

STATE OF MICHIGAN

BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * *

In the matter of the application of)
GLACIER MEADOWS SOLAR, LLC)
for a Renewable Energy or Storage)
Siting Certificate to construct a)
solar energy facility.)
_____)

Case No. U-22044

EXHIBITS OF

ENERGY OPERATIONS DIVISION

MICHIGAN PUBLIC SERVICE COMMISSION

July 20, 2026



STATE OF MICHIGAN

GRETCHEN WHITMER
GOVERNOR

DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS
LANSING

MARLON L BROWN
DIRECTOR

May 20, 2026

Lisa Felice
Executive Secretary
Michigan Public Service Commission
Lansing, Michigan, 48917

Re: In the matter of the application of GLACIER MEADOWS SOLAR, LLC for a Renewable Energy or Storage Siting Certificate to construct a solar energy facility. Case No. U-22044.

Dear Ms. Felice,

Pursuant to the Commission's October 10, 2024, Application Filing Instructions and Procedures for PA 233 cases, attached for filing in the above referenced matter is Staff's Fee Exhibit (Exhibit S-1).

People with disabilities may request this material in an alternate format by emailing LARA-MPSC-ADA-Requests@Michigan.gov or calling 1-517-284-8090.

Michigan Public Service Commissioners
Katherine Peretick, Commissioner Dan Scripps, Chair Shaquila Myers, Commissioner
7109 WEST SAGINAW HIGHWAY • PO BOX 30221 • LANSING, MICHIGAN 48909
Michigan.gov/MPSC • 517-248-8100

Exhibit: S-1
Witness: MPSC Staff
Case No.: U-22044
Date: 5/19/26

PA 233 Fee Exhibit

Project Name: Glacier Meadows Solar, LLC

Subject Area	Contractor	Estimated Hours	Estimated Fees
Sound Report and Monitoring	Grid Strategies, LLC	130	\$24,700
Decommissioning	Weston, LLC	169	\$30,535
Total Estimated Fees			\$55,235

Staff Proposed Conditions – Redlined

1. ~~An agreement from the applicant to obtain and comply with construction or building permits from the ALU for the renewable energy and energy storage facilities; or The Applicant is required~~ to enter into a ~~T~~third-~~P~~party ~~I~~independent ~~M~~monitor (TPIM) agreement, funded by the applicant, ~~where the monitor is~~ selected in consultation with the ~~MPSC~~ Staff to be onsite during the periods when construction is taking place on a weekly basis to monitor the construction activities. The ~~independent monitor~~TPIM would be granted authority to resolve complaints and request immediate cessation of activities that the monitor can document are in ~~material~~ breach of any plan, permit or agreement pertaining to the construction of the facility. The ~~third-party independent monitor~~Applicant's TPIM ~~shall is required to~~ provide ~~periodic monthly~~ reports to the Staff ~~and, the ALU on the progress of construction and, and the applicant from the start of construction and~~ continuing through the first 3 months of commercial operation. ~~The cadence of the reports will be determined by the independent monitor in consultation with the Staff.~~
2. ~~An agreement from~~the Applicant ~~is required~~ to participate in a pre-construction meeting with the Staff and ~~either the ALUs, who has issued a construction or building permit, or a third-party independent monitor, to ensure the Staff has access to the most recent information and final documentation prior to construction for use in answering questions and assisting with complaints. The Applicant must extend i~~Invitations to attend the pre-construction meeting ~~should be extended to representatives of each ALU(s), however, their attendance would not be required. Prior to the pre-construction meeting, the Applicant is required to:~~ The certificate may also be conditioned on the applicant's agreement to file the final drawings, plans, and permits received in the docket prior to the start of construction. The filing of final drawings, plans, and permits received are for completeness and transparency in the record and the pre-construction meeting serves to ensure that the final plans conform with the certificate approved by the Commission.
 - a. File final drawings, plans, compliance and permits received into the E-docket for this case consistent with AFIP Section 8.1(a)(1-3).
 - b. Provide final versions of the Emergency Response Plan (A-1.9) and Fire Response Plan (A-1.10).
 - c. Provide the final version of the Unanticipated Discoveries Plan (A-1.14), including a mutually agreed upon turnaround time and/or process for the State Historic Preservation Office (SHPO) to respond to discoveries and avoidance plans submitted by the Applicant; and materials resulting from SHPO's completed review

of the project, including evidence that any identified impacts to cultural resources have been addressed according to SHPO's recommendations in the final site plan.

- d. File an updated decommissioning plan, an updated third-party decommission cost estimate, and a demonstration of financial assurance acquired to date. Such materials must reflect the planned facility layout, equipment quantities, disturbed acreage, and participating parcels; must follow the requirements of AFIP Exhibit A-13 and Section 8 and be cross-consistent in commitments, plans, and financial estimates; and must account for the land enrolled in the Michigan Farmland Open Space Preservation Program (commonly referred to as PA 116), consistent with the requirements of other conditions of this certificate. The decommissioning plan shall also include the following:
 - i. Address how damage from extreme weather events or damage from human causes will be addressed, and/or how they might lead to applicant-initiated decommissioning.
 - ii. Include additional soil sampling at a rate of no less than one (1) sample per 40 acres for the following:
 - A. Phosphorus, potassium, calcium, magnesium, sodium, sulfur, manganese, copper, and zinc; pH and acidity; soil organic matter content, cation exchange capacity, and topsoil depth.
 - B. Any hazardous substances contained in equipment which is introduced to the site by the Company.
 - iii. Include "the reasoning and agreement with [each] property owner" for all project related facilities and equipment intended to be kept in place, including specific locations and affected property owners.
 - iv. Include procedures to address issues of dust, noise, and traffic in accordance with 6.3.13(a)1 of the AFIP.
 - v. Include removal methods and site clearance activities for the project substation, O&M building, gen-tie line, and points where underground collection lines enter or exit the ground at a depth less than four feet.
 - vi. Include the locations of the inverters, substation, and collection line entrance and exit points as part of the 100% design set anticipated immediately prior to commencement of construction consistent with the

Company's response to discovery request GM-6-7 and 8 of Exhibit S-6.1.

- vii. Include a list of all hazardous substances including those in facility equipment (including, but not limited to solar panels and switchgears), and all information as provided in response to discovery request GM-6-11 of Exhibit S-6.1, as well as any updated information as applicable.
- viii. Include the following commitments and information in its final decommissioning plan and agreement, as well as a description of how it will meet such commitments:
 - A. A commitment to repeat its pre-application soil sampling, in a manner consistent with the baseline soil health survey plan, at decommissioning.
 - B. A commitment to restoration of the project area, including soils, to a useful condition similar to that which existed before construction.
 - C. Perform remediation of any hazardous substances introduced by project activities through a release, as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S.C. § 9601(14) and (22).
 - D. Utilize, at minimum, the Generic Residential Cleanup Criteria in R 299.46 under Part 201 of the Natural Resources and Environmental Protection Act (NREPA) as necessary to ensure the soil restoration standard in PA 233 is met with regard to the identified hazardous substances of concern.
 - E. Comply with any applicable federal environmental laws or environmental laws of this State regarding remediation which are more stringent than the criteria set forth in R 299.46.
 - F. Describe how required soil decompaction and grading will be identified and performed as provided in response to question 17 of Exhibit S-6.1.
- ix. Regarding commitments and agreements with property owners, the Company is required to replace the language in Section 6.b. of Exhibit A-13.1, with "The restoration measures agreed to by individual

landowners will conform to the terms of each written landowner agreement. The land will be returned to its pre-construction condition leaving any desirable infrastructure as requested by the subsequent landowner.”

- x. The Company is required to update the language in Section 6.c. of Exhibit A-13.1, by either removing the phrase “to the extent possible” entirely, or use language that might apply to specific situations where planning and coordinating with landowners is not possible. In addition, the Company is required to include a plan, per AFIP section 6.3.13(a)5.iii, including the method of how landowners, ALUs, and local governments will be coordinated with and timelines and methods of communication.
- e. At least 60 days prior to the pre-construction meeting, the Applicant is required to file the following:
 - i. Final Noise Modeling Report – a final noise modeling report demonstrating compliance using the final facility layout and final make and model of all operational sound sources, including inverter and transformer cooling systems and any auxiliary equipment, consistent with AFIP Attachment D requirements. The final report must include the final source sound-power data and associated source-data uncertainty or a conservative uncertainty allowance, and the final substation sound-barrier design information, including height, length, location, material, transmission loss or insertion loss, absorptive treatment, and any openings or penetrations, with confirmation that the final barrier design is acoustically equivalent to, or more protective than, the modeled design. The final report must also include a complete and internally consistent final source inventory and coordinate table confirming all modeled operational sound sources and disclose unrounded modeled results and source-category contributions at the controlling receptor and any receptor modeled at 53 dBA or higher. The final report must either retain the +5 dB tonal penalty for the inverters or substantiate its removal consistent with AFIP Table 1, including underlying one-third-octave-band or narrowband source data, receptor-level tonal-prominence calculations, and measured background sound (lowest hourly L90). If the Applicant seeks to remove the inverter tonal penalty, the final report must also include a sensitivity run retaining the penalty.

- ii. Baseline Sound Monitoring Report – a baseline sound monitoring report, consistent with AFIP Attachment D pre-construction monitoring requirements.
- iii. Construction Noise Control Plan – a plan describing major construction activities/equipment; standard work hours; exceptions/notice procedures; equipment maintenance/mufflers; idling limits; and specific controls for any high-noise activities, if applicable. When a complaint reasonably indicates material construction noise impacts, the Applicant must promptly investigate and implement corrective actions consistent with the construction noise control plan. If effective corrective actions cannot be implemented promptly, the Applicant is required to implement reasonable interim controls and adjust operations as necessary to address the complained-of impacts until controls are implemented.
- f. Provide the signed and executed project labor agreement or collective bargaining agreement consistent with Condition 20.
- g. Provide any plans required under the Natural Resources and Environmental Protection Act (NREPA), upon completion by the Applicant. This includes Spill Prevention Control, and Countermeasure Plan (SPCC), Pollution Incident Prevention Plan (PIPP), Soil Erosion and Sedimentation Control (SESC) plans, and Stormwater Pollution and Prevention Plans (SWPPP), as applicable.
- h. Provide the final version of the Michigan State University Pollinator Scorecard for Solar Sites, and any vegetation and/or soil management plans.
- i. If the Applicant is unable to execute host community agreement(s) after good-faith negotiations with an ALU or ALUs, it must provide a plan identifying one or more community-based organizations providing benefits within or serving the residents of the applicable ALU(s), with which the Applicant may execute a community benefits agreement. The Applicant must thoroughly explain how the community benefits agreement executed with the community-based organization(s) will prioritize benefits to the communities in which the energy facility is to be located.
- j. The following costs are required to be included as line items in the decommissioning cost estimates:
 - i. Costs associated with insurance (bond and commercial liability, property, workman's compensation and environmental).
 - ii. Costs associated with soil assessment and remediation.
 - iii. Costs associated with decommissioning of the substation, gen-tie lines, O&M Building and access roads.

- k. To address deer entrapment, the Applicant must develop a facility-specific fencing and entrapment plan prior to the start of operations, including the following:
- i. Regular inspections of fences for damage that could allow deer to enter over or under the fence.
 - ii. Frequent inspections for entrapped deer.
 - iii. Protocols that minimize the time that gates to the facility are left open.
 - iv. Contingency plans for removing deer that have become entrapped.
 - v. Contact numbers for the local Department of Natural Resources Wildlife Division Office.
- a.l. The Applicant is required to submit the decommissioning cost estimate model input parameters with the revised decommissioning cost estimate required by Proposed Minimum Condition No. 2.j.
3. ~~An agreement by T~~ The Applicant is required to repair or replace all public and private drainage systems damaged from construction or decommissioning processes, ~~except for those D~~ except for those drainage systems that are already specifically addressed in lease-separate agreements with the Applicant will be repaired or replaced pursuant to those pre-existing or other agreements in place. This shall include county or intercounty drains in the event there are established county or intercounty drains that are part of the public drainage system.
4. ~~An agreement by T~~ The Applicant is required to file a mechanical completion certificates for the facilities in the MPSC ~~docket assigned to the project~~ docket for Case No. U-22044.
5. ~~An agreement by T~~ The Applicant is required to implement a complaint resolution process provided in Exhibit A-1.16. The Applicant is required to keep up to date the following information: as approved by the Commission as a condition of certificate approval that includes the name of a designated developer/operator representative provided with the authority to resolve local complaints, a dedicated phone number for complaints, an email address for complaints, and website information instructing the public on the complaint resolution process.
6. ~~An agreement by T~~ The Applicant is required to provide emergency contact information for the facility representative of the proposed facility in the MPSC docket assigned to the project in Case No. U-22044. Initial emergency contact information must be filed prior to commencing construction, and then ~~and to file updated emergency contact~~

- ~~information at a minimum~~ on an annual basis, and at the time a change is made to the designated emergency contact(s). ~~or as necessitated by applicant personnel changes.~~
7. ~~An agreement by T~~The Applicant is required to implement vegetative screening as described in its application and responses to Staff discovery, presented in Exhibits S-5.1 and S-5.2, and amended as follows: including, but not limited to, vegetation, walls, and fencing berms, as approved by the Commission as a condition of the siting certificate.
 - a. The Applicant is required to plant evergreen shrubs as at least 50% of the plantings in its understory, as identified in Exhibit A-1.1, Sheet no. C.506;
 - b. The Applicant is required to plant evergreen trees that are between 5ft and 6ft in height at the time of planting;
 - c. The Applicant is required to replace all dead and dying vegetation within the next appropriate growing season; and,
 - d. The Applicant is required to solicit the screening preferences of adjacent non-participating residences among the screening described here, the “no screening” option with payment in lieu of screening, and a “no screening” option with no such payment; and the Applicant is required to implement screening for each such residence consistent with its expressed preference. If no preference is indicated by a residence, the Applicant may choose to implement screening for that residence.
 8. ~~An agreement by T~~The Applicant is required to implement vegetative ground cover in consideration of Michigan State University’s “Michigan Pollinator Habitat Planning Scorecard for Solar Sites”, and ~~avoiding~~ invasive species in its project area, by implementing at least the steps described in its application and responses to Staff discovery in Case No. U-22044, presented in Exhibit S-5.1 and S-5.2, as approved by the Commission as a condition to the siting certificate.
 9. ~~An agreement by T~~The Applicant is required to bury underground infrastructure to a minimum depth of 4 feet or as approved by the Commission as a condition to the siting certificate.
 10. ~~Prior to commencement of commercial operation, An agreement by t~~The Applicant is required to contract with and pay for a qualified, independent, third-party acoustics expert. Such expert is required ~~to~~ conduct post-construction sound ~~measurements~~ monitoring in accordance AFIP Attachment D, ensuring that facility operation is assessed in a variety of conditions, including those associated with maximum sound

~~emissions from the facility. Post-construction sound monitoring shall be conducted within one year after commercial operation, unless otherwise directed with sound modeling and measurement procedures adopted by the Commission. and file the results in a report in the MPSC docket assigned to the project. The post-construction sound monitoring report must be submitted within 60 days of the end of the field data collection. The Applicant is required to file the results in a report to the MPSC docket in Case No. U-22044. An agreement that if the post-construction sound measurements do not meet the statutory requirements, noise mitigation plans will be implemented, and the post-construction sound measurements will be repeated and the results will be filed in a subsequent report in the docket.~~

~~If the post construction sound measurements or complaint-triggered monitoring demonstrate an exceedance of the statutory requirements, the Applicant is required to:~~

- ~~a. file to the docket in Case No. U-22044, within 30 days, a corrective action plan identifying source(s), mitigation measures, and schedule;~~
- ~~b. implement reasonable interim operational controls, including, where necessary to restore compliance, low-noise operating modes, curtailment, or temporary shutdown of the specific sound-emitting equipment while permanent mitigation is designed and installed;~~
- ~~c. implement permanent noise mitigation as expeditiously as practicable, not to exceed 90 days unless otherwise approved by the Commission;~~
- ~~d. repeat measurements, consistent with AFIP Attachment D, with mitigation measures in place until the statutory limits are met; and~~
- ~~7.e. file the results in a subsequent report to the docket in Case No U-22044.~~

11. ~~An agreement by Tthe Aapplicant is required to design and operate the facility in demonstrate compliance with MCL 460.1226(8)(a)(iv), and to demonstrate compliance with that statutory requirement in accordance with sound modeling and measurement procedures adopted by the Commission with the sound provisions in the statute upon request by the Commission MPSC in response to customer complaints and to maintain compliance with the sound provisions in the statute by implementing additional noise mitigation measures during facility operations should the sound levels be non-compliant with the statute.~~
12. ~~For a wind project, an agreement by the applicant to mitigate shadow flicker that does not meet the statutory provisions, report to the Commission on the mitigation plans, and report to the Commission on the results of the mitigation to reduce the shadow~~

- ~~flicker. Such reports shall be filed in the MPSC docket assigned to the project. Not applicable.~~
13. ~~An agreement by the applicant to, at the applicant's cost, contract with a third party to conduct a pre-construction study of radio reception near planned installation of wind facilities and to remedy, at the applicant's cost, any impacts to reception caused by the wind energy facility and restore reception to at least the levels present before the wind energy facility began operations. If no impact is expected, provide support for why this is not necessary to include. Not applicable.~~
 14. ~~For battery storage projects, an agreement by the applicant to provide annual training for local fire departments and other first responders. For wind and solar projects, an agreement~~ The Applicant is required to conduct or provide funding for additional training for local fire departments and other first responders prior to beginning commercial operations, and then upon request, but no more than once annually.
 15. ~~Approval contingent upon receiving~~ The Applicant is required to receive approval for all necessary applicable state, federal, and local permits and all permits need to be obtained before beginning construction on the portion of the project for which the permit is necessary.
 - a. Within the Completion Report, the Applicant is required to submit all agency-required plans created after the issuance of the certificate.
 16. ~~The Applicant is required to execute the Approval contingent upon the execution of a decommissioning agreement approved by the Commission. The Applicant is required and an agreement by the applicant~~ to demonstrate that financial assurance has been acquired and will be maintained throughout the operational life of the facilities, as outlined in the decommissioning agreement.
 17. ~~An agreement by the applicant to comply with all other applicable (non-zoning) ordinances throughout the operational life of the facilities that were in effect at the time the MPSC certificate was issued. Removed.~~
 18. ~~An agreement by the~~ The Applicant is required to file annual reports to the docket in Case No. U-22044, with the first report due at the end of the calendar year in which the project reaches commercial operations. The Annual Report shall contain the following: to comply with the provision of periodic reports over time (as specified by the Commission as a condition of approval) on the amount of electricity produced per turbine or per parcel, a report listing complaints received during the time period as well as the developer/operators' response including resolution and/or plans for mitigation, a report outlining the operating condition and performance of the facilities on the site

~~(including non-producing ancillary equipment, structures, fencing, locks, gates, screening, vegetative ground cover and other items specifically listed in the condition); a report listing any failures of equipment or structures that took place during the period as well as repairs that have been made during the time period or are planned or underway, and a report of any improvements made to the site or facilities during the period as well as any planned improvements or planned changes to the site or facilities including changes to fencing or ancillary equipment during the reporting period, to be filed in the docket.~~

- a. A report showing the amount of electricity produced for the project per parcel
 - b. A summary of complaints received during the time period as well as the resolution and/or plans for mitigation;
 - c. A report outlining the operating condition and performance of the facilities on the site;
 - d. A report listing any equipment or structural failures that took place during the period, as well as repairs planned or underway;
 - e. A report listing any improvements to the site or changes to site facilities, as well as those planned or underway;
 - f. Annual Maintenance Plans, including the Applicant's lighting maintenance records (Note, this item was originally listed independently as PMC No. 19, however, Staff suggests efficiency by providing the plan as part of this Annual Report.);
 - g. Annual Inspection Results (Note, originally part of PMC No. 19.); and,
 - a-h. Proof that the financial assurance remains in effect and sufficient, as well as any other updated decommissioning materials required by the terms of the Decommissioning Agreement including Decommissioning Cost Updates and Decommissioning Plans.
19. ~~An agreement by the applicant to provide annual maintenance plans and annual inspection results in the MPSC docket assigned to the project.~~ Incorporated above as subparts 18f and 18g.
20. ~~An agreement by T~~the Aapplicant is required to utilize a project labor agreement or operate under a collective bargaining agreement for the construction and maintenance work to be performed.

21. ~~An agreement by the Applicant is required~~ to enter into an agreement with ~~the~~ Lenawee County Road Agency Commission regarding reimbursement for the repair and restoration of County roads modified or damaged during the construction process. ~~If the Lenawee County Road Commission determines that such In lieu of an agreement with a County Road Agency, a signed letter from the County Road Agency indicating that an agreement is not necessary may be submitted~~ the Applicant must provide a letter to the docket in Case No. U-22044 signed by a representative of the County to verify this determination.
22. Within 90 days of achieving the project Commercial Operation Date (COD), the Applicant must submit an ALTA/ACSM (American Land Title Association/American Congress on Surveying and Mapping) as-built survey in the Case No. U-22044 as well as a letter in the case docket that confirms the same as-built survey was submitted to the Affected Local Unit(s) in the same docket.
23. Upon any transfer in ownership of project property or facilities, the Company is required to identify the new entity responsible for decommissioning of such property or facilities, through a letter submitted to the docket in the instant case, in addition to the Applicant's commitments as provided in Exhibit A-13.1, page 4, "Change of Ownership".
24. The Applicant is required to comply with the conservation measures as stated in Exhibit A-4.4, p 51 and copied below:

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/easternmassasauga-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.

25. The final Stormwater Mitigation Plan must not be inconsistent with the requirements as described in the "Rules of the Lenawee County Drain Commissioner".
26. Upon notice to the Commission within a letter uploaded to the docket in Case No. U-22044, the Applicant is authorized to make the following changes to the project, even if the changes would otherwise not fall within the discretion provided under the AFIP:
- a. Changes to locations for the collection line crossings of existing infrastructure, waterbodies, cultural resources, county drains, and/or intercounty drains, including associated horizontal directional drilling bore pits, bore lines, and associated temporary workspaces, to the extent that such changes:
 - i. Are within the locations described in Exhibit A-1.6, Change 2;
 - ii. Would only be considered non-minor on the basis of being outside the approved project footprint; and,
 - iii. Are required by the Department of Environment, Great Lakes, and Energy; the State Historic Preservation Office; and/or the Lenawee County Drain Commissioner's Office.
 - b. Changes to the location of the generator tie-line, including length of wire and number of poles, to the extent that such changes:
 - i. Are constrained to the yellow-hatched area depicted in the application, Exhibit A-1.6, Figure 3;
 - ii. Would only be considered non-minor on the basis of being outside the approved project footprint; and,

~~i.iii.~~ Are consistent with industry-standard design principles, and otherwise minimize the length of the feature and area of disturbance except to avoid impacts, as described in the Company's responses to Staff discovery, presented in Exhibit S-5.4.

27. The Applicant is required to enter into a host community agreement with each of the ALUs. The host community agreements must, at a minimum, guarantee \$2,000 per megawatt of nameplate capacity located within the respective ALU. Such payments must be made upon commencement of operation of the facility. The Applicant must submit each executed host community agreement to the docket in Case No. U-22044. Should the Applicant be unable to execute host community agreements after good-faith negotiations with each ALU, the Applicant is required to enter into community benefits agreements with one or more community-based organizations providing benefits within or serving the residents of each ALU without a signed host community agreement. The community benefits agreement must, at a minimum, guarantee \$2,000 per megawatt of nameplate capacity located within the respective ALU in the form of payments to be used for community benefits. Such payments must be made upon commencement of operation of the facility. The Applicant must submit the executed community benefits agreement to the docket in Case No. U-22044.
28. Within 60 days of the commencement of operation of the Facility, the Applicant is to have the project's tax value assessed, and is required to provide updated tax revenue estimates based upon the assessment, which must include any construction costs to date and any applicable administrative fees under the Property Tax Administration Fee of MCL 211.44, for each of the ALUs based upon the most updated millage rates from all eligible local taxing jurisdictions available. The estimates must detail the tax revenue generated year over year through each specific millage rate to which the project would be subjected. The Applicant must submit the updated estimates to the docket in Case No. U-22044.
29. If the Applicant chooses to fulfill its financial assurance obligations under Public Act 230 of 2023 through provision of financial assurance to the Commission, the Applicant is prohibited from subtracting salvage value from

the cost to decommission facilities on land enrolled in Michigan's Farmland and Open Space Preservation Program in all future decommissioning materials produced for the project. This includes updates to decommissioning cost estimates and decommissioning financial assurance, and within the Decommissioning Agreement.

30. The Applicant shall not use dust suppressant products with petroleum-based binders or hazardous constituents as defined by state and federal regulations.

Staff Proposed Conditions – Redlined

1. The Applicant is required to enter into a Third-Party Independent Monitor (TPIM) agreement, funded by the applicant, selected in consultation with the MPSC Staff to be onsite during the periods when construction is taking place on a weekly basis to monitor the construction activities. The TPIM would be granted authority to resolve complaints and request immediate cessation of activities that the monitor can document are in breach of any plan, permit or agreement pertaining to the construction of the facility. The Applicant's TPIM is required to provide monthly reports to the Staff and the ALU on the progress of construction and continuing through the first 3 months of commercial operation.
2. The Applicant is required to participate in a pre-construction meeting with the Staff and the ALUs. The Applicant must extend invitations to attend the pre-construction meeting to each ALU(s), however, their attendance would not be required. Prior to the pre-construction meeting, the Applicant is required to:
 - a. File final drawings, plans, compliance and permits received into the E-docket for this case consistent with AFIP Section 8.1(a)(1-3).
 - b. Provide final versions of the Emergency Response Plan (A-1.9) and Fire Response Plan (A-1.10).
 - c. Provide the final version of the Unanticipated Discoveries Plan (A-1.14), including a mutually agreed upon turnaround time and/or process for the State Historic Preservation Office (SHPO) to respond to discoveries and avoidance plans submitted by the Applicant; and materials resulting from SHPO's completed review of the project, including evidence that any identified impacts to cultural resources have been addressed according to SHPO's recommendations in the final site plan.
 - d. File an updated decommissioning plan, an updated third-party decommission cost estimate, and a demonstration of financial assurance acquired to date. Such materials must reflect the planned facility layout, equipment quantities, disturbed acreage, and participating parcels; must follow the requirements of AFIP Exhibit A-13 and Section 8 and be cross-consistent in commitments, plans, and financial estimates; and must account for the land enrolled in the Michigan Farmland Open Space Preservation Program (commonly referred to as PA 116), consistent with the requirements of other conditions of this certificate. The decommissioning plan shall also include the following:

- i. Address how damage from extreme weather events or damage from human causes will be addressed, and/or how they might lead to applicant-initiated decommissioning.
- ii. Include additional soil sampling at a rate of no less than one (1) sample per 40 acres for the following:
 - A. Phosphorus, potassium, calcium, magnesium, sodium, sulfur, manganese, copper, and zinc; pH and acidity; soil organic matter content, cation exchange capacity, and topsoil depth.
 - B. Any hazardous substances contained in equipment which is introduced to the site by the Company.
- iii. Include “the reasoning and agreement with [each] property owner” for all project related facilities and equipment intended to be kept in place, including specific locations and affected property owners.
- iv. Include procedures to address issues of dust, noise, and traffic in accordance with 6.3.13(a)1 of the AFIP.
- v. Include removal methods and site clearance activities for the project substation, O&M building, gen-tie line, and points where underground collection lines enter or exit the ground at a depth less than four feet.
- vi. Include the locations of the inverters, substation, and collection line entrance and exit points as part of the 100% design set anticipated immediately prior to commencement of construction consistent with the Company’s response to discovery request GM-6-7 and 8 of Exhibit S-6.1.
- vii. Include a list of all hazardous substances including those in facility equipment (including, but not limited to solar panels and switchgears), and all information as provided in response to discovery request GM-6-11 of Exhibit S-6.1, as well as any updated information as applicable.
- viii. Include the following commitments and information in its final decommissioning plan and agreement, as well as a description of how it will meet such commitments:

- A. A commitment to repeat its pre-application soil sampling, in a manner consistent with the baseline soil health survey plan, at decommissioning.
 - B. A commitment to restoration of the project area, including soils, to a useful condition similar to that which existed before construction.
 - C. Perform remediation of any hazardous substances introduced by project activities through a release, as defined by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) 42 U.S.C. § 9601(14) and (22).
 - D. Utilize, at minimum, the Generic Residential Cleanup Criteria in R 299.46 under Part 201 of the Natural Resources and Environmental Protection Act (NREPA) as necessary to ensure the soil restoration standard in PA 233 is met with regard to the identified hazardous substances of concern.
 - E. Comply with any applicable federal environmental laws or environmental laws of this State regarding remediation which are more stringent than the criteria set forth in R 299.46.
 - F. Describe how required soil decompaction and grading will be identified and performed as provided in response to question 17 of Exhibit S-6.1.
- ix. Regarding commitments and agreements with property owners, the Company is required to replace the language in Section 6.b. of Exhibit A-13.1, with “The restoration measures agreed to by individual landowners will conform to the terms of each written landowner agreement. The land will be returned to its pre-construction condition leaving any desirable infrastructure as requested by the subsequent landowner.”
- x. The Company is required to update the language in Section 6.c. of Exhibit A-13.1, by either removing the phrase “to the extent possible” entirely, or use language that might apply to specific situations where planning and coordinating with landowners is not possible. In addition, the Company is required to include a plan, per AFIP section 6.3.13(a)5.iii, including the method of how landowners, ALUs, and

local governments will be coordinated with and timelines and methods of communication.

- e. At least 60 days prior to the pre-construction meeting, the Applicant is required to file the following:
 - i. Final Noise Modeling Report – a final noise modeling report demonstrating compliance using the final facility layout and final make and model of all operational sound sources, including inverter and transformer cooling systems and any auxiliary equipment, consistent with AFIP Attachment D requirements. The final report must include the final source sound-power data and associated source-data uncertainty or a conservative uncertainty allowance, and the final substation sound-barrier design information, including height, length, location, material, transmission loss or insertion loss, absorptive treatment, and any openings or penetrations, with confirmation that the final barrier design is acoustically equivalent to, or more protective than, the modeled design. The final report must also include a complete and internally consistent final source inventory and coordinate table confirming all modeled operational sound sources and disclose unrounded modeled results and source-category contributions at the controlling receptor and any receptor modeled at 53 dBA or higher. The final report must either retain the +5 dB tonal penalty for the inverters or substantiate its removal consistent with AFIP Table 1, including underlying one-third-octave-band or narrowband source data, receptor-level tonal-prominence calculations, and measured background sound (lowest hourly L90). If the Applicant seeks to remove the inverter tonal penalty, the final report must also include a sensitivity run retaining the penalty.
 - ii. Baseline Sound Monitoring Report – a baseline sound monitoring report, consistent with AFIP Attachment D pre-construction monitoring requirements.
 - iii. Construction Noise Control Plan – a plan describing major construction activities/equipment; standard work hours; exceptions/notice procedures; equipment maintenance/mufflers; idling limits; and specific controls for any high-noise activities, if applicable. When a complaint reasonably indicates material construction noise impacts, the Applicant must promptly investigate and implement corrective actions consistent with the construction noise control plan. If effective corrective actions cannot be implemented promptly, the Applicant is required to implement reasonable interim controls and adjust

operations as necessary to address the complained-of impacts until controls are implemented.

- f. Provide the signed and executed project labor agreement or collective bargaining agreement consistent with Condition 20.
- g. Provide any plans required under the Natural Resources and Environmental Protection Act (NREPA), upon completion by the Applicant. This includes Spill Prevention Control, and Countermeasure Plan (SPCC), Pollution Incident Prevention Plan (PIPP), Soil Erosion and Sedimentation Control (SESC) plans, and Stormwater Pollution and Prevention Plans (SWPPP), as applicable.
- h. Provide the final version of the Michigan State University Pollinator Scorecard for Solar Sites, and any vegetation and/or soil management plans.
- i. If the Applicant is unable to execute host community agreement(s) after good-faith negotiations with an ALU or ALUs, it must provide a plan identifying one or more community-based organizations providing benefits within or serving the residents of the applicable ALU(s), with which the Applicant may execute a community benefits agreement. The Applicant must thoroughly explain how the community benefits agreement executed with the community-based organization(s) will prioritize benefits to the communities in which the energy facility is to be located.
- j. The following costs are required to be included as line items in the decommissioning cost estimates:
 - i. Costs associated with insurance (bond and commercial liability, property, workman's compensation and environmental).
 - ii. Costs associated with soil assessment and remediation.
 - iii. Costs associated with decommissioning of the substation, gen-tie lines, O&M Building and access roads.
- k. To address deer entrapment, the Applicant must develop a facility-specific fencing and entrapment plan prior to the start of operations, including the following:
 - i. Regular inspections of fences for damage that could allow deer to enter over or under the fence.
 - ii. Frequent inspections for entrapped deer.
 - iii. Protocols that minimize the time that gates to the facility are left open.
 - iv. Contingency plans for removing deer that have become entrapped.

- v. Contact numbers for the local Department of Natural Resources Wildlife Division Office.
- 1. The Applicant is required to submit the decommissioning cost estimate model input parameters with the revised decommissioning cost estimate required by Proposed Minimum Condition No. 2.j.
- 3. The Applicant is required to repair or replace all public and private drainage systems damaged from construction or decommissioning processes. Drainage systems already addressed in separate agreements with the Applicant will be repaired or replaced pursuant to those pre-existing agreements. This shall include county or intercounty drains in the event there are established county or intercounty drains that are part of the public drainage system.
- 4. The Applicant is required to file a mechanical completion certificate for the facilities in the MPSC docket for Case No. U-22044.
- 5. The Applicant is required to implement a complaint resolution process provided in Exhibit A-1.16. The Applicant is required to keep up to date the following information: the name of a designated developer/operator representative provided with the authority to resolve local complaints, a dedicated phone number for complaints, an email address for complaints, and website information instructing the public on the complaint resolution process.
- 6. The Applicant is required to provide emergency contact information for the facility representative in the docket in Case No. U-22044. Initial emergency contact information must be filed prior to commencing construction, and then on an annual basis, and at the time a change is made to the designated emergency contact(s).
- 7. The Applicant is required to implement vegetative screening as described in its application and responses to Staff discovery, presented in Exhibits S-5.1 and S-5.2, and amended as follows:
 - a. The Applicant is required to plant evergreen shrubs as at least 50% of the plantings in its understory, as identified in Exhibit A-1.1, Sheet no. C.506;
 - b. The Applicant is required to plant evergreen trees that are between 5ft and 6ft in height at the time of planting;
 - c. The Applicant is required to replace all dead and dying vegetation within the next appropriate growing season; and,

- d. The Applicant is required to solicit the screening preferences of adjacent non-participating residences among the screening described here, the “no screening” option with payment in lieu of screening, and a “no screening” option with no such payment; and the Applicant is required to implement screening for each such residence consistent with its expressed preference. If no preference is indicated by a residence, the Applicant may choose to implement screening for that residence.
8. The Applicant is required to implement vegetative ground cover in consideration of Michigan State University’s “Michigan Pollinator Habitat Planning Scorecard for Solar Sites”, and avoid invasive species in its project area, by implementing at least the steps described in its application and responses to Staff discovery in Case No. U-22044, presented in Exhibit S-5.1 and S-5.2.
9. The Applicant is required to bury underground infrastructure to a minimum depth of 4 feet or as approved by the Commission as a condition to the siting certificate.
10. Prior to commencement of commercial operation, the Applicant is required to contract with and pay for a qualified, independent, third-party acoustics expert. Such expert is required to conduct post-construction sound monitoring in accordance AFIP Attachment D, ensuring that facility operation is assessed in a variety of conditions, including those associated with maximum sound emissions from the facility. Post-construction sound monitoring shall be conducted within one year after commercial operation, unless otherwise directed by the Commission. The post-construction sound monitoring report must be submitted within 60 days of the end of the field data collection. The Applicant is required to file the results in a report to the MPSC docket in Case No. U-22044.

If the post construction sound measurements or complaint-triggered monitoring demonstrate an exceedance of the statutory requirements, the Applicant is required to:

- a. file to the docket in Case No. U-22044, within 30 days, a corrective action plan identifying source(s), mitigation measures, and schedule;
- b. implement reasonable interim operational controls, including, where necessary to restore compliance, low-noise operating modes, curtailment, or temporary shutdown of the specific sound-emitting equipment while permanent mitigation is designed and installed;
- c. implement permanent noise mitigation as expeditiously as practicable, not to exceed 90 days unless otherwise approved by the Commission;

- d. repeat measurements, consistent with AFIP Attachment D, with mitigation measures in place until the statutory limits are met; and
 - e. file the results in a subsequent report to the docket in Case No U-22044.
- 11. The Applicant is required to design and operate the facility in compliance with MCL 460.1226(8)(a)(iv), and to demonstrate compliance with that statutory requirement upon request by the Commission in response to complaints.
 - 12. Not applicable.
 - 13. Not applicable.
 - 14. The Applicant is required to conduct or provide funding for additional training for local fire departments and other first responders prior to beginning commercial operations, and then upon request, but no more than once annually.
 - 15. The Applicant is required to receive approval for all necessary applicable state, federal, and local permits and all permits need to be obtained before beginning construction on the portion of the project for which the permit is necessary.
 - a. Within the Completion Report, the Applicant is required to submit all agency-required plans created after the issuance of the certificate.
 - 16. The Applicant is required to execute the decommissioning agreement approved by the Commission. The Applicant is required to demonstrate that financial assurance has been acquired and will be maintained throughout the operational life of the facilities, as outlined in the decommissioning agreement.
 - 17. Removed.
 - 18. The Applicant is required to file annual reports to the docket in Case No. U-22044, with the first report due at the end of the calendar year in which the project reaches commercial operations. The Annual Report shall contain the following:
 - a. A report showing the amount of electricity produced for the project per parcel
 - b. A summary of complaints received during the time period as well as the resolution and/or plans for mitigation;
 - c. A report outlining the operating condition and performance of the facilities on the site;

- d. A report listing any equipment or structural failures that took place during the period, as well as repairs planned or underway;
 - e. A report listing any improvements to the site or changes to site facilities, as well as those planned or underway;
 - f. Annual Maintenance Plans, including the Applicant's lighting maintenance records (Note, this item was originally listed independently as PMC No. 19, however, Staff suggests efficiency by providing the plan as part of this Annual Report.);
 - g. Annual Inspection Results (Note, originally part of PMC No. 19.); and,
 - h. Proof that the financial assurance remains in effect and sufficient, as well as any other updated decommissioning materials required by the terms of the Decommissioning Agreement including Decommissioning Cost Updates and Decommissioning Plans.
19. Incorporated above as subparts 18f and 18g.
20. The Applicant is required to utilize a project labor agreement or operate under a collective bargaining agreement for the construction and maintenance work to be performed.
21. The Applicant is required to enter into an agreement with Lenawee County Road Commission regarding reimbursement for the repair and restoration of County roads modified or damaged during the construction process. If the Lenawee County Road Commission determines that such an agreement is not necessary the Applicant must provide a letter to the docket in Case No. U-22044 signed by a representative of the County to verify this determination.
22. Within 90 days of achieving the project Commercial Operation Date (COD), the Applicant must submit an ALTA/ACSM (American Land Title Association/American Congress on Surveying and Mapping) as-built survey in the Case No. U-22044 as well as a letter in the case docket that confirms the same as-built survey was submitted to the Affected Local Unit(s) in the same docket.
23. Upon any transfer in ownership of project property or facilities, the Company is required to identify the new entity responsible for decommissioning of such property or facilities, through a letter submitted to the docket in the instant case, in addition to the Applicant's commitments as provided in Exhibit A-13.1, page 4, "Change of Ownership".

24. The Applicant is required to comply with the conservation measures as stated in Exhibit A-4.4, p 51 and copied below:

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/easternmassasauga-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.

25. The final Stormwater Mitigation Plan must not be inconsistent with the requirements as described in the "Rules of the Lenawee County Drain Commissioner".
26. Upon notice to the Commission within a letter uploaded to the docket in Case No. U-22044, the Applicant is authorized to make the following changes to the project, even if the changes would otherwise not fall within the discretion provided under the AFIP:

- a. Changes to locations for the collection line crossings of existing infrastructure, waterbodies, cultural resources, county drains, and/or intercounty drains, including associated horizontal directional drilling bore pits, bore lines, and associated temporary workspaces, to the extent that such changes:
 - i. Are within the locations described in Exhibit A-1.6, Change 2;
 - ii. Would only be considered non-minor on the basis of being outside the approved project footprint; and,
 - iii. Are required by the Department of Environment, Great Lakes, and Energy; the State Historic Preservation Office; and/or the Lenawee County Drain Commissioner's Office.
 - b. Changes to the location of the generator tie-line, including length of wire and number of poles, to the extent that such changes:
 - i. Are constrained to the yellow-hatched area depicted in the application, Exhibit A-1.6, Figure 3;
 - ii. Would only be considered non-minor on the basis of being outside the approved project footprint; and,
 - iii. Are consistent with industry-standard design principles, and otherwise minimize the length of the feature and area of disturbance except to avoid impacts, as described in the Company's responses to Staff discovery, presented in Exhibit S-5.4.
27. The Applicant is required to enter into a host community agreement with each of the ALUs. The host community agreements must, at a minimum, guarantee \$2,000 per megawatt of nameplate capacity located within the respective ALU. Such payments must be made upon commencement of operation of the facility. The Applicant must submit each executed host community agreement to the docket in Case No. U-22044. Should the Applicant be unable to execute host community agreements after good-faith negotiations with each ALU, the Applicant is required to enter into community benefits agreements with one or more community-based organizations providing benefits within or serving the residents of each ALU without a signed host community agreement. The community benefits agreement must, at a minimum, guarantee \$2,000 per megawatt of nameplate capacity located within the respective ALU in the form of payments to be used for community benefits. Such payments must be

- made upon commencement of operation of the facility. The Applicant must submit the executed community benefits agreement to the docket in Case No. U-22044.
28. Within 60 days of the commencement of operation of the Facility, the Applicant is to have the project's tax value assessed, and is required to provide updated tax revenue estimates based upon the assessment, which must include any construction costs to date and any applicable administrative fees under the Property Tax Administration Fee of MCL 211.44, for each of the ALUs based upon the most updated millage rates from all eligible local taxing jurisdictions available. The estimates must detail the tax revenue generated year over year through each specific millage rate to which the project would be subjected. The Applicant must submit the updated estimates to the docket in Case No. U-22044.
 29. If the Applicant chooses to fulfill its financial assurance obligations under Public Act 230 of 2023 through provision of financial assurance to the Commission, the Applicant is prohibited from subtracting salvage value from the cost to decommission facilities on land enrolled in Michigan's Farmland and Open Space Preservation Program in all future decommissioning materials produced for the project. This includes updates to decommissioning cost estimates and decommissioning financial assurance, and within the Decommissioning Agreement.
 30. The Applicant shall not use dust suppressant products with petroleum-based binders or hazardous constituents as defined by state and federal regulations.

Please refer to Exhibit A-1.1:

10. What stage of the engineering design process does the submitted site plan for Glacier Meadows represent? This question may be answered descriptively (e.g. conceptual, preliminary, or final design) or by providing a quantifiable percentage of completion (e.g. 10%, 50%, or 100%). If applicable, detail preliminary engineering design separately from final engineering design.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “stage,”

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“engineering design process,” “completion,” “preliminary,” and “final” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The submitted site plan represents a conceptual 10% design. The site plan was not prepared by the Project’s engineering, procurement, and construction (“EPC”) contractor, who has yet to be contracted, thus it is considered “conceptual.” The submitted 10% design is intended to represent a conservative Project footprint that will be refined through further detailed design with the Project’s selected EPC contractor.

15. Please confirm that DarkSky International's five dark sky friendly principles will be implemented during the construction phase of the facility.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term "implemented" is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed. Glacier Meadows will implement DarkSky International's five dark sky friendly principles during the construction phase of the facility. Answering further, Glacier Meadows refers to and incorporates by reference Exhibit A-11 (Dark Skies) from its Application.

14. Please explain how and at what days and times lighting will be used during the construction phase of the facility.

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RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “how,” “days and times,” and “lighting” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Temporary lighting is anticipated to be used during the early morning and late afternoon hours and mainly around the Project’s site office and laydown areas. Answering further, Glacier Meadows refers to and incorporates by reference Exhibit A-11 (Dark Skies) from its Application.

GLACIER MEADOWS SOLAR, LLC'S RESPONSE TO THE
MICHIGAN PUBLIC SERVICE COMMISSION STAFF REQUEST
SET NO. 9
CASE NO. U-22044

REQUEST NO. Staff-GM-9-1

Please refer to Exhibit A-14:

5. Regarding Condition No. 3, please confirm whether the Applicant's agreement to repair or replace all public and private drainage systems damaged during construction or decommissioning includes county and intercounty drains.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "agreement" is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed that Glacier Meadows' agreement to repair or replace all public and private drainage systems damaged during construction or decommissioning includes county and intercounty drains.

6. Regarding Condition No. 15, please confirm whether the Applicant's agreement to obtain all necessary applicable state, federal, and local permits also represents agreement to obtain necessary permits before beginning construction on the portion of the project for which the permit is necessary.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "confirm," "agreement," "applicable," "obtain," "portion of the project," and "necessary" are vague,

ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed that Glacier Meadows will obtain and comply with all lawfully required permits and conditions of approval.

Please refer to Exhibit A-13.2, page 5 of 16, Table 1:

15. Insurance was not specifically identified in Table 1 or elsewhere within Exhibit A-13.2. Please provide a line item to include the following types of insurance:

- a. Bond and commercial liability;
- b. Property;
- c. Workman's Compensation; and
- d. Environmental liability.

If not provided as a line item, please indicate where and how these costs are accounted for.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term "insurance" is vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: The decommissioning cost estimate within Exhibit A-13.2 does include the costs of the various insurance types stated above. Section 4.1 discusses that the costs of insurance are included in the line item "soft costs." Soft costs are not limited to insurance costs, and the

total for all soft costs is presented in Table 3. Soft costs are combined with mobilization costs and presented as a line item in Table 1.

16. Many unit costs were provided in Exhibit A-13.2, and some project quantities were referenced in Exhibit A-1.1 Sheet C.005. However, no unit values were provided for labor hours for each category in Table 1. Since a model was used to develop the costs, please provide all model input parameters (i.e., number of units) in addition to unit rates.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “unit costs,” “project quantities,” “unit values,” “labor hours,” “model,” “costs,” “model input parameters,” and “unit rates” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Exhibit A-13.2 Page 7, Table 4, lists labor costs assumptions in dollars per hour, for the three labor types assumed to contribute during the decommissioning of the Project. Table 4 also includes transportation rates for all truck types assumed in the calculations. Page 5 of Exhibit A-13.2 lists values for scrap prices, recycling prices, and landfill prices, presented in dollars per ton. These labor, transportation, and disposal costs represent the unit rates used in the decommissioning calculations. Page 4 of Exhibit A-13.2 references the project quantities, used as the inputs to the decommissioning calculations, are correlated to the project quantities identified in Exhibit A-1.1. Glacier Meadows requests that Staff initiate a meet and confer if it requires additional information or updated tables in connection with this Request.

Dated: July 10, 2026

Respectfully submitted,

GLACIER MEADOWS SOLAR, LLC

By: Ørsted Onshore DevCo, LLC, its sole member
By: Ørsted Onshore North America, LLC, its sole
member

/s/ Marla Korpar

Marla Korpar, Director of Development
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Attorneys for Glacier Meadows Solar, LLC

Staff's Second Discovery Request to Company and Responses, including Supplemental Responses and Attachment, Items 1 and 2

Please refer to Exhibit A-1.6:

1. Please provide definitions for Project footprint, Project area, and Project Site and clarify how each is measured in the application.

RESPONSE: Glacier Meadows objects to this Request as the term “measured” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject and without waiving any objections, Glacier Meadows states as follows: The terms Project footprint, Project area, and Project Site are all used to describe the Project’s leased acreage making up the Project boundary: approximately 2,213 acres. This represents the full area within which the Project has land rights to install facilities, conduct earthwork during construction, etc. Refer to Exhibit A-1.1, sheet C.002, in Glacier Meadows’ Application for the project boundary.

Please refer to Exhibit A-1.3:

2. The Michigan Pollinator Habitat Planning Scorecard for Solar Sites outlines a plan to establish, but not to maintain, pollinator habitat. The application, Exhibit A-1.1, contains references to a “vegetation management plan” and a “vegetation and soil management plan,” but no such document appears to have been provided.

a. Please provide the maintenance plan or identify which portions within the application contain or describe such plan.

b. Please explain how the plan will ensure maintenance of the pollinator habitat throughout the lifetime of the proposed facility.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “ensure maintenance” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. Consistent with standard industry practice at this stage of the Project lifecycle, Glacier Meadows has not yet finalized a vegetation management plan. As such, no finalized vegetation management plan was included in the application materials. However, a draft vegetation management plan is currently being developed and will continue to be developed in coordination with the Project's selected Engineering, Procurement, and Construction ("EPC") contractor(s) through Q2 2027. Glacier Meadows is committed to ensuring its vegetation management plan meets all requirements and conditions imposed in connection with a certificate issued in this matter and any requirements necessary to meet screening and vegetation conditions imposed in connection with same.**
- b. Glacier Meadows' vegetation management plan will include a detailed maintenance schedule, including mowing and weed control, designed to encourage the persistence and dominance of pollinator habitat throughout the lifetime of the Project. Maintenance will occur at regular intervals for the duration of the Project lifecycle. The interval for such maintenance will depend on several factors, including the type of maintenance, seasonable impacts, and other factors. Intensive maintenance is anticipated during the first three to five years until sitewide vegetation has been sufficiently established and is less susceptible to the threat of competition from drought, invasive and non-native weed species, and other threats. Mowing is planned to be timed prior to flowering and seed set of weed species to facilitate native**

species' blooming periods and encourage diverse array of pollinator resources.

Weed control and monitoring will be ongoing throughout the Project's lifecycle. Both mowing and weed control will be undertaken as needed based on growth, seasonal impacts, and other factors.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows is producing a draft version of its in-progress vegetative management plan. Refer to document Bates-labeled GlacierMeadows0000066 – GlacierMeadows0000091. As discussed in connection with its original Response to Request No. 2 above, this plan is still being developed at this stage of the project lifecycle and is subject to change—including, *inter alia*, with respect to being tailored to the needs of the Project, based on feedback and requirements of the Engineering, Procurement, and Construction (“EPC”) contractor, and based on any requirements issued as a condition to a solar siting certificate in this matter. Glacier Meadows is committed to meeting the requirements of PA 233 and the AFIP with respect to the details and content of its final vegetative management plan.

GLACIER MEADOWS SOLAR PROJECT

DRAFT Vegetation Management Plan

Blissfield and Deerfield Townships, Lenawee County, MI

Prepared for:

Glacier Meadows Solar, LLC

401 N. Michigan Avenue

Suite 501

Chicago, IL 60611

Prepared by:

DNV Energy USA Inc.

19219 Katy Fwy

Suite 175

Katy, TX 77094

October 24, 2025

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1 PROJECT OVERVIEW

Glacier Meadows Solar, LLC proposes to construct and operate a ground-mounted photovoltaic solar energy system known as the proposed Glacier Meadows Solar Project (the "Project"). The Project is expected to have a nameplate capacity of 200 megawatts (MW) and is located on approximately 2,213 acres of private land in Blissfield Township and Deerfield Township, Lenawee County, Michigan.

1.1 Purpose

The purpose of this Vegetation Management Plan (VMP) is to provide a strategy and management framework for establishing and maintaining screening, landscaping, vegetative cover, and pollinator habitat sitewide in compliance with regulatory requirements. Further, this VMP also establishes maintenance practices to aid in the successful establishment of vegetation, weed control, and soil stabilization and erosion control for the duration of the Project.

Vegetation management goals addressed in this VMP include:

- Ensure regulatory compliance;
- Minimize existing noxious and invasive plant species in the Project area;
- Control noxious and invasive plant species throughout the Project lifespan;
- Revegetate with appropriate grasses and forbs native to the ecoregion;
- Provide habitat resources for wildlife; and
- Improve soil stabilization and reduce wind and water erosion.

1.2 Regulatory Context

This VMP has been prepared pursuant to the Michigan Public Service Commission (MPSC) [Public Act 233 of 2023 \(PA 233\) Application Filing Instructions and Procedures \(AFIP\)](#), which requires the establishment and maintenance of vegetative ground cover and pollinator habitat for the life of the Project. Further, the MPSC AFIP requires the Project to meet or exceed pollinator standards throughout the lifetime of the Project as established by the [Michigan Pollinator Habitat Planning Scorecard for Solar Sites](#) (Scorecard). Further, this VMP was prepared in accordance with the Michigan Department of Agriculture and Rural Development (MDARD) [Policy to Allow Commercial Solar Panel Development on Public Act 116 \(PA 116\) Lands](#).

1.3 MPSC PA 233 Requirements

- **Exhibit A-1.3(a)5 - Provide a description of the planned screening, landscaping, and vegetative cover. For solar developments, describe the plan to establish and maintain pollinator habitat and vegetative ground cover for the life of the proposed facility. This information is not required if the proposed facility is located entirely on brownfield land.**

The Project is committed to establishing and maintaining pollinator habitat and vegetative groundcover within the fenced-in areas of the Project site for the life of the Project. Refer to Exhibit A-1.1, Sheet C.202 for the Project's proposed screening and pollinator seeding plan. Refer to Exhibit A-1.1, Sheet C.507 for the sample species to be considered in the Project's pollinator and vegetative ground cover seed mixes.

For adjacent non-participating landowners who do not have preexisting natural vegetation screening, Glacier Meadows will attempt to work on vegetative screening plans with those landowners who express interest. Such landowners will have the ability to indicate a preference for the Project to a) install a mix of native trees

and shrubs along the Project fenceline; or b) reasonably compensate the landowner to install screening on their own property. The Project's proposed vegetative screening details and a list of sample species for vegetative screening is provided in Exhibit A-1.1, Sheet C.506.

- **Exhibit A-1.3(a)5.i - Describe the plan to meet or exceed pollinator standards throughout the lifetime of the proposed facility as established by the "Michigan Pollinator Habitat Planning Scorecard for Solar Sites" developed by the Michigan State University Department of Entomology in effect on February 27, 2024, or any applicable successor standards approved by the Commission.**

The Project is committed to meeting or exceeding a minimum score of 76 on the Michigan Pollinator Habitat Planning Scorecard for Solar Sites. A completed scorecard will be submitted to MPSC prior to construction once final seed mixes have been confirmed. Currently, the Project anticipates achieving a score of 78, which "meets pollinator standards." A copy of the Project's preliminary scorecard is provided in Appendix A. The Project's proposed pollinator seeding plan is provided in Exhibit A-1.1, Sheet C.202.

- **Exhibit A-1.3(a)5.ii - Explain how the seed mix used to establish pollinator plantings shall not include invasive species as identified by the Midwest Invasive Species Information Network, led by researchers at the Michigan State University Department of Entomology and supporting regional partners.**

Sample species to be considered in the seed mix to establish pollinators in the Project area are provided in Exhibit A-1.1, Sheet C.507. The Project will work with its EPC contractor to develop and implement a regionally appropriate pollinator seed mix that shall not include invasive species as identified by the Midwest Invasive Species Information Network. The seed mix will be planted onsite after the completion of construction. The Project will routinely maintain the fenced-in Project site for invasive species prevention and vegetative ground cover upkeep.

- **Exhibit A-14, Condition 8 - An agreement by the applicant to implement vegetative ground cover in consideration of Michigan State University's "Michigan Pollinator Habitat Planning Scorecard for Solar Sites" and avoiding invasive species as approved by the Commission as a condition to the siting certificate.**

Glacier Meadows agrees to implement vegetative ground cover throughout the Project area in consideration of the Scorecard, and agrees to avoid invasive species as approved by the Commission.

- **Exhibit A-14, Condition 18 - An agreement by the applicant to comply with the provision of periodic reports over time (as specified by the Commission as a condition of approval) on the amount of electricity produced per turbine or per parcel, a report listing complaints received during the time period as well as the developer/operators' response including resolution and/or plans for mitigation, a report outlining the operating condition and performance of the facilities on the site (including non-producing ancillary equipment, structures, fencing, locks, gates, screening, vegetative ground cover and other items specifically listed in the condition), a report listing any failures of equipment or structures that took place during the period as well as repairs that have been made during the time period or are planned or underway, and a report of any improvements made to the site or facilities during the period as well as any planned improvements or planned changes to the site or facilities including changes to fencing or ancillary equipment during the reporting period, to be filed in the docket.**

Glacier Meadows agrees to comply with all reporting requirements as required by the Commission, specifically as it pertains to vegetative ground cover.

1.4 MDARD PA 116 Requirements

- Within the fenced area and where it is suitable, the site should be designed and planned to achieve a score of at least 76 on the Michigan Pollinator Habitat Planning Scorecard for Solar Sites. The pollinator habitat area must allow for replanting when the usable life of the pollinator habitat expires. The ground cover is to be established and maintained. MDARD expects this will be the Solar Project Company's responsibility under the Commercial Solar Agreement.

The Project is committed to meeting or exceeding a minimum score of 76 on the Michigan Pollinator Habitat Planning Scorecard for Solar Sites. A copy of the Project's preliminary scorecard is provided in Appendix A.

- Any portion of the site not included in pollinator plantings must maintain United States Department of Agriculture – Natural Resource Conservation Service [Conservation Cover Standard 327](#).

The Project will maintain Conservation Cover Standard 327 in portions of the site that are not included in pollinator plantings.

1.5 Site Description

The Project is located within the Maumee Lake Plain Level IV Ecoregion of the Huron/Erie Lake Plains Level III Ecoregion, which is characterized by fertile plains and artificially drained, productive cropland producing corn, soybeans, and livestock [1]. Natural vegetation in the Ecoregion includes elm-ash swamp and beech forests, with oak savannas restricted to dunes and beach ridges. Forests and marshlands that previously dominated the region have since been drained and are now used for agriculture with corn (*Zea mays*) and soybeans (*Glycine max*) as dominant crops.

The climate is characterized by cold winters (18–32° Fahrenheit [-8–0° Celsius] in January) and warm summers (62–84° Fahrenheit [17–29° Celsius] in July) with an average of 32 inches (81 centimeters [cm]) of precipitation per year [2].

The Project area is comprised primarily of cultivated land used for row crop agricultural activities [3]. The surrounding landscape primarily consists of cultivated agricultural land, River Raisin, and includes a small number of developed areas associated with residential properties, small-scale commercial properties, and farming land uses.

1.6 Site Characterization

Between 2022 and 2025, several site characterization studies to identify wetlands, vegetation cover, soils and topography, and protected species and habitat were conducted within the Project area.

1.6.1 Vegetation Communities

Existing vegetation community and land covers at the Project site were mapped and verified during desktop analyses and field study efforts conducted between 2022-2024. Agricultural land and developed/paved surfaces comprised the majority of the study area, while forested, ruderal, and wetland/riparian communities were observed at low densities. The primary vegetative cover in the Project Area is characterized by agricultural fields cultivated primarily with soybeans (*Glycine max*), corn (*Zea mays*), winter wheat (*Triticum aestivum*), alfalfa (*Medicago sativa*), cabbage (*Brassica oleracea*), and other vegetables. Forest, ruderal/disturbed, and developed land covers constitute the remainder of the Project area. Forested areas are characterized by shagbark hickory (*Carya ovata*), pin oak (*Quercus palustris*), red maple (*Acer rubrum*), and ash (*Fraxinus* sp.).

1.6.1.1 Prior Vegetation Communities

Due to the agricultural condition of the Project area and surrounding landscape, few native plant species remain within the Project area, and vegetation communities and assemblages which previously occurred are no longer intact. According to the Michigan Natural Features Inventory [4], the Project area was likely previously inhabited by dry-mesic and/or mesic prairie vegetation communities. Both communities are native grasslands dominated by little blue stem (*Schizachyrium scoparium*), big blue stem (*Andropogon gerardii*), and Indian grass (*Sorghastrum nutans*). These communities are often associated with oak woodland openings throughout southern Lower Michigan on loam, sandy loam, or silt loam soils. Due to widespread agricultural activities throughout southern Lower Michigan, prairie vegetation communities are generally absent. Vegetation assemblages are generally considered to be dominated by perennial grasses interspersed with forbs such as butterfly weed (*Asclepias tuberosa*), smooth aster (*Symphotrichum leave*), and black-eyed Susan (*Rudbeckia hirta*).

1.6.2 Protected Species

Field assessments occurred between 2022-2025 to evaluate the presence of potential habitat for federal- and/or state-listed plant and wildlife species and to record listed species observations. Minimal suitable habitat for state and federally listed species was observed within the Project area. Forested habitat suitable for use by listed bat species for roosting and foraging was noted within the Project area; however, presence/probable absence surveys conducted in July 2022 resulted in a probable absence of listed bats (including the northern long-eared bat [*Myotis septentrionalis*; federally endangered, state threatened] and Indiana bat [*Myotis sodalis*; federally endangered, state endangered]). Monarch butterfly (*Danaus plexippus*, federally proposed threatened) was observed during field surveys, as well as milkweed, a host plant for the species. No migratory birds of concern were observed. Suitable habitat for cup plant (*Silphium perfoliatum*; state-threatened) and toadshade (*Trillium sessile*; state-threatened), characterized by moist soils, floodplains, and wet wooded areas, was documented within forested wetland areas; however, neither species was observed during field surveys.

1.6.3 Soils and Topography

According to Natural Resources Conservation Service Web Soil Survey data [5], the Project area is dominated by glaciofluvial deposits and alluvium. There is no prime farmland within the Project area. Approximately 95.8% of the Project area is classified as prime farmland, if drained, 0.78% prime farmland if protected from flooding or not frequently flooded during the growing season, 2.03% farmland of local importance, and 1.4% not prime farmland. The water table is shallow and most of the soils are classified as poorly drained to somewhat poorly drained. Soils in the Project area consist primarily of very fine sandy loam, fine sandy loams, and loams. Topography is relative flat throughout the Project area.

1.6.4 Wetlands and Waterbodies

Wetland and stream delineations were completed between 2022-2025. The Project area contains 23 wetland totaling approximately 8.8 acres, 12 stream segments totaling approximately 33,199.48 linear feet, five man-made ditches totaling approximately 5,601.25 linear feet, and nine drains/culverts. A jurisdictional determination has not yet been obtained for the Project. The Project will avoid and minimize impacts to jurisdictional wetlands and waterbodies to the extent practicable.

2 VEGETATION ESTABLISHMENT STRATEGY

The Project's Vegetation Establishment Strategy was designed in accordance with the MPSC PA 233 AFIP, the Michigan Pollinator Habitat Planning Scorecard, and MDARD PA 116 requirements. General management strategies outlined below are based on site-specific information obtained through site characterization studies as well as a review of local vegetation resources, including the University of Michigan Herbarium [6], Michigan Department of Natural Resources [7], and Michigan State University Extension [8]. Key recommendations and considerations for the

Project include plant and seed mix species selection, site preparation, seed installation, and maintenance. Refer to **Error! Reference source not found.** for an overview of the proposed sitewide vegetation strategy.

The preliminary Scorecard prepared for the Project is provided in Appendix A. The Scorecard may be updated over the course of Project development and construction in response to changes in construction plans, the availability of materials (e.g., seeds and plantings), and scheduling. Refer to Exhibit A-1.1, Sheet C.202 for the Project's proposed screening and pollinator seeding plan. Refer to Exhibit A-1.1, Sheet C.507 for the sample species to be considered in the Project's pollinator and vegetative ground cover seed mixes.

2.1 Plant Species Selection

The plant species identified in the section below were selected for the Project based on a variety of factors. Most notably, the species provided in Table 2-1 and **Error! Reference source not found.** are native to Lenawee County [6], provide a diverse array of pollinator resources [9], and have been planted at other projects throughout the region [10]. In addition, these plant species were selected based on characteristics including height, habitat, soil type, and blooming period in order to coincide with Project attributes (e.g., panel height, soil type) and satisfy the requirements of the Scorecard.

Sample seed mixes including seeding rates are provided in Table 2-1 and **Error! Reference source not found.**, however, seed mixes are subject to change based on seed availability and seed vendor recommendations. A comprehensive list of suggested species for the Project is provided in Appendix C to help select plant species for additional seeding efforts and to serve as substitutions should species in the sample seed mixes be unavailable. In addition, recommended tree and shrub species for vegetative screening are provided in **Error! Reference source not found.**. A list of suggested local seed suppliers is provided in Appendix B.

2.1.1 Array Seed Mix

A diverse pollinator-friendly seed mix will be installed beneath the solar arrays throughout the Project area. The array seed mix shall be designed to feature low-growing native resilient species capable of withstanding regular mowing and/or grazing. The array seed mix shall balance species diversity, cost, and coincide with maintenance limitations and height restrictions.

Per the Project's Scorecard, the array seed mix shall feature a low-growing wildflower mix or clover/grass mix. The seed mix shall consider forbs that bloom between spring (April-May), summer (June-August), and fall (September-October). Additionally, the array seed mix shall include wildflower seeds to achieve wildflower cover across 26-50% of the site (when averaged across the site along with the perimeter seed mix) using at least 40 seeds/square foot. Table 2-1 provides a sample array seed mix featuring two native grass species and five native forb species featuring approximately 77 seeds per square foot.

Table 2-1 Sample Solar Array Seed Mix

Common Name	Scientific Name	Minimum Pure Live Seed (PLS) (%)	Mean Height (feet)	PLS Ounces	PLS Pounds
Blue grama grass	<i>Bouteloua gracilis</i>	75	1.5	32	2
Butterfly weed ¹	<i>Asclepias tuberosa</i>	60	2	16	1
Hoary vervain ¹	<i>Verbena stricta</i>	85	1.5	16	1
June grass	<i>Koeleria macrantha</i>	80	1.5	12	0.75
Nodding wild onion	<i>Allium cernuum</i>	60	1.5	4	0.25
Path rush	<i>Juncus tenuis</i>	55	0.75	4	0.25
Sand coreopsis	<i>Coreopsis lanceolata</i>	65	1.5	16	1
Total per Acre				100	6.25

¹ Based on the approximate species height. These selections may be adjusted.

2.1.2 Perimeter Seed Mix

The perimeter seed mix will be installed throughout temporary impact areas (e.g., construction laydown yards, temporary access roads) and along the edges of the arrays to the Project fence line. The perimeter seed mix will feature species that are native, occur onsite or in the immediate vicinity, and provide a diverse array of pollinator resources during the spring, summer, and fall. Since the Project perimeter areas would not require as much maintenance or be restricted by height, the diversity and application density (seeds per square foot) may be higher.

Per the Project's Scorecard, the perimeter seed mix shall include 16-20 flowering plant species. The seed mix shall consider forbs that bloom between spring (April-May), summer (June-August), and fall (September-October). Additionally, the perimeter seed mix shall include wildflower seeds to achieve wildflower cover across 26-50% of the site (when averaged across the site along with the array seed mix) using at least 40 seeds/square foot. **Error! Reference source not found.** provides a sample perimeter seed mix that includes two native grass species and eight native forb species featuring approximately 115 seeds per square foot.

Table 2-2 Sample Perimeter Seed Mix

Common Name	Scientific Name	Minimum Pure Live Seed (PLS) (%)	Mean Height (feet)	PLS Ounces	PLS Pounds
Black-eyed susan	<i>Rudbeckia hirta</i>	80	2	8	0.5
Bottlebrush grass	<i>Elymus hystix</i>	90	3.5	8	0.5
Canada goldenrod	<i>Solidago canadensis</i>	80	4.5	4	0.25
Columbine	<i>Aquilegia canadensis</i>	70	2	8	0.5
Golden alexanders	<i>Zizia aurea</i>	80	3	12	0.75
Hairy beardtongue	<i>Penstemon hirsutus</i>	80	2	4	0.25
Indian grass	<i>Sorghastrum nutans</i>	90	5	16	1
New England aster	<i>Symphotrichum novae-angliae</i>	70	4.5	12	0.75
Pinnate prairie coneflower	<i>Ratibida pinnata</i>	88	4	12	0.75
Yarrow	<i>Achillea millefolium</i>	80	2	4	0.25
Total per Acre				88	5.5

2.1.3 Vegetative Screening

The Project will install vegetation along the Project fence line in select areas to screen the Project from non-participating landowners who express interest in screening. Alternatively, the Project will reasonably compensate non-participating landowners who express interest in screening to install and maintain screening on their own property. For vegetative screening planned on the Project site, Glacier Meadows will utilize self-sustaining, hardy, native species that provide habitat value and visually screen the Project. This shall include 2-3 overstory species and 2-3 understory species. Spacing between individual shrubs or trees will depend on the chosen species. Native species that are ideal candidates for visual screening, including some species recommended by the Michigan State University (MSU) Extension Pollinator Protection Program [8], are listed in [Error! Reference source not found.](#).

Table 2-3 Sample Species for Vegetation Screening

Common Name	Scientific Name	Habit	Approximate Height (feet)	Documented within the Project Area
OVERSTORY				
American basswood	<i>Tilia americana</i>	Deciduous	75-130	No
Arbor vitae	<i>Thuja occidentalis</i>	Evergreen	20-30	No
Hackberry	<i>Celtis occidentalis</i>	Deciduous	40-60	Yes
Eastern white pine	<i>Pinus strobus</i>	Evergreen	50-80	No
Eastern red cedar	<i>Juniperus virginiana</i>	Evergreen	30-40	No
Red maple	<i>Acer rubrum</i>	Deciduous	40-60	Yes
UNDERSTORY				
Black-eyed Susan	<i>Rudbeckia hirta</i>	Deciduous	2-3	No
Common ninebark	<i>Physocarpus opulifolius</i>	Deciduous	5-9	No
Pussy willow	<i>Salix discolor</i>	Deciduous	6-25	No
Red-berried elder	<i>Sambucus racemosa</i>	Deciduous	5-20	No
Red osier dogwood	<i>Cornus sericea</i>	Deciduous	6-9	No
Switchgrass	<i>Panicum virgatum</i>	Deciduous	3-6	No
Winged sumac	<i>Rhus copallina</i>	Deciduous	10-25	No

2.2 Site Preparation

Site preparation shall include weed control, soil preparation and testing, and topsoil salvage and stockpiling (if substantial grading is required).

Site personnel will oversee site preparation activities and provide recommendations for non-native and invasive species control and timing of maintenance in accordance with site conditions. Furthermore, they will assist with protection of native vegetation areas during construction to avoid, minimize, and mitigate impacts to native vegetation and other sensitive biological resources, to the extent practicable.

Throughout construction, they will oversee installation of the desired native seed mix and container plants (if applicable). They will inspect the seed mix and container plants to ensure they are free of invasive species, pathogens, pests, and are consistent with the approved species identified. If a prescribed species is not available at

the time of installation, they may prescribe a replacement. Refer to Appendix C for a list of recommended native, pollinator-friendly species.

2.2.1 Weed Control

Early, preventative weed control efforts shall be conducted in accordance with the Scorecard. Early and preventative weed control efforts will aim to deplete the non-native and invasive species from the seed bank and prevent competition to germinating species from the applied seed mix. Beginning weed control efforts prior to grading and earthwork activities is preferred. If this isn't feasible, weed control efforts shall occur immediately following the cessation of earthwork and grading. To the extent practicable, preventative weed control efforts shall be conducted during the growing season prior to site-wide seeding efforts.

- **Weed Control Strategy #1:** Planting a temporary nurse crop (i.e., ryegrass, oats, short lived perennials, legumes, and forbs) prior to construction is an effective strategy for outcompeting and preventing the establishment of weeds, preventing erosion, retaining soil moisture, and improving soil quality. Depending on the species selected for temporary nurse crops, maintenance (e.g., mowing) may be required to prevent the crop from going to seed and becoming a weed problem when trying to establish native cover. The Project may plant nurse crops that will not produce viable seed, therefore, negating the need for maintenance, subject to seed availability. Temporary seeding may be conducted prior to construction, and once or twice during construction at the beginning of each growing season (April/May).
- **Weed Control Strategy #2:** Alternatively utilizing a grow-kill cycle is another effective weed control strategy. Over the course of one year prior to restoration seeding, weed control efforts shall be timed to occur following major rain events, or at least three times per year, and based on the growth and development of weed species onsite. The grow-kill strategy works by allowing weed species to grow following rain events and then killing weeds prior to flowering and seed set. This strategy depletes the weed species in the seed bank and prevents them from setting seed that may germinate in the future and outcompete species in the applied seed mix. A grow-kill strategy can be implemented using manual, mechanical, biological, and chemical control methods. See Section 3 for a discussion of weed control methods. If chemical control methods are utilized, only non-persistent, low toxicity herbicides will be used during site preparation.

2.2.2 Soil Preparation

Soil preparation shall be completed to ensure that the land is able to be returned to agricultural use upon decommissioning, in accordance with PA 233 and MDARD PA 116 requirements. Soil preparation for site restoration will include baseline soil nutrient measurements or testing to assess soil nutrients and determine if soil amendments may be required to support Project vegetation. Other soil preparation activities include topsoil salvage and redistribution (if needed), grading/earthwork, soil decompaction, and soil preparation for seeding.

2.2.2.1 Topsoil Testing

Soil testing shall be conducted prior to weed control to establish a baseline for Project restoration and a second time prior to seeding. Soil testing prior to seeding shall be conducted after all earthwork, grading, decompaction, and topsoil redistribution is complete (as described in Section 2.2.2.2). Soil testing will assess the overall health of the topsoil and available plant nutrient levels including pH, phosphorus, potassium, magnesium, calcium, and organic matter.

2.2.2.2 Topsoil Salvage and Treatment

Topsoil salvage is recommended when substantial soil removal (cut) is required for the Project. The Project is relatively flat, and earthwork and grading is expected to be minor. If significant grading and earthwork is required, topsoil salvage may be required.

Existing access road beds will be removed to the subgrade. New roads will be constructed with 8-12 inches of cement treated subgrade and the laydown yard and roads will be surfaced with 4 inches of road aggregate for the surface material after the topsoil has been segregated and stockpiled. Salvaged topsoil may be included in ongoing weed control efforts and covered or seeded with a cover crop to prevent weed species from germinating during temporary stockpiling. After earthwork activities have been completed, stockpiled topsoil may be redistributed across the site.

If soil compaction is anticipated to occur due to heavy equipment and vehicular traffic during Project construction, it is recommended that the first four to eight inches of topsoil is ripped or tilled prior to seeding. In addition, creating microtopography on the soil surface using a sheepsfoot roller or imprinter prior to seeding may also enhance seed contact with the soil and water infiltration, ultimately improving the germination rate from the applied seed mix.

2.2.3 Signage and Communication

In accordance with the Scorecard, signage will be installed around the perimeter of the Project stating, "Pollinator Friendly Solar Habitat." Signage will be legible from at least 40 feet away from the Project.

2.3 Seed Installation

Seed installation shall occur in the spring and early summer (April – June) and/or late fall to mid-winter (October – February) when snow is absent. Seeding and planting shall be avoided during hot summer months (July-September) to avoid seedling mortality and poor germination rates. In general, it is recommended that forb installation occurs in the fall and grasses in either spring or fall. The Project's seed installation recommendations include:

- Utilize a no-till grain drill or large broadcast seeder for planting large areas. Alternatively, utilize a mechanical seeder or hand broadcasting (however these methods are less efficient and cost-effective for large areas).
- Minimize soil disturbance during seeding to reduce the germination of weed species and subsequent competition with applied seed mix.
- Add a bag of inert, cracked oat to help evenly distribute the seed since native seeds tend to be very small [7].
- Immediately following broadcast seeding, rake or chain drag the area to ensure the seed is lightly buried, maximizing soil contact.

Seed installation methods will vary based on the availability of equipment, plant species selected for seeding, and the season.

3 MAINTENANCE AND WEED CONTROL STRATEGY

The Project is committed to a progressive, adaptive, and ecologically beneficial approach to managing vegetation in the Project area that minimizes adverse effects to existing soil and vegetation conditions, protected species habitat, and the surrounding landscape. The following section describes the Project's vegetation management approach throughout construction and operations.

3.1 Best Management Practices

The best management practices (BMPs) outlined in this section are based on industry standards, local, state, and federal regulations, the Scorecard, and the Ørsted Onshore Corporate Solar Wildlife Protection Plan (WPP) [11].

3.1.1 Construction

Vegetation management BMPs during Project construction are listed below:

- Equipment and vehicle traffic will be limited to established roads or specific construction pathways during construction to reduce habitat disturbance, minimize the potential for soil compaction, and prevent spread of invasive and non-native vegetation species. Construction traffic, parking, and laydown areas will be located within previously disturbed lands to the extent practicable.
- Minimize of vehicle traffic on exposed soils during site clearing, grubbing, grading and topsoil removal.
- Construction footprints will be minimized in areas of native vegetation. Disturbed soils, if not replanted with crops, will be reclaimed with weed-free native grass and forbs, if approved by landowner.
- Areas of native vegetation will be marked for construction crews to highlight their location and minimize disturbance in those areas.
- Avoid forested areas that were identified as suitable habitat for state-threatened cup plant and toadshade.
- Exclude cup plant and toadshade from pollinator seed mixes.
- Work areas will be delineated using erosion fencing, or other barrier, to minimize seed transfer.
- A site-specific worker environmental training program will be developed and implemented throughout the construction of the Project. All employees and contractors working in the field will be required to attend an environmental training session prior to working onsite.
- Any use of herbicides, fertilizers, and other chemicals will be in accordance with federal and state laws to minimize drift and other impacts on native habitat. Insecticides will not be used on the Project site, in accordance with the Scorecard.
- Developing a Stormwater Pollution Prevention Plan (SWPPP; including BMPs for minimizing drainage and sediment wash into waterways).
- Implementing minimum disturbance techniques, such as matting, reduced soil stripping, minimized fencing and reduced road grades.
- Scheduling grading to avoid times of high runoff volumes, wherever practicable.
- Vegetation clearing and tree removal will occur between August 16 – March 14, outside the peak bird nesting season, to the extent practicable.
- Salvaging of topsoil may occur in areas subject to high vehicular traffic or compaction as a result of construction activities and topsoil will be stockpiled onsite and re-distributed prior to seeding.
- Establishing vegetation sitewide, including below the solar panels and around the perimeter of the site will be implemented in conformance with the Scorecard and regulatory requirements, as summarized in Section 2 of this VMP.
- Regular inspection and cleaning of construction vehicles and equipment.
- Inspecting seed mixes and plants prior to installation to ensure they are free of pests, disease, and invasive species.

3.1.2 Operations and Maintenance

Vegetation and soil maintenance will be more time- and cost-intensive during the first three to five years following seed installation and planting, however, successful implementation of this VMP is intended to create sustainable vegetation assemblages requiring minimal maintenance for the majority of the Project's lifecycle. Vegetation management BMPs during Project operations and maintenance are listed below:

- A site-specific worker environmental training program will be developed and implemented throughout the construction of the Project. All employees and contractors working in the field will be required to attend an environmental training session prior to working onsite.

- Implementing minimum disturbance techniques, such as matting, reduced soil stripping, minimized fencing, and reduced road grades.
- Equipment and vehicle traffic will be limited to designated, controlled access roads during operations to reduce habitat disturbance, minimize the potential for soil compaction, and prevent spread of invasive and non-native vegetation species. Clear delineation of work areas using erosion fencing, or other barrier, to minimize seed transfer.
- Regular inspection and cleaning of operations vehicles and equipment.
- Vegetation maintenance methods (refer to Section 3.2) under consideration include mowing (manual or autonomous), grazing, manual and mechanical weed control methods, and chemical weed control methods.
- Landscaping and vegetation clearing will occur between August 16 – March 14, outside the peak bird nesting season, to the extent practicable.

3.2 Vegetation Maintenance and Weed Control

To ensure the successful establishment and maintenance of Project vegetation, maintenance will occur at regular intervals for the duration of the Project lifecycle. Intensive maintenance is expected only to be required during the first three to five years until sitewide vegetation has been sufficiently established and is less susceptible to the threat of competition from drought, invasive and non-native weed species, and other threats. Ongoing weed control is a constant and iterative process that requires preventative efforts, regular monitoring for early detection and eradication, and prioritization of treating large weed infestations and invasive species upon discovery. The following section details the long-term vegetation and weed control strategy for the Project. Given the size of the Project area, mowing and grazing are considered the most efficient and cost-effective vegetation maintenance and weed control option. Table 3-1 provides a comparison of the two methods in addition to supplemental weed control via mechanical/manual and chemical control methods.

Table 3-1 Maintenance and Weed Control Schedule

Year	Mowing	Grazing	Supplemental Weed Control
0	Mow the site two times throughout the growing season (spring/early summer and late summer/early fall) to a height of 6-8 inches prior to seed set of invasive and non-native species.	Grazing prior to seeding is an option to control weeds and eliminate any temporary nurse crops. However, light grazing is recommended to prevent soil compaction prior to seeding.	Spray or mechanically treat invasive and non-native species as needed, depending on the species identified. Spraying should include a non-persistent herbicide. Manual and mechanical control methods may be substituted for herbicide application.
1	Mow the site at a height of 6-8 inches two times throughout the growing season (spring/early summer and late summer/early fall) prior to seed set of invasive and non-native species.	Grazing is not recommended during the first year of maintenance following seeding. If weed growth is substantial, light grazing may be utilized in the late summer/early fall after most native species have flowered and set seed.	Spray invasive and non-native species with a non-persistent herbicide, as needed. Manual and mechanical control methods may be substituted for herbicide application.
2-3	Mow the site at a height of 8 inches two times throughout the growing season (spring/early summer and late summer/early fall) once plants grow to approximately 12-18 inches tall.	One light rotational grazing effort may be scheduled in the late spring/early summer. Avoid overgrazing to prevent damage to establishing native species.	Spot spray invasive and non-native species with a non-persistent herbicide, as needed. Avoid applying herbicide to native plants and/or species in the applied seed mix. Manual and mechanical control methods may be substituted for herbicide application.
4-5	Mow the site once annually in the late summer/early fall to control weeds and reduce thatch. Avoid mowing when native species are in flower or setting seed, to the extent practicable.	Graze the site one or two times during the growing season (late spring or early summer) prior to weed growth and seed set. In addition, one grazing rotation may be scheduled in the fall to reduce weed seed from entering the seed bank and to reduce thatch.	Spot spray invasive and non-native species with a non-persistent herbicide, as needed. Avoid applying herbicide to native plants and/or species in the applied seed mix. Manual and mechanical control methods may be substituted for herbicide application.
6+	Mowing should no longer be required to control weeds; however, optional mowing may occur in the fall to reduce thatch. Avoid mowing when native species are in flower or setting seed, to the extent practicable.	Grazing should no longer be required to control weeds; however, optional grazing may occur up to three times annually in accordance with weed growth and seed set, and to reduce thatch accumulation.	Spot spray invasive and non-native species with a non-persistent herbicide, as needed. Avoid applying herbicide to native plants and/or species in the applied seed mix. Manual and mechanical control methods may be substituted for herbicide application.

3.2.1 Mowing

Mowing is the most commonly utilized vegetation management strategy for solar projects. The primary objective of mowing is to control weed species rather than control the height of native species since the prescribed native seed mix will be tailored to have a maximum height of growth below the solar arrays. Table 3-1 provides an overview of mowing activities for the duration of the Project's operational lifespan. The Project's mowing strategy involves:

- Timing mowing events prior to flowering and seed set of weed species and outside the peak bird nesting season (March 15 – August 15), to the extent practicable, to prevent competition to native species and to ensure the successful establishment of vegetation sitewide.
- Varying the timing of mowing events each year to accommodate different species' blooming periods thus providing a diverse array of pollinator resources. Alternatively, varying mowing on a row-by-row basis is another strategy to maximize the availability and diversity of floral resources for pollinators. Implementing a

rotational mowing schedule will promote long-term site success by increasing species richness and reducing impacts to pollinators.

- Regular high mowing during the first growing season after seeding will help prevent weed establishment, deplete weed species in the seed bank, and allow sunlight to penetrate down to where low-growing wildflowers are establishing. During the first year following seeding, mowing will occur at a height of 6-8 inches. In the second year, high mowing will be implemented as necessary (e.g., prior to weed species flowering and seed set) triggered when vegetation reaches a height of 12-18 inches. After the third year, periodic high mowing in the spring, fall or to avoid impacting native species in flower would be necessary to maintain sitewide vegetative cover.
- Mowing will be timed in accordance with rain events and the flowering of weed species to be most effective. In general, a mowing event shall occur once in the early spring (April – May) and once in the fall (September – October) to effectively control weeds and reduce the accumulation of thatch.

Mowing may be considered as the initial method for weed and sitewide vegetation management, with livestock grazing as a secondary method if determined to be economically comparable and feasible to mowing, as described in Section 0. Weed control using chemical, manual, and mechanical methods, as described in Section 3.2.3, may be required between mowing events to effectively control weed species.

3.2.2 Grazing

The Project may consider grazing as an optional alternative to mowing, if practicable. Grazing may provide a host of benefits for native vegetation communities including selective grazing of undesirable species (weeds), increasing soil aeration, improving soil quality, increasing biodiversity, and reducing soil compaction. In addition to grazing, weed control using chemical, manual, and mechanical (e.g. mowing and weed whacking) methods may be required to effectively control weed species before and after grazing. If utilized, the Project's grazing strategy involves:

- Grazing is recommended to occur at least two times annually for the first five years of the Project to support the establishment of native species. Grazing may be scheduled in late spring or early summer (May-July) to maximize weed growth prior to grazing, however, grazing timed before most weed species have set seed is optimal for reducing the prevalence of weed species.
- Substantial preparation and planning is recommended to effectively utilize grazing as a maintenance strategy. Temporary fencing, water tanks, site monitoring (graziers), and precautions to prevent damage to solar arrays is recommended.
- A rotational grazing schedule is required to responsibly manage grazing activities and prevent over-grazing and damage to native vegetation, erosion, and soil compaction. For optimal results, beginning after the first year to allow native species to establish and to prevent impacts from potential overgrazing and trampling is preferred.
- Sheep are the preferred type of livestock for maintaining solar projects. Up to 5-6 sheep per acre is recommended to control vegetation growth.

Grazing may be considered as a rotational or permanent method of weed and sitewide vegetation control. Considerations for use may be based on livestock availability, associated costs from the livestock provider, and any site improvements required such as water tanks and precautions necessary to prevent damage.

3.2.3 Supplemental Weed Control

The Project will take measures during operations to control invasive weeds at the Project. Table 3-2 lists invasive terrestrial plant species that are identified by the Michigan Invasive Species Program [12] and the Midwest Invasive Species Information Network (MISIN) [13] as species of concern, restricted, or prohibited within the state. Michigan's prohibited and restricted species are governed by Part 413 of the Natural Resources Environmental Protection Act (NREPA; Act 451 of 1994). The species listed in Table 3-2 are recommended for control and removal from the Project area immediately upon discovery to protect the ecological integrity of the Project and to prevent competition to establishing native species. In addition to invasive plant species, non-native species may also pose a risk to establishing native vegetation. Although not as competitive as some invasive species, common non-natives species may proliferate and outcompete recently germinated native species in the early stages of native vegetation establishment efforts.

Common weed species expected to occur within the Project area, Lenawee County, and/or throughout Michigan include, but are not limited to, annual bluegrass (*Poa annua*), broadleaf plantain (*Plantago major*), buckhorn plantain (*Plantago lanceolata*), chicory (*Cichorium intybus*), clover (*Trifolium* spp.), common chickweed (*Stellaria media*), common purslane (*Portulaca oleracea*), creeping thistle (*Cirsium arvense*), crownvetch (*Securigera varia*), curly dock (*Rumex crispus*), dandelion (*Taraxacum officinale*), heal all (*Prunella vulgaris*), henbit (*Lamium amplexicaule*), orange hawkweed (*Hieracium aurantiacum*), purple deadnettle (*Lamium purpureum*), redroot pigweed (*Amaranthus retroflexus*), smooth crabgrass (*Digitaria ischaemum*), and spotted knapweed (*Centaurea stoebe*) [6].

Additional information regarding non-native and invasive plant species control is provided in Section 2.2.1.

Table 3-2 Michigan Invasive Species

Common Name	Scientific Name	Michigan Invasive Plant Status ¹	Documented within the Project Area	Recommended Control Method(s)
Autumn olive	<i>Elaeagnus umbellata</i>	Restricted	No	Mechanical, Chemical
Black locust	<i>Robinia pseudoacacia</i>	-	No	Mechanical, Chemical
Black swallow-wort	<i>Cynanchum louiseae</i>	-	No	Chemical
Butterbur	<i>Petasites hybridus</i>	-	No	Chemical
Calligraphy sedge	<i>Carex kobomugi</i>	Watch list	No	Mechanical
Chaff flower	<i>Achyranthes japonica</i>	Watch list	No	Mechanical, Chemical
Cinnamon vine	<i>Dioscorea polystachya</i>	Watch list	No	Mechanical, Chemical
Common buckthorn	<i>Rhamnus cathartica</i>	-	No	Mechanical, Chemical
Flowering rush	<i>Butomus umbellatus</i>	Restricted	No	Chemical
Garlic mustard	<i>Alliaria petiolata</i>	-	No	Mechanical
Giant hogweed	<i>Heracleum mantegazzianum</i>	Restricted	No	Chemical
Giant knotweed	<i>Polygonum sachalinensis</i>	-	No	Mechanical, Chemical
Glossy buckthorn	<i>Rhamnus frangula</i>	-	Yes	Mechanical, Chemical
Japanese barberry	<i>Berberis thunbergii</i>	Prohibited	No	Mechanical, Chemical
Japanese knotweed	<i>Fallopia japonica</i>	Restricted	No	Chemical
Kudzu	<i>Pueraria montana var. lobata</i>	Watch list	No	Mechanical, Chemical
Lesser celandine	<i>Ficaria verna</i>	Watch list	No	Chemical
Mile-a-minute weed	<i>Persicaria perfoliata</i>	Watch list	No	Mechanical, Chemical
Multiflora rose	<i>Rosa multiflora</i>	-	No	Mechanical, Chemical
Oriental bittersweet	<i>Celastrus orbiculatus</i>	-	No	Mechanical, Chemical
Pale swallow-wort	<i>Cynanchum rossicum</i>	-	No	Chemical
Phragmites (common reed)	<i>Phragmites australis</i>	Restricted	Yes	Chemical
Purple jewelweed	<i>Impatiens glandulifera</i>	Watch list	No	Chemical, Mechanical
Purple loosestrife	<i>Lythrum salicaria</i>	Restricted	No	Chemical
Spotted knapweed	<i>Centaurea stoebe</i>	-	No	Mechanical, Chemical
Stiltgrass	<i>Microstegium vimineum</i>	Watch list	No	Chemical
Tree of heaven	<i>Ailanthus altissima</i>	-	No	Mechanical, Chemical
Wild parsnip	<i>Pastinaca sativa</i>	-	No	Mechanical, Chemical

¹ Prohibited = Species that are not widely distributed in the state and management techniques are not readily known; Restricted = Species that are established in the state and management techniques are known; Watch list = Invasive, non-native species not yet listed in the state, but known to be potentially harmful to Michigan's economy, environment, and/or human health.

3.2.3.1 Manual and Mechanical Control

Manual and mechanical control methods shall include manual removal (e.g., hand pulling, shovels, rakes, grubbing hoes, etc.), weed whipping, and mowing. A discussion of the proposed mowing regime is described in Section 3.2.1. In addition to mowing, mechanical and manual removal of weeds is recommended in smaller areas dominated by native vegetation, especially when native species have recently germinated or are actively flowering. Manual and mechanical methods can target specific species for removal and can be used in sensitive habitat areas where herbicide may not be appropriate or preferred. Manual and mechanical control methods may be used as needed for the duration of the Project to effectively control and remove weed species throughout the Project Area.

3.2.3.2 Chemical Control

Chemical control methods for the Project will be limited to the extent practicable and would include site registration and communication with local chemical applicators through DriftWatch (<https://mi.driftwatch.org/map>) to continually evaluate new methods of weed control. If chemical control is required, the application of non-persistent herbicides to target invasive weed species may be required to supplement other weed control activities. A broad application of herbicides will not be permitted unless large-scale infestations are identified. If a large-scale infestation is identified, drone-based spraying will be considered for chemical application.

In small infestations, target invasive species will be spot sprayed, and special care will be taken to avoid impacts to native species and to avoid herbicide application in and adjacent to sensitive habitat areas (e.g., wetlands) or drifting on to adjacent properties. Herbicide application will adhere to required and recommended restrictions on herbicide labels. In addition, a communication plan will be implemented to provide notification of treatment activities. Backpack applicators and ground vehicles will be equipped with handheld spraying equipment for spot treatment.

Herbicide application will not occur within 24 hours of a forecasted rain event, during winds exceeding 5 miles per hour (mph), or when snow or ice covers the foliage of target invasive weed species. Herbicide will not be applied within 100 feet of wetlands or 50 feet from streams (top of bank) to the extent practicable. All herbicides used within the Project area will be approved and registered with the U.S. Environmental Protection Agency (EPA). Pre-emergent herbicide application will be avoided to prevent poor germination of the applied seed and impacts to native species.

Herbicides will be transported to, and applied within, the Project area with the following provisions:

- All herbicide use will be conducted in compliance with the Michigan NREPA, Part 83 (Pesticide Control) and under delegated authority to enforce the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) under state laws and administrative rules.
- Herbicides will be transported to the Project site daily or will be stored under proper precautions at the Project operations and maintenance (O&M) facility.
- On-site herbicide quantities will be limited as practicable.
- Concentrate will be transported in approved containers only and in a manner that will prevent tipping or spilling, and in a compartment that is isolated from food, clothing, and safety equipment.
- Mixing will be conducted in an upland area and at a distance greater than 100 feet from open or flowing water or wetlands, greater than 200 feet from private wells, and greater than 400 feet from public wells.
- All herbicide equipment and containers will be inspected for leaks daily.
- All herbicide applicators will have a Commercial Applicator's license with Michigan Department of Agriculture and Rural Development (MDARD) for the use of restricted use herbicides and have adequate training for the use of general herbicides.
- Exercise "safety first" at all times.
- Herbicide will be applied only as intended and consistent with state and federal herbicide use laws.
- Herbicide will only be applied as directed by the product label.

3.3 Operational Monitoring

Monitoring for the duration of the Project's operational lifespan will be conducted passively by Project O&M staff. If the vegetation management strategy is successful, maintenance requirements will be reduced for the majority of the Project's operational lifespan since sitewide vegetation has been designed to be self-sustaining.

4 ADAPTIVE MANAGEMENT

As the construction and operation phases of the Project will occur within a period of more than 30 years, the Project recognizes the importance of adaptive management and progressive planning. Refining and updating this VMP based on the results of monitoring and the success of sitewide vegetation establishment, as well as any new information or changes relevant to the Project, will ensure that future vegetation management activities are tailored to the Project's site-specific conditions.

Commented [KB1]: This section is not final. We anticipate building this section out more in coordination with our operations team to include short-term (years 0-5) and long-term (years 5+) operational maintenance schedules. We anticipate expanding upon Table 3-1 to include more details re: frequency/timing, means/methods, and responsible parties for monitoring, remedial seeding, mowing, and weed control; as well as how maintenance/monitoring records will be maintained.

5 REFERENCES

- [1] U.S. Environmental Protection Agency, "Michigan Level III and IV Ecoregion Descriptions / Mapping Issues," 27 December 2007.
- [2] National Centers of Environmental Information, "Climate at a Glance County Mapping," November 2024. [Online]. Available: <https://www.ncei.noaa.gov/access/monitoring/climate-at-a-glance/county/mapping>.
- [3] Copperhead Environmental Consulting, Inc., "Vegetation Community Assessment Report for the Glacier Meadows Solar Project," 27 February 2025.
- [4] Michigan Natural Features Inventory, Michigan State University Extension, "Natural Community Classification [web application]," 2020. [Online]. Available: <https://mnfi.anr.msu.edu/communities/prairie-group>. [Accessed 31 March 2025].
- [5] U.S. Department of Agriculture Natural Resources Conservation Service, "Custom Soil Resource Report for Lenawee County, Michigan," 26 November 2024.
- [6] University of Michigan Herbarium, "Search," [Online]. Available: <https://www.michiganflora.net/search>. [Accessed November 2024].
- [7] Michigan Department of Natural Resources, "Wildflower Planting," 5 May 2000. [Online]. Available: https://www.dnr.state.mi.us/publications/pdfs/huntingwildlifehabitat/landowners_guide/habitat_mgmt/Backyard_Wildflower_Planting.htm.
- [8] Michigan State University Extension, "Pollinator supportive trees and shrubs for farm and orchard windbreaks," 8 April 2022. [Online]. Available: <https://www.canr.msu.edu/news/pollinator-supportive-trees-and-shrubs-for-farm-and-orchard-windbreaks>. [Accessed 20 February 2025].
- [9] Michigan State University Extension, "Native Plants and Ecosystem Services Plant Search Tool," [Online]. Available: https://www.canr.msu.edu/nativeplants/plant_facts/plant-search-tool. [Accessed November 2024].
- [10] Michigan Department of Transportation, "Special Provision for Wetland and Berm Seeding," 2021.
- [11] DNV, "Corporate Solar Wildlife Protection Plan," 08 April 2021.
- [12] State of Michigan, "Michigan Invasive Species Program," 2024. [Online]. Available: <https://www.michigan.gov/invasives>.
- [13] Midwest Invasive Species Information Network, "Michigan," [Online]. Available: <https://www.misin.msu.edu/states/michigan/>. [Accessed 1 April 2025].
- [14] Native Connections, "Cultural Guide".
- [15] Michigan State University Department of Entomology, "Michigan Pollinator Habitat Planning Scorecard for Solar Sites".
- [16] J. McCall, J. Macdonald, R. Burton and J. Macknick, "Vegetation Management Cost and Maintenance Implications of Different Ground Covers at Utility-Scale Solar Sites," *Sustainability MDPI*, 2023.
- [17] DNV ENERGY USA Inc., "Glacier Meadows Solar Decommissioning Plan and Cost Analysis," March 2025.
- [18] Copperhead Environmental Consulting, Inc., "Sensitive Species Habitat Assessment for the Glacier Meadows Solar Project," 27 February 2025.
- [19] M. S. University, Extension Bulletin E-3360 - Establishing Wildflower Habitat to Support Pollinators for Michigan Fruit Crops, July 2017.
- [20] M. D. o. Transportation, Pollinator Habitat Management Program, No Date.
- [21] M. S. University, Agrivoltaic opportunities: Grazing livestock in solar energy systems, <https://www.canr.msu.edu/news/agrivoltaic-opportunities-grazing-livestock-in-solar-energy-systems#:~:text=Livestock%20are%20a%20very%20effective,underneath%20and%20around%20solar%20area,25%20September%202024>.
- [22] Copperhead Environmental Consulting, Inc., "Wetland and Stream Delineation Report for the Proposed Glacier Meadows Solar Project," 10 April 2025.

**APPENDIX A – MICHIGAN POLLINATOR HABITAT PLANNING SCORECARD
FOR SOLAR SITES**

DRAFT

Michigan Pollinator Habitat Planning Scorecard for Solar Sites

This form was developed by the MSU Department of Entomology to guide vegetation management at solar installations to make them more supportive for native pollinators. Check the boxes and add up the points to determine whether the plans meet or exceed the minimum requirements. For more local information on pollinators and habitat: www.pollinators.msu.edu

PROJECT DETAILS

Solar developer: Glacier Meadows Solar, LLC

Vegetation consultant: DNV Energy USA Inc.

Project location: Lenawee County

Project size (acres): 2,359

SITE SCORES

1. SITE PLANNING AND MANAGEMENT
 - ☒ Detailed plant establishment and vegetation management plan developed +10 pts
 - ☐ Site plan developed with a vegetation management company +5 pts
 - ☒ Signage legible at forty or more feet stating pollinator friendly solar habitat +3 pts
2. HABITAT SITE PREPARATION PRIOR TO IMPLEMENTATION
 - ☐ Measures taken to control weeds during season prior to seeding +10 pts
 - ☐ No weed control -20 pts
3. INSECTICIDE RISK
 - ☐ Planned on-site use of insecticide or pre-planting seed/plant treatment (excluding buildings/electrical boxes, etc) -40 pts
 - ☒ Communication with local chemical applicators and site registered on <https://mi.driftwatch.org/map> +20 pts
4. AVAILABLE HABITAT COMPONENTS WITHIN 0.25 MILES (check/add all that apply)
 - ☒ Native bunch grass for bee nesting +1 pt
 - ☒ Open sandy soil areas for bee nesting +1 pt
 - ☒ Trees/shrubs for bee nesting +1 pt
 - ☒ Clean, perennial water sources +1 pt

FLOWERING PLANT SCORES

5. FLOWERING PLANT SPECIES SEEDED IN PERIMETER AREA (species with more than 1% cover)
 - ☐ 5-10 species +1 pts
 - ☐ 10-15 species +3 pts
 - ☒ 16-20 species +8 pts
 - ☐ >20 species +10 pts

Exclude invasive plant species from total
6. PLANT DIVERSITY UNDER SOLAR ARRAY*
 - ☐ Grass only +2 pts
 - ☐ Clover/grass mix +8 pts
 - ☒ Low-growing wildflower mix +10 pts
7. PERCENT OF SITE PLANNED TO BE DOMINATED BY WILDFLOWERS**
 - ☐ 0 - 25% 0 pts
 - ☒ 26- 50 % +3 pts
 - ☐ 51-75 % +8 pts
 - ☐ More than 75% +15 pts

Projects may have different species mixes under the solar array panels and in the perimeter. Flower cover should be averaged across the entire site.
8. SEEDS USED FOR WILDFLOWER AREAS
 - ☒ Mixes are seeded using at least 40 seeds/square foot +5 pts
 - ☐ All wildflower seeds are from a source within 150 miles of the site +5 pts
9. SEASONS WITH AT LEAST THREE BLOOMING FORB SPECIES PRESENT (check all that apply)
 - ☒ Spring (April-May) +5 pts
 - ☒ Summer (June-August) +5 pts
 - ☒ Fall (September-October) +5 pts

* For seeding in the panel array, these can be a short-stature wildflower mix or clovers and other non-native species beneficial to pollinators. If clovers are used, these should be seeded in locations separate from the native wildflowers in the perimeter locations.

** Wildflowers in Question 7 refer to forbs which are flowering plants that are not woody, and are not grasses, sedges, etc. Measurements of percent cover should be based on the percent of the ground surface covered by foliage as viewed from above.

Refer to www.nativeplants.msu.edu or a local native wildflower supplier for advice on plants that are attractive to pollinators and will work in various Michigan settings.

For more on pollinator habitat: www.pollinators.msu.edu

Total points:

78

Provides exceptional habitat 90+ points
Meets pollinator standards 76 – 89 points
Does not meet standards below 75 points



MICHIGAN STATE UNIVERSITY Extension

APPENDIX B – SEED SUPPLIERS

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Native Connections

3815 N Westnedge Ave
Kalamazoo, MI 49004
Phone: (269) 459-6900
Website: nativeconnections.net
Email: info@nativeconnections.net

Wildtype Native Plant Nursery

900 N Every Road
Mason, MI 48854
Phone: (517) 244-1140
Website: wildtypes.com
Email: info@wildtypeplants.com

Michigan Wildflower Farm

11770 Cutler Road
Portland, MI 48875
Phone: (514) 647-6010
Website: michiganwildflowerfarm.com
Email: michiganwildflowerfarm@gmail.com

Hidden Savanna Nursery

18 N Van Kal Street
Kalamazoo, MI 49009
Phone: (269) 352-3876
Website: hiddensavanna.com
Email: info@hiddensavanna.com

APPENDIX C – SUGGESTED NATIVE SPECIES FOR SEED MIXES

Table D-1 Recommended Native Species for Seed Mixes

Common Name	Scientific Name	Habit	Approximate Height (feet) [14]	Blooming Period	Documented within the Project Area
Big blue stem	<i>Andropogon gerardii</i>	Perennial	4-8	Fall	No
Black-eyed susan	<i>Rudbeckia hirta</i>	Perennial	1-3	Summer/Fall	No
Blue grama grass	<i>Bouteloua gracilis</i>	Perennial	1-2	Summer/Fall	No
Bottlebrush grass	<i>Elymus hystix</i>	Perennial	2-5	Summer/Fall	No
Butterfly weed	<i>Asclepias tuberosa</i>	Annual	1-3	Summer	No
Canada goldenrod	<i>Solidago canadensis</i>	Perennial	2-7	Fall	Yes
Columbine	<i>Aquilegia canadensis</i>	Annual	1-3	Spring	No
Common boneset	<i>Eupatorium perfoliatum</i>	Shrub	3-5	Summer/Fall	No
False sunflower	<i>Heliopsis helianthoides</i>	Perennial	3-5	Summer	No
Frost aster	<i>Symphyotrichum pilosum</i>	Perennial	2-4	Summer/Fall	Yes
Golden alexanders	<i>Zizia aurea</i>	Perennial	2-4	Spring	No
Hairy beardtongue	<i>Penstemon hirsutus</i>	Perennial	1-3	Spring	No
Heath aster	<i>Symphyotrichum ericoides</i>	Perennial	1-3	Fall	No
Hoary vervain	<i>Verbena stricta</i>	Annual	2-4	Summer	No
Horsemint	<i>Monarda punctata</i>	Perennial	1-2	Summer/Fall	No
Ironweed	<i>Vernonia fasciculata</i>	Annual	3-6	Summer/Fall	Yes
Indian grass	<i>Sorghastrum nutans</i>	Perennial	4-6	Fall	No
June grass	<i>Koeleria macrantha</i>	Perennial	1-2	Spring/Summer	No
Little bluestem	<i>Schizachyrium scoparium</i>	Perennial	2-4	Fall	No
New England aster	<i>Symphyotrichum novae-</i>	Perennial	3-6	Fall	No
Nodding wild onion	<i>Allium cernuum</i>	Perennial	1-2	Summer	No
Paleleaf woodland	<i>Helianthus strumosus</i>	Perennial	3-5	Summer/Fall	No
Partridge pea	<i>Chamaecrista fasciculata</i>	Perennial	1-3	Summer/Fall	No
Path rush	<i>Juncus tenuis</i>	Perennial	0.5-1	Spring/Summer/Fall	No
Pinnate prairie coneflower	<i>Ratibida pinnata</i>	Perennial	3-5	Summer/Fall	No
Rough blazing star	<i>Liatris spicata</i>	Perennial	3-5	Summer/Fall	No
Sand coreopsis	<i>Coreopsis lanceolata</i>	Perennial	1-2	Spring/Summer	No
Showy goldenrod	<i>Solidago speciosa</i>	Perennial	2-5	Fall	No
Shrubby cinquefoil	<i>Potentilla fruticosa</i>	Shrub	1-3	Summer/Fall	No
Slender mountain mint	<i>Pycnanthemum tenuifolium</i>	Perennial	2-3	Summer	No

Common Name	Scientific Name	Habit	Approximate Height (feet) [14]	Blooming Period	Documented within the Project Area
Spiderwort	<i>Tradescantia ohiensis</i>	Perennial	2-3	Spring/Summer	No
Yarrow	<i>Achillea millefolium</i>	Perennial	1-3	Summer	No

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Staff's Third Discovery Request to Company and Responses, including Attachment, Items 1 through 16

Please refer to Exhibit A-1.1 and A-1.2:

1. Provide all GIS files that were used to create the maps in Exhibit A-1.1 and A-1.2.

Please ensure that the GIS files contain all relevant layers and attribute data needed to produce the maps as submitted in the original filing. For any responsive GIS data, please ensure: (1) any data provided in a shapefile format is contained within a zipped folder; (2) the data includes any corresponding metadata that provides context to the data.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “used” is vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to this Request to the extent it seeks production of documents in a format inconsistent with ESI best practices or in a burdensome or inaccessible format.

Subject and without waiving any objections, Glacier Meadows states as follows: GIS files for Exhibit A-1.1 and Exhibit A-1.2 are being produced herewith in true native zipped folders for accessibility purposes.

Please refer to Exhibit A-1.3:

2. Please provide the methodology that the Applicant will use to determine where pre-existing natural vegetation obviates the need for additional screening, including, for example, the threshold for the minimum density of existing vegetation that would obviate the need for additional screening.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “methodology,”

“determine,” “obviates,” “additional screening,” “threshold,” and “minimum density” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Exhibit A-1.1, sheet C.202 outlines areas adjacent to the Project with pre-existing natural vegetation. For adjacent non-participating landowners who do not have pre-existing natural vegetative screening and express interest in screening, Glacier Meadows will attempt to work with those landowners on a vegetative screening plan (as described in Exhibit A-1.3).

Please refer to Exhibit A-13.1 and Exhibit A-13.3:

3. Please provide a current copy of the screening ordinances (or sections of relevant ordinances relating to screening for projects of this type) for Blissfield and Deerfield Townships.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “screening ordinances,” “relevant ordinances,” and “type” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Refer to Exhibit A-15, Attachment A for a copy of Deerfield Township's Zoning Ordinance; screening requirements are included in Section 7.26.1.b.1.f.7. Refer to attachment for a copy of Blissfield Township's Zoning Ordinance - Supplementary Regulations for Solar Energy Conversion Systems, which is being produced herewith as documents Bates-labeled GlacierMeadows0000139 – GlacierMeadows0000153; screening requirements are included

in Section 6.31.D.7. Upon information and belief, these are the current screening ordinances for Blissfield and Deerfield Townships.

4. Please confirm that the proposed landscape planting details, including locations, are consistent with Blissfield Township Zoning Ordinance Section 6.31 and Deerfield Township Zoning Ordinance Section 7.26.1. If not confirming, please explain.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “consistent” is vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows is seeking siting approval for the Project under Public Act 233, which imposes detailed and specific Conditions, including, but not limited to, those set forth in Exhibit A-14 in relation to screening and vegetation. As set forth in Exhibit A-14, and as further expounded in the Application materials generally, Glacier Meadows commits to complying with the requirements set forth in Public Act 233, as detailed in the Application Filing Instructions and Procedures, including such conditions imposed by the Commission under Public Act 233 in connection with such a siting certificate.

Answering further, Glacier Meadows’ proposed landscaping planting detail consists of shrubbery, trees (including evergreens), and other non-invasive plant species to provide a visual screen, which, though not required under PA 233, are consistent with Blissfield Township and Deerfield Township Zoning Ordinances. During a public hearing on

September 10, 2025, the Deerfield Township Planning Commission Chair indicated that screening was not deemed an effective form of proper maintenance (see Exhibit A-4.3). In response, Glacier Meadows proposes that existing vegetation at occupied structures will screen the Project (see Exhibit A-1.1, sheet C.202); however, for those adjacent non-participating landowners who do not have preexisting natural vegetation screening and express interest in screening, Glacier Meadows will attempt to work on vegetative screening plans with those landowners (as outlined in Exhibit A-1.3).

5. Please provide the method(s) of contact that the Applicant will use to work with adjacent non-participating landowners on vegetative screening plans for those landowners.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “method(s)” “work with” and vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: The Notice of Hearing, which was provided to all postal addressees within one mile of the Project, provided direct contact information for Glacier Meadows and notice of the Application and filing—which provides information regarding screening. Contact information for Glacier Meadows is also set forth in Exhibit A-2. In the interests of direct collaboration, Glacier Meadows is also opening a Project office located at 600 W. Adrian St., Blissfield, MI 49228 in Q2 2026. Glacier Meadows will provide this information to the Townships for ease of access by local residents in the community, including notification to

the Township clerks, in a local newspaper, on the Project's website (<https://glaciermeadowssolar.com>), and on the Project's Facebook page (<https://www.facebook.com/glaciermeadowssolarproject/>). All adjacent non-participating landowners are welcome to come discuss additional vegetative screening needs—and other Project-related concerns—with Glacier Meadows' local representative.

6. Please explain how the Applicant will ensure that the outreach to adjacent non-participating landowners, regarding vegetative screening preferences or compensation in lieu of screening, will reach all adjacent non-participating landowners.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “ensure,” “outreach,” and “reach” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows incorporates its Response to Request No. 5 above. Answering further, Glacier Meadows is willing to consider reasonable additional conditions regarding the method and timing for outreach to adjacent non-participating landowners with respect to screening if necessary for issuance of a certificate for the Project.

7. Please explain how the amount of compensation in lieu of screening for non-participating landowners will be determined on a landowner-by-landowner basis.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “compensation”

and “determined” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Compensation for adjacent non-participating landowners without pre-existing natural vegetation will be calculated on a linear foot basis (i.e., the length of the Project fenceline adjacent to their property that is not screened) and based upon the equivalent cost to install the Project’s proposed vegetative screening found on Exhibit A-1.1, sheet C.506 along that length of fenceline.

8. Please confirm that the Applicant agrees, if required by a certificate condition, to solicit the screening preferences of all adjacent non-participating landowners, and to follow its proposed screening plan for each residence based on those preferences (screening or compensation in lieu of screening), with screening as a default upon no response or agreement.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “agrees,” “solicit,” “preferences,” “follow,” and “default” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows will comply with all applicable conditions issued in connection with PA 233 as it relates to a siting certificate for the Project. Glacier Meadows is willing to consider

reasonable conditions beyond those expressly required by PA 233, such as soliciting preferences of adjacent non-participating landowners as to screening. Subject to review of the specific language of such a condition, Glacier Meadows is willing to consider same and will follow the proposed screening plan set forth in the Application with respect to any such condition. Adjacent non-participating landowners who feel they are affected and do not have sufficient pre-existing natural vegetation screening will have the opportunity to speak with Glacier Meadows regarding screening plans at the Project's local office at 600 W. Adrian St., Blissfield, MI 49228, planned to open in Q2 2026. Answering further, Glacier Meadows incorporates its Responses to Request Nos. 5 and 6 above.

9. Please provide the percentage of the site that is proposed to be planted with a seed mix that is "dominated by wildflowers" according to Exhibit A-1.1, Sheet C.202.

RESPONSE: Glacier Meadows objects to this Request as the term "percentage" is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows is planning for 26-50% of the site to be dominated by wildflowers, pending coordination with the Project's Engineering, Procurement, and Construction ("EPC") contractor. See a copy of the Project's Pollinator Habitat Planning Scorecard in Exhibit A-1.1, Sheet C.507.

10. Please confirm whether all species on the seed tags for pollinator and other groundcover plantings will be cross-referenced against the Midwest Invasive Species Information Network (MISIN) database to prevent the introduction of invasive species. If not confirming, please explain.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “cross-referenced” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed. Glacier Meadows will cross-reference all species on seed tags for pollinator and other groundcover plantings against the MISIN database to prevent the introduction of invasive species.

11. Please confirm whether, and to what extent, personnel will be required to clean equipment before entering and leaving the site, to minimize the spread of invasive species. If not confirming, please explain why not.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “required,” “clean,” and “minimize the spread” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: During construction, equipment will be required to arrive clean and will be inspected prior to starting work onsite. Equipment will remain onsite until construction is done. When paired with the Project’s proposed weed prevention plans (see draft vegetation management plan), invasive species spread is anticipated to be minimized.

Please refer to Exhibit A-1.5:

12. Please provide a narrative discussing the Applicant’s efforts to comply with the overlay districts of Blissfield and Deerfield Townships.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “narrative,” “efforts,” and “comply” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: The Deerfield Township overlay district is limited to parcels within 1,250' of the centerline of a transmission line. The Blissfield Township overlay district is limited exclusively to parcels located in Section 16. These restrictive districts are incompatible with utility scale renewable energy development and would not make it possible for the Project to meet the requirements of the Generator Interconnection Agreement (“GIA”) with the Michigan Electric Transmission Company and the Midcontinent Independent System Operator that outlines the Project location and capacity, which directly correlates to the footprint required for the Project.

13. Please provide the target direct current (DC) nameplate capacity of panels to be installed for the project.

RESPONSE: Glacier Meadows objects to this Request as the term “to be installed” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The target DC nameplate capacity of the Project is currently 282 MWdc.

14. Please provide the target DC nameplate capacity of panels to be installed for the project divided by the nominal alternating current (AC) output of the project inverters (the target DC/AC ratio).

RESPONSE: Glacier Meadows objects to this Request as the term “to be installed” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The Project’s DC/AC ratio at the POI is currently targeted to be 1.41. The Project’s DC/AC ratio at the inverter level is currently targeted to be 1.30.

15. Please provide the total DC nameplate capacity of panels proposed in the application. Please indicate any changes from the plans presented in the application to current plans.

RESPONSE: Glacier Meadows objects to this Request as the term “changes” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows incorporates its Responses to Request Nos. 13 and 14 above. Answering further, the current target DC nameplate capacity of the Project is 282 MWdc. To achieve this DC capacity, 522,828 PV modules are currently proposed. Each PV module is proposed to have a nominal power output of 540 watts. Currently, there have been no changes to the plans presented in the Application. However, as the Project proceeds forward in the equipment selection process with its Engineering, Procurement, and Construction (“EPC”) contractor, the nominal power output of each module could change, which could lead to a change in the overall number of modules and/or a change in the overall DC capacity, among other things.

16. Please provide evidence and justification for why the Applicant's selected project size (capacity and footprint) is an appropriate tradeoff between increased benefits and increased impacts. In particular, please provide evidence and justification for why the Applicant did not select an alternative that occupies a smaller land area, even if such alternative would have a lower nameplate capacity.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "evidence," "justification," "appropriate," "tradeoff," "benefits," "impacts," and "alternative" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The Project has been proposed to meet the needs of both utility and corporate customers and support Michigan's renewable energy goals, pursuant to PA 234 of 2023, to achieve 50% renewable energy by 2030, 60% renewable energy by 2035, and 100% clean energy statewide by 2040. The Project is anticipated to generate enough clean renewable energy to power approximately 50,000 homes in Michigan annually, providing sustainable, secure, and reliable energy to customers. Glacier Meadows has executed a Generator Interconnection Agreement ("GIA") with the Michigan Electric Transmission Company and the Midcontinent Independent System Operator that outlines the Project location and capacity which directly correlates to the footprint required for the Project. The GIA requires the Project to be able to generate 200MWac of energy, which correlates to a need of over 2,000 acres. The Project was selected based on its proximity to the POI and minimizing impacts to environmental resources and utilities, as informed by extensive site characterization

studies and engineering efforts advanced during project development. Appendix II, Exhibit A-1.5 outlines this further.

Blissfield Township Zoning Ordinance
ARTICLE 6
SUPPLEMENTARY REGULATIONS

SECTION 6.31 SOLAR ENERGY COVERSION SYSTEM

Section 6.31 entitled Solar Energy Conversion Systems is hereby added to Article 6 of the Township's Zoning Ordinance to read, in its entirety, as follows:

A. PURPOSE

To promote the effective and efficient use of solar energy within Blissfield Township as a clean alternative energy source and provide for land development, while regulating the installation, construction, and maintenance of Solar Energy Systems to protect public health, safety, and welfare.

B. DEFINITIONS

1. Abandonment: A SES that ceases to produce energy on a continuous basis for a 12-month period will be considered abandoned.
2. Accessory Solar Energy System or Accessory SES: These SESs provide electricity to the property, such as a residence or a commercial building, and provides electricity exclusively for use by a primary structure located on the same parcel as the SES, except for the sale of surplus electrical energy back to the electrical grid. Accessory SESs may be Roof-Mounted, Ground-Mounted, or Building-Integrated.
3. AC Power (Alternating Current): An electrical current whose magnitude and direction varies. It is considered the "standard" electrical power.
4. Attached System: A solar energy system in which solar panels are mounted directly on the building, typically the roof.
5. Building-Integrated Solar Energy System or Building-Integrated SES: A SES that is integrated into a primary or accessory building or structure (rather than a separate mechanical device), replacing or substituting for an architectural or structural component of the building or

structure. Building-integrated SES include, but are not limited to, photovoltaic or hot water SESs that are contained within roofing materials, windows, skylights, and awnings.

6. DC Power (Direct Current): An electrical current whose magnitude and direction stay constant. The photovoltaic cells on solar panels capture energy from sunlight in the form of DC and must be converted to an AC by an inverter.
7. Distributed Generation: As opposed to centralized generation, distributed generation refers to a number of small power-generating modules located at or near the point of energy consumption.
8. Dual Use: A SES that employs one or more of the following land management and conservation practices throughout the project site:
 - a. Pollinator Habitat: Solar sites designed to meet a score of 76 or more on the Michigan Pollinator Habitat Planning Scorecard for Solar Sites. Alternatively, the Tier 2 Pollinator Scorecard developed by the Rights-of-Way as Habitat Working Group can be used to evaluate pollinator habitat and management practices.
 - b. Conservation Cover: Solar sites designed in consultation with conservation organizations that focus on restoring native plants, grasses, and prairie with the aim of protecting specific species (e.g., bird habitat) or providing specific ecosystem services (e.g., carbon sequestration, soil health).
 - c. Forage for Grazing: Solar sites that incorporate rotational livestock grazing and forage production as part of an overall vegetative maintenance plan.
 - d. Agrivoltaics: Solar sites that combine raising crops for food, fiber, or fuel and generating electricity within the project area to maximize land use.
9. Gigawatt: A unit of power equal to one billion watts.
10. Grid: The infrastructure of power lines, transformers and substations that delivers electric power to buildings. The utility grid is owned and managed by electric utility companies.
11. Ground-Mounted Solar Energy System or Ground-Mounted SES: A solar energy system mounted on support posts, like a rack or pole, that are attached to or rest on the ground. Such systems are not attached to or mounted to any roof or exterior wall of any principal or accessory building.
12. Interconnections: A link between utility company power distribution and local power generation that enables power to move in either direction.

- 13. Inverter:** A device that converts DC power captured by the photovoltaic cells on solar panels into AC power.
- 14. Kilowatt:** A unit of power equal to one thousand watts.
- 15. Megawatt:** A unit of power equal to one million watts.
- 16. Maximum Tilt:** The maximum angle of a solar array (i.e., most vertical position) for capturing solar radiation as compared to the horizon line.
- 17. Minimum Tilt:** The minimal angle of a solar array (i.e., most horizontal position) for capturing solar radiation as compared to the horizon line.
- 18. NEC:** National Electric Code.
- 19. Non-Participating Lot(s):** One or more lots for which there is not a signed lease, easement, or other agreement for development of a Principal-Use SES associated with the applicant project.
- 20. Participating Lot(s):** One or more lots under a signed lease, easement, or other agreement for development of a Principal-Use SES associated with the applicant project.
- 21. Permitting:** The process by which a local unit of government allows for certain development, changes, and activities in their jurisdiction.
- 22. Photovoltaic (PV):** A method of generating electrical power by converting solar radiation (sunlight) into direct current electricity using semiconductors.
- 23. Photovoltaic (PV) System:** A semiconductor material that generates electricity from sunlight.
- 24. Principal-Use Solar Energy System or Principal-Use SES:** A SES that generates electricity distributed off-site through the grid and exported to a wholesale or retail utility market.
- 25. Repowering:** Reconfiguring, renovating, or replacing an SES to maintain or increase the power rating of the SES within the existing project footprint.
- 26. Roof-Mounted Solar Energy System or Roof-Mounted SES:** A SES mounted on racking that is attached to or ballasted on the roof of a building or structure.
- 27. Setback Waiver:** Written agreement between project developers and landowner to reduce the setback requirement provided for in this Ordinance.
- 28. Solar Array:** A photovoltaic panel, solar thermal collector, or collection of panels or collectors in a SES that collects solar radiation.
- 29. Solar Carport:** A SES of any size that is installed on a structure that is accessory to a parking area, and which may include electric vehicle supply equipment or energy storage facilities.

Solar panels affixed on the roof of an existing carport structure are considered a Roof-Mounted SES.

- 30. Solar Energy System (SES):** A photovoltaic system or solar thermal system for generating and/or storing electricity or heat, including all above and below ground equipment or components required for the system to operate properly and to be secured to a roof surface or the ground. This includes any necessary operations and maintenance building(s), but does not include any temporary construction offices, substation(s), or other transmission facilities between the SES and the point of interconnection to the electric grid.
- 31. Solar Thermal System:** A system of equipment that converts sunlight into heat.
- 32. Weed:** Native or non-native plant that is not valued in the place where it is growing.
- 33. Wildlife-Friendly Fencing:** A fencing system with openings that allow wildlife to traverse over or through a fenced area.

C. ACCESSORY SOLAR ENERGY SYSTEM REQUIREMENTS

1. General Provisions

- a. A building permit shall be required for any Accessory SES.
- b. When solar storage batteries are included as part of the SES, they must be placed in a secure container or enclosure meeting the requirements of the State Building Code. When no longer in use, shall be disposed of in accordance with applicable laws and regulations.
- c. Glare: SES shall be designed and located to avoid glare or reflection onto adjacent lots and adjacent roadways and shall not interfere with traffic or create a safety hazard off-site.

2. Accessory Roof-Mounted SES

- a. Height: Accessory Roof-Mounted SES shall not extend above the finished roof peak, exempt from any rooftop equipment or mechanical system screening, and consistent with building and electrical codes.
- b. Accessory Roof-Mounted SES may not extend more than 3 inches above the surface of the roof.
- c. No Accessory Roof-Mounted SES may protrude beyond the edge of the roof.
- d. Nonconformities: An Accessory Roof-Mounted SES or Accessory Building-Integrated SES installed on a nonconforming building, structure, or use shall not be considered an expansion of the nonconformity.

- e. Application: All Accessory SES applications must include plan (e.g., plot or site, whichever is required for a zoning compliance review). Applications for Accessory Roof-Mounted SES must include horizontal and vertical elevation drawings that show the location and height of the Accessory Roof-Mounted SES on the building and dimensions of the Accessory Roof-Mounted SES.
 - f. If an Accessory Roof-Mounted SES has been abandoned, the property owner must remove it within three (3) months after the date of abandonment.
3. Accessory Building-Integrated SES
- a. Accessory Building-Integrated SESs are subject to zoning regulations applicable to the structure or building, and consistent with building and electrical codes.
 - b. Accessory Building-Integrated SESs are not subject to Accessory Ground, or Accessory Roof-Mounted SES requirements, except the requirement to obtain a building permit.
4. Accessory Ground-Mounted SES
- a. Height Restrictions: Accessory Ground-Mounted photovoltaic panels shall not exceed 12 feet measured from the ground to the top of the system when oriented at maximum tilt.
 - b. Setbacks:
 - 1) An Accessory Ground-Mounted SES for use on a parcel zoned agricultural residential shall be consistent with the setback provisions found in Section 4.07, **Schedule of Regulations**.
 - 2) Setback distance is measured from the property line to the closest point of the Accessory Ground-Mounted SES at minimum tilt.
 - c. Lot Coverage: The area of the solar array shall not exceed 20% of the lot.
 - d. Visibility (Residential): An Accessory Ground-Mounted SES in agricultural residential districts shall be located on the side or rear yard to minimize visual impacts from the public right-of-way(s).
 - 1) Accessory Ground-Mounted SES may be placed in the front yard with administrative approval, where the applicant can demonstrate that placement of the SES in the rear or side yard will:
 - a. Decrease the efficiency of the SES due to topography, accessory structures, or vegetative shading from the subject lot or adjoining lots;
- or

- b. Interfere with septic system, accessory structures, or accessory uses.
- e. Exception: An Accessory SES used to power a single device or specific piece of equipment such as a lawn ornament, lights, weather station, thermometer, clock, well pump, or other similar singular device is exempt from Accessory Ground-Mounted SES provisions.
- f. Nonconformities: An Accessory Ground-Mounted SES installed on a nonconforming lot or use shall not be considered an expansion of the nonconformity.
- g. All power transmission or other lines, wires, or conduits from an Accessory Ground-Mounted SES to any building or other structure must be located underground. If batteries are used as part of the Accessory Ground-Mounted SES, they must be placed in a secured container or enclosure.
- h. Greenbelt screening is required around any Accessory Ground-Mounted SES and around any equipment associated with the system to obscure, to the greatest extent possible, the SES from any adjacent residences. The greenbelt must consist of shrubbery, trees, or other non-invasive plant species that provide a visual screen. In lieu of a planting greenbelt, a decorative fence that is at least 50% opaque (meeting the requirements of this Ordinance applicable to fences) may be used if approved by the Township.
- i. If an Accessory Ground Mounted SES has been abandoned, the property owner must notify the Township and remove the system within three (3) months after the date of abandonment.

D. PRINCIPAL-USE SOLAR ENERGY SYSTEM

1. Application Requirements: The applicant for a Principal-Use SES must provide the Township with all of the following:
 - a. All Principal-Use SES applications must be for Ground-Mounted SESs and include a site plan that addresses all issues set forth in this solar section.
 - b. Applications for Principal-Use Ground-Mounted SESs must include drawings that identify the location of the SES on the property, height, tilt features (if applicable), the primary structure, accessory structures, access route(s), and setbacks to property lines.
 - c. In addition to the requirements of article 7 of the zoning ordinance, all applications for a special land use permit for Principal-Use Ground-Mounted SESs shall be subject to special land use standards in article 8 of the zoning ordinance and shall include the following:

- 1) Project description and rationale. Identify the type, size, rated power output (dc), performance, safety, and noise characteristics of the SES, including the name and address of the manufacturer, and model. Identify the time frame, including project useful life, development phases, likely markets for the generated energy, possible future expansions, proposed materials for the project (including all rare earth materials/elements) and include Material Safety Data Sheets for all products, including PFAS, GenX and/or other known carcinogens and chemicals.
 - 2) Analysis of onsite traffic. Estimated construction jobs, estimated permanent jobs associated with the development and local impact.
- d. Visual impacts: Review and demonstrate the visual impact using photos or renditions of the project or similar projects with consideration given to tree plantings and setback requirements.
 - e. Wildlife: Review potential impact on wildlife on the site.
 - f. Environmental analysis: An analysis by a third-party qualified professional to identify and assess any potential impacts on the natural environment including, but not limited to, wetlands and other fragile ecosystems, wildlife, endangered and threatened species, historical and cultural sites, and antiquities. If required, the analysis shall identify all appropriate measures to minimize, eliminate or mitigate adverse impacts identified and show those measures on the site plan, where applicable.
 - g. Drainage analysis:
 - 1) Prior to approval of the special use permit, the applicant must obtain and provide documentation of existing drainage tile for the site.
 - 2) A statement by the applicant that any damage to underground drainage tile, or other stormwater infrastructure, ditches and/or drains caused during the installation of the project shall be repaired by the applicant/successor within 90 days of discovery of the damage.
 - h. Stormwater study: An analysis by a third-party qualified professional that takes into account the proposed layout of the SES and how the spacing, row separation, and slope affects stormwater infiltration, including calculations for a 100-year rain event (storm).
 - 1) Percolation tests or site-specific soil information shall be provided to demonstrate infiltration on-site without the use of engineered solutions.

- 2) Documentation of compliance with erosion requirements, storm drainage easements (if any), and stormwater study review from Lenawee County Drain Commissioner and/or other reviewing entities.
- i. Waste: Identify solid waste or hazardous waste generated by the project and proposed management of the waste generated.
- j. Lighting: Provide lighting plans showing all lighting within the facility. No light may adversely affect adjacent parcels. All lighting must be shielded from adjoining parcels, and light poles are restricted to eighteen (18) feet in height.
- k. Transportation Plan: Provide access plan for construction and operation phases.
 - 1) The applicant shall submit to the appropriate state or county agency a description of the routes to be used by construction and delivery vehicles and anticipated road improvements that will be necessary to accommodate construction vehicles, equipment, or other deliveries. The applicant shall comply with all state or county requirements regarding the use and/or repair of the roads used by construction and delivery vehicles. Any material damages to a public road located within the township resulting from the construction, maintenance, or operation of a solar energy system shall be repaired at the applicant's expense.
 - 2) Due to infrequent access to such facilities after construction is completed, applicant/successor is not required to pave or curb solar panel access drives.
- l. Public Safety: Identify emergency and normal shutdown procedures. Identify potential hazards to adjacent properties, public roadways, and to the community in general that may be created.
- m. Sound Limitations and Review: Identify sound levels at the property line of the project boundary when completed.
- n. Telecommunications Interference: Identify electromagnetic fields and communications interference generated by the project and identify resolution for anticipated interference.
- o. Suspected Carcinogens: In the form of an affidavit from the project manager and senior business officer (CEO or President) that the project does not have any material containing any of the following: PFAS, GenX, or other known or suspected carcinogens.

- p. Abandonment: A statement affirming that any Principal-Use SES, or any portion thereof, SES not operated for a continuous period of twelve (12) months shall be considered abandoned and shall be removed by the permit holder under the decommissioning plan.
 - q. Decommissioning Plan: as required by this Ordinance.
 - r. Complaint Resolution Plan: as required by this Ordinance.
2. Height Restrictions: Principal-Use Ground-Mounted photovoltaic panels shall not exceed 12 feet measured from the ground to the top of the system when oriented at maximum tilt.
3. Setbacks:
- a. Photovoltaic solar panels and support structures associated with Principal-Use Ground-Mounted SES (excluding perimeter security fencing) shall be a minimum of one-hundred fifty (150) feet from a side or rear property line and a minimum of one-hundred (100) feet from the nearest boundary of any road or highway right-of-way.
 - b. Measuring: Any measurement for Principal-Use Ground-Mounted SES setbacks shall use the property/lot line or the nearest boundary of any road or highway right-of-way and not the center of the most immediate public road/highway.
 - c. Agricultural Setbacks: Two participating agricultural parcels that are immediately adjacent are not required to have a setback; e.g., zero (0) setback.
 - d. Non-Participation Setbacks: Residential property owners with less than or equal to five (5) acres and not participating in a Principal-Use Ground-Mounted SES lease agreement are entitled to a three hundred (300) foot setback along the nonparticipating property line.
4. Minimum Lot Size and Maximum Lot Coverage: Principal-Use Ground-Mounted SESs shall not be constructed on parcels less than twenty (20) acres in size. The project may include an adjacent parcel(s) with less than 20 acres if included in the project application.
- a. Maximum lot coverage for Principal-Use Ground-Mounted SES shall be no more than 30% in the Agricultural and Agriculture/Residential Zoning Districts.
 - b. Principal-Use Ground Mounted SES shall be reasonably screened from the view of the surrounding streets and roads to the maximum extent practicable by garden walls, fences, hedges, landscaping, earth berms, or other means, except to the extent that such screening is either impracticable or would result in ineffective solar access on the lot in question. Principal-Use Ground Mounted SES that are visible from a road or adjacent properties shall, to the maximum extent feasible, and without compromising the ability to effectively

use solar collectors on the lot in question, use materials, textures, screening, and landscaping that will screen the Principal-Use Ground Mounted SES from view, and blend with the natural setting, existing environment, and neighborhood character. All Principal-Use Ground Mounted SES that rely on landscaping or a vegetative buffer for screening shall maintain a minimum opacity of at least eighty percent (80%), and a mature height of not less than the greater of six (6) feet or sixty percent (60%) of the height of the Principal-Use Ground Mounted SES when oriented to maximum tilt.

5. Safety/Access:
 - a. Fences shall be constructed in accordance with current NEC specifications.
 - b. Lock box and keys shall be provided at locked entrances for emergency personnel access.
 - c. Electric fencing is not permitted. Fencing is not subject to setbacks.
6. Sound Pressure Level: Ambient sound pressure levels shall be measured from the property line where the Principal-Use Ground-Mounted SES is located and shall not exceed 40 db(A).
7. Landscaping: The perimeter of Principal-Use Ground-Mounted SES shall be screened and buffered by installed evergreen or native vegetative plantings whenever existing natural vegetation does not otherwise reasonably obscure the Principal-Use Ground-Mounted SES from any public street and/or adjacent agricultural residential structures, consistent with the recommendations and/or requirements of the Michigan Department of Agriculture and Rural Development.
 - a. All unhealthy foliage (forty (40) percent dead or greater) of a tree or individual planting shall be replaced by the applicant/owner/operator within six months (6) months of the date of identification, or the next appropriate planting period, whichever comes first.
 - b. All ground cover in and around the Principal-Use Ground-Mounted SES will be seeded with native grasses and vegetation. Selection of vegetation shall be in accordance with current MDARD and Conservation Reserve Enhancement Program. All unhealthy (forty (40) percent dead or greater) of native grasses, vegetation, or individual planting shall be replaced by the applicant within six months (6) months of the date of identification, or the next appropriate planting period, whichever comes first.
8. Local, State and Federal Permits: Principal-Use Ground-Mounted SES shall be required to obtain and comply with all required local, state, and federal permits, rules, and regulations.

9. **Electric Interconnections:** All electrical interconnection or distribution lines shall comply with all applicable codes (including NEC) and standard commercial large-scale utility requirements. Use of above ground transmission lines shall be prohibited within the site. If batteries are used as part of the Principal-Use Ground-Mounted SES, they must be placed in a secured container or enclosure.
10. **Signage:** No advertising or non-project related graphics shall be mounted on any part of the solar arrays or other components of the Principal-Use Ground-Mounted SES. This exclusion does not apply to entrance gate signage or notifications containing points of contact or any and all other information that may be required by authorities having jurisdiction for electrical operations and the safety and welfare of the public.
11. **Decommissioning:** The applicant shall submit a Decommissioning Plan provided by an independent engineering firm that identifies the process to be followed at the end of the useful life of the SES, which shall include the following:
 - a. Elements to be included in the decommissioning plan.
 - b. Estimated cost of decommissioning, financial resources to be used to accomplish decommissioning, the escrow agent with whom the resources will be deposited, and proposed process for return of remaining escrow funds, if any.
12. **Removal of Project Materials:** All structures, concrete, piping, facilities, and other project related materials above grade and any structures up to three (3) feet below-grade shall be removed to a disposal area certified or licensed to receive the materials removed from the decommissioned site. Certification and/or licensure of the disposal site for the materials shall be provided in the Decommissioning Plan.
13. **Disposal Documentation:** Documentation of the disposal from the site shall be submitted to the Blissfield Township office within thirty (30) days of decommissioning a project site.
14. **Access Roads or Driveways:** All access roads or driveways shall be removed, cleared, and graded by the applicant, unless the property owner(s) requests, in writing, a desire to maintain any access road or driveways. The Township or County will not take ownership of any access road or driveway, unless otherwise agreed in writing.
15. **Site Restoration:** The ground must be restored to its original topography or mutually agreed variation of the original topography within three hundred sixty-five (365) days of abandonment or decommissioning. The decommissioning plan shall include:

- a. Timeline for submission of a decommissioning plan, and schedule for removal of the SES and all its components.
 - b. Process for notifying MDARD of the decommissioning.
 - c. Confirmation from MDARD of compliance with the requirements for land stewardship.
 - d. Confirmation to MDARD and the landowner that the real property is fit for agricultural production and has been returned to the property owner.
 - e. Relinquishment of the Special Land Use Permit issued for the SES.
- 16. Repowering:** A Principal-Use Ground-Mounted SES may at any time be repowered, without the need to apply for a new special land-use permit, by reconfiguring, renovating, or replacing components of the SES to increase the power rating within the existing project footprint and consistent with this Ordinance. A proposal to change the project footprint of an existing Principal-Use Ground-Mounted SES shall be considered a new project and require a new application, subject to applicable standards at the time of the request. Expenses for legal services and other studies resulting from an application to modify a Principal-Use Ground-Mounted SES will be reimbursed to the Township by the SES owner in compliance with established escrow policy.
- 17. Building Permit:** Prior to the issuance of the building permit, the applicant shall furnish to the Township a performance guarantee in the form of a surety bond, cash deposit into an escrow account with an escrow agent acceptable to the Township, or irrevocable letter of credit from a U.S. financial institution and payable on demand to the benefit of Blissfield Township (bond) in an amount equal to One Hundred Fifty percent (150%) of the estimated cost of decommissioning. The terms and amount of the surety bond shall be reviewed every three years and modified based upon the circumstances and conditions. The applicant shall be responsible for all costs associated with the project for the life of the SES.
- 18. Code Enforcement and Reclamation Costs:** Blissfield Township shall have access to the escrow account funds for code enforcement and decommissioning if decommissioning is not completed by the applicant within Three Hundred Sixty-Five (365) days of the end of project life or facility abandonment. In the event that the applicant/owner/successor does not complete the decommissioning and requires Township intervention to complete decommissioning, the applicant/ owner/successor shall forfeit the escrow and shall be surcharged an additional fifty percent (50%) of the decommissioning costs for administrative costs in overseeing the

decommissioning. The applicant/owner/successor shall not have access to the escrow funds without the express written authorization and consent of the Blissfield Township Supervisor, Blissfield Township Board, and Blissfield Township Zoning and Planning Chair.

- 19. Right of Entry:** Blissfield Township or its designated agent is granted the right of entry onto the site, pursuant to reasonable notice, to effect or complete decommissioning.
- 20. Injunctive Relief:** Blissfield Township has the right to seek injunctive relief to effect or complete decommissioning, as well as the right to seek reimbursement from applicant or applicant's successor for decommissioning costs in excess of the amount deposited in escrow and to file a lien against any real estate owned by applicant or applicant's successor, or in which they have an interest, for the amount of the excess, and to take all steps allowed by law to enforce said lien.
- 21. Maintenance and Repair:** The applicant or applicant's successor is responsible for the maintenance, repair, and appearance of the Principal-Use Ground-Mounted SES. If the Township Enforcement Officer determines that a Principal-Use Ground-Mounted SES fails to meet the requirements of this ordinance and the Special Land Use Permit, or that a Principal-Use Ground-Mounted SES poses a safety hazard, the Enforcement Officer, or designee, shall provide notice to the applicant/successor of the safety hazard. If, after a reasonable cure period (not to exceed seven (7) days), the safety hazards are not corrected, the applicant/owner/successor shall immediately shut down the Principal-Use Ground-Mounted SES and not operate, start, or restart the Principal-Use Ground-Mounted SES until the issues have been resolved. Applicant/owner/successor shall keep a maintenance log on the SES, which shall be available for the Township's review upon forty-eight (48) hours' notice. Applicant/owner/successor shall keep the Principal-Use Ground-Mounted SES site neat, clean and free of refuse, hazardous, or unsanitary conditions.
- 22. Complaint Resolution:** The applicant proposing a Principal-Use Ground-Mounted SES shall submit a detailed, written complaint resolution process to resolve complaints from the Township Board, property owners, or residents concerning the construction or operation of the Principal-Use Ground-Mounted SES. The complaint resolution process must be approved by the Planning Commission as a condition of approval of the Special Land Use Permit application. The Complaint Resolution Committee shall consist of three (3) members appointed by the Blissfield Township Board comprised of one (1) Township board

member, one (1) Planning Commission member, and one (1) Township resident. The Complaint Resolution Committee shall oversee and participate in all complaint resolution discussion.

- a. In the event the Complaint Resolution Committee determines that the Principal-Use Ground-Mounted SES owner has violated an applicable ordinance or the terms and conditions of the approved application or special use permit, the owner shall be responsible for all costs incurred by the Township regarding the complaint and the resolution of the complaint, including any other penalties for violation(s) of the Township's Zoning Ordinance and shall be deducted from the escrow funds on deposit.
- b. The Township Board shall be kept apprised of all complaints and shall receive a report outlining the issues, the progress, and the resolution of each such complaint. The Township Board is authorized to enforce resolution of a complaint.
- c. This section is not a waiver of the Township's authority to seek any relief at law or equity to abate such violations or enforce Township Ordinances.

23. Insurance: The applicant/owner/successor or operator will maintain property/casualty insurance and general commercial liability insurance in an amount of at least \$10 million per occurrence.

24. Transferability: A special use permit for a Principal Use Ground-Mounted SES is transferable to a new owner. The new owner must register its name and business address with the Township and must comply with this Ordinance and all approvals and conditions issued by the Township.

E. SEVERABILITY

The provisions of this Ordinance are hereby declared to be severable and if any provision, section, or part of this Ordinance is declared invalid or unconstitutional by a court of competent jurisdiction, such decision shall only affect the particular provisions, section, or part involved in such decision and shall not affect or invalidate the remainder of such Ordinance, which shall continue in full force and effect.

F. EFFECTIVE DATE

This Ordinance shall become effective seven (7) days after its publication following final adoption or as required by law.

G. REPEAL

All Ordinances or parts of Ordinances in conflict with this ordinance are hereby repealed.

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Staff's Fourth Discovery Request to Company and Responses, Items 1 through 4

Please refer to Exhibit A-1.1 and A-1.3:

1. Please provide the methodology that the Applicant used to determine where “Existing Vegetative Treelines” exist, as identified in Exhibit A-1.1, Sheet C.202. **RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “methodology” and “determine” are vague, ambiguous, and subject to multiple, subjective interpretations.**

Subject and without waiving any objections, Glacier Meadows states as follows:

Existing vegetative treelines were derived per aerial mapping LiDAR returns and imagery.

2. Please provide the methodology that the Applicant used to determine the instances in which such treelines obviate the need for additional screening. If the presence of such treelines are assumed to always obviate the need for additional screening, please state as such, and please provide a narrative explaining/supporting such assumption.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “methodology,” “determine,” “obviate,” and “additional screening” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

The presence of treelines is assumed to obviate the need for additional screening. As stated in Exhibit A-1.3, Glacier Meadows will attempt to work with adjacent non-participating

landowners who do not have preexisting natural vegetation and express interest in additional screening.

Please refer to Exhibit A-1.3:

3. Within the proposed screening, please provide the proposed height of evergreen trees at the time of planting.

RESPONSE: Glacier Meadows objects to this Request as the terms “proposed height” and “time of planting” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows anticipates planting evergreens that are approximately 2 feet in height, subject to further coordination with Glacier Meadow’s selected Engineering, Procurement, and Construction (“EPC”) contractor on sourcing/availability.

4. Confirm that the amount of compensation in lieu of screening for each landowner will be equal to the avoided cost to install the Project’s proposed vegetative screening, on a linear foot basis, for that landowner. If not confirming, please explain the methodology for calculating the amount of the compensation, providing a sample calculation.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “compensation,” “avoided cost,” “linear foot basis,” and “methodology” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed that the amount of compensation in lieu of screening for each landowner will be

equal to the avoided cost to install the Project's proposed vegetative screening, on a linear foot basis, for that landowner.

Staff's Seventh Discovery Request to Company and Responses, Items 1 through 6

Please refer to Exhibit A-1.3:

1. Please list and describe the Applicant's experience with planting vegetative screening for previous solar projects in Michigan, or in other locations with similar climates. Specifically, for each example, please indicate:

- a. The height of evergreen trees at the time of planting,
- b. The survival rate of the evergreen plantings at 3, 5, and 10 years; and,
- c. The year following planting in which the evergreen trees reached 6 feet in height, on average.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "experience," "previous solar project," "similar climates, and "survival" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows does not have experience planting vegetative screening for solar projects in Michigan specifically; however, it has relevant experience with vegetative screening and evergreen planting on projects in other locations, including the following:

North Dakota: Glacier Meadows has experience with evergreen tree planting on projects in North Dakota in support of local permitting requirements. While the climate differs from Michigan, both regions share characteristics relevant to screening design including cold-weather species' hardiness requirements and wind exposure considerations.

Arizona: Glacier Meadows has experience installing vegetative barriers on solar projects in Arizona. Although the climate is arid and distinct from Michigan, many of the

foundational considerations apply, including species selection for screening effectiveness, establishment, and maintenance planning, and coordination with civil and grading design.

Answering further, Glacier Meadows will engage qualified local landscape and ecology professionals with Michigan-specific knowledge to inform species selection and planting design for Glacier Meadows, consistent with MPSC requirements and community screening objectives.

Glacier Meadows's standard is to utilize an agricultural fence to blend more seamlessly with surrounding properties in alignment with the selected EPC contractor, and to incorporate vegetative buffer on parcels according to community feedback and requests. This method is applied across the majority of Glacier Meadows's 6 GW onshore North America operational portfolio.

- a. North Dakota: Evergreens were planted at a height of 1-2 feet. Arizona: Evergreens were not planted due to climatic differences.
- b. At this time, the screening plantings are too young to provide this information. Research on this topic indicates that in North Dakota, evergreen plantings generally see a 70% to 90% survival rate after 3 years, dropping to 60% to 75% at 5 years. By 10 years, survival typically levels out around 50% to 60%. In Arizona, evergreen planting survival is highly dependent on timing of planting and supplemental irrigation.
- c. At this time, Glacier Meadows' screening plantings are too young to provide this information; however, research on this topic indicates that evergreens planted when they are 1-2 feet in height typically require 3

to 10 years following planting to reach 6 feet in height, depending on the species and site conditions. Fast-growing evergreen varieties under ideal conditions can reach 6-feet in height within 3 years, but generally, evergreens are expected to mature in 6-10 years.

Please refer to Exhibit A-1.2 and Exhibit A-9:

2. Please provide a map, either as a PDF or GIS/KMZ files, showing all participating parcels that have agricultural drain tile.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “agricultural drain tile” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows lacks information necessary to respond to this Request. Answering further, Glacier Meadows does not yet have mapping showing participating parcels that have agricultural drain tile. Glacier Meadows will consult with all participating landowners prior to the start of construction in Q2 2027 to identify known agricultural drain tile locations.

Please refer to Exhibit A-1.6. Note that, per the AFIP 7.6(b)(1), minor changes do not include any changes that would expand the footprint of the facility – in other words, the proposed fenced perimeter and other limits of disturbance. Note also that in previous cases, Staff has recommended the Commission consider specific changes to be minor, in the context of a particular project, when sufficient evidence has been provided to justify such recommendation. With that context:

3. Regarding Change 1, with respect to placement of photovoltaic and other (non-substation) equipment within red-hashed area in Figure 1 that is not already part of the project footprint (“additional potential equipment locations”):

- a. Please discuss the extent to which the additional potential equipment locations have been subject to desktop/field studies regarding impacts.
- b. Are there any studies related to project impacts that were not conducted across the additional potential equipment locations? If so, please list them.
- c. Would use of the additional potential equipment locations create new or additional impacts, require new permits, or run afoul of any of the criteria in 7.6(b) from the AFIP, other than 7.6(b)(1)?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “placement,” “project footprint,” “extent,” “additional,” “locations,” “impacts,” “studies,” “conducted,” “other equipment,” and “run afoul” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **The additional locations are within the scope of the Project’s evaluated study area and are consistent with the assumptions used in the applicable environmental and permitting analyses.**
- b. **If inverter or main power transformer locations shift, noise impacts will be re-evaluated through an updated sound model. Otherwise, other Project studies (including water resources, habitat, and cultural resources) considered impacts across the entire Project footprint.**
- c. **No. The additional potential facility locations would not create new or additional impacts, require new permits, or trigger any of the criteria in AFIP 7.6(b), other than 7.6(b)(1). Specifically, the additional**

locations would not affect water detention or retention, stormwater management, drainage patterns, or stormwater runoff and therefore do not implicate AFIP 7.6(b)(4).

4. Regarding Change 1, with respect to placement of the substation facilities within the blue-dotted area in Figure 1 that is not already being used for the substation facilities (“additional potential facility locations”):

- a. Please discuss the extent to which the additional potential facility locations have been subject to desktop/field studies regarding impacts. Are there any studies related to project impacts that were not conducted across the additional potential facility locations? If so, please list them.
- b. Would use of the additional potential facility locations create new or additional impacts, require new permits, or run afoul of any of the criteria in 7.6(b) from the AFIP, other than 7.6(b)(1)? Please specifically address 7.6(b)(4).

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “placement” “substation facilities,” “extent,” “subject,” “studies,” “conducted,” “impacts,” and “run afoul” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **Desktop and field studies related to Project impacts have been completed for all parcels within the Project footprint.**
- b. **No. The additional potential facility locations would not create new or additional impacts, require new permits, or trigger any of the criteria in AFIP §7.6(b), other than §7.6(b)(1). Specifically, the additional locations would not affect water detention or retention, stormwater management, drainage patterns, or stormwater runoff and therefore do not implicate AFIP §7.6(b)(4).**

5. Regarding Changes 2 and 3, please confirm that the final collection system and HDD crossing design, for both collection line and the gen-tie line, will be designed consistent with typical industry practices to minimize the total length of such features and therefore the total area of disturbance, except where additional length may be necessary for avoidance of specific impacts. Please further confirm that the final version of those features will be of similar length and location to the features as proposed in the application, other than as changed consistent with those design principles and avoidance measures. If not confirming both, please explain why not.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “final,” “collection system,” “designed consistent,” “typical,” “industry practices,” “minimize,” “necessary,” “features,” “similar,” and “principles and avoidance measures” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed. Both the collection line and the gen-tie line will be designed consistent with typical industry practices to minimize the total length of such features and therefore the total area of disturbance, except where additional length may be necessary for avoidance of specific impacts. Confirmed further that the final version of those features will be of similar length and location to the features as proposed in the Application, other than as changed consistent with those design principles and avoidance measures.

6. Regarding Change 6, please provide any updates to the necessity of such change since submission of the application.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “updates” and “necessity” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: ITC has developed a design to accommodate the Project’s interconnection into the existing Morocco Substation within the existing POI footprint without necessitating a bump-out/substation enclosure expansion; thus Change 6 is not presently anticipated to occur.

Jurisdiction	Total Area	Developed	Water	Farmable	Prime, Soils	Developed & Prime	Prime %
Blissfield	13454.5	1483.1	21	11950.4	5454.8	197.2	44.0%
Deerfield	16116.8	875.8	23.9	15217.1	1487.0	46.8	9.5%
Lenawee	487197	47204.5	7674.1	432318.4	116681.89	16011.0	23.3%
Unit	Acres	Acres	Acres	Acres	Acres	Acres	%
Source or Formula	Exhibit A-9	CroplandCROS	CroplandCROS	=[@[Total Area]]- [[@Developed]-[[@Water]	SSURGO	CroplandCROS + SSURGO	=([@[Prime, Soils]]- [[@[Developed & Prime]]])/[[@Farm able]

Exist. Gen.	Exist. Gen. %	Land for Specialty Crops	Proj. Farmable	Proj. Prime	Proj. Prime %	Proj. Farmland Use %
0	0.0%	721	150.4	0.0	0.0%	1.3%
0	0.0%	1161.4	939.4	0.0	0.0%	6.2%
1196	0.25%	4305.9	1089.8	0.0	0.0%	0.3%
Acres	%	Acres	Acres	Acres	%	%

Exhibit A-2	$= \frac{[@\text{Exist. Gen.}]}{[@\text{Total Area}] - [@\text{Water}]}$	CroplandCROS	Staff Calculation of Company GIS Fenced Area	SSURGO	$= \frac{[@\text{Proj. Prime}]}{[@\text{Proj. Farmable}]}$	$= \frac{[@\text{Proj. Farmable}]}{[@\text{Farmable}]}$
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Proj Prime Use %	Final Gen.	Final Gen. %
0.0%	150.388954	1.1%
0.0%	939.364017	5.8%
0.0%	2285.752971	0.5%
%	Acres	%

=[@[Proj.
 Prime]]/([@[Prime,
 Soils]]-[@[Developed &
 Prime]])
 =[@[Project
 Farmable]]+[@[Exist.
 Gen.]]
 =[@[Final Gen.]]/[@[Total Area]]

Value	Category	Pixel count	Area (acres)	Specialty?
5	Soybeans	220516	5449.1	FALSE
1	Corn	145788	3602.5	FALSE
243	Cabbage	20331	502.4	TRUE
36	Alfalfa	10913	269.7	FALSE
24	Winter Wheat	10322	255.1	FALSE
61	Fallow/Idle Cropland	6602	163.1	FALSE
54	Tomatoes	4745	117.3	TRUE
43	Potatoes	2386	59	TRUE
216	Peppers	828	20.5	TRUE
12	Sweet Corn	425	10.5	TRUE
31	Canola	214	5.3	FALSE
44	Other Crops	179	4.4	FALSE
26	Dbl Crop WinWht/Soybeans	153	3.8	FALSE
21	Barley	143	3.5	FALSE
47	Misc Veggies & Fruits	142	3.5	TRUE
50	Cucumbers	110	2.7	TRUE
28	Oats	86	2.1	FALSE
68	Apples	76	1.9	TRUE
27	Rye	61	1.5	FALSE
6	Sunflower	54	1.3	FALSE
228	Dbl Crop Triticale/Corn	41	1	FALSE
60	Switchgrass	39	1	FALSE
229	Pumpkins	39	1	TRUE
42	Dry Beans	38	0.9	TRUE
58	Clover/Wildflowers	29	0.7	TRUE
37	Other Hay/Non Alfalfa	22	0.5	FALSE
69	Grapes	13	0.3	TRUE
4	Sorghum	9	0.2	FALSE
56	Hops	7	0.2	TRUE
221	Strawberries	3	0.1	TRUE
59	Sod/Grass Seed	2	0	FALSE
76	Walnuts	1	0	TRUE
225	Dbl Crop WinWht/Corn	1	0	FALSE
176	Grassland/Pasture	27275	674	FALSE
122	Developed/Low Intensity	25995	642.3	FALSE
141	Deciduous Forest	24600	607.9	FALSE
121	Developed/Open Space	18402	454.7	FALSE
123	Developed/Med Intensity	11595	286.5	FALSE
190	Woody Wetlands	6730	166.3	FALSE
124	Developed/High Intensity	4030	99.6	FALSE
111	Open Water	848	21	FALSE
131	Barren	409	10.1	FALSE
195	Herbaceous Wetlands	176	4.3	FALSE
143	Mixed Forest	59	1.5	FALSE
142	Evergreen Forest	48	1.2	FALSE
152	Shrubland	2	0	FALSE

Value	Category	Pixel count	Area (acres)	Specialty?
5	Soybeans	298778	7383	FALSE
1	Corn	159133	3932.3	FALSE
24	Winter Wheat	39361	972.6	FALSE
243	Cabbage	20726	512.1	TRUE
68	Apples	10325	255.1	TRUE
54	Tomatoes	8680	214.5	TRUE
216	Peppers	4420	109.2	TRUE
61	Fallow/Idle Cropland	4066	100.5	FALSE
229	Pumpkins	1360	33.6	TRUE
36	Alfalfa	1248	30.8	FALSE
43	Potatoes	709	17.5	TRUE
12	Sweet Corn	368	9.1	TRUE
50	Cucumbers	229	5.7	TRUE
27	Rye	160	4	FALSE
60	Switchgrass	134	3.3	FALSE
76	Walnuts	72	1.8	TRUE
44	Other Crops	57	1.4	FALSE
42	Dry Beans	43	1.1	TRUE
26	Dbl Crop WinWht/Soybeans	38	0.9	FALSE
47	Misc Veggies & Fruits	24	0.6	TRUE
59	Sod/Grass Seed	24	0.6	FALSE
228	Dbl Crop Triticale/Corn	19	0.5	FALSE
6	Sunflower	16	0.4	FALSE
69	Grapes	14	0.3	TRUE
58	Clover/Wildflowers	13	0.3	TRUE
71	Other Tree Crops	13	0.3	TRUE
37	Other Hay/Non Alfalfa	11	0.3	FALSE
39	Buckwheat	7	0.2	FALSE
31	Canola	6	0.1	FALSE
4	Sorghum	5	0.1	FALSE
221	Strawberries	5	0.1	TRUE
70	Christmas Trees	4	0.1	TRUE
254	Dbl Crop Barley/Soybeans	3	0.1	FALSE
21	Barley	2	0	FALSE
28	Oats	2	0	FALSE
222	Squash	1	0	TRUE
225	Dbl Crop WinWht/Corn	1	0	FALSE
176	Grassland/Pasture	31413	776.2	FALSE
141	Deciduous Forest	27771	686.2	FALSE
121	Developed/Open Space	15576	384.9	FALSE
122	Developed/Low Intensity	14066	347.6	FALSE
190	Woody Wetlands	5562	137.4	FALSE
123	Developed/Med Intensity	4746	117.3	FALSE
124	Developed/High Intensity	1052	26	FALSE
111	Open Water	969	23.9	FALSE
131	Barren	816	20.2	FALSE

195 Herbaceous Wetlands	95	2.3	FALSE
142 Evergreen Forest	68	1.7	FALSE
143 Mixed Forest	25	0.6	FALSE

Value	Category	Pixel count	Area (acres)	Specialty?
5	Soybeans	6111523	151018.8	FALSE
1	Corn	3742091	92468.9	FALSE
24	Winter Wheat	1004877	24831	FALSE
36	Alfalfa	483240	11941.1	FALSE
61	Fallow/Idle Cropland	70555	1743.4	FALSE
243	Cabbage	58115	1436.1	TRUE
228	Dbl Crop Triticale/Corn	33197	820.3	FALSE
54	Tomatoes	21878	540.6	TRUE
60	Switchgrass	18738	463	FALSE
42	Dry Beans	18718	462.5	TRUE
43	Potatoes	17631	435.7	TRUE
58	Clover/Wildflowers	16453	406.6	TRUE
26	Dbl Crop WinWht/Soybeans	15316	378.5	FALSE
216	Peppers	14729	364	TRUE
68	Apples	11172	276.1	TRUE
44	Other Crops	10632	262.7	FALSE
205	Triticale	7822	193.3	FALSE
21	Barley	5570	137.6	FALSE
28	Oats	4496	111.1	FALSE
12	Sweet Corn	4428	109.4	TRUE
27	Rye	4242	104.8	FALSE
229	Pumpkins	2871	70.9	TRUE
71	Other Tree Crops	2413	59.6	TRUE
47	Misc Veggies & Fruits	2379	58.8	TRUE
50	Cucumbers	1885	46.6	TRUE
4	Sorghum	1690	41.8	FALSE
59	Sod/Grass Seed	1541	38.1	FALSE
37	Other Hay/Non Alfalfa	1454	35.9	FALSE
69	Grapes	673	16.6	TRUE
254	Dbl Crop Barley/Soybeans	579	14.3	FALSE
76	Walnuts	508	12.6	TRUE
31	Canola	465	11.5	FALSE
30	Speltz	242	6	FALSE
70	Christmas Trees	189	4.7	TRUE
221	Strawberries	147	3.6	TRUE
6	Sunflower	85	2.1	FALSE
225	Dbl Crop WinWht/Corn	45	1.1	FALSE
222	Squash	31	0.8	TRUE
56	Hops	29	0.7	TRUE
39	Buckwheat	24	0.6	FALSE
13	Pop or Orn Corn	3	0.1	FALSE
141	Deciduous Forest	2416035	59701.4	FALSE
176	Grassland/Pasture	2333863	57670.9	FALSE
190	Woody Wetlands	1174305	29017.7	FALSE
121	Developed/Open Space	809225	19996.4	FALSE
122	Developed/Low Intensity	762659	18845.7	FALSE

111 Open Water	310559	7674.1	FALSE
123 Developed/Med Intensity	255498	6313.5	FALSE
124 Developed/High Intensity	82915	2048.9	FALSE
142 Evergreen Forest	29355	725.4	FALSE
131 Barren	23854	589.4	FALSE
143 Mixed Forest	14778	365.2	FALSE
195 Herbaceous Wetlands	8160	201.6	FALSE
152 Shrubland	100	2.5	FALSE

Cropland	CROS Value	Crop Name
	71	Other Tree Crops
	42	Dry Beans
	12	Sweet Corn
	50	Cucumbers
	229	Pumpkins
	47	Misc Veggies & Fruits
	56	Hops
	68	Apples
	14	Mint
	43	Potatoes
	66	Cherries
	70	Christmas Trees
	69	Grapes
	242	Blueberries
	222	Squash
	53	Peas
	58	Clover/Wildflowers
	54	Tomatoes
	216	Peppers
	76	Walnuts
	221	Strawberries
	243	Cabbage
	67	Peaches

Area

29.52026
33.65435
59.74592
49.0592
26.65092
30.07243
17.00983
25.72292
0.04026
8.972398
10.80238
23.71229
23.68445
5.591317
3.65303
18.74633
14.94952
40.38679
17.82775
79.84312
52.93057
4.722583
1.33121
14.5138
6.784118
19.28899
0.647763
7.687974
27.93782
9.246588
13.92968
16.70111
23.22252
25.66041
37.59667

Total PA 116 Acres	781.8473 =SUM(B2:B30)
PA 116 Fraction	71.7% =B37/1089.8



OPEN

The potential land requirements and related land use change emissions of solar energy

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Although the transition to renewable energies will intensify the global competition for land, the potential impacts driven by solar energy remain unexplored. In this work, the potential solar land requirements and related land use change emissions are computed for the EU, India, Japan and South Korea. A novel method is developed within an integrated assessment model which links socioeconomic, energy, land and climate systems. At 25–80% penetration in the electricity mix of those regions by 2050, we find that solar energy may occupy 0.5–5% of total land. The resulting land cover changes, including indirect effects, will likely cause a net release of carbon ranging from 0 to 50 gCO₂/kWh, depending on the region, scale of expansion, solar technology efficiency and land management practices in solar parks. Hence, a coordinated planning and regulation of new solar energy infrastructures should be enforced to avoid a significant increase in their life cycle emissions through terrestrial carbon losses.

The technologies harnessing renewable energy sources are characterized by a power density several orders of magnitude lower than fossil fuels¹. As a consequence, the transition to these sources of energy is expected to intensify the global competition for land^{2–4}. For example, the sprawl of bioenergy has been already identified as the major driver of recent land use change (LUC) in developed regions^{5,6}. Increasing land competition can cause various environmental impacts intensifying biodiversity loss, water use or indirect land use change (iLUC) emissions. The latter refers to emissions produced by using cropland for energy purposes and, therefore, indirectly increasing land competition elsewhere in the world to meet global food demand, potentially replacing land with high carbon stocks, such as natural forests^{7–10}. For example, the literature estimates that the indirect land competition induced by liquid biofuels in developed regions leads to global land clearing and associated iLUC emissions higher than the emission savings achieved by replacing gasoline by these biofuels during 30 years^{11–13}.

For sources of renewable energy other than bioenergy, land requirements and the associated environmental impacts remain understudied in the literature from a quantitative point of view^{1,10}. In the case of solar energy, the land competition element is usually expected to be negligible due to its higher relative energy density compared to bioenergy and the possibility to integrate it in urban areas or non-productive land^{7,14–16}, and as such is currently excluded from official statistical reporting and integrated assessment models (IAMs). However, recent studies based on satellite views of utility-scale solar energy (USSE) under operation, either in the form of photovoltaics (PV) or concentrated solar power (CSP), show that their land use efficiency (LUE) is up to six times lower than initial estimates^{17–19}. Applying such observed LUEs accordingly reduces the potential contribution of solar on rooftop space^{1,20,21}.

The installation of USSE on land is subject to a diversity of constraints: solar resource constraints, which are related to the solar irradiance in a certain area; geographical constraints such as the slope and the existing use of the land; and regulatory constraints, e.g. the protected status of the land, often related to ecosystem and wildlife preservation^{21–27}. Therefore, where available, deserts and dry scrubland with high solar irradiance and which are generally not suitable for human activities, are used or planned to be used for solar energy^{26–28}. However, beyond hard restrictions, other features such as the lack of road, electricity and water infrastructures, and the distance

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from human settlements complicate the large scale construction, operation and maintenance of solar power in these areas²². On top of that, spatial frictions might occur if land which is made available for solar energy by national or local governments is in reality a biodiversity hotspot^{29,30} or the home of human communities^{31,32}. Recent developments show that USSE in densely populated countries is often installed on arable land that is used or potentially suitable for other productive uses such as agriculture or forestry^{17,26,33,34}, intensifying land competition for the same reasons as the sprawl of bioenergy does. Furthermore, clearing currently vegetated land for USSE also has local impacts on biodiversity, carbon cycling and aesthetics^{25,30,35}.

The share of solar energy in global electricity scenarios that are largely or fully decarbonized by 2050 usually vary from about 20% to 60%^{36,37}. For specific regions, these penetration levels can even range up to 90%³⁷. Due to the potential relevance and relatively low power density of solar energy in a decarbonized future, and given that PV in urban areas will only be able to cover a share of the total demand^{1,21}, this paper aims to quantify the potential land occupation of solar energy installed up to 2050, and the related direct and indirect impacts on carbon cycles, within a context of global climate action as proposed in the Paris Agreement. We concentrate on three regions with heterogeneous features where futures with a high solar energy penetration have been identified in the literature as likely to induce land competition: the European Union (EU), India and jointly Japan and South-Korea. Uncertainties in terms of future solar module efficiency improvements up to 2050 (20, 24, 28%) are taken into account, as well as solar land management options and their different associated impacts on local carbon cycles: depending on how the land below and around solar energy installations is managed, and on the land use prior to the conversion to solarland, land transformation for hosting USSE can cause a net release of carbon that was stored in soil and vegetation, or can lead to net carbon uptake³⁸. See Section 2 of the Supplementary Material (SM) for an overview of the scenarios designed for this study.

Results

A novel method has been specifically designed in this work which allows dynamically accounting for the land occupation of solar energy, depending on the geographical location and year of installation and based on real-world LUE observations^{1,17}, within a state-of-the-art Integrated Assessment Model (IAM) that links energy, land, socioeconomic and climate systems (see “Methods” section) and that has also been applied in other studies to measure the terrestrial carbon leakage induced by bioenergy in a climate change mitigation context^{9,39,40}. Through this model, a range of electricity mix penetration scenarios are simulated for solar energy technologies (and bioenergy for comparison). Based on the spatially defined LUE of solar energy, as well as the identified potential for solar energy in urban areas, deserts and dry scrublands, land use for solar energy competes with other land uses through the inherent relative profitability of each land use. The induced global land cover changes and related LUC emissions are then compared with scenarios where the same emission reduction targets in the electricity sector are achieved without solar and bioenergy, to isolate the additional land requirements, land cover impacts and related LUC emissions provoked by solar and bioenergy.

Solar land occupation. Table 1 shows the obtained results for absolute and relative land requirements of solar energy, based on land that is (potentially) suitable for commercial production (i.e. crops, animal husbandry, and forestry, so excluding the use of rooftops deserts and dry scrublands), for the simulated scenarios at penetration rates ranging from 26 to 79% of the electricity mix, and for the range of future solar PV module efficiencies. Due to the lower irradiance and higher latitude of Europe, absolute land use of per unit of solar output is almost twice as high as in Japan and South-Korea and three times higher as in India (see Fig S6 in the SM). This ratio increases with higher penetration rates, due to the saturation of the potential to generate solar energy on rooftops (see also Figure S12 in the SM) in combination with the decreasing marginal returns for land-based solar energy. With solar energy accounting for 25 to 80% of the electricity mix, land occupation by USSE is projected to be significant, ranging from 0.5 to 2.8% of total territory in the EU, 0.3 to 1.4% in India, and 1.2 to 5.2% in Japan and South-Korea. This occupation is unequally spread within each of the regions, as areas that are relatively attractive for solar energy are prioritized in each region, such as southern Europe, north western India, and southern Japan and South-Korea (see Fig. 1).

The future land requirements of solar energy obtained for each scenario and region can be put in perspective compared, for example, to the current level of built-up area and agricultural cropland. In the three regions, a large part of the total built-up area (urban and solar land) will consist of solar PV panels or CSP heliostats by 2050 if at least half of the produced electricity comes from solar power. Land for solar would amount to over 50% of the current EU urban land, over 85% for India, and over 75% in Japan and South-Korea. From a different perspective, a significant part of the sunlight captured for commercial use would be used for electricity generation instead of growing crops, especially in Japan and South-Korea (29–39%) and the EU (8–10%). The relative projected land area dedicated to either crops or solar energy strongly differs within each region, with potential local ecosystem and landscape implications (see Figure S16 in the SM).

Land cover changes. Solar energy infrastructure currently occupies a negligible amount of land globally. Our results show that this changes in scenarios with a high share of solar energy in the future electricity mix. Figure 2 shows the obtained land cover changes related to increasing solar energy (see Table 1), within each of the three regions (upper part of the figure), and indirectly driven land cover changes outside of these regions in the rest of the world (lower part). Based on assumptions on economic and suitability constraints (see Section 1c in SM), solar energy expansion in the three regions is found to predominantly replace (or avoid future land conversion to) land used for commercial purposes, such as cropland or commercial forest (e.g. for timber products or biomass). Instead, solar energy penetration is not found to significantly affect the cover of unmanaged land in each of the three regions. However, the displacement of commercial land within each of the three focus regions

Focus region	Solar penetration by 2050 ^a	Rooftop PV generation share of solar (2050)	Occupation of land suitable for commercial purposes (^b) by 2050		Relative solar land occupation by 2050 ^c			Occupation of land suitable for commercial purposes (^b)
	% of total electricity (PWh in 2050)	% of solar penetration by 2050	Solar energy	Bioenergy (% within region)	% of total land area	Compared to urban area in 2010 (%)	Compared to crop area in 2050 (%)	km ² per TWh solar (average 2020–2050)
			1000 km ²					
European Union	26 (1.19)	24.3–23.0	21–28	366 (45)	0.5–0.7	20–27	1.9–2.5	19.4–24.2
	53 (2.54)	12.3–11.6	53–69	614 (38)	1.3–1.7	50–66	4.8–6.3	22.1–28.0
	79 (3.87)	8.1–7.6	85–111	969 (32)	2.1–2.8	81–106	7.7–10	23.5–29.7
India	30 (1.8)	10.6–9.9	10–14	596 (16)	0.3–0.5	46–62	0.6–0.9	6.4–8.2
	54 (3.29)	5.9–5.5	20–26	1051 (12)	0.7–0.9	88–118	1.2–1.6	6.5–8.5
	78 (4.88)	3.6–3.3	30–41	1516 (10)	1.0–1.4	137–182	1.9–2.5	6.9–8.8
Japan and South-Korea	28 (0.5)	25.0–22.1	5–6	185 (17)	1.2–1.6	36–48	8.3–11	12.9–15.6
	46 (0.8 PWh)	15.6–13.8	9–12	279 (13)	2.3–3	68–89	16–21	13.3–16.4
	74 (1.3 PWh)	9.0–8.1	16–21	429 (10)	4–5.2	120–157	29–39	13.9–17.1

Table 1. Land occupation characteristics at different solar penetration levels by 2050. Ranges show results for with different future solar module efficiencies with left values within each solar-related column representing 28% efficiency and right values 20%. Results for bioenergy scenarios included for comparison. ^aThese are realized penetration levels. See Section 1b in the SM for more information. ^bLand suitable for commercial purposes does not include the use of rooftop space, deserts or dry scrublands that are not suitable for crop, pasture or forest cultivation. Deserts and dry scrublands in India host about 11.5–12% of solar energy throughout all penetration scenarios of solar energy in India (see Figure S8 in the SM). See the “Methods” section and Section 2b in the SM for modelling details with respect to location choices. ^cThese columns compare the “Land suitable for commercial purposes by 2050” to total land, urban land (in 2010; future urban expansion is not modelled) and total crop area (abstracted from the same modelled scenarios).

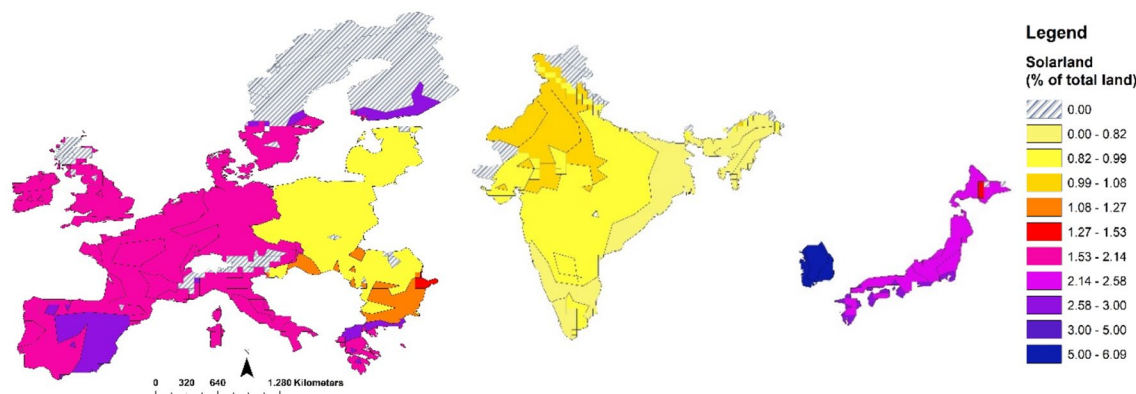


Figure 1. Geographical distribution of the share of total land occupied by solar energy within each region, by agro-ecological zone. See “Methods” section and Figure S1 of the SM for more information on the spatial resolution used in this study. Source: Authors’ own elaboration with the Arc GIS 10.5.1 Desktop (Esri) software.

would incentivise the use of currently unused arable land in other regions, while also boosting the commercialisation of unmanaged land, indirectly leading to the loss of natural land cover. The magnitude of this indirect land cover impact depends on the crop and forestry productivity in regions where solar energy penetration takes place: relatively high crop productivities in the EU, Japan and South-Korea mean that the displacement of cropland from these regions to regions with lower crop productivities would indirectly increase global cropland cover, amplifying the impact of solar energy expansion in these regions on global land competition by up to 22%. This effect is lower at lower solar energy penetration levels (even negative in the EU), as solar energy is projected to displace the most marginal cropland first. In India, where current and projected crop productivities are below the global average, the impact of solar expansion on global land competition is less significant.

Figure 2 shows that, either directly or indirectly, expansion in solar energy predominantly reduces non-commercial land cover on a global scale: for every 100 hectares of solarland in the EU, we find that, depending on the solar penetration level, 31 to 43 hectares of unmanaged forest may be cleared throughout all the world. The same amount of solarland in India would clear 27 to 30 hectares of unmanaged forest, and for Japan and South-Korea, the ratio is 49 to 54 hectares.

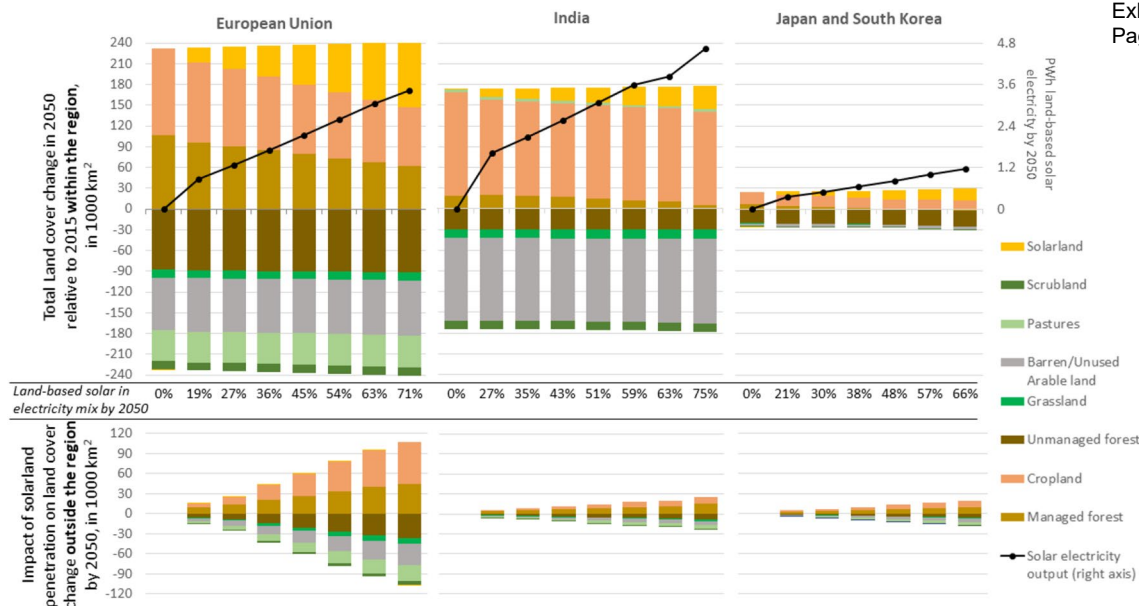


Figure 2. Global land-cover changes by 2050 due to solar expansion, for a range of solar energy penetration levels and for an average efficiency of installed solar modules of 24% by 2050. The upper graphs shows total land cover changes by 2050 relative to 2015 within each region and the lower side shows the land cover changes in the rest of the world (leaking), indirectly driven by the penetration of solarland within the region. Positive land cover changes refer to increases and negative to land cover loss. See Section 3b in the SM for aggregated global land cover changes. Note that land cover changes do not correspond with land use changes: this figure compares total land cover in different scenarios of land-based solar energy penetration, but does not show which specific types of land convert to solarland (or any other type of land). Note that these land cover changes are based on simulated land use decisions driven by economic optimisation. See “Methods” section for more details.

Impact on terrestrial carbon stocks. The land cover changes in Fig. 2 imply that solar expansion leads to LUC emissions, such as iLUC emissions related to increasing global land competition, emissions related to vegetation loss if forest and scrubland makes place for solarland (either directly through deforestation or indirectly by avoiding future afforestation), and carbon release from soil and vegetation directly below the installed panels, where sunlight is much reduced³⁵. However, an important part of the emission balance is related to the land management regime applied in solarland. If all vegetation is cleared and avoided to regrow through the application of herbicides, which is a common practice in various countries⁴¹, LUC emissions from solar expansion are further amplified. In contrast, if arable land plots are converted to solar parks whose surface is managed as pastures, there will be a net carbon sequestration in vegetation and soil in the decades following upon the conversion (apart from the land directly below the panels, where photosynthesis is largely blocked)³⁵, offsetting some or all of the inevitable LUC emissions caused by land competition. In reality, the application of a particular land management practice depends on a diversity of local factors (policies, climate, etc.). See “Methods” section for a detailed explanation of each land management regime.

Figure 3 and Table 2 show the obtained LUC emissions per unit of solar energy installed from 2020 to 2050 associated to the different simulated solar penetration and module efficiency scenarios, and for different management regimes of the land in solar parks. They show that solar expansion scenarios until 2050 will most likely lead to net LUC emissions, although there can be a net carbon sequestration in India when managing the land in solar parks as pastures. The sequestration effect is amplified if delayed post-2050 impacts on local carbon cycles are taken into account (see Table 2). In the absence of land management practices specifically aiming at carbon sequestration, land cover change due to the expansion of solar energy in the EU would cause 13 to 53 g of CO₂ per produced kilowatt-hour (kWh) of electricity, about 4 to 16% of the CO₂ emissions from natural gas fired electricity. Solar energy in India involves significantly less land cover change per unit of output (see Fig. 2), and estimated LUC emissions per kWh are below 12 g of CO₂ for all scenarios. In Japan and South-Korea, LUC emissions related to the expansion of solar energy are 11 to 35 g of CO₂ per kWh. When using relatively efficient PV technologies such as monocrystalline and multicrystalline silicon (made from a single crystal of silicon and from many silicon fragments melted together, respectively) (lower range of estimated LUC emissions, higher range of non-land life cycle emissions), our results show that LUC emissions are comparable to about 10 to 50% the current non-land life cycle emissions for such technologies. Instead, when using less space-efficient but more resource-efficient PV technologies such as thin-film Cadmium telluride (CdTe) made by depositing one or more thin layers of photovoltaic material on a glass, plastic or metal substrate (higher range of LUC emissions, lower range of non-land life cycle emissions), we estimate LUC emissions in the range of 50 to 150% of the non-land life cycle emissions. If solarland is seeded with herbs and managed as pasture, net LUC emissions drop by more than 50% in most cases.

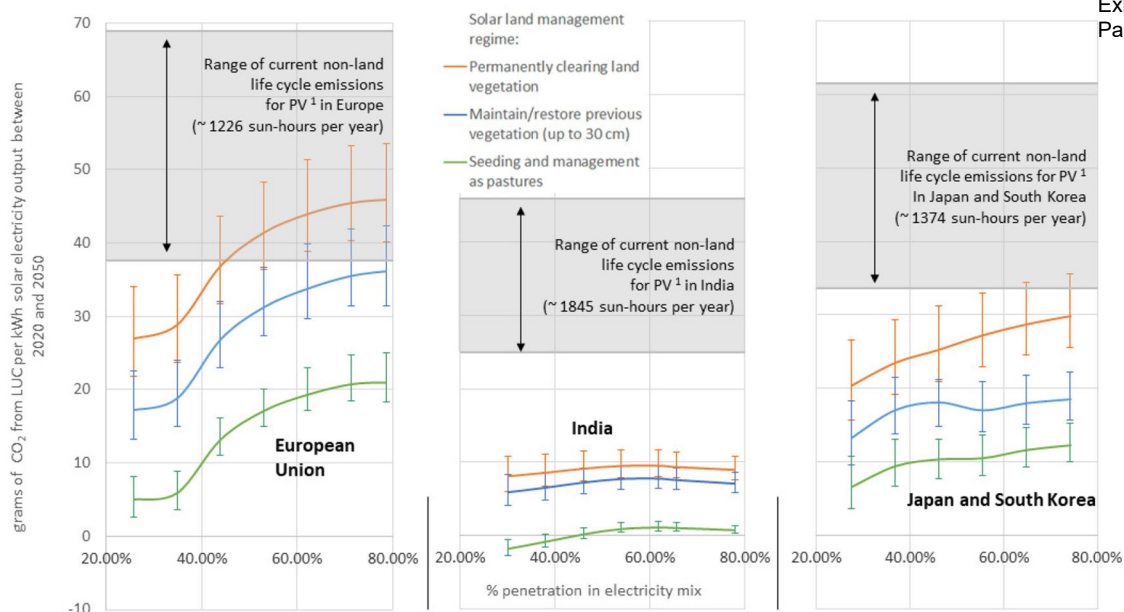


Figure 3. Land use change emissions related to land occupation per kWh of solar energy from 2020 to 2050, for the three solarland management regimes applied (see “Methods” section for more details), and relative to other life cycle emissions of PV systems (depend on location of installation) and emissions from natural gas fired electricity (independent of location). Uncertainty bounds reflect solar module efficiency scenarios (reaching average efficiencies of 20, 24 and 28% for modules installed in 2050; see Section 2c in SM). ¹ Non-land life cycle emissions of PV are based on a range of PV technologies, including mono and multicrystalline silicon (higher range), thin-film CdTe (lower range), CIS and a-Si systems as calculated in Liu & van den Bergh (2020)⁴², and based on an average global carbon intensity of electricity (0.48 kg CO₂/kWh). The range is calculated by dividing the regionally weighted solar electricity output per m² as used in this study, by CO₂ emissions per m² panel surface.

Table 2 also shows the obtained emissions per m² of land occupation by solar energy, which reflect the value of the used land in terms of its potential to sequester carbon: either directly by its capacity to sequester carbon in soil and vegetation, or indirectly by its agricultural productivity which, if being displaced by solarland, will lead to conversion of non-commercial land to agricultural land elsewhere. Since in our simulations land for USSE predominantly replaces commercial land growing crops or timber products within each region (see Fig. 2), solar energy expansion displaces commercial timber production to other regions, indirectly increasing carbon sequestration outside the region by incentivising currently degraded forest or other arable land to be commercialised for timber production. At higher solar penetration rates however, increasing land pressure causes more natural forests to be used for timber or crop production, leading to higher land use change emissions outside the region. This effect is best visible for solar penetration scenarios in the EU, due to the high absolute amount of land use.

Solar energy versus bioenergy. IAMs which link energy, economy, land and climate modules tend to rely strongly on the cultivation of dedicated bioenergy crops (such as switchgrass and miscanthus) in global climate change mitigation scenarios⁴³. As the land use impacts of bioenergy have been extensively analysed in other studies, using the same model^{9,39}, we proceed to compare the land occupation and related LUC emissions of electricity production from solar energy and bioenergy, with the purpose of improving the comparability of the obtained results.

Table 1 shows that land requirements for reaching certain levels of electricity penetration with solar energy are about a magnitude lower than land requirements to meet those same levels with bioenergy. Comparing the additional global LUC emissions until 2100 as a result of reaching certain shares of bioenergy in the electricity mix of 2050 in the regions in this study, we observe from Table 2 that emissions per dedicated m² are in many cases lower than for solar energy at the same penetration level in the electricity mix. However, the energy density of solar energy is a magnitude higher than that of bioenergy. By comparing the total LUC emissions from one unit of solar and bioenergy to the “avoided” periodical combustion emissions from natural gas fired electricity, we calculate the “CO₂ payback period” of these renewable alternatives for electricity production, which is a common method to compare LUC emission impacts of different types of bioenergy^{13,44}. Table 2 shows that the payback period of bioenergy is significantly higher (~4 years) than that of solar energy (<8 months), as the higher land requirements for bioenergy more than offset the lower emissions per m² found in most cases. However, since the physical characteristics of bioenergy allow for trade over large distances, comparable to fossil fuels and in contrast to electricity from solar energy, only a limited part of the land requirements and related LUC emissions driven by bioenergy expansion is projected to be within the EU, India, Japan and South-Korea. Note that these results do only focus at solar and bioenergy based in land with potential commercial use. Solar energy in urban areas,

	Solar penetration level	Land management scenario in solarland ^a	Direct and indirect land use change (LUC) emissions due to solar energy ^b			LUC emissions per occupied m ^{2c}		LUC CO ₂ payback period when replacing gas-fired electricity ^d	
	% and PWh in 2050 elect. mix		Within region	Outside region	Total	Solar energy	Bio-energy	Solar energy	Bio-energy
			Grams of CO ₂ per kWh of solar electricity output between 2020 and 2050 (average)			kg CO ₂ (2020–2100) per m ² of dedicated land in 2050		Months	
European Union	26% (1.19 PWh)	CLEAR	28.1 to 38.6	– 6.4 to – 4.6	21.8 to 34.0	4.4 to 5.2	3	4.7 to 7.1	46.9
		MAINT	19.7 to 27.1		13.3 to 22.5	3.1 to 3.7		3.2 to 5.2	
		SEED	9.0 to 12.7		5.0 to 8.1	1.1 to 1.7		1.2 to 2.4	
	53% (2.54 PWh)	CLEAR	33.0 to 43.5	3.3 to 4.7	36.3 to 48.3	6.7 to 6.8	3.1	6.2 to 8.2	49.2
		MAINT	24.0 to 30.9		27.3 to 36.6	5.3 to 5.4		4.8 to 6.5	
		SEED	11.7 to 15.4		15.0 to 20.1	~ 3.1		2.9 to 3.8	
	79% (3.87 PWh)	CLEAR	34.6 to 46.7	5.6 to 6.9	40.2 to 53.6	7.2 to 7.3	3	6.4 to 8.3	49.3
		MAINT	25.8 to 35.5		31.4 to 42.4	~ 5.9		5.2 to 6.7	
		SEED	12.7 to 18.1		18.3 to 24.9	3.5 to 3.6		3.2 to 4.0	
India	30% (1.8 PWh)	CLEAR	10.0 to 12.5	– 4.0 to – 1.6	6.0 to 10.8	1.3 to 2.4	2.3	0.3 to 0.8	41.7
		MAINT	8.1 to 10.0		4.1 to 8.4	0.6 to 1.7		0.2 to 0.6	
		SEED	1.1 to 1.3		– 2.7 to – 0.6	– 5.2 to – 6.2		– 1.5 to – 1.7	
	54% (3.29 PWh)	CLEAR	10.8 to 13.0	– 2.8 to – 1.3	8.0 to 11.7	2.5 to 3.1	2.3	0.6 to 1.0	43.2
		MAINT	9.1 to 10.8		6.3 to 9.5	1.9 to 2.4		0.5 to 0.8	
		SEED	3.0 to 3.2		0.4 to 1.7	– 4.5 to – 5.0		– 1.2 to – 1.5	
	78% (4.88 PWh)	CLEAR	9.7 to 11.7	– 2.1 to – 0.9	7.6 to 10.8	2.9 to 3.2	2.4	0.7 to 1.1	43.9
		MAINT	8.0 to 9.5		5.9 to 8.6	2.1 to 2.5		0.5 to 0.8	
		SEED	2.3 to 2.5		0.4 to 1.4	– 4.4 to – 4.8		– 1.2 to – 1.5	
Japan and South-Korea	28% (0.5 PWh)	CLEAR	18.9 to 25.8	– 3.2 to 0.8	15.7 to 26.6	4.8 to 6.8	2.7	2.9 to 5.2	47.7
		MAINT	12.8 to 17.5		9.6 to 18.2	2.2 to 4.1		1.4 to 3.1	
		SEED	6.8 to 10.0		3.6 to 10.7	– 0.3 to – 2.2		– 0.2 to – 1.3	
	46% (0.8 PWh)	CLEAR	23.0 to 30.6	– 2.1 to 0.6	20.9 to 31.1	6.1 to 7.2	2.6	3.3 to 5.0	47.3
		MAINT	16.9 to 20.5		14.8 to 21.1	3.9 to 4.3		2.1 to 2.9	
		SEED	9.9 to 12.5		7.7 to 13.1	– 0.2 to – 1.2		– 0.2 to – 0.7	
	74% (1.3 PWh)	CLEAR	25.6 to 33.3	0.0 to 2.3	25.6 to 35.6	7.1 to 7.7	2.7	3.6 to 5.0	48.9
		MAINT	15.6 to 20.0		15.6 to 22.2	3.5 to 3.9		1.8 to 2.6	
		SEED	10.0 to 12.9		10.0 to 15.2	– 0.5 to 0.0		– 0.3 to 0.0	

Table 2. Land use change emissions and payback periods for solar penetration and solarland management scenarios. Ranges show results for with different future solar module efficiencies with left values within each solar-related column representing 28% efficiency and right values 20%. Results for bioenergy scenarios included for comparison. ^aCLEAR: permanently clearing land vegetation; MAINT: Maintain/restore previous vegetation (up to 30 cm); SEED: Seeding and management as pastures. See “Methods” section for a detailed description of these land management scenarios. ^bDividing all LUC emissions from 2020 to 2050 to the total amount of generated electricity (including non-land-based sources, such as solar rooftops, unproductive land or waste-to-energy plants for bioenergy). ^cDividing all LUC emissions from 2020, including delayed carbon release or sequestration until 2100, by the total land area dedicated to solar and bioenergy by 2050 (maximum point). Negative values indicate net carbon sequestration for every m² of solarland. ^dCalculated assuming a thermal efficiency of 50% for natural gas power plants. Only taking account direct combustion emissions.

deserts and dry scrublands, as well as bioenergy from waste or agricultural and forestry residue, are assumed not to contribute to LUC emissions nor carbon sequestration.

Discussion

By representing the land requirements of solar energy within an IAM that integrates energy, land, socioeconomic and climate systems, we were able to, for the first time in the literature to our knowledge, estimate the land cover impacts and related LUC emissions of solar energy within climate change mitigation scenarios up to 2050. The obtained results represent a contribution to the novel field of research which analyses the environmental impacts of significantly up scaling renewables other than biomass^{45,46}.

A combination of technical and geopolitical reasons complicates the installation of solar energy far from consumption points. Therefore, a high share of solar generation in the energy mix in relatively densely populated regions with high per capita energy demands can require a significant share of domestic land, comparable to the current built-up area in these regions. The most relevant factors influencing the land use per unit of solar energy are solar irradiation, latitude, and future solar module efficiencies. At the domestic level, solar energy is found to predominantly compete for land with cropland and managed forests, while on a global scale, 27 to 54% of the land required for solar energy is found to indirectly displace unmanaged forests, predominantly outside the

region where the solar energy is consumed. Note that this iLUC has been documented to happen for biofuels¹¹, although the strength of this effect is not comparable for solar energy given that the power density of solar is much higher than that of biofuels. Still, we do find a non-negligible effect in this study. The obtained land cover change imply environmental consequences such as greenhouse gas emissions and biodiversity loss⁴⁷. However, the impact of USSE on local environmental impacts depends strongly on how this new solarland will be managed. If all previous vegetation is permanently cleared, the total (direct and indirect) LUC emissions related to the expansion of solar energy from 2020 to 2050 correspond to 5 to 16% of emissions from natural gas combustion for power generation in developed regions such as the EU, Japan and South-Korea, and about 2.5–3.5% in India, where conditions for solar energy are more favourable and crop yields are lower, implying less indirect emissions. However, if solarland is seeded with herbs and managed as pastures, total LUC emissions per kWh of electricity in the studied period are 3 to 5 times lower, and could even be negative (i.e., becoming net sources of carbon sequestration) in India, Japan and South-Korea, if long-term effects (post 2050) are taken into account.

Numerous Life Cycle Assessments (LCA) have been performed for solar energy, estimating the life cycle emissions of solar energy systems depending on many factors, such as the year and location of construction, solar module efficiency, mounting system, location of input production, among others^{42,48}. Comparing the non-land life cycle emissions from LCAs to the LUC emissions estimated in this study, we can conclude that LUC emissions (which are normally not included in LCAs) increase total life cycle emissions of new USSE projects by 10 to 150% in the absence of land management practices focused on sequestering carbon in solarland, depending mainly on the region where the infrastructure is installed and the type of technology used. While this is a notable increase in life cycle emissions, it is also important to consider that LUC emissions will not repeat if a solar plant is renewed or upgraded after the initial construction phase, and therefore average LUC emissions of solar energy will be lower in the future. Also, this terrestrial part of solar energy life cycle emissions could be avoided by applying land management practices focused on carbon sequestration in solarland.

Using an existing IAM to study the potential land impacts of solar energy expansion, we were bound to the limitations of this model. One of these was the division of land zones in the model (corresponding to Agro-Ecological zones, see “Methods” section), which determine the boundaries of the geographical competition to host solar energy within each region. This pre-defined distribution was originally designed to capture variations in crop yields, and is not ideal for defining the geographical diversity of solar energy “yields” within a region. Although a general good correspondence is found, there are also exceptions (see Figure S6 in the SM). This limitation could be dampened in future work by using/developing a land cover layer that matches better with geographical differences in solar irradiation and latitude. We were also not able to account for the suitability of land for solar energy limited by the slope or the protection of the land²⁴. Therefore, we implicitly assumed that those hectares that are converted to solarland in our scenarios are indeed suitable for hosting solar energy. In contrast, some land is suitable for solar energy and not for commercial crops or forests, such as dry scrubland and deserts, which are by default excluded from land competition in the applied model. The inclusion of a solar potential on identified “wastelands” in India (see “Methods” section) should have largely circumvented this inherent limitation in the applied method. To extend the analysis performed in this study to other regions, it is important to have a well-quantified potential for solar energy in areas that are not suitable to host other commercial land uses such as agriculture and forestry. Finally, we have not taken into account the potential to integrate solar systems in agricultural land (agrivoltaic systems), a technique that is currently in an early stage of research and development and of which the large-scale performance is still uncertain⁴⁹.

To date, land use for solar energy is negligible compared to other human land uses. However, the obtained results show that in future scenarios, with a largely decarbonized electricity system, high penetration rates of solar energy will require significant amounts of land to be occupied by solar power plants. Further work applying ecological tools should be focused towards investigating the implications of these additional land occupation levels -including the additional transmission power lines- in terms of habitat fragmentation and ecosystem disturbance. Siting policies for USSE should avoid adverse land impacts and limit land competition, for example by excluding high yield cropland as already performed in some countries⁵⁰, maximising the use of urban areas and degraded arable land²², or by seeding solarland with herbs and managing these lands as common pastures (e.g. by allowing extensive animal grazing), converting solarland to a net source of carbon sequestration³⁵. Such techno-ecological synergies are crucial for minimising the unintended consequences of solar expansion³⁸, such as the potential impacts on land cover change and LUC emissions as measured in this study. The results in this study also indicate that minimum efficiency standards for solar modules help to reduce solar land requirements and limit land competition, although there might be a trade-off with non-land life cycle impacts, which tend to be higher for high-efficiency solar modules. Finally, the inclusion of this new type of land use in integrated energy-land-climate models, as has been done in this paper, will be useful to capture a larger range of implications of specific energy transition scenarios.

Methods

The Global Change Assessment Model (GCAM), version 4.3, has been used as a base for this study⁵¹. GCAM is a dynamic-recursive model with technology-rich representations of the economy, energy sector and land use linked to a climate model that can be used to explore climate change mitigation policies including carbon taxes, carbon trading, regulations and accelerated deployment of energy technologies. See Section 1a of the SM for a wider description of the model. The background scenario for the model exercises in this study consist of the “Middle of the Road” Shared Socioeconomic Pathway (SSP 2)⁵² with global CO₂ reduction targets as defined by the Nationally Determined Contributions (NDCs) with increased ambitions after 2030⁵³.

In order to identify the effects that solar energy and bioenergy pathways have on land use and land use change emissions, three pathways have been modelled achieving a defined penetration level in the electricity mix from

2020 to 2050, using different electricity generation technologies (see Section 2b in the SM on how the different penetration levels have been modelled):

- Solar energy pathway (S): land-based PV, rooftop-based PV, CSP
- Bioenergy pathway (B): Conventional biomass and biomass gasification (with and without Carbon Capture and Storage), Biomass-driven Combined Heat and Power.
- Non-land-occupying pathway (NL): wind, geothermal, rooftop-based PV (and nuclear in scenarios where penetration level cannot be reached with the first 3 technologies together)

The land occupation of solar and bioenergy (Figs. 1 and 2, Table 1) is identified using Eq. (1), land use change emissions per unit of output from 2020 to 2050 (for Fig. 3 and Table 2) from 2020 to 2050 have been calculated using Eq. (2), and the CO₂ payback period (Table 2) has been calculated using Eq. (3). In these equations, the subscript r defines the region, p the electricity penetration level, i the technologies included in either the solar- or bioenergy pathway, NL defines non-land-occupying energy technologies and $i(l)$ represents land-competing solar- or bioenergy, so not taking into account solar energy based on rooftops, deserts or dry scrublands or bioenergy from waste or agricultural residues. The parameter a defines the CO₂ emission factor per unit of electricity output of the alternative thermal generation technology (i.e. natural gas). Scenarios are run until 2050, but delayed effects on carbon release or sequestration in vegetation and soils can be abstracted until 2100. The impact from land management regimes have been calculated through off-model calculations, as such regimes are assumed not to affect the allocation procedure of new solar energy. See Section 2d of the SM for more details.

$$\text{Land occupation}_{i,p,r} = \text{land for } i_{p,r} - \text{land for } i_{NL,p,r} \quad (1)$$

$$\text{LUC per output unit}_{i,p,r} = \frac{\sum_{p,r}^{2020 \text{ to } 2050} (LUC_i - LUC_{NL})}{\sum_{p,r}^{2020 \text{ to } 2050} (\text{output } i - \text{output } i_{NL})} \quad (2)$$

$$\text{CO}_2 \text{ payback period}_{i(l),p,r,a} = \frac{\sum_{p,r}^{2020 \text{ to } 2100} (LUC_i - LUC_{NL})}{\text{output}_{i(l)}^{2050=\max} * a} \quad (3)$$

Land competition in GCAM. Land use and agricultural output in GCAM version 4.3 are calibrated for pre-defined Agro-Ecological Zones (AEZs), which sub-divide geo-political regions in 18 different types of land regions, based on differences in climate zones (tropical, temperate, boreal) and the length of growing periods for crops⁵⁴. See Figure S1 in the SM for an overview of the AEZs within the three focus regions of this study.

Land use in GCAM has been divided in different nodes that affect the level of competition between different uses (see Figure S3 in SM). Those land-use categories (e.g. corn, wheat, bioenergy) belonging to the same node (crops in this example) are assumed to compete more directly with each other than with those land-uses in other nodes (e.g. forest or pasture). For each land use, assumptions on carbon stocks in the vegetation and the soil are made (see Table S1 in SM). A change in land cover either leads to positive or negative LUC emissions, driven by the difference in the assumed carbon stocks (in vegetation and soil) between the original and the new land use. Based on the profitability of each land use, which depends on assumed yields, production costs and commodity prices, land owners choose between different land uses to maximise profit. Such land use decisions are based on the logit model of sharing, taking into account the heterogeneity of local circumstances within each AEZ, and avoiding extreme “winner-takes-it-all” outcomes⁵⁵. See Section 1a in the SM for more details, and see Wise et al.⁵⁶ for a detailed explanation on the approach and design of the land module in GCAM.

Solar land-use module. An additional module has been developed for the GCAM model to link the consumption of solar energy with land use, competing with other commercial (crops, timber and intensive pastures) and non-commercial (natural forest, grassland, scrubland) land uses. Specifically, the solarland category is included in the “Crops” land node (Figure S3 in SM), which means that demand for solarland will primarily compete with used, degraded and potential cropland (including chemically fertilised meadows). Indirectly, solarland also competes with other land uses such as forest, grass- and scrubland. This structure is based on observed tendencies for solar siting in Europe, India, Japan and South-Korea (see Table S2 in SM), showing that mainly arable land is used for current USSE projects, and supported by academic literature^{17,33,34,57,58} and solar industry reports^{59,60}. Also, the optimal microclimate for solar energy production (based on insolation, air temperature, wind speed and humidity) is found over land that is currently used as cropland⁶¹, supporting the assumption that future investors will have a slight preference for cropland (in use or fallow) for the allocation of solar energy projects, among other factors such as flatness and connectivity in terms of roads and electricity grids²². Nevertheless, an important driver for land use decisions in the model is land profitability: even if land covered by crop cultivation is perceived as the most suitable by investors in solar energy, high observed or potential profitability of crop cultivation on such land could force investors to focus on other land types.

To define the value of land for hosting solar energy, a yield in terms of energy output per unit of land has been defined for every AEZ. Equation (4) defines this yield for each AEZ, which depends on average solar irradiation (I) per AEZ, average efficiency of solar power plants (f_1) at the year of installation (t), the averaged performance ratio over the life cycle of the solar power plant (f_2) and the land occupation ratio (f_3)^{1,17}. To estimate I per AEZ,

we overlapped the solar irradiance annual average data⁶² (tilt radiation, i.e. the position where the tilt coincides with the latitude, which is the optimal position of PV panels to take advantage of the solar resource at each location) with each AEZ and geopolitical region in GCAM 4.3 using a GIS tool. The land occupation ratio, defined by Eq. (5), depends on the packing factor (PF) and the Generator-to-system area (GSR). PF is the ratio between the PV panels or heliostats and the ground area required for arrays' installation including separation to avoid excessive self-shading, while GSR represents the share of the full area enclosed by the site boundary of the power plant which is covered by the PV panels and heliostats including the separation between them. Hence, with relation to the PF, the GSR accounts for the additional space required to host physical infrastructure such as access roads, substations service buildings, and other infrastructure, as well as land not being able to be directly used due to orography and unevenness of the plot preventing the optimization of the layout of the solar arrays. GSR is dependent on the size and shape of the terrain and plots and should be analysed on a case by case basis. GSR ranges of 0.7–0.85 have been reported⁶³ although larger plants tend to have lower GSR due to more difficult use-optimization of land plots at large scale productions, hence here we take a GSR of 0.7 assuming that the deployment of scale of solar power plants on land will likely be based on larger-size plants due to the incentives of economics of scale^{17,19}. The packing factor again depends on the average latitude of each AEZ and is defined by Eq. (6): the further from the equator, the more space is needed between the different panels or heliostats to avoid self-shading, so the lower the packing factor. The theoretical equation of PF dependent on the sun elevation, the sun azimuth and the tilt angle, which can be simplified assuming that tilt coincides with the latitude ($\beta = \varnothing$) and taking the conservative shading criterion of avoiding shading only at noon⁶³. This formula is only valid for latitudes $< 66.5^\circ$ (to ensure $PF > 0$), but in this study we constrained solar deployment in high latitudes areas since low solar irradiance in these areas make solar power uneconomical (see Section 1c of the SM). For simplicity, we have based the PF estimation on fixed tracking PV systems on flat land. Solar yields can slightly differ (about 25% in both ways) for 1- or 2-axis PV tracking systems or for CSP systems¹⁹. See Table S5 in the SM for the assumed values of the parameters in Eq. (4) for the focus regions of this study.

$$\rho_e^{AEZ} = I^{AEZ} \cdot f_1^t \cdot f_2 \cdot f_3^{AEZ} \quad (4)$$

$$f_3^{AEZ} = GSR \cdot PF^{AEZ} \quad (5)$$

$$PF^{AEZ} = (\cos \beta^{AEZ} + \frac{\sin \beta^{AEZ}}{\tan(66.55^\circ \cdot (\frac{\pi}{180^\circ}) - \varnothing^{AEZ})})^{-1}; \beta \text{ and } \varnothing \text{ in radians} \quad (6)$$

Figure S6 of the SM defines the solar yield per AEZ. Note that this figure only represents the land inputs per unit of energy output. The capital inputs per unit of output depend only on I^{AEZ} , f_1^t and f_2 and since capital costs tend to be larger than land costs, investors in solar energy tend to choose the location predominantly based on solar irradiance instead of the solar energy yield per land unit. Consistently exporting or importing large shares of solar energy between geographically and/or politically distinct regions faces both technical and geopolitical challenges. Therefore, we have chosen a conservative assumption that solar energy must be produced and consumed in the same geopolitical GCAM region.

Impact of solar energy infrastructure on local carbon cycle. The impact of USSE infrastructures on local microclimates is a field in early research stages, although some case studies have been performed. In the case of solar energy on pastures in wet climates, a significant loss of carbon in vegetation and soils can be expected in the land below the infrastructure that is permanently blocked from sunlight, but the year-round carbon cycle in gap areas between rows of solar panels will be hardly affected³⁵. However, in semi-arid pastures with wet winters, opposite effects are observed, and microclimates below panels seem to enhance vegetation growth⁶⁴. Evidence from agrivoltaic systems show that year-round leaf growth below solar infrastructure is about 20% lower below solar modules, and that this effect is strongest in summer⁶⁵. What can be concluded from these studies is that local microclimates depend on many factors, which are yet too uncertain to draw robust assumptions from. However, it also shows that the design and management of solar parks is of high importance for the carbon cycle in such parks. For example, higher placed modules are beneficial for vegetation growth below the modules, as it allows more sunlight to reach the vegetation. But a crucial aspect for local carbon cycles is the decision on how to manage the land below the solar energy infrastructure. That is why we have framed the uncertainty related to local carbon cycle impacts on management decisions, based on three different regimes identified through literature review:

- Land clearing: Clearing and grubbing of soil and roots, topsoil stripping and stockpiling, land grading and levelling, and soil compaction. Existing vegetation that supports habitat is removed and any other vegetation is often discouraged; weeds and other unwanted vegetation are generally managed with herbicides and by covering the ground with gravel; this is a common practice in various countries^{41,66}. Modules are placed at ground level, which is cheaper, and the absence of vegetation avoids shading effects.
- Maintaining previous vegetation: Vegetation as in previous land uses is as much as possible maintained, so arable land stays arable and pastures stay pastures. All vegetation in previous land cover above 30 cm height, such as trees, bushes and high grass, will be removed such that the vegetation that is left is similar to that in pastures. Areas directly below solar modules are cleared for the construction phase, but weeds might grow after that phase. Modules are placed slightly higher to avoid potential shading from vegetation. This regime

is based on a rationale of balancing cost minimisation (i.e. no seeding, no herbicides) with land conservation (i.e. minimising ecosystem disturbance).

- Pasture conversion: Irrespective of the previous land use, all land below and around the infrastructure is (re)seeded with grass before or right after the construction phase, and the land will be managed as pasture, allowing for extensive animal grazing around the solar modules³⁵. Modules will be placed higher to allow small grazers to pass below⁶⁷, and allowing some sunlight to reach vegetation below panels.

The impacts of each of these solarland management regimes on the local carbon cycle depend on the specific location, and the previous land use, and result from off-model calculations applied to the GCAM scenario outcomes which provide land cover changes per year, AEZ, and scenario. Section 2d of the SM gives full details on all applied assumptions and derived carbon cycle impacts.

Use of non-competing space on rooftops and in deserts and dry scrublands. Rooftop space is often used for smaller scale PV systems and has the advantage of not competing for space with other uses and avoiding some of the losses related to electricity transmission and distribution. On the other side, rooftop spaces are often not optimal, and only about 2 to 3% of urbanized surface area can be used for PV systems with reasonable efficiencies (taking into account specific factors such as roof slopes and shadows between buildings)^{1,21}. Taking these constraints into account, rooftop space is limited to 3% of expected urbanized land by 2050 (end year of the scenarios in this study) in each geo-political region, while non-optimality of rooftop space has been modelled through a supply curve which represents increasing capital costs for each additional space used for rooftop PV systems⁶⁸.

Land that is not used and neither has potential for any other productive use from a human perspective, such as deserts and dry scrublands, can be suitable for solar energy. By default, deserts are exempted from land competition in GCAM, while only 10% of current scrublands are included in the land competition module in GCAM v4.3, taking into account both non-fertility of scrublands as well as the protected status of some of these land areas. The EU, Japan and South-Korea have limited amounts of deserts and scrublands (see Table S4 in the SM), and of which a significant share is protected⁶⁹. Therefore, apart from the 10% of scrublands which enter by default into the land competition module, we assumed no additional availability of suitable deserts and scrublands for solar energy in these regions. For India, the pre-identified potential for PV and CSP capacity in identified “wasteland”²⁷ is included to the model as an alternative to competitive land, under assumptions as specified in Section 1d of the SM.

Further background assumptions related to the modelling can be found in the SM.

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References

1. Capellán-Pérez, I., de Castro, C. & Arto, I. Assessing vulnerabilities and limits in the transition to renewable energies: land requirements under 100% solar energy scenarios. *Renew. Sustain. Energy Rev.* **77**, 760–782 (2017).
2. Rao, G. L. & Sastri, V. M. K. Land use and solar energy. *Habitat Int.* **11**, 61–75 (1987).
3. Nonhebel, S. Land-use changes induced by increased use of renewable energy sources. In *Global Environmental Change and Land Use* (eds. Dolman, A. J., Verhagen, A. & Rovers, C. A.) 187–202 (Springer Netherlands, 2003). https://doi.org/10.1007/978-94-017-0335-2_8.
4. Scheidel, A. & Sorman, A. H. Energy transitions and the global land rush: ultimate drivers and persistent consequences. *Glob. Environ. Change* **22**, 588–595 (2012).
5. Trainor, A. M., McDonald, R. I. & Fargione, J. Energy sprawl is the largest driver of land use change in United States. *PLoS ONE* **11**, 1–16 (2016).
6. Don, A. *et al.* Land-use change to bioenergy production in Europe: implications for the greenhouse gas balance and soil carbon. *GCB Bioenergy* **4**, 372–391 (2012).
7. Nonhebel, S. Renewable energy and food supply: will there be enough land?. *Renew. Sustain. Energy Rev.* **9**, 191–201 (2005).
8. Ovando, P. & Caparrós, A. Land use and carbon mitigation in Europe: a survey of the potentials of different alternatives. *Energy Policy* **37**, 992–1003 (2009).
9. Calvin, K. *et al.* Trade-offs of different land and bioenergy policies on the path to achieving climate targets. *Clim. Change* **123**, 691–704 (2014).
10. Gasparatos, A., Doll, C. N. H., Esteban, M., Ahmed, A. & Olang, T. A. Renewable energy and biodiversity: Implications for transitioning to a Green Economy. *Renew. Sustain. Energy Rev.* **70**, 161–184 (2017).
11. Searchinger, T. *et al.* Use of U. S. croplands for biofuels increases greenhouse gases through emissions from land use change. *Science* (80-.) **319**, 1238–40 (2008).
12. Overmars, K. P., Stehfest, E., Ros, J. P. M. & Prins, A. G. Indirect land use change emissions related to EU biofuel consumption: an analysis based on historical data. *Environ. Sci. Policy* **14**, 248–257 (2011).
13. Fargione, J., Hill, J., Tilman, D., Polasky, S. & Hawthorne, P. Land clearing and the biofuel carbon debt. *Science* (80-.) **319**, 1235–1238 (2008).
14. de Vries, B. J. M., van Vuuren, D. P. & Hoogwijk, M. M. Renewable energy sources: their global potential for the first-half of the 21st century at a global level: an integrated approach. *Energy Policy* **35**, 2590–2610 (2007).
15. Timilsina, G. R., Kurdgelashvili, L. & Narbel, P. A. Solar energy: markets, economics and policies. *Renew. Sustain. Energy Rev.* **16**, 449–465 (2012).
16. Jacobson, M. Z. & Delucchi, M. A. Providing all global energy with wind, water, and solar power, part I: technologies, energy resources, quantities and areas of infrastructure, and materials. *Energy Policy* **39**, 1154–1169 (2011).
17. De Castro, C., Mediavilla, M., Miguel, L. J. & Frechoso, F. Global solar electric potential: a review of their technical and sustainable limits. *Renew. Sustain. Energy Rev.* **28**, 824–835 (2013).
18. Hernandez, R. R., Hoffacker, M. K. & Field, C. B. Land-use efficiency of big solar. *Environ. Sci. Technol.* **48**, 1315–1323 (2014).

19. Ong, S., Campbell, C., Denholm, P., Margolis, R. & Heath, G. *Land-Use Requirements for Solar Power Plants in the United States* (National Renewable Energy Laboratory, Golden, 2013).
20. Denholm, P. & Margolis, R. M. Land-use requirements and the per-capita solar footprint for photovoltaic generation in the United States. *Energy Policy* **36**, 3531–3543 (2008).
21. Dupont, E., Koppelaar, R. & Jeanmart, H. Global available solar energy under physical and energy return on investment constraints. *Appl. Energy* **257**, 113968 (2020).
22. Hernandez, R. R., Hoffacker, M. K. & Field, C. B. Efficient use of land to meet sustainable energy needs. *Nat. Clim. Change* **5**, 353–358 (2015).
23. Lopez, A., Roberts, B., Heimiller, D., Blair, N. & Porro, G. *US Renewable Energy Technical Potentials: A GIS-Based Analysis*. <https://www.nrel.gov/docs/fy12osti/51946.pdf> (2012).
24. Deng, Y. Y. *et al.* Quantifying a realistic, worldwide wind and solar electricity supply. *Glob. Environ. Change* **31**, 239–252 (2015).
25. Turney, D. & Fthenakis, V. Environmental impacts from the installation and operation of large-scale solar power plants. *Renew. Sustain. Energy Rev.* **15**, 3261–3270 (2011).
26. Hernandez, R. R. *et al.* Solar energy development impacts on land cover change and protected areas. *Proc. Natl. Acad. Sci.* **113**, E1768–E1768 (2016).
27. Mahtta, R., Joshi, P. K. & Jindal, A. K. Solar power potential mapping in India using remote sensing inputs and environmental parameters. *Renew. Energy* **71**, 255–262 (2014).
28. Trieb, F., Schillings, C., Pregger, T. & O'Sullivan, M. Solar electricity imports from the Middle East and North Africa to Europe. *Energy Policy* **42**, 341–353 (2012).
29. Lovich, J. E. & Ennen, J. R. Wildlife conservation and solar energy development in the desert southwest, United States. *Bioscience* **61**, 982 (2011).
30. Hernandez, R. R. *et al.* Environmental impacts of utility-scale solar energy. *Renew. Sustain. Energy Rev.* **29**, 766–779 (2014).
31. Yenneti, K., Day, R. & Golubchikov, O. Spatial justice and the land politics of renewables: dispossessing vulnerable communities through solar energy mega-projects. *Geoforum* **76**, 90–99 (2016).
32. Sharma, C., Sharma, A. K., Mullick, S. C. & Kandpal, T. C. Assessment of solar thermal power generation potential in India. *Renew. Sustain. Energy Rev.* **42**, 902–912 (2015).
33. De Marco, A. *et al.* The contribution of Utility-Scale Solar Energy to the global climate regulation and its effects on local ecosystem services. *Glob. Ecol. Conserv.* **2**, 324–337 (2014).
34. Prados, M. J. Renewable energy policy and landscape management in Andalusia, Spain: the facts. *Energy Policy* **38**, 6900–6909 (2010).
35. Armstrong, A., Ostle, N. J. & Whitaker, J. Solar park microclimate and vegetation management effects on grassland carbon cycling. *Environ. Res. Lett.* **11**, 74016 (2016).
36. Breyer, C. *et al.* On the role of solar photovoltaics in global energy transition scenarios. *Prog. Photovolt. Res. Appl.* **25**, 727–745 (2017).
37. Jacobson, M. Z. *et al.* 100% clean and renewable wind, water, and sunlight all-sector energy roadmaps for 139 countries of the world. *Joule* **1**, 108–121 (2017).
38. Hernandez, R. R. *et al.* Techno-ecological synergies of solar energy for global sustainability. *Nat. Sustain.* **2**, 560–568 (2019).
39. Wise, M. *et al.* Implications of limiting CO₂ concentrations for land use and energy. *Science* (80-.) **324**, 1183–1186 (2009).
40. González-Eguino, M., Capellán-Pérez, I., Arto, I., Ansuategi, A. & Markandya, A. Industrial and terrestrial carbon leakage under climate policy fragmentation. *Clim. Policy* **17**, S148–S169 (2017).
41. NREL. *Native Vegetation Performance Under a Solar PV Array at the National Wind Technology Center* (2017).
42. Liu, F. & van den Bergh, J. C. J. M. Differences in CO₂ emissions of solar PV production among technologies and regions: application to China, EU and USA. *Energy Policy* **138**, 111234 (2020).
43. Popp, A. *et al.* Land-use transition for bioenergy and climate stabilization: model comparison of drivers, impacts and interactions with other land use based mitigation options. *Clim. Change* **123**, 495–509 (2014).
44. Elshout, P. M. F. *et al.* Greenhouse-gas payback times for crop-based biofuels. *Nat. Clim. Change* **5**, 604 (2015).
45. Miller, L. M. & Keith, D. W. Climatic impacts of wind power. *Joule* **2**, 2618–2632 (2018).
46. Valero, A., Valero, A., Calvo, G. & Ortego, A. Material bottlenecks in the future development of green technologies. *Renew. Sustain. Energy Rev.* **93**, 178–200 (2018).
47. Powers, R. P. & Jetz, W. Global habitat loss and extinction risk of terrestrial vertebrates under future land-use-change scenarios. *Nat. Clim. Change* **9**, 323–329 (2019).
48. Ludin, N. A. *et al.* Prospects of life cycle assessment of renewable energy from solar photovoltaic technologies: a review. *Renew. Sustain. Energy Rev.* **96**, 11–28 (2018).
49. Amaducci, S., Yin, X. & Colauzzi, M. Agrivoltaic systems to optimise land use for electric energy production. *Appl. Energy* **220**, 545–561 (2018).
50. Ministry of Housing Communities and Local Government. *National Planning Policy Framework* (2019).
51. JGCRI. GCAM v4.3 Documentation. <http://jgcric.github.io/gcam-doc/v4.3/toc.html> (2016).
52. O'Neill, B. C. *et al.* A new scenario framework for climate change research: the concept of shared socioeconomic pathways. *Clim. Change* **122**, 387–400 (2014).
53. Fawcett, A. A. *et al.* Can Paris pledges avert severe climate change?. *Science* (80-.) **350**, 1168–1169 (2015).
54. Monfreda, C., Ramankutty, N. & Hertel, T. W. Global agricultural land use data for climate change analysis. *Econ. Anal. Land Use Glob. Clim. Change Policy* **14**, 33 (2009).
55. McFadden, D. Conditional logit analysis of qualitative choice behavior. In *Frontiers in Econometrics* (Academic Press, 1974).
56. Wise, M., Calvin, K., Kyle, P., Luckow, P. & Edmonds, J. Economic and physical modeling of land use in GCAM 3.0 and an application to agricultural productivity, land, and terrestrial carbon. *Clim. Change Econ.* **05**, 1450003 (2014).
57. Dias, L., Gouveia, J. P., Lourenço, P. & Seixas, J. Interplay between the potential of photovoltaic systems and agricultural land use. *Land Use Policy* **81**, 725–735 (2019).
58. Vranceanu, A. *et al.* Impacts of photovoltaic farms on the environment in the Romanian Plain. *Energies* **12**, 2533 (2019).
59. Hahn, E. *The Japanese Solar PV Market and Industry*. Minerva Fellowship Programme. <https://www.eu-japan.eu/publications/japanese-solar-pv-market-and-industry-business-opportunities-european-companies> (2014).
60. Power Technology. Japan to slash solar subsidies as feed-in tariff costs mount (2019).
61. Adeb, E. H., Good, S. P., Calaf, M. & Higgins, C. W. Solar PV power potential is greatest over croplands. *Sci. Rep.* **9**, 11442 (2019).
62. NASA Langley Atmospheric Sciences Data Center. *Average Monthly and Annual Direct Normal Irradiance Data, One-Degree Resolution of the World, 1983–2005*. <https://geo.nyu.edu/catalog/stanford-fd535zg0917>.
63. Martín-Chivelet, N. Photovoltaic potential and land-use estimation methodology. *Energy* **94**, 233–242 (2016).
64. Adeb, E. H., Selker, J. S. & Higgins, C. W. Remarkable agrivoltaic influence on soil moisture, micrometeorology and water-use efficiency. *PLoS ONE* **13**, e0203256 (2018).
65. Dupraz, C. *et al.* Combining solar photovoltaic panels and food crops for optimising land use: Towards new agrivoltaic schemes. *Renew. Energy* **36**, 2725–2732 (2011).
66. MITECO. *ESTUDIO AMBIENTAL ESTRATÉGICO PLAN NACIONAL INTEGRADO DE ENERGÍA Y CLIMA 2021–2030*. <https://energia.gob.es/es-es/Participacion/Paginas/DetalleParticipacionPublica.aspx?k=236> (2020).

67. BRE. Planning guidance for the development of large scale ground mounted solar PV systems (2013).
68. Denholm, P. & Margolis, R. *Supply curves for rooftop solar pv-generated electricity for the United States*. https://digitalscholarship.unlv.edu/renew_pubs/25 (2008).
69. Chape, S., Spalding, M. & Jenkins, M. D. *The World's Protected Areas* (University of California Press, Berkeley, 2008).

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Author contributions

D.V., I.C.P., I.A. and M.G.E. prepared the topic and framing of the paper. D.V., I.C.P. and I.A. prepared the scenario set-up. D.V. and I.C.P. prepared the analysis, main write-up, (non-map) figures and graphs. I.C. provided geographically explicit inputs to the analysis and all map-based figures. P.P. provided methodological support. All authors reviewed the manuscript.

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Competing interests

The authors declare no competing interests.

Additional information

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GLACIER MEADOWS SOLAR, LLC'S RESPONSE TO THE
MICHIGAN PUBLIC SERVICE COMMISSION STAFF REQUEST
SET NO. 6
CASE NO. U-22044

REQUEUST NO. Staff-GM-6-1

Please refer to Exhibit A-13.1, p 3:

1. How would damage from extreme weather events or damage from human causes (e.g., vandalism) be managed related to decommissioning?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “human causes” and “managed” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject and without waiving any objections, Glacier Meadows states as follows: Damage from extreme weather events or human causes will be addressed on an incident-by-incident basis. Presently, Glacier Meadows anticipates that most damage will likely result in equipment being repaired or replaced. If damage occurs at end of operational phase and prior to decommissioning phase, equipment will likely be left in place and removed during decommissioning phase.

2. How would the Applicant intend to respond to such circumstances (e.g., repair, decommission)?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “respond” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Glacier Meadows will address damage to bring the Project's facilities back to operating state in the following order: (1) repair existing material, or, if necessary, (2) replace damaged equipment and recycle or responsibly dispose of equipment (depending on the type and extent of damaged components). Glacier Meadows plans to prioritize recycling over disposal where possible.

3. What aspects of the decommissioning plan would change under such circumstances?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "aspects," "change," and "such circumstances" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows does not presently anticipate any changes to the decommissioning plan under either circumstance described in Request Nos. 1 and 2 above.

Please refer to Exhibit A-13.1, pp 5-6:

4. Please provide a list of materials that captures all of the components that will be used in the facility, identifying those that will be removed and those that will be kept in place.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "captures," "components," and "used" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Glacier Meadows presently anticipates that substation fencing and main power transformer components will be kept in place if a plan for re-use is identified and approved. If no such plan is approved, then Glacier Meadows anticipates those will be removed.

Answering further:

Steel – Removed.

Aluminum wire – If below 4’ in depth, then kept in place; shallower pieces removed.

Fiber Optic – If below 4’ in depth, then kept in place; shallower pieces removed.

Copper wire – Removed.

Road Base material – Removed if landowner agreements require removal.

Concrete – Removed.

Insulated rock – Removed.

Aluminum fencing – Removed.

Bare Copper/copper clad steel and or galvanized steel – Removed.

5. Please confirm that the project substation, O&M building, and gen-tie line will be left in place if a plan for reuse is identified and approved, and otherwise that all those facilities will be decommissioned. If not confirming, please explain the decommissioning plan with respect to those facilities; specifically, if none, or some of the facility components listed are anticipated to not be decommissioned, please explain why they would not be decommissioned.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “left in place,” “plan for reuse,” and “identified and approved” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Confirmed that if a plan for reuse is identified and approved, then the Project substation,

operations and maintenance (“O&M”) building, and gen-tie line will be left in place. If no such plan is identified and approved, then those facilities will be decommissioned.

6. Please confirm whether the proposed project substation, O&M building, and gen-tie line are not planned to be located on PA 116 enrolled land.

RESPONSE: Glacier Meadows objects to this Request as the term “planned” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed that the proposed substation, operations and maintenance (“O&M”) building, and gen-tie line are not planned to be located on PA 116 enrolled land.

7. The plan states that underground collection lines will remain in place as they will be installed to a depth greater than 4 feet below grade; however, the plan does not address collection line entrance/exit points. How will the points where underground lines enter and exit the ground be addressed during decommissioning?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “remain in place” and “addressed” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Collection line entrance/exit points at a depth less than 4 feet below grade will be removed. Removal of these components is anticipated to include de-energization, excavation, cutting and removal of collection lines followed by backfill and restoration.

8. Please confirm whether collection line entrance and exits points are visually shown on Exhibit A-1.1 and identify. If these points are not visually shown on the submitted Exhibit A-1.1, please provide a map showing the anticipated locations of such points, and state when entrance/exit locations for collections line will be finalized.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “visually shown,” “anticipated locations,” and “finalized” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Collection line entrance/exit points will be located at the inverters and the substation, as shown in Exhibit A-1.1, sheets C.301-334. These locations are subject to change pending detailed design by the Project’s Engineering, Procurement, and Construction (“EPC”) contractor. The exact locations of the inverters/substation and collection line entrance/exit points will be finalized as part of the 100% design set anticipated immediately prior to commencement of construction (presently estimated in Q2 2027).

9. Please confirm that property owners will be informed on final location routes of proposed underground lines. Additionally, please state what the underground lines are made of, and describe potential impact on future land use.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “informed” and “potential impact” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Upon completion of construction, As-Built drawings will be completed showing the final location of all facilities. Underground lines will consist of aluminum wiring with a protective jacket, fiber optics and electrical marking tape. Location of underground lines and As-Built will be provided to landowners upon request or as agreed upon within individual lease agreements. As standard, property owners are recommended to call MISS DIG 811 prior to breaking ground on land post-decommissioning. Future land use can be returned to current, pre-construction/pre-operation use.

Please refer to Exhibit A-13.1, pp 6-7:

10. Table 1 lists the facility components and their associated removal methods. Please confirm all items that have not been predetermined to be kept in place, by agreement with property owners, are included in this section.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “predetermined” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Confirmed that Table 1 in Exhibit A-13.1 (pp. 6-7) includes all items that have not been predetermined to be kept in place by agreement with property owners.

11. Please refer to Exhibit A-13.1, p 7, the plan lists petroleum fuels, lubricants, hydraulic fluids, and insulating oil. This section does not appear to have considered other hazardous materials such as heavy metals and per- and polyfluoroalkyl (PFAS) substances inside

panels and insulating gases such as sulfur hexafluoride (SF6) in switchgear, circuit breakers, or other electrical equipment.

- a. Please provide an assessment of all hazardous materials, including the above, in facility equipment.
- b. Please differentiate between the hazardous materials that will be present only within equipment, stored on site, and both; and differentiate between those that will be present only during facility operation, only during construction/decommissioning, and both.
- c. Does Glacier Meadows intend to use electrical equipment containing SF6? If so, please describe how SF6 will be contained to prevent emissions into the atmosphere during decommissioning.
- d. Please provide a detailed description of how “[h]azardous materials will be stored and labeled... to prevent leaks or spills.” This description may include details regarding volumes and storage containers. Please specifically explain how hazardous materials stored on site will be protected from stormwater exposure, particularly to prevent ground contamination.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “considered,” “assessment,” “differentiate,” “intend,” and “protected from” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **SF6 is anticipated to be contained within the high-voltage (“HV”) circuit breakers located within the Project substation. Upon decommissioning, Glacier Meadows anticipates that the HV circuit breakers will likely be recycled or repurposed (depending on whether an approved re-use plan is established for the Project substation). SF6 will be removed in accordance with applicable removal procedures and disposed of as hazardous waste.**

PFAS may be contained within the solar panels, pending final panel selection. Upon decommissioning, the solar panels will be transported to an

appropriate disposal, salvage, or recycling facility as described within Exhibit A-13.1.

Presently, hazardous heavy metal materials are not anticipated to occur at the Project.

b. Glacier Meadows states as follows:

Petroleum fuels - will be present within equipment and stored onsite; will be present during construction/decommissioning and operations.

Lubricants - will be present within equipment only; will be present during construction/decommissioning only.

Hydraulic fluids - will be present within equipment and stored onsite; will be present during construction/decommissioning only.

Insulating oil - will be present within equipment and stored onsite; will be present during construction/decommissioning and operations.

SF6 - will be present within equipment (HV circuit breakers) and stored onsite; will be present during construction/decommissioning and operations.

PFAS - may be present within equipment (solar panels); will be present during construction/decommissioning and operations.

c. As noted above, SF6 is anticipated to be contained within the high-voltage (“HV”) circuit breakers located within the Project substation. It is anticipated that SF6 will be removed from the equipment per manufacturer specifications utilizing an adsorbent filtration process prior to the HV circuit breaker equipment being recycled/disposed of.

- d. **Both hazardous waste and hazardous materials will be stored in an elevated covered secondary containment near the operations and maintenance (“O&M”) building to prevent ground contamination and stormwater exposure. Hazardous waste bins/used oil tank will be covered, and waste removed from site regularly by a certified hazardous waste disposal company. Hazardous materials will be stored in their original container with labels clearly marked identifying the substance(s) contained within, until the material is required to be used in its application. A transfer pump will be utilized to transfer the hazardous materials from the original container within the containment area. Employees will refer to the safety data sheets of the materials for proper handling, personal protective equipment (“PPE”) requirements and disposal instructions. The Project's Spill Prevention, Control, and Countermeasure (“SPCC”) plan will be the guide for any spills or discharges of any hazardous material.**

12. Please refer to the following statement from Exhibit A-13.1, p 7: *“Low-grade material such as contaminated aggregate, concrete rubble, wood, non-recyclable materials and other mixed general waste will in all likelihood be sent to landfill at cost to the Project.”*

- a. Please explain whether the plan considers beneficial reuse or recycling of concrete rubble. Has recycling of “concrete rubble” been investigated for the proposed project’s decommissioning?
- b. Please define "contaminated aggregate". Further please explain what this material is anticipated to include, specifically focusing on items deemed "contaminated."
- c. Please provide a more detailed description of "non-recyclable materials"; how will these be classified?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “considers,” “beneficial reuse or recycling,” “investigated,” “anticipated,” “deemed,” and “classified” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. The decommissioning plan does not consider concrete rubble being sent to a specialized concrete recycling facility for reuse. Commercial concrete recycling facilities are not as prevalent as general waste landfills, especially in rural areas. The current decommissioning plan provides for concrete rubble to be separated from other materials, such as PV support piles, and sent to a landfill in compliance with applicable regulation.**
- b. Contaminated aggregate is construction material that contains unwanted fines, organic matter, or pollutants, which can compromise structural performance and durability. There are a couple instances within a solar project where concrete aggregate may be “contaminated.” One instance is where in-grade concrete foundations are removed from the ground and large quantities of soil, clay, or organic material cling to the concrete. Another instance is with project access roads. Aggregate for access roads are typically placed over a geotextile fabric to help hold the aggregate in place. However, when the roads are decommissioned, the geotextile can become torn apart and hard to separate from the aggregate. The final and least likely instance is if an oil or lubricant spills from a transformer as that material can seep into the pores of the concrete.**

- c. **Non-recyclable materials will mainly consist of interior finishes found within the O&M building, such as drywall and acoustical ceiling tiles, etc. Non-recyclable materials will also include smaller plastic and rubber components of the PV equipment and electrical balance of plant system, such as gaskets, which may not be accepted at recycling facilities. These materials will be categorized along the lines of the U.S. Resource Conservation and Recovery Act.**

Please refer to Exhibit A-13.1, pp 8-9:

13. The plan does not appear to address dust, noise, or traffic during decommissioning activities. Please explain how dust, noise, and traffic impacts will be mitigated during decommissioning.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “address,” “impacts,” and “mitigated” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:
The following mitigation measures are anticipated during mitigation measures, if needed:

- **Dust mitigation - apply water/dust suppressants to active work areas and access roads during decommissioning activities where necessary; cover stockpiles with tarps.**
- **Noise mitigation - plan work during daytime hours Monday through Friday as practicable to minimize weekend/evening noise impacts. If necessary based**

on landowner complaints, Glacier Meadows may install noise mitigation measures (i.e., mufflers) on decommissioning equipment and erect temporary noise barriers in active work zones.

- **Traffic mitigation - coordinate decommissioning road use activities with the Lenawee County Road Commission and MI Department of Transportation as necessary to plan activities around planned/emergency road closures and other community events with increased traffic.**

Please refer to Exhibit A-13.1, p 9:

14. Please describe the process and criteria the Applicant will use to determine whether and where topsoil salvage and redistribution is needed.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “process,” “criteria,” “determine,” and “needed” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Topsoil salvage and redistribution will be managed in accordance with the Project’s civil design and site-specific hydrology requirements. During the design phase, Glacier Meadows’ civil engineer will assess the site to identify areas requiring grading or soil disturbance. Topsoil stripping will be limited to areas where grading activities necessitate removal, consistent with the goal of minimizing overall soil disturbance across the project footprint. Where topsoil stripping is required, stripped topsoil will be stockpiled onsite in designated areas to preserve its viability for reuse. Stockpiles will be managed to protect against erosion

and degradation during the construction period. Stockpiled topsoil will be redistributed across disturbed project areas during final grading, reclamation, and seeding activities at project completion. Redistribution locations and depths will be guided by the final civil design and hydrology plan to support successful vegetation establishment and long-term site stability.

15. Please explain how soil characteristics will be assessed to determine that the soil has been returned and restored to its pre-construction state.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “soil characteristics,” “assessed,” and “determined” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: During decommissioning, Glacier Meadows will employ standard soil restoration techniques (e.g., topsoil salvage and redistribution, aeration, organic matter incorporation) to ensure the soil is returned to a useful condition similar to its pre-construction state, in compliance with PA116 lands where applicable and in compliance with Public Act 233.

16. Please confirm whether soil sampling will be conducted by Glacier Meadows after decommissioning activities are complete to confirm post project conditions match the initial physical and chemical analysis.

RESPONSE: Glacier Meadows objects to this Request as the terms “conducted,” “confirm,” and “match” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Confirmed that Glacier Meadows will undertake soil sampling after decommissioning activities are complete to confirm post project conditions match the initial physical and chemical analysis if required as a condition for a certificate for the Project.

17. Regarding "Grading/Earthwork":

- a. Please describe the process and criteria the Applicant will use to determine whether and where grading will be required/necessary.
- b. Please describe the process and criteria the Applicant will use to determine whether and where soil decompaction is necessary.
- c. Please describe how soil decompaction will be conducted.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “process,” “criteria,” “determine,” “required/necessary,” and “conducted” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **Glacier Meadows’ civil engineer will assess the site to identify areas where grading is needed to restore pre-construction contours and drainage patterns. Grading will be required in areas where infrastructure removal, equipment staging, or construction activities resulted in material changes to existing grade. Final grading criteria will be governed by the Project’s decommissioning plan and any applicable permit conditions.**
- b. **Areas subject to compaction from vehicle traffic, equipment staging, and construction laydown will be identified during decommissioning site assessment. Soil decompaction will be required in any such areas prior to final**

reclamation and seeding to restore soil structure and support vegetative reestablishment.

- c. Soil decompaction will be performed using a deep tillage implement such as a subsoiler or ripper operated to a depth sufficient to break up compacted layers, typically 12–18 inches. Work will be conducted when soil moisture conditions are appropriate and will precede topsoil redistribution and seeding operations.

Please refer to Exhibit A-13.1, p 10:

18. Please explain what the Company’s approach would entail if disputes arise with landowners concerning site conditions during or following decommissioning.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “approach,” “entail,” and “disputes” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows will abide by all terms and conditions in its decommissioning plan, as required in an approved MPSC siting certificate, and based on the Project’s individual lease agreements with landowners. Answering further, Glacier Meadows refers to and incorporates by reference Exhibit A-1.16 (Complaint Resolution Process) in Glacier Meadows’ Application.

19. What process will be used to resolve such disputes?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “process,” “resolve,” “disputes” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows refers to and incorporates its Response to Request No. 18 above.

Please refer to Exhibit A-13.1, p 11:

20. Please provide the Applicant’s intended methods of planning and coordinating with landowners and ALUs, including timelines and media of communication.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “intended methods,” “planning,” “coordinating,” “timelines,” and “media of communication” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Landowners will be notified prior to decommissioning in compliance with the timeline and communication method defined in landowner agreements. Written communication is often required per the landowner agreements. Communications with affected local units (“ALUs”) will be attempted via email or mail notification, or as appropriate per ALUs standard communication methods.

Exhibit S-7.1: Staff's Seventh Discovery Request, Items 16 through 21, and Company Response

Please refer to Exhibit A-1.2:

16. Figure 8 depicts at least two areas in yellow where easements are located, which according to the legend are based on United States Fish and Wildlife Services information. Please provide additional information to identify what type of easements are located within the project area or 1000-foot buffer. This description should include whether the easements are protected and if so, under what circumstances. Last please describe whether these easements may have an impact on project design, and if actions must be taken on behalf of the Applicant to address the easements.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “based on,” “United States Fish and Wildlife Services information,” “protected,” “impact,” and “address” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The United States Fish and Wildlife Service (“USFWS”) easement areas were identified utilizing United States Geological Survey (“USGS”) Protected Areas Database of the US (“PAD-US”) data. The easement area to the north of the Project within the 1,000-foot buffer is a USFWS Farm Service Agency conservation easement. Because the Project is not directly impacting this area, specific easement details are not known (i.e., whether it is protected and under what circumstances). Glacier Meadows consulted with USFWS, who reviewed the Project area (see Exhibit A-4.4) and has not shared specific actions or concerns regarding the easement. The easement does not impact Project design, and no actions must be taken to

address the easement. To the extent Staff is seeking information regarding additional easements, Glacier Meadows requests that Staff specifically identify any additional easements for which they seek information.

Please refer to Exhibit A-6.2:

17. Regarding Section 3.3.3, please provide the following:
 - a. Confirm whether the voluntary setbacks as listed refer to both regulated and non-regulated wetlands and streams.
 - b. Indicate whether a frac-out plan will be utilized to mitigate potential impacts from horizontal directional drilling.
 - c. Provide narrative and supporting evidence to support the determination that project activities avoid Part 31 regulated floodplains, including whether the project area contains drainage areas of 2 square miles or more.
 - d. Identify each location where an impact to a wetland or stream/drainage feature is currently proposed due to the installation of access roads, crossing lines (including horizontal directional drilling), fencing, panel arrays, or any other project activity.
 - e. For any access roads or access road entrances impacting a wetland or stream/drainage feature, please describe whether any alternatives were considered and why the site design as submitted represents the most feasible and prudent design with respect to the planned roads and entrances.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “frac-out plan,” “utilized,” “mitigate,” “impacts,” “narrative,” “determination,” “drainage areas,” “wetland or stream/drainage feature,” “alternatives,” “considered,” “most feasible,” and “prudent design” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **The voluntary setbacks apply to both regulated and non-regulated wetlands and streams.**
- b. **Confirmed that Glacier Meadows will utilize a frac-out plan to mitigate**

potential impacts from horizontal directional drilling if needed.

- c. The Project Area does not contain drainage areas of 2 square miles or more, as demonstrated within the Project's Exhibit A-6.2, Attachment A: Wetland and Stream Delineation Report. The location of the Part 31 regulated floodplain is depicted in Figure 3 of Exhibit A-6.2, Attachment A. Project infrastructure is not overlapping with the floodplain area, as demonstrated in Exhibit A-1.1, Sheet C.002, and it is not planned to overlap with the floodplain area, as demonstrated in Exhibit A-1.6, Figure 1.**
- d. Preliminary wetland/stream HDD crossings are shown on Exhibit A-1.1, Sheets C.310, C.314, C.315, C.317, C.320, C.321, and C.323 as indicated by the "Proposed Bore Pit (Typ.)" and "Proposed Bore Line (Typ.)" callouts. Preliminary drainage feature impacts from access road entrances are shown on Exhibit A-1.1, Sheets C.315 (EC-05), C.317 (EC-04), C.323 (EC-04), C.325 (EC-02), and C.329 (EC-03) as indicated by the "Proposed Entrance Culvert Location" call-outs, which are identified as "EC-XX." Direct impacts to wetlands/streams/drainage features from access roads (outside of entrance locations), collection lines, fencing, panel arrays, or other project activities are not anticipated.**
- e. Alternatives were considered and will be further detailed in the Project's MI EGLE Minor Permit application, which Glacier Meadows**

anticipates submitting between Q4 2026-Q1 2027.

18. Regarding Section 4.2, please indicate whether a 660-foot buffer from Bald Eagle nests will be implemented as described in the United States Fish and Wildlife Service's National Bald Eagle Management Guidelines (May 5, 2007).

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term "implemented" is vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: There are no bald eagle nests present within 660-feet of the Project site. As such, there is no basis to require a 660-foot buffer for bald eagle nests. Glacier Meadows commits to complying with required guidance and direction from U.S. Fish and Wildlife Service if any bald eagle nests are identified.

19. Regarding Section 6.2, please confirm whether the project will comply with 2.11 of the Wildlife Conservation Order, under the Michigan Department of Natural Resources (MDNR), including whether prevention and response measures for entrapped or injured wildlife will be implemented, and whether the MDNR will be contacted if a large animal becomes entrapped by fencing.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “comply,” “prevention,” “response measures,” “entrapped,” “injured,” and “large animal” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

20. Regarding Section 7.4, please provide the following information:
- a. Describe the referenced standard best management practices for dust suppression and equipment maintenance.
 - b. Verify whether dust suppression will be included within the Soil Erosion and Sedimentation Control Plan.
 - c. Indicate whether chemical dust suppressants may be utilized, and if so, please provide a representative Safety Data Sheet for the potential product(s) or product type(s) planned for use.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “dust suppression,” “equipment maintenance,” and “chemical dust suppressants” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **Dust suppression best management practices (BMPs) are anticipated to include the application of water/dust suppressants to active work areas and access roads during construction activities where necessary, and covering stockpiles with tarps. Equipment maintenance BMPs are detailed in the Response to Request No. 20(b) below.**
- b. **Dust suppression is not typically addressed within the Soil Erosion and Sedimentation Control Plan, which is primarily focused on stormwater and sediment controls. Dust mitigation during construction will be addressed through the Project’s construction management procedures**

and contractor requirements. Standard dust suppression measures will include water application on exposed soil surfaces and unpaved haul roads during dry or windy conditions, speed restrictions on unpaved site roads, and stabilization of inactive disturbed areas in accordance with the Project's erosion control plan. Glacier Meadows will confirm whether dust suppression measures will be formally incorporated into the SESC Plan or addressed in a separate construction environmental controls document as the Project progresses through final design.

- c. Chemical dust suppressants may be utilized during construction. The specific product(s) will be determined by the engineering, procurement, and construction ("EPC") contractor following contract award and development of the site-specific construction management plan. The EPC contractor will confirm that any chemical dust suppressants employed are appropriate to Project permit conditions and applicable environmental standards. Representative Safety Data Sheets for the selected product(s) will be available once the EPC contractor has finalized the site-specific dust suppression approach. Typical products may include magnesium chloride or similar compounds, but no product selection has been made at this time.**

21. Regarding Attachments A and C: Wetland Delineation and Habitat Assessment Reports, respectively, please verify whether the study area included parcels DEO-225-4700-00, DEO-225-4300-00, DEO-236-RAIL-00, and DEO-225-4800-00 (near where the existing

substation is located). If so, please provide supporting evidence to resolve the apparent discrepancy between Figure 1 of the Wetland Delineation and Habitat Assessment (in Attachment A and C of Exhibit A-6.2, respectively) and the proposed project area as defined in Exhibit A-1.1 Site Plans. Provide supporting narrative for any other areas of the application that may need to be clarified in this regard. Snapshots with the apparent discrepancy indicated by a shaded green polygon with dotted border are provided below for your reference.



Exhibit A-1.1, Sheet C.100 Rev A



Exhibit A-6.2, Attachments A and C, Figure 1:1¹

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “study area,” “supporting evidence,” and “apparent discrepancy” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

¹ Only one figure is provided here because the figures in each report appear identical.

Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

Exhibit S-7.2: *National Bald Eagle Management Guidelines*

See Attachment A.

Exhibit S-7.2
Attachment A

NATIONAL BALD EAGLE MANAGEMENT GUIDELINES

U.S. Fish and Wildlife Service

May 2007

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INTRODUCTION

The bald eagle (*Haliaeetus leucocephalus*) is protected by the Bald and Golden Eagle Protection Act (Eagle Act) and the Migratory Bird Treaty Act (MBTA). The MBTA and the Eagle Act protect bald eagles from a variety of harmful actions and impacts. The U.S. Fish and Wildlife Service (Service) developed these National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles when and under what circumstances the protective provisions of the Eagle Act may apply to their activities. A variety of human activities can potentially interfere with bald eagles, affecting their ability to forage, nest, roost, breed, or raise young. The Guidelines are intended to help people minimize such impacts to bald eagles, particularly where they may constitute "disturbance," which is prohibited by the Eagle Act.

The Guidelines are intended to:

- (1) Publicize the provisions of the Eagle Act that continue to protect bald eagles, in order to reduce the possibility that people will violate the law,
- (2) Advise landowners, land managers and the general public of the potential for various human activities to disturb bald eagles, and
- (3) Encourage additional nonbinding land management practices that benefit bald eagles (see Additional Recommendations section).

While the Guidelines include general recommendations for land management practices that will benefit bald eagles, the document is intended primarily as a tool for landowners and planners who seek information and recommendations regarding how to avoid disturbing bald eagles. Many States and some tribal entities have developed state-specific management plans, regulations, and/or guidance for landowners and land managers to protect and enhance bald eagle habitat, and we encourage the continued development and use of these planning tools to benefit bald eagles.

Adherence to the Guidelines herein will benefit individuals, agencies, organizations, and companies by helping them avoid violations of the law. However, the Guidelines themselves are not law. Rather, they are recommendations based on several decades of behavioral observations, science, and conservation measures to avoid or minimize adverse impacts to bald eagles.

The U.S. Fish and Wildlife Service strongly encourages adherence to these guidelines to ensure that bald and golden eagle populations will continue to be sustained. The Service realizes there may be impacts to some birds even if all reasonable measures are taken to avoid such impacts. Although it is not possible to absolve individuals and entities from liability under the Eagle Act or the MBTA, the Service exercises enforcement discretion to focus on those individuals, companies, or agencies that take migratory birds without regard for the consequences of their actions and the law, especially when conservation measures, such as these Guidelines, are available, but have not been implemented. The Service will prioritize its enforcement efforts to focus on those individuals or entities who take bald eagles or their parts, eggs, or nests without implementing appropriate measures recommended by the Guidelines.

The Service intends to pursue the development of regulations that would authorize, under limited circumstances, the use of permits if “take” of an eagle is anticipated but unavoidable. Additionally, if the bald eagle is delisted, the Service intends to provide a regulatory mechanism to honor existing (take) authorizations under the Endangered Species Act (ESA).

During the interim period until the Service completes a rulemaking for permits under the Eagle Act, the Service does not intend to refer for prosecution the incidental “take” of any bald eagle under the MBTA or Eagle Act, if such take is in full compliance with the terms and conditions of an incidental take statement issued to the action agency or applicant under the authority of section 7(b)(4) of the ESA or a permit issued under the authority of section 10(a)(1)(B) of the ESA.

The Guidelines are applicable throughout the United States, including Alaska. The primary purpose of these Guidelines is to provide information that will minimize or prevent violations only of *Federal* laws governing bald eagles. In addition to Federal laws, many states and some smaller jurisdictions and tribes have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines. If you are planning activities that may affect bald eagles, we therefore recommend that you contact both your nearest U.S. Fish and Wildlife Service Field Office (see the contact information on p.16) and your state wildlife agency for assistance.

LEGAL PROTECTIONS FOR THE BALD EAGLE

The Bald and Golden Eagle Protection Act

The Eagle Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, including their parts, nests, or eggs. The Act provides criminal and civil penalties for persons who “take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof.” The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb.” “Disturb” means:

“Disturb means 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.”

In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle=s return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

A violation of the Act can result in a criminal fine of \$100,000 (\$200,000 for organizations), imprisonment for one year, or both, for a first offense. Penalties increase substantially for additional offenses, and a second violation of this Act is a felony.

The Migratory Bird Treaty Act

The MBTA (16 U.S.C. 703-712), prohibits the taking of any migratory bird or any part, nest, or egg, except as permitted by regulation. The MBTA was enacted in 1918; a 1972 agreement supplementing one of the bilateral treaties underlying the MBTA had the effect of expanding the scope of the Act to cover bald eagles and other raptors. Implementing regulations define “take” under the MBTA as “pursue, hunt, shoot, wound, kill, trap, capture, possess, or collect.”

Copies of the Eagle Act and the MBTA are available at: <http://permits.fws.gov/ltr/ltr.shtml>.

State laws and regulations

Most states have their own regulations and/or guidelines for bald eagle management. Some states may continue to list the bald eagle as endangered, threatened, or of special concern. If you plan activities that may affect bald eagles, we urge you to familiarize yourself with the regulations and/or guidelines that apply to bald eagles in your state. Your adherence to the Guidelines herein does not ensure that you are in compliance with state laws and regulations because state regulations can be more specific and/or restrictive than these Guidelines.

NATURAL HISTORY OF THE BALD EAGLE

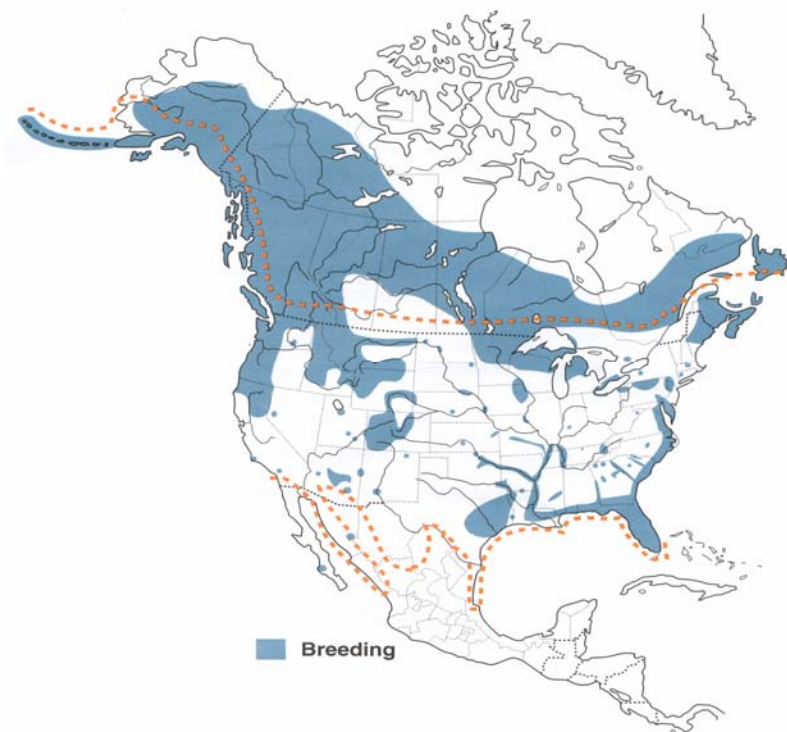
Bald eagles are a North American species that historically occurred throughout the contiguous United States and Alaska. After severely declining in the lower 48 States between the 1870s and the 1970s, bald eagles have rebounded and re-established breeding territories in each of the lower 48 states. The largest North American breeding populations are in Alaska and Canada, but there are also significant bald eagle populations in Florida, the Pacific Northwest, the Greater Yellowstone area, the Great Lakes states, and the Chesapeake Bay region. Bald eagle distribution varies seasonally. Bald eagles that nest in southern latitudes frequently move northward in late spring and early summer, often summering as far north as Canada. Most eagles that breed at northern latitudes migrate southward during winter, or to coastal areas where waters remain unfrozen. Migrants frequently concentrate in large numbers at sites where food is abundant and they often roost together communally. In some cases, concentration areas are used year-round: in summer by southern eagles and in winter by northern eagles.

Juvenile bald eagles have mottled brown and white plumage, gradually acquiring their dark brown body and distinctive white head and tail as they mature. Bald eagles generally attain adult plumage by 5 years of age. Most are capable of breeding at 4 or 5 years of age, but in healthy populations they may not start breeding until much older. Bald eagles may live 15 to 25 years in the wild. Adults weigh 8 to 14 pounds (occasionally reaching 16 pounds in Alaska) and have wingspans of 5 to 8 feet. Those in the northern range are larger than those in the south, and females are larger than males.

Where do bald eagles nest?

Breeding bald eagles occupy “territories,” areas they will typically defend against intrusion by other eagles. In addition to the active nest, a territory may include one or more alternate nests (nests built or maintained by the eagles but not used for nesting in a given year). The Eagle Act prohibits removal or destruction of both active and alternate bald eagle nests. Bald eagles exhibit high nest site fidelity and nesting territories are often used year after year. Some territories are known to have been used continually for over half a century.

Bald eagles generally nest near coastlines, rivers, large lakes or streams that support an adequate food supply. They often nest in mature or old-growth trees; snags (dead trees); cliffs; rock promontories; rarely on the ground; and with increasing frequency on human-made structures such as power poles and communication towers. In forested areas, bald eagles often select the tallest trees with limbs strong enough to support a nest that can weigh more than 1,000 pounds. Nest sites typically include at least one perch with a clear view of the water where the eagles usually forage. Shoreline trees or snags located in reservoirs provide the visibility and accessibility needed to locate aquatic prey. Eagle nests are constructed with large sticks, and may be lined with moss, grass, plant stalks, lichens, seaweed, or sod. Nests are usually about 4-6 feet in diameter and 3 feet deep, although larger nests exist.



Copyright *Birds of North America*, 2000

The range of breeding bald eagles in 2000 (shaded areas). This map shows only the larger concentrations of nests; eagles have continued to expand into additional nesting territories in many states. The dotted line represents the bald eagle's wintering range.

When do bald eagles nest?

Nesting activity begins several months before egg-laying. Egg-laying dates vary throughout the U.S., ranging from October in Florida, to late April or even early May in the northern United States. Incubation typically lasts 33-35 days, but can be as long as 40 days. Eaglets make their first unsteady flights about 10 to 12 weeks after hatching, and fledge (leave their nests) within a few days after that first flight. However, young birds usually remain in the vicinity of the nest for several weeks after fledging because they are almost completely dependent on their parents for food until they disperse from the nesting territory approximately 6 weeks later.

The bald eagle breeding season tends to be longer in the southern U.S., and re-nesting following an unsuccessful first nesting attempt is more common there as well. The following table shows the timing of bald eagle breeding seasons in different regions of the country. The table represents the range of time within which the majority of nesting activities occur in each region and does not apply to any specific nesting pair. Because the timing of nesting activities may vary within a given region, you should contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16) and/or your state wildlife conservation agency for more specific information on nesting chronology in your area.

National Bald Eagle Management Guidelines

Chronology of typical reproductive activities of bald eagles in the United States.

Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.
SOUTHEASTERN U.S. (FL, GA, SC, NC, AL, MS, LA, TN, KY, AR, eastern 2 of TX)											
Nest Building											
		Egg Laying/Incubation									
			Hatching/Rearing Young								
					Fledging Young						
CHESAPEAKE BAY REGION (NC, VA, MD, DE, southern 2 of NJ, eastern 2 of PA, panhandle of WV)											
		Nest Building									
				Egg Laying/Incubation							
					Hatching/Rearing Young						
								Fledging Young			
NORTHERN U.S. (ME, NH, MA, RI, CT, NY, northern 2 of NJ, western 2 of PA, OH, WV exc. panhandle, IN, IL, MI, WI, MN, IA, MO, ND, SD, NB, KS, CO, UT)											
			Nest Building								
					Egg Laying/Incubation						
						Hatching/Rearing Young					
								Fledging Young			
PACIFIC REGION (WA, OR, CA, ID, MT, WY, NV)											
				Nest Building							
					Egg Laying/Incubation						
						Hatching/Rearing Young					
								Fledging Young			
SOUTHWESTERN U.S. (AZ, NM, OK panhandle, western 2 of TX)											
		Nest Building									
				Egg Laying/Incubation							
					Hatching/Rearing Young						
							Fledging Young				
ALASKA											
					Nest Building						
							Egg Laying/Incubation				
								Hatching/Rearing Young			
Ing Young											Fledg-
Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	Aug.

How many chicks do bald eagles raise?

The number of eagle eggs laid will vary from 1-3, with 1-2 eggs being the most common. Only one eagle egg is laid per day, although not always on successive days. Hatching of young occurs on different days with the result that chicks in the same nest are sometimes of unequal size. The overall national fledging rate is approximately one chick per nest, annually, which results in a healthy expanding population.

What do bald eagles eat?

Bald eagles are opportunistic feeders. Fish comprise much of their diet, but they also eat waterfowl, shorebirds/colonial waterbirds, small mammals, turtles, and carrion. Because they are visual hunters, eagles typically locate their prey from a conspicuous perch, or soaring flight, then swoop down and strike. Wintering bald eagles often congregate in large numbers along streams to feed on spawning salmon or other fish species, and often gather in large numbers in areas below reservoirs, especially hydropower dams, where fish are abundant. Wintering eagles also take birds from rafts of ducks at reservoirs and rivers, and congregate on melting ice shelves to scavenge dead fish from the current or the soft melting ice. Bald eagles will also feed on carcasses along roads, in landfills, and at feedlots.

During the breeding season, adults carry prey to the nest to feed the young. Adults feed their chicks by tearing off pieces of food and holding them to the beaks of the eaglets. After fledging, immature eagles are slow to develop hunting skills, and must learn to locate reliable food sources and master feeding techniques. Young eagles will congregate together, often feeding upon easily acquired food such as carrion and fish found in abundance at the mouths of streams and shallow bays and at landfills.

The impact of human activity on nesting bald eagles

During the breeding season, bald eagles are sensitive to a variety of human activities. However, not all bald eagle pairs react to human activities in the same way. Some pairs nest successfully just dozens of yards from human activity, while others abandon nest sites in response to activities much farther away. This variability may be related to a number of factors, including visibility, duration, noise levels, extent of the area affected by the activity, prior experiences with humans, and tolerance of the individual nesting pair. The relative sensitivity of bald eagles during various stages of the breeding season is outlined in the following table.

Nesting Bald Eagle Sensitivity to Human Activities

Phase	Activity	Sensitivity to Human Activity	Comments
I	Courtship and Nest Building	Most sensitive period; likely to respond negatively	Most critical time period. Disturbance is manifested in nest abandonment. Bald eagles in newly established territories are more prone to abandon nest sites.
II	Egg laying	Very sensitive period	Human activity of even limited duration may cause nest desertion and abandonment of territory for the breeding season.
III	Incubation and early nestling period (up to 4 weeks)	Very sensitive period	Adults are less likely to abandon the nest near and after hatching. However, flushed adults leave eggs and young unattended; eggs are susceptible to cooling, loss of moisture, overheating, and predation; young are vulnerable to elements.
IV	Nestling period, 4 to 8 weeks	Moderately sensitive period	Likelihood of nest abandonment and vulnerability of the nestlings to elements somewhat decreases. However, nestlings may miss feedings, affecting their survival.
V	Nestlings 8 weeks through fledging	Very sensitive period	Gaining flight capability, nestlings 8 weeks and older may flush from the nest prematurely due to disruption and die.

If agitated by human activities, eagles may inadequately construct or repair their nest, may expend energy defending the nest rather than tending to their young, or may abandon the nest altogether. Activities that cause prolonged absences of adults from their nests can jeopardize eggs or young. Depending on weather conditions, eggs may overheat or cool too much and fail to hatch. Unattended eggs and nestlings are subject to predation. Young nestlings are particularly vulnerable because they rely on their parents to provide warmth or shade, without which they may die as a result of hypothermia or heat stress. If food delivery schedules are interrupted, the young may not develop healthy plumage, which can affect their survival. In addition, adults startled while incubating or brooding young may damage eggs or injure their young as they abruptly leave the nest. Older nestlings no longer require constant attention from the adults, but they may be startled by loud or intrusive human activities and prematurely jump from the nest before they are able to fly or care for themselves. Once fledged, juveniles range up to ¼ mile from the nest site, often to a site with minimal human activity. During this period, until about six weeks after departure from the nest, the juveniles still depend on the adults to feed them.

The impact of human activity on foraging and roosting bald eagles

Disruption, destruction, or obstruction of roosting and foraging areas can also negatively affect bald eagles. Disruptive activities in or near eagle foraging areas can interfere with feeding, reducing chances of survival. Interference with feeding can also result in reduced productivity (number of young successfully fledged). Migrating and wintering bald eagles often congregate at specific sites for purposes of feeding and sheltering. Bald eagles rely on established roost sites because of their proximity to sufficient food sources. Roost sites are usually in mature trees where the eagles are somewhat sheltered from the wind and weather. Human activities near or within communal roost sites may prevent eagles

from feeding or taking shelter, especially if there are not other undisturbed and productive feeding and roosting sites available. Activities that permanently alter communal roost sites and important foraging areas can altogether eliminate the elements that are essential for feeding and sheltering eagles.

Where a human activity agitates or bothers roosting or foraging bald eagles to the degree that causes injury or substantially interferes with breeding, feeding, or sheltering behavior and causes, or is likely to cause, a loss of productivity or nest abandonment, the conduct of the activity constitutes a violation of the Eagle Act's prohibition against disturbing eagles. The circumstances that might result in such an outcome are difficult to predict without detailed site-specific information. If your activities may disturb roosting or foraging bald eagles, you should contact your local Fish and Wildlife Service Field Office (see page 16) for advice and recommendations for how to avoid such disturbance.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT NEST SITES

In developing these Guidelines, we relied on existing state and regional bald eagle guidelines, scientific literature on bald eagle disturbance, and recommendations of state and Federal biologists who monitor the impacts of human activity on eagles. Despite these resources, uncertainties remain regarding the effects of many activities on eagles and how eagles in different situations may or may not respond to certain human activities. The Service recognizes this uncertainty and views the collection of better biological data on the response of eagles to disturbance as a high priority. To the extent that resources allow, the Service will continue to collect data on responses of bald eagles to human activities conducted according to the recommendations within these Guidelines to ensure that adequate protection from disturbance is being afforded, and to identify circumstances where the Guidelines might be modified. These data will be used to make future adjustments to the Guidelines.

To avoid disturbing nesting bald eagles, we recommend (1) keeping a distance between the activity and the nest (distance buffers), (2) maintaining preferably forested (or natural) areas between the activity and around nest trees (landscape buffers), and (3) avoiding certain activities during the breeding season. The buffer areas serve to minimize visual and auditory impacts associated with human activities near nest sites. Ideally, buffers would be large enough to protect existing nest trees and provide for alternative or replacement nest trees.

The size and shape of effective buffers vary depending on the topography and other ecological characteristics surrounding the nest site. In open areas where there are little or no forested or topographical buffers, such as in many western states, distance alone must serve as the buffer. Consequently, in open areas, the distance between the activity and the nest may need to be larger than the distances recommended under Categories A and B of these guidelines (pg. 12) if no landscape buffers are present. The height of the nest above the ground may also ameliorate effects of human activities; eagles at higher nests may be less prone to disturbance.

In addition to the physical features of the landscape and nest site, the appropriate size for the distance buffer may vary according to the historical tolerances of eagles to human activities in particular localities, and may also depend on the location of the nest in relation

to feeding and roosting areas used by the eagles. Increased competition for nest sites may lead bald eagles to nest closer to human activity (and other eagles).

Seasonal restrictions can prevent the potential impacts of many shorter-term, obtrusive activities that do not entail landscape alterations (e.g. fireworks, outdoor concerts). In proximity to the nest, these kinds of activities should be conducted only outside the breeding season. For activities that entail both short-term, obtrusive characteristics and more permanent impacts (e.g., building construction), we recommend a combination of both approaches: retaining a landscape buffer *and* observing seasonal restrictions.

For assistance in determining the appropriate size and configuration of buffers or the timing of activities in the vicinity of a bald eagle nest, we encourage you to contact the nearest U.S. Fish and Wildlife Service Field Office (see page 16).

Existing Uses

Eagles are unlikely to be disturbed by routine use of roads, homes, and other facilities where such use pre-dates the eagles' successful nesting activity in a given area. Therefore, in most cases *ongoing* existing uses may proceed with the same intensity with little risk of disturbing bald eagles. However, some *intermittent, occasional, or irregular* uses that pre-date eagle nesting in an area may disturb bald eagles. For example: a pair of eagles may begin nesting in an area and subsequently be disturbed by activities associated with an annual outdoor flea market, even though the flea market has been held annually at the same location. In such situations, human activity should be adjusted or relocated to minimize potential impacts on the nesting pair.

ACTIVITY-SPECIFIC GUIDELINES

The following section provides the Service's management recommendations for avoiding bald eagle disturbance as a result of new or intermittent activities proposed in the vicinity of bald eagle nests. Activities are separated into 8 categories (A – H) based on the nature and magnitude of impacts to bald eagles that usually result from the type of activity. Activities with similar or comparable impacts are grouped together.

In most cases, impacts will vary based on the visibility of the activity from the eagle nest and the degree to which similar activities are already occurring in proximity to the nest site. Visibility is a factor because, in general, eagles are more prone to disturbance when an activity occurs in full view. For this reason, we recommend that people locate activities farther from the nest structure in areas with open vistas, in contrast to areas where the view is shielded by rolling topography, trees, or other screening factors. The recommendations also take into account the existence of similar activities in the area because the continued presence of nesting bald eagles in the vicinity of the existing activities indicates that the eagles in that area can tolerate a greater degree of human activity than we can generally expect from eagles in areas that experience fewer human impacts. To illustrate how these factors affect the likelihood of disturbing eagles, we have incorporated the recommendations for some activities into a table (categories A and B).

First, determine which category your activity falls into (between categories A – H). If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity represented.

If your activity is under A or B, our recommendations are in table form. The vertical axis shows the degree of visibility of the activity from the nest. The horizontal axis (header row) represents the degree to which similar activities are ongoing in the vicinity of the nest. Locate the row that best describes how visible your activity will be from the eagle nest. Then, choose the column that best describes the degree to which similar activities are ongoing in the vicinity of the eagle nest. The box where the column and row come together contains our management recommendations for how far you should locate your activity from the nest to avoid disturbing the eagles. The numerical distances shown in the tables are the closest the activity should be conducted relative to the nest. In some cases we have included additional recommendations (other than recommended *distance* from the nest) you should follow to help ensure that your activity will not disturb the eagles.

Alternate nests

For activities that entail permanent landscape alterations that may result in bald eagle disturbance, these recommendations apply to both active and alternate bald eagle nests. Disturbance becomes an issue with regard to alternate nests if eagles return for breeding purposes and react to land use changes that occurred while the nest was inactive. The likelihood that an alternate nest will again become active decreases the longer it goes unused. If you plan activities in the vicinity of an alternate bald eagle nest and have information to show that the nest has not been active during the preceding 5 breeding seasons, the recommendations provided in these guidelines for avoiding disturbance around the nest site may no longer be warranted. The nest itself remains protected by other provisions of the Eagle Act, however, and may not be destroyed.

If special circumstances exist that make it unlikely an inactive nest will be reused before 5 years of disuse have passed, and you believe that the probability of reuse is low enough to warrant disregarding the recommendations for avoiding disturbance, you should be prepared to provide all the reasons for your conclusion, including information regarding past use of the nest site. Without sufficient documentation, you should continue to follow these guidelines when conducting activities around the nest site. If we are able to determine that it is unlikely the nest will be reused, we may advise you that the recommendations provided in these guidelines for avoiding disturbance are no longer necessary around that nest site.

This guidance is intended to minimize disturbance, as defined by Federal regulation. In addition to Federal laws, most states and some tribes and smaller jurisdictions have additional laws and regulations protecting bald eagles. In some cases those laws and regulations may be more protective (restrictive) than these Federal guidelines.

Temporary Impacts

For activities that have temporary impacts, such as the use of loud machinery, fireworks displays, or summer boating activities, we recommend seasonal restrictions. These types of activities can generally be carried out outside of the breeding season without causing disturbance. The recommended restrictions for these types of activities can be lifted for alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched (depending on the distance between the alternate nest and the active nest).

In general, activities should be kept as far away from nest trees as possible; loud and disruptive activities should be conducted when eagles are not nesting; and activity between the nest and the nearest foraging area should be minimized. If the activity you plan to undertake is not specifically addressed in these guidelines, follow the recommendations for the most similar activity addressed, or contact your local U.S. Fish and Wildlife Service Field Office for additional guidance.

If you believe that special circumstances apply to your situation that increase or diminish the likelihood of bald eagle disturbance, or if it is not possible to adhere to the guidelines, you should contact your local Service Field Office for further guidance.

Category A:

Building construction, 1 or 2 story, with project footprint of ½ acre or less.
 Construction of roads, trails, canals, power lines, and other linear utilities.
 Agriculture and aquaculture – new or expanded operations.
 Alteration of shorelines or wetlands.
 Installation of docks or moorings.
 Water impoundment.

Category B:

Building construction, 3 or more stories.
 Building construction, 1 or 2 story, with project footprint of more than ½ acre.
 Installation or expansion of marinas with a capacity of 6 or more boats.
 Mining and associated activities.
 Oil and natural gas drilling and refining and associated activities.

	<i>If there is no similar activity within 1 mile of the nest</i>	<i>If there is similar activity closer than 1 mile from the nest</i>
<i>If the activity will be visible from the nest</i>	660 feet. Landscape buffers are recommended.	660 feet, or as close as existing tolerated activity of similar scope. Landscape buffers are recommended.
<i>If the activity will not be visible from the nest</i>	Category A: 330 feet. Clearing, external construction, and landscaping between 330 feet and 660 feet should be done outside breeding season. Category B: 660 feet.	330 feet, or as close as existing tolerated activity of similar scope. Clearing, external construction and landscaping within 660 feet should be done outside breeding season.

The numerical distances shown in the table are the closest the activity should be conducted relative to the nest.

Category C. Timber Operations and Forestry Practices

- Avoid clear cutting or removal of overstory trees within 330 feet of the nest at any time.
- Avoid timber harvesting operations, including road construction and chain saw and yarding operations, during the breeding season within 660 feet of the nest. The distance may be decreased to 330 feet around alternate nests within a particular territory, including nests that were attended during the current breeding season but not used to raise young, after eggs laid in another nest within the territory have hatched.
- Selective thinning and other silviculture management practices designed to conserve or enhance habitat, including prescribed burning close to the nest tree, should be undertaken outside the breeding season. Precautions such as raking leaves and woody debris from around the nest tree should be taken to prevent crown fire or fire climbing the nest tree. If it is determined that a burn during the breeding season would be beneficial, then, to ensure that no take or disturbance will occur, these activities should be conducted only when neither adult eagles nor young are present at the nest tree (i.e., at the beginning of, or end of, the breeding season, either before the particular nest is active or after the young have fledged from that nest). Appropriate Federal and state biologists should be consulted before any prescribed burning is conducted during the breeding season.
- Avoid construction of log transfer facilities and in-water log storage areas within 330 feet of the nest.

Category D. Off-road vehicle use (including snowmobiles). No buffer is necessary around nest sites outside the breeding season. During the breeding season, do not operate off-road vehicles within 330 feet of the nest. In open areas, where there is increased visibility and exposure to noise, this distance should be extended to 660 feet.

Category E. Motorized Watercraft use (including jet skis/personal watercraft). No buffer is necessary around nest sites outside the breeding season. During the breeding season, within 330 feet of the nest, (1) do not operate jet skis (personal watercraft), and (2) avoid concentrations of noisy vessels (e.g., commercial fishing boats and tour boats), except where eagles have demonstrated tolerance for such activity. Other motorized boat traffic passing within 330 feet of the nest should attempt to minimize trips and avoid stopping in the area where feasible, particularly where eagles are unaccustomed to boat traffic. Buffers for airboats should be larger than 330 feet due to the increased noise they generate, combined with their speed, maneuverability, and visibility.

Category F. Non-motorized recreation and human entry (e.g., hiking, camping, fishing, hunting, birdwatching, kayaking, canoeing). No buffer is necessary around nest sites outside the breeding season. If the activity will be visible or highly audible from the nest, maintain a 330-foot buffer during the breeding season, particularly where eagles are unaccustomed to such activity.

Category G. Helicopters and fixed-wing aircraft.

Except for authorized biologists trained in survey techniques, avoid operating aircraft within 1,000 feet of the nest during the breeding season, except where eagles have demonstrated tolerance for such activity.

Category H. Blasting and other loud, intermittent noises.

Avoid blasting and other activities that produce extremely loud noises within 1/2 mile of active nests, unless greater tolerance to the activity (or similar activity) has been demonstrated by the eagles in the nesting area. This recommendation applies to the use of fireworks classified by the Federal Department of Transportation as Class B explosives, which includes the larger fireworks that are intended for licensed public display.

RECOMMENDATIONS FOR AVOIDING DISTURBANCE AT FORAGING AREAS AND COMMUNAL ROOST SITES

1. Minimize potentially disruptive activities and development in the eagles' direct flight path between their nest and roost sites and important foraging areas.
2. Locate long-term and permanent water-dependent facilities, such as boat ramps and marinas, away from important eagle foraging areas.
3. Avoid recreational and commercial boating and fishing near critical eagle foraging areas during peak feeding times (usually early to mid-morning and late afternoon), except where eagles have demonstrated tolerance to such activity.
4. Do not use explosives within ½ mile (or within 1 mile in open areas) of communal roosts when eagles are congregating, without prior coordination with the U.S. Fish and Wildlife Service and your state wildlife agency.
5. Locate aircraft corridors no closer than 1,000 feet vertical or horizontal distance from communal roost sites.

ADDITIONAL RECOMMENDATIONS TO BENEFIT BALD EAGLES

The following are additional management practices that landowners and planners can exercise for added benefit to bald eagles.

1. Protect and preserve potential roost and nest sites by retaining mature trees and old growth stands, particularly within ½ mile from water.
2. Where nests are blown from trees during storms or are otherwise destroyed by the elements, continue to protect the site in the absence of the nest for up to three (3) complete breeding seasons. Many eagles will rebuild the nest and reoccupy the site.
3. To avoid collisions, site wind turbines, communication towers, and high voltage transmission power lines away from nests, foraging areas, and communal roost sites.
4. Employ industry-accepted best management practices to prevent birds from colliding with or being electrocuted by utility lines, towers, and poles. If possible, bury utility lines in important eagle areas.
5. Where bald eagles are likely to nest in human-made structures (e.g., cell phone towers) and such use could impede operation or maintenance of the structures or jeopardize the safety of the eagles, equip the structures with either (1) devices engineered to discourage bald eagles from building nests, or (2) nesting platforms that will safely accommodate bald eagle nests without interfering with structure performance.
6. Immediately cover carcasses of euthanized animals at landfills to protect eagles from being poisoned.
7. Do not intentionally feed bald eagles. Artificially feeding bald eagles can disrupt their essential behavioral patterns and put them at increased risk from power lines, collision with windows and cars, and other mortality factors.
8. Use pesticides, herbicides, fertilizers, and other chemicals only in accordance with Federal and state laws.
9. Monitor and minimize dispersal of contaminants associated with hazardous waste sites (legal or illegal), permitted releases, and runoff from agricultural areas, especially within watersheds where eagles have shown poor reproduction or where bioaccumulating contaminants have been documented. These factors present a risk of contamination to eagles and their food sources.

CONTACTS

The following U.S. Fish and Wildlife Service Field Offices provide technical assistance on bald eagle management:

<u>Alabama</u>	Daphne	(251) 441-5181	<u>New Hampshire</u>	Concord	(603) 223-2541
<u>Alaska</u>	Anchorage	(907) 271-2888	<u>New Jersey</u>	Pleasantville	(609) 646-9310
	Fairbanks	(907) 456-0203	<u>New Mexico</u>	Albuquerque	(505) 346-2525
	Juneau	(907) 780-1160	<u>New York</u>	Cortland	(607) 753-9334
<u>Arizona</u>	Phoenix	(602) 242-0210		Long Island	(631) 776-1401
<u>Arkansas</u>	Conway	(501) 513-4470	<u>North Carolina</u>	Raleigh	(919) 856-4520
<u>California</u>	Arcata	(707) 822-7201		Asheville	(828) 258-3939
	Barstow	(760) 255-8852	<u>North Dakota</u>	Bismarck	(701) 250-4481
	Carlsbad	(760) 431-9440	<u>Ohio</u>	Reynoldsburg	(614) 469-6923
	Red Bluff	(530) 527-3043	<u>Oklahoma</u>	Tulsa	(918) 581-7458
	Sacramento	(916) 414-6000	<u>Oregon</u>	Bend	(541) 383-7146
	Stockton	(209) 946-6400		Klamath Falls	(541) 885-8481
	Ventura	(805) 644-1766		La Grande	(541) 962-8584
	Yreka	(530) 842-5763		Newport	(541) 867-4558
<u>Colorado</u>	Lakewood	(303) 275-2370		Portland	(503) 231-6179
	Grand Junction	(970) 243-2778		Roseburg	(541) 957-3474
<u>Connecticut</u>	(See New Hampshire)		<u>Pennsylvania</u>	State College	(814) 234-4090
<u>Delaware</u>	(See Maryland)		<u>Rhode Island</u>	(See New Hampshire)	
<u>Florida</u>	Panama City	(850) 769-0552	<u>South Carolina</u>	Charleston	(843) 727-4707
	Vero Beach	(772) 562-3909	<u>South Dakota</u>	Pierre	(605) 224-8693
	Jacksonville	(904) 232-2580	<u>Tennessee</u>	Cookeville	(931) 528-6481
<u>Georgia</u>	Athens	(706) 613-9493	<u>Texas</u>	Clear Lake	(281) 286-8282
	Brunswick	(912) 265-9336	<u>Utah</u>	West Valley City	(801) 975-3330
	Columbus	(706) 544-6428	<u>Vermont</u>	(See New Hampshire)	
<u>Idaho</u>	Boise	(208) 378-5243	<u>Virginia</u>	Gloucester	(804) 693-6694
	Chubbuck	(208) 237-6975	<u>Washington</u>	Lacey	(306) 753-9440
<u>Illinois/Iowa</u>	Rock Island	(309) 757-5800		Spokane	(509) 891-6839
<u>Indiana</u>	Bloomington	(812) 334-4261		Wenatchee	(509) 665-3508
<u>Kansas</u>	Manhattan	(785) 539-3474	<u>West Virginia</u>	Elkins	(304) 636-6586
<u>Kentucky</u>	Frankfort	(502) 695-0468	<u>Wisconsin</u>	New Franken	(920) 866-1725
<u>Louisiana</u>	Lafayette	(337) 291-3100	<u>Wyoming</u>	Cheyenne	(307) 772-2374
<u>Maine</u>	Old Town	(207) 827-5938		Cody	(307) 578-5939
<u>Maryland</u>	Annapolis	(410) 573-4573			
<u>Massachusetts</u>	(See New Hampshire)				
<u>Michigan</u>	East Lansing	(517) 351-2555			
<u>Minnesota</u>	Bloomington	(612) 725-3548			
<u>Mississippi</u>	Jackson	(601) 965-4900			
<u>Missouri</u>	Columbia	(573) 234-2132			
<u>Montana</u>	Helena	(405) 449-5225			
<u>Nebraska</u>	Grand Island	(308) 382-6468			
<u>Nevada</u>	Las Vegas	(702) 515-5230			
	Reno	(775) 861-6300			

National Office
 U.S. Fish and Wildlife Service
 Division of Migratory Bird Management
 4401 North Fairfax Drive, MBSP-4107
 Arlington, VA 22203-1610
 (703) 358-1714
<http://www.fws.gov/migratorybirds>

State Agencies

To contact a state wildlife agency, visit the Association of Fish & Wildlife Agencies' website at http://www.fishwildlife.org/where_us.html

GLOSSARY

The definitions below apply to these National Bald Eagle Management Guidelines:

Communal roost sites – Areas where bald eagles gather and perch overnight – and sometimes during the day in the event of inclement weather. Communal roost sites are usually in large trees (live or dead) that are relatively sheltered from wind and are generally in close proximity to foraging areas. These roosts may also serve a social purpose for pair bond formation and communication among eagles. Many roost sites are used year after year.

Disturb – 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.

In addition to immediate impacts, this definition also covers impacts that result from human-caused alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

Fledge – To leave the nest and begin flying. For bald eagles, this normally occurs at 10-12 weeks of age.

Fledgling – A juvenile bald eagle that has taken the first flight from the nest but is not yet independent.

Foraging area – An area where eagles feed, typically near open water such as rivers, lakes, reservoirs, and bays where fish and waterfowl are abundant, or in areas with little or no water (i.e., rangelands, barren land, tundra, suburban areas, etc.) where other prey species (e.g., rabbit, rodents) or carrion (such as at landfills) are abundant.

Landscape buffer – A natural or human-made landscape feature that screens eagles from human activity (e.g., strip of trees, hill, cliff, berm, sound wall).

Nest – A structure built, maintained, or used by bald eagles for the purpose of reproduction. An **active** nest is a nest that is attended (built, maintained or used) by a pair of bald eagles during a given breeding season, whether or not eggs are laid. An **alternate** nest is a nest that is not used for breeding by eagles during a given breeding season.

Nest abandonment – Nest abandonment occurs when adult eagles desert or stop attending a nest and do not subsequently return and successfully raise young in that nest for the duration of a breeding season. Nest abandonment can be caused by altering habitat near a nest, even if the alteration occurs prior to the breeding season. Whether the eagles migrate during the non-breeding season, or remain in the area throughout the non-breeding season, nest abandonment can occur at any point between the time the eagles return to the nesting site for the breeding season and the time when all progeny from the breeding season have

dispersed.

Project footprint – The area of land (and water) that will be permanently altered for a development project, including access roads.

Similar scope – In the vicinity of a bald eagle nest, an existing activity is of similar scope to a new activity where the types of impacts to bald eagles are similar in nature, and the impacts of the existing activity are of the same or greater magnitude than the impacts of the potential new activity. Examples: (1) An existing single-story home 200 feet from a nest is similar in scope to an additional single-story home 200 feet from the nest; (2) An existing multi-story, multi-family dwelling 150 feet from a nest has impacts of a greater magnitude than a potential new single-family home 200 feet from the nest; (3) One existing single-family home 200 feet from the nest has impacts of a lesser magnitude than three single-family homes 200 feet from the nest; (4) an existing single-family home 200 feet from a communal roost has impacts of a lesser magnitude than a single-family home 300 feet from the roost but 40 feet from the eagles' foraging area. The existing activities in examples (1) and (2) are of similar scope, while the existing activities in example (3) and (4) are not.

Vegetative buffer – An area surrounding a bald eagle nest that is wholly or largely covered by forest, vegetation, or other natural ecological characteristics, and separates the nest from human activities.

RELATED LITERATURE

Andrew, J.M. and J.A. Mosher. 1981. Bald eagle nest site selection and nesting habitat in Maryland. *Journal of Wildlife Management* 46:382-390.

Anonymous. 1977. Bald Eagle Habitat Management Guidelines, Forest Service – California Region. U.S Forest Service, San Francisco, CA.

Anthony, R.G. 2001. Low productivity of bald eagles on Prince of Wales Island, southeast Alaska. *Journal of Raptor Research* 35:1-8.

Anthony, R.G., R.W. Frenzel, F.B. Isaacs, and M.G. Garrett. 1994. Probable causes of nesting failures in Oregon's bald eagle population. *Wildlife Society Bulletin* 22:576-582.

Anthony, R.G. and F.B. Isaacs. 1989. Characteristics of bald eagle nest sites in Oregon. *Journal of Wildlife Management* 53:148-158.

Arizona Game and Fish Department. 1999. Bald Eagle Conservation Assessment and Strategy (draft).

Avian Power Line Interaction Committee (APLIC). 1996. Suggested Practices for Raptor Protection on Power Lines: The State of the Art in 1996. Edison Electric Institute, Raptor Research Foundation, Washington, D.C.

Bangs, E.E., T.N. Bailey and V.D. Berns. Ecology of nesting bald eagles on the Kenai National Wildlife Refuge, Alaska. (USFWS staff)

Becker, J.M. 2002. Response of wintering bald eagles to industrial construction in southeastern Washington. *Wildlife Society Bulletin* 30:875-878.

Brauning, D.W. and J.D. Hassinger. 2000. Pennsylvania Recovery and Management Plan for the Bald Eagle (draft). Pennsylvania Game Commission. Harrisburg, PA.

Brown, B.T., G.S. Mills, C. Powels, W.A. Russell, G.D. Therres and J.J. Pottie. 1999. The influence of weapons-testing noise on bald eagle behavior. *Journal of Raptor Research* 33:227-232.

Brown, B.T. and L.E. Stevens. 1997. Winter bald eagle distribution is inversely correlated with human activity along the Colorado River, Arizona. *Journal of Raptor Research* 31:7-10.

Buehler, D.A. 2000. Bald Eagle (*Haliaeetus leucocephalus*). In *The Birds of North America*, No. 506 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Effects of human activity on bald eagle distribution on the northern Chesapeake Bay. *Journal of Wildlife Management* 55:282-290.

Buehler, D.A., T.J. Mersmann, J.D. Fraser, and J.K.D. Seegar. 1991. Nonbreeding bald eagle communal and solitary roosting behavior and roost habitat on the northern Chesapeake Bay. *Journal of Wildlife Management* 55:273-281.

Chandler, SK., J.D. Fraser, D.A. Buehler and J.K.D. Seegar. 1995. Perch trees and shoreline development as predictors of bald eagle distribution on the Chesapeake Bay. *Journal of Wildlife Management* 59:325-332.

Cline, K. 1985. Bald Eagles in the Chesapeake: A Management Guide for Landowners. National Wildlife Federation. Washington, D.C.

Dell, D.D. and P.J. Zwank. 1986. Impact of a high-voltage transmission line on a nesting pair of southern bald eagles in southeast Louisiana. *Journal of Raptor Research* 20(3/4):117-119.

Dunwiddie, P.W. and R.C. Kuntz. 2001. Long-term trends of bald eagles in winter on the Skagit River, Washington. *Journal of Wildlife Management* 65(2):290-299.

Fletcher, R.J. et. al. 1999. Effects of recreational trails on wintering diurnal raptors along riparian corridors in a Colorado grassland. *Journal of Raptor Research* 33(3):233-239.

Fraser, J.D. 1981. The breeding biology and status of the bald eagle on the Chippewa National Forest. PhD. Dissertation, University of Minnesota.

Fraser, J.D., LD. Frenzel and J.E. Mathisen. 1985. The impact of human activities on breeding bald eagles in north-central Minnesota. *Journal of Wildlife Management* 49(3):585-592.

Garrett, M.G., J.W. Watson, and R.G. Anthony. 1993. Bald eagle home range and habitat use in the Columbia River Estuary. *Journal of Wildlife Management* 57(1):19-27.

Gerrard J.M. and G.R. Bortolotti. 1988. The Bald Eagle: Haunts and Habits of a Wilderness Monarch. Smithsonian Institution Press. Washington, D.C.

Grier, J.W. 1969. Bald eagle behavior and productivity responses to climbing to nests. *Journal of Wildlife Management* 33:961-966.

Grier, J.W. and J.E. Guinn. 2003. Bald eagle habitats and responses to human disturbance in Minnesota. Report to the Minnesota Department of Natural Resources.

Grubb, T.G. 1976. Survey and analysis of bald eagle nesting in western Washington. M.S. thesis, Univ. of Washington, Seattle.

Grubb, T.G. and R.M. King. 1991. Assessing human disturbance of breeding bald eagles with classification tree models. *Journal of Wildlife Management* 55:500-511.

Grubb, T.G., W.L. Robinson and W.W. Bowerman. 2002. Effects of watercraft on bald eagles nesting in Voyageurs National Park, Minnesota. *Wildlife Society Bulletin* 30:156-161.

Grubb, T.G. and W.W. Bowerman. 1997. Variations in breeding bald eagle response to jets, light planes and helicopters. *Journal of Raptor Research* 31:213-222.

Grubb, T.G., W.W. Bowerman, A.J. Bath, J.P. Giesy, D.V.C. Weseloh. 2003. Evaluating Great Lakes bald eagle nesting habitat with Bayesian inference. RMRS-RP-45. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO, 10 pp.

Hansen, J.A. 1977. Population dynamics and night roost requirements of bald eagles wintering in the Nooksack River Valley, WA. Huxley College of Environmental Studies, Western Washington State College, Bellingham, WA. (Problem Series)

Hansen, J.A., M.V. Stalmaster and J.R. Newman. 1980. Habitat characteristics, function, and destruction of bald eagle communal roosts in western Washington. Huxley college of Environmental Studies, Western Washington University.

Hunt, W.G., D.E. Driscoll, E.W. Bianchi, and R.E. Jackman. 1992. Ecology of bald eagles in Arizona. Report to U.S. Bureau of Reclamation, Contract 6-CS-30-04470. BioSystems Analysis Inc., Santa Cruz, California.

Isaacs, F.B and R.G. Anthony. 1987. Abundance, foraging, and roosting of bald eagles wintering in the Harney Basin, Oregon. Northwest Science 61(2), pp. 114-121.

Juenemann, B.G. 1973. Habitat evaluations of selected bald eagle nest sites on the Chippewa National Forest. M.S. thesis, University of Minnesota, Minneapolis.

Keister, G.P., R.G. Anthony and E.J. O'Neill. 1987. Use of communal roosts and foraging area by bald eagles wintering in the Klamath Basin. Journal of Wildlife Management 51(2):415-420.

Knight, R. and S.K. Knight. 1984. Responses of wintering bald eagles to boating activity. Journal of Wildlife Management 48:999-1004.

Linscombe, J.T., T.J. Hess, Jr., and V.L. Wright. 1999. Effects of seismic operations on Louisiana's nesting bald eagles. Proceedings of the Southeastern Association of Fish and Wildlife Agencies. 54:235-242.

Maine (State of) Inland Fisheries and Wildlife Rules. Chapter 8.05 Essential Habitat for Species Listed as Threatened or Endangered.

Mathisen, J.E. 1968. Effects of human disturbance on nesting bald eagles. Journal of Wildlife Management 32(1): 1-6.

McGarigal, K., R.G. Anthony and F.B. Isaacs. 1991. Interactions of humans and bald eagles on the Columbia River estuary. Wildlife Monographs 115:1-47.

McKay, K.J., J.W. Stravers, B.R. Conklin, U. Konig, S. Hawks, C.J. Kohrt, J.S. Lundh and G.V. Swenson. 2001. Potential human impacts on bald eagle reproductive success along the Upper Mississippi River.

McKewan, L.C. and D.H. Hirth. 1979. Southern bald eagle productivity and nest site selection. Journal of Wildlife Management 43:585-594.

Millsap, B.A. Status of wintering bald eagles in the conterminous 48 States. 1986. Wildlife Society Bulletin 14:433-440.

Millsap, B.A, T. Breen, E. McConnell, T. Steffer, L. Phillips, N. Douglass, and S. Taylor. In Press. Comparative fecundity and survival of bald eagles fledged from suburban and rural natal areas in Florida. Journal of Wildlife Management 68(4).

Montana Bald Eagle Working Group. 1986. Montana Bald Eagle Management Plan. Department of the Interior, Bureau of Land Management. Billings, MT.

Nesbitt, S.A., M.J. Folk and D.A. Wood. 1993. Effectiveness of bald eagle habitat protection guidelines in Florida. Proceedings of the Annual Conference of the Southeast Association of Fish and Wildlife Agencies.

Newman, J.R., W.H. Brennan and L.M. Smith. 1977. Twelve-year changes in nesting patterns of bald eagles on San Juan Island, Washington. The Murrelet 58(2)37-39.

Postapulsky, S. 1974. Raptor reproductive success: some problems with methods, criteria, and terminology. Pages 21-31 in F.N. Hammerstrom, Jr., B.E. Harrell, and R.R. Olendorff, eds. Management of raptors. Raptor Res. Found., Vermillion, S.D.

Rodgers, J.A. and Schwikert, S.T. 2003. Buffer zone distances to protect foraging and loafing waterbirds from disturbance by airboats in Florida. Waterbirds 26(4): 437-443.

Russell, D. 1980. Occurrence and human disturbance sensitivity of wintering bald eagles on the Sauk and Suiattle Rivers, Washington. In R.L. Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 165-174.

Shapiro, A.E., F. Montalbano, and D. Mager. 1982. Implications of construction of a flood control project upon bald eagle nesting activity. Wilson Bulletin 94(1), pp. 55-63.

Skagen, S.K. 1980. Behavioral responses of wintering bald eagles to human activity on the Skagit River, Washington. In R.L. Knight, G.T. Allen, M.V. Stalmaster and C.W. Servheen [eds.]. Proceedings of the Washington Bald Eagle Symposium. Nature Conservancy, Seattle, Washington, pp. 231-241.

Skagen, S.K., R.L. Knight and G.J.H. Orians. 1991. Human disturbance of an avian scavenging guild. Ecological Applications 1:215-225. (Internet)

Stalmaster, M.V. 1976 Winter ecology and effects of human activity on bald eagles in the Nooksack River Valley, Washington. MS Thesis, Western Washington State College, Bellingham.

Stalmaster, M.V. 1980. Management strategies for wintering bald eagles in the Pacific Northwest. Proceedings of the Washington Bald Eagle Symposium, pp 49-67.

Stalmaster, M.V. and J.L. Kaiser. 1998. Effects of recreational activity on wintering bald eagles. Wildlife Monographs 137:1-46.

- Stalmaster, M.V. and J.L. Kaiser. 1997. Flushing responses of wintering bald eagles to military activity. *Journal of Wildlife Management* 61:1307-1313.
- Stalmaster, M.V. and J.R. Newman. 1978. Behavioral responses of wintering bald eagles to human activity. *Journal of Wildlife Management* 42:506-513.
- Steenhof, K. 1978. Management of Wintering Bald Eagles. FWS/OBS-78/79. U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C.
- Steidl, R.J. and R.G. Anthony. 2000. Experimental Effects of Human Activity on Breeding Bald Eagles. *Ecological Applications* 10(1), pp. 258-268.
- Therres, G.D., M.A. Byrd and D.S. Bradshaw. 1993. Effects of development on nesting bald eagles: case studies from Chesapeake Bay. *Transactions of the North American Wildlife and Natural Resources Conference* 58:62-69.
- U.S. Fish and Wildlife Service. 1979. Bald Eagle Management Guidelines: Oregon – Washington. Portland. OR.
- U.S. Fish and Wildlife Service. 1983. Northern States bald eagle recovery plan. Appendices E, F, and G. U.S. Fish and Wildlife Service, Region 6, Denver, CO.
- U.S. Fish and Wildlife Service. 1987. Habitat Management Guidelines for the Bald Eagle in the Southeast Region. U.S. Fish and Wildlife Service, Region 4. Atlanta, GA.
- U.S. Fish and Wildlife Service. 1993. Bald Eagle Basics. Anchorage, AK.
- U.S. Fish and Wildlife Service. 1993. Habitat Management Guidelines for Bald Eagles in Texas. Austin, TX.
- U.S. Fish and Wildlife Service and Virginia Department of Game and Inland Fisheries. 2001. Bald Eagle Protection Guidelines for Virginia. Gloucester and Richmond, VA.
- Watson, J.W. 1993. Responses of nesting bald eagles to helicopter surveys. *Wildlife Society Bulletin* 21:171-178.
- Watson, J.W. 2004. Responses of nesting bald eagles to experimental pedestrian activity. *Journal of Raptor Research* 38:295-305.
- Wood, P.B. 1999. Bald eagle response to boating activity in northcentral Florida. *Journal of Raptor Research* 33:97-101.
- Wood, P.B., T.C. Edwards Jr. and M.W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. *Journal of Wildlife Management* 53(2):441-449.
- Young, L.S. 1980. A quantitative evaluation of human disturbance impacts on breeding eagle ecology of bald eagles in the San Juan Islands, Washington. Washington Department of Game, Olympia.

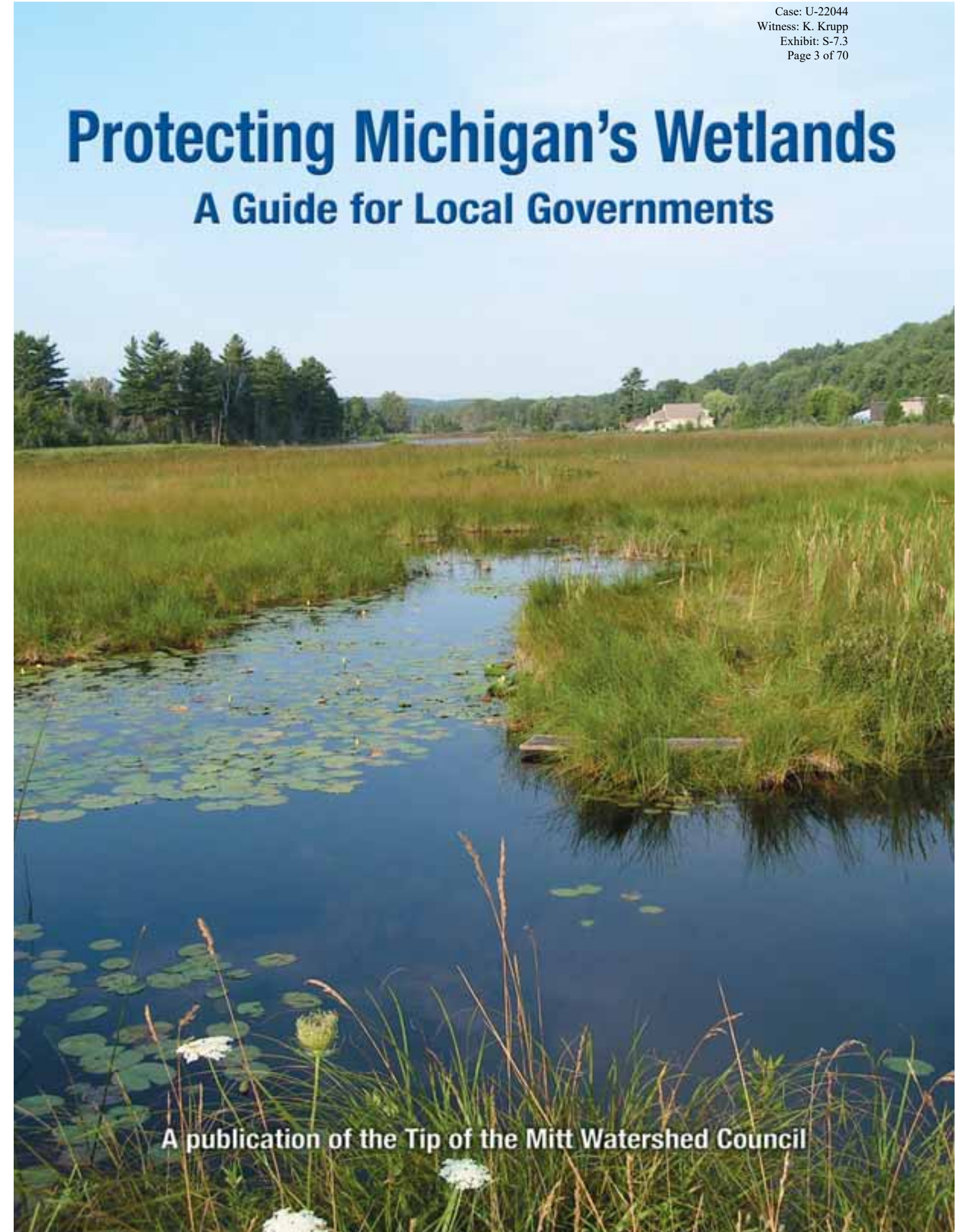
Exhibit S-7.3: *Protecting Michigan's Wetlands: A Guide for Local Governments*

See Attachment A.

Exhibit S-7.3
Attachment A

Protecting Michigan's Wetlands

A Guide for Local Governments



A publication of the Tip of the Mitt Watershed Council

Protecting Michigan's Wetlands

A Guide for Local Governments

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PROTECTING MICHIGAN'S WETLANDS

A Guide For Local Governments

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Why Local Wetland Protection?

This guidebook is designed for you – the local government official or interested citizen who faces important questions about wetlands. Why should you consider protecting them. We hope that the information contained in the following pages will help you understand why wetlands are important, and provide information to help you make decisions about the wetlands in your local community.

CHAPTER 1: Why Local Wetland Protection?

Local communities are often at the center of debates regarding changes in land use. How many times have you heard these comments?

"I never used to have flooding problems on my property, but since my neighbor filled in the low spots on their property my yard floods all the time."

"We used to have so much wildlife in this area, now we hardly have any."

"I moved to this area to get away from the city, now all we're seeing built are strip malls and parking lots."

Local governments often hear comments like these as residents in their communities grapple with growth and the subsequent loss of open space and wetlands. This guidebook is designed to help local officials and concerned citizens understand how wetlands provide benefits to communities, and the regulations that govern wetlands. It offers effective tools that can help local governments protect wetlands and other open spaces.



Why Local Government Involvement?

As communities grow, differences can arise between landowners who would like to develop their property and other property owners who wish to preserve wetlands, waterways, and open space in their neighborhood or community. Because the wetland permitting process allows for public notice and public comment, wetland issues are at the forefront of many of these disputes. These environmental conflicts are particularly common in rapidly developing areas where people moved to escape from urban and suburban landscapes. Citizens usually look to local officials first when attempting to resolve land use conflicts. For this reason it is essential that local officials have an understanding of the intimate role that wetlands play in their community's environmental health.

Wetlands are a crucial part of a community's natural plumbing system. They help protect Michigan communities from the ravages of flooding, purify polluted runoff, and help stabilize erodible shorelines. The ecological functions that wetlands provide help numerous property owners. Conversely, land use alterations that disturb or alter wetland areas can create nuisances or cause damage to surrounding land owners (e.g., downstream flooding as a result of upstream wetland filling), as well as affect broader public health issues (e.g., wetland loss can lead to water quality impairment of lakes and streams). It is critical that local officials understand these dynamics so they can help to prevent the environmental consequences associated with wetland loss.

How Wetlands Protect the Community Bottom Line

Objections to protecting wetland areas are sometimes based on the premise that the resulting economic loss outweighs the open space, recreational, and ecological benefits provided by wetlands. This argument has lost much of its credibility as the understanding of the connection between wetlands, water resources, and public health grows.

Today, you are more likely to find studies detailing how suburban style development has a greater fiscal impact on local governments than the preservation of open space. In fact, time and again, research has shown that the cost of providing services to new development, such as roads, sewers, police, and fire is greater to the local community



than the revenues brought in by the increased property taxes. For example, a Wisconsin study showed that for each \$1 million in new residential development, \$30 is added to each tax bill to pay for the additional police, schools, fire and utilities.

While wetlands have been historically maligned, today they are more frequently appreciated for the critical role they play in water resource and wildlife protection. This can be difficult to define to the public. The most obvious functions wetlands provide communities include:

- Flood control
- Water quality protection
- Shoreline stabilization
- Wildlife/fisheries habitat

When wetlands are destroyed, communities lose these important functions and the economic benefits that come with them. The loss of these wetland functions can create both hidden and obvious economic costs for communities and private property owners. (The functions and values that wetlands provide Michigan communities is discussed in greater detail in Chapter 2.)



When issues of land use regulations arise, local units of government often must weigh the costs and benefits of a project. Although it is obvious that these ecosystems are valuable, it is difficult to place a dollar value on the range of ecological functions that wetlands provide. This difficulty is due to many inherent problems associated with evaluating the dollar value of wetlands, three of which are discussed below.

- **The dollar value of certain wetland functions can be difficult to quantify.** Wetlands are valuable for many different reasons. Each wetland performs many different functions, the value of which often depends upon the person making the evaluation. Some functions are relatively easy to quantify (e.g., the value of the standing timber in a cedar swamp), while others are nearly impossible (e.g., the value of seeing a bobcat stalk a snowshoe hare in the same swamp).
- **Economic benefit derived from wetland functions may not be realized by the landowner.** Many wetland functions provide services that benefit the public as much (if not more) than the individual landowner. It is precisely because wetland functions are valued by society that regulations have been passed to protect them. However, some wetland functions, such as the flood storage capacity provided by a wetland located in the headwaters of a major river system, benefit downstream property owners more than the actual landowner. For another example, consider the owner of a large marsh adjacent to a lake. The landowner does not economically benefit from the bass, pike, and other wetland-dependent fish that are caught in the lake by other anglers.

- **It may take years to realize the economic benefits of wetland protection.** Perhaps the most critical problem with attempting to quantify wetland values is the issue of time frame. Wetlands provide ecological functions in perpetuity. Private entrepreneurs typically expect to recoup their investments within 10 to 30 years. Comparisons between short-term high economic yield projects and long-term ecological functions are inappropriate because economic analysis typically discounts the future value. Because of this, the short-term decision regarding whether to convert a wetland (assuming the absence of regulations) will sometimes favor wetland destruction. It is important to remember that the destruction of wetlands by permanent conversion (e.g., house construction, filling, or draining) removes the ecological functions forever.



Michigan's Tradition of Home Rule

Proactive efforts by local governments to preserve the quality of life in their communities are part of the rich history of home rule in Michigan. In an era of budget cutting and fiscal conservatism at the state and federal level, local governments must accept the responsibility of environmental protection.

Local decision makers have numerous land use tools available that can help them effectively, and with little cost, protect sensitive landscapes valuable to their community. Building permits, zoning authority, a wetland permit program, enforcement of the sanitary code, and soil erosion control review all fall under the authority of local government – and within each of these areas exists an opportunity to protect wetlands. Whether it be in the form of vigorous site plan review or in the establishment of open space zoning techniques, local governments have the ability, authority, and responsibility to protect their community's character at the same time as they are protecting the overall public and environmental health for the long term.

Opportunities for Protection

There are many tools available to help local governments act in the public interest to protect wetlands. If local officials accept their responsibility and work to protect wetlands, the future generations will be able to experience (and surely find value in) the leap of a largemouth bass on the end of their line, abundant game in marshes and swamps across the state, and high quality water resources for a variety of uses.

The following is a guide to aid local officials and interested citizens in understanding the biological functions that wetlands provide Michigan communities, the regulations that govern these landscapes, and the tools that local governments have available to better protect wetland environments within their jurisdiction. Protecting the water resources of a community does not always require elaborate or expensive regulations. The following chapters outline the wide variety of wetland protection techniques that are available, from the simple enforcement of existing statutes to a comprehensive wetland protection ordinance.



Why Are Wetlands Important?



WETLAND LOSSES

Michigan has lost approximately one-half of its wetland resources since European settlement due to filling and draining.

- U.S. Fish and Wildlife Service

CHAPTER 2: Why Are Wetlands Important?

An old farm adage, “too thick to drink and too thin to plow,” describes both the nature of wetlands as a transitional zone between upland and aquatic habitats, as well as the lack of value attributed to them in the past.

When this country was first settled by Europeans, few of the functions of wetlands were recognized, let alone valued as important to society. Prior to the mid-1970s, the destruction of wetlands through dredging, draining, and filling were accepted practices. As a result, according to the U.S. Fish and Wildlife Service, Michigan has lost approximately one-half of its wetland resources since European settlement due to filling and draining.

Wetlands act as natural sponges, protecting water quality, attenuating flood events, stabilizing our shorelines and stream banks, storing excess stormwater, providing bountiful fish and wildlife habitat, recharging our ground water supplies, and creating tremendous recreational, research, and tourism opportunities. In short, wetlands help maintain and protect the economic vitality of our communities and the high quality of life that we enjoy in Michigan.



What are Wetlands?

MICHIGAN'S STATUTORY DEFINITION

“Wetland means land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh...”

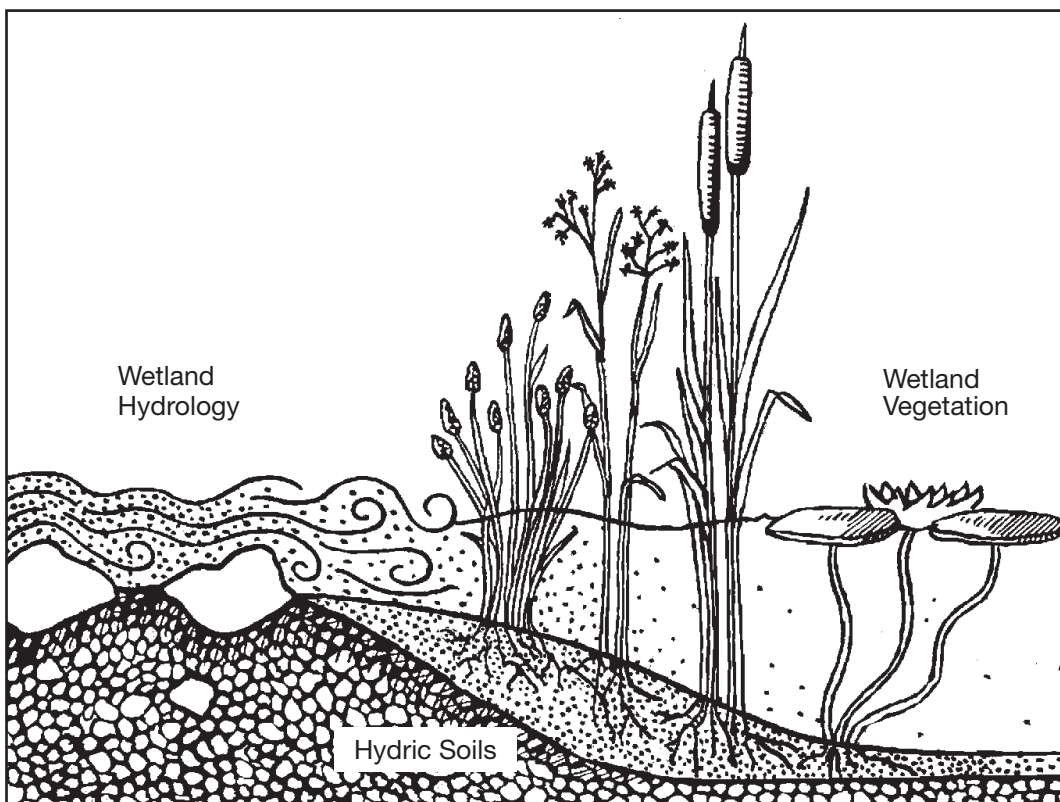
(Section 30301(d) of Part 303, Wetland Protection, Act 451 of 1994 as amended)

What are Wetlands?

Wetlands are unique ecosystems found in the transitional zone between deep water and upland habitat.

Wetlands are typically differentiated from upland habitats by three common characteristics:

- Wetland Vegetation: plants adapted to life in water or saturated conditions.
- Wetland Hydrology: the presence of water at a frequency and duration sufficient to support wetland vegetation or aquatic life.
- Hydric Soils: soils that form under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions (no oxygen) in the upper part.



When considering whether an area should be developed or protected because it is a wetland, a delineation should be conducted by a professional. This delineation will define the edges of the wetland and identify what sections development activity should avoid, in order to preserve the functions and values provided by the wetland area. Some physical indications can be used to help decide if a wetland delineation is needed. If the ground is soggy in the spring, or if water pools in depressions in the spring or after a rain, it is possible that a wetland is present on the property. If fallen leaves are black or very darkly stained, and if vegetation is different than in the higher ground around the area, these are also good indicators that a professional delineation should be conducted.

Examples of Wetlands Found In Michigan



Aquatic Bed

Michigan is fortunate to contain a diversity of wetland types ranging from coastal marshes to small isolated bogs.

Aquatic Bed

Areas of shallow permanent water that are dominated by plants that grow on or below the surface of the water.

Vernal Pools

Small pools located in oak-hickory, beech-maple forests, and northern hardwood-conifer forests. They provide critical breeding habitat for amphibians and invertebrates, and feeding sites for many other species.

Great Lakes Coastal Wetlands

The hydrology of these wetlands is driven by Great Lakes water level fluctuations. There are different types of these rare wetlands due to substrate (sand, clay, muck) and exposure to wind and wave action: barrier-beach wetland, protected embayment, tombolo, interdunal-swale, and drowned river mouth. All are very important to the health of the Great Lakes.

Interdunal Swale Wetland

A wetland dominated by grass-like vegetation that occurs in the low areas between sand dunes or beach ridges along the Great Lakes shoreline.



Vernal Pool



**Great Lakes Coastal Wetland
Protected Embayment**



Interdunal Swale

Swamp

Wooded wetland that is inundated or saturated periodically, such as a Cedar, Hardwood or Shrub-scrub Swamp. In addition to providing flood control and groundwater recharge, swamps provide critical habitat for plants, birds, fish, and invertebrates.

Marsh

These wetlands are often associated with lakes and rivers, and are permanently or periodically covered by standing or slow-moving water and dominated by grass-like vegetation. Because they typically contain a very high level of nutrients, freshwater marshes are one of the most productive ecosystems on earth.

Peatlands

Peat-accumulating wetland that includes both bogs and fens. A bog is isolated from groundwater (acidic), while a fen receives inputs of groundwater (basic). Both contain unique plants adapted to pH conditions.

Wet Prairie

Wet prairies once covered the flat lakeplains of southern Michigan, but are now considered rare. They typically experience seasonal flooding and are among the most diverse plant communities in Michigan.



Swamp



Marsh



Wet Prairie



Bog

Wetland Functions and Values



WETLANDS ARE KNOWN TO BE...

the most biologically productive ecosystems in the temperate regions of the earth. Their biological productivity rivals that of tropical rainforests and involves complex nutrient and energy cycles.

Wetland Functions and Values

Why are wetlands important? Through the work of scientists, hunters, anglers, naturalists, and land managers, we are now better able to answer this question than ever before. Wetlands are complex ecosystems that provide numerous benefits to society. In Michigan these benefits increase in significance as we continue to lose wetlands. The valuable ecological functions of wetlands, and the aesthetically pleasing open space they provide, benefit local economies and enhance the quality of life for Michigan communities and their visitors.

When discussing the importance of wetlands, the terms “wetland functions” and “wetland values” are often used. Wetland functions, such as sediment control and flood storage, are natural processes that continue regardless of their perceived value. Value is usually associated with goods and services that wetlands provide. For this reason, wetland values, such as water quality maintenance and flood protection, are the goods and services that wetlands provide. Some common wetland functions and values are listed below.

Fish and Wildlife Habitat

Wetlands are considered “Nature’s Nurseries.” Some species spend their entire lives in wetlands, while others utilize them intermittently for feeding or rearing their young. Most freshwater fish are considered wetland dependent and many important sport fishes spawn in or near wetlands. Like fish, many bird species are dependent on wetlands for either migratory resting places, breeding or feeding grounds, or cover from predators. Nearly all of Michigan’s amphibians are wetland dependent, especially for breeding.



Wetlands serve as the preferred habitat for many mammals such as muskrat, beaver, otter, mink, and raccoon. In Northern Michigan, cedar swamps are critical to white-tailed deer for many reasons, including winter browse and important thermal cover during harsh winters. With Michigan's economy so heavily dependent on tourist dollars from hunting, fishing, wildlife observation, and other forms of outdoor recreation associated with wetlands, this function is an economic powerhouse.

More than one-third of all threatened or endangered animal species in the United States either live in wetland areas or depend on them. This is especially critical considering that wetlands comprise only about five percent of the lower 48 United States. In Michigan, at least 41 listed, threatened, and endangered species of animals depend upon wetlands at some point in their life cycle. Examples of Michigan's threatened or endangered animals that rely on wetlands include the bald eagle, osprey, common loon, and king rail. Of Michigan's total 395 rare plant species, 194 of them are found in wetland habitats.

Water Quality Protection

A major function of wetlands is the preservation of water quality. Wetlands act as "Nature's Kidneys" by removing polluting nutrients and sediments from surface and ground water. Although less well known than providing fish and wildlife habitat, this wetland function is very important to local units of government, particularly in watersheds that are connected to the municipal water supply.



For example, excess inputs of nutrients, such as phosphorus and nitrogen, can cause severe problems in aquatic ecosystems. Nutrients are necessary, but they can be a classic example of how "too much of a good thing is bad." Excess nutrients can cause an undesirable increase in algae and aquatic plant growth. The result is water that is reminiscent of pea soup, weed-choked lakes, depleted dissolved oxygen levels, and the rapid aging or eutrophication of a lake. In the Great Lakes Region, the massive algae blooms and depleted dissolved oxygen levels of Lake Erie in the early 1970's is a classic example of what happens to an aquatic system under the strain of too many nutrients.

Sedimentation Control

As sediment-laden water flows through a wetland from the surrounding watershed, the sediments are deposited, or trapped, in the wetland. This reduces siltation into lakes, rivers, and streams.

There is a strong tendency for heavy metals and other toxic chemicals to attach to the sediment particles found in surface water runoff. Wetlands can trap these pollutants and remove them from the water. However, when the natural ability of wetlands to function as filters is over-stressed from human inputs, the wetland and its functions can be destroyed. In fact, when overloaded, wetlands can actually become sources of pollutants, exporting materials that have been filtered and stored for centuries.

Flood Prevention

Wetlands act as hydrologic sponges, temporarily storing flood waters and releasing them slowly, thus reducing flood peaks and protecting downstream property owners from flood damage.

Wetlands and adjacent floodplains often form natural floodways that convey flood waters from upland to downstream points. These functions become increasingly important in urban areas where development has increased the rate and volume of runoff.



Each year, many Michigan communities experience severe flooding and millions of dollars in damage is caused by flooding across the United States. Due to the below market cost of federal flood insurance and other forms of federal assistance to help flood victims, the American taxpayer bears the majority of the financial burden of flood damage. The flood storage and conveyance functions of wetlands can help to prevent flooding, resulting in substantial savings to the taxpayer. The most dramatic example of how this can go wrong occurred in August 2005, when Hurricane Katrina hit the Gulf Coast. Historically, coastal wetlands in the region acted as buffers for communities against storm surges. Unfortunately, years of dredging for navigation canals, oil and gas exploration, and construction of a vast levee system all combined to devastate those wetlands and the natural storm shield they provided. Rebuilding the Gulf Coast will come at a tremendous cost because development was not designed to incorporate the valuable features that wetlands provided. Fortunately, due to Michigan's geography, our communities are not subject to this magnitude of flooding. However, wetlands can still provide significant flood protection and storage to Michigan's communities.

Shoreline Protection

In their natural condition, wetlands function as a barrier to erosion along shorelines. The root systems of wetland plants stabilize soil at the water's edge and enhance soil accumulation at the shoreline. Wetland vegetation along shorelines reduces erosion by dampening wave action and slowing current speed.

Education and Research

Wetlands serve as wonderful outdoor classrooms, providing excellent opportunities for discovery and living examples of nearly all ecological principles. Boardwalks and observation platforms have been constructed in many wetlands across the state to facilitate educational activities. Many local governments have featured their wetland resources in various ways, preserving them in parks and other recreational or educational settings.



Recreational Opportunities

Wildlife-related recreation is a \$22 billion industry in the Great Lakes states. In Michigan alone, anglers spend more than \$1.5 billion on their sport and generate nearly \$3 billion in total economic output. Since nearly all sport fishes, many popular game animals, and most fur-bearing animals depend on wetlands for their survival, healthy and functioning wetland ecosystems are necessary to maintain the resource base for this segment of the economy. Bird watching also is becoming an important tourist activity in the off-season.

Ground Water Recharge

Wetlands are usually found where the ground water table intersects or is close to the land surface. They are usually sites of ground water discharge (places where ground water seeps or flows to the earth's surface) and are important in providing high quality water for our lakes and streams, especially in dry months. On the other hand, some wetlands are found where water moves into the ground water system, serving as a source of ground water recharge. These wetlands replenish groundwater supplies, and their filtering capacity can also help protect groundwater quality. The recharge potential of a wetland varies according to a variety of factors, including wetland type, geographic location, subsurface geology, soil type, and precipitation.

Water Supply

Whether it is used for recreation, drinking water, or industrial processes, everyone needs clean water. On the delivery side of the water equation, clean water resulting from the water quality maintenance function of wetlands helps to keep water treatment costs low. Ground water is vulnerable to contamination at many recharge areas. The filtering capacity of wetlands and the absence of pollution-generating uses in wetlands serve to protect vulnerable aquifers. For this reason, the federal Safe Drinking Water Act contains a provision to encourage local governments to protect wetlands and watersheds determined to be important to municipal water supplies.

Food and Fiber Production

Wetlands support many commercial activities. They provide a variety of natural products including blueberries, cranberries, and wild rice. Wetland grasses are hayed in many places for winter livestock feed. Forested wetlands, such as cedar swamps, can provide sustained yields of valuable timber if harvested with careful management and planning. It must be noted that many commercial activities, such as, logging, livestock grazing, or cranberry cultivation, can severely degrade wetlands if not done on a small scale with the utmost care.

Aesthetic Values

The richness of the plant and animal communities found in wetlands make them some of Michigan's most beautiful natural environments. Rare, threatened, and endangered plant and animal species provide added interest for naturalists. Wetlands provide valuable open space for visual and recreational enjoyment. In many cases throughout the state, protected wetlands have been shown to enhance the value of neighboring properties due to these factors. Perhaps the most valued function of wetlands is the space they provide for introspection and quiet reflection. The stresses of a busy day seem to fade away when one is watching a Great Blue Heron fishing in the marsh.

Summary

Many of the wetland functions discussed above benefit local units of government and members of their communities. Accordingly, local units of governments have a responsibility to protect these functions by maintaining wetlands.



The Existing Legal Framework



WHY ADD LOCAL PROTECTION?

- Federal and state laws provide limited protection to isolated wetlands.
- Isolated wetlands that are not otherwise protected provide important functions and values.
- Isolated wetlands become more important for habitat and flood storage as an area develops.
- Local governments are well suited to integrate wetlands into land use decisions.

CHAPTER 3: The Existing Legal Framework

At the heart of Michigan's wetland regulatory program is Part 303, Wetlands Protection, of the Natural Resources and Environmental Protection Act (Act 451 of 1994 as amended), formerly referred to as the Goemaere-Anderson Wetlands Protection Act (Act 203 of 1979). The Michigan Department of Environmental Quality (MDEQ) administers this statute. The MDEQ has also assumed the administration of Section 404 of the federal Clean Water Act, which protects wetlands at the federal level.

Part 303 includes several provisions:

- 1) It establishes a state policy to protect the public against the loss of wetlands and makes explicit findings as to the benefits wetlands provide.
- 2) It establishes a permit program regulating most activities that alter wetlands.
- 3) It provides enforcement language and sets maximum penalties for violations.
- 4) It explicitly authorizes regulation of wetlands by local governments.

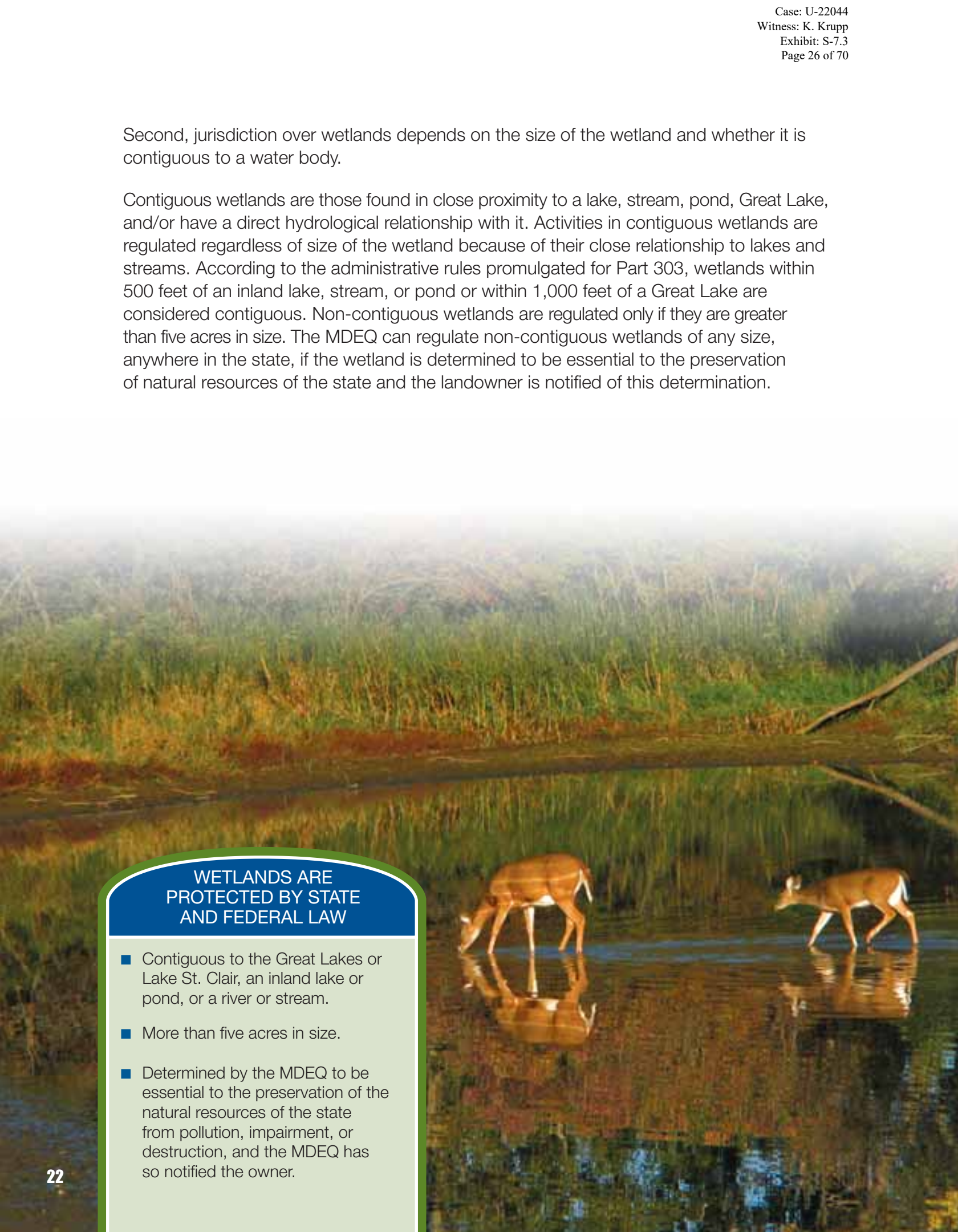
The activities that are regulated by Part 303 only apply to wetlands as defined in the Act. The definition of wetlands in the Act has two components. First, Part 303 defines a wetland as:

"land characterized by the presence of water at a frequency and duration sufficient to support, and that under normal circumstances does support, wetland vegetation or aquatic life, and is commonly referred to as a bog, swamp, or marsh."



Second, jurisdiction over wetlands depends on the size of the wetland and whether it is contiguous to a water body.

Contiguous wetlands are those found in close proximity to a lake, stream, pond, Great Lake, and/or have a direct hydrological relationship with it. Activities in contiguous wetlands are regulated regardless of size of the wetland because of their close relationship to lakes and streams. According to the administrative rules promulgated for Part 303, wetlands within 500 feet of an inland lake, stream, or pond or within 1,000 feet of a Great Lake are considered contiguous. Non-contiguous wetlands are regulated only if they are greater than five acres in size. The MDEQ can regulate non-contiguous wetlands of any size, anywhere in the state, if the wetland is determined to be essential to the preservation of natural resources of the state and the landowner is notified of this determination.



WETLANDS ARE PROTECTED BY STATE AND FEDERAL LAW

- Contiguous to the Great Lakes or Lake St. Clair, an inland lake or pond, or a river or stream.
- More than five acres in size.
- Determined by the MDEQ to be essential to the preservation of the natural resources of the state from pollution, impairment, or destruction, and the MDEQ has so notified the owner.

Permits

Under Part 303, a permit is required for the following activities in regulated wetlands: deposit or place fill material in a wetland; dredge, remove, or permit removal of soil or minerals from a wetland; construct, operate, or maintain any use or development in a wetland; or drain surface water from a wetland.

Part 303 includes specific standards that must be met before a permit is issued. The permit standards essentially involve the application of three “tests” to each application.

- 1) Is the project in the public interest?
- 2) Has the applicant shown that impacts are not unacceptable?
- 3) Is the project dependent on being placed in a wetland; does a feasible and prudent alternative exist?



REGULATED ACTIVITIES IN WETLANDS

Under Part 303, a permit is needed to:

- Place fill in a wetland.
- Dredge or remove soil or minerals from a wetland.
- Construct, operate, or maintain any use or development in a wetland.
- Drain surface water from a wetland.

To determine whether the activity is in the public interest, the benefit from the proposed project is balanced against the detriments of the activity according to the following general criteria:

- The relative extent of the public and private need for the proposed activity. (The MDEQ must give serious consideration to findings of necessity made by other state agencies.)
- The availability of feasible and prudent alternative locations and methods to accomplish the expected benefits from the activity. (Note that an analysis of alternatives is required under this subsection even if the project is wetland dependent.)
- The extent and permanence of the beneficial or detrimental effects on the public and private uses of the area, including the benefits the wetland provides.
- The probable impact of each proposal in relation to the cumulative effect created by other existing and anticipated activities in the watershed.
- The probable impact on recognized historic, cultural, scenic, ecological, or recreational values and on the public health or fish or wildlife.
- The size of the wetland being considered.
- The amount of remaining wetland in the general area.
- Proximity to any waterway.
- Economic value, both public and private, of the proposed land change to the general area.

Part 303 requires that the decision reflect the national and state concern for the protection of natural resources from pollution, impairment, and destruction.

To determine whether impacts to aquatic resources are unacceptable, the MDEQ must consider the public interest criteria and the criteria set forth in the legislative findings of Part 303. The legislature found that a loss of a wetland may deprive the people of the state of some or all of the following benefits derived from wetlands:

- Flood and storm control by the hydrologic absorption and storage capacity of the wetland.
- Protection of subsurface water resources and provision of valuable watersheds and recharging ground water supplies.
- Pollution treatment by serving as a biological and chemical oxidation basin.

- Erosion control by serving as a sedimentation area and filtering basin, absorbing silt and organic matter.
- Wildlife habitat by providing breeding, nesting, and feeding grounds and cover for many forms of wildlife, waterfowl (including migratory waterfowl), and rare, threatened, or endangered wildlife species.
- Sources of nutrients in water food cycles and nursery grounds and sanctuaries for fish.

A wetland dependent activity is one that must have wetland conditions (wetland hydrology, soils, and/or plants) to fulfill its basic purpose. If an activity can be undertaken on an upland site then it is not wetland dependent. One activity that is typically considered wetland dependent is peat extraction.

The language of Part 303 establishes a presumption that there is an alternative to impacting a wetland and that a permit cannot be issued unless the applicant demonstrates that there is no feasible and prudent alternative. Feasible and prudent alternatives include other locations, project size and configurations, and methods. If the MDEQ finds that an applicant has failed to demonstrate that there are no feasible and prudent alternatives, then it must deny a permit.

The MDEQ also administers Part 301, Inland Lakes and Streams, and Part 325, Great Lakes Submerged Lands of the Natural Resources and Environmental Protection Act (Act 451 of 1994 as amended).

In situations where two or more resource management acts apply, MDEQ reviews one permit application under the criteria of all the applicable acts. This permit consolidation prevents unnecessary duplication of permits and review processes.



Exemptions

During the legislative process when Part 303 was originally passed in 1979, some activities were exempted from the need for a wetlands permit. These exemptions include:

- Recreational activities such as fishing, trapping, hunting, boating, swimming and hiking.
- Silviculture and lumbering activities including harvesting of commercial forest products.
- Specified agricultural activities, including grazing, cultivation, and minor drainage.
- Maintenance of county drains.
- Specified power line or small gas pipeline construction, if impacts are minimized.
- Forest and farm roads if Best Management Practices (BMPs) are followed.

Mitigation

If the MDEQ determines that a project meets the criteria described above and issues a permit authorizing wetland impacts that are determined to be unavoidable, Part 303 authorizes the MDEQ to require the applicant to take actions to mitigate the loss of wetland area and function. The mitigation guidelines in Part 303's administrative rules require:

- A no net loss of wetlands.
- A preference for wetland restoration.
- Mitigated wetlands be of a similar ecological type.
- Mitigation projects near the same site as the impacted wetland or within the same watershed in most cases.
- Consideration be given to replacement of predominant functional values lost within the impacted wetland.
- Financial assurances that the mitigation will be completed.
- Ratios of mitigation ranging from 1.5 – 5: 1, depending on the type of wetland impacted, and 10:1 and special provisions for preservation as mitigation.
- Permanent protection must be established for the mitigated wetlands.

MITIGATION

Permitting sequence:

- Avoid wetlands
- Minimize impacts
- Mitigate for unavoidable impacts



Local Wetland Ordinances



CHAPTER 4: Local Wetland Ordinances

In Michigan, local government has traditionally shouldered the primary responsibility for land use control through zoning. Local wetlands protection, in addition to MDEQ regulation, is consistent with this home rule tradition. Part 303 authorizes municipalities to regulate wetlands using the same definition, regulatory standards, and application procedures established in Part 303. This authority is supplemental to the existing authority of a municipality to enact zoning ordinances in the public interest under the County, Township, and City, and Village Zoning Enabling Acts. Under these acts, local governments can use various tools, including protecting native vegetation and requiring buffer strips around natural features such as wetlands. Given the importance of the functions and values that wetlands provide, some local governments in Michigan have adopted local wetland ordinances.



Everyone Benefits from Local Wetland Ordinances

Many benefits result from the local regulation of wetlands in addition to the state and federal programs: the wetland benefits, the individual applicant benefits, and the general public benefits.

Benefits to wetlands by filling gaps in state and federal law and increasing support:

- Protection of small isolated wetlands not subject to state or federal regulation.
- Local involvement allows for early integration of wetland protection during the development of site plans (e.g., conservation planning, see Chapter 5).
- Difficult for MDEQ staff alone to monitor all activities that can occur throughout the entire state.

Benefits to the applicant by addressing wetlands early in the project:

- Reduced costs and time delays that result from improper planning.
- Local government can provide incentives (density bonuses, variances, etc.).
- Complete applications may expedite state and federal processes.
- Violations/conflicts with other laws may be avoided.
- Nature sells!

Benefits to the community by enhancing wetland protection:

- Helps foster better land use decisions.
- Improves water quality, reduces flood damage, protects wildlife habitat, and preserves valuable open space and recreational areas.
- Reduces tax payer dollars spent replacing lost wetland functions and values.
- Savings for individual homeowners by avoiding costs of repairing settling foundations and leaky basements.
- Preserves the special features unique to the community.
- Protects the local economy by enhancing the quality of life.



Elements to Consider

What wetlands should be regulated?

If your local government decides to enact a wetland ordinance, you must decide what wetlands should be regulated:

- Only those regulated by MDEQ?
- Only those NOT regulated by MDEQ?
- All wetlands regardless of size?
- All wetlands to a certain arbitrary size?

Small wetlands provide unique benefits to wildlife and the ecosystem, including critical breeding habitats for amphibians. Because small wetlands provide unique benefits, many communities regulate all wetlands regardless of size or regulate down to 1/4 of an acre. Once your community decides what wetlands to regulate, there are a number of important elements that must be taken into account by local governments wishing to enact a local wetland ordinance.

Part 303 Requirements for Local Ordinances

Part 303 includes requirements for local units of government to follow if they wish to regulate wetlands. These include:

- A wetland ordinance cannot require a permit for activities exempted from regulation under Part 303.
- A wetland ordinance must use the same wetland definition as in Part 303, except that the local government can regulate isolated wetlands smaller than 5 acres.
- Local units of government must publish a wetland inventory before adopting a wetland ordinance. This inventory serves as a general guide and does not delineate jurisdictional boundaries.
- Local units of government that adopt wetland ordinances must notify the MDEQ.
- If a local government wishes to regulate a wetland less than 2 acres in size, the local government must grant a permit unless it is determined that the wetland is essential to the preservation of the community's natural resources according to criteria in Part 303.
- Local governments must make decisions on wetland permit applications in 90 days unless waived by the applicant.
- Local governments must forward a copy of each application to the MDEQ, along with state application fees for projects.
- Local governments must process wetland applications in a manner that ensures that the same entity makes decisions on site plans, plats, and wetlands and cannot require an applicant to submit to a hearing on the application before more than one local government decision-making body.

Mapping first makes sense!

Part 303 requires a local inventory of your community's wetlands. This is not a jurisdictional map – it is only for planning and notification purposes. Thanks to the growth in GIS and available data, wetland inventories are easy and relatively inexpensive to create. However, this inventory does not substitute for on-site review.

Landowners must be notified on the inventory map's availability. Creating the wetland inventory map early in the process builds awareness of wetland resources in the community and builds support for protection among stakeholders. The map is required by Part 303 but is valuable beyond just for wetland protection. It can also be used for preparing a master plan and making planning and zoning decisions.

MDEQ Permits

If a community has a local wetland ordinance, a permit applicant must also request a permit from the MDEQ. The local permit review process should be conducted in the same time frame as the state review process. Approval from both the MDEQ and the local government are necessary in order to proceed with the project.

Perceived “Costs” to Enacting a Local Ordinance

Some common concerns regarding a local ordinance include worries that economic, community, and job growth/development will be slowed or halted. Other objections voiced may include worries that lawsuits will bankrupt the community, or that takings claims will be filed. However, all of these concerns can be addressed. Communities with wetland ordinances are among Michigan's fastest growing. Also, well-crafted and fairly administered wetland ordinances are very defensible and rarely challenged. To date, there have been no successful takings claims against local wetland ordinances. Finally, local ordinances that protect important community assets are popular—as long as they develop ownership among community stakeholders.

**An Example of a Local Wetland Ordinance is available at:
www.michigan.gov/deqwetlands**



Additional Options For Local Protection of Wetlands

CHAPTER 5: Additional Options For Local Protection of Wetlands

In addition to enacting a stand-alone wetland ordinance, there are various wetland protection tools available to local governments. Wetland protection can take many forms, and in most cases it should reflect the needs of the resources and the concern of the community. Some communities integrate wetland protection provisions into their site plan review process, while others maintain comprehensive stand-alone ordinances complete with maps designating wetland areas. The form of wetland protection that a community is likely to pursue is dependent on a number of variables, some of which include: political climate, available funding or funding mechanisms, administrative capacity, etc. Some of the most common protection options are discussed in this section, including:

Use of Local Regulatory Programs

- Community Option #1: Natural Features Setback Ordinances
- Community Option #2: Soil Erosion and Sedimentation Control Ordinances
- Community Option #3: Floodplain Management Ordinances

Use of Site Planning

- Community Option #4: Site Plan Review Regulations
- Community Option #5: Linking Local Approval to State and Federal Permits
- Community Option #6: Lot Split or Lot Division Regulations
- Community Option #7: Local Stormwater Management
- Community Option #8: Open Space Zoning and Conservation Design
- Community Option #9: Performance Based Zoning
- Community Option #10: Performance Guarantees
- Community Option #11: Environmental Planning in Public Infrastructure Projects

Use of Voluntary Protection

- Community Option #12: Partnerships Between Local Units
of Government and Landowners

At a minimum, local governments can review state and federal wetland dredge and fill applications that apply to their area. This should include an analysis of the local zoning ordinance to ensure compliance with any local provisions that might be used to protect the wetland. If a project violates the local ordinance, the MDEQ and the U.S. Army Corps of Engineers, where applicable, should be notified during the public comment process. In addition, the local zoning administrator or reviewing body should be made aware of the proposed activity to ensure appropriate local review. Keep in mind that local governments have 45 days to review the application and provide comments – while citizens only have 20 days.

Natural Features Setback Ordinances

Because people are drawn to the water, residential and recreational pressure to develop properties along lakes, streams, and wetlands is immense – the same natural features that attract people to our communities are at a high risk for being degraded or destroyed by adjacent development.

One way to protect important natural features in your community is to require “setbacks,” which are intended to provide a buffer between the natural feature and development. This can be accomplished by including a natural features setback as part of the zoning ordinance to ensure that buildings or various activities, such as grading or cutting vegetation, are located a safe distance from a wetland or other natural feature.

Natural feature setbacks can protect local rivers and streams, lake shorelines, and wetlands. They also provide additional benefits including:



- Protection of surface water run-off and water quality for pollution prevention.
- Assistance in beneficial water recharge for drinking, irrigation and other purposes.
- Provision of water storage areas during storm events.
- Preservation of aesthetic views and enjoyment of natural resources.
- Stabilization and protection of soil resources, including the prevention of erosion and prohibition of loss due to moving water.
- Protection of wildlife habitat, including preservation of threatened and endangered species habitat.

Natural feature setbacks are typically 25 to 40 feet in width, but larger setbacks (up to 200 feet) are desirable for best protection of the adjacent resource. Setbacks should not be included in a wetland regulatory ordinance. However, local governments can require setbacks from wetlands in a separate zoning ordinance.

An example of a natural feature setback ordinance can be found on the Huron River Watershed Council's website at [www. hrwc.org](http://www.hrwc.org).

Example of a Natural Features Setback Ordinance Intent and Purpose Clause:

It is the intent of this ordinance to require a minimum setback from natural features, and to regulate property within such setback in order to prevent physical harm, impairment and/or destruction of or to a natural feature. It has been determined that, in the absence of such a minimum setback, intrusions in or onto natural features would occur, resulting in harm, impairment and/or destruction of natural features contrary to the public health, safety and general welfare. This regulation is based on the police power, for the protection of the public health, safety and welfare, including the authority granted in the Zoning Enabling Act.

It is the purpose of this section to establish and preserve minimum setback from natural features in order to recognize and protect the special interrelationship and interdependency between the natural feature and the setback area. Components of interrelationship which this section is intended to protect include: (1) the spatial relationship; (2) interdependency in terms of physical location, plant species, animal species and encouragement of diversity and richness of plant and animal species; (3) overland and subsurface hydrology; (4) water table; (5) water quality; (6) prevention of erosion or sediment deposition.



Soil Erosion and Sedimentation Control Ordinances

Sediment can be a significant contributor to the decline in wetland viability by reducing water depths, decreasing sunlight penetration, and smothering plant and animal species. Additionally, contaminants such as pesticides, heavy metals, oil and grease, bacteria, plant nutrients, and other chemical wastes are often attached to the sediment and deposited into wetlands. Part 91, Soil Erosion and Sedimentation Control (SESC), of the Natural Resources and Environmental Protection Act (Act 451 of 1994 as amended) formerly Act 347 of 1972, was enacted to protect the waters of the state from sedimentation caused by unchecked soil erosion.

Part 91 gives the primary responsibility for administering the statute to the counties. The County Board of Commissioners must designate a county enforcing agency such as the Drain Commissioner, Road Commission, Building Department, or the local Soil Conservation District to administer the soil erosion control program on behalf of the county. Counties may administer this by using a resolution or an SESC Ordinance. SESC ordinances can be more restrictive than the statute. Part 91 allows cities, villages, charter townships, and some general law townships to assume responsibility within their jurisdictions by adopting a MDEQ-approved SESC Ordinance. The costs of administering county/local erosion programs may be covered by charging fees for inspections, permits, and reviewing plans.

Similar to other regulatory programs, Part 91 requires permits for all regulated activities. Permits are required for all earth changes that disturb one or more acres OR that are within 500 feet of a lake or stream. Plowing, tilling, and some logging and mining activities are exempt under Part 91. Since wetlands are often contiguous to lakes and streams, Part 91 may be a useful tool for protecting wetlands. Given that SESC Ordinances can be more restrictive than the statute, the county or local governmental agency may require (if desired) SESC permits within 500 feet of wetlands, lakes, or streams. Prior to receiving a permit, the applicant must complete an application and develop a soil erosion and sedimentation control plan to minimize erosion and off-site sedimentation.

Summary

- Adopt a county/local ordinance subject to approval from the MDEQ.
- Designate enforcing agency (e.g., Drain Commissioner, Road Commission, Building Department, or the local Soil Conservation District).
- Review and approve soil erosion and sediment control permit applications.

Seven Principles of Erosion/Sediment Control to be Incorporated Into Every Plan and Construction Activity

1. Design and construct terrain features such as slopes and drainage ways to minimize the erosion potential of the exposed site based on the soil type, time of year, proximity to water ways, duration of exposure, length/steepness of the slope, and the anticipated volume and intensity of runoff.
2. Minimize the surface area of unstabilized soils left unprotected and vulnerable to runoff and wind at any one time.
3. Minimize the amount of time that unstabilized soil areas are exposed to erosive forces.
4. Protect and shield exposed soil areas with a cover of live vegetation, mulch, or approved erosion resistant material during the temporary and permanent control periods of construction.
5. Avoid concentrating runoff. When concentrated runoff cannot be avoided, runoff velocities must be reduced to non-erosive velocities.
6. Trap eroded sediments on-site with temporary and permanent barriers, basins or other sediment retention devices while allowing for the controlled discharge of runoff waters at non-erosive velocities.
7. Implement a continuous inspection and maintenance program.



Incorporating these principles will help prevent this.

Floodplain Management Ordinances

Protecting floodplains from development is an urgent public health and safety matter for officials in many Michigan communities. Floodplains are the natural low areas adjacent to surface water bodies that hold floodwaters. Since it's common to find extensive wetlands in the floodplains of rivers, lakes, and streams, floodplain management generally involves wetland protection.

When floodplains are altered by development, filling, sedimentation, and/or vegetation destruction, their ability to handle floodwaters are greatly reduced, aggravating flooding and subsequent flood damages, especially downstream. Communities throughout the state have developed specific regulations to control development in floodplains. Local floodplain regulations generally promote the following goals:

- Limit the alteration of natural flood plains, streams, wetlands and natural protective barriers (e.g., floodplain slopes) that store and attenuate flood waters.
- Control activities like filling, grading, and dredging, which may increase flooding.
- Prevent encroachment on stream channels and wetlands.
- Prevent construction of flood barriers that will unnaturally divert flood waters or may increase flood hazards in other areas.
- Slow runoff volume and rate to reduce flooding, sedimentation, and channel and property damage.
- Promote intergovernmental cooperation (state, federal, and local coordination) through consistent application of regulations, so one unit of government does not transport flooding problems to another because of poor floodplain management.
- Require the elevation of structures above the 100-year flood elevation to reduce the damage.
- Save community's dollars by preserving natural flood protection features.

There are a number of options available for floodplain protection. The MDEQ has jurisdiction over many floodplain areas, yet local governments can regulate development in floodplains through a separate floodplain ordinance or through special provisions in the zoning ordinance or building code. Coordinating state and local floodplain regulations is essential for appropriate management of floodplains.

Defining and Mapping Floodplains

One of the first steps in protecting floodplains is to delineate the floodplain area on an official map. This map becomes the basis for local regulations. (Using floodplain regulations will not protect isolated wetlands, or wetlands not found within the designated floodplain.) Many Michigan communities already have official floodplain maps, developed by the Federal Emergency Management Act (FEMA). These maps are known as a Flood Insurance Rate Maps.

If a hazard map does not exist for a community, then the expertise of a wetland scientist or hydrologist may be required. The use of the National Wetlands Inventory (NWI) Maps, Michigan Resource Inventory System (MIRIS) maps, soil surveys, current aerial photos, U.S.G.S. topographic maps, and some field verification is usually required. This map will serve as a guide, not as a detailed site specific map.

Zoning for Floodplain Protection

Floodplain zoning ordinances regulate the types of land uses that are permitted in the floodplain. Floodplain zoning districts only allow uses that are not susceptible to flood damage (e.g. recreation facilities, agriculture, conservation/education areas, and planned unit developments that cluster buildings out of the flood prone areas). Many communities with flooding problems participate in the National Flood Insurance Program (NFIP).

Planning and Public Floodplain Acquisition for Greenways and Parklands

Pro-active planning for community greenways located in floodplain areas can create many economic benefits for a community. Park and recreation plans often target the acquisition of floodplain areas for use as passive nature recreation areas or for more intensive forms of recreation that are not permanently damaged by flooding (e.g., soccer or softball fields). Since floodplains are vulnerable to periodic flooding and the ability to develop these lands is marginal, they can often be purchased at reduced prices. Strategic long-range planning for protection and acquisition of floodplains by parks and recreation commissions can contribute significantly to the protection of riparian wetlands as well as improve the quality of life benefits for the community.



Site Plan Review Regulations

Good development design strengthens economic activity, improves community attitudes, reduces nuisance impacts, decreases the cost of development, improves property values, and enhances public safety. For these reasons, it is in a community's interest to conduct a site plan review process. Site plans are the documents and drawings that present information showing what an applicant for zoning approval wants to achieve on a parcel of land. Because good site plans usually include information on stormwater patterns, topography, soils, and wetland locations, they can help local decision makers better assess what might be necessary to protect water resources before construction begins.

Local Site Plan Review Regulations

Site plan review regulations are provisions in a zoning ordinance for the administrative review of the physical layout of proposed projects to assure the standards contained in the zoning ordinance are complied with as each property is developed. Many local governments already administer site plan review as part of their planning process, so adding wetland review often does not add to the administrative work load.

In addition to specifying the procedures for submission and approval of site plans, site plan review regulations also identify the land uses subject to review and the individual or body responsible for administering the review. Site plan review typically requires professional assistance and trained decision makers if it is to be used most effectively. This may require hiring outside consultants with the cost borne by fees paid by applicants. Site plan review is often applied to commercial/industrial facilities, and other uses that require a more detailed review to look at number of parking spaces, structure size, and development in sensitive environmental areas such as wetlands.

The inclusion of standards within site plan review regulations is essential to ensure effective and legally rooted review decisions. Standards typically used include: data submittal standards, nondiscretionary review standards, discretionary review standards, and conditional standards to ensure ordinance conformance.

The most important of these are discretionary standards, which address issues ranging from impacts on the environment and adjoining land uses, in conformance with any related federal, state or county regulations. If development does not proceed according to an approved site plan, legal means (such as performance guarantees mentioned under Community Option #10) can be initiated to require enforcement.



Local Site Plan Review and Designing Developments to Protect Wetlands

Wetland protection can be integrated into both residential and commercial development plans. To plan developments that protect wetlands, an assessment of the wetland should first be conducted. This assessment should include (at a minimum):

- Wetland boundaries
- Wetland size
- Wetland type
- Connections to other bodies of water
- Critical upland habitat that should be protected along with the wetland

Once these are determined, the next step is to determine what type of development is most compatible with protecting wetlands on the site.

The layout for buildings and roads should be designed to avoid wetlands altogether, or if unavoidable, minimize wetland crossings. How the upland adjacent to a wetland will be developed has important implications for the long-term health of the wetland. Important considerations include establishment of greenbelts and buffer zones around wetlands, managing the quantity and quality of stormwater in a way that does not harm the wetland, human access and use of the wetland, and land use practices (e.g., fertilizer and pesticide use) as discussed in Community Option #7.

Linking Local Approval to State and Federal Permits

A local government's most basic approach to wetland protection is to tie local approval for a proposed development to the acquisition of the necessary state and federal wetland permits required for project completion. This regulatory technique links approval for all zoning and subdivision to all local, state, and federal permits.

The advantages of a regulatory networking approach include:

- It ensures wetland issues are considered early in the planning process.
- It facilitates communication between local government and federal and state regulatory agencies.
- It ensures wetlands are regulated to state and federal standards at a minimum.
- It provides information on water resources to the local government with little additional cost.
- It can help local governments better understand the environmental aspects of project design utilizing existing regulations rather than creating new ones.

The disadvantages to linking approvals are that it leaves some significant land use decisions regarding wetlands entirely up to state and federal officials, and critical isolated wetlands and habitats may not be protected on any level. If local governments would like to be more involved or more protective in the wetlands decision-making process, other options should be investigated.



Step 1: Encourage those in the process of planning land development to conduct a wetland delineation prior to designing the project. This is an important way to avoid wetlands and wetland regulations altogether. Providing a list of wetland consultants to property owners will facilitate this process. You can also recommend using the MDEQ Wetland Identification Program.

Step 2: Land developers should be informed in the early stages of site planning that project approval is conditional on the project receiving the proper federal and state permits. A community may stamp on the permit something to the effect of “Permit Approval Conditional to the Acquisition of Necessary State and Federal Wetland Permits.”

Step 3: Provide easily accessible educational materials on wetlands to individuals interested in land development. MDEQ produces fact sheets on the wetland regulatory process, which can be accessed at www.michigan.gov/wetlands_deq.



If local governments pursue this easy but effective option, some local wetland conflicts can be avoided altogether.

Lot Split or Lot Division Regulations

Unchecked land division can remove forever large amounts of forests and farmland from production. It can also unnecessarily burden public facilities and services by the creation of vast “rural development.” Finally, poorly planned land divisions can create parcels that may require the destruction of wetlands to adequately site houses.

The Land Division Act, Act 288 of 1967 as amended (formally known as the Subdivision Control Act) does not regulate the creation of parcels greater than 40 acres in size. The Land Division Act requires approval from the MDEQ for the preliminary plat of any subdivision containing lots within or affected by a floodplain, and any subdivision involving land abutting a lake or stream where public rights may be affected. Local governments interested in having more control over land divisions in order to protect wetlands can create local based land division and subdivision regulations.

Local Land Division Regulations

If land division trends appear to be alarming, a local government can consider adopting a land division regulation. Local land division regulations apply to all lands. These regulations serve to prevent the creation of “unbuildable parcels” with lot width, depth, area, shape and/or frontage that do not meet ordinance minimums, and ensure that access meets minimum public safety and drainage standards. They are also structured to prevent the unnecessary fragmentation of valuable natural resource areas and to prevent a proliferation of strip commercial parcels along major roadways.

Land division regulations can help prevent over-development along rural corridors and premature obsolescence of rural roads.



Elements To Consider Locally

- Location of natural or artificial drainage courses, lakes, streams, wetlands, critical sand dunes, threatened or endangered species, unusual topography, and major stands of trees.
- The size, shape, orientation, and existing zoning of the lots and parcels should be appropriate for the type of development and land use contemplated. No split should be approved that would conflict with existing drainage ditches, natural watercourses, easements, or public rights-of-way.
- Parcel splits should minimize the division of wetland areas and other natural features. No parcel should be created solely of critical sand dune, wetland, lake or river bottom, or stream bed.



Local Stormwater Management

Stormwater management regulations are designed to address the challenges posed by flooding and nonpoint source pollution. The term “nonpoint” refers to pollutants that originate from diffuse sources rather than a specific point or an easily identified source (e.g., from snow melt or stormwater runoff versus an outlet pipe). Stormwater runoff can carry with it high concentrations of sediment (soil particles), hydrocarbons and other hazardous chemicals, pesticides, bacteria, nutrients, and heavy metals.

Local governments are becoming increasingly involved in the administration of stormwater management activities, particularly in rapidly urbanizing areas where the impacts of development on water quality and quantity are most pronounced. In many areas of Michigan, polluted runoff from lawns, roads, and agricultural areas account for as much as 70% of the water quality problems of a waterway.

Research shows that when an urbanizing watershed reaches a level of 10% impervious cover (roads, parking lots, rooftops), the water quality and fish habitat problems rapidly accelerate. By using effective site planning to manage stormwater and soil erosion, local governments can protect wetlands and waterways from siltation, avoid the creation of excessive imperviousness, and minimize alterations in hydrology.

Stormwater Management Considerations

- Consider watershed boundaries and wetlands in planning, not political boundaries.
- Discourage use of natural wetlands to treat stormwater – instead encourage low impact development, creation of rain gardens, green roofs, wet detention basins, and other engineered solutions throughout the local area.
- Control quantity, timing, and quality of runoff.
- Limit impervious areas.
- Encourage “green” infrastructure.
- Require routine maintenance.
- Treat “first flush” runoff, meaning the peak concentrations of contaminants that occur at the initial stage of runoff events.

Site Planning for Stormwater Management

Site planning (detailed in Community Option #4) is an invaluable tool local governments can use when attempting to control the amount, quality, and timing of runoff to prevent its damaging effects on natural resources, private property, and public infrastructure. In the early stages of the site plan process, the environmentally sensitive areas (e.g., wetlands, floodplains, and steep slopes) should be identified. Wetlands and wetland protection are an essential component in any stormwater management system.

The following are a few elements that should be considered when reviewing site plans for stormwater management:

- Protect streambank and other natural vegetation and provide setbacks.
- Prohibit direct discharge of stormwater into wetlands.
- Prevent fill in wetlands, floodplains, and other natural stormwater collection areas.
- Set a limit on the percentage of impervious surfaces in a development.
- Reduce design demands for curbs and gutters, allow replacement with grassed swales where appropriate.
- Limit impervious surfaces by reducing parking area requirements.
- Require pervious surfaces whenever possible.
- Require a stormwater management plan at the site plan review stage for new, modified or expanded developments.
- Ensure proper installation and maintenance of stormwater control measures to preserve the natural runoff system on and adjacent to development sites. An example of this would be requiring grading plans for private road development and driveways to divert stormwater from washing out these areas.

The U.S. EPA has developed a guide entitled *Protecting Wetlands: A Guide to Stormwater Best Management Practices*, which is available at www.epa.gov/owow/wetlands/watersheds.

Urban Cooperation Agreements and Stormwater Management

Since stormwater runoff does not respect municipal boundaries, it makes sense for local governments to coordinate with surrounding units of government on stormwater management. Cooperative agreements among local governments, known as urban cooperation agreements (UCA), are legally allowed under the Urban Cooperation Act of 1967. It has become increasingly common to manage and fund trans-boundary matters such as fire services, recreational facilities, and water and sewer services using UCAs. Stormwater management is no different.

Prior to adopting a local plan, an area-wide stormwater management plan can provide the rationale and guidelines for local regulation. Once these regional guidelines have been established, it is much easier for local governments to develop their individual ordinances. UCAs can easily be applied to a public works program that would allow for construction of systems for stormwater management that might include area-wide retention basins, monitoring programs, and financing mechanisms, such as special assessments or utility fees.



Open Space Zoning and Conservation Design

Open space zoning regulations are techniques used by communities to accommodate growth while preserving wetlands and other natural resources, rural character, prime agricultural and forest lands, scenic views, historic landmarks, and other special features that are important to the community. Open space zoning enables communities to require a certain percentage of a site to be preserved as open space to protect these resources.

There are four fundamental components of open space zoning:

- 1) Special site features are inventoried and mapped.
- 2) A significant portion of the site is protected as permanent open space.
- 3) Building envelopes are sited to respect special features and preserve the quantity and quality of open space on the site.
- 4) Viewsheds are protected by maintaining a low visual impact, particularly along public roadways and waters.

Techniques for Open Space and Conservation Design

Below is a brief description of some of the more established land use tools that can protect both open space and wetlands.

Conservation Subdivision

Conservation subdivision allows for clustering of building sites to provide open space protection of areas that contain wetlands, steep slopes, views, agricultural lands, and other special features. Clustering building sites not only protects sensitive landscapes, it also provides more open space for recreation and can preserve scenic views that contribute to higher property values. Additionally, a more compact site design can significantly lower the costs of infrastructure, surveying, and engineering.



Traditional Subdivision Design (shown at left)

Grid layout with little regard for natural and special features

Conservation Design (shown at right)

Trees, wetlands, scenic views, and natural features are retained. All homes have lake views. All residents have equal access to the shoreline. Single-loaded roads provide more privacy and better views. Trails make a pedestrian and recreation-friendly development.

The image of condominium complexes or tightly packed dwellings is often associated with conservation subdivision, but in actuality this is usually not the case in open space zoning. Rather, open space zoning reduces lot size, but the open space found adjacent to and surrounding the lots give a sense of much larger lots.

Conservation Easements

Conservation easements can be used to provide permanent land protection. The explosive growth of the land trust movements in Michigan and nationwide is allowing local governments to create public-private partnerships in land protection. This topic is more thoroughly discussed under Community Option #12.

Planned Unit Developments

Planned unit developments (PUD) are authorized under state enabling acts to provide opportunities for more flexible land use and site development. PUDs generally encourage site designs that integrate structures and uses with natural site characteristics to minimize impacts on the site and adjoining properties and include planned open space. PUDs can create larger areas of open space through clustering of units than lot-by-lot development. PUD projects must undergo a site plan review process, and thus these regulations are administratively more complex than traditional lot area and bulk regulations.

Implementing Open Space Zoning

When local government pursues open space zoning, the regulations should reflect the community's comprehensive plan to assure legal validity. Site development regulations should be consistent with local rural character, privacy, and open space access. Permitting should be no more difficult than for traditional subdivisions and if substantially easier, will result in more open space projects. In some cases, density bonuses for open space projects should be considered to increase financial attractiveness of open space developments.



What Does Conservation Design Add Up To?

Preservation of natural features +
Private lots and common areas +
Increased sense of community & social opportunities +
Shoreline use concentrated in single dock area

HIGHER PROPERTY VALUES!

Performance Based Zoning

Traditional community zoning techniques are designed to allow specific land use activities (commercial, residential, industrial) only in pre-defined geographic areas, or zones. Zoning commissions then have the task of reviewing proposed projects in reference to approved zoning maps that detail the areas where certain land uses are prohibited, authorized, or are authorized with certain conditions.

Performance based zoning, on the other hand, does not divide land uses into separate zoning districts. Instead, land use is regulated by particular performance standards that developers must meet. If developers agree to meet these pre-defined standards, then a project can be sited in a broader range of geographic settings. Typical performance standards include wetland protection, amount of impervious surface, building density, waterfront setbacks, buffering requirements, and open space ratios. Examples of performance standards that protect wetlands:

- Prevent filling of wetlands by sand, gravel, solid wastes, or structures.
- Protect wetland water supply (quantity).
- Protect wetland soils.
- Maintain free circulation of wetland waters.
- Protect wetland vegetation from cutting and grading.

A significant benefit of performance based zoning is that it allows communities to promote infill in underutilized urban and suburban areas, in turn limiting the progress of sprawl. The practice of infilling has the tendency to revitalize economically distressed neighborhoods by providing a greater diversity of residential and commercial uses. To ensure there is a compatibility between land uses, buffers and setbacks should be included as in the community's performance standards.





The other significant benefit of performance based zoning is that it gives developers a certain flexibility in designing a plan as long as all the conditions laid out by the local government are met. Developers then have a broad range of design options that they can pursue, many of which can provide significant cost savings. For example, if a developer is required to limit impervious surface and protect slopes greater than fifteen percent, the developer then can cluster buildings, mix building types, and alter road layout to meet those performance standards.

How is Performance Based Zoning Unique?

- It does not divide land use into separate zoning districts (residential, commercial, industrial)
- Regulates land use by particular, pre-defined standards to which developers must adhere (including wetland protection and waterfront setbacks)
- Helps revitalize communities by promoting infill and limiting sprawl
- Offers flexibility and cost savings to developers

Performance Guarantees

Performance guarantees are traditionally used by local governments as a legal mechanism to ensure that developers establish predefined improvements as conditions of local project approval. Performance guarantees are a form of “insurance” to protect a community from unmarketable sites due to project abandonment or partial completion, where required public or environmental improvements have not been completed.

Roads, sidewalks, lighting, and utilities are all common site features for which local governments can require performance guarantees in the form of surety bonds, cash, or cash equivalence. The guarantee is returned to the developer when the project improvements are completed within a specified timeline and an agreed upon project site plan. Performance guarantees can be



used to protect wetlands by assuring that proposed land alterations are constructed as specified by community planners. For example, if a stormwater feature, such as infiltration swales or detention basins, are required to treat runoff before it enters a wetland, a performance guarantee will help assure that these stormwater treatment features are properly constructed. Performance guarantees enable communities to pay the cost to protect or restore wetlands or other sensitive features, if the developer or contractor fails to do so.

Why Use Performance Guarantees?

They are collected as “insurance” to protect a community if a development project goes wrong.

Communities interested in utilizing performance guarantees should include in their local zoning, PUD, condominium, or subdivision ordinances standards that have been predefined to guide these guarantees. These standards will define timelines for project completion and the resulting penalties if the predetermined standards are not met. If the project is completed to the satisfaction of the municipality, then the guarantee will be released in full in a timely manner. If the developer does not fulfill the specified obligation, then the municipality may obtain the guaranteed funds and hire its own contractor to complete the project.

It is important to establish reasonable and accurate estimates of the value of the improvements when determining the amount of the guarantee.

Predefined Standards May Include:

- Protected areas during and after construction
- Stormwater management
- Project completion deadlines
- Penalties



Environmental Planning in Public Infrastructure Projects

As communities grow, it is usually necessary to upgrade and expand public infrastructure. One of the responsibilities of local government is to plan to improve public infrastructure with an eye to directing growth into areas that will have the least environmental impact. Some of the most common growth-inducing actions that local governments undertake are road building and widening, sewerage, water main construction, and siting the locations of schools. Typically, these growth-inducing actions lead to subdivision and commercial development. Consideration of the location of wetlands and water resources during master planning can help direct growth-inducing activities away from environmentally sensitive landscapes.

Of all infrastructure improvements, sewer expansion has the greatest potential to have environmental impact when it comes to wetlands. Often times the only factor limiting building in wetlands is the inability to site fully functioning septic systems. When sewers are installed in areas with a high water table and abundant wetlands – areas considered unsuitable for on-site septic disposal – it tends to direct development into those areas.

Many Michigan communities, due to their small size or limited institutional capacity, lack any type of comprehensive planning and zoning that can help direct and control growth. In those communities it is commonly the development of a public infrastructure plan that determines where community growth will occur. In other communities where a master plan exists, or is in the process of being developed, a sewer facility plan should be included in the master plan. The extent of municipal sewers should be determined in part by the need to protect drinking water, lakes, streams, and wetlands. Indeed, the protection of these water resources is the primary reason why sewers are established.



What do public infrastructure projects have to do with wetland protection at the local level?

Infrastructure typically induces residential and commercial development. Local government can plan and direct growth to areas that need infill and away from sensitive areas.

To Sewer or Not To Sewer

Below are considerations that should be taken into account when determining where future sewer projects should be allowed in areas where there is an abundance of water resources. (All conditions should be met.)

- There is an existing, documented waste treatment problem that cannot be solved by any other feasible and prudent on-site alternative.
- Dense development currently exists. More than 100 homes per mile and average lot size of less than 0.5 acres are standard criteria identified by the U.S. EPA.
- Areas that are environmentally sensitive (pertaining to water resources) are absent, or are identified and afforded adequate protection through deed restriction, zoning, or other types of protection methods.
- Sewage is treated using current best management practices, and the treated effluent is unlikely to have a negative impact on water resources in downstream communities.
- The diversion of water will not negatively impact the hydrology or ecosystem(s) in and adjacent to the newly sewered area.

By assuring that all these conditions are met, communities can help prevent negative water resource impacts that sewerage can create.



Partnerships Between Local Units of Government and Landowners

Because of their love for the land, many property owners with wetlands want to permanently protect their property. Local governments can assist in this process by gaining a firm understanding of the many protection options that are available to private landowners. Donations or sale of property to a conservation organization, or the creation of what is known as a conservation easement, can effectively protect wetlands in perpetuity. In addition to benefiting individual property owners, local communities benefit from the voluntary and permanent protection of wetlands. Because of this, provisions in the tax codes allow for financial benefits in the form of income and property tax reductions.

Donation

With a land donation, the owner gives his or her land (or a specified part of it) to a qualified non-profit organization or governmental agency for conservation purposes. A donor's gift of land is tax deductible and each donation has different tax advantages for different individuals. Landowners considering donation of wetland property are encouraged to retain a tax attorney or accountant to analyze the tax consequences.

Conservation Easements

A conservation easement is a voluntary agreement that is used to transfer certain rights concerning the use of land to a qualified non-profit organization, governmental body, or other legal entity without transferring title to the land. In Michigan, Part 21 of the Michigan Natural Resources and Environmental Protection Act (Act 451 of 1994 as amended) (formerly the Conservation and Historic Preservation Easement Act; Act 197 of 1980), authorizes the creation of voluntary conservation easements. A conservation easement under this statute can provide limitations on the use of, or can prohibit certain acts on, a parcel of land. The easement is considered a conveyance of real property and must be recorded with the register of deeds in the appropriate county to be enforceable against a subsequent purchaser of the property. A common misconception about conservation easements is that the land must be open to public access. The public does not have access to property protected by a conservation easement unless the landowner who grants the easement specifically allows it.

To be eligible for a tax deduction, conservation easements must be granted in perpetuity by the landowner. Several tax benefits may be available to the grantor, including deduction of the value of an easement as a charitable contribution, as determined by the amount by which the easement reduces the market value of the property. In addition, the development restrictions placed on a property by a conservation easement may also result in reducing property taxes. As with land donations, if a conservation easement is considered, an attorney or accountant should be consulted for an analysis of possible tax benefits.

Deed Restrictions and Covenants

Deed restrictions are clauses placed in deeds restricting the future use of land. When property containing wetlands is transferred, deed restrictions can prohibit uses or activities by the new owners that would destroy, damage, or modify wetlands. A covenant is a contract between a landowner and another party stating that the landowner will use or refrain from using their land in a certain manner. Like a deed restriction, a covenant can require that landowners refrain from activities that will damage wetlands. Once placed in deeds, covenants become deed restrictions.

Although deed restrictions and covenants have been used across the country to protect wetlands, their use in Michigan is not as effective as conservation easements. Unlike a conservation easement that is granted to and signed by an organization that has a commitment and responsibility to resource protection, the enforcement of deed restrictions and covenants is less reliable. There is no continuity of oversight, unlike the continuous ownership of an easement holder. It is also relatively easy for a future landowner to petition the courts to vacate a particular deed restriction. Although it is theoretically possible to modify a conservation easement, many changes are prohibited by federal regulations where income tax deductions are involved and all signatories to the easement must agree to proposed changes. It is unlikely that a qualified organization would agree to modifications of a conservation easement that would result in adverse wetland impacts.

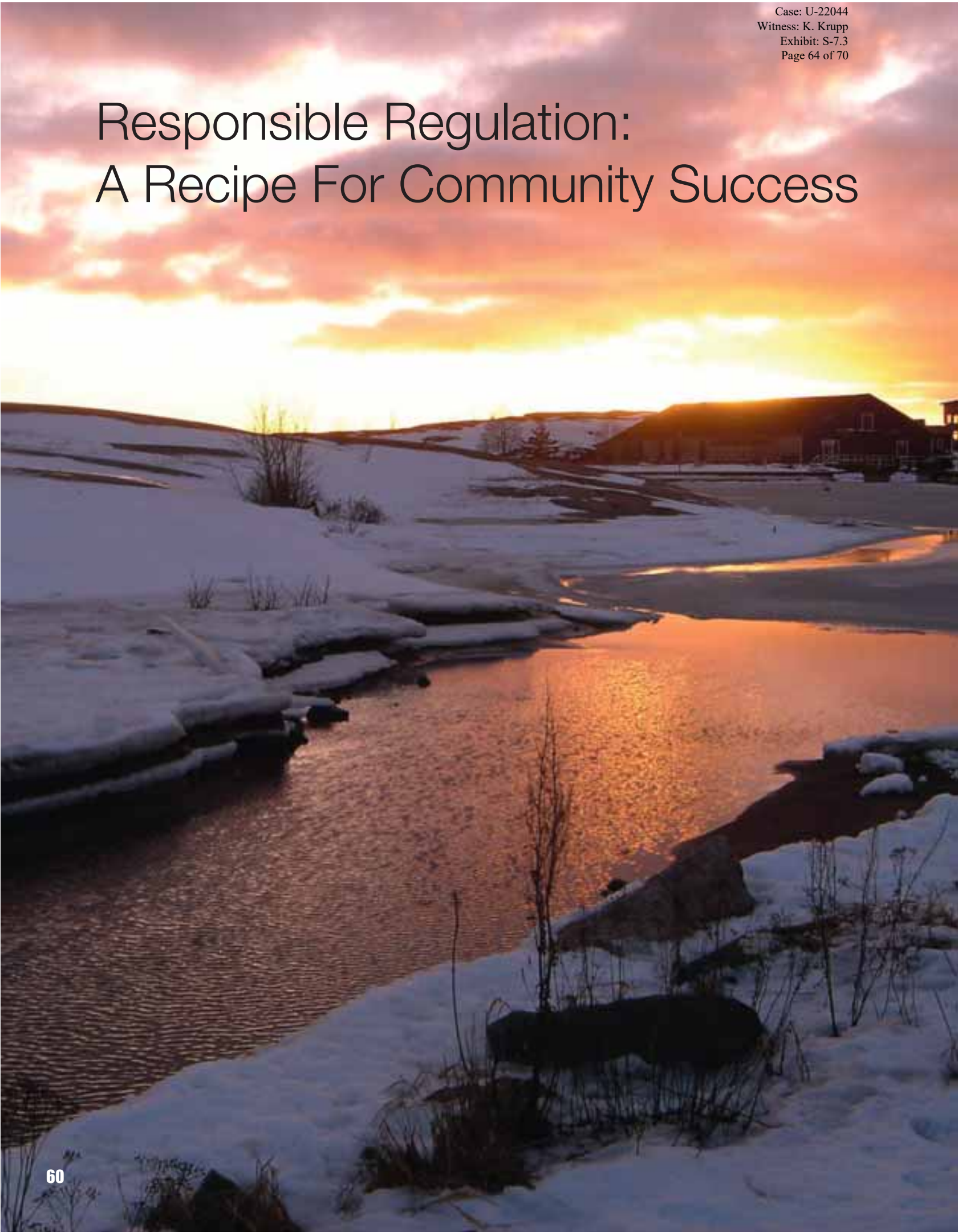
Purchase of Wetland Areas

Local units of government can acquire wetlands for floodplain protection, the development of greenways, and as part of a community-wide water quality protection program. If there is broad community support for land acquisition efforts, and at times an educational effort is needed to build support for funding such efforts, then the revenue can be generated through ballot proposals for specified land parcels, bond issuance, or millages/assessments.

For more information on opportunities for public-private partnerships in land protection in Michigan, visit the Heart of the Lakes Center for Land Conservation Policy website at www.heartofthelakes.org.



Responsible Regulation: A Recipe For Community Success



CHAPTER 6: Responsible Regulation: A Recipe for Community Success

For communities interested in protecting wetlands and other sensitive environmental features, there are strategies that should be helpful in successful passage and implementation of wetland regulations and ensuring that the long-term goal of wetland protection will stand up to legal challenge.

Wetland regulations attempt to navigate the sometimes rocky waters of determining where an individual's property rights end and where the public's interest in resource protection begins. An analogy that is sometimes helpful is the example of the fist and the nose: my individual "right" to swing my fist is restricted by my responsibility to respect your nose. In the terms of wetland regulation, the rights of a property owner to alter wetlands (dredge, fill, drain, etc.) is limited by the responsibility to act in a way that does not impact their neighbors or the larger community. Of course, there are situations when it is legally and morally acceptable for my fist to connect with someone's nose (e.g., self defense). Likewise, there are situations in which activities regulated by wetland laws are permitted to occur (e.g., when all less damaging alternatives have been utilized and impacts have been mitigated).



The Fifth Amendment of the U.S. Constitution provides in part: “nor shall private property be taken for public use, without just compensation.” This is known as the “Takings Clause.” The government’s physical invasion of private land, whether by roadway, public park, or for the construction of city hall, entitles the owner to “just compensation.” In our system, this private land owner’s loss has been compensated by the public treasury. The concept of “regulatory takings” is a relatively new legal concept. If a decline in property value results not from a physical invasion of the land, but rather from the enforcement of a regulation then this is called a regulatory taking.

If local environmental protection measures are carefully crafted and applied fairly, it is unlikely that a regulatory taking will occur. On the other hand, it is likely that a regulatory taking has occurred if the following two conditions have been met:

- The regulation does not substantially advance legitimate public interests.
- The regulation denies the landowner virtually all economical uses of the land.

Below are some of the most important considerations that will help ensure that a protection program will be fair, equitable, and legal.

Understand Your Options

Determine what’s best for your community based upon previous planning efforts, including such things as existing Master Plans or Comprehensive Plans. Understand exactly what wetland resources exist in your community, and solicit input from State and Federal Agencies that may have jurisdiction. Also, take stock of any available funding sources and make an attempt to gauge the political will so that educational efforts can be effective.



Establish Reasonable Goals

Any attempts to protect sensitive lands will fail if the goals and means to the goals are not viewed as reasonable. One way to ensure that a protection effort is reasonable is to clearly articulate exactly why the protection effort is necessary. In the case of wetland protection, efforts will be more likely viewed as reasonable if it is clearly understood that by protecting wetlands, the laws are protecting the public from harm from flooding, degraded water quality, and the loss of fisheries and wildlife.

Educate Your Community

Use various methods to bring about an understanding in the community about the functions, values, and benefits provided by wetlands. For example, wage a “coffee cup campaign,” use word of mouth and local newspapers to highlight these issues, and do a local inventory of wetland resources.

Involve the Public and Key Stakeholders to Build Community Support

Be sure to include members of the regulated community and all stakeholders, such as developers and contractors, realtors, river and/or lake associations, environmental groups, and citizens at large. Form an advisory committee to help with these effort. Issue public notices and have public meetings and hearings on all drafts of any ordinance or regulatory proposals. Reach out to all affected stakeholders and be sure to fully answer any questions that arise.

Make Sure Final Language is Legally Defensible

Utilize model ordinances that are available. Consult your municipal attorney as you proceed.

Implement and Administer Fully and Fairly

Enforcement and penalties are unpopular, but they are important, and consistency is crucial.

Maintain Economic Viability of Properties

Another aspect of reasonableness is the ability of a landowner to continue to utilize their land. If an aggrieved landowner believes that a government sponsored protection effort, or regulation, has removed the ability to utilize his or her land, then they may file a “takings” suit. As noted earlier, environmental regulations can generally stand the challenge of takings suits as long as the regulated property has not been deprived of all economic use.

How to Avoid a Regulatory Taking

- Carefully craft regulations with input from all community stakeholders
- Establish reasonable goals
- Maintain economic viability of properties (exemptions alone constitute economic viability of most properties)
- Consistently apply regulations
- Communicate and educate
- Review by municipal attorney

Open Communication Between Local Officials and Landowners

Maintaining open channels of communication between local officials and landowners is a way to ensure landowners are aware of the numerous land protection options available to them, and the economic and environmental purposes of the regulations. Local officials will benefit from open dialogue by gaining a better understanding of the needs of landowners.

Local Leadership

For local wetland protection to succeed, it requires the existence of local champions. Champions can be individuals from the local government or from any sector of the community. It is important that their opinions are respected by a broad range of citizens. Without the existence of local champions, attempts to establish protection programs will often languish, or existing programs will lack any enforcement efforts.

Public Support for Conservation

Wetland protection efforts require broad public support for them to be successful. Any type of regulation will ultimately fail if residents of the community do not understand and support the need for the protection effort.



Meanwhile, we welcome you to join the Local Government Wetland Network listserve..

- Share your experiences!
- Get your questions answered!
- Support others who are working to protect their community assets!

To join the listserve, called the Michigan Local Government Wetland Network (mlgowetnet), go to www.great-lakes.net. Select the Environment link, then e-mail lists, then private, then scroll down to "General Environment" where you will find "mlgowetnet." Click on that link for subscription information.

For additional information contact:

East Michigan Environmental Action Council

21220 West 14 Mile Road
Bloomfield Hills, MI 48301
(248) 258-5188
www.emeac.org

Tip of the Mitt Watershed Council

426 Bay Street
Petoskey, MI 49770
(231) 347-1181
www.watershedcouncil.org

Michigan Department of Environmental Quality

For Local Ordinance Questions
(517) 373-1170

For other wetland information:
1-800-662-9278

www.michigan.gov/deqwetlands



www.watershedcouncil.org

Protecting Michigan's Wetlands A Guide for Local Governments

ISBN: 978-1-889313-12-2

ACKNOWLEDGEMENTS



Exhibit S-7.4 PUBLIC: Staff's Fifth Discovery Request and Company

Response See Attachment A.

Exhibit S-7.4 PUBLIC

Attachment A: Staff's Fifth Discovery Request and Company Response

STATE OF MICHIGAN
BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter of the application of	)	
GLACIER MEADOWS SOLAR, LLC	)	
for a Renewable Energy or Storage	)	Case No. U-22044
Siting Certificate to construct a solar	)	
energy facility.	)	
_____	)	

**GLACIER MEADOWS SOLAR, LLC'S RESPONSE TO THE
MICHIGAN PUBLIC SERVICE COMMISSION STAFF'S
FIFTH DISCOVERY REQUEST**

Glacier Meadows Solar, LLC ("Glacier Meadows" or "Applicant"), for its Response to the Michigan Public Service Commission Staff's ("Staff's") Fifth Discovery Request to Glacier Meadows, states as follows:

PRELIMINARY STATEMENT

Glacier Meadow's Response ("Response") is based on its current knowledge, understanding, and belief as to the information and documents reasonably available to it as of the date of this Response.

Glacier Meadows Solar responds to Staff's Fifth Discovery Request without conceding objections to relevancy, materiality, or admissibility and without prejudice to Glacier Meadows' right to object to further inquiry concerning the subject matter of any response or the use of any information contained therein for any purpose. Glacier Meadows further reserves the right to amend and/or supplement its Response if it deems such amendment and/or supplementation to be appropriate.

By submitting its answers and responses, Glacier Meadows does not in any way adopt Staff's proffered definitions of words and phrases. Glacier Meadows objects to those definitions to the extent that they are inconsistent with (a) the ordinary and customary meaning of such words

and phrases, (b) the rules governing the permissible scope of discovery, or (c) the definitions set forth by Glacier Meadows in its response, if applicable, or otherwise.

Several of Glacier Meadows' objections may apply to one or more of Staff's requests. To avoid repetition of objections that apply to several of the requests, those objections are set forth fully below as General Objections.

Glacier Meadows' Response is made without waiving any of its objections, and Glacier Meadows reserves the right to amend and/or supplement its Response if additional facts and information become known to it during these proceedings.

Any statement herein agreeing to search for or produce documents in response to a request is not to be treated as an admission that responsive, non-privileged documents, in fact, exist.

GENERAL OBJECTIONS

1. Glacier Meadows objects to the requests to the extent that they are overly broad.
2. Glacier Meadows objects to the requests to the extent that they are unduly burdensome.
3. Glacier Meadows objects to the requests to the extent that they are vague and ambiguous and improperly require Glacier Meadows to speculate as to their meaning.
4. Glacier Meadows objects to the requests to the extent that they seek information, documents or materials that are privileged and protected from discovery or disclosure as attorney work product, as prepared in anticipation of litigation or for trial, by the attorney-client privilege, or are otherwise protected, exempt, or immune from discovery or disclosure. To the extent that any privileged or otherwise protected information, documents, or materials are disclosed or produced—whether inadvertently or otherwise—such disclosure or production shall not be deemed to constitute a waiver of any such privilege or protection.

5. Glacier Meadows objects to the requests to the extent that they seek information, documents, or materials that are highly proprietary and confidential, and/or are of a highly commercially-sensitive nature absent a protective order governing the disclosure of same.

6. Glacier Meadows objects to the requests to the extent that they seek information, documents or materials that were previously provided to Staff and/or which are currently in the knowledge, possession, custody, and/or control of Staff.

7. Glacier Meadows objects to each request to the extent that it goes beyond the scope of discovery permitted under applicable rules, orders, protocols, or law.

8. Glacier Meadows objects to each request, instruction, and definition to the extent it seeks to impose any duty or obligation beyond those authorized by applicable rules, orders, protocols, or law.

9. Glacier Meadows objects to any requests that seek the identification of “all” facts or information, or similar requests seeking “all” documents, because such requests are overbroad and may be premature. Glacier Meadows’ responses are as complete as current information and reasonable diligence permit. Some of the information responsive to such requests may not be fully known to Glacier Meadows at the time this Response is submitted.

10. As to the production of electronically-stored information (“ESI”), Glacier Meadows objects to the production of documents in true-Native format except for some media files, Excel and spreadsheet files, and/or other file formats not easily producible in near-Native TIFF images. Glacier Meadows will be producing documents in accordance with ESI best practices and subject to a mutually-agreeable production specification format, including load files specifications and producible metadata.

INTERROGATORIES AND REQUEST FOR PRODUCTION OF DOCUMENTS

Please refer to Exhibit A-6.2:

1. Please provide the product safety data sheet(s) (SDS) for photovoltaic modules to be installed in the proposed project area. If modules have not been procured yet, provide a sample or similar product SDS that is representative of the anticipated modules to be installed.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “to be installed,” “sample,” “similar,” “representative,” and “anticipated” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to this Request to the extent it seeks production of documents in a format inconsistent with ESI best practices or in a burdensome or inaccessible format.

Subject and without waiving any objections, Glacier Meadows states as follows: A product safety data sheet (“SDS”) is a document that provides detailed information about the potential hazards of a chemical, not equipment; therefore, SDS generally do not exist for photovoltaic modules. Glacier Meadows is producing herewith a sample environmental product declaration (industry equivalent of an SDS for equipment) representative of the anticipated modules to be installed. Refer to document Bates-labeled GlacierMeadows0000182 – GlacierMeadows0000190. Note photovoltaic modules have not yet been procured for the Project.

2. Please provide supporting evidence demonstrating that the panels are expected to pass Toxic Characteristic Leaching Procedure (TCLP) analysis.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “supporting evidence” and “pass” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Refer to document Bates-labeled GlacierMeadows0000191, which is being produced herewith and is a sample memo demonstrating that photovoltaic modules (representative of those anticipated to be installed) are expected to pass TCLP analysis.

3. Please verify whether the project includes any Waters of the United States (WOTUS) under the jurisdiction of the United States Army Corps of Engineers.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “includes” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows does include Water of the United States (“WOTUS”) under the jurisdiction of the United States Army Corps of Engineers (“USACE”). WOTUS are identified as “jurisdictional feature(s) under Section 404 of the CWA [Clean Water Act]” in Exhibit A-6.2, Attachment A under Sections 4.2.1 and 4.2.2.

Answering further, the Michigan Department of Environment, Great Lakes, and Energy (“EGLE”) has been granted administrative responsibilities over Section 404 of the Clean Water Act, which grants EGLE the opportunity to perform tasks related to Section 404 that are ordinarily delegated to the USACE. Federal review of WOTUS in EGLE permit

applications is waived unless alterations to critical environmental areas or major discharges into regulated wetlands are anticipated. Impacts to critical environmental areas and major discharges are not anticipated; thus, USACE review is not anticipated. More information on state and federal wetland regulations/permitting responsibilities can be found on EGLE's website: <https://www.michigan.gov/egle/about/organization/water-resources/wetlands/state-and-federal-wetland-regulations>.

Please refer to Exhibit A-6.3:

4. Please indicate whether the Applicant has verified if the project triggers applicability for a Clean Water Act Section 401 Water Quality Certification as listed in Exhibit A-6.3, Table 1.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “verified” and “triggers applicability” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows has not yet formally verified whether a Clean Water Act Section 401 Water Quality Certification is needed. Glacier Meadows plans to verify this after its pre-application meeting with EGLE and after it has more detailed design from its Engineering, Procurement, and Construction (“EPC”) contractor, anticipated in Q4 2026.

Dated: June 23, 2026

Respectfully submitted,

GLACIER MEADOWS SOLAR, LLC

By: Ørsted Onshore DevCo, LLC, its sole member

By: Ørsted Onshore North America, LLC, its sole
member

/s/ Marla Korpar

Marla Korpar, Director of Development
Ørsted Onshore North America, LLC

DICKINSON WRIGHT PLLC

/s/ Salina M. Hamilton

Brandon C. Hubbard (P71085)

Ryan M. Shannon (P74535)

Salina M. Hamilton (P75296)

123 W. Allegan Street, Suite 900

Lansing, MI 48933

(517) 487-4724

Attorneys for Glacier Meadows Solar, LLC

ver1 2015



ENVIRONMENTAL PRODUCT DECLARATION

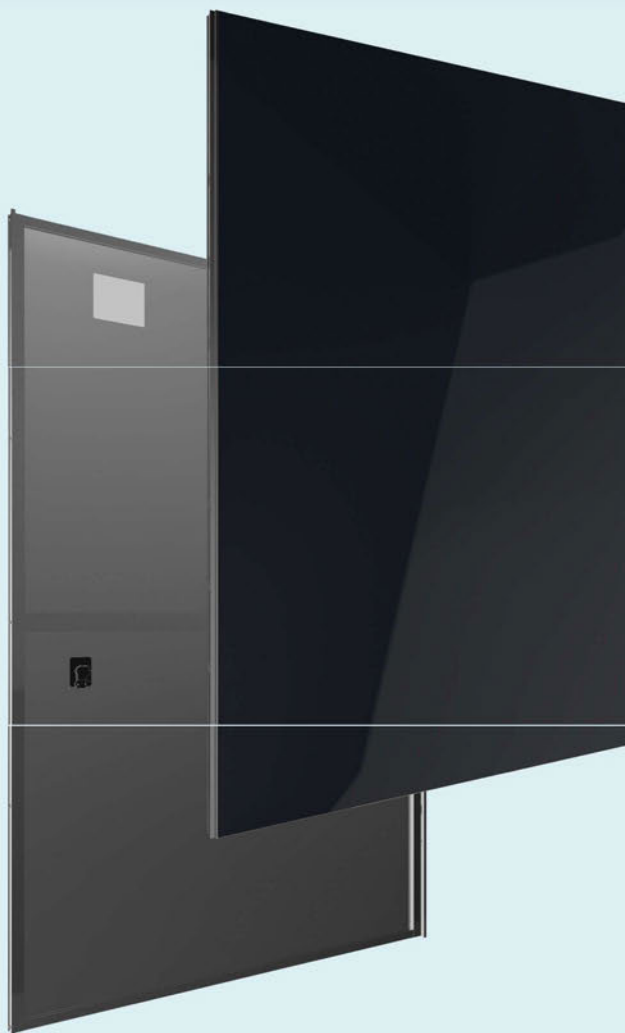
in accordance with ISO 14025, ISO 21930 and EN 15804

Owner of the declaration:	First Solar
Program operator:	The Norwegian EPD Foundation
Publisher:	The Norwegian EPD Foundation
Declaration number:	NEPD-2993-1671-EN
Registration number:	NEPD-2993-1671-EN
ECO Platform reference number:	-
Issue date:	06.08.2021
Valid to:	06.08.2026

Series 6 Photovoltaic Module

First Solar

www.epd-norge.no



General information

Product:

Series 6 Photovoltaic Module

Program operator:

The Norwegian EPD Foundation
P.O. Box 5250 Majorstuen, 0303 Oslo
Phone: +47 23 08 80 00
e-mail: post@epd-norge.no

Declaration number:

NEPD-2993-1671-EN

ECO Platform reference number:**Owner of the declaration:**

First Solar
Contact person: Parikhith Sinha
Phone: 1.480.619.3960
e-mail: parikhith.sinha@firstsolar.com

Manufacturer:

First Solar
350 W Washington St, Tempe, AZ 85281
Phone: 1.419.662.6899
e-mail: sustainability@firstsolar.com

Place of production:

Perrysburg, USA; Kulim, Malaysia; Ho Chi Minh City, Vietnam

Management system:

ISO 9001, ISO 14001, ISO 45001, EPEAT Silver

This declaration is based on Product Category Rules:

EN 15804:2012+A2:2019 serves as core PCR
NPCR Part A: Construction products and services, Version 2.0
NPCR 029:2020 Part B Version 1.1, Photovoltaic modules
used in the building and construction industry

Statement of liability:

The owner of the declaration shall be liable for the
underlying information and evidence. EPD Norway shall
not be liable with respect to manufacturer information, life
cycle assessment data and evidences.

Organisation no:

Not applicable

Issue date:

06.08.2021

Valid to:

06.08.2026

Declared unit:

1 Watt peak (Wp)*

Year of study:

2021

Declared unit with option:**Comparability:**

EPD of construction products may not be comparable if they
not comply with EN 15804 and seen in a building context.

Functional unit:

1 Wp*

*Life cycle impacts per initial Wp are scaled up by 7.5% to account for the
average long-term degradation of the PV module over the reference
service life (based on 0.5%/yr long-term degradation rate, 30 yr life).

Verification:

The CEN Norm EN 15804 serves as the core PCR.
Independent verification of the declaration and data,
according to ISO 14025:2010

☐ internal ☒ external

Third party verifier:

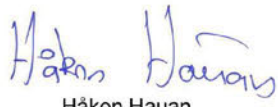

Joep Meijer, President of the Right Environment
(Independent verifier approved by EPD Norway)

The EPD has been worked out by:

Parikhith Sinha




Approved


Håkon Hauan
Managing Director of EPD-Norway

Product

Product description:

Series 6 PV modules are characterized by reliable performance in high temperature and humidity (IEC 61215, 61730; UL 1703, 61730), extreme desert (IEC 60068-2-68), and coastal applications (IEC 61701); high lifetime energy yield based on temperature coefficient, degradation rate, spectral response, and shading behavior; glass/glass construction with anti-reflective coating; under-mount frame; no losses from light induced degradation (LID) and light and elevated temperature induced degradation (LeTID); warranted against power loss from cell cracking; hail impact certification; global PV module recycling services.

Product specification:

Rated output: 420-450 Wp; number of PV cells: up to 264; yearly degradation rate: 0.5%/yr; technology: thin film CdTe

Materials	% by weight
Glass	84.3
Aluminum frame	11.3
Polyolefin encapsulant	2.7
Silicon-based frame adhesive	0.83
Thin film CdTe semiconductor	0.15
Polyphenylene junction box	0.13

Technical data:

<https://www.firstsolar.com/Modules/Series-6>

Parameter	Unit	Value
Module area	m ²	2.47
Module weight	kg	34.5
Average conversion efficiency*	kWp/m ²	0.176 (or 17.6%)

*17.0-18.2% conversion efficiency for 420-450 Wp

Market:

Europe

Reference service life (RSL), product:

30 years (LEIDOS, 2021)

Manufacturing process:

Manufactured under one roof with 100% traceable QA/QC
Semiconductor deposition, cell definition, and module finishing

LCA: Calculation rules

Declared unit:

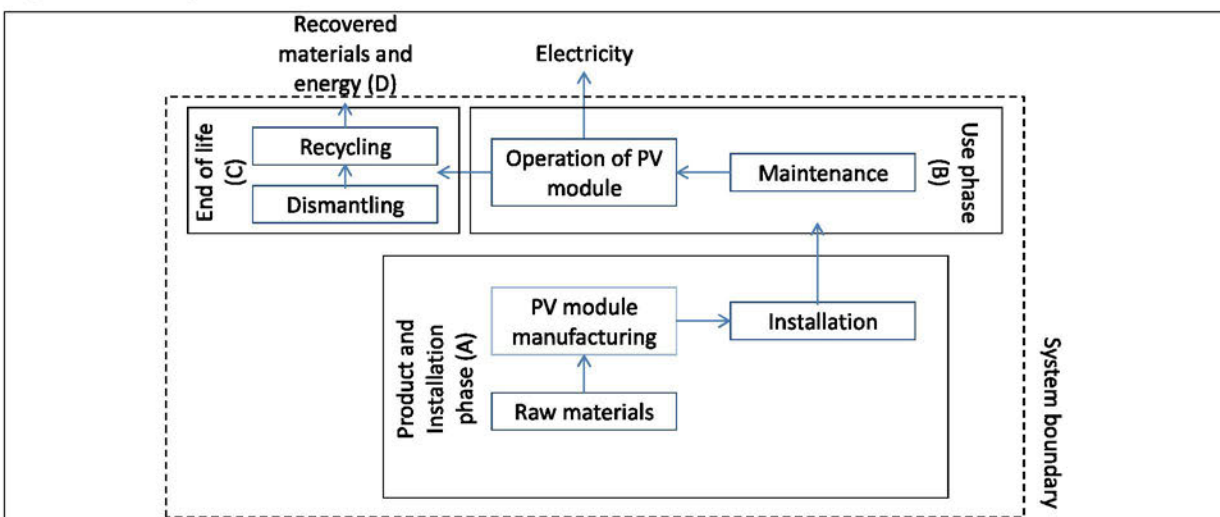
Wp

System boundary:

A1 – D (cradle-to-grave)

Module D includes net benefits from recycled materials and exported energy.

Figure 1. Product system of a First Solar Series 6 PV module



Data quality:

Primary data is from First Solar manufacturing facilities in year 2020 (annual average). Background data source: SimaPro 9.1.1 w/ Ecoinvent 3.6 (2019) "allocation, cut-off by allocation - unit" database. Inventory quantities have good or better data quality using pedigree matrix approach, and the Ecoinvent unit processes representing the quantities generally have fair or better data quality.

Allocation:

The allocation is made in accordance with the provisions of EN 15804. Allocation among multiple products is not necessary as the manufacturing facility only produces one product. Effects of primary production of recycled materials allocated to the main product in which the material was used. The recycling process and transportation of the material is allocated to this analysis.

Cut-off criteria:

All major raw materials and all essential energy are included. Strapping accounts for <1% of product packaging by mass and is not included. This cut-off rule does not apply for hazardous materials and substances. Long-term emissions (>100 years) are excluded and infrastructure processes are included.

LCA: Scenarios and additional technical information

The following information describe the scenarios in the different modules of the EPD.

The modules A1-A3 are the product stage from raw materials to manufacturing (cradle-to-gate).

Raw materials to manufacturing (A1-A3)

Production location	Proportion of Production	Electricity usage (kWh/m ²)	Natural gas usage (MJ/m ²)	Water usage (m ³ /m ²)
Malaysia (MY)	22.8%	21.7	0	118
USA	29.9%	22.6	6.31	61.0
Vietnam (VN)	47.2%	19.3	0	76.6

The module A4 refers to transport from the manufacturer to the European market via Rotterdam as receiving port.

Transport from production place to user (A4)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption	Value
Truck	50%	Euro6 16-32 MT lorry	1886	kg/tkm	0.04
Boat (MY production)	100%	Container ship	14783	kg/tkm	14
Boat (USA production)	100%	Container ship	6469	kg/tkm	14
Boat (VN production)	100%	Container ship	16546	kg/tkm	14

There is minimal energy and material use during PV module installation (A5), as balance of system components such as inverters, mounting, and cabling are not included in scope. Electricity use for power tools and lifting equipment is included, an installation breakage rate of 0.36% is assumed, and waste treatment of wood pallet is modeled as 75% recycling/25% incineration. There are no material or energy requirements during the use phase (B1) of the PV module.

Assembly (A5)

	Unit/m ²	Value
Auxiliary	kg	0
Water consumption	m ³	0
Electricity consumption	kWh	0.008
Other energy carriers	MJ	0
Material loss	m ²	0.0036
Output materials from waste treatment	kg	0.38
Dust in the air	kg	0

Use (B1)

	Unit	Value
None		

All modules in the use stage (B1-B7) have been assessed, but there are no impacts associated with this stage, except for maintenance (B2) and replacement (B4). There is typically no use of water for cleaning in the European market but water use for cleaning and associated wastewater treatment of the cleaning water is considered. There are no parts with reference service life shorter than the declared product. However, to account for potential PV module breakage during use, a 0.74% replacement rate over the reference service life (30 yrs) is considered, based on warranty breakage statistics.

Maintenance (B2)

	Unit/m ²	Value
Maintenance cycle	/yr	1
Auxiliary	kg	0
Other resources	kg	0
Water consumption over reference service life	L	20
Electricity consumption	kWh	0
Other energy carriers	MJ	0
Material loss	kg	0

Replacement (B4)

	Unit/m ²	Value
Replacement cycle	/yr	0.0333
Electricity consumption	kWh	0.008
Replacement of worn parts	m ²	0.0074

There is no operational electricity (B6) or water consumption (B7). Annual PV module electricity production is modeled over the reference service life (30 years) for an average European installation (1073 kWh/kWp), with values for some specific countries provided. Disassembly of PV modules (C1) is based on installation (A5). The EU WEEE Directive mandates recycling and prohibits disposal of end-of-life PV modules. Therefore, 100% recycling and no waste disposal of end-of-life PV modules (C4) is considered. There was no significant difference in impacts based on sensitivity analysis of PV module recycling rate (85% compared to 100%).

Operational energy (B6)

	Unit	Value
Water consumption	m ³ /m ²	0
Electricity consumption	kWh/m ²	0
Power output of equipment	kW	0.42-0.45
Average annual electricity production (France)	kWh/kWp	1068
Average annual electricity production (Italy)	kWh/kWp	1274
Average annual electricity production (Norway)	kWh/kWp	817

End of Life (C1, C3, C4)

	Unit/kg	Value
Hazardous waste disposed	kg	0
Collected as mixed construction waste	kg	0
Reuse	kg	0
Recycling	kg	1
Energy recovery	kg	0
To landfill	kg	0

Transport of end-of-life PV modules is modeled to First Solar's recycling facility in Frankfurt-Oder, Germany, which is an authorized waste management facility in accordance with the Ordinance on Specialized Waste Management Companies (EfBV). The products of recycling meet the depollution requirements in EN 50625-2-4:2017 and CLC/TS 50625-3-5:2017 under the collection, logistics & treatment requirements for the EU WEEE Directive, and therefore meet an end-of-waste state.

Transport to waste processing (C2)

Type	Capacity utilisation (incl. return) %	Type of vehicle	Distance km	Fuel/Energy consumption	Value
Truck (to collection point)	50%	Euro6 3.5-7.5 MT lorry	200	kg/tkm	0.11
Truck (to recycling facility)	50%	Euro6 16-32 MT lorry	2400	kg/tkm	0.04

The net avoided burdens related to glass, aluminum, semiconductor (PV module recycling) and wood (pallet recycling) are modeled, by accounting for the benefits of displacing primary production and the loads for secondary production (D).

Benefits and loads beyond the system boundaries (D)

Scrap	Input (kg/m2)	Primary content (%)	Input (primary; kg/m ²)	Output (primary; kg/m ²)	Net output (primary; %)*
Glass	1.18E+01	100	1.18E+01	1.06E+01	90
Frame	1.58E+00	26	4.11E-01	4.11E-01	100
Semiconductor	2.14E-02	100	2.14E-02	1.93E-02	90
Wood	3.75E-01	25	9.38E-02	7.03E-02	75

*Recycling yield

LCA: Results

Potential life cycle environmental impact according to EN 15804:2012+A2:2019 are provided per functional unit (Wp). Modules not shown (e.g., B1, B3, B5-B7, C4) are assessed but do not have non-zero results.

System boundaries (X=included, MND= module not declared, MNR=module not relevant)

Product stage			Assembly stage		Use stage							End of life stage				Beyond the system boundaries
Raw materials	Transport	Manufacturing	Transport	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Environmental impact per Wp

Parameter	Unit	Type	A1- A3 ³	A4 ³	A5	B2	B4	C1	C2 ⁴	C3 ⁴	D
AP	mol H ⁺ eq.	Core	2.04E-03	4.23E-04	1.05E-05	7.58E-07	2.00E-05	8.80E-07	1.21E-04	6.02E-05	-5.12E-04
GWP-total	kg CO ₂ eq.	Core	2.67E-01	3.78E-02	5.38E-03	1.21E-04	2.71E-03	1.56E-04	4.22E-02	1.98E-02	-9.69E-02
GWP-biogenic	kg CO ₂ eq.	Core	-4.22E-03	7.41E-06	3.93E-03	3.05E-05	8.33E-06	4.57E-06	2.19E-05	1.38E-03	2.97E-04
GWP-fossil	kg CO ₂ eq.	Core	2.71E-01	3.78E-02	1.44E-03	9.07E-05	2.69E-03	1.51E-04	4.21E-02	1.84E-02	-9.71E-02
GWP-luluc	kg CO ₂ eq.	Core	4.07E-04	1.72E-05	1.96E-06	8.84E-08	3.40E-06	3.51E-07	1.68E-05	2.03E-05	-1.56E-04
Eco-toxicity (freshwater) ²	CTUe	Additional	6.14E+00	4.43E-01	2.83E-02	3.19E-02	5.43E-02	2.13E-03	5.25E-01	2.83E-01	-2.25E+00
EP-freshwater	kg P eq.	Core	1.05E-05	2.99E-07	6.40E-08	1.14E-07	1.02E-07	1.61E-08	3.65E-07	2.62E-06	-2.51E-06
EP-marine	kg N eq.	Core	3.34E-04	1.00E-04	1.95E-06	2.51E-06	3.75E-06	1.12E-07	2.35E-05	1.28E-05	-1.24E-04
EP-terrestrial	mol N eq.	Core	3.98E-03	1.11E-03	2.27E-05	1.84E-06	4.36E-05	1.38E-06	2.64E-04	1.31E-04	-9.02E-04
Human toxicity, cancer ²	CTUh	Additional	2.17E-10	1.51E-11	9.90E-13	3.49E-13	1.92E-12	5.51E-14	1.54E-11	1.15E-11	-8.39E-11

Human toxicity, non- cancer	CTUh	Additional	4.06E-09	4.15E-10	2.11E-11	9.85E-12	3.83E-11	1.88E-12	5.46E-10	1.66E-10	-1.82E-09
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Environmental impact per Wp (continued)

Parameter	Unit	Type	A1- A3 ³	A4 ³	A5	B2	B4	C1	C2 ⁴	C3 ⁴	D
Ionizing radiation, human health ¹	kBq U235 eq.	Additional	8.83E-03	2.25E-03	7.57E-05	8.58E-06	1.06E-04	2.72E-05	2.77E-03	8.53E-04	-1.77E-03
Land use related impacts/ Soil quality ²	dimensionless	Additional	1.73E+00	2.94E-01	9.55E-03	4.72E-04	1.85E-02	7.60E-04	4.17E-01	5.03E-02	-3.19E-01
ODP	kg CFC 11 eq.	Core	1.95E-08	8.03E-09	1.44E-10	7.07E-12	2.75E-10	1.28E-11	9.47E-09	1.40E-09	-5.97E-09
Particulate Matter emissions	Disease incidence	Additional	2.23E-08	2.04E-09	1.01E-10	6.12E-12	2.04E-10	2.31E-12	2.53E-09	2.88E-10	-5.55E-09
POCP	kg NMVOC eq.	Core	1.04E-03	3.09E-04	6.04E-06	3.76E-07	1.17E-05	3.49E-07	1.01E-04	2.97E-05	-2.44E-04
ADP-fossil ²	MJ	Core	3.24E+00	5.37E-01	1.92E-02	1.22E-03	3.40E-02	3.12E-03	6.34E-01	2.61E-01	-9.06E-01
ADP-minerals & metals ²	kg Sb eq.	Core	6.43E-05	8.09E-07	2.39E-07	1.87E-09	4.92E-07	1.10E-09	1.35E-06	1.38E-07	-2.82E-06
WDP ²	m ³	Core	7.54E-02	1.52E-03	3.54E-04	5.10E-03	6.57E-04	3.48E-05	1.89E-03	9.93E-03	-1.99E-02

AP = Acidification potential, GWP-fossil = Global Warming Potential fossil fuels; GWP-biogenic = Global Warming Potential biogenic; GWP-luluc = Global Warming Potential land use and land use change; Accumulated Exceedance; EP-freshwater = Eutrophication potential, fraction of nutrients reaching freshwater end compartment; EP-marine = Eutrophication potential, fraction of nutrients reaching marine end compartment; EP-terrestrial = Eutrophication potential, Accumulated Exceedance; ODP = Depletion potential of the stratospheric ozone layer; POCP = Formation potential of tropospheric ozone; ADP-minerals&metals = Abiotic depletion potential for non-fossil resources; ADP-fossil = Abiotic depletion for fossil resources potential; WDP = Water (user) deprivation potential, deprivation-weighted water consumption

1 - This impact category deals mainly with the eventual impact of low dose ionizing radiation on human health of the nuclear fuel cycle. It does not consider effects due to possible nuclear accidents, occupational exposure nor due to radioactive waste disposal in underground facilities. Potential ionizing radiation from the soil, from radon and from some construction materials is also not measured by this indicator.

2 - The results of this environmental impact indicator shall be used with care as the uncertainties on these results are high or as there is limited experience with the indicator.

3 - The product stage (A1-A3) and product transport (A4) LCIA results are based on the proportion of production in three manufacturing locations in year 2020 (29.9% U.S., 22.8%, Malaysia, 47.2% Vietnam). Sensitivity analysis of these proportions indicates a median coefficient of variation of 8% and 11%, respectively, in the LCIA results.

4 - The end-of-life stage (C) considers 100% recycling and no disposal of end-of-life PV modules in accordance with the EU WEEE Directive. In sensitivity analysis of the recycling rate with 85% recycling/15% landfill disposal, median differences in LCIA results compared to 100% recycling were -14% and -10% for C2 and C3, respectively.

Resource use per Wp

Parameter	Unit	A1- A3	A4	A5	B2	B4	C1	C2	C3	D
PERE	MJ	3.80E-01	5.48E-03	2.07E-03	2.11E-04	3.14E-03	6.03E-04	1.00E-02	2.88E-02	-8.26E-02
PERM	MJ	1.19E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	-1.19E-02
PERT	MJ	3.92E-01	5.48E-03	2.07E-03	2.11E-04	2.11E-04	6.03E-04	1.00E-02	2.88E-02	-9.45E-02
PENRE	MJ	3.24E+00	5.37E-01	1.92E-02	1.22E-03	3.40E-02	3.11E-03	6.34E-01	2.61E-01	-9.06E-01
PENRM	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PENRT	MJ	3.24E+00	5.37E-01	1.92E-02	1.22E-03	3.40E-02	3.11E-03	6.34E-01	2.61E-01	-9.06E-01
SM	kg	7.22E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
RSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NRSF	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
FW	m ³	1.80E-03	4.96E-05	1.01E-05	1.35E-05	1.64E-05	1.87E-06	7.09E-05	3.04E-04	-7.08E-04

PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Use of net fresh water

Waste per Wp

Parameter	Unit	A1- A3	A4	A5	B2	B4	C1	C2	C3	D
HW	kg	3.14E-05	1.18E-06	1.26E-07	1.77E-08	2.53E-07	2.07E-09	1.68E-06	7.45E-08	1.82E-05
NHW	kg	4.11E-02	1.97E-02	3.49E-04	3.08E-05	7.07E-04	1.05E-05	2.85E-02	5.11E-04	-1.22E-02
RW	kg	8.41E-06	3.58E-06	7.95E-08	6.70E-09	1.24E-07	2.22E-08	4.30E-06	2.36E-07	-2.16E-06

HW Hazardous waste disposed; NHW Non hazardous waste disposed; RW Radioactive waste disposed

Output flow per Wp

Parameter	Unit	A1- A3	A4	A5	B2	B4	C1	C2	C3	D
CR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MR	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.51E-02	0.00E+00
MER	kg	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
EEE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.94E-04
ETE	MJ	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.00E-03

CR Components for reuse; MR Materials for recycling; MER Materials for energy recovery; EEE Exported electric energy; ETE Exported thermal energy

Reading example: 9.00 E-03 = 9.00*10⁻³ = 0.00900

Figure 2. Main contributors to core and additional life cycle environmental impacts

Parameter	Type	Electricity (A3)	Glass (A1)	Aluminum (A1)	Copper (A1)	Sea transport (A2, A4)	Natural gas (A3)	Solid waste disposal (A3)	PV panel factory (A1)	Pallet (A1)	Tap water (A1)
AP	Core	X	X	X	X	X					
GWP-total	Core	X	X	X	X	X					
GWP-biogenic	Core	X	X					X	X	X	
GWP-fossil	Core	X	X	X		X					
GWP-luluc	Core	X									
Eco-toxicity (freshwater)	Additional	X	X	X	X		X	X			
EP-freshwater	Core	X		X							
EP-marine	Core	X	X	X		X					
EP-terrestrial	Core	X	X	X		X					
Human toxicity, cancer	Additional			X							
Human toxicity, non-cancer effects	Additional			X	X						
Ionizing radiation, human health	Additional	X									
Land use related impacts/ Soil quality	Additional								X		
ODP	Core			X		X					
Particulate Matter emissions	Additional	X	X	X							
POCP	Core	X	X			X					
ADP-fossil	Core	X	X	X		X					
ADP-minerals & metals	Core			X							
WDP	Core			X							X

Biogenic carbon content per Wp

Parameter	Unit	Quantity
In product	kg C	0.00E+00
In packaging	kg C	1.14E-03

Additional Norwegian requirements

Greenhouse gas emission from the use of electricity in the manufacturing phase

National production mix with import, at medium voltage (production of transmission lines, in addition to direct emissions and losses in grid) of applied electricity for the manufacturing process (A3; source: Ecoinvent 3.6).

National electricity grid	Amount	Unit
USA	0.577	kg CO ₂ -eq/kWh
Malaysia	0.848	kg CO ₂ -eq/kWh
Vietnam	0.480	kg CO ₂ -eq/kWh

Dangerous substances

- ☐ The product contains no substances given by the REACH Candidate list or the Norwegian priority list
- ☐ The product contains substances given by the REACH Candidate list or the Norwegian priority list that are less than 0,1 % by weight.
- ☐ The product contain dangerous substances, more then 0,1% by weight, given by the REACH Candidate List or the Norwegian Priority list.
- ☐ The product contains no substances given by the REACH Candidate list or the Norwegian priority list. The product is classified as hazardous waste (Avfallsforskriften, Annex III).

IEC 62474 declarable substances and substance groups	Amount
Cadmium compounds (>0.01% by weight)	0.15% by weight

Indoor environment

No tests have been carried out on the product concerning indoor climate - Not relevant

Carbon footprint

The product stage (A1-A3) carbon footprint is 0.267 kg CO₂-eq/Wp.

Bibliography

CENELEC TS50625-3-5	<i>Collection, logistics, and treatment requirements for WEEE – Part 3-5: Technical specifications for de-pollution – Photovoltaic panels.</i>
EN 15804:2012+A2:2019	<i>Sustainability of construction works - Environmental product declaration - Core rules for the product category of construction products</i>
EN 50625-2-4:2017	<i>Collection, logistics & treatment requirements for WEEE – Part 2-4: Treatment requirements for photovoltaic panels</i>
EU WEEE	<i>Directive 2012/19/EU of the European Parliament and of the Council of 4 July 2012 on waste electrical and electronic equipment (WEEE) (recast)</i>
IEC 60068-2-68:1994	<i>Environmental testing - Part 2-68: Tests - Test L: Dust and sand</i>
IEC 61215:2016	<i>Terrestrial photovoltaic (PV) modules - Design qualification and type approval</i>
IEC 61701:2020	<i>Photovoltaic (PV) modules - Salt mist corrosion testing</i>
IEC 61730-1:2016	<i>Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction</i>
IEC 62474:2018	<i>Material Declaration for Products of and for the Electrotechnical Industry</i>
ISO 14025:2010	<i>Environmental labels and declarations - Type III environmental declarations - Principles and procedures</i>
ISO 14044:2006	<i>Environmental management - Life cycle assessment - Requirements and guidelines</i>
ISO 21930:2007	<i>Sustainability in building construction - Environmental declaration of building products</i>
LEIDOS 2021	<i>Independent Engineer's Report – First Solar PV Technology Review Series 6 and Series 6 Plus Modules</i>
LCI/LCA Report Version 1.2	<i>First Solar Series 6 Photovoltaic Module</i>
NPCR Part A Version 2.0	<i>Construction products and services</i>
NPCR 029:2020 Part B Version 1.1	<i>Photovoltaic modules used in the building and construction industry</i>
UL 1703	<i>Standard for Flat-Plate Photovoltaic Modules and Panels</i>
UL 61730	<i>Standard for Photovoltaic (PV) Module Safety Qualification</i>

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EXHIBIT S-7.4 PAGE 19 OF 19
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Exhibit S-7.5: Resilient Connected Networks

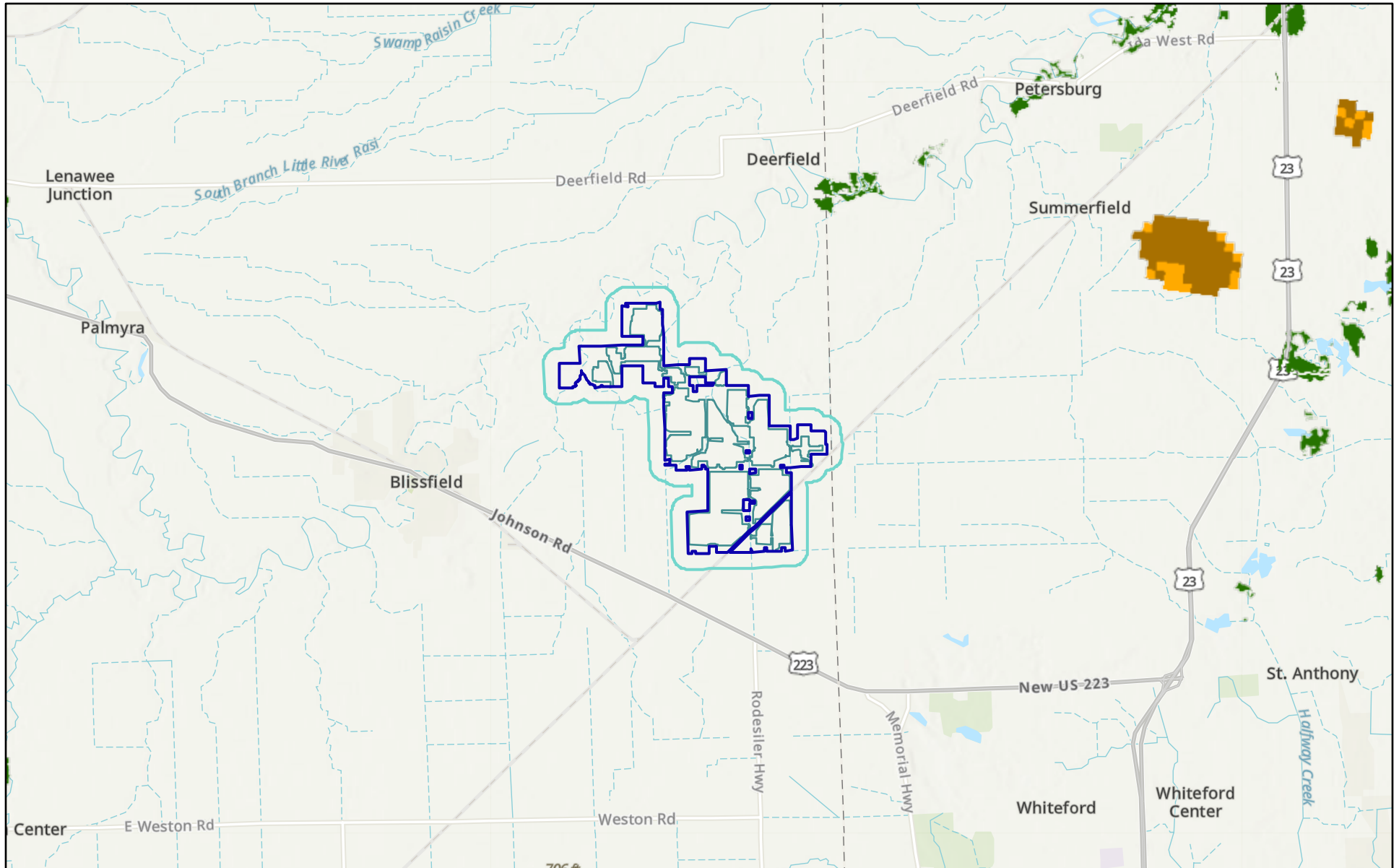
See Attachment A

Exhibit S-7.5

Attachment A: Resilient Connected Networks

U-22044 Glacier Meadows Project Area and Resilient Connected Networks

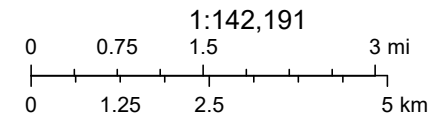
Case: U-22044
Witness: K. Krupp
Kit S-7.5
Page 3 of 3



6/24/2026

Resilient and Connected Network TNC Customized (Detailed)

- | | | |
|---|--|--|
| ■ Resilient, Diffuse Flow (Climate Informed), Recognized Biodiversity Value | ■ Mostly Resilient, Concentrated Flow, Recognized Biodiversity | ■ Restoration Sites |
| ■ Resilient, Diffuse Flow (Climate Informed) | ■ Mostly Resilient, Concentrated Flow | ■ Tribal lands excluded (pending review) |
| ■ Resilient, Diffuse Flow, Recognized Biodiversity | ■ Resilient Coastal Migration Space | ■ Project Boundary |
| ■ Resilient, Diffuse Flow | ■ Resilient, Recognized Biodiversity | ■ 1000ft Buffer Project |
| ■ Resilient, Concentrated Flow (Climate Informed), Recognized Biodiversity | ■ Additional Resilient Secured (GAP 3) | ■ 2026.05.11 Disturbance Limits |
| ■ Resilient, Concentrated Flow (Climate Informed) | ■ Flow and Recognized Biodiversity | ■ World_Hillshade |



Center for Resilient Conservation Science (CRCS), The Nature Conservancy,
Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap

Exhibit S-7.6 Midwest Conservation Blueprint

See Attachment A

Exhibit S-7.6

Attachment A: Midwest Conservation Blueprint

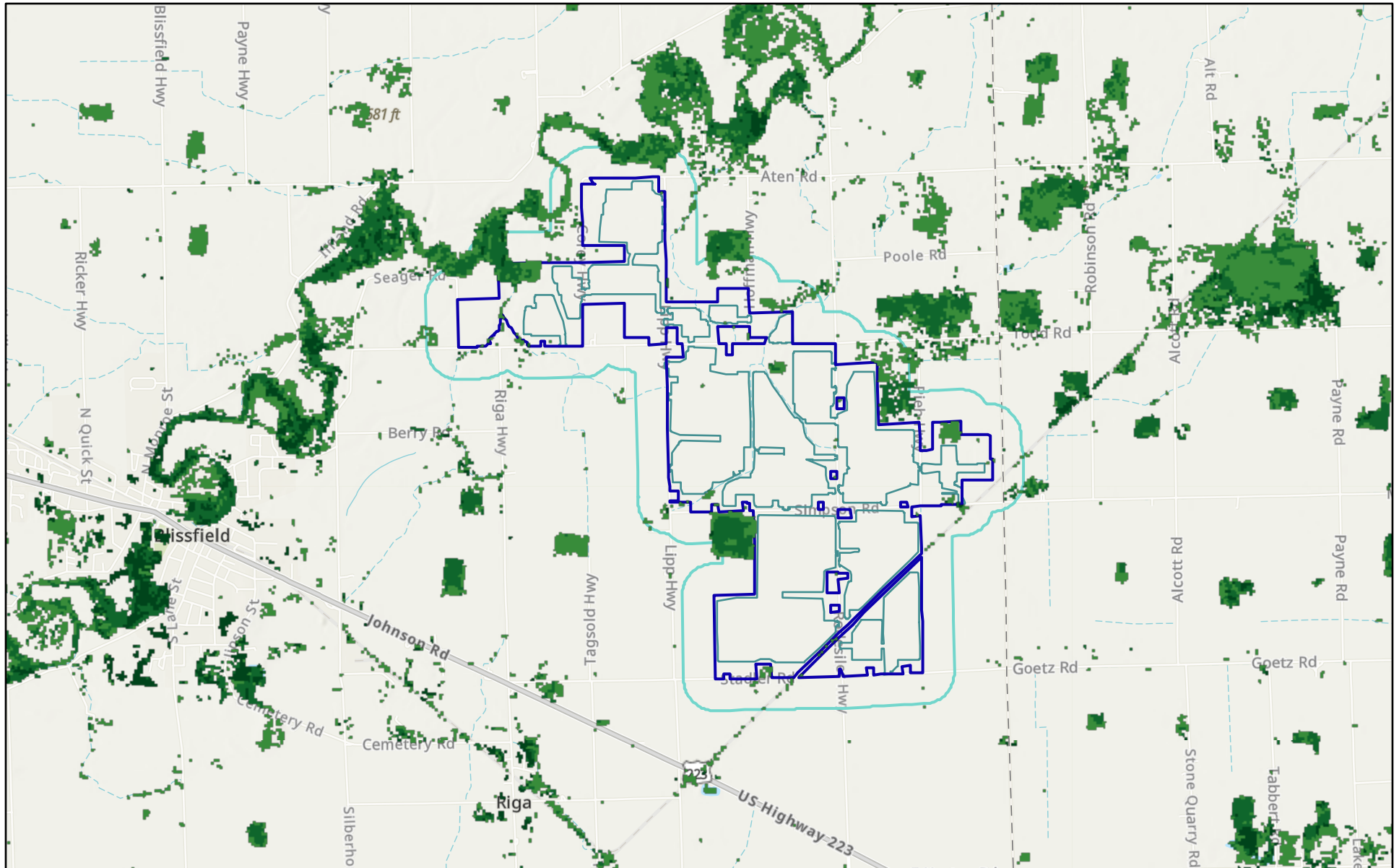
U-22044 Glacier Meadows and Midwest Conservation Blueprint 2026

U-22044

Witness: K. Krupp

Exhibit S-7.6

Page 3 of 3



6/24/2026

Midwest Conservation Blueprint 2026

Priority for Conservation
Medium Conservation Priority

High Conservation Priority

Highest Conservation Priority

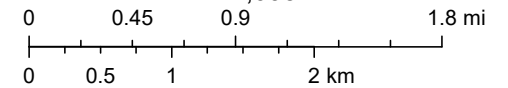
Project Boundary

1000ft Buffer Project

2026.05.11 Disturbance Limits

World_Hillshade

1:71,095



Sources: Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community, Esri, NASA, NGA, USGS, FEMA

Exhibit S-7.7: Staff's Third Discovery Request, Items 18, 19, and Company Response

18. Regarding historic and cultural sites, is the consultation with the State Historic Preservation Office (SHPO) expected to be completed prior to the closure of the evidentiary record (e.g. conclusion of cross-examination)?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "consultation," "expected," and "completed" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The timing and completion of SHPO consultation is dependent upon SHPO's review of the Project's archaeological report. If SHPO concurs with the results and recommendations within the archaeological report, then Glacier Meadows anticipates that SHPO consultation will be complete prior to the closure of the evidentiary record. If SHPO does not concur with the archaeological report and requires further field surveys or reporting, then SHPO consultation may continue past the closure of the evidentiary record.

19. Are determinations made by SHPO with respect to project impacts expected to be completed prior to the closure of the evidentiary record (e.g. conclusion of cross-examination)?

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “determinations” and “completed” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows incorporates its Response to Request No. 18 above.

Exhibit S-7.8: Staff's Ninth Discovery Request, Items 1 through 6, and Company Response

Please refer to Exhibit A-1.14:

1. Regarding the proposed 15-day turnaround time in which the State Historic Preservation Office (SHPO) and/or the Tribal Historic Preservation Office (THPO) must respond to Glacier Meadows in the event that a potentially protected cultural resource is discovered in the project area, please indicate whether SHPO and/or THPO have approved this requirement; if only one agency has approved, please specify which. Additionally, please state whether the Applicant would commit to a mutually agreed upon turnaround time if requested by SHPO and/or THPO.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “potentially protected,” “discovered,” “approved,” “commit” and “mutually agreed turnaround time” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: The proposed 15-day turnaround requirement has not been approved by SHPO and/or THPO; however, it represents an industry standard timeframe that Glacier Meadows will request SHPO and/or THPO adhere to when communicating. Glacier Meadows is requesting this timeframe to allow for construction to reasonably commence without significant delay due to lack of response. Glacier Meadows will consider alternative turnaround times requested by SHPO and or/THPO as necessary.

Please refer to Exhibit A-4.4 and Exhibit A-6.2:

2. Please provide evidence that the Applicant received concurrence from the Michigan Department of Natural Resources (MDNR) regarding the Applicant's position of "no impact" to state listed threatened or endangered species.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "evidence," "concurrence," and "position" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows refers to and incorporates by reference Exhibit A-4.4, Attachment A (particularly pages 107-108) and Attachment B, in its Application.

3. Please indicate whether a finalized archaeological survey report has been submitted to SHPO for review as of the date of the Applicant's response to this discovery request. If it has not, provide a timeline for when it is expected to be submitted.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "finalized," "submitted" and "timeline" are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: A finalized archaeological survey report was submitted to SHPO on May 27, 2026. On June 18, 2026, Dr. Sarah Surface-Evans from SHPO sent a memo requesting additional information needed to fully consider and address impacts on cultural and historic sites. On July 1, 2026,

Glacier Meadows submitted the requested additional information to SHPO. Glacier Meadows is awaiting final concurrence from SHPO. Refer to documents Bates-labeled GlacierMeadows0000470 – GlacierMeadows0000518 and GlacierMeadows0000519 – GlacierMeadows0000549, which are being produced herewith.

4. Regarding encroachment and crossing of pipelines within the project area, please provide a narrative and supporting documentation, such as survey(s), report(s), or application(s) (i.e. submittals to Panhandle Eastern Pipeline Company and Southern Michigan Pipeline) that consider and address the potential impact of the project activities on pipelines within the project area. Please include the planned setbacks from these pipelines, and any additional measures proposed to avoid, minimize, and mitigate impacts to the pipelines, the environment, and natural resources as a result of conducting project activities withing proximity of these pipelines.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “encroachment,” “narrative,” “supporting documentation,” “potential,” “pipelines,” “measures,” “proposed,” and “conducting” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Panhandle Eastern Pipeline Company (“Panhandle”): Glacier Meadows will comply with all Panhandle requirements to avoid, minimize, and mitigate impacts to the pipelines. This includes observing a setback from the pipelines in the placement and siting of project surface infrastructure and installing any underground electrical lines that cross the pipelines via horizontal directional drilling (“HDD”) or other trenchless installation methods. At the

request of Panhandle, Glacier Meadows conducted a field investigation to locate and record the depth of the pipelines in an effort to ensure that the Project's design meets Panhandle's requirements. Glacier Meadows refers to and incorporates by reference the supporting documentation (i.e. submittals to Panhandle Eastern Pipeline Company) previously provided in Exhibit A-4.4 in its Application.

Southern Michigan Pipeline ("Southern Michigan"): In conversations with Southern Michigan, the company confirmed that no subsurface utility engineering investigation was required by them. Southern Michigan agreed that they are comfortable moving forward with a Letter of No Objection that outlines all company requirements specific to setbacks, crossing depths, and any measures to mitigate impact to the pipeline. Glacier Meadows has provided Southern Michigan with its Letter of No Objection form so that they may list any measures that will be required of the Project at the crossing site. See also Exhibit A-4.4 in the Application.

Please refer to Exhibit A-14:

5. Regarding Condition No. 3, please confirm whether the Applicant's agreement to repair or replace all public and private drainage systems damaged during construction or decommissioning includes county and intercounty drains.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "agreement" is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Confirmed that Glacier Meadows' agreement to repair or replace all public and private drainage systems damaged during construction or decommissioning includes county and intercounty drains.

6. Regarding Condition No. 15, please confirm whether the Applicant's agreement to obtain all necessary applicable state, federal, and local permits also represents agreement to obtain necessary permits before beginning construction on the portion of the project for which the permit is necessary.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms "confirm," "agreement," "applicable," "obtain," "portion of the project," and "necessary" are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows:

Confirmed that Glacier Meadows will obtain and comply with all lawfully required permits and conditions of approval.

Exhibit S-7.9: Company's First Supplemental Response to Staff's Seventh Discovery Request, Items 19 and 21

19. Regarding Section 6.2, please confirm whether the project will comply with 2.11 of the Wildlife Conservation Order, under the Michigan Department of Natural Resources (MDNR), including whether prevention and response measures for entrapped or injured wildlife will be implemented, and whether the MDNR will be contacted if a large animal becomes entrapped by fencing.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “comply,” “prevention,” “response measures,” “entrapped,” “injured,” and “large animal” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: Section 2.11 of the Wildlife Conservation Order under MDNR is not believed to be applicable to the Project. The Glacier Meadows Project is a bulk electric system facility subject to NERC Critical Infrastructure Protection (“CIP”) standards, which establishes federal requirements governing physical security perimeter design, including fencing. Fencing design must first satisfy those federal standards. Further, Glacier Meadows has expressly consulted with MDNR (see Exhibit A-4.4) for recommendations and feedback including regarding fencing requirements that may be

applicable. Glacier Meadows is evaluating wildlife-friendly fencing measures in response to MDNR recommendations, including 8-foot minimum height and berms or other features to allow egress for entrapped deer. If a large animal becomes entrapped, Glacier Meadows will coordinate its response with MDNR. Regardless of the scope of Wildlife Conservation Order 2.11 as applied to utility infrastructure, Glacier Meadows is committed to implementing MDNR-recommended measures to the extent consistent with federal safety and security requirements.

21. Regarding Attachments A and C: Wetland Delineation and Habitat Assessment Reports, respectively, please verify whether the study area included parcels DEO-225-4700-00, DEO-225-4300-00, DEO-236-RAIL-00, and DEO-225-4800-00 (near where the existing substation is located). If so, please provide supporting evidence to resolve the apparent discrepancy between Figure 1 of the Wetland Delineation and Habitat Assessment (in Attachment A and C of Exhibit A-6.2, respectively) and the proposed project area as defined in Exhibit A-1.1 Site Plans. Provide supporting narrative for any other areas of the application that may need to be clarified in this regard. Snapshots with the apparent discrepancy indicated by a shaded green polygon with dotted border are provided below for your reference.



Exhibit A-1.1, Sheet C.100

Rev A: Exhibit A-6.2, Attachments A and C, Figure 1:1¹

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “study area,” “supporting evidence,” and “apparent discrepancy” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this

¹ Only one figure is provided here because the figures in each report appear identical.

Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: The discrepancy between the Study Area depicted in Figure 1 and the parcel coverage shown in Site Plan reflects the distinction between the wetland delineation and habitat assessment Study Areas and the overall Project Boundary.

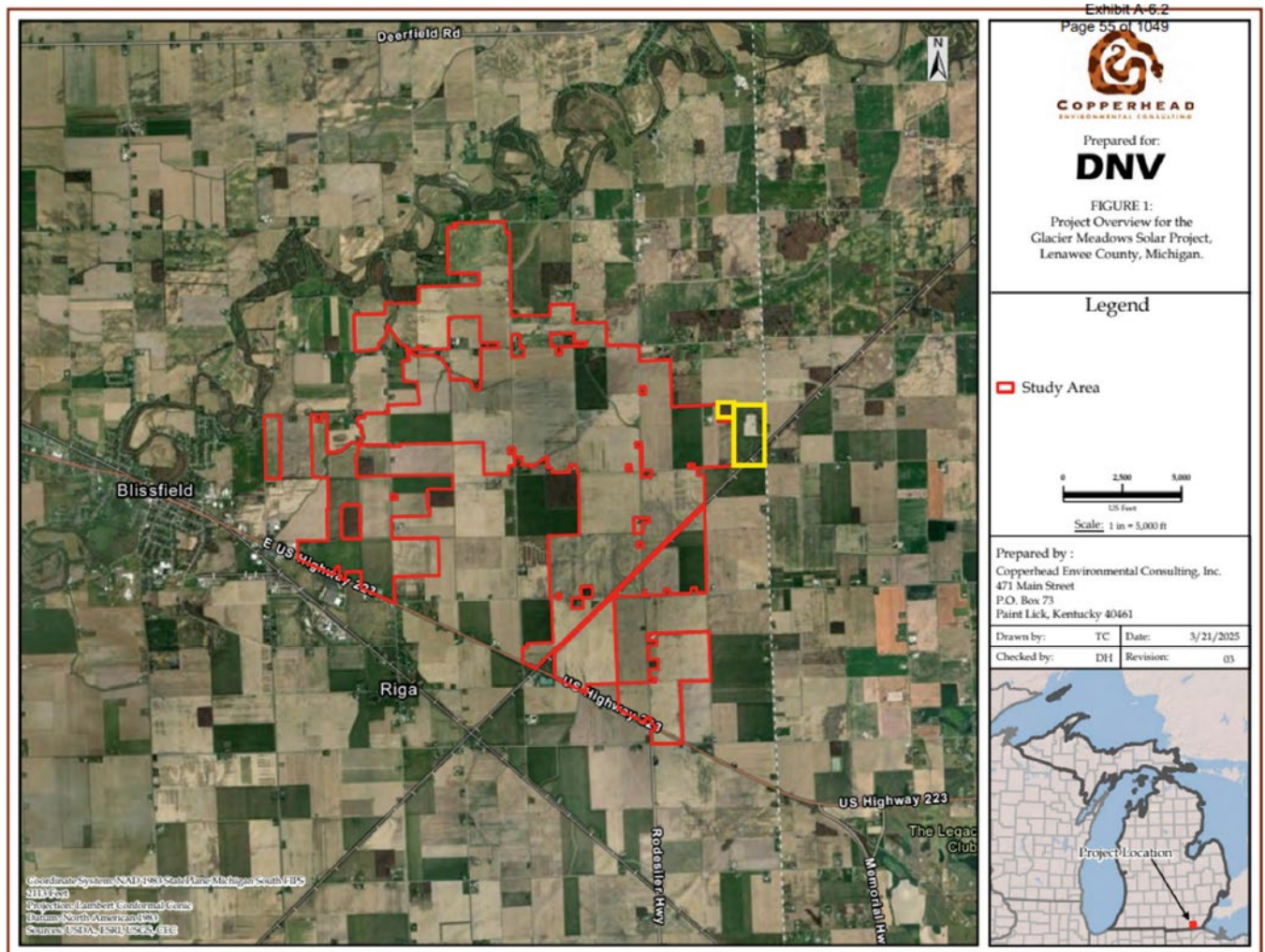


Figure 1 Study Area from Wetland Delineation Report

Figure 1 presents the wetland delineation Study Area, limited to areas outlined in red, which represent the portions of the Project evaluated during the wetland delineation and habitat assessment. The parcels highlighted in yellow (and shown in green in Figure 2) are included within the broader Project Boundary, but were not uniformly included in the delineation because they fall largely outside the Project's Limit of Disturbance (LOD). Additionally, parcels DEO-225-4700-00, DEO-225-4300-00, DEO-236-RAIL-00, and DEO-225-4800-00 were assessed as part of the 2022 habitat assessment (Figure 3). Parcel DEO-236-RAIL-00

is included in the Site Plan Project Boundary.

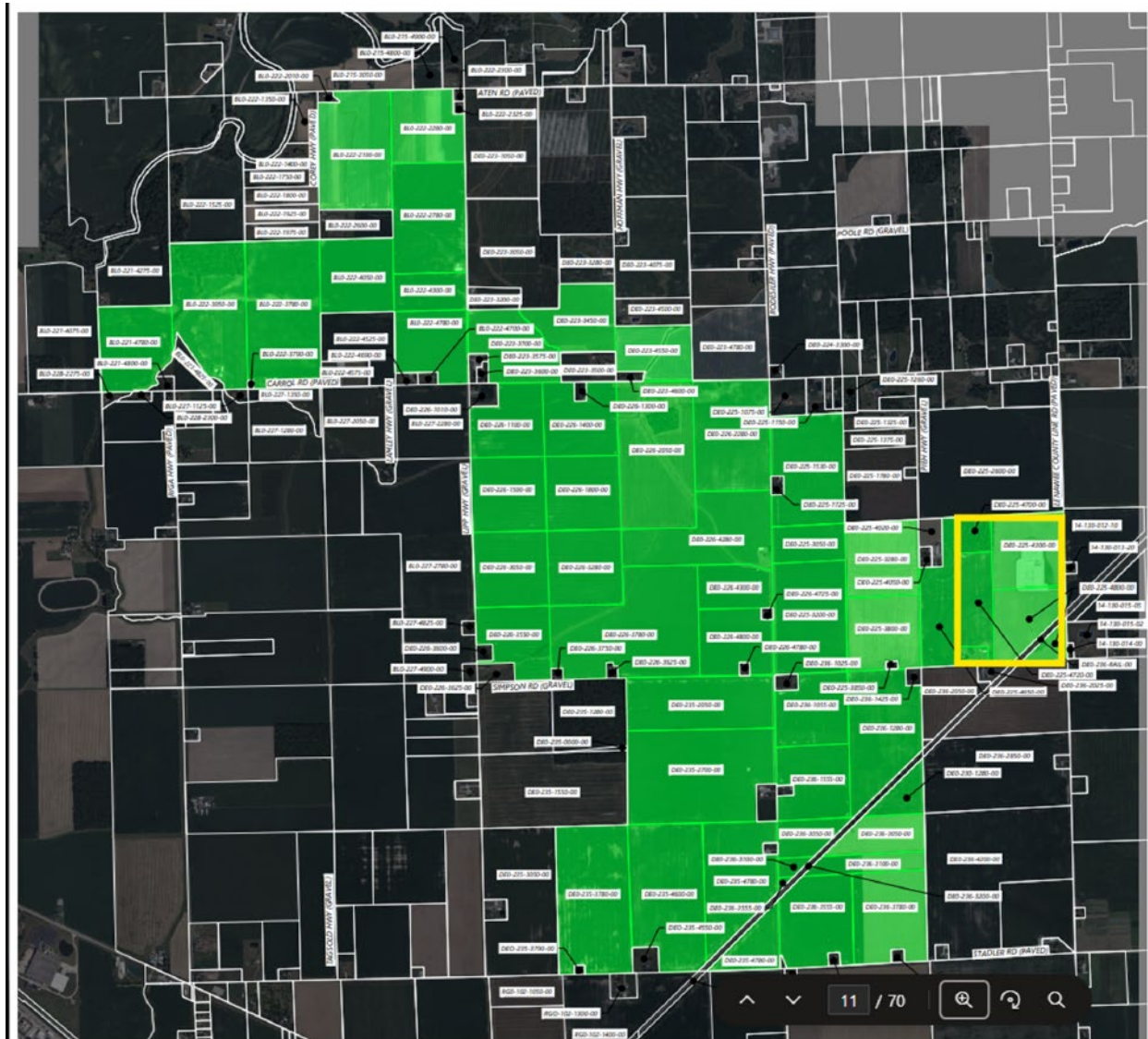


Figure 2 Project Boundary as shown in the Site Plan

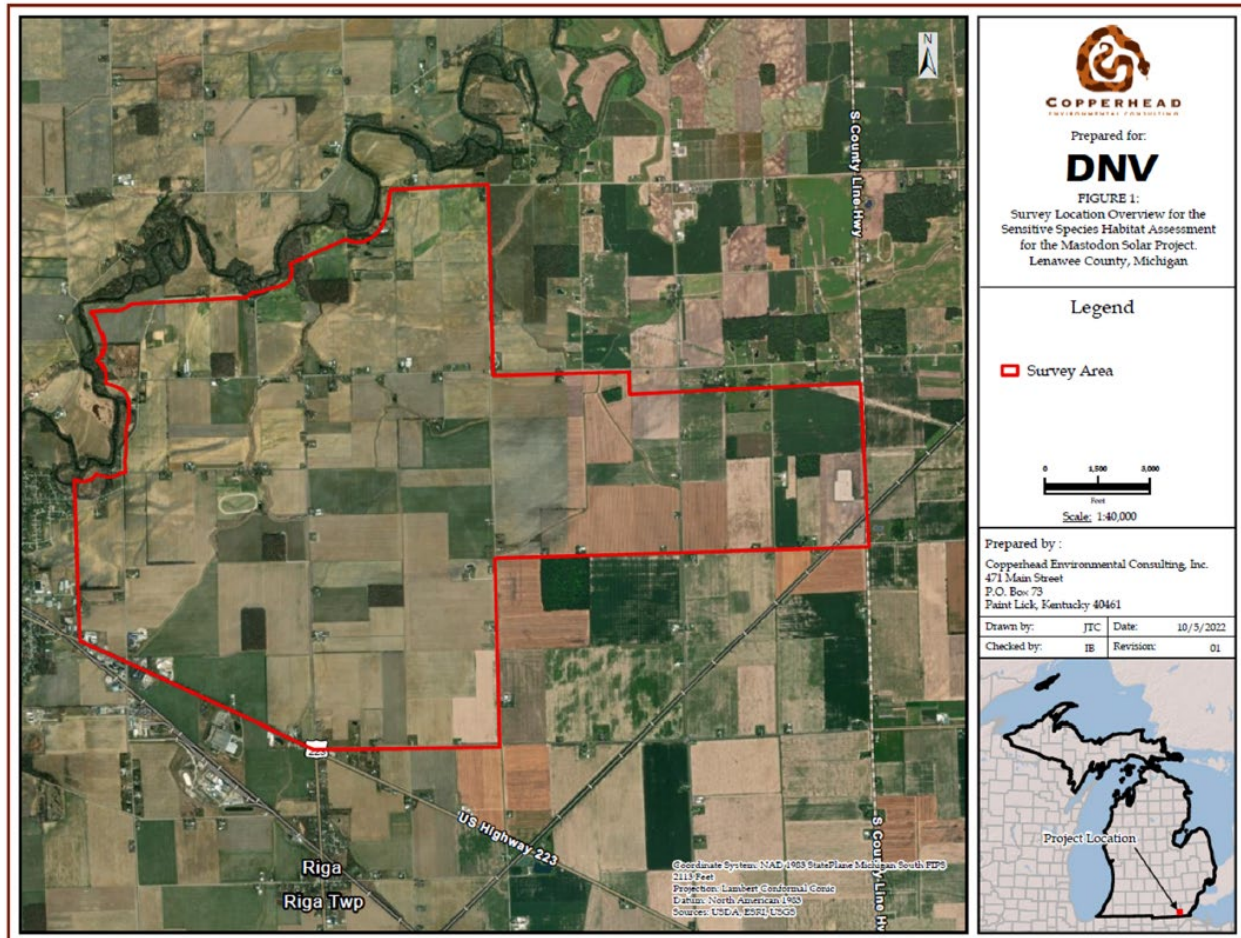


Figure 3 2022 Habitat Assessment Study Area

All areas with potential for disturbance were appropriately evaluated, as summarized below:

- Parcel DEO-225-4700-00 was considered during the wetland delineation and habitat assessment. This parcel was identified as a forested wetland exclusion area and is designated for complete avoidance; therefore, no impacts are proposed.
- Parcel DEO-225-4800-00 is intersected by the LOD only in a limited area. This portion was included in the 2023 desktop wetland delineation (Figure 3), and no wetlands were identified within the area of potential disturbance.

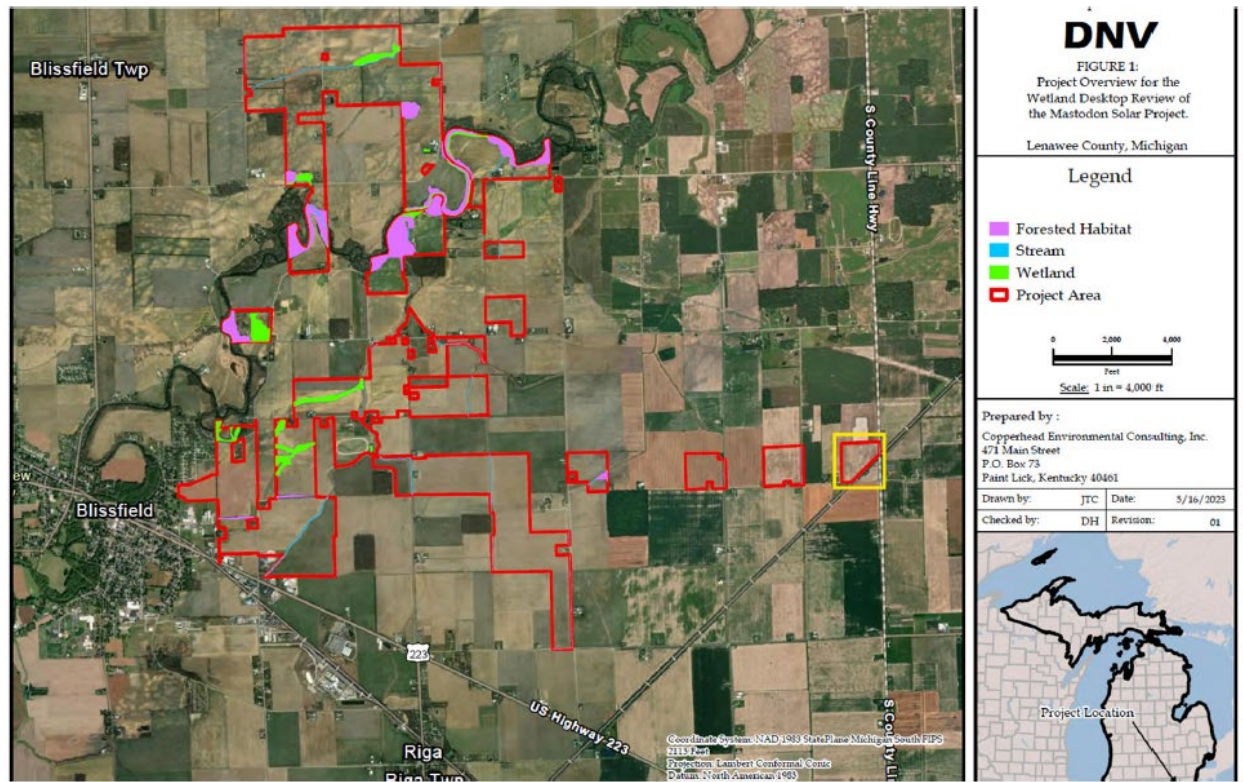
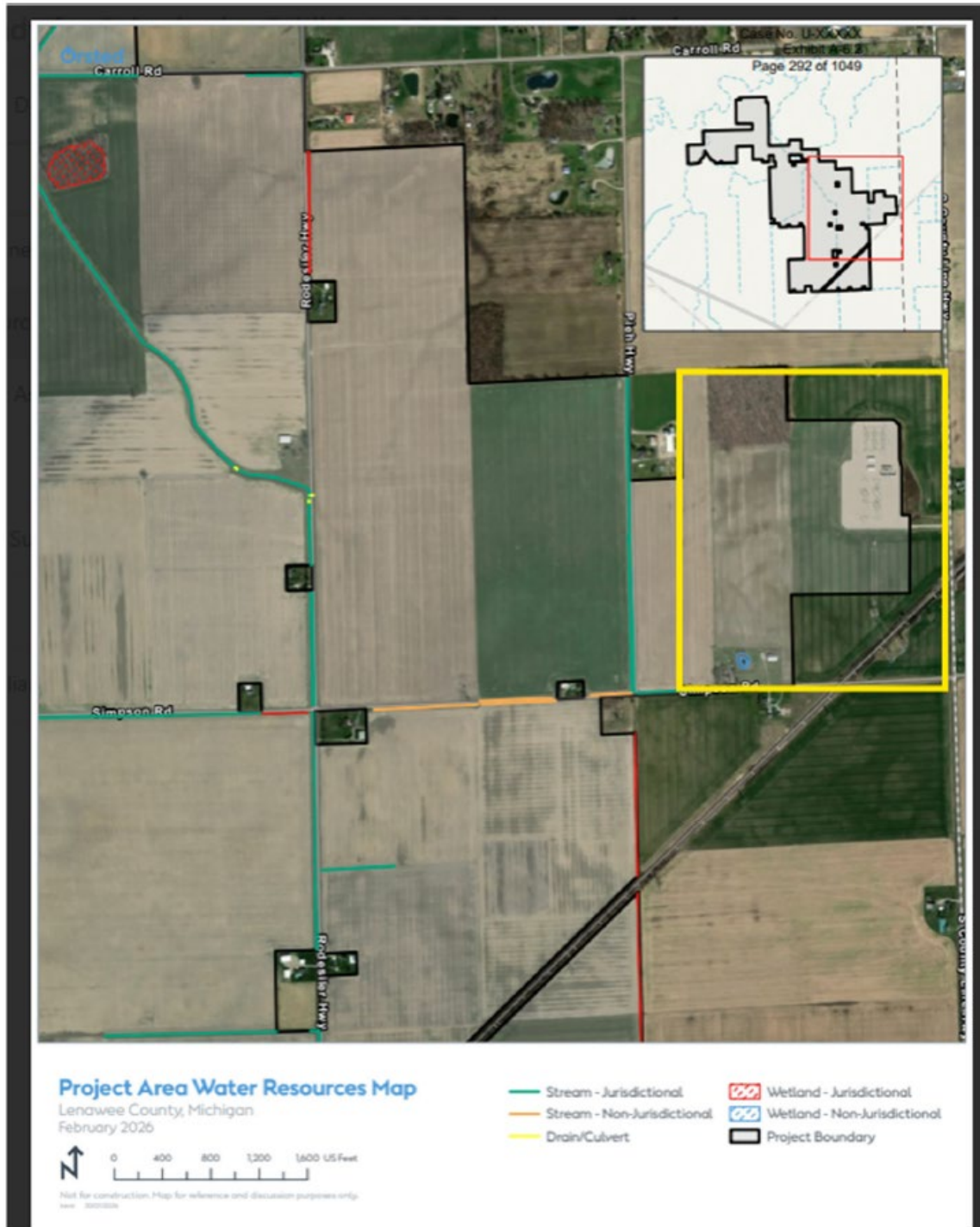


Figure 4 Study Area from 2023 Desktop Wetland Evaluation

The remaining portions of the yellow-highlighted parcels, including areas within Parcels DEO-225-4300-00 and DEO-225-4800-00, are located outside the LOD. These areas will not be impacted by Project activities and were, therefore, not subject to detailed field delineation, consistent with standard industry practice.

Additionally, Attachment B of Exhibit A-6.2 includes Parcels DEO-225-4700-00, DEO-225-4300-00, and a portion of DEO-225-4800-00, and confirms that no aquatic resources were identified within these parcels.



In summary, the wetland delineation and habitat assessment appropriately focused on areas within the LOD, and all areas with potential for impact have been evaluated.

Staff's Third Discovery Request to Item 25 and Company Response

Please refer to Exhibit A-8.1:

25. Please confirm whether the projections provided for this exhibit include any applicable administrative fees on all taxes paid.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “confirm,” “projects,” and “applicable administrative fees” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Based on a reasonable understanding of this Request as written, administrative fees (if applicable) were not expressly considered in the analysis in Exhibit A-8.1.

Staff's Third Discovery Request to Item 24 and Company Response

Please refer to Exhibit A-8.1:

24. Please provide a narrative detailing the next steps and timeline of applying for a Solar Energy Facility Exemption Certificate (SEFEC) for the project.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “narrative,” “detailing,” and “steps” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Utility scale solar energy generation facilities can often be eligible to apply for a Solar Energy Facility Exemption Certificate (“SEFEC”) that entitles a qualified facility to an exemption from ad valorem real property taxes for a term of up to 20 years. Glacier Meadows has not yet made any decision as to whether it will or will not seek to apply for an SEFEC for the Project.

Staff's Fourth Discovery Request to Items 5 and 6 and Company Response

Please refer to Exhibit A-8.3:

5. Please confirm that the Applicant will execute a Host Community Agreement with Lenawee County. If the Applicant is unable to do so, please confirm that the \$2,000.00 per megawatt of nameplate capacity payment would instead be issued to one or more community-based organizations within, or serve the residents of, Lenawee County.

RESPONSE: Glacier Meadows objects to this Request as the terms “unable to do so,” “issued,” and “serve” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Filing Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows confirms that it would be willing to sign a Host Community Agreement with Lenawee County, or a sufficient Community Benefits Agreement in lieu of such Host Community Agreement, if required by law or by the Commission as a certificate condition consistent with the requirements of Public Act 233.

6. Please provide a narrative of the good-faith negotiations between the Applicant and Lenawee County to execute a Host Community Agreement.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “narrative” is vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Filing Instructions and Procedures related thereto.

Subject to and without waiving any objections, Glacier Meadows states as follows: Good faith negotiations with Lenawee County are ongoing. On May 7, 2026, the Michigan Court of Appeals issued a decision in In re Implementing Provisions of Public Act 233 of 2023 suggesting that a non-zoning jurisdiction may nevertheless be considered an affected land unit (“ALU”) under Public Act 233 of 2023 (“PA 233”). This was a departure from the Michigan Public Service Commission’s October 10, 2024, Order and Application Filing Instructions and Procedures (“AFIP”). Although Glacier Meadows disagrees with the Court of Appeals decision, which is non-final and may be subject to further appeal, Glacier Meadows initiated good faith negotiations for a host community agreement (“HCA”) with Lenawee County on June 9, 2026 via email to Commission Chair Van Doren and on June 12, 2026 via email to Deputy Administrator Shannon Elliott and Administrator Kim Murphy. See documents Bates-labeled GlacierMeadows0000154 - GlacierMeadows0000170, which are being produced herewith. Glacier Meadows reserves all rights, defenses, or arguments with respect to HCA obligations under PA 233 and Commission Order. Glacier Meadows has not received a response to its outreach emails regarding good faith negotiations for an HCA.

Glacier Meadows remains committed to good faith negotiations with Lenawee County regarding an HCA. As set forth in Response to Request No. 5 above, however, Glacier Meadows commits to entering into a qualifying Community Benefits Agreement, in the alternative and consistent with Public Act 233 and Commission Order, if required as a condition to a certificate in this matter it is unable to reach an agreement as to an HCA with Lenawee County.

GlacierMeadows0000154_0000155.pdf

Message

From: Patrick Kunc [PATKU@orsted.com]
Sent: 6/12/2026 9:19:09 PM
To: kim.murphy@lenawee.mi.us; shannon.elliott@lenawee.mi.us
Subject: Glacier Meadows Solar, LLC - Host Community Agreement

Shannon and Kim,

Following up on the MPSC technical hearing today for our Glacier Meadows project I wanted to send along the information about the Host Community Agreement. Below is the email I previously sent to Commissioner Van Doren and permitting schedule.

Schedule Milestones	Dates
Staff and Intervenor Testimony	July 15, 2026
Rebuttal Testimony	August 12, 2026
Motions to Strike	August 21, 2026
Responses to Motions to Strike	August 28, 2026
Cross-Examination	August 31 – September 3, 2026, 10:00 am (via Microsoft Teams)
Briefs	October 13, 2026
Reply Briefs	November 10, 2026
Proposal for Decision Target Date	December 8, 2026

If you click this link it should take you to our project's application at the MPSC.

[Filing: U-22044-0001](#)

Please let me know if you need anything else or have any questions.

Thanks

Best regards,
Patrick Kunc
Sr. Manager, Project Development
Project Development, MISO
Commercial

Tel. +19189141004
patku@orsted.com



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Austin, TX 78701

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From: Patrick Kunc
Sent: Tuesday, June 9, 2026 1:36 PM

To: comm.vandoren@lenawee.mi.us
Subject: Glacier Meadows Solar, LLC - Host Community Agreement

Commissioner Van Doren,

As you may be aware, Glacier Meadows Solar, LLC is applying for a State Siting Certificate at the Michigan Public Service Commission for a utility-scale solar energy facility (Case No. U-22044). While it is our understanding that the County does not exercise zoning jurisdiction and has not enacted a compatible renewable energy ordinance under Public Act 233, on May 7, 2026, the Michigan Court of Appeals issued a decision in *In re Implementing Provisions of Public Act 233 of 2023* suggesting that a non-zoning jurisdiction may nevertheless be considered an affected land unit ("ALU") under Public Act 233 of 2023 ("PA 233"). This was a departure from the Michigan Public Service Commission's October 10, 2024, Order and Application Filing Instructions and Procedures ("AFIP").

Although the Project disagrees with the Court of Appeals decision, which is non-final and may be subject to further appeal, and without waiving the Project's rights, defenses, or arguments, we would be pleased to meet with you either virtually or in person to further discuss the site plan for the proposed project and discuss a potential host community agreement ("HCA"). We look forward to hearing from you. We appreciate the County's engagement throughout this process and look forward to continuing to work together as the proceeding moves forward. If you have any questions please don't hesitate to ask.

Thanks

Best regards,
Patrick Kunc
Sr. Manager, Project Development
Project Development, MISO
Commercial

Tel. +19189141004
patku@orsted.com



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Austin, TX 78701

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GlacierMeadows0000156.pdf

Message

From: Patrick Kunc [PATKU@orsted.com]
Sent: 6/9/2026 6:36:24 PM
To: comm.vandoren@lenawee.mi.us
Subject: Glacier Meadows Solar, LLC - Host Community Agreement

Commissioner Van Doren,

As you may be aware, Glacier Meadows Solar, LLC is applying for a State Siting Certificate at the Michigan Public Service Commission for a utility-scale solar energy facility (Case No. U-22044). While it is our understanding that the County does not exercise zoning jurisdiction and has not enacted a compatible renewable energy ordinance under Public Act 233, on May 7, 2026, the Michigan Court of Appeals issued a decision in *In re Implementing Provisions of Public Act 233 of 2023* suggesting that a non-zoning jurisdiction may nevertheless be considered an affected land unit ("ALU") under Public Act 233 of 2023 ("PA 233"). This was a departure from the Michigan Public Service Commission's October 10, 2024, Order and Application Filing Instructions and Procedures ("AFIP").

Although the Project disagrees with the Court of Appeals decision, which is non-final and may be subject to further appeal, and without waiving the Project's rights, defenses, or arguments, we would be pleased to meet with you either virtually or in person to further discuss the site plan for the proposed project and discuss a potential host community agreement ("HCA"). We look forward to hearing from you. We appreciate the County's engagement throughout this process and look forward to continuing to work together as the proceeding moves forward. If you have any questions please don't hesitate to ask.

Thanks

Best regards,
Patrick Kunc
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Austin, TX 78701

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GlacierMeadows0000157_0000159.pdf

Message

From: Patrick Kunc [PATKU@orsted.com]
Sent: 6/12/2026 9:24:17 PM
To: kim.murphy@lenawee.mi.us; shannon.elliott@lenawee.mi.us
Subject: RE: Glacier Meadows Solar, LLC - Host Community Agreement
Attachments: GMS Technical Conference 6-12-26.pptx

Attached is the project presentation I shared on the call today.

Thanks

Best regards,
Patrick Kunc
Sr. Manager, Project Development
Project Development, MISO
Commercial

Tel. +19189141004
patku@orsted.com



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Austin, TX 78701

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From: Patrick Kunc
Sent: Friday, June 12, 2026 4:19 PM
To: 'kim.murphy@lenawee.mi.us' <kim.murphy@lenawee.mi.us>; 'shannon.elliott@lenawee.mi.us' <shannon.elliott@lenawee.mi.us>
Subject: Glacier Meadows Solar, LLC - Host Community Agreement

Shannon and Kim,

Following up on the MPSC technical hearing today for our Glacier Meadows project I wanted to send along the information about the Host Community Agreement. Below is the email I previously sent to Commissioner Van Doren and permitting schedule.

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Proposal for Decision Target Date	December 8, 2026

If you click this link it should take you to our project's application at the MPSC.

GlacierMeadows0000157

[Filing: U-22044-0001](#)

Please let me know if you need anything else or have any questions.

Thanks

Best regards,
Patrick Kunc
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Commercial

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patku@orsted.com



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To: comm.vandoren@lenawee.mi.us
Subject: Glacier Meadows Solar, LLC - Host Community Agreement

Commissioner Van Doren,

As you may be aware, Glacier Meadows Solar, LLC is applying for a State Siting Certificate at the Michigan Public Service Commission for a utility-scale solar energy facility (Case No. U-22044). While it is our understanding that the County does not exercise zoning jurisdiction and has not enacted a compatible renewable energy ordinance under Public Act 233, on May 7, 2026, the Michigan Court of Appeals issued a decision in *In re Implementing Provisions of Public Act 233 of 2023* suggesting that a non-zoning jurisdiction may nevertheless be considered an affected land unit ("ALU") under Public Act 233 of 2023 ("PA 233"). This was a departure from the Michigan Public Service Commission's October 10, 2024, Order and Application Filing Instructions and Procedures ("AFIP").

Although the Project disagrees with the Court of Appeals decision, which is non-final and may be subject to further appeal, and without waiving the Project's rights, defenses, or arguments, we would be pleased to meet with you either virtually or in person to further discuss the site plan for the proposed project and discuss a potential host community agreement ("HCA"). We look forward to hearing from you. We appreciate the County's engagement throughout this process and look forward to continuing to work together as the proceeding moves forward. If you have any questions please don't hesitate to ask.

Thanks

Best regards,
Patrick Kunc
Sr. Manager, Project Development
Project Development, MISO
Commercial

GlacierMeadows0000158

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Glacier Meadows Technical Conference - Agenda

- Welcome and Introductions
- Level Set on Current Stage of the Contested Case Process
- Applicant Overview of the Proposed Energy Generation Facility
- Break (if needed)
- Comments and Questions about the Proposed Energy Facility
 - By staff
 - By intervenors
- Closing Remarks & Next Steps
- Adjourn



Orsted Onshore

Onshore renewables

- Top 10 U.S. developer
- 6 GW of operational onshore wind, solar and battery storage projects
- Develop, operate and own onshore wind, solar PV and storage projects



Orsted



Development experience

Working with Landowners

We are a good steward of the land. With extensive experience in a variety of regions, land lease partners can be confident our projects will:

- Ensure the protection of roads
- Minimize impacts on neighbors
- Preserve the integrity of the soil and land



Working with Local Governments

A solar energy project can boost rural economies, which enhances the quality of life and opportunities in a community. With millions of dollars in new tax revenue (or directed payments in lieu of taxes) communities can:

- Build new school facilities
- Enhance roads and bridges
- Expand emergency services



Working with Local Communities

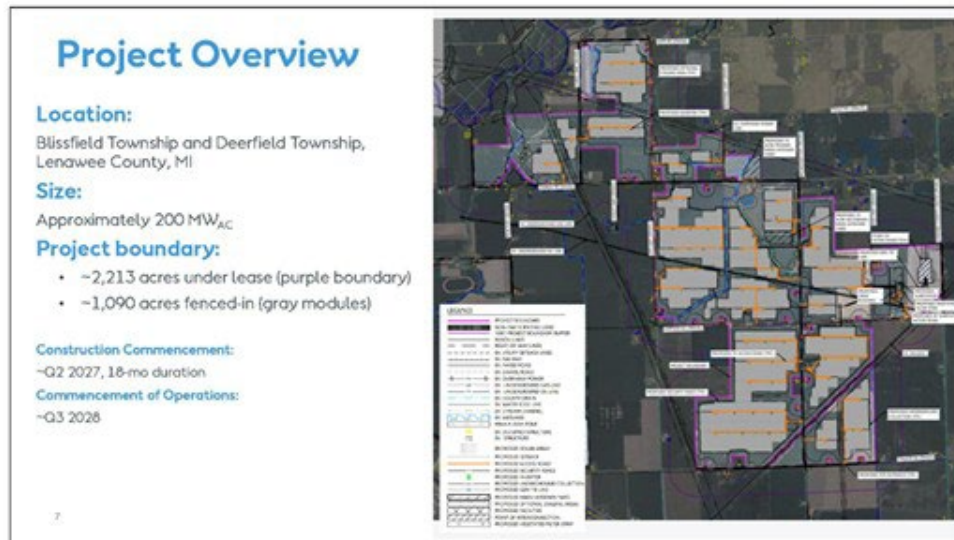
We are committed to being a good neighbor for years to come by listening to communities and supporting local causes.

Our Mockingbird Solar Center earned **Solar Ecosystem of the Year** at the 2025 North American Agrivoltaics Award for our 1,000-acre land conservation effort with The Nature Conservancy.



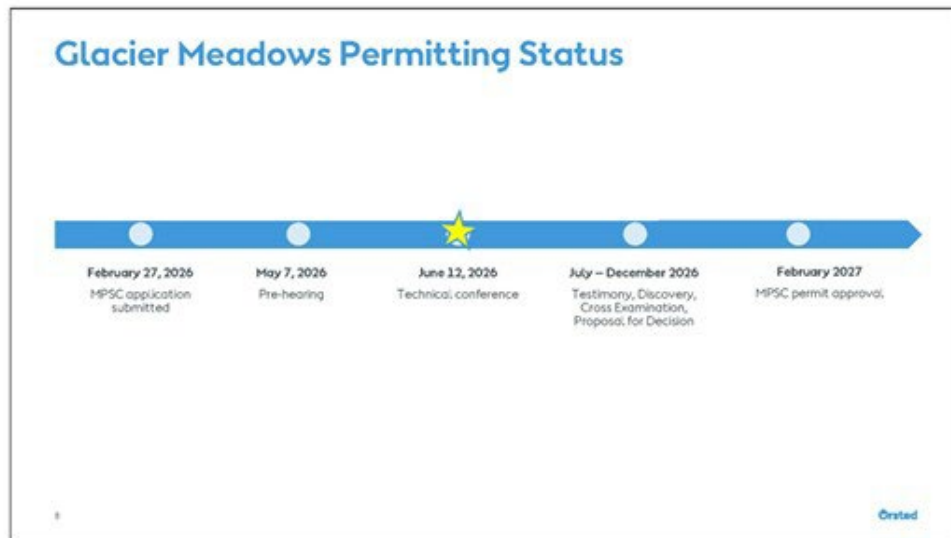
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Notes

200 MW = enough to power approx. 50,000 homes in Michigan annually





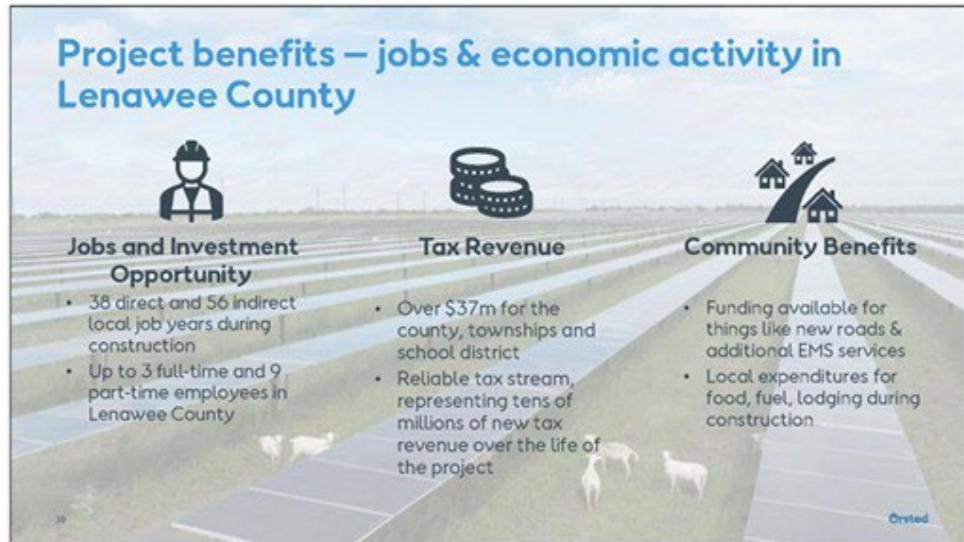
Host Benefits Agreement

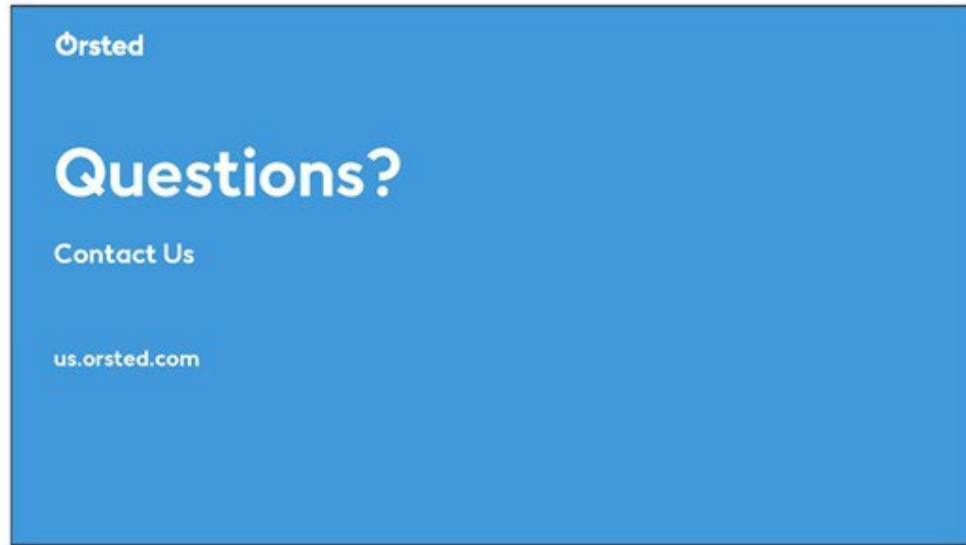
Glacier Meadows is working with Blissfield Township, Deerfield Township, and Lenawee County to enter into a **Host Benefits Agreement** in compliance with PA 233.

This benefit package is agreed upon with local officials and can be used to support local needs such as:

- Local infrastructure
- Parks & libraries
- Community centers

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Staff's Third Discovery Request to Items 26 and 27 and Company Response

Please refer to Exhibit A-8.3:

26. Please confirm that if the Applicant is unable to enter into a Host Community Agreement with Deerfield Township, that the Applicant will enter into a Community Benefits Agreement within which the amount paid will be greater than or equal to, what the Applicant would have paid Deerfield Township had the Host Community Agreement been executed.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “confirm” and “unable” are vague, ambiguous, and subject to multiple, subjective interpretations.

**Subject to and without waiving any objections, Glacier Meadows states as follows:
Confirmed.**

27. Please identify the community-based organization(s) with which the Applicant is prepared to enter into Community Benefits Agreement(s) should the Applicant and the Deerfield Township fail to execute the proposed Host Community Agreement. Include an explanation of terms detailing how the payments to the community-based organization(s) would provide benefits within or serve the residents living within the jurisdiction of Deerfield Township.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “prepared to enter” and “fail to execute” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows has executed a Host Community Agreement with Blissfield Township and has reached verbal agreement with Deerfield Township who communicated that they would execute a Host Community Agreement after the Project receives its PA 233 certificate from the MPSC. In the unlikely event that an HCA is not signed with Deerfield Township, Glacier Meadows will work with its consultant Good Steward to identify qualifying local community-based organizations that would benefit the local community by receiving funds that otherwise would be allocated through the Host Community Agreements.

Exhibit S-9.1: Excerpts of Staff's Eighth Discovery Request, Company's Response, and Company's First Supplemental Response (July 16, 2026)

A. Inverter Tonal Penalty

1. Please provide all data, calculations, assumptions, and supporting materials relied upon to remove the +5 dB tonal penalty for the GE Vernova Flexinverter units in Exhibit A-1.7, including:

- a. the exact inverter make, model, variant, firmware/control configuration if relevant to acoustic operation, noise-control configuration including whether standard ventilation hoods, acoustic hoods, or a reduced-noise variant are assumed, cooling-fan configuration, fan-speed assumptions, operating-load assumptions, and operating modes assumed in the acoustic model;
- b. the complete manufacturer sound-power and spectral data for the modeled inverter configuration, including full-octave, one-third-octave-band, narrowband, or other spectral data; test reports; test conditions; fan-speed and operating-load assumptions; measurement standard used including whether ISO 3746 or another standard was used; and whether the values are guaranteed, tested, preliminary, estimated, or provided for modeling use only;
- c. the ANSI S12.9 tonal-prominence analysis relied upon to conclude that the inverters are not tonal, including the standard, part, annex, and tonal-prominence criteria applied; the calculation method; the source spectra used; and receptor-level one-third-octave-band or narrowband calculations at the controlling dwelling(s), at any inverter-dominated receptors, and at any receptor modeled at 53 dBA or higher;
- d. any measured, assumed, surrogate, or prior-project background sound data, if any, relied upon to support removal of the +5 dB inverter tonal penalty, including any lowest hourly L90 value used or considered;
- e. any calculations, workpapers, or analyses showing how background sound was considered in determining whether the inverter sound would have tonal prominence at a dwelling under AFIP Attachment D, Table 1;
- f. any sensitivity run, model output, calculation, or workpaper evaluating Project sound levels with the +5 dB inverter tonal penalty retained. If no such sensitivity run, model output, or calculation exists, state that fact and explain whether Applicant contends the current Record is sufficient to support removal of the +5 dB inverter tonal penalty without such a sensitivity analysis; and
- g. any additional documents, data, correspondence, application notes, manufacturer evaluations, third-party acoustic analyses, prior-proceeding submittals, operating-project measurements, consultant memoranda, or internal workpapers not otherwise produced in response to subparts (a) through (f) that Applicant relied upon or considered to support the conclusion that the GE Vernova Flexinverter units are non-tonal at dwellings, including any materials addressing spectral characteristics, tonal characteristics, directivity, fan operation, noise-control configurations, reduced-noise configurations, discrete tones, or environmental-noise-modeling limitations.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “data,” “calculations,” “assumptions,” “configuration,” “standard,” “complete,” “tonal,” “analyses,” “guaranteed,” “tested,” “sensitivity,” “preliminary,” “estimated,” “provided for modeling use only,” “prior-project background sound data,” “relied upon or considered,” and “limitations” are vague, ambiguous, and subject to multiple, subjective interpretations. Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. The acoustic model assumes use of the GE FLEXINVERTER SLR-PS-XXX-1030-156X with standard hoods, rated power, and 100% fan operations. See document Bates-labeled GlacierMeadows0000192, which is being produced herewith.
- b. Glacier Meadows refers to and incorporates its Response to Request No. A.1.a above. Answering further, see document Bates-labeled GlacierMeadows0000192, which is being produced herewith.
- c. The GE 1/3 octave band sound power levels provided in document Bates-labeled GlacierMeadows0000192, which is being produced herewith, are the basis of the tonal-prominence analysis.
- d. The inverter tonal penalty was evaluated based on the GE sound power level data provided in GlacierMeadows0000192, which is being produced herewith. When the sound power level does not indicate a tone, the tonal penalty was not considered. The potential masking provided by ambient sound levels was not considered.
- e. Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.
- f. Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.
- g. See document Bates-labeled GlacierMeadows0000192, which is being produced herewith and provides the data that was evaluated for tonal prominence.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows:

- c. The 1/3 octave sound power data for the modeled inverter is provided in tabular form in tab A.1.c in the spreadsheet being produced herewith as document Bates-labeled GlacierMeadows0000641.
- d. No reliance has been made on analysis of the background sound data to support removal of the +5dB penalty for the inverters. The analysis of the sound power spectrum (see response to Request No. A.1.c above) demonstrates that tonality would not be expected in the near field of the inverters. Therefore, tonality would not be expected in the far field, regardless of any masking that would potentially provided by background sound.
- e. Glacier Meadows refers to and incorporates its Response to Request A.1.d above.
- f. Refer to tab A.1.f in document Bates-labeled GlacierMeadows0000641, which is being produced herewith.

- g. Tonality analysis based on Attachment A is provided in tab A.1.c of the spreadsheet Bates-labeled GlacierMeadows0000641, which being produced herewith.

B. Preconstruction Background Sound Monitoring

1. Exhibit A-1.7 states that preconstruction sound monitoring was not conducted as part of the assessment. Please explain the basis on which Applicant determined that the inverters would not have tonal prominence at a dwelling when the measured background sound of the lowest hourly L90 is considered under AFIP Attachment D, Table 1. Please identify and produce any background sound data, surrogate data, prior-project data, assumed L90 values, calculations, standards, or guidance relied upon for that determination.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “determined,” “tonal prominence,” “background sound data,” “surrogate data,” “prior-project data,” “assumed,” “calculations,” “standards,” and “guidance” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Filing Instructions and Procedures related thereto. Subject to and without waiving any objections, Glacier Meadows states as follows: The inverter tonal penalty was evaluated based on the GE sound power level data provided in document Bates-labeled GlacierMeadows0000192, which is being produced herewith. When the sound power level does not indicate a tone, the tonal penalty was not considered. The potential masking provided by ambient sound levels was not considered.

C. Substation Transformer Source Data and Tonality

1. Please produce the source documentation and calculations for the substation transformer sound-power levels used in Exhibit A-1.7, Table 4-1, including the Crocker (2007) reference values, the preliminary vendor data, the NEMA TR-1 85 dBA basis, and any calculations converting vendor or reference sound levels into modeled octave-band sound-power levels. Please state whether final manufacturer-guaranteed or tested sound-power and spectral data for the proposed 167 MVA transformers exist; if so, produce them; if not, state when they are expected.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “source documentation,” “calculations,” “sound-power levels,” “preliminary vendor data,” “final manufacturer-guaranteed,” and “exist” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto. Glacier Meadows further objects to this Request to the extent it seeks information or documents in the possession, custody, or control of non-parties or entities other than Glacier Meadows. Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: Source documentation used for the substation transformer sound power levels is being produced herewith as documents Bates-labeled GlacierMeadows0000588 –

GlacierMeadows0000633. Final manufacturer-guaranteed or tested sound-power and spectral data for the transformers has not been completed yet; it is expected in mid-to-late 2028. Analysis presented in document Bates-labeled GlacierMeadows0000634 – GlacierMeadows0000640, which is being produced herewith, indicates that the sound power data derived using Crocker (2007) used in the noise modeling is likely to be conservative compared to modern transformers used in solar projects.

2. Please produce the one-third octave-band or narrowband sound-power data for the substation transformers, if available, and describe the basis for applying the +5 dB tonal penalty to the transformers, including whether the penalty was applied to broadband sound power, each octave band, or receptor-level results.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “basis” and “applied” are vague, ambiguous, and subject to multiple, subjective interpretations. Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows did not receive 1/3 octave band sound data for the transformer. As transformers are a recognized potential source of tonality, the +5dB penalty has been applied to the sound power for the transformers’ sources. Refer to Tab C.2 in document Bates-labeled GlacierMeadows0000641, which is being produced herewith, for the derived power levels of the substation transformers. Refer also to document Bates-labeled GlacierMeadows0000634 – GlacierMeadows0000640, which is being produced herewith and addresses tonality of the substation transformers.

3. Please provide the modeled transformer-only contribution, with and without the +5 dB transformer tonal penalty, at R241 and at each receptor modeled at 53 dBA or higher.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “modeled” and “contribution” are vague, ambiguous, and subject to multiple, subjective interpretations. Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: Refer to tab C.3 in document Bates-labeled GlacierMeadows0000641, which is being produced herewith. Answering further, without the +5 dB tonal penalty, 53 dBA is not exceeded.

D. Substation Sound Barriers and Other Mitigation

1. Please produce the design basis for the 8.5-meter sound barriers around the substation transformers modeled in Exhibit A-1.7, including:

- a. barrier height, length, location, top elevation, modeled ground elevation, source-to-barrier geometry, barrier-to-receptor geometry, and model inputs;

- b. barrier material, surface density, assumed transmission loss or insertion loss by frequency band, and any manufacturer or engineering support for those assumptions;
- c. the assumed absorptive treatment of interior surfaces, including noise reduction coefficient or frequency-band absorption coefficients;
- d. any proposed openings, gaps, gates, penetrations, clearance at grade, or ventilation/cooling provisions, and how those features were modeled acoustically; and
- e. whether the barrier design is final. If not final, state when final design is expected and identify the criteria that will be used to confirm that the final design is acoustically equivalent to, or more protective than, the modeled design.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “design basis,” “support,” “assumptions,” “assumed,” “final,” “expected,” “criteria,” “confirm,” and “acoustically equivalent to, or more protective than” are vague, ambiguous, and subject to multiple, subjective interpretations. Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.
- b. Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.
- c. Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.
- d. Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.
- e. Sound barrier design is not final. Final sound barrier design will be developed based on final vendor submittals for the transformers, anticipated in Q2 2027. This model will be used to refine the proposed design, as appropriate. Glacier Meadows is committed to complying with all applicable and lawful requirements of Public Act 233 and any conditions imposed in connection with a solar siting certificate for the Project.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. Refer to document Bates-labeled GlacierMeadows0000634 – GlacierMeadows0000640, which is being produced herewith. Answering further, refer to the native CadnaA model files that are being produced herewith.
- b. Refer to document Bates-labeled GlacierMeadows0000634 – GlacierMeadows0000640, which is being produced herewith.
- c. Refer to document Bates-labeled GlacierMeadows0000634 – GlacierMeadows0000640, which is being produced herewith.
- d. Refer to document Bates-labeled GlacierMeadows0000634 – GlacierMeadows0000640, which is being produced herewith.

2. Because Exhibit A-1.7 states that the 8.5-meter substation sound barriers are the basis of the modeled results, sound contours, and finding of compliance, please provide the modeled facade-adjusted sound level at R241, and at each receptor modeled at 53 dBA or higher, with the barriers removed, with the barriers as modeled, and with any alternative barrier or mitigation configuration currently under consideration.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “alternative barrier,” “mitigation configuration,” and “under consideration” are vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public Act 233 or the Application Instructions and Procedures related thereto. Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: Refer to Tab D.2 in document Bates-labeled GlacierMeadows0000641, which is being produced herewith.

E. Acoustic Model Files and Modeled Receptor Results

2. Please explain why Exhibit A-1.7, Attachment A, Table A-1 appears to include duplicate entries for INV-53, INV-54, and INV-56 with coordinates matching INV-1, INV-2, and INV-3, and state whether those duplicate entries were included in the Cadna/A model or are tabulation errors. If any duplicate inverter sources were included in the model, please provide corrected model results.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “tabulation errors” and “corrected” are vague, ambiguous, and subject to multiple, subjective interpretations. Subject to and without waiving any objections, Glacier Meadows states that it is preparing information responsive to this Request and will supplement its Response once it has information responsive to this Request.

FIRST SUPPLEMENTAL RESPONSE: Subject to and without waiving any objections, Glacier Meadows states as follows: The duplicate entries in Table A-1 were tabulation errors. These errors were not included in the Cadna/A model. A corrected version of Table A-1 is being produced herewith as documents Bates-labeled GlacierMeadows0000550 – GlacierMeadows0000587.

F. Statutory Standard

1. Please confirm that the noise standard governing the Project is MCL 460.1226(8)(a)(iv), applicable to solar energy facilities, and explain the citation in Exhibit A-1.7, Section 3.1, to MCL 460.1226(8)(c)(iii), applicable to energy storage facilities. If the Applicant contends that any energy-storage noise standard applies to the Project, explain the basis and identify the equipment to which it applies.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “confirm” noise standard” is vague, ambiguous, and subject to multiple, subjective interpretations. Glacier Meadows further objects to the extent this Request seeks to impose or imply a burden greater than that set forth under Public

Act 233 or the Application Instructions and Procedures related thereto. Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows relies upon and incorporates MCL 460.1226 et seq, which speaks for itself. Answering further, Glacier Meadows states that it is seeking a siting certificate for a solar energy facility—not an energy storage facility—and confirms that only those noise standards governing solar energy facilities are applicable.

EXHIBIT S-9.2

IS CONFIDENTIAL AND BEING FILED
UNDER SEAL WITH THE MPSC

EXHIBIT S-9.3

IS CONFIDENTIAL AND BEING FILED
UNDER SEAL WITH THE MPSC

Please refer to the Emergency Response Plan (Exhibit A-1.9) and the Fire Response Plan (Exhibit A-1.10):

7. Please describe the timeline and process for future updates to and finalization of the Emergency Response Plan (ERP) and the Fire Response Plan (FRP).

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “timeline,” “process,” “future updates,” and “finalization” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: During operations, Glacier Meadows’ operations and maintenance (“O&M”) contractor will be responsible for updating the ERP and FRP. The ERP and FRP will be treated as a living document (i.e., to keep all contact information updated) and will be updated at least once every three years in consultation with fire departments, first responders, and county emergency managers. Consistent with standard industry practice at this stage of the Project lifecycle, Glacier Meadows has not yet hired an O&M contractor.

8. Regarding Evacuation Control Measures for multiple contingencies, please describe which personnel are responsible for determining whether to evacuate, and for accounting for personnel following evacuation and/or when gathering at a muster point.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “responsible,” “determining,” “accounting for,” and “muster point” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows’ plant manager will be responsible for determining whether to evacuate the Project site and will work with the site manager for accounting for personnel following an evacuation and/or when gathering at a muster point. Additionally, every person coming on site will be required to go through the site orientation before being allowed on the Project site. During site orientation, personnel will be provided with information regarding site muster points for emergency evacuations and storm shelter locations for weather warnings.

9. Regarding the Catastrophic Equipment Failure contingency and associated measures:

- a. Please describe how the Company defines a Catastrophic Equipment Failure and how it might occur.
- b. Please describe how and where Sulphur Hexafluoride gas (SF6) could become a hazard.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the terms “contingency,” “associated measures,” “defines,” and “hazard” are vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows:

- a. **Catastrophic equipment failure (“CEF”) is defined as a sudden and complete breakdown of a system or component. For example, an HV bushing failure that causes a fire resulting in a total loss of the main power transformer would be considered a CEF.**
- b. **In the event of a catastrophic failure within the HV breaker, it could result in the release of the SF6 gas within the substation. In this situation, there would be no immediate concern for the gases causing asphyxiation, as the breakers are stored above ground and not in a vault where the gases could accumulate.**

10. Please correct areas under section 4.1 which note “Error! Reference source not found” and provide the corrected document or portions thereof.

RESPONSE: Glacier Meadows objects to this Request as overly broad and unduly burdensome. Glacier Meadows further objects to this Request as the term “correct” is vague, ambiguous, and subject to multiple, subjective interpretations.

Subject to and without waiving any objections, Glacier Meadows states as follows: Glacier Meadows refers to and incorporates document Bates-labeled GlacierMeadows0000193 – GlacierMeadows0000469, which is being produced herewith and contains an updated Exhibit A-1.9 with updated references in Section 4.1.

STATE OF MICHIGAN
BEFORE THE MICHIGAN PUBLIC SERVICE COMMISSION

* * * * *

In the matter of the application of)
GLACIER MEADOWS SOLAR, LLC)
for a Renewable Energy or Storage)
Siting Certificate to construct a)
solar energy facility.)
_____)

Case No. U-22044

PROOF OF SERVICE

Michelle L. Conarton, being duly sworn, deposes and says that on July 20, 2026, A.D.,
she emailed a copy of the attached MPSC Public Testimony and Exhibits to the persons
as shown on the attached list.

Michelle L.
Conarton

Digitally signed by
Michelle L. Conarton
Date: 2026.07.20
13:23:16 -04'00'

Michelle L. Conarton

Subscribed and sworn to before me
This 20th day of July 2026

Jillian Bowden

Jillian Bowden, Notary Public
State of Michigan, County of Ingham
Acting in the County of Eaton
My Commission Expires June 19, 2032

Glacier Meadows Solar, LLC:

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Ryan Shannon

Brandon Hubbard

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Deerfield Township and Blissfield

Township:

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