of converting solar energy to electrical energy for transfer off-site, such as into the electrical power grid servicing the community.

A complete Sheridan Charter Township SLU application form is provided in Attachment 6. A detailed description confirming the Project meets the Sheridan Charter Township's requirements for a C SES as defined in Section 3.26(II)(D) of the SES Amendment to the FCJPC Zoning Ordinance is included in the subsections below. These subsections include the township's requirements (text in black) and how Sylvan Solar will meet each one (text in blue).

3.1 Landowner Authorization

Requirement: Participating parcel list including parcel numbers, the complete name of the parcel owners, the mailing address of the parcel owners, and the telephone numbers of the parcel owners. The parcel list must indicate which parcels the C SES is the primary use.

A participating parcel list, including parcel numbers and each landowner's contact information, is provided in the Site Plan (Attachment 1) and separately in Attachment 2. All participating parcels, except for those hosting solely MV easements (PIDs 62-17-23-200-009, 62-17-24-100-002, 62-17-24-300-019, and 62-17-25-400-004), will have primary use as a C SES.

Requirement: Authorization from the participating parcel owners for the applicant to apply for the special land use.

The signed landowner authorizations are included in Attachment 2.

3.2 Project Description, Expected Use, and Public Benefits

Requirement: The planned date for the start of construction and the expected duration of construction. A description of the C SES, including a site plan. A description of the portion of the community where the C SES will be located.

A description of the Project is provided in Section 2 (Project Information) of this document. Project construction is planned to begin in 2027. The expected duration of construction is 19 months. The Site Plan (Attachment 1) illustrates the location of the Project area in Sheridan Charter Township.

Interconnection que information for the applicable regional transmission organization.

The Midcontinent Independent System Operator (MISO) queue number for the Sylvan Solar Project is J2001.

Requirement: A description of the expected use of the C SES. Expected public benefits of the proposed C SES.

The Project area is expected to be used as a solar generation facility (C SES) to generate an annual average of approximately 445,000 MW hours of renewable energy over its anticipated 35-year life span, which is enough electricity to power the equivalent of approximately 55,000 Michigan homes per year.

Regarding public benefits of the proposed C SES, the Project incorporates a well-sited design and will provide direct and indirect social and economic benefits to Sheridan Charter Township and Newaygo County. The Project represents a significant private investment into Newaygo County which will contribute to the local labor income and tax basis with no local incentives or long-term strain on township and county services.

The Project is expected to bring significant economic benefits to the region. Michigan State University (MSU) Extension conducted an Economic Impact Study that identified the following economic benefits:

- ~$402 million in capital investment in the Project,
- ~$293 million in net economic benefits for southern Newaygo County,
- Approximately 1,085 net average annual jobs during construction, including construction workers and supporting employment for local businesses,
- Approximately 10 net jobs during operation, and
- Project ancillary benefits to the local community such as supporting local businesses including restaurants, convenience stores, construction equipment, building materials and lodging.

In addition to these significant economic benefits, the Project will also strengthen the regional electric grid and create valuable pollinator habitat. By producing electricity during peak summer demand and diversifying energy resources, the Project helps to improve overall grid reliability. At the same time, the proposed native seed plantings beneath and around the PV panels will provide food sources for bees, butterflies, and other pollinators, supporting nearby farms and enhancing soil and water quality. Finally, the Project provides stable income to participating landowners that is not subject to fluctuating commodity prices and allows landowners to keep land in the family for the long-term. Together, these benefits improve community resilience, protect natural resources, and contribute to the local economy.

3.3 Environmental Impact

Requirement: The expected direct impacts of the proposed C SES on the environment and natural resources and how the applicant intends to address and mitigate these impacts.

The Applicant completed several surveys and studies to support the Project design (Table 3-1). The results of these assessments were and will continue to guide the layout and siting of the Project. Sylvan Solar's proposed mitigation measures to avoid and/or minimize any expected direct impacts from the Project on the environment and its natural resources are listed in Table 3-1.

Table 3-1 Expected Environmental Impacts and Mitigation Measures

Category	Environmental Considerations	Assessment Completed	Assessment Findings and Resulting Project Actions	Applicant's Proposed Mitigation Measures
Aesthetics	Visual intrusion or glare affecting nearby residents or scenic views	Visual Renderings (Attachment 11), Glare Study	Twelve visual renderings were prepared to illustrate different viewsheds, including the proposed landscape screening, site entrances/gates, PV panels and perimeter fence, and the Project substation and utility-owned switchyard.	Sylvan Solar will install landscape screening (shrubs, trees) between adjacent residences and the Project. Setbacks were incorporated into the design to provide for additional distance from adjacent residences. Sylvan Solar conducted a glare study that found no glare at adjacent residences and no adverse impacts on adjacent roadways; as such, no mitigation is proposed for glare.
Cultural Resources	Disturbance to archaeological sites or culturally significant landscapes	Cultural Resources Desktop Report & Survey (March 2025)	Report identified areas with a high probability of containing archeological artifacts in September 2023. Field surveys of the high probability zones were completed in November 2024 and March 2025. Seven historic farmstead sites were identified in the field survey. Sylvan Solar elected to voluntarily avoid these seven areas in the Project design.	Sylvan Solar elected to voluntarily avoid seven historic farmstead sites in the Project design. Sylvan Solar will implement an Unanticipated Discovery Plan that outlines methods to address potential effects to any significant archaeological sites if cultural materials are discovered during ground-disturbing activities associated with Project construction.
Land Resources	Returning land to agricultural uses at the end of Project lifespan	Decommissioning Plan (Attachment 5)	Plan states that Sylvan Solar will provide financial assurance in the form of a performance bond or letter of credit for the amount equal to the estimated cost of decommissioning, less the salvage value. In the case of abandonment, Sylvan Solar agrees to remove the C SES no less than 180 days after abandonment, and decommissioning activities will occur within 18 months after the end of the Project's lifespan.	Sylvan Solar prepared a decommissioning plan that describes how Project equipment will be reused, scrapped, recycled, or safely disposed of with certified waste handlers during decommissioning.
Noise Quality	Construction and inverter noise disturbing residents or wildlife	Noise Impact Assessment Report (Attachment 12)	Sylvan Solar completed a 24-hour noise monitoring study in July 2025 at three monitoring locations in the Project area. Observed noise levels ranged from 20 to 65 dBA Leq (i.e., the average sound level over a specified period). Based on the collected noise monitoring data, a noise model was used to predict noise conditions in the Project vicinity during Project operations. Potential Project operational sound levels at non-participating residences were modeled to range from 21 dBA to 41 dBA. These modeled levels fall within the range of the observed existing noise levels. The noise study report shows that operation of the solar generation facility will not exceed 55 dBA at the property line of adjacent, non-participating parcels or at public road rights-of-way.	Sylvan Solar will limit construction to daytime hours; place inverters away from property lines where possible; and implement equipment setbacks in the site design.

Category	Environmental Considerations	Assessment Completed	Assessment Findings and Resulting Project Actions	Applicant's Proposed Mitigation Measures
Soil	Earth disturbances and heavy equipment leading to soil erosion, compaction, rutting, or sedimentation of waterways	Stormwater Pollution Prevention Plan (SWPPP) Geotechnical Study	A geotechnical study will evaluate subsurface soil conditions, such as soil bearing capacity, settlement potential, and erosion risks, to inform the design and development. In addition, Sylvan Solar will develop a SWPPP prior to construction that will outline BMPs to minimize erosion and compaction.	Sylvan Solar will minimize grading with low impact machinery, install Soil Erosion and Sedimentation Control (SESC) measures (e.g., silt fences, erosion blankets, vegetated swales), and revegetate surfaces promptly.
Wetlands, Floodplains, Surface Waters	Increased runoff from impervious areas; potential sediment or pollutant discharges into county drains or wetlands.	Wetland Delineations (Figure 3) Stormwater Assessment (Attachment 10), Hydrologic Study (December 2024), SWPPP	A wetland delineation was completed per the standards outlined in the U.S. Army Corps of Engineers (USACE) 1987 Manual and Regional Supplement. Based on FEMA's flood map, the Project does not propose construction within the FEMA Floodplain. Sylvan Solar will use the Hydrology Study results to develop a SWPPP to meet National Pollutant Discharge Elimination System (NPDES) and Newaygo County Drain Commission (NCDC) stormwater management standards for approval prior to construction.	All impacts, permanent and temporary, to regulated wetlands and surface waters will be permitted through the Michigan Department of Energy, Great Lakes, and the Environment (EGLE) and the NCDC, as applicable. Sylvan Solar will design and maintain stormwater management measures (e.g., detention ponds, swales) following SESC and Construction Stormwater permitting requirements for disturbing more than 1 acre of land within 500 feet of a lake or stream during construction. The detailed Project design is ongoing. Sylvan Solar will bore the MV collection lines crossing county drains in accordance with NCDC crossing standards and not impact the drains. Sylvan Solar designed the Project to have a 75-foot setback between solar panels and regulated wetlands, streams, lakes, and county drains.
Threatened and Endangered Species	Direct or indirect impacts to listed species or critical habitats	Qualitative Habitat Assessment (QHA) (July 2024)	A QHA was completed by recording all habitat types on the Project and determining if the present habitat can support federal and state threatened and endangered species. The Project area in Sheridan Charter Township contains potential suitable habitat for the Northern Long-Eared Bat (NLEB; federally listed as endangered) and the wood turtle (state listed as threatened). A consultation letter dated July 1, 2025, and generated by the USFWS Michigan Ecological Field Office indicates that Project activities are Not Likely to Adversely Affect or have No Effect on federally listed species (Attachment 7). In addition, Sylvan Solar discussed the wood turtle with the Michigan Department of Natural Resources (DNR) and designed the Project to avoid direct impacts to the streams that have potential suitable wood turtle habitat.	Forested areas and streams were excluded from the Project design, and Sylvan Solar will follow U.S. Fish and Wildlife Service (USFWS) guidelines to avoid impacts to the NLEB. In addition, Sylvan Solar will implement the Michigan DNR's recommended mitigation measures to avoid impacts to the wood turtle. Sylvan Solar will continue coordinating with the USFWS and Michigan DNR as the design progresses to avoid or minimize impacts to federal and state-listed species.
Traffic	Construction traffic increasing congestion or creating safety hazards	Traffic Impact Statement (Attachment 3)	As described in the Traffic Impact Statement, O&M employees are anticipated to visit each site entrance approximately five times per day in light duty trucks. This level of traffic is compatible with existing traffic patterns and is not expected to have an adverse impact on daily traffic. At the peak of construction, approximately 350 passenger vehicles and 80 semi-truck deliveries are anticipated to visit the site entrances throughout the Project area per day. This level of activity during construction will be temporary and localized.	To mitigate traffic impacts during construction, Sylvan Solar will prepare a traffic management plan, schedule equipment deliveries during off-peak hours when possible, and coordinate with the Newaygo County Road Commission and Emergency Services.
Vegetation	Clearing and grading, removing native vegetation, fragmentation of habitat, disturbing wildlife corridors, compacting soil	Vegetation Management Plan (Attachment 4)	Plan includes guidelines and recommendations regarding site preparation, seed mixes, management of invasive species and noxious weeds, and ongoing management and monitoring after construction. Note that the plan will be updated in accordance with FCJPC Zoning Ordinance and SES Amendment after ongoing consultation with appropriate stakeholders and review by Sylvan Solar's construction contractors.	Sylvan Solar selected previously disturbed agricultural lands for the Project area and will use native seed to revegetate disturbed areas and plant native vegetation buffers.

Requirement: Proof of environmental compliance, including compliance with Part 31, Water Resources Protection, of the Natural Resources and Environmental Protection Act (NREPA); Part 91, Soil Erosion and Sedimentation Control, and any corresponding Newaygo County ordinances; Part 301, Inland Lakes and Streams; Part 303, Wetlands; Part 365, Endangered Species Protection; and any other applicable laws and rules in force at the time the application is considered.

Sylvan Solar will obtain the necessary permits/approvals for the Project as detailed in the Project's Permit Matrix (Attachment 7). Several state and local permits/approvals are currently anticipated for the Project, including:

- Spill Prevention, Control, and Countermeasures (SPCC) Plan for the US Environmental Protection Agency (USEPA);
- Joint Permit Application for impacts to regulated wetlands and surface waters from EGLE;
- Water Withdrawal Permit from EGLE;
- NPDES General Permit – Construction Stormwater Notice of Coverage from EGLE;
- Discharge Request from EGLE;
- Oversize and/or Overweight Vehicles and Loads Permits from the Michigan Department of Transportation (MDOT);
- Driveway/Construction Permits from MDOT;
- Stormwater Permit, SESC Permit, and County Drain Encroachment/Crossings Permits from the Newaygo County Drain Commission;
- Right-of-Way Permits from the Newaygo County Road Commission (NCRC);
- Construction Permit (Commercial Driveway Approach), Utility Permit, and Transportation Permit from the NCRC;
- Conditional Use Permit, Site Plan Review, Electrical Permit, and Zoning Compliance Permit from Garfield Township;
- SLU Permit, Site Plan Review from the FCJPC; and
- Zoning Permit from Sheridan Charter Township.

Requirement: Evidence of consultation, before submission of the application, with EGLE, and other relevant state and federal agencies before submitting the application, including, but not limited to, the Michigan DNR, and the Michigan Department of Agriculture and Rural Development (MDARD).

Sylvan Solar's summary of consultation with local and state agencies is provided in Attachment 7. Sylvan Solar has consulted with the following state and federal agencies to date: USFWS, MDARD, and the Michigan DNR. Sylvan Solar conducted wetland delineations in accordance with USACE/EGLE procedures and initiated outreach to the EGLE permitting contact for Newaygo County. Per EGLE's typical process, Sylvan Solar will engage in formal discussions with EGLE after a more advanced Project design is available to discuss the wetlands and waterbodies within the Project area and applicable EGLE permits.

Sylvan Solar has also met with the following local agencies: Sheridan Charter Township, FCJPC, Garfield Township, Fremont Fire Department, Newaygo County Drain Commission, Newaygo County Road Commission, Newaygo Fire Department, and Newaygo County Emergency Services.

Requirement: The soil and economic survey report under Section 60303 of the NREPA for Newaygo County.

The soil and economic survey report for the Project area is provided in Attachment 8.

3.4 Public Safety

Requirement: Information on the effects of the proposed C SES on public health and safety.

Construction and operation of the Project is not anticipated to result in adverse impacts to public health or safety. To protect the public, the Project design will meet the requirements of the NESC such that the security fencing and locked entrance gates will prevent unauthorized access to the C SES. Noise monitoring and modeling (Attachment 12) confirmed that the Project will not generate excessive noise, and appropriate setbacks will be implemented to increase the distance between the Project and adjacent residential homes. In addition, the Project will not produce odors or emissions, further ensuring compatibility with surrounding land uses.

Sylvan Solar developed Fire and Emergency Response Plans for the Project (Attachment 9), which collectively address the following:

- Medical emergencies,
- Fires,
- Severe or adverse weather,
- Evacuation drills,
- Terrorist or bomb threats, and
- Facility shutdown process and emergency services notification process.

The Fire and Emergency Response Plans were discussed with the Newaygo County Emergency Services, Newaygo Fire Department, and Fremont Fire Department. The initial and follow-up meetings, held on May 29 and August 27, 2025, involved an introduction to the Project and discussions of site access, safety equipment and training needs, Project layout, construction and operational safety practices, and emergency protocols. These plans will be reviewed at least every three years with the relevant emergency services. In addition, Sylvan Solar will provide site-specific training for local emergency response groups so that they are prepared to manage specific conditions associated with a solar project.

Requirement: If the C SES is reasonably expected to have an impact on television signals, microwave signals, agricultural global position systems, radio reception, or weather and doppler radio, a plan to minimize and mitigate that impact. Each C SES shall be designed, constructed, and operated so as not to cause radio or television interference.

The National Renewable Energy Laboratory (NREL) fact sheet "Electro-Magnetic Interference from Solar Photovoltaic Arrays" (NREL 2017) explains that PV systems pose a very low risk of causing electromagnetic or radar interference, particularly with radio, television, or navigational systems. The NREL fact sheet concludes that properly designed and installed PV systems are highly unlikely to interfere with communication or radar signals. The Project poses a very low risk to causing electromagnetic or radar interference within the Project vicinity.

Requirement: A fire response plan and emergency response plan.

Sylvan Solar’s Fire and Emergency Response Plans (Attachment 9) meet the requirements outlined in Section 3.26 (II)(D)(1)(q) of the SES Amendment to the FCJPC Zoning Ordinance.

Feedback and information from the Newaygo County Emergency Services, Newaygo Fire Department, and Fremont Fire Department were incorporated into the plans. As noted in Attachment 7, the first meeting with Newaygo County Emergency Services and the Fremont Fire Department was held on May 29, 2025. During this meeting, the Project was introduced and the proposed site entrances and emergency access routes were discussed.

During the subsequent meeting with the Newaygo County Emergency Services and Newaygo Fire Department on August 27, 2025, the meeting discussion sought to identify any potential safety equipment and/or safety training deficiencies at the township or county level. The Newaygo Fire Department identified a need for a water source at the site; as such, Sylvan Solar proposed providing water storage tanks within the facility or outside the fence line. Sylvan Solar will continue to coordinate with local emergency response groups in the pre-planning stage and will provide site-specific training. Other topics of discussion during the August 2025 meeting included the proposed Project layout and access points, typical construction and operational safety practices, emergency response protocols, and a request for feedback. These two plans will be reviewed at least once every three years with Newaygo County Emergency Services, Newaygo County Fire Department, and the Fremont Fire Department.

3.5 Stormwater

Requirement: A stormwater assessment and a plan to minimize, mitigate, and repair any drainage impacts. The applicant shall make reasonable efforts to consult with the county drain commissioner before submitting the application and shall include evidence of those efforts in this application.

Sylvan Solar's stormwater assessment plan and documentation of meeting discussions with the Newaygo County Drain Commission are provided in Attachment 9. The first meeting with the Newaygo County Drain Commission was held on December 16, 2024. The topics of discussion included the requirements for setbacks from county drains, entering into a Cooperation Agreement, plans for fencing, and access for maintenance activities. In addition, a .kmz file of the parcel boundary was provided to the Newaygo County Drain Commission following the meeting. An on-site meeting with the Newaygo County Drain Commission staff and engineer was held on May 15, 2025. Topics of discussion included the maintenance practices for county and private drains, seed mixes, and stormwater management systems. Notes from the meeting on May 15, 2025, are provided in Attachment 9.

The results from the Stormwater Assessment Plan (Attachment 9) indicate that converting the existing land use from primarily crops to a solar generation facility does not increase the stormwater runoff inputs into the county drains in Sheridan Charter Township. In fact, the stormwater runoff volume actually decreases due to the conversion of crop land to grassland / meadow land.

3.6 Signage

Requirement: Each C SES shall have one sign not to exceed two square feet posted at the access point to the facility that includes: the words "Warning – High Voltage"; emergency contact telephone numbers; and the name, address, telephone number, and email address of the operator of the C SES.

Sylvan Solar will meet the township's signage requirements. A sign, not to exceed two square feet, will be installed at each access point with the following information: "Warning – High Voltage" message; emergency contact telephone numbers; and the name, address, telephone number, and email address of the operator of the C SES.

3.7 Access Drives

Requirement: Each C SES shall be served by a road or drive that provides ready, dependable access.

Each solar array block is accessible via 24-foot-wide site entrance gates from township or county roadways and 16-foot-wide interior gravel access roads. Sylvan Solar provided a map highlighting the proposed site entrance points from public roadways to local emergency response groups and the Newaygo County Road Commission. As discussed with local emergency response groups on August 27, 2025, Sylvan Solar will establish 22-foot-wide minimum turnaround areas within the solar generation facility that will be accessible to local emergency responders according to the Site Plan (Attachment 1).

3.8 Design

Requirement: Color of supports and peripheral equipment shall be flat-finish neutral colors such as black, gray, or brown.

The Project supports and peripheral equipment will be flat finished with neutral colors as required. Typical racking systems consist of unpainted steel piles and support structures. The Project's Site Plan is provided in Attachment 1.

Requirement: A site development plan shall be provided along with the SLU Permit application, in accordance with subsection D(2) of the SES Amendment to the FCJPC Zoning Ordinance.

The Site Plan for the Project is provided in Attachment 1 in accordance with Section 3.26 (II)(D)(2) of the SES Amendment to the FCJPC Zoning Ordinance. In addition, the SLU Application form is provided in Attachment 6 in accordance with 3.26 (II)(D) of the SES Amendment to the FCJPC Zoning Ordinance.

Requirement: A narrative describing the proposed C SES, including an overview of the project, the approximate generating capacity of the C SES, the number, representative types and height of the C SES to be constructed, including the generating capacity and respective manufacturers, and a description of ancillary facilities.

Sylvan Solar is proposing to construct, own, operate, and decommission the 220 MW Sylvan Project, which spans both Sheridan Charter and Garfield Townships. The Project will generate an annual average of approximately 445,000 MW hours of renewable energy over its anticipated 35-year life span. A complete description of the Project, including the information requested above, is provided in Section 2 (Project Information) of this Application and the Site Plan (Attachment 1).

Descriptions of the equipment that was assumed for the current Project design are listed in Table 3-2. The table includes the equipment manufacturer, brand/series, and model/power rating. The equipment manufacturer and type are subject to change closer to construction based on availability and cost.

Table 3-2 Anticipated Equipment and Respective Manufacturer, Brand/Series, and Model/Power Rating

Equipment[1]	Manufacturer	Brand/Series	Model/Power Rating	Quantity
Solar modules[2]	Qcells (or equivalent)	Q.PEAK DUO ML-G12S	660W - 680W	154,740
Inverter skids	SMA America (or equivalent)	SC FLEX PCU	7040	12
Racking	NexTracker Inc. (or equivalent)	Horizon 1P	Single-axis Tracker	To be determined

[1] The equipment manufacturer, brand/series, and model/power rating are subject to change prior to construction based on availability and cost. Equivalent manufacturers to those listed in the table may be used.
[2] The height of the solar panels at maximum tilt is estimated to be approximately 9 feet on average above the ground surface.

3.9 Topsoil

Requirement: No C SES shall remove or disturb existing topsoil for more than necessary to permit the installation of equipment, screening, and related access. Where temporary removal of topsoil is necessary to facilitate grading, such topsoil shall be retained on-site and replaced to promote regrowth of vegetation.

Sylvan Solar will limit land disturbance and vegetation clearing to what is minimally necessary for the installation and operation of the Project. The Site Plan (Attachment 1) depicts the maximum extent of acres required for the Project; as additional engineering studies are completed, the Project area may be reduced further prior to construction. Sylvan Solar will obtain all applicable permits related to land disturbance, including preparing a SWPPP and obtaining a SESC Permit prior to construction. Attachment 7 includes the Project's permit matrix. Any excavated or graded topsoil will be retained and remain within the Project area in Sheridan Charter Township.

3.10 Vegetation

Requirement: Following installation, disturbed areas shall be reseeded with native wildflowers/grasses to provide for pollinators and other eco-system elements. A narrow buffer area surrounding the installation along the fence line of up to twenty-five (25) feet may be maintained with non-native grasses for fire and weed control.

Sylvan Solar will plant and maintain the Project area with native wildflowers/grasses, provide pollinator buffers, and manage Project vegetation to meet the FCJPC vegetation requirements as indicated in the VMP (Attachment 4). The proposed seed mixes include a shortgrass mix beneath the solar arrays and outside the perimeter fence, a tall pollinator mix outside the perimeter fence in setback areas, and a stormwater basin mix for stormwater management features. The goal of using these seed mixes is to provide beneficial species habitat and ecosystem services through improved soil and water quality.

3.11 Screening/Landscaping

Requirement: Screening of C SES installations shall be required adjacent to any residential use. Screening may consist of natural growth or planted elements such as trees and shrubs, or solid fencing not to exceed six (6) feet in height.

Residential landscape screening, in the form of tree and shrub species ranging up to approximately 20 feet at mature height (typical growth rate of 3-5 years to reach maturity for most species), will be installed between the Project and adjacent, non-participating residential dwellings where existing vegetation is not present. Proposed landscape screening areas are shown as green linear areas (residential screening) on the Site Plan (Attachment 1) and described further in the VMP (Attachment 4, Figure 6).

The VMP includes a list of proposed tree and shrub species to be used as residential landscape screening. Visual renderings of the Project during the operation stage, from representative vantage points within the Project area, are provided in Attachment 11. Several of the visual renderings (e.g., Key Observation Points 2, 5, and 7) include viewpoints of the proposed residential screening.

3.12 Security Fencing

Requirement: Security fencing is allowed but must be of an open nature and cannot exceed six (6) feet in height, except where mandated by Federal or State standards. Fencing setback shall be a minimum of twenty-five (25) feet from all adjacent, primarily residential use, property lines, or may be located on the property line when adjacent to non-residential uses.

The Project's perimeter fencing will be 7 feet in height as required by Section 110.31 of the National Electric Code (NEC). The Project was designed such that perimeter fencing will be a minimum of 50 feet from adjacent, non-participating property lines (refer to Section 3.13 below for more information about setbacks). Sylvan Solar proposes to install an open style, woven wire fence. The post material for the woven wire fence will be either wood or steel, depending on availability and costs of materials closer to construction. The Project design includes security fencing and locked gates to restrict unauthorized access per the NESC. Sylvan Solar has initiated conversations and will continue to coordinate with local emergency personnel to provide access to the C SES in the event of an emergency.

3.13 Setbacks

Requirement: Setbacks for installation equipment, other than fences, from adjacent, primarily residential use, non-participatory property lines shall be not less than one hundred (100) feet, and adjacent, non-participatory residences, not less than two hundred (200) feet. Setbacks for installation equipment other than fences shall be not less than fifty (50) feet where adjacent to non-residential uses.

The Project proposes to meet the setback requirements from non-participating property lines by incorporating the following minimum standards:

- a 50-foot setback between the perimeter fence line and adjacent, non-participating property lines with a primary agricultural use, and
- a 100-foot setback between solar panels and other aboveground Project equipment and adjacent, non-participating property lines with a primary residential use (as defined in Section 3.26(II)(B) of the SES Amendment to the FCJPC Zoning Ordinance).

In addition, the Project incorporates a 75-foot setback between the perimeter fence line and township and county road rights-of-way, and 75-foot setback between solar panels and regulated wetlands, lakes, streams, and Newaygo County drains. The Project was designed such that the perimeter fence line will be set back 300-feet from existing, occupied dwellings on adjacent non-participating parcels.

3.14 Height

Requirement: Maximum height of solar panels and support structures shall be twenty-five (25) feet above finished grade.

The total height of the PV solar panels and support structures will not exceed 25 feet measured from the ground to the top of the system when oriented at maximum tilt. Based on the anticipated racking system and module specifications, the height of the solar panels at maximum tilt is estimated to be approximately 9 feet on average above the ground surface.

3.15 Maintenance

Requirement: All C SES shall be maintained in a neat and orderly fashion.

Sylvan Solar will comply with this requirement to maintain the C SES during operation of the Project.

3.16 Parcel Coverage

Requirement: C SES shall not be located on parcels less than ten (10) acres in size. The maximum lot area for each C SES shall be five hundred (500) acres in size. In each participating municipality, the aggregate amount of land to be used by all C SES together, or in total, shall not exceed 5 percent of the total amount of land in that municipality.

The Project is not located on parcels less than ten (10) acres in size or greater than five hundred (500) acres in size. In Sheridan Charter Township, the aggregate amount of land to be used by the Project will not exceed 5 percent of the total township area. The proposed Project design indicates that the Development Area within the perimeter fencing totals approximately 420 acres in Sheridan Charter Township (approximately 1.9 percent of the total Sheridan Charter Township area).

3.17 Noise

Requirement: A report detailing the sound modeling results along with mitigation plans to ensure that sound emitted from the C SES will remain below the statutory limit throughout the operational life of the C SES.

Sylvan Solar completed a 24-hour noise monitoring study between July 7 and July 14, 2025, at three monitoring locations in the Project area to evaluate existing noise conditions. One monitoring site (ML2) was located in Sheridan Charter Township and the other two monitoring sites (ML1 and ML3) were located in Garfield Township. Observed noise levels at all three monitoring locations ranged from 20 to 65 dBA Leq (i.e., the equivalent sounds level or average sound over a specified period).

Based on the collected noise monitoring data, a noise model was used to predict noise conditions in the Project vicinity during Project operations. Potential Project operational sound levels at non-participating residences were modeled to range from 21 dBA to 41 dBA. These modeled levels fall within the range of the observed existing noise levels. The noise impact assessment report (Attachment 12) shows that operation of the solar generation facility will not exceed 55 dBA at the property line of adjacent, non-participating parcels or at public road rights-of-way.

Construction noise impacts are anticipated to be temporary, intermittent, limited to daytime hours, and localized. The noise from construction activities would dissipate with distance and may be audible at varying decibels, depending on the distance from the equipment to the receptor. Construction activity for the Project will be limited to daytime hours to minimize potential impacts to neighboring properties.

3.18 Decommissioning

Requirement: A decommissioning plan that describes the actions to be taken following the abandonment or discontinuation of the C SES and which includes an estimate of the total cost of decommissioning as described in subsection D(4) of the SES Amendment to the FCJPC Zoning Ordinance. Any abandoned C SES must be decommissioned and removed not less than 180 days following abandonment.

Sylvan Solar prepared a Decommissioning Plan (Attachment 5) in accordance with the requirements stated above and in Section 3.26(II)(D) of the SES Amendment to the FCJPC Zoning Ordinance. Table 3-3 provides a summary of decommissioning estimates.

Table 3-3 Decommissioning Cost Estimates

Decommissioning Estimates	Total
Total Decommissioning Cost	$4,506,000
Salvage Value	$1,531,000
Net Decommissioning Cost Estimate	**$2,975,000**

To provide for an accurate financial assurance amount at the time of construction, Sylvan Solar will hire an independent, third-party registered engineer to update the net decommissioning cost estimate and provide it to Sheridan Charter Township prior to construction after final equipment has been identified. A review of the amount of the performance guarantee based on inflation, salvage value, and current removal costs shall be completed every five (5) years for the life of the Project.

Sylvan Solar will provide financial assurance in the form of a performance bond or letter of credit for the amount equal to the estimated cost of decommissioning, less salvage value, per Section (D)(4)(e) of the SES Amendment to the FCJPC Zoning Ordinance. Financial assurance will be maintained during the deferment period after initiation of construction activities, unless there is abandonment or decommissioning of the Project prior to that time and secured.

In the case of abandonment, Sylvan Solar agrees to remove the C SES not less than 180 days after abandonment, and decommissioning activities will occur within 18 months after the end of the Project's lifespan.

Requirement: The C SES operator shall maintain a current liability insurance policy or present proof of adequate liability insurance coverage provided by self insurance or other means, in an amount equal to the installation and operation of the C SES.

Sylvan Solar will maintain a current liability insurance policy in an amount equal to the installation and operation of the Project, which will be presented prior to the issuance of a building permit.

3.19 Zoning

Requirement: C SES shall be subject to zoning regulations as primary uses, and shall be permitted as a SLU, in the AG-2 and AG-3 districts only.

Sylvan Solar requests an SLU Permit for the Project to be located in the AG-2 zoning district in Sheridan Charter Township. The participating parcels table in Attachment 2 include parcels zoned as AG-2.

3.20 Special Land Use General Standards

A written response that supports each of the SLU general standards as outlined in Chapter 9 “Special Land Uses” of the FCJPC Zoning Ordinance:

1. The Project will be designed, constructed, operated, and maintained in a manner harmonious with the character of the adjacent properties and surrounding area.
2. The Project will not change the essential character of the surrounding area.
3. The Project will not be hazardous to adjacent properties or involve uses, activities, material, or equipment which will be detrimental to the health, safety, or welfare of person or property through the creation of hazardous or potentially hazardous situations or the excessive production of traffic, noise, odor, smoke, dust, fumes, glare, or site drainage.
4. The Project will not place demands on public services and facilities in excess of current capacity.
5. The Project will be in general agreement with the Fremont Community Joint Comprehensive and Growth Management Plan.
6. The Project will comply with all applicable site plan review standards.
7. The Project will be in general agreement with the intent and purposes of the FCJPC Zoning Ordinance.

The Project will temporarily convert the existing agricultural land uses over its anticipated 35-year lifespan. As described in Attachment 5, the goal of decommissioning the Project will be to return the land to agricultural use at the end of its lifespan, or to the landowner’s preferred use. The Project has been designed, constructed, and will be operated in a harmonious manner with adjacent agricultural and rural residential properties (#1), and will maintain the essential character of the surrounding area by preserving open space and agricultural potential (#2).

The Project will not be hazardous to adjacent properties or detrimental to the health, safety, or welfare of residents. It will not generate odors, emissions, or hazardous materials, and noise monitoring and modeling (Attachment 12) confirm the Project will not result in excessive noise. Fencing, locked gates, and compliance with NEC and NESC standards will further protect public safety, while setbacks, vegetative screening, negligible road usage during operations, and stormwater controls will minimize potential for glare, traffic, or drainage concerns (#3). Active site management reduces widespread chemical applications such as pesticides and herbicides, and there is active spot management of noxious and invasive weeds, in compliance with state and local policies. And once established, the native species grown on-site can reduce erosion by up to 95% and increase water retention up to 9.5% (ACP February 2023).

The Project will not place demands on public services or facilities beyond existing capacity. Once constructed, solar facilities require minimal staff, limited maintenance activities, and negligible traffic, resulting in no additional burden to local infrastructure or public services (#4).

The Project is aligned with the Fremont Community Joint Comprehensive and Growth Management Plan, which supports the continued viability of agricultural lands. By returning the property to agricultural use following decommissioning, if desired by the landowner, and by precluding more intensive permanent residential, commercial, or industrial development, the Project aligns with the long-term vision of the community plan (#5). Other agricultural benefits include reduced nitrous oxide emissions and increased carbon sequestration due to reduced tillage. Soil health is also improved through reduced insecticide and herbicide use, and reduced erosion (as described above). Finally, the Project provides a stable income for participating landowners from lease payments that would dampen the impact of weather events and fluctuating commodity prices on any ongoing farming operations. This steady income allows farmers to maintain generational ownership of the leased land.

The Project will comply with all applicable site plan review standards by providing detailed engineering drawings (Attachment 1), stormwater management measures, and emergency response coordination with local agencies (Attachment 9). Sylvan Solar will continue coordination with the FCJPC and Sheridan Charter Township Zoning Administrator throughout the site plan review process (#6).

Finally, the Project is consistent with the intent and purposes of the FCJPC Zoning Ordinance and SES Amendment by supporting responsible land use and protecting the public's health, safety, and welfare. Sylvan Solar will ensure ongoing compliance through adherence to all zoning requirements and permit conditions (#7) as noted in Attachment 7.

4 Community Engagement

AES is committed to ensuring communities are informed and heard throughout the development of our projects. Our Stakeholder Engagement and Communications team exists to serve this purpose, engaging as early and often as possible, maintaining clear and timely communications, building relationships, and fostering transparency and trust.

Our team collaborates to produce multiple means of communication for the community to participate in and voice their opinions on the Project. To date, we have sent newsletters and mailings, hosted in-person meetings with neighbors, landowners, and local officials and organizations, and created a Project phone number, email, and webpage.

AES also strengthens positive impact through mutually beneficial partnerships in the communities where we work. We are currently partnering with Camp Newaygo and TrueNorth Community Services to mobilize the reforestation of the Wetland Trail and have sponsored the River Country Chamber of Commerce Gus Macker Basketball Tournament. AES will continue partnering with organizations within the community throughout the lifetime of the Project that align with our Social Impact focus pillars:

- Accessibility to Affordable Energy and Basic Services,
- Inclusive Economic Growth & Education,
- Environmental Health, and
- Community Well-Being.

Sylvan Solar brought in the Center for Energy Education to present one Utility-Scale Solar Workshop for Public Officials on May 8, 2025, and held two Open Houses on May 13 and July 23, 2025, to answer questions and receive feedback on how the Project could best benefit and integrate into the community. Table 4-1 below provides a summary of comments and concerns received during the open houses, officials workshop, and community or neighbor meetings, along with Sylvan Solar's planned mitigation measures.

Table 4-1 Local Agency and Community Feedback

Topic	Question / Concern	Addressed in Permit Application
Loss of Farmland	Concern about removal of farmland from production and reduction in the land available to produce food.	The Project has an anticipated 35-year lifespan, at which time the Project will be decommissioned (or repowered based on economic outlook and landowner approval). The Project's Decommissioning Plan details how the Project components will be removed and the land restored in accordance with landowner agreements. The Project allows landowners to diversify their land assets while keeping the land in families for future generations.
Wildlife Corridors and Protected Species	Concern about how fencing would affect movement of deer through project area. Concern about the Project's impact on protected species.	The fencing in the design was modified to maintain connections between forested areas where possible. For example, Project neighbor feedback was the basis for removing fencing between two forested areas south of West 80th Street and east of South Luce Avenue. A qualitative habitat assessment identified areas of potential suitable habitat for protected species. As a result of the assessment and to minimize impacts on protected species, the Project design avoids forested areas under guidance provided by the USFWS and Michigan DNR.
Property Values	Concern about the potential impact on property values of surrounding properties.	A Michigan- and site-specific property value study was performed to assess the potential impact to property values, which found "*no consistent negative impact has occurred to adjacent property that could be attributed to proximity to the adjacent solar farm, with regard to unit sale prices or other influential market indicators*." Refer to the executive summary from CohnReznick for additional details (Attachment 13).

Topic	Question / Concern	Addressed in Permit Application
Aesthetics / Visual Impact	Concerns and questions about how the project would change the current rural aesthetics of the area, and what the project will look like after construction.	To mitigate the potential visual impact through screening, the VMP (Attachment 4) includes descriptions of the proposed tree and shrub species that will be installed and maintained between the Project and adjacent residences where existing tree lines do not exist, and the proposed tall pollinator seed mix that will be planted and maintained between the Project and adjacent public roadways. In addition, a series of twelve (12) photo-realistic visual renderings were completed to show what the views may look like post-construction at key vantage points throughout the Project area (Attachment 11). Vantage points were selected based on topography, locations of project components, and proximity of residences. The visual renderings incorporate the proposed visual screening as described in Section 4.5 of this Application.
Site Entrances	Concern about an initial site entrance location on Warner Avenue.	Sylvan Solar initiated coordination with the Newaygo County Road Commission and will continue to coordinate as the Project approaches construction. Based on feedback from the Road Commission, one site entrance off of Warner Avenue (north of West 88^{th} Street in Sheridan Charter Township) was shifted to be oriented north-south off of West 88^{th} Street to minimize impacts to traffic and to address safety concerns.

Topic	Question / Concern	Addressed in Permit Application
Drainage	Concern about impacts to existing drain tile and access to county drains for maintenance activities.	Sylvan Solar entered into a Cooperation Agreement with the Newaygo County Drain Commission and will continue to coordinate and obtain applicable approvals from the Drain Commission as the Project approaches construction. Sylvan Solar will avoid, repair, or replace existing private drain tiles as needed during construction in order to maintain existing drainage conditions to the extent possible. In addition, the Project components will be set back 75-feet from the Newaygo County drain centerlines, and the drains will not be fenced across so as to not encumber the county's maintenance activities.

5 Conclusion

Sylvan Solar is committed to developing a Project that benefits the environment and the community of Sheridan Charter Township. The Project is designed to comply with the requirements of FCJPC Zoning Ordinance, SES Amendment, and SLU requirements. Sylvan Solar therefore respectfully requests review and approval of the SLU Permit application.

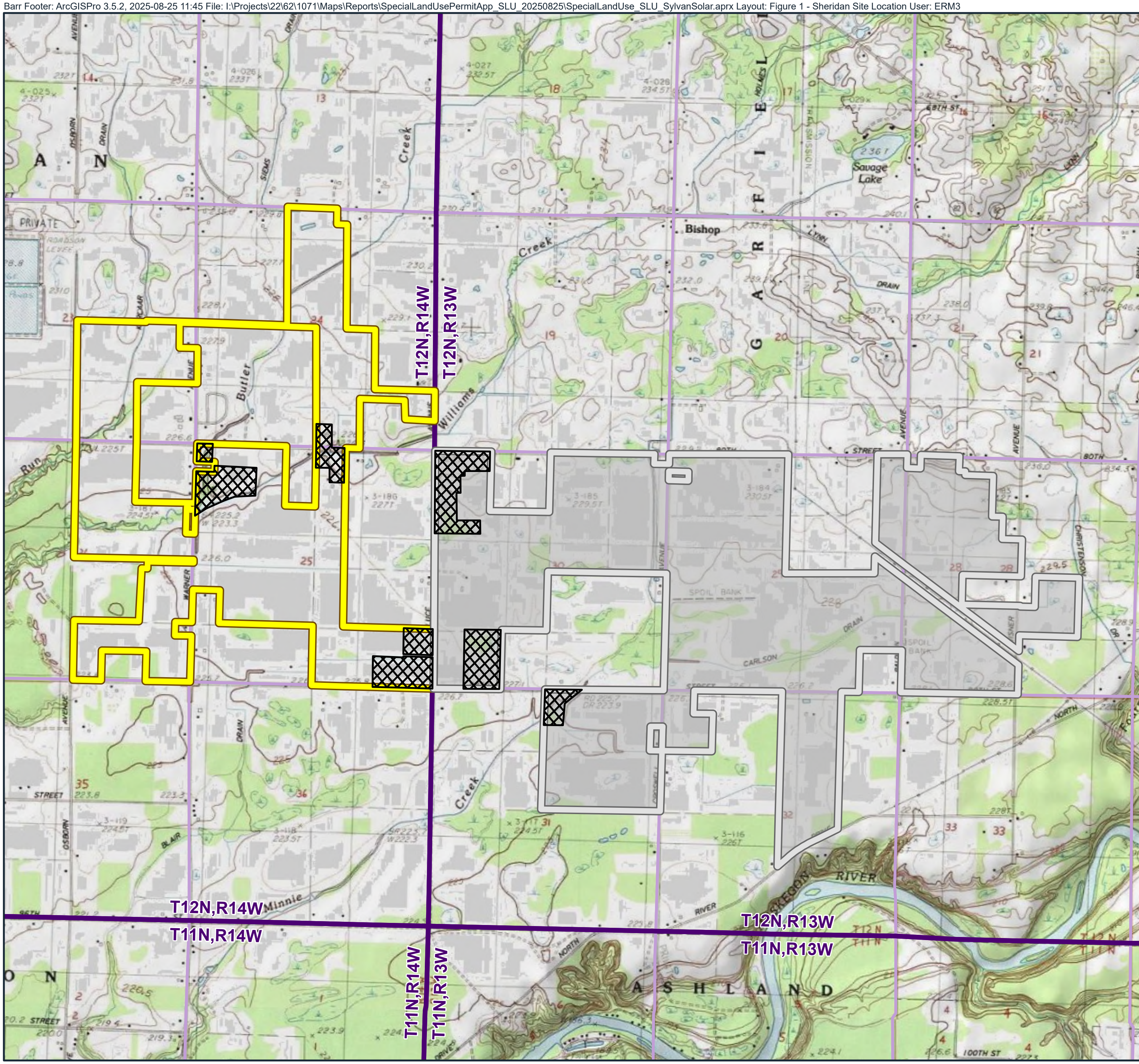
If you have any questions or require more information on the permit application or Project, please contact Dana Schultz, Project Developer, at (720) 416-4524 or dana.schultz@aes.com or Lauren Colwell, Permitting Project Manager, at (763) 269-5892 or lauren.colwell@aes.com.

6 References

National Renewable Energy Laboratory. 2017. *Electro-Magnetic Interference from Solar Photovoltaic Arrays*. Golden, CO: U.S. Department of Energy, National Renewable Energy Laboratory. NREL/FS-5J00-67440. https://docs.nrel.gov/docs/fy17osti/67440.pdf.

Figures

Barr Footer: ArcGISPro 3.5.2, 2025-08-25 11:45 File: I:\Projects\22\62\1071\Maps\Reports\SpecialLandUsePermitApp_SLU_20250825\SpecialLandUse_SLU_SylvanSolar.aprx Layout: Figure 1 - Sheridan Site Location User: ERM3



Sheridan Charter Township Project Boundary

Garfield Township Project Boundary

Public Land Survey Township

Public Land Survey Section

Excluded Area

N

0 1,500 3,000

Feet

Basemap: USGS USA Topo, Esri

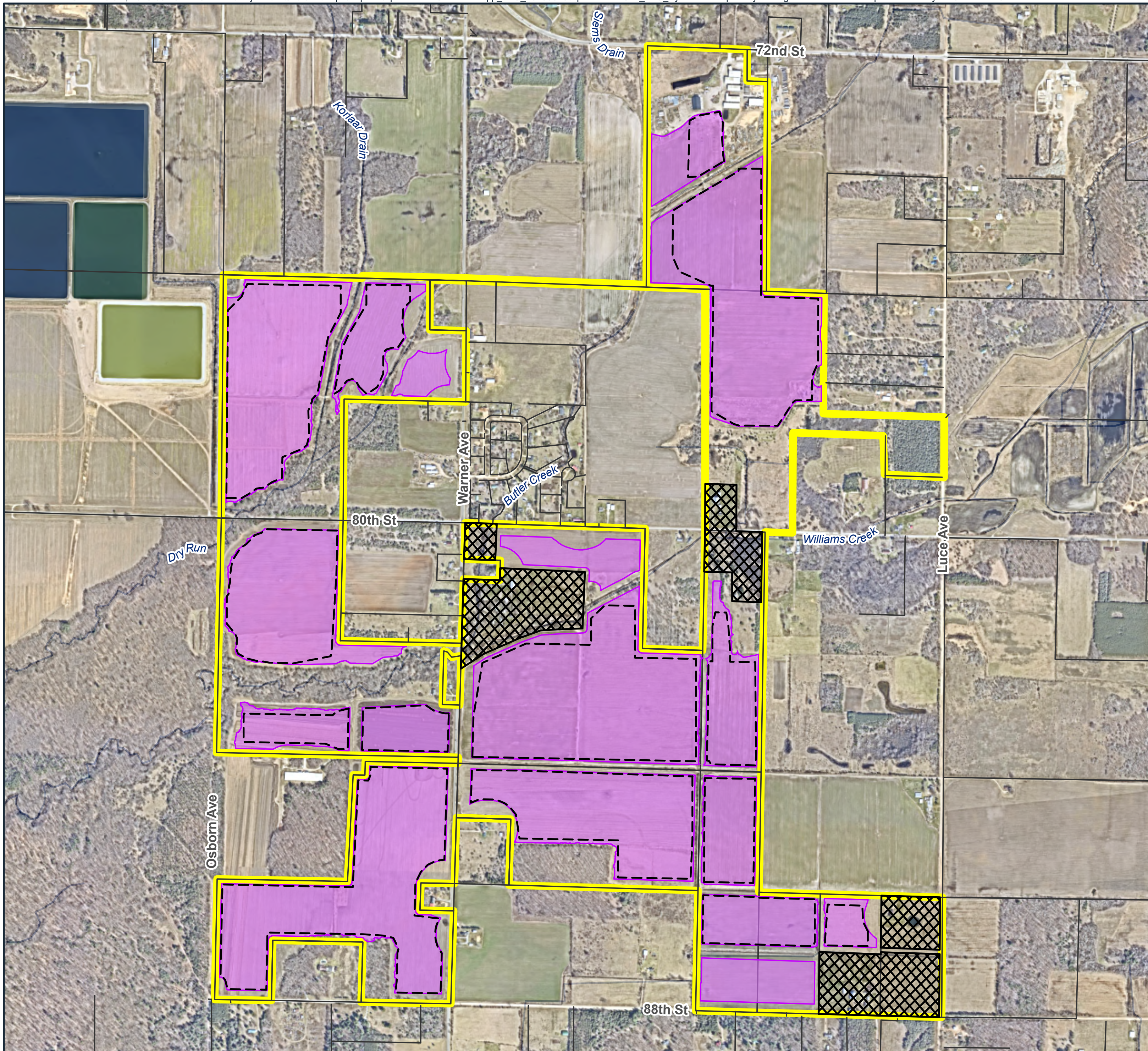
Site Location

Sylvan Solar Project

Sheridan Charter Township, Michigan

FIGURE 1

BARR®



Project Boundary
Parcel Boundary
Buildable Area
Excluded Area

Development Area

Perimeter Fencing

N

0 750 1,500
Feet

Imagery: Nearmap (4/4/2025)

Project Parcels
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 2

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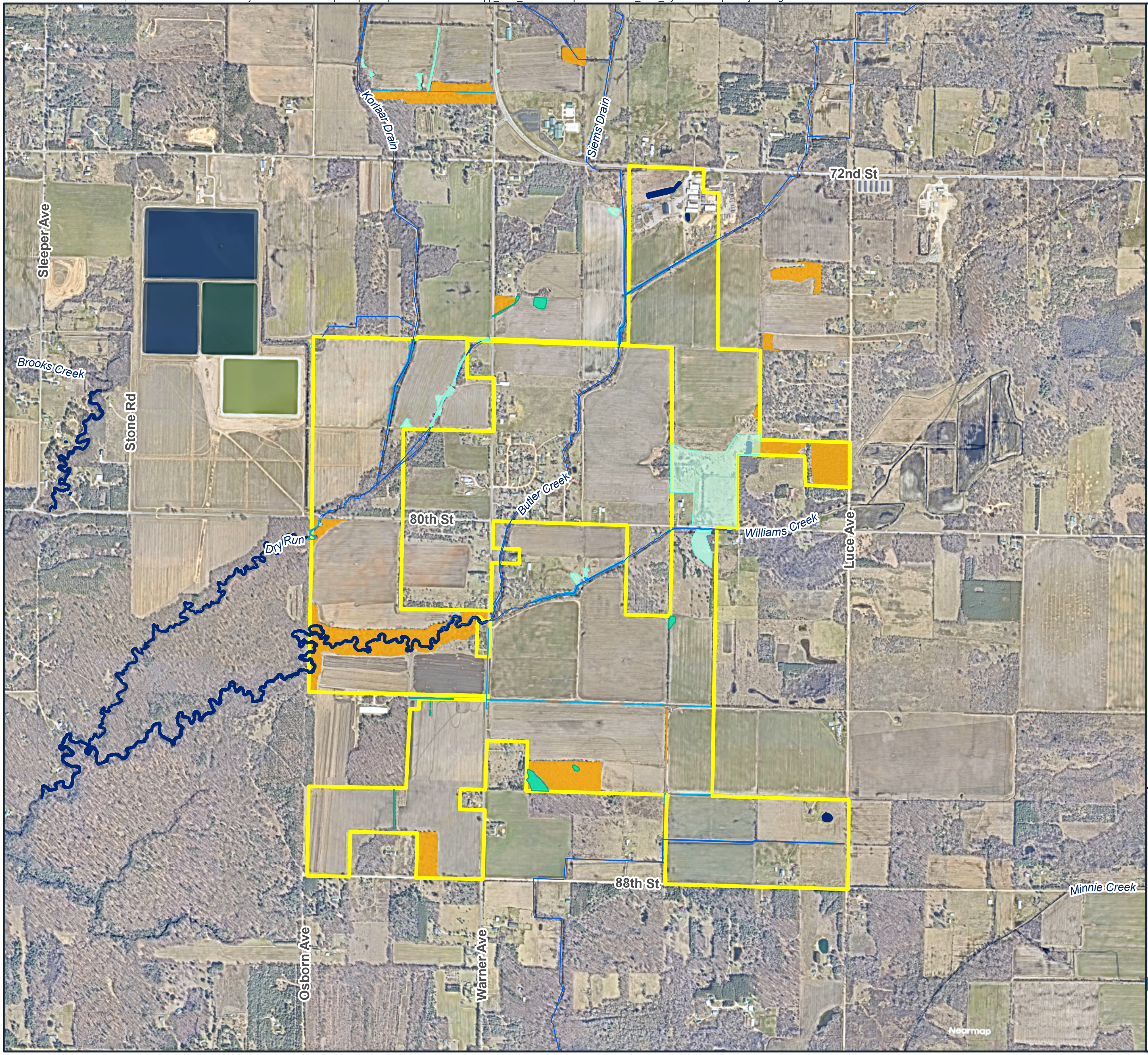

Project Boundary
County Drain
Drainage Ditch
Streams
Potentially Regulated Wetland
Non-Regulated Wetland
Potential Protected Species Habitat

N

0 1,000 2,000
Feet

Imagery: Nearmap (4/4/2025)

Delineated Wetlands & Streams
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 3

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Appendix 1 - Site Plan

Attachment 1 - Site Plan

SYLVAN SOLAR

NO.	PARCEL ID	LANDOWNER NAME	MAILING ADDRESS	LAND USE	ZONING	TOWNSHIP
1	62-17-13-300-003	WAGLER PHILIP & FANNIE FAMILY TRUST	5223 W 72ND ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
2	62-17-13-300-004	WAGLER PHILIP & FANNIE FAMILY TRUST	5223 W 72ND ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
3	62-17-13-400-002	HULST NATHANAEL S ET UX AMY	5131 W 72ND ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
4	62-17-13-400-007	MELLEMA PAUL & SALLY LIVING TRUST	6376 PAT ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
5	62-17-14-300-001	SCHMITT FRANK J JR ET UX DEANNA D	6361 W 72ND ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
6	62-17-14-300-004	WARD DANIEL J ET UX MALINDA A WARD	6453 W 72ND ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
7	62-17-14-300-005	NIEBOER DOUGLAS J ET UX NANCI A	7075 S OSBORN AVE FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
8	62-17-15-400-042	WARD DANIEL J ET UX MALINDA A	6453 W 72ND ST FREMONT MI 49412	Residential	A-3	SHERIDAN CHARTER
9	62-17-22-200-010	DELIA CHRISTOPHER MICHAEL ET UX	PO BOX 895 NEWAYGO MI 49337	Residential	A-2	SHERIDAN CHARTER
10	62-17-22-200-012	PONCE LETICIA	6520 W 72ND ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
11	62-17-22-200-013	KMAX LAND COMPANY LLC	7084 W 72ND ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
12	62-17-22-400-003	CITY OF FREMONT	101 E MAIN ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
13	62-17-22-400-012	ROTTIER STANLEY KEITH ET UX	6455 W 80TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
14	62-17-22-400-015	BRAAFHART HARRY G & ASHTON L HOOKER	4888 LESTER FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
15	62-17-22-400-018	BURT RANDY & BRENDA REV TRUST	7823 S STONE RD FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
16	62-17-23-100-006	RYZEBOL PROPERTIES LLC	2190 SQUIRES RD BAILEY MI 49303	Agricultural	A-2	SHERIDAN CHARTER
17	62-17-23-100-007	CITY OF FREMONT	101 E MAIN ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
18	62-17-23-200-009	KOLK LESLIE J ET UX SANDRA J ET AL	4039 SHOREWOOD FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
19	62-17-23-200-014	HANNA JARED G ET UX KRISY	5858 W 72ND ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
20	62-17-23-400-004	PICKARD KATHY ET VIR PETER	7793 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
21	62-17-23-400-006	KRUSZYNSKI SCOTT W ET UX	7901 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
22	62-17-23-400-007	WALTON RONALD ET UX	7661 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
23	62-17-24-100-002	VOGEL REAL ESTATE LLC	6726 W LAKE DR FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
24	62-17-24-100-008	KARNEMAAT MARLENE J TRUST	5118 W 72ND ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
25	62-17-24-200-001	WEXFORD SKY LLC	5118 WEST 72ND ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
26	62-17-24-200-012	ACRETRADER 192 LLC	112 W CENTER STREET, STE 600 FAYETTEVILLE AR 72701	Agricultural	A-2	SHERIDAN CHARTER
27	62-17-24-200-014	KARNEMAAT ALVIN L	5118 W 72ND ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
28	62-17-24-300-003	QUINN TERRY ET UX ROBIN	7742 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
29	62-17-24-300-004	QUINN TERRY ET UX ROBIN	7742 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
30	62-17-24-300-014	COLE SANDRA L	5357 W 80TH ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
31	62-17-24-300-015	COLE SANDRA L	5357 W 80TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
32	62-17-24-300-017	DEULING GARY L & JAIME L TRUSTEES	7680 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
33	62-17-24-300-018	DEULING GARY L & JAIME L TRUSTEES	7680 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
34	62-17-24-351-002	MOONEY BARBARA	5520 W RONDA DR FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
35	62-17-24-351-009	BRYAN REGGIE L ET UX LINDA K	5409 W 80TH ST FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
36	62-17-24-351-011	PAGEL KENNETH D ET UX TRACY	7902 S MURRAY LN FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
37	62-17-24-351-013	ARCHBOLD PATRICIA K	7969 MURRAY LANE FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
38	62-17-24-351-014	WAYBILL RANDY ET UX PAULA	7964 S WARNER AVE FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
39	62-17-24-351-020	KRUSZYNSKI LEONARD(GERALDINE) ET AL	5538 W RONDA DR FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
40	62-17-24-351-026	FLYNN JENIFER L	7843 RONDA DR FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
41	62-17-24-351-027	FOLKEMA BRIAN ET UX ASHLEY M	5525 W RONDA DR FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
42	62-17-24-351-028	BRADLEY LESLIE J	5537 W RONDA DR FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
43	62-17-24-372-001	ZUWERINK PAMELA N	5565 W 80TH ST FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
44	62-17-24-372-002	TERVEER MATTHEW	5521 W 80TH ST FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
45	62-17-24-372-007	DELOSSANTOS ELIZABETH ET VIR ALBERT	5479 W 80TH ST FREMONT MI 49412	Residential	R-1	SHERIDAN CHARTER
46	62-17-24-400-002	RITSEMA CRAIG A ET UX LISA	7611 S LUCE AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
47	62-17-24-400-004	ROCHELEAU ANDREW ET UX STEPHANIE	7819 S LUCE AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
48	62-17-24-400-005	BONTRAGER CHRISTY R ET AL KATIE K	4967 W 80TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
49	62-17-24-400-007	BROWN KENNETH ET UX ROBIN R	7675 S LUCE AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
50	62-17-24-400-008	CHRISTENSEN SCOTT ETUX DIANE MICHEL	7721 S LUCE AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
51	62-17-24-400-010	SHEARS MONTE ET UX CHERI	4883 W 80TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
52	62-17-24-400-011	ROSEMA NORMAN W	5175 W 80TH ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
53	62-17-25-100-005	LOEHMER HARRIETTE H ET AL	5220 W 80TH ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
54	62-17-25-100-006	JOHNSON RANDALL & GENISE TRUST	8102 S WARNER AVE FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
55	62-17-25-100-007	JOHNSON RANDALL & GENISE TRUST	8102 S WARNER AVE FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
56	62-17-25-200-001	MULDER ROBERT A ET UX SALLY L	5200 KENOWA AVE SW GRANDVILLE MI 49418	Agricultural	A-2	SHERIDAN CHARTER
57	62-17-25-200-005	HOMRICH KEVIN A ET UX MELISSA A	8123 S LUCE AVE FREMONT M I 49412	Agricultural	A-2	SHERIDAN CHARTER
58	62-17-25-200-007	TIMOTHY SCOTT JEWETT AND	5134 W 80TH ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
59	62-17-25-300-002	TELLKAMP DAN	PO BOX 248 GRANT MI 49327	Agricultural	A-2	SHERIDAN CHARTER
60	62-17-25-300-003	WYLIE ROBERT ET UX SABINA	5271 W 88TH ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
61	62-17-25-300-004	KARNEMAAT KENT ET AL	5118 W 72ND ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
62	62-17-25-300-005	WILKINSON NANCY KAY	8510 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
63	62-17-25-400-002	COOK MICHAEL M ET UX JOAN M TRUST	2849 BALDWIN FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
64	62-17-25-400-004	VANNIEUWENHUYZEN WESLEY	PO BOX 187 FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
65	62-17-25-400-005	VOGEL SCOTT A ET UX ASHLEIGH J	17573 EGAN DR COOPERSVILLE MI 49404	Agricultural	A-2	SHERIDAN CHARTER
66	62-17-25-400-007	VOGEL PRODUCE INC	6720 MAPLE ISLAND ROAD HOLTON MI 49425	Agricultural	A-2	SHERIDAN CHARTER
67	62-17-25-400-008	YODER CHESTER J ET UX CLARA M	4949 W 88TH ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
68	62-17-26-100-003	SHERIDAN CHARTER TOWNSHIP	6409 S FITZGERALD AVE FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
69	62-17-26-100-004	CITY OF FREMONT	101 E MAIN ST FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
70	62-17-26-200-002	BRADLEY SCOTT	8025 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
71	62-17-26-200-003	DERKS DAVID NEIL ET UX HELEN MAE	8149 S LUCE AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
72	62-17-26-200-004	FRANKHOUSER RICHARD E ET UX	8089 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
73	62-17-26-200-008	BUNCE GEOFFREY A	8179 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
74	62-17-26-200-009	ROSE JERRY E & LUCILLE M	8199 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
75	62-17-26-200-011	LUGO VALENTIN	8287 S. WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
76	62-17-26-200-012	ACRETRADER 192 LLC	112 W CENTER STREET, STE 600 FAYETTEVILLE AR 72701	Agricultural	A-2	SHERIDAN CHARTER
77	62-17-26-300-004	SHERIDAN TOWNSHIP	6360 S TOWNSHIP PKWY FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
78	62-17-26-400-008	MARTIN MARVIN ET UX BECKY	8919 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
79	62-17-26-400-011	TOTH MICHAEL J ET UX LISA	5821 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
80	62-17-26-400-012	JP FARM SERVICES LLC	6755 GRAY RD INDIANAPOLIS IN 46237	Agricultural	A-2	SHERIDAN CHARTER
81	62-17-26-400-014	ACRETRADER 192 LLC	112 W CENTER STREET, STE 600 FAYETTEVILLE AR 72701	Agricultural	A-2	SHERIDAN CHARTER
82	62-17-27-200-015	TREPTOW KEVIN	138 PORTER RD MUSKEGON MI 49441	Residential	A-2	SHERIDAN CHARTER
83	62-17-35-100-013	SNYDER TERRY A ET AL AMY TRUST	8925 S OSBORN AVE FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
84	62-17-35-200-008	NEWSTED FLORENCE J	5936 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
85	62-17-35-200-010	FROEHLE MICHAEL B ET UX	8882 S OSBORN AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
86	62-17-35-200-016	MOON CHARLES N ET UX MARY JO	5770 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
87	62-17-35-200-019	GOLEMBESKI CARMEN M	8887 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
88	62-17-35-200-021	HIRTZ DOUGLAS ET UX - CYNTHIA L	5862 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
89	62-17-36-100-007	LUMMEN ROBERT J	PO BOX 54 FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
90	62-17-36-100-010	KEITH MICHAEL G	8924 S WARNER AVE FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
91	62-17-36-200-001	BEELER SHERYL	5166 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
92	62-17-36-200-009	DUNBAR RAYMOND L	5110 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
93	62-17-36-200-013	GERDES DANIEL J ET UX	4998 W 88TH ST FREMONT MI 49412	Residential	A-2	SHERIDAN CHARTER
94	62-17-36-200-017	FARBER LORI J ET AL	1358 SWAIN ST WHITE CLOUD MI 49439	Residential	A-2	SHERIDAN CHARTER
95	62-17-36-200-019	YODER ERVIN RAY ET UX MARY M	9045 S NATURE TRAIL FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
96	62-17-36-200-024	SCHROCK ANDY ET AL PHILLIP SCHROCK	9050 NATURE TRAIL FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
97	62-17-36-200-025	SCHROCK ANDY E ET UX-	9050 S NATURE TRAIL FREMONT MI 49412	Agricultural	A-2	SHERIDAN CHARTER
98	62-18-19-300-002	KMAX LAND COMPANY LLC	7084 W 72ND ST FREMONT MI 49412	Agricultural	AG	GARFIELD
99	62-18-19-300-004	SOVINSKI BENJAMIN JON	7606 S LUCE AVE FREMONT MI 49412	Agricultural	AG	GARFIELD
100	62-18-19-300-005	KMAX LAND COMPANY LLC	7084 W 72ND ST FREMONT MI 49412	Agricultural	AG	GARFIELD
101	62-18-30-100-001	BROWN LARRY TRUST	8112 S LUCE AVE FREMONT MI 49412	Agricultural	AG	GARFIELD
102	62-18-30-300-001	VOGEL REAL ESTATE LLC	6726 LAKE DR FREMONT MI 49412	Agricultural	AG-R	GARFIELD
103	62-18-30-300-003	CALKINS RONALD CLIFFORD	6535 MYERS LAKE AVE ROCKFORD MI 49341	Agricultural	AG-R	GARFIELD
104	62-18-31-100-014	WEAVER MIKE ET AL WEAVER LAURA	517 LANKAMP ST NW GRAND RAPIDS MI 49544	Agricultural	AG-R	GARFIELD

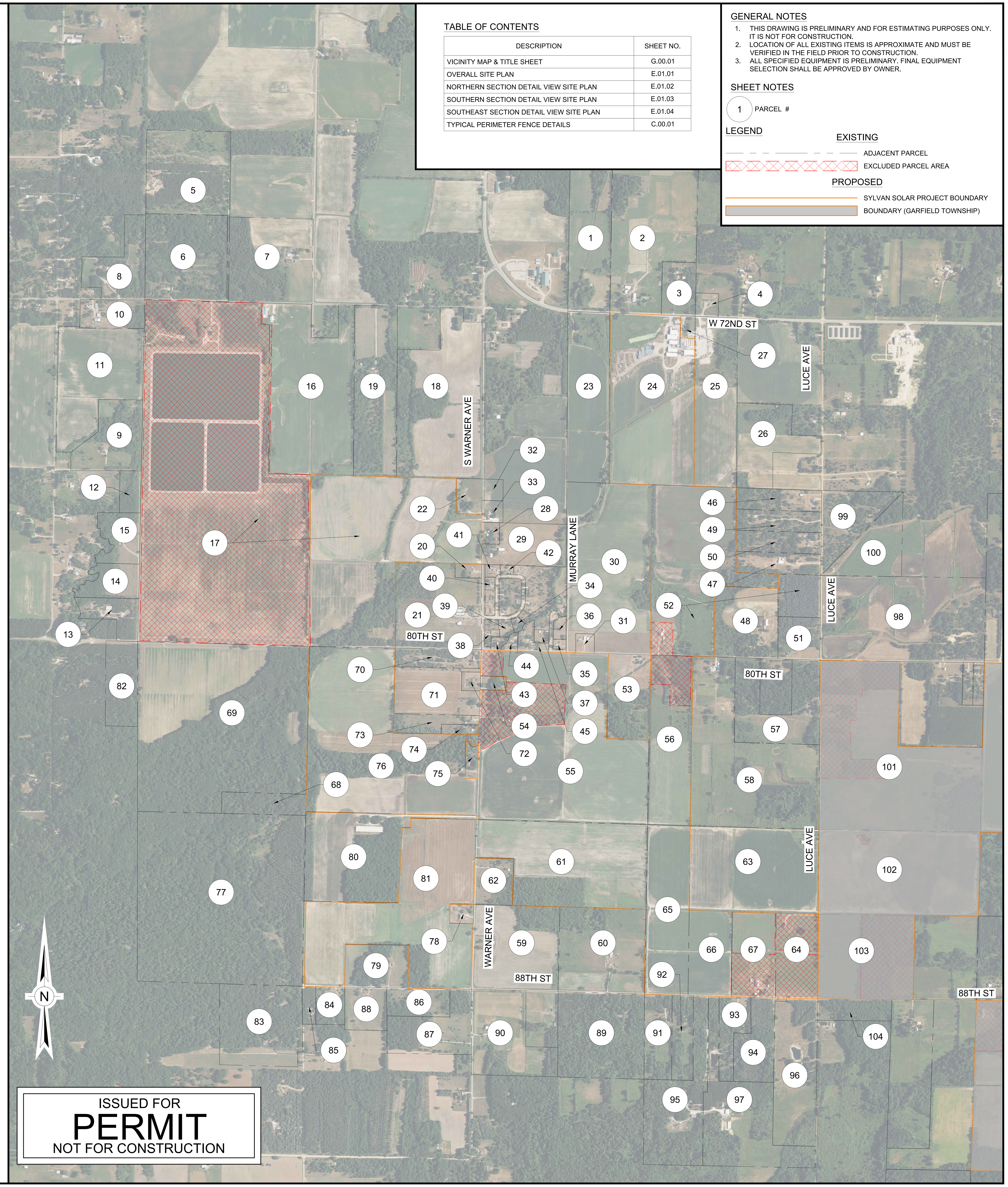

TABLE OF CONTENTS

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SHEET NOTES

1 PARCEL #

LEGEND

EXISTING

ADJACENT PARCEL

EXCLUDED PARCEL AREA

PROPOSED

SYLVAN SOLAR PROJECT BOUNDARY

BOUNDARY (GARFIELD TOWNSHIP)

ISSUED FOR
PERMIT
NOT FOR CONSTRUCTION

aes

2180 South 1300 East, Suite 600
Salt Lake City, UT 84106-2749
(801) 679 - 3500

PE STAMP:

KEY PLAN:

PV-E.01.02
PV-E.01.04
PV-E.01.03

REVISIONS:

NO.	DATE	DESCRIPTION
0	05/22/2025	INITIAL CUP SET
1	06/05/2025	ADDED VICINITY MAP PARCELS
2	07/02/2025	ADDED MISSING PARCEL WITHIN SITE
3	07/15/2025	REVISED BUILDABLE AREA CONSTRAINTS

PROJECT TITLE:

SYLVAN SOLAR

PROJECT LOCATION:

SHERIDAN CHARTER TOWNSHIP, NEWAYGO COUNTY, MICHIGAN 49412

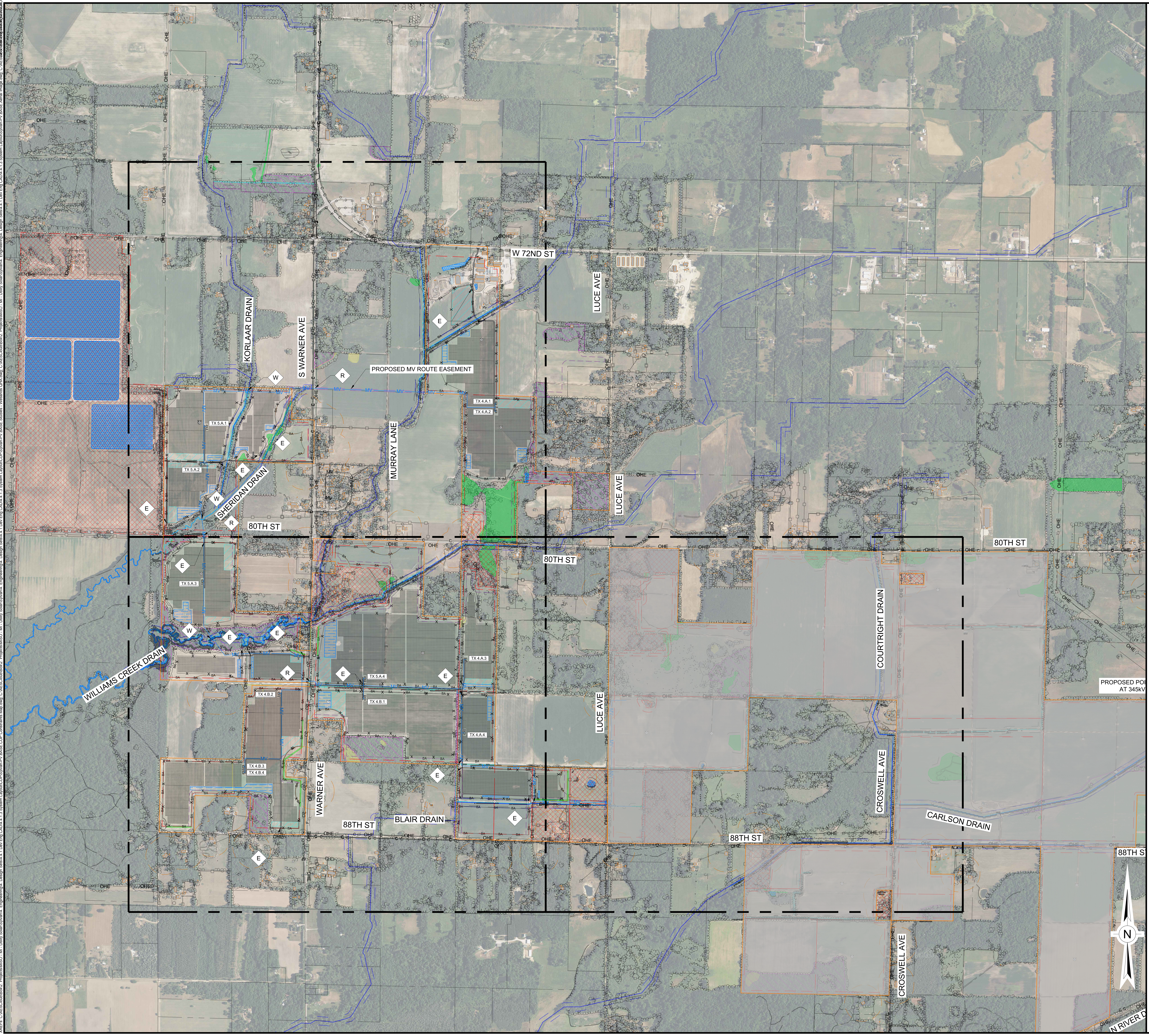
SHEET TITLE & DESCRIPTION:

VICINITY MAP & TITLE SHEET

PROJ NUM:
DES: S. PERI
DWN: J. PERRINE
CHK: D. SCHULTZ
APV:
DATE: 05/22/2025

SCALE AT 24" x 36":
0 400' 800' 1,200' 1,600'
1" = 800'

SHEET NO: PV-G.00.01
REV: 3



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SHEET NOTES

- E — SITE ENTRANCE W/ 24' GATE
- W — WETLAND/WATER UG MV CROSSING
- R — ROAD UG MV CROSSING

LEGEND

EXISTING

- AES PARCEL BOUNDARY
- AES PARCEL SETBACK
- ADJACENT PARCEL
- EXCLUDED PARCEL AREA
- MAJOR PUBLIC ROAD
- GRAVEL ROAD
- DIRT ROAD
- ROAD RIGHT-OF-WAY
- POTENTIALLY REGULATED WETLAND
- WETLAND SETBACK
- NON-REGULATED WETLAND
- WASH / DRAINAGE
- WASH / DRAINAGE SETBACK
- COUNTY DRAIN CENTERLINE
- COUNTY DRAIN SETBACK
- RIVER
- RIVER SETBACK
- WATERBODY
- 100-YEAR FLOOD BOUNDARY
- POTENTIAL PROTECTED SPECIES HABITAT
- AVOIDANCE AREA
- SLOPE KEEPOUT
- TREE LINE
- BUILDING
- BUILDING SETBACK
- FENCE
- UNDERGROUND TRANSMISSION LINE (MV)
- ELECTRIC METER & BOX
- OVERHEAD POWER LINE & POLE (OHE)
- OVERHEAD XFMR & LIGHT POLE
- UTILITY ROW
- IRRIGATION PIVOT & VALVE
- COMMUNICATIONS LINE & PEDESTAL
- FIBER LINE

PROPOSED

- SYLVAN SOLAR PROJECT BOUNDARY
- BOUNDARY (GARFIELD TOWNSHIP)
- BUILDABLE AREA (BA)
- EQUIPMENT SETBACK
- MV ROUTE EASEMENT
- FENCE
- POTENTIAL STORMWATER MANAGEMENT AREA
- INTERIOR ROADS
- LAYDOWN AREA
- VEGETATIVE SCREENING AREA
- UG MV FEEDER
- XFMR SKID
- PV PANELS

MINIMUM SETBACKS

FEATURE	DISTANCE (FT)
NON-PARTICIPATING DWELLING	300
ADJACENT NON-PARTICIPATING PROPERTY LINE-RESIDENTIAL USE	100
ADJACENT NON-PARTICIPATING PROPERTY LINE-AGRICULTURAL USE	50
NEWAYGO COUNTY DRAIN	75
REGULATED STREAM, WETLAND, POND, OR LAKE	75
STATE HIGHWAY RIGHT-OF-WAY	125
TOWNSHIP OR COUNTY ROAD RIGHT-OF-WAY	75

ISSUED FOR
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2180 South 1300 East, Suite 600
Salt Lake City, UT 84106-2749
(801) 679 - 3500

PE STAMP:

KEY PLAN:

PV-E.01.02 | PV-E.01.04 | PV-E.01.03

REVISIONS:

NO.	DATE	DESCRIPTION
0	05/22/2025	INITIAL CUP SET
1	06/05/2025	ADDED SETBACK TABLE
2	07/02/2025	ADDED PARCEL WITHIN SITE & SETBACK
3	07/15/2025	REVISED BUILDABLE AREA CONSTRAINTS

PROJECT TITLE:

SYLVAN SOLAR

PROJECT LOCATION:

SHERIDAN CHARTER TOWNSHIP, NEWAYGO COUNTY, MICHIGAN 49412

SHEET TITLE & DESCRIPTION:

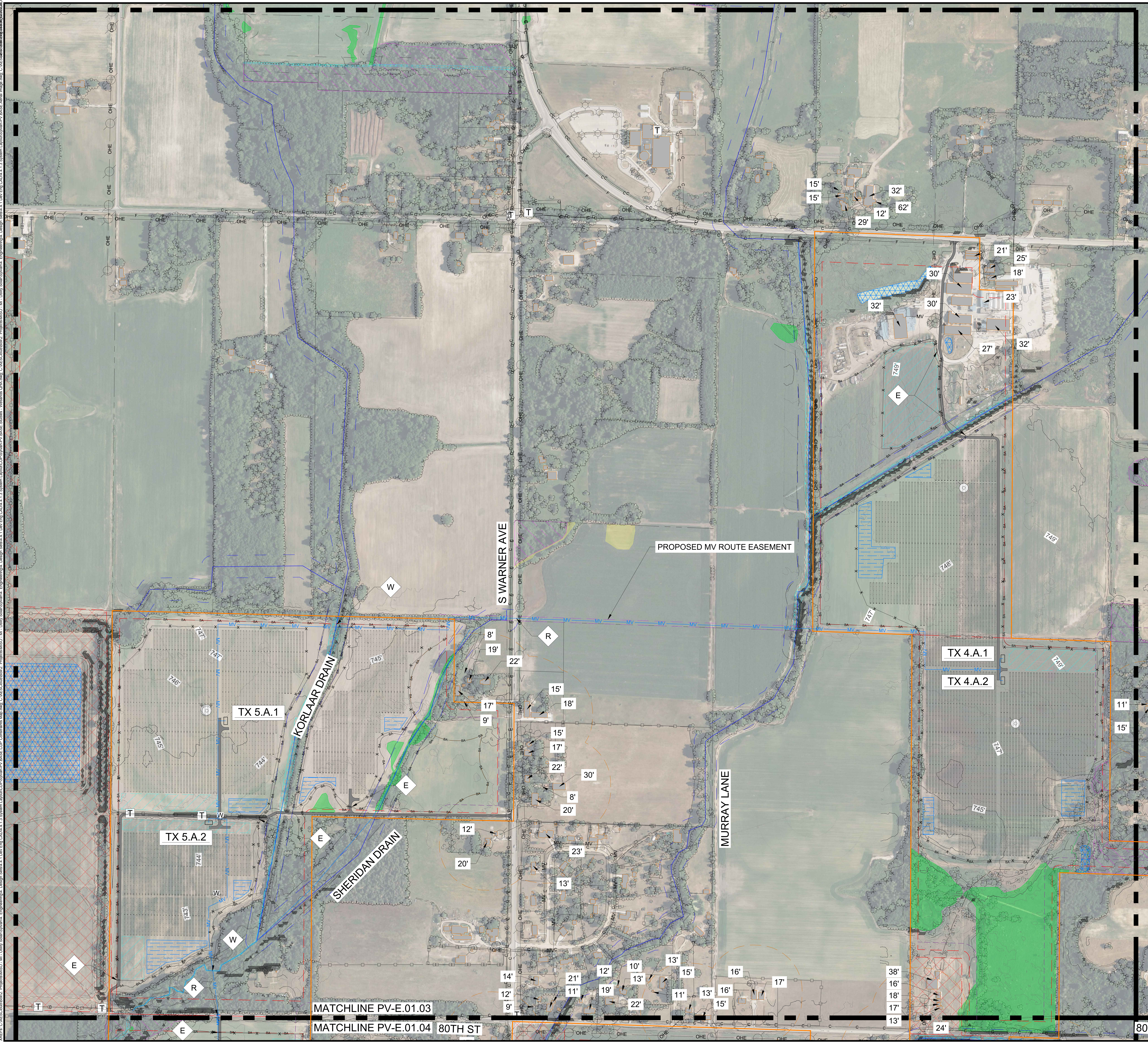
OVERALL SITE PLAN

220 MW AC

PROJ NUM:	
DES:	S. PERI
DWN:	J. PERRINE
CHK:	D. SCHULTZ
APV:	
DATE:	05/22/2025

SCALE AT 24" x 36":
0 400' 800' 1,200' 1,600'
1" = 800'

SHEET NO:	REV:
PV-E.01.01	3



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SHEET NOTES

E — SITE ENTRANCE W/ 24' GATE
W — WETLAND/WATER UG MV CROSSING
R — ROAD UG MV CROSSING

LEGEND

EXISTING

AES PARCEL BOUNDARY
AES PARCEL SETBACK
ADJACENT PARCEL
EXCLUDED PARCEL AREA
10' MAJOR CONTOURS
2' MINOR CONTOURS
MAJOR PUBLIC ROAD
GRAVEL ROAD
DIRT ROAD
ROAD RIGHT-OF-WAY
POTENTIALLY REGULATED WETLAND
WETLAND SETBACK
NON-REGULATED WETLAND
WASH / DRAINAGE
WASH / DRAINAGE SETBACK
COUNTY DRAIN CENTERLINE
COUNTY DRAIN SETBACK
RIVER
RIVER SETBACK
WATERBODY
100-YEAR FLOOD BOUNDARY
POTENTIAL PROTECTED SPECIES HABITAT
AVOIDANCE AREA
SLOPE KEEPOUT
TREE LINE
BUILDING
BUILDING SETBACK
FENCE
UNDERGROUND TRANSMISSION LINE
ELECTRIC METER & BOX
OVERHEAD POWER LINE & POLE
OVERHEAD XFMR & LIGHT POLE
UTILITY ROW
IRRIGATION PIVOT & VALVE
COMMUNICATIONS LINE & PEDESTAL
FIBER LINE

PROPOSED

SYLVAN SOLAR PROJECT BOUNDARY
BUILDABLE AREA
100' EQUIPMENT SETBACK
MV ROUTE EASEMENT
FENCE
POTENTIAL STORMWATER MANAGEMENT AREA
INTERIOR ROADS
LAYDOWN AREA
UG MV FEEDER
XFMR SKID
PV PANELS

N

ISSUED FOR
PERMIT
NOT FOR CONSTRUCTION

aes
2180 South 1300 East, Suite 600
Salt Lake City, UT 84106-2749
(801) 679 - 3500

PE STAMP:

KEY PLAN:
PV-E.01.02
PV-E.01.04
PV-E.01.03

REVISIONS:

NO.	DATE	DESCRIPTION
0	05/22/2025	INITIAL CUP SET
1	06/05/2025	ADDED STRUCTURE HEIGHTS
2	07/02/2025	ADDED MISSING PARCEL WITHIN SITE
3	07/15/2025	REVISED BUILDABLE AREA CONSTRAINTS

PROJECT TITLE:
SYLVAN SOLAR

PROJECT LOCATION:
SHERIDAN CHARTER TOWNSHIP, NEWAYGO COUNTY, MICHIGAN 49412

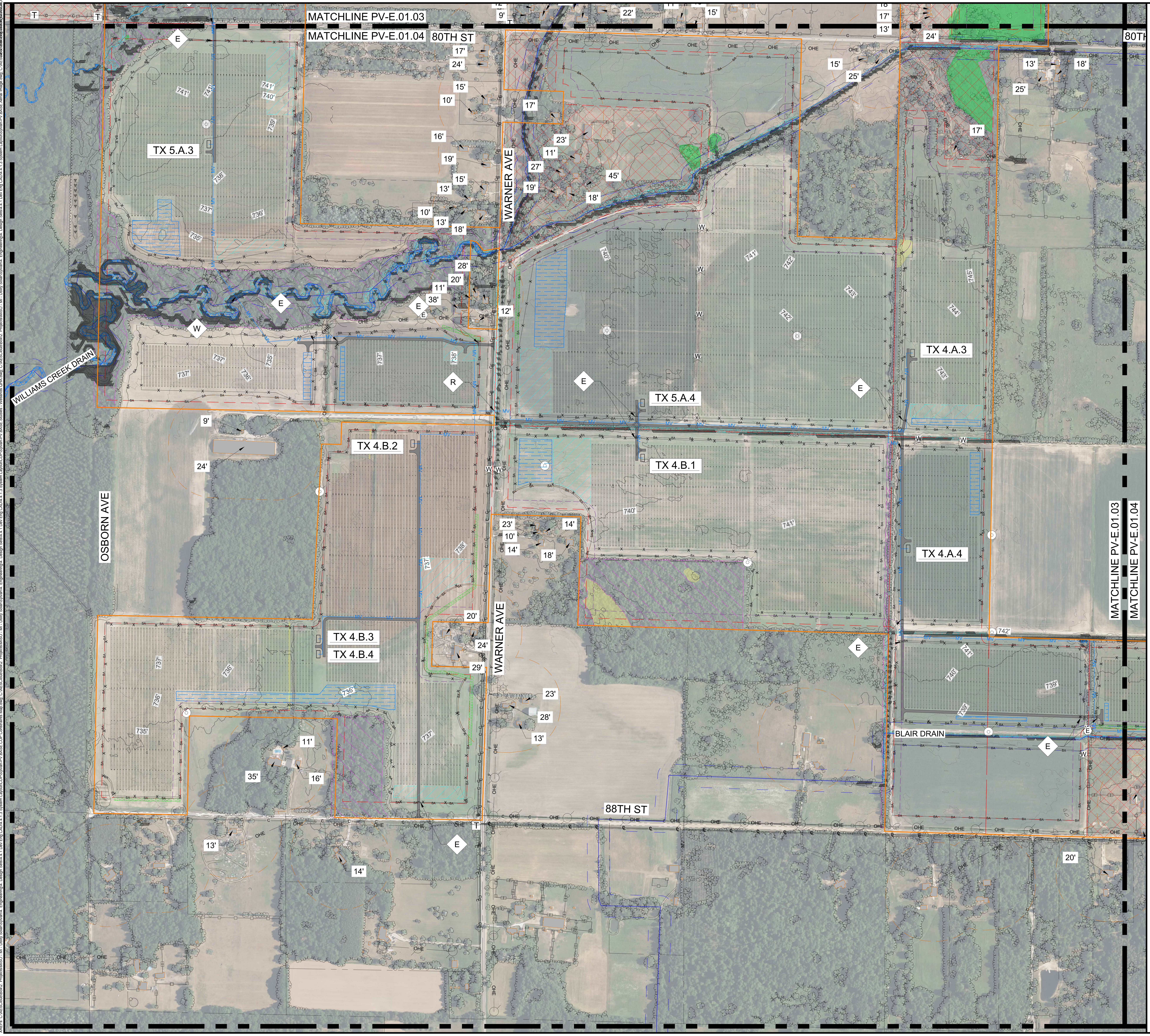
SHEET TITLE & DESCRIPTION:
NORTHERN SECTION DETAIL VIEW

220 MW AC

PROJ NUM:	
DES:	S. PERI
DWN:	J. PERRINE
CHK:	D. SCHULTZ
APV:	
DATE:	05/22/2025

SCALE AT 24" x 36":
0 150' 300' 450' 600'
1" = 300'

SHEET NO: PV-E.01.02
REV: 3



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- R — ROAD UG MV CROSSING

LEGEND

EXISTING

- AES PARCEL BOUNDARY
- AES PARCEL SETBACK
- ADJACENT PARCEL
- EXCLUDED PARCEL AREA
- 10' MAJOR CONTOURS
- 2' MINOR CONTOURS
- MAJOR PUBLIC ROAD
- GRAVEL ROAD
- DIRT ROAD
- ROAD RIGHT-OF-WAY
- POTENTIALLY REGULATED WETLAND
- WETLAND SETBACK
- NON-REGULATED WETLAND
- WASH / DRAINAGE
- WASH / DRAINAGE SETBACK
- COUNTY DRAIN CENTERLINE
- COUNTY DRAIN SETBACK
- RIVER
- RIVER SETBACK
- WATERBODY
- 100-YEAR FLOOD BOUNDARY
- POTENTIAL PROTECTED SPECIES HABITAT
- AVOIDANCE AREA
- SLOPE KEEPOUT
- TREE LINE
- BUILDING
- BUILDING SETBACK
- FENCE
- MV — UNDERGROUND TRANSMISSION LINE
- E — ELECTRIC METER & BOX
- OHE — OVERHEAD POWER LINE & POLE
- E — OVERHEAD XFMR & LIGHT POLE
- UTILITY ROW
- W — IRRIGATION PIVOT & VALVE
- T — C — COMMUNICATIONS LINE & PEDESTAL
- F — FIBER LINE

PROPOSED

- SYLVAN SOLAR PROJECT BOUNDARY
- BA — BUILDABLE AREA
- 100' EQUIPMENT SETBACK
- FENCE
- POTENTIAL STORMWATER MANAGEMENT AREA
- INTERIOR ROADS
- LAYDOWN AREA
- VEGETATIVE SCREENING AREA
- MV — UG MV FEEDER
- XFMR SKID
- PV PANELS

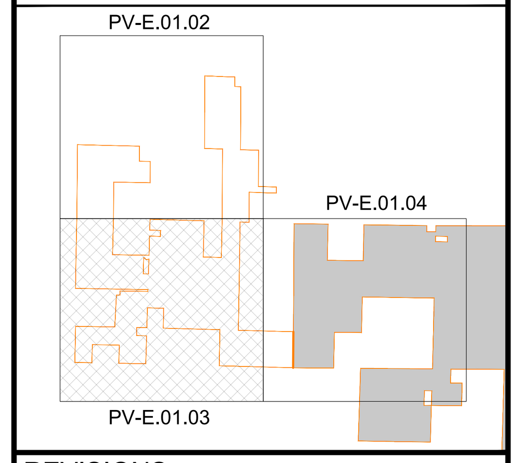
N

ISSUED FOR
PERMIT
NOT FOR CONSTRUCTION

aes
2180 South 1300 East, Suite 600
Salt Lake City, UT 84106-2749
(801) 679 - 3500

PE STAMP:

KEY PLAN:



REVISIONS:

NO.	DATE	DESCRIPTION
0	05/22/2025	INITIAL CUP SET
1	06/05/2025	ADDED STRUCTURE HEIGHTS
2	07/02/2025	ADDED PARCEL WITHIN SITE & SETBACK
3	07/15/2025	REVISED BUILDABLE AREA CONSTRAINTS

PROJECT TITLE:

SYLVAN SOLAR

PROJECT LOCATION:

SHERIDAN CHARTER TOWNSHIP, NEWAYGO COUNTY, MICHIGAN 49412

SHEET TITLE & DESCRIPTION:

SOUTHERN SECTION DETAIL VIEW

220 MW AC

PROJ NUM:	
DES:	S. PERI
DWN:	J. PERRINE
CHK:	D. SCHULTZ
APV:	
DATE:	05/22/2025

SCALE AT 24" x 36":
0 150' 300' 450' 600'
1" = 300'

SHEET NO: PV-E.01.03
REV: 3

GENERAL NOTES

1. THIS DRAWING IS PRELIMINARY AND FOR ESTIMATING PURPOSES ONLY. IT IS NOT FOR CONSTRUCTION.
2. LOCATION OF ALL EXISTING ITEMS IS APPROXIMATE AND MUST BE VERIFIED IN THE FIELD PRIOR TO CONSTRUCTION.
3. ALL SPECIFIED EQUIPMENT IS PRELIMINARY. FINAL EQUIPMENT SELECTION SHALL BE APPROVED BY OWNER.

SHEET NOTES

E SITE ENTRANCE W/ 24' GATE

W WETLAND/WATER UG MV CROSSING

R ROAD UG MV CROSSING

LEGEND

EXISTING

AES PARCEL BOUNDARY
AES PARCEL SETBACK
ADJACENT PARCEL
EXCLUDED PARCEL AREA
10' MAJOR CONTOURS
2' MINOR CONTOURS
MAJOR PUBLIC ROAD
GRAVEL ROAD
DIRT ROAD
ROAD RIGHT-OF-WAY
POTENTIALLY REGULATED WETLAND
WETLAND SETBACK
NON-REGULATED WETLAND
WASH / DRAINAGE
WASH / DRAINAGE SETBACK
COUNTY DRAIN CENTERLINE
COUNTY DRAIN SETBACK
RIVER
RIVER SETBACK
WATERBODY
100-YEAR FLOOD BOUNDARY
POTENTIAL PROTECTED SPECIES HABITAT
AVOIDANCE AREA
SLOPE KEEPOUT
TREE LINE
BUILDING
BUILDING SETBACK
FENCE
UNDERGROUND TRANSMISSION LINE
ELECTRIC METER & BOX
OVERHEAD POWER LINE & POLE
OVERHEAD XFMR & LIGHT POLE
UTILITY ROW
IRRIGATION PIVOT & VALVE
COMMUNICATIONS LINE & PEDESTAL
FIBER LINE

PROPOSED

SYLVAN SOLAR PROJECT BOUNDARY
BOUNDARY (GARFIELD TOWNSHIP)
BUILDABLE AREA
100' EQUIPMENT SETBACK
FENCE
POTENTIAL STORMWATER MANAGEMENT AREA
INTERIOR ROADS
LAYDOWN AREA
VEGETATIVE SCREENING AREA
UG MV FEEDER
XFMR SKID
PV PANELS

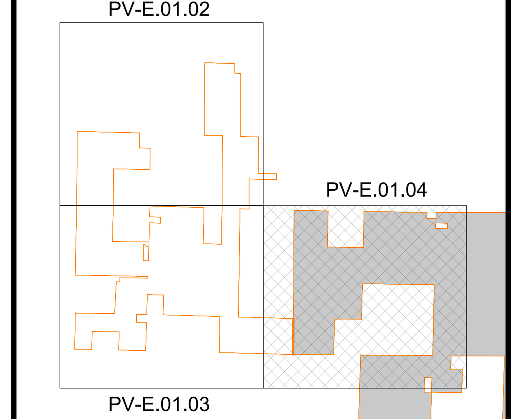
ISSUED FOR
PERMIT
NOT FOR CONSTRUCTION

aes

2180 South 1300 East, Suite 600
Salt Lake City, UT 84106-2749
(801) 679 - 3500

PE STAMP:

KEY PLAN:



REVISIONS:

NO.	DATE	DESCRIPTION
0	05/22/2025	INITIAL CUP SET
1	06/05/2025	ADDED STRUCTURE HEIGHTS
2	07/02/2025	ADDED MISSING PARCEL WITHIN SITE
3	07/15/2025	REVISED BUILDABLE AREA CONSTRAINTS

PROJECT TITLE:

SYLVAN SOLAR

PROJECT LOCATION:

SHERIDAN CHARTER TOWNSHIP, NEWAYGO COUNTY, MICHIGAN 49412

SHEET TITLE & DESCRIPTION:

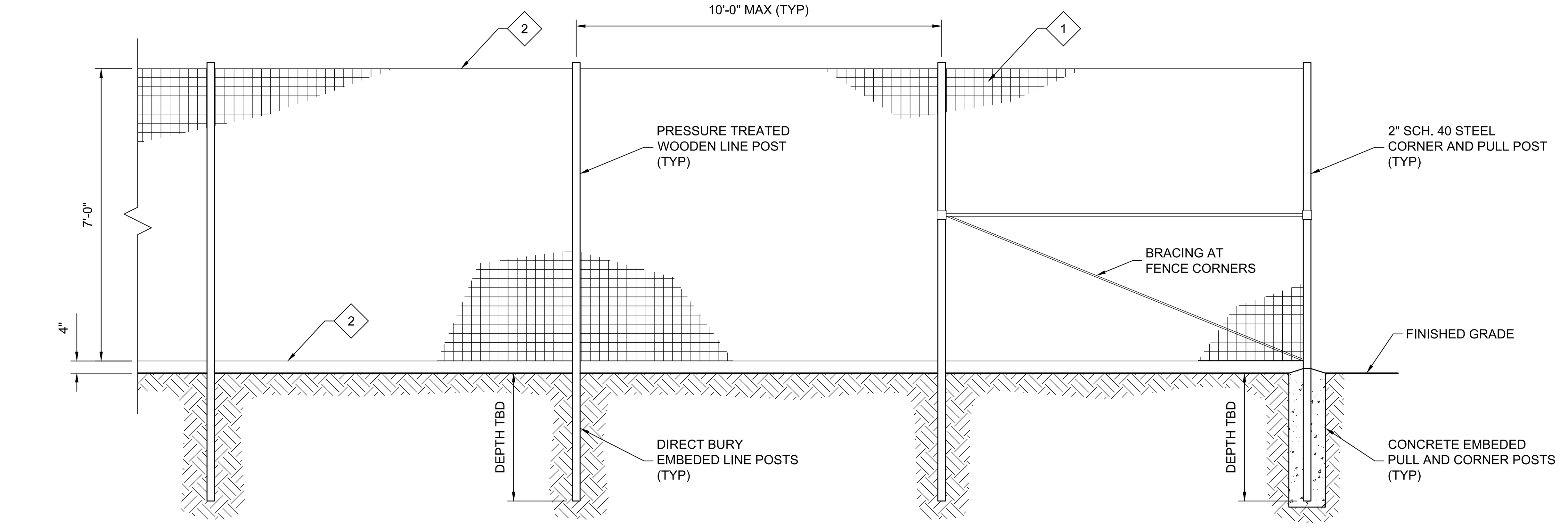
SOUTHEAST SECTION DETAIL VIEW

220 MW AC

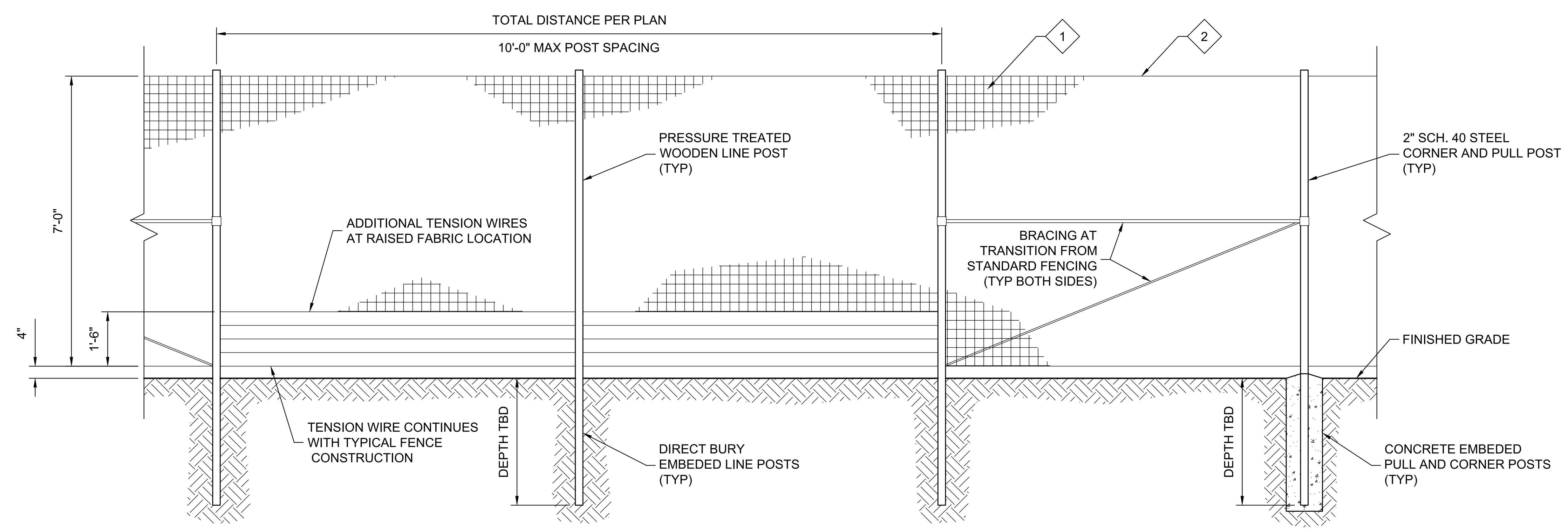
PROJ NUM:	
DES:	S. PERI
DWN:	J. PERRINE
CHK:	D. SCHULTZ
APV:	
DATE:	05/22/2025

SCALE AT 24" x 36":
0 150' 300' 450' 600'
1" = 300'

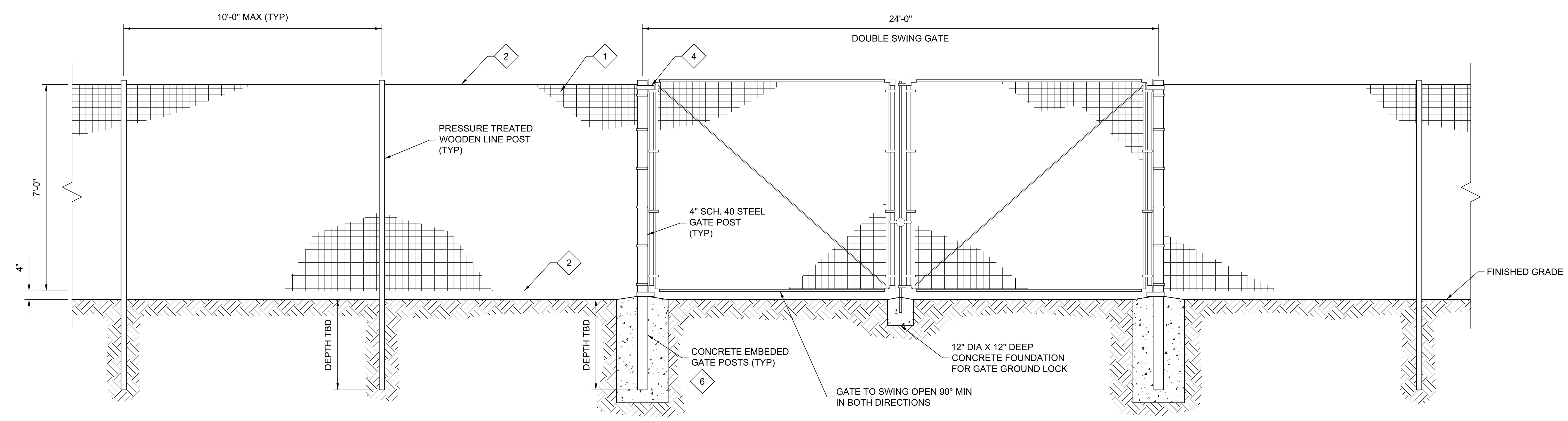
SHEET NO: PV-E.01.04
REV: 3



1 TYPICAL PERIMETER FENCE



2 TYPICAL STORMWATER CROSSING FENCE



3 TYPICAL SITE ACCESS GATE

GENERAL NOTES

1. ALL DIMENSIONS WHEN SHOWN ARE APPROXIMATE AND SHALL BE VERIFIED IN THE FINAL DESIGN.
2. ALL SPECIFIED EQUIPMENT IS PRELIMINARY. FINAL EQUIPMENT SELECTIONS SHALL BE APPROVED BY OWNER.

SHEET NOTES

1. FABRIC - 12 GAUGE, WOVEN WIRE FENCING; GALVANIZED ASTM A392, CLASS 2.
2. FENCE SHALL HAVE A TOP RAIL, BOTTOM TENSION WIRE. BOTTOM WIRE SHALL BE INSTALLED 4" MAXIMUM FROM FINISHED GRADE.
3. CLAMPED GATE HINGES SHALL BE WELDED TO PREVENT SETTLEMENT AND SLIPPAGE.

ISSUED FOR
PERMIT
NOT FOR CONSTRUCTION

aes
2180 South 1300 East, Suite 600
Salt Lake City, UT 84106-2749
(801) 679 - 3500

PE STAMP:

KEY PLAN:

REVISIONS:

NO.	DATE	DESCRIPTION
0	05/22/2025	INITIAL CUP SET
2	07/02/2025	REVISED FENCE HEIGHT IN DETAIL

PROJECT TITLE:

SYLVAN SOLAR

PROJECT LOCATION:

SHERIDAN CHARTER TOWNSHIP, NEWAYGO COUNTY, MICHIGAN 49412

SHEET TITLE & DESCRIPTION:

TYPICAL PERIMETER FENCE DETAILS

CIVIL DETAIL

PROJ NUM:
DES: S. PERI
DWN: J. PERRINE
CHK: D. SCHULTZ
APV:
DATE: 05/22/2025
SCALE AT 24" x 36":
NTS
SHEET NO: PV-C.00.01
REV: 3

Appendix 2 – Participating Parcels

Attachment 2 - Participating Parcels

Sylvan Solar Special Land Use Permit Application

Attachment 2 – Sheridan Charter Township Participating Parcels

PARCEL ID	LANDOWNER NAME	MAILING ADDRESS	ZONING	LEGAL DESCRIPTION
62-17-23-100-007	CITY OF FREMONT	101 E MAIN STREET FREMONT MI 49412	AG-2	The N 1/2 of the SE 1/4 of Section 23, T12 North, R14W, Sheridan Township, Newaygo County, Michigan, EXCEPT the following parcel: Commencing at the E 1/4 corner of said Section; thence S 550 feet; thence W 400 feet; thence N 550 feet; thence E 400 feet to the Point of Beginning.
62-17-24-100-008	KARNEMAAT, MARLENE TRUST	5118 W 72ND ST FREMONT MI 49412	AG-2	The E 1/2 of the E 1/2 of the NW 1/4 of Section 24, T12N, R14W. Also, the W 1/2 of the W 1/2 of the NE 1/4, except the N 345 feet of the E 225 feet thereof.
62-17-24-400-011	ROSEMA, NORMAN	5175 W 80TH ST FREMONT MI 49412	AG-2	Commencing at the center of the SE 1/4 of Section 24, T12N, R14W, thence W 20 rods, thence S 13 and one-half rods, thence E 20 rods, thence N 13 and 1/2 rods to the point of beginning. And: The W 1/2 of the SE 1/4, except the E 1/4 of the SW 1/4 of the SE 1/4, Section 24, T12N, R14W. And: The N 1/2 of the E 1/2 of the SE 1/4 of the SE 1/4 of Section 24, and the N 222.75 feet of the W 1/2 of the SE 1/4 of the SE 1/4 of Section 24, T12N, R14W, Sheridan Township, Newaygo County, Michigan.
62-17-25-100-007	JOHNSON, RANDALL & GENISE TRUST	8102 S WARNER FREMONT MI 49412	AG-2	W 1/2 of NE 1/4 of NW 1/4, also SE 1/4 of NW 1/4, also W 1/2 of NW 1/4, Except Commencing 400 feet S of NW corner Section, S 218 feet, E 400 feet; N 218 feet; W 400 feet; to Beginning Section 25 T12N R14W
62-17-25-200-001	MULDER ROBERT A ET UX SALLY L	5200 KENOWA AVE SW GRANDVILLE MI 49418	AG-2	W 1/2 of W 1/2 of NE 1/4 of Section 25, T12N, R14W
62-17-25-300-004	KARNEMAAT, KENT ET AL	5118 W 72ND ST FREMONT MI 49412	AG-2	The N 1/2 of the SW 1/4 of Section 25, T12N, R14W, except the S 726 feet of the W 600 feet thereof.
62-17-25-400-005	VOGEL, SCOTT A ET UX ASHLEY J	17573 EGAN DRIVE COOPERSVILLE MI 49404	AG-2	The W ¼ of the SE ¼ of Section 25, T12N, R14W, Township of Sheridan, Newaygo County, Michigan
62-17-25-400-007	VOGEL PRODUCE INC	6720 MAPLE ISLAND ROAD HOLTON MI 49425	AG-2	The E 1/2 of the SW 1/4 of the SE 1/4 of Section 25, T12N; R14W, Sheridan Township, Newaygo County, Michigan more particularly described as beginning at a point on the S Section Line that is S 88°05'05" E 677.72 feet from the S ¼ corner of Section 25; thence S 88°05'05" E 677.72 feet; thence N 01°07'51" E 1323.82 feet; thence N 88°04'09'' W 673.79 feet; thence S 01°18'03'' W 1323.95 feet to the point of beginning.
62-17-25-400-008	YODER, CHESTER J ET UX CLARA M	4949 W 88TH ST FREMONT MI 49412	AG-2	The W 1/2 of the SE 1/4 of the SE 1/4 of Section 25, T12N, R14W, Sheridan Township, Newaygo, Michigan, more particularly described as: Beginning at a point on the S Section line that is S 88°05'05" E 1355.44 feet from the S ¼ corner of Section 25; thence S 88°05'05" E 677.72 feet;

PARCEL ID	LANDOWNER NAME	MAILING ADDRESS	ZONING	LEGAL DESCRIPTION
				thence N 00°57'39" E 1323.70 feet; thence N 88°04'09" W 673.79 feet; thence S 01°07'51" W 1323.82 feet to the Point of Beginning.
62-17-26-200-012	ACRETRADER 192 LLC	26 W CENTER ST FL 2 FAYETTEVILLE AR 72701	AG-2	Parcel 4: The NW 1/4 of the NE 1/4 of Section 26, T12N, R14W; Parcel 5: That part of the E 1/2 of Section 26, T12N, R14W, Sheridan Township, Newaygo County, Michigan, described as commencing at the NE corner of said Section, thence S 01°41'51" W along the E line of said Section a distance of 1324.35 feet to the N 1/16 line of said Section and the point of beginning; thence S 01°41'51" W along said E line a distance of 137.52 feet to a meander traverse line along the Northerly bank of Butler Drain; thence S 79°45'15" W along said traverse line a distance of 104.73 feet; thence S 79°45'15" W along said traverse line a distance of 104.73 feet; thence N 39°40 '35" W along said traverse line a distance of 75.63 feet; thence N 74°22'11" W along said traverse line a distance of 40.75 feet; thence leaving said traverse line S 01°41'51" W parallel with said E line a distance of 589.47 feet; thence S 88°18'09" E a distance of 192.00 feet to said E line; thence S 01°41'51" W along said E line a distance of 576.25 feet; thence N 88°51'20" W parallel with the E and W 1/4 line of said section a distance of 2660.60 feet to the N and S 1/4 line of said Section; thence N 01°08'51" E along said N and S 1/4 line a distance of 1257.52 feet to the N 1/16 line of said Section; thence S 88°52'19" E along said N 1/16 line a distance of 2672.68 feet to the point of beginning. Including all land lying between said meander traverse line and the thread of Butler Drain.
62-17-26-400-014	ACRETRADER 192 LLC	26 W CENTER ST FL 2 FAYETTEVILLE AR 72701	AG-2	Parcel 5: ALSO: That part of the E 1/2 of Section 26, T12N, R14W, Sheridan Township, Newaygo County, Michigan, described as beginning at the E 1/4 corner of said section; thence S 01°41'48" W along the E line of said section a distance of 1323.87 feet to the S 1/16th line of said section; thence N 88°55'09" W along said 1/16th line a distance of 1177.27 feet; thence N 03°01'32" E a distance of 1175.75 feet; thence S 88°51'20" E parallel with the E and W 1/4 line of said section a distance of 129.85 feet; thence N 01°41'48" E parallel with said E line a distance of 150.01 feet to said 1/4 line; thence S 88°51'20" E along said 1/4 line a distance of 1020.13 feet to the point of beginning.

PARCEL ID	LANDOWNER NAME	MAILING ADDRESS	ZONING	LEGAL DESCRIPTION
				Parcel 6: The S 1/2 of the SE 1/4 of Section 26, T12N, R14W, Sheridan Township, Newaygo County, Michigan. EXCEPT the SE 1/4 of the SW 1/4 of the SE 1/4 of said Section 26. ALSO EXCEPT the W 1/2 of the SW 1/4 of the SE 1/4 of the SE 1/4 of said Section 26. ALSO EXCEPT the N 300 feet of the E 370 feet of the S 1/2 of the SE 1/4 of said Section 26. LESS AND EXCEPT: That part of the SE 1/4 of Section 26, T12N, R14W, Sheridan Township, Newaygo County, Michigan, described as beginning at the S 1/4 corner of said section; thence N01°08'51"E along the N and S 1/4 line a distance of 1326.74 feet to the S 1/16th line of said section; thence S88°55'05"E along said South 1/16th line a distance of 33.00 feet; thence S01°08'51"W parallel with said 1/4 line a distance of 1326.70 feet to the S line of said section; thence N88°59'00"W along said S line a distance of 33.00 feet to the point of beginning. Containing 1.01 acres. Subject to easements or right of ways of record.
62-17-23-200-009	KOLK LESLIE J ET UX SANDRA J ET AL	4039 SHOREWOOD FREMONT MI 49412	AG-2	(Easement) The E 1/2 of the NE 1/4 of Section 23, T12N, R14W, excepting 10 acres in the NW corner thereof, described as the NW 1/4 of the NE 1/4 of the NE 1/4, and further excepting the E 300 feet of the N 220 feet of the E 1/2 of the NE 1/4 thereof, Sheridan Township, Newaygo County, Michigan; SUBJECT to highways, easements, reservations and restrictions of record.
62-17-25-400-004	VANNIEUWENHUYZEN WESLEY	PO BOX 187 FREMONT MI 49412	AG-2	(Easement) The E 1/2 of the SE 1/4 of the SE 1/4, Section 25, T12N, R14W, Sheridan Township, Newaygo County, Michigan
62-17-24-300-019	VOGEL PRODUCE INC	6720 MAPLE ISLAND ROAD HOLTON MI 49425	AG-2	(Easement) S1/2 SW 1/4 NW 1/4 SEC 24, T12N-R14W, SHERIDAN TWP ALSO PT SW1/4 COM W1/4 COR SD SEC, TH S87D59'29"E 327.21 FT TO Point of Beginning, TH S87D59'29"E 995.30 FT, TH S00D17'25"W 664.68 FT, TH N88D03'00"W 995.05 FT, TH N00D16'16"E 665.70 FT TO Point of Beginning
62-17-24-100-002	VOGEL REAL ESTATE LLC	6726 W LAKE DR FREMONT MI 49412	AG-2	(Easement) The W ½ of the E ½ of the NW ¼, Section 24, T12N, R14W, Sheridan Township, Newaygo County, Michigan

Landowner Authorizations

LANDOWNER AUTHORIZATION FOR SPECIAL LAND USE PERMIT APPLICATION - SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Acretrader Legal Descriptions:
PID 62-17-26-200-012 (Parcel 4 and part of Parcel 5) & 62-17-26-400-014(Parcel 6 and part of Parcel 5):

Parcel 4: The Northwest Quarter of the Northeast Quarter of Section 26, Township 12 North, Range 14 West;

Parcel 5: That part of the East 1/2 of Section 26, Town 12 North, Range 14 West, Sheridan Township, Newaygo County, Michigan, described as commencing at the Northeast corner of said Section, thence South 01 degrees 41 minutes 51 seconds West along the East line of said Section a distance of 1324.35 feet to the North one-sixteenth line of said Section and the point of beginning; thence South 01 degrees 41 minutes 51 seconds West along said East line a distance of 137.52 feet to a meander traverse line along the Northerly bank of Butler Drain; thence South 79 degrees 45 minutes 15 seconds West along said traverse line a distance of 104.73 feet; thence North 39 degrees 40 minutes 35 seconds West along said traverse line a distance of 75.63 feet; thence North 74 degrees 22 minutes 11 seconds West along said traverse line a distance of 40.75 feet; thence leaving said traverse line South 01 degrees 41 minutes 51 seconds West parallel with said East line a distance of 589.47 feet; thence South 88 degrees 18 minutes 09 seconds East a distance of 192.00 feet to said East line; thence South 01 degrees 41 minutes 51 seconds West along said East line a distance of 576.25 feet; thence North 88 degrees 51 minutes 20 seconds West parallel with the East and West 1/4 line of said section a distance of 2660.60 feet to the North and South 1/4 line of said Section; thence North 01 degrees 08 minutes 51 seconds East along said North and South 1/4 line a distance of 1257.52 feet to the North one-sixteenth line of said Section; thence South 88 degrees 52 minutes 19 seconds East along said North one-sixteenth line a distance of 2672.68 feet to the point of beginning. Including all land lying between said meander traverse line and the thread of Butler Drain.

ALSO: That part of the East 1/2 of Section 26, Town 12 North, Range 14 West, Sheridan Township, Newaygo County, Michigan, described as beginning at the East 1/4 corner of said section; thence South 01 degrees 41 minutes 48 seconds West along the East line of said section a distance of 1323.87 feet to the South 1/16th line of said section; thence North 88 degrees 55 minutes 09 seconds West along said 1/16th line a distance of 1177.27 feet; thence North 03 degrees 01 minutes 32 seconds East a distance of 1175.75 feet; thence South 88 degrees 51 minutes 20 seconds East parallel with the East and West 1/4 line of said section a distance of 129.85 feet; thence North 01 degrees 41 minutes 48 seconds East parallel with said East line a distance of 150.01 feet to said 1/4 line; thence South 88 degrees 51 minutes 20 seconds East along said 1/4 line a distance of 1020.13 feet to the point of beginning.

Parcel 6: The South Half of the Southeast Quarter of Section 26, Township 12 North, Range 14 West, Sheridan Township, Newaygo County, Michigan. EXCEPT the Southeast Quarter of the Southwest Quarter of the Southeast Quarter of said Section 26. ALSO EXCEPT the West 1/2 of the Southwest Quarter of the Southeast Quarter of the Southeast Quarter of said Section 26. ALSO EXCEPT the North 300 feet of the East 370 feet of the South Half of the Southeast Quarter of said Section 26.

LESS AND EXCEPT:

That part of the Southeast 1/4 (SE/4) of Section Twenty-Six (26), Township Twelve (12) North, Range Fourteen (14) West, Sheridan Township, Newaygo County, Michigan, described as beginning at the South 1/4 corner of said section; thence N01°08'51"E along the North and South 1/4 line a distance of 1326.74 feet to the South 1/16th line of said section; thence S88°55'05"E along said South 1/16th line a distance of 33.00 feet; thence S01°08'51"W parallel with said 1/4 line a distance of 1326.70 feet to the South line of said section; thence N88°59'00"W along said South line a distance of 33.00 feet to the point of beginning. Containing 1.01 acres. Subject to easements or right of ways of record.

Acretrader 192, LLC, an Arkansas limited liability company

Signature: Signed by: Robert Moore B191992A1C13406...

Printed Name: Robert Moore - General Manager, Acretrader Management, LLC

Date: 9/4/2025

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

City of Fremont

Todd M. Blake
City Manager/Finance Director

City of Fremont Legal Descriptions:

PID 62-17-23-100-007: The North 1/2 of the Southeast 1/4 of Section 23, Town 12 North, Range 14 West, Sheridan Township, Newaygo County, Michigan, EXCEPT the following parcel: Commencing at the East 1/4 corner of said Section; thence South 550 feet; thence West 400 feet; thence North 550 feet; thence East 400 feet to the Point of Beginning.

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Randall Drew Johnson

Randall Drew Johnson, Trustee

Genise Joy Johnson

Genise Joy Johnson, Trustee

Johnson Trust Legal Descriptions:

PID 62-17-25-100-007: West 1/2 of Northeast 1/4 of Northwest 1/4, also Southeast 1/4 of Northwest 1/4, also West 1/2 of Northwest 1/4, Except Commencing 400 feet South of Northwest corner Section, South 218 feet, East 400 feet; North 218 feet; West 400 feet; to Beginning Section 25 Township 12 North Range 14 West

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Kent Karnemaat

Kent Karnemaat, individually

Karnemaat's LLC

Kent Karnemaat

Kent Karnemaat, Member

Thomas B Karnemaat

Thomas B. Karnemaat, Member

Marlene Karnemaat

Marlene Karnemaat, Member

Karnemaat Legal Descriptions:

PID 62-17-25-300-004: The North 1/2 of the Southwest 1/4 of Section 25, Town 12 North, Range 14 West, except the South 726 feet of the West 600 feet thereof.

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

The Marlene J. Karnemaat Trust under agreement of trust dated December 31, 1993

Marlene Karnemaat

Marlene Karnemaat, Member

Karnemaat Trust Legal Descriptions:

PID 62-17-24-100-008: The East half of the East half of the Northwest quarter of Section 24, Town 12 North, Range 14 West. Also, the West half of the West half of the Northeast Quarter, except the North 345 feet of the East 225 feet thereof.

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

as POA

Sandra J. Kolk

Bryan J. Kolk

Margaret V. Kolk

Kolk Legal Descriptions:

PID 62-17-23-200-009:

The East Half (E 1/2) of the Northeast Quarter (NE 1/4) of Section Twenty-three (23), Township Thirteen (13) North, Range Fourteen (14) West, excepting ten (10) acres in the Northwest Corner thereof, described as the Northwest Quarter (NW 1/4) of the Northeast Quarter (NE 1/4) of the Northeast Quarter (NE 1/4), and further excepting the East three hundred (300) feet of the North two hundred twenty (220) feet of the East half (E 1/2) of the Northeast Quarter (NE 1/4) thereof, Sheridan Township, Newaygo County, Michigan; SUBJECT to highways, easements, reservations and restrictions of record.

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Robert A. Mulder

Robert A. Mulder

Sally L. Mulder

Sally L. Mulder

Mulder Legal Descriptions:

PID 62-17-25-200-001: West half of West half of Northeast Quarter of Section 25, Township 12 North, Range 14 West

LANDOWNER AUTHORIZATION FOR
SPECIAL LAND USE PERMIT APPLICATION -
SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Norman W Rosema

Norman W. Rosema

Rosema Legal Descriptions:

PID 62-17-24-400-011: Commencing at the center of the Southeast Quarter of Section 24, Township 12 North, Range 14 West, thence West 20 rods, thence South 13 and one-half rods, thence East 20 rods, thence North 13 and one- half rods to the point of beginning.

And:

The West Half of the Southeast Quarter, except the East Quarter of the Southwest Quarter of the Southeast Quarter, Section 24, Township 12 North, Range 14 West.

And:

The North Half of the East Half of the Southeast Quarter of the Southeast Quarter of Section 24, and the North 222.75 feet of the West Half of the Southeast Quarter of the Southeast Quarter of Section 24, Township 12 North, Range 14 West, Sheridan Township, Newaygo County, Michigan.

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Wesley VanNieuwenhuyzen

Wesley Vannieuwenhuyzen

9-9-2025

Vannieuwenhuyzen Legal Descriptions:

PID 62-17-25-400-004: The East 1/2 of the Southeast 1/4 of the Southeast 1/4, Section 25, Town 12 North, Range 14 West, Sheridan Township, Newaygo County, Michigan

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Vogel Produce, Inc., a Michigan Corporation

Glenn R Vogel

Glenn R. Vogel, President

Vogel Produce Legal Descriptions:

PID 62-17-25-400-007: The East 1/2 of the Southwest 1/4 of the Southeast 1/4 of Section 25, Town 12 North; Range 14 West, Sheridan Township, Newaygo County, Michigan more particularly described as beginning at a point on the South Section Line that is South 88°05'05" East 677.72 feet from the South ¼ corner of Section 25; thence South 88°05'05" East 677.72 feet; thence North 01°07'51" East 1323.82 feet; thence North 88°04'09'' West 673.79 feet; thence South 01°18'03'' West 1323.95 feet to the point of beginning.

PID 62-17-24-300-019: S1/2 SW1/4 NW1/4 SEC 24, T12N-R14W, SHERIDAN TWP ALSO PT SW1/4 COM W1/4 COR SD SEC, TH S87D59'29"E 327.21 FT TO POB, TH S87D59'29"E 995.30 FT, TH S00D17'25"W 664.68 FT, TH N88D03'00"W 995.05 FT, TH N00D16'16"E 665.70 FT TO POB

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Vogel Real Estate, LLC a Michigan limited liability company

Scott A Vogel

Scott A Vogel, Member

Vogel Real Estate Legal Descriptions:

PID 62-17-24-100-002: The West ½ of the East ½ of the Northwest ¼, Section 24, T12N, R14W, Sheridan Township, Newaygo County, Michigan.

LANDOWNER AUTHORIZATION FOR

SPECIAL LAND USE PERMIT APPLICATION -

SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Scott A Vogel

Scott A. Vogel, individually and as life estate tenant, and as Trustee of the Scott and Ashleigh Vogel Trust U/A/D 3-25-14

Ashleigh J Vogel

Ashleigh J. Vogel, individually and as life estate tenant, and as Trustee of the Scott and Ashleigh Vogel Trust U/A/D 3-25-14

Vogel Legal Descriptions:

PID 62-17-25-400-005: The West ¼ of the Southeast ¼ of Section 25, Town 12 North, Range 14 West, Township of Sheridan, Newaygo County, Michigan

LANDOWNER AUTHORIZATION FOR
SPECIAL LAND USE PERMIT APPLICATION -
SHERIDAN CHARTER TOWNSHIP

The undersigned landowners, participating in the development of Sylvan Solar, a 220MWac solar project in Sheridan Charter Township, Newaygo County, Michigan, do hereby affirm that they are the owners of the property described below and have authorized Sylvan Solar, LLC to apply for a Special Land Use Permit for said project.

Chester Jay Yoder

Chester Jay Yoder

Clara Mae Yoder

Clara Mae Yoder

Yoder Legal Descriptions:

PID 62-17-25-400-008: The West 1/2 of the Southeast 1/4 of the Southeast 1/4 of Section 25, Town 12 North, Range 14 West, Sheridan Township, Newaygo, Michigan, more particularly described as: Beginning at a point on the South Section line that is South 88 degrees 05 minutes 05 seconds East 1355.44 feet from the South ¼ corner of Section 25; thence South 88 degrees 05 minutes 05 seconds East 677.72 feet; thence North 00 degrees 57 minutes 39 seconds East 1323.70 feet; thence North 88 degrees 04 minutes 09 seconds West 673.79 feet; thence South 01 degrees 07 minutes 51 seconds West 1323.82 feet to the Point of Beginning.

Appendix 3 – Traffic Impact Statement

Attachment 3 - Traffic Impact Statement

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

Traffic Impact Statement

Sylvan Solar Project

Prepared for
Sylvan Solar, LLC

Prepared by
Prein&Newhof

September 2025

100 E. Chapin Street, Suite A Cadillac, MI 49601 t. 231-468-3456 f. 616-364-6955 www.preinnewhof.com

Prein&Newhof
Engineers ▪ Surveyors ▪ Environmental ▪ Laboratory

September 5, 2025
2250662

RE: Sylvan Solar Project, Sheridan Charter Township, Michigan
Traffic Impact Statement

This brief traffic impact statement (TIS) was developed prior to the proposed construction of the Sylvan Solar Project (Project) located in Sheridan Charter Township, Newaygo County, Michigan. The Project vicinity is shown in **Figure 1.** The proposed Project will consist of constructing an up to 220-megawatt (MW) solar generation facility within 2,166-acres of undeveloped land in Sheridan Charter Township. The Project is primarily located south of Michigan Highway 82 (M-82), north of North River Drive, west of Bingham Avenue, and east of South Osborn Avenue in an area that consists of mostly agricultural fields, wooded areas, agricultural ditches, and Newaygo County designated drains. Access to the Project area will be provided by seven access points in Sheridan Charter Township. This TIS will focus on three representative new access points, with each access located along the east sides of Warner Avenue, Croswell Avenue, and Baldwin Avenue, respectively, as shown in **Figure 2**. Construction of the Project is anticipated to begin by mid-2027, and the solar energy generation facility is expected to be operational by late 2028.

Although the project is expected to generate more than 100 peak hour trips during the construction phase, this limited traffic impact statement does not include an analysis of the site total generated traffic impact on the adjacent roadway network. During normal post-construction operations, the Solar Project is expected to generate less than 100 inbound trips during any one hour of the day and this limited number of Project generated trips is not expected to have any significant impact on the surround roadway network.

Existing Roadway Conditions

Michigan Highway 82 (M-82), within the vicinity of the Project, is a two-lane, undivided roadway with gravel shoulders and has a National Functional Classification (NFC) of a minor arterial. M-82 provides connectivity from the City of Newaygo to the City of Fremont, providing access to various agricultural, commercial, and residential properties in the Project vicinity. With an east/west alignment, M-82 has a posted speed limit of 55 miles per hour (mph). There are no pedestrian facilities present along this highway. The current Average Daily Traffic (ADT) on M-82 is approximately 8,274 vehicles per day (vpd) as reported from MDOT's online *Transportation Data Management System Traffic Counts*.

With north/south alignments, Warner Avenue and Baldwin Avenue are two-lane, rural roadways with gravel shoulders and both roadways have a National Functional Classification of a major collector. Warner Avenue and Baldwin Avenue have posted speed limits of 55 mph and offer parallel routes between the City of Bridgeton and River Drive to the south and M-82 to the north, providing access to various agricultural and residential properties. The current ADT on Warner Avenue is 6,029 vpd, while the current ADT on Baldwin Avenue is 474 vpd.

Croswell Avenue is classified as a local two-lane roadway and is unpaved within the vicinity of the Project. It has a north/south alignment and extends from North River Drive in the south towards M-82 to the north. There is no posted speed limit on Croswell Avenue.

80th Street serves the area as a paved, two-lane roadway with an east/west alignment. There is no posted speed limit within the vicinity of the Project area. 80th Street is a rural, local roadway that currently provides access to various residential and agricultural properties. With the construction of the proposed Project, 80th Street will serve as the primary east/west corridor for Project generated traffic, utilizing this paved roadway connection to access the adjacent north/south roadways and the proposed Project area. There is no curb, gutter, or pedestrian facilities present along the roadway.

88th Street is an unpaved rural roadway, with no posted speed limit. 88th Street has an east/west alignment and extends from Osborn Avenue in the west to Wisner Avenue towards the east providing access to agricultural and residential properties.

The intersection of M-82/Warner Avenue is an un-signalized, four-leg intersection controlled by a STOP sign on the northbound and southbound approaches. Eastbound and westbound traffic on M-82 is free flow. The northbound and westbound approaches to the intersection each provide an exclusive left turn lane and a shared through/right turn lane. The eastbound approach offers an exclusive left turn lane, a single through lane and an exclusive right turn lane, while the southbound vehicles approaching the intersection utilize a single shared left turn/through/right turn lane.

The un-signalized, four-leg, two-way STOP controlled intersections of M-82/Croswell Avenue, M-82/Baldwin Avenue, and 80th Street/Baldwin are controlled by STOP signs on the northbound and southbound approaches. Eastbound and westbound traffic on M-82 and 80th Street is free flow. All three intersections offer the same lane configurations by providing a single shared left turn/through/right turn lane in the northbound, southbound, eastbound and westbound directions.

The intersection of Warner Avenue/80th Street is an un-signalized, four-leg, two-way STOP controlled intersection. The eastbound and westbound approaches to the intersection are controlled by a STOP sign, while northbound and southbound traffic is free flow. Each approach to the intersection provides a single shared left turn/through/right turn lane.

The un-signalized intersection of 80th Street/Croswell Avenue is a four-leg intersection with All-Way STOP control on all four approaches. Each leg of the intersection offers a single shared left turn/though/right turn lane.

Existing lane configurations and traffic control are shown in **Figure 3**.

Proposed Access

Access to the proposed Project area in Sheridan Charter Township will be provided by seven (7) proposed gated access points that will serve the Project and be in operation during construction and post-construction. Three of these typical access points were selected as representative sites for this conservative analysis.

The first Project access point selected for study will be located along the east side of Baldwin Avenue, approximately 1,400 feet south of 80th Street and form a new 'T' shaped intersection. The Baldwin Avenue access will provide vehicles exiting the Project site with a single shared left turn/right turn lane and will be under STOP sign control. Traffic on Baldwin Avenue will remain free flow. Northbound traffic entering this access point will be offered a single shared through/right turn lane, while southbound traffic will utilize a single shared left turn/through lane. This access point into the Project area will also have a 24-foot gate installed to prevent unauthorized vehicles from entering the Project area.

The second Project access point for study will be located along the east side of Croswell Avenue, approximately 2,900 feet south of 80th Street and form a new ‘T’ shaped intersection. The Croswell Avenue access will offer vehicles exiting the Project area with a single shared left turn/right turn lane and will be under STOP sign control. Traffic on Croswell Avenue will remain free flow. Northbound traffic entering the site will be offered a single shared through/right turn lane, while southbound traffic will utilize a single shared left turn/through lane. A 24-foot gate will be installed to prevent unauthorized vehicles from entering the proposed Project area at this ingress/egress location.

Approximately 2,600 feet south of 80th Street, along the east side of Warner Avenue will be the proposed third access point for review into the Project area forming a new ‘T’ shaped intersection. The Warner Avenue access will provide a single shared through/right turn lane for northbound vehicles and a single shared left turn/through lane for southbound vehicles turning into the Project area. Westbound vehicles exiting the Project area will utilize a single shared left turn/right turn lane and will be under STOP sign control. Traffic on Warner Avenue will remain free flow. This primary access into the Project area will also have a 24-foot gate installed to restrict unauthorized vehicles from entering the proposed Project area.

Sight distances at the future proposed access points should be verified during the Project design process.

Trip Generation

Trip generations for potential development projects are typically developed utilizing nationally agreed upon data contained in the Institute of Transportation Engineers (ITE) publication *Trip Generation, 10th Edition*. Solar farms are not included as a land use code in the ITE trip generation manual, therefore, trip generation estimates were based on conversations and information provided by AES Clean Energy (AES) and distributed on the adjacent roadway network based on current traffic trends and engineering judgement.

The proposed solar generation facility will require construction equipment, trucks and workers to travel to and from the Project area throughout construction and will also require a significantly lower total number of daily maintenance workers after construction is completed. A conservative approach was used to determine the number of daily trips by utilizing the highest expected number of heavy vehicle trips generated during construction.

Trip generation for the Project was estimated based on the following:

- During peak construction, it is estimated that a maximum number of 80 trips per day will occur, as mostly large dumps trucks, and the expected construction traffic will be divided between the seven (7) proposed access points. However, for this limited analysis a conservative approach was used by dividing the Project generated heavy truck traffic between the three typical proposed access points outlined above.
- In addition to the expected heavy vehicle truck traffic generated by the Project during construction, it is estimated that approximately 530 construction workers will be on site during the peak construction phase. The workers are expected to travel to/from the Project site in a similar distribution pattern as the heavy vehicle trips and are estimated to add an additional 350 trips as

personal vehicles, utilizing the three outlined study access points and parking in designated areas on-site.
- During normal operations and maintenance, after completion of the construction phases, five (5) trips per day, as mostly ¾-ton trucks and passenger vehicles are expected at each of the three access points.
- A limited approach was taken for the trip generation by assuming the highest number of daily truck trips expected (30 heavy vehicle trips per access) will occur during the AM and PM peak hours of the day at each of the study access points.

The cumulative result of the above outlined weekday peak trip generation for the Project is estimated to be approximately fifteen (15) average daily peak hour inbound/outbound heavy vehicle trips per access point. During the peak hours of the solar generation facility's construction and operation, it is expected that the majority of inbound truck traffic will concentrate at the three access points outlined for this limited analysis.

This limited traffic impact statement does not include further analysis of the estimated 350 personal vehicle trips to/from the Project area (approximately 117 personal vehicle trips per access point) needed to accommodate the estimated 530 construction workers during the peak construction phase.

Trip distribution for the proposed Project was based on current volumes and traffic patterns near the Project area. **Figure 4** shows the weekday trip distribution for the Project as a percentage of net new primary trips as well as the traffic assignment of the new site generated heavy vehicle trips to/from the Project intersections within the Project vicinity.

With the number of existing low volume, paved arterial and collector roadways providing multiple routes in the Project vicinity to access the Project as well as the adjacent properties surrounding the Project area having a similar type of land use with large areas of land served by larger style equipment, it is expected that this new solar energy generation facility will fit with the character of the Project vicinity.

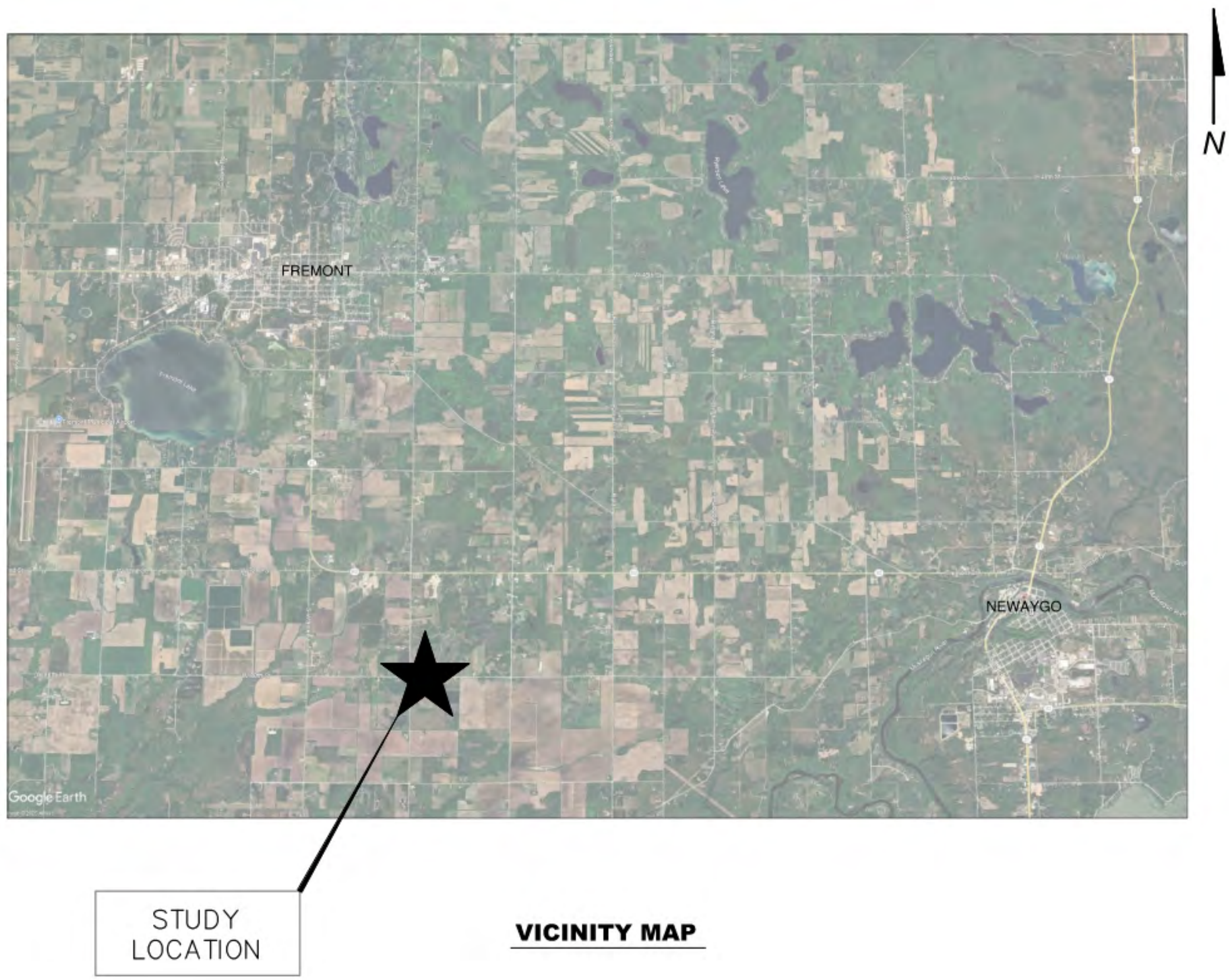
Further analysis would be required to fully understand how the total number of Project generated trips impacts the surrounding roadway network. Sight distances and proper spacing requirements for the proposed access point locations along Baldwin Avenue, Croswell Avenue, and Warner Avenue should be evaluated during the Project design process.

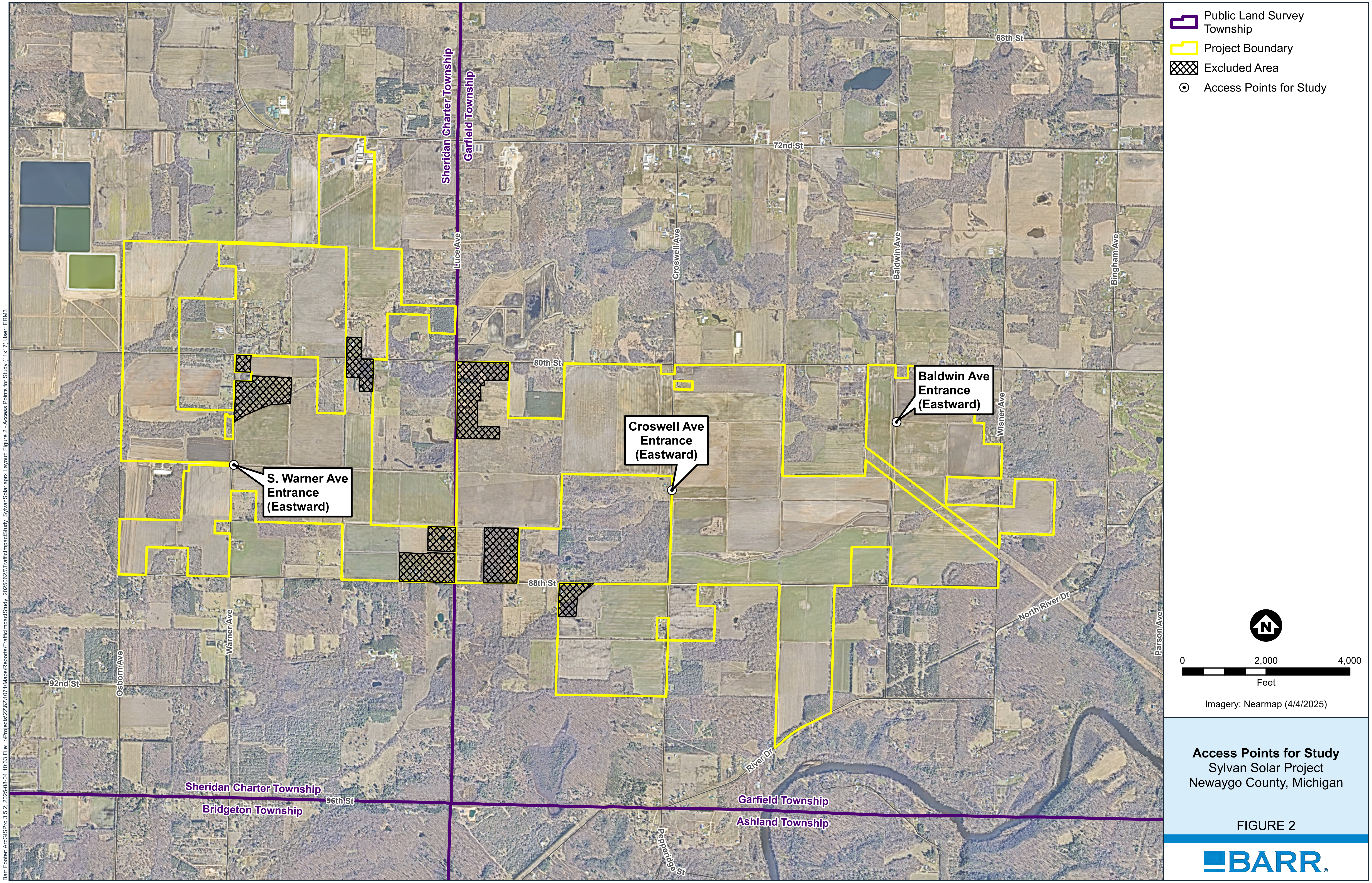
Each of the three main access points are recommended to have STOP signs installed on the outbound approaches to the adjacent roadways.

Proposed lane configurations and traffic control for each study intersection are shown in **Figure 5**.

Attachments: Figure 1: Vicinity Map
Figure 2: Project Site Plan
Figure 3: Existing Lane Configurations
Figure 4: Trip Assignment & Distribution for Heavy Vehicles
Figure 5: Proposed Lane Configurations

Figure 1: Vicinity Map





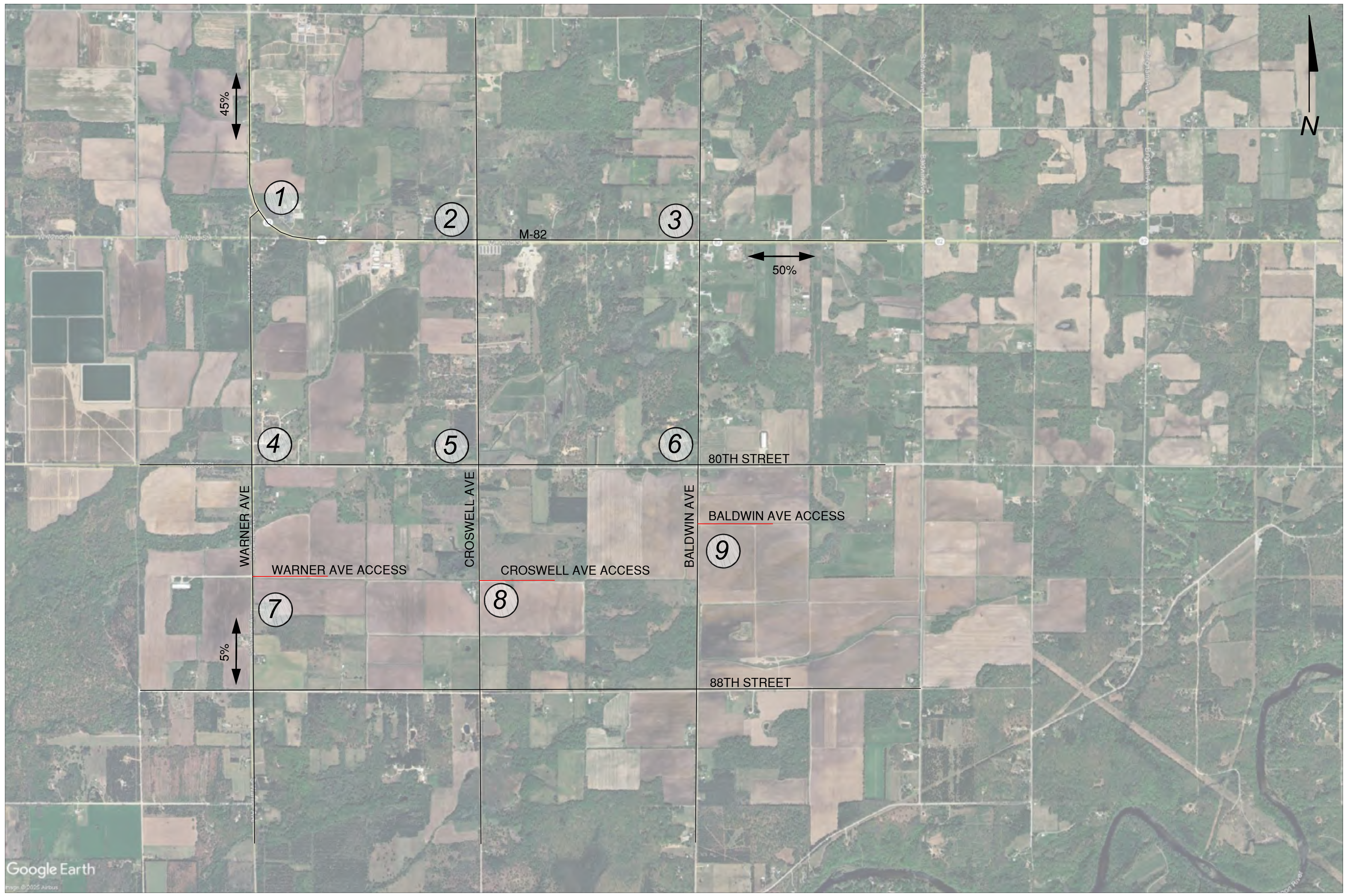
Access Points for Study
Sylvan Solar Project
Newaygo County, Michigan

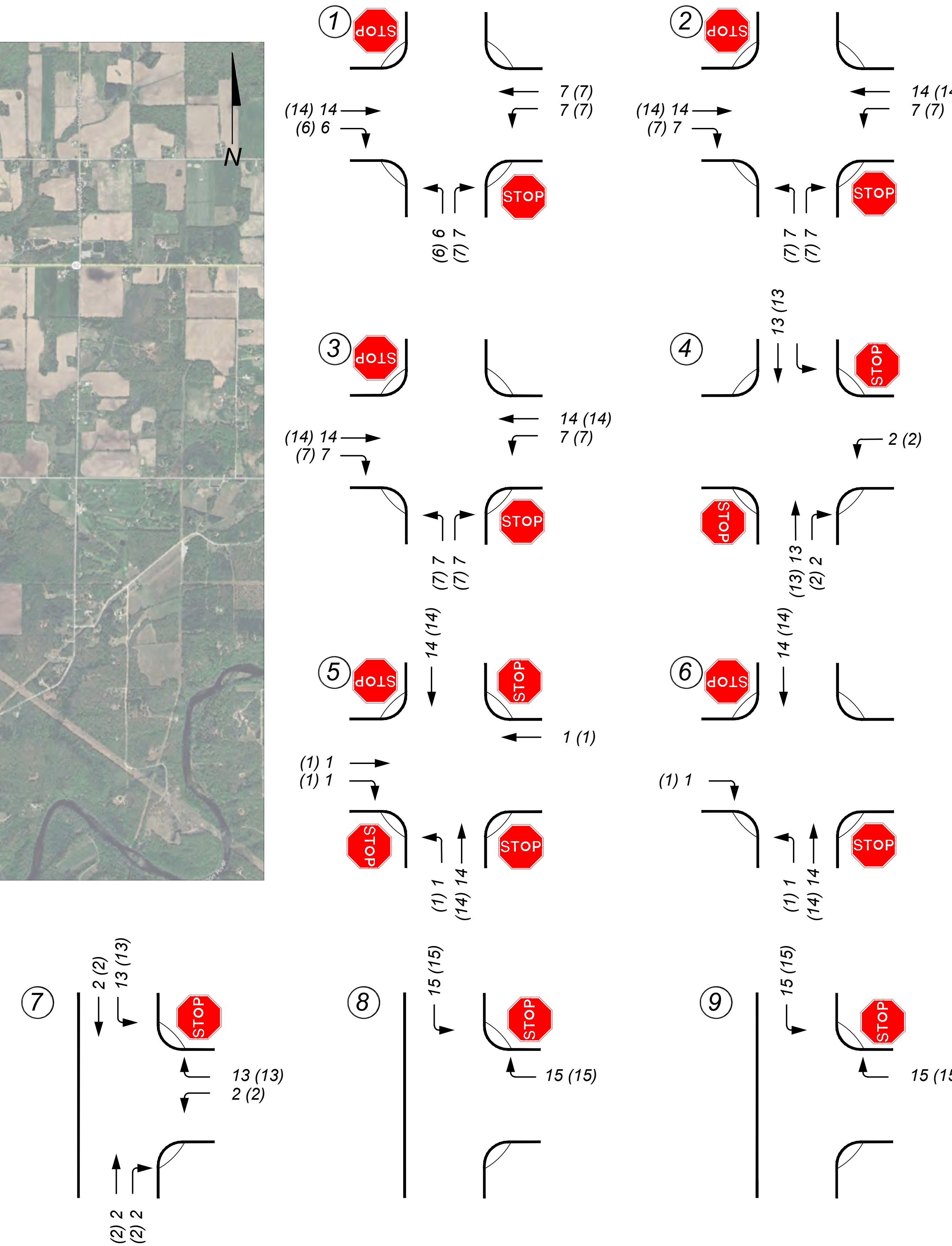
FIGURE 2

BARR

Barr Footer: ArcGISPro 3.5.2, 2025-08-04 10:33 File: I:\Projects\22\62\1071\Maps\Reports\TrafficImpactStudy_20250625\TrafficImpactStudy_SylvanSolar.aprx Layout: Figure 2 - Access Points for Study (11x17) User: ERM3

Figure 3: Existing Lane Configurations / Traffic Control





LEGEND:

XX = AM Peak Hour
(XX) = PM Peak Hour

STOP = STOP SIGN

Figure 4: Trip Assignment and Distribution for Heavy Vehicles

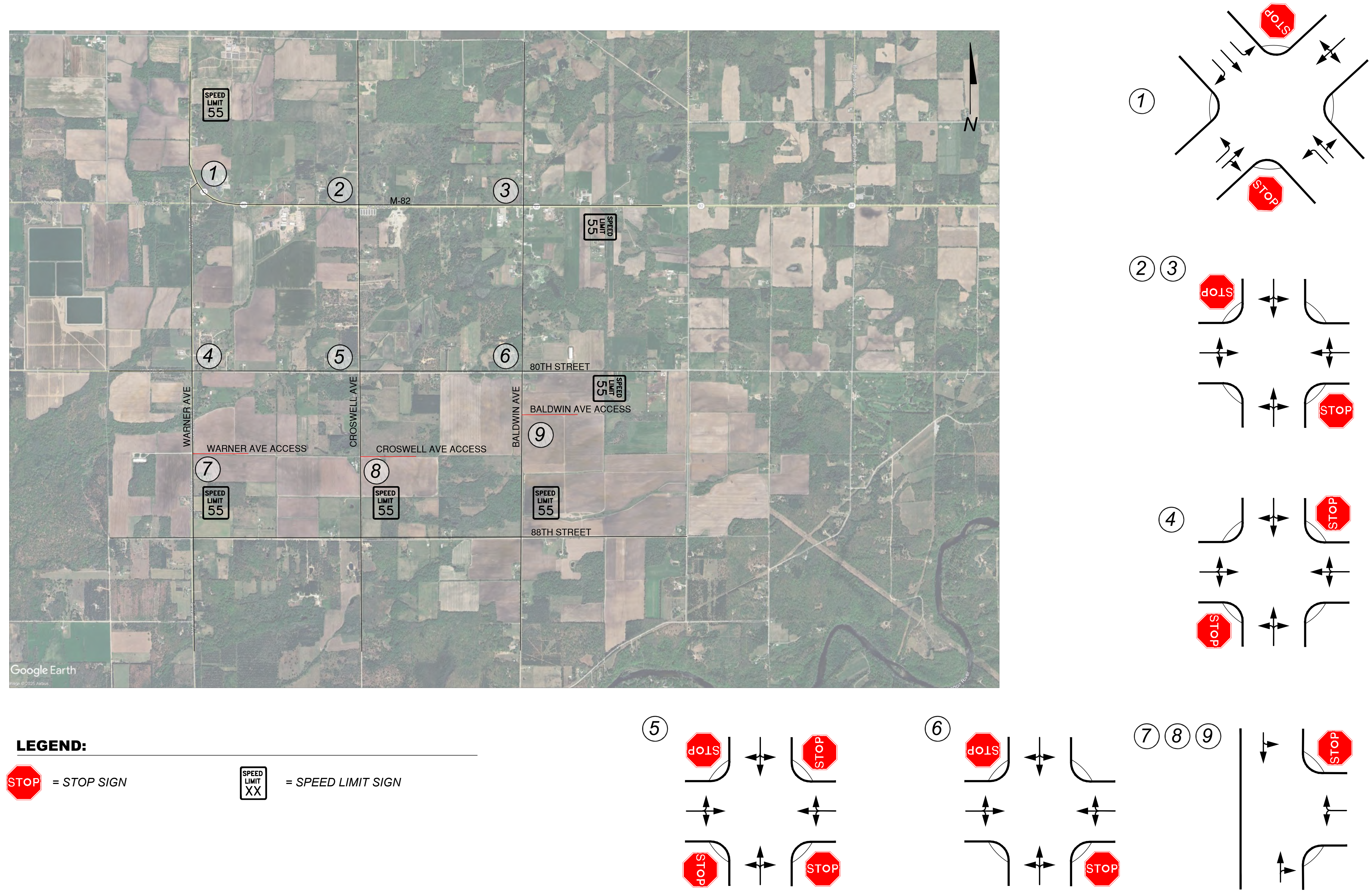


Figure 5: Proposed Lane Configurations / Traffic Control

Appendix 4 – Vegetation Management Plan

Attachment 4 - Vegetation Management Plan

Vegetation Management Plan

Sylvan Solar Project: Sheridan Charter Township

Prepared for
Sylvan Solar, LLC

Prepared by
MNL, Inc

September 2025

MNL, Inc
8740 77th Street NE
Otsego, MN 55362

Vegetation Management Plan

September 2025

Contents

Tables

Figures

Appendices

Abbreviations

AES	AES Clean Energy
BESS	Battery Energy Storage Systems
FCJPC	Fremont Community Joint Planning Commission
gen-tie	generation tie line
GWs	gigawatts
kV	kilovolt
MW	megawatt
MDARD	Michigan Department of Agriculture & Rural Development
MNFI	Michigan Natural Features Inventory
NREPA	Natural Resources and Environmental Protection Act
NRCS	Natural Resources Conservation Service
PEM	palustrine emergent wetland
PFO	palustrine forested wetland
Plan	Vegetation Management Plan
Project	Sylvan Solar Project
PSS	palustrine scrub-shrub wetland
PV	photovoltaic
ROW	Rights-of-Way
SES	Solar Energy Systems
SESC	Soil Erosion and Sedimentation Control
USDA	U.S. Department of Agriculture

1 Project Overview

MNL has prepared this Vegetation Management Plan (Plan) on behalf of Sylvan Solar, LLC (Sylvan Solar), an affiliate of AES Clean Energy Development, LLC (AES), for the Sylvan Solar Project (Project) in Newaygo County, Michigan (Figure 1). AES is a subsidiary of The AES Corporation based in the United States that owns and operates solar, wind, battery, and green hydrogen projects across the United States, grossing 9.1 gigawatts (GWs) in operation at the end of 2024. Sylvan Solar, a Delaware limited liability company, is an independent power producer that is qualified to do business in Michigan.

Sylvan Solar is proposing to construct, own, operate, and decommission the 220-megawatt (MW) Sylvan Solar Project (Project), which spans both Sheridan Charter and Garfield Townships. The Project will generate an annual average of approximately 445,000 megawatt (MW) hours of renewable energy over its anticipated 35-year life span, which is enough electricity to power the equivalent of 55,000 Michigan homes per year.

The proposed Project is an up to 220-MW photovoltaic (PV) solar generation facility within a 2,166-acre Project area on land within Sheridan Charter and Garfield Townships, Newaygo County, Michigan. The Project is approximately 4.5 miles southeast of Fremont, Michigan. The Project is generally north of North River Drive, west of Bingham Avenue, south of Michigan Highway 82, and east of South Osborn Avenue. The Project boundary and surrounding area primarily consists of agricultural fields, wooded areas, agricultural ditches, and Newaygo County designated drains. The Muskegon River is approximately 900 feet south of the Project at its closest point.

Of the total 2,166 acres leased for the Project, approximately 1,250 acres of the Project area will consist of the solar energy facility and generation tie line (gen-tie). Buried medium voltage (MV) collection lines will be installed within and outside the fenced area to connect the blocks of solar panels in the Project area.

A <500-foot overhead high voltage (HV) generation tie line (gen-tie) will be constructed in Garfield Township between the proposed Project substation and a proposed utility-owned and operated switchyard connected to the existing 345-kilovolt (kV) Ludington to Kenowa overhead transmission line (point of interconnection). The gen-tie line and point of interconnection are located near the northeast corner of the Project area in Garfield Township. The following table summarizes the estimated metrics for the Project in Sheridan Charter Township:

Table 1-1 Project Quantities

Project Details	Sheridan Charter Township
Megawatts (MW)	76 MW
Total acres (including easements)	783 acres
Fenced area	420 acres

Project Details	Sheridan Charter Township
Project Substation and Utility-owned Switchyard (Garfield Township)	N/A
HV Gen-tie Line (Garfield Township)	N/A

Construction of the Project is anticipated to commence in mid-2027, and the solar energy facility is expected to be operational in late 2028.

1.1 Purpose

The Plan has been established to comply with the ground cover and landscape screening provisions in Section D(5) of the Fremont Community Joint Planning Commission (FCJPC) Solar Energy Systems (SES) and Battery Energy Storage Systems (BESS) Ordinance. Specifically, Section D(5)(i)(j) of the FCJPC SES and BESS Ordinance requires the use of native vegetation in disturbed areas, 25 feet of non-native grasses along the SES fence line, and landscape screening outside the perimeter fence line between the Project and any residential use.

This Plan describes how Sylvan Solar will restore native plants, grasses, and prairie in consultation with the NRCS with the goal of protecting beneficial species habitat and providing ecosystem services through improved soil health. This Plan also meets the minimum score on the Michigan Pollinator Habitat Scorecard for solar sites. Finally, Sylvan Solar will maintain an option for sheep grazing (i.e., forage) as a vegetation management tool (refer to Section 4.3 of this Plan).

Further, the Plan highlights strategies for quickly establishing vegetation to stabilize soils, reduce erosion, and minimize offsite sedimentation in accordance with Part 91, Soil Erosion and Sedimentation Control (SESC) of the Natural Resources and Environmental Protection Act (NREPA).

1.1.1 Ground Cover

As described above, Section d(5)(i) states the following:

> *"Following installation, disturbed areas shall be reseeded with native wildflowers / grasses to provide for pollinators and other ecosystem elements. A narrow buffer area surround the installation along the fence line of up to 25 feet may be maintained with non-native grasses for fire and weed control."*

Sylvan Solar proposes to meet this requirement by seeding disturbed areas with the native wildflower and grass species identified in the Array, Tall Pollinator, and Stormwater Basin Seed Mixes identified in Appendix A.

1.1.2 Landscape Screening

As described above, Section d(5)(j) states the following:

"Screening of C SES installations shall be required adjacent to any residential use. Screening may consist of natural growth or planted elements such as trees and shrubs, or solid fencing not to exceed six (6) feet in height."

Sylvan Solar proposes to meet this requirement by installing visual screening where existing trees, shrubs, or tall vegetation are not present between the Project perimeter fence and adjacent occupied residential dwellings.

Sylvan Solar proposes to plant various types of trees and shrubs with heights ranging up to approximately 20 feet tall to provide a visual buffer from the perimeter fence and Project components behind the fence line. Refer to Section 3 of this Plan for a detailed description of how Sylvan Solar will meet the FCJPC screening requirements.

1.2 Current Site Conditions

1.2.1 Soils and Topography

The USDA-NRCS soil map (Figure 2) shows 12 unique soils within the Project area in Sheridan Charter Township. The mapped soils range from loamy fine sand to sand with several wet areas with muck soils. The most common soil types are shown in Table 1-2. The soil map indicates that the soils in the Project area range from very poorly drained to moderately well drained sandy soils, including several soils with mucky sand at the surface.

Topography within the Project area ranges from approximately 740 to 750 feet above mean sea level (Figure 3). The Project's sandy soil is anticipated to have low erosivity; however, in high slope areas, establishing vegetation quickly in graded areas will be critical to reduce erosion.

Table 1-2 Soil Types Mapped in the Project Area in Sheridan Charter Township

Symbol	Name	Project Area (acres)
19B	Covert sand, 0 to 4 percent slopes	2.2
21	Kingsville mucky sand	61.0
23	Lamson loamy fine sand	27.1
28B	Watseka loamy sand, 0 to 4 percent slopes	27.7
3	Adrian muck, 0 to 1 percent slopes	26.8
32	Carlisle muck, 0 to 2 percent slopes	8.8
4A	Cosad loamy sand, 0 to 3 percent slopes	1.9
51B	Thetford loamy fine sand, 0 to 4 percent slopes	89.2
5B	Pipestone sand, 0 to 4 percent slopes	419.3
72	Udipsamments, nearly level and gently sloping	22.2
82	Algansee loamy fine sand	35.0
94B	Brems sand, 0 to 4 percent slopes	126.6
W	Water	1.0

1.2.2 Wetlands and Site Hydrology

Within the entire Project area encompassing both townships, field surveys identified 47 wetlands (Figure 4) totaling approximately 50.97 acres based on data collected during field surveys (Tetra Tech, Inc. 2024). Of the 47 wetland features, 27 features are classified as emergent wetland (PEM); two features are classified as palustrine forested wetland (PFO); six features are classified as palustrine scrub-shrub/emergent wetland (PSS/PEM); five features are classified as palustrine forested/emergent wetland (PFO/PEM); one feature is classified as palustrine forested/scrub-shrub wetland (PFO/PSS); and six features are classified as palustrine forested/scrub-shrub/emergent wetland (PFO/PSS/PEM). Many of the palustrine emergent wetlands are within cultivated fields and have row crops (often stunted) growing within the wetlands. Many of the wetland areas are dominated by reed canary grass (*Phalaris arundinacea*) in the herbaceous layer. Common shrubs include willows (*Salix* spp.) and common trees include green ash (*Fraxinus pennsylvanica*) and silver maple (*Acer saccharinum*).

In addition, 28 stream features were identified within the entire Project area encompassing both townships. Of the 28 stream features, 26 are classified as perennial and two are classified as intermittent. These streams primarily flow south and west to the Muskegon River, which is south of the Project area and flows west into Lake Michigan. In Sheridan Charter Township, these waterbodies primarily include designated county drains.

1.2.3 Historic Vegetation

The Michigan Natural Features Inventory (MNFI) indicates that the historic vegetation community in the Project vicinity as of 1800 was primarily mixed conifer swamp (Cohen et al. 2020). This area has likely been drained for use in agriculture, whereas other surrounding drier areas are still in forested cover. Common trees in this community in the 1800's included red maple (*Acer rubrum*), black ash (*Fraxinus nigra*), white pine (*Pinus strobus*), and hemlock (*Tsuga canadensis*). Common small trees and shrubs included mountain maple (*Acer spicatum*), tag alder (*Alnus incana*), and paper birch (*Betula papyrifera*). Common herbaceous layer species included wild sarsaparilla (*Aralia nudicaulis*), Jack-in-the-pulpit (*Arisaema triphyllum*), beggar-ticks (*Bidens* spp.), and many species of sedge (including *Carex intumescens*, *C. crinita*, and others).

According to the MNFI, western portions of the Project area were historically in a beech-sugar maple-hemlock forest, whereas the eastern portions were in a white pine-mixed hardwood forest. These forested communities were in drier soil than the mixed conifer swamp, primarily in well-drained sandy soils. Much of these areas and the surrounding landscape are still forested.

1.2.4 Existing Vegetation

Existing vegetation within the Project area consists predominantly of agricultural crops including corn (*Zea mays*) and soybeans (*Glycine max*). Common species in field perimeters and wetlands include common milkweed (*Asclepias syriaca*), smooth brome (*Bromus inermis*), sedges (*Carex* spp.), Canada thistle (*Cirsium arvense*), green ash (*Fraxinus pennsylvanica*), jewelweed (*Impatiens capensis*), perennial rye grass (*Lolium perenne*), reed canary grass (*Phalaris arundinacea*), Kentucky bluegrass (*Poa pratensis*), and common buckthorn (*Rhamnus cathartica*).

2 Vegetation Establishment

This vegetation establishment plan is for the areas where Sylvan Solar intends to plant and maintain native vegetation from seed mixes installed within the Project area. Other areas will be maintained according to the adaptive vegetation management plan described in Section 3.0 including management of prohibited, restricted, and noxious weed species in accordance with Michigan Act 359 (Noxious Weeds) and Michigan Seed Law Act 329.

2.1 Vegetation Establishment Sequence

The majority of the existing vegetation within the Project area is currently in row crops, which is generally already being managed to provide for a well-prepared seed bed. Existing vegetation (other than row crops) will need to be managed before seeding by mowing and/or herbicide treatments. Table 2-1 summarizes the planned activities for vegetation establishment.

Table 2-1 Vegetation Establishment Sequence

Vegetation Establishment Activities	Timing of Activities
Existing vegetation that may interfere with new vegetation establishment may be treated with mowing and/or herbicide treatments. (This step may not be necessary in actively farmed crops.)	Beginning up to 1 year prior to seeding
Prepare seedbed via topsoil decompaction, vegetation removal, and disking where necessary.	<1 month prior to seeding
Install seed mixes throughout the Project area.[1]	Prior to construction
Construction activities, including temporary seeding, where necessary.	During construction
Re-seed permanent seed mixes in disturbed soils following completion of activities in each area.	Primarily during construction as work in each area is completed; may continue to post-construction, if needed.

[1] Cover crops may be installed in areas that will be disturbed by construction.

2.2 Contractor Qualifications

Sylvan Solar will select seeding and management contractor(s) prior to Project construction. Contractors will provide references demonstrating their ability to successfully perform similar work on utility scale solar projects or expect to work with a contractor to direct their work.

2.3 Site Preparation

Before and during grading activities, the contractor will install SESC controls in accordance with the Project's Soil Erosion Plan and SESC Permit. Sylvan Solar will limit grading work to the degree feasible to minimize areas of disturbance and to reduce impacts to the existing topsoil. The proposed Project layout is shown in Figure 5.

2.3.1 Topsoil Management

Generally, seed installation will occur before construction, grading, and earthwork activities that disturb the soil. During construction, it is expected that some of the recently seeded areas will be disturbed. These areas will require re-seeding. Soil in the disturbed areas will be managed to preserve the topsoil and ensure a suitable seedbed for post-construction seeding. The contractor may segregate topsoil during grading and redistribute it across graded areas. Where necessary, the contractor may decompact topsoil impacted by construction activities with chisel plows, rippers, or tillers depending on the depth and severity of the compaction. Any disturbed topsoil will be disked to prepare a smooth, evenly textured soil surface for seeding.

2.3.2 Existing Vegetation Management

Before construction, weed management will consist of a combination of herbicide applications and mowing to control prohibited, restricted, and noxious weeds and prevent the production of undesirable seeds according to Michigan Act 359. If possible, Sylvan Solar will work with landowners to pre-treat areas with prohibited, restricted, or noxious weeds and invasive species in the prior growing season in preparation for seed installation. These areas will primarily include field edges, but treatment may also be required in larger field areas that will be seeded within the Project area as needed. Tree clearing, grubbing, and stump removal will occur only where necessary.

Preparatory treatments may occur on existing undesirable vegetation within the Project area as necessary to prepare areas for seeding and/or to reduce seed production into the Project area. Mowing may occur to reduce the height of the vegetation or to prepare it for more effective herbicide applications. Herbicide application may occur before scheduled seeding, with an application of a non-specific herbicide to live vegetation and may include additional herbicides for species that may be present. Herbicide selection and application will be completed under the guidance and oversight of a commercial applicator certified by the Michigan Department of Agriculture & Rural Development (MDARD). Herbicide will not be applied within 50 feet of any wetlands or streams depicted on Figure 4 or onto surface water. Herbicide use will be discontinued at least one year prior to decommissioning to ensure breakdown of residual herbicides prior to restoration activities. Before seeding, dead plant material may require removal to open the soil for future seeding.

2.3.3 Seedbed Preparation

Prior to application of the seed mixes, the contractor will prepare the seed bed to promote successful propagation and survival of the desired plants. Where necessary, decompaction or vegetation removal areas will be followed by disking to prepare a smooth and evenly textured soil surface. Sylvan Solar may seed some areas with previously existing vegetation directly into the killed vegetation or stubble. As much as possible, areas that are not compacted will remain intact, without decompaction or tilling, to preserve soil structure.

2.4 Seed Installation

Seed will be installed prior to construction to establish vegetation that will provide soil stability during construction activities, prevent erosion, and maintain a cleaner working area for the equipment. Construction will inevitably result in some disturbance to these seeded areas, which may require re-seeding after completion of the work in that area.

All seed will be installed using a Truax no-till drill or Trillion type seeder (or similar) specific to native seed mixes. Where drill-seeding is not practical due to site conditions, including the presence of solar panels and posts, seed will be broadcast onto the soil surface using a Vicon seeder (or similar) and raked to ensure good seed-to-soil contact.

The seeding contractor will calibrate and adjust seeding equipment beforehand to ensure the proper seeding rate and depth. Operators will ensure complete coverage during operation. Equipment will be thoroughly washed before seeding work begins to prevent contamination from outside seed sources.

2.4.1 Seed Mixes

Three conservation cover seed mixes (Appendix A) were developed for the Project to be tolerant of disturbance during construction, grow to an appropriate height, and adapted to sandy soils. As much as possible, the seed mixes will be purchased from a local vendor and from locally sourced seed. These three unique native-dominated seed mixes will be planted within different areas of the Project area (Table 2-2; Figure 6)

Table 2-2 Seed Mixes

Seed Mixes	Location
1. Array Seed Mix	Solar array areas Within 15 feet inside and outside of the perimeter fence line Perimeter areas (between the fence line and Project boundary) that will not be used for pollinator buffers or will not continue to be farmed
2. Tall Pollinator Seed Mix	Perimeter areas (between the fence line and the Project boundary) that will not be used for the short-statured solar array seed mix or will not continue to be farmed
3. Stormwater Basin Seed Mix	Stormwater basins in Project area

Each of these seed mixes are composed of plant species native to open grassland habitats in the region and will have the following characteristics:

1. **Array Seed Mix** will be seeded within the solar array footprint including underneath panels, in array rows, surrounding equipment and roads within the arrays, within a minimum of 15 feet inside and outside of fence lines, and in perimeter areas (between the fence lines and Project boundary) that are not farmed or used for pollinator buffers.

    a. Composed of short-statured native species that will remain mostly shorter than 24 inches tall (lowest panel height) and will include mostly grasses and sedges. Several species of native forbs will be included all of which are generally tolerant of clopyralid herbicide (brand name: Transline®, Sonora™). This will allow for management of many noxious weed species with minimal impact on the seed mix.

    o Provide conservation cover benefits for species habitat and improved soil health. The area will be regularly maintained to prevent interference with operations, reduce thatch, and control undesirable plant species.

- **Tall Pollinator Seed Mix** will be seeded in perimeter areas that will not be used for the short-statured array mix or will not continue to be farmed.
    - o Seeded with diverse native species that are expected to reach 4 feet tall on average and up to 6 feet tall and will include grasses, sedges, and forbs.
    - a. Provide high-quality native habitat and be maintained for control of undesirable species, to prevent interference with operations, and to reduce thatch.
- **Stormwater Basin Seed Mix** will be seeded in Project stormwater basins within the Project area.
    - a. Seeded with diverse native species with emergent wetland and sedge meadow species, and will include a high diversity of grasses, sedges, and forbs.
    - b. Provide wetland habitat along with infiltration and stormwater retention functions and be maintained to prevent noxious and undesirable species.

The native-dominated seed mixes will have the following characteristics:

- Seed mixes will be composed of primarily native species, which are hardy and tolerate a wide variety of environmental conditions (drought, periods of excessive moisture, etc.)
- Seed mixes will contain a blend of grasses, sedges, and forbs to maximize adaptability to potential growing conditions, including shade-tolerant species for under panel areas and bunch-forming grasses for habitat structure.
- Seed mixes will be dominated by perennial species that greatly reduce the likelihood of re-seeding during the lifespan of the solar site.
- Seed mixes will be adaptable to soil conditions present within the Project area including species that can tolerate dry, mesic, and wet-mesic conditions. The Stormwater Basin Mix is adapted to wet soils.
- Seed mixes will include temporary cover crops to stabilize soils quickly.

2.4.1.1 Timing of Seed Installation

The majority of pre-construction seeding will occur during spring, summer, and dormant season timeframes. These are the preferred seed timing windows: spring (April 1 to May 20), late summer (August 10 to October 1), or dormant season (after hard frost until spring). After construction, seed installation may occur at any time of the year, after the soil disturbance is complete and a proper seedbed is restored and prepared for seed.

2.4.1.2 Cover crops

During site construction, temporary cover crop seed will be applied to disturbed soils within five calendar days of achieving final grade or the final earth change to reduce the risk of erosion in accordance with Part 91 of NREPA. Permanent seed mixes will include cover crops, at a reduced rate, during vegetation establishment. Cover crops are annual grass species that germinate and establish quickly, such as oats (for spring or summer seeding), annual rye (for spring or summer seeding), or wheat (for fall seeding).

2.4.2 Seed Substitutions

Availability of species in planned seed mixes is subject to change based on Project approval and construction timelines, and variability in supply. Sylvan Solar must approve any substitutions, and they must remain consistent with the stated goals and objectives in this Plan. Suitability for substitutions should consider bloom season, phenology, sun exposure and soil preferences, height, cost, and native status.

3 Landscape Screening Areas

Section D(5)(j) of the FCJPC SES Ordinance requires tree and shrub plantings between adjacent occupied residential structures on non-participating parcels (Table 3-1).

Table 3-1 Proposed Landscape Screening

Seed Mixes	Location
Tree and Shrub Plantings	Between the Project perimeter fence line and adjacent non-participating residential structures

The tree and shrub plantings will include installation of trees and shrubs within the designated areas shown in Figure 6. Trees and shrubs will be installed at spacing to appropriately screen the Project area once the trees and shrubs have reached their full expected height. Tree and shrub species may include those listed in Table 3-2; however, other species may be used if the selected species are appropriate for the conditions and non-invasive.

Table 3-2 Potential Trees and Shrubs for Landscape Screening

Scientific Name	Common Name	Approximate Height at Maturity (feet)	Approximate Age to Maturity (years)
Amorpha fruticosa	False Indigo	10 to 15	3 to 6
Aronia melanocarpa	Chokeberry	8 to 10	3 to 5
Cephalanthus occidentalis	Buttonbush	6 to 12	3 to 5
Cornus sericea	Red osier dogwood	6 to 10	3 to 5
Juniperus scopulorum 'Moonglow'	Juniper moonglow	15 to 20	10 to 15
Lindera benzoin	Spicebush	8 to 12	5 to 7
Physocarpus opulifolius	Common ninebark	6 to 9	3 to 5
Picea glauca 'Conica'	Dwarf Alberta spruce	10 to 13	25 to 30
Sambucus canadensis	Black elderberry	5 to 12	3 to 5
Thuja occidentalis 'Smaragd'	Emerald green arborvitae	10 to 15	12 to 18
Viburnum trilobum	Highbush Cranberry	6 to 15	5 to 7

4 Adaptive Vegetation Management

To establish vegetation that meets Project requirements, ongoing maintenance will be necessary. During the first growing season, mowing is anticipated to be the predominant measure used to manage, reduce, and eliminate invasive species and prohibited, restricted, and noxious weeds. In cases where woody species or perennial invasive or noxious weed species are present, herbicide may be used as an alternative. Table 4-1 provides typical vegetation management services following an adaptive management approach.

Table 4-1 Typical Adaptive Management Approach

Adaptive Management Technique	Timeframe	Notes
Early season site assessment, planning, and reporting	Spring	Incorporate recommendations from the previous year, as needed
First round of maintenance: mowing or sheep grazing is typical	Early Summer	Spot-cutting preferred if possible
Second round of maintenance: spot herbicide treatment is typical	Mid-Summer	Targeted applications
Third round of maintenance: mowing, spot cutting, spot herbicide treatment as needed	Late Summer to Fall	Mowing or spot cutting employed to remove shading/interference
End of season site assessment and reporting	Fall	Assess the impact of techniques performed during the year; suggest adjustments if needed

4.1 Mowing

Mowing reduces vegetation height, prevents or removes shading from solar modules, controls weeds and woody species, clears away dormant vegetation, and improves the aesthetics of a site. After vegetation establishment, mowing may occur in the following areas: solar array area, open area(s) within the fence, entrances around gates, and area(s) outside the fence. Mowing implements include agricultural tractors with flail or rotary mower attachments, zero-turn mowers, robotic mowers, and/or other mechanical options (with Sylvan Solar's approval). Flail mower implements mulch the cut material and avoid forming a mat of cut vegetation which could smother desirable plant growth. Where appropriate, mower height should be at least 6" from the ground to minimize damage to native plants.

Wet areas pose challenges for mowers because water restricts access and increases the risk of equipment damaging the soil and/or seeded plants through rutting. Therefore, mowing in wet areas should occur only when conditions are dry, or avoided altogether and replaced with hand cutting/weed whipping if necessary.

Mowing native pollinator species more than once per month after establishment and/or too low (repeatedly less than 6") will damage or kill these species and reduce overall habitat quality.

4.2 Herbicide

Herbicide treatments may include selective or non-selective herbicides, spot or broadcast applications, and pre-emergent applications. Treatments will be used to control prohibited, restricted, and noxious weeds and woody species which mowing does not effectively control alone. Herbicide treatment will reduce the populations of undesirable species, prevent the spread of noxious weed seeds, and kill vegetation that may be encroaching on or shading solar modules and equipment. Herbicide selection and application will be completed under the guidance and oversight of a commercial applicator certified by the MDARD. Herbicide will not be applied within 50 feet of any wetlands or streams depicted on Figure 4 or onto surface water.

For general noxious weed and tree control in pollinator habitat, selective herbicides (formulated for specific plant groups) and spot application (applying directly to the foliage of target plants) are preferential over broadcast and non-selective applications. This will promote good control of undesirable species while minimizing off-target damage to desirable species. Broadcast applications may occur if there are large areas dominated by a single noxious weed species or type, such as Canada thistle (*Cirsium arvense*). In that scenario, Sylvan Solar will use the most selective herbicide and limit the application to the minimum effective area or use proper timing to minimize non-target damage. If non-selective herbicides are necessary for certain weed species, Sylvan Solar will limit their use to the minimum effective area and method of application.

In addition to herbicide treatment for weeds, pre-emergent and non-selective herbicides application may occur in specific areas of the Project area (around electrical equipment and along roads/gravel) to maintain bare ground. Herbicide treatments for bare ground include a chemical adjuvant to increase soil deposition/adsorption and prevent runoff.

4.3 Sheep Grazing

Sheep grazing is an option to manage plant height and shading, reduce thatch, and provide weed control, while also maintaining pollinator habitat value. Grazing has the potential to reduce or eliminate the necessity for other vegetation management services such as mowing, haying, weed whipping, noxious weed herbicide treatments, and/or bare ground herbicide treatments. This is because sheep can easily access areas of solar sites where equipment cannot, removing vegetation around equipment, underneath panels, and along interior fence lines. Grazing is also the most effective method of reducing vegetative thatch buildup which reduces the risk and intensity of wildfires. Grazing animals are more ecologically-appropriate and sustainable than mechanical cutting, enhancing the benefits of pollinator habitats by enhancing soil carbon and nutrients.

To provide uniform height and vegetation reduction across the site, grazing should occur at high animal stocking density (greater than 20 animal units per acre) for a short duration (1-2 weeks per deployment, no more than 4 weeks on a particular area). This method achieves a high-intensity grazing event that clears or defoliates 70-90 percent of vegetation, mimicking the effect of fire. To maintain the diversity and health of native plant communities, grazing should not occur more than once during each growing season. Low-intensity grazing may occur in certain situations, particularly for dormant season thatch reduction or on sites with non-native vegetation.

4.4 Invasive Species and Weed Species Management

Sylvan Solar will manage prohibited, restricted, and noxious weeds for the life of the Project as required for safe operation of the solar equipment and in accordance with Michigan laws. NREPA Act 359 Part 413 should be referenced for a list of prohibited and restricted weeds in the state of Michigan. This list includes species that may occur within the Project area (among others):

- European Frog-bit (*Hydrocharis morsus-ranae*)
- Flowering Rush (*Butomus umbellatus*)
- Giant Hogweed (*Heracleum mantegazzianum*)
- Japanese Knotweed (*Fallopia japonica*)
- Phragmites (*Phragmites australis*)
- Purple Loosestrife (*Lythrum salicaria*)

Michigan Seed Law Act 329 of 1965 should be referenced for a list of noxious weed species. This list includes species that may occur within the Project area (among others):

- Canada thistle (*Cirsium arvense*)
- Giant ragweed (*Ambrosia trifida*)
- Wild parsnip (*Pastinaca sativa*)
- Poison hemlock (*Conium maculatum*)
- Yellow nutsedge (*Cyperus esculentus*)
- Leafy spurge (*Euphorbia esula*)

Sylvan Solar will manage invasive plant species to prevent or remove interference with solar equipment and maintain the health and quality of pollinator habitat. Sylvan Solar may not control certain invasive species such as reed canary grass and smooth brome unless they are expected to interfere with operations or solar panels. These species are often extremely difficult to eradicate without extensive effort and collateral damage to desirable species. In addition, they are already abundant in the area, are not considered prohibited, restricted, and noxious weeds, and are not expected to negatively impact neighboring properties.

Other undesirable species on solar projects are those which interfere with electrical equipment, shade panels, or damage fences or other infrastructure, particularly trees, shrubs, vines, and tall and aggressive herbaceous species.

Sylvan Solar will require inspection and cleaning of vegetation management equipment prior to arrival at the Project to minimize the importation of invasive species. This consists of removing plants, seeds, mud, and dirt clods by washing or blowing with compressed air as applicable. Sylvan Solar will require the cleaning and inspection of any unclean equipment arriving at the Project site.

5 References

Cohen, J.G., M.A. Kost, B.S. Slaughter, D.A. Albert, J.M. Lincoln, A.P. Kortenhoven, C.M. Wilton, H.D. Enander, and K.M. Korroch. 2020. Michigan Natural Community Classification [web application]. Michigan Natural Features Inventory, Michigan State University Extension, Lansing, Michigan. Available https://mnfi.anr.msu.edu/communities/classification. (Accessed: May 21, 2025).

Tetra Tech, Inc. 2024. *Wetland Delineation Report*. Presented to AES Clean Energy Development, LLC. July 2024.

Appendix A

Appendix A – Sylvan Solar Seed Mixes

Grass PLS lbs/ac:	7.78
Sedge PLS lbs/ac:	0.72
Forb PLS lbs/ac:	0.50
Species Count:	19
Grass/Sedge Seeds/SF:	58
Forb Seeds/SF:	18
Avg Height Range:	12-30"

Sylvan Solar
Array Mix - Dry Soil
Newaygo County, Michigan

	Scientific Name	Common Name	% of Mix	PLS lbs/ac	Bloom Season	Seeds/SF
Grasses:	Bouteloua curtipendula	Side-oats Grama	26.00	2.34		8.55
	Bromus kalmii	Prairie Brome	8.00	0.72		2.12
	Elymus hystrix	Bottlebrush Grass	6.00	0.54		1.51
	Elymus trachycaulus	Slender Wheat Grass	11.00	0.99		2.51
	Elymus villosus	Silky Wild Rye	11.00	0.99		2.00
	Koeleria macrantha	Junegrass	1.00	0.09		5.79
	Schizachyrium scoparium	Little Bluestem	20.45	1.84		10.14
	Sporobolus cryptandrus	Sand Dropseed	3.00	0.27		19.83
Sedges:	Carex brevior	Plains Oval Sedge	5.00	0.45		4.79
	Carex houghtoniana	Houghtons Sedge	1.00	0.09		0.16
	Carex sprengelii	Long-beaked Sedge	2.00	0.18		0.66
Forbs:	Achillea millefolium	Yarrow	0.75	0.07	Summer	4.34
	Allium cernuum	Nodding Onion	0.75	0.07	Summer	0.19
	Aquilegia canadensis	Columbine	0.75	0.07	Spring	0.94
	Drymocallis arguta	Prairie Cinquefoil	0.50	0.05	Summer	3.80
	Monarda punctata	Spotted Bee Balm	0.30	0.03	Summer	0.89
	Symphyotrichum lateriflorum	Calico Aster	0.75	0.07	Fall	6.20
	Verbena stricta	Hoary Vervain	1.00	0.09	Summer	0.93
	Zizia aurea	Golden Alexanders	0.75	0.07	Spring	0.27
Cover Crop:	Determined at the time of seeding	Oats/Winter Wheat		25.00		
						75.61

Terms:

Down Payment: 25% down payment required to secure order.

Pricing: Prices and availability subject to change at any time without notice.

Terms: Payment due upon receipt for all customers. Approved credit customers Net 30 days.

Freight: All prices are FOB Foley MN. Shipping and/or delivery available.

Warranty: MNL strives to produce the highest quality native seed and plants, but we do not warranty/guarantee our products due to factors outside our control. If an item was damaged in shipping or you have other concerns about quality, please contact MNL Customer Service at info@mnlcorp.com

8740 77th St NE Otsego, MN 55362 Office: (763) 271-1074

Grass PLS lbs/ac:	6.48
Sedge PLS lbs/ac:	0.34
Forb PLS lbs/ac:	2.18
Species Count:	36
Grass/Sedge Seeds/SF:	33
Forb Seeds/SF:	37
Avg Height Range:	24-72"

Sylvan Solar
Tall Grass Pollinator Mix - Dry Soil
Newaygo County, Michigan

	Scientific Name	Common Name	% of Mix	PLS lbs/ac	Bloom Season	Seeds/SF
Grasses:	Andropogon gerardii	Big Bluestem	8.00	0.72		2.64
	Bouteloua curtipendula	Side-oats Grama	16.00	1.44		5.26
	Bromus kalmii	Prairie Brome	6.00	0.54		1.59
	Elymus canadensis	Canada Wild Rye	10.00	0.90		1.72
	Elymus trachycaulus	Slender Wheat Grass	5.00	0.45		1.14
	Koeleria macrantha	Junegrass	1.00	0.09		5.79
	Schizachyrium scoparium	Little Bluestem	13.00	1.17		6.45
	Sorghastrum nutans	Indian Grass	10.00	0.90		3.97
	Sporobolus heterolepis	Prairie Dropseed	3.00	0.27		1.59
Sedges:	Carex bicknellii	Bicknell's Sedge	1.00	0.09		0.56
	Carex brevior	Plains Oval Sedge	1.75	0.16		1.68
	Carex houghtoniana	Houghtons Sedge	1.00	0.09		0.16
Forbs:	Achillea millefolium	Yarrow	0.50	0.05	Summer	2.89
	Aquilegia canadensis	Columbine	0.50	0.05	Spring	0.63
	Asclepias syriaca	Common Milkweed	0.50	0.05	Summer	0.07
	Asclepias tuberosa	Butterfly Milkweed	0.75	0.07	Summer	0.11
	Baptisia alba	White Wild Indigo	0.75	0.07	Spring	0.04
	Chamaecrista fasciculata	Partridge Pea	4.50	0.41	Fall	0.40
	Dalea purpurea	Purple Prairie Clover	6.00	0.54	Summer	2.98
	Drymocallis arguta	Prairie Cinquefoil	0.10	0.01	Summer	0.76
	Heliopsis helianthoides	Common Ox-eye	1.00	0.09	Summer	0.21
	Lespedeza capitata	Round-headed Bushclover	0.25	0.02	Summer	0.07
	Liatris aspera	Rough Blazing Star	1.00	0.09	Summer	0.53
	Lupinus perennis	Wild Lupine	1.00	0.09	Spring	0.04
	Monarda fistulosa	Wild Bergamot	0.25	0.02	Summer	0.58
	Monarda punctata	Spotted Bee Balm	0.50	0.05	Summer	1.49
	Penstemon gracilis	Slender Penstemon	0.15	0.01	Spring	2.98
	Pseudognaphalium obtusifolium	Sweet Everlasting	0.25	0.02	Fall	7.81
	Rudbeckia hirta	Black-eyed Susan	2.25	0.20	Summer	6.84
	Solidago nemoralis	Gray Goldenrod	0.25	0.02	Fall	2.48
	Solidago rigida	Stiff Goldenrod	0.25	0.02	Fall	0.34
	Symphyotrichum laeve	Smooth Blue Aster	0.75	0.07	Fall	1.36
	Symphyotrichum oolentangiense	Sky-blue Aster	1.25	0.11	Fall	3.31
	Tradescantia ohiensis	Ohio Spiderwort	0.50	0.05	Spring	0.13
	Verbena stricta	Hoary Vervain	0.50	0.05	Summer	0.46
	Zizia aurea	Golden Alexanders	0.50	0.05	Spring	0.18
Cover Crop:	Determined at the time of seeding	Oats/Winter Wheat		25.00		
						69.20

Terms:

Down Payment: 25% down payment required to secure order.

Pricing: Prices and availability subject to change at any time without notice.

Terms: Payment due upon receipt for all customers. Approved credit customers Net 30 days.

Freight: All prices are FOB Foley MN. Shipping and/or delivery available.

Warranty: MNL strives to produce the highest quality native seed and plants, but we do not warranty/guarantee our products due to factors outside our control. If an item was damaged in shipping or you have other concerns about quality, please contact MNL Customer Service at info@mnlcorp.com

MNL

Sylvan Solar
Stormwater Basin Mix
Newaygo County, Michigan

Grass PLS lbs/ac:	5.16
Sedge PLS lbs/ac:	0.82
Forb PLS lbs/ac:	2.02
Species Count:	30
Grass/Sedge Seeds/SF:	126
Forb Seeds/SF:	127
Avg Height Range:	30-48"

	Scientific Name	Common Name	% of Mix	PLS lbs/ac	Bloom Season	Seeds/SF
Grasses:	Beckmannia syzigachne	American Slough Grass	20.00	1.60		29.38
	Calamagrostis canadensis	Blue-joint Grass	0.50	0.04		4.11
	Elymus virginicus	Virginia Wild Rye	21.00	1.68		2.59
	Glyceria striata	Fowl Manna Grass	6.00	0.48		15.87
	Leersia oryzoides	Rice Cutgrass	10.00	0.80		9.99
	Spartina pectinata	Prairie Cordgrass	7.00	0.56		1.36
Sedges:	Carex hystericina	Porcupine Sedge	1.75	0.14		1.54
	Carex stipata	Awl-fruited Sedge	2.00	0.16		2.00
	Carex vulpinoidea	Fox Sedge	5.00	0.40		11.90
	Scirpus atrovirens	Green Bulrush	0.75	0.06		10.14
	Scirpus cyperinus	Woolgrass	0.75	0.06		37.47
Forbs:	Acorus americanus	Sweet Flag	1.00	0.08	Summer	0.19
	Asclepias incarnata	Rose Milkweed	5.00	0.40	Summer	0.71
	Bidens cernua	Nodding Beggarstick	2.00	0.16	Summer	2.06
	Boltonia asteroides	False Aster	1.50	0.12	Fall	7.05
	Eryngium yuccifolium	Rattlesnake Master	1.50	0.12	Summer	0.33
	Eutrochium maculatum	Joe-pye Weed	0.50	0.04	Summer	1.77
	Eupatorium perfoliatum	Boneset	0.75	0.06	Fall	5.51
	Helenium autumnale	Sneezeweed	1.50	0.12	Fall	5.73
	Liatris pycnostachya	Prairie Blazing Star	2.00	0.16	Summer	0.65
	Lythrum alatum	Winged Loosestrife	0.50	0.04	Summer	13.88
	Mimulus ringens	Monkey Flower	1.00	0.08	Summer	67.58
	Monarda fistulosa	Wild Bergamot	0.50	0.04	Summer	1.03
	Solidago rigida	Stiff Goldenrod	1.00	0.08	Fall	1.20
	Sparganium eurycarpum	Giant Burreed	2.00	0.16	Summer	0.03
	Symphyotrichum novae-angliae	New England Aster	0.75	0.06	Fall	1.45
	Thalictrum dasycarpum	Purple Meadow Rue	0.75	0.06	Summer	0.44
	Verbena hastata	Blue Vervain	2.00	0.16	Summer	5.47
	Veronicastrum virginicum	Culver's Root	0.50	0.04	Summer	11.75
	Zizia aurea	Golden Alexanders	0.50	0.04	Spring	0.16
Cover Crop:	Determined at the time of seeding	Oats/Winter Wheat		25.00		
						253.36

Terms:

Down Payment: 25% down payment required to secure order.

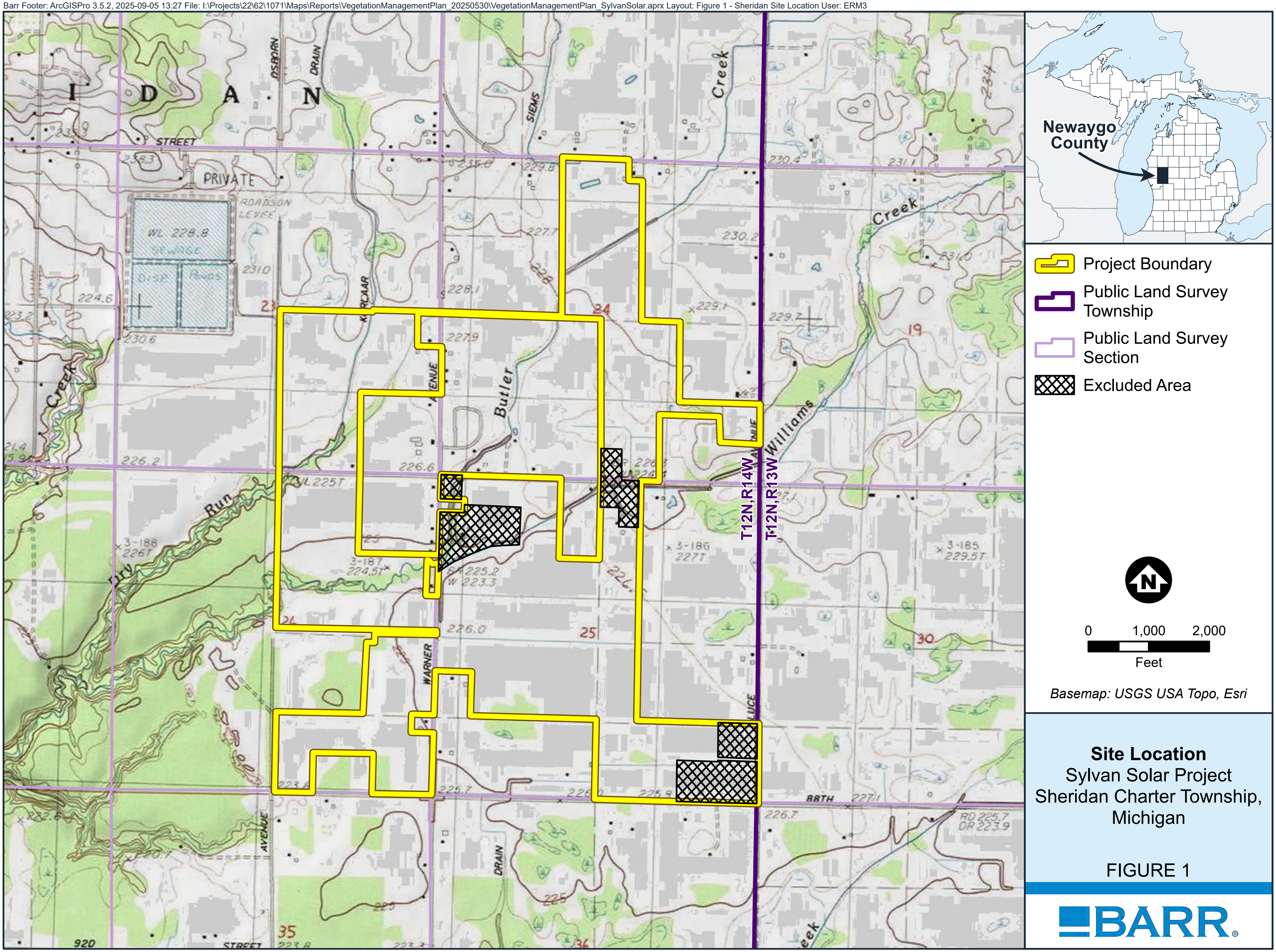
Pricing: Prices and availability subject to change at any time without notice.

Terms: Payment due upon receipt for all customers. Approved credit customers Net 30 days.

Freight: All prices are FOB Foley MN. Shipping and/or delivery available.

Warranty: MNL strives to produce the highest quality native seed and plants, but we do not warranty/guarantee our products due to factors outside our control. If an item was damaged in shipping or you have other concerns about quality, please contact MNL Customer Service at info@mnlcorp.com

Figure 1 **Site Location**



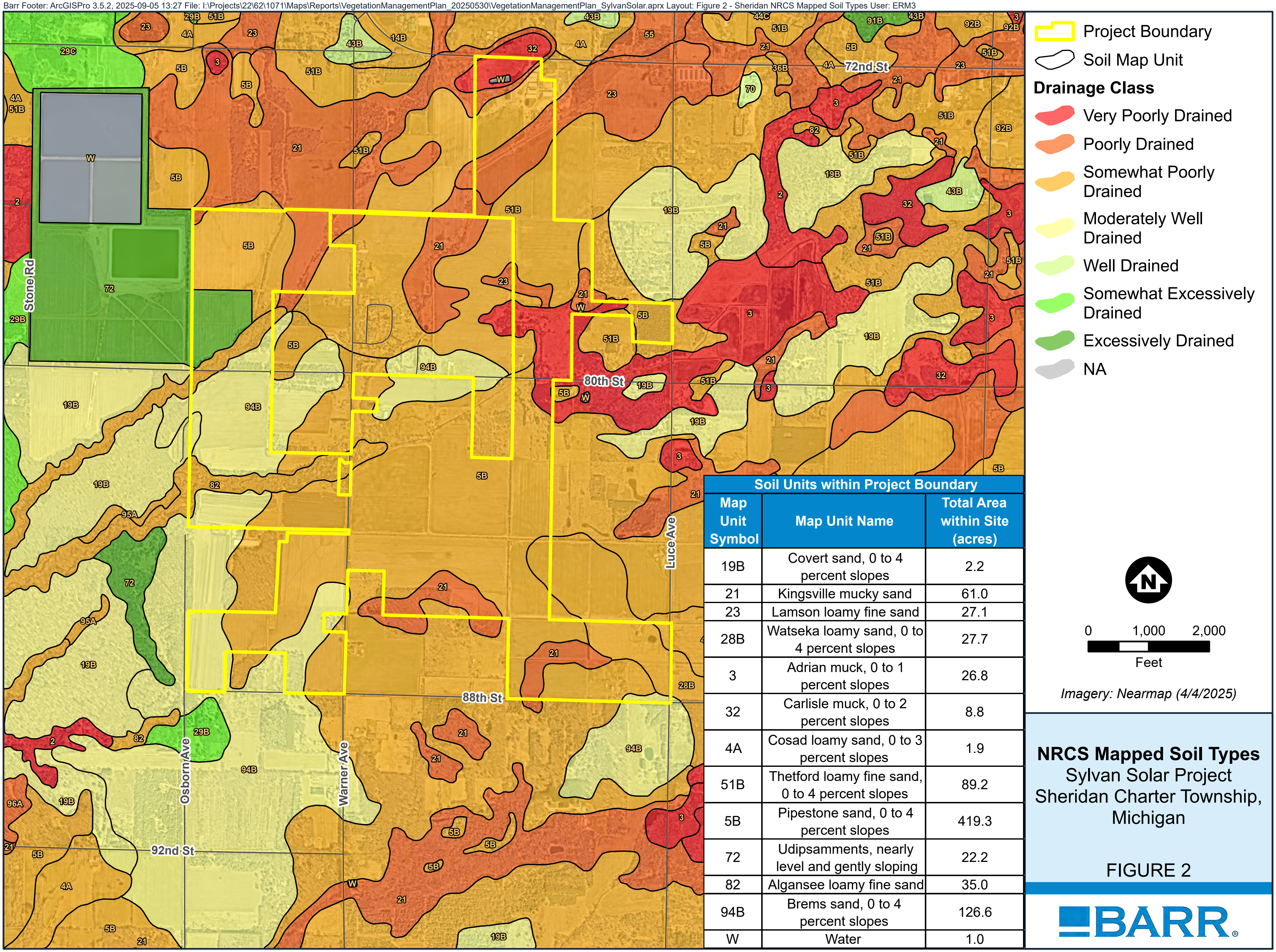
Site Location
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 1

BARR

Figure 2 NRCS Mapped Soil Types

Barr Footer: ArcGISPro 3.5.2, 2025-09-05 13:27 File: I:\Projects\22\62\1071\Maps\Reports\VegetationManagementPlan_20250530\VegetationManagementPlan_SylvanSolar.aprx Layout: Figure 2 - Sheridan NRCS Mapped Soil Types User: ERM3



Imagery: Nearmap (4/4/2025)

Soil Units within Project Boundary		
Map Unit Symbol	Map Unit Name	Total Area within Site (acres)
19B	Covert sand, 0 to 4 percent slopes	2.2
21	Kingsville mucky sand	61.0
23	Lamson loamy fine sand	27.1
28B	Watseka loamy sand, 0 to 4 percent slopes	27.7
3	Adrian muck, 0 to 1 percent slopes	26.8
32	Carlisle muck, 0 to 2 percent slopes	8.8
4A	Cosad loamy sand, 0 to 3 percent slopes	1.9
51B	Thetford loamy fine sand, 0 to 4 percent slopes	89.2
5B	Pipestone sand, 0 to 4 percent slopes	419.3
72	Udipsamments, nearly level and gently sloping	22.2
82	Algansee loamy fine sand	35.0
94B	Brems sand, 0 to 4 percent slopes	126.6
W	Water	1.0

NRCS Mapped Soil Types
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 2

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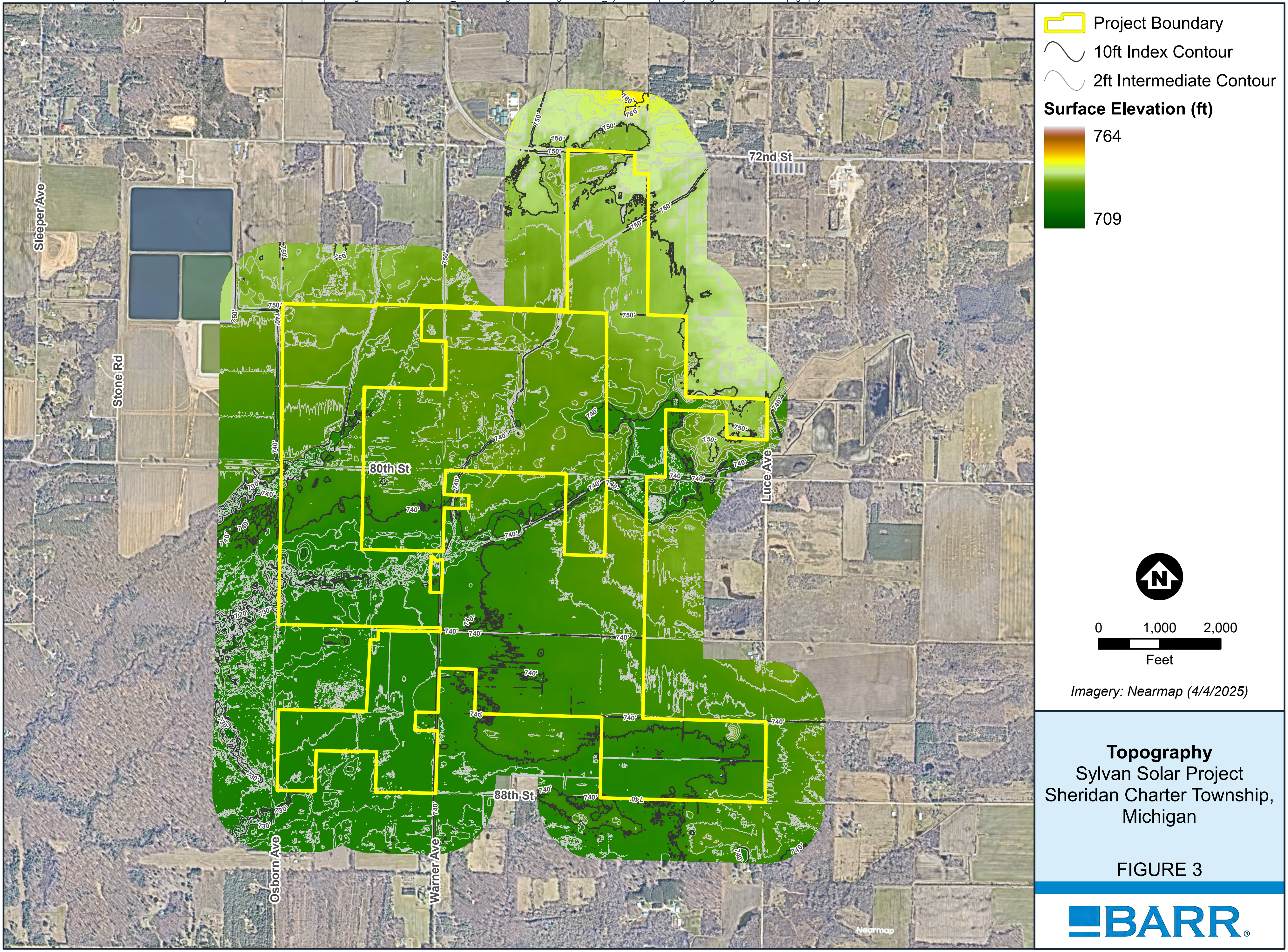
Figure 3 Topography



Imagery: Nearmap (4/4/2025)

Topography
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 3

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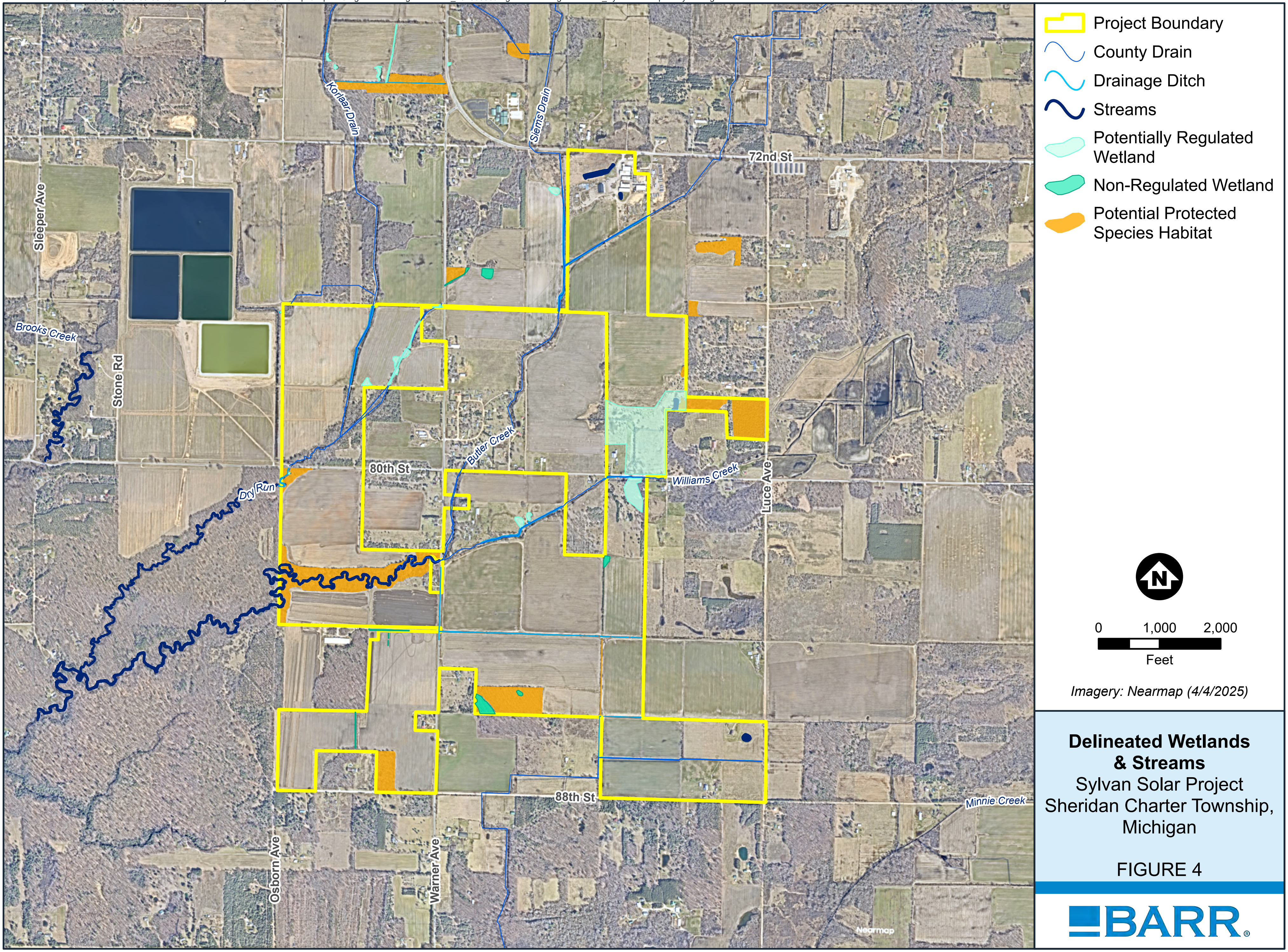
Figure 4 Delineated Wetlands and Streams



Delineated Wetlands & Streams
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 4

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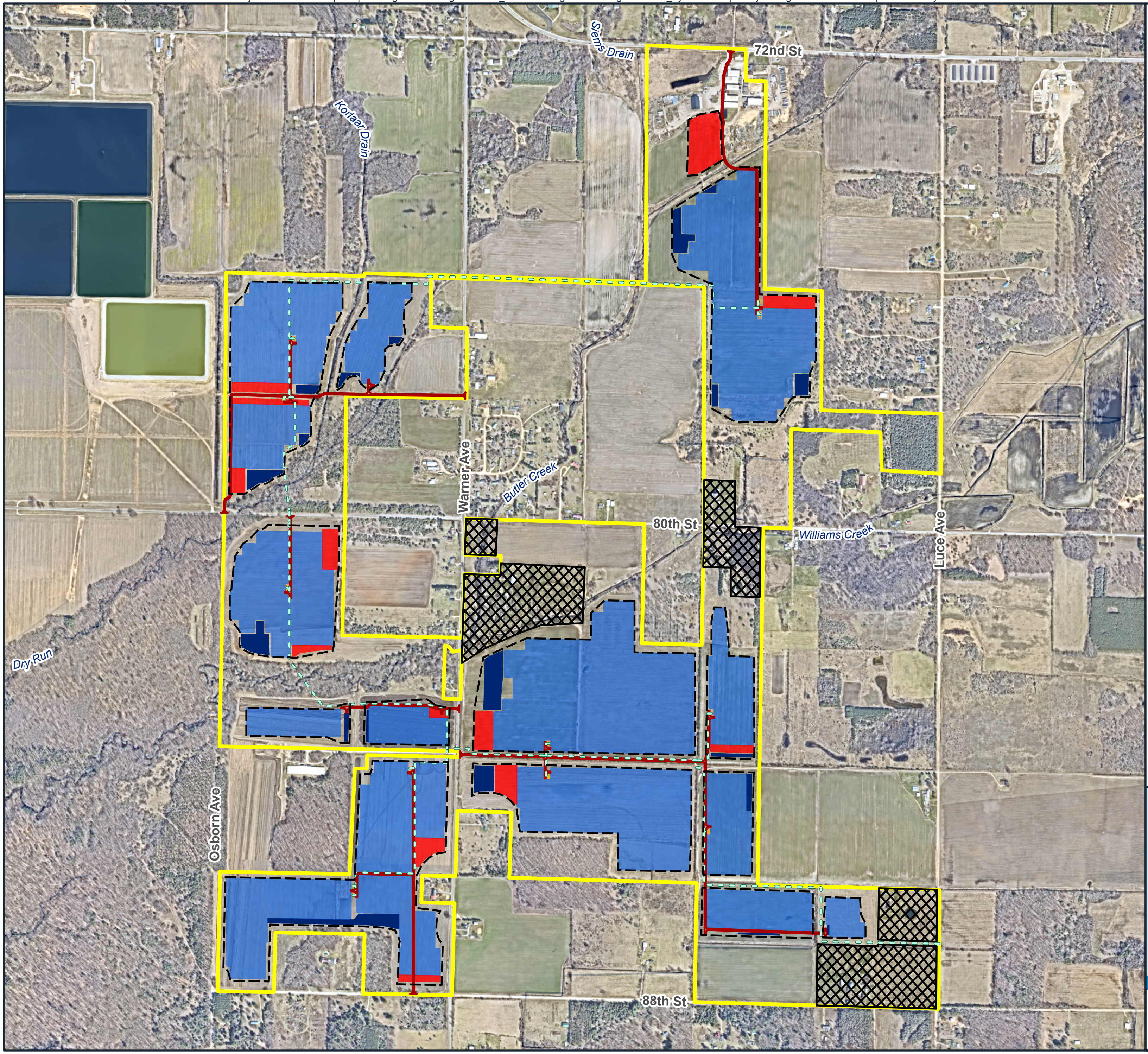
Figure 5 Proposed Site Layout



Project Boundary
Perimeter Fencing
Underground Medium Voltage Collection Line
Excluded Area
Interior Road
Stormwater Basin
Solar Panels
Laydown Area
Inverter Skid

N

0 750 1,500
Feet

Imagery: Nearmap (4/4/2025)

Proposed Site Layout
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 5

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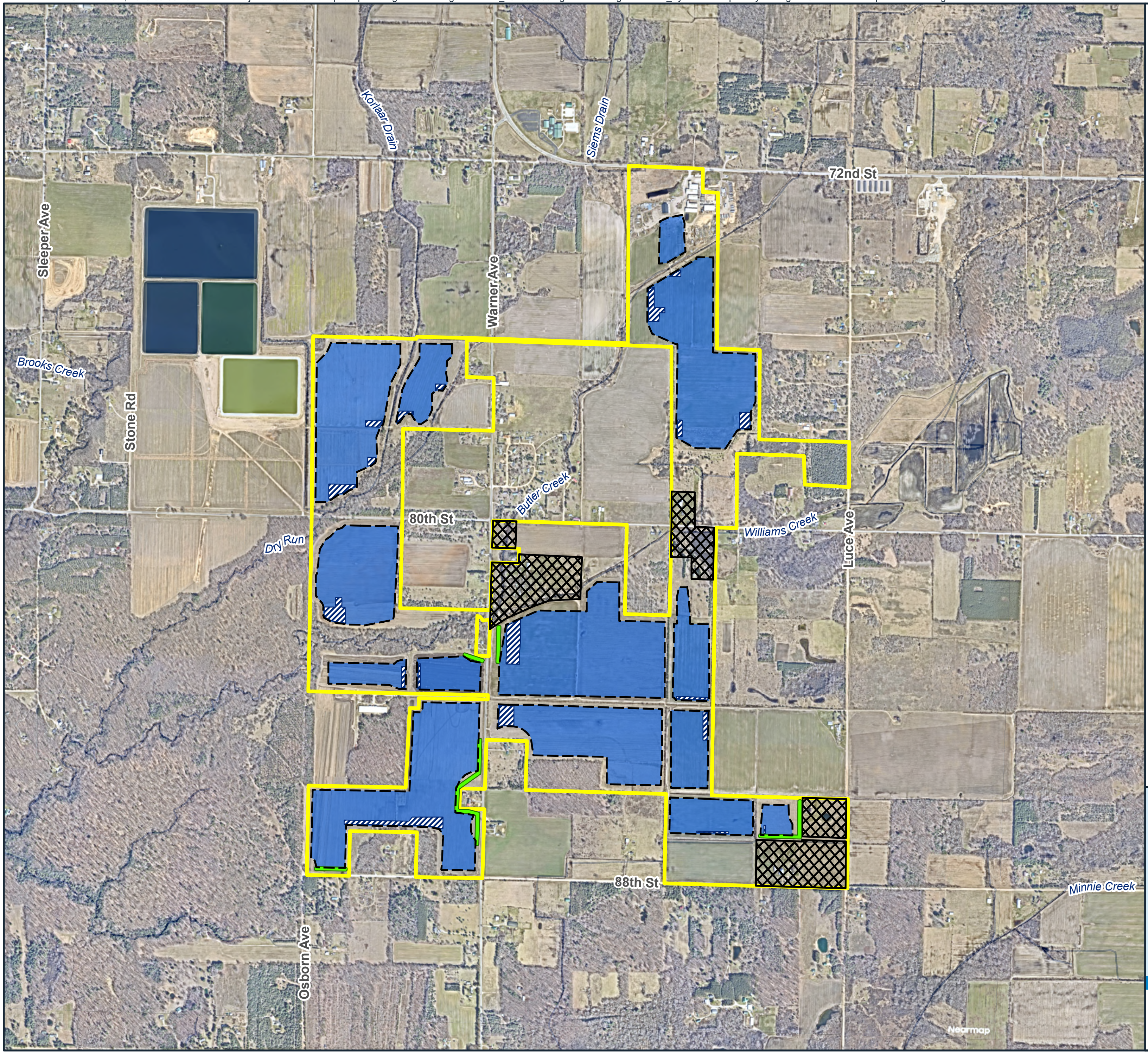
Figure 6 Proposed Screening and Seed Mix Areas



Project Boundary
Perimeter Fencing
Residential Screening *(Tree/Shrub Plantings)*
Solar Array *(Shortgrass Native Array Seed Mix)*
Stormwater Basin *(Stormwater Basin Seed Mix)*
Excluded Area

Note:
- Disturbed areas and fallow agricultural fields outside the perimeter fence will either be seeded with Solar Array seed mix and/or Tall Pollinator seed mix, or will continue to be used for agricultural activities during Project operation.

0 1,000 2,000
Feet

Imagery: Nearmap (4/4/2025)

Proposed Screening and Seed Mix Areas
Sylvan Solar Project
Sheridan Charter Township, Michigan

FIGURE 6

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Appendix 5 – Decommissioning Plan

Attachment 5 - Decommissioning Plan

Decommissioning Plan

Sylvan Solar Project – Sheridan Charter Township

Prepared for
Sylvan Solar, LLC

Prepared by
Barr Engineering Michigan LLC

September 2025

3005 Boardwalk Street, Suite 100
Ann Arbor, MI 48108
734.922.4400

barr.com

Certification

Joel Bahma, PE	September 8, 2025 Date

BARR

Decommissioning Plan

September 2025

Contents

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Tables

Figures

Abbreviations

AC	alternating current
AES	AES Clean Energy Development, LLC
Barr	Barr Engineering Michigan LLC
BMPs	Best Management Practices
DC	direct current
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EPA	U.S. Environmental Protection Agency
gen-tie	generation tie line
HV	high voltage
kV	kilovolt
MDOT	Michigan Department of Transportation
MW	megawatt
MPSC	Michigan Public Service Commission
O&M	Operations & Maintenance
Plan	Decommissioning Plan
Project	Sylvan Solar Project
PV	photovoltaic
SCADA	supervisory control and data acquisition
SES	solar energy system
SESC	Soil Erosion and Sedimentation Control
SPCC	Spill Prevention, Control, and Countermeasures
SWPPP	Stormwater Pollution Prevention Plan
Sylvan Solar	Sylvan Solar, LLC

1 Introduction

Barr Engineering Michigan LLC (Barr) has prepared this Decommissioning Plan (Plan) on behalf of Sylvan Solar, LLC (Sylvan Solar), an affiliate of AES Clean Energy Development, LLC, for the Sylvan Solar Project (Project) in Newaygo County, Michigan. AES Clean Energy (AES) is a division of The AES Corporation based in the United States that owns and operates solar, wind, and battery projects across the country. The intent of the Project is to generate an annual average of approximately 445,000 megawatt (MW) hours of renewable energy over its anticipated 35-year life span.

This Plan was written in accordance with the Fremont Community Joint Planning Commission Solar Energy System (SES) Ordinance. The purpose of this Plan is to assess the potential impacts of the Project and to restore the Project area to its prior agricultural use or to another use if the economic conditions and landowner intentions indicate another use is appropriate for the Project area, in accordance with applicable local requirements.

2 Project Information

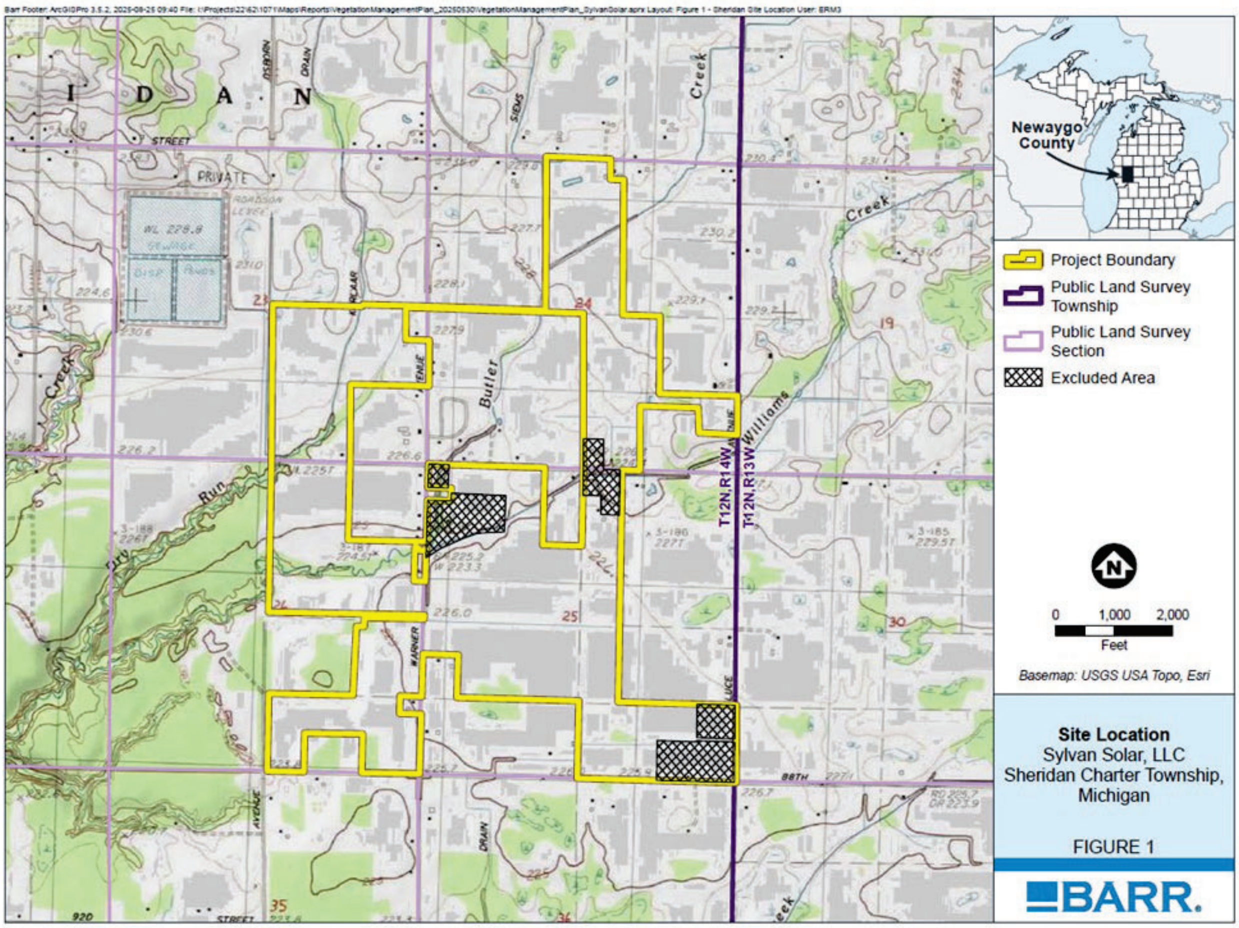
2.1 Project Description

The Project is an up to 220-MW photovoltaic (PV) solar generation facility within a 2,166-acre Project area of land within Garfield Township and Sheridan Charter Township, Newaygo County, Michigan. The Project is approximately 4.5 miles southeast of Fremont, Michigan (Figure 1). The Project is generally north of North River Drive, west of Bingham Avenue, south of Michigan Highway 82, and east of South Osborn Avenue. The Project footprint and surrounding area primarily consist of agricultural fields, wooded areas, agricultural ditches, and Newaygo County designated drains. The Muskegon River is approximately 900 feet south of the Project at its closest point.

Of the total 783 acres under contract for the Project in Sheridan Charter Township, approximately 420 acres of the Project area will be within the perimeter fence.

On-site construction of the Project is anticipated to commence in mid-2027, and the solar energy facility is expected to be operational in late 2028.

Figure 1 Site Location



2.2 General Facility Description

The facility will include multiple rows of PV solar panels oriented north-south on single-axis tracking structures, inverters that convert direct current (DC) to alternating current (AC), transformers, primarily underground 34.5-kV medium voltage collection lines, meteorological stations, a stormwater management system, and a 345-kV Project substation with associated high-voltage (HV) gen-tie.

In Sheridan Charter Township, the Project area within the fence line will encompass approximately 420 acres. The Development Area represents Sylvan Solar's anticipated maximum number of developed acres within the Project boundary in Sheridan Charter Township.

The Development Area (420 acres) includes the following Project components:

- PV solar arrays,
- inverter skids that will house inverters and medium voltage step-up transformers,
- underground medium voltage collection lines,
- gravel access roads,
- meteorological stations,
- security fencing and gates,
- temporary construction laydown areas, and
- stormwater management system.

In addition, the potential exists that the Operations and Maintenance (O&M) building may utilize an existing building (if available) or a laydown area within the Project area in Sheridan Charter Township.

The PV solar arrays will occupy a significant portion of the private parcels at full build-out. The Project area will include underground medium voltage collection lines inside and outside the fence, which will connect the blocks of PV solar arrays within the Project area.

The PV modules will convert sunlight into DC electricity. Combiner boxes will collect the DC electricity from each PV module and convey it to an inverter. The inverter will convert the DC power to AC power, which will then flow to the medium-voltage transformers. The collection lines will transport electricity from the PV solar arrays to the proposed Project substation in Garfield Township.

During site development, temporary laydown areas, construction trailers, and parking areas will be provided within the Project area. Fencing, lighting in select areas, and electronic security systems will secure the Project facilities. The perimeter fence will be an approximate 7-foot-high woven wire fence. Downlit, dark-sky friendly security lighting will be installed at the Project entrance gates as well as the O&M building and Project substation. The Project's O&M building will include maintenance facilities, restrooms, and ancillary support systems such as component storage.

3 Time & Notification

3.1 Anticipated Project Timeline

On-site construction of the Project is anticipated to commence in 2027. The current anticipated lifespan is 35 years from the start of construction. In accordance with Section D(4)(d) of the Fremont Community Joint Planning Commission SES Ordinance, Sylvan Solar will update the decommissioning plan and cost estimate prior to construction and every five years during operation.

3.2 Decommissioning Period

Sylvan Solar anticipates decommissioning would be complete within eighteen (18) months after abandonment or the end of its useful life. The end of useful life shall be presumed if no electricity is generated or stored for a continuous period of twelve (12) months.

3.3 Notification

Sylvan Solar will provide written notification of intent to decommission to landowners, Newaygo County and Sheridan Charter Township prior to commencing decommissioning activities. Sylvan Solar will also confirm applicable local permitting requirements (e.g., regarding road restrictions or permits required prior to ground disturbance) with Newaygo County and Sheridan Charter Township. Sylvan Solar will provide written notification to landowners, Newaygo County, and Sheridan Charter Township upon completion of decommissioning and restoration activities.

4 Permitting

Sylvan Solar will confirm permitting requirements prior to decommissioning activities and will obtain applicable approvals prior to ground-disturbing activities. Sylvan Solar anticipates a Soil Erosion and Sedimentation Control (SESC) Permit will be necessary for greater than one acre of disturbance. Local permits from Newaygo County and Sheridan Charter Township will also be considered, including potential permits required for work in road rights-of-way (Table 1).

Table 1 Potential Decommissioning Permits

Regulatory Authority	Permit/Authorization
Michigan Department of Environment, Great Lakes, and Energy (EGLE)	Natural Resources and Environmental Protection Act Part 303 permit for impacts to Waters of the U.S. and Waters of the State, including wetlands.
U.S. Environmental Protection Agency (EPA)	Spill Prevention, Control, and Countermeasures (SPCC) Plan if/when aggregate aboveground storage capacity is greater than 1,320 gallons
U.S. Fish and Wildlife Service (USFWS)	Section 7 or Section 10 consultation may be required if the construction activities have the potential for “take” of a federally-listed threatened or endangered species.
Michigan Department of Transportation (MDOT)	Oversize/Overweight Permit for State Highways
Newaygo County Drain Commissioner	A SESC Permit is required for any earth change activity which disturbs one or more acres of land or which is within 500 feet of a lake or stream.

Regulatory Authority	Permit/Authorization
Newaygo County Road Commission	Moving permits for Oversize/Overweight loads

5 Decommissioning Tasks

5.1 Modules

Sylvan Solar intends to use approximately 154,740 bifacial (PV) modules for the Project portion located in Sheridan Charter Township. This Plan is based on the QCells Q.Peak Due ML-G125 module. Each module assembly (with frame) will have a total weight of approximately 84 pounds. The modules will be approximately 94 inches by 52 inches in width. The modules are mainly comprised of non-metallic materials such as silicon, glass, composite film, plastic, and epoxies, with an anodized aluminum frame. The equipment manufacturer and type are subject to change closer to construction based on availability and cost.

Once deenergized, the modules will be disassembled and prepared for shipment. At the time of decommissioning, module components in working condition may be refurbished and sold in a secondary market yielding greater revenue than selling as salvage material. Modules that are not in working condition or are not marketable for resale will be recycled, if practicable, or landfilled.

5.2 Racking System and Supports

Cabling, wiring and electrical components will be removed from racking. Racking and racking components will be disassembled and removed from the steel foundation posts, processed to appropriate size, and sent to a metal scrap facility.

5.3 Module Piles and Foundations

Module foundations are assumed to be comprised of steel driven piles. Steel piles will be fully removed from the ground, processed to an appropriate size and sent to a metal scrap facility. Concrete foundations or slabs will be demolished and hauled to a licensed facility. Remaining excavations and voids will be backfilled with soil. During decommissioning, the area around the foundation posts may be compacted by equipment and, if compacted, the area will be de-compacted in a manner to adequately restore the topsoil and sub-grade material to a density consistent for vegetation.

5.4 Overhead and Underground Cables

Underground cables, conduits and junction boxes within 48 inches of the top of grade will be removed. Where facilities are removed, topsoil will be segregated and stockpiled for later use prior to any excavation and the subsurface soils will be staged next to the excavation. Overhead lines and posts will be removed from the Project. Cabling will be scrapped or recycled based on current market rates.

5.5 Power Conversion Stations

Electrical equipment will be disconnected and disassembled. Parts will be removed from the site and reconditioned and reused, sold as scrap, recycled, or disposed of appropriately, at Sylvan Solar's sole discretion, consistent with applicable regulations and industry standards.

Foundations will be demolished and removed to a depth of 48 inches below grade. Remaining excavations and voids will be backfilled with soil.

5.6 Site Roads and Fencing

The Project will include a perimeter security fence around the solar array areas. The perimeter fence and foundations will be removed from the site to 48 inches below grade and then scrapped or hauled to a landfill.

Access roads will be removed from the Project unless written communication is received from the landowner requesting that the road be retained. Decommissioning activities include the removal and stockpiling of aggregate materials onsite for salvage preparation. Local townships or residents may accept the material prior to processing for use on local roads or field access roads.

Following removal of aggregate, the access road areas will be graded, de-compacted, backfilled with native soils, as needed, and land contours restored as near as practicable to pre-construction conditions.

5.7 Site Restoration

Per Section D(4) of the Fremont Community Joint Planning Commissiong SES Ordinance, decommissioning must commence in 180 days following abandonment and must be complete within eighteen (18) months after the end of useful life.

Erosion control measures will be installed during decommissioning per the site requirements, the SESC Plan, and the Project's Stormwater Prevention Pollution Plan (SWPPP). Excavated and backfilled areas will be graded as previously described to restore land contours as near as practicable to pre-construction conditions. Topsoil will be returned to disturbed areas and seeding will be applied based on the intended post-solar land use agreed to with participating landowners. After topsoil has been replaced, all areas that were traversed by vehicles and decommissioning equipment will be decompacted to restore soil conditions.

6 Cost Estimate

6.1 Decommissioning Cost Estimate

Costs and salvage values associated with decommissioning the Project will be dependent on labor costs and market value of salvageable materials at the time of decommissioning. The cost estimate below was estimated using 2025 dollars. No escalation or future value has been calculated for the cost estimate.

This concept-level (Class IV, per *AACEI 17R-97: Cost Estimate Classification System*) cost estimate is based on partial design and is meant for feasibility uses. Costs will change with further design changes. Class IV estimates are typically used for project screening, determination of feasibility, concept evaluation, and preliminary budget approval. The estimated accuracy range for the total cost is -30% to +50%. The accuracy range is based on professional judgment considering the level of design completed, the complexity of the Project, and the uncertainties in the Project as scoped.

Table 2 summarizes the Project's decommissioning costs for facilities sited in Sheridan Charter Township.

Table 2 Estimated Decommissioning Costs

Activity	Total[1]
General Conditions	$689,000
PV Panel	$2,407,000
Power Conversion Stations (Inverter Skids and Controller Stations)	$254,000
Collection Circuit Line	$23,000
Site Restoration	$157,000
Fencing	$221,000
Met Station Removal	$4,000
Contingency	$751,000
Total Estimated Decommissioning Cost	**$4,506,000**
Total Estimated Decommissioning Cost (Low Range -30%)	$3,154,200
Total Estimated Decommissioning Cost (High Range +50%)	$6,759,000

[1] Line-item totals rounded up to nearest thousand

6.2 Net Decommissioning Cost Estimate

The market value of scrap materials fluctuates daily. Salvage value estimates were based on the five-year average price of steel, copper, and aluminum and derived from the online resource scrapmonster.com. The salvage value was calculated based on anticipated end-of-life values, with depreciation, instead of the salvage value at the start of construction. Table 3 summarizes the estimated decommissioning cost, estimated salvage value for the solar components, steel structures and construction materials, and net estimated decommissioning cost of the Project.

Table 3 Estimated Net Decommissioning Costs

Activity	Total[1]
Total Estimated Decommissioning Cost	$4,506,000
Total Estimated Salvage Value	$1,531,000
Net Estimated Decommissioning Cost	**$2,975,000**
Net Estimated Decommissioning Cost (Low Range -30%)	$2,082,500
Net Estimated Decommissioning Cost (High Range +50%)	$4,462,500

[1] Line-item totals rounded up to nearest thousand

7 Financial Assurance

Sylvan Solar will provide financial assurance in either a performance bond or letter of credit prior to commencing construction. Such financial assurance shall be expressly held for the benefit of Sheridan Charter Township.

In accordance with the Fremont Community Joint Planning Commission SES ordinance, decommissioning cost will include the removal of SES panels, supports, buildings, and electrical components, as well as any other associated facilities, to a depth of 48 inches below grade. Sylvan Solar will post and maintain decommissioning funds in an amount equal to the estimated cost of decommissioning, less salvage value, as updated every five (5) years.

All of the funds for decommissioning will come from the owner of the solar facility or from the decommissioning bond.

To provide for an accurate financial assurance amount at the time of construction, Sylvan Solar will hire an independent, third-party registered engineer to update the net decommissioning cost estimate and provide it to Sheridan Charter Township prior to construction after final equipment has been identified. A review of the amount of the performance guarantee based on inflation, salvage value, and current removal costs shall be completed every five (5) years for the life of the Project.

Appendix 6 – Special Land Use Permit Application Form

Attachment 6 - Special Land Use Permit Application Form

FREMONT COMMUNITY PLANNING AND ZONING SPECIAL LAND USE PERMIT APPLICATION

DAYTON TOWNSHIP, SHERIDAN CHARTER TOWNSHIP AND THE CITY OF FREMONT

This application will not be accepted if incomplete. All required materials must be submitted to the Zoning Administrator forty-five (45) days prior to the next scheduled Joint Planning Commission meeting to allow time to administer the public hearing notices. Joint Planning Commission meetings are held on the 4th Tuesday of each month at 7:00 p.m. in the Council Chambers of the Fremont Municipal Building located at 101 E. Main Street, Fremont, MI.

Applicant Information

Name: Frank Krawczel, Director of Development
Phone: 540-420-4460
Address: Sylvan Solar, LLC
2180 S 1300 E #500
Salt Lake City, UT 84106
E-mail: frank.krawczel@aes.com

Applicant's interest in project: ______ Owner X Lessee _____ Other
If other, outline interest: ____________________

Owner Information (if other than Applicant)

Name: See Attachment 2 (Participating
Address: Parcels) for landowner names and contact information.
Phone: ____________________
E-mail: ____________________

Property Information

Parcel number: See Attachment 2 (Participating
Address: Parcels) for parcel numbers and addresses.
Current zoning: AG-2
Size: 420 Acres ________ Square Feet

Short description of project: The proposed photovoltaic energy facility will generate 220-megawatts (MW) of solar power within a 2,166-acre project area. Of the 2,166 acres, 783 acres are within Sheridan Charter Township. Of the 783 acres, 420 acres are in the Development Area (within the perimeter fence) and will generate approximately 76 MW.

Information to be Submitted:

1. Legal Description
2. Eighteen copies of a site plan meeting the requirements set forth in Chapter 10, Section 10.09 "Application and Review" and applicable items of the Site Plan checklist, Appendix 3.
3. A written response that supports each of the following Special Land Use general standards as outlined in Chapter 9 "Special Land Uses" of the Fremont Community Joint Zoning Ordinance that will assist the Fremont Community Joint Planning Commission in its review process.
    a. The Special Land Use shall be designed, constructed, operated and maintained in a manner harmonious with the character of adjacent property and the surrounding area.
    b. The Special Land Use shall not change the essential character of the surrounding area.

c. The Special Land Use shall not be hazardous to adjacent property, or involve uses, activities, materials or equipment which will be detrimental to the health, safety or welfare or persons or property through the creation of hazardous or potentially hazardous situations or the excessive production of traffic, noise, odor, smoke, dust, fumes, glare or site drainage.

d. The Special Land Use shall not place demands on public services and facilities in excess of current capacity.

e. The Special Land Use shall be in general agreement with the Fremont Community Joint Comprehensive and Growth Management Plan.

f. The Special Land Use shall comply with all applicable site plan review standards.

g. The Special Land Use shall be in general agreement with the intent and purposes of the Fremont Community Joint Zoning Ordinance.

4. Additional evidence/responses must be submitted that illustrate that the proposed use will meet the specific standards set forth in the applicable section(s) of Chapter 9 "Special Land Use" of the Fremont Community Joint Zoning Ordinance.

Affirmation

I hereby attest that the information on this application and provided in association with it is, to the best of my knowledge, true and accurate. I understand that the deliberate withholding or falsification of information required above may result in denial of this application.

Signature of applicant: Frank Krawczel Date: 9/9/2025

Printed name of applicant: Frank Krawczel, Director of Development

Signature of owner (if other than applicant): ______________________ Date: ____________________

Printed name of owner: Landowner authorizations for the special land use are provided in Attachment 2 (Participating Parcels).

I hereby grant permission for members of the Fremont Community Joint Planning Commission and the Dayton Township Board, the Sheridan Charter Township Board and the Fremont City Council to enter the above described property for purposes of gathering information related to this application. (Note to applicant: This is optional and will not affect any decision on your application.)

Signature of owner: ____________________________________ Date: ____________________

Please return the application to the municipality wherein the subject parcel is located, as noted below.

City of Fremont	Dayton Township	Sheridan Charter Township
101 E. Main Street	PO Box 68	PO Box 53
Fremont, MI 49412	3215 S. Stone Road	6360 S. Township Parkway
	Fremont, MI 49412	Fremont, MI 49412

===

FOR CITY/TOWNSHIP USE

Application accepted by: ______________________________ Date accepted: ____________________

Fee received: ______________________ Escrow fee, if any ($1000 minimum): ________________

Public hearing date: __________________________ Hearing notice published in a newspaper of record (minimum 15 days prior to hearing) on: ______________________

An affidavit of mailing is on file. _____ yes _____ no

*A check from Barr Engineering Co. on behalf of Sylvan Solar, LLC for the permit fee ($175.00) is enclosed.

Appendix 7 – Permit Matrix and Agency Correspondence

Attachment 7 - Permit Matrix and Agency Correspondence

Regulatory Authority	Permit/Authorization	Permit Trigger Threshold Description	Status and Timing
FEDERAL			
U.S. Fish and Wildlife Service (USFWS)	Consultation under Section 7 of the Endangered Species Act (ESA)	Required if federal permit or other federal action is required, or the project involves federal funding.	Current design avoids potential suitable habitat for federally listed species. A consultation letter dated July 1, 2025, generated by the USFWS Michigan Ecological Field Office indicates that Project activities are Not Likely to Adversely Affect or have No Effect on federally listed species (refer to attached USFWS letter).
Federal Aviation Administration (FAA)	Determination of No Hazard to Air Navigation (Form 7460-1 Notice of Proposed Construction or Alteration)	Required if Project features or equipment are more than 200 feet tall or within 20,000 feet of a public use or military airport which exceeds a 100:1 surface from any point on the runway.	Current design does not require filing with the FAA as anticipated equipment heights do not trigger the Notice Criteria.
U.S. Environmental Protection Agency (USEPA)	Spill Prevention, Control, and Countermeasure (SPCC) Plan	Plan required where oil storage of 1,320 gallons or more occurs.	Anticipated to be needed for storage at the Project substation. Will be completed prior to construction.
FEDERAL / STATE OF MICHIGAN			
Michigan Department of Environment, Great Lakes, and Energy (EGLE) Water Resources Division / U.S. Army Corps of Engineers (USACE)	Joint Permit Application (JPA) for Wetlands, Streams, & Floodplain permitting	Impacts to regulated wetlands and surface waters. EGLE has implemented four permit categories: General, Minor, Individual, and Major, which are organized by severity of impacts to water resources.	Will apply for appropriate category of EGLE permitting in 2026 when finalized waterbody crossing locations and crossing depths are available.
Michigan State Historic Preservation Office (SHPO)	Cultural Resources Review	Required if federal permit is required or the project involves federal funding.	The Project is not anticipated to require a federal permit; as such, consultation with the SHPO is not required. Current design avoids field-identified archaeological resources within the Project area.
STATE			
Michigan Natural Features Inventory (MNFI) / Michigan Department of Natural Resources (DNR)	Threatened & Endangered (T&E) Species Review/Permit	If a “take” is proposed on a state-listed T&E species.	The DNR provided best management practices (BMPs) to be implemented during construction and operation to avoid impacts to state-listed species. Sylvan Solar will follow the DNR’s BMPs, and the current design avoids potentially suitable habitat for state-listed species; as such, a T&E Permit is not anticipated to be required.
EGLE	Water Withdrawal Permit	Water withdrawal permit for >2,000,000 gallons per day (GPD) or	Will obtain prior to construction, if needed.

Regulatory Authority	Permit/Authorization	Permit Trigger Threshold Description	Status and Timing
		1,388 gallons per minute (GPM). Water withdrawal registration for 100,000 GPD (or 70 GPM) to 2,000,000 GPD (1,388 GPM). Not required for temporary withdrawals of less than 180,000,000 gallons.	
EGLE	National Pollutant Discharge Elimination System (NPDES) General Permit – Construction Stormwater Notice of Coverage (NOC)	Earth disturbance that is larger than 5 acres. Sites disturbing less than 5 acres must apply for and will receive automatic permit coverage with the issuance of a Soil Erosion and Sedimentation Control (SESC) permit.	Will obtain prior to construction after receiving the SESC Permit from Newaygo County Drain Commission (see below).
EGLE	Discharge Request	If culverts will be installed on streams with an upstream drainage area of more than 2 square miles (i.e., floodplain regulated by EGLE and a JPA may be required).	Will obtain prior to construction, as needed.
Michigan Department of Transportation (MDOT)	Oversize and/or Overweight Vehicles and Loads Permits	Transportation and use of oversize and/or overweight vehicles on state roads.	Will obtain prior to construction.
MDOT	Driveway/Construction	Construction work and installation of driveway within state road right-of-way (ROW).	Will obtain prior to construction.
Michigan Health Department District 10	Sewage and Well Permit	Required for the installation of on-site sewage disposal systems (septic systems) and water supply systems (potable wells).	Will obtain prior to construction, if needed.
Newaygo County Drain Commission	Soil Erosion and Sedimentation Control (SESC) Permit	Any earth disturbance within 500 feet of any lake, river, stream, creek, drain, or watercourse, etc. of the county, or any grading, stripping, excavation or filling of more than one acre of land.	Will obtain in 2026.
Newaygo County Drain Commission	Stormwater	Required to minimize flow rates after new developments/construction. Development of stormwater detention and/or retention measures.	Will obtain in 2026.

Regulatory Authority	Permit/Authorization	Permit Trigger Threshold Description	Status and Timing
Newaygo County Drain Commission	County Drain Encroachment Permit	Required to encroach within a drain easement.	Will apply in 2026 after locations of medium-voltage collection lines are finalized.
Newaygo County Drain Commission	County Drain Crossing Permit	Required to cross, modify, or discharge to a county drain.	Will apply in 2026 when engineering designs of county drain crossings are available.
Newaygo County Road Commission	Right-of-way (ROW) Permit	Work within a county road right-of-way	Will apply prior to construction.
Newaygo County Road Commission	Construction Permit (Commercial Driveway Approach)	Required for creating access from a county road.	Will apply prior to construction.
Newaygo County Road Commission	Utility Permit	Required if directional boring or open trenching (parallel to or across the road) are required for utility installation.	Will apply prior to construction.
Newaygo County Road Commission	Transportation Permit	Transportation of construction equipment on seasonal and county roads.	Will apply prior to construction.
TOWNSHIP			
Garfield Township	Conditional Use Permit / Site Plan Review	Required to construct a principal-use solar energy system (SES) within Garfield Township.	In progress. An application for a Conditional Use Permit is anticipated to be submitted in August 2025.
Garfield Township	Electrical Permit	Electrical work associated with a new facility.	Will apply prior to construction.
Garfield Township	Zoning Compliance Permit	Required prior to issuance of a building permit.	Will apply prior to construction.
Fremont Community Joint Planning Commission (FCJPC)	Special Land Use Permit / Site Plan Review	Required to construct a commercial SES within Sheridan Charter Township.	In progress. An application for a Special Land Use Permit is anticipated to be submitted in October 2025.
Sheridan Charter Township	Zoning Permit	Required prior to issuance of a building permit.	Will apply prior to construction.

Sylvan Solar Special Land Use Permit Application

Attachment 7 – Key Stakeholder Meetings

Date	Key Stakeholders	Topics Discussed
January 16, 2023	Initial introductions to Sheridan Charter Township Supervisor and The Right Place Director	Met individually with Supervisor and The Right Place Director to introduce AES and the potential solar project.
April 5, 2023	Michigan Department of Agriculture and Rural Development (MDARD)	Contacted MDARD to confirm the list of potential Project parcels enrolled in PA 116.
April 14, 2023	City of Fremont Manager	Introduced AES and the potential solar project.
April 15, 2023	Garfield Township Supervisor	Introduced AES and the potential solar project.
June 27, 2023	Fremont Community Joint Planning Commission (FCJPC) and Garfield Township Planning Commission	AES attended both Planning Commission meetings to introduce AES and discuss solar energy in the communities.
October 10, 2023	Garfield Township Board	AES attended the monthly board meeting and answered general questions about solar development.
February 28 and 29, 2024	Garfield Township Supervisor and Sheridan Charter Township Supervisor	AES met individually with Supervisors to provide information about the general project location and discuss the state siting bill.
September 16, 2024	Michigan Department of Natural Resources (DNR)	AES discussed potential suitable wood turtle habitat with the DNR.
October 3, 2024	Garfield Township Supervisor and Sheridan Charter Township Supervisor	AES met individually with Supervisors to provide more detailed information about the project location and environmental studies completed to date.
November 21, 2024	Garfield Township Supervisor, Sheridan Charter Township Supervisor, and Drain Commission	Introduced AES and the project to the Deputy Drain Commissioner. Discussed the Project footprint, development timeline, potential amendments to zoning ordinances to include solar facilities, drainage agreements, location information, and answered questions.
December 16, 2024	Drain Commission	Discussed the Newaygo County Drain Commission requirements for setbacks from county drains, entering into a Cooperation Agreement, plans for fencing and access for maintenance activities. AES provided a KMZ of the parcel boundary to the Drain Commission.
January 28, 2025	FCJPC	AES attended the monthly meeting to answer general questions about solar and the project. The Planning Commission discussed the latest draft of the solar ordinance amendment.
January 30, 2025	Garfield Township Supervisor, Sheridan Charter Township Supervisor, and Drain Commission	AES shared Project overview maps and information about the Renewables Ready Community Award. The group discussed setbacks in each draft solar ordinance, timing of solar ordinance, and Drain Commission requirements and agreements.
February 21, 2025	DNR	Followed up with the DNR regarding potential wood turtle habitat, and the DNR provided a list of best practices to minimize impacts to the wood turtle.
February 25, 2025	Garfield Township Planning Commission	AES attended to listen to the solar ordinance discussion and answer questions about solar development and the Project. AES provided information on operating AES projects in Michigan.

Date	Key Stakeholders	Topics Discussed
March 25, 2025	Garfield Township Planning Commission and FCJPC	AES attended both public hearings for the draft solar ordinances in each township.
April 14, 2025	Sheridan Charter Township Supervisor	AES met with Supervisor to share updates about the Project, upcoming events in May, and clarify requirements in draft solar ordinance.
April 15, 2025	Garfield Township Supervisor and Newaygo County Road Commission	Met individually with Supervisor and Road Commission. AES met with Supervisor to share updates about the Project, upcoming events in May, and clarify requirements in draft solar ordinance. Introduced AES and the Project to the Road Commission Superintendent and Manager.
May 8, 2025	Local Officials' Workshop	Center for Energy Education (C4EE) presented an educational workshop for local officials.
May 13, 2025	Community Open House	AES hosted a community open house in Fremont and shared an overview of the Project, a map of the buildable area, information about studies completed to date, and the anticipated permitting timeline.
May 15, 2025	Garfield Township Supervisor, Sheridan Charter Township Supervisor, Drain Commission, and Road Commission	The group discussed the latest updates on the draft solar ordinances and questions about maintenance of private drains, seed mixes, and stormwater management systems. The Road Commission provided updates on 2027 and 2028 road construction projects and feedback on preliminary site entrances.
May 15, 2025	Newaygo County Environmental Coalition	Introduced AES and the solar project. Discussed potential partnership and educational opportunities.
May 27, 2025	Garfield Township Planning Commission	AES attended the public hearing for the solar ordinance and provided additional solar information to the Planning Commission members after the meeting.
May 29, 2025	Newaygo County Emergency Services and Fremont Fire Department	Introduced AES and the solar project. Discussed site entrance points and access in the event of an emergency.
June 10, 2025	Garfield Township Board	AES attended the monthly meeting when the Township Board adopted the solar ordinance.
June 25, 2025	Garfield Township Supervisor	Met with Supervisor to review the preliminary Site Plan and discuss the permitting timeline and anticipated application submittal dates in 2025.
June 26, 2025	Sheridan Charter Township Supervisor	Met with Supervisor to review the preliminary Site Plan and discuss the permitting timeline and anticipated application submittal dates in 2025.
July 23, 2025	Community Open House	AES hosted a community open house in Newaygo and shared the proposed Project layout, visual renderings, and property value study information. C4EE showed a video of a typical solar project, and Michigan State University Extension shared information about the Project's economic impact.
August 26, 2025	Garfield Township Planning Commission	The Planning Commission conducted a completeness review of the Conditional Use Permit application, and AES addressed initial questions and concerns.
August 27, 2025	Newaygo County Emergency Services, Newaygo Fire Department	Met with emergency services groups to provide the proposed Project layout, share typical construction and operation safety practices and emergency response protocols at solar sites, and request feedback.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Michigan Ecological Services Field Office
2651 Coolidge Road Suite 101
East Lansing, MI 48823-6360
Phone: (517) 351-2555 Fax: (517) 351-1443

In Reply Refer To: 07/01/2025 22:05:39 UTC
Project code: 2025-0116708
Project Name: Sylvan Solar

Subject: Technical Assistance letter for 'Sylvan Solar' for specified threatened and endangered species that may occur in your proposed project location consistent with the Michigan Endangered Species Determination Key (Michigan DKey)

Dear Lauren Colwell:

The U.S. Fish and Wildlife Service (Service) received on **July 01, 2025** your effect determination(s) for the 'Sylvan Solar' (the Action) using the Michigan DKey within the Information for Planning and Consultation (IPaC) system. The Service developed this system in accordance with the Endangered Species Act of 1973 (ESA) (87 Stat.884, as amended; 16 U.S.C. 1531 et seq.).

Based on your answers and the assistance of the Service's Michigan DKey, you made the following effect determination(s) for the proposed Action:

Species	**Listing Status**	**Determination**
Eastern Massasauga (=rattlesnake) (*Sistrurus catenatus*)	Threatened	NLAA
Monarch Butterfly (*Danaus plexippus*)	Proposed Threatened	No effect
Northern Long-eared Bat (*Myotis septentrionalis*)	Endangered	NLAA

Coordination with the Michigan Ecological Services Office is complete. Thank you for considering federally listed species during your project planning.

Please provide sufficient project details on your project homepage in IPaC (Define Project, Project Description) to support your conclusions. Failure to disclose important aspects of your project that would influence the outcome of your effects determinations may negate your determinations and invalidate this letter. If you have site-specific information that leads you to believe a different determination is more appropriate for your project than what the Dkey concludes, you can and should proceed based on the best available information.

The Service recommends that you contact the Service or re-evaluate the project in IPaC if: 1) the scope or location of the proposed Action is changed; 2) new information reveals that the action may affect listed species or designated critical habitat in a manner or to an extent not previously considered; 3) the Action is modified in a manner that causes effects to listed species or designated critical habitat; or 4) a new species is listed or critical habitat designated. If any of the above conditions occurs, additional consultation with the Service should take place before project changes are final or resources committedThe

Your project is in the vicinity of a National Wildlife Refuge (NWR), https://fws.gov/visit-us/refuges. The intent of this letter is limited to assisting you in evaluating the effects of your action on Federally listed species in Michigan; other FWS programs may have additional input on your project. We recommend you contact the NWR near your project to determine whether additional FWS coordination is needed on your project.

Bald and Golden Eagles:
Bald eagles, golden eagles, and their nests are protected under the Bald and Golden Eagle Protection Act (54 Stat. 250, as amended, 16 U.S.C. 668a-d) (Eagle Act). The Eagle Act prohibits, except when authorized by an Eagle Act permit, the "taking" of bald and golden eagles and defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." The Eagle Act's implementing regulations define disturb as "…to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, (1) injury to an eagle, (2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or (3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

If the Action may impact bald or golden eagles, additional coordination with the Service under the Eagle Act may be required. For more information on eagles and conducting activities in the vicinity of an eagle nest, please visit https://www.fws.gov/library/collections/all-about-eagles. In addition, the Service developed the National Bald Eagle Management Guidelines (May 2007) in order to assist landowners in avoiding the disturbance of bald eagles. The full Guidelines are available at https://www.fws.gov/media/national-bald-eagle-management-guidelines-0.

If you have further questions regarding potential impacts to eagles, please contact Chris Mensing, Chris_Mensing@fws.gov or 517-351-2555.

Planning Recommendations for Utility-Scale Solar Energy Developments in Michigan
We have compiled planning recommendations for utility-scale solar energy developments in Michigan (available here: https://www.fws.gov/media/generic-michigan-solar-letter-d-key), which we encourage solar developers to consider and implement to the extent practicable.

Monarch butterfly and other pollinators
Monarch butterfly was proposed for listing as threatened on December 12, 2024. Through May 19, 2025, we are gathering input through an extended public comment period to encourage the submission of any new information. We will review these comments and then will ultimately issue a final rule. If listed, protections would only go into place after the final rule is published. Section 7 conferences are required if a federal action is likely to jeopardize the continued existence of a proposed species.

For all projects, we recommend the following best management practices (BMPs) to benefit monarch and other pollinators.

Monarch and Pollinator BMP Recommendations

Consider monarch and other pollinators in your project planning when possible. Many pollinators are declining, including species that pollinate key agricultural crops and help maintain natural plant communities. Planting a diverse group of native plant species will help support the nutritional needs of Michigan's pollinators. We recommend a mix of flowering trees, shrubs, and herbaceous plants so that something is always blooming and pollen is available during the active periods of the pollinators, roughly early spring through fall (mid-March to mid-October). To benefit a wide variety of pollinators, choose a wide range of flowers with diverse colors, heights, structure, and flower shape. It is important to provide host plants for any known butterfly species at your site, including native milkweed for Monarch butterfly. Incorporating a water source (e.g., ephemeral pool or low area) and basking areas (rocks or bare ground) will provide additional resources for pollinators.

Many pollinators need a safe place to build their nests and overwinter. During spring and summer, leave some areas unmowed or minimize the impacts from mowing (e.g., decrease frequency, increase vegetation height). In fall, leave areas unraked and leave plant stems standing. Leave patches of bare soil for ground nesting pollinators.

Avoid or limit pesticide use. Pesticides can kill more than the target pest. Some pesticide residues can kill pollinators for several days after the pesticide is applied. Pesticides can also kill natural predators, which can lead to even worse pest problems.

Planting native wildflowers can also reduce the need to mow and water, improve bank stabilization by reducing erosion, and improve groundwater recharge and water quality.

Resources:

https://www.fws.gov/initiative/monarchs
https://www.fws.gov/library/collections/pollinators

Wetland impacts:
Section 404 of the Clean Water Act of 1977 (CWA) regulates the discharge of dredged or fill material into waters (including wetlands) of the United States. Regulations require that activities permitted under the CWA (including wetland permits issued by the Michigan Department of Environment, Great Lakes, and Energy (EGLE)) not jeopardize the continued existence of species listed as endangered or threatened. Permits issued by the U.S. Army Corps of Engineers must also consider effects to listed species pursuant to section 7 of the Endangered Species Act. The Service provides comments to the agencies that may include permit conditions to help avoid or minimize impacts to wildlife resources including listed species. For this project, we consider the conservation measures you agreed to in the determination key and/or as part of your proposed action to be non-discretionary. If you apply for a wetland permit, these conservation measures should be explicitly incorporated as permit conditions. Include a copy of this letter in your wetland permit application to streamline the threatened and endangered species review process.

Summary of conservation measures for your project You agreed to the following conservation measures to avoid adverse effects to listed species and our concurrence is only valid if the measures are fully implemented. These must be included as permit conditions if a permit is required and/or included in any contract language.

Eastern Massasauga: Materials used for erosion control and site restoration must be wildlife-friendly. Do not use erosion control products containing plastic mesh netting or other similar material that could entangle eastern massasauga rattlesnake (EMR). Several products for soil erosion and control exist that do not contain plastic netting including net-less erosion control blankets (for example, made of excelsior), loose mulch, hydraulic mulch, soil binders, unreinforced silt fences, and straw bales. Others are made from natural fibers (such as jute) and loosely woven together in a manner that allows wildlife to wiggle free.

Eastern Massasauga: To increase human safety and awareness of EMR, those implementing the project must first review the EMR factsheet (available at https://www.fws.gov/media/eastern-massasauga-rattlesnake-fact-sheet), and watch MDNR’s “60-Second Snakes: The Eastern Massasauga Rattlesnake” video (available at https://www.youtube.com/watch?v=-PFnXe_e02w).

Eastern Massasauga: During project implementation, report sightings of any federally listed species, including EMR, to the Service within 24 hours.

Eastern Massasauga: The project will not result in permanent loss of more than one acre of wetland or conversion of more than 10 acres of EMR upland habitat (uplands associated with high quality wetland habitat) to other land uses.

Listed Bats: When installing new or replacing existing permanent lights, you will use downward-facing, full cut-off lens lights (with same intensity or less for replacement lighting); or for those transportation agencies using the BUG system developed by the Illuminating Engineering Society, the goal is to be as close to 0 for all three ratings with a priority of "uplight" of 0 and "backlight" as low as practicable. You will direct temporary lighting away from suitable listed bat habitat during the active season.

Listed Bats: Tree cutting/trimming and/or prescribed burning will not clear ≥20 contiguous acres of forest (excluding narrow, linear corridors <1000 feet wide) and will not fragment a connective corridor between 2 or more forest patches of at least 5 acres.

Listed Bats: Herbicide application will follow all label instructions and limit application to targeted methods such as spot-spraying, hack-and-squirt, basal bark, injections, cut-stump, or foliar spraying on individual plants.

Listed Bats: All tree cutting/trimming will be conducted outside the period of October 1 through April 14 (that is, limited to April 15 through September 30).

Listed Bats: The project will not include the application or potential drift of insecticides, fungicides, or rodenticides into forested habitats.

Listed Bats: The action will not include prescribed burning within or adjacent to (within 200 feet of) mature forest.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

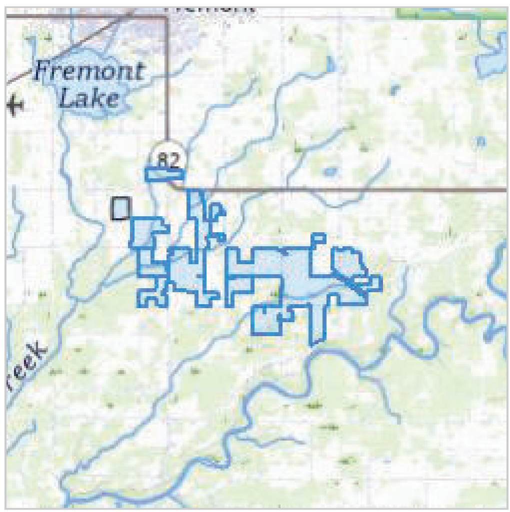
Sylvan Solar

2. Description

The following description was provided for the project 'Sylvan Solar':

> Sylvan Solar (Project) is a proposed 220-megawatt solar facility that spans portions of Garfield and Sheridan Charter Townships in Newaygo County, Michigan. The Project's fenced area encompasses approximately 1,250 acres of agricultural land.

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@43.3967194,-85.89200301089839,14z



Appendix 8 - Soil and Economic Survey Report

Attachment 8 - Soil and Economic Survey Report

United States
Department of
Agriculture

Soil
Conservation
Service

Forest Service

In cooperation with
Michigan Department of
Agriculture, Michigan
Technological University,
Michigan Agricultural
Experiment Station, and
Michigan Cooperative
Extension Service

Soil Survey of Newaygo County, Michigan

This soil survey is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey.

Major fieldwork for this soil survey was completed in 1989. Soil names and descriptions were approved in 1990. Unless otherwise indicated, statements in this publication refer to conditions in the survey area in 1989. This survey was made cooperatively by the United States Department of Agriculture, Soil Conservation Service and Forest Service; Michigan Department of Agriculture; Michigan Technological University; Michigan Agricultural Experiment Station; and Michigan Cooperative Extension Service. The survey is part of the technical assistance furnished to the Newaygo County Conservation District. The Newaygo County Board of Commissioners provided financial assistance for the survey.

Soil maps in this survey may be copied without permission. Enlargement of these maps, however, could cause misunderstanding of the detail of mapping. If enlarged, maps do not show the small areas of contrasting soils that could have been shown at a larger scale.

All programs and services of the Soil Conservation Service are offered on a nondiscriminatory basis, without regard to race, color, national origin, religion, sex, age, marital status, or handicap.

Cover: Stripcropping in an area of Metea-Marlette-Spinks complex, 6 to 12 percent slopes, and Marlette loam, moderately wet, 1 to 6 percent slopes. Napoleon peat is in the low-lying area in the foreground.

Contents

Issued February 1995

Foreword

This soil survey contains information that can be used in land-planning programs in Newaygo County, Michigan. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to ensure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Homer R. Hilner
State Conservationist
Soil Conservation Service

Soil Survey of Newaygo County, Michigan

By Thomas H. Purkey, Soil Conservation Service

Fieldwork by Thomas H. Purkey, Robert E. Evon, and Kenneth W. Farrish, Soil Conservation Service; Mary I. Dugan, Saiid Mahjoory, and Terri M. Smith, Michigan Department of Agriculture; and Richard L. Watson, United States Department of Agriculture, Forest Service

United States Department of Agriculture, Soil Conservation Service and Forest Service, in cooperation with
Michigan Department of Agriculture, Michigan Technological University, Michigan Agricultural Experiment Station, and Michigan Cooperative Extension Service

Newaygo County is in the west-central part of the Lower Peninsula of Michigan (fig. 1). It is about 24 miles wide and 36 miles long. It has an area of 551,757 acres, or about 862 square miles, of which 9,760 acres is water. White Cloud, the county seat, is in the central part of the county. In 1984, the county had a population of 36,238.

This soil survey updates the survey of Newaygo County published in 1951 *(12)*. It provides additional interpretive information and has larger maps, which show the soils in greater detail.

General Nature of the County

This section provides general information about Newaygo County. It describes climate, history and development, physiography and relief, lakes and streams, and farming.

Climate

Prepared by the Michigan Department of Agriculture, Environmental Division, Climatology Program, East Lansing, Michigan.

The climate of Newaygo County is highly varied because of topographical variations and the proximity of the county to Lake Michigan. The climatological records kept in the county are not considered reliable. Therefore, this report gives data from stations in Baldwin, which is about 6 miles north of the county; Big Rapids, about 4 miles east of the county; and Hesperia, west of the county, near the Newaygo-Oceana County line. Baldwin is in Lake County; Big Rapids, in Mecosta County; and Hesperia, in Oceana County.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Baldwin, Big Rapids, and Hesperia in the years 1951 through 1980. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 22.0 degrees F at Baldwin, 21.9 degrees at Big Rapids, and 22.9 degrees at Hesperia. The average daily minimum temperature is 12.5 degrees at Baldwin, 13.4 degrees at Big Rapids, and 14.6 degrees at Hesperia. The lowest temperature on record is -49 degrees at Baldwin, -36 degrees at Big Rapids, and -35 degrees at Hesperia. In summer the average daily maximum temperature is 81.1 degrees at Baldwin, 79.6 degrees at Big Rapids, and 80.1 degrees at Hesperia. The highest recorded temperature is 104 degrees at Baldwin, 103 degrees at Big Rapids, and 100 degrees at Hesperia.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the

Figure 1.—Location of Newaygo County in Michigan.

average temperature each day exceeds a base temperature (50 degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

The total annual precipitation is 33.97 inches at Baldwin, 31.90 inches at Big Rapids, and 33.57 inches at Hesperia. Of these totals, 19.18 inches at Baldwin, 18.52 inches at Big Rapids, and 18.91 inches at Hesperia usually fall in April through September. The growing season for most crops falls within this period. In 2 years out of 10, the rainfall in April through September is less than 15.81 inches at Baldwin, 15.20 inches at Big Rapids, and 14.94 inches at Hesperia. The heaviest 1-day rainfall during the period of record was 3.75 inches at Baldwin, 4.55 inches at Big Rapids, and 6.19 inches at Hesperia. Thunderstorms occur on about 34 days each year at Baldwin and 36 days each year at Big Rapids and Hesperia. June, July, and August each have an average of six thunderstorms.

The average seasonal snowfall is 82.7 inches at Baldwin, 70.5 inches at Big Rapids, and 75.5 inches at Hesperia. The greatest snow depth at any one time during the period of record was 41 inches at Baldwin, 38 inches at Big Rapids, and 30 inches at Hesperia. On the average, 111 days at Baldwin, 103 days at Big Rapids, and 97 days at Hesperia have at least 1 inch of snow on the ground. The number of such days varies greatly from year to year.

The heaviest 1-day snowfall on record was 33.5 inches at Baldwin, 16.0 inches at Big Rapids, and 11.0 inches at Hesperia. The greatest monthly snowfall was 65.3 inches at Baldwin, 44.5 inches at Big Rapids, and 48.1 inches at Hesperia. The greatest seasonal snowfall was 126.1 inches at Baldwin, 115.3 inches at Big Rapids, and 120.0 inches at Hesperia. The least seasonal snowfall was 23.5 inches at Baldwin, 13.0 inches at Baldwin, and 30.1 inches at Hesperia.

The average relative humidity at 1 p.m. is about 62 percent at all three stations. Humidity is higher at night, and the average at 7 a.m. is about 83 percent. The prevailing wind is from the southwest. Average windspeed is highest, 11.3 miles per hour, in January. The sun shines 62 percent of the time possible in summer and 30 percent in winter.

History and Development

From 11,000 years ago until the arrival of the first Europeans in Michigan, various Indian peoples periodically occupied what is now Newaygo County. During the retreat of the last glacier, tundra and forests of spruce covered the landscape. Indians of the Paleo Period followed caribou into what is now Michigan *(6)*. Projectile points (fluted, lanceolate points) that were used by the Indians have been found north of the Muskegon River in Newaygo County *(16)*.

By 2000 B.C., the forests and rivers began to look like those of today. Between 2000 B.C. and about 500 B.C., Indians of the Archaic Period hunted deer in winter and fished in summer *(6)*. By about 100 B.C., the Hopewell Indians lived in what is now Newaygo County. The Hopewell culture probably extended as far north as the Muskegon River in Newaygo County. Artifacts from this period have been found in numerous mounds on the river bluffs between Newaygo and Croton, where the Hopewell Indians buried artifacts with their dead *(16)*.

The Mallon Mounds near Brooks Lake and other mounds date from the Woodland Period (700 to 1000 A.D.). Indians of this period were probably the progenitors of the Ottawa Indians, who made contact with the first Europeans *(16)*. The Ottawas engaged mainly in specialized fur trapping. They exchanged furs for agricultural products grown to the south *(15)*. They fished in summer and hunted in winter. Archaeological evidence at sites in Oceana County indicates that their prey were buffalo, beaver, and elk.

The first Europeans to navigate the Muskegon River were French trappers who traded with the Indians well before recorded history. The earliest permanent trading post on the Muskegon River dates to about 1834. Another trading post was established at Old Woman's Bend, 2 miles below the present city of Newaygo *(19)*.

European settlement of Newaygo County began with lumbering. When the Indians gave up title to their land following the Treaty of 1836, speculators came to Newaygo County from Chicago. They established claims over vast timber resources, established squatter's rights at river mouths, and ran sawmills with water power. Newaygo was the first European settlement in the county. For the next 60 years, logging had the biggest influence on settlement in the county. Newaygo and Croton became important logging centers. It is believed that more logs have floated down the Muskegon River than any other river in the world *(20)*. As the timber along the river was removed, roads and railroads were built to transport logs. In about 50 years, the forest and the soils were forever changed as a result of clearcutting, forest fires, and farming.

The crops in the areas of cleared forest were used to feed the growing population in the lumbering camps. Several hundred acres were cultivated during the mid-1800's in an area of remnant prairie in what is now Big Prairie Township. The soil in this area was a Sparta sand that had a 12- to 18-inch layer of mixed sand and organic material. It was devoid of trees and could be easily farmed. The fertility of the soil was fair, and good crops were produced during the first few years. After removal of the plant cover and depletion of plant nutrients, however, the soil was dry and subject to soil blowing. In some areas 2 to 3 feet of soil was eroded. As a result, the largest area of desert east of the Mississippi River was created *(4)*. This area became a tourist attraction until it was reforested. Plantations of pine now cover much of the area.

By the last quarter of the 19th century, some of the more affordable wetlands were converted to farmland *(13)*. In the early 20th century, Rice Lake, in Grant Township, was drained. Its lakebed is now used for specialty crops *(21)*. As the logging industry slowed and the extent of farming increased, a canning factory established in Fremont to market the produce grew into a big business.

Not all of the land that was originally settled was suitable for farming, and many farms were later abandoned. Farmland that reverted to the Federal Government is today managed as the Manistee National Forest. Other farmland was purchased for use as recreational areas. The current economy of the county depends on farming, recreation, and timber products from the second-growth forest.

Physiography and Relief

The bedrock in Newaygo County consists of the edges of bowlike formations that fill the Michigan Basin. Marshall Sandstone underlies all of the county. It is the uppermost bedrock in the western half of the county. The Michigan Formation overlies the Marshall Sandstone in the eastern half of the county. This formation is primarily limestone, gypsum, and dolomite interbedded with shale and sandstone. To the east, Bayport Limestone and Parma Sandstone progressively overlie these rocks. In the central part of the county and in some areas in the eastern half, red beds overlie the Michigan, Saginaw, and Grand River Formations. They consist mainly of sandstone, shale, clay, and minor beds of limestone and gypsum *(3)*.

Overlying the rock formations is a mass of glacial drift, which was deposited after the Wisconsinan Glaciation. The glacial drift ranges from 200 to 800 feet in thickness. It is coarse gravel to fine lacustrine clay. Many of the soils in the county formed in the drift.

The present surface features in the county generally are the result of glacial action. Two major physiographic regions are recognized in the county *(9)*. One consists of several outwash plains and lake plains in nearly level valleys having definite boundaries (fig. 2). Glacial meltwater streams, which were much larger than the current rivers and streams, deposited outwash material in the valleys. The abandoned meltwater channels are filled with organic deposits in some areas and are kettle lakes in others. As the ice receded and the levels of the glacial lakes dropped, the valleys were incised and terraces formed along the present streams and rivers. The other physiographic region consists of rolling and hilly morainic areas rising from the nearly level valleys or plains. These areas consist of ground, end, recessional, and disintegration moraines.

Streams and rivers have greatly modified the surface in Newaygo County only in the valley of the Muskegon River. The surface remains much as it was when the last glaciers receded.

The lowest elevation in the county is 600 feet above mean sea level. It is in an area where the Muskegon River exits the southwestern part of the county. The highest elevation is 1,300 feet above mean sea level. It is in an area in the far northeastern part of the county.

Lakes and Streams

Newaygo County has abundant surface and ground water resources. The ground water is a source of good-quality drinking water for residents of the county. The 460 natural lakes, 234 of which are larger than 1.3

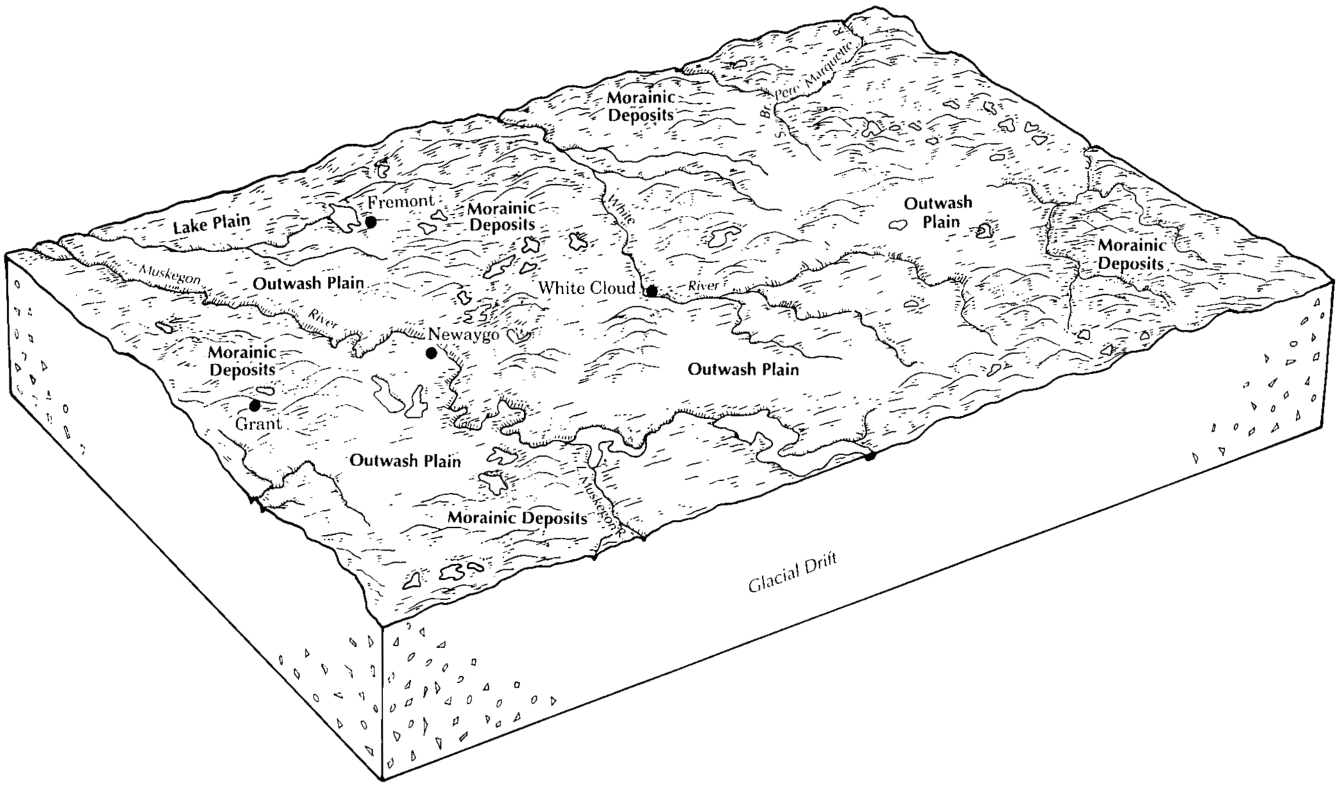


Figure 2.—Physiography of Newaygo County, Michigan.

acres in size, and the 356 miles of streams in the county provide ample opportunities for recreation. Hydroelectric dams on the Muskegon River have formed two manmade lakes—Hardy Pond, which is 2,845 acres in size, and Croton Dam Pond, which is 1,235 acres in size. These lakes provide opportunities for recreation *(14)*.

Most of the larger natural lakes are in the southern half of the county. They are within 10 miles of the city of Newaygo. Hess Lake, the largest, is 1,125 acres in size, and Fremont Lake, the next largest, is 790 acres in size. Brooks, Bills, Pickerel, Brookings, and Ryerson Lakes are all larger than 200 acres in size. The areas around the larger lakes have been intensively developed for residential uses. In some of the lakes in the county, there are problems with water quality because the soils around the lakes are sandy and are used intensely for residential and agricultural purposes. Algae blooms, for example, have occurred in some areas where the lakes have received runoff containing phosphorus from fertilized fields. Nearly all of the lakes have high-quality water that requires only initial treatment to be suitable for food processing and drinking. Exceptions are Hess, Fremont, Peterson, and Hesperia Lakes. The smaller lakes in the public forests provide opportunities for recreational activities. Numerous unnamed bodies of water provide habitat for many species of wetland wildlife.

Newaygo County is drained by several rivers. The northern part of the county is drained by the Pere Marquette and Little Pere Marquette Rivers. The White River originates in the central plain in the county and flows west. The Muskegon River drains a large area in the middle and southern parts of the county. Crockery Creek and the Rogue River, which are in the southernmost part of the county, drain into the Grand River.

Farming

Glenn Lamberg, district conservationist, and Maya Hamady, soil conservationist, Soil Conservation Service, helped prepare this section.

About 160,100 acres in Newaygo County, or 29 percent of the total acreage, is farmland. About 103,600 acres is used for crops or pasture. About 4,600 acres is used as permanent pasture. Because most row crop rotations include several years of hay or pasture, the combined acreage of pasture and hayland in any one year is estimated at about 56,000 acres. Of the acreage used as cropland, roughly 90,000 acres is used for row crops, mostly corn; 3,000 acres is used for orchard crops, mainly apples, peaches, cherries, plums, and pears; and 6,000 acres is used for vegetable crops, mainly mint, asparagus, celery, squash, peppers, turnips, cabbage, tomatoes, parsnips, and sweet corn. In 1986, about 25,000 acres was used for corn and 3,950 acres for small grain, mainly oats and wheat. An estimated 4,000 acres is used for Christmas tree farms. Dairy products and livestock also are important parts of the agriculture in the county.

Because many of the soils are suitable for cropland, the climate is favorable, and markets for farm products are nearby, farming probably will continue to be an important part of the economy in Newaygo County. The available farmland has been under increasing pressure from nonagricultural uses, such as building site development.

How This Survey Was Made

This survey was made to provide information about the soils in the survey area. The information includes a description of the soils and their location and a discussion of the suitability, limitations, and management of the soils for specified uses. Soil scientists observed the steepness, length, and shape of slopes; the general pattern of drainage; and the kinds of crops and native plants growing on the soils. They dug many holes to study the soil profile, which is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

The soils in the survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil is associated with a particular kind of landscape or with a segment of the landscape. By observing the soils in the survey area and relating their position to specific segments of the landscape, a soil scientist develops a concept, or model, of how the soils were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. The system of taxonomic classification used in the United States is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot assure that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Map Unit Composition

A map unit delineation on a soil map represents an area dominated by one major kind of soil or an area dominated by two or three kinds of soil. A map unit is identified and named according to the taxonomic classification of the dominant soil or soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural objects. In common with other natural objects, they have a characteristic variability in their properties. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of soils of other taxonomic classes. Consequently, every map unit is made up of the soil or soils for which it is named and some soils that belong to other taxonomic classes. These latter soils are called inclusions or included soils.

Most inclusions have properties and behavioral patterns similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting (similar) inclusions. They are described but are not identified by name in the map unit descriptions. Other inclusions, however, have properties and behavior divergent enough to affect use or require different management. These are contrasting (dissimilar) inclusions. They generally occupy small areas and cannot be shown separately on the soil maps because of the scale used in mapping. The inclusions of contrasting soils are identified by name in the map unit descriptions. A few inclusions may not have been observed and consequently are not mentioned in the descriptions, especially where the soil pattern was so complex that it was impractical to make enough observations to identify all of the kinds of soil on the landscape.

The presence of inclusions in a map unit in no way diminishes the usefulness or accuracy of the soil data. The objective of soil mapping is not to delineate pure taxonomic classes of soils but rather to separate the landscape into segments that have similar use and management requirements. The delineation of such landscape segments on the map provides sufficient information for the development of resource plans, but onsite investigation is needed to plan for intensive uses in small areas.

Survey Procedures

The general procedures followed in making this survey are described in the "National Soils Handbook" of the Soil Conservation Service *(26)*. The Huron-Manistee National Forest ecological classification system was used in conjunction with the handbook to prepare the soil survey on most of the Forest Service lands and on some private tracts within the administrative boundary of the Manistee National Forest *(5)*. The map units on the Forest Service lands were designed differently from those in other parts of the survey area. The Soil Conservation Service and the Michigan Department of Agriculture mapped most of the private and State lands. The Forest Service mapped most of the Federal lands.

The ecological classification system is an integrated system that includes evaluation and classification of landscape areas. Ecological units are mapped on aerial photographs, and interpretations are made from inventory maps for use in forest land and resource management.

General Procedures

The soil survey maps made for conservation planning prior to the start of the project and the survey of Newaygo County published in 1951 *(12)* were among the references used in making this survey. Before the fieldwork began, preliminary boundaries of slopes and landforms were plotted stereoscopically on 1:15,840 leaf-off aerial photography. U.S. Geologic Survey topographic maps, at a scale of 1:24,000, helped the soil scientists to relate land and image features.

A reconnaissance was made by pickup truck before the soil scientists traversed the surface on foot, examining the soils. In areas where the soil pattern is very complex, traverses and random observations were spaced as close as 200 yards. In areas where the soil pattern is relatively simple, traverses were about 0.25 mile apart.

As they traversed the surface, the soil scientists divided the landscape into segments. For example, a hillside was separated from a swale and a gently sloping ridgetop from a very steep side slope.

Observations of such items as landforms, blown-down trees, vegetation, and roadbanks were made without regard to spacing. Soil boundaries were determined on the basis of soil examinations, observations, and photo interpretation. The soil material was examined with the aid of a hand auger or a spade to a depth of about 5 feet. The pedons described as typical were observed and studied in pits that were dug with shovels, mattocks, and digging bars.

Extensive notes were taken on the composition of map units during the first year of the project. These notes were supplemented by additional notes as mapping progressed and the composition of individual map units was determined.

Samples for chemical and physical analyses were taken from representative sites of some soils in the survey area. The analyses were made by the Soil Research Laboratory, Michigan Technological University, Houghton, Michigan, and the Soil Survey Laboratory, Lincoln, Nebraska. The results of the studies can be obtained on request from the two laboratories or from the Michigan State Office, Soil Conservation Service, East Lansing, Michigan.

After the completion of soil mapping on aerial photographs, map unit delineations were transferred by hand to another set of the same photographs. Cultural features were recorded from observations of the maps and the landscape.

Procedures in the Huron-Manistee National Forest

Before ecological units were mapped, information about the climate, geology, soils, hydrology, and vegetation in the survey area was collected. Research techniques were used in mid-late successional stands to collect information on vegetative and soil components in areas on uplands. Samples were not collected on early successional aspen stands, young stands, plantations, or stands disturbed by recent harvesting or by fires. The results were used in developing ecological map units that are defined on the basis of either abiotic landscape characteristics, such as climate and landforms, which generally are stable through time, or biotic landscape characteristics, such as vegetation, which generally are unstable through time.

A premapping reconnaissance was conducted in the survey area before the start of the field inventory. An important result of the reconnaissance activities was a list of the ecological units expected to be mapped in the area, a definition of the features differentiating the units, and a set of specific sites in the Manistee National Forest where detailed data had been collected and analyzed in the laboratory for quality control.

Following reconnaissance, the mapping personnel traversed the landscape, evaluated the components of the current ecosystems, determined and observed the boundaries of the ecological units in the field, and delineated preliminary map units on aerial photographs. During field mapping, stereo images, photo tones, and photo colors were used to delineate landscape features on the aerial photographs. Some important characteristics used by the field personnel to evaluate the context of an area included water table levels, soil texture and color, drainage systems, geologic indicators, and interpretation of groups of vegetative species.

Mappers inventoried 300 to 500 acres per day. During a typical day, they performed detailed evaluations and completed note cards on 10 to 15 strategically selected sites. The landscape features were examined, and data on overstory, understory, ground flora, forest floor, soil, substratum, and ground water were collected. Sandy soils were described to a depth of 15 feet. These data are a permanent part of the forest records available at the office of the supervisor of the Huron-Manistee National Forest.

Following field inventory, the final boundaries of the ecological units were drawn on the aerial photographs. The completed photography was checked for line closure and for matching of delineations across photographs.

General Soil Map Units

The general soil map at the back of this publication shows the soil associations in this survey area. Each association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape. Typically, an association consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one association can occur in another but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one association differ from place to place in slope, depth, drainage, and other characteristics that affect management.

Some of the boundaries on the general soil map of Newaygo County do not match those on the maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences result from modifications or refinements in soil series concepts and from variations in the intensity of mapping or in the extent of the soils in the counties.

Soil Descriptions

1. Plainfield-Grattan-Brems Association

Nearly level to steep, excessively drained and moderately well drained, sandy soils on outwash plains and moraines

This association consists mainly of Plainfield soils on outwash plains and Grattan and Brems soils on outwash plains and moraines. Slope ranges from 0 to 30 percent.

This association makes up about 30 percent of the county. It is about 47 percent Plainfield and similar soils, 32 percent Grattan and similar soils, 11 percent Brems and similar soils, and 10 percent soils of minor extent.

Plainfield soils are nearly level to rolling and are excessively drained. Typically, the surface layer is black sand about 2 inches thick. The subsoil is dark brown and strong brown, loose sand about 25 inches thick. The underlying material to a depth of 60 inches is very pale brown sand.

Grattan soils are nearly level to steep and are excessively drained. Typically, the surface layer is black sand about 4 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 14 inches of dark brown, loose sand that has a few chunks of brittle material. The underlying material to a depth of 60 inches is strong brown sand.

Brems soils are nearly level and very gently sloping and are moderately well drained. Typically, the surface layer is dark brown sand about 8 inches thick. The subsoil is mottled sand about 38 inches thick. The upper part is strong brown and very friable, and the lower part is brownish yellow and loose. The underlying material to a depth of 60 inches is light yellowish brown, mottled, loose sand.

The minor soils in this association include the excessively drained Sparta and Coloma soils. Sparta soils are on flats and knolls, and Coloma soils are on flats, knolls, and ridges.

Most areas of this association are used as woodland and wildlife habitat. Because of soil blowing and droughtiness, the major soils are generally unsuited to cropland and poorly suited to pasture. They are fairly well suited to woodland. The equipment limitation, the hazard of erosion, and seedling mortality are the major concerns in managing woodland.

The major soils are well suited, fairly well suited, or poorly suited to building site development, depending on the slope. They are poorly suited to septic tank absorption fields because of a poor filtering capacity.

2. Cosad-Del Rey-Sickles Association

Nearly level and gently undulating, somewhat poorly drained and poorly drained, sandy and loamy soils on lake plains

Areas of the major soils in this association are intermingled on broad plains, low ridges, and knolls. Slope ranges from 0 to 4 percent.

This association makes up about 3 percent of the

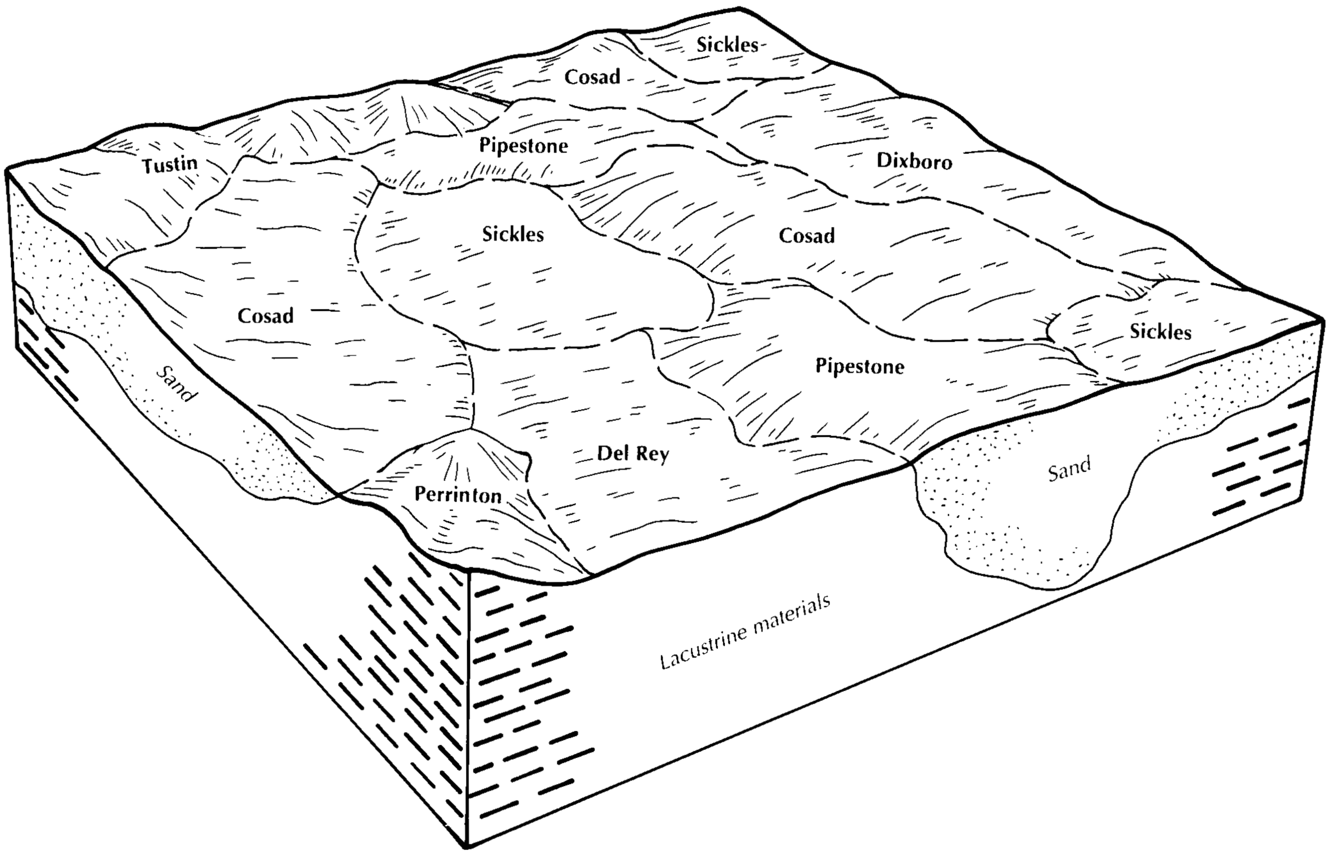


Figure 3.—Typical pattern of soils and parent material in Cosad-Del Rey-Sickles association.

county. It is about 35 percent Cosad and similar soils, 26 percent Del Rey and similar soils, 18 percent Sickles and similar soils, and 21 percent soils of minor extent (fig. 3).

Cosad soils are somewhat poorly drained. Typically, the surface layer is very dark gray loamy sand about 12 inches thick. The subsoil is pale brown, mottled, very friable loamy sand about 9 inches thick. The underlying material to a depth of 60 inches is grayish brown, mottled silty clay loam.

Del Rey soils are somewhat poorly drained. Typically, the surface layer is dark brown loam about 11 inches thick. The subsurface layer is light brownish gray and brown, mottled loam about 4 inches thick. The subsoil is about 9 inches of dark yellowish brown and yellowish brown, mottled, firm silty clay loam and very fine sandy loam. The underlying material to a depth of 60 inches is brown, mottled silty clay loam.

Sickles soils are poorly drained. Typically, the surface layer is black loamy fine sand about 8 inches thick. The next layer is grayish brown, very friable loamy fine sand about 12 inches thick. Below this is about 7 inches of light brownish gray, mottled, friable, stratified loamy fine sand and silt loam. The underlying material to a depth of 60 inches is brown, mottled silty clay.

The minor soils in this association include Dixboro, Pipestone, Perrinton, and Tustin soils. Dixboro soils are somewhat poorly drained and are on nearly level plains and along the upper edges of some drainageways. Pipestone soils are somewhat poorly drained and are on flats and slight rises. Perrinton and Tustin soils are well drained and are on the tops and sides of ridges.

Most areas of this association are used as cropland. Some areas are used as woodland or are left idle. The major soils are well suited to cropland. Wetness, water erosion, and soil blowing are the major concerns in managing cropland. If the sandy soils are drained, drought is a hazard. The major soils are fairly well suited to woodland. The equipment limitation, seedling mortality, and the hazard of windthrow are the major concerns in managing woodland.

The major soils are poorly suited or generally unsuited to septic tank absorption fields and building site development. Wetness and restricted permeability are the major management concerns.

3. Glendora-Abscota-Algansee Association

Nearly level and gently undulating, very poorly drained, somewhat poorly drained, and moderately well drained, sandy and loamy soils on flood plains

This association consists mainly of Glendora soils, commonly on the first bottoms of flood plains, and Abscota and Algansee soils on the first or second bottoms of flood plains and on natural levees in areas of the first bottoms. Slope ranges from 0 to 3 percent.

This association makes up about 5 percent of the county. It is about 64 percent Glendora and similar soils, 20 percent Abscota and similar soils, 12 percent Algansee and similar soils, and 4 percent soils of minor extent.

Glendora soils are nearly level and very poorly drained. Typically, the surface layer is black mucky sand about 5 inches thick. The next 8 inches is light brownish gray, mottled, very friable loamy fine sand. The next 7 inches is brown, mottled, loose sand that has streaks of fine sandy loam. The next 3 inches is dark gray, mottled, very friable loamy fine sand. The underlying material to a depth of 60 inches is gray, dark gray, and brown, mottled sand and very gravelly sand.

Abscota soils are nearly level and very gently sloping and are moderately well drained. Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is dark brown, very friable loamy fine sand about 7 inches thick. The underlying material to a depth of 60 inches is dark yellowish brown, brownish yellow, light yellowish brown, and very pale brown, mottled sand.

Algansee soils are nearly level and very gently sloping and are somewhat poorly drained. Typically, the surface layer is dark grayish brown loamy fine sand about 7 inches thick. The next layer is brown, friable loamy fine sand about 5 inches thick. Below this to a depth of 60 inches is very pale brown and light gray, mottled fine sand.

The minor soils in this association include Ceresco and Adrian soils. Ceresco soils are somewhat poorly drained and are on natural levees and first bottoms. Adrian soils are very poorly drained and are in swales and low areas on the flood plains.

Most areas of this association are used as woodland or are left idle. A few areas are used as cropland. Abscota and Algansee soils are fairly well suited to cropland and well suited to woodland. Glendora soils are generally unsuited to cropland. Wetness and flooding are the major concerns in managing cropland. If the sandy soils are drained, drought is a hazard. Soil blowing is a hazard on the sandy soils. The equipment limitation and the hazard of windthrow are the major concerns in managing woodland.

The major soils are generally unsuited to septic tank absorption fields and building site development because of wetness and flooding.

4. Marlette-Metea-Spinks Association

Nearly level to steep, moderately well drained and well drained, loamy and sandy soils on moraines

This association consists mainly of Marlette, Metea, and Spinks soils on flats, knolls, and ridges. Slope ranges from 0 to 40 percent.

This association makes up about 17 percent of the county. It is about 30 percent Marlette and similar soils, 26 percent Metea and similar soils, 19 percent Spinks and similar soils, and 25 percent soils of minor extent.

Marlette soils are nearly level to rolling and are well drained and moderately well drained. Typically, the surface layer is dark grayish brown loam about 8 inches thick. The next layer is brown and pale brown, friable loam about 8 inches thick. The subsoil is brown, firm clay loam about 11 inches thick. The underlying material to a depth of 60 inches is yellowish brown loam.

Metea soils are nearly level to steep and are well drained. Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is strong brown and pale brown, very friable and loose sand about 24 inches thick. The subsoil is brown, firm clay loam about 16 inches thick. The underlying material to a depth of 60 inches is brown loam.

Spinks soils are nearly level to steep and are well drained. Typically, the surface layer is dark brown loamy sand about 11 inches thick. The subsurface layer is yellowish brown and brownish yellow, loose sand about 16 inches thick. The subsoil to a depth of 60 inches is brownish yellow and yellowish brown, loose sand that has thin lamellae of strong brown and brown, very friable loamy sand.

The minor soils in this association include the well drained Perrinton soils, the somewhat poorly drained Selfridge soils, and the poorly drained Parkhill soils. Perrinton soils are on knolls and ridges. Selfridge and Parkhill soils are in depressions, in drainageways, and on low flats.

Most areas of this association are used as cropland. Some areas are used as woodland and wildlife habitat. The nearly level to undulating soils are well suited or fairly well suited to cropland. The soils that have slopes of more than 12 percent are poorly suited or generally unsuited to cropland. Water erosion is a hazard. Deterioration of tilth in the Marlette soils and droughtiness and soil blowing in areas of the Metea and Spinks soils are additional management concerns. All of the major soils are well suited to woodland. Erosion and the equipment limitation are concerns in managing woodland in the more sloping areas.

The major soils are well suited, fairly well suited, poorly suited, or generally unsuited to building site development and septic tank absorption fields. The slope is a management concern on the undulating to very steep soils. Moderately slow permeability in the Marlette and Metea soils also is a management concern.

5. Coloma-Spinks-Metea Association

Nearly level to steep, excessively drained and well drained, sandy soils on moraines

This association consists mainly of Coloma, Spinks, and Metea soils on knolls and ridges. Slope ranges from 0 to 40 percent.

This association makes up about 26 percent of the county. It is about 47 percent Coloma and similar soils, 13 percent Spinks and similar soils, 11 percent Metea and similar soils, and 29 percent soils of minor extent.

Coloma soils are excessively drained. Typically, the surface layer is black sand about 3 inches thick. The subsurface layer is brown and yellow sand about 40 inches thick. Below this to a depth of 60 inches is very pale brown, loose sand that has thin lamellae of yellowish red, loose loamy sand.

Spinks soils are well drained. Typically, the surface layer is dark brown, loose loamy sand about 11 inches thick. The subsurface layer is yellowish brown and brownish yellow, loose sand about 16 inches thick. The subsoil to a depth of 60 inches is brownish yellow and yellowish brown, loose sand that has thin lamellae of strong brown and brown, very friable loamy sand.

Metea soils are well drained. Typically, the surface layer is very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is strong brown and pale brown, very friable and loose sand about 24 inches thick. The subsoil is brown, firm clay loam about 16 inches thick. The underlying material to a depth of 60 inches is brown clay loam.

The minor soils in this association include the excessively drained Grattan soils, the somewhat poorly drained Pipestone soils, the excessively drained Plainfield soils, and the somewhat poorly drained Selfridge soils. Pipestone and Selfridge soils are in depressions, in drainageways, and on low flats on moraines. Grattan and Plainfield soils are on knolls and ridges.

Most areas of this association are used as woodland. Some areas are used as cropland or wildlife habitat. The nearly level to undulating soils are fairly well suited or poorly suited to cropland. The soils that have slopes of more than 12 percent are poorly suited or generally unsuited to cropland because of the hazard of water erosion. Droughtiness and soil blowing are the major concerns in managing cropland. All of the major soils are well suited to woodland. Erosion and the equipment limitation are concerns in managing woodland in the sloping to steep areas. Seedling mortality also is a concern in managing woodland.

Depending on the slope, the major soils are well suited, fairly well suited, poorly suited, or generally unsuited to building site development and septic tank absorption fields. The slope of all three soils, a poor filtering capacity in the Coloma soils, and moderately slow permeability in the subsoil of the Metea soils are the major management concerns.

6. Toogood-Boyer Association

Nearly level to steep, somewhat excessively drained to moderately well drained, sandy soils on outwash plains and terraces

This association consists mainly of Toogood and Boyer soils on broad, flat plains, on the side slopes of drainageways, and on ridges and knolls. Slope ranges from 0 to 18 percent.

This association makes up 4 percent of the county. It is about 60 percent Toogood and similar soils, 30 percent Boyer and similar soils, and 10 percent soils of minor extent.

Toogood soils are nearly level to rolling and are somewhat excessively drained and moderately well drained. Typically, the surface layer is black loamy sand about 4 inches thick. The upper part of the subsoil is dark brown, very friable loamy sand about 4 inches thick. The next part is yellowish brown, very friable loamy sand about 26 inches thick. The lower part is dark brown, very friable gravelly sandy loam about 2 inches thick. The underlying material to a depth of 60 inches is light yellowish brown gravelly coarse sand.

Boyer soils are nearly level to steep and are well drained. Typically, the surface layer is dark brown loamy sand about 10 inches thick. The subsoil is about 20 inches thick. The upper part is dark brown, very friable loamy sand. The lower part is reddish brown, friable gravelly sandy loam. The underlying material to a depth of 60 inches is yellowish brown gravelly coarse sand.

The minor soils in this association include Coloma soils, the Granby soils that have a gravelly substratum, and Kingsville and Watseka soils. The somewhat excessively drained Coloma soils are on broad, flat plains, on the side slopes of steep drainageways, and on ridges and knolls. The somewhat poorly drained Watseka soils, the poorly drained Granby soils that have a gravelly substratum, and the poorly drained Kingsville soils are on low plains, in depressions, and in drainageways.

Most areas of this association are used as woodland. Some areas are used as cropland. Toogood soils are poorly suited or generally unsuited to cropland, and Boyer soils are fairly well suited. Drought and soil blowing are hazards. In areas that have slopes of more than 6 percent, water erosion also is a hazard. The major soils are well suited, fairly well suited, or poorly suited to woodland. Seedling mortality is a management concern on the Toogood soils. The equipment limitation is a management concern in the steeper areas of the Boyer soils.

The major soils are well suited, fairly well suited, poorly suited, or generally unsuited to building site development. The slope is a limitation in the strongly sloping to steep areas. The major soils are fairly well suited, poorly suited, or generally unsuited to septic tank absorption fields. A poor filtering capacity is the main management concern. The slope also is a concern in some areas.

7. Adrian-Carlisle-Martisco Association

Nearly level, very poorly drained, organic soils on lake plains and outwash plains

The major soils in this association are on broad, smooth or slightly concave plains, in depressions, and in drainageways. Slope ranges from 0 to 2 percent.

This association makes up about 4 percent of the county. It is about 50 percent Adrian and similar soils, 24 percent Carlisle and similar soils, 10 percent Martisco and similar soils, and 16 percent soils of minor extent.

Typically, the surface layer of the Adrian soils is black muck about 5 inches thick. The next 14 inches also is black muck. The underlying material to a depth of 60 inches is light brownish gray and gray sand and loamy sand.

Typically, the surface layer of the Carlisle soils is black muck about 18 inches thick. The underlying layers to a depth of 60 inches are black and very dark brown muck.

Typically, the surface layer of the Martisco soils is black muck about 11 inches thick. The underlying material to a depth of 60 inches is olive gray marl.

The minor soils in this association include the very poorly drained Edwards, poorly drained Kingsville, and somewhat poorly drained Thetford soils. Edwards soils are on broad, smooth or slightly concave plains, in depressions, and in drainageways. Kingsville soils are on slight rises and in other areas on broad plains. Thetford soils are on slight rises and low ridges.

Most areas of this association are used as woodland. The largest single area is used for truck crops. The major soils are poorly suited to cropland. Wetness, soil blowing, and subsidence are the major management concerns. All of the major soils are poorly suited to woodland. The equipment limitation, seedling mortality, and the hazard of windthrow are concerns in managing woodland.

The major soils are generally unsuited to building site development and septic tank absorption fields. Wetness and low strength in all of the major soils are the main management concerns.

8. Pipestone-Covert-Kingsville Association

Nearly level and gently undulating, somewhat poorly drained, moderately well drained, and poorly drained, sandy soils on outwash plains

This association consists mainly of Pipestone soils on broad, smooth or slightly convex plains, on low ridges, and on side slopes; Covert soils on uplands, knolls, and plains; and Kingsville soils on low flats and in depressions and drainageways. Slope ranges from 0 to 5 percent.

This association makes up about 11 percent of the county. It is about 34 percent Pipestone and similar soils, 33 percent Covert and similar soils, 23 percent Kingsville and similar soils, and 10 percent soils of minor extent.

Pipestone soils are nearly level and gently undulating and are somewhat poorly drained. Typically, the surface layer is very dark gray sand about 7 inches thick. The subsurface layer is pale brown, mottled sand about 6 inches thick. The subsoil is about 16 inches of reddish brown and brown, mottled, friable and loose sand that has common chunks and pieces of reddish brown and brown, brittle material. The underlying material to a depth of 60 inches is light yellowish brown, mottled sand.

Covert soils are nearly level and gently undulating and are moderately well drained. Black, well decomposed forest litter about 4 inches thick is on the surface. Typically, the surface layer is pinkish gray sand about 4 inches thick. The subsoil is about 20 inches of dark brown, very friable sand that has a few chunks of dark reddish brown, brittle material. The underlying material to a depth of 60 inches is light yellowish brown, mottled sand.

Kingsville soils are nearly level and poorly drained. Typically, the surface layer is black mucky sand about 7 inches thick. The subsoil is pale brown, loose sand about 28 inches thick. The underlying material to a depth of 60 inches is brown sand.

The minor soils in this association include the very poorly drained Adrian and poorly drained Jebavy soils on low flats and in depressions and drainageways.

Most areas of this association are used as woodland. Some areas are used as cropland or are left idle. The major soils are poorly suited or generally unsuited to cropland. Drought and soil blowing are hazards. Also, wetness is a concern in managing Kingsville and Pipestone soils. The major soils are well suited, fairly well suited, or poorly suited to woodland. Seedling mortality and the equipment limitation are concerns in managing woodland. Also, windthrow is a concern on Kingsville and Pipestone soils.

The major soils are poorly suited or generally unsuited to building site development and septic tank absorption fields. Wetness in all of the major soils is the main management concern.

Broad Land Use Considerations

Each year, some areas in Newaygo County are developed for residential, commercial, or industrial uses. Deciding what land should be used for urban development is a very important issue. The general soil map is suitable for broad land use planning, but it is not suitable for selecting a site for a specific use.

Extensive areas of soils are severely limited as sites for residential and other urban uses. The seasonal high water table and moderately slow permeability are severe limitations on a large acreage in the Cosad-Del Rey-Sickles association. The seasonal high water table is a severe limitation in areas of the Pipestone-Covert-Kingsville association. Flooding, ponding, and the seasonal high water table are severe limitations in areas of the Glendora-Abscota-Algansee association. The seasonal high water table, ponding, and the instability of organic material are severe limitations in areas of the Adrian-Carlisle-Martisco association. The slope is a severe limitation in parts of the Marlette-Metea-Spinks and Coloma-Spinks-Metea associations.

Some of the soils in the county can be developed for urban uses. These include the less sloping, well drained soils in the Plainfield-Grattan-Brems, Coloma-Spinks-Metea, and Toogood-Boyer associations.

The Cosad-Del Rey-Sickles and Marlette-Metea-Spinks associations are better suited to farming than the other associations. Their suitability should be considered when broad land use decisions are made. A considerable acreage of these associations is already used for building sites, golf courses, or other nonfarm uses.

Some of the soils in the county are well suited to farming but are poorly suited to nonfarm uses. The major soils in the Cosad-Del Rey-Sickles association are examples. Wetness limits farm uses on these soils, but it can be overcome by a drainage system and by land shaping. It cannot be easily overcome on sites for nonfarm uses.

Most of the soils in the county are well suited or fairly well suited to woodland. Many soils are well suited to parks and other recreational areas. Undrained areas of Adrian and other poorly drained or very poorly drained soils provide habitat for many species of wildlife and are good nature study areas.

Detailed Soil Map Units

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More information on each map unit, or soil, is given under the heading "Use and Management of the Soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil and gives the principal hazards and limitations to be considered in planning for specific uses.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Plainfield sand, 0 to 6 percent slopes, is a phase of the Plainfield series.

Some map units are made up of two or more major soils. These map units are called soil complexes or undifferentiated groups.

A *soil complex* consists of two or more soils, or one or more soils and a miscellaneous area, in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Selfridge-Capac complex, 0 to 5 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils in the mapped areas are not uniform. An area can be made up of only one of the major soils, or it can be made up of all of them. Histosols and Aquents, ponded, is an undifferentiated group in this survey area.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Pits, sand and gravel, is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Some of the boundaries on the detailed soil maps of Newaygo County do not match those on the soil maps of adjacent counties, and some of the soil names and descriptions do not fully agree. Differences are the result of modifications or refinements in soil series concepts or variations in the intensity of mapping or in the extent of the soils in the counties.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of Tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The "Glossary" defines many of the terms used in describing the soils.

Soil Descriptions

2—Glendora mucky sand. This nearly level, very poorly drained soil is on the first bottoms of flood plains. It is frequently flooded. Slope ranges from 0 to 2 percent. Individual areas are narrow to broad and elongated and range from 3 to 150 acres in size.

Typically, the surface layer is black mucky sand about 5 inches thick. The next 8 inches is light brownish gray, mottled, very friable loamy fine sand. The next 7 inches is brown, mottled, loose sand that has streaks of fine sandy loam. The next 3 inches is dark gray, mottled, very friable loamy fine sand. The underlying material to a depth of 60 inches is gray, dark gray, and brown, mottled sand and very gravelly sand. In places the surface layer is muck less than 16 inches thick.

Included with this soil in mapping are small areas of steep and very steep soils, the somewhat poorly drained Algansee and Ceresco soils, the poorly drained Cohoctah soils, and the very poorly drained Adrian soils. The steep and very steep soils are along the edges of the mapped areas, adjacent to uplands. Algansee and Ceresco soils are on the slightly higher knolls and natural levees. Cohoctah soils are dominantly loamy throughout. They are in landscape positions similar to those of the Glendora soil. Adrian soils are in the slightly lower swales. They have more than 16 inches of muck in the upper part. The steep and very steep soils make up about 5 percent of the unit, and the other included soils make up 10 to 15 percent.

Permeability is rapid in the Glendora soil, and the available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is at or near the surface from late fall through late spring and during excessively wet periods.

Most areas are used as woodland or are left idle. Some of the idle areas are covered with brush. Because of flooding and wetness, this soil is generally unsuited to pasture and cropland. Draining the soil is difficult because adequate drainage outlets are not available in all areas.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. The use of equipment is restricted during wet periods, but the equipment can be used when the soil is relatively dry or frozen. Seedling losses may be high because of wetness. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is Vlw. The woodland ordination symbol is 3W. The Michigan soil management group is L-4c.

3—Adrian muck. This nearly level, very poorly drained soil is on till plains, outwash plains, and moraines. Slope ranges from 0 to 2 percent. Individual areas are irregularly shaped or oval and range from 2 to 400 acres in size.

Typically, the surface layer is black muck about 5 inches thick. The next 14 inches also is black muck. The underlying material to a depth of 60 inches is light brownish gray and gray sand and loamy sand. In places the muck is less than 16 inches thick.

Included with this soil in mapping are small areas of Edwards, Carlisle, and Kingsville soils. The very poorly drained Edwards and poorly drained Kingsville soils generally are on the edges of the mapped areas. Edwards soils are underlain by marl at a depth of 16 to 50 inches. Kingsville soils are sand throughout. The very poorly drained Carlisle soils generally are in the middle of the mapped areas. They have mineral material at a depth of more than 50 inches. Included soils make up 4 to 15 percent of the unit.

Permeability is moderately slow to moderately rapid in the organic layers of the Adrian soil and rapid in the sandy material. The available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring and during excessively wet periods.

Most areas are used as woodland. Some areas are used for shallow-rooted vegetable crops.

This soil is poorly suited to cropland unless it is drained. Where drained, it is used for such crops as corn, carrots, and onions. Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system or open ditches can help to remove excess water. Draining the soil is difficult in many areas because drainage outlets are not readily available. Controlled drainage improves the stability of the soil and reduces the risk of subsidence. Wind stripcropping, windbreaks, vegetative barriers, and cover crops help to control soil blowing. The use of equipment is limited during wet periods.

This soil is fairly well suited to pasture. Grazing when the soil is wet can destroy forage plants and damage soil structure. The legumes and grasses that are tolerant of wet conditions grow best.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. The use of heavy harvesting equipment is limited by wetness and by low soil strength. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. The use of equipment should be restricted to periods when the soil is frozen. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of wetness, subsidence, and low strength, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is IVw. The woodland ordination symbol is 2W. The Michigan soil management group is M/4c.

4A—Cosad loamy sand, 0 to 3 percent slopes. This somewhat poorly drained, nearly level and gently undulating soil is in depressions on outwash plains and lake plains. Individual areas range from 2 to 250 acres in size.

Typically, the surface layer is very dark gray loamy sand about 12 inches thick. The subsoil is pale brown, mottled, very friable loamy sand about 9 inches thick. The underlying material to a depth of 60 inches is grayish brown, mottled silty clay loam. In places the subsoil is dark brown.

Included with this soil in mapping are small areas of Del Rey, Pipestone, and Sickles soils. Del Rey soils are somewhat poorly drained and are in landscape positions similar to those of the Cosad soil. They are loamy in the upper part. Pipestone soils are somewhat poorly drained and are in landscape positions similar to those of the Cosad soil or on slight rises. They are sandy throughout. Sickles soils are poorly drained and are in slight depressions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Cosad soil and slow in the lower part. The available water capacity is moderate. Surface runoff is slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from late fall through spring and during excessively wet periods.

Most areas are used as cropland. Some areas are used as woodland or pasture or are left idle.

This soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness, water erosion, and soil blowing. If drainage outlets are available, a subsurface drainage system is effective in reducing wetness. Suitable filtering material may be needed around tile lines to keep fine sand and silt from flowing into the lines. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and increase the available water capacity. Vegetative barriers and field windbreaks also help to control soil blowing.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during excessively wet or dry periods help to keep the pasture in good condition. The legumes and grasses that are tolerant of wet conditions grow best in undrained areas.

Where this soil is used as woodland, the equipment limitation is the major management concern. Ruts can form if heavy equipment is used during wet periods. The equipment should be used only when the soil is relatively dry or frozen.

Because of the high water table and a high shrink-swell potential in the underlying material, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of the high water table and the slow permeability in the underlying material. Buildings can be constructed on suitable well compacted fill material, which raises the site. Subsurface drains lower the water table. If the foundation reaches to the underlying material, widening the foundation trenches and then backfilling with suitable coarse textured material can help to prevent the structural damage caused by shrinking and swelling. All sanitary facilities should be connected to municipal sewage systems.

The land capability classification is IIIw. The woodland ordination symbol is 3W. The Michigan soil management group is 4/1b.

5B—Pipestone sand, 0 to 4 percent slopes. This nearly level and very gently sloping, somewhat poorly drained soil is on low knolls and ridges on lake plains and outwash plains. Individual areas are irregular in shape and range from 2 to 375 acres in size.

Typically, the surface layer is very dark gray sand about 7 inches thick. The subsurface layer is pale brown, mottled sand about 6 inches thick. The subsoil is about 16 inches of reddish brown and brown, mottled, friable and loose sand that has common chunks and pieces of brittle material. The underlying material to a depth of 60 inches is light yellowish brown, mottled sand. In places the subsoil is a lighter shade of brown and does not have chunks of brittle material.

Included with this soil in mapping are small areas of Thetford and Kingsville soils. Thetford soils have bands of loamy sand in the subsoil. They are in landscape positions similar to those of the Pipestone soil. Kingsville soils are in slight depressions. Included soils make up less than 10 percent of the unit.

Permeability is rapid in the Pipestone soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 0.5 foot to 1.5 feet from fall through late spring and during excessively wet periods.

Most areas are used as woodland or are left idle. A few areas are used as pasture or cropland.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and blueberries can be grown. The major management concerns are droughtiness, soil blowing, and wetness. If drainage outlets are available, a subsurface drainage system is effective in reducing wetness. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface can help to control soil blowing and conserve moisture. Growing cover crops and green manure crops and regularly adding organic material to the soil increase the available water capacity and help to control soil blowing. Vegetative barriers and field windbreaks also help to control soil blowing.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during excessively wet or dry periods help to keep the pasture in good condition.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Ruts can form if heavy equipment is used during wet periods. The equipment should be used only when the soil is relatively dry or frozen. The trees that can withstand seasonal wetness should be selected for planting. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

Because of wetness, this soil is poorly suited to building site development and generally is unsuitable as a site for septic tank absorption fields. A surface or subsurface drainage system lowers the water table on building sites. Buildings can be constructed on suitable well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewage systems. Sites that are better suited to septic systems generally are available.

The land capability classification is IVw. The woodland ordination symbol is 3W. The Michigan soil management group is 5b.

8—Cohoctah fine sandy loam. This nearly level, poorly drained soil is on the first bottoms of flood plains. It is frequently flooded. Slope ranges from 0 to 2 percent. Individual areas are narrow to broad and elongated and range from 3 to 170 acres in size.

Typically, the surface layer is very dark gray fine sandy loam about 11 inches thick. The next 6 inches is grayish brown, mottled sandy loam. The next 13 inches is light brownish gray and dark gray loam that has very dark gray streaks. The underlying material to a depth of 60 inches is very dark gray mucky sandy loam.

Included with this soil in mapping are small areas of steep and very steep soils. Also included are the somewhat poorly drained Algansee and Ceresco soils on the slightly higher knolls and natural levees and the very poorly drained Glendora soils. Glendora soils are dominantly sandy throughout. They are in landscape positions similar to those of the Cohoctah soil. The steep and very steep soils are along the edges of the mapped areas, adjacent to uplands. They make up about 5 percent of the unit. The other included soils make up 10 to 15 percent of the unit.

Permeability is moderately rapid in the Cohoctah soil, and the available water capacity is moderate. Surface runoff is very slow. The seasonal high water table is at or near the surface from early fall through spring and during excessively wet periods.

Most areas are used as woodland or are left idle. Some of the idle areas are covered with brush. Because of frequent flooding and wetness, this soil is unsuited to cultivated crops. Draining the soil is difficult because the water table is often at the same level as the water in the adjacent streams.

This soil is poorly suited to pasture. Wetness can be reduced in areas where a surface drainage system can be installed. The forage species that can tolerate the wetness should be selected for planting. Operating equipment during excessively wet periods alters soil structure and can result in compaction. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the main management concerns. The use of equipment should be restricted to periods when the soil is relatively dry or frozen. Because of wetness and flooding, loss of natural tree seedlings can be more than 50 percent. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is L-2c.

10B—Sparta sand, 0 to 6 percent slopes. This level to gently sloping, excessively drained soil is in flat or slightly concave areas on outwash plains. Individual areas are irregular in shape and range from 3 to 770 acres in size.

Typically, the surface layer is black sand about 12 inches thick. The subsoil is dark yellowish brown and yellowish brown, loose sand about 20 inches thick. The underlying material to a depth of 60 inches is very pale brown sand. In places the surface layer is thinner and lighter colored.

Permeability is rapid, and the available water brown and yellow, friable and loose sand about 40 inches thick. Below this to a depth of 60 inches is very pale brown, loose sand that has thin lamellae of yellowish red, loose loamy sand. In some places the soil has layers of fine sand. In other places it has no lamellae.

Included with these soils in mapping are small areas of Marlette, Toogood, and Scalley soils. Marlette soils are loamy throughout, Toogood soils have gravel in the lower part, and Scalley soils are loamy in the upper part. All of the included soils are in landscape positions similar to those of the Spinks, Metea, and Coloma soils. They make up 10 to 20 percent of the unit.

Permeability is moderately rapid in the Spinks soil, and the available water capacity is low. Surface runoff is slow.

Permeability is rapid in the upper part of the Metea soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is slow.

Permeability is rapid in the Coloma soil, and the available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. Some areas are used as cropland or pasture.

These soils are fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, droughtiness, and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material can reduce soil loss and conserve moisture. Wind stripcropping, vegetative barriers, and field windbreaks help to control soil blowing.

These soils are well suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

Where these soils are used as woodland, the equipment limitation and seedling mortality are the major management concerns on the Coloma soil. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Planting containerized seedlings or larger than usual nursery stock, planting in furrows, and applying herbicides can reduce the seedling mortality rate.

These soils are well suited to building site development and fairly well suited to septic tank absorption fields. The Spinks soil is better suited to septic tank absorption fields than the Metea and Coloma soils. The moderately slow permeability in the lower part of the Metea soil is a limitation. The Coloma soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IIIs. The woodland ordination symbol assigned to the Spinks and Metea soils is 4A, and that assigned to the Coloma soil is 2S. The Michigan soil management groups are 4a, 4/2a, and 5a.

17C—Spinks-Metea-Coloma complex, 6 to 12 percent slopes. These gently rolling soils are on moraines. Individual areas are irregular in shape and range from 2 to 140 acres in size. They are 20 to 30 percent well drained Spinks soil, 20 to 30 percent well drained Metea soil, and 20 to 30 percent excessively drained Coloma soil. These soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Spinks soil has a surface layer of dark brown loamy sand about 11 inches thick. The subsurface layer is yellowish brown and brownish yellow, loose sand about 16 inches thick. The subsoil to a depth of 60 inches is brownish yellow and yellowish brown, loose sand that has thin lamellae of strong brown and brown, very friable loamy sand. In places the subsoil has mottles.

Typically, the Metea soil has a surface layer of very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is strong brown and pale brown, very friable and loose sand about 24 inches thick. The subsoil is brown, firm clay loam about 16 inches thick. The underlying material to a depth of 60 inches is brown loam. In some places the subsoil is mottled. In other places the sandy material is more than 40 inches thick.

Typically, the Coloma soil has a surface layer of black sand about 3 inches thick. The subsurface layer is brown and yellow, friable and loose sand about 40 inches thick. Below this to a depth of 60 inches is very pale brown, loose sand that has thin lamellae of yellowish red, loose loamy sand. In some places the soil has layers of fine sand. In other places it has no lamellae.

Included with these soils in mapping are small areas of Toogood and Scalley soils. Toogood soils have gravel in the lower part, and Scalley soils are loamy in the upper part. Both of the included soils are in landscape positions similar to those of the Spinks, Metea, and Coloma soils. They make up 10 to 20 percent of the unit.

Permeability is moderately rapid in the Spinks soil, and the available water capacity is low. Surface runoff is slow.

Permeability is rapid in the upper part of the Metea soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is slow.

Permeability is rapid in the Coloma soil, and the available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. Some areas are used as cropland or pasture.

These soils are fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, droughtiness, and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material can reduce soil loss and conserve moisture. Wind stripcropping, vegetative barriers, and field windbreaks help to control soil blowing.

These soils are well suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

Where these soils are used as woodland, the equipment limitation and seedling mortality are the major management concerns on the Coloma soil. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Planting containerized seedlings or larger than usual nursery stock, planting in furrows, and applying herbicides can reduce the seedling mortality rate.

These soils are fairly well suited to building site development and septic tank absorption fields. The Spinks soil is better suited to septic tank absorption fields than the Metea and Coloma soils. The moderately slow permeability in the lower part of the Metea soil is a limitation. The Coloma soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water. The slope is the major management concern. Buildings should be designed so that they conform to the natural slope of the land. Land shaping is needed in some areas. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly.

The land capability classification is IIIe. The woodland ordination symbol assigned to the Spinks and Metea soils is 4A, and that assigned to the Coloma soil is 2S. The Michigan soil management groups are 4a, 4/2a, and 5a.

17D—Spinks-Metea complex, 12 to 25 percent slopes. These rolling and hilly, well drained soils are on moraines. Individual areas are irregular in shape and range from 2 to 80 acres in size. They are 35 to 50 percent Spinks soil and 30 to 40 percent Metea soil. These soils occur as areas so intricately mixed or so small that separating them in mapping was not practical.

Typically, the Spinks soil has a surface layer of dark brown loamy sand about 11 inches thick. The subsurface layer is yellowish brown and brownish yellow, loose sand about 16 inches thick. The subsoil to a depth of 60 inches is brownish yellow and yellowish brown, loose sand that has thin lamellae of strong brown and brown, very friable loamy sand.

Typically, the Metea soil has a surface layer of very dark grayish brown loamy sand about 8 inches thick. The subsurface layer is strong brown and pale brown, very friable and loose sand about 24 inches thick. The subsoil is brown, firm clay loam about 16 inches thick. The underlying material to a depth of 60 inches is brown loam. In some places the subsoil is mottled. In other places the sandy material is more than 40 inches thick.

Included with these soils in mapping are small areas of the excessively drained Plainfield, well drained Scalley, and somewhat excessively drained Toogood soils. Plainfield soils have sand throughout and have no lamellae of loamy sand. Scalley soils are loamy in the upper part. Toogood soils have gravel in the lower part. All of the included soils are in landscape positions similar to those of the Spinks and Metea soils. They make up 10 to 20 percent of the unit.

Permeability is moderately rapid in the Spinks soil, and the available water capacity is low. Surface runoff is medium.

Permeability is rapid in the upper part of the Metea soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is medium.

Most areas are used as woodland. Some areas are used as pasture.

These soils are unsuited to cropland. The slope, water erosion, droughtiness, and soil blowing are the major management concerns.

These soils are poorly suited to pasture. The slope, water erosion, soil blowing, and droughtiness are the major management concerns. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition.

Where these soils are used as woodland, the hazard of erosion and the equipment limitation are the major management concerns. Because of the hazard of erosion, logging roads, skid trails, and landings should be established on gentle grades and water should be removed by water bars, out-sloping road surfaces, and culverts. Seeding logging roads, skid trails, and landings after the trees are logged helps to prevent excessive erosion. Because of the slope, special care is needed in laying out logging roads and landings and in operating logging equipment. Logging roads should be designed so that they conform to the topography. The grade should be kept as low as possible.

Because of the slope, these soils are generally unsuited to building site development and septic tank absorption fields. Better suited sites generally are nearby.

The land capability classification is VIe. The woodland ordination symbol is 4R. The Michigan soil management groups are 4a and 4/2a.

19B—Covert sand, 0 to 4 percent slopes. This nearly level and very gently sloping, moderately well drained soil is on flats and in slight depressions on outwash plains and moraines. Individual areas are irregular in shape and range from 3 to 215 acres in size.

Black, well decomposed forest litter about 4 inches thick is on the surface. Typically, the surface layer is pinkish gray sand about 4 inches thick. The subsoil is about 20 inches of dark brown, very friable sand that has a few chunks of dark reddish brown, brittle material. The underlying material to a depth of 60 inches is light yellowish brown, mottled sand. In some areas the soil is not mottled in the underlying material. In places the subsoil is a lighter shade of brown and does not have chunks of brittle material.

Included with this soil in mapping are small areas of Kingsville, Pipestone, and Thetford soils. Kingsville soils are poorly drained and are in drainageways and depressions. Pipestone and Thetford soils are somewhat poorly drained and are in depressions. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the Covert soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2.0 to 3.5 feet from late fall through spring and during excessively wet periods.

Most areas are used as woodland or are left idle. A few areas are used as pasture or cropland.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Wind stripcropping, vegetative barriers, and field windbreaks also help to control soil blowing. Growing small grain crops that are planted in fall or early in spring makes good use of the limited amount of available soil moisture.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted grazing during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

Where this soil is used as woodland, the equipment limitation and seedling mortality are the major management concerns. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Planting when the soil is moist can reduce the seedling mortality rate. Planting containerized seedlings or special nursery stock also reduces the mortality rate.

Because of the seasonal high water table, this soil is poorly suited to building site development. Buildings with basements can be constructed on suitable well compacted fill material, which raises the site. A drainage system lowers the water table. Because of the water table and a poor filtering capacity, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water. Special construction methods, such as filling or mounding with suitable material, may be needed to raise the site above the water table.

The land capability classification is IVs. The woodland ordination symbol is 4S. The Michigan soil management group is 5a.

20—Granby mucky sand. This nearly level, poorly drained soil is in drainageways and low areas on lake plains and outwash plains. Slope ranges from 0 to 2 percent. Individual areas are irregular in shape and range from 3 to 530 acres in size.

Typically, the surface layer is black mucky sand about 10 inches thick. The subsoil is pale brown, very friable sand about 14 inches thick. The underlying material to a depth of 60 inches is yellowish brown and pale brown, mottled fine sand and sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Pipestone soils on slight rises and small areas of Jebavy soils. Jebavy soils have a cemented subsoil. They are in scattered areas throughout the unit. Included soils make up 3 to 15 percent of the unit.

Permeability is rapid in the Granby soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is near or above the surface from late fall through late spring and during excessively wet periods.

Most areas are used as cropland or pasture or are left idle. Some areas are used as woodland.

If drained, this soil is poorly suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are droughtiness, soil blowing, and wetness. A subsurface drainage system is effective in removing excess water, but drainage outlets are not readily available in some areas. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and increase the available water capacity during dry periods. Wind stripcropping, vegetative barriers, and field windbreaks also help to control soil blowing. The soil can be used for specialty crops, such as blueberries, carrots, and onions, but a drainage system is needed during wet periods and irrigation is needed during dry periods.

This soil is fairly well suited to pasture. If possible, a surface drainage system should be installed to reduce the wetness. The forage species that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted use during excessively wet or dry periods help to keep the pasture in good condition.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Heavy equipment should be used only when the soil is relatively dry or frozen. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness, this soil is generally unsuited to septic tank absorption fields and building site development. Better suited sites generally are available.

The land capability classification is IVw. The woodland ordination symbol is 2W. The Michigan soil management group is 5c.

21—Kingsville mucky sand. This nearly level, poorly drained soil is in drainageways and low areas on lake plains and outwash plains. Slope ranges from 0 to 2 percent. Individual areas are irregular in shape and range from 3 to 800 acres in size.

Typically, the surface layer is black mucky sand about 7 inches thick. The subsoil is pale brown, loose sand about 28 inches thick. The underlying material to a depth of 60 inches is brown sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Pipestone soils on slight rises and small areas of Jebavy soils. Jebavy soils have a cemented subsoil. They are in scattered areas throughout the unit. Included soils make up 3 to 15 percent of the unit.

Permeability is rapid in the Kingsville soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is near or above the surface from late fall through spring and during excessively wet periods.

Most areas are used as woodland.

Because of wetness, this soil is not suited to cropland. Overcoming the wetness generally is not practical.

This soil is poorly suited to pasture. If possible, a surface drainage system should be installed to reduce the wetness. The forage species that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods are needed.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Heavy equipment should be used only when the soil is relatively dry or frozen. Planting containerized seedlings or larger than usual nursery stock and planting on the ridges of furrows can reduce the seedling mortality rate. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness, this soil is generally unsuited to septic tank absorption fields and building site development. Better suited sites generally are available.

The land capability classification is Vw. The woodland ordination symbol is 5W. The Michigan soil management group is 5c.

22B—Scalley loam, 1 to 6 percent slopes. This nearly level to undulating, well drained soil is on low knolls and ridges on moraines. Individual areas are irregular in shape and range from 3 to 150 acres in size.

Typically, the surface layer is dark brown loam about 7 inches thick. The subsoil is firm clay loam about 29 inches thick. The upper part is dark brown and brown, and the lower part is dark brown. The underlying material to a depth of 60 inches is stratified brown and reddish yellow fine sand. In places depth to the sandy material is more than 40 inches.

Included with this soil in mapping are small areas of Metea soils and the somewhat poorly drained Capac soils. Capac soils are loamy throughout. They are in narrow drainageways and depressions. Metea soils are sandy in the upper part and loamy in the lower part.

and loamy in the lower part. They are in landscape positions similar to those of the Scalley soil. They make up 2 to 10 percent of the unit.

Permeability is moderately slow in the upper part of the Scalley soil and rapid in the lower part. The available water capacity is moderate. Surface runoff is rapid.

Most areas are used as woodland or pasture. Some areas are used as cropland.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are water erosion, deterioration of tilth, and the equipment limitation caused by the slope. Cover crops, green manure crops, and contour farming, where possible, help to slow runoff. A system of conservation tillage that does not invert the soil and that leaves all or part of the crop residue on the surface helps to slow runoff, control water erosion, and improve tilth. Tillage or harvesting during wet periods can result in the formation of clods, alteration of soil structure, and compaction.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in slowing runoff and controlling water erosion. Proper stocking rates and pasture rotation help to keep the pasture in good condition.

No major hazards or limitations affect the use of this soil as woodland.

Because of the slope, this soil is generally unsuited to septic tank absorption fields and building site development.

The land capability classification is IVe. The woodland ordination symbol is 3A. The Michigan soil management group is 3/5a.

23—Lamson loamy fine sand. This poorly drained, nearly level soil is in depressions on lake plains. Slope ranges from 0 to 2 percent. Individual areas range from 3 to 75 acres in size.

Typically, the surface layer is black loamy fine sand about 9 inches thick. The next 4 inches is light brownish gray, mottled, loose sand that has thin strata of fine sandy loam. The next 13 inches is grayish brown, mottled, firm very fine sandy loam that has thin strata of sand. The underlying material to a depth of 60 inches is grayish brown, mottled, very friable, calcareous, stratified fine sand and loamy very fine sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Dixboro soils on slight rises. These soils make up 2 to 5 percent of the unit.

Permeability and the available water capacity are moderate in the Lamson soil. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring and during other excessively wet periods.

Most areas are used as woodland. Some areas are used as cropland or are left idle.

If drained, this soil can be used for such crops as corn and hay, and for specialty crops, such as onions and carrots. Wetness, soil blowing, and deterioration of tilth are the major management concerns. A subsurface drainage system is effective in removing excess water. Draining many areas is difficult, however, because outlets are not readily available. Suitable filtering material may be needed around tile lines to keep sand and silt from flowing into the lines. Tilling when the soil is too wet can alter soil structure and can result in compaction. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control soil blowing and improve tilth. Wind stripcropping, vegetative barriers, and field windbreaks also help to control soil blowing.

This soil is poorly suited to pasture. If drainage outlets are available, a surface drainage system can help to remove excess water. Restricted grazing during wet periods helps to keep the pasture in good condition. The forage species that can tolerate wetness should be selected for planting.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Equipment should be used only when the soil is relatively dry or frozen. When the soil is wet, logging roads tend to become slippery and ruts form quickly. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness, this soil is generally unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is Vw. The woodland ordination symbol is 8W. The Michigan soil management group is 3c-s.

24—Edwards muck. This nearly level, very poorly drained soil is on low, broad flats and in depressions on outwash plains and lake plains. Slope ranges from 0 to 2 percent. Individual areas are irregular in shape and range from 2 to 86 acres in size.

Typically, the surface layer is black muck about 21 inches thick. The underlying layers to a depth of 60 inches are dark gray and olive gray marl.

Included with this soil in mapping are small areas of Adrian and Martisco soils. Adrian soils are underlain by sand. Martisco soils have less than 16 inches of muck and are underlain by marl. Both of the included soils are in landscape positions similar to those of the Edwards soil. They make up as much as 5 percent of the unit.

Permeability is moderately slow to moderately rapid in the upper part of the Edwards soil and slow in the underlying marl. The available water capacity is moderate. Runoff is very slow or ponded. The seasonal high water table is at or above the surface from early fall through late spring and during excessively wet periods.

Most areas are used as cropland. Many areas are used for vegetable crops. Some areas are used as pasture or support native vegetation.

This soil is poorly suited to most crops. If the soil is drained, such crops as corn, carrots, celery, onions, and peppers can be grown. Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system is effective in removing excess water. In some areas draining the soil is difficult because drainage outlets are not readily available. Controlled drainage helps to prevent excessive soil blowing and subsidence. Field windbreaks, buffer strips, and cover crops help to control soil blowing. The use of equipment is restricted during wet periods. A subsurface drainage system may not be economically feasible if the organic material is shallow.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. The use of heavy harvesting equipment is limited by wetness and by low soil strength. The equipment should be used only when the soil is frozen. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of wetness and low strength, this soil is unsuited to septic tank absorption fields and building site development. Better suited sites generally are available.

The land capability classification is IVw. The woodland ordination symbol is 2W. The Michigan soil management group is M/mc.

27—Granby mucky sand, gravelly substratum. This nearly level, poorly drained soil is in low areas on outwash plains and in glacial drainageways. Slope ranges from 0 to 2 percent. Individual areas are irregular in shape and range from 3 to 220 acres in size.

Typically, the surface layer is black mucky sand about 13 inches thick. The next 27 inches is stratified brown and pale brown, loose loamy sand and coarse sand. The underlying material to a depth of 60 inches is light yellowish brown gravelly loamy sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Watseka soils on slight rises and small areas of Kingsville soils. Kingsville soils do not have a gravelly calcareous layer in the lower part. They are in scattered areas throughout the unit. Included soils make up 3 to 5 percent of the unit.

Permeability is rapid in the Granby soil, and the available water capacity is low. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through late spring and during excessively wet periods.

Most areas are used as woodland.

This soil is unsuited to cropland because of wetness. Overcoming the wetness generally is not practical.

This soil is poorly suited to pasture. If possible, a surface drainage system should be installed to reduce the wetness. The forage species that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods are needed.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Heavy equipment should be used only when the soil is relatively dry or frozen. Planting containerized seedlings or larger than usual nursery stock and planting on the ridges of furrows can reduce the seedling mortality rate. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness, this soil is generally unsuited to septic tank absorption fields and building site development. Better suited sites generally are available.

The land capability classification is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is 5c.

28B—Watseka loamy sand, 0 to 4 percent slopes. This nearly level and very gently sloping, somewhat poorly drained soil is on low knolls and ridges on outwash plains. Individual areas are irregular in shape and range from 2 to 105 acres in size.

Typically, the surface layer is very dark grayish brown loamy sand about 14 inches thick. The subsoil is strong brown and very pale brown, mottled, very friable, loose sand about 27 inches thick. The underlying material to a depth of 60 inches is yellowish brown gravelly coarse sand. In places the underlying material does not contain gravel.

Included with this soil in mapping are small areas of the poorly drained Granby soils that have a gravelly substratum. These soils are in slight depressions. They make up less than 10 percent of the unit.

Permeability is moderately rapid in the upper part of the Watseka soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods.

Most areas are used as woodland or are left idle. A few areas are used as pasture or cropland.

This soil is poorly suited to corn, but such crops as winter wheat and oats can be grown. The major management concerns are droughtiness, soil blowing, and wetness. If drainage outlets are available, a subsurface drainage system is effective in reducing wetness. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface can help to control soil blowing and conserve moisture. Growing cover crops and green manure crops and regularly adding organic material to the soil increase the available water capacity and help to control soil blowing. Wind stripcropping, vegetative barriers, and field windbreaks also help to control soil blowing.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during excessively wet or dry periods help to keep the pasture in good condition.

Where this soil is used as woodland, the equipment limitation is a management concern. Ruts can form if heavy equipment is used during wet periods. The equipment should be used only when the soil is relatively dry or frozen.

Because of wetness, this soil is poorly suited to building site development and septic tank absorption fields. A surface or subsurface drainage system helps to lower the water table on building sites. Buildings can be constructed on suitable well compacted fill material, which raises the site. Sanitary facilities should be connected to municipal sewage systems. Sites that are better suited to septic systems generally are available.

The land capability classification is IIIs. The woodland ordination symbol is 6W. The Michigan soil management group is 4b.

29B—Coloma sand, 0 to 6 percent slopes. This nearly level to undulating, excessively drained soil is on outwash plains. Individual areas are irregular in shape and range from 2 to 600 acres in size.

Typically, the surface layer is black sand about 3 inches thick. The subsurface layer is brown and yellow sand about 40 inches thick. Below this to a depth of 60 inches is very pale brown, loose sand that has thin lamellae of yellowish red, loose loamy sand. In some places the subsoil has no lamellae. In other places the total thickness of the lamellae of loamy sand is more than 6 inches. In some areas the soil is fine sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Thetford, well drained Metea, and somewhat excessively drained or moderately well drained Toogood soils. Thetford soils are in slight depressions and in drainageways. Metea and Toogood soils are in landscape positions similar to those of the Coloma soil. Metea soils are loamy in the lower part of the subsoil and are less droughty than the Coloma soil. Toogood soils have gravel in the lower part. Included soils make up as much as 10 percent of the unit.

Permeability is rapid in the Coloma soil, and the available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland or are planted to pine. Some areas are left idle or are used as cropland.

This soil is poorly suited to corn, but such crops as wheat, oats, hay, and asparagus can be grown. The major management concerns are droughtiness and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Vegetative barriers and field windbreaks also help to control soil blowing. Growing small grain crops that are planted in fall or early spring makes good use of the limited amount of available soil moisture.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

Where this soil is used as woodland, the equipment limitation and seedling mortality are the major management concerns. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Planting when the soil is moist can reduce the seedling mortality rate. Planting containerized seedlings or special nursery stock also reduces the mortality rate.

This soil is well suited to building site development, but it is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water.

loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Planting when the soil is moist can reduce the seedling mortality rate. Planting containerized seedlings or special nursery stock also reduces the mortality rate.

Because of the slope, this soil is generally unsuited to building site development and septic tank absorption fields.

The land capability classification is VIIs. The woodland ordination symbol is 2S. The Michigan soil management group is 5a.

32—Carlisle muck. This nearly level, very poorly drained soil is in depressions on till plains, outwash plains, and moraines. Slope ranges from 0 to 2 percent. Individual areas are irregularly shaped or oval and range from 2 to 110 acres in size.

Typically, the surface layer is black muck about 18 inches thick. The underlying layers to a depth of 60 inches are black and very dark brown muck.

Included with this soil in mapping are small areas of the very poorly drained Adrian and Linwood soils. These soils are in landscape positions similar to those of the Carlisle soil. Adrian soils have sand in the underlying layers, and Linwood soils have loam in the underlying layers. Included soils make up 2 to 5 percent of the unit.

Permeability is moderately slow to moderately rapid in the Carlisle soil, and the available water capacity is very high. Surface runoff is very slow. The seasonal high water table is near or above the surface from early fall through late spring and during excessively wet periods.

Most areas are used as woodland. Some areas are used as cropland.

If drained, this soil is fairly well suited to such crops as corn, carrots, celery, and onions (fig. 5). Wetness, soil blowing, and subsidence are the major management concerns. A subsurface drainage system or open ditches help to remove excess water. Draining many areas is difficult, however, because drainage outlets are not readily available. Controlled drainage improves the stability of the soil and reduces the extent of subsidence. Wind stripcropping, windbreaks, and cover crops help to control soil blowing. The use of equipment is limited during wet periods.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. The use of heavy harvesting equipment is limited by wetness and by low soil strength. The equipment should be used only when the soil is frozen. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed.

Because of wetness and low strength, this soil is unsuited to septic tank absorption fields and building site development. Better suited sites generally are available.

The land capability classification is IIIw. The woodland ordination symbol is 2W. The Michigan soil management group is Mc.

36B—Del Rey loam, 0 to 4 percent slopes. This somewhat poorly drained, nearly level and gently undulating soil is in depressions on lake plains. Individual areas range from 2 to 300 acres in size.

Typically, the surface layer is dark brown loam about 11 inches thick. The subsurface layer is light brownish gray and brown, mottled loam about 4 inches thick. The subsoil is about 9 inches of dark yellowish brown and yellowish brown, mottled, firm silty clay loam and very fine sandy loam. The underlying material to a depth of 60 inches is brown, mottled silty clay loam.

Included with this soil in mapping are small areas of the somewhat poorly drained Cosad soils and the well drained Perrinton and Tustin soils. Cosad and Tustin soils are sandy in the upper part. Cosad soils are in landscape positions similar to those of the Del Rey soil. Perrinton and Tustin soils are on the slightly higher rises. Included soils make up 5 to 15 percent of the unit.

Permeability is slow in the Del Rey soil, and the available water capacity is moderate. Surface runoff is slow or medium. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods.

Most areas are used as cropland or woodland. Some areas are used as pasture or are left idle.

This soil is well suited to such crops as corn, winter wheat, hay, and oats (fig. 6). The major management concerns are wetness, water erosion, and deterioration of tilth. If drainage outlets are available, a subsurface drainage system is effective in reducing wetness. Suitable filtering material may be needed around tile lines to keep fine sand and silt from flowing into the lines. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and improve tilth. The soil tends to puddle and crust after heavy rains. Tillage or harvesting when the soil is too wet can result in the formation of clods, alteration of soil structure, and compaction.

Figure 5.—Celery in an area of Carlisle muck.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling erosion. Restricted grazing during wet periods helps to prevent compaction and helps to keep the pasture in good condition. The forage species that can tolerate wetness should be selected for planting.

Where this soil is used as woodland, the major management concerns are the equipment limitation, seedling mortality, and the hazard of windthrow. Ruts can form if heavy equipment is used when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen. Special site preparation, such as bedding, is needed in some areas to increase the seedling survival rate. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

Because of wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of wetness and the slow permeability. Buildings can be constructed on suitable well compacted fill material, which raises the site. A surface or subsurface drainage system helps to lower the water table on building sites. All sanitary facilities should be connected to municipal sewage systems.

The land capability classification is IIe. The woodland ordination symbol is 3C. The Michigan soil management group is 1.5b.

39B—Boyer loamy sand, 0 to 6 percent slopes. This nearly level to gently sloping, well drained soil is on outwash plains and terraces. Individual areas are irregular in shape and range from 2 to 550 acres in size.

deep-rooted forage species for planting helps to overcome the droughtiness. Proper stocking rates, pasture rotation, and restricted use during dry periods are needed.

No major hazards or limitations affect the use of this soil as woodland.

This soil is fairly well suited to building site development and poorly suited to septic tank absorption fields. The slope is a limitation on building sites. A poor filtering capacity and the slope are limitations on sites for septic tank absorption fields. Buildings should be designed so that they conform to the natural slope of the land. Land shaping is needed in some areas. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs. The woodland ordination symbol is 6A. The Michigan soil management group is 4a.

47D—Toogood loamy sand, 12 to 18 percent slopes. This rolling, somewhat excessively drained soil is on high knolls on moraines. Individual areas are irregular in shape and range from 3 to 25 acres in size.

Typically, the surface layer is black loamy sand about 4 inches thick. The upper part of the subsoil is dark brown, very friable loamy sand about 4 inches thick. The next part is yellowish brown, very friable loamy sand about 26 inches thick. The lower part is dark brown, very friable gravelly sandy loam about 2 inches thick. The underlying material to a depth of 60 inches is light yellowish brown very gravelly coarse sand. In some areas the underlying material is sand.

Permeability is rapid in the upper part of the soil and very rapid in the lower part. The available water capacity is low. Surface runoff is medium.

Most areas are used as woodland. This soil is unsuited to cropland and pasture because of droughtiness, the slope, and the hazards of water erosion and soil blowing.

No major hazards or limitations affect the use of this soil as woodland.

Because of the slope, this soil is poorly suited to building site development. It is poorly suited to septic tank absorption fields because of the slope and a poor filtering capacity. Buildings should be designed so that they conform to the natural slope of the land. In some areas land shaping is necessary. Land shaping and installing the distribution lines across the slope help to ensure that septic tank absorption fields function properly. The soil readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs. The woodland ordination symbol is 6A. The Michigan soil management group is 4a.

49B—Toogood loamy sand, moderately wet, 0 to 4 percent slopes. This nearly level and very gently sloping, moderately well drained soil is on outwash plains and terraces. Individual areas are irregular in shape and range from 3 to 325 acres in size.

Typically, the surface layer is black loamy sand about 4 inches thick. The upper part of the subsoil is dark brown, very friable loamy sand about 4 inches thick. The next part is yellowish brown, very friable loamy sand about 26 inches thick. The lower part is dark brown, very friable gravelly sandy loam about 2 inches thick. The underlying material to a depth of 60 inches is brown and yellowish brown, mottled, loose very gravelly loamy sand. In some areas the soil has no gravel.

Included with this soil in mapping are small areas of Watseka and Granby soils and the somewhat excessively drained Toogood soils. Watseka soils are somewhat poorly drained, and Granby soils are poorly drained. Both of these soils are in the lower landscape positions. The somewhat excessively drained Toogood soils are in the slightly higher landscape positions. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the upper part of the Toogood soil and very rapid in the lower part. The available water capacity is low. Surface runoff is slow. The seasonal high water table is at a depth of 2 to 3 feet from late fall through spring and during excessively wet periods.

Most areas are used as woodland or are left idle.

This soil is poorly suited to corn, but such crops as winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Vegetative barriers and field windbreaks also help to control soil blowing. Growing small grain that is seeded in the fall or spring makes good use of the limited amount of available soil moisture.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

No major hazards or limitations affect the use of this soil as woodland.

Because of the seasonal high water table, this soil is only fairly well suited to building site development. Buildings with basements can be constructed on suitable well compacted fill material, which raises the site. A drainage system lowers the water table. Because of the water table and a poor filtering capacity, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water. Special construction methods may be needed to raise the site above the water table and to increase the filtering capacity.

The land capability classification is IVs. The woodland ordination symbol is 6A. The Michigan soil management group is 4a.

51B—Thetford loamy fine sand, 0 to 4 percent slopes. This nearly level and very gently sloping, somewhat poorly drained soil is on low knolls and ridges on outwash plains, lake plains, and moraines. Individual areas are irregular in shape and range from 2 to 375 acres in size.

Typically, the surface layer is very dark grayish brown loamy fine sand about 9 inches thick. The subsoil is about 41 inches thick. The upper part is dark yellowish brown, mottled, very friable loamy fine sand. The next part is yellowish brown, mottled loamy fine sand. The lower part is light yellowish brown and yellowish brown loamy fine sand that has thin lamellae of brown fine sandy loam and loamy fine sand. The underlying material to a depth of 60 inches is yellowish brown fine sand.

Included with this soil in mapping are small areas of Pipestone and Kingsville soils. Pipestone soils are in landscape positions similar to those of the Thetford soil. They do not have lamellae of fine sandy loam in the subsoil. Kingsville soils are in slight depressions. Included soils make up less than 10 percent of the unit.

Permeability is rapid in the Thetford soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods.

Most areas are used as woodland or are left idle. A few areas are used as pasture or cropland.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are droughtiness, soil blowing, and wetness. If drainage outlets are available, a subsurface drainage system is effective in reducing wetness. Suitable filtering material is needed around tile lines to keep fine sand from flowing into the lines. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface can help to control soil blowing and conserve moisture. Growing cover crops and green manure crops and regularly adding organic material to the soil increase the available water capacity and help to control soil blowing. Vegetative barriers and field windbreaks also help to control soil blowing.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during excessively wet or dry periods help to keep the pasture in good condition.

Where this soil is used as woodland, the equipment limitation is the major management concern. Ruts can form if heavy equipment is used during wet periods. The equipment should be used only when the soil is relatively dry or frozen.

Because of wetness, this soil is poorly suited to building site development and generally is unsuitable as a site for septic tank absorption fields. A surface or subsurface drainage system lowers the water table on building sites. Buildings can be constructed on suitable well compacted fill material, which raises the site. All sanitary facilities should be connected to municipal sewage systems. Sites that are better suited to septic systems generally are available.

The land capability classification is IIIw. The woodland ordination symbol is 3W. The Michigan soil management group is 5b.

52—Linwood muck. This nearly level, very poorly drained soil is in depressions on lake plains, outwash plains, and moraines. Slope ranges from 0 to 2 percent. Individual areas are irregularly shaped or oval and range from 2 to 40 acres in size.

Typically, the surface layer is black muck about 25 inches thick. The next 4 inches is dark brown, mottled, friable sandy loam. The next 7 inches is very dark grayish brown, mottled loam that has thin strata of sand. The next 14 inches is dark grayish brown, mottled clay loam. The underlying material to a depth of 60 inches is gray, mottled sandy clay loam. In places the muck is less than 16 inches thick.

Included with this soil in mapping are small areas of Edwards, Carlisle, and Parkhill soils. The very poorly drained Edwards soils generally are on the edges of the mapped areas. They are underlain by marl at a depth of 16 to 50 inches. The very poorly drained Carlisle soils generally are in the middle of the mapped areas. They are more than 50 inches deep to loamy material. The poorly drained, loamy Parkhill soils generally are on the edges of the mapped areas. Included soils make up 4 to 10 percent of the unit.

Permeability is moderately slow to moderately rapid in the organic layers of the Linwood soil and moderately slow in the mineral layers. The available water capacity is very high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from fall through late spring and during excessively wet periods.

Most areas are used as woodland.

This soil is poorly suited to pasture. Grazing when the soil is wet can destroy forage plants and damage soil structure.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. The use of heavy planting and harvesting equipment is limited by wetness and by low soil strength. The equipment should be used only when the soil is frozen. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced. Windthrown trees should be periodically removed. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil.

Because of wetness and low strength, this soil is unsuited to septic tank absorption fields and building site development.

The land capability classification is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is M/3c.

53—Parkhill loam. This poorly drained, nearly level soil is in depressions on till plains and moraines. Slope ranges from 0 to 2 percent. Individual areas range from 3 to 75 acres in size.

Typically, the surface layer is very dark grayish brown loam about 9 inches thick. The subsoil is grayish brown, mottled, friable loam about 16 inches thick. The underlying material to a depth of 60 inches is brown and reddish brown, mottled loam and brown clay loam.

Included with this soil in mapping are small areas of the very poorly drained Wauseon and poorly drained Sickles soils. These soils are in landscape positions similar to those of the Parkhill soil. Wauseon soils have more clay than the Parkhill soil. Sickles soils are sandy in the upper part. Included soils make up 2 to 5 percent of the unit.

Permeability is moderately slow in the Parkhill soil, and the available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring and during excessively wet periods.

Most areas are used as woodland. Some areas are used as cropland or are left idle.

If drained, this soil is well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are wetness and deterioration of tilth. If adequate drainage outlets are available, a subsurface drainage system is effective in removing excess water. Draining many areas is difficult, however, because outlets are not readily available. Tilling or harvesting when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth and increase the rate of water infiltration.

This soil is poorly suited to pasture. If drainage outlets are available, a surface drainage system can help to remove excess water. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to prevent compaction and deterioration of the pasture. The forage species that can tolerate wetness should be selected for planting.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Equipment should be used only when the soil is relatively dry or frozen. When the soil is wet, logging roads tend to become slippery and ruts form easily. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness, this soil is generally unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is IIw. The woodland ordination symbol is 3W. The Michigan soil management group is 2.5c.

55—Sickles loamy fine sand. This poorly drained, nearly level soil is in depressions on lake plains. Slope ranges from 0 to 2 percent. Individual areas range from 2 to 230 acres in size.

Typically, the surface layer is black loamy fine sand about 8 inches thick. The next 12 inches is grayish brown, very friable loamy fine sand. The next 7 inches is light brownish gray, mottled, friable, stratified loamy fine sand and silt loam. The underlying material to a depth of 60 inches is brown, mottled silty clay.

Included with this soil in mapping are small areas of the poorly drained Lamson and somewhat poorly drained Del Rey soils. Lamson soils have less clay throughout than the Sickles soil. They are in landscape positions similar to those of the Sickles soil. Del Rey soils are on slight rises. Included soils make up 2 to 15 percent of the unit.

Permeability is rapid in the upper part of the Sickles soil and very slow in the lower part. The available water capacity is moderate. Surface runoff is very slow or ponded. The seasonal high water table is near or above the surface from late fall through spring and during excessively wet periods.

Most areas are used as woodland. Some areas are used as cropland or are left idle.

If drained, this soil is fairly well suited to cultivated crops. The major management concerns are wetness, droughtiness, and soil blowing. A subsurface drainage system is effective in reducing wetness. Suitable filtering material may be needed around tile lines to keep fine sand from flowing into the lines. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops increase the available water capacity during dry periods and help to control soil blowing.

This soil is well suited to pasture. If drainage outlets are available, a surface drainage system can help to remove excess water. Proper stocking rates, pasture rotation, and restricted grazing during excessively wet or dry periods are needed. The forage species that can tolerate wetness should be selected for planting.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Equipment should be used only when the soil is relatively dry or frozen. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow.

Because of wetness, this soil is generally unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is IIIw. The woodland ordination symbol is 5W. The Michigan soil management group is 4/1c.

60B—Grattan sand, 0 to 6 percent slopes. This nearly level to gently sloping, excessively drained soil is on the tops and side slopes of knolls and ridges on outwash plains and moraines. Individual areas are irregular in shape and range from 3 to 90 acres in size.

Typically, the surface layer is black sand about 4 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 14 inches of dark brown, loose sand that has a few chunks of brittle material. The underlying material to a depth of 60 inches is strong brown sand. In some places the subsoil is a lighter shade of brown and does not have chunks of brittle material. In other places mottles are within a depth of 30 inches.

Included with this soil in mapping are small areas of the somewhat poorly drained Pipestone soils. These soils are in small depressions. They make up as much as 5 percent of the unit.

Permeability is rapid in the Grattan soil, and the available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland. Some areas were formerly used as cropland but are now idle. Because of droughtiness, crop production generally is not practical on this soil.

This soil is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Selection of deep-rooted forage species for planting can help to overcome the droughtiness. Limiting the stocking rates and grazing mainly during wet periods help to prevent deterioration of the pasture. Pasture rotation is beneficial.

Where this soil is used as woodland, the equipment limitation and seedling mortality are the major management concerns. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Planting when the soil is moist can reduce the seedling mortality rate. Planting containerized seedlings or special nursery stock also reduces the mortality rate.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is VIs. The woodland ordination symbol is 9S. The Michigan soil management group is 5.3a.

60C—Grattan sand, 6 to 18 percent slopes. This gently rolling and rolling, excessively drained soil is on the side slopes of knolls and ridges on outwash plains and moraines. Individual areas are irregular in shape and range from 2 to 80 acres in size.

Typically, the surface layer is black sand about 4 inches thick. The subsurface layer is brown sand about 2 inches thick. The subsoil is about 14 inches of dark brown, loose sand that has a few chunks of brittle material. The underlying material to a depth of 60

Most areas are used as woodland. A few areas are left idle.

This soil is unsuited to cropland because of wetness. Overcoming the wetness generally is not practical.

This soil is poorly suited to pasture. If possible, a surface drainage system should be installed to reduce the wetness. The forage species that can tolerate the wetness should be selected for planting. Proper stocking rates, pasture rotation, and restricted grazing during wet periods help to keep the pasture in good condition.

Where this soil is used as woodland, the equipment limitation, seedling mortality, and the hazard of windthrow are the major management concerns. Heavy equipment should be used only when the soil is relatively dry or frozen. Harvest methods that do not isolate the remaining trees or leave them widely spaced reduce the hazard of windthrow. Planting containerized seedlings or larger than usual nursery stock and planting on the ridges of furrows can reduce the seedling mortality rate.

Because of wetness, this soil is generally unsuited to building site development and septic tank absorption fields.

The land capability classification is Vw. The woodland ordination symbol is 2W. The Michigan soil management group is 5b-h.

65—Wauseon loam. This very poorly drained, nearly level soil is in depressions on lake plains. Slope ranges from 0 to 2 percent. Individual areas range from 2 to 145 acres in size.

Typically, the surface layer is very dark gray loam about 17 inches thick. The upper part of the subsoil is gray, mottled, friable loam about 11 inches thick. The lower part is gray, mottled, friable silty clay loam about 4 inches thick. The underlying material to a depth of 60 inches is olive brown and olive gray, mottled silty clay. In places the underlying material has thin strata of silt loam, fine sand, and sand.

Included with this soil in mapping are small areas of the somewhat poorly drained Del Rey soils on low knolls. These soils make up 2 to 5 percent of the unit.

Permeability is slow or very slow in the Wauseon soil, and the available water capacity is high. Surface runoff is very slow or ponded. The seasonal high water table is above the surface to 1 foot below the surface from late fall through spring and during excessively wet periods.

Most areas are used as cropland or woodland. Some areas are used as pasture or are left idle.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are the seasonal high water table, puddling and crusting, and the slow rate at which the soil warms up in the spring. Because of wetness, a drainage system is necessary for most crops. It minimizes puddling and crusting. Puddling and crusting also can be minimized by tilling or harvesting when the soil is not excessively wet and by applying a system of conservation tillage.

This soil is well suited to pasture. Grazing when the soil is wet results in surface compaction, excessive runoff, and damage to soil structure. The legumes and grasses that are tolerant of wet conditions grow best in undrained areas.

This soil is poorly suited to woodland. The major management concerns are the equipment limitation, seedling mortality, and the hazard of windthrow. The wet, sticky nature of the soil limits the use of equipment during wet periods. Because of wetness, seedling mortality, and plant competition, trees are not planted on this soil. The hazard of windthrow can be reduced by harvest methods that do not isolate the remaining trees or leave them widely spaced.

This soil is generally unsuited to building site development and septic tank absorption fields because of wetness and the slow permeability. Better suited sites generally are available.

The land capability classification is IIIw. The woodland ordination symbol is 2W. The Michigan soil management group is 3/1c.

70—Udorthents, loamy, nearly level and gently sloping. These nearly level to undulating, well drained or moderately well drained soils are on till plains and moraines. Slope ranges from 0 to 6 percent. Some areas have been excavated, and other areas have been filled. The soil material has been so altered that identification of the soil series is not possible. Individual areas are irregularly shaped or rectangular and range from 2 to 40 acres in size.

The texture of these soils ranges from sandy loam to clay loam. The color varies.

Included with these soils in mapping are small areas of somewhat poorly drained and poorly drained soils. These included soils may be sandy or clayey or have organic material below a depth of 5 feet. They make up 5 to 10 percent of the unit.

Most areas are used as sites for buildings or are left idle. Onsite investigation is necessary to determine the suitability for specific uses.

No interpretive groups are assigned.

72—Udipsamments, nearly level and gently sloping. These nearly level to undulating, well drained or moderately well drained soils are on outwash plains and lake plains. Slope ranges from 0 to 6 percent.

Some areas have been excavated, and other areas have been filled. Blowouts are in some areas. The soil material has been so altered that identification of the soil series is not possible. Individual areas are irregularly shaped or rectangular and range from 2 to 195 acres in size.

The texture of these soils ranges from fine sand to gravelly coarse sand. The color varies.

Included with these soils in mapping are small areas of somewhat poorly drained and poorly drained soils. These included soils may be loamy or sandy or have organic material below a depth of 5 feet. They make up 5 to 10 percent of the unit.

Most areas are used as sites for buildings or are left idle. Onsite investigation is necessary to determine the suitability for specific uses.

No interpretive groups are assigned.

82—Algansee loamy fine sand. This nearly level and very gently sloping, somewhat poorly drained soil is on the first or second bottoms of flood plains. It is occasionally flooded. Slope ranges from 0 to 3 percent. Individual areas are broad to narrow and elongated and range from 3 to 90 acres in size.

Typically, the surface layer is dark grayish brown loamy fine sand about 7 inches thick. The next layer is brown, friable loamy fine sand about 5 inches thick. Below this to a depth of 60 inches is very pale brown and light gray, mottled fine sand. In places gravelly sand and gravel are in the underlying material.

Included with this soil in mapping are small areas of steep and very steep soils. Also included are the poorly drained Glendora soils in slight depressions and drainageways; small areas of the somewhat poorly drained Ceresco soils in landscape positions similar to those of the Algansee soil; and, on natural levees, small areas of soils that are better drained than the Algansee soil. Ceresco soils are dominantly loamy throughout. The steep and very steep soils are along the edges of the mapped areas, adjacent to uplands. They make up about 5 percent of the unit. The other included soils make up as much as 15 percent of the unit.

Permeability is rapid in the Algansee soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods.

Most areas are left idle or are used as woodland. A few areas are used as pasture or cropland.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. Wetness, flooding, soil blowing, and droughtiness are the major management concerns. A subsurface drainage system and surface drains are effective in removing excess water. Draining some areas is difficult because drainage outlets are not readily available. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material help to control soil blowing and increase the available water capacity.

This soil is well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. A good surface drainage system lowers the water table and removes floodwater. Proper stocking rates, pasture rotation, timely deferment of grazing, and restricted use during wet periods help to keep the pasture in good condition. The forage species that can tolerate the wetness should be selected for planting.

Where this soil is used as woodland, the equipment limitation is a major management concern. Ruts can form if heavy equipment is used during wet periods. The equipment should be used only when the soil is relatively dry or frozen.

Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is IIIw. The woodland ordination symbol is 4W. The Michigan soil management group is L-4c.

88—Ceresco fine sandy loam. This nearly level, somewhat poorly drained soil is on the first or second bottoms of flood plains. It is occasionally flooded. Slope ranges from 0 to 3 percent. Individual areas are narrow to broad and elongated and range from 3 to 150 acres in size.

Typically, the surface layer is very dark grayish brown fine sandy loam about 11 inches thick. The subsurface layer is dark brown very fine sandy loam about 6 inches thick. The subsoil is grayish brown, mottled, friable very fine sandy loam about 13 inches thick. The underlying material to a depth of 60 inches is stratified pale brown and grayish brown, mottled fine sandy loam and very fine sandy loam. In some places the underlying material is sand and gravel. In other places the soil has bands of sand, fine sand, or loamy sand 20 to 30 inches thick.

Included with this soil in mapping are small areas of steep and very steep soils. Also included are small areas of the poorly drained Cohoctah and somewhat poorly drained Algansee soils. Cohoctah soils are in the slightly lower landscape positions and in meander scars. Algansee soils are dominantly sandy throughout. They are in landscape positions similar to those of the Ceresco soil. The steep and very steep soils are along the edges of the mapped areas, adjacent to uplands. They make up about 5 percent of the unit. The other included soils make up 5 to 15 percent of the unit.

Permeability is moderate in the Ceresco soil, and the available water capacity is high. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet from fall through spring and during excessively wet periods.

Most areas are used as woodland or are left idle. Some areas are used as cropland or pasture.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are flooding, wetness, and deterioration of tilth. If a subsurface drainage system is installed, crops can be planted after floodwater recedes. Suitable filtering material is needed around tile lines to keep fine sand and silt from flowing into the lines. Draining some areas is difficult because drainage outlets are not readily available. Tilling or harvesting when the soil is too wet can alter soil structure and can result in compaction and the formation of clods. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops improve tilth.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted use during wet periods help to keep the pasture in good condition. If possible, a surface drainage system should be installed to reduce the wetness. The forage species that can tolerate the wetness should be selected for planting.

Where this soil is used as woodland, the major management concern is the equipment limitation. Ruts can form if heavy equipment is used when the soil is wet. The equipment should be used only when the soil is relatively dry or frozen.

Because of wetness and flooding, this soil is unsuited to building site development and septic tank absorption fields. Better suited sites generally are available.

The land capability classification is IIIw. The woodland ordination symbol is 4W. The Michigan soil management group is L-2c.

90—Histosols and Aquents, ponded. These nearly level, very poorly drained soils are in bogs, along drainageways, and in depressions in the uplands. They are covered by shallow water most of the year. Slopes are 0 to 1 percent. The Histosols are organic, and the Aquents are sandy or loamy. Individual areas are round, elongated, or irregular in shape and range from 2 to 40 acres in size. Some areas are made up entirely of either Histosols or Aquents, and others are made up of both soils.

The texture and color of these soils vary. Permeability and the available water capacity also vary. Surface runoff is ponded. The high water table is above the surface most of the year.

Most areas support native vegetation, primarily cattails and reeds. These soils are well suited to wetland wildlife but are unsuited to most other uses. They provide habitat for many aquatic animals, including ducks, geese, and other birds. Most areas collect, store, and filter runoff from the adjacent uplands and recharge the supply of ground water.

These soils are unsuited to septic tank absorption fields and building site development because of ponding and wetness.

No interpretive groups are assigned.

91B—Plainfield sand, 0 to 6 percent slopes. This nearly level to gently sloping, excessively drained soil is on outwash plains. Individual areas are irregular in shape and range from 2 to 2,600 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsoil is dark brown and strong brown, loose sand about 25 inches thick. The underlying material to a depth of 60 inches is very pale brown sand. In some areas mottles are within a depth of 30 inches. In other areas the subsoil is fine sand.

Included with this soil in mapping are small areas of the excessively drained Coloma, somewhat excessively drained Toogood, and excessively drained Grattan soils. These soils are in landscape positions similar to those of the Plainfield soil. Coloma soils have strata of loamy sand in the lower part. Toogood soils have gravelly layers in the lower part. Grattan soils have a subsoil that is darker than that of the Plainfield soil. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Plainfield soil, and the available water capacity is low. Surface runoff is very slow.

Most areas are used as woodland or are left idle (fig. 9). Some areas are planted to Christmas trees.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. Droughtiness and soil blowing are the major management concerns. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface increases the available water capacity and reduces the susceptibility to soil blowing.

This soil is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Selection of deep-rooted forage species for planting helps to overcome the droughtiness. Limited stocking rates, pasture rotation, and restricted use during dry periods are needed.

Where this soil is used as woodland, the equipment limitation and seedling mortality are the major management concerns. Loose sand in heavily traveled areas can interfere with the traction of wheeled

Figure 9.—Black oak and white oak in an area of Plainfield sand, 0 to 6 percent slopes.

equipment, especially during dry periods. Because of droughtiness, loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Planting when the soil is moist can reduce the seedling mortality rate. Planting containerized seedlings or special nursery stock also reduces the mortality rate.

This soil is well suited to building site development. It is poorly suited to septic tank absorption fields because of a poor filtering capacity. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water.

The land capability classification is IVs. The woodland ordination symbol is 8S. The Michigan soil management group is 5.3a.

91C—Plainfield sand, 6 to 18 percent slopes. This gently rolling and rolling, excessively drained soil is on the uneven side slopes of knolls and ridges on outwash plains and moraines. Individual areas are irregular in shape and range from 2 to 500 acres in size.

Typically, the surface layer is black sand about 2 inches thick. The subsoil is dark brown and strong brown, loose sand about 25 inches thick. The underlying material to a depth of 60 inches is very pale brown sand. In some areas the subsoil has thin layers of loamy sand. In a few areas it is fine sand.

Permeability is rapid, and the available water capacity is low. Surface runoff is slow.

Most areas are used as woodland or are left idle. Some areas are planted to Christmas trees. Because of droughtiness and the hazard of soil blowing, this soil is unsuited to cultivated crops.

This soil is poorly suited to pasture. A cover of pasture plants is effective in controlling soil blowing and water erosion. Selection of deep-rooted forage species for planting helps to overcome the droughtiness. Limited stocking rates, pasture rotation, and restricted use during dry periods are needed.

Where this soil is used as woodland, the equipment and in small depressions on till plains and moraines. Individual areas are irregular in shape and range from 2 to 315 acres in size.

Typically, the surface layer is dark brown loamy sand about 14 inches thick. The subsoil is about 23 inches thick. It is mottled. The upper part is yellowish brown, very friable loamy sand, and the lower part is brown, firm loam. The underlying material to a depth of 60 inches is brown, mottled clay loam. In places the upper part of the soil is sandy loam. In some areas the depth to carbonates is more than 40 inches. In a few areas the soil does not have loam or clay loam within 40 inches of the surface.

Included with this soil in mapping are small areas of the poorly drained Sickles soils. These soils are in drainageways and depressions. They make up 1 to 5 percent of the unit.

Permeability is rapid in the upper part of the Selfridge soil and moderately slow in the lower part. The available water capacity is moderate. Surface runoff is very slow. The seasonal high water table is at a depth of 1 to 2 feet from late fall through spring and during excessively wet periods.

Most areas are used as cropland or are left idle. Some areas are used as pasture or woodland.

This soil is fairly well suited to such crops as corn, winter wheat, oats, and hay. The major management concerns are water erosion, wetness, and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops help to control water erosion and soil blowing and increase the available water capacity. Wind stripcropping, vegetative barriers, and field windbreaks also help to control soil blowing. If drainage outlets are available, a subsurface drainage system is effective in reducing wetness. Suitable filtering material may be needed around tile lines to keep fine sand and silt from flowing into the lines.

This soil is well suited to pasture. Proper stocking rates, pasture rotation, and restricted grazing during wet periods or prolonged dry periods help to keep the pasture in good condition. The forage species that can tolerate wetness should be selected for planting.

Where this soil is used as woodland, the major management concern is the equipment limitation. Ruts can form if heavy equipment is used when the soil is excessively wet. The equipment should be used only when the soil is moist and friable or is frozen.

Because of wetness, this soil is poorly suited to building site development. It is generally unsuited to septic tank absorption fields because of wetness and the moderately slow permeability in the loamy subsoil and underlying material. A surface or subsurface drainage system lowers the water table on building sites. The buildings can be constructed on suitable well compacted fill material, which raises the site. Better suited sites generally are available.

The land capability classification is IIIe. The woodland ordination symbol is 6W. The Michigan soil management group is 4/2b.

93—Pits, sand and gravel. This map unit consists of open excavations from which sand or gravel has been removed for use elsewhere as fill or aggregate. The material that remains supports few plants. The pit bottoms are dry or are ponded seasonally or throughout the year. Individual areas vary considerably in shape and range from 2 to 45 acres in size.

Most areas are used by wildlife or are still being mined. A few areas are used for recreation. Onsite investigation is necessary to determine the suitability for specific uses.

No interpretive groups are assigned.

94B—Brems sand, 0 to 4 percent slopes. This nearly level and gently undulating, moderately well drained soil is in nearly flat areas and in slight depressions on outwash plains and moraines. Individual areas are irregular in shape and range from 3 to 360 acres in size.

Typically, the surface layer is dark brown sand about 8 inches thick. The subsoil is mottled sand about 38 inches thick. The upper part is strong brown and very friable, and the lower part is brownish yellow and loose. The underlying material to a depth of 60 inches is light yellowish brown, mottled, loose sand. In some areas the subsoil is reddish brown and has chunks of brittle material. In other areas the subsoil is grayer.

Included with this soil in mapping are small areas of the excessively drained Plainfield soils. These soils are on slight rises. They make up 1 to 5 percent of the unit.

Permeability is rapid in the Brems soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2 to 3 feet during winter and spring and excessively wet periods.

Most areas are used as woodland or are left idle (fig. 10). A few areas are used as pasture.

This soil is poorly suited to such crops as corn, but winter wheat, oats, and hay can be grown. The major management concerns are droughtiness and soil blowing. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, green manure crops, and regular additions of organic material increase the available water capacity and reduce the susceptibility to soil blowing. Growing small grain crops that are planted

Figure 10.—A red pine plantation in an area of Brems sand, 0 to 4 percent slopes.

in fall or early in spring makes good use of the limited amount of available soil moisture.

This soil is fairly well suited to pasture. A cover of pasture plants is effective in controlling soil blowing. Proper stocking rates, pasture rotation, and restricted use during dry periods help to keep the pasture in good condition. Selection of deep-rooted forage species for planting helps to overcome the droughtiness.

Where this soil is used as woodland, the equipment limitation and seedling mortality are the major management concerns. Loose sand in heavily traveled areas can interfere with the traction of wheeled equipment, especially during dry periods. Logging roads should be stabilized. Because of droughtiness, loss of planted or natural tree seedlings can be as high as 25 to 50 percent. Planting when the soil is moist can reduce the seedling mortality rate. Planting containerized seedlings or special nursery stock also reduces the mortality rate.

Because of wetness, this soil is only fairly well suited to building site development. Buildings with basements can be constructed on suitable well compacted fill material, which raises the site. A drainage system lowers the water table. Because of wetness and a poor filtering capacity, the soil is poorly suited to septic tank absorption fields. It readily absorbs but does not adequately filter the effluent in the absorption fields. The poor filtering capacity can result in the pollution of ground water. Special construction methods, such as filling or mounding the absorption field with suitable material, may be needed to raise the site above the water table and increase the filtering capacity.

The land capability classification is IVs. The woodland ordination symbol is 3S. The Michigan soil management group is 5b.

95A—Abscota loamy sand, 0 to 3 percent slopes. This nearly level and very gently sloping, moderately well drained soil is in large, flat areas and on natural levees on flood plains. It is occasionally flooded. Individual areas are irregularly shaped or narrow and elongated and range from 2 to 70 acres in size.

Typically, the surface layer is dark brown loamy sand about 9 inches thick. The subsoil is dark brown, very friable loamy fine sand about 7 inches thick. The underlying material to a depth of 60 inches is dark yellowish brown, brownish yellow, light yellowish brown, and very pale brown, mottled sand. In places the water table is below a depth of 5 feet.

Included with this soil in mapping are small areas of steep and very steep soils. These soils are along the edges of the mapped areas, adjacent to uplands. Also included are the somewhat poorly drained Algansee soils in the slightly lower landscape positions and adjacent to natural levees. Included soils make up 5 to 15 percent of the unit.

Permeability is rapid in the Abscota soil, and the available water capacity is low. Surface runoff is very slow. The seasonal high water table is at a depth of 2.5 to 5.0 feet during the winter and spring and during excessively wet periods.

Most areas are used as woodland or are left idle. Some areas are used as pasture.

This soil is poorly suited to most crops, but such crops as winter wheat, oats, and hay can be grown. Droughtiness, soil blowing, and the occasional flooding are the major management concerns. A system of conservation tillage that does not invert the soil and leaves all or part of the crop residue on the surface, cover crops, and green manure crops conserve moisture and reduce the hazard of soil blowing. Wind stripcropping and vegetative barriers also help to control soil blowing.

and building site development. Better suited sites generally are nearby.

The land capability classification is Vw. No woodland ordination symbol is assigned. The Michigan soil management group is Mc.

Prime Farmland

Prime farmland is one of several kinds of important farmland defined by the U.S. Department of Agriculture. It is of major importance in meeting the Nation's short- and long-range needs for food and fiber. Because the supply of high-quality farmland is limited, the U.S. Department of Agriculture recognizes that responsible levels of government, as well as individuals, should encourage and facilitate the wise use of our Nation's prime farmland.

Prime farmland, as defined by the U.S. Department of Agriculture, is the land that is best suited to food, feed, forage, fiber, and oilseed crops. It may be cultivated land, pasture, woodland, or other land, but it is not urban or built-up land or water areas. It either is used for food or fiber crops or is available for those crops. The soil qualities, growing season, and moisture supply are those needed for a well managed soil to produce a sustained high yield of crops in an economic manner. Prime farmland produces the highest yields with minimal expenditure of energy and economic resources, and farming it results in the least damage to the environment.

Prime farmland has an adequate and dependable supply of moisture from precipitation or irrigation. The temperature and growing season are favorable. The level of acidity or alkalinity is acceptable. Prime farmland has few or no rocks and is permeable to water and air. It is not excessively erodible or saturated with water for long periods and is not frequently flooded during the growing season. The slope ranges mainly from 0 to 6 percent. More detailed information about the criteria for prime farmland is available at the local office of the Soil Conservation Service.

A recent trend in land use in some parts of the county has been the loss of some prime farmland to industrial and urban uses. The loss of prime farmland to other uses puts pressure on marginal lands, which generally are more erodible, droughty, and less productive and cannot be easily cultivated.

The map units in the survey area that are considered prime farmland are listed in table 5. This list does not constitute a recommendation for a particular land use. The extent of each listed map unit is shown in table 4. The location is shown on the detailed soil maps at the back of this publication. The soil qualities that affect use and management are described under the heading "Detailed Soil Map Units."

Some soils that have a seasonal high water table and all soils that are frequently flooded during the growing season qualify as prime farmland only in areas where these limitations have been overcome by drainage measures or flood control. The need for these measures is indicated after the map unit name in table 5. Onsite evaluation is needed to determine whether or not these limitations have been overcome by corrective measures.

Use and Management of the Soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help prevent soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavioral characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties *(18)*.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where wetness or firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

Crops and Pasture

Glen Lamberg, district conservationist, and Maya Hamady, soil conservationist, Soil Conservation Service, helped prepare this section.

General management needed for crops and pasture is suggested in this section. The crops best suited to the soils, including some not commonly grown in the survey area, are identified; the system of land capability classification used by the Soil Conservation Service is explained; and the estimated yields of the main crops are listed for each soil.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under the heading "Detailed Soil Map Units." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

About 160,100 acres in Newaygo County, or 29 percent of the total acreage, is farmland. About 103,600 acres is used for crops and pasture. About 4,600 acres is used as permanent pasture. Most row crop rotations include several years of hay or pasture. As a result, the combined acreage of pasture and hayland in any one year is estimated to be about 56,000 acres. Of the total acreage of cropland, about 90,000 acres is used for row crops, 3,000 acres for orchards, and 6,000 acres for vegetable crops *(10)*. In 1986, about 25,000 acres was used for corn and 3,950 acres for small grain. An estimated 4,000 acres was used for Christmas tree farms.

The most common row crops that are suited to the soils and climate in Newaygo County are corn, dry beans, soybeans, and potatoes. The most common close-growing crops are oats and wheat. Rye, barley, and buckwheat are not so common, but they can be grown. Alfalfa and red clover grown in mixtures with grasses are the most common hay crops.

The main management needs on the cropland and pasture in the county are measures that help to control water erosion and soil blowing, reduce wetness, conserve soil moisture, and improve fertility and tilth.

Water erosion and soil blowing are major management concerns on most of the cropland in the county. Loss of the surface layer through erosion reduces the productivity of the soils. Productivity is reduced as the surface layer is lost and part of the subsoil is incorporated into the plow layer. Loss of the surface layer is especially damaging on soils that have a clayey subsoil, such as Perrinton and Del Rey soils,

Figure 11.—Soil blowing in an area of Adrian muck.

and on soils that tend to be droughty, such as Spinks and Coloma soils. Erosion on farmland causes the sedimentation of streams. Controlling erosion minimizes this pollution and improves the quality of water for municipal and recreation uses and for fish and wildlife.

Water erosion is a serious hazard on all of the soils that have slopes of 2 percent or more. Preparing a good seedbed is difficult on some of the soils because the friable surface layer has been eroded away in places.

Erosion-control practices provide a protective cover, reduce the runoff rate, and increase the rate of water infiltration. A cropping system that keeps a plant cover on the surface for extended periods reduces the susceptibility to erosion and preserves the productive capacity of the soil. On livestock farms, where pasture and hay are needed, including forage crops of grasses and legumes in the cropping sequence helps to control erosion in the more sloping areas, provides nitrogen for subsequent crops, and improves tilth. Conservation tillage helps to control runoff and erosion by leaving protective amounts of crop residue on the surface. Cover crops, diversions, and grassed waterways also help to control erosion.

Soil blowing is a hazard on the sandy Coloma, Plainfield, Spinks, Boyer, Metea, Cosad, and Selfridge soils and on the mucky Carlisle, Edwards, Linwood, and Adrian soils (fig. 11). It can damage these soils in a few hours, especially the mucky soils, if the wind is strong, the soils are dry, and the surface is bare. An adequate plant cover, surface mulch, wind stripcropping, and tillage methods that leave the surface rough help to control soil blowing. Wind barriers and conservation tillage also help to control soil blowing. Examples of wind barriers are stands of tall wheatgrass and windbreaks of trees and shrubs.

No-till farming, which is becoming increasingly common in the county, is effective in controlling water erosion and soil blowing because it leaves crop residue on the surface. It is suited to most of the soils in the county. It is not so successful, however, on soils that have a clayey surface layer. Because of no-till farming, erodible areas that otherwise are only marginally productive can be used for corn. No-till farming helps to maintain the productive capacity of nearly all cropland. In areas where no-till crops are grown, different methods of planting and of controlling insects and weeds are needed. The proper time for planting, the selection of herbicides that are suited to the existing vegetation, an adequate supply of plant nutrients, and the selection of tillage systems based on soil characteristics are important management requirements.

Much of the permanent pasture in the county is in areas where erosion is a hazard. Controlling erosion is particularly important when the pasture is seeded. The number of livestock that the pasture supports, the length of time that they graze, and the distribution of rainfall influence forage production and the extent to which the plant cover protects the surface. Good pasture management includes stocking rates that maintain the key forage species, pasture rotation, deferred grazing, timely grazing, and strategically located water supplies for livestock.

Information about the design and application of erosion-control measures for each kind of soil is available in the local office of the Soil Conservation Service.

Soil drainage is a major management concern in many areas used for crops or pasture in the county. Draining cropland improves the air-water relationship in the root zone. In areas where drainage is poor, spring planting, spraying, and harvesting are delayed and controlling weeds is difficult. Properly designed subsurface drainage systems, surface drainage systems, or both, can be used to remove excess water.

Unless drained, Carlisle, Selfridge, Cohoctah, Del Rey, Capac, Parkhill, and Wauseon soils are naturally so wet that crops cannot be planted, must be planted late, or are damaged by water. A drainage system has lowered the water table in these soils so that the common field crops and specialty crops can be grown. Natural drainage is good in Marlette and Perrinton soils during most of the year, but these soils tend to dry slowly after rains. Small areas of somewhat poorly drained soils along drainageways and in swales are commonly included in some areas of these soils, especially where slopes are 1 to 6 percent. A drainage system is needed in some of these wetter areas.

The design of surface and subsurface drainage systems varies with the kind of soil. A combination of surface and subsurface drains is used in most areas of poorly drained and very poorly drained soils that are intensively row cropped. The drains are more closely spaced in slowly permeable soils than in the more permeable soils. Subsurface drainage is slow or very slow in Del Rey, Capac, Perrinton, and Wauseon soils. Adequate outlets for subsurface drainage systems are not readily available in many areas of Cohoctah, Adrian, Granby, Glendora, Carlisle, and Linwood soils. Diversions can be used to remove surface runoff from some wet areas. Good tilth and an ample supply of organic matter also improve drainage.

Organic soils oxidize and subside when the water in their pore space is replaced with air. As a result, special systems are needed to control the depth and period of drainage. Maintaining the water table at the level required by the crops during the growing season and raising it to the surface during other parts of the year minimize the oxidation and subsidence of these soils.

Information about the design of drainage systems for each kind of soil is available in the local office of the Soil Conservation Service.

Conserving soil moisture during dry periods is a management concern in areas of Coloma, Boyer, Toogood, Metea, Cosad, Selfridge, and Spinks soils. No-till farming and other kinds of conservation tillage that leave all or part of the crop residue on the surface can conserve soil moisture. Increasing the organic matter content increases the available water capacity. Irrigation, which improves productivity, may become more important in the county in the future. If properly managed, the droughty soils and many other soils in the county are suited to irrigation.

Soil fertility is naturally medium or high in loamy soils and low in most sandy soils on uplands. Soils on flood plains, such as Cohoctah and Ceresco soils, range from slightly acid to mildly alkaline and are naturally higher in content of plant nutrients than most soils on uplands.

Many sandy soils naturally range from strongly acid to slightly acid. If lime has never been applied on these soils, applications of ground limestone are needed to raise the pH level sufficiently for the production of alfalfa and other crops that grow well only on nearly neutral soils. Available phosphorus and potassium levels are naturally low or medium in most of these soils. On all soils, additions of lime and fertilizer should be based on the results of soil tests, on the needs of the crop, and on the expected level of yields *(11)*. If applied in excess of that needed by the crops, fertilizer can be leached into ground water or surface water. The Cooperative Extension Service can help in determining the kinds and amounts of fertilizer and lime needed.

Soil tilth is an important factor affecting the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous.

Some of the soils used for crops in the county have a loamy surface layer that is light in color and low in organic matter content. Generally, the structure of such soils is weak. A surface crust forms during periods of intensive rainfall. The crust hinders the emergence of plant seedlings, decreases the rate of water infiltration, and increases the runoff rate. Regular additions of crop residue, manure, and other organic material can improve tilth and can help to prevent surface crusting.

Maintaining good tilth is difficult in the finer textured Del Rey, Parkhill, and Wauseon soils because these soils stay wet until late in spring. If plowed when wet, the soils tend to be very cloddy when dry and are compacted. As a result, preparing a good seedbed is difficult. Cover crops, green manure crops, proper management of crop residue, conservation tillage, and applications of livestock manure help to maintain or improve tilth and increase or maintain the organic matter content. Fall plowing and chisel plowing at the proper moisture content can help to prevent deterioration of tilth in nearly level, poorly drained or somewhat poorly drained soils. These measures also allow the soils to be tilled earlier the following spring. Fall plowing is not suitable on sloping soils or on soils that are subject to soil blowing. Good management is needed in intensively cropped areas and in areas that are cultivated year after year.

Livestock grazing on wet, loamy or clayey soils results in surface compaction and poor tilth. The compaction caused by grazing during wet periods retards the growth of pasture plants. Proper harvesting methods, such as those for hay or silage, improve plant growth and help to prevent compaction.

Specialty Crops

The variety of soils, topography, and climatic conditions in Newaygo County allows for the production of a wide variety of vegetable, berry, and fruit crops. The county is the top producer of onions and carrots in the state. Other vegetable crops include mint, asparagus, celery, squash, sweet corn, cucumbers, peppers, turnips, cabbage, cauliflower, tomatoes, melons, parsnips, snap beans, broccoli, and peas *(14)*. Most of the carrots, onions, celery, parsnips, and mint are grown east of the town of Grant, in the Rice Lake area. They are grown on organic soils that have been drained. Mucky soils are well suited to blueberries and a wide variety of vegetable crops, but a drainage system and protection from soil blowing are needed. Carlisle, Edwards, and Adrian soils are examples.

Berry crops, including strawberries, raspberries, and blueberries, are grown on approximately 400 acres in the county. Deep soils that are characterized by good natural drainage and that warm up early in spring are especially well suited to vegetables and small fruits. Examples are the Boyer, Spinks, Metea, and Toogood soils that have slopes of less than 6 percent. If irrigated, the Plainfield and Coloma soils that have slopes of less than 6 percent also are well suited to vegetables. Crops generally can be planted and harvested earlier on these soils than on other soils in the survey area.

Certain areas in the county, most notably those south of Hesperia in the western part, are especially well suited to fruit trees. The fruit grown in the county includes dwarf and standard apples, peaches, sweet and tart cherries, plums, pears, apricots, and nectarines. Some sites are better suited than others, mainly because of differences in air temperature and air drainage. Differences in air temperature are caused by variations in elevation and in the proximity to Lake Michigan.

Carefully selecting the sites used for fruit crops helps to ensure productivity. Agricultural records indicate that some sites are better suited to fruit production than others, mainly because of differences in the kind of soil and in air temperature. These differences can occur within short distances. Soil properties affect management practices, tree growth, and the productivity of the orchards. Local climatic conditions affect fruit-set, pollination by bees, the number of blossoms per tree, and frost damage to woody parts of the trees.

The latest information about growing specialty crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

Yields per Acre

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 6. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors. The land capability classification of each map unit also is shown in the table.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green manure crops; and harvesting that ensures the smallest possible loss.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

Crops other than those shown in table 6 are grown in the survey area, but estimated yields are not listed because the acreage of such crops is small. The local office of the Soil Conservation Service or of the

Cooperative Extension Service can provide information about the management and productivity of the soils for those crops.

Land Capability Classification

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops *(23)*. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The criteria used in grouping the soils do not include major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor do they include possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for woodland and for engineering purposes.

In the capability system, soils are generally grouped at three levels—capability class, subclass, and unit. Only class and subclass are used in this survey.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations or hazards that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations or hazards that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations or hazards that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations or hazards, impractical to remove, that limit their use.

Class VI soils have severe limitations or hazards that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations or hazards that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations or hazards that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main hazard is the risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c,* used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, woodland, wildlife habitat, or recreation.

The acreage of soils in each capability class and subclass is shown in table 7. The capability classification of each map unit is given in the section "Detailed Soil Map Units" and in the yields table.

Also given at the end of each map unit description is a Michigan soil management group. The soils are assigned to a group according to the dominant profile texture, the natural drainage class, and the major management concerns. For soils making up a complex, the management groups are listed in the same order as the series named in the complex. The local office of the Soil Conservation Service can provide further information about these groups.

Woodland Management and Productivity

Maya Hamady, soil conservationist, Soil Conservation Service, helped prepare this section.

Prior to settlement, forest vegetation covered a large part of Newaygo County. The sandy soils in the Toogood-Boyer association, which is described under the heading "General Soil Map Units," were covered with extensive stands of white pine and red pine. The droughtiest soils, such as those in the Plainfield-Grattan-Brems association, were covered with a mixed forest of jack pine and black oak. The more clayey and moister soils in the Marlette-Metea-Spinks association were covered with hardwood stands dominated by sugar maple and American beech. The associated species in these stands included yellow birch, elm, hemlock, and red oak. The well drained soils in the Coloma-Spinks-Metea association supported stands of maple and beech. The very poorly drained soils in the Adrian-Carlisle-Martisco association supported swamp forest vegetation consisting of northern whitecedar and tamarack. The moderately well drained to poorly drained soils in the Pipestone-Covert-Kingsville association were covered with lowland hardwoods, mainly silver maple, red maple, ash, and elm.

The once extensive forest was virtually all harvested by about 50 years after the first settlers arrived in the county in 1834. Repeated fires following logging burned the organic matter in the sandier soils. As a result, the soils that once supported majestic white pine could only support the tree species that are tolerant of impoverished soils. Also, clear cutting of large areas favored sunlight-tolerant species, such as aspen and oak, which currently dominate the landscape.

Many of the soils that were cleared for farming were too droughty and low in fertility to support productive agriculture. These soils have reverted to Federal and State ownership as tax-delinquent lands. Currently, the Forest Service manages about 106,820 acres, or nearly 20 percent of the total acreage in the county. The State owns 1,900 acres in parks and roadways in the county.

Since the lands that were least suited to agriculture and had the poorest soils reverted to government agencies, the more productive timber sites in the county generally are privately owned. Most of the woodland in the county, whether private or public, is dominated by pole-size stands about 50 to 70 years old. The dominant forest types are oak, which covers about 34 percent of the total forested area, and aspen, which covers about 31 percent *(7, 17)*.

Growing Christmas trees is an important enterprise in the county. More than 6,000 acres in the county is used for Christmas trees. Many more areas could be used for these trees. The most common Christmas tree species are Scotch pine on the droughty, sandy soils and blue spruce and Douglas-fir on the loamy soils. Douglas-fir, white fir, and other specialty Christmas trees are grown in the southern and western parts of the county. These species are easily damaged by frost. They should be grown on north- and east-facing slopes, where early spring growth is less likely.

Table 8 can be used by woodland owners or forest managers in planning the use of soils for wood crops. Only those soils suitable for wood crops are listed. The table lists the ordination symbol for each soil. Soils assigned the same ordination symbol require the same general management and have about the same potential productivity.

The first part of the *ordination symbol*, a number, indicates the potential productivity of the soils for an indicator tree species. The number indicates the volume, in cubic meters per hectare per year, which the indicator species can produce. The number 1 indicates low potential productivity; 2 and 3, moderate; 4 and 5, moderately high; 6 to 8, high; 9 to 11, very high; and 12 to 39, extremely high. The second part of the symbol, a letter, indicates the major kind of soil limitation. The letter *R* indicates steep slopes; *X*, stoniness or rockiness; *W*, excess water in or on the soil; *T*, toxic substances in the soil; *D*, restricted rooting depth; *C*, clay in the upper part of the soil; *S*, sandy texture; and *F*, a high content of rock fragments in the soil. The letter *A* indicates that limitations or restrictions are insignificant. If a soil has more than one limitation, the priority is as follows: R, X, W, T, D, C, S, and F.

In table 8, *slight, moderate,* and *severe* indicate the degree of the major soil limitations to be considered in management.

Erosion hazard is the probability that damage will occur as a result of site preparation and cutting where the soil is exposed along roads, skid trails, and fire lanes and in log-handling areas. Forests that have been burned or overgrazed are also subject to erosion. Ratings of the erosion hazard are based on the percent of the slope. A rating of *slight* indicates that no particular prevention measures are needed under ordinary conditions. A rating of *moderate* indicates that erosion-control measures are needed in certain silvicultural activities. A rating of *severe* indicates that special precautions are needed to control erosion in most silvicultural activities.

Equipment limitation reflects the characteristics and conditions of the soil that restrict use of the equipment generally needed in woodland management or harvesting. The chief characteristics and conditions considered in the ratings are slope, stones on the surface, rock outcrops, soil wetness, and texture of the surface layer. A rating of *slight* indicates that under normal conditions the kind of equipment and season of use are not significantly restricted by soil factors. Soil wetness can restrict equipment use, but the wet period does not exceed 1 month. A rating of *moderate* indicates that equipment use is moderately restricted because of one or more soil factors. If the soil is wet, the wetness restricts equipment use for a period of 1 to 3 months. A rating of *severe* indicates that equipment use is severely restricted either as to the kind of equipment that can be used or the season of use. If the soil is wet, the wetness restricts equipment use for more than 3 months.

Seedling mortality refers to the death of naturally occurring or planted tree seedlings, as influenced by the kinds of soil, soil wetness, or topographic conditions. The factors used in rating the soils for seedling mortality are texture of the surface layer, depth to a seasonal high water table and the length of the period when the water table is high, rock fragments in the surface layer, effective rooting depth, and slope aspect. A rating of *slight* indicates that seedling mortality is not likely to be a problem under normal conditions. Expected mortality is less than 25 percent. A rating of *moderate* indicates that some problems from seedling mortality can be expected. Extra precautions are advisable. Expected mortality is 25 to 50 percent. A rating of *severe* indicates that seedling mortality is a serious problem. Extra precautions are important. Replanting may be necessary. Expected mortality is more than 50 percent.

Windthrow hazard is the likelihood that trees will be uprooted by the wind because the soil is not deep enough for adequate root anchorage. The main restrictions that affect rooting are a seasonal high water table and the depth to firm layers. A rating of *slight* indicates that under normal conditions no trees are blown down by the wind. Strong winds may damage trees, but they do not uproot them. A rating of *moderate* indicates that some trees can be blown down during periods when the soil is wet and winds are moderate or strong. A rating of *severe* indicates that many trees can be blown down during these periods.

The *potential productivity* of merchantable or *common trees* on a soil is expressed as a *site index* and as a *volume* number. The site index is the average height, in feet, that dominant and codominant trees of a given species attain in a specified number of years. The site index applies to fully stocked, even-aged, unmanaged stands. Commonly grown trees are those that woodland managers generally favor in intermediate or improvement cuttings. They are selected on the basis of growth rate, quality, value, and marketability.

The *volume*, a number, is the yield likely to be produced by the most important trees. This number, expressed as cubic feet per acre per year, indicates the amount of fiber produced in a fully stocked, even-aged, unmanaged stand. The volume was determined through the use of standard yield tables *(25)*.

The first species listed under *common trees* for a soil is the indicator species for that soil. It generally is the most common species on the soil and is the one that determines the ordination class.

Trees to plant are those that are suitable for commercial wood production.

Table 9 gives information about operating harvesting or thinning equipment in logging areas and on skid trails, landings, and logging roads. Limitations are given for the most limiting season and for the preferred season. The *most limiting season* in Newaygo County generally is spring or late fall. In some areas, however, it is during dry periods in summer, when loose sand can limit trafficability on deep, well drained, sandy soils. The *preferred operating season* is the period when harvesting or thinning causes the least amount of damage to the soil. This period generally is when the soil is not too wet or when the ground is frozen or partly frozen.

In table 9, a rating of *slight* indicates that the use of conventional logging equipment is not restricted if normal logging methods are used. A rating of *moderate* indicates that the use of equipment is restricted because of one or more soil factors. If wetness is a limitation, high flotation equipment or special procedures may be needed to prevent the formation of ruts. A rating of *severe* indicates that the kind of equipment that can be used is seriously restricted.

Logging areas and skid trails include areas where some or all of the trees are being cut. Generally, equipment traffic is least intensive in the logging areas. Skid trails, which generally are within the logging areas, are roads or trails over which logs are dragged or hauled from the stump to a log landing.

Landings are areas where logs are assembled for transportation. Wheeled equipment may be used more frequently in these areas than in any other areas affected by logging.

Logging roads are access roads leading from primary or surfaced roads to the logging areas. The logging roads serve as transportation routes for wheeled logging equipment and logging trucks. Generally, they are unpaved roads. Some are graveled.

Windbreaks and Environmental Plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, help to keep snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To ensure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 10 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 10 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a commercial nursery.

Recreation

Maya Hamady, soil conservationist, Soil Conservation Service, helped prepare this section.

Cropland is mainly in the southern part of Newaygo County, and woodland is in the northern part. As a result, the county is considered the gateway to northern Michigan. The 106,820 acres in the Manistee National Forest, the 280 acres in Newaygo State Park, the 356 miles of rivers and streams, and the 234 lakes in the county provide ample opportunities for recreation. More than 35 miles of the North Country Trail is in the county. This is a national trail built across public and private land. It is 3,600 miles long. The national headquarters for the trail is in Lincoln Township.

Five natural preserves represent the types of vegetation in the county. They include areas of natural prairie vegetation and a natural wooded swamp. Sixteen historical sites in the county depict the logging era from the latter part of the last century to the beginning of this century. The sites include ghost towns, logging camps, and old-time sawmills. Historical Indian sites include burial mounds and campsites. Five scenic areas overlook river and stream valleys.

The county has numerous resorts, cabins, motels, and private and public campgrounds, mostly along the larger lakes. The public campgrounds are on Federal, State, county, and municipal lands. They include primitive tent campsites and trailer hookup sites.

Many of the opportunities for recreation in the county are provided by areas of water. The many lakes offer excellent opportunities for catching bluegill, sunfish, bass, and pike. Some lakes have been stocked with rainbow trout and brown trout. Many miles of streams offer prime opportunities for catching brook trout, rainbow trout, and brown trout. The Muskegon River and many other rivers have been stocked with walleye, chinook salmon, and coho salmon. Canoeing is popular on the Muskegon, Pere Marquette, and White Rivers. Powerboats can be used on the larger lakes. The county has canoe liveries and boat marinas.

The Newaygo County Parks Commission, in cooperation with the Manistee National Forest, provides miles of marked cross-country trails for skiing and snowmobiling. The privately developed recreational facilities in the county include horseback riding trails and golf courses.

The soils of the survey area are rated in table 11 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewer lines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreational uses by the duration and intensity of flooding and the season when flooding occurs. In planning recreational facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 11, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 11 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 14 and interpretations for dwellings without basements and for local roads and streets in table 13.

Camp areas require site preparation, such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have gentle slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry.

Paths and trails for hiking and horseback riding should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.

Wildlife Habitat

Maya Hamady, soil conservationist, and Lynn Sampson, biologist, Soil Conservation Service, helped prepare this section. The sources of information about threatened species were Fred Ignatoski, wildlife biologist, Michigan Department of Natural Resources, Baldwin, Michigan; Dave Vandenbelt, Audubon Society, Fremont, Michigan; Michigan Natural Features Inventory; and U.S. Fish and Wildlife Service.

Prior to European settlement, many wildlife species inhabited the wilderness of Newaygo County. They included black bear, mountain lion, lynx, bobcat, elk, and timber wolf. The passenger pigeon and the eastern wild turkey were abundant in the pristine forests of the county. The passenger pigeon became extinct at the beginning of this century.

Since European settlement, human activities have significantly affected the composition of wildlife species in the county. In the 1800's, logging created conditions resembling those of a prairie. Many wildlife species associated with prairies increased in number or expanded their range from the west. The sharp-tailed grouse and the prairie chicken, which invaded the newly created prairie habitat, remained abundant as long as suitable habitat was available.

As the forest regenerated after it was logged, the population of white-tailed deer, which was relatively small in the pristine forest, soared in response to abundant browse. The timber wolf was replaced by the coyote, which is a more adaptable species. Most of the wildlife species that currently inhabit the county are adapted to second-growth forest, brushy edges, and agricultural areas.

The ring-necked pheasant was introduced in the newly created agricultural habitat. The eastern wild turkey was recently reintroduced into the county. Such species as the European starling, the Norway rat, and the house mouse were inadvertently introduced.

An area where farmland is interspersed with woodland is ideal habitat for white-tailed deer, which are very abundant in the county. The deer can increase to such a plentiful level during consecutive years of mild winters that they can cause damage to crops, tree seedlings, saplings, and other vegetation. Feeding the deer can help to maintain an artificially high population that exceeds the natural carrying capacity of the land and perpetuates the damage to vegetation.

The ring-necked pheasant is at the northern end of its range in Newaygo County. It can survive in areas of farmland if enough cover and food are provided in nearby areas. Providing undisturbed nesting cover of grasses and legumes is critical in maintaining the population of this species. The Sichuan pheasant, which is being studied by the Michigan Department of Natural Resources, might prove to be hardier than the ring-necked pheasant in this county.

Ruffed grouse in Newaygo County currently are more abundant than they were in the pristine forest because of the expansion of the aspen forest type. The population of this species fluctuates from year to year. The grouse generally favor aspen forest during winter and early spring because the catkins of the male flowers are high-energy food for this bird. Shrubs that provide small fruit, such as hawthorn, attract the grouse in fall and late summer. The grouse also use small openings in wooded areas, which provide forbs. Grouse broods use young, dense aspen stands. The slightly larger aspens are the best source of winter food. If properly managed, aspen stands can provide cover, food, and drumming sites for the ruffed grouse throughout the year.

Cottontail rabbits inhabit areas of cropland, farmsteads, and abandoned building sites and have adapted to municipal areas. Swampy areas in the northern part of the county provide habitat for snowshoe hare.

Fox squirrels inhabit nearly every hardwood woodlot on the farms in the county. They eat corn and thus thrive in agricultural areas. Gray squirrels and black squirrels inhabit the oak forests in the county. Red squirrels inhabit the pine forests and swampy areas.

Several species of furbearers, including mink, river otter, red fox, and gray fox, are abundant in the county. Pine martens have recently been reintroduced. As the forests mature, black bears are becoming more common. The hundreds of miles of wooded streams provide good habitat for beavers, the population of which currently is high in the county.

Much of the original wetland habitat in the county has already been drained. The remaining marshes and the areas that are subject to flooding in the county provide important habitat for a variety of waterfowl. Flooded areas of timber are good nesting sites for wood ducks. Nesting boxes provided in appropriate areas of the habitat have been responsible for a recent increase in the number of wood ducks. A few secluded lakes in the northern part of the county could provide habitat for common loons. Other species that reportedly have nested in the county are sandhill crane, upland plover, goshawk, red-shouldered hawk, and green heron.

The lakes and streams in Newaygo County provide habitat for many species of fish. Bass, various species of sunfish, and northern pike inhabit most of the lakes. A number of lakes have been stocked with rainbow trout and walleye. Brown and rainbow trout and coho and chinook salmon have been stocked in the Muskegon River. The White River is considered one of the better streams for brook trout in Michigan.

The plant communities in Newaygo County include many species that the State of Michigan considers rare, threatened, or endangered. These species include false arrow feather (*Aristida necopino*), western silvery aster (*Aster sericeus*), prairiesmoke (*Geum triflorum*), and smallflower hemicarpha (*Hemicarpha micrantha*). The county also includes unique upland areas of prairie plant communities.

The bald eagle (*Hiliaeetus leucocephalus*), the Karner blue butterfly (*Lycaeides melissa samuelis*), and the lake sturgeon (*Acipenser fulvescens*) all inhabit the county. The U.S. Fish and Wildlife Service considers the bald eagle a threatened species. The Karner blue butterfly has been proposed for inclusion as an endangered species on the federal list of endangered and threatened species. The lake sturgeon is being studied for possible inclusion on the list.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 12, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

Grain and seed crops are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, rye, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flooding, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, bromegrass, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flooding. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are goldenrod, white aster, stinging nettle, and cardinalflower.

Hardwood trees and woody understory produce nuts or other fruit, buds, catkins, twigs, bark, and foliage. Soil properties and features that affect the growth of hardwood trees and shrubs are depth of the root zone, available water capacity, and wetness. Examples of these plants are oak, aspen, cherry, apple, hawthorn, dogwood, hickory, blackberry, and blueberry. Examples of fruit-producing shrubs that are suitable for planting on soils rated *good* are Russian-olive, autumn-olive, and crabapple.

Coniferous plants furnish browse and seeds. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, and cedar.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, wildrice, rushes, sedges, and reeds.

Shallow water areas have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

Habitat for openland wildlife consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. Wildlife attracted to these areas include ring-necked pheasant, meadowlark, field sparrow, cottontail, and red fox.

Habitat for woodland wildlife consists of areas of deciduous plants or coniferous plants or both and associated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include wild turkey, ruffed grouse, woodcock, thrushes, woodpeckers, squirrels, red fox, gray fox, raccoon, deer, and bear.

Habitat for wetland wildlife consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. Ratings are given for building site development, sanitary facilities, construction materials, and water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil Properties" section.

Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.

The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations should be considered in planning, in site selection, and in design.

Soil properties, site features, and observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to evaluate the potential of areas for residential, commercial, industrial, and recreational uses; make preliminary estimates of construction conditions; evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; plan detailed onsite investigations of soils and geology; locate potential sources of gravel, sand, earthfill, and topsoil; plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the "Glossary."

Building Site Development

Table 13 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, local roads and streets, and lawns and landscaping. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by a firm, dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and depth to the water table.

Dwellings and *small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwellings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrinking and swelling, and organic layers can cause the movement of footings. A high water table, large stones, slope, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 or 6 feet are not considered.

Local roads and streets have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material; a base of gravel, crushed rock, or stabilized soil material; and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic-supporting capacity.

Lawns and landscaping require soils on which turf and ornamental trees and shrubs can be established and maintained. The ratings are based on soil properties, site features, and observed performance of the soils. Soil reaction, a high water table, and the available water capacity in the upper 40 inches affect plant growth. Flooding, wetness, slope, stoniness, and the amount of sand, clay, or organic matter in the surface layer affect trafficability after vegetation is established.

Sanitary Facilities

Table 14 shows the degree and kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 14 also shows the suitability of the soils for use as daily cover for landfill. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, and flooding affect absorption of the effluent. Large stones interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel are less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to filter the effluent effectively. Many local ordinances require that this material be of a certain thickness.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 14 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, flooding, large stones, and content of organic matter.

Excessive seepage resulting from rapid permeability in the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope can cause construction problems, and large stones can hinder compaction of the lagoon floor.

Sanitary landfills are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground-water pollution. Ease of excavation and revegetation should be considered.

The ratings in table 14 are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, and soil reaction affect trench landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

Daily cover for landfill is the soil material that is used to cover compacted solid waste in an area sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

Construction Materials

Table 15 gives information about the soils as a source of roadfill, sand, gravel, and topsoil. The soils are rated *good, fair,* or *poor* as a source of roadfill and topsoil. They are rated as a *probable* or *improbable* source of sand and gravel. The ratings are based on soil properties and site features that affect the removal of the soil and its use as construction material. Normal compaction, minor processing, and other standard construction practices are assumed. Each soil is evaluated to a depth of 5 or 6 feet.

Roadfill is soil material that is excavated in one place and used in road embankments in another place. In this table, the soils are rated as a source of roadfill for low embankments, generally less than 6 feet high and less exacting in design than higher embankments.

The ratings are for the soil material below the surface layer to a depth of 5 or 6 feet. It is assumed that soil layers will be mixed during excavating and spreading. Many soils have layers of contrasting suitability within their profile. The table showing engineering index properties provides detailed information about each soil layer. This information can help to determine the suitability of each layer for use as roadfill. The performance of soil after it is stabilized with lime or cement is not considered in the ratings.

The ratings are based on soil properties, site features, and observed performance of the soils. The thickness of suitable material is a major consideration. The ease of excavation is affected by large stones, a high water table, and slope. How well the soil performs in place after it has been compacted and drained is determined by its strength (as inferred from the engineering classification of the soil) and shrink-swell potential.

Soils rated *good* contain significant amounts of sand or gravel or both. They have at least 5 feet of suitable material, a low shrink-swell potential, few cobbles and stones, and slopes of 15 percent or less. Depth to the water table is more than 3 feet. Soils rated *fair* are more than 35 percent silt- and clay-sized particles and have a plasticity index of less than 10. They have a moderate shrink-swell potential, slopes of 15 to 25 percent, or many stones. Depth to the water table is 1 to 3 feet. Soils rated *poor* have a plasticity index of more than 10, a high shrink-swell potential, many stones, or slopes of more than 25 percent. They are wet and have a water table at a depth of less than 1 foot. They may have layers of suitable material, but the material is less than 3 feet thick.

Sand and *gravel* are natural aggregates suitable for commercial use with a minimum of processing. They are used in many kinds of construction. Specifications for each use vary widely. In table 15, only the probability of finding material in suitable quantity is evaluated. The suitability of the material for specific purposes is not evaluated, nor are factors that affect excavation of the material.

The properties used to evaluate the soil as a source of sand or gravel are gradation of grain sizes (as indicated by the engineering classification of the soil), the thickness of suitable material, and the content of rock fragments. Kinds of rock, acidity, and stratification are given in the soil series descriptions. Gradation of grain sizes is given in the table on engineering index properties.

A soil rated as a probable source has a layer of clean sand or gravel or a layer of sand or gravel that is up to 12 percent silty fines. This material must be at least 3 feet thick and less than 50 percent, by weight, large stones. All other soils are rated as an improbable source. Coarse fragments of soft bedrock, such as shale and siltstone, are not considered to be sand and gravel.

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity, and fertility. The ease of excavating, loading, and spreading is affected by rock fragments, slope, a water table, soil texture, and thickness of suitable material. Reclamation of the borrow area is affected by slope, a water table, rock fragments, and toxic material.

Soils rated *good* have friable, loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel, and have slopes of less than 8 percent. They are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated *fair* are sandy soils, loamy soils that have a relatively high content of clay, soils that have only 20 to 40 inches of suitable material, soils that have an appreciable amount of gravel or stones, or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated *poor* are very sandy or clayey, have less than 20 inches of suitable material, have a large amount of gravel or stones, have slopes of more than 15 percent, or have a seasonal high water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

Water Management

Table 16 gives information on the soil properties and site features that affect water management. The degree and kind of soil limitations are given for pond reservoir areas; embankments, dikes, and levees; and aquifer-fed excavated ponds. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and are easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increase in construction costs, and possibly increased maintenance are required.

This table also gives for each soil the restrictive features that affect drainage, irrigation, and grassed waterways.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have low seepage potential in the upper 60 inches. The seepage potential is determined by the permeability of the soil and the depth to fractured bedrock or other permeable material. Excessive slope can affect the storage capacity of the reservoir area.

Embankments, dikes, and levees are raised structures of soil material, generally less than 20 feet high, constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of material for embankment fill. The ratings apply to the soil material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping, and erosion and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or boulders or of organic matter. A high water table affects the amount of usable material. It also affects trafficability.

Aquifer-fed excavated ponds are pits or dugouts that extend to a ground-water aquifer or to a depth below a permanent water table. Excluded are ponds that are fed only by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Excavated ponds are affected by depth to a permanent water table and permeability of the aquifer. The content of large stones affects the ease of excavation.

Drainage is the removal of excess surface and subsurface water from the soil. How easily and effectively the soil is drained depends on the depth to a firm layer or to other layers that affect the rate of water movement; permeability; depth to a high water table or depth of standing water if the soil is subject to ponding; slope; susceptibility to flooding; subsidence of organic layers; and the potential for frost action. Excavating and grading and the stability of ditchbanks are affected by the depth to a firm layer, large stones, slope, and the hazard of cutbanks caving. Availability of drainage outlets is not considered in the ratings.

Irrigation is the controlled application of water to supplement rainfall and support plant growth. The design and management of an irrigation system are affected by depth to the water table, the need for drainage, flooding, available water capacity, intake rate, permeability, erosion hazard, and slope. The construction of a system is affected by large stones. The performance of a system is affected by the depth of the root zone and soil reaction.

Grassed waterways are natural or constructed channels, generally broad and shallow, that conduct surface water to outlets at a nonerosive velocity. Large stones, wetness, and slope affect the construction of grassed waterways. A hazard of soil blowing, low available water capacity, restricted rooting depth, and restricted permeability adversely affect the growth and maintenance of the grass after construction.

Soil Properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help to characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classification, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

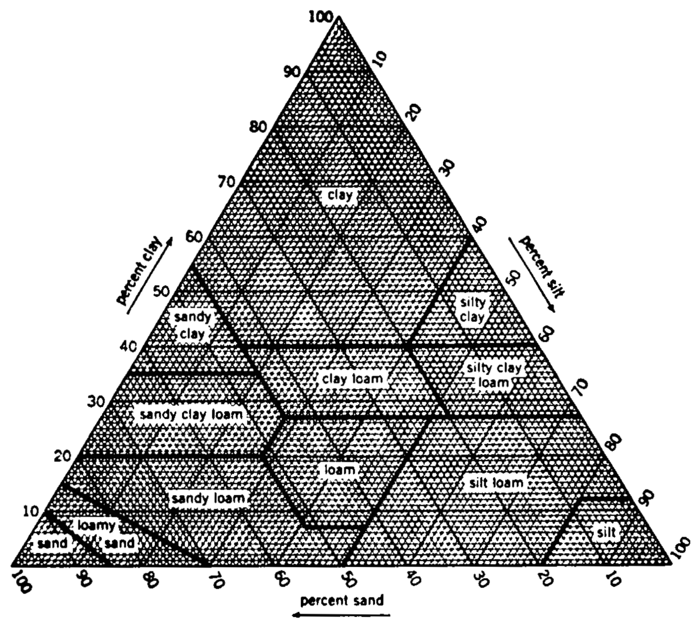


Figure 12.—Percentages of clay, silt, and sand in the basic USDA soil textural classes.

Engineering Index Properties

Table 17 gives estimates of the engineering classification and of the range of index properties for the major layers of each soil in the survey area. Most soils have layers of contrasting properties within the upper 5 or 6 feet.

Depth to the upper and lower boundaries of each layer is indicated. The range in depth and information on other properties of each layer are given for each soil series under the heading "Soil Series and Their Morphology."

Texture is given in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in the fraction of the soil that is less than 2 millimeters in diameter (fig. 12). "Loam," for example, is soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If the content of particles coarser than sand is as much as about 15 percent, an appropriate modifier is added, for example, "gravelly." Textural terms are defined in the "Glossary."

Classification of the soils is determined according to the Unified soil classification system *(2)* and the system adopted by the American Association of State Highway and Transportation Officials *(1)*.

The Unified system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter and according to plasticity index, liquid limit, and organic matter content. Sandy and gravelly soils are identified as GW, GP, GM, GC, SW, SP, SM, and SC; silty and clayey soils as ML, CL, OL, MH, CH, and OH; and highly organic soils as PT. Soils exhibiting engineering properties of two groups can have a dual classification, for example, CL-ML.

The AASHTO system classifies soils according to those properties that affect roadway construction and maintenance. In this system, the fraction of a mineral soil that is less than 3 inches in diameter is classified in one of seven groups from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines (silt and clay). At the other extreme, soils in group A-7 are fine grained. Highly organic soils are classified in group A-8 on the basis of visual inspection.

If laboratory data are available, the A-1, A-2, and A-7 groups are further classified as A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, or A-7-6. As an additional refinement, the suitability of a soil as subgrade material can be indicated by a group index number. Group index numbers range from 0 for the best subgrade material to 20 or higher for the poorest.

Rock fragments 3 to 10 inches in diameter are indicated as a percentage of the total soil on a dry-weight basis. The percentages are estimates determined mainly by converting volume percentage in the field to weight percentage.

Percentage (of soil particles) passing designated sieves is the percentage of the soil fraction less than 3 inches in diameter based on an ovendry weight. The sieves, numbers 4, 10, 40, and 200 (USA Standard Series), have openings of 4.76, 2.00, 0.420, and 0.074 millimeters, respectively. Estimates are based on laboratory tests of soils sampled in the survey area and in nearby areas and on estimates made in the field.

Liquid limit and *plasticity index* (Atterberg limits) indicate the plasticity characteristics of a soil. The estimates are based on test data from the survey area or from nearby areas and on field examination.

The estimates of grain-size distribution, liquid limit, and plasticity index are generally rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount (1 or 2 percentage points) across classification boundaries, the classification in the marginal zone is omitted in the table.

Physical and Chemical Properties

Table 18 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations.

Moist bulk density is the weight of soil (ovendry) per unit volume. Volume is measured when the soil is at field moisture capacity, that is, the moisture content at ⅓-bar moisture tension. Weight is determined after drying the soil at 105 degrees C. In this table, the estimated moist bulk density of each major soil horizon is expressed in grams per cubic centimeter of soil material that is less than 2 millimeters in diameter. Bulk density data are used to compute shrink-swell potential, available water capacity, total pore space, and other soil properties. The moist bulk density of a soil indicates the pore space available for water and roots. A bulk density of more than 1.6 can restrict water storage and root penetration. Moist bulk density is influenced by texture, kind of clay, content of organic matter, and soil structure.

Permeability refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems and septic tank absorption fields.

Available water capacity refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

Soil reaction is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

Shrink-swell potential is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others, swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value, the more susceptible the soil is to sheet and rill erosion by water.

Erosion factor T is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Wind erodibility groups are made up of soils that have similar properties affecting their resistance to soil blowing in cultivated areas. The groups indicate the susceptibility to soil blowing. Soils are grouped according to the following distinctions:

1. Coarse sands, sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy coarse sands, loamy sands, loamy fine sands, loamy very fine sands, and sapric soil material. These soils are very highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

3. Coarse sandy loams, sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control soil blowing are used.

4L. Calcareous loams, silt loams, clay loams, and silty clay loams. These soils are erodible. Crops can be grown if intensive measures to control soil blowing are used.

4. Clays, silty clays, noncalcareous clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control soil blowing are used.

5. Noncalcareous loams and silt loams that are less than 20 percent clay and sandy clay loams, sandy clays, and hemic soil material. These soils are slightly erodible. Crops can be grown if measures to control soil blowing are used.

6. Noncalcareous loams and silt loams that are more than 20 percent clay and noncalcareous clay loams that are less than 35 percent clay. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

7. Silts, noncalcareous silty clay loams that are less than 35 percent clay, and fibric soil material. These soils are very slightly erodible. Crops can be grown if ordinary measures to control soil blowing are used.

8. Soils that are not subject to soil blowing because of coarse fragments on the surface or because of surface wetness.

Organic matter is the plant and animal residue in the soil at various stages of decomposition. In table 18, the estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

Soil and Water Features

Table 19 gives estimates of various soil and water features. The estimates are used in land use planning that involves engineering considerations.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are assigned to one of four groups. They are grouped according to the infiltration of water when the soils are thoroughly wet and receive precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to two hydrologic groups in table 19, the first letter is for drained areas and the second is for undrained areas.

Flooding, the temporary inundation of an area, is caused by overflowing streams, by runoff from adjacent slopes, or by tides. Water standing for short periods after rainfall or snowmelt is not considered flooding, nor is water in swamps and marshes.

Table 19 gives the frequency and duration of flooding and the time of year when flooding is most likely.

Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions (the chance of flooding is nearly 0 percent to 5 percent in any year); *occasional* that it occurs infrequently under normal weather conditions (the chance of flooding is 5 to 50 percent in any year); and *frequent* that it occurs often under normal weather conditions (the chance of flooding is more than 50 percent in any year). Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, *long* if 7 days to 1 month; and *very long* if more than 1 month. Probable dates are expressed in months. About two-thirds to three-fourths of all flooding occurs during the stated period.

The information is based on evidence in the soil profile, namely thin strata of gravel, sand, silt, or clay deposited by floodwater; irregular decrease in organic matter content with increasing depth; and little or no horizon development.

Also considered are local information about the extent and levels of flooding and the relation of each soil on the landscape to historic floods. Information on the extent of flooding based on soil data is less specific than that provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table (seasonal) is the highest level of a saturated zone in the soil in most years. The estimates are based mainly on the evidence of a saturated zone, namely grayish colors or mottles in the soil. Indicated in table 19 are the depth to the seasonal high water table; the kind of water table—that is, perched or apparent; and the months of the year that the water table commonly is high. A water table that is seasonally high for less than 1 month is not indicated in table 19.

An *apparent* water table is a thick zone of free water in the soil. It is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil. A *perched* water table is water standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

Only saturated zones within a depth of about 6 feet are indicated. A plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. Table 19 shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, permeability, content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage mainly to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than steel in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion is also expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

United States Department of Agriculture

NRCS

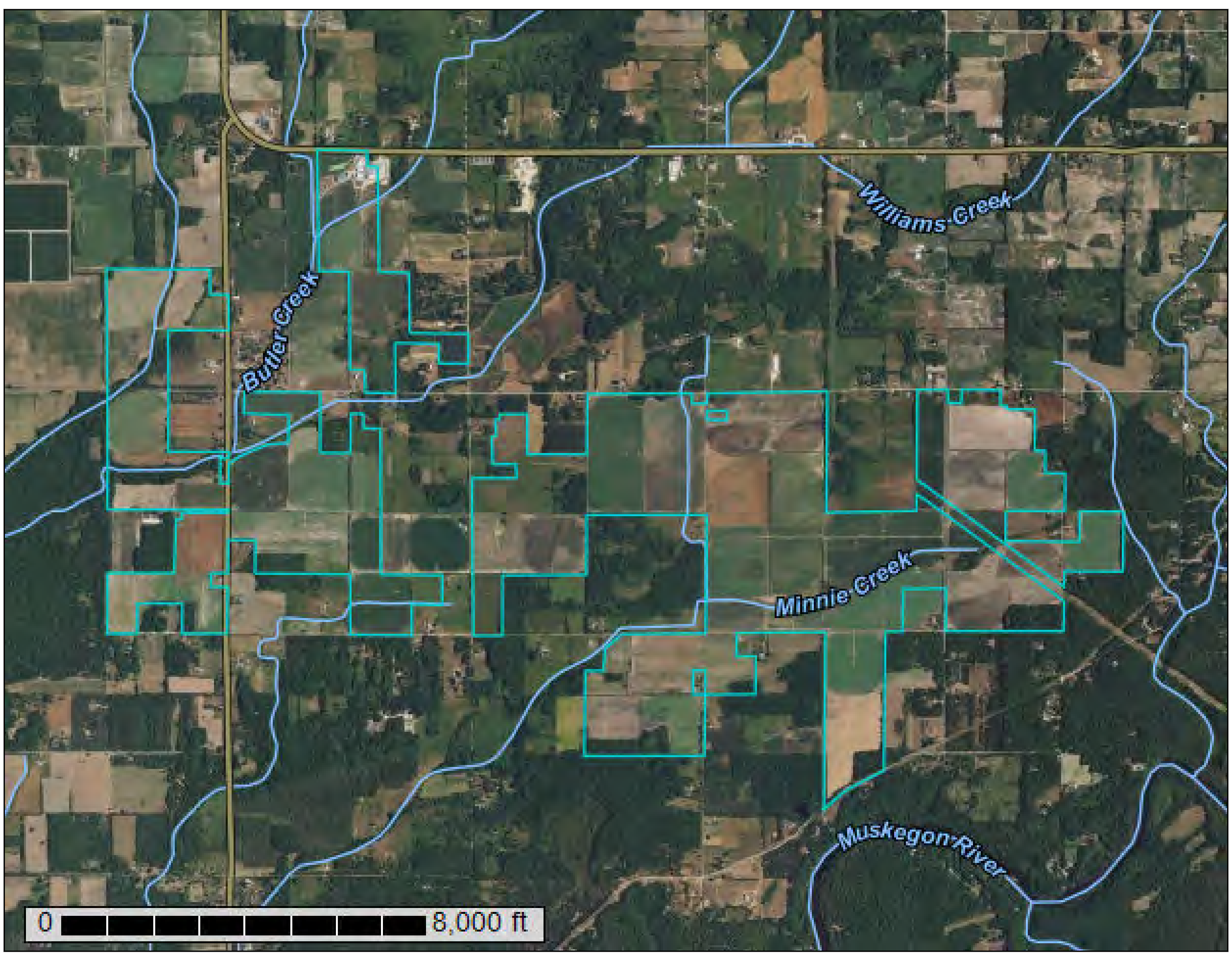
Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Newaygo County, Michigan

Sylvan Project Boundary



September 8, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

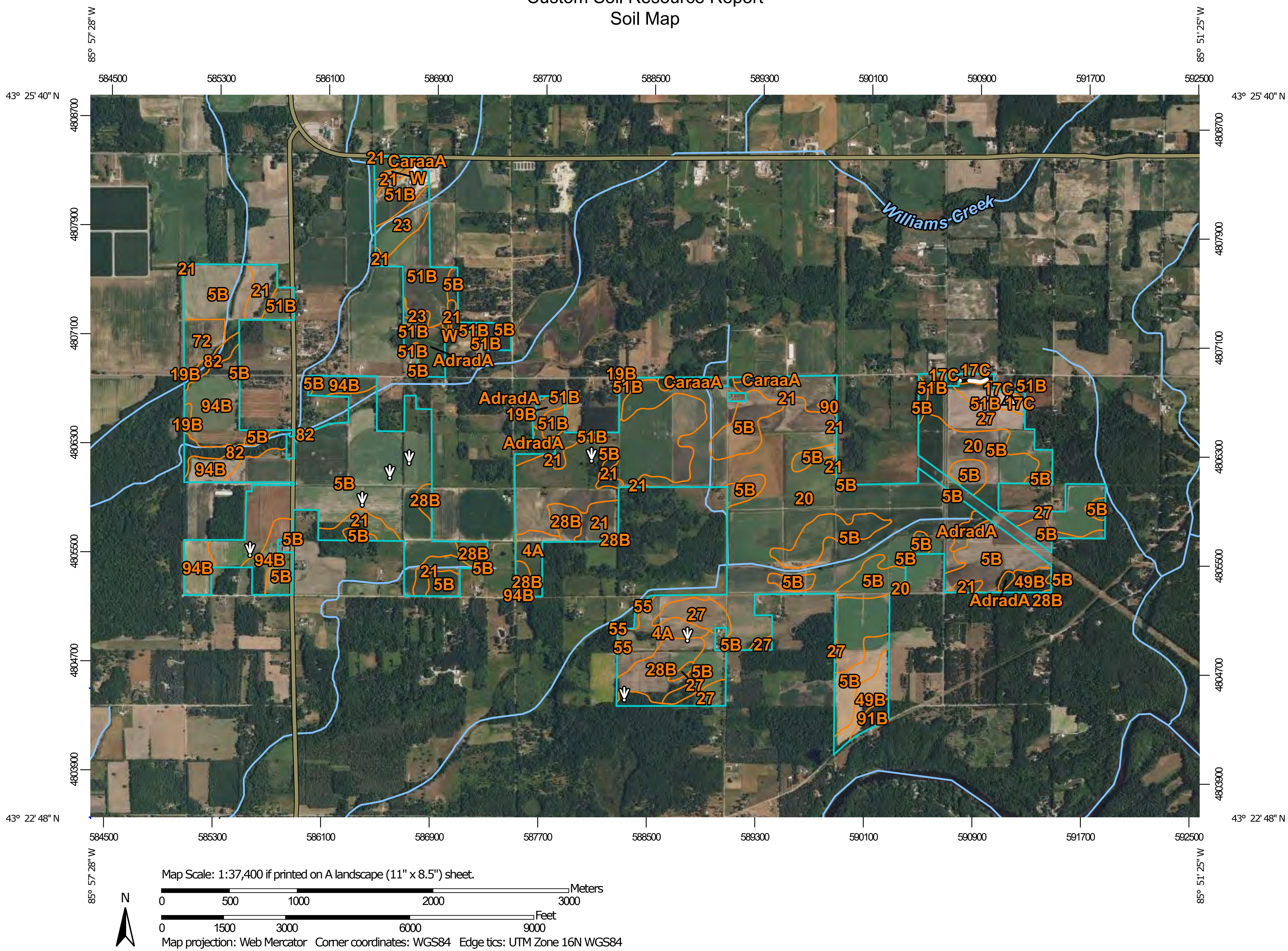
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Newaygo County, Michigan
Survey Area Data: Version 20, Aug 27, 2024

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 2, 2020—Nov 12, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
4A	Cosad loamy sand, 0 to 3 percent slopes	54.3	2.5%
5B	Pipestone sand, 0 to 4 percent slopes	810.8	37.5%
17C	Spinks-Metea-Coloma complex, 6 to 12 percent slopes	5.3	0.2%
19B	Covert sand, 0 to 4 percent slopes	9.4	0.4%
20	Granby mucky sand	515.7	23.9%
21	Kingsville mucky sand	134.3	6.2%
23	Lamson loamy fine sand	27.0	1.2%
27	Granby mucky sand, gravelly substratum	130.4	6.0%
28B	Watseka loamy sand, 0 to 4 percent slopes	77.7	3.6%
49B	Toogood loamy sand, moderately wet, 0 to 4 percent slopes	34.1	1.6%
51B	Thetford loamy fine sand, 0 to 4 percent slopes	120.6	5.6%
55	Sickles loamy fine sand	4.2	0.2%
72	Udipsamments, nearly level and gently sloping	22.2	1.0%
82	Algansee loamy fine sand	31.3	1.4%
90	Histosols and Aquents, ponded	1.7	0.1%
91B	Plainfield sand, 0 to 6 percent slopes	8.3	0.4%
94B	Brems sand, 0 to 4 percent slopes	123.9	5.7%
AdradA	Adrian muck, lake moderated cool, 0 to 1 percent slopes	34.6	1.6%
CaraaA	Carlisle muck, lake moderated cool, 0 to 2 percent slopes	15.0	0.7%
W	Water	1.0	0.0%
Totals for Area of Interest		**2,161.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps.

The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Newaygo County, Michigan

4A—Cosad loamy sand, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 6820
Elevation: 200 to 1,020 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Cosad and similar soils: 88 percent
Minor components: 12 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Cosad

Setting

Landform: Lake plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy over loamy and/or clayey lacustrine deposits

Typical profile

Ap - 0 to 12 inches: loamy sand
Bw - 12 to 21 inches: loamy sand
2C - 21 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: F096XB023MI - Sandy Depression
Hydric soil rating: No

Minor Components

Pipestone

Percent of map unit: 4 percent
Hydric soil rating: No

Sickles

Percent of map unit: 4 percent
Landform: Depressions
Hydric soil rating: Yes

Del rey

Percent of map unit: 4 percent
Hydric soil rating: No

5B—Pipestone sand, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 6825
Elevation: 600 to 1,200 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Pipestone and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Pipestone

Setting

Landform: Lake plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

H1 - 0 to 8 inches: sand
H2 - 8 to 11 inches: sand
H3 - 11 to 21 inches: sand
H4 - 21 to 60 inches: sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F097XA006MI - Moist Acidic Sandy Flatwoods, F096XB021MI - Acidic Sandy Depression
Hydric soil rating: No

Minor Components

Thetford

Percent of map unit: 3 percent
Hydric soil rating: No

Kingsville

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

17C—Spinks-Metea-Coloma complex, 6 to 12 percent slopes

Map Unit Setting

National map unit symbol: 680d
Elevation: 580 to 1,360 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Spinks and similar soils: 26 percent
Metea and similar soils: 25 percent
Coloma and similar soils: 24 percent
Minor components: 25 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Spinks

Setting

Landform: Moraines
Landform position (two-dimensional): Summit, backslope
Landform position (three-dimensional): Interfluve, side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy drift

Typical profile

H1 - 0 to 11 inches: loamy sand
H2 - 11 to 27 inches: sand
H3 - 27 to 60 inches: sand

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: A
Ecological site: F098XA013MI - Piney Dry Sandy Drift Plains, F094AA006MI - Snowy Sandy Drift, F096XB019MI - Rich Sandy Drift
Hydric soil rating: No

Description of Metea

Setting

Landform: Moraines
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Rise
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy and/or loamy till

Typical profile

H1 - 0 to 8 inches: loamy sand
H2 - 8 to 32 inches: sand
H3 - 32 to 48 inches: clay loam
H4 - 48 to 60 inches: loam

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Available water supply, 0 to 60 inches: Moderate (about 6.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: F098XA013MI - Piney Dry Sandy Drift Plains, F094AA006MI - Snowy Sandy Drift, F096XB019MI - Rich Sandy Drift
Hydric soil rating: No

Description of Coloma

Setting

Landform: Outwash plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Sandy glacial drift

Typical profile

A - 0 to 3 inches: sand
E - 3 to 43 inches: sand
E and Bt - 43 to 60 inches: sand

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: A
Ecological site: F098XA013MI - Piney Dry Sandy Drift Plains, F094AA006MI - Snowy Sandy Drift, F096XB020MI - Sandy Drift
Hydric soil rating: No

Minor Components

Toogood

Percent of map unit: 13 percent
Hydric soil rating: No

Scalley

Percent of map unit: 12 percent
Hydric soil rating: No

19B—Covert sand, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 680j
Elevation: 600 to 1,200 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Covert and similar soils: 91 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Covert

Setting

Landform: Moraines
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy till

Typical profile

E - 0 to 6 inches: sand
Bs - 6 to 10 inches: sand
C1 - 10 to 25 inches: sand
C2 - 25 to 60 inches: sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 24 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F096XB021MI - Acidic Sandy Depression

Hydric soil rating: No

Minor Components

Pipestone

Percent of map unit: 3 percent
Hydric soil rating: No

Kingsville

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

Thetford

Percent of map unit: 3 percent
Hydric soil rating: No

20—Granby mucky sand

Map Unit Setting

National map unit symbol: 680l
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Granby and similar soils: 91 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Granby

Setting

Landform: Depressions, outwash plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

Ap - 0 to 10 inches: mucky sand
Bg - 10 to 24 inches: sand
C - 24 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Negligible

Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: A/D
Ecological site: F097XA008MI - Wet Sandy Flatwoods, F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Minor Components

Jebavy

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Pipestone

Percent of map unit: 4 percent
Hydric soil rating: No

21—Kingsville mucky sand

Map Unit Setting

National map unit symbol: 680m
Elevation: 600 to 1,000 feet
Mean annual precipitation: 28 to 38 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 160 days
Farmland classification: Not prime farmland

Map Unit Composition

Kingsville and similar soils: 91 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Kingsville

Setting

Landform: Lake plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciolacustrine deposits

Typical profile
A - 0 to 7 inches: mucky sand
Bw - 7 to 60 inches: sand

Properties and qualities
Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 5.4 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Minor Components

Jebavy
Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Pipestone
Percent of map unit: 4 percent
Hydric soil rating: No

23—Lamson loamy fine sand

Map Unit Setting
National map unit symbol: 680r
Elevation: 50 to 1,100 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Prime farmland if drained

Map Unit Composition
Lamson and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Lamson

Setting

Landform: Lake plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy glaciolacustrine deposits

Typical profile

Ap - 0 to 9 inches: loamy fine sand
Cg - 9 to 26 inches: very fine sandy loam
2Cg - 26 to 60 inches: stratified fine sand to loamy very fine sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Available water supply, 0 to 60 inches: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: B/D
Ecological site: F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Minor Components

Dixboro

Percent of map unit: 3 percent
Hydric soil rating: No

27—Granby mucky sand, gravelly substratum

Map Unit Setting

National map unit symbol: 680t
Elevation: 580 to 1,300 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Farmland of local importance

Map Unit Composition

Granby and similar soils: 96 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Granby

Setting

Landform: Depressions, outwash plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

Ap - 0 to 13 inches: mucky sand
Bg - 13 to 40 inches: sand
C - 40 to 60 inches: sand

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 15 percent
Available water supply, 0 to 60 inches: Low (about 5.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Minor Components

Watseka

Percent of map unit: 4 percent
Hydric soil rating: No

28B—Watseka loamy sand, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 680v
Elevation: 580 to 1,300 feet

Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Farmland of local importance

Map Unit Composition

Watseka and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Watseka

Setting

Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

H1 - 0 to 14 inches: loamy sand
H2 - 14 to 60 inches: gravelly coarse sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A/D
Ecological site: F098XA019MI - Moist Sandy Drift Plains, F096XB023MI - Sandy Depression
Hydric soil rating: No

Minor Components

Granby

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

49B—Toogood loamy sand, moderately wet, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 681z
Elevation: 580 to 1,300 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Toogood, moderately wet, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Toogood, Moderately Wet

Setting

Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy and gravelly outwash

Typical profile

H1 - 0 to 4 inches: loamy sand
H2 - 4 to 34 inches: loamy sand
H3 - 34 to 36 inches: gravelly sandy loam
H4 - 36 to 60 inches: very gravelly coarse sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Available water supply, 0 to 60 inches: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F096XB023MI - Sandy Depression
Hydric soil rating: No

Minor Components

Toogood

Percent of map unit: 4 percent
Hydric soil rating: No

Watseka

Percent of map unit: 3 percent
Hydric soil rating: No

Granby

Percent of map unit: 3 percent
Landform: Depressions
Hydric soil rating: Yes

51B—Thetford loamy fine sand, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 6821
Elevation: 600 to 1,200 feet
Mean annual precipitation: 28 to 36 inches
Mean annual air temperature: 45 to 50 degrees F
Frost-free period: 120 to 170 days
Farmland classification: Farmland of local importance

Map Unit Composition

Thetford and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Thetford

Setting

Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy lacustrine deposits

Typical profile

H1 - 0 to 9 inches: loamy fine sand
H2 - 9 to 26 inches: loamy fine sand
H3 - 26 to 50 inches: loamy fine sand
H4 - 50 to 60 inches: fine sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very low

Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: F097XA012MI - Moist Sandy Depression, F096XB023MI - Sandy Depression
Hydric soil rating: No

Minor Components

Pipestone

Percent of map unit: 3 percent
Hydric soil rating: No

Kingsville

Percent of map unit: 2 percent
Landform: Depressions
Hydric soil rating: Yes

55—Sickles loamy fine sand

Map Unit Setting

National map unit symbol: 6824
Elevation: 50 to 1,100 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Sickles and similar soils: 91 percent
Minor components: 9 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sickles

Setting

Landform: Depressions, lake plains
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy glaciofluvial deposits over clayey lacustrine deposits

Typical profile

H1 - 0 to 8 inches: loamy fine sand
H2 - 8 to 27 inches: loamy fine sand
H3 - 27 to 60 inches: silty clay

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 30 percent
Available water supply, 0 to 60 inches: Low (about 5.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: D
Ecological site: F097XA008MI - Wet Sandy Flatwoods, F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Minor Components

Lamson

Percent of map unit: 5 percent
Landform: Depressions
Hydric soil rating: Yes

Del rey

Percent of map unit: 4 percent
Hydric soil rating: No

72—Udipsamments, nearly level and gently sloping

Map Unit Setting

National map unit symbol: 682d
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Udipsamments and similar soils: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Udipsamments

Setting

Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy drift

Typical profile

H1 - 0 to 60 inches: sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Hydrologic Soil Group: A
Ecological site: F096XB020MI - Sandy Drift
Hydric soil rating: No

82—Algansee loamy fine sand

Map Unit Setting

National map unit symbol: 682g
Elevation: 600 to 1,300 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Farmland of local importance

Map Unit Composition

Algansee and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Algansee

Setting

Landform: Flood plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Sandy alluvium

Typical profile

Ap - 0 to 7 inches: loamy fine sand
C - 7 to 60 inches: stratified fine sand to loamy fine sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: A/D
Ecological site: F097XA025MI - Moist Floodplain, F096XB025MI - Floodplain
Hydric soil rating: No

Minor Components

Glendora

Percent of map unit: 4 percent
Landform: Flood plains
Hydric soil rating: Yes

Ceresco

Percent of map unit: 4 percent
Hydric soil rating: No

90—Histosols and Aquents, ponded

Map Unit Setting

National map unit symbol: 682j
Elevation: 600 to 1,400 feet
Mean annual precipitation: 27 to 34 inches
Mean annual air temperature: 41 to 48 degrees F
Frost-free period: 60 to 180 days
Farmland classification: Not prime farmland

Map Unit Composition

Aquents and similar soils: 51 percent
Histosols and similar soils: 49 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aquents

Setting

Landform: Depressions
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

H1 - 0 to 60 inches: variable

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6w
Hydric soil rating: Yes

Description of Histosols

Setting

Landform: Depressions, marshes
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Herbaceous organic material

Typical profile

Oa - 0 to 51 inches: muck
H2 - 51 to 60 inches: variable

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 5.95 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F098XA006MI - Mucky Depressions
Hydric soil rating: Yes

91B—Plainfield sand, 0 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2w4kb
Elevation: 580 to 1,030 feet
Mean annual precipitation: 30 to 41 inches
Mean annual air temperature: 41 to 52 degrees F
Frost-free period: 110 to 200 days
Farmland classification: Not prime farmland

Map Unit Composition

Plainfield and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Plainfield

Setting

Landform: Moraines, outwash plains, outwash terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

A - 0 to 6 inches: sand
Bw - 6 to 26 inches: sand
BC - 26 to 34 inches: sand
C - 34 to 80 inches: sand

Properties and qualities

Slope: 0 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (1.42 to 14.17 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 0.1 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water supply, 0 to 60 inches: Low (about 3.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A

Ecological site: F096XB020MI - Sandy Drift
Hydric soil rating: No

Minor Components

Covert

Percent of map unit: 4 percent
Landform: Outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, interfluve, tread
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Pipestone

Percent of map unit: 2 percent
Landform: Outwash plains, outwash terraces, moraines
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave, linear, convex
Across-slope shape: Linear
Hydric soil rating: No

Spinks

Percent of map unit: 2 percent
Landform: Outwash plains, moraines, outwash terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Interfluve, head slope, nose slope, side slope, tread
Down-slope shape: Convex, linear
Across-slope shape: Linear
Hydric soil rating: No

94B—Brems sand, 0 to 4 percent slopes

Map Unit Setting

National map unit symbol: 682r
Elevation: 600 to 1,150 feet
Mean annual precipitation: 30 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 140 to 150 days
Farmland classification: Not prime farmland

Map Unit Composition

Brems and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Brems

Setting

Landform: Outwash plains
Landform position (three-dimensional): Rise
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy outwash

Typical profile

Ap - 0 to 8 inches: sand
Bw - 8 to 46 inches: sand
C - 46 to 60 inches: sand

Properties and qualities

Slope: 0 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: A
Ecological site: F096XB023MI - Sandy Depression
Hydric soil rating: No

Minor Components

Plainfield

Percent of map unit: 3 percent
Hydric soil rating: No

AdradA—Adrian muck, lake moderated cool, 0 to 1 percent slopes

Map Unit Setting

National map unit symbol: 2zdlh
Elevation: 610 to 990 feet
Mean annual precipitation: 33 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 110 to 155 days
Farmland classification: Farmland of local importance

Map Unit Composition

Adrian and similar soils: 92 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Adrian

Setting

Landform: Depressions on outwash plains, depressions on moraines on outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, dip
Down-slope shape: Concave
Across-slope shape: Linear
Parent material: Herbaceous organic material over sandy glaciofluvial deposits

Typical profile

Oa1 - 0 to 12 inches: muck
Oa2 - 12 to 34 inches: muck
Cg - 34 to 80 inches: sand

Properties and qualities

Slope: 0 to 1 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline (0.3 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 0.2
Available water supply, 0 to 60 inches: Very high (about 15.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F096XB027MI - Mucky Depression
Hydric soil rating: Yes

Minor Components

Kingsville

Percent of map unit: 3 percent
Landform: Outwash plains, nearshore zones (relict)
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Houghton

Percent of map unit: 2 percent

Landform: Depressions on outwash plains, depressions on moraines on outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, dip
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F096XB027MI - Mucky Depression
Hydric soil rating: Yes

Edwards
Percent of map unit: 2 percent
Landform: Depressions on outwash plains, depressions on moraines on outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, dip
Down-slope shape: Concave, linear
Across-slope shape: Linear
Ecological site: F096XB027MI - Mucky Depression
Hydric soil rating: Yes

Gilford, gravelly subsoil
Percent of map unit: 1 percent
Landform: Glacial drainage channels, glacial drainage channels
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

CaraaA—Carlisle muck, lake moderated cool, 0 to 2 percent slopes

Map Unit Setting
National map unit symbol: 2zdl0
Elevation: 680 to 980 feet
Mean annual precipitation: 33 to 36 inches
Mean annual air temperature: 45 to 48 degrees F
Frost-free period: 110 to 155 days
Farmland classification: Farmland of local importance

Map Unit Composition
Carlisle, cool, and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Carlisle, Cool

Setting
Landform: Depressions on moraines, depressions on glacial drainage channels, depressions on outwash plains, depressions on till plains

Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Parent material: Woody organic material

Typical profile

Oa1 - 0 to 13 inches: muck
Oa2 - 13 to 37 inches: muck
Oa3 - 37 to 80 inches: muck

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Very poorly drained
Runoff class: Negligible
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to high (0.14 to 14.17 in/hr)
Depth to water table: About 0 inches
Frequency of flooding: None
Frequency of ponding: Frequent
Maximum salinity: Nonsaline (0.0 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 0.6
Available water supply, 0 to 60 inches: Very high (about 23.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 5w
Hydrologic Soil Group: A/D
Ecological site: F096XB027MI - Mucky Depression
Hydric soil rating: Yes

Minor Components

Adrian

Percent of map unit: 5 percent
Landform: Drainageways on moraines, depressions on moraines, drainageways on moraines, drainageways on glacial drainage channels, drainageways on outwash plains, depressions on outwash plains, depressions on outwash plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F096XB027MI - Mucky Depression
Hydric soil rating: Yes

Kingsville

Percent of map unit: 3 percent
Landform: Outwash plains, nearshore zones (relict)
Landform position (three-dimensional): Dip
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F096XB024MI - Wet Sandy Depression
Hydric soil rating: Yes

Wallkill

Percent of map unit: 2 percent
Landform: Depressions on glacial drainage channels, depressions on moraines, depressions on till plains
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope
Down-slope shape: Concave, linear
Across-slope shape: Concave, linear
Ecological site: F096XB018MI - Wet Loamy Depression
Hydric soil rating: Yes

W—Water

Map Unit Composition

Water: 100 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

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Appendix 9 - Fire and Emergency Response Plans

Attachment 9 - Fire and Emergency Response Plans

AES Clean Energy
Preliminary O&M Emergency Response & Communication Plan

AES Clean Energy

Sylvan Solar

Sheridan Charter and Garfield Townships, Newaygo County, Michigan

Table of Contents

Purpose

The purpose of the AES Clean Energy O&M Emergency Response and Communication Plan (ERCP) is to assist employees and management in making quality decisions during times of crisis. The (ERCP) contains guidance in determining appropriate actions to take to prevent injury and property loss from the occurrence of emergency incidents. The ERCP will also assist facility management in ensuring the survivability of the various business assets at AES Clean Energy O&M in the event of an incident.

The ERCP will meet the applicable requirements of federal regulations, including 29 CFR 1910.38(a), as well as state and local regulations regarding emergency action planning. When an emergency occurs at the facility during normal operating hours, the safety of employees and visitors will be coordinated by AES Clean Energy EHS.

This plan is preliminary and will be finalized with updated contact information, procedures, maps, and other details prior to commencement of project construction. All employees and visitors shall be trained on this plan or escorted while on site.

Per Section 3.26(II)(D)(q) of the Fremont Community Joint Planning Commission (FCJPC) Solar Energy Systems (SES) ordinance, this FRCP was updated to reflect feedback received from the Newaygo County Emergency Services Department, City of Fremont Fire Department, and City of Newaygo Fire Department during meetings on May 29 and August 27, 2025. Key feedback included:

- Identification of a lack of water sources within the Sylvan Solar Project area. In response, Sylvan Solar proposed providing water storage tanks placed throughout the Project area that will be accessible to local fire departments (See the “Fires” section on page 16 of this FRCP).
- Sylvan Solar will coordinate with local emergency response groups and the Road Commission during the construction phase regarding traffic routes to minimize impacts to Project neighbors. A construction-focused ERCP will be prepared by the Engineering, Procurement, and Construction (EPC) contractor prior to construction.

As discussed on August 27, 2025, AES will coordinate with local emergency response groups during the following key stages:

- **Development**: AES will confirm if the ERCP is aligned with acceptable operating procedures, capabilities, and resources, and verify if the ERCP and FRCP can be implemented by existing local emergency response capacity. Equipment or training deficiencies will be identified along with mitigation measures.
- **Construction**: Prior to construction kickoff, AES will coordinate meetings between local emergency response groups and the EPC. Collaboration between teams is important, as it will mainly be the EPC contacting local emergency response groups during this stage.
- **Operation**: During the transition period between construction and operations, AES will coordinate a site introduction and tour for local emergency response groups. This allows the local emergency response groups to become familiar with the constructed site, and meet and exchange contact information with operations staff. AES will review this ERCP with local emergency response groups at least once every three years.

Scope

This ERCP applies to all AES employees, its contractors, and sub-contractors performing work at the AES Clean Energy Sylvan Solar Project. This plan also applies to anyone visiting an AES Clean Energy operational site or office.

Definitions

AES Person – Any person directly employed by AES Corporation

AES Contract Person - Any person contracted to work on behalf of an AES Business and directly supervised by an AES Person.

AES Integrated Energy (AIE)- transmission planner, Qualified Scheduling Entity (QSE)

Emergency – An emergency is a situation that causes or has potential to cause injury to workers, customers, or the public; property damage; business disruption; or environmental impacts. All emergencies require well developed response plans and prompt actions according to those plans to protect the health, safety, or welfare of people, and limit property damage, environmental impacts and/or business disruption. For this AES Standard, emergencies will be classified into three primary categories: natural emergencies (weather, climate, seismic, wildfires, pandemics, etc.), man-made on-site/operational emergencies (explosion, chemical release, fire, etc.) and man-made off-site emergencies (train derailment, chemical release from neighboring industries, threats of terrorism, etc.).

Emergency Action Plan (EAP) – See Emergency Operations Plan (EOP)

Emergency Management Director ("EMD") - The EMD is in command and control of the Emergency Operations Center (EOC) and the Team. EMD will direct and coordinate the utilization of (Site Name)'s resources and provide and interface with Nolan County, Taylor County, and surrounding emergency services, if it is activated. EMD will coordinate with the Incident Commander to ensure the safest and most expedient mitigation for the incident. EMD or designee will keep the Regional Manager, and other senior AES management informed as to the status of the emergency if requested. EMD will supervise distribution of emergency information for (Site Name) through Team Leaders. EMD with the help of Team Leaders will coordinate and implement the BCP to restore normal operations.

Emergency Management Team - The team oversees the incident operations and supports Incident Commander ("IC"), person on-site who oversees the response to emergency, by providing resources and recommending financial assistance, as needed. The team will:

- Determine short-term and long-term effects of the emergency
- In consultation with the Incident Commander, order an evacuation or shutdown of the plant
- Mobilize resources, as needed
- Develop and implement a plan for the orderly return to normal operations (BCP) Business Continuity Plan
- Interface with outside organizations and media
- Communicate situation reports to employees

Emergency Operations Plan (EOP) – A written detailed program of actions and communications protocols to manage emergency situations, minimize their effects, and restore the facility to full operation, contained within the ERCP.

Emergency Response and Communication Plan (ERCP) - A written detailed program of actions and communications protocols to minimize and mitigate the effects of an emergency. Contains the site EOP.

General Manager (GM) – The person ultimately responsible for the content, review, distribution, and implementation of the processes contained in the ERCP and EOP. May be Regional Manager or designee. See the General Manager Affidavit for further definition detail.

Hazard - A situation with potential for human injury, damage to property, damage to the environment, or some combination of these.

Incident Commander ("IC") - The IC is the person at the site of the emergency who oversees the immediate emergency response. This will vary depending on the nature of the incident. The IC must have the capability and expertise to assume command of an emergency as described in this procedure. The IC will manage on-scene operations of an emergency response. The IC is responsible for the technical aspects of the response as well as the tactical planning, security, execution, and determining the need for outside assistance and resources, and interface with the EOC. During an incident, the IC will:

- Maintain regular communication with EMD.
- Utilize (Site Name) personnel to set-up security points to keep unauthorized people away for the emergency and allow entry to emergency response equipment and personnel.
- Assume command, notify the EMD, implement the emergency procedures specified for the incident, assess the situation, implement this plan, activate resources, order and initiate evacuation of persons in harm's way, and upon conclusion of the incident, declare the emergency in over. If emergency services local, state or federal agencies are on the scene the IC will act as the liaison with these departments.

Intelligence Security Operations Center (ISOC) – This team within the IS shared service is responsible for the monitoring of physical and cyber controls implemented throughout AES US operations. Members of this team are also responsible for threat identification and analysis for AES Facilities in the US.

NERC – National Electric Reliability Council

Responders - Persons identified in the ERCP as being responsible for actions that are intended to minimize the risk, loss, and damage resulting from the emergency. These persons can represent external resources (e.g., ambulance, fire, police, contractors, or neighboring industries with capabilities) or be the workers or management of AES Businesses.

ROCC – Remote Operations Control Center

Objective

To provide employees with procedures to follow for effective and safe response to emergency situations, and to aid in the prevention of and planning for emergencies at the Sylvan Solar facility.

Emergency Identification and Risk Assessment

The AES Clean Energy O&M Emergency Identification and Risk Assessment/Impact Analysis will be completed prior to operation of the Project.

Emergency Response Communication Plans and Emergency Identification and Risk Assessment may also be posted in the O&M and office buildings or onsite in vehicles. Electronic copies will also be stored on the AES CE EHS SharePoint website.

Roles and Responsibilities

An emergency management Team has been established to assume the responsibility for addressing emergencies at the Sylvan Solar Project. Team is headed by the General Manager or equivalent, and is comprised of the following members:

1) Emergency Management Director ("EMD")

- General Manager (or another appropriate leader, e.g. Regional Manager)

2) Team Leaders

- List of Team Leaders will be provided to local emergency response groups prior to operation of the project.

3) The team oversees the incident operations and supports Incident Commander ("IC"), person on-site who oversees the response to emergencies, by providing resources and recommending financial assistance, as needed. The team will: Determine short-term and long-term effects of the emergency.

- In consultation with the Incident Commander, order an evacuation or shutdown of the plant.
- Mobilize resources, as needed.
- Develop and implement a plan for the orderly return to normal operations (BCP) Business Continuity Plan
- Interface with outside organizations and media
- Communicate situation reports to employees.

4) Emergency Management Director ("EMD")

- The EMD is in command and control of the Emergency Operations Center (EOC) and the Team. The EOC/ Incident Command Center are located at the Polaris Substation main office or other location if the Main building is compromised. EMD will direct and coordinate the utilization of resources and provide and interface with team leads, safety and surrounding emergency services, if it is activated. EMD will coordinate with the Incident Commander to ensure the safest and most expedient mitigation for the incident.
- EMD or designee will keep the Regional Manager, and other senior AES management informed as to the status of the emergency if requested. EMD will supervise distribution of emergency information for the Mountain Region O&M through Team Leaders. EMD with the help of Team Leaders will coordinate and implement the project to restore normal operations.
- If the O&M Manager is not available, the EMD responsibilities will be assumed by a designated leader or site representative.

5) Incident Commander (IC)

- The EHS contact will determine if IC is necessary.
- The IC is the person at the site of the emergency who oversees the immediate emergency response. This will vary depending on the nature of the incident. The IC must have the capability and expertise to assume command of an emergency as described in this procedure.
- The designated IC for West Region O&M are:
    - EHS Coordinator
    - Team Leaders
    - Site Technician until relieved by one of the above

Emergency Communication

During an emergency, AES CE O&M Team Leaders and/or EHS Specialist will have the responsibility for ensuring that proper actions are taken to ensure the safety of employees and visitors to the facility. Management grants them the authority to carry out those tasks and functions identified in the plan that provides for the safety of personnel. Communication during emergency events may take place using cell phones, radios, satellite phones, or other methods approved by the West Region O&M Manager. Mass notification software systems, such as Everbridge, or weather alert software such as INDJI, may be utilized to communicate hazards or emergency situations to all technicians. As such, all workers must always have access to a communication device while on site.

Internal Contact List:

(Will be updated prior to operation of the project)

Name	Title	Mobile Number	Email address

External Emergency Contacts

ALL ON SITE EMERGENCIES: DIAL 911

Emergency Management Department:
Newaygo County Emergency Services
306 North Street
White Cloud, MI 49349

Emergency Information:

Emergency Response:	Dial 911
Fire: City of Newaygo Fire Department 177 W Cooperative Center Drive Newaygo, MI 49337 City of Fremont Fire Department 101 E Main Street, Suite 2 Fremont, MI 49412	Non-Emergency Numbers City of Newaygo Fire Department: 231-652-7788 City of Fremont Fire Department: 231-924-2103
Police Newaygo County Sheriff's Office 1035 E James St White Cloud, MI 49349	Non-Emergency Numbers Newaygo County Sheriff's Office: 231-689-7303
Ambulance	Dial 911
Medivac (medical air transport) TBD	Telephone: Coordinates:
Medical Care & Work Injuries:	Clinic: Corewell Health Primary Care Clinic in Newaygo 211 West Pine Lake Drive, Newaygo MI 49337 Hospitals: Corewell Health Gerber Hospital in Fremont 212 S Sullivan Ave, Fremont MI 49412 Trinity Health Muskegon Hospital 1500 E Sherman Blvd, Muskegon MI 49444

Assigned Roles

- In the event of an emergency, the following responsibilities are assigned: (non-applicable roles for a facility may be removed)

Task or Duty	Primary Person	Back-up Person
Notify Appropriate Rescue Personnel – Administrator		
Notify AES EHS		
Notify AES Corporate Safety Leadership		
Notify Owner		
Spokesperson		
Incident Commander		
Evacuation Director		
Care for Injured Worker(s)		
Crowd Control		
Coordinate Emergency Gathering area		
Direct Emergency Vehicles from Street w/Security vehicle		
Accompany Injured to Hospital (AES Persons)		
Accompany Injured to Hospital (Contractor)		
Initiate Investigation Process & secure accident scene, Obtain list of witnesses		
Take Photographs		
Obtain Witness Statements and Reports		
Obtain List of Hazardous Chemicals/Materials		
Emergency Response Team		

Emergency Reporting:

In the event of an emergency the nearest supervisor will be notified. Per the above protocol, Site Management is to be notified immediately and told the nature and degree of emergency. Project Management, Safety Specialist and the Immediate Supervisor of the affected work area shall respond to the emergency scene and manage emergency operations. Emergencies must be reported in compliance with AES Global Standards:

- AES-STD-OHS12 Incident Management 4.2.1.6
  - SIP and Non-SIP Incidents (excluding LTI and Fatality) and Workplace Hazards: An Intelex notification is sufficient information sent to Regional/ Global Leadership.
  - LTI and Fatality (AES, Contractor or Public): As soon as becoming aware of an LTI or Fatality, following chain to communication should be followed. Phone and/or email shall

be used to ensure fast and quick communication: Supervisor or Designee>Business Leader, Business Safety manager>SBU-EHS Director/Leader>Managing Director EHS & Security>SBU President, SBU COO, VP of Global Operations, AES SVP & COO

- If the injury requires hospitalization of the injured person for treatment beyond the day of the incident, the business must also:
    - Contact and notify International SOS (ISOS) requesting support for medical monitoring of the injured personnel.
    - Engage ISOS by calling one of the following ISOS Assistance centers:
        - Philadelphia, US: +1-215-942-8226
        - London, England: +44-20-8762-8008
        - Singapore: +65-6338-7800

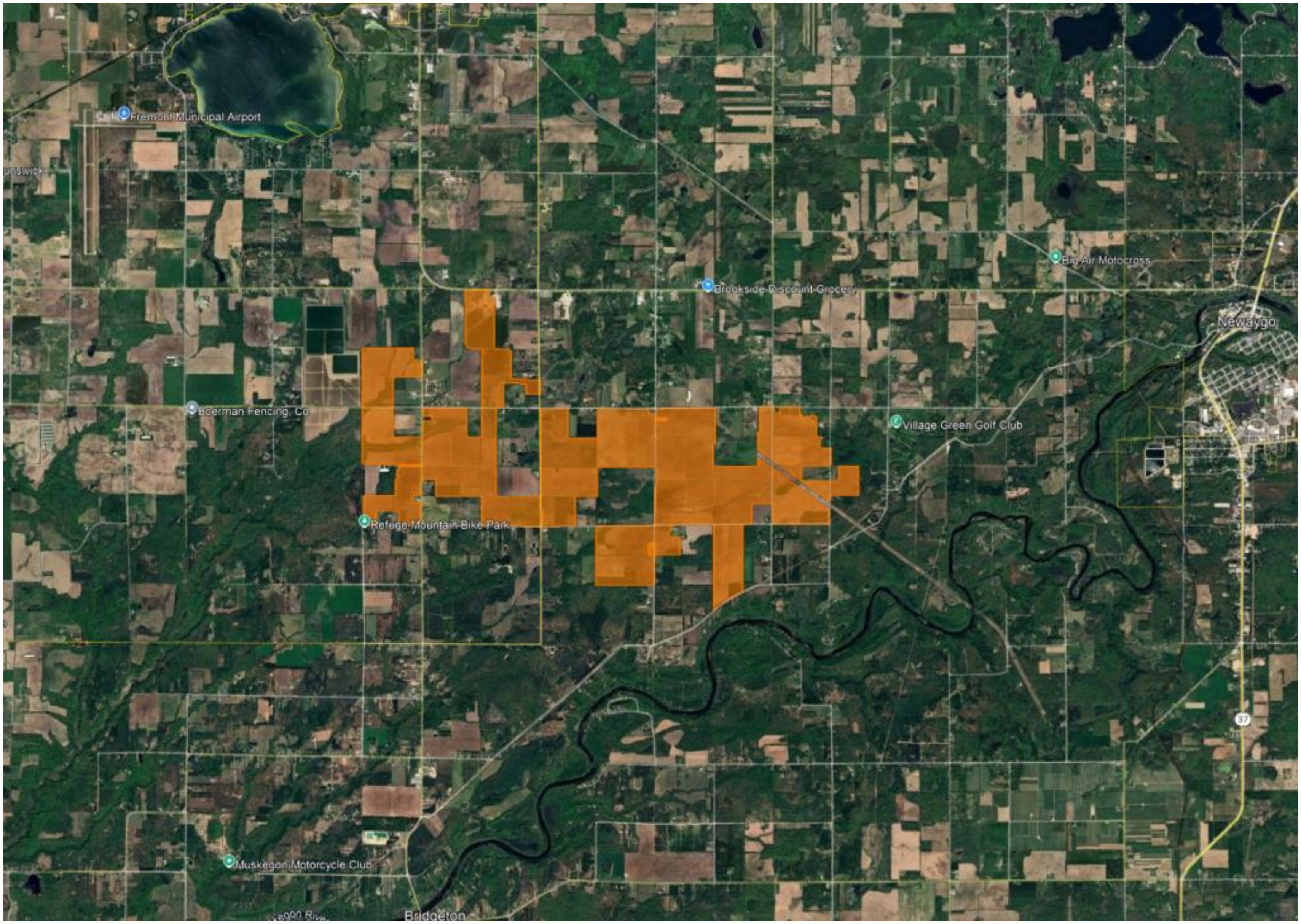
- Caller will be asked to provide at a minimum:
    - AES ISOS Membership Number: 11-BCPA-000-152
    - Their Name
    - Contact information
    - Name of Injured Person
    - AES Location of injured person
    - Medical status of injured person
    - Name, address and phone number of the medical facility the injured person was taken to
    - ISOS will contact medical facility, Injured Person (IP)'s family to attempt to obtain necessary permission to provide care guidance and update non-medical reports.
    - ISOS will coordinate with AES to provide appropriate services.
    - ISOS will send non-medical condition updates to AES Authorized People.
    - ISOS will close the file (end their assistance) after the IP is discharged from the medical facility or if AES elects to end their monitoring service.

Intelex Reporting:

- The Safety Manager or a designated person from the Business is expected to create an Initial Incident Report containing basic information in the AES EMIS according to the below timeframe.
- The Initial Incident Report must be factual, avoid speculative comments and be based on the best available information at the time it is prepared.
    - AES reportable Non-SIP Incidents (three working days)
        - Near-miss, first aid, recordable (excluding LTI) or AES reportable SIP Incidents, excluding Fatality (two working days)
        - Near-miss, First Aid, Recordable, LTI (SIP and Non-SIP)
        - SIP Unsafe Condition or SIP Unsafe Behavior or Fatality (one working day)
        - AES persons
        - Contractor
        - Public non-AES reportable, excluding Fatality (five working days)
- Reports to external agencies, such as OSHA, will be made by the EHS personnel or, designee, in conjunction with the Regional Manager.

Emergency Response Overview

- The Site address is: TBD – typically the address of the O&M facility, with a list of assignments to specific site entrances made available to local emergency response groups and at the O&M facility.
- Alarm Descriptions:
  - Medical-Air horn: 1 blast with simultaneous cell phone notification
  - Fire- Air horn: 2 blasts with simultaneous cell phone notification
  - Evacuate- 3 blasts with simultaneous cell phone notification
  - Seek Shelter- 4 blasts with simultaneous cell phone notification
- Mustering Points (see site maps, *will be updated prior to operations*)
- In the event of a major medical emergency the person-in-charge of the emergency scene will dispatch someone to the site access point nearest the emergency scene to direct and lead arriving outside responders to the emergency scene.



Sylvan Solar Project Boundary (orange polygon)

Nearest Medical Facility Travel:

- **Insert Address with pictures**

8/11/25, 5:58 PM   West 88th Street & South Warner Avenue to Corewell Health Gerber Hospital - Google Maps

Google Maps

W 88th St & S Warner Ave, Sheridan Township, MI 49412 to Corewell Health Gerber Hospital, 212 S Sullivan Ave, Fremont, MI 49412   Drive 5.4 miles, 8 min

Map data ©2025 , Map data ©2025 Google   1 mi

W 88th St & S Warner Ave
Sheridan Township, MI 49412

1. Head north on S Warner Ave toward W 80th St — 2.2 mi
2. Turn left onto M-82 W — 2.7 mi
3. Turn left onto E Maple St
   Destination will be on the left — 0.5 mi

Corewell Health Gerber Hospital
212 S Sullivan Ave, Fremont, MI 49412

Training

- AES employees will be trained on the ERCP upon hire, whenever changes are introduced, and refresher training annually.
- Contractors and sub-contractors will be familiarized with components of the ERCP applicable to their work scope on site during orientation or upon applicable changes in job scope determined by management.
- All personnel at each AES Clean Energy facility must be familiarized with the facility specific ERCP as part of site orientation, and before starting working at the site.
- AES Clean Energy employees identified in the ERCP with defined responsibilities, must be thoroughly familiar with the facility specific ERCP, including their roles and responsibilities.
- Training and retraining in first aid, with trauma kits, CPR, the use of an AED, first response and rescue procedures shall be provided to all relevant personnel with specific responsibilities.

Implementation/Drills

- Drills or other tests of the ERCP must take place at least semi-annually and be documented. Drills must be specific, and the results of the exercises must be documented. Areas of improvement must be identified with a post-exercise review conducted by management, EHS, and/or the Safety Committee, and improvements or corrections must be documented in a format such as a management of change report, or meeting minutes that list the problem areas identified, and the corrections made. All deficiencies must be given urgent (high) priority and corrected immediately.

- Communication systems (cell phones, radios, sat phones, computer messaging systems) must be tested at least every three months and documented. Satellite phones tests are documented by ISOC. All others are documented locally, and available from the EHS department.

Review/Auditing

- The ERCP will be reviewed and updated annually or when changes are introduced to the plant or processes. EHS will be auditing in accordance with the AES Internal Audit Schedule.
- AES will review this ERCP with Newaygo County Emergency Services, Newaygo County Sheriff's Office, City of Fremont Fire Department, and City of Newaygo Fire Department a minimum of once every three years during operation of the project or more frequently, as needed.

Emergency Response Plans:

Emergency response plans have been generated for potential emergencies identified in the assessment/impact analysis. Where applicable, means of prevention will be described in addition to preparation for and response to situations. These will be reviewed and updated with relevant site-specific information prior to operations.

Emergency Medical Situations

Prevention: AES persons and Contractors put Safety first, assessing jobs, identifying hazards and mitigating them sufficiently to create a workplace free of recognized hazards.

Preparation: AES CE O&M will ensure all employees are appropriately trained in CPR/First Aid, and AED. The locations of first aid kits, AEDs, eyewash stations, and other relevant emergency response equipment will be added to this ERCP prior to operations and reviewed with AES persons and Contractors. The contents of the first-aid kit(s) shall be inspected quarterly for expended items and such items will be replaced promptly.

Response: Employee Procedures for Medical Emergency (office, warehouse)

1) **Do Not** move victim unless safety dictates.
2) Notify the EHS Representative, Team Leader, and/or O&M Manager
3) If the injury appears to be life threatening or disabling, call 911.
4) First Aid care and/or CPR may be provided by a trained employee, or the injured person can be transported to the appropriate medical facility by authorized personnel.

Response: Employee Procedures for Medical Emergency (field)

If the victim is on the ground, **DO NOT** move them unless safety dictates!

- Assess the Accident Scene
  - Upon arriving at the scene of an injury related accident, the first person shall survey the scene (is it safe?), then notify Team Leaders and EHS Specialist.
    - Severity of the victim's injury
    - Emergency (911) personnel "are" or "are not" required.
    - The workers on scene my call 911, or delegate the call to another worker, Team Leader, or EHS
    - If the injury appears to be life threatening, be prepared to give "calling party" as much information as possible so that they can relay the information to 911.
    - On regular workdays, the EHS Safety Specialist and Team Leaders should be notified immediately and will respond to the scene.
    - On weekends, the victim's work partner will call 911 if needed and dispatch another employee to:

      (1) rendezvous with the EMS vehicle

      (2) coordinating which Air Evac landing location
- If Emergency Personnel Are Not Required
  - First-aid may be provided by a trained employee and/or the victim may be transported to the appropriate medical facility by an assigned employee.
- If Emergency Personnel Are Required
  a) On regular workdays, the O&M designated person will acquire information from the field and call 911 to ensure complete and accurate information is given, as well as established ambulance and/or Air Evac evacuation points, if needed.
  b) On weekends, the victim's work partner will call 911 for help, if needed. Once 911 call has been

made and the victim is safe, a call will be made to the affected employees' supervisor and EHS Safety Specialist.

Building Evacuations

- Building evacuation will occur upon instruction by management personnel. Notification to building employees will be made via direct voice communication, phone
- Be aware of all marked exits from your area and building. Know the routes from your work area. Marked exit signs are installed in all buildings. Evacuation plans are posted in various places within the building
- Take note of physically handicapped individuals in your area that may need assistance
- When instructed to evacuate, walk quickly to the nearest marked exit and ask others to do the same. On your way, out, check for occupancy in the offices you pass, and, if unoccupied, shut those doors behind you. Proceed to the nearest exit.
- All personnel should meet at their designated rendezvous location, until rollcall has been taken by a manager. Do not leave premises until accounted for and given permission to do so by authorized personnel. Keep fire lanes, hydrants and walkways clear for emergency crews and equipment
- During emergency, only personnel authorized by management will be allowed in the building to perform such responsibilities as shutting down power, potentially hazardous equipment, heat sources, gases, machine and other electrical equipment
- If you become trapped in a building, **DO NOT PANIC**:
  - If a window is available, place an article of clothing outside the window as a marker for rescue crews
  - If there is no window, pound loudly on the wall and shout at regular intervals to alert emergency crews
  - During a fire, if there is no window, stay near the floor where the air will be less toxic
  - During a fire, if the door is warm, **DO NOT** open it. If smoke is entering the room through cracks around the door, stuff something in the cracks to slow the flow

Adverse Weather Conditions/Natural Disasters

Adverse weather can take many forms, including tornado, lightning, hurricane, earthquake, flood, or winter storm. These situations can impact the facility. Most adverse weather situations provide some degree of warning or buildup, which will allow for necessary preparations to be implemented. Adverse weather listed above, severe thunderstorms and lightning are the most likely to impact the site.

Extreme Heat

Prevention: Follow prevention procedures in AES-STD-OHS30 - Heat and Cold Stress Prevention and 30 - AES CE OPS EHSS (Heat Stress Prevention) Clean Rev. 0

Preparation: Ambient outdoor temperatures can exceed 100°F. Such temperatures pose a serious threat to the employees' health. Work should be scheduled for cooler parts of the day in warmer months. Work pace should be moderate, with frequent breaks. Ice, water, and air-conditioned areas are available to all workers. All workers are trained to recognize the signs of heat illnesses and respond to them appropriately. Training is conducted at hire, and periodically throughout the year. Workers are also instructed to:

- Drink plenty of fluids
- Eat “light” foods, avoiding sugars
- Wear a hat
- Keep shirts on
- Take breaks/rest periods in a cool environment air-conditioned vehicle

Response: If an extreme heat event occurs, work may be stopped if it is deemed unsafe or unhealthful. Workers are expected to stop work anytime symptoms of heat illness present in the field. Workers should watch for signs of heat illness including **heat cramps**, **heat exhaustion** (cool, moist skin with goose bumps when in the heat, heavy sweating, faintness, dizziness, fatigue, weak, rapid pulse, low blood pressure upon standing, muscle cramps, nausea, headache), and **heat stroke** (high body temperature, alteration in mood or behavior, hot, dry skin, flushing, nausea, vomiting, headache, rapid heart rate, rapid breathing, loss of consciousness).

- In the event of heat cramps:
    - Move to a cooler location, and rest or cool down
    - Drink clear juice or an electrolyte containing drink
    - Practice gentle range-of-motion stretching and gentle massage of the affected muscle group(s)
    - Rest from strenuous activity for several hours or more after cramps subside
- In the event of heat exhaustions:
    - Rest in a cool place (shaded, ventilated area, or air-conditioned building/vehicle)
    - Drink cool fluids, such as water or electrolyte drinks
    - Loosen clothing
    - Utilize cooling measures (fans, wet compresses, ice packs, etc.)
    - Seek medical attention if symptoms do not improve within an hour.
- In the event of heat stroke:
    - Activate EMS ***IMMEDIATELY***
    - Move victim to cool environment and loosen clothing
    - Actively cool victim with any means available (fans, douse with water, immerse in water, place ice packs in groin and under arms, etc.)
    - Monitor pulse and respirations, be prepared to perform CPR if necessary
    - Heat stroke requires professional medical treatment every time

Severe Thunderstorms

Prevention: None.

Preparation: Severe thunderstorms include heavy rain, hail, lightning, and tornadoes. Lightning is the greatest danger during a severe thunderstorm. Emergency supplies are located (*specific location on site, will be updated prior to operations*) Back-up generators are installed at (*specific location on site, will be updated prior to operations if applicable*) to allow for continued site communication in the event of a power loss. Storms are tracked and monitored using (*applicable source to be updated prior to operations).*

Response: Workers are notified of inclement weather or storms via (*applicable notification system to be updated prior top operations*). In the event of a severe thunderstorm, site personnel must:

1. Remain indoors
2. Stay away from open doors or windows, metal pipes or electrical appliances
3. Immediately climb down from all turbines, towers, or poles
4. Lower all heavy equipment booms, retract outriggers, and exit man baskets
5. Watch for flash flooding

Flooding

Prevention: None

Preparation: Monitor local weather conditions. Take applicable steps from Severe Thunderstorm or Tornado guidelines if necessary.

Response:

- Office/Warehouse
  - If possible, disconnect electric motors and store in dry place
  - If possible, put merchandise on pallets
  - Shut off main power and valves
- Field concerns, watch out for:
  - Downed power lines
  - Transformers down, exposing primary/secondary lines
  - Control panels down, exposing secondary lines

Lightning

Prevention: None

Preparations: Weather conditions should be monitored, and workers in the field notified via text, call, or radio if lightning is possible in their work area. Forecasts should be checked before any field work begins, and weather discussed during the prejob briefing. The work limitations for lightning in the area are:

- **Watch Alert** is defined as confirmed lightning between 30-50 miles (48 and 80 km) from an O&M Site. During a Watch Alert, all personnel are to be made aware of the lightning in the area and should be prepared to stop work and seek shelter as the storm moves closer

- **Warning Alert** is defined as confirmed lightning less than 30 miles (48 km) from an O&M Site. During a Warning Alert, all personnel are to stop work immediately and seek shelter until the storm passes

- **All Clear** is given when the lightning is greater than 50 miles (80 km) out from an O&M Site for more than 30 minutes

Response: When lightning occurs in work areas, employees working outside should do the following:

1. Immediately lower all heavy equipment booms, retract the outriggers, and exit the man baskets
2. Get to your work vehicle or heavy equipment cab and remain there
3. Maintain contact with supervisors for further instructions

4. As weather conditions develop and with formation of thunderstorms, use extreme caution when working in the field paying special attention to developing weather conditions
5. Site personnel should understand when, where, and how thunderstorms develop. If there is thunder and lightning in an approaching cloud, all work will STOP, and all personnel will seek shelter
6. It is everyone's responsibility to make sure that all personnel are notified of lightening in the area
7. Contact the Team Leader or designee to inform them of lightning sightings
8. Team Leader or designee then notifies all personnel in the field that lightning is in the area
9. **EVERY** crew must respond by radio or other communications, acknowledging they have received the warning
10. Team Leader or designee will decide if the employees should return to the O&M building or wait in service trucks for the storm to pass
11. All work on tall, conductive structures will be stopped (this will include and is not limited to HV transmission lines, SCADA infrastructure, MET towers, or WTGs)

Fog

Prevention: None

Preparation: Check local forecasts, notify workers commuting to site and advise them to allow more time for travel.

Response:
- All personnel work in groups of two or more employees
- Notice will be made to management or office personnel when personnel are going on site
- Site personnel will always have communication devices on their person
- Reduce vehicle speed appropriate for visibility and conditions. Ice may also be present on roads requiring further reduction in vehicle speed

Snow/Ice

Prevention: None

Preparation: Check weather forecasts, notify workers to allow more time for travel. Monitor conditions throughout the day. Ensure vehicles are in good mechanical condition and fuel tanks are filled, workers have water and appropriate clothing, food stores at O&M are stocked, and vehicle rescue equipment is available.

Response:
- During snow conditions monitor weather forecast frequently throughout the day
- Dress appropriately for cold weather conditions
- Plan - carry extra water and food
- Carry company radio and/or cell phone
- Use ice scraper to clear windows and outside mirrors of vehicles of ice and snow
- As needed, put company vehicles into 4WD
- Carry snow chains, shovels and a tow strap

- Beware of black ice
- Drive and park company vehicles sufficiently away from project components to prevent damage from falling ice.
- Use caution when driving through snow drifts and be careful when walking - rocks, boulders, holes, gullies, ravines, or drop-offs may be hidden underneath.

Extreme Cold

Prevention: None

Preparation:
To address three of the basic needs, warmth, food and communication, all personnel are required to have the following items as standard inventory on their company vehicles or on their person before leaving to the operating facilities:

- Standard first-aid kit/AED
- Warm clothing
- Vehicle fuel tanks full

Shelter: If conditions warrant a need for shelter, and personnel are unable to leave the site, they have two options for shelter from the elements: their service vehicle or building. Materials that must be stored in the shelter are as follows:

1. Three days' supply of food which does not require preparation, and which is rich in carbohydrates and protein
2. Three days' supply of water

Response:

1. All personnel work in groups of two or more employees
2. Notice will be made to management or office personnel when personnel are going on site
3. Site personnel will always have communication devices on their person
4. All personnel shall have as part of their first-aid training how to prevent, diagnose and treat health-related injuries that may be caused in extreme cold weather conditions (e.g., frostbite, hypothermia, etc.)

Earthquakes

Prevention: None

Preparation: Ensure emergency response supplies are stocked and accessible, including first aid supplies, flashlights, water, and communication equipment.

Response:

- **Stay in the building**. Many injuries occur while people run through the building to the outside. It is possible to be hit by flying objects, plaster falling or other debris.
- Assist any handicapped person and find a safe place for them.

- **Drop, cover and hold.** Try to take cover under a table or other sturdy furniture. Kneel, sit or stay close to the floor. Hold onto furniture legs for balance. Be prepared to move with your cover and face away from windows. Doorways may not be the safest location for protection. If you are outside, stay outside. Go to a clear area away from buildings, trees and power lines

Immediately AFTER the earthquake:

- Be prepared for aftershocks. Although usually less intense than the main quake, they can cause further structural damage
- Gas leaks might be present. Do not use lanterns, torches, lighted cigarettes or open flames
- If fire is caused by the earthquake, implement the fire procedures
- If evacuation is ordered, follow building evacuation procedures

Field Response:

- Move to an open area away from power lines and poles
- Get low to the ground and balance yourself. The ground may move violently for several minutes

Immediately AFTER the earthquake:

- Be prepared for aftershocks. Although usually less intense than the main quake, they can cause further damage
- Use your radio to notify management of your status and position.
- Remain at your designated rendezvous location until you have answered to a roll call by a manager**.** **<u>Do not</u>** leave the premises until accounted for and given permission to do so by a manager. Valuable time could be wasted searching for personnel that have not followed correct procedures. You may be directed to return to the AES office location.
- Only members of management can declare the state of emergency over and give permission to leave the designated rendezvous location or the AES shelter area

Material Spills

Prevention: All AES workers are trained in spill prevention, control, and countermeasures (SPCC), and all site personnel will operate withing the parameters of the program for each respective site. The programs are available at: SiteDocs2023>Resources>-SPCC

Preparation:
Material spills can be classified into two distinct categories: ***incidental releases*** and ***emergency releases***.

Incidental Releases

- Incidental releases are small, isolated releases of chemicals, such as cleaning solvents, which do not present or have the potential to cause injuries or require evacuation other than from the immediate release area. Incidental spills can be cleaned up by personnel who have received proper training under the AES global standard and have the proper safety equipment. Incidental releases do not require the response of emergency personnel and/or local fire department.

Emergency Releases

- Emergency releases are incidents that involve large quantities of chemicals and/or have the potential to cause injuries. A release that requires the response of an outside vendor, emergency personnel and/or local fire department is an emergency release.

Safety Data Sheets (SDS) for all chemicals used at O&M can be obtained from: Main office

Response:
If a spill or leak occurs in conjunction with a fire, workers must **IMMEDIATELY** evacuate the area and notify the fire department. First responders **MUST** be informed of the chemicals released in the area and be provided with SDS sheets if requested.

Employee Procedures for Material Spills (Office)

1. Do not come-in contact with the chemical
2. If the spill or vapors may cause an immediate threat to human life or health, evacuate the area **IMMEDIATELY!**
3. If spill isn't immediately hazardous to life or health, unnecessary personnel should leave the immediate area.
4. Visitors, contractors and handicapped personnel in the area may need help exiting.
5. Anyone who is contaminated by the spill should avoid spreading the contamination
6. Seal-off area to prevent contamination of others. If the product is known, obtain and consult the SDS, and follow the guidelines found therein
7. Initiate washing-off and first aid for anyone who has been contaminated by the spill
8. Report the incident to the EHS Safety Coordinator, Team Leaders or Manager 8. Management will record the following information and inform the facility EHS:
   - Type of incident.
   - Injuries
   - Name and quantity of the material, if known
   - Possible hazards to persons or the environment
9. Containment and clean-up will be conducted by trained staff designated by management, following the applicable guidelines as shown in the section of this document entitled "Material Spill – Field"
10. If the spill has occurred in a warehouse/shop area, perform the following:
    - Isolate the area and open bay doors
    - Confine spill with the proper material
    - Turn off all oxygen tank valves
    - Turn off inert gas valves
    - If deemed necessary, remove all vehicles (including forklifts) from the building
    - If instructed to evacuate, follow the building evacuation guideline
    -

Employee Procedures for Material Spills (Field) Evaluation:

- Identify spill "transportation" mechanism; Spill "transportation" mechanisms are routes by which the spilled material will move. These routes may include drains, sumps, towers, nacelle bedplate, blade hubs, channels, ducts, and exposed soils Identify source, (gearbox, transformer, brake system, generator, main bearing and blade)
- If possible, note the condition of the source.
- Check for the following: gearbox casing cracks, defective hoses, ruptures, physical damage, valve

leaking, and container damage

- Obtain the SDS for the product **Secure the Area:**
    - To secure the area, barriers such as caution tape or cones may be used. If more than one AES employee is available, perform a security role, keeping other employees out of the area while a second employee notifies a supervisor **Notify Supervisor(s):**
    - When area is secured so that an unsuspecting individual will not be harmed by chancing upon the spill, the person who discovered the spill should notify EHS and their supervisor. Important information that needs to be conveyed to the EHS Specialist:
        - Exact **location** of the spill
        - **Volume** of material released
        - **Rate** of release
        - **Direction** of spill movement
        - **Product** involved

Personal Protective Equipment (PPE): For most small spills, personal protective equipment may be limited to chemical resistant gloves, protective eyewear and an apron. (Consult the SDS for handling instructions.)

Control the Spill: Stop the flow of material releasing, if possible, e.g., close valves, tighten hose connections, plugging a hole or breach, or righting a tipped container.

Contain the Spill: Where "control the spill" refers to stopping the release at the source, "containing the spill" refers to stopping the movement of the spilled material once it has been released. Spill containment may include such things as using dirt dikes for ground related spills or temporarily sealing any openings in the bedplate for nacelle related spills. Absorbent pads and/or absorbent media such as "Bio sweep" or equivalent compounds can be used

Clean Up: We use two basic means for cleaning up a spill. The material may be recovered and absorbed. Once the spill is cleaned up, the debris generated during this operation needs to be disposed of properly. Also, any contaminated equipment (including personal protective equipment) and personnel must be decontaminated.

Recovery

- Interior / Exterior Cleanup (WATER): The recovery of water generated from interior/exterior tower cleanup requires appropriate equipment, such as a special vacuum unit (e.g., bilge pump).
- Exterior Cleanup (SOIL): Cleanup of contaminated soil may include the use of a shovel and or backhoe. All soil with visible traces of contamination must be removed and placed in DOT approved drums.

Absorption

- Absorption of a spill requires the use of a material that will not react with the spill but will soak it up; collecting it into a form that may be safely handled. The standard issue rags are used for interior spills.

Containers.

- All materials recovered from a spill must be placed in DOT approved containment drums. Each container must be labeled before use

Decontamination.

- The equipment and personnel decontamination are typically very easy. The following is a simplified overview of decontamination procedures. The actual steps taken should be appropriate for the materials/substances being handled during the spill cleanup. SDS's give specific recommendations on decontamination.

- PPE (e.g., gloves) utilized during clean up, must be properly disposed of. Gloves should be inverted so that contamination is "contained" inside the glove. Tools may also be washed in a mild soap and water solution.
- If an employee meets a hazardous or potentially hazardous substance, the affected area should be washed, using plenty of water and a mild soap (for skin).

Reporting: The requirements of the appropriate SPCC (Spill Prevention Control & Countermeasure) plan must be followed.

Hazardous Waste Transportation: Certified waste transporters must be used when transporting waste to a disposal/collection site. AES uses DOT approved hazardous material contractors. All transported materials are documented via hazardous material manifest and if applicable reported to the appropriate regulatory agencies.

Bomb Threats/Sabotage

Prevention: None

Preparation: AES will conduct training at least annually via any approved method, to instruct workers how to respond to bomb threats. Training may be included with Active Shooter or other crisis response/management training. AES will maintain compliance with all NERC physical security requirements, and audit compliance as prescribed by AES corporate policy.

Response:

Bomb Threat

- Remain calm.
- Notify a facility supervisor, such as a Team Leader or EHS, who will notify authorities immediately
- Call 9-1-1 or your local law enforcement if no facility supervisor is available.
- Refer to the DHS Bomb Threat Checklist for guidance, if available.
- For threats made via phone:
- Keep the caller on the line as long as possible. Be polite and show interest to keep them talking. DO NOT HANG UP, even if the caller does.
- If possible, signal or pass a note to other staff to listen and help notify authorities.
- Write down as much information as possible—caller ID number, exact wording of threat, type of voice or behavior, etc.—that will aid investigators.
- Record the call, if possible.
- For threats made in person, via email, or via written note, refer to the DHS Bomb Threat Checklist and DHS-DOJ Bomb Threat Guidance for more information.
- Be available for interviews with facility supervisors and/or law enforcement.
- Follow authorities' instructions.
- Facility supervisors and/or law enforcement will assess the situation and provide guidance regarding facility lock-down, search, and/or evacuation.

Suspicious Packages/Items

- Remain calm.
- Do NOT touch, tamper with, or move the package, bag, or item.
- Notify a facility supervisor, such as a Team Leader or EHS, who will notify authorities immediately
- Call 9-1-1 or your local law enforcement if no supervisor is available.
- Explain why the package, bag, or item appears suspicious.
- Follow instructions. Team Leaders, EHS, and/or law enforcement will assess the situation and provide guidance regarding shelter-in-place or evacuation.
- If no guidance is provided and you feel you are in immediate danger, calmly evacuate the area. Distance and protective cover are the best ways to reduce injury from a bomb.
- Be aware. There could be other threats or suspicious items.

Building Utility Failures

Prevention: None

Preparation: Ensure flashlights are available to facility workers in the O&M building. Inspect back-up generators on site periodically and verify their functional availability

Response:

1. Unless there is another related problem, such as a fire, remain in your designated work area until directed to do differently by a supervisor
2. Assist visitors as necessary
3. Use flashlights where available **DO NOT** use candles or other types of flame or heat-producing devices for illumination
4. Assigned personnel should place emergency generator on-line to provide essential power to critical areas of the facility
5. Follow proper communication procedures

Building Plumbing Failures/Flooding/Water Leak

Prevention: Maintain septic system and water treatment system per manufacturer's instructions.

Preparation: Review procedures with all site personnel.

Response:

- Cease using all electrically powered devices and equipment
- Evacuate the immediate area to prevent injuries
- Notify a manager immediately

Natural Gas Leaks

Prevention: Inspect systems such as heaters and generators that operate on natural gas or liquid propane (LP) periodically and replace any faulty or questionable parts.

Preparation: Review procedures with all site personnel

Response:
DO NOT SWITCH LIGHTS ON/OFF OR UNPLUG ANY ELECTRICAL EQUIPMENT. ELECTRICAL ARCING COULD TRIGGER AN EXPLOSION

1. Cease all operations
2. Evacuate area immediately
3. Notify a manager immediately

Ventilation Problems

Prevention: None

Preparation: None

Response:
If smoke or odors comes from the ventilation system, immediately notify a manager and if necessary, cease all operations and vacate the area. Ascertain cause of smoke or odor if possible, and shut off malfunctioning system (heat, A/C, etc.) Notify emergency services in case of fire or medical emergency resulting from exposure.

Crime, Violent Behavior & Civil Disturbances

Prevention: None

Preparation: Periodic review of response procedures with site personnel.

Response:

Crime and/or Violent Behavior (In progress)

If you are a victim or a witness to any criminal offense, report the incident as soon as possible, providing the following information:

1. Call "911"
2. Give the dispatcher: Nature of the incident, location of the incident, a description of the suspect(s) involved, a description of any weapons involved, and a description of any property involved
3. Notify a manager
4. Stay on the line with the dispatcher until a police officer arrives at the scene
5. Keep the dispatcher informed of any changes in the situation so that updated information can be relayed to the responding units. Even if you are the victim and unable to communicate further, try to keep the line open

Crime and/or Violent Behavior (Not in progress)
All crime should be reported. Be prepared to provide the following information to the investigating officer:

1. When the incident occurred
2. If a property crime, what was taken or damaged

3. The names and/or descriptions of any suspects or witnesses

Civil Disturbances

Any employee noting a possible civil disturbance should contact a manager immediately:

1. If necessary, secure building entrances and exits
2. Should unauthorized intruders gain access onto premises, refrain from any contact with the intruders
3. All employees should remain in the area, remain calm and follow instructions from management
4. Should intruders gain access into the building and damage property, employees should not interfere. The personal safety of our employees is more important than the protection of our property

Gun Shots:

1. Immediately climb down from the project equipment
2. Notify manager
3. Evacuate all personnel in the area immediately
4. Immediately report the following:
   - Type of incident
   - Are there any injuries
   - Location of the source of gunfire

Active Shooter

Prevention: None

Preparations:

1. Incident Command Team (ICT) or Senior Management should establish a procedure for review of existing emergency plans on a regularly scheduled basis (at least annually).
2. ICT or Senior Management should establish a procedure for performing a hazard vulnerability analysis review and threat assessment to determine necessary resources to respond to an Active Shooter incident (at least annually).
3. AES O&M should conduct drills/exercises to test response to an Active Shooter emergency that includes all areas/personnel as well as local, regional, state and private sector partners.
4. AES O&M should develop an after-action report (AAR) to evaluate current policies and procedures and update plans based on the AAR's strengths and areas for improvement.
5. An Active Shooter is an individual actively engaged in killing or attempting to kill people in a confined and populated place; in most cases, active shooters use firearms and there is no pattern or method to their selection of victims.
   Active shooter situations are unpredictable and evolve quickly. Typically, the immediate deployment of law enforcement is required to stop the shooting and mitigate harm to victims. Because active shooter situations are often over within 10-15 minutes, before law enforcement arrives on the scene, individuals must be prepared both mentally and physically to deal with an active shooter situation.
6. An active shooter in your workplace may be a current of former employee or an acquaintance of a current or former employee. Staff may notice characteristics of potentially violent behavior in an employee. Alert your Human Resources Department or Management if you believe an employee exhibits potentially violent behavior.
7. To best prepare staff for an active shooter situation, create an Active Shooter emergency plan/procedure and conduct training exercises. This will prepare staff to effectively respond and help

minimize the loss of life. The most effective way to train staff to respond to an active shooter situation is to conduct mock active shooter training exercises. Local law enforcement is an excellent resource in designing training exercises.

- Ensure the facility has at least two evacuation routes
- Post evacuation routes in conspicuous locations throughout your facility
- Be aware of indications of workplace violence and take remedial actions accordingly
- Institute access controls (keys, security pass codes)
- Make sure plans include relevant information and address individuals with special needs/functional needs

8. Assemble crisis kits
    - Radios
    - Floor plans
    - Staff roster with contact information
    - First aid kits/AED
    - Flashlights
9. Components of an Active Shooter Training Plan
    - Recognizing the sound of gunshots
    - Reacting quickly when gunshots are heard and/or when a shooting is witnessed
    - Evacuating the area
    - Hiding out
    - Acting against the shooter as last resort
    - Calling 911
    - Reacting when law enforcement arrives
    - Adopting the survival mindset during times of crisis

Response:
Quickly determine the most reasonable way to protect your own life. Remember that injured people are likely to follow the lead of employees and managers during an active shooter situation.

1. Take note of the two nearest exits
2. If you are in an office/room, stay there and secure the door (door should open in)
3. If you an in a hallway, get into a room and secure the door (door should open in)
4. Call 911 when it is safe to do so and alert police to the shooter's location. If you cannot speak, leave the line open and allow the dispatcher to listen
5. If active shooter is nearby: lock the door, silence your cell phone, turn off any source of noise, hide behind large items and remain quiet

- **<u>Evacuate:</u>** (if escape route is accessible)
    - Have an escape route in mind
    - Evacuate regardless of whether others agree to follow
    - Leave your belongings behind
    - Help others escape, if possible
    - Prevent individuals from entering an area where the active shooter may be
    - Keep your hands visible
    - Follow the instructions of any police officers
    - Do not attempt to move wounded people
    - Call 911 when you are safe

- **<u>Hide Out:</u>** (if evacuation is not possible)
    - Hiding place should be out of shooter's view
    - Provide protection if shots are fired in your direction
    - Do not trap yourself or restrict your options for movement
    - Lock the door
    - Blockade the door with heavy furniture (door should open in)
- **<u>Take-Action:</u>** (Last Resort, imminent danger)
    - As a last resort, attempt to take the active shooter down. When the shooter is close range and you cannot flee, your chance of survival is much greater if you try to incapacitate him/her
    - Attempt to disrupt and/or incapacitate the active shooter
    - Act as aggressively as possible against him/her
    - Throwing items and improvising weapons
    - Yelling
    - Commit to your actions

Recovery

1. Critical Incident Stress Debriefing and/or counseling should be made available to impacted parties to provide any necessary physical, emotional, and psychological support.

<u>Pandemic outbreak at the AES CE O&M facilities.</u>

Prevention: None

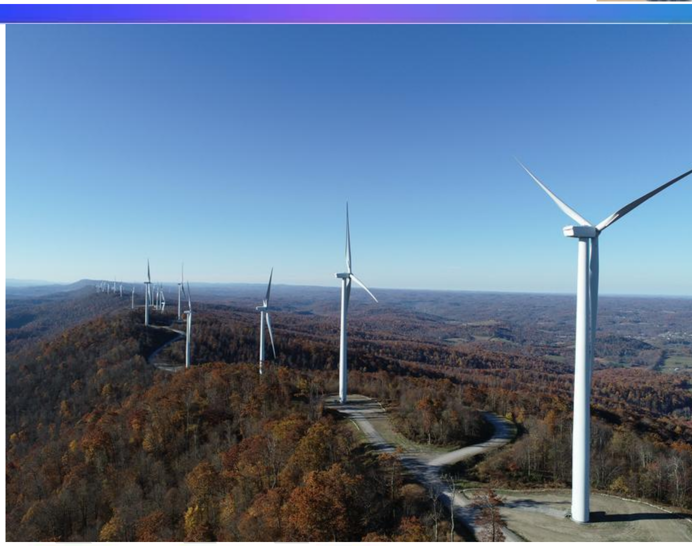
Preparation: Periodically review response procedures with site personnel. Ensure Team Leaders are familiar with the response and their roles therein.

Response:

Pandemic Emergencies (Outbreak 24/7 functioning)

1. Form "Essential Personnel Teams". An "Essential Personnel Team" (EPT) consists of one (1) Team leader and two (2) technicians, team will rotate as needed
2. All personnel except for the EPT shall remain at home and not report to site
3. EPT shall report to the site during normal 8-hour work shift, Monday – Friday, and shall be responsible for the day to-day operations of the business and no 24/7 coverage required at the site
4. Main gate to the office compound and the O&M building doors will remain locked while personnel are on-site in addition to being locked after-hours
5. Inspect weekly the on-site gasoline/diesel tanks and verify adequate quantity in storage
6. Stock sufficient food and water on site as emergency supplies
7. All personnel to report to the on shift EPT of their personal situation daily
8. Daily conference calls will be held among leaders and the on-shift EPT to communicate the situation at the site as well as the personnel situations
9. Communicate any changes in the situation to AES management as necessary

AES Clean Energy
Preliminary O&M Fire Response & Communication Plan



AES Clean Energy

Sylvan Solar

Garfield and Sheridan Charter Townships, Newaygo County, Michigan

September 2025

Table of Contents

Purpose

The purpose of the AES Clean Energy O&M Fire Response and Communication Plan (FRCP) is to assist employees and management in making quality decisions during times of crisis. The FRCP contains guidance in determining appropriate actions to take to prevent injury and property loss from the occurrence of fire incidents. The FRCP will also assist facility management in ensuring the survivability of the various business assets at AES Clean Energy O&M in the event of an incident.

The FRCP will meet the applicable requirements of federal regulations, including 29 CFR 1910.38(a), as well as state and local regulations regarding emergency action planning. When an emergency occurs at the facility during normal operating hours, the safety of employees and visitors will be coordinated by AES Clean Energy EHS.

This plan is preliminary and will be finalized with updated contact information, procedures, maps, and other details prior to commencement of project operation. All employees and visitors shall be trained on this plan or escorted while on site.

Per Section 3.26(II)(D)(q) of the Fremont Community Joint Planning Commission (FCJPC) Solar Energy Systems (SES) ordinance, this FRCP was updated to reflect feedback received from the Newaygo County Emergency Services Department, City of Fremont Fire Department, and City of Newaygo Fire Department during meetings on May 29 and August 27, 2025. Key feedback included:

- Identification of a lack of water sources within the Sylvan Solar Project area. In response, Sylvan Solar proposed providing water storage tanks placed throughout the Project area that will be accessible to local fire departments (See the “Fires” section on page 16 of this FRCP).
- Sylvan Solar will coordinate with local emergency response groups and the Road Commission during the construction phase regarding traffic routes to minimize impacts to Project neighbors. A construction-focused ERCP will be prepared by the Engineering, Procurement, and Construction (EPC) contractor prior to construction.

As discussed on August 27, 2025, AES will coordinate with local emergency response groups during the following key stages:

- **Development**: AES will confirm if the FRCP is aligned with acceptable operating procedures, capabilities, and resources, and verify if the ERCP and FRCP can be implemented by existing local emergency response capacity. Equipment or training deficiencies will be identified along with mitigation measures.
- **Construction**: Prior to construction kickoff, AES will coordinate meetings between local emergency response groups and the EPC. Collaboration between teams is important, as it will mainly be the EPC contacting local emergency response groups during this stage.
- **Operation**: During the transition period between construction and operations, AES will coordinate a site introduction and tour for local emergency response groups. This allows the local emergency response groups to become familiar with the constructed site, and meet and exchange contact information with operations staff. During operation of the project, AES will review this FRCP with local emergency response groups at least once every three years.

Scope

This FRCP applies to all AES employees, its contractors, and sub-contractors performing work at the AES Clean Energy Sylvan Solar Project. This plan also applies to anyone visiting an AES Clean Energy operational site or office.

Definitions

AES Person – Any person directly employed by AES Corporation

AES Contract Person - Any person contracted to work on behalf of an AES Business and directly supervised by an AES Person.

AES Integrated Energy (AIE)- transmission planner, Qualified Scheduling Entity (QSE)

Emergency – An emergency is a situation that causes or has potential to cause injury to workers, customers, or the public; property damage; business disruption; or environmental impacts. All emergencies require well developed response plans and prompt actions according to those plans to protect the health, safety, or welfare of people, and limit property damage, environmental impacts and/or business disruption. For this AES Standard, emergencies will be classified into three primary categories: natural emergencies (weather, climate, seismic, wildfires, pandemics, etc.), man-made on-site/operational emergencies (explosion, chemical release, fire, etc.) and man-made off-site emergencies (train derailment, chemical release from neighboring industries, threats of terrorism, etc.).

Emergency Action Plan (EAP) – See Emergency Operations Plan (EOP)

Emergency Management Director ("EMD") - The EMD is in command and control of the Emergency Operations Center (EOC) and the Team. EMD will direct and coordinate the utilization of (Site Name)'s resources and provide and interface with Nolan County, Taylor County, and surrounding emergency services, if it is activated. EMD will coordinate with the Incident Commander to ensure the safest and most expedient mitigation for the incident. EMD or designee will keep the Regional Manager, and other senior AES management informed as to the status of the emergency if requested. EMD will supervise distribution of emergency information for (Site Name) through Team Leaders. EMD with the help of Team Leaders will coordinate and implement the BCP to restore normal operations.

Emergency Management Team - The team oversees the incident operations and supports Incident Commander ("IC"), person on-site who oversees the response to emergency, by providing resources and recommending financial assistance, as needed. The team will:

- Determine short-term and long-term effects of the emergency
- In consultation with the Incident Commander, order an evacuation or shutdown of the plant
- Mobilize resources, as needed
- Develop and implement a plan for the orderly return to normal operations (BCP) Business Continuity Plan
- Interface with outside organizations and media
- Communicate situation reports to employees

Emergency Operations Plan (EOP) – A written detailed program of actions and communications protocols to manage emergency situations, minimize their effects, and restore the facility to full operation, contained within the FRCP.

Fire Response and Communication Plan (FRCP) - A written detailed program of actions and communications protocols to minimize and mitigate the effects of an emergency. Contains the site EOP.

General Manager (GM) – The person ultimately responsible for the content, review, distribution, and implementation of the processes contained in the FRCP and EOP. May be Regional Manager or designee. See the General Manager Affidavit for further definition detail.

Hazard - A situation with potential for human injury, damage to property, damage to the environment, or some combination of these.

Incident Commander ("IC") - The IC is the person at the site of the emergency who oversees the immediate emergency response. This will vary depending on the nature of the incident. The IC must have the capability and expertise to assume command of an emergency as described in this procedure. The IC will manage on-scene operations of an emergency response. The IC is responsible for the technical aspects of the response as well as the tactical planning, security, execution, and determining the need for outside assistance and resources, and interface with the EOC. During an incident, the IC will:

- Maintain regular communication with EMD.
- Utilize (Site Name) personnel to set-up security points to keep unauthorized people away for the emergency and allow entry to emergency response equipment and personnel.
- Assume command, notify the EMD, implement the emergency procedures specified for the incident, assess the situation, implement this plan, activate resources, order and initiate evacuation of persons in harm's way, and upon conclusion of the incident, declare the emergency in over. If emergency services local, state or federal agencies are on the scene the IC will act as the liaison with these departments.

Intelligence Security Operations Center (ISOC) – This team within the IS shared service is responsible for the monitoring of physical and cyber controls implemented throughout AES US operations. Members of this team are also responsible for threat identification and analysis for AES Facilities in the US.

NERC – National Electric Reliability Council

Responders - Persons identified in the FRCP as being responsible for actions that are intended to minimize the risk, loss, and damage resulting from the emergency. These persons can represent external resources (e.g., ambulance, fire, police, contractors, or neighboring industries with capabilities) or be the workers or management of AES Businesses.

ROCC – Remote Operations Control Center

Objective

To provide employees with procedures to follow for effective and safe response to fire-related emergency situations, and to aid in the prevention of and planning for emergencies at the Sylvan Solar facility.

Roles and Responsibilities

An emergency management Team has been established to assume the responsibility for addressing emergencies at the Sylvan Solar facility. Team is headed by the General Manager or equivalent, and is comprised of the following members:

1) Emergency Management Director (“EMD”)

- General Manager (or another appropriate leader, e.g. Regional Manager)

2) Team Leaders

- List of Team Leaders will be provided to local emergency response groups prior to operation of the project.

3) The team oversees the incident operations and supports Incident Commander (“IC”), person on-site who oversees the response to emergencies, by providing resources and recommending financial assistance, as needed. The team will:

- Determine short-term and long-term effects of the emergency.
- In consultation with the Incident Commander, order an evacuation or shutdown of the plant.
- Mobilize resources, as needed.
- Develop and implement a plan for the orderly return to normal operations Business Continuity Plan (BCP)
- Interface with outside organizations and media
- Communicate situation reports to employees.

4) Emergency Management Director (“EMD”)

- The EMD is in command and control of the Emergency Operations Center (EOC) and the Team. The EOC/ Incident Command Center are located at the Polaris Substation main office or other location if the Main building is compromised. EMD will direct and coordinate the utilization of resources and provide and interface with team leads, safety and surrounding emergency services, if it is activated. EMD will coordinate with the Incident Commander to ensure the safest and most expedient mitigation for the incident.
- EMD or designee will keep the Regional Manager, and other senior AES management informed as to the status of the emergency if requested. EMD will supervise distribution of emergency information for the Mountain Region O&M through Team Leaders. EMD with the help of Team Leaders will coordinate and implement the project to restore normal operations.
- If the O&M Manager is not available, the EMD responsibilities will be assumed by a designated leader or site representative.

5) Incident Commander (IC)

- The EHS contact will determine if IC is necessary.
- The IC is the person at the site of the emergency who oversees the immediate emergency response. This will vary depending on the nature of the incident. The IC must have the capability and expertise to assume command of an emergency as described in this procedure.
- The designated IC for Central Region O&M are:
    - EHS Coordinator
    - Team Leaders
    - Site Technician until relieved by one of the above.

Emergency Communication

During an emergency, AES CE O&M Team Leaders and/or EHS Specialist will have the responsibility for ensuring that proper actions are taken to ensure the safety of employees and visitors to the facility. Management grants them the authority to carry out those tasks and functions identified in the plan that provides for the safety of personnel. Communication during emergency events may take place using cell phones, radios, satellite phones, or other methods approved by the West Region O&M Manager. Mass notification software systems, such as Everbridge, or weather alert software such as INDJI, may be utilized to communicate hazards or emergency situations to all technicians. As such, all workers must always have access to a communication device while on site.

Internal Contact List:

(Will be updated prior to operation of the project)

Name	Title	Mobile Number	Email address

External Emergency Contacts

ALL ON SITE EMERGENCIES: DIAL 911

Emergency Management Department:

Newaygo County Emergency Services
306 North Street
White Cloud, MI 49349

Emergency Information:

Emergency Response:	Dial 911
Fire: City of Newaygo Fire Department 177 W Cooperative Center Drive Newaygo, MI 49337 City of Fremont Fire Department 101 E Main Street, Suite 2 Fremont, MI 49412	Non-Emergency Numbers City of Newaygo Fire Department: 231-652-7788 City of Fremont Fire Department: 231-924-2103
Police Newaygo County Sheriff's Office 1035 E James St White Cloud, MI 49349	Non-Emergency Numbers Newaygo County Sheriff's Office: 231-689-7303
Ambulance	Dial 911
Medivac (medical air transport) TBD	Telephone: Coordinates:
Medical Care & Work Injuries:	Clinic: Corewell Health Primary Care Clinic in Newaygo 211 West Pine Lake Drive, Newaygo MI 49337 Hospitals: Corewell Health Gerber Hospital in Fremont 212 S Sullivan Ave, Fremont MI 49412 Trinity Health Muskegon Hospital 1500 E Sherman Blvd, Muskegon MI 49444

Assigned Roles

- In the event of an emergency, the following responsibilities are assigned: (non-applicable roles for a facility may be removed)

Task or Duty	Primary Person	Back-up Person
Notify Appropriate Rescue Personnel – Administrator		
Notify AES EHS		
Notify AES Corporate Safety Leadership		
Notify Owner		
Spokesperson		
Incident Commander		
Evacuation Director		
Care for Injured Worker(s)		
Crowd Control		
Coordinate Emergency Gathering area		
Direct Emergency Vehicles from Street w/Security vehicle		
Accompany Injured to Hospital (AES Persons)		
Accompany Injured to Hospital (Contractor)		
Initiate Investigation Process & secure accident scene, Obtain list of witnesses		
Take Photographs		
Obtain Witness Statements and Reports		
Obtain List of Hazardous Chemicals/Materials		
Emergency Response Team		

Emergency Reporting:

In the event of an emergency the nearest supervisor will be notified. Per the above protocol, Site Management is to be notified immediately and told the nature and degree of emergency. Project Management, Safety Specialist and the Immediate Supervisor of the affected work area shall respond to the emergency scene and manage emergency operations. Emergencies must be reported in compliance with AES Global Standards:

- AES-STD-OHS12 Incident Management 4.2.1.6
    - SIP and Non-SIP Incidents (excluding LTI and Fatality) and Workplace Hazards: An Intelex notification is sufficient information sent to Regional/ Global Leadership.
    - LTI and Fatality (AES, Contractor or Public): As soon as becoming aware of an LTI or Fatality, following chain to communication should be followed. Phone and/or email shall be used to ensure fast and quick communication: Supervisor or Designee>Business

Leader, Business Safety manager>SBU-EHS Director/Leader>Managing Director EHS & Security>SBU President, SBU COO, VP of Global Operations, AES SVP & COO

- If the injury requires hospitalization of the injured person for treatment beyond the day of the incident, the business must also:
    - Contact and notify International SOS (ISOS) requesting support for medical monitoring of the injured personnel.
    - Engage ISOS by calling one of the following ISOS Assistance centers:
        - Philadelphia, US: +1-215-942-8226
        - London, England: +44-20-8762-8008
        - Singapore: +65-6338-7800

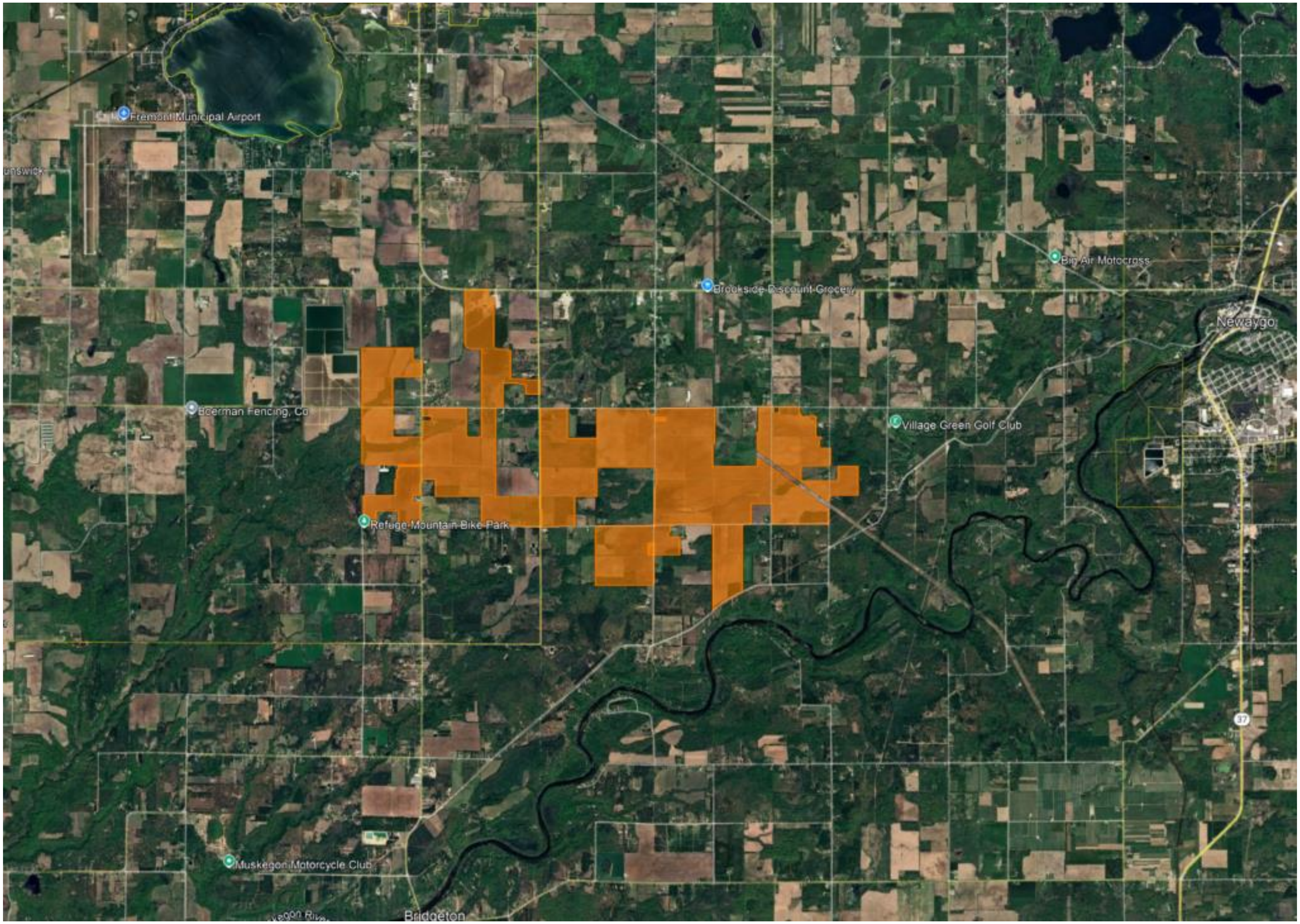
- Caller will be asked to provide at a minimum:
    - AES ISOS Membership Number: 11-BCPA-000-152
    - Their Name
    - Contact information
    - Name of Injured Person
    - AES Location of injured person
    - Medical status of injured person
    - Name, address and phone number of the medical facility the injured person was taken to
    - ISOS will contact medical facility, Injured Person (IP)'s family to attempt to obtain necessary permission to provide care guidance and update non-medical reports.
    - ISOS will coordinate with AES to provide appropriate services.
    - ISOS will send non-medical condition updates to AES Authorized People.
    - ISOS will close the file (end their assistance) after the IP is discharged from the medical facility or if AES elects to end their monitoring service.

Intelex Reporting:

- The Safety Manager or a designated person from the Business is expected to create an Initial Incident Report containing basic information in the AES EMIS according to the below timeframe.
- The Initial Incident Report must be factual, avoid speculative comments and be based on the best available information at the time it is prepared.
    - AES reportable Non-SIP Incidents (three working days)
        - Near-miss, first aid, recordable (excluding LTI) or AES reportable SIP Incidents, excluding Fatality (two working days)
        - Near-miss, First Aid, Recordable, LTI (SIP and Non-SIP)
        - SIP Unsafe Condition or SIP Unsafe Behavior or Fatality (one working day)
        - AES persons
        - Contractor
        - Public non-AES reportable, excluding Fatality (five working days)
- Reports to external agencies, such as OSHA, will be made by the EHS personnel or, designee, in conjunction with the Regional Manager.

Emergency Response Overview

- The Site address is: TBD – typically the address of the O&M facility, with a list of assignments to specific site entrances made available to local emergency response groups and at the O&M facility.
- Alarm Descriptions:
  - Medical-Air horn: 1 blast with simultaneous cell phone notification
  - Fire- Air horn: 2 blasts with simultaneous cell phone notification
  - Evacuate- 3 blasts with simultaneous cell phone notification
  - Seek Shelter- 4 blasts with simultaneous cell phone notification
- Mustering Points (see site maps, *will be updated prior to operations*)
- In the event of a major medical emergency the person-in-charge of the emergency scene will dispatch someone to the site access point nearest the emergency scene to direct and lead arriving outside responders to the emergency scene.



Sylvan Solar Project Boundary (orange polygon)

Nearest Medical Facility Travel:

8/11/25, 5:58 PM — West 88th Street & South Warner Avenue to Corewell Health Gerber Hospital - Google Maps

Google Maps

W 88th St & S Warner Ave, Sheridan Township, MI 49412 to Corewell Health Gerber Hospital, 212 S Sullivan Ave, Fremont, MI 49412 — Drive 5.4 miles, 8 min

Map data ©2025 , Map data ©2025 Google 1 mi

W 88th St & S Warner Ave
Sheridan Township, MI 49412

1. Head north on S Warner Ave toward W 80th St — 2.2 mi
2. Turn left onto M-82 W — 2.7 mi
3. Turn left onto E Maple St
   Destination will be on the left — 0.5 mi

Corewell Health Gerber Hospital
212 S Sullivan Ave, Fremont, MI 49412

Training

- AES employees will be trained on the FRCP upon hire, whenever changes are introduced, and refresher training annually.
- Contractors and sub-contractors will be familiarized with components of the FRCP applicable to their work scope on site during orientation or upon applicable changes in job scope determined by management.
- All personnel at each AES Clean Energy facility must be familiarized with the facility specific FRCP as part of site orientation, and before starting working at the site.
- AES Clean Energy employees identified in the FRCP with defined responsibilities, must be thoroughly familiar with the facility specific FRCP, including their roles and responsibilities.
- Training and retraining in first aid, with trauma kits, CPR, the use of an AED, first response and rescue procedures shall be provided to all relevant personnel with specific responsibilities.

Implementation/Drills

- Drills or other tests of the FRCP must take place at least semi-annually and be documented. Drills must be specific, and the results of the exercises must be documented. Areas of improvement must be identified with a post-exercise review conducted by management, EHS, and/or the Safety Committee, and improvements or corrections must be documented in a format such as a management of change report, or meeting minutes that list the problem areas identified, and the corrections made. All deficiencies must be given urgent (high) priority and corrected immediately.

- Communication systems (cell phones, radios, sat phones, computer messaging systems) must be tested at least every three months and documented. Satellite phones tests are documented by ISOC. All others are documented locally, and available from the EHS department.

Review/Auditing

- The FRCP will be reviewed and updated annually or when changes are introduced to the plant or processes. EHS will be auditing in accordance with the AES Internal Audit Schedule.
- AES will review this FRCP with Newaygo County Emergency Services, Newaygo County Sheriff's Office, City of Fremont Fire Department, and City of Newaygo Fire Department a minimum of once every three years during operation of the project or more frequently, as needed.

Emergency Medical Situations

Prevention: AES persons and Contractors put Safety first, assessing jobs, identifying hazards and mitigating them sufficiently to create a workplace free of recognized hazards.

Preparation: AES CE O&M will ensure all employees are appropriately trained in CPR/First Aid, and AED. The locations of first aid kits, AEDs, eyewash stations, and other relevant emergency response equipment will be added to this FRCP prior to operations and reviewed with AES persons and Contractors. The contents of the first-aid kit(s) shall be inspected quarterly for expended items and such items will be replaced promptly.

Response: Employee Procedures for Medical Emergency (office, warehouse)

1) **<u>Do Not</u>** move victim unless safety dictates.
2) Notify the EHS Representative, Team Leader, and/or O&M Manager
3) If the injury appears to be life threatening or disabling, call 911.
4) First Aid care and/or CPR may be provided by a trained employee, or the injured person can be transported to the appropriate medical facility by authorized personnel.

Response: Employee Procedures for Medical Emergency (field)

If the victim is on the ground, **<u>DO NOT</u>** move them unless safety dictates!

- <u>Assess the Accident Scene</u>
    - Upon arriving at the scene of an injury related accident, the first person shall survey the scene (is it safe?), then notify Team Leaders and EHS Specialist.
        - Severity of the victim's injury
        - Emergency (911) personnel "are" or "are not" required.
        - The workers on scene my call 911, or delegate the call to another worker, Team Leader, or EHS
        - If the injury appears to be life threatening, be prepared to give "calling party" as much information as possible so that they can relay the information to 911.
        - On regular workdays, the EHS Safety Specialist and Team Leaders should be notified immediately and will respond to the scene.
        - On weekends, the victim's work partner will call 911 if needed and dispatch another employee to:
            (1) rendezvous with the EMS vehicle
            (2) coordinating which Air Evac landing location
- <u>If Emergency Personnel Are Not Required</u>
    - First-aid may be provided by a trained employee and/or the victim may be transported to the appropriate medical facility by an assigned employee.
- <u>If Emergency Personnel Are Required</u>
    a) On regular workdays, the O&M designated person will acquire information from the field and call 911 to ensure complete and accurate information is given, as well as established ambulance and/or Air Evac evacuation points, if needed.
    b) On weekends, the victim's work partner will call 911 for help, if needed. Once 911 call has been made and the victim is safe, a call will be made to the affected employees' supervisor and EHS Safety Specialist.

<u>Building Evacuations</u>

- Building evacuation will occur upon instruction by management personnel. Notification to building employees will be made via direct voice communication, phone
- Be aware of all marked exits from your area and building. Know the routes from your work area. Marked exit signs are installed in all buildings. Evacuation plans are posted in various places within the building
- Take note of physically handicapped individuals in your area that may need assistance

- When instructed to evacuate, walk quickly to the nearest marked exit and ask others to do the same. On your way, out, check for occupancy in the offices you pass, and, if unoccupied, shut those doors behind you. Proceed to the nearest exit.
- All personnel should meet at their designated rendezvous location, until rollcall has been taken by a manager. Do not leave premises until accounted for and given permission to do so by authorized personnel. Keep fire lanes, hydrants and walkways clear for emergency crews and equipment
- During emergency, only personnel authorized by management will be allowed in the building to perform such responsibilities as shutting down power, potentially hazardous equipment, heat sources, gases, machine and other electrical equipment
- If you become trapped in a building, **DO NOT PANIC**:
    - If a window is available, place an article of clothing outside the window as a marker for rescue crews
    - If there is no window, pound loudly on the wall and shout at regular intervals to alert emergency crews
    - During a fire, if there is no window, stay near the floor where the air will be less toxic
    - During a fire, if the door is warm, **DO NOT** open it. If smoke is entering the room through cracks around the door, stuff something in the cracks to slow the flow

Fires

Solar arrays and PV modules are fire-resistant, as they are constructed largely of steel, glass, aluminum, or components housed within steel enclosures. As the tops and sides of the panels are constructed from glass and aluminum, PV modules are not vulnerable to ignition from firebrands from wildland fires. In a wildfire situation, the panels would be rotated and stowed in a panel-up position. The rotation of the tracker rows would be controlled remotely via a wireless local area network. All trackers could be rotated simultaneously in a hazard situation. The Project Operator will implement the following during operations, maintenance, and decommissioning:

- Train all workers to prevent fires and to respond quickly and effectively if an incident occurs.
- Inspect and maintain a fire extinguisher and any other required fire prevention equipment in each vehicle.
- Prohibit smoking outside of designated smoking areas.
- Perform hot-work in controlled areas. Hot work areas will be wetted down as necessary before hot work is performed.
- Welding, cutting, grinding, or other flame- or spark- producing operations should be minimized and, if required, closely supervised, with fire extinguishing equipment at hand.
- Remote monitoring of all major electrical equipment (transformers and inverters) will be used to screen for unusual operating conditions. Higher than nominal temperatures, for example, can be compared with other operational factors to indicate the potential for overheating which under certain conditions could precipitate a fire. Units could then be shut down or generation curtailed remotely until corrective actions are taken.
- On-site vegetation near all solar arrays, ancillary equipment, and access roads shall be maintained to minimize the risk of a grassfire.
- Schedule maintenance activities outside of the fire season, when possible, to minimize activity during high fire risk days.

Prevention: Any work that can or has the potential to use or produce flames or sparks, must be performed under the guidance of the AES Hot-Work program. Vehicles must not be parked in grass while running. Trailer chains or other objects that could be dragged from a vehicle must be secure to prevent contact with the road that could create sparks.

Preparation: AES facility buildings are equipped with fire/smoke detectors and fire extinguishers. Site vehicles are equipped with fire extinguishers. Employees are trained on fire extinguisher use at hire and refresher training is given at least annually.

AES will not request employees to engage in the practice of fighting fires. Firefighting equipment is only to be utilized to extinguish small incipient stage fires or hotspots from a previously extinguished fire. In the event the fire is large and fully developed; employees must leave and secure the area.

Local Feedback: On August 27, 2025, the Newaygo Fire Department identified a need for a water source at the site. Based on this need, Sylvan Solar proposed placing water storage tanks at various locations throughout the project area, either inside or outside the fence as preferred by the local fire departments, to provide for a water source.

Response: Employee Procedures for Fires (office, warehouse, or shop)

- Fire discovered by employee:
    - Confine the fire by closing doors to the area
    - Alert employees of fire by yelling "fire"; be sure to include the location
    - Employee will call 911
    - On hearing "fire", employees will evacuate the building using the closest exit route. Once employees have left the building, they may not go back in.
- Employees will assist visitors, contractors and any handicapped person with evacuation to the designated evacuation location (Muster Point)
- Employees will immediately report to their supervisors in the designated evacuation location
- Supervisors will assist the EHS Coordinator to perform employee roll call ensuring everyone is present. If employees are in the field, supervisors contact to ensure their location and safety
- If possible, retrieve the Contractor/Visitor sign in log from main lobby

Response: Employee Procedures for Fires (field)

1. Fire discovered by employee.
2. Field personnel shall immediately report the fire to EHS and Team Leaders. Designated person will call "911".
3. For wildfires, stay upwind and crosswind of the fire while evacuating the area.

Appendix 10 - Stormwater Assessment Plan and NCDC Communications

Attachment 10 - Stormwater Assessment Plan and NCDC Communications

Stormwater Assessment Plan

Sylvan Solar Project

Prepared for
Sylvan Solar, LLC

Prepared by
Barr Engineering Michigan, LLC

September 2025

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Stormwater Assessment Plan

September 2025

Contents

Tables

Figures

Attachments

Abbreviations

AC	alternating current
AES	AES Clean Energy
Barr	Barr Engineering Michigan LLC
BMPs	Best Management Practices
CN	Curve Number
DC	direct current
DEM	Digital Elevation Model
EGLE	Michigan Department of Environment, Great Lakes, and Energy
EGLE Spreadsheet	EGLE Calculations for Storm Water Runoff Volume Control (EQP9278)
gen-tie	generation tie line
HSG	Hydrologic Sil Group
kV	kilovolt
MW	megawatt
MPSC	Michigan Public Service Commission
NCDC	Newaygo County Drain Commissioner
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmosphere Administration
NRCS	Natural Resource Conservation Service
O&M	Operations & Maintenance
Plan	Stormwater Assessment Plan
Project	Sylvan Solar Project
PV	photovoltaic
SCADA	supervisory control and data acquisition
SES	solar energy systems
Sylvan Solar	Sylvan Solar LLC
TR-55	Technical Release 55 Urban Hydrology for Small Watersheds
USDA	United States Department of Agriculture
USGS	United States Geological Survey

1 Introduction

Barr Engineering Michigan LLC (Barr) has prepared this Stormwater Assessment Plan (Plan) on behalf of Sylvan Solar, LLC (Sylvan Solar), an affiliate of AES Clean Energy Development, LLC (AES) for the Sylvan Solar Project (Project) in Newaygo County, Michigan. AES is a subsidiary of The AES Corporation based in the United States that owns and operates solar, wind, battery, and green hydrogen projects across the United States, grossing 9.1 gigawatts (GWs) in operation at the end of 2024. Sylvan Solar, a Delaware limited liability company, is an independent power producer that is qualified to do business in Michigan.

Sylvan Solar is proposing to construct, own, operate, and decommission the 220-megawatt (MW) Sylvan Solar Project (Project), which spans both Sheridan Charter and Garfield Townships. The Project will generate an annual average of approximately 445,000 megawatt (MW) hours of renewable energy over its anticipated 35-year life span, which is enough electricity to power the equivalent of 55,000 Michigan homes per year. The Project represents a significant private investment into Newaygo County which will contribute to the local labor income and tax base with no local incentives or long-term strain on township and county services. Additionally, the Project incorporates a well-sited design and will provide direct and indirect social and economic benefits to the townships and county.

This Plan was written in accordance with the Fremont Community Joint Planning Commission Solar Energy System (SES) Ordinance. The purpose of this Plan is to assess the potential impacts of the Project on stormwater runoff inputs to nearby streams and drains in Sheridan Charter Township in accordance with applicable local requirements.

2 Project Information

2.1 Project Description

The proposed Project is an up to 220-MW photovoltaic (PV) solar generation facility within a 2,166-acre Project area within Sheridan Charter and Garfield Townships, Newaygo County, Michigan. The Project area is approximately 4.5 miles southeast of Fremont, Michigan (Attachment 1, Map 1). The Project is generally north of North River Drive, west of Bingham Avenue, south of Michigan Highway 82, and east of South Osborn Avenue. The Project footprint and surrounding area primarily consists of agricultural fields, wooded areas, agricultural ditches, and Newaygo County designated drains. The Muskegon River is approximately 900 feet south of the Project at its closest point.

Of the total 2,166 acres leased for the Project, approximately 1,250 acres of the Project area will consist of the solar energy facility and generation tie line (gen-tie). Buried medium voltage (MV) collection lines will be installed within and outside the fenced area to connect the blocks of solar panels in the Project area.

A <500-foot overhead high voltage (HV) generation tie line (gen-tie) will be constructed in Garfield Township between the proposed Project substation and a proposed utility-owned and operated switchyard connected to the existing 345-kilovolt (kV) Ludington to Kenowa overhead transmission line (point of interconnection). The gen-tie line and point of interconnection are located near the northeast corner of the Project area in Garfield Township. Table 1 summarizes the estimated metrics for the Project:

Table 1 **Project Quantities**

Project Details	Sheridan Charter Township
Megawatts (MW)	76 MW
Total acres (including easements)	783 acres
Fenced area	420 acres
Project Substation and Utility-owned Switchyard (Garfield Township)	N/A
HV Gen-tie Line (Garfield Township)	N/A

On-site construction of the Project is anticipated to commence in mid-2027, and the solar energy facility is expected to be operational in late 2028.

2.2 General Facility Description

The solar energy facility will generate up to 220 MW of solar power. The facility will include multiple rows of PV solar panels oriented north-south on single-axis tracking structures, inverters that convert direct current (DC) to alternating current (AC), transformers, primarily underground 34.5-kV MV collection lines, meteorological stations, a stormwater management system, and a 345-kV Project substation.

For the purposes of this Plan, the Project area within Sheridan Charter Township will be referred to as the Site. The Site within the fence line will encompass approximately 420 acres and include the following Project components:

- PV solar arrays,
- inverter skids that will house inverters and medium voltage step-up transformers,
- underground medium voltage collection lines,
- gravel access roads,
- meteorological station(s),
- security fencing and gates,
- temporary construction laydown areas, and
- stormwater management system.

In addition, the potential exists that the Operations and Maintenance (O&M) building may utilize an existing building (if available) or a laydown area within the Project area in Sheridan Charter Township.

The PV solar arrays will occupy a significant portion of the private parcels at full build-out. The Project area will include underground medium voltage collection lines, which will connect the blocks of PV solar arrays within the Project area. The solar arrays will convert sunlight into DC electricity, which is conveyed to an inverter. The inverter will convert the DC power to AC power, which will then flow to the medium-voltage transformers. The MV collection lines will transport electricity from the PV solar arrays to the proposed Project substation in Garfield Township.

During construction, temporary laydown areas, construction trailers, and parking areas will be located within the Project area. Fencing, lighting at the Project substation and O&M building, and electronic security systems will secure the Project facilities. The perimeter fence in Sheridan Charter Township will be an approximate 7-foot-high woven wire fence.

During operation of the Project, downlit, dark-sky friendly security lighting will be installed at the O&M building and Project substation. The Project's O&M building will be located either within a laydown area near the substation or in an existing building within the Project area (potentially within Sheridan Charter Township), and will include maintenance facilities, restrooms, and ancillary support systems such as component storage.

3 Study

3.1 Purpose

This Plan summarizes the effects of the Project, and proposed land use changes, on stormwater runoff conditions of the Site. The Project will primarily convert existing cropland into approximately 420 acres of solar PV arrays. The PV array areas will be pre-seeded with shortgrass native array seed mix under and between the elevated solar panels according to the Project's Vegetation Management Plan. The Project area will also include impervious gravel internal access roads, equipment laydown areas, and stormwater basins. These stormwater basins will be constructed within the Site to manage potential stormwater runoff increases. While some Site grading will occur during construction, the existing drainage patterns are not anticipated to change after construction.

Since existing county drains cross the Site, which direct stormwater runoff generally to the west, the Newaygo County Drain Commissioner's office was consulted about the Project. During an onsite meeting on May 14, 2025, it was indicated that post-construction runoff to the county drains will not be allowed to exceed pre-construction conditions.

After the Project construction is complete and the pre-seeded areas are vegetated, the land cover will primarily consist of the meadow/grassland land cover type. The PV panels will be elevated at a minimum of two feet off the ground surface at maximum tilt and will not reduce the perviousness of the groundcover. During storm events, rainfall will flow off the solar panels onto the ground below. The only areas where the land cover types will change significantly between existing and proposed conditions, where the stormwater runoff volume would increase, is within the proposed interior roads and temporary equipment laydown areas. The analysis for this plan included the temporary equipment laydown areas to ensure a conservative assessment. A comparison of existing and proposed conditions is necessary to determine how this change in land use will affect stormwater runoff conditions.

To compare the existing and proposed conditions for the Site, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) Calculations for Storm Water Runoff Volume Control (EQP9278) (Calculations for Stormwater Runoff Volume Control: EQP9278 2024) spreadsheet (EGLE Spreadsheet) was used. This EGLE Spreadsheet references "Pre-settlement" conditions (i.e., before European settlement and any land development) but it can also be used for existing conditions with the correct input parameters. These input parameters are drainage area, rainfall depth, Hydrologic Soil Group (HSG), and land cover classification. The land cover classification is determined using the Technical Release 55 Urban Hydrology for Small Watersheds (TR-55) (Conservation Engineering Division 1986) runoff curve number (CN) method. Stormwater runoff curve numbers were assigned to each land cover/HSG group from Table 2-2 in TR-55, with higher CN values indicating higher runoff generation. The remaining inputs were determined using National Oceanic and Atmosphere Administration (NOAA) Atlas 14 Point Precipitation Frequency Estimates (NOAA Atlas14 Point Precipitation Frequency Estimates 2017), United States Geological Survey (USGS) 2023 National Land Cover Dataset (NLCD) (National Land Cover Database 2023), and the United States Department of Agriculture (USDA) Web Soil Survey (Web Soil Survey n.d.).

3.2 Drainage Area

For this analysis, the approximately 783-acre Project area within Sheridan Charter Township (Attachment 1, Map 1), was analyzed. In addition, a small section of solar arrays outside of the Sheridan Charter Township was included in the analysis because they will contribute stormwater runoff to Sheridan Charter

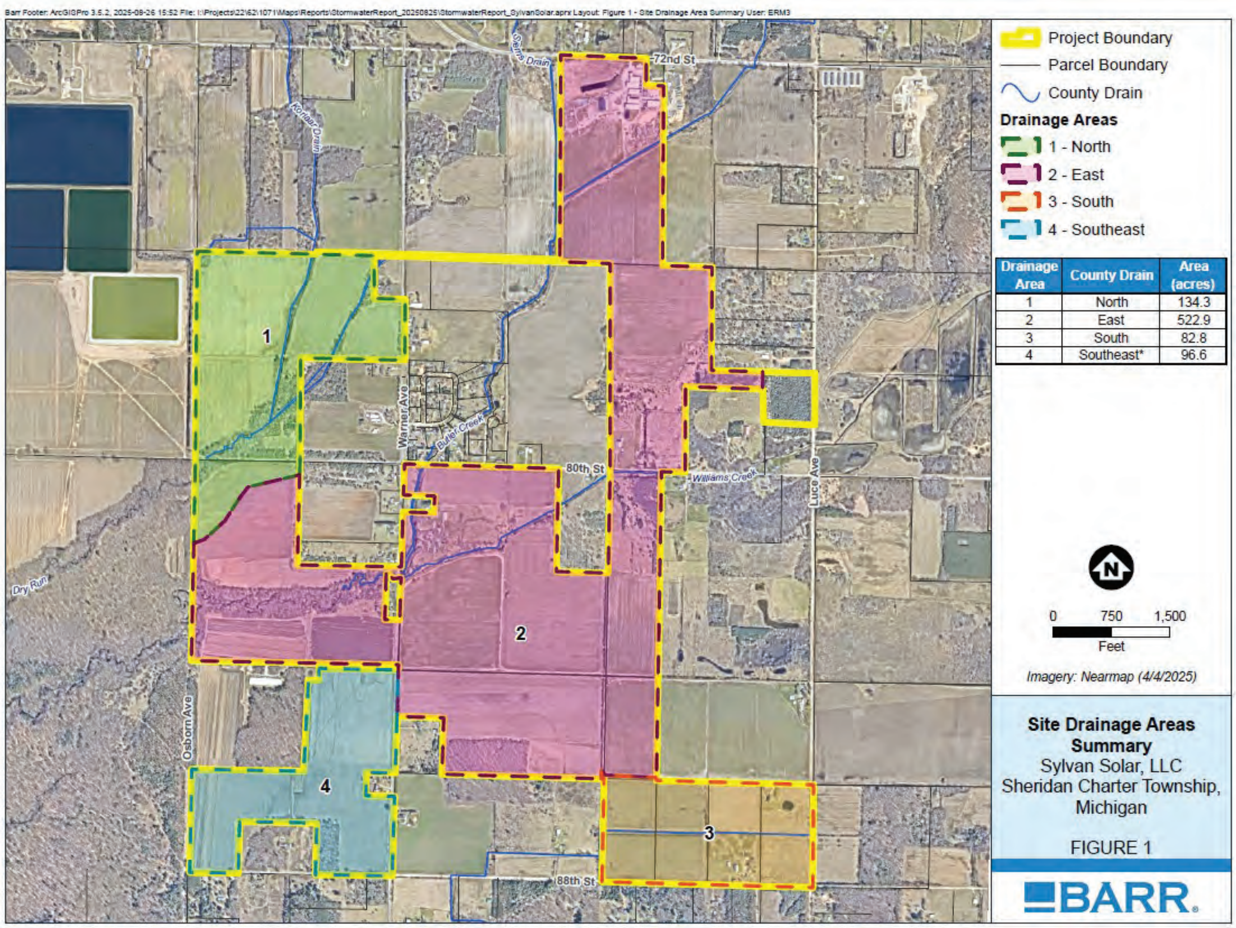
Township through a county drain under S. Luce Avenue. The Newaygo County Drain Commissioner's Office approved grouping participating parcels by subcatchment (for each county drain) for this stormwater analysis. As explained in the next section, Section 3.2.1, the study parcels were divided into four drainage areas: North (1), East (2), South (3), and Southeast (4).

3.2.1 Elevation Data

USGS Digital Elevation Model (DEM) elevation data (Attachment 1, Map 3) was used to determine flow direction and delineate the four drainage areas (Figure 1). Grading will likely be required during construction but it is assumed that grading will not measurably change the boundaries of the drainage areas.

There are three major drainage areas at the Site: North (1), East (2), and South (3). The North (1) and East (2) drainage areas drain to Brooks Creek, outside the Project area boundary. The Southeast (4) subcatchment does not include a stream or county drain; however, its overland flow is directed toward Brooks Creek. The South (3) subcatchment continues south beyond the Project area boundary and flows to Minnie Creek. Map 4 of Attachment 1 shows the Project area and delineated streams and county drains.

Figure 1 Site Drainage Areas Summary



3.3 Rainfall Depth

Based on the Fremont Community Joint Planning Commission SES Ordinance, Sheridan Charter Township does not have any specific requirements for which storm events should be considered in this stormwater analysis. However, the EGLE Spreadsheet recommends using the 2-year, 24-hour storm event, which is 2.57 inches at the Site using NOAA Altas 14 data (Attachment 2).

3.4 Impervious Area

Impervious areas for the proposed conditions were determined using the proposed Project layout (Attachment 1, Map 5. The proposed impervious areas primarily include the proposed interior roads and equipment laydown areas. The Great Plains Institute determined that the spaces under and between solar arrays can be designed and maintained to create infiltration areas to disconnect impervious surfaces from receiving waterbodies (Photovoltaic Stormwater Management Research and Testing (PV-SMaRT) 2023). Therefore, the PV arrays were not considered typical impervious surfaces for this stormwater analysis since the solar panels will be a minim of two feet off the ground surface at maximum tilt with space between the panels where precipitation can infiltrate into the ground. Based on the proposed Project layout, the proposed impervious surfaces and solar array areas will be constructed within existing crop fields.

3.5 Land Cover and HSG

Tables 2 and 3 provide the different land cover / HSG classifications within the Site, and the corresponding CN values. HSGs are defined as A, B, C, or D, and can also include dual soil types. For example, the A/D soil type indicates that the soil behaves like an A soil if there are onsite drainage practices (e.g., underdrain or tile drain) and behaves like a D soil if there are no onsite drainage practices. Any dual soil types were assumed to behave in the drained condition. For this study, drained soils are assumed for the existing cropland areas and for the proposed grassland / meadow land cover type. Soil types for the Project area (Attachment 1, Map 2) are generally very poorly drained to moderately well drained according to the USDA Natural Resource Conservation Service (NRCS).

Table 2 **Existing Land Cover Types, Soil Types, and Curve Numbers**

Land Cover Type	Soil Type	CN
Woods	A	30
Grassland / Meadow	A	30
Crops	A	67
Developed	A	67
Crops	A/D	67
Crops	B/D	78
Crops	C/D	85
Woods	D	77
Grassland / Meadow	D	78
Developed	D	92
Wetland / Open Water	N/A	98

Table 3 **Proposed Land Cover Types, Soil Types, and Curve Numbers**

Land Cover Type	Soil Type	CN
Woods	A	30
Grassland / Meadow	A	30
Crops	A	67
Developed	A	67
Crops	A/D	67
Crops	B/D	78
Crops	C/D	85
Woods	D	77
Grassland / Meadow	A/D	30
Grassland / Meadow	B/D	58
Grassland / Meadow	C/D	71
Developed	D	92
Wetland / Open Water	N/A	98
Impervious	N/A	98

The major change in land cover types between existing and proposed conditions is from crop land to grassland / meadow. For example, the CN decreases from 67 (crops) to 30 (grassland / meadow) in A/D soils. The other change is from crop lands to impervious surfaces where roads and equipment laydown areas are proposed. Table 4 summarizes the land cover acreages from existing to proposed conditions. The EGLE Spreadsheet predicts a significant decrease in stormwater runoff volume inputs to the nearby county drains based on these land cover changes. Note, Table 4 does not include the total Site area, as much of the land use does not change between existing and proposed conditions.

Table 4 Land Cover Acreage Comparison for Existing and Proposed Conditions

	Drainage Area 1		Drainage Area 2		Drainage Area 3		Drainage Area 4	
	Existing	Proposed	Existing	Proposed	Existing	Proposed	Existing	Proposed
Crops	116.5	34.5	392.1	100.6	89.9	50.3	86.7	16.2
Grassland / Meadow	2.2	75.5	60.8	325.0	7.5	45.6	2.8	66.6
PV Array	N/A	73.2	N/A	264.3	N/A	38.2	N/A	63.8
Impervious	N/A	6.2	N/A	16.3	N/A	1.0	N/A	3.9

According to the EGLE Spreadsheet's provided example, wetlands are considered open water with a TR-55 CN classification of 98. Map 6 of Attachment 1 illustrates the planting areas where land cover will change from the existing conditions.

3.6 Results

The results of the EGLE Spreadsheet calculations for each drainage area are summarized in Table 5. As shown, there is no increase in stormwater runoff volume for the four drainage areas. Instead, there is a total decrease in stormwater runoff volume for the Site. The EGLE Spreadsheet calculations are included in Attachment 3.

Table 5 EGLE Spreadsheet Calculation Results for 2-year, 24-hour Event

Drainage Area	Existing Runoff Volume (cu. ft)	Proposed Runoff Volume (cu. ft)	Total Change (cu. ft.)
1	278,490	233,066	-45,424
2	1,174,786	806,051	-368,734
3	185,175	135,764	-49,412
4	146,707	105,622	-41,085
Total	**1,785,158**	**1,280,503**	-504,655

In addition, the EGLE Spreadsheet calculations determined the water quality runoff volume (i.e., representing the first inch of precipitation across each drainage area) that would need to be captured, detained, or treated to effectively remove pollutants and protect water quality. These water quality runoff volumes are noted in Attachment 3.

3.7 Conclusion

The EGLE Spreadsheet calculations show that converting the existing land use from primarily crops to a solar generation facility with grassland / meadow ground cover, interior roads, and equipment laydown areas does not increase the stormwater runoff inputs into the county drains in Sheridan Charter Township. In fact, the stormwater runoff volume actually decreases due to the conversion of crop land to grassland / meadow. As noted in Section 3.4, based on their PV stormwater management research and testing, the Great Plains Institute determined that the spaces under and between solar arrays can be designed and maintained to create infiltration areas to disconnect impervious surfaces from receiving waterbodies (Photovoltaic Stormwater Management Research and Testing (PV-SMaRT) 2023).

Considering the results in Table 5, land cover change is the major factor driving the decrease in stormwater runoff volume; therefore, it is necessary that the proposed solar array area be properly seeded and maintained to remain consistent with the assumptions used in this stormwater analysis. Implementation of soil erosion and stormwater control measures during construction will be necessary to prevent a temporary increase in stormwater runoff inputs into the nearby county drains. In addition, implementation of stormwater management practices to manage the water quality runoff volume from the proposed impervious areas in each drainage area will be necessary to meet EGLE’s water quality runoff volume requirements.

4 References

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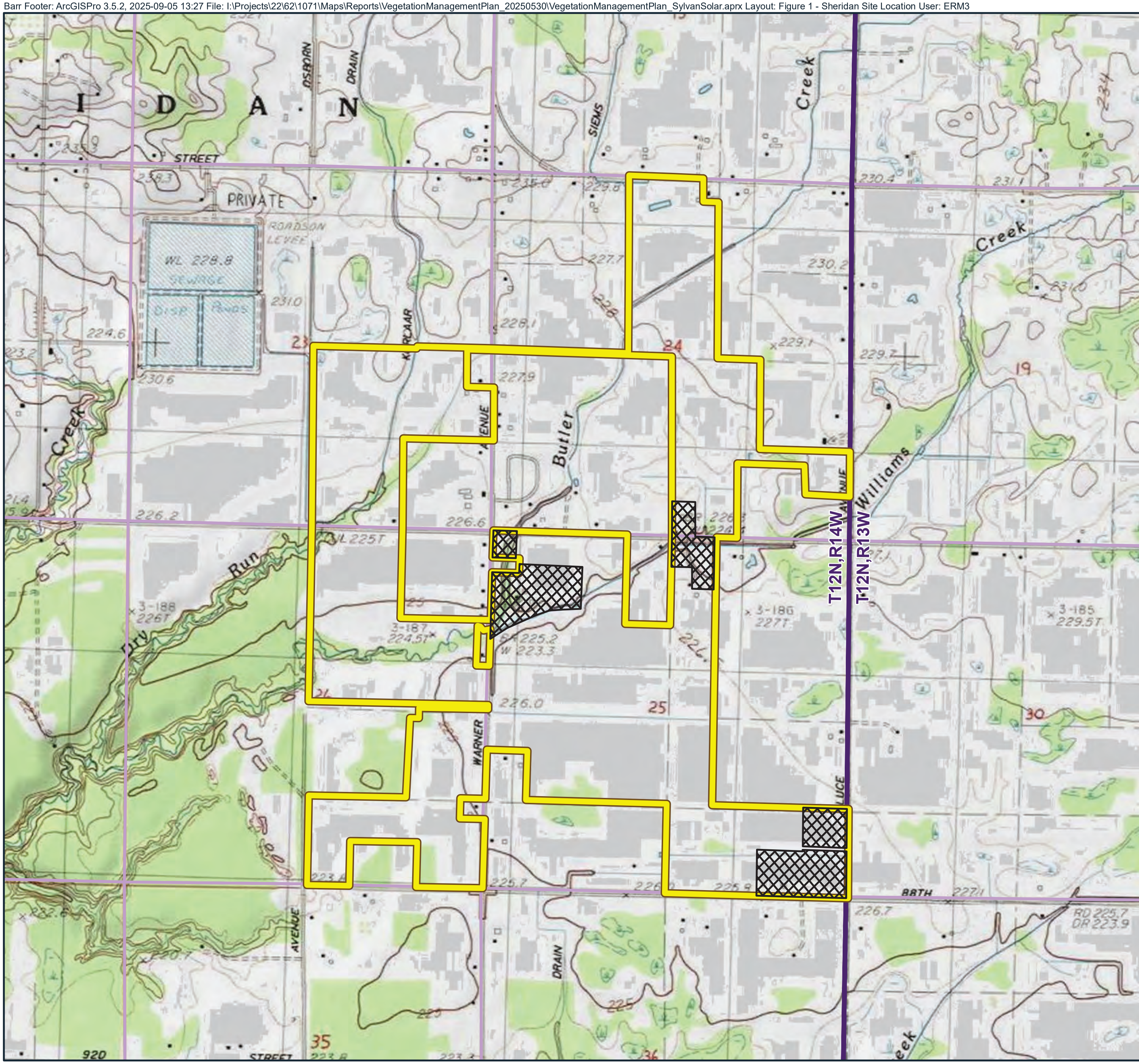
Attachment 1 – Project Maps



Project Boundary
Public Land Survey Township
Public Land Survey Section
Excluded Area

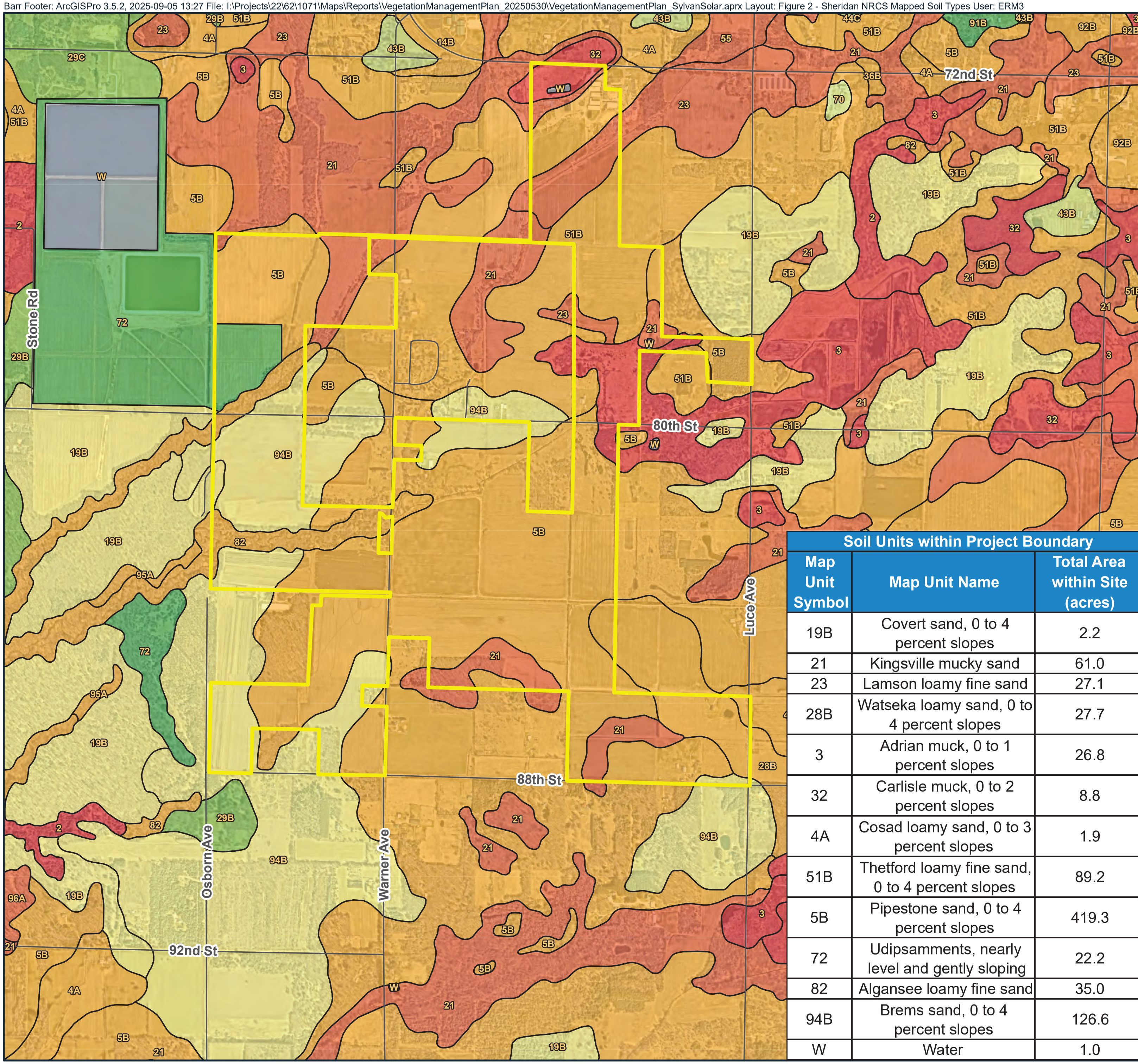
0 1,000 2,000
Feet

Basemap: USGS USA Topo, Esri

Site Location
Sylvan Solar Project
Sheridan Charter Township, Michigan

Map 1

BARR



Soil Units within Project Boundary		
Map Unit Symbol	Map Unit Name	Total Area within Site (acres)
19B	Covert sand, 0 to 4 percent slopes	2.2
21	Kingsville mucky sand	61.0
23	Lamson loamy fine sand	27.1
28B	Watseka loamy sand, 0 to 4 percent slopes	27.7
3	Adrian muck, 0 to 1 percent slopes	26.8
32	Carlisle muck, 0 to 2 percent slopes	8.8
4A	Cosad loamy sand, 0 to 3 percent slopes	1.9
51B	Thetford loamy fine sand, 0 to 4 percent slopes	89.2
5B	Pipestone sand, 0 to 4 percent slopes	419.3
72	Udipsamments, nearly level and gently sloping	22.2
82	Algansee loamy fine sand	35.0
94B	Brems sand, 0 to 4 percent slopes	126.6
W	Water	1.0

Project Boundary
Soil Map Unit

Drainage Class

- Very Poorly Drained
- Poorly Drained
- Somewhat Poorly Drained
- Moderately Well Drained
- Well Drained
- Somewhat Excessively Drained
- Excessively Drained
- NA

N

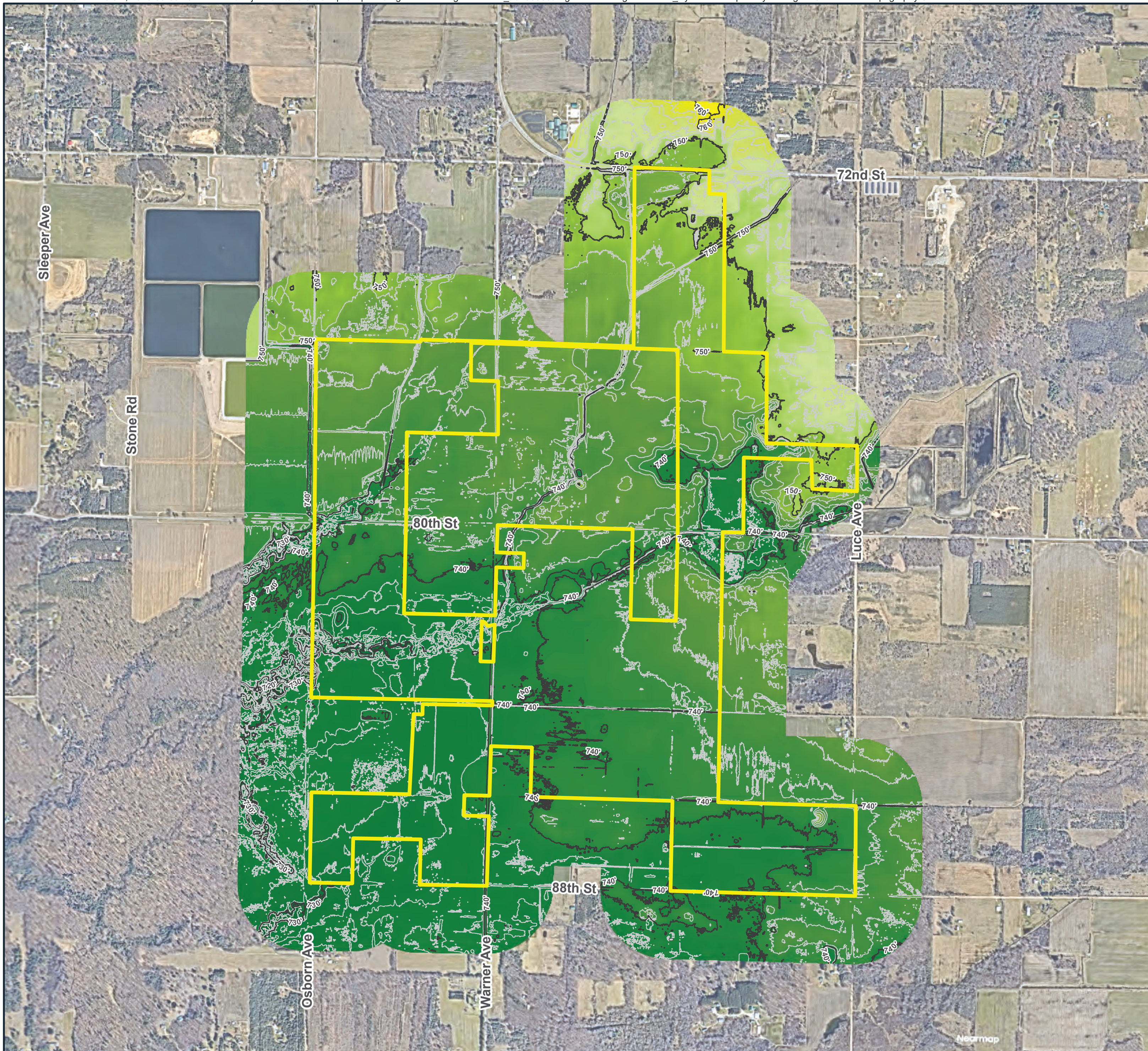
0 1,000 2,000
Feet

Imagery: Nearmap (4/4/2025)

NRCS Mapped Soil Types
Sylvan Solar Project
Sheridan Charter Township, Michigan

Map 2

BARR



Project Boundary
10ft Index Contour
2ft Intermediate Contour
Surface Elevation (ft)
764
709

0 1,000 2,000
Feet

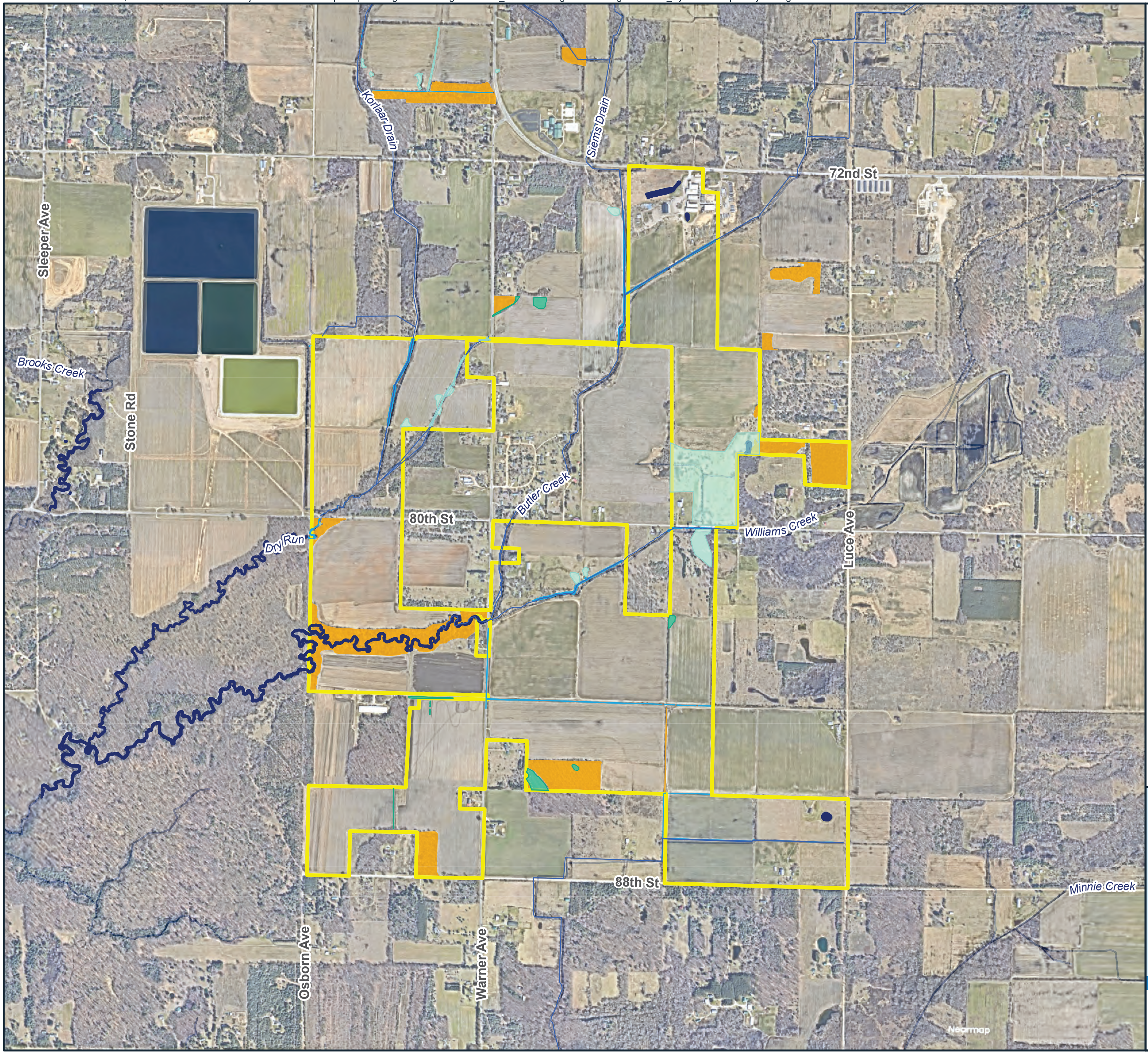
Imagery: Nearmap (4/4/2025)

Topography
Sylvan Solar Project
Sheridan Charter Township, Michigan

Map 3

BARR

Barr Footer: ArcGISPro 3.5.2, 2025-09-05 13:27 File: I:\Projects\22\62\1071\Maps\Reports\VegetationManagementPlan_20250530\VegetationManagementPlan_SylvanSolar.aprx Layout: Figure 4 - Sheridan Delineated Wetlands and Streams User: ERM3



Project Boundary
County Drain
Drainage Ditch
Streams
Potentially Regulated Wetland
Non-Regulated Wetland
Potential Protected Species Habitat

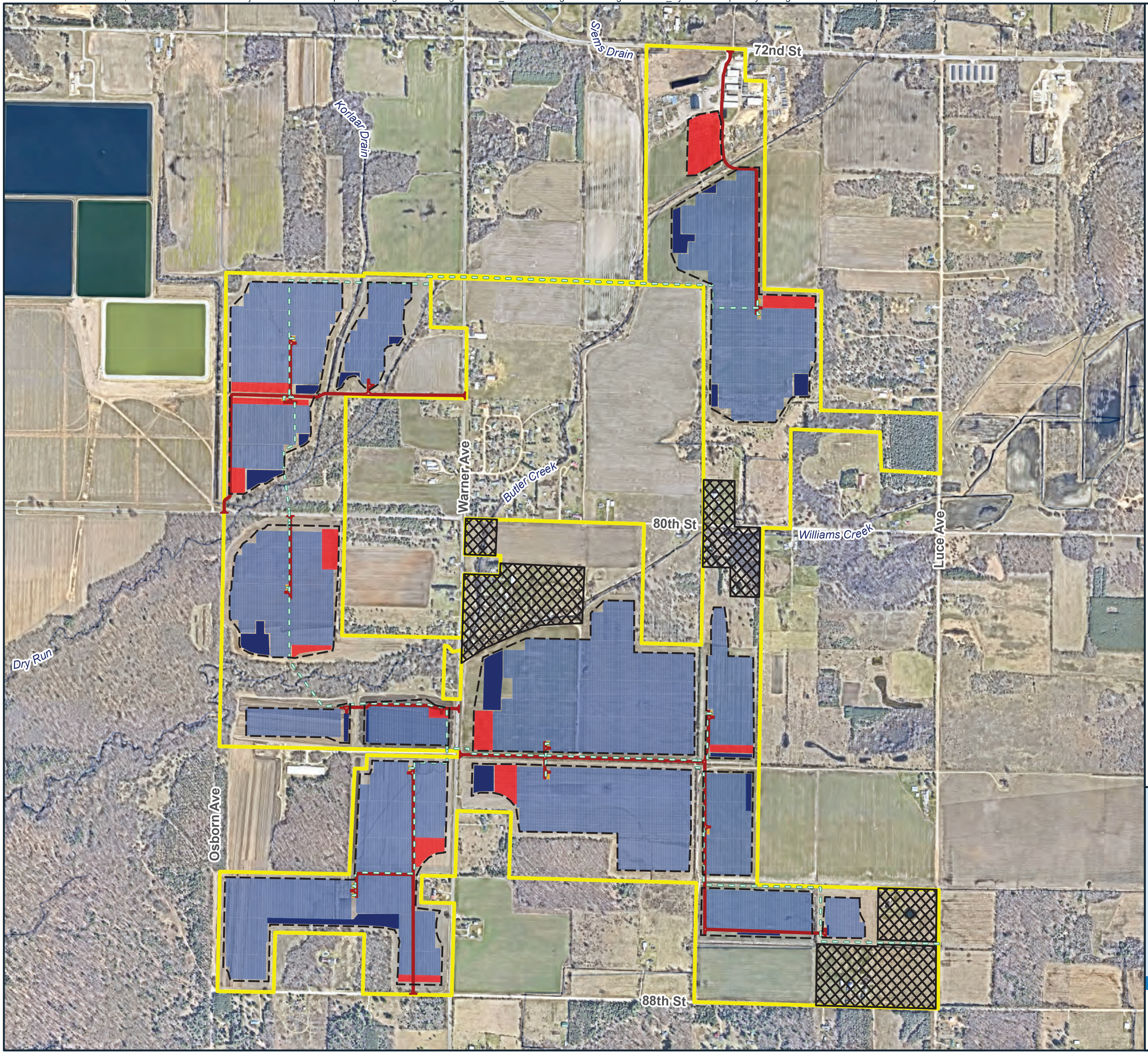
0 1,000 2,000
Feet

Imagery: Nearmap (4/4/2025)

Delineated Wetlands & Streams
Sylvan Solar Project
Sheridan Charter Township, Michigan

Map 4

BARR



Project Boundary
Perimeter Fencing
Underground Medium Voltage Collection Line
Excluded Area
Interior Road
Stormwater Basin
Solar Panels
Laydown Area
Inverter Skid

0 750 1,500
Feet

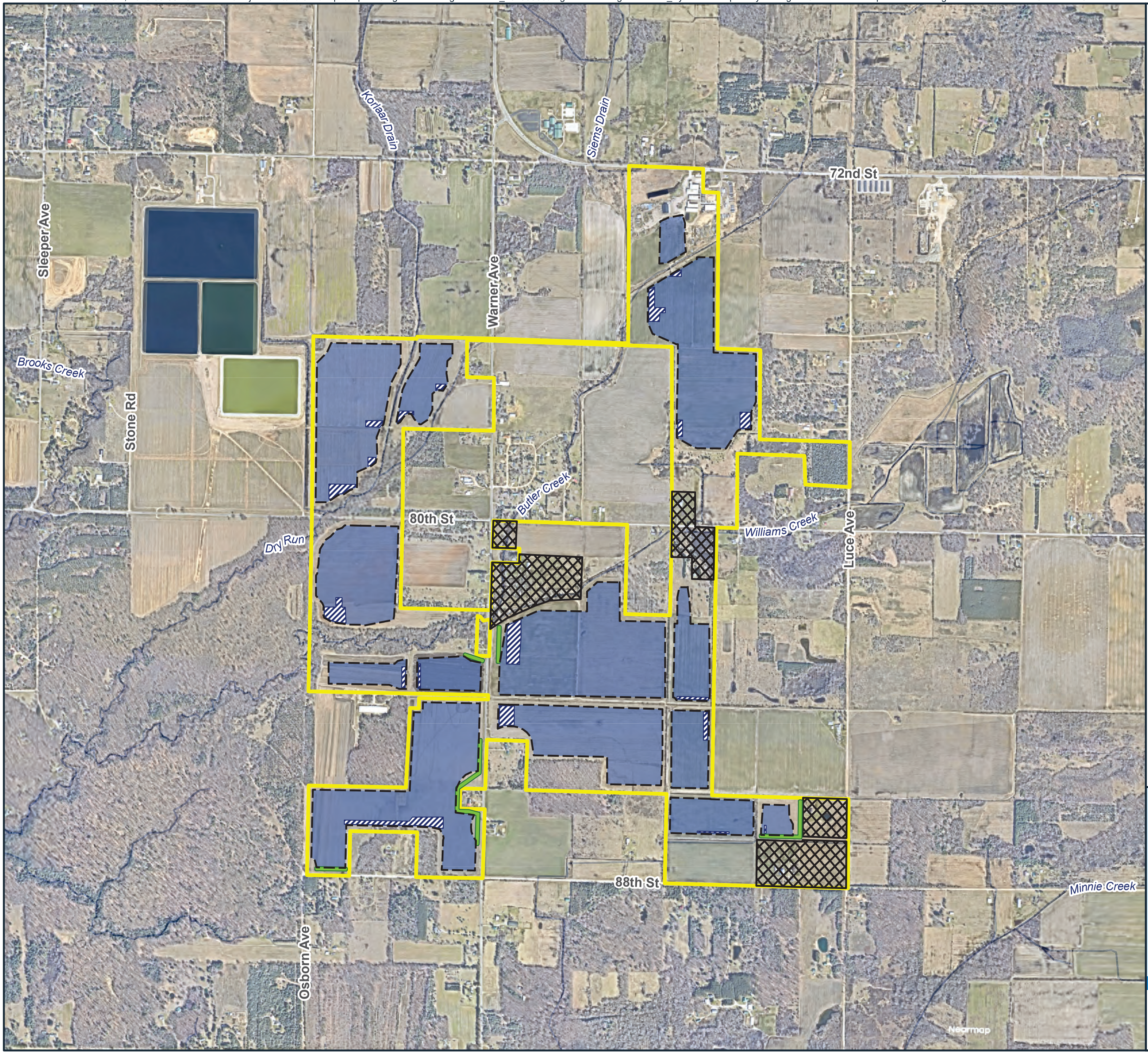
Imagery: Nearmap (4/4/2025)

Proposed Site Layout
Sylvan Solar Project
Sheridan Charter Township, Michigan

Map 5

BARR

Barr Footer: ArcGISPro 3.5.2, 2025-09-05 13:27 File: I:\Projects\22\62\1071\Maps\Reports\VegetationManagementPlan_20250530\VegetationManagementPlan_SylvanSolar.aprx Layout: Figure 6 - Sheridan Proposed Screening and Seed Mix Areas User: ERM3



Project Boundary

Perimeter Fencing

Residential Screening *(Tree/Shrub Plantings)*

Solar Array *(Shortgrass Native Array Seed Mix)*

Stormwater Basin *(Stormwater Basin Seed Mix)*

Excluded Area

Note:
- Disturbed areas and fallow agricultural fields outside the perimeter fence will either be seeded with Solar Array seed mix and/or Tall Pollinator seed mix, or will continue to be used for agricultural activities during Project operation.

N

0 1,000 2,000
Feet

Imagery: Nearmap (4/4/2025)

Proposed Screening and Seed Mix Areas
Sylvan Solar Project
Sheridan Charter Township, Michigan

Map 6

BARR

Attachment 2 – NOAA Rainfall Data

NOAA Atlas 14, Volume 8, Version 2
Location name: Fremont, Michigan, USA*
Latitude: 43.4038°, Longitude: -85.9339°
Elevation: 741 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffrey Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.298** (0.239-0.372)	**0.354** (0.284-0.443)	**0.451** (0.361-0.565)	**0.537** (0.426-0.675)	**0.662** (0.510-0.867)	**0.765** (0.574-1.01)	**0.873** (0.631-1.18)	**0.987** (0.683-1.37)	**1.15** (0.762-1.63)	**1.28** (0.821-1.83)
10-min	**0.437** (0.351-0.545)	**0.519** (0.416-0.648)	**0.661** (0.528-0.828)	**0.786** (0.624-0.989)	**0.969** (0.747-1.27)	**1.12** (0.840-1.48)	**1.28** (0.924-1.73)	**1.45** (1.00-2.01)	**1.68** (1.12-2.39)	**1.87** (1.20-2.68)
15-min	**0.533** (0.428-0.665)	**0.633** (0.507-0.790)	**0.806** (0.644-1.01)	**0.958** (0.761-1.21)	**1.18** (0.911-1.55)	**1.37** (1.02-1.81)	**1.56** (1.13-2.11)	**1.76** (1.22-2.45)	**2.05** (1.36-2.92)	**2.28** (1.47-3.27)
30-min	**0.752** (0.603-0.939)	**0.896** (0.719-1.12)	**1.15** (0.916-1.44)	**1.36** (1.08-1.72)	**1.68** (1.30-2.20)	**1.95** (1.46-2.57)	**2.22** (1.60-3.00)	**2.51** (1.74-3.48)	**2.91** (1.93-4.14)	**3.23** (2.08-4.64)
60-min	**0.991** (0.796-1.24)	**1.17** (0.940-1.46)	**1.49** (1.19-1.87)	**1.78** (1.41-2.24)	**2.20** (1.70-2.89)	**2.56** (1.92-3.39)	**2.93** (2.12-3.98)	**3.33** (2.31-4.64)	**3.90** (2.59-5.56)	**4.36** (2.81-6.26)
2-hr	**1.23** (0.997-1.52)	**1.45** (1.17-1.79)	**1.84** (1.48-2.28)	**2.19** (1.75-2.73)	**2.72** (2.12-3.55)	**3.17** (2.40-4.17)	**3.64** (2.66-4.91)	**4.16** (2.91-5.75)	**4.89** (3.28-6.94)	**5.49** (3.56-7.84)
3-hr	**1.39** (1.13-1.71)	**1.62** (1.32-2.00)	**2.05** (1.66-2.52)	**2.44** (1.97-3.02)	**3.05** (2.40-3.97)	**3.56** (2.72-4.68)	**4.12** (3.04-5.54)	**4.74** (3.33-6.53)	**5.61** (3.79-7.94)	**6.32** (4.13-9.00)
6-hr	**1.67** (1.37-2.03)	**1.93** (1.59-2.35)	**2.43** (1.99-2.97)	**2.90** (2.36-3.56)	**3.65** (2.90-4.73)	**4.29** (3.32-5.61)	**5.00** (3.72-6.69)	**5.78** (4.11-7.94)	**6.92** (4.72-9.74)	**7.85** (5.17-11.1)
12-hr	**1.95** (1.62-2.35)	**2.25** (1.86-2.72)	**2.83** (2.34-3.42)	**3.39** (2.78-4.12)	**4.29** (3.45-5.52)	**5.07** (3.95-6.58)	**5.93** (4.45-7.88)	**6.89** (4.95-9.40)	**8.28** (5.70-11.6)	**9.44** (6.28-13.3)
24-hr	**2.24** (1.87-2.67)	**2.57** (2.15-3.06)	**3.22** (2.68-3.85)	**3.85** (3.19-4.63)	**4.88** (3.97-6.24)	**5.78** (4.56-7.45)	**6.79** (5.16-8.97)	**7.92** (5.75-10.7)	**9.58** (6.66-13.3)	**11.0** (7.34-15.3)
2-day	**2.55** (2.15-3.00)	**2.90** (2.45-3.42)	**3.60** (3.03-4.26)	**4.30** (3.59-5.11)	**5.43** (4.46-6.88)	**6.43** (5.12-8.22)	**7.55** (5.79-9.90)	**8.81** (6.46-11.9)	**10.7** (7.48-14.7)	**12.2** (8.26-16.9)
3-day	**2.75** (2.34-3.23)	**3.16** (2.68-3.71)	**3.93** (3.32-4.63)	**4.68** (3.93-5.53)	**5.87** (4.83-7.36)	**6.90** (5.52-8.75)	**8.05** (6.19-10.5)	**9.32** (6.86-12.5)	**11.2** (7.88-15.4)	**12.7** (8.65-17.5)
4-day	**2.95** (2.52-3.44)	**3.38** (2.88-3.95)	**4.19** (3.56-4.91)	**4.96** (4.18-5.84)	**6.17** (5.09-7.69)	**7.21** (5.78-9.09)	**8.36** (6.45-10.8)	**9.63** (7.10-12.8)	**11.5** (8.11-15.7)	**13.0** (8.87-17.9)
7-day	**3.54** (3.04-4.10)	**3.95** (3.39-4.58)	**4.73** (4.05-5.50)	**5.48** (4.66-6.40)	**6.67** (5.55-8.24)	**7.70** (6.22-9.62)	**8.84** (6.88-11.3)	**10.1** (7.51-13.3)	**11.9** (8.50-16.2)	**13.5** (9.26-18.4)
10-day	**4.08** (3.52-4.69)	**4.49** (3.88-5.18)	**5.28** (4.54-6.10)	**6.03** (5.15-7.01)	**7.22** (6.02-8.84)	**8.24** (6.68-10.2)	**9.37** (7.32-11.9)	**10.6** (7.93-13.9)	**12.4** (8.89-16.8)	**13.9** (9.62-19.0)
20-day	**5.55** (4.84-6.32)	**6.15** (5.36-7.01)	**7.18** (6.23-8.21)	**8.08** (6.97-9.29)	**9.39** (7.85-11.2)	**10.5** (8.52-12.7)	**11.6** (9.08-14.5)	**12.7** (9.56-16.5)	**14.4** (10.3-19.2)	**15.7** (10.9-21.2)
30-day	**6.78** (5.95-7.67)	**7.54** (6.61-8.54)	**8.80** (7.68-9.99)	**9.84** (8.53-11.2)	**11.3** (9.44-13.3)	**12.4** (10.1-14.9)	**13.5** (10.6-16.7)	**14.6** (11.0-18.7)	**16.2** (11.7-21.4)	**17.3** (12.1-23.3)
45-day	**8.37** (7.38-9.40)	**9.28** (8.18-10.4)	**10.7** (9.44-12.1)	**11.9** (10.4-13.5)	**13.5** (11.3-15.8)	**14.7** (12.0-17.5)	**15.8** (12.5-19.4)	**17.0** (12.8-21.5)	**18.4** (13.3-24.2)	**19.5** (13.7-26.2)
60-day	**9.74** (8.63-10.9)	**10.7** (9.50-12.0)	**12.3** (10.9-13.9)	**13.6** (11.9-15.4)	**15.3** (12.9-17.8)	**16.5** (13.6-19.6)	**17.7** (14.0-21.6)	**18.8** (14.3-23.8)	**20.3** (14.8-26.5)	**21.3** (15.1-28.6)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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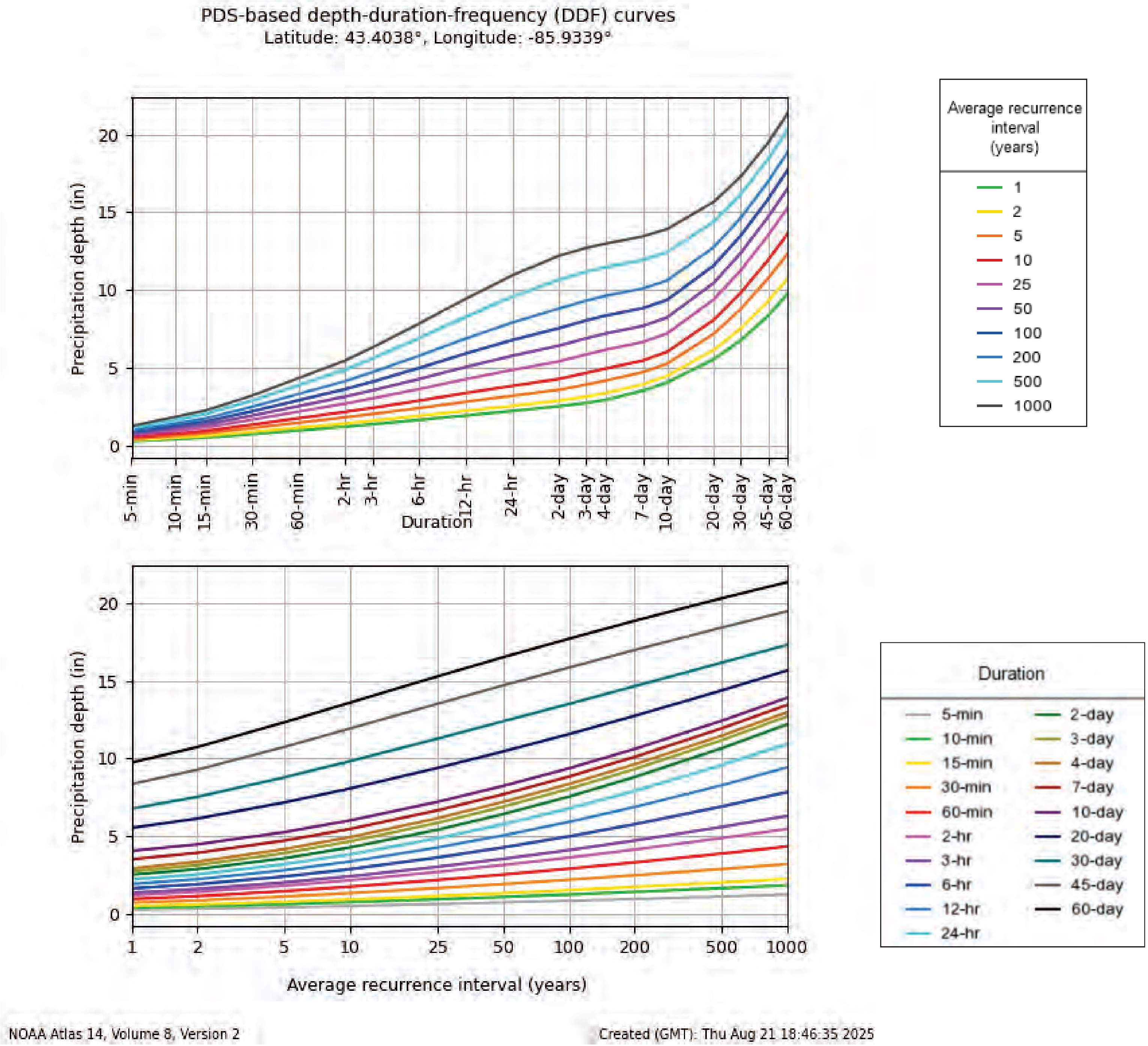
PF graphical



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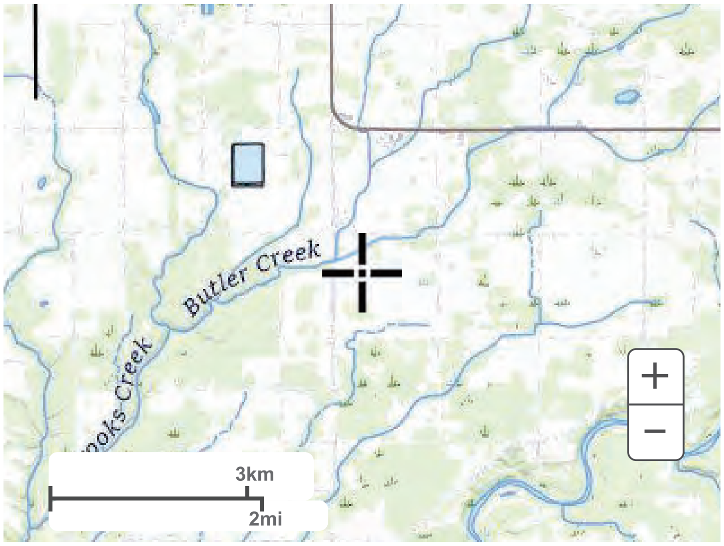
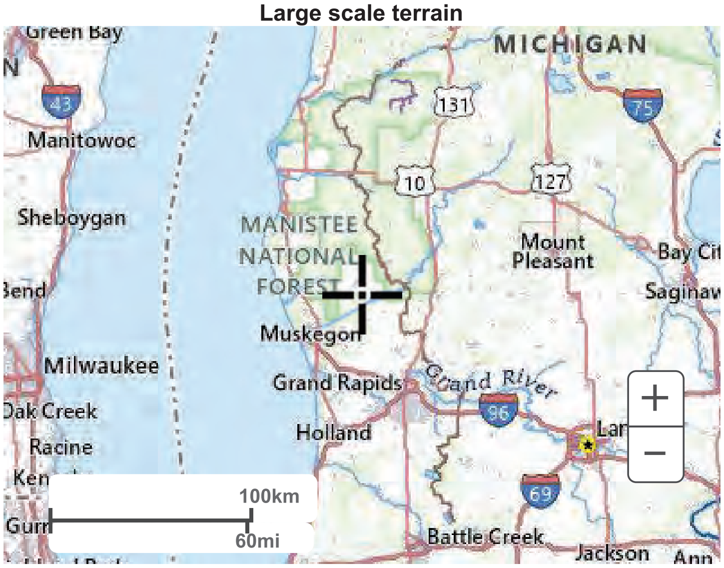
Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

Large scale aerial

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Attachment 3 – EGLE Calculations for Storm Water Runoff Volume Control Spreadsheet Results

Calculations for Stormwater Runoff Volume Control

SITE NAME: Sylvian Solar - Sheridan Charter Township - Area 1

Total Drainage Area: 134.79 acres

Design Rainfall Event: 2.57 in
(see Rainfall Tab or Section 2.0 for aid in using ATLAS 14 for determining local or site specific rainfall events)

Pre-Development Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN (from TR-55)	S	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
					$\frac{1000}{CN} - 10$	$\frac{(P-0.2S)^2}{(P+0.8S)}$	
Woods	A	7754	0.18	30	23.3	0	0.0
Grassland / Meadow	A	28068	0.64	30	23.3	0	0.0
Crops	A	1725384	39.61	67	4.9	0.38584843	55,478.1
Developed	A	102507	2.35	67	4.9	0.38584843	3,296.0
Crops	A/D	3348973	76.88	67	4.9	0.38584843	107,683.0
Woods	D	34751	0.80	77	3.0	0.78456576	2,272.0
Grassland / Meadow	D	68798	1.58	78	2.8	0.83366815	4,779.5
Developed	D	68908	1.58	92	0.9	1.7580662	10,095.3
Wetland / Open Water	N/A	486523	11.17	98	0.2	2.34033997	94,885.7
Other:		0			0.0	0	0.0
Other:		0			0.0	0	0.0
TOTAL:	**N/A**	**5871665**	**134.79**	**N/A**	**N/A**	**N/A**	**278,489.7**

Post-Development Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN*	S	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Woods	A	7754	0.18	30	23.3	0	0.0
Grassland / Meadow	A	1204188	27.64	30	23.3	0	0.0
Crops	A	549264	12.61	67	4.9	0.38584843	17,661.1
Developed	A	102507	2.35	67	4.9	0.38584843	3,296.0
Crops	A/D	954480	21.91	67	4.9	0.38584843	30,690.4
Woods	D	34751	0.80	77	3.0	0.78456576	2,272.0
Grassland / Meadow	A/D	2083012	47.82	30	23.3	0	0.0
Developed	D	68908	1.58	92	0.9	1.7580662	10,095.3
Wetland / Open Water	N/A	595858	13.68	98	0.2	2.34033997	116,209.2
Impervious	N/A	270943	6.22	98	0.2	2.34033997	52,841.6
TOTAL:	**N/A**	**5871665**	**134.79**	**N/A**	**N/A**	**N/A**	**233,065.7**

Runoff Volume Increase (ft^3): -45,424.02

Runoff Volume Increase = (Post-Dev. Runoff Volume) MINUS (Pre-Dev. Runoff Volume)

1. Runoff (in) = Q = (P - Ia)2 / (P- Ia)+S
Ia =0.2S therefore;
Runoff (in) = Q = $(P - 0.2S)^2 / (P + 0.8S)$

2. Runoff Volume (ft^3) = Q x 1/12 x Area

Where:
P = 2-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (in)
Area = Area of specific land cover (ft^2)

* Runoff Volume must be calculated separately for pervious and impervious areas (without using a weighted CN)

Instructions

1. At the top of the spreadsheet, enter a site name and the total drainage area of the site in acres.

2. Enter the design rainfall event in inches in the space provided. Follow the guidance on the Rainfall tab or in Section 2.0 of the "NPS Stormwater Calculator Manual" for determining local rainfall amounts (often the 2-yr 24-hr storm). It is important to note that this is the total amount of rainfall and not runoff for the site.

3. In the presettlement table, enter the area of each applicable land cover and soil combination for the presettlement condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. No composite CN can be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying presettlement land cover and soils, please see the "Presettlement Land Cover" and "Soils" tabs of the spreadsheet or Sections 3.0 and 4.0 of the "NPS Stormwater Calculator Manual",

4. In the post-development table enter the proposed cover type and soil type and the amount of impervious area. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the presettlement table, unless new soils are being brought to the site. Cover and soil type can be copied from the presettlement table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs should not be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN.

5. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet and it's shown in the blue cell near the bottom of the spreadsheet. This is the volume of stormwater runoff that must be controlled.

6. For additional guidance on how to use this spreadsheet please see the "Example Scenario" tab or Section 5.0 of the "NPS Stormwater Calculator Manual" for a filled-out example of how to use this spreadsheet.

Note: If the goal for the site is to treat the Water Quality Volume generated by 1 inch of runoff over the entire site the cell below performs that calculation based on the value provided for the "Total Drainage Area" at the top of this sheet.

Water Quality Runoff Volume = 489,288 ft^3

Version 2, May 2024

Calculations for Stormwater Runoff Volume Control

SITE NAME: Sylvian Solar - Sheridan Charter Township - Area 2

Total Drainage Area: 523.98 acres

Design Rainfall Event: 2.57 in

(see Rainfall Tab or Section 2.0 for aid in using ATLAS 14 for determining local or site specific rainfall events)

Existing Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN (from TR-55)	S	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Woods	A	101806	2.34	30	23.3	0	0.0
Grassland / Meadow	A	127880	2.94	30	23.3	0	0.0
Crops	A	2627079	60.31	67	4.9	0.38584843	84,471.2
Developed	A	38486	0.88	67	4.9	0.38584843	1,237.5
Crops	A/D	13284199	304.96	67	4.9	0.38584843	427,140.6
Woods	D	1053141	24.18	77	3.0	0.78456576	68,854.8
Grassland / Meadow	D	2519448	57.84	78	2.8	0.83366815	175,032.0
Developed	D	706405	16.22	92	0.9	1.7580662	103,492.3
Wetland / Open Water	N/A	1196098	27.46	98	0.2	2.34033997	233,273.0
Crops	B/D	1170022	26.86	78	2.8	0.83366815	81,284.1
Other:		0			0.0	0	0.0
TOTAL:	N/A	21654543	523.98	N/A	N/A	N/A	1,174,785.6

Proposed Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN*	S	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Woods	A	101806	2.34	30	23.3	0	0.0
Grassland / Meadow	A	127880	2.94	30	23.3	0	0.0
Crops	A	2627079	60.31	67	4.9	0.38584843	84,471.2
Developed	A	38486	0.88	67	4.9	0.38584843	1,237.5
Crops	A/D	1288646	29.58	67	4.9	0.38584843	41,435.2
Woods	D	1053141	24.18	77	3.0	0.78456576	68,854.8
Grassland / Meadow	A/D	13324506	305.89	30	23.3	0	0.0
Developed	D	706405	16.22	92	0.9	1.7580662	103,492.3
Wetland / Open Water	N/A	1677872	38.52	98	0.2	2.34033997	327,232.5
Grassland / Meadow	B/D	705672	16.20	58	7.2	0.15045432	8,847.6
Crops	B/D	464350	10.66	78	2.8	0.83366815	32,259.5
Impervious	N/A	708721	16.27	98	0.2	2.34033997	138,220.7
TOTAL:	N/A	22824564	523.98	N/A	N/A	N/A	806,051.3

Runoff Volume Increase (ft^3): -368,734

Runoff Volume Increase = (Post-Dev. Runoff Volume) MINUS (Pre-Dev. Runoff Volume)

1. Runoff (in) = Q = (P - Ia)2 / (P- Ia)+S
Ia =0.2S therefore;
Runoff (in) = Q = $(P - 0.2S)^2 / (P + 0.8S)$

2. Runoff Volume (ft^3) = Q x 1/12 x Area

Where:
P = 2-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (in)
Area = Area of specific land cover (ft^2)

* Runoff Volume must be calculated separately for pervious and impervious areas (without using a weighted CN)

Instructions

1. At the top of the spreadsheet, enter a site name and the total drainage area of the site in acres.

2. Enter the design rainfall event in inches in the space provided. Follow the guidance on the Rainfall tab or in Section 2.0 of the "NPS Stormwater Calculator Manual" for determining local rainfall amounts (often the 2-yr 24-hr storm). It is important to note that this is the total amount of rainfall and not runoff for the site.

3. In the presettlement table, enter the area of each applicable land cover and soil combination for the presettlement condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. No composite CN can be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying presettlement land cover and soils, please see the "Presettlement Land Cover" and "Soils" tabs of the spreadsheet or Sections 3.0 and 4.0 of the "NPS Stormwater Calculator Manual",

4. In the post-development table enter the proposed cover type and soil type and the amount of impervious area. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the presettlement table, unless new soils are being brought to the site. Cover and soil type can be copied from the presettlement table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs should not be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN.

5. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet and it's shown in the blue cell near the bottom of the spreadsheet. This is the volume of stormwater runoff that must be controlled.

6. For additional guidance on how to use this spreadsheet please see the "Example Scenario" tab or Section 5.0 of the "NPS Stormwater Calculator Manual" for a filled-out example of how to use this spreadsheet.

Note: If the goal for the site is to treat the Water Quality Volume generated by 1 inch of runoff over the entire site the cell below performs that calculation based on the value provided for the "Total Drainage Area" at the top of this sheet.

Water Quality Runoff Volume = 1,902,037 ft^3

Version 2, May 2024

Calculations for Stormwater Runoff Volume Control

SITE NAME: Sylvian Solar - Sheridan Charter Township - Area 3

Total Drainage Area: 101.43 acres

Design Rainfall Event: 2.57 in

(see Rainfall Tab or Section 2.0 for aid in using ATLAS 14 for determining local or site specific rainfall events)

Pre-Development Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN (from TR-55)	S	Q Runoff[1] (in)	Runoff Volume[2] (ft³)
Woods	A	0		30	23.3	0	0.0
Grassland / Meadow	A	57504	1.32	30	23.3	0	0.0
Crops	A	39118	0.90	67	4.9	0.38584843	1,257.8
Developed	A	0		67	4.9	0.38584843	0.0
Crops	A/D	3369465	77.35	67	4.9	0.38584843	108,341.9
Woods	D	32496	0.75	77	3.0	0.78456576	2,124.6
Grassland / Meadow	A/D	267372	6.14	30	23.3	0	0.0
Developed	D	145325	3.34	92	0.9	1.7580662	21,291.0
Wetland / Open Water	N/A	0		98	0.2	2.34033997	0.0
Crops	C/D	507038	11.64	85	1.8	1.23446517	52,160.1
Other:		0			0.0	0	0.0
TOTAL:	N/A	3911281	101.43	N/A	N/A	N/A	185,175.4

Post-Development Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN*	S	Q Runoff[1] (in)	Runoff Volume[2] (ft³)
Woods	A	0	0.00	30	23.3	0	0.0
Grassland / Meadow	A	57504	1.32	30	23.3	0	0.0
Crops	A	39118	0.90	67	4.9	0.38584843	1,257.8
Developed	A	0	0.00	67	4.9	0.38584843	0.0
Crops	A/D	1871611	42.97	67	4.9	0.38584843	60,179.8
Woods	D	32496	0.75	77	3.0	0.78456576	2,124.6
Grassland / Meadow	A/D	1703110	39.10	30	23.3	0	0.0
Developed	D	145325	3.34	92	0.9	1.7580662	21,291.0
Wetland / Open Water	N/A	18600	0.43	98	0.2	2.34033997	3,627.6
Grassland / Meadow	C/D	226512	5.20	71	4.1	0.52647521	9,937.7
Crops	C/D	280526	6.44	85	1.8	1.23446517	28,858.3
Impervious	N/A	43516	1.00	98	0.2	2.34033997	8,486.9
TOTAL:	N/A	4418319	101.43	N/A	N/A	N/A	135,763.8

Runoff Volume Increase (ft^3): -49,412

Runoff Volume Increase = (Post-Dev. Runoff Volume) MINUS (Pre-Dev. Runoff Volume)

1. Runoff (in) = Q = (P - Ia)2 / (P- Ia)+S
Ia =0.2S therefore;
Runoff (in) = Q = $(P - 0.2S)^2 / (P + 0.8S)$

2. Runoff Volume (ft^3) = Q x 1/12 x Area

Where:
P = 2-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (in)
Area = Area of specific land cover (ft^2)

* Runoff Volume must be calculated separately for pervious and impervious areas (without using a weighted CN)

Instructions

1. At the top of the spreadsheet, enter a site name and the total drainage area of the site in acres.

2. Enter the design rainfall event in inches in the space provided. Follow the guidance on the Rainfall tab or in Section 2.0 of the "NPS Stormwater Calculator Manual" for determining local rainfall amounts (often the 2-yr 24-hr storm). It is important to note that this is the total amount of rainfall and not runoff for the site.

3. In the presettlement table, enter the area of each applicable land cover and soil combination for the presettlement condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. No composite CN can be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying presettlement land cover and soils, please see the "Presettlement Land Cover" and "Soils" tabs of the spreadsheet or Sections 3.0 and 4.0 of the "NPS Stormwater Calculator Manual",

4. In the post-development table enter the proposed cover type and soil type and the amount of impervious area. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the presettlement table, unless new soils are being brought to the site. Cover and soil type can be copied from the presettlement table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs should not be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN.

5. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet and it's shown in the blue cell near the bottom of the spreadsheet. This is the volume of stormwater runoff that must be controlled.

6. For additional guidance on how to use this spreadsheet please see the "Example Scenario" tab or Section 5.0 of the "NPS Stormwater Calculator Manual" for a filled-out example of how to use this spreadsheet.

Note: If the goal for the site is to treat the Water Quality Volume generated by 1 inch of runoff over the entire site the cell below performs that calculation based on the value provided for the "Total Drainage Area" at the top of this sheet.

Water Quality Runoff Volume = 368,191 ft^3

Version 2, May 2024

Calculations for Stormwater Runoff Volume Control

SITE NAME: Sylvian Solar - Sheridan Charter Township - Area 4

Total Drainage Area: 97.56 acres

Design Rainfall Event: 2.57 in

(see Rainfall Tab or Section 2.0 for aid in using ATLAS 14 for determining local or site specific rainfall events)

Pre-Development Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN (from TR-55)	S	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
					$\frac{1000}{CN}-10$	$\frac{(P-0.2S)^2}{(P+0.8S)}$	
Woods	A	141322	3.24	30	23.3	0	0.0
Grassland / Meadow	A	61349	1.41	30	23.3	0	0.0
Crops	A	1473680	33.83	67	4.9	0.38584843	47,384.8
Developed	A	45631	1.05	67	4.9	0.38584843	1,467.2
Crops	A/D	2304397	52.90	67	4.9	0.38584843	74,095.7
Woods	D	391	0.01	77	3.0	0.78456576	25.5
Grassland / Meadow	A/D	60948	1.40	30	23.3	0	0.0
Developed	D	161998	3.72	92	0.9	1.7580662	23,733.7
Wetland / Open Water	N/A	0		98	0.2	2.34033997	0.0
Other:		0			0.0	0	0.0
Other:		0			0.0	0	0.0
TOTAL:	**N/A**	**4249717**	**97.56**	**N/A**	**N/A**	**N/A**	**146,706.9**

Post-Development Conditions

Land Cover Type	Soil Type	Area (sf)	Area (ac)	CN*	S	Q Runoff[1] (in)	Runoff Volume[2] (ft^3)
Woods	A	141322	3.24	30	23.3	0	0.0
Grassland / Meadow	A	874179	20.07	30	23.3	0	0.0
Crops	A	660850	15.17	67	4.9	0.38584843	21,249.0
Developed	A	45631	1.05	67	4.9	0.38584843	1,467.2
Crops	A/D	42849	0.98	67	4.9	0.38584843	1,377.8
Woods	D	391	0.01	77	3.0	0.78456576	25.5
Grassland / Meadow	A/D	2026288	46.52	30	23.3	0	0.0
Developed	D	161998	3.72	92	0.9	1.7580662	23,733.7
Wetland / Open Water	N/A	128066	2.94	98	0.2	2.34033997	24,976.6
Impervious	N/A	168142	3.86	98	0.2	2.34033997	32,792.4
TOTAL:	**N/A**	**4249717**	**97.56**	**N/A**	**N/A**	**N/A**	**105,622.2**

Runoff Volume Increase (ft^3): -41,085

Runoff Volume Increase = (Post-Dev. Runoff Volume) MINUS (Pre-Dev. Runoff Volume)

1. Runoff (in) = Q = (P - Ia)2 / (P- Ia)+S
Ia =0.2S therefore;
Runoff (in) = Q = $(P - 0.2S)^2 / (P + 0.8S)$

2. Runoff Volume (ft^3) = Q x 1/12 x Area

Where:
P = 2-Year, 24-Hour Rainfall (in)
S = 1000/ CN - 10
CN = Curve Number
Q = Runoff (in)
Area = Area of specific land cover (ft^2)

* Runoff Volume must be calculated separately for pervious and impervious areas (without using a weighted CN)

Instructions

1. At the top of the spreadsheet, enter a site name and the total drainage area of the site in acres.

2. Enter the design rainfall event in inches in the space provided. Follow the guidance on the Rainfall tab or in Section 2.0 of the “NPS Stormwater Calculator Manual” for determining local rainfall amounts (often the 2-yr 24-hr storm). It is important to note that this is the total amount of rainfall and not runoff for the site.

3. In the presettlement table, enter the area of each applicable land cover and soil combination for the presettlement condition in acres. The total area must add up to the total drainage area recorded at the top of the spreadsheet. Note here the runoff volume for each land use cover and soil type must be calculated separately and then summed for the entire site. No composite CN can be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN. For guidance on identifying presettlement land cover and soils, please see the "Presettlement Land Cover" and "Soils" tabs of the spreadsheet or Sections 3.0 and 4.0 of the “NPS Stormwater Calculator Manual”, respectively.

4. In the post-development table enter the proposed cover type and soil type and the amount of impervious area. The total area at the bottom of the table must match the total drainage area recorded at the top of the spreadsheet. Similarly, the total area for each soil group should be equal to or less (depending on the amount of impervious surface added) to the values reported in the presettlement table, unless new soils are being brought to the site. Cover and soil type can be copied from the presettlement table and pasted to the post-development table if applicable. A CN for each new cover type must be selected but composite CNs should not be used. Consult with NPS technical staff if a land cover at the site is not represented to determine an appropriate CN.

5. The spreadsheet automatically calculates the Runoff Volume Increase in cubic feet and it's shown in the blue cell near the bottom of the spreadsheet. This is the volume of stormwater runoff that must be controlled.

6. For additional guidance on how to use this spreadsheet please see the "Example Scenario" tab or Section 5.0 of the “NPS Stormwater Calculator Manual” for a filled-out example of how to use this spreadsheet.

Note: If the goal for the site is to treat the Water Quality Volume generated by 1 inch of runoff over the entire site the cell below performs that calculation based on the value provided for the "Total Drainage Area" at the top of this sheet.

Water Quality Runoff Volume = 354,143 ft^3

Version 2, May 2024

Sylvan Solar LLC Sylvan Solar Project
Newaygo County Drain Commissioner's Office (NCDC) Site Visit
Stormwater Assessment Discussion Summary
May 14, 2025

Attendees: Charles Smith – Spicer Group, Edward Miller - NCDC, Lauren Colwell – AES Clean Energy (AES), Matt Lessard - AES, LaurieBeth Nederveld – Barr Engineering, Co.

Meeting Notes:

County Requirements

- Stormwater runoff volumes at post-construction conditions must equal stormwater runoff volumes at pre-construction conditions.
- NCDC does not want fence gates, which would limit access to the county drains.
- NCDC is requiring a 75-ft. setback from all county drain centerlines. The county drain easements are typically 30-ft. wide.
- NCDC will consider activities within the 75-ft setback area as drain encroachment, which will require an encroachment permit from the NCDC.
- NCDC suggested AES review the Newaygo County Stormwater Standards, which are available at www.newaygocountymi.gov/departments/drain-commission/storm-water-design/
- NCDEC prefers stormwater detention over stormwater retention. The county's detention requirements are available at www.newaygocountymi.gov/departments/drain-commission/storm-water-design/
- NCDC expects that the proposed storm drainage enclosures will be designed so they will not adversely impact any adjacent properties, upstream or downstream.
- NCDC requires that there will be no detrimental effect on the floodway or the floodplain elevation during a 25-year design storm upstream or downstream of the proposed development area as a result of the proposed development.
- Crossing a county drain requires signage.
- NCDC requires two (2) feet minimum over storm drainage systems.
- Bankfull width measurements will be required by the NCDC for any proposed county drain alterations.

Sylvan Solar LLC Sylvan Solar Project
Newaygo County Drain Commissioner's Office (NCDC) Site Visit
Stormwater Assessment Discussion Summary
May 14, 2025

General

- Contech, in Grand Rapids, MI, is a local provider of Corrugated Metal Pipe Arches.
- NCDC will require riprap to the top of pipe.
- NCDC considers the bottom of a county drain at the point of refusal, not the top of any loose sediment.
- Houghton muck is present in the county and has a thick organic layer that will be difficult to install pilings on.
- The county drain west of Coswell Rd. receives high volumes of stormwater runoff.
- Several landowners have installed perched culverts in the project area.

County Approvals

- All project parcels must have a public stormwater outlet. The NCDC can assume the responsibility for any necessary drain extensions under Section 433 of Michigan's Drain Code (MCL 280.433), which allows for extensions and improvements to existing drains and the addition of land to drainage districts. This process typically involves a landowner entering into an agreement with the drain commissioner to construct and/or pay for the extension or improvement. This agreement allows the drain commissioner to take over maintenance and operation of the new or improved system.
- NCDC offered to review the project's Preliminary Stormwater Assessment Plan.

Information Requests

- Contact Stephanie from the NCDC for information from the landowner complaints database.
- County inspection reports are available from the NCDC upon request.
- Email Charles Smith, Spicer Group, to request typical drawings for stream crossings, etc.
- AES to determine if landowners or AES will be responsible for future drain district assessment fees.

Appendix 11 – Visual Renderings

Attachment 11 - Visual Renderings

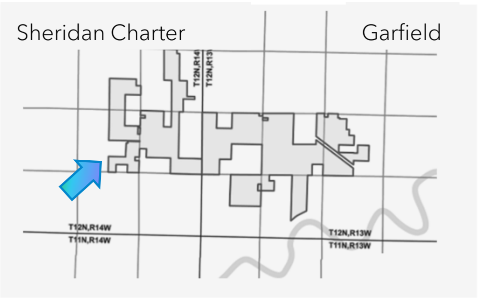
Sylvan Solar Project,

Garfield and Sheridan Charter Townships, Newaygo County, Michigan
Sylvan Solar, LLC
Final visual renderings (12 locations)

Sylvan Solar Project Visual Renderings

KOP 1: View Near Bike Entrance

Project area



2025 photograph

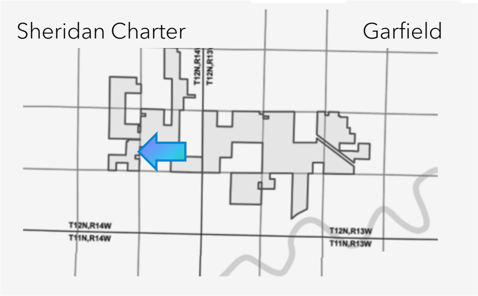
3D visual render

View facing Northeast from West 88th Street

Sylvan Solar Project Visual Renderings

KOP 2: Example of Proposed Residential Screening

Project area



2025 photograph

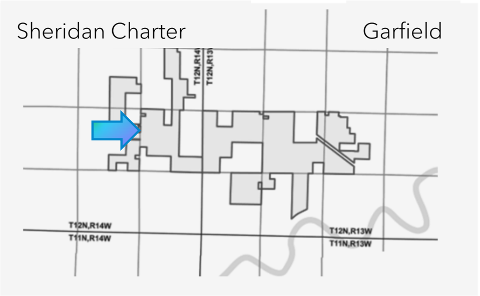
View facing West from S. Warner Avenue

3D visual render

Sylvan Solar Project Visual Renderings

KOP 3: Example of Proposed View Near Farm

Project area



2025 photograph

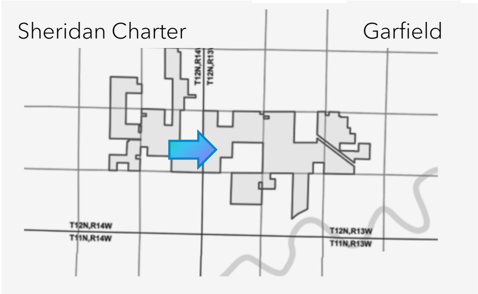
View facing East from South Warner Avenue

3D visual render

Sylvan Solar Project Visual Renderings

KOP 4: Example of Proposed View Near Farm

Project area



2025 photograph

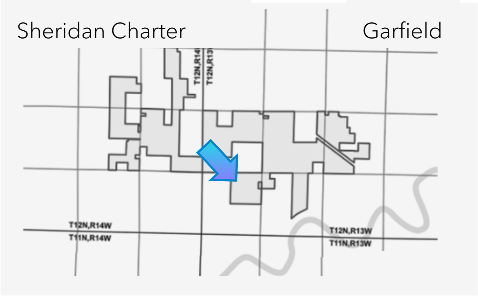
View facing East from South Luce Avenue

3D visual render

Sylvan Solar Project Visual Renderings

KOP 5: Example of Proposed View Near Residences

Project area



2025 photograph

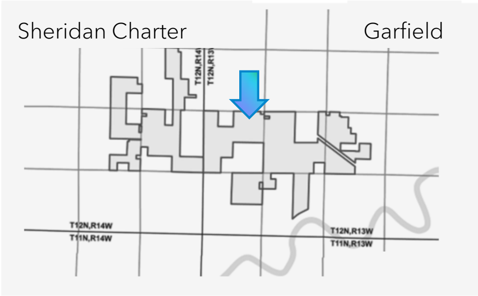
3D visual render

View facing Southeast West 88th Street

Sylvan Solar Project Visual Renderings

KOP 6: Example of View from a Busy Road

Project area



2025 photograph

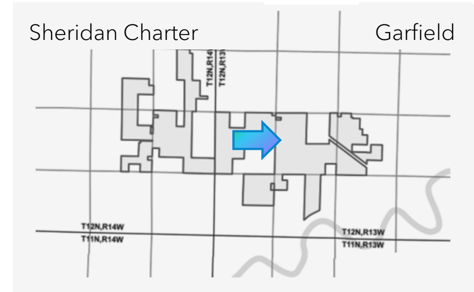
View facing South from West 80th street

3D visual render

Sylvan Solar Project Visual Renderings

KOP 7: Example of Proposed Site Near Residence

Project area



2025 photograph

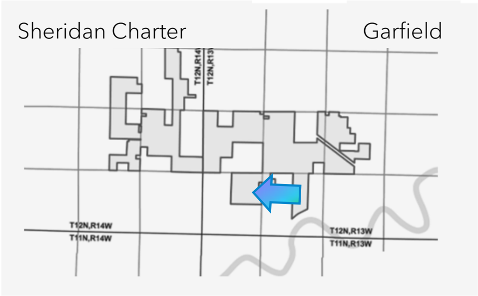
View facing East Croswell Avenue

3D visual render

Sylvan Solar Project Visual Renderings

KOP 8: Example of Proposed Site Entrance/Gate

Project area



2025 photograph

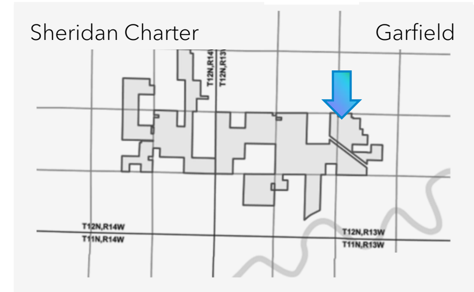
3D visual render

View facing West from Croswell Avenue

Sylvan Solar Project Visual Renderings

KOP 9: Example of a View Near Busy Road

Project area



2025 photograph

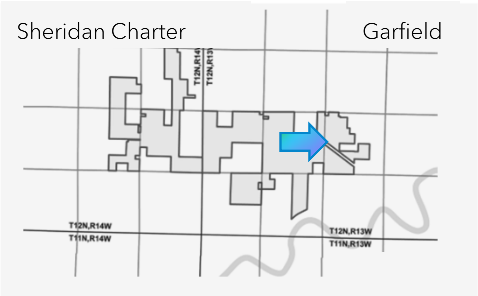
3D visual render

View facing South from West 80th Street and Baldwin

Sylvan Solar Project Visual Renderings

KOP 10: View Near Project Substation

Project area



2025 photograph

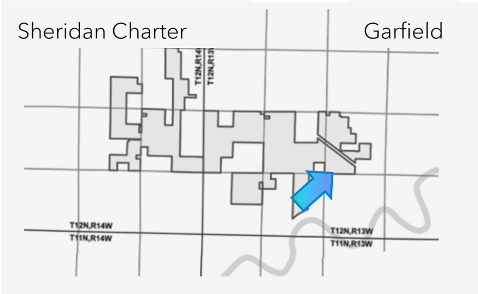
3D visual render

View facing East from Baldwin Avenue

Sylvan Solar Project Visual Renderings

KOP 11: Example of a View Near Site Entrance/Gate

Project area



2025 photograph

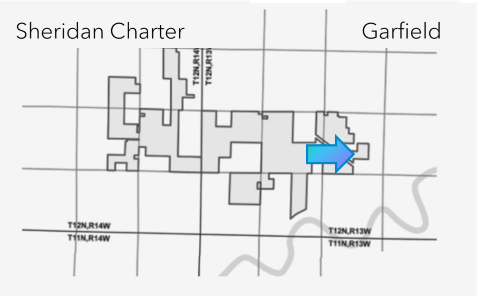
3D visual render

View facing Northeast West 88th Street

Sylvan Solar Project Visual Renderings

KOP 12: Example of a Non-Residential Screened Setback

Project area



2025 photograph

View facing East from Wisner Avenue

3D visual render

Appendix 12 - Noise Impact Assessment Report

Attachment 12 - Noise Impact Assessment Report

Noise Impact Assessment

Sylvan Solar Project

Prepared for
Sylvan Solar, LLC

Prepared by
Barr Engineering Michigan LLC

August 2025

3005 Boardwalk Street, Suite 100
Ann Arbor, MI 48108
734.922.4400

barr.com

BARR

Noise Impact Assessment

August 2025

Contents

Figures

Tables

Diagram

Abbreviations

AES	AES Clean Energy
AC	alternating current
Barr	Barr Engineering Michigan LLC
BESS	battery energy storage systems
BMPs	best management practices
dBA	A-weighted decibels[i]
dB	decibel[ii]
DC	direct current
FCJPC	Fremont Community Joint Planning Commission
FHWA	Federal Highway Administration
gen-tie	generation tie line
GWs	gigawatts
HV	high voltage
kV	kilovolt
L_{10}	sound level, expressed in dBA, which is exceeded 10 percent of the time
L_{50}	sound level, expressed in dBA, which is exceeded 50 percent of the time
L_{90}	sound level, expressed in dBA, which is exceeded 90 percent of the time
L_{eq}	equivalent average sound level
ML	monitoring location
MW	megawatt
MPSC	Michigan Public Service Commission
MV	medium voltage
m/s	meters/second
NESC	National Electrical Safety Code
O&M	Operations & Maintenance
Plan	pre-construction Noise Monitoring Plan
Project	Sylvan Solar Project
PV	photovoltaic
Report	noise impact assessment report
SCADA	supervisory control and data acquisition
Sylvan Solar	Sylvan Solar, LLC

[i] A-weighted decibels (dBA) adjust the sound level spectrum to represent the sensitivity of the human ear to sounds of low to moderate level to produce a single value (in A-weighted decibels) in accordance with ASA/ANSI S1.4 Part 1.
[ii] A unit of sound pressure level, abbreviated as dB.

1 Introduction

Barr Engineering Michigan LLC (Barr) has prepared this Noise Impact Assessment Report (Report) for the Sylvan Solar Project (Project) in Newaygo County, Michigan. This report was prepared on behalf of Sylvan Solar, LLC (Sylvan Solar), an affiliate of AES Clean Energy Development, LLC (AES). AES is a subsidiary of The AES Corporation based in the United States that owns and operates solar, wind, battery, and green hydrogen projects across the United States, grossing 9.1 gigawatts (GWs) in operation at the end of 2024. Sylvan Solar, a Delaware limited liability company, is an independent power producer that is qualified to do business in Michigan.

This Report was prepared in accordance with the Michigan Public Service Commission (MPSC) *Certificate for Solar Energy, Wind Energy, and Energy Storage Facilities, Pursuant to Public Act 233 of 2023, Application Filing Instructions and Procedures* (MPSC 2024), the Garfield Township Zoning Ordinance (Garfield Township 2025), and Fremont Community Joint Planning Commission (FCJPC) Solar Energy Systems and Battery Energy Storage Systems (BESS) Ordinance (FCJPC 2025). The purpose of this report is to summarize the results of the pre-construction sound monitoring study and the results of Project sound level modeling demonstrating compliance with the MPSC and local noise standards.

The sound evaluation objectives include:

- Establishing baseline sound levels at three residential receptor sites within the Project area, including the modeled most-impacted receptor in each township.
- Estimating Project sound levels at potential residential receptors within one mile of the Project sound sources.
- Assessing modeled Project sound levels in comparison to MPSC and local noise standards at each modeled receptor.

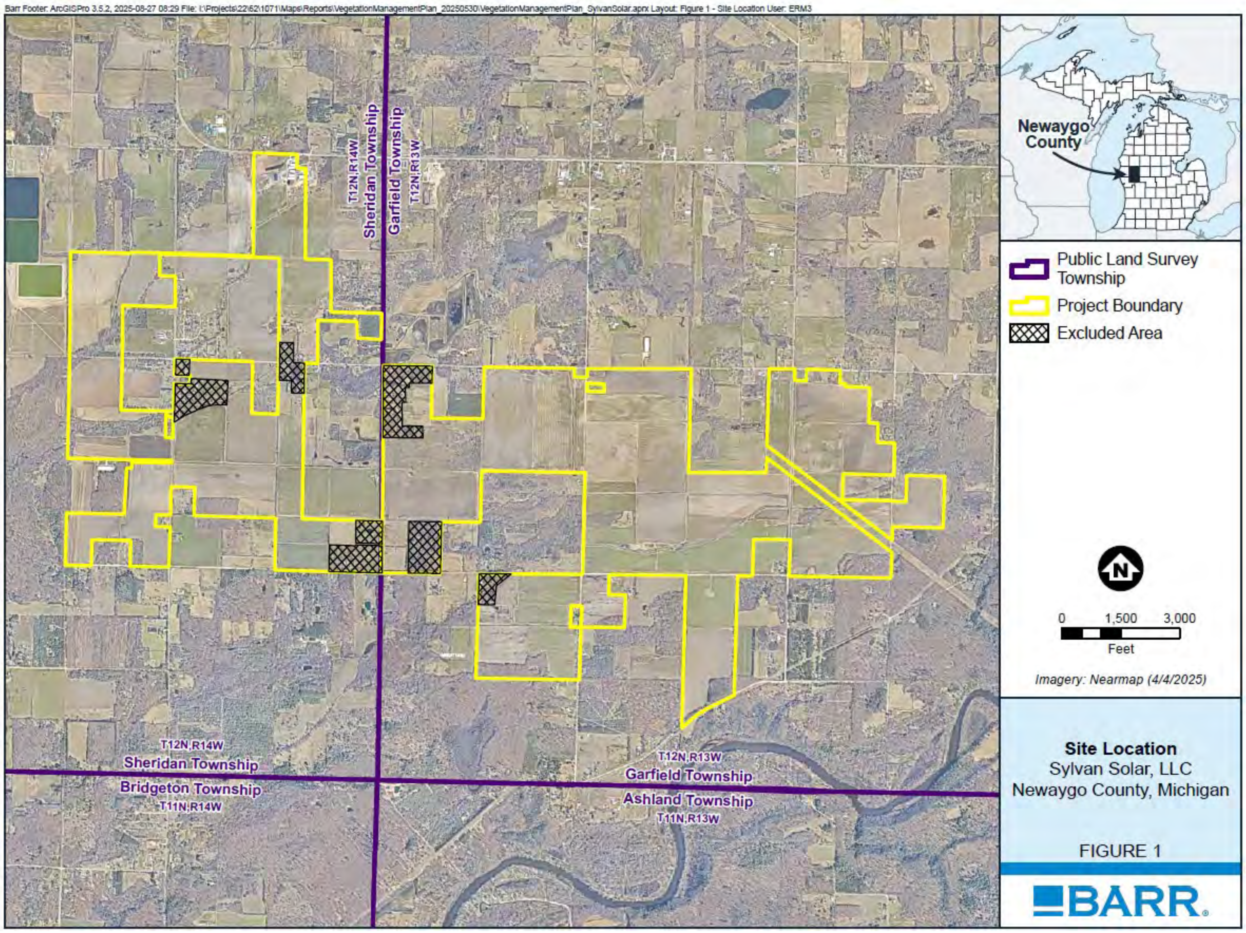
2 Project Information

2.1 Project Description

The proposed Project is an up to 220-MW photovoltaic (PV) solar generation facility within a 2,166-acre Project area on land within Sheridan Charter and Garfield Townships, Newaygo County, Michigan (Figure 1). The Project is approximately 4.5 miles southeast of Fremont, Michigan. The Project is generally north of North River Drive, west of Bingham Avenue, south of Michigan Highway 82, and east of South Osborn Avenue. The Project boundary and surrounding area primarily consists of agricultural fields, wooded areas, agricultural ditches, and Newaygo County designated drains. The Muskegon River is approximately 900 feet south of the Project at its closest point.

Of the total 2,166 acres leased for the Project, approximately 1,250 acres of the Project area will consist of the solar energy facility and generation tie line (gen-tie). Buried medium voltage (MV) collection lines will be installed within and outside the fenced area to connect the blocks of solar panels in the Project area.

Figure 1 Project Location



A <500-foot overhead high voltage (HV) generation tie line (gen-tie) will be constructed in Garfield Township between the proposed Project substation and a proposed utility-owned and operated switchyard connected to the existing 345-kilovolt (kV) Ludington to Kenowa overhead transmission line (point of interconnection). The gen-tie line and point of interconnection are located near the northeast corner of the Project area in Garfield Township. Construction of the Project is anticipated to commence in mid-2027, and the solar energy facility is expected to be operational in late 2028.

2.2 General Facility Description

In Sheridan Charter Township, the Project area within the fence line will encompass approximately 420 acres. The Development Area represents Sylvan Solar's anticipated maximum number of developed acres within the Project boundary in Sheridan Charter Township. As the Project approaches construction, additional engineering studies will be completed that may further refine the design shown on the attached Site Plan. Typical changes include shifting equipment within the Development Area and a potential reduction of the area within the perimeter fence line. These changes will be minimal, result in the same or lesser environmental and social impact, and are typical of solar project development. Sylvan Solar will coordinate a pre-construction meeting with the FCJPC to review the final Site Plan.

The Development Area (420 acres) includes the following Project components:

- PV solar arrays,
- inverter skids that will house inverters and MV step-up transformers,
- underground MV collection lines,
- gravel access roads,
- meteorological stations,
- security fencing and gates,
- temporary construction laydown areas, and
- stormwater management system.

In Garfield Township, the Project area within the fence line (Development Area) will encompass approximately 830 acres. The Development Area represents Sylvan Solar's anticipated maximum number of developed acres within the Project boundary in Garfield Township.

The Development Area includes the following Project components:

- PV solar arrays,
- inverter skids that will house inverters and medium voltage step-up transformers,
- underground MV collection lines,
- gravel access roads,
- meteorological stations,
- security fencing and gates,
- stormwater management system,
- Project substation and control room housing the supervisory control and data acquisition
- (SCADA) system,
- <500-foot-long overhead HV gen-tie line between the Project substation and utility-owned
- switchyard,
- temporary construction laydown areas,
- operations and maintenance (O&M) building, which will be located within a proposed construction
- laydown area near the substation or utilize an existing building within the Project area, and
- utility-owned and operated switchyard and overhead HV gen-tie.

The PV solar arrays will occupy a significant portion of the parcels at full build-out. The solar arrays will convert sunlight into DC electricity, which is conveyed to an inverter. The inverter will convert the DC power to AC power, which will then flow to the medium-voltage transformers. The MV collection lines will be installed to connect the blocks of solar panels and will transport electricity from the PV solar arrays to the proposed Project substation in Garfield Township.

During construction, temporary laydown areas, construction trailers, and parking areas will be located within the Project area. Fencing, lighting in select areas (i.e., Project substation and O&M building), and electronic security systems will secure the Project facilities. The perimeter fence will be an approximately 7 or 8-foot-high woven wire fence. Security fencing around the Project substation and utility-owned switchyard will consist of a 7-foot-tall chain link fence topped with a 1-foot barbed wire strand per the National Electrical Safety Code.

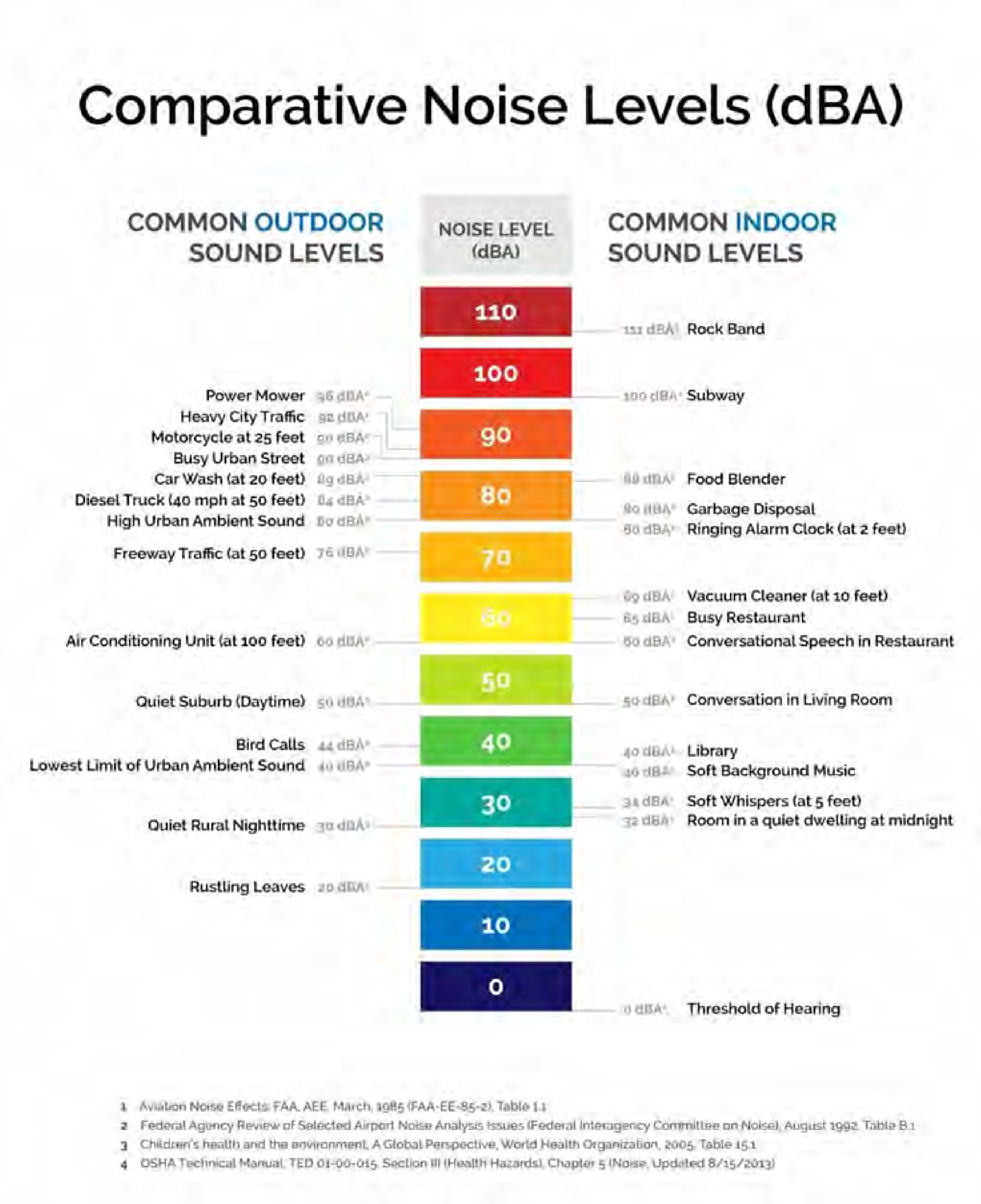
During the operation of the Project, downlit, dark-sky friendly security lighting will be installed at the O&M building and Project substation. The Project's O&M building will be located either within a laydown area near the substation or in an existing building within the Project area, and will include maintenance facilities, restrooms, and ancillary support systems such as component storage.

3 Baseline Monitoring

3.1 Basics of Noise

Noise levels are usually measured in units of decibels (dB). For applications where human hearing is the prime consideration, A-weighting is applied to yield A-weighted decibels (dBA). This weighting serves to better replicate the way the human ear perceives sound. A level of 0 dBA is nominally the threshold of hearing, below which a healthy human ear cannot detect sound. Most situations never yield levels this low, with a quiet bedroom falling around 32 dBA (Diagram 1). Decibels are on a logarithmic scale, thus add logarithmically rather than arithmetically. Combining two equal sound levels results in a net increase of +3 dBA. For example, a 37 dBA new source added to a 37 dBA background level results in a combined sound level of 40 dBA. A just barely perceptible change in sound level is considered to be 3 dBA, while an increase in dBA of 10 is typically perceived as a doubling of the sound level.

Diagram 1 Common Noise Sources

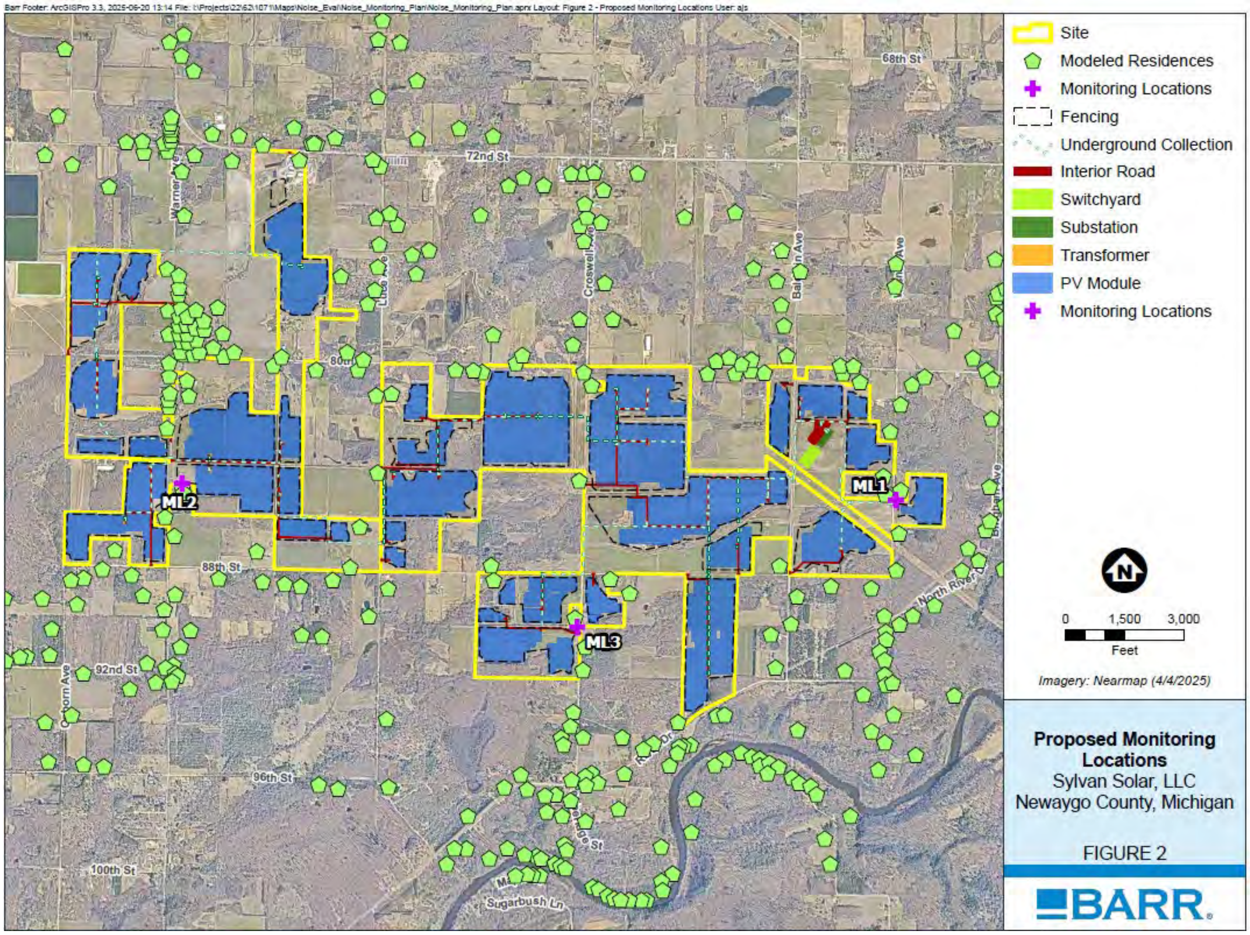


3.2 Monitoring Locations

Existing conditions were monitored in three locations to establish baseline noise levels. The three pre-construction monitoring locations were selected based on MPSC sound guidance (MPSC 2024) and informed by pre-construction sound modeling. The monitoring locations were primarily selected to represent the residences having the highest modeled sound levels, with some adjustment to provide broader geographic coverage of the Project.

Monitors were set up away from structures and areas of large vegetation on the properties to minimize any sound shielding or reflective effects. Figure 2 shows the monitoring locations, identified as ML1, ML2, and ML3.

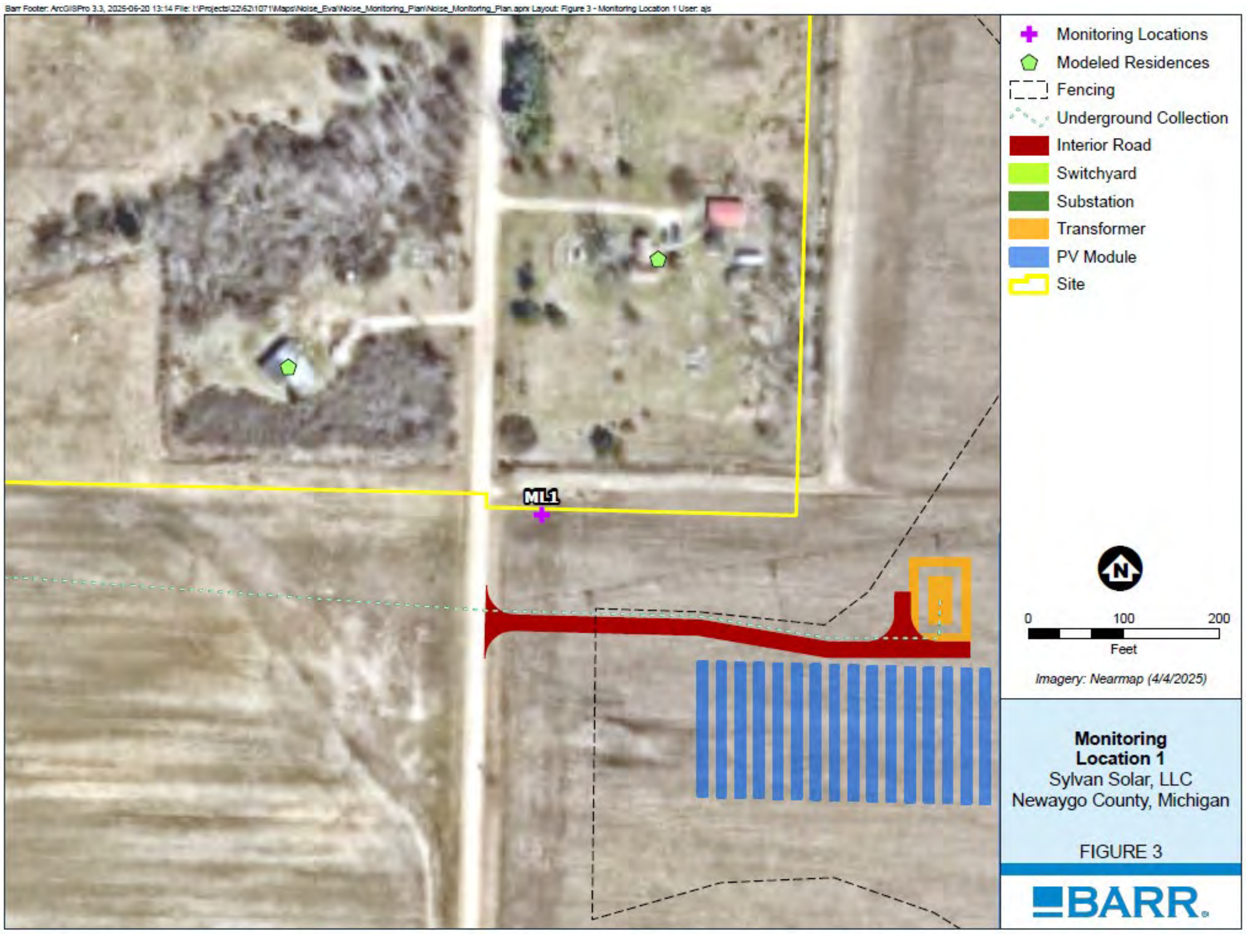
Figure 2 Pre-Construction Monitoring Locations



3.2.1 Monitoring Location ML1

The location identified in Figure 2 as ML1 is the location for the first monitor. Details of this monitoring location in Garfield Township are shown in Figure 3. This location represents the highest modeled non-participating sound receptor location from the 2025 modeling effort (Modeled receptor R1, LAeq = 41.1 dBA). The MPSC sound guidance (MPSC 2024) prescribes placing a monitor representative of the highest modeled non-participating receptor location. This receptor is also the highest modeled sound receptor in Garfield Township. The monitoring location is in the Project area south of the receptor. The monitoring location balances maintaining a comparable distance from the nearest inverter skid with distance from the nearby road. The nearest Project inverter to ML1 is approximately 380 feet at the nearest point.

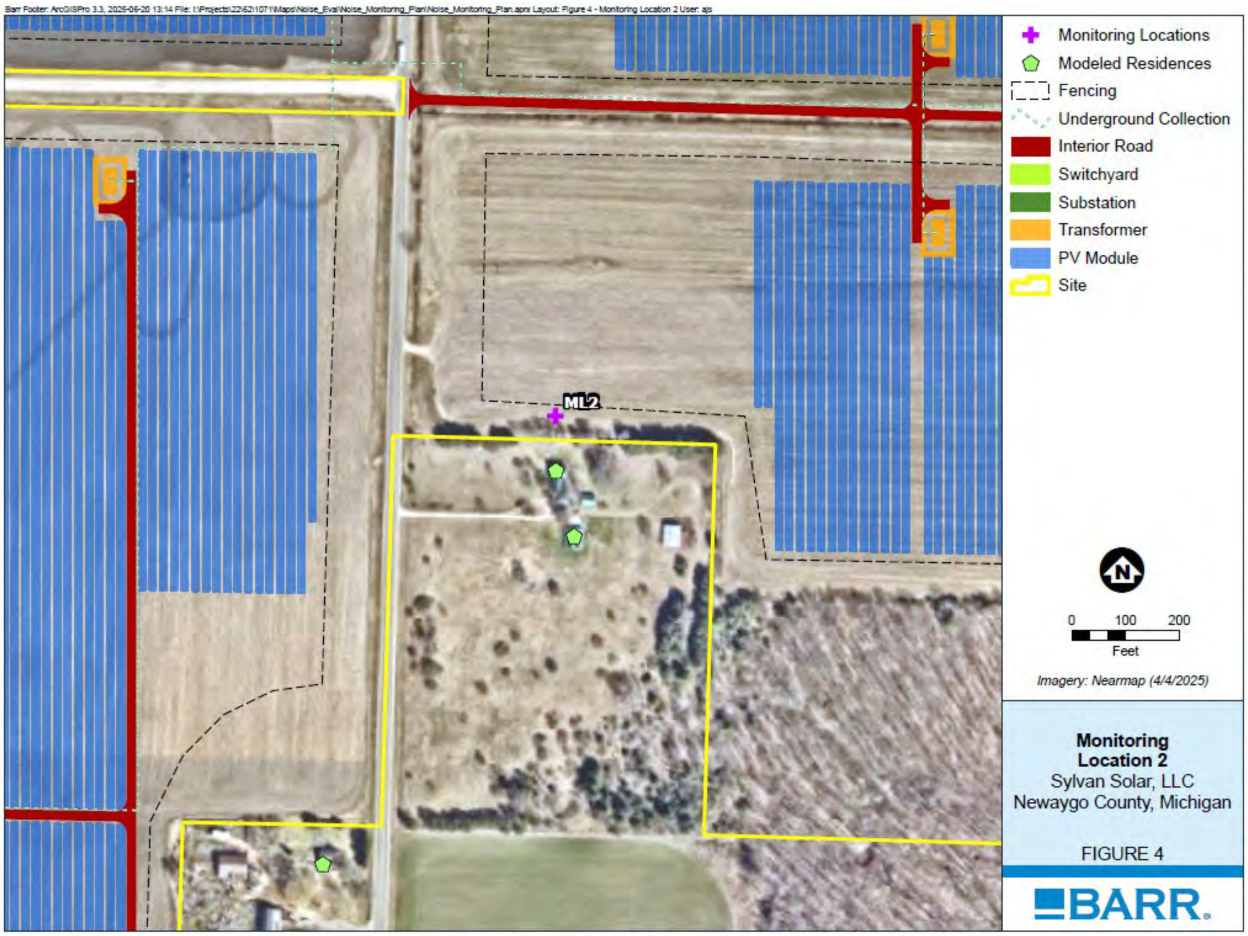
Figure 3 Monitoring Location 1 – Garfield Township



3.2.2 Monitoring Location ML2

The location identified in Figure 2 as ML2 is the location for the second monitor. Details of this monitoring location in Sheridan Charter Township are shown in Figure 4. This location represents the second-highest modeled non-participating sound receptor location from the 2025 modeling effort (Modeled receptor R2, LAeq = 40.8 dBA). This location represents the highest modeled sound receptor in Sheridan Charter Township. The monitoring location is located in the Project area immediately north of the receptor, comparable in distance from the nearby road and slightly closer to the nearest modeled inverter skids. The nearest Project inverter to ML2 is approximately 740 feet at the nearest point.

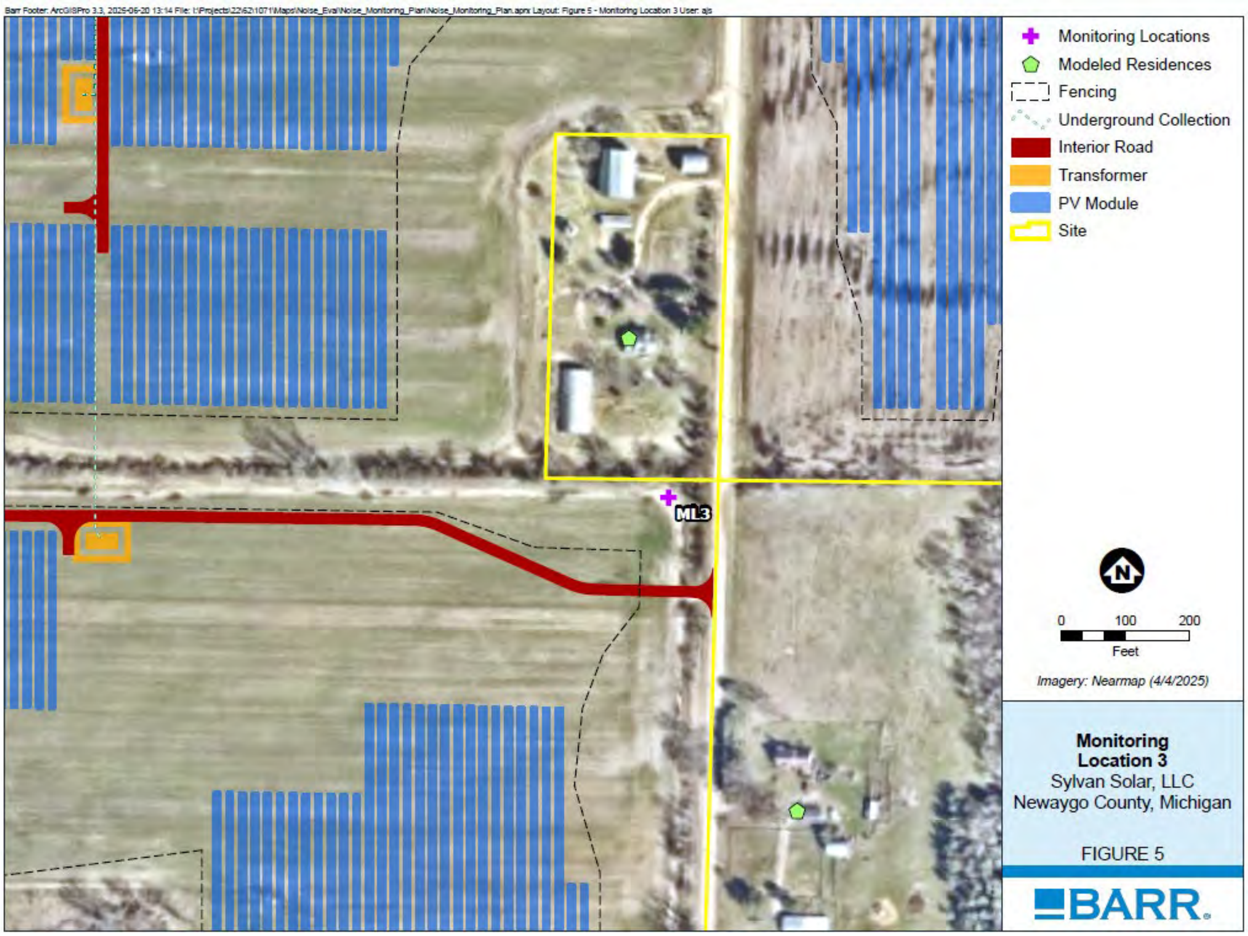
Figure 4 Monitoring Location 2 – Sheridan Charter Township



3.2.3 Monitoring Location ML3

The location identified in Figure 2 as ML3 is the location for the third monitor. Details of this monitoring location in Garfield Township are shown in Figure 5. ML3 provides a representative location in the south-central portion of the Project area (Modeled receptor R5, LAeq = 40.2 dBA). The selected location represents the fifth-highest modeled receptor, and targets baseline conditions for the central portion of the Project. The monitoring location is located in the Project area to the south of the residence, comparable in distance from the nearby road and modeled inverter skids as the modeled residence. The third and fourth highest modeled receptors (R3 and R4) were not used for determining ML3 given their locations relatively close to monitoring location ML2. R3 is approximately one mile east of ML2, while R4 is adjacent to R2 and thus well represented by ML2. ML3's site was selected to provide balanced coverage of site conditions and avoid concentrating monitoring locations in one portion of the Project. The nearest Project inverter to ML3 is approximately 840 feet at the nearest point.

Figure 5 Monitoring Location 3 – Garfield Township



3.3 Monitoring Method

3.3.1 Monitoring Equipment

Monitoring equipment consisted of Larson-Davis 831C Type 1 sound level meters, with logging capability. Sound level meter field calibration was performed before and after the monitoring period and revealed no significant drift throughout the monitoring period (<0.1dB). The meters were equipped with enclosures to protect against damage and weather effects. The microphones were mounted approximately 1.8m above ground level and included 7-inch diameter hydrophobic windscreens, slightly higher than proposed in guidance. This was the minimum height possible with the robust tripods used. The impact of this height to monitored levels is expected to be minimal. Meteorological monitoring equipment was collocated with sound level monitors to provide mic-level wind speed, wind direction, temperature, relative humidity, barometric pressure, and precipitation information.

3.3.2 Monitoring Duration

Monitoring units were deployed for seven days, deployed July 7 and retrieved July 14, 2025. In accordance with MPSC sound guidance (MPSC 2024), data collected with microphone height wind speeds greater than 5 meters/second (m/s) is not used for compliance demonstration.

3.3.3 Monitored Data

The sound level meters were configured to collect time synchronized one-third octave band levels on one-second intervals, to help identify short-term events if needed. Monitoring equipment was set to automatically begin audio recordings if the meters recorded sound levels above 44 dBA, highlighting periods above the potentially applicable MPSC sound guidance (MPSC 2024) project threshold: 55 dBA less a 5 dBA correction factor for tonal elements and further 6 dBA adjustment for building façade effects. These recordings provide for the identification of any unusual intermittent sound sources during data analysis. Given the pre-construction monitoring targets overall existing conditions, no data periods were excluded on this basis. Sounds observed throughout the period included road traffic on nearby roads, agricultural equipment, aircraft overhead, field sprinklers and their pump engines, along with birds, insects, and rustling vegetation. Sound level data gathered includes A-weighted hourly statistical levels including L_{eq}, L_{10}, L_{50}, and L_{90}.

3.4 Monitoring Data Analysis

Monitoring data was routinely downloaded and reviewed throughout the monitoring period. Sound levels and their matching microphone level weather data were compiled for analysis.

Pre-construction monitoring data is summarized into observed hourly L_{eq}, L_{10}, L_{50}, and L_{90} dBA data, along with time series comparing the hourly sound levels with observed meteorological conditions.

3.4.1 General Data Processing

Data periods with microphone-level wind speeds in excess of 5 m/s, periods of precipitation, periods with anomalous short-term noise events, and periods outside meter weather specifications are eliminated from compliance calculations, consistent with MPSC sound guidance (MPSC 2024), to ensure an acoustically valid dataset. No anomalous short-term noise events were identified for filtering. No significant rain accumulation occurred during the monitoring period. Short intervals where the co-located weather stations recorded measurable accumulation were filtered for the few cases it was observed. Periods with wind gusts in excess of 5 m/s were filtered out of the data as well. Variation resulting from this filtering was minimal. Hours with less than half of the valid data points were excluded from the analysis.

Data was reviewed for biogenic sounds (i.e., sound produced or brought about by living organisms) consistent with MPSC sound guidance section D1.2.4.2 (MPSC 2024) and filtered accordingly. Biogenic sounds are evaluated through filtering of the data using the “ANS” frequency weighting as defined in ANSI/ASA S12.100 (ANSI/ASA 2014). For some of the monitored hours, overall dBA sound levels are greater than 3 dB above the ANS-weighted levels, therefore both dBA and ANS-weighted results are reported.

3.5 Monitoring Results

Overall pre-construction L_{eq} sound levels observed during the monitoring period ranged from approximately 24 dBA to 65 dBA. This range of levels is consistent with those of a typical rural environment. When filtered using the ANS weighting approach to filter biogenic sounds (e.g., insects, birds, amphibians), this range decreases slightly to 20 to 62 dB. Biogenic versus anthropogenic effects vary across the monitoring sites and on a diurnal basis. More detailed discussion of this variability is provided for the individual sites.

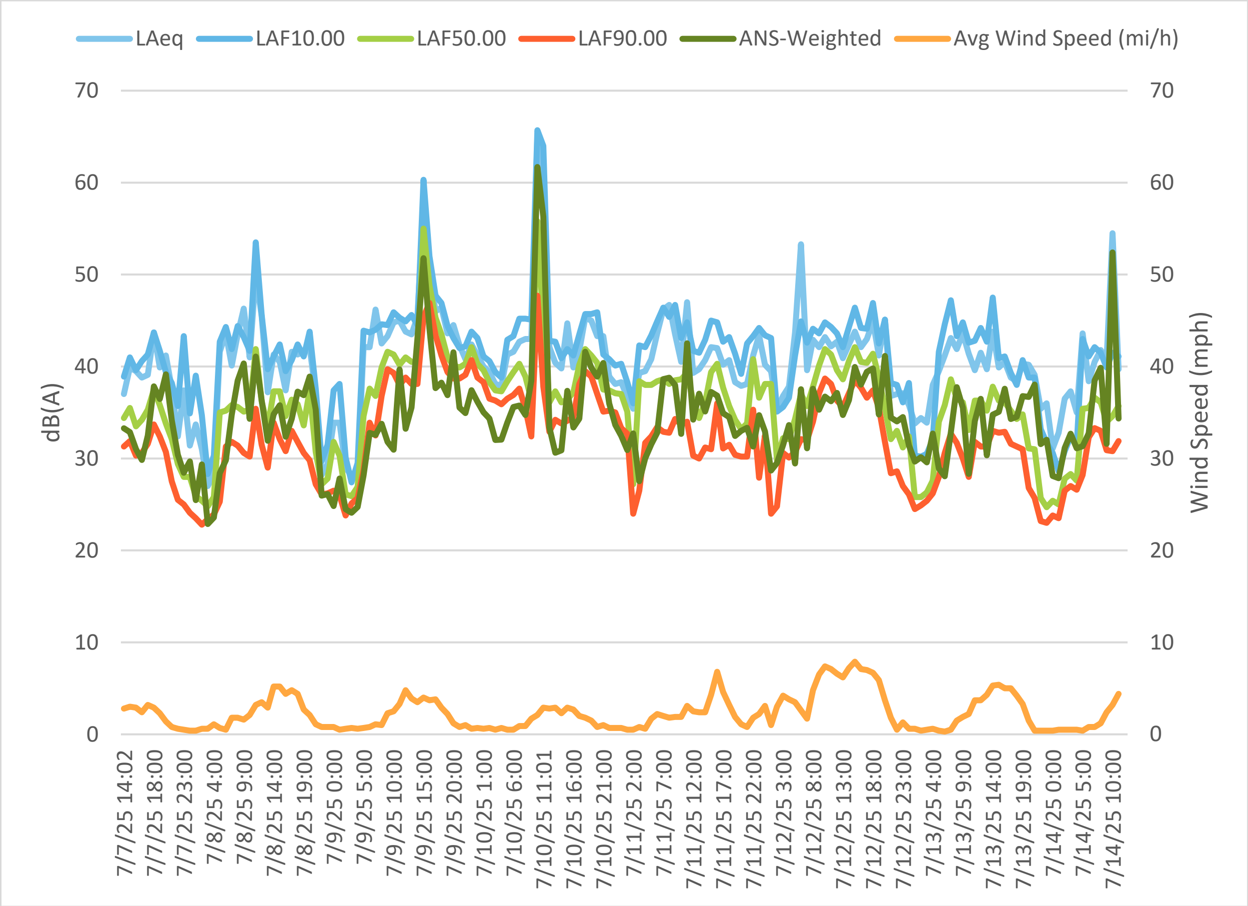
3.5.1 ML1 Monitoring Results

Sound levels observed at ML1 ranged from 27 to 65 dBA (Table 3-1). Sounds levels typically follow a diurnal pattern, with lower sound levels observed overnight. Review of potential biogenic effects indicated that ANS-weighting is warranted for ML1. As seen in Figure 6, ANS-weighted L_{eq} tracks L_{A90} most closely, implying the variability and higher levels seen in L_{Aeq}, L_{A10}, and L_{A50} are primarily associated with biogenic sources. This is consistent with audio samples from the site which included bird and insect sounds. Initial evening monitoring had some apparent hammering/knocking sounds that were only semi-regular and rather ongoing into the evening, likely associated with normal maintenance activities. Among the anthropogenic activities observed in the data, lawnmowing at the nearby residence occurred on July 10th, confirmed with sound level patterns as well as audio samples.

Table 3-1 ML1 Sound Levels Summary

	Maximum	Minimum	Average
L_{Aeq}	64.9	27	40.6
L_{ANS}	61.7	22.9	34.4
L_{A10}	65.7	27.4	41.4
L_{A50}	55.8	24.7	35.8
L_{A90}	47.7	22.8	32.1

Figure 6 ML1 Sound Levels vs. Meteorological Conditions



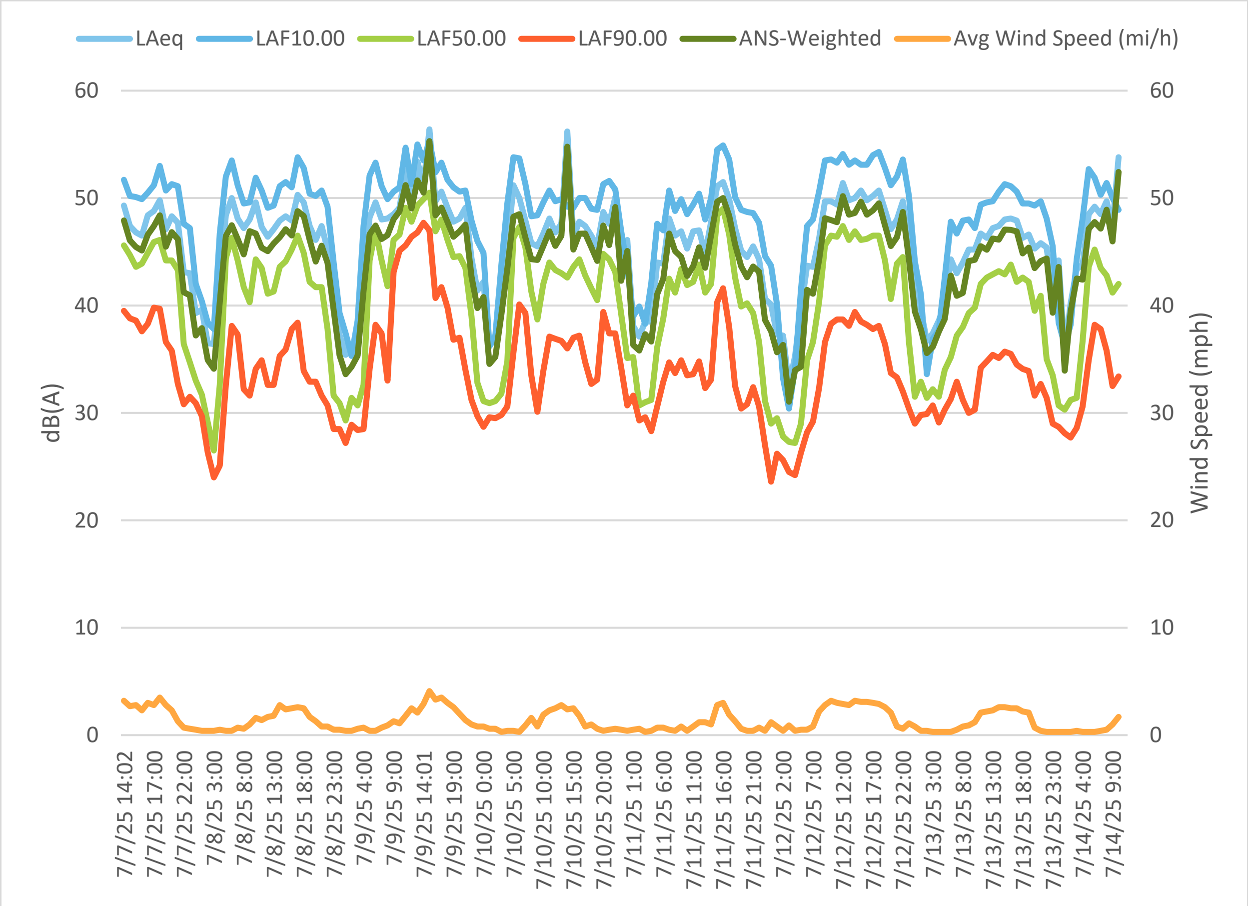
3.5.2 ML2 Monitoring Results

Sound levels observed at ML2 ranged from 33 to 56 dBA (Table 3-2). Potential effects of biogenic sounds indicated that ANS-weighting would not be warranted if looking at this site independently, as only 3 hours of the week-long monitoring had a L_{Aeq} versus L_{ANSeq} differential greater than 3 dB. Figure 7 reflects this as well, as L_{Aeq} and L_{ANSeq} track one another relatively closely. Audio samples included what sounded like steady engine noise for several periods, accompanied by impact sprinkler sounds of varying levels. This is likely associated with field irrigation operating near the site.

Table 3-2 ML2 Sound Levels Summary

	Maximum	Minimum	Average
L_{Aeq}	56.4	32.5	45.7
L_{ANS}	55.3	31.0	44.2
L_{A10}	55.3	30.4	48.2
L_{A50}	50.5	26.5	40.2
L_{A90}	47.7	23.6	33.8

Figure 7 ML2 Sound Levels vs. Meteorological Conditions



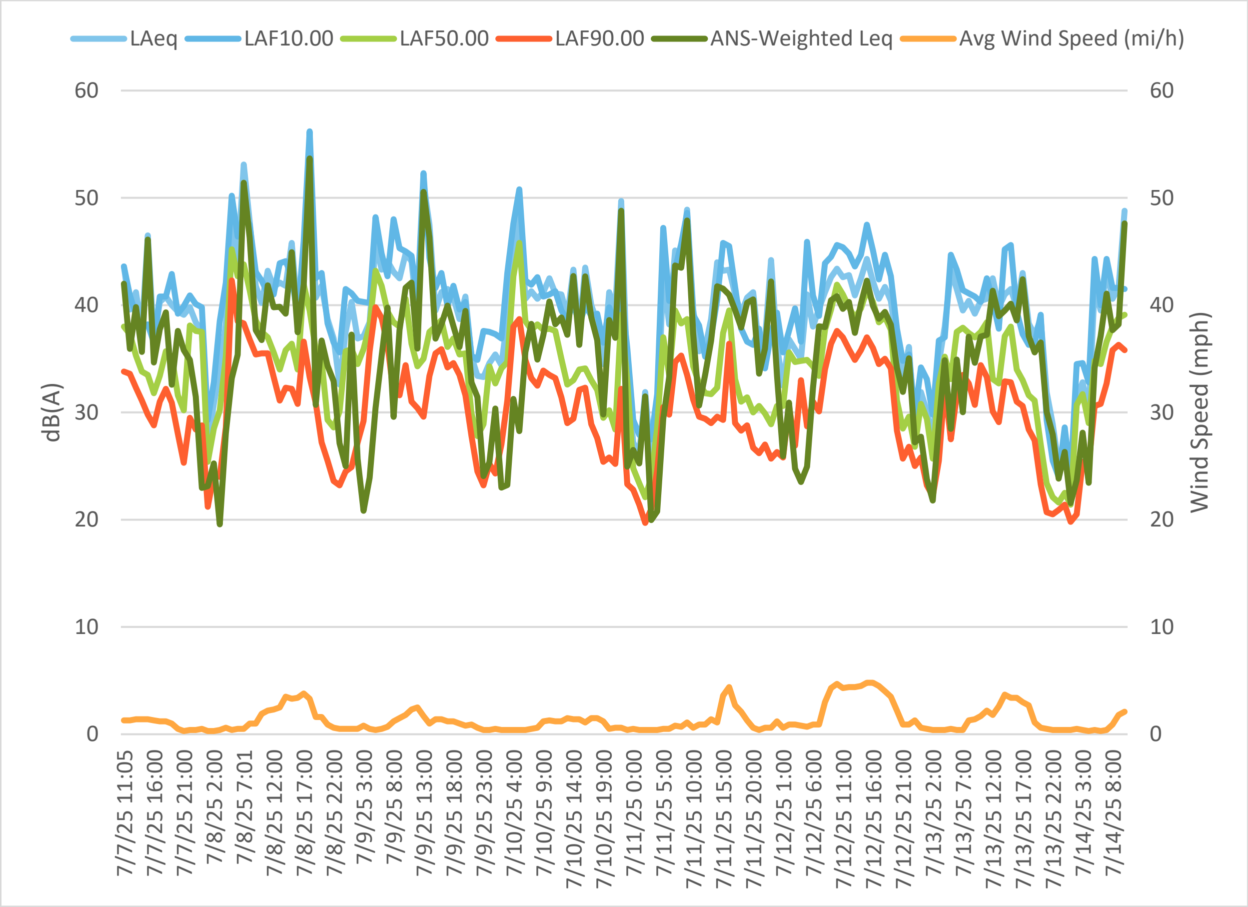
3.5.3 ML3 Monitoring Results

Sound levels observed at ML3 ranged from 24 to 55 dBA (Table 3-3). There appears to be a mixture of biogenic and anthropogenic-driven impacts for ML3. There were 69 hours with L_{Aeq} versus L_{ANSeq} differential more than 3 dB, a little over one third of the overall monitored data, implying meaningful biogenic contributions to existing conditions; therefore, ANS-weighting analysis was included. The pattern seen in Figure 8 of the L_{Aeq} versus the ANS-weighted L_{eq} converges in midday and remains relatively similar through the nights until the mornings. The 5:00 am and 6:00 am hours include the max values. The dawn chorus of biogenic sounds (e.g., birds, insects, etc.) results in spikes in short-term levels (e.g., L_{A10}, L_{A50}, and also raising L_{Aeq}), while L_{A90} and L_{ANSeq} tend to remain lower. As the days progress, the effects of anthropogenic sounds appear to bring up the baseline levels and biogenic sounds no longer appear to drive the overall sound level.

Table 3-3 ML3 Sound Levels Summary

	Maximum	Minimum	Average
L_{Aeq}	54.5	24.4	39.3
L_{ANS}	53.7	19.6	35.0
L_{A10}	56.2	23.9	40.0
L_{A50}	45.8	21.4	34.4
L_{A90}	42.3	19.7	30.2

Figure 8 ML3 Sound Levels vs. Meteorological Conditions



4 Modeling

An assessment of operational noise impacts from the Project was performed using a noise propagation model. Impacts were assessed at nearby properties using Garfield Township Solar Energy Systems Ordinance (Garfield Township 2025, 18.19.B.p), FCJPC Solar Energy Systems and BESS Ordinance (FCJPC, 2025, 3.26.II.D.1.r), and Michigan's noise standards (Michigan Legislature 2023, § 460.1226, D3.4) and generated contours showing expected noise decay in the Project vicinity. This section summarizes the methodology and input assumptions used for modeling.

4.1 Model Configuration

Figures 9 and 10 show the modeled domain as well as sound level contours projected for the Project vicinity using the iNoise model (DGMR B.V.). The iNoise modelling used the ISO 9613 standard methods for calculating outdoor sound propagation/attenuation (ISO 9613-2 2024). The model assumes ideal wind and weather conditions for sound propagation. Conservative estimates regarding ground effect and ground conditions were used. The ground attenuation value was modeled as mixed hardness (hardness value 0.5) and level throughout the modeling domain. Attenuation by vegetation or other foliage was conservatively excluded. Actual conditions in the Project area are likely to include additional elements which will reduce actual noise levels below the modeled projections (e.g. additional tree, vegetation, and terrain attenuation). Noise model receptors were placed 1.5m above ground level to approximate a typical listener and typical monitoring height as well as at 4.0m above ground level to represent potential second story residential receptors.

4.2 Model Source Inputs

Modeling noise impacts examined the Project inverter skids and Project substation transformers alone. No other significant sources of noise are expected as part of the solar generation facility. Noise data for the equipment was derived from limited equipment specifications. Modeling used these equipment specifications:

- SMA Flex Power Converter Skids: 65 dBA at 10m, 50 dBA at 50m per manufacturer spec.
- Substation GSU: 87 dBA at 6 feet per NEMA TR-1 (NEMA 2019).
- Substation Service Power Transformer: 51 dBA at 6 feet per NEMA TR-1.
- Power Co. Substation/Switchyard Transformer: 87 dBA at 6 feet (assumed size match to substation GSU, level per NEMA TR-1).

Using this data, the equivalent sound power level was determined for the equipment. The calculated sound power levels were used as input to the model. Since there are no significant structures proposed for installation around the sources at this time, no barriers were incorporated into the modeling. The modeling was performed across the project, including sources and receptors in both Garfield Township and Sheridan Charter Township.

Given source sound level details, overall levels do not include 1/1 or 1/3 octave band information, modeling versus the MPSC sound guidance standard (MPSC 2024) conservatively assumes results may have tonal impact and incorporates the 5 dBA tonal adjustment factor.

4.3 Modeling Results

Modeling yielded levels in compliance with Garfield Township Solar Energy Systems Ordinance (Garfield Township 2025, 18.19.B.p), FCJPC Solar Energy Systems and BESS Ordinance (FCJPC 2025), and Michigan noise standards (Michigan Legislature 2023 § 460.1226, D3.4) (Figures 9 and 10 and Table 4). The maximum modeled sound level at a Garfield Township residence was 41.1 dBA at receptor R1. The maximum modeled sound level at a non-participating Sheridan Charter Township residence was 40.8 dBA at receptor R2. The modeled distance from the inverters to the 55 dBA contour typically ranges from 22 to 28m (72 to 92 feet) depending on overlapping effects of other inverters. The modeled sound levels fall within the range of hourly sound levels observed during the monitoring described in Section 3. Modeled project levels could yield an increase in overall sound levels when compared to the quietest monitored periods, while they could have minimal effect during the louder periods observed. Garfield Township limits sound levels from solar energy systems to 55 dBA at the property line of non-participating adjoining lots or at a public or private road right-of-way or easement. FCJPC ordinance calls for demonstration of compliance with "statutory limits", which we have assumed to align with their wind ordinance calling for "55 dBA as measured outside and within ten feet of any human occupied structure…" (FCJPC 2025, 3.26.II.D.r and 3.26.I.E.8). State regulations in PA233 call for sound levels no higher than 55 dBA at the wall of non-participating residences (with application guidance calling for factors accounting for wall reflection and tonal elements yielding a net limiting modeled level of 44 dBA) (MPSC 2024, Att. D). Modeled impacts from the Project are well below the noise thresholds identified by Garfield and Sheridan Charter Townships and the state of Michigan.

Figure 9 **Modeled Noise Impacts - Garfield Township**

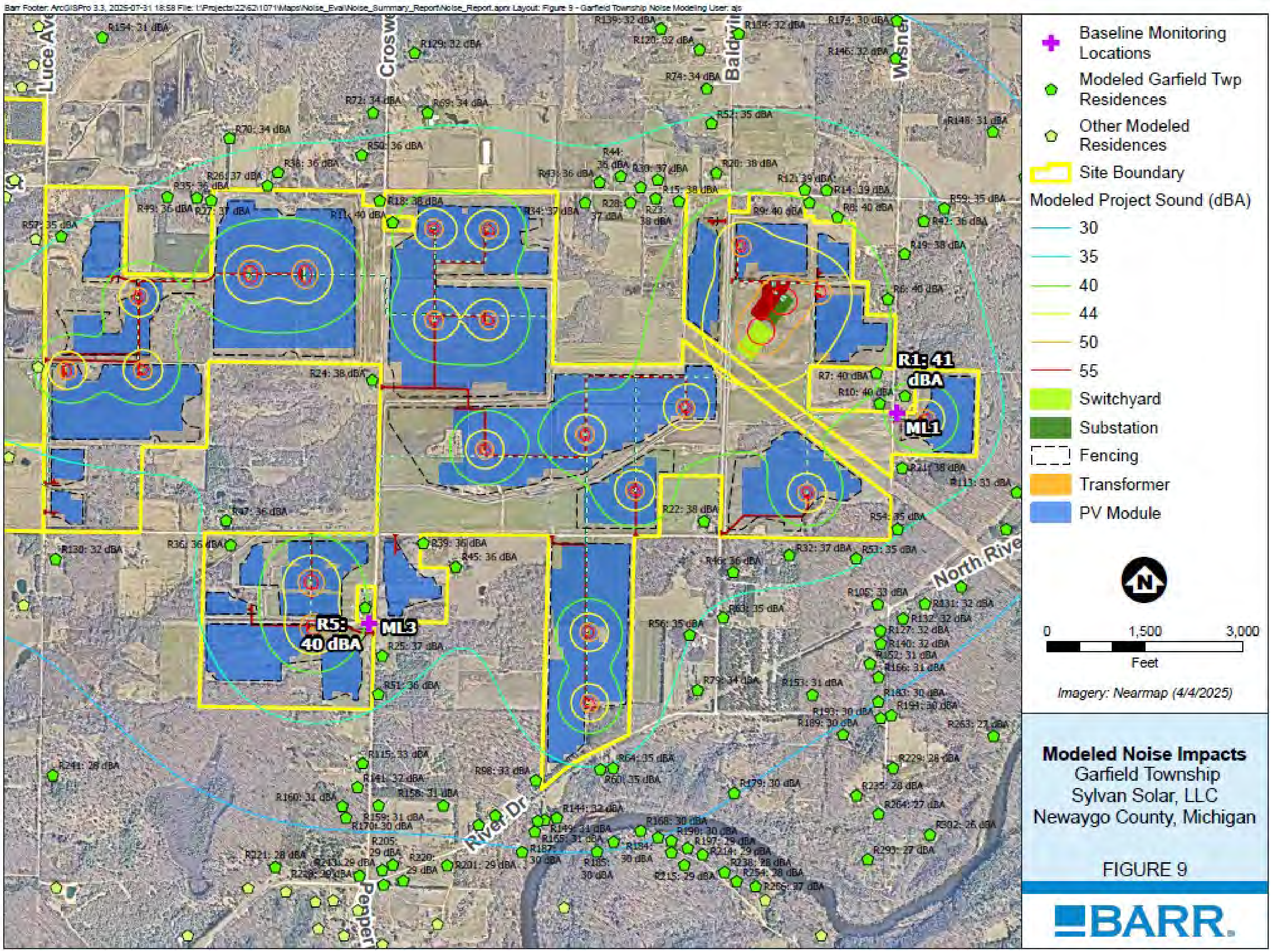


Figure 10 **Modeled Noise Impacts - Sheridan Charter Township**

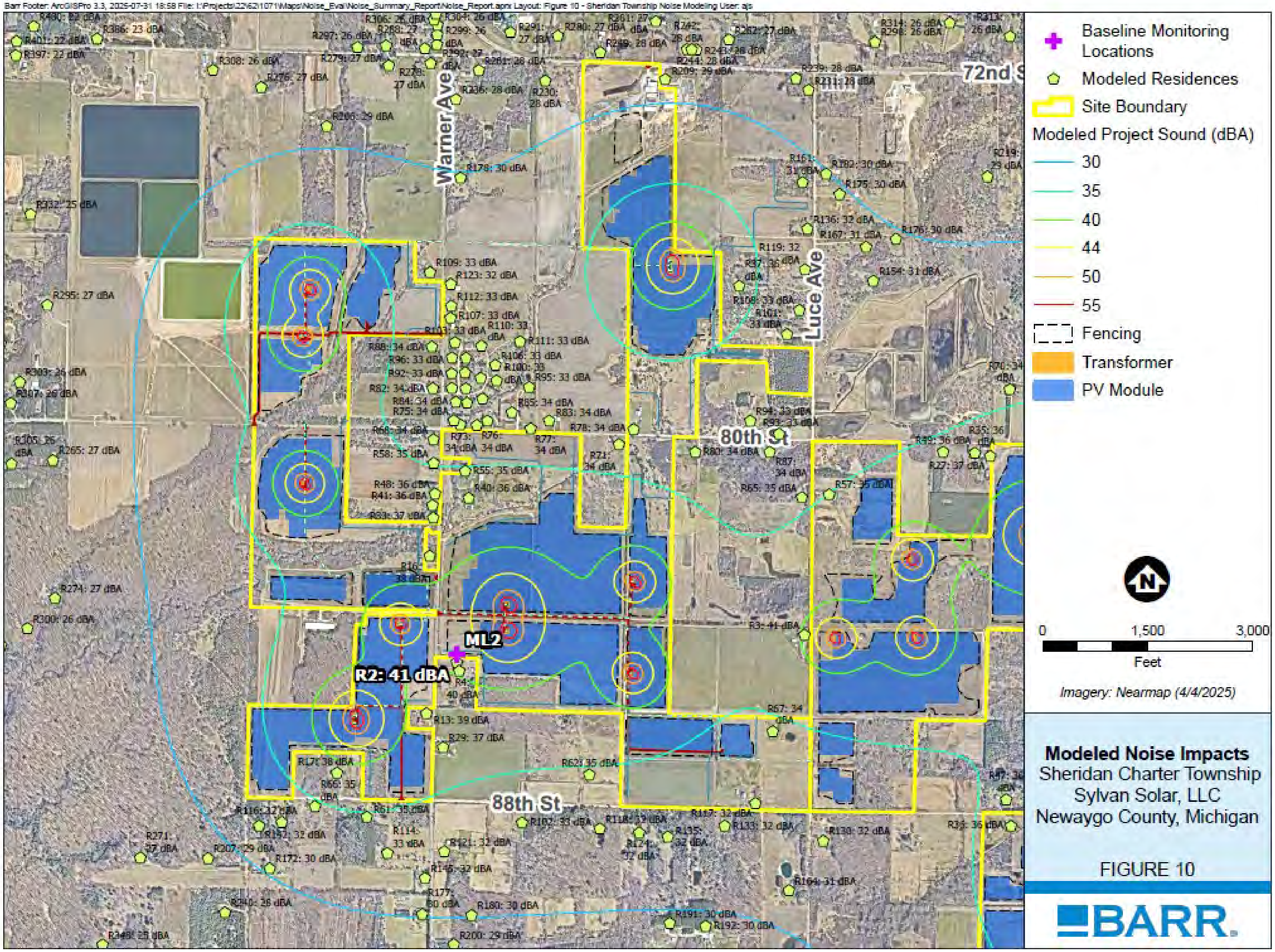


Table 4-1 Modeled Project Sound Levels

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R01	591515	4805963	41.1	55
R02	585959	4805804	40.8	55
R03	587466	4805971	40.7	55
R04	585970	4805767	40.4	55
R05	589027	4804896	40.2	55
R06	591420	4806413	40.2	55
R07	591377	4806066	40.2	55
R08	591174	4806787	40.1	55
R09	591040	4806850	40.1	55
R10	591398	4805924	39.9	55
R11	589099	4806697	39.7	55
R12	591017	4806910	39.2	55
R13	585834	4805577	38.8	55
R14	591119	4806910	38.7	55
R15	590431	4806837	38.4	55
R16	585827	4806263	38.4	55
R17	585453	4805307	38.3	55
R18	589036	4806796	38.1	55
R19	591492	4806625	38.1	55
R20	590602	4806975	38.1	55
R21	591512	4805626	38	55
R22	590596	4805349	37.8	55
R23	590322	4806848	37.5	55
R24	589027	4805958	37.5	55
R25	589114	4804674	37.4	55
R26	588510	4806851	37.2	55
R27	588249	4806773	37.1	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R28	590206	4806824	37	55
R29	585911	4805432	37	55
R30	590329	4806934	36.9	55
R31	590251	4806897	36.7	55
R32	590998	4805203	36.7	55
R33	585836	4806429	36.7	55
R34	589993	4806816	36.6	55
R35	588182	4806783	36.5	55
R36	588390	4805169	36.5	55
R37	587135	4807478	36.5	55
R38	588557	4806913	36.4	55
R39	589289	4805205	36.4	55
R40	585988	4806519	36.2	55
R41	585831	4806483	36.2	55
R42	591577	4806780	36.1	55
R43	590058	4806914	36	55
R44	590157	4806947	36	55
R45	589444	4805100	35.9	55
R46	590739	4805116	35.8	55
R47	588366	4805282	35.8	55
R48	585841	4806533	35.8	55
R49	588044	4806783	35.8	55
R50	588944	4807007	35.7	55
R51	589101	4804495	35.7	55
R52	590572	4807205	35.4	55
R53	591311	4805198	35.4	55
R54	591499	4805341	35.3	55
R55	585970	4806636	35.1	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R56	590545	4804817	35.1	55
R57	587555	4806584	35	55
R58	585831	4806666	34.9	55
R59	591671	4806844	34.9	55
R60	590148	4804177	34.7	55
R61	585589	4805120	34.7	55
R62	586550	4805333	34.6	55
R63	590699	4804902	34.6	55
R64	590207	4804185	34.6	55
R65	587436	4806567	34.6	55
R66	585362	4805159	34.6	55
R67	587342	4805546	34.5	55
R68	585827	4806769	34.4	55
R69	589246	4807214	34.3	55
R70	588326	4807065	34.3	55
R71	586634	4806772	34.1	55
R72	588991	4807206	34	55
R73	585941	4806836	33.9	55
R74	590545	4807366	33.9	55
R75	585913	4806854	33.9	55
R76	586014	4806836	33.9	55
R77	586248	4806830	33.9	55
R78	586695	4806840	33.9	55
R79	590589	4804561	33.8	55
R80	586966	4806749	33.8	55
R81	586059	4806857	33.7	55
R82	585817	4806991	33.7	55
R83	586327	4806866	33.7	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R84	585920	4806935	33.6	55
R85	586164	4806897	33.5	55
R86	585968	4806933	33.5	55
R87	587290	4806760	33.5	55
R88	585807	4807171	33.5	55
R89	585900	4806994	33.4	55
R90	586034	4806952	33.4	55
R91	585961	4806994	33.3	55
R92	585897	4807058	33.3	55
R93	587328	4806840	33.3	55
R94	587201	4806893	33.3	55
R95	586236	4807009	33.2	55
R96	585896	4807127	33.1	55
R97	585956	4807064	33.1	55
R98	589848	4804116	33.1	55
R99	586024	4807042	33.1	55
R100	586093	4807032	33.1	55
R101	587349	4807274	33	55
R102	586264	4805116	33	55
R103	585907	4807193	33	55
R104	585958	4807128	33	55
R105	591418	4804987	32.9	55
R106	586085	4807101	32.9	55
R107	585884	4807299	32.8	55
R108	587400	4807380	32.8	55
R109	585789	4807494	32.7	55
R110	586022	4807182	32.7	55
R111	586190	4807206	32.7	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R112	585886	4807351	32.7	55
R113	592050	4805530	32.7	55
R114	585683	4804965	32.6	55
R115	589037	4804169	32.6	55
R116	585220	4805085	32.5	55
R117	587276	4805232	32.5	55
R118	586604	4805100	32.5	55
R119	587418	4807558	32.4	55
R120	590505	4807548	32.4	55
R121	585930	4804981	32.4	55
R122	592200	4806009	32.4	55
R123	585881	4807446	32.4	55
R124	586775	4805089	32.2	55
R125	592180	4805674	32.1	55
R126	592007	4805356	32.1	55
R127	591434	4804865	32	55
R128	592211	4805745	32	55
R129	589177	4807491	32	55
R130	587576	4805078	32	55
R131	591638	4804996	32	55
R132	591538	4804924	32	55
R133	587145	4805130	32	55
R134	590685	4807628	31.9	55
R135	586899	4805075	31.9	55
R136	587424	4807734	31.8	55
R137	592200	4806536	31.7	55
R138	591804	4805081	31.7	55
R139	590322	4807639	31.6	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R140	591438	4804805	31.6	55
R141	589018	4804059	31.6	55
R142	585122	4805067	31.6	55
R143	592134	4805438	31.5	55
R144	589952	4803945	31.5	55
R145	585850	4804862	31.5	55
R146	591421	4807535	31.5	55
R147	592041	4807000	31.4	55
R148	591886	4807208	31.3	55
R149	589895	4803933	31.3	55
R150	592324	4805873	31.2	55
R151	589864	4803928	31.2	55
R152	591391	4804710	31.2	55
R153	591126	4804556	31.2	55
R154	587717	4807517	31.1	55
R155	589665	4803947	31	55
R156	592145	4806910	31	55
R157	592361	4805990	31	55
R158	589421	4803985	31	55
R159	589119	4803976	30.9	55
R160	588949	4803968	30.9	55
R161	587396	4807936	30.9	55
R162	592197	4806841	30.9	55
R163	590538	4807784	30.8	55
R164	587433	4804858	30.8	55
R165	589851	4803877	30.8	55
R166	591432	4804647	30.7	55
R167	587681	4807664	30.7	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R168	590345	4803897	30.5	55
R169	589588	4803899	30.5	55
R170	588969	4803915	30.5	55
R171	590220	4803841	30.4	55
R172	585173	4804883	30.3	55
R173	592400	4805672	30.3	55
R174	591422	4807711	30.3	55
R175	587558	4807890	30.2	55
R176	587809	4807703	30.2	55
R177	585843	4804705	30.1	55
R178	585909	4807910	30.1	55
R179	590776	4804086	30.1	55
R180	586057	4804707	30.1	55
R181	592439	4805732	30.1	55
R182	587498	4807976	30.1	55
R183	591435	4804533	30	55
R184	590427	4803868	30	55
R185	590144	4803793	30	55
R186	592328	4805378	29.9	55
R187	589795	4803779	29.9	55
R188	589005	4807810	29.9	55
R189	591275	4804375	29.8	55
R190	590490	4803855	29.7	55
R191	586920	4804700	29.7	55
R192	587076	4804691	29.7	55
R193	591448	4804457	29.6	55
R194	591498	4804472	29.5	55
R195	592516	4805635	29.3	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R196	590492	4803800	29.3	55
R197	590566	4803823	29.3	55
R198	592592	4806085	29.3	55
R199	588969	4807924	29.2	55
R200	585984	4804577	29.2	55
R201	589447	4803707	29.2	55
R202	589131	4807958	29.1	55
R203	589778	4808018	29.1	55
R204	592598	4805863	29.1	55
R205	589194	4803702	29.1	55
R206	585320	4808115	29	55
R207	584905	4804918	29	55
R208	592625	4805976	29	55
R209	586785	4808366	29	55
R210	590168	4808069	29	55
R211	592208	4807349	28.9	55
R212	589022	4807993	28.9	55
R213	589146	4803676	28.9	55
R214	590638	4803794	28.8	55
R215	590554	4803743	28.8	55
R216	592270	4807313	28.7	55
R217	592568	4805486	28.7	55
R218	589040	4803645	28.6	55
R219	588199	4807986	28.6	55
R220	589245	4803629	28.6	55
R221	588646	4803673	28.5	55
R222	589154	4803607	28.5	55
R223	592208	4807474	28.4	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R224	592525	4805281	28.4	55
R225	592689	4805738	28.3	55
R226	589001	4808098	28.3	55
R227	592730	4806073	28.3	55
R228	585933	4804436	28.3	55
R229	591514	4804227	28.2	55
R230	586264	4808342	28.2	55
R231	587410	4808339	28.2	55
R232	592219	4807508	28.2	55
R233	585730	4804442	28.2	55
R234	589999	4803527	28.1	55
R235	591347	4804093	28.1	55
R236	585878	4808250	28.1	55
R237	585875	4804411	28.1	55
R238	590743	4803716	28.1	55
R239	587353	4808387	28	55
R240	584985	4804685	28	55
R241	587594	4804070	27.9	55
R242	586875	4808498	27.9	55
R243	586916	4808498	27.9	55
R244	586896	4808498	27.9	55
R245	585949	4804372	27.9	55
R246	588699	4803560	27.9	55
R247	588920	4803527	27.9	55
R248	589143	4808210	27.8	55
R249	586499	4808474	27.8	55
R250	585969	4804354	27.8	55
R251	592279	4807547	27.7	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R252	588838	4803518	27.7	55
R253	588522	4803572	27.7	55
R254	590800	4803675	27.7	55
R255	592442	4807360	27.7	55
R256	589037	4803485	27.7	55
R257	588410	4808219	27.5	55
R258	588680	4808232	27.5	55
R259	589410	4803431	27.5	55
R260	585927	4804309	27.5	55
R261	585974	4808380	27.5	55
R262	587057	4808546	27.4	55
R263	591978	4804390	27.4	55
R264	591452	4804010	27.4	55
R265	584175	4806626	27.3	55
R266	590890	4803653	27.3	55
R267	585802	4804297	27.3	55
R268	589405	4808346	27.3	55
R269	588522	4808284	27.3	55
R270	588986	4808330	27.2	55
R271	584610	4804911	27.2	55
R272	589068	4808342	27.2	55
R273	592189	4807769	27.2	55
R274	584203	4806028	27.2	55
R275	588889	4808329	27.2	55
R276	585030	4808276	27.1	55
R277	592775	4806914	27.1	55
R278	585764	4808402	27.1	55
R279	585582	4808387	27.1	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R280	586312	4808540	27	55
R281	586737	4808615	27	55
R282	588856	4803393	27	55
R283	592572	4804919	27	55
R284	588976	4803364	26.9	55
R285	590937	4803592	26.9	55
R286	589158	4803328	26.8	55
R287	585603	4804240	26.7	55
R288	585736	4808466	26.7	55
R289	585240	4804349	26.7	55
R290	584976	4804485	26.7	55
R291	586106	4808549	26.7	55
R292	585788	4808485	26.7	55
R293	591408	4803797	26.6	55
R294	589979	4803271	26.6	55
R295	584131	4807300	26.6	55
R296	585567	4808474	26.5	55
R297	585444	4808463	26.5	55
R298	587692	4808556	26.5	55
R299	585788	4808528	26.4	55
R300	584088	4805893	26.3	55
R301	592896	4806984	26.3	55
R302	591695	4803921	26.3	55
R303	584022	4806961	26.2	55
R304	585788	4808570	26.2	55
R305	583996	4806605	26.1	55
R306	585772	4808592	26	55
R307	583985	4806869	26	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R308	584818	4808344	26	55
R309	589749	4803150	26	55
R310	588247	4803341	26	55
R311	585779	4808618	25.9	55
R312	584798	4804467	25.9	55
R313	588278	4808599	25.9	55
R314	588014	4808650	25.8	55
R315	589001	4803146	25.8	55
R316	587627	4803546	25.8	55
R317	584746	4804462	25.7	55
R318	585785	4808668	25.6	55
R319	583919	4806350	25.6	55
R320	589020	4803102	25.6	55
R321	583976	4805815	25.6	55
R322	583932	4807126	25.5	55
R323	591203	4803435	25.5	55
R324	583872	4806703	25.4	55
R325	593203	4806543	25.3	55
R326	583963	4805624	25.2	55
R327	587379	4808874	25.2	55
R328	588560	4803101	25.2	55
R329	588788	4803049	25.1	55
R330	592630	4804447	25.1	55
R331	583853	4806970	25.1	55
R332	584045	4807693	25.1	55
R333	588694	4803056	25.1	55
R334	593039	4805063	25.1	55
R335	588823	4803029	25.1	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R336	584636	4804426	25.1	55
R337	591011	4803252	25	55
R338	588931	4802995	25	55
R339	587237	4803519	25	55
R340	588975	4802976	24.9	55
R341	583854	4807211	24.9	55
R342	589845	4802944	24.9	55
R343	587086	4803547	24.9	55
R344	589014	4802960	24.8	55
R345	583889	4807402	24.8	55
R346	593305	4806461	24.8	55
R347	593313	4806375	24.8	55
R348	584458	4804528	24.8	55
R349	593324	4805899	24.8	55
R350	588245	4803088	24.7	55
R351	585160	4804024	24.7	55
R352	588423	4803019	24.6	55
R353	588150	4803086	24.6	55
R354	589759	4802885	24.6	55
R355	583765	4806102	24.6	55
R356	583746	4806290	24.6	55
R357	593359	4806355	24.6	55
R358	588821	4802899	24.4	55
R359	584909	4808649	24.4	55
R360	587675	4809008	24.4	55
R361	588762	4802900	24.4	55
R362	588720	4802907	24.4	55
R363	583786	4805748	24.4	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R364	583867	4807557	24.4	55
R365	593355	4805609	24.4	55
R366	589229	4802823	24.3	55
R367	589771	4802813	24.2	55
R368	588630	4802892	24.2	55
R369	589277	4802806	24.2	55
R370	583741	4807310	24.1	55
R371	583703	4805860	24.1	55
R372	591059	4803057	24.1	55
R373	589347	4802760	24	55
R374	588095	4802965	24	55
R375	585946	4809030	23.9	55
R376	589400	4802737	23.9	55
R377	584958	4803962	23.9	55
R378	589649	4802735	23.9	55
R379	589608	4802733	23.9	55
R380	589513	4802731	23.9	55
R381	583775	4807540	23.9	55
R382	589448	4802731	23.9	55
R383	583608	4806675	23.8	55
R384	583730	4805429	23.7	55
R385	583569	4806461	23.6	55
R386	584310	4808464	23.4	55
R387	585421	4803635	23.3	55
R388	585848	4809145	23.3	55
R389	587536	4809299	23.2	55
R390	587365	4809315	23.1	55
R391	585263	4803644	23.1	55

Receptor	X (m) UTM 16N	Y (m) UTM 16N	Modeled Sylvan Solar Sound Pressure Level (dBA)	Garfield and Sheridan Charter Township Noise Limit (dBA)
R392	585754	4809246	22.7	55
R393	584990	4803659	22.6	55
R394	585861	4809308	22.5	55
R395	583524	4805349	22.5	55
R396	587395	4809466	22.5	55
R397	583959	4808381	22.3	55
R398	583967	4804424	22.3	55
R399	584017	4804335	22.2	55
R400	584033	4808509	22.1	55
R401	583961	4808441	22.1	55
R402	583862	4808329	22.1	55
R403	584945	4809167	21.9	55
R404	583822	4804398	21.6	55
R405	583837	4808481	21.5	55
R406	583724	4808368	21.4	55
R407	584043	4808721	21.4	55
R408	583854	4808570	21.2	55

4.4 Construction Sound Assessment

Distinct noise impacts during construction are anticipated to be minimal to significant depending on the activity occurring and equipment being used. Noise from construction will be temporary, intermittent, limited to daytime hours, and localized. The noise from construction activities would dissipate with distance and may be audible at varying decibels, depending on the distance from the equipment to the receptor.

Noise producing activities related to the installation of solar arrays are associated with clearing and grading, material delivery, and driving foundation posts. Much of the construction equipment that could be used on the site, such as grading equipment, man-lifts, and compactors, is anticipated to generate noise between 80-85 dBA at 50 feet from the equipment. Sound levels from grading equipment and compactors will be similar to typical tractors and other heavy equipment already used in agricultural communities. Driving of the rack supports, or helical pile equipment if Sylvan Solar decides to use helical piles, will be the most significant source of construction noises. The Federal Highway Administration Construction Noise Handbook shows the noise from power hammers to be approximately 90 dBA at 50 feet from the equipment (FHWA 2006). Rhythmic pounding of foundation posts may be disruptive for the short period of post installation even if the noise levels associated with the activity have decayed with distance. If Sylvan Solar elects to install helical pile foundations based on conditions at the Project site, the installation will take longer but would be quieter. Sound levels typically decay 6 dBA per doubling of distance. Heavy construction equipment levels would accordingly decay with distance to range from 74-84 dBA at 100 feet, 68-78 dBA at 200 feet, 62-72 dBA at 400 feet, 56-66 dBA at 800 feet, and so on.

Other construction activities, for example, installation of solar panels, are anticipated to have minimal noise impacts. A forklift is typically used to place solar panels on the racking system. Construction activities will be sequenced, that is, site grading may occur at one location while post driving occurs at another location while racking and panel assembly might occur at another location, at the same time. Impact associated with a given element of construction is expected to be of short duration for any given receptor as Project development proceeds across the site. Construction activity for the Project will be limited to daytime hours only to minimize potential impacts to neighboring properties.

5 Conclusions

Monitoring data of the existing sound levels in the Project area is consistent with conditions expected of a rural area. Observed levels range from 20 to 65 dBA L_{eq}, a relatively broad range of variability. Overnight periods often reach quite quiet levels, while daytime conditions tend to experience more varied sound levels, influenced by a mix of biogenic and anthropogenic noises.

Construction noise impacts are anticipated to be temporary, intermittent, limited to daytime hours, and localized. The noise from construction activities would dissipate with distance and may be audible at varying decibels, depending on the distance from the equipment to the receptor. Construction activity for the Project will be limited to daytime hours, minimizing potential impacts to neighboring properties.

Potential Project operational sound levels at non-participating residences were modeled to range from 21 to 41 dBA. These modeled noise levels fall within the range of observed existing noise levels, indicating that for some periods the Project may yield an increase in overall noise, while having minimal impact to other intervals. The maximum modeled operational sound level from the Project was 41 dBA at receptor R1, on the eastern end of the Project, southeast of the Project substation. **Modeled impacts from the Project are well below the noise thresholds identified by Garfield and Sheridan Charter Townships and the state of Michigan.**

6 References

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