BIG PLAIN SOLAR, LLC'S JUNE 17, 2020 RESPONSES TO STAFF'S JUNE 15, 2020 DATA REQUESTS

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need	))))	Case No. 19-1823-EL-BGN

1. According to page 98 of the Application, three structures (one residence, one barn, and one shed) may be removed for construction and operation of the facility. Please provide the location of these structures.

   Response: *These structures are on the Phillippi property south of Big Plain Circleville Rd. The real estate agreement for this property is now executed and does not include the area with these structures; the project will not remove the structures.*

2. According to page 7 of the Application, the project proposes up to 1.6 miles of overhead collection line, the typical alternative for collection lines is underground. Please provide a cost comparison for the overhead collection line versus underground.

   Response: *The cost savings is yet unknown as the project has not requested nor received a formal proposal for the design and construction on the collector lines. This will occur as part of the EPC process to occur as early as 2021.*

3. According to page 7 of the Application, the project proposes up to 1.6 miles of overhead collection line. The shapefiles seem to only show approximately 1.2 miles of overhead collection line, please explain or confirm the proposed length.

   Response: *The total length of overhead lines is 1.6 miles. Possibly the 1.2 mile count is a result of counting the 5 lines that are going into the collector substation only once.*

BIG PLAIN SOLAR, LLC'S JUNE 19, 2020 RESPONSES TO STAFF'S JUNE 12, 2020 DATA REQUESTS

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need	))))	Case No. 19-1823-EL-BGN

1. Please detail the status of all cultural resources studies for this project. Include history/architecture and archaeology studies. Please include dates.
   - Literature or desktop review:
   - Work plan submitted and approved by OHPO:
   - Actual field studies history/architecture:
   - Actual field/pedestrian studies archaeology:
   - Any additional studies (Phase I, etc. needed):
   - Study results/reports compiled:
   - OHPO concurrence or coordination:

   Response:

   - Literature or desktop review: *A desktop review of cultural resources was conducted to support the application and included as Appendix E to Exhibit I. The review is dated November 21, 2019*
   - Work plan submitted and approved by OHPO: *The Applicant met with the OHPO May 2, 2019 to present a survey plan and to discuss the project and the Applicant's proposed process for the completion of the Phase I Cultural Study, including field work. At the meeting, OHPO indicated agreement with the process and plan proposed by the Applicant. The Applicant has not yet submitted or requested approval of a formal work plan from OHPO.*
   - Actual field studies history/architecture: *The Applicant is currently reviewing a draft architecture study and anticipates finalizing this study no later than September 4, 2020.*
   - Actual field/pedestrian studies archaeology: *Field work for a Phase I Cultural Study is currently being conducted. Estimated completion of this field work is July 31, 2020 with study reports being finalized September 4, 2020.*
   - Any additional studies (Phase I, etc. needed): *No additional studies beyond the architecture study and Phase I Cultural Study are anticipated at this time.*
   - Study results/reports compiled: *The Applicant is currently reviewing the draft architecture study. The Applicant is also awaiting the draft Phase I Cultural*

Study report which is expected to be issued on September 4, 2020, following the completion of field work.

- OHPO concurrence or coordination: *The Applicant met with the OHPO to present a survey plan and to discuss the project on May 2, 2019. The Applicant will work with OHPO to obtain concurrence after finalization of the Phase I Cultural Study and architecture study.*

BIG PLAIN SOLAR, LLC'S JULY 29, 2020 RESPONSES TO STAFF'S JULY 24, 2020 DATA REQUESTS

In the Matter of the Application of	)	
Big Plain Solar, LLC for a Certificate	)	Case No. 19-1823-EL-BGN
of Environmental Compatibility and	)	
Public Need	)	

1. Please send us a copy of the plan referenced in the application (p.117 paragraph 3).

   Response: Please see the attached document titled "Preliminary Hydrology Report Madison Solar Energy Project" and dated January 2020.

2. In addition to the drainage plan please also provide:

   - How non-participating adjacent parcels owners are engaged for determining the location of drainage mains.

     Response: As noted at page 116 of the Application, the Applicant will work with county and townships to identify drainage mains in the Project Area and replace the mains, which will avoid potential impacts. The Applicant also intends to engage adjacent parcel owners through direct communications (telephone or mail) to obtain information on the location of drainage mains on the adjacent properties, particularly where mains cross property boundaries.

   - Once the new mains are installed, a map of the mains.

     Response: An as-built of new mains can be provided to the OPSB Staff upon completion of construction.

   - Complaint resolution process – what steps will be taken if a non-participating adjacent parcel owner claims pooling on their property is due to drain main damage on project leased land.

     Response: As noted in the Application at page 32, a complaint resolution procedure will be implemented to ensure that any complaints regarding Facility construction or operation are adequately investigated and resolved. Once construction begins, a hotline will be set up to receive and formally document all complaints, which will then be investigated by onsite Facility staff. At least seven days prior to the start of construction, the Applicant will notify affected property owners and tenants of the approved Complaint Resolution Plan and other sources of information about the Facility.

     Any adjacent landowner with complaints about project construction or operation (including any claims of pooling due to main damage) may utilize the complaint resolution process. The Complaint Resolution Plan was included in the Application as Exhibit N.

PRELIMINARY HYDROLOGY REPORT
MADISON SOLAR ENERGY PROJECT

PREPARED FOR:

FIRST SOLAR, INC.
350 WEST WASHINGTON, SUITE 600
TEMPE, AZ 85281

PREPARED BY:

WESTON SOLUTIONS, INC.
1400 WESTON WAY
WEST CHESTER, PA, 19380

January 2020
Rev 1 (2/20)

STATE OF OHIO
JOSEPH R
DIETRICH
E-77535
REGISTERED
PROFESSIONAL ENGINEER

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF FIGURES

1.0 Existing Site Features and Proposed Development

The purpose of this Conceptual Hydrology Report is to present stormwater management planning for the First Solar Madison County photovoltaic (PV) solar project located in Madison County, OH. This report is organized as follows:

Section 1: Existing Site Features and Proposed Development
Section 2: Hydrologic and Hydraulic Analysis
Section 3: Site Grading Exhibits
Section 4: Stormwater Management
Section 5: Conclusions

1.1 Site Description

The First Solar Midwest-OH-Madison Solar Project (Project) site near the City of London, OH is in a rural, unincorporated area of Madison County (see **Figure 1.01**) and is located approximately 20 miles southwest of Columbus, OH. The site is approximately 1,900 acres with the proposed 196 MWac solar array development area occupying approximately 1,050 acres. **Figure 1.02** presents the site layout plan provided by First Solar.

Figure 1.03 presents the approximate site boundary on the USGS Topographic Big Plain Quadrangle Map excerpt for Madison County, Ohio (NGA REF NO. USGSX24K3798). The site is bound by rear property lines along McGuire Road to the north, Glade Run Road on the west, rear property lines along Big Plain Circleville Road to the south, and property lines along Hume Lever Road to the east. The existing land use at the site consists of a combination of cropland, small wooded areas, isolated wetlands, wetland stream buffers, and small stream waterways. The site consists of gently sloping land with runoff concentrating into swales and streams that drain into the nearby Deer Creek, which drains into the Scioto River and eventually joins the Ohio River. Deer Creek is a jurisdictional waters under the Clean Water Act and is a topographical low point that generally bisects the southeastern corner of the site. The majority of the area slopes to the southwest and west toward Deer Creek and Glade Run Creek. The remaining site area drains to an unnamed jurisdictional creek on the south side of the project. This drainage eventually discharges to Deer Creek. The creek enters the project site via a bridge crossing at Glade Run Road.

According to the U.S. Fish & Wildlife Service National Wetlands Inventory website, the property also contains wetlands which are shown in **Figure 1.04**, see Section 1.4 for further discussion regarding the presence of on-site wetlands and the regulatory authorities having jurisdiction.

1.2 Proposed Development

First Solar's Madison County solar project consists of a proposed PV solar energy generating facility with a capacity of 196 megawatt (MW) on approximately 1,900 acres. Proposed site development features are presented in **Figure 1.02** and include:

- Perimeter fence
- Site access road, perimeter access roads and interior access roads
- Tracker arrays
- Inverters

- Transformers
- 138kV overhead transmission lines
- Overhead electrical collection lines
- Substation
- Switchyard

Some grading along with surface compaction is proposed to prepare a smooth ground surface and meet the slope requirements for solar panel installation. Gravel roads will be installed for site access and plant operations and maintenance activities. A new substation/switchyard is planned for the interconnection of the plant with site transmission. It is assumed the substation area will have a gravel surface and substation equipment will have secondary containment as required by regulatory authorities. No paved impervious surfacing is anticipated to be added as part of the development. An important component in the development of this site is to reduce the potential for flow concentration and protect the facility from high velocities and erosion. Grading will be limited to the greatest extent possible and will be focused on reducing high slope areas to accommodate tracking system installation and improve stormwater characteristics.

1.3 Flood Insurance Rate Maps

The Federal Emergency Management Agency (FEMA) publishes Flood Insurance Rate Maps (FIRM) showing areas subject to inundation during the 100-year flood event. The project site is located on Flood Insurance Rate Map (FIRM) Number 39097C0300D. **Figure 1.05** is an exhibit reproduced from FEMA National Flood Hazard Layer and shows the project site in relation to FIRM Panels 300 unincorporated Madison County, Ohio, effective June 18, 2010. According to FEMA, the majority of the site is located within an area of minimal flood hazard. A Special Hazard Flood Area (Zone A), typically known as the 100-year flood zone, is associated with Deer Creek. The Zone A designation indicates an estimated flood zone that does not have a base flood elevation established. Based on the array layout provided by First Solar, all arrays appear to be located outside of the Zone A designated areas.

1.4 Authorities Having Jurisdiction

The Ohio Environmental Protection Agency (OEPA), Division of Surface Water (DSW) is the primary authority having jurisdiction (AHJ) that regulates water quality within Ohio. There are additional local agencies that regulate water quality and add an additional jurisdictional approval layer within Ohio, known as municipal separate storm sewer (MS4) communities. However, the Project site is not located within the boundaries of an MS4 community and, as such, OEPA-DSW will be the AHJ for construction and post-construction stormwater control. Specifically, OEPA's Central District Office located in Columbus, OH will be the regional office having jurisdiction of the project site. For construction activities to occur at the proposed site, the project will need to apply for coverage under the OEPA General Permit Authorization for Stormwater Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System (NPDES). This permit is also known as OEPA Permit No. OHC000005. The project site is not located within any of Ohio's Municipal Separate Storm Sewer System (MS4) communities and the site is not a part of the Big Darby Creek or Olentangy River watersheds. Projects located within these specific areas have additional levels of permit approvals that would need to be obtained which will not be necessary for the Madison Solar Site.

The OHC000005 permit process requires the submission to OEPA of an online Notice of Intent (NOI) for coverage under the General Permit at a minimum of 21 calendar days in advance of the start of construction. The NOI describes the site activities and includes relevant information such as a project description, developer/permittee information, proposed land disturbance area, watershed location, etc. Additionally, in order for the NOI to be submitted, a Storm Water Pollution Prevention Plan (SWP3) must be completed for the project site. The SWP3 contains the erosion and sediment control plans, post-construction stormwater management plans along with related calculations, details, project narratives, and operations and maintenance procedures. The SWP3 is to be prepared by an Ohio licensed professional engineer and it is to be available on-site at all times during construction and must be updated as site modifications to the plan occur.

Given the nature of the site topography and the large areas of land that could potentially be under development, the use of temporary sediment basins for every 10 acres of disturbance would be both costly and pose significant challenges during construction. Other methods of erosion control and best management practices (BMPs) that would meet the intent of the permit should be considered during the design phase of the project in order to minimize site development impacts. For example, using other BMPs (such as the collection berms discussed later in this report, which will functionally act to remove sediment), sequencing construction and stabilization to limit exposed areas or applying slope treatments. The permit also includes post-construction stormwater management requirements for the reduction of Total Suspended Solids (TSS) from runoff from the site. These reductions can be accomplished with minimizing and disconnecting impervious surfaces and providing opportunities for runoff infiltration and/or flow over grass/vegetated areas. Stormwater management regulations are discussed further in Section 4 of this report. Early coordination with authorities having jurisdiction is recommended to discuss construction BMPs, establish variances or exceptions and confirm all permitting requirements.

The site also contains streams and wetlands that are regulated. Within Ohio, streams and wetlands are regulated by Ohio Department of Natural Resources (ODNR) and ultimately, The Army Corps of Engineers (USACE). The Louisville District Office of the USACE is the regional AHJ for wetlands and waterway related permitting. As previously indicated, **Figure 1.04** depicts National Wetlands Inventory mapping of the project site. It is recommended that wetlands delineation of the site be completed as additional wetlands may be present at the site and can potentially impact allowable areas of project development. ODNR has wetlands buffer setback requirements that vary from 25 to 125 feet depending on the identified category/quality of the wetlands. Any disturbance to wetlands areas will require permit approvals through ODNR and USACE.

2.0 Hydrologic and Hydraulic Analysis

The hydrologic and hydraulic methods used in this report are discussed in this section.

2.1 Hydrologic and Hydraulic Modeling

PCSWMM was used to perform the hydrologic (2-year and 100-year, 24-hour storms) and hydraulic modeling of the pre- and post-development drainage conditions of the Madison County site to review depth and velocities to be expected at the site under existing and preliminarily proposed grading conditions. This section provides a discussion of the modeling approach and input parameters used in the PCSWMM models. The PCSWMM model was set up to evaluate a 3,953 acre watershed, which includes the 1,900 acre project site and watershed area to the northwest of the site that is tributary to the stream flows within Deer Creek. The project site is located within the Deer Creek Watershed Basin and all remaining off-site drainage generated upstream of the PCSWMM model area was estimated using the mean annual flow estimated with USGS StreamStats at a point within Deer Creek immediately downstream of the project site. This estimated USGS StreamStats flow was conservatively distributed upstream amongst the three main tributaries entering and passing through the project site. The three inflow tributaries include Deer Creek, Glade Run, and Oak Run.

The hydrologic rainfall distribution models for the 2- and 100-year storms were developed by Weston based on the Department of Agriculture (USDA) Soil Conservation Service (SCS). A Type II, 24-hour design storm distribution and 2.64 and 5.55 inch storm depths were used as input for the 2- and 100-year design storms, respectively. Storm depths were extracted from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Precipitation Frequency Data Server. Parameters used in the modeling of the Madison County solar project are described below. The *Rainwater and Land Development Standards* (Ohio Department of Natural Resources (ODNR), 3rd edition with 11-6-14 updates) was consulted for local requirements.

The flow routing portion of PCSWMM transports hydrologic runoff through conveyance systems of channels. Flow routing within a conduit link in PCSWMM is governed by the conservation of mass and momentum equations for gradually varied, unsteady flow (i.e., the Saint Venant flow equations). Flow is simulated at one of three levels of sophistication: Steady Flow Routing, Kinematic Wave Routing, and Dynamic Wave Routing (Rossman, 2010). Dynamic wave routing was selected for this flooding simulation because it is the only method capable of simulating backwater effects from pressurized flow, entrance/exit losses, flow reversal, and non-dendritic layouts.

The PCSWMM model created for the Madison Solar Energy Project is an integrated one-dimensional and two-dimensional model. The 1-D portion of the model consists of a network of irregular shaped conduits that simulate flow through the existing streams present within the project site. The irregular shaped conduits representing the stream beds were defined using transects placed at varying spacing along all streams in the project area. On average, the transects were placed about every 250 feet along the study streams and the stationing used to create these transects were at 10-foot intervals. Transect station elevations were determined from their location on the Digital Elevation Model (DEM) surface. **Figure 2.01** and **Figure 2.02** present an overall and close-up view of the 1-D model. The 2-D portion of the model consists of a hexagonal mesh grid to simulate overland flow, and a rectangular directional mesh to simulate stream flow above the 1-D model. **Figure 2.03** and **Figure 2.04** present the 2-D model cells prior to running the model and cell rendering. The 1-D model was clipped at stream bank stations along the entire length of all streams within the model. After stormwater in the 1-D model exceeds the stream's bank elevations, the flood waters overflow into the directional mesh in the 2-D model and combine with runoff generated from the hexagonal mesh to subsequently compute flow velocities and depths within the study area.

Elevation Data

Site elevation data was provided by First Solar and was supplemented by regional LiDAR data from the Ohio Geographically Referenced Information Program (OGRIP) for the offsite portions of the watershed. The surface elevation data was merged together and exported as a geotif surface file that was imported into PCSWMM for the pre-development conditions model. The re-graded surface, as presented in the Preliminary Grading Plans in **Appendix C**, was transformed into a DEM file, merged with the supplemental OGRIP surface elevation data, and imported into PCSWMM as a geotif surface file for the post-development conditions model.

Grid Size and Nodes

100-foot hexagonal shaped cells were used to model overland runoff conditions, and 10-feet by 10-feet directional cells were used to model stream flow for Deer Creek, Glade Run, and Oak Run. These grid sizes result in sufficient model resolution to evaluate flow patterns within the site without the runtime becoming excessive.

Design Storm

Site conditions were modeled for the 2- and 100-year, 24-hour storm events. The 2- and 100-year, 24-hour storms are typical design criteria for drainage engineering to account for the 50% and 1% annual chance storms. The 2-year, 24-hour storm event represents the more common storm that stormwater controls are typically designed to manage at a minimum. The 100-year, 24-hour storm event represents the unlikely catastrophic storm that design standards typically do not exceed.

Rainfall and Rainfall Data

Precipitation data for the 2- and 100-year, 24-hour storms was obtained from NOAA Atlas 14 using the Point Precipitation Frequency Estimates and determined to be 2.64 and 5.55 inches, respectively. The project is located in an SCS Type II storm distribution area. Infiltration was not considered for this model to conservatively estimate inundation conditions. A 2.64 inch and 5.55 inch SCS Type II 24-hour design storms were generated in the program and used to compute the node specific rainfall curve inflows expected throughout the entire 24-hour storm duration. Inflows at each specific node were combined with a scaling factor that was specific to each associated cell area.

Hydrologic Soil Groups and Runoff Curve Numbers

The SCS method uses a combination of soil conditions and land uses to assign a runoff factor to an area. These runoff factors, called runoff curve numbers (CN), indicate the runoff potential of an area. Soil properties influence the relationship between runoff and rainfall because soils have differing rates of infiltration. Based on infiltration rates, the SCS has divided soils into four hydrologic soil groups:

Hydrologic Soil Group A – Soils having a low runoff potential due to high infiltration rates. These soils consist primarily of deep, well-drained sands and gravels.

Hydrologic Soil Group B – Soils having a moderately low runoff potential due to moderate infiltration rates. These soils consist primarily of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Hydrologic Soil Group C – Soils having a moderately high runoff potential due to slow infiltration rates. These soils consist primarily of soils in which a layer exists near the surface that impedes the downward movement of water or soils with moderately fine to fine texture.

Hydrologic Soil Group D – Soils having a high runoff potential due to very slow infiltration rates. These soils consist primarily of clays with high swelling potential, soils with permanently high water tables, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious parent material.

The soils at the Madison County site consist of Hydrologic Soil Groups B, C, B/D, and C/D. **Appendix B** presents a USDA NRCS Custom Soil Resource Report for the site and contains figures indicated soil type that are anticipated at the site. The land use is primarily cultivated crops with small areas of isolated woods and wetlands. Soil conditions from the NRCS soil report were used to aid in the selection of a Manning's roughness factor for land cover conditions within the site. Site soil conditions are critical to accurately perform further stormwater analyses to refine runoff volumes, and size stormwater collection, conveyance, and detention systems that are typically evaluated in the next stage of site stormwater analysis.

Hydraulic Surface Roughness Factor (Manning's n)

PCSWMM uses Manning's *n* coefficients to account for the effects of surface roughness. The Manning's *n* values used in PCSWMM model are specific to unsteady overland flow computations, which tend to be higher than Manning's *n* values specific to steady state, open channel flow computations. The typical value used for the pre-development Manning's *n* was 0.04, which is the lower end of the range given for *Open Ground, No Debris* for the project site. Since erosion is a primary concern at this site, the lower end of the range was used to provide more conservative velocity results.

2.2 Hydrologic and Hydraulic Results

Hydrology Results

The Ohio DNR provides guidelines to help manage stormwater to address potential water pollution issues (*Rainwater and Land Development Standards*). Potential water pollution issues include changes in peak flow characteristics, changes in total runoff, changes in water quality and changes in hydrologic amenities such as the appearance or impression that a creek leaves with the observer. Impervious surfaces that are created as a result of development increase the amount of runoff and peak flow during rainfall events which can erode stream channels, increase pollutant loading, cause downstream flooding, and prevent groundwater recharge. No paved impervious area is expected to be added as a result of this project. All area cleared for the installation of the arrays will be planted and restored to vegetated meadow conditions. Gravel roads will be installed for access to the array and are typically present around the perimeter of the development areas as well as several intermediate locations within the array blocks. On October 15, 2019, OEPA released a technical guidance memorandum to provide clarification to the definition of impervious surfaces. Within the memorandum, OEPA indicates that gravel roads are to be considered as impervious surfaces. The technical memorandum is included in **Appendix D**. This interpretation will impact the site development and will result in the need for BMPs to mitigate increases in peak stormwater flow rates, total runoff quantity, and water quality when post-construction conditions are compared to pre-development conditions.

Hydraulic Results

Figure 2.05 through **Figure 2.08** present the existing 2-year, 24-hour storm runoff conditions. Included in these figures in the following respective order are a peak runoff depth gradient map, a peak runoff depth hazard map, a peak velocity gradient map, and a peak velocity hazard map. **Figure 2.09** through **Figure 2.12** present the proposed 2-year, 24-hour storm runoff conditions. Included in these figures in the following respective order are a peak runoff depth gradient map, a peak runoff depth hazard map, a peak velocity gradient map, and a peak velocity hazard map. **Figure 2.13** through **Figure 2.16** present the existing 100-year, 24-hour storm runoff conditions. Included in these figures in the following respective order are a peak runoff depth gradient map, a peak runoff depth hazard map, a peak velocity gradient map, and a peak velocity hazard map. **Figure 2.17** through **Figure 2.20** present the proposed 100-year, 24-hour storm runoff conditions. Included in these figures in the following respective order are a peak runoff depth gradient map, a peak runoff depth hazard map, a peak velocity gradient map, and a peak velocity hazard map. Proposed site grading is described in Section 3.

The hazard maps listed above are ideal for determining where higher runoff velocities or greater runoff depths may be encountered throughout the site. Higher hazard areas will need additional stormwater management practices to ensure the continued stability of the site. When looking at the entire site area, excluding flow within the 100-year floodplain, proposed grading conditions under the 2-year, 24-hour storm frequency produce maximum peak runoff depths of 5.3 feet and maximum peak runoff velocities of 2.5 feet-per-second. Site conditions for the previously described site area under the 100-year, 24-hour storm frequency produce maximum peak runoff depths of 5.8 feet and maximum peak runoff velocities of 2.8 feet-per-second. These peak runoff velocities were primarily observed where multiple concentrated flow paths joined together, and peak runoff depths were primarily observed in isolated low areas. Specifically, the only proposed solar array located on the west side of Deer Creek experienced greater flood depths within any of the proposed array footprints. The east bank of Deer Creek, in the center of the project site, where 3 flow paths converge into one that discharges into Deer Creek, is another location that experienced greater flow depths and the greatest flow velocities occurring anywhere on the project site, outside of the 100-year floodplain. The areas of concentrated flow that flow adjacent to proposed solar arrays in the Southeast corner of the project site experienced the greatest flow depths occurring anywhere on the project site and greater flow velocities, outside of the 100-year floodplain. The areas described, as well as other areas of concentrated flow or inundation shown on the hazard maps, will need to be evaluated further to determine the appropriate BMP type and size needed to convey these flows. Open-channel swales will likely be needed in these areas to control and convey flows through and around the developed areas. Typically, grass lined swales are capable of conveying flows with a velocity of 1 fps, but this depends on other factors, including channel slope. As velocities increase, additional channel lining measures, such as riprap or geosynthetic matting, will be necessary to protect from erosion.

3.0 Site Grading Exhibits

Grading at a solar facility is critical to ensure that the arrays receive as much direct sun exposure possible to maximize power generation. Grading guidelines have been developed by First Solar depending on location and whether the arrays are fixed or whether they track the sun. The Madison County project is a tracker site utilizing Nextracker systems in the northern hemisphere with a latitude greater than 36° and therefore the following grading guidelines apply. Site grading shall have:

- A maximum ground slope in the north/south direction of 6% for unmodified Nextracker strings
- A maximum ground slope in the north/south direction of 15% for upgraded Nextracker strings
- Maximum slope in the east/west direction was not considered a construction constraint, but will need to be evaluated based on the site's glass cover ratio (GCR) and tracker row spacing to consider potential shading effects

Appendix C, Sheets 1 through 8 of 8 present plans showing the existing site grades and areas of proposed grading that will be necessary to meet the unmodified Nextracker rack slope requirements. The plans show that grading can be completed in isolated areas to achieve the desired slopes. Sheet 1 shows the overall site and key map locating the more detailed sheets of the project in relation to one another. The grading presented is approximately 83,000 cubic yards (cy) of cut and 48,500 cy of fill, resulting in a net cut of approximately 34,500 cy. This excess does not account for any fill placement/consolidation factors and does not currently account for the construction of any stormwater basins or grading associated with significant stormwater channels or conveyances.

4.0 Stormwater Management

4.1 General

Existing stormwater flows through the site primarily as sheet flow which then concentrates into drainage swales, channels, and ultimately into Deer Creek. Any flows entering the site through Deer Creek, Glade Run, or Oak Run have been accounted for as headwater inflows. There are several areas as indicated by the figures presented in **Appendix A** where the sheet flows become concentrated within planned array areas. Mitigation measures will be necessary to protect the arrays from erosion and high water levels through diversion and/or routing of runoff swales and channels. Conceptual mitigation measures are discussed below.

It is anticipated stormwater management measures will be necessary due to the potential runoff flow increases from planned gravel access roads and substation areas. Some AHJs do not consider gravel as an impervious surface that would result in an increase of runoff. However, as previously indicated, OEPA issued a technical memorandum clarifying that compacted gravel must be included in development calculations as impervious. The overall array development area is not expected to significantly increase runoff in the post developed condition since the final grass and meadow vegetation will be similar or an improvement to existing site conditions. One item to note is that Ohio will consider the PV panels as disconnected flows provided that an appropriate aisle width is present between panel rows. A guidance document is provided in **Appendix D**. The guidance document indicates that an aisle width roughly the width of the PV panel table is necessary for the array area to be considered pervious. **This requirement will have an effect on panel spacing different than typically expected in utility scale developments**. In general, the guidelines will, in general, require that there be a glass cover ratio of 50% or less within the array area. Grass and meadow conditions are an improvement, with respect to surface runoff coefficients, as compared to cultivated agriculture cover. With the potential increase in runoff in the post development condition, stormwater management basins or other BMPs to control runoff rate, quantity and quality will be necessary down-gradient of project development areas.

The BMPs will need to be designed in accordance with the latest edition of ODNR.s Rainwater and Land Development Manual. In summary, Ohio stormwater regulations require BMPs to be installed to control pollution of public waters by soil sediment from accelerated stream channel erosion and to control flood plain erosion caused by accelerated stormwater runoff from development areas. The increased peak rates and volumes of runoff shall be controlled such that:

1. The peak rate of runoff from the critical storm and all more frequent storms occurring on the development area does not exceed the peak rate of runoff from a one year frequency storm (of 24 hours duration) occurring on the same area under pre-development conditions.
2. Storms of less frequent occurrence than the critical storm, up to the one-hundred year storm, have peak runoff rates no greater than the peak runoff rates from equivalent size storms under pre-development conditions.

4.2 Mitigation for Flow Depth

In general, flow depths within the proposed arrays during the 100-year, 24-hour storm event are less than 6 inches. However, there are some low areas, primarily near the southeastern array development area, that are in excess of one foot and potentially reach up to 5.8 feet. Flows within these areas will need to be conveyed to avoid impacts to racking system posts. There are several ways to protect the arrays in these areas from high water depths, which include:

- Fill the low areas above the 100-year water surface elevation (this may have permitting implications that would need to be fully investigated, see below);
- Raise the elevation of the solar panels and equipment above the predicted water levels; or
- Remove the arrays from these areas.

The areas where high flow depths are predicted are part of the floodplain for Deer Creek and arrays are generally not located within the identified flood area. While they are not in a FEMA floodplain nor a jurisdictional buffer, they provide flood storage during large storm events. These areas could be filled, however filling would remove flood storage. Flood storage attenuates flow in the creek, which reduces peak flows downstream. Filling might increase downstream flows and cause or exacerbate downstream flooding. Instead, it is recommended that care be taken to locate the solar panels and equipment above the predicted water levels in these areas and pile foundations be driven below the scour depth. If filling is elected, it is recommended that compensatory storage be excavated elsewhere along the creek (ideally opposite of where the fill is located) to restore the lost flood storage.

4.3 Mitigation for Velocity and Concentrated Flow

Mitigation measures are proposed to address potential erosion issues that occur in areas where runoff may concentrate and high velocities are predicted. Preliminary stormwater management features that may be necessary to adequately convey stormwater flows through the site and within the arrays are shown on Figures 4.02 through 4.08. These measures include:

Diversion Berms: Diversion berms paired with open channels will be necessary to divert any minimal offsite runoff around the arrays to prevent this flow from flowing through the site. Erosion protection, such as turf reinforcement mat (TRM) or riprap channel lining, will be needed where the potential for scour is higher.

Collection Berms: Collection berms and open channel swales will be necessary to collect sheet flow on the slopes before it concentrates and has the potential to cause erosion. Open channels are discussed below. The collection berms will convey the flow to a swales, which will route it to a downstream existing receiving water body or a stormwater control BMP measure. A conceptual cross section of a collection berm is shown in **Figure 4.01** below. The collection berms will be similar to the figure except they will not be constructed along an interior road. The collection berms are to be placed along the slopes parallel to the contour lines. The berm height will increase along its length to correspond with the hydraulic gradeline of the flow plus freeboard. The end of the collection berms where flow will transition to an open channel will require turf reinforcement mat or rock to protect them from erosion. The final size and the spacing of the collection berms will need to be evaluated.

Open Channels: Proposed open channels will collect the runoff from the collection berms and route the flow down slope to stormwater management BMPs. The location and spacing of open channels will need to be evaluated during the final design phase. Additionally, the open channel lining materials will vary from grass to riprap depending on anticipated channel flows. Riprap dissipators or level spreaders will be necessary at the end of the swales to dissipate flows where they will either enter an existing stream channel or be spread to overland flow.

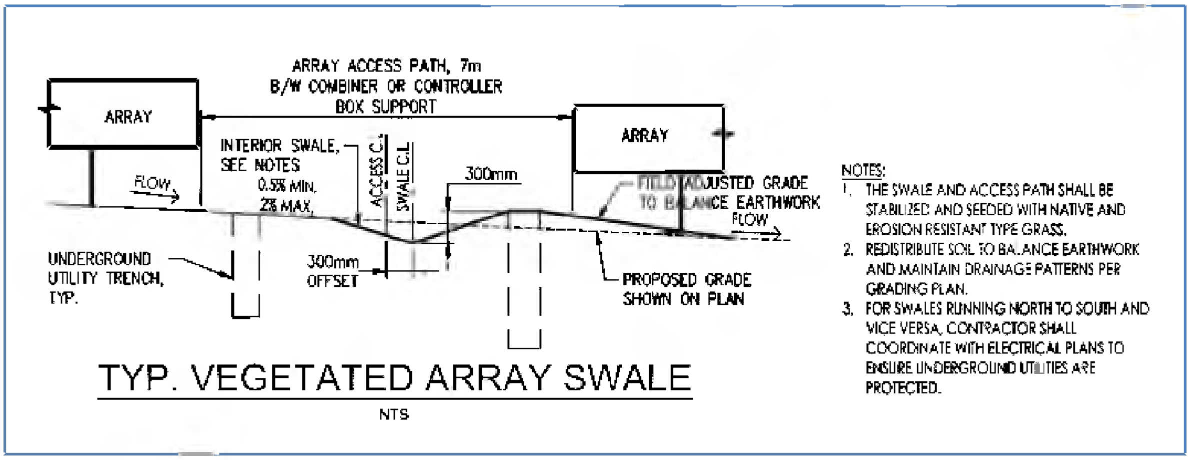


Figure 4.01 Collection Berm Conceptual Cross Section

TRM or Riprap Rock Protection: The existing conditions analysis indicates velocities greater than 2 fps for the 100-year event in areas adjacent to Deer Creek and in a number of existing drainages within and adjacent to the proposed arrays, which will continue to be used for conveyance under post-construction conditions. To protect these areas from erosion, these drainages are proposed to be lined with TRM or riprap rock to prevent erosion.

Cutoff Walls and Rock or Concrete Fords: Where concentrated flow crosses the proposed access roads throughout the site, cutoff walls on both sides of the road are recommended for erosion protection. The cutoff walls will protect the road from being damaged in the event of a large storm. Between the cutoff walls, it is recommended that a rock or concrete ford be used to convey flow across the road without damaging it. A rock or concrete ford consists of a lined channel that is constructed in the roadway where vehicles can simply drive across. The bottom of the ford should match the elevation of the drainage channel. Riprap is recommended on the downstream side of the roadway to protect the embankment.

Stormwater Piping and Inlets: While the use of stormwater piping and inlets is typically not utilized within solar array developments, there are several locations where the use of underground piping is recommended to convey flows within the development. These locations are where more concentrated flows exist and piping can be utilized to bypass the arrays. The alignment of the piping will need to be align with roadways or with foundation systems so that the piping does not impact post driving.

Detention / Infiltration Basins: Stormwater basins will be necessary to control increases in stormwater flows to comply with local stormwater regulations. Basins are expected to be necessary where land cover has changed from pervious type vegetated cover to impervious cover. It is anticipated basins will be necessary for the development of the site's substation and switchyards. As indicated Ohio DNR considers gravel roadways and gravel yard areas to be impervious and as such, stormwater controls will be necessary to offset the new impervious cover.

5.0 Conclusions

This study presents hydrologic analysis to evaluate potential flow depths and velocities at the Madison County Solar Project site. Under pre-development conditions, stormwater runoff is conveyed through the site as sheet flow and concentrated flow in local drainages. The results of the PCSWM model for existing conditions as well as evidence from aerial photos indicate that stormwater management measures to reduce the risk of erosion and damage due to water levels in channelized flow areas should be implemented.

It is recommended that First Solar equipment be elevated above the predicted 100-year flow depths and that foundation posts may need to be driven deeper in certain areas to minimize potential scour effects. In addition, BMP measures are recommended to control stormwater quantity, rate and quality and to reduce the potential for erosion that could undermine and damage equipment at the site. These measures include constructing:

- Diversion berms
- Collection berms
- Stormwater conveyance systems and stormwater management basins
- Erosion protection (e.g., TRM)
- Rock or concrete-line fords

The extent at which these measures are implemented can be adjusted. For example, the collection berms could be eliminated. However, the less erosion protection provided at site, the higher the frequency of monitoring and maintenance can be expected.

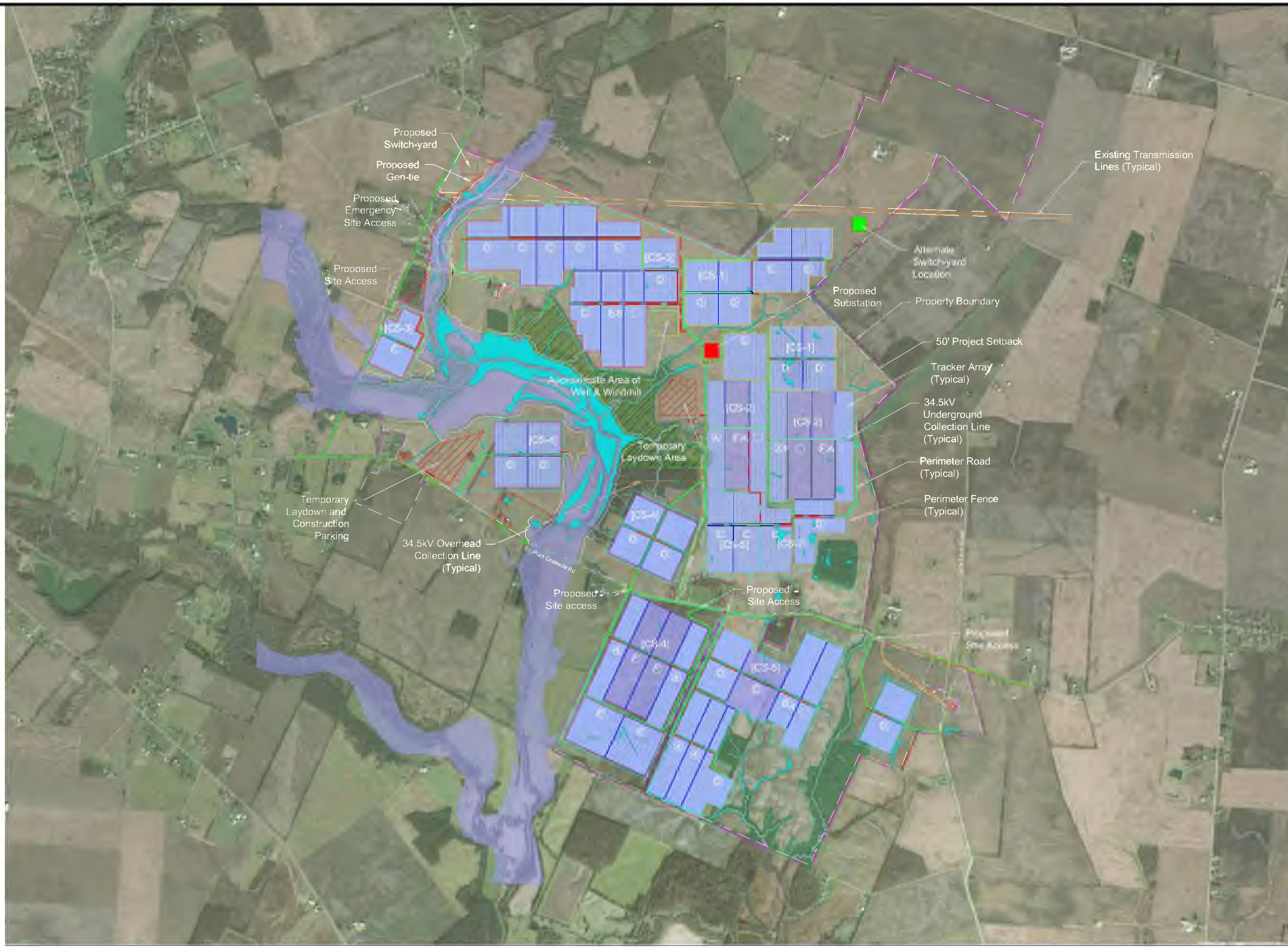
APPENDIX A
REPORT FIGURES

First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 1.01
GENERAL SITE LOCATION MAP



NOTE:
INFORMATION PULLED FROM DRAWING SD-100-T-ALT-3 FIRST SOLAR

MADISON SOLAR
BIG PLAIN, MADISON COUNTY, OHIO

PRODUCT OFFERING
POWER PLANT

PROJECT DEVELOPER/OPERATOR OWNER
FIRST SOLAR

PROJECT SITE DESCRIPTION

2773.15	± ACRE SITE
1062.95	± ACRE ARRAY
LATITUDE	39.854225°N
LONGITUDE	-83.329026°W
ELEVATION	940 FT. MIN. - 985 FT. MAX

PROJECT CLIMATE CONDITIONS
ASHRAE STATION NO. 724284

EXTREME MAX (50 YEAR) TEMP	101.9°F
EXTREME MIN (50 YEAR) TEMP	-19.9°F
ANNUAL COOLING DESIGN TEMP	90.4°F
ANNUAL HEATING DESIGN TEMP	5.3°F

(ASHRAE 2013)

PROJECT DESIGN DATA

SNOW LOAD	20 PSF
WIND LOAD	90 MPH (ASCE 7-10, CAT 1)
SEISMIC LOAD	Ss=0.159g, S1=0.062g

PROJECT INTERCONNECTION
138kV TRANSMISSION LINE TO X SUBSTATION

Site Plan Data Source

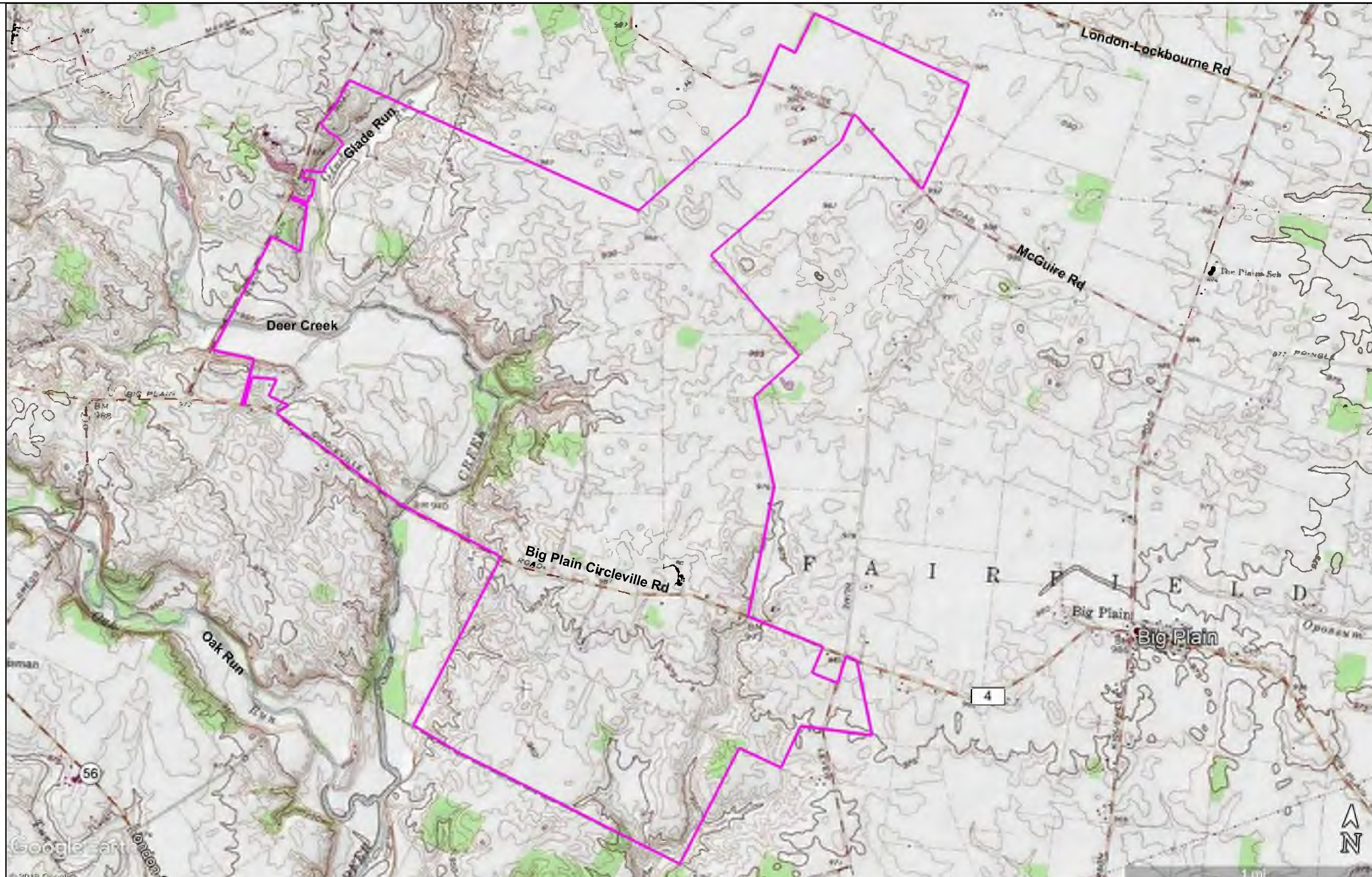
Feature	Description
Boundary	Madison - Site Constraints Map - 080219
Coordinate System	NAD83 Ohio State Planes, South Zone, US Foot

Legend:

- Project Boundary
- AC Elec. Collection Line (Underground)
- AC Elec. Collection Line (Overhead)
- Existing Distribution / Transmission Line
- Perimeter Fence
- Proposed Perimeter Road (Dirt)
- AC Elec. Collection System 1
- AC Elec. Collection System 2
- AC Elec. Collection System 3
- AC Elec. Collection System 4
- AC Elec. Collection System 5

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 1.02
SITE PLAN



First Solar

WESTON SOLUTIONS

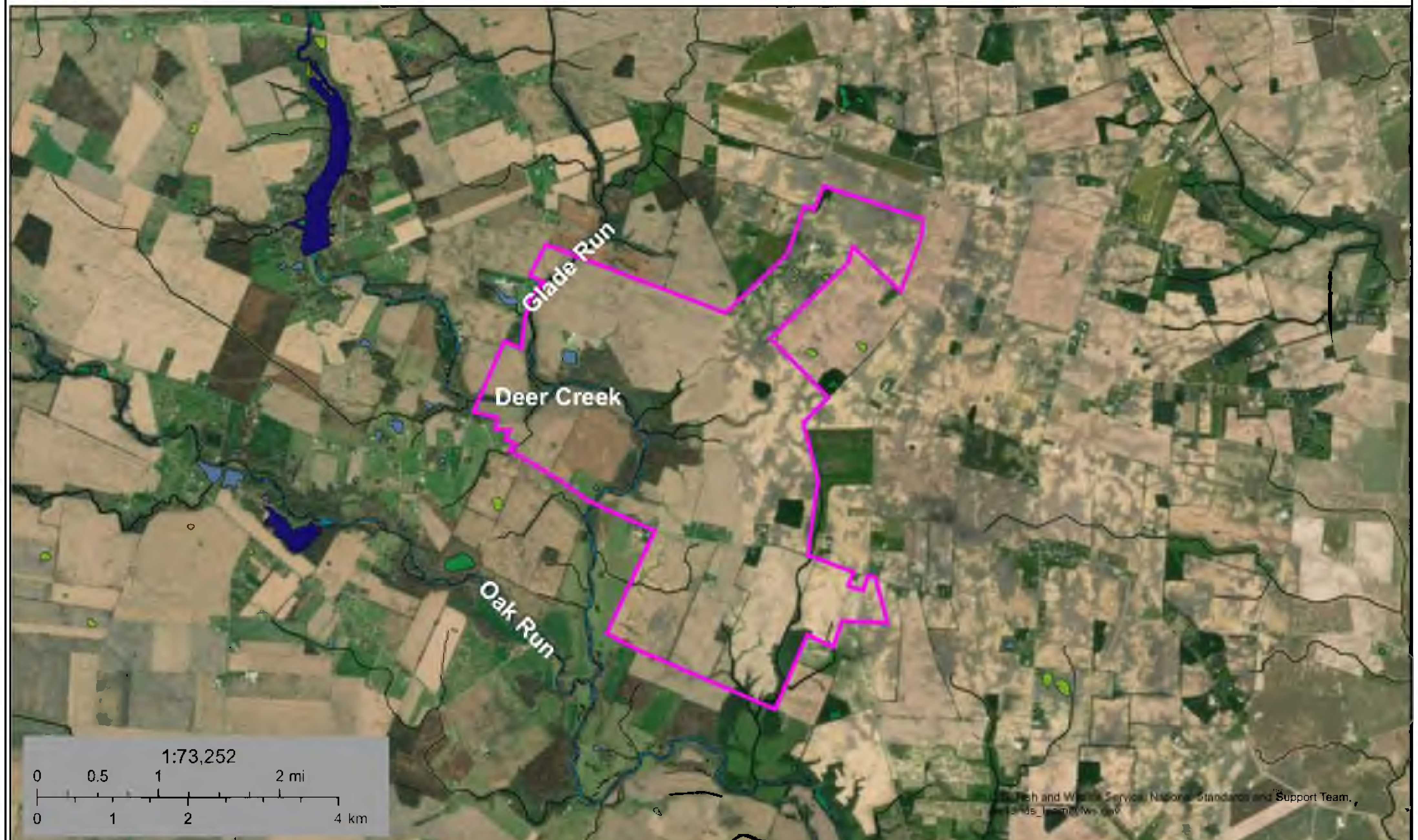
FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 1.03
USGS TOPOGRAPHY MAP
MADISON COUNTY, OHIO

U.S. Fish and Wildlife Service

National Wetlands Inventory

Wetlands



January 2, 2020

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

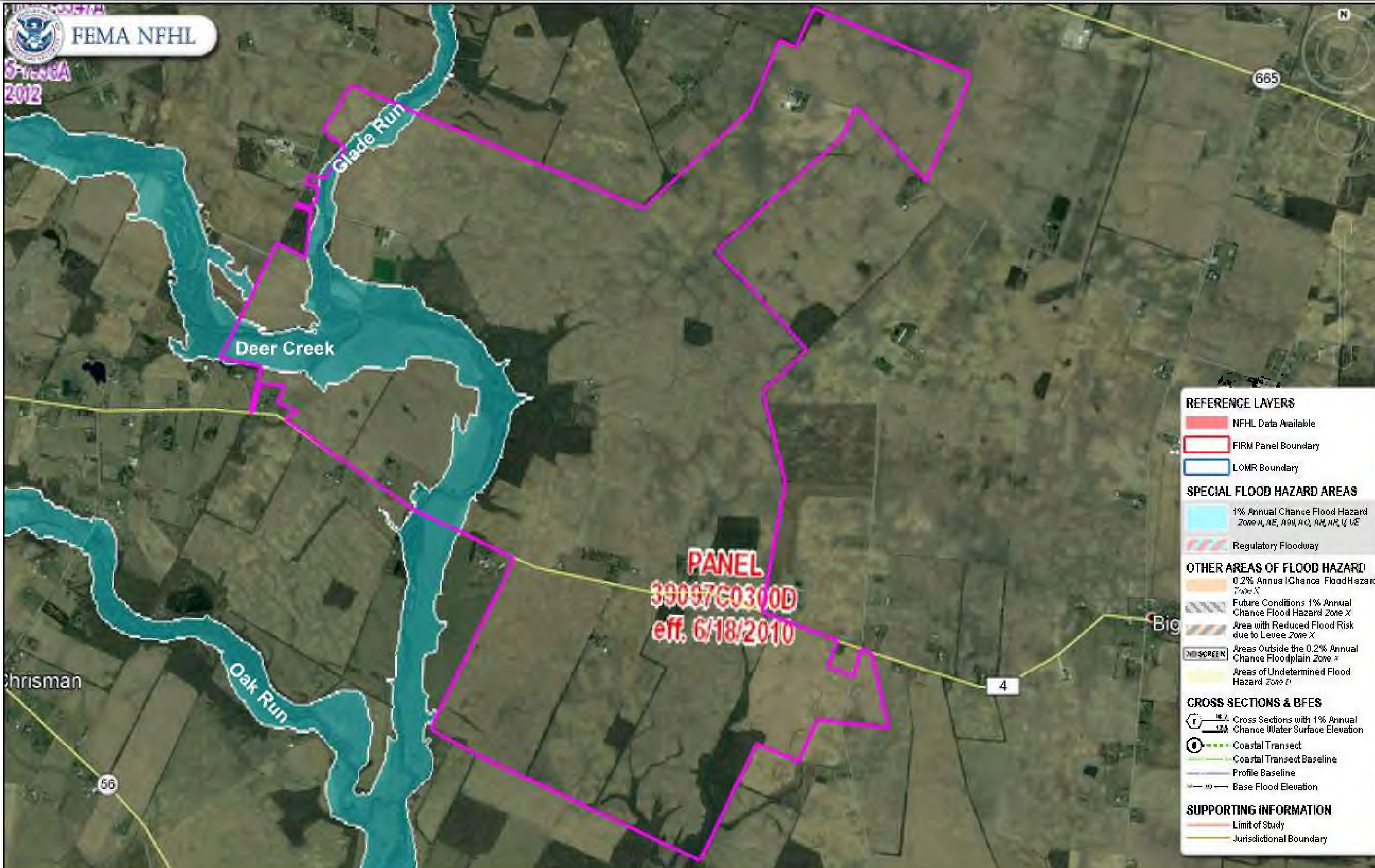
This map is for general reference only. The US Fish and Wildlife Service is not responsible for the accuracy or currentness of the base data shown on this map. All wetlands related data should be used in accordance with the layer metadata found on the Wetlands Mapper web site.

First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 1.04
NATIONAL WETLANDS INVENTORY
SITE MAPPING

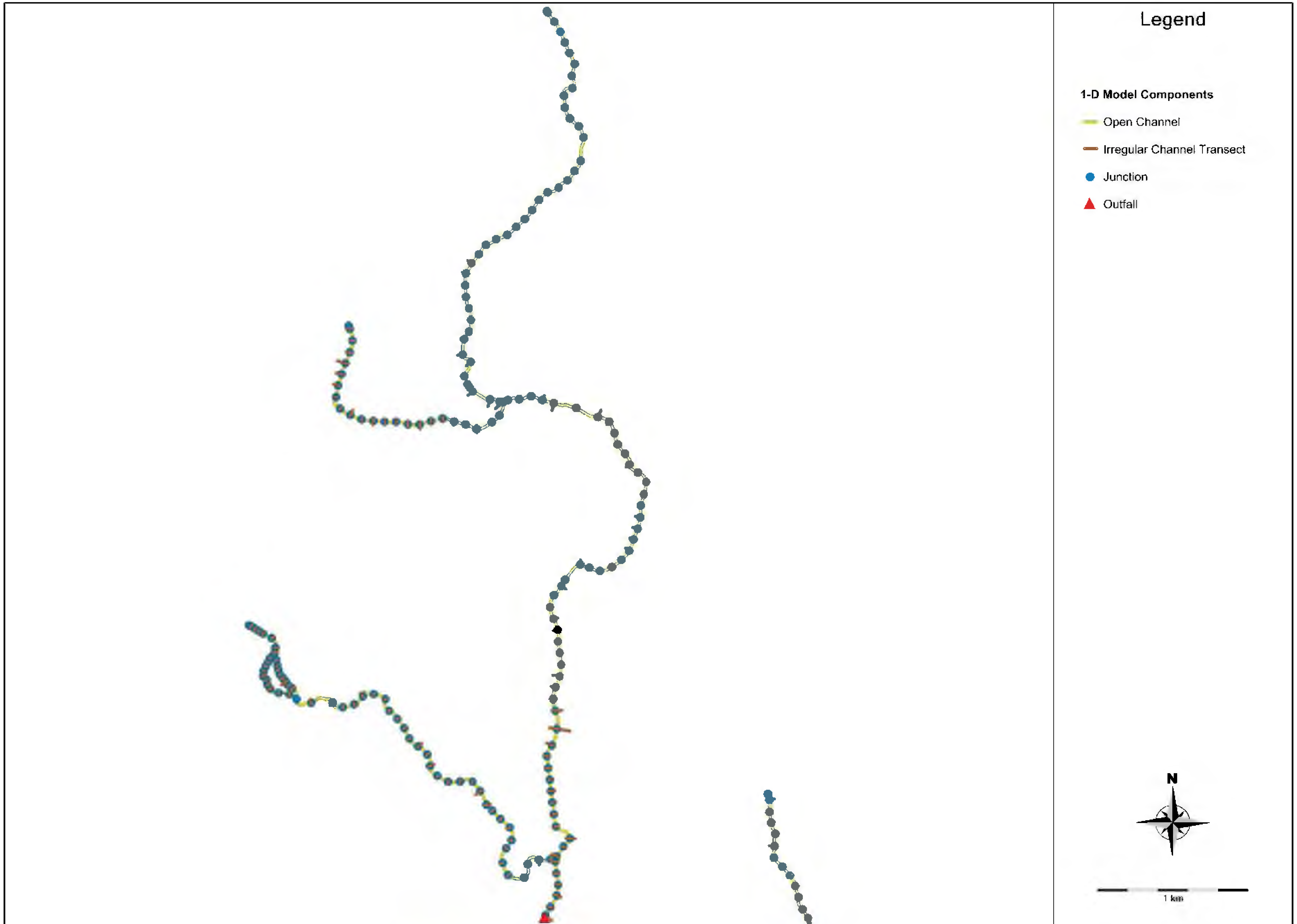


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 1.05
FEMA FLOOD INSURANCE RATE MAP



First Solar

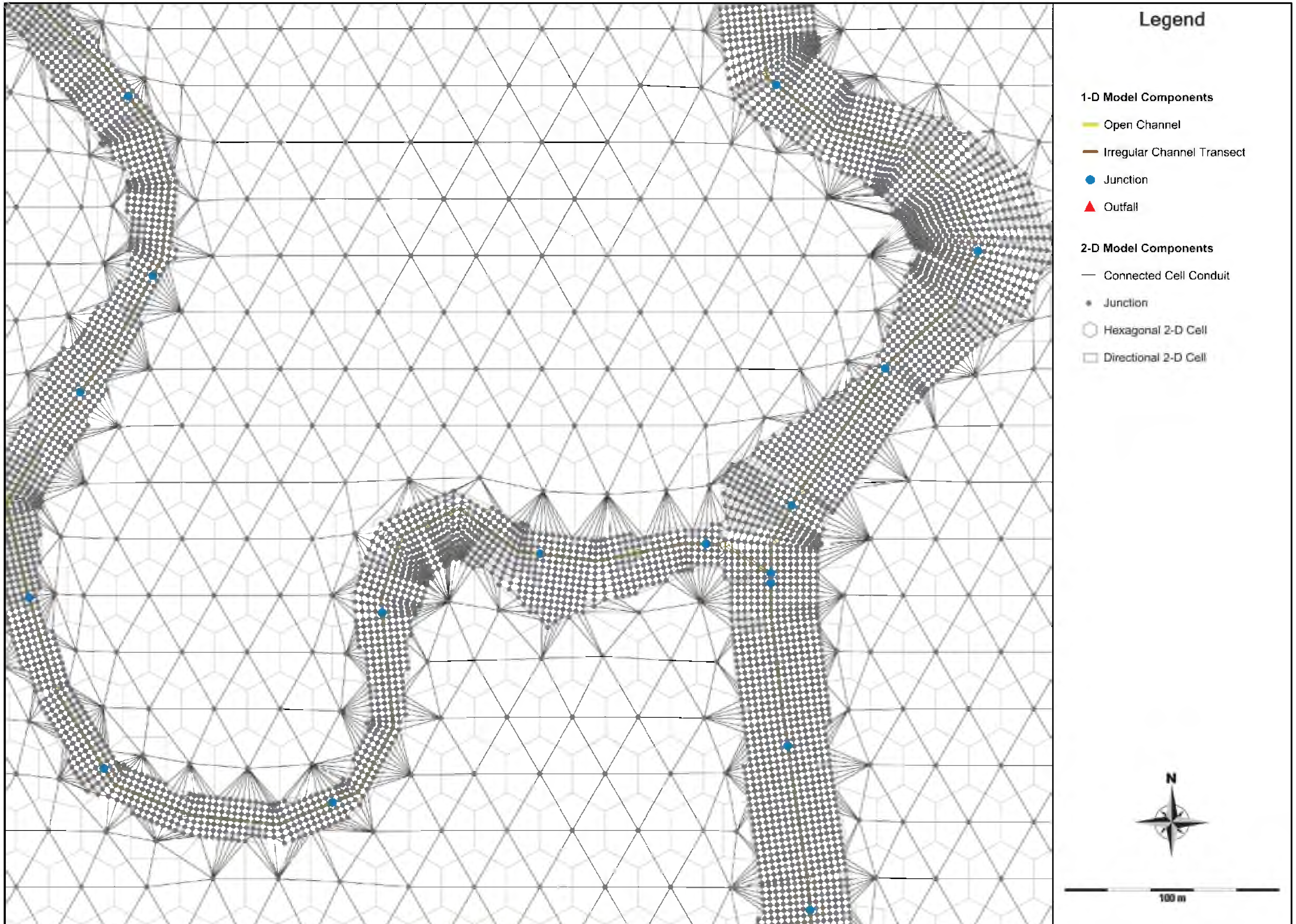
WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.01
1–D MODEL OVERALL MAP

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.02
1-D MODEL CLOSE-UP MAP

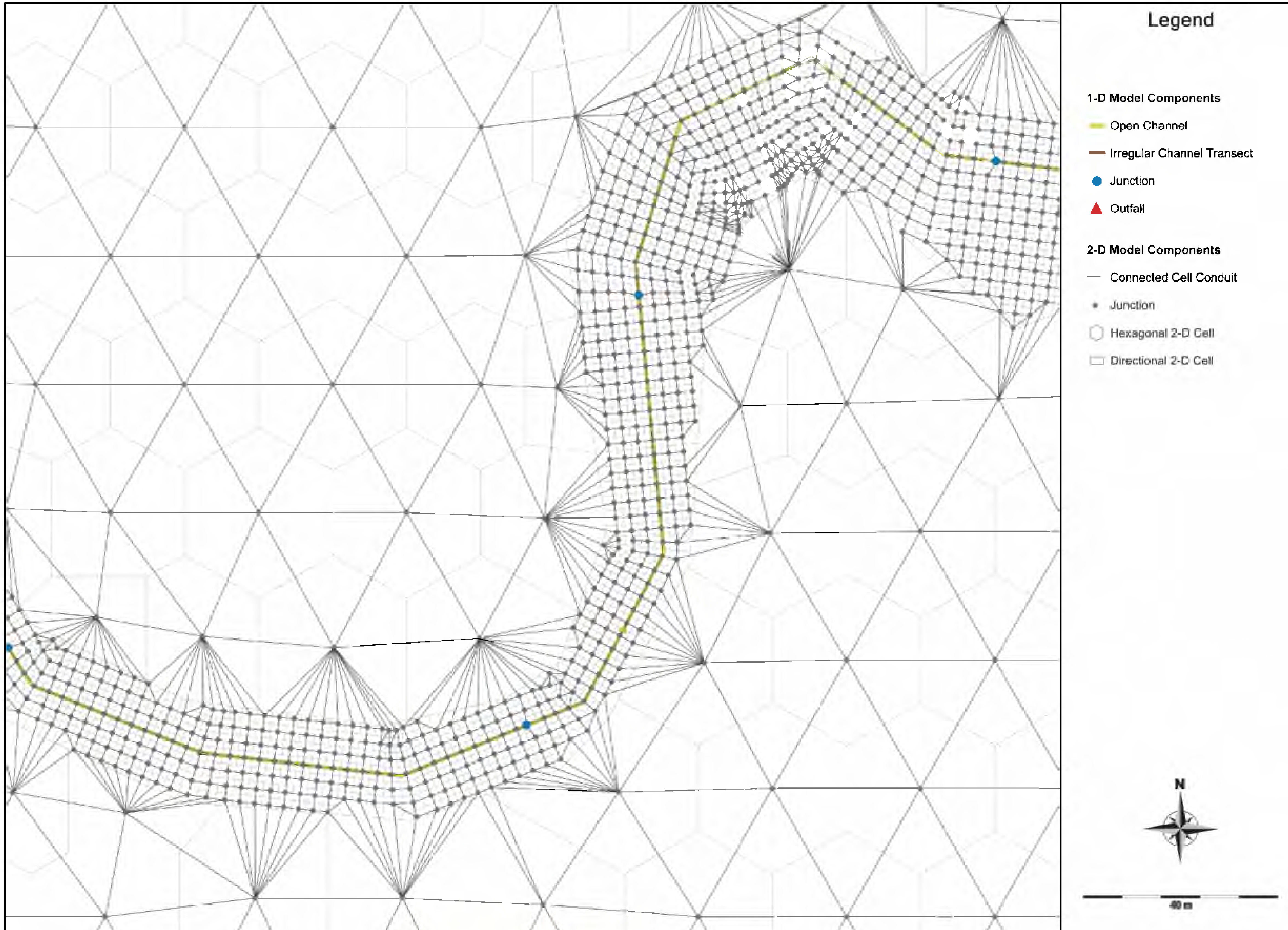


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.03
2–D MODEL UNRENDERED CELLS
CLOSE–UP

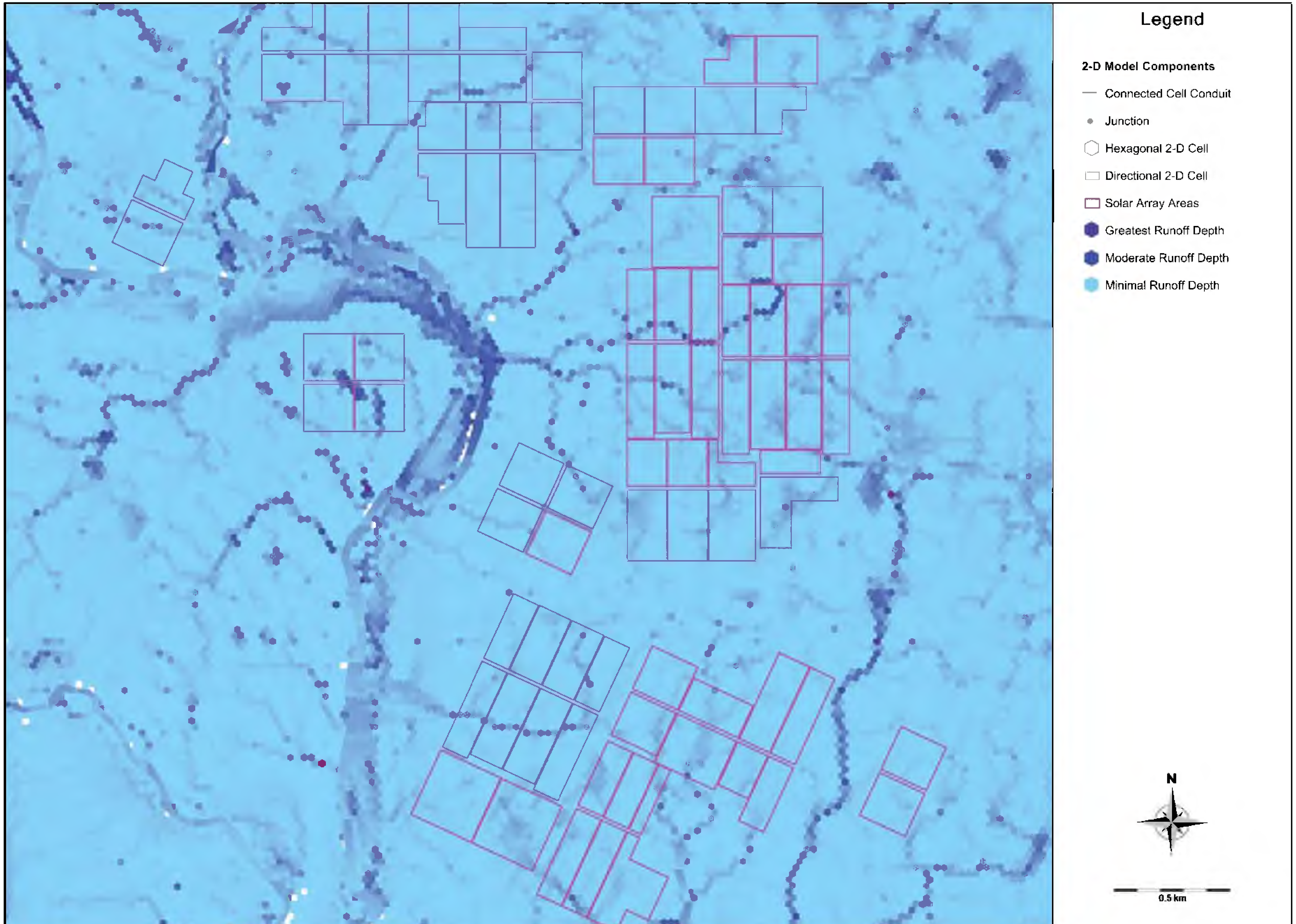


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.04
2–D MODEL UNRENDERED CELLS
CLOSE–UP

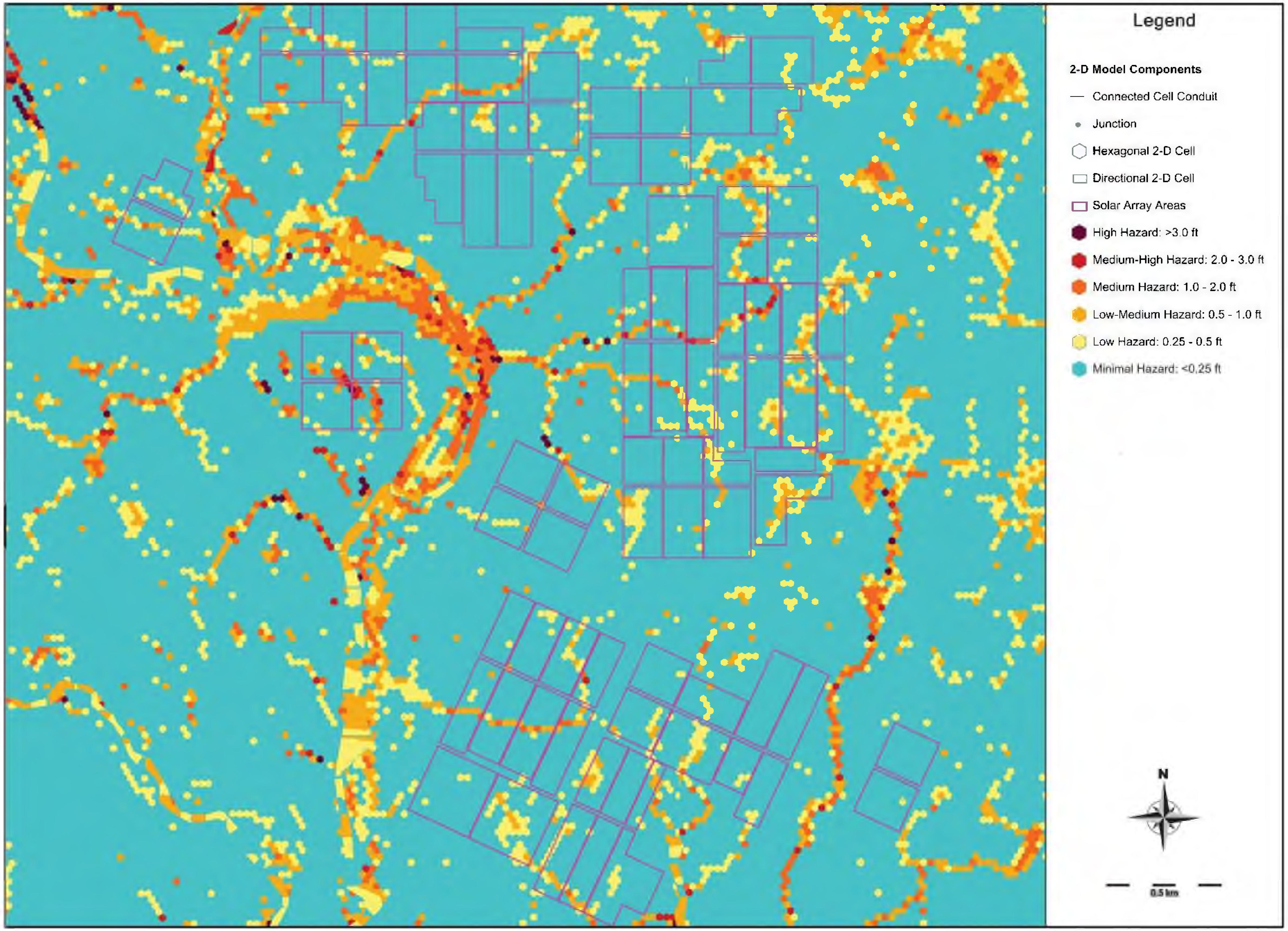


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.05
2 YR EXISTING RUNOFF DEPTH
GRADIENT MAP

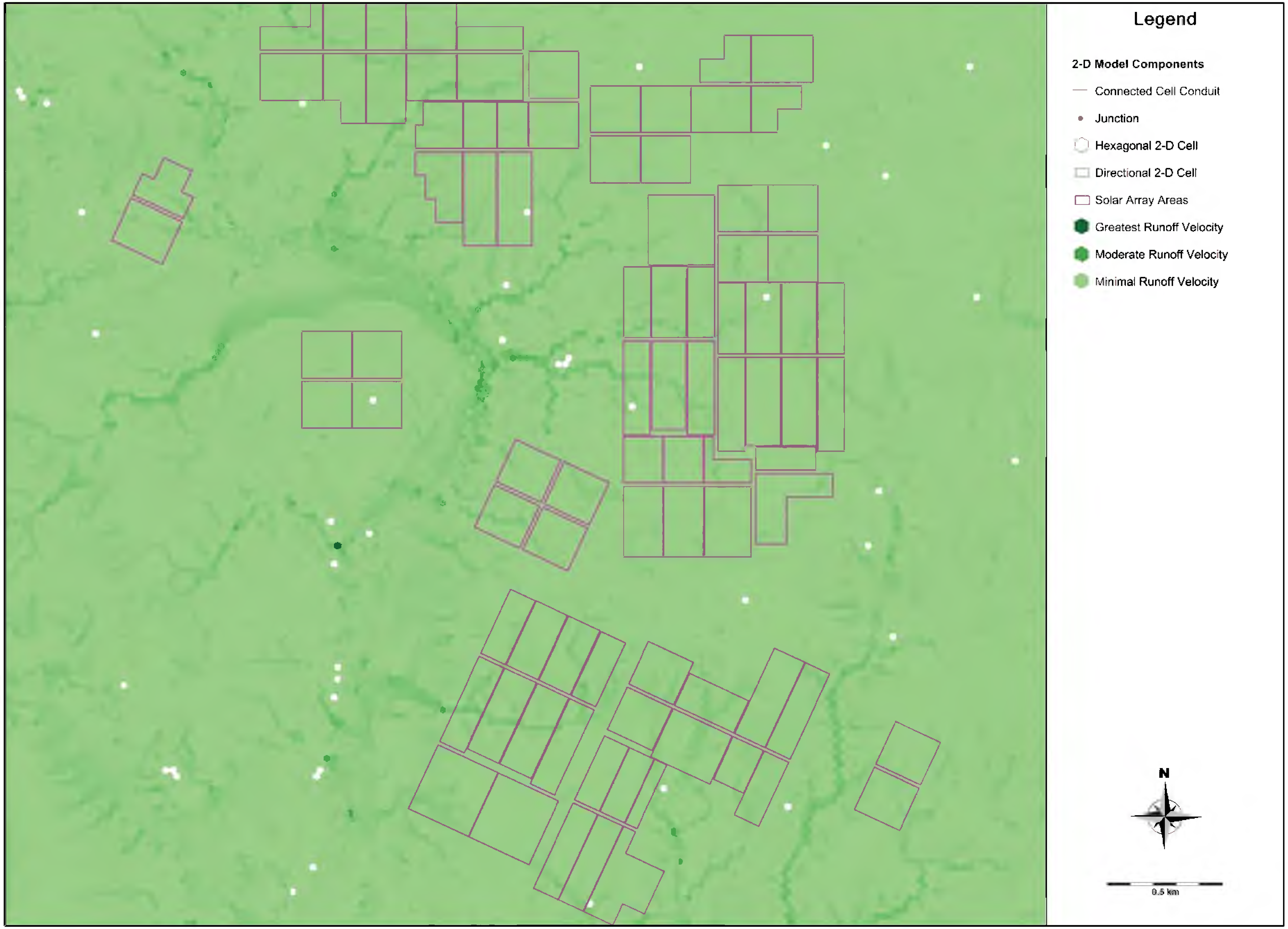


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.06
2 YR EXISTING RUNOFF DEPTH
HAZARD MAP

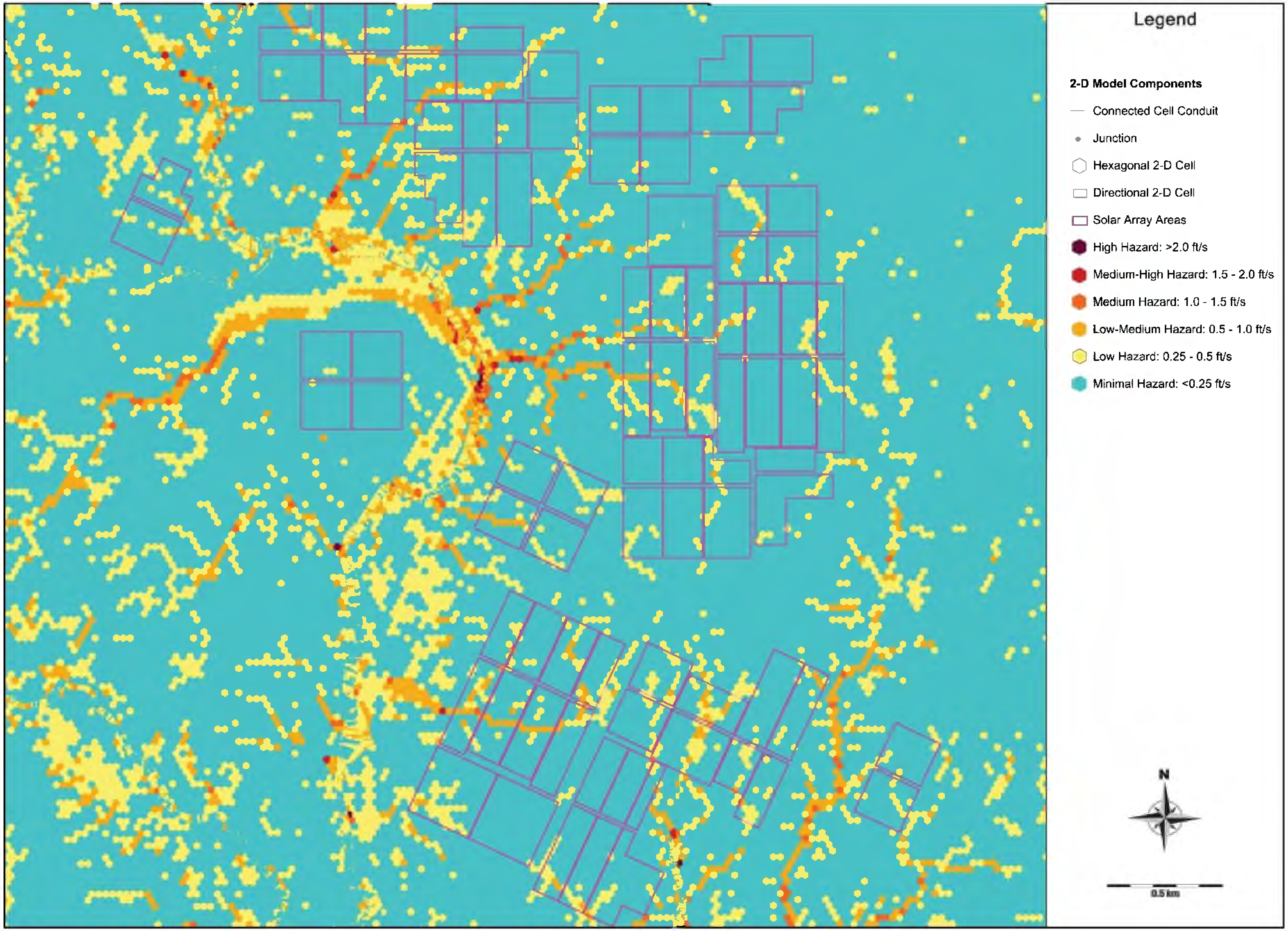


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.07
2 YR EXISTING RUNOFF VELOCITY GRADIENT MAP

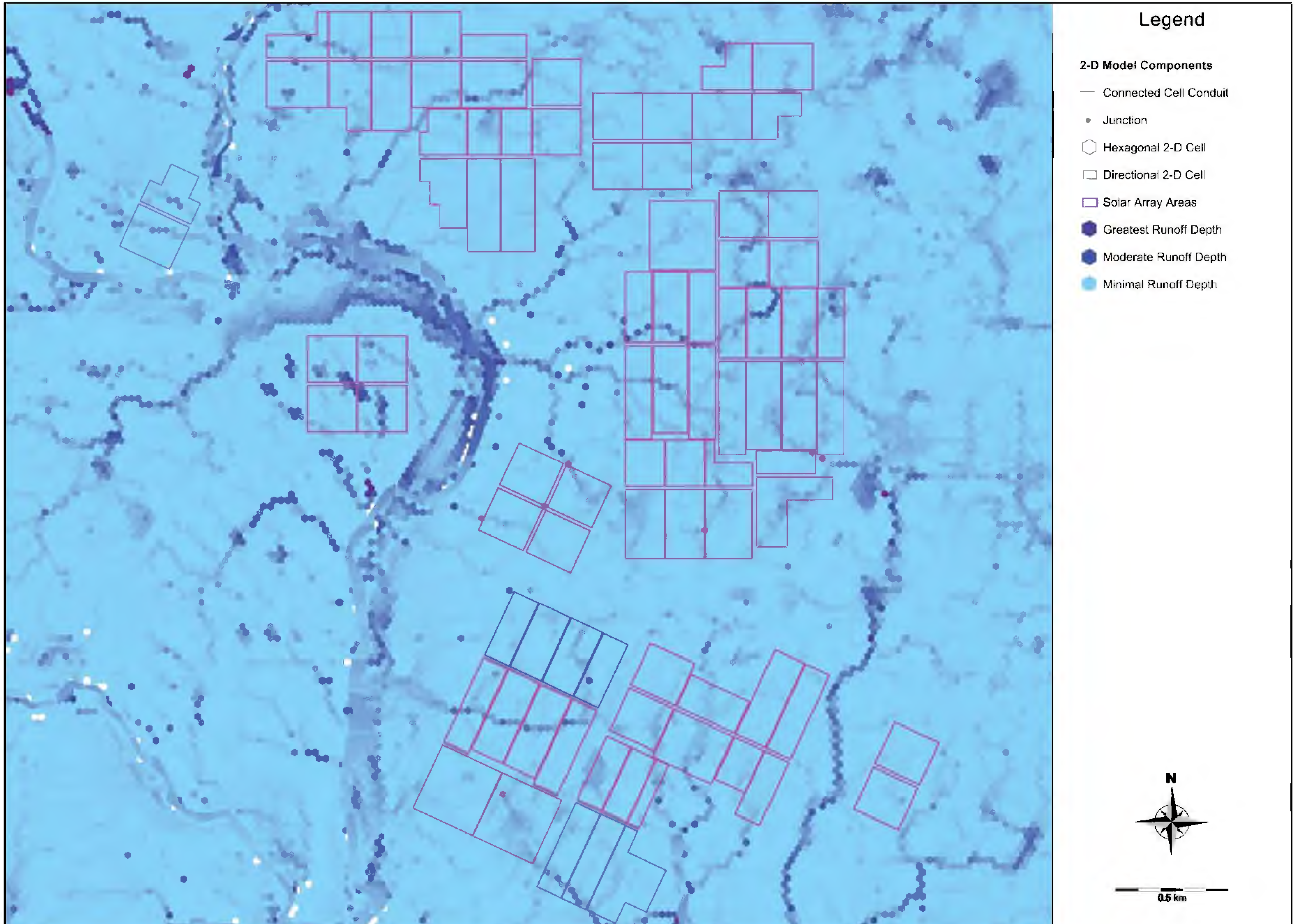


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.08
2 YR EXISTING RUNOFF VELOCITY HAZARD MAP

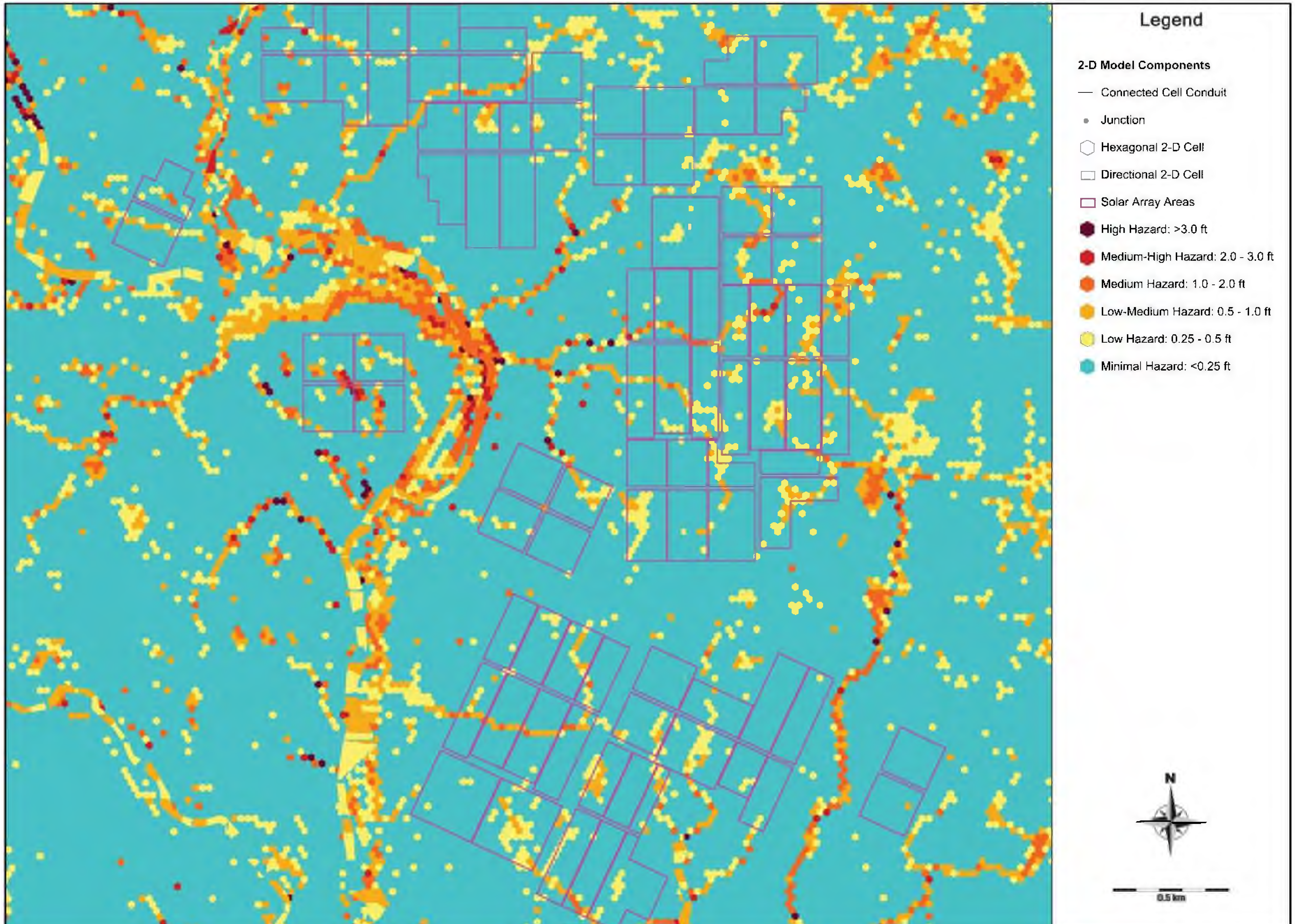


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.09
2 YR PROPOSED RUNOFF DEPTH GRADIENT MAP

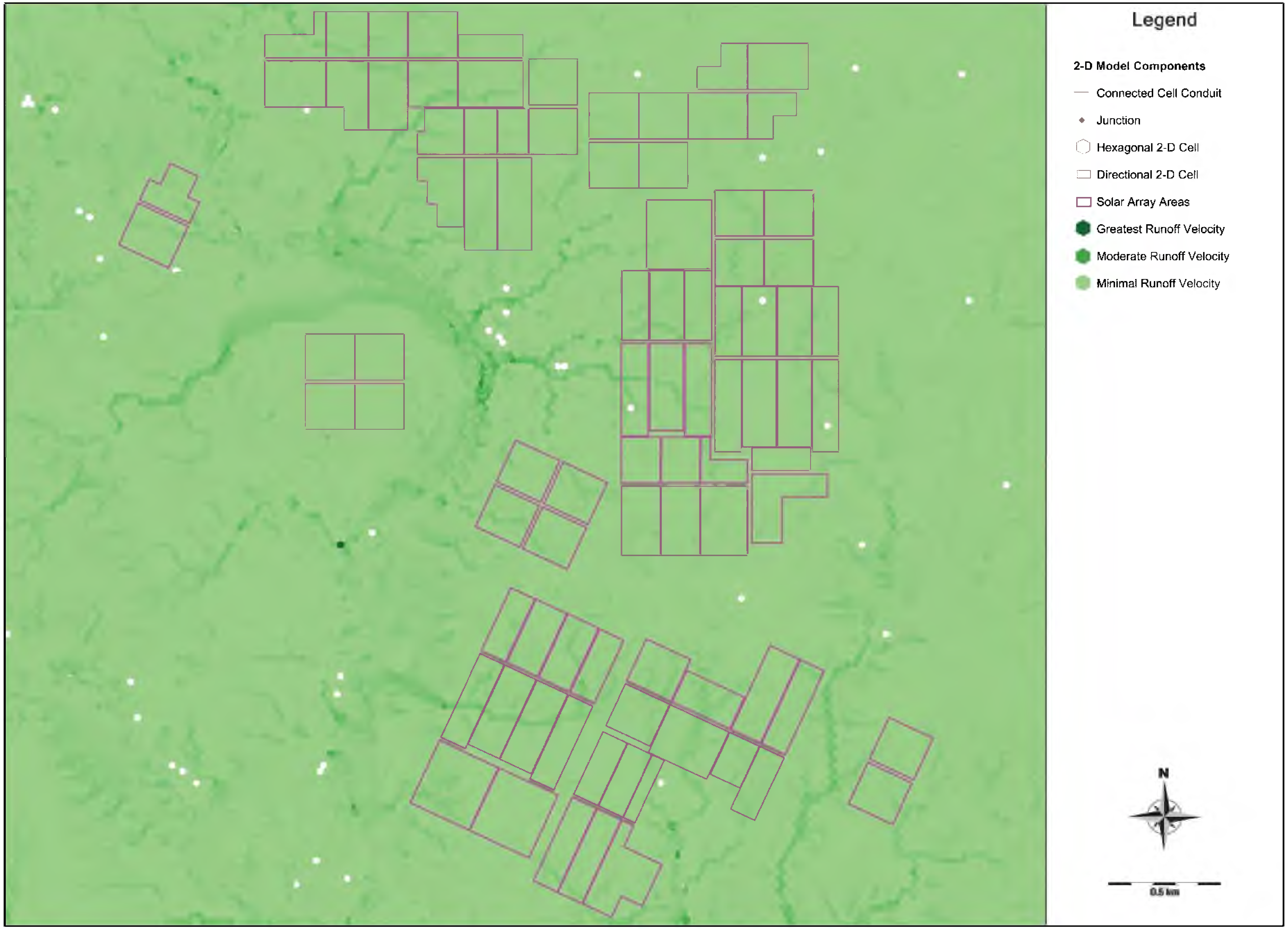


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.10
2 YR PROPOSED RUNOFF DEPTH
HAZARD MAP

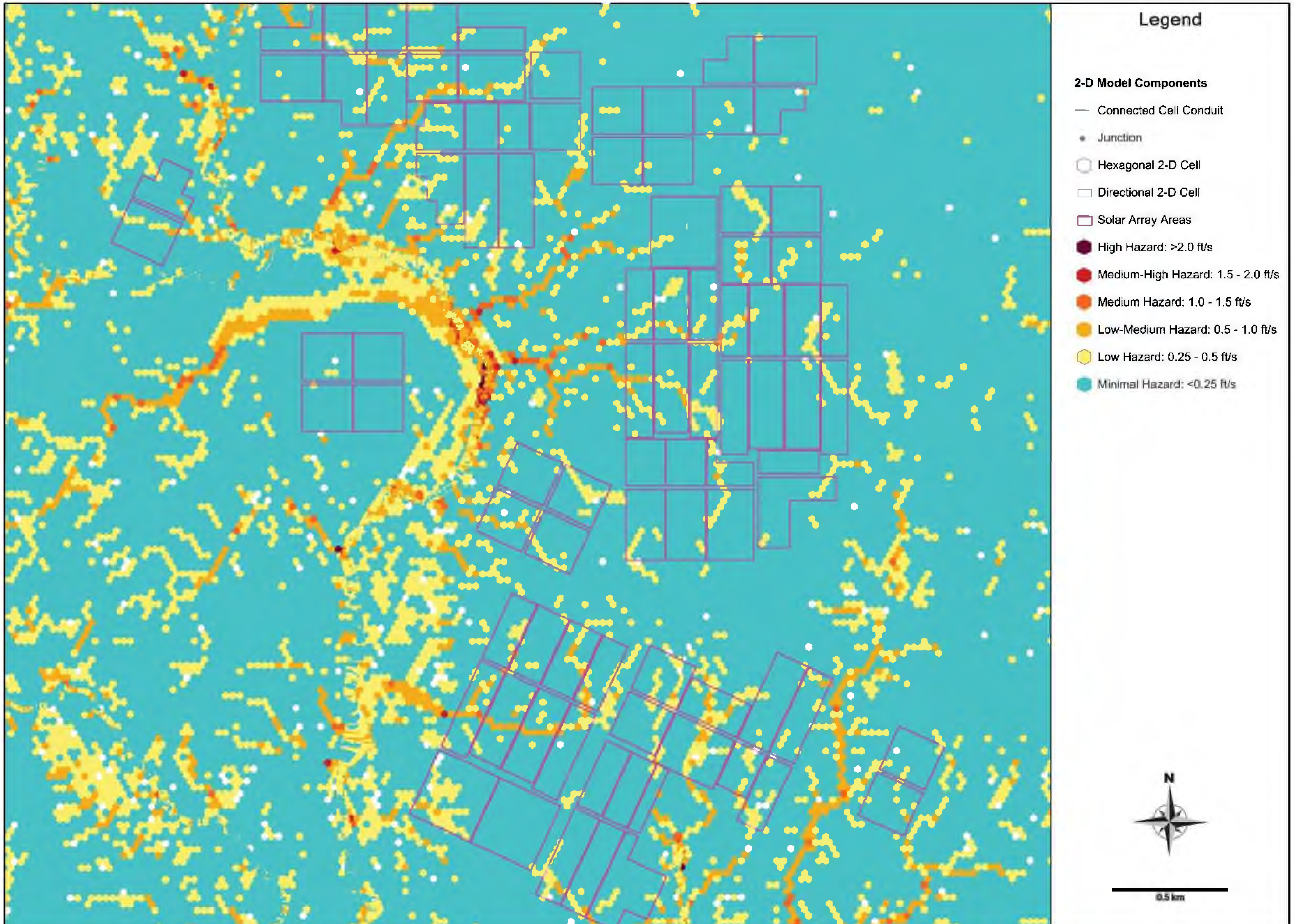


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.11
2 YR PROPOSED RUNOFF VELOCITY GRADIENT MAP

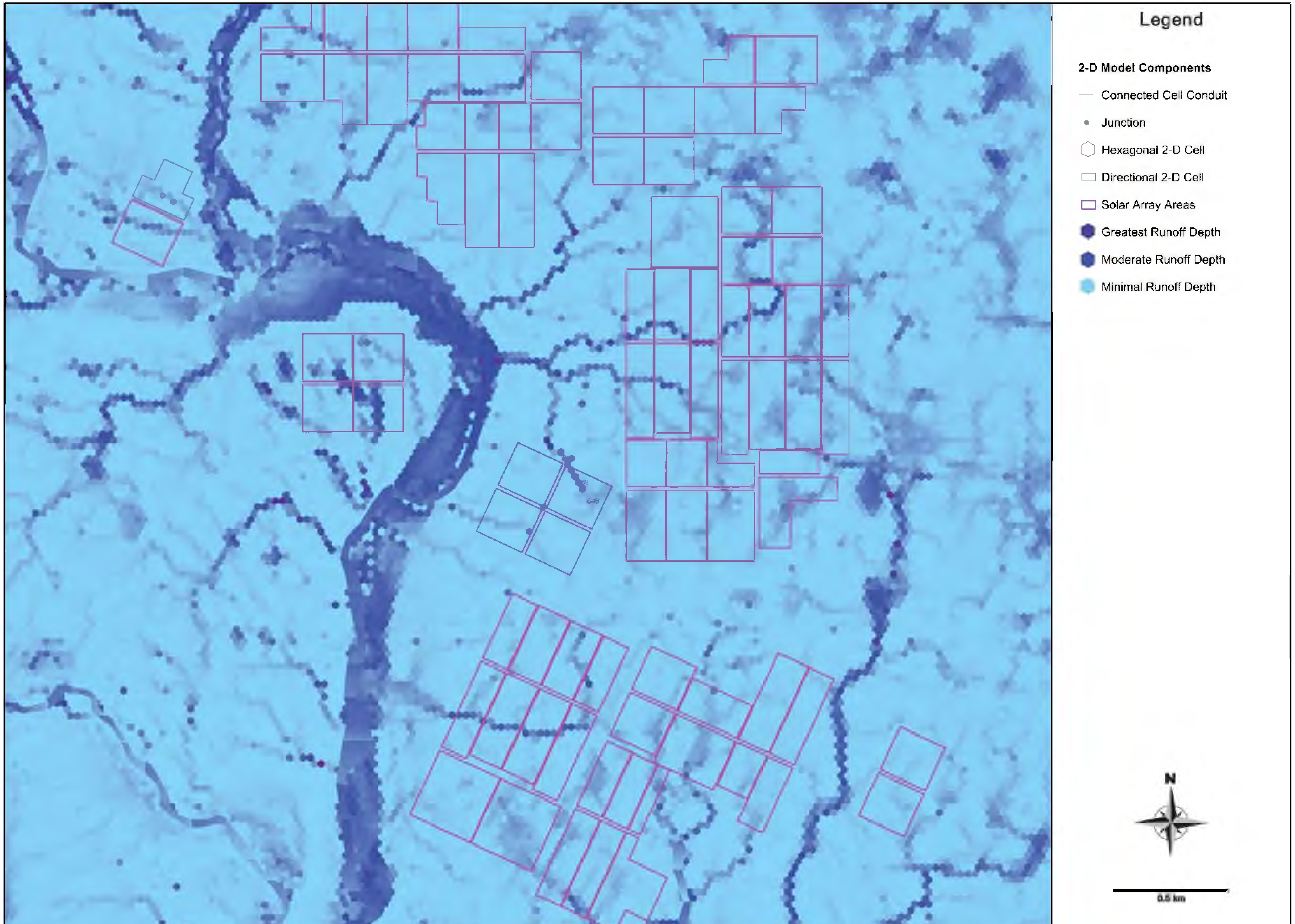


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.12
2 YR PROPOSED RUNOFF VELOCITY HAZARD MAP

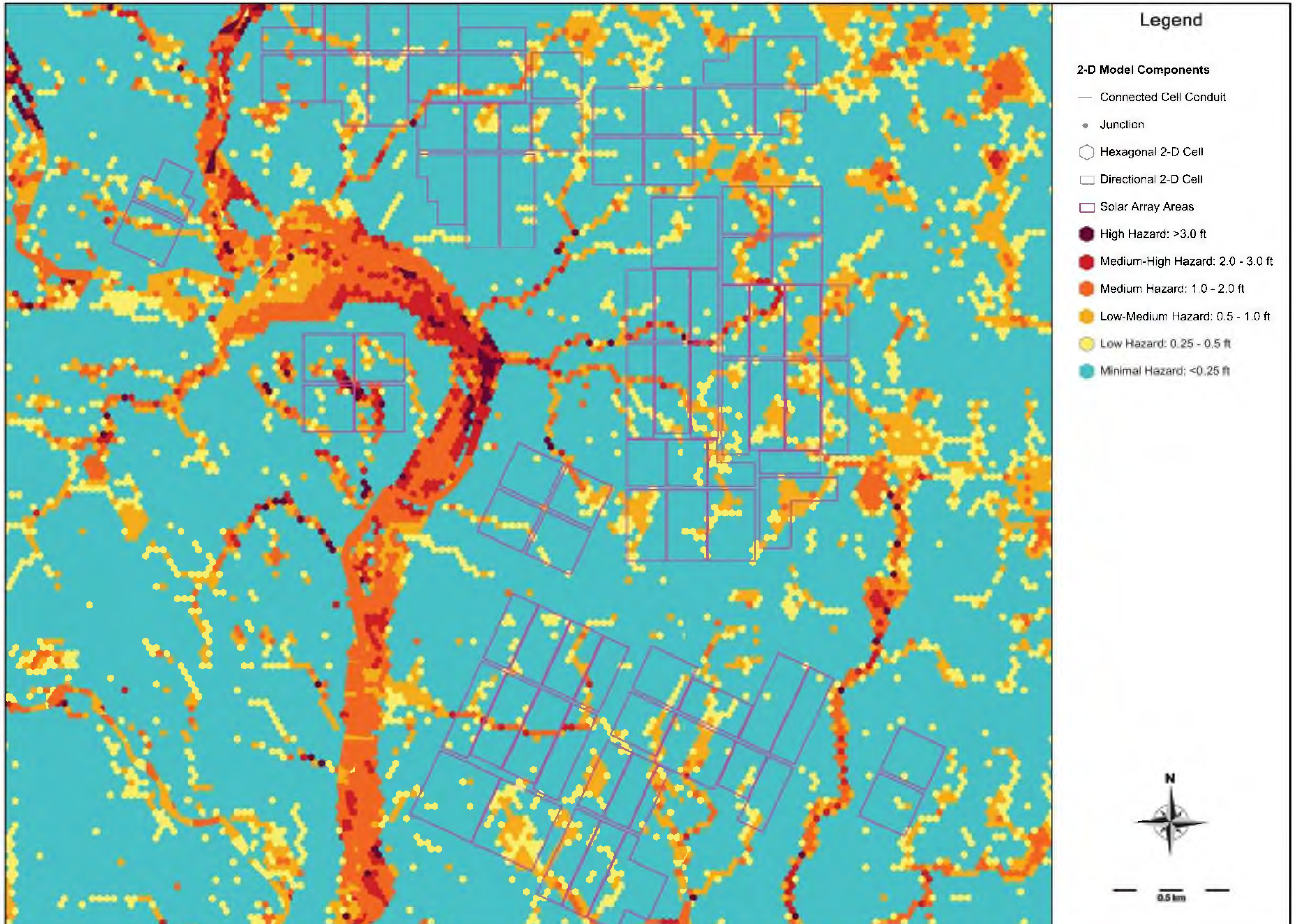


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.13
100 YR EXISTING RUNOFF DEPTH GRADIENT MAP

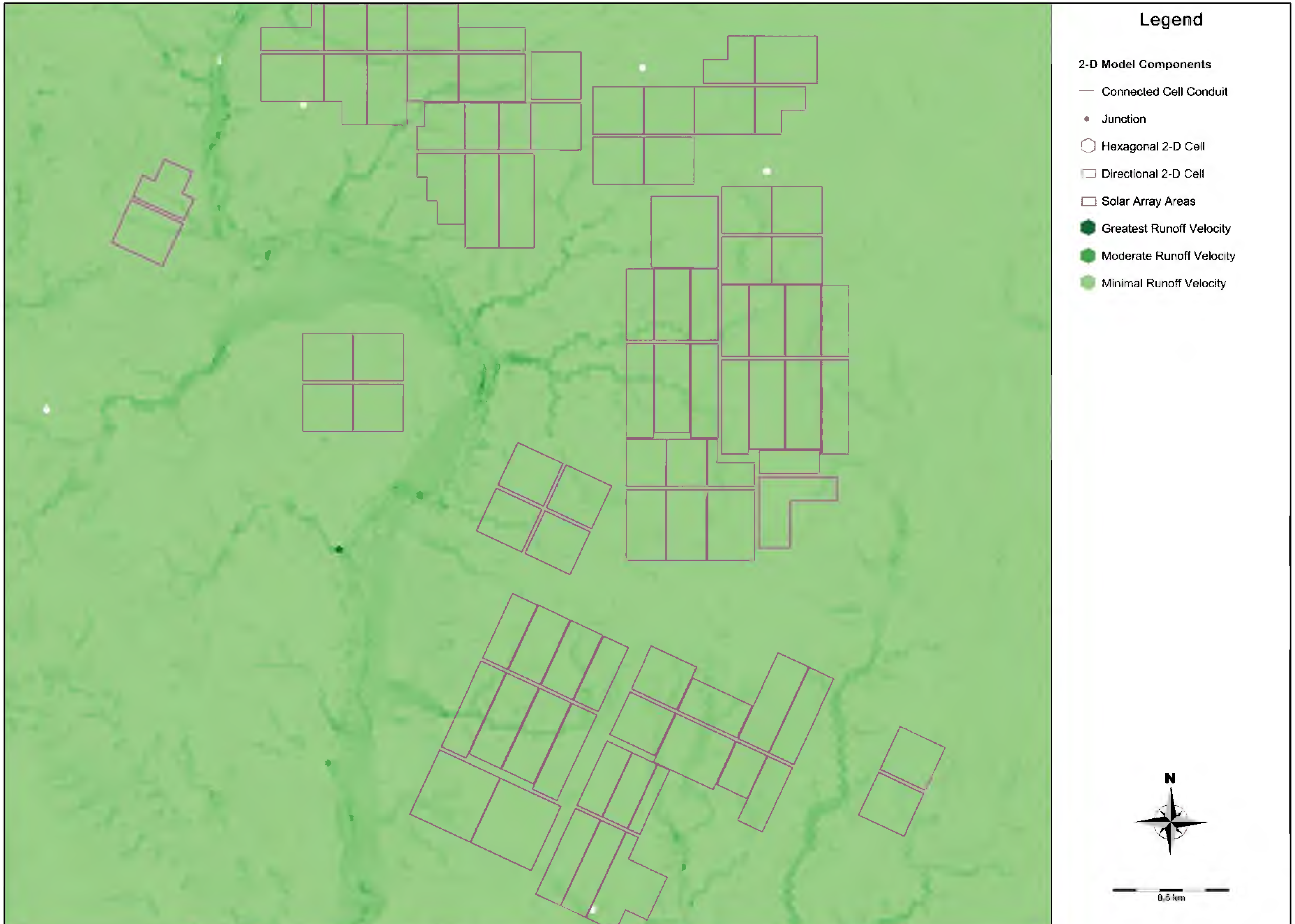


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.14
100 YR EXISTING RUNOFF DEPTH HAZARD MAP

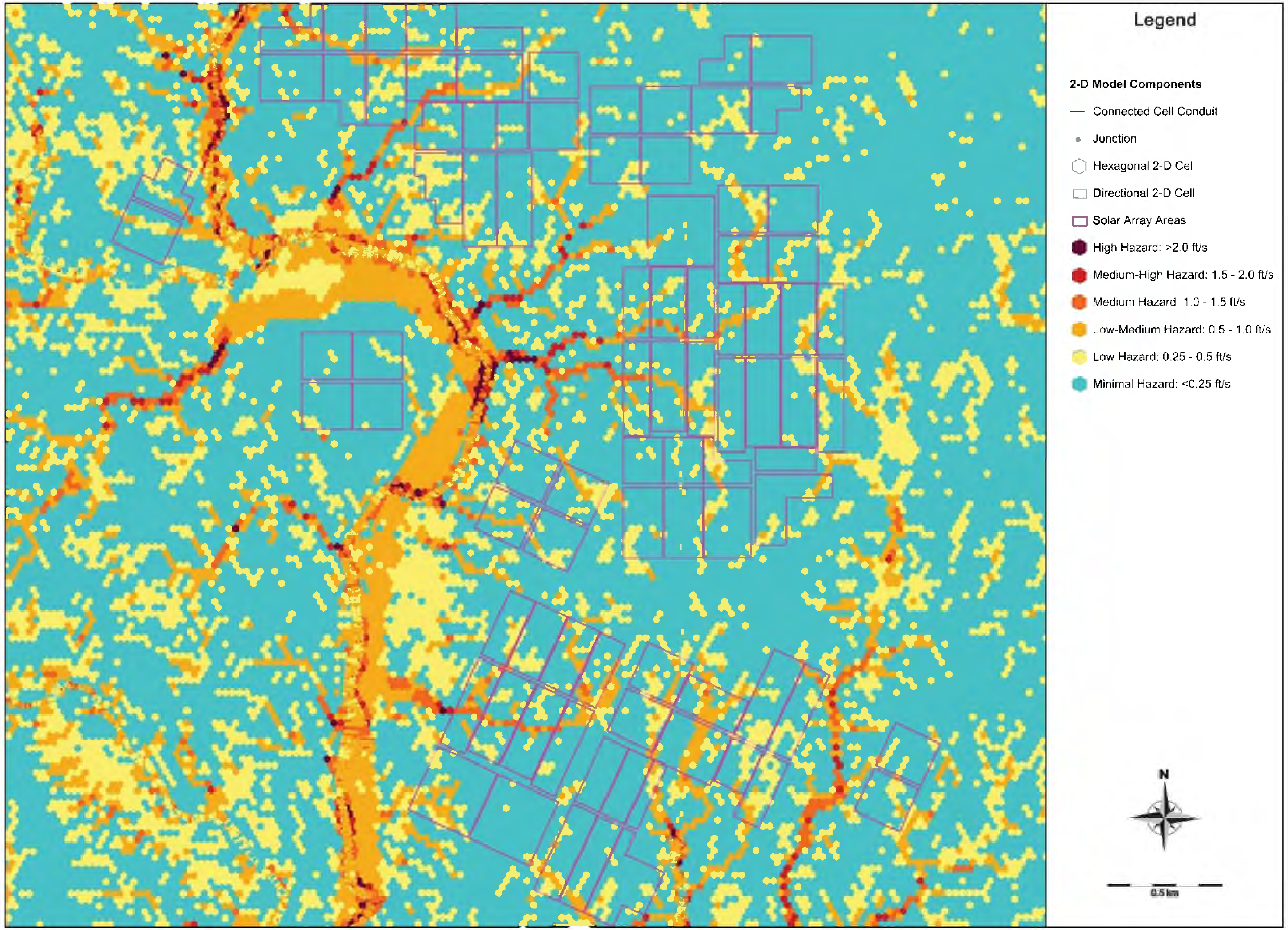


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.15
100 YR EXISTING RUNOFF VELOCITY
GRADIENT MAP

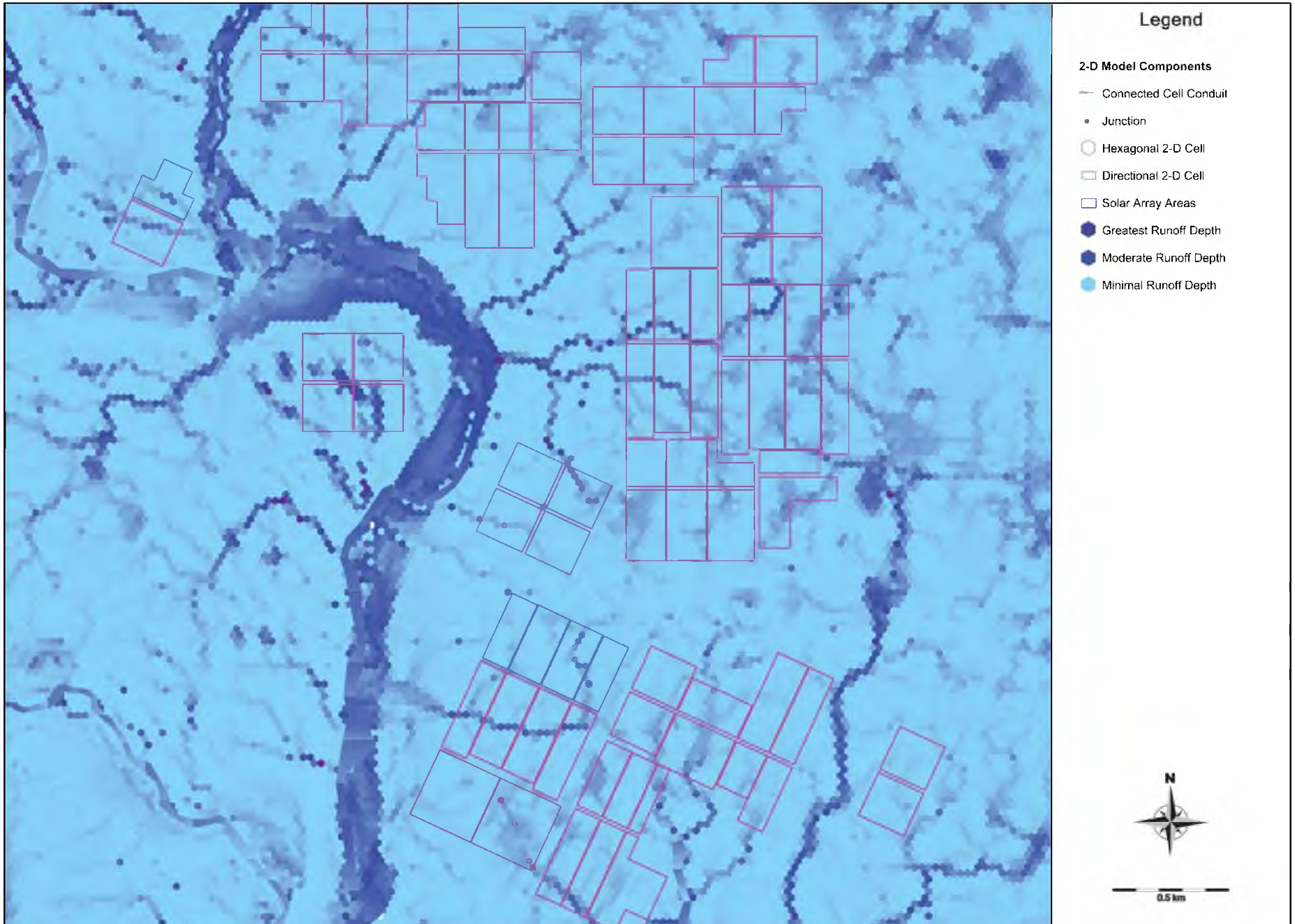


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.16
100 YR EXISTING RUNOFF VELOCITY HAZARD MAP

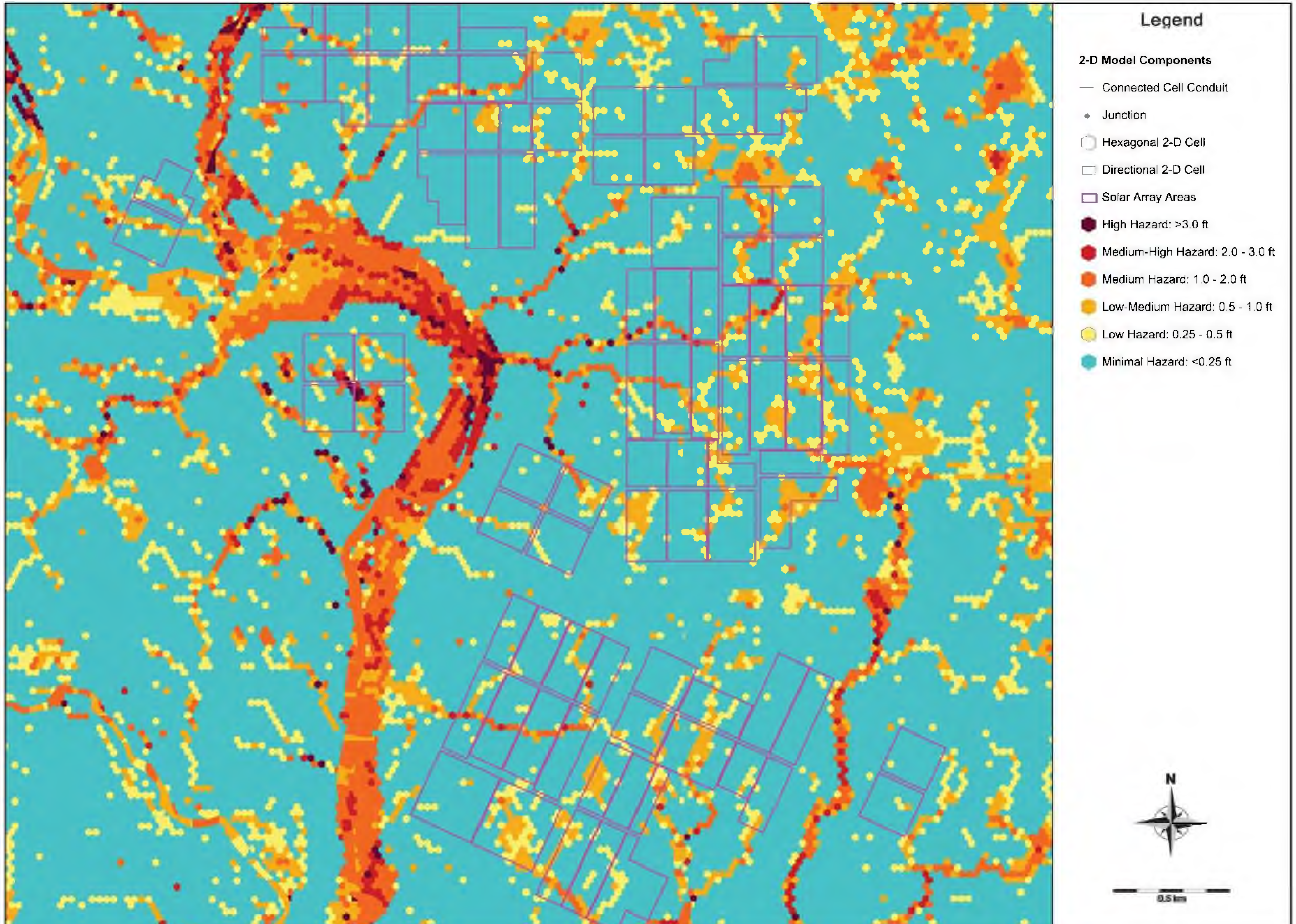


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.17
100 YR PROPOSED RUNOFF DEPTH GRADIENT MAP

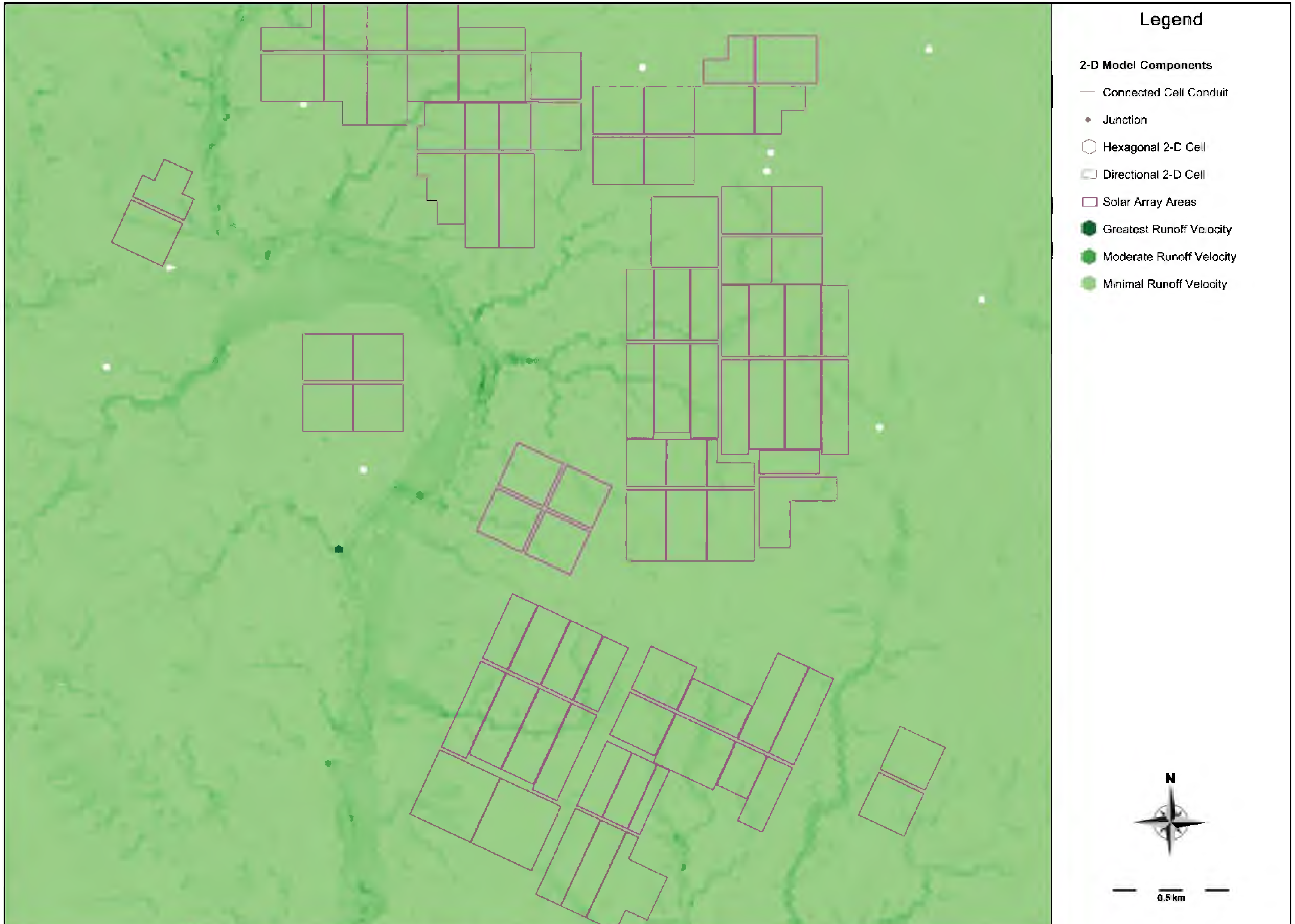


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.18
100 YR PROPOSED RUNOFF DEPTH HAZARD MAP

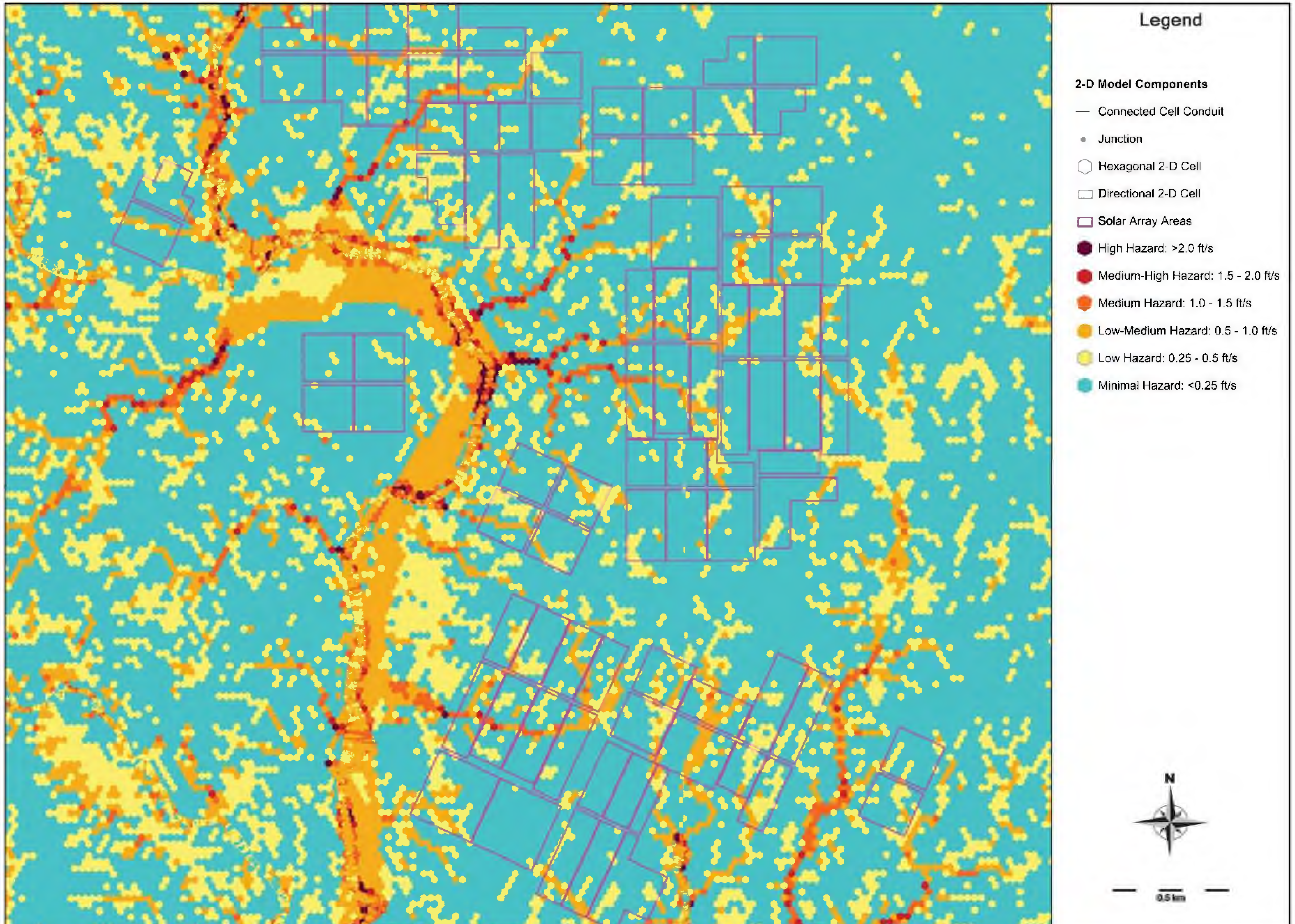


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.19
100 YR PROPOSED RUNOFF VELOCITY GRADIENT MAP

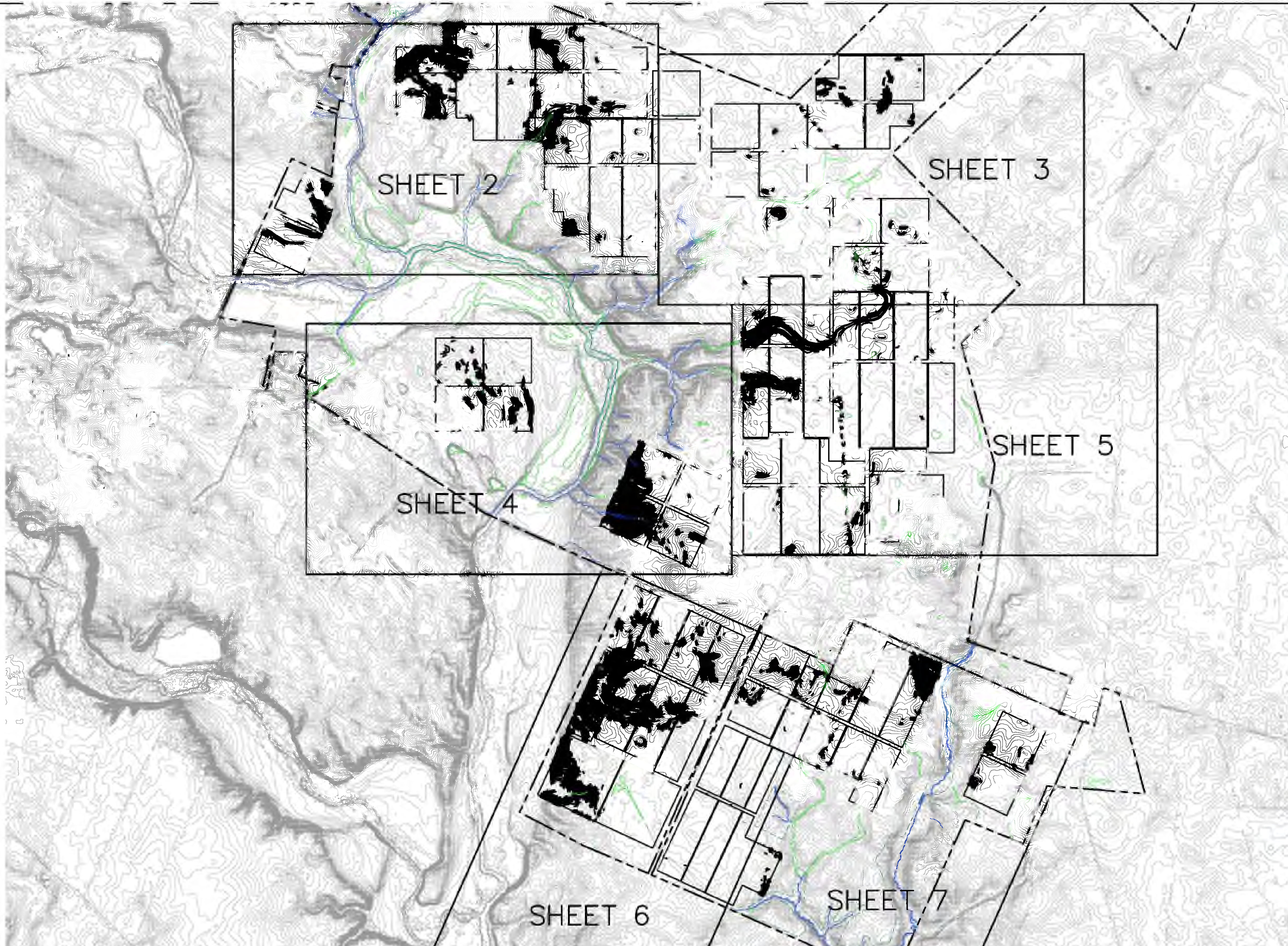


First Solar

WESTON SOLUTIONS

FIRST SOLAR
MADISON SOLAR ENERGY PROJECT
MADISON COUNTY, OH

FIGURE 2.20
100 YR PROPOSED RUNOFF VELOCITY HAZARD MAP



Proposed Stormwater Management Measures Legend

- Open Channel
- Diversion Berm
- Conduit
- Flow Direction
- Inlet
- Detention Basin

LEGEND

- PROPERTY LINE
- EXISTING GRADE CONTOURS
- WETLANDS
- WATER LINE
- EXISTING GRADE CONTOURS
- PROPOSED GRADE CONTOURS
- SLOPE 6–15%
- SLOPES GREATER THAN 15%

N

0 750'

SCALE

NO	DATE	APPR.	REVISION	NO	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO

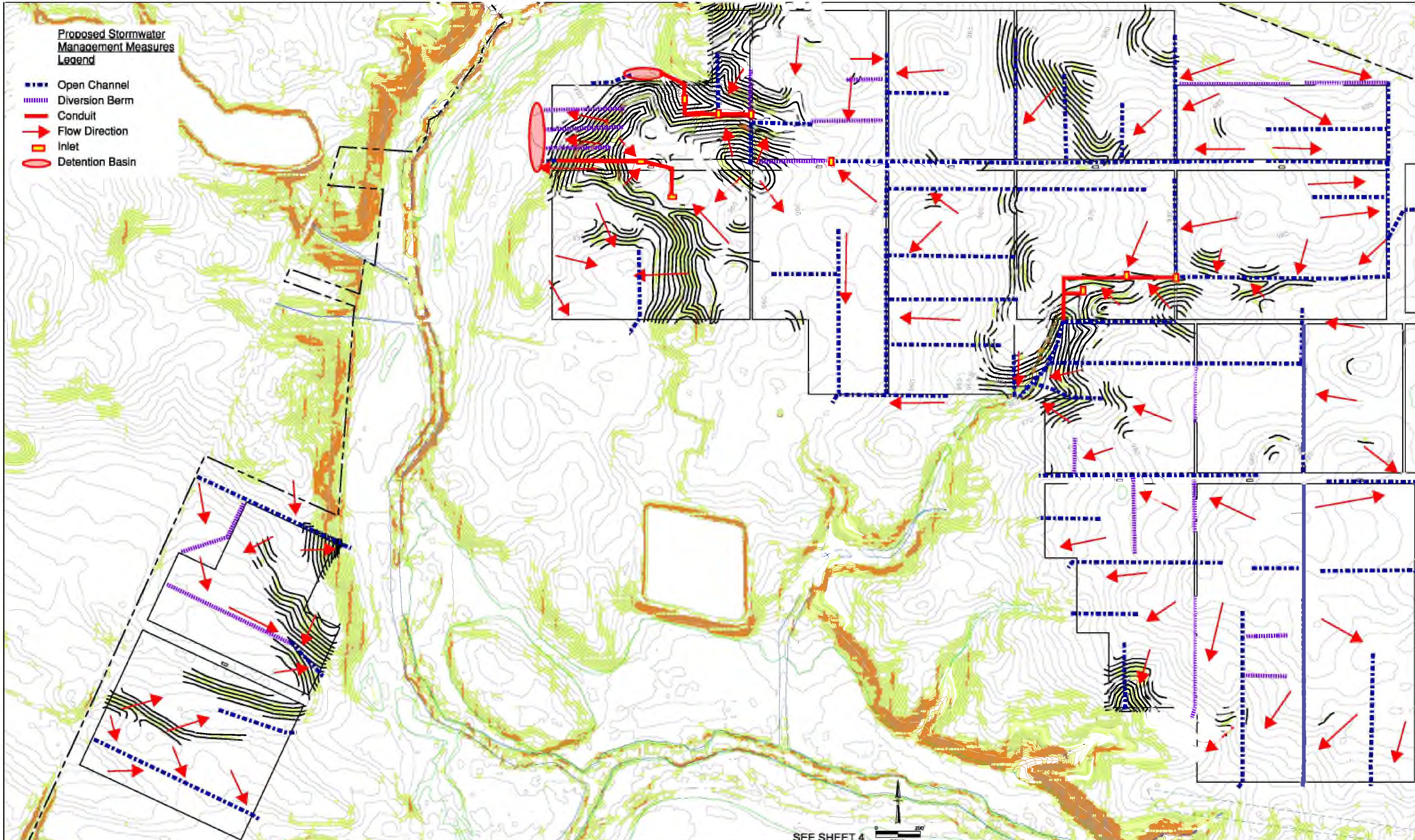
WESTON SOLUTIONS
MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

FIGURE 4.02
PRELIMINARY STORMWATER MANAGEMENT KEY PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	1	—
SCALE: AS SHOWN	W.O. NO.	SHT. 1 OF 7	

\\VFS-MADISON\dem3m2fl_conts-PR-GRADE-NEW.dwg, 12/3/2019 9:18:15 AM, hernandd



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

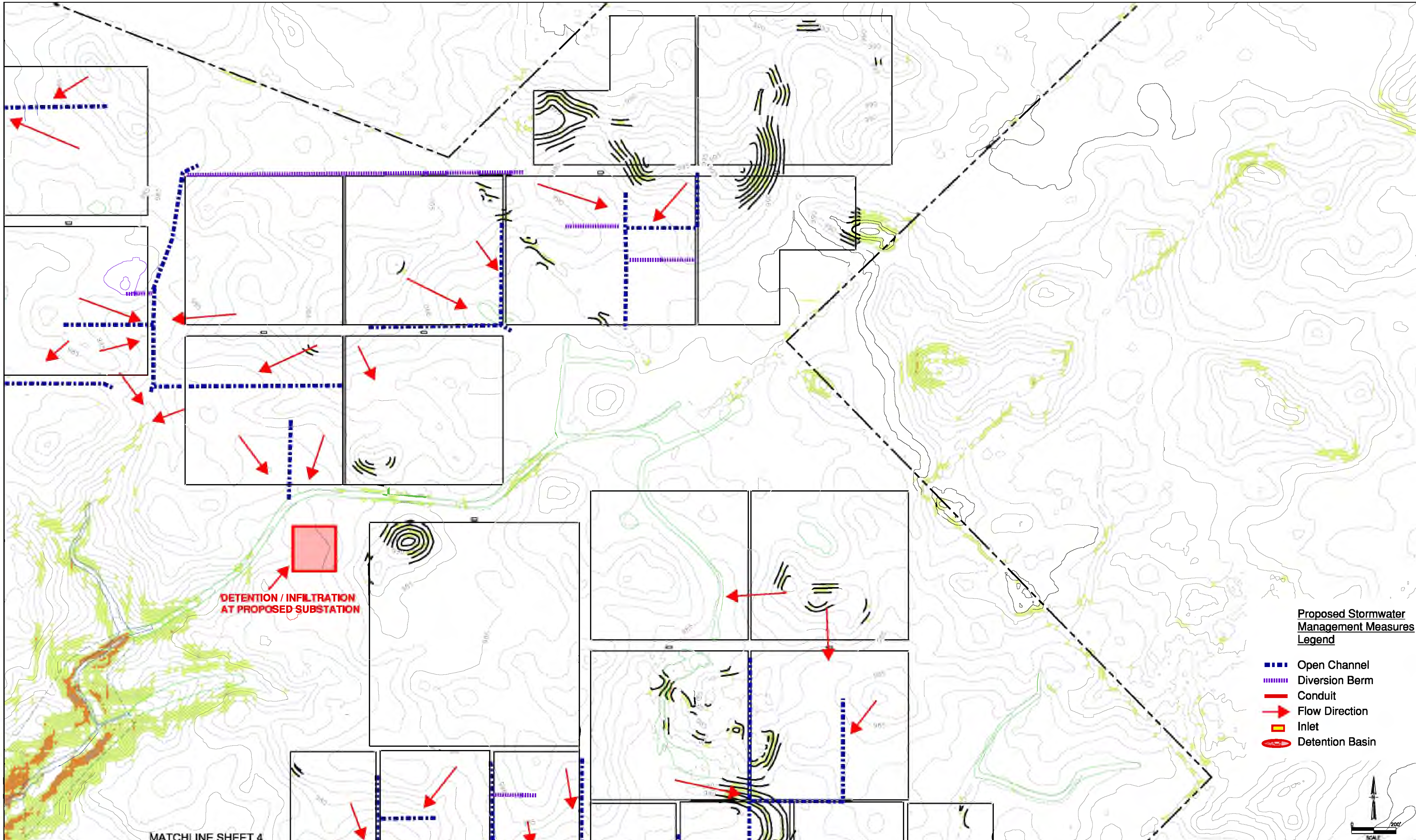
MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS
MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

FIGURE 4.03
PRELIMINARY STORMWATER MANAGEMENT
SHEET 2 OF 7

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	2	—
SCALE: AS SHOWN	W.O. NO.	SHT. 2 OF 7	



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

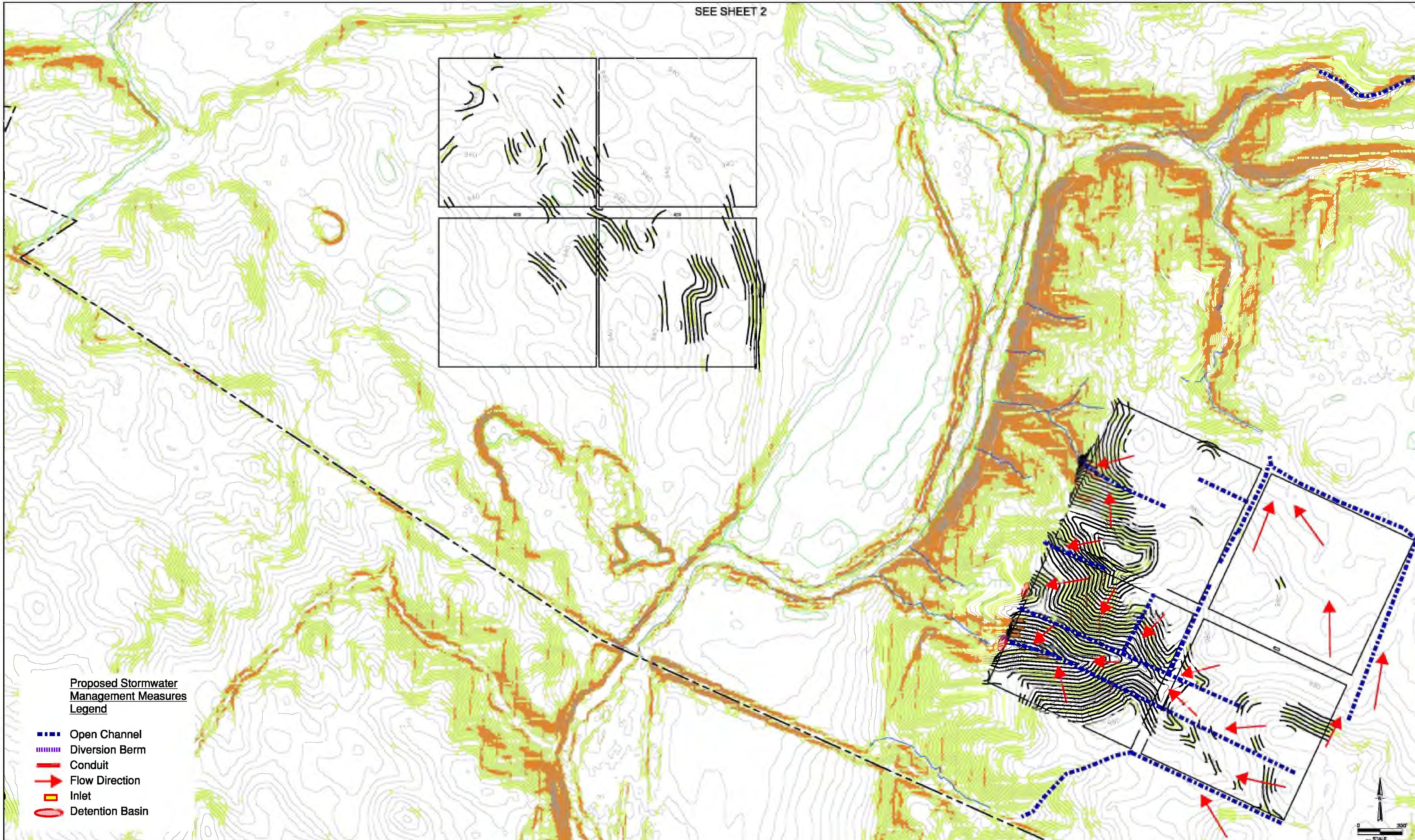
MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS
MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

FIGURE 4.04
PRELIMINARY STORMWATER MANAGEMENT
SHEET 3 OF 7

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	3	—
SCALE: AS SHOWN	W.O. NO.	SHT 3 OF 7	



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

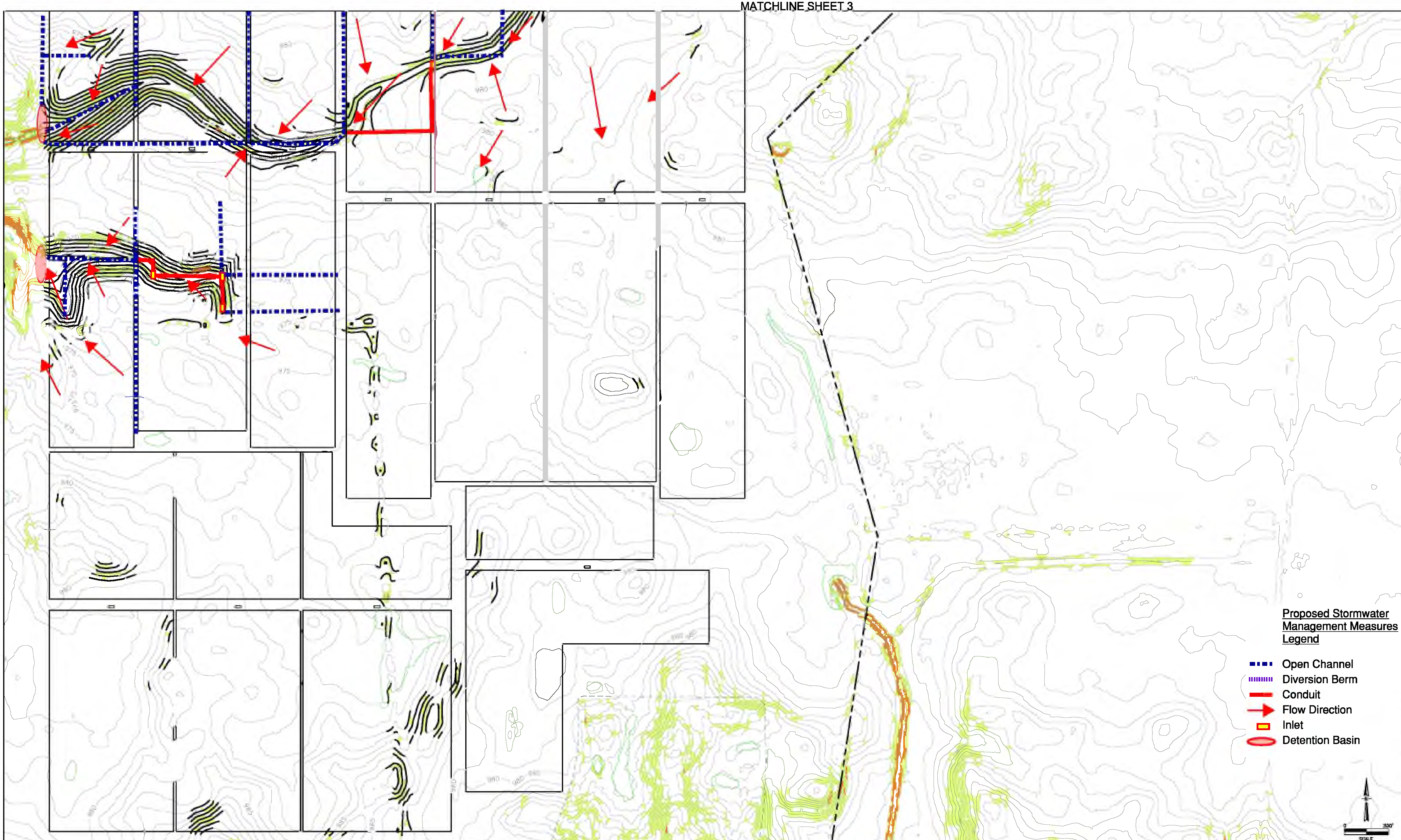
MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO
WESTON SOLUTIONS
MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

FIGURE 4.05
PRELIMINARY STORMWATER MANAGEMENT
SHEET 4 OF 7

DRAWN	DATE	DWG. NO	REV. NO
DCH	NOV. 2019	4	—
SCALE: AS SHOWN	W.O. NO.	SHT. 4 OF 7	

J:\FS-MADISON\dem3runf_conts-PR-GRADE-NEW.dwg, 12/3/2019 9:19:02 AM, hernandd



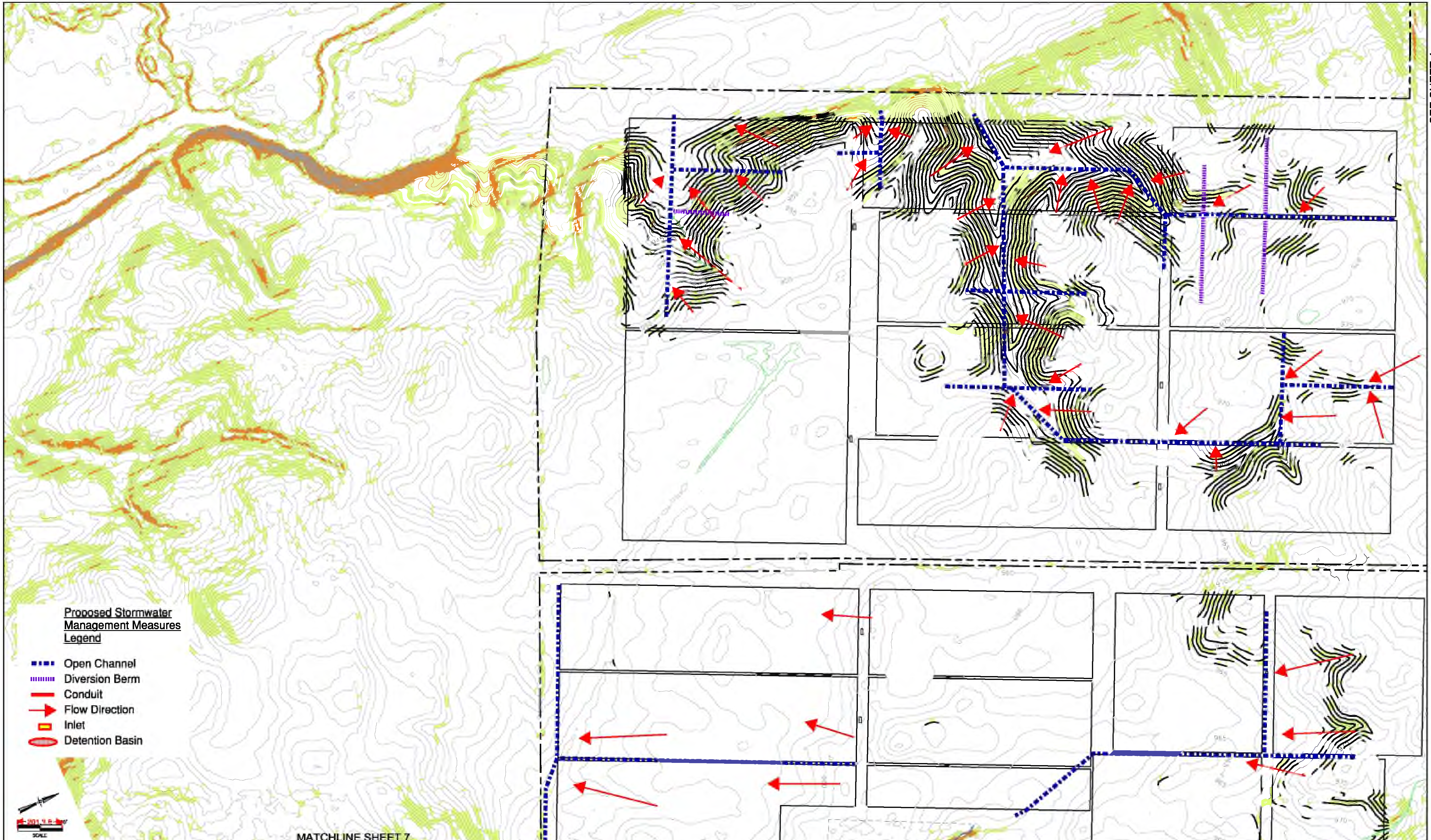
MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS

MUNDELEIN ILLINOIS

FIGURE 4.06
PRELIMINARY STORMWATER MANAGEMENT
SHEET 5 OF 7

DRAWN	DATE	DWG. NO.
DCH	NOV. 2019	5
SCALE	W.O. NO.	SHT 5 OF 7
AS SHOWN		



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

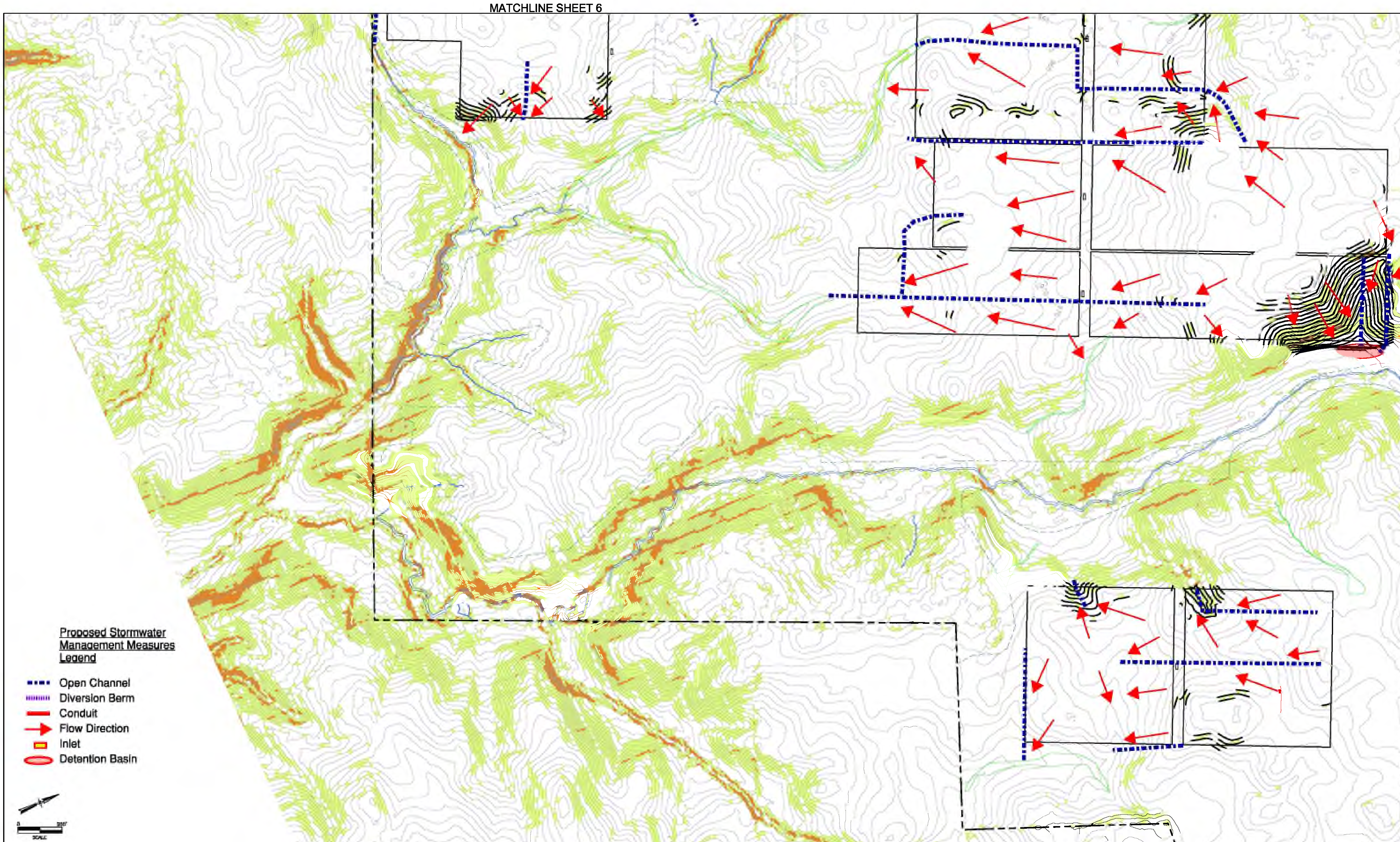
MADISON SOLAR
FIRST SOLAR
LONDON — MADISON COUNTY — OHIO

WESTON SOLUTIONS
MUNDELEIN — ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PREL. ENG.			
PREL. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

FIGURE 4.07
PRELIMINARY STORMWATER MANAGEMENT
SHEET 6 OF 7

DRAWN	DATE	DWG. NO	REV. NO.
DCH	NOV. 2019	6	—
SCALE: AS SHOWN	W.O. NO.	SHT. 6 OF 7	



NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO
WESTON
MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

FIGURE 4.08
PRELIMINARY STORMWATER MANAGEMENT
SHEET 7 OF 7

DRAWN	DATE	DWG. NO	REV. NO.
DCH	NOV. 2019	7	—
SCALE AS SHOWN	W.O. NO.	SHT. 7 OF 7	

APPENDIX B
SUPPLEMENTAL DOCUMENTS

Madison County, OH Watershed Map

NOAA Atlas 14 Precipitation Frequency Estimates

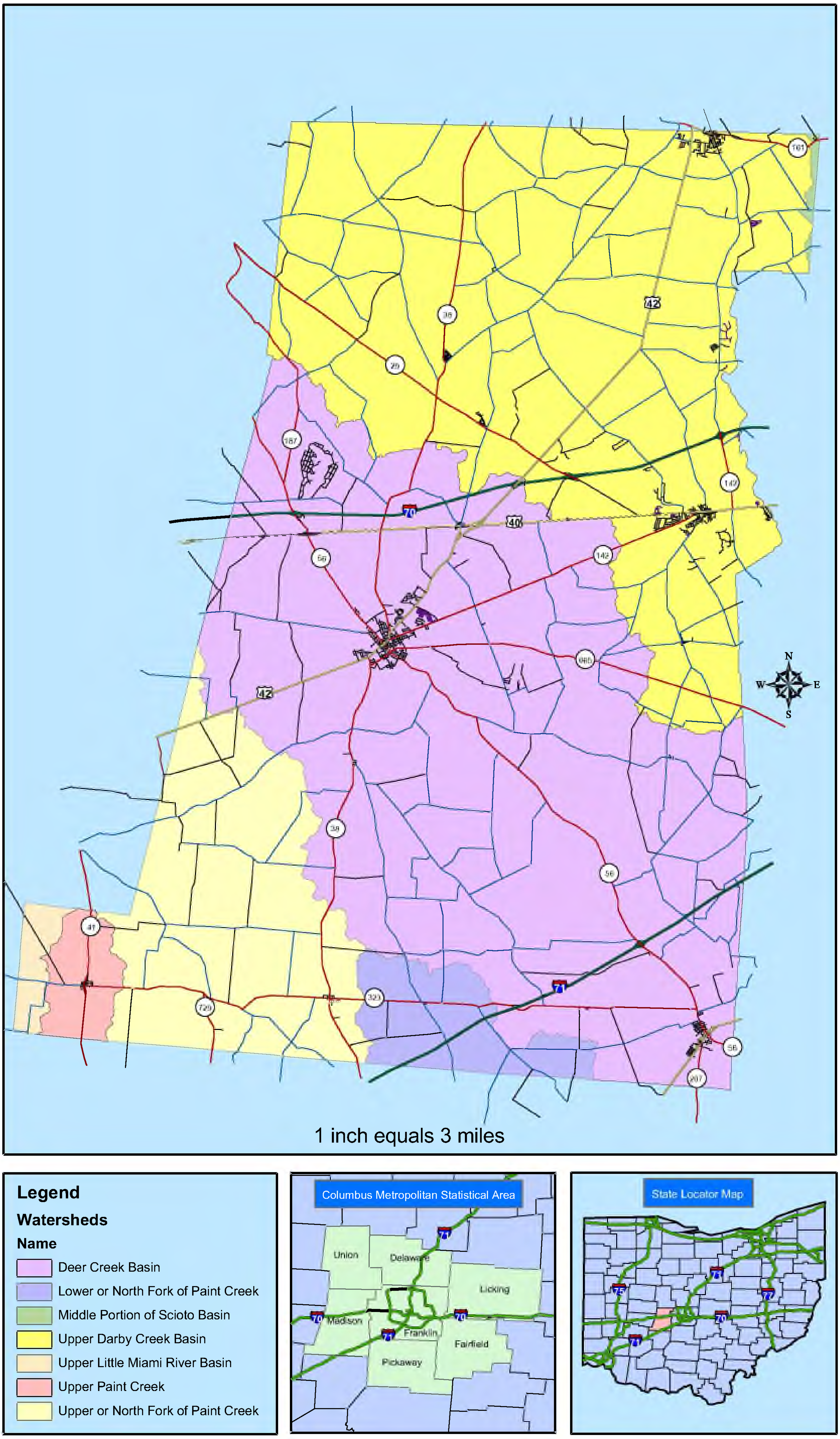
USGS StreamStats Report

NRCS Web Soil Survey Report

MADISON COUNTY, OHIO WATERSHED MAP

Madison County, Ohio 2014 Comprehensive Plan

Map 05: Watersheds



Madison County GIS

NOAA ATLAS 14 PRECIPITATION FREQUENCY ESTIMATES

NOAA Atlas 14, Volume 2, Version 3
Location name: London, Ohio, USA*
Latitude: 39.8536°, Longitude: -83.3462°
Elevation: 934.21 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.357 (0.319-0.399)	0.426 (0.381-0.476)	0.510 (0.456-0.569)	0.577 (0.514-0.642)	0.662 (0.588-0.736)	0.728 (0.644-0.809)	0.794 (0.698-0.881)	0.862 (0.754-0.958)	0.955 (0.829-1.06)	1.02 (0.882-1.14)
10-min	0.554 (0.496-0.621)	0.664 (0.594-0.743)	0.792 (0.708-0.884)	0.890 (0.794-0.991)	1.01 (0.899-1.13)	1.10 (0.976-1.23)	1.20 (1.05-1.33)	1.29 (1.13-1.43)	1.40 (1.22-1.56)	1.49 (1.28-1.66)
15-min	0.680 (0.608-0.761)	0.812 (0.727-0.909)	0.973 (0.870-1.09)	1.10 (0.976-1.22)	1.25 (1.11-1.39)	1.37 (1.21-1.52)	1.49 (1.31-1.65)	1.60 (1.40-1.78)	1.75 (1.52-1.95)	1.86 (1.61-2.07)
30-min	0.899 (0.804-1.01)	1.09 (0.972-1.22)	1.33 (1.19-1.49)	1.52 (1.36-1.69)	1.77 (1.57-1.97)	1.95 (1.73-2.17)	2.14 (1.89-2.38)	2.34 (2.04-2.60)	2.60 (2.25-2.88)	2.79 (2.41-3.10)
60-min	1.10 (0.982-1.23)	1.33 (1.19-1.49)	1.67 (1.49-1.87)	1.94 (1.73-2.15)	2.29 (2.03-2.55)	2.57 (2.27-2.86)	2.87 (2.52-3.18)	3.17 (2.77-3.52)	3.59 (3.12-3.99)	3.92 (3.38-4.36)
2-hr	1.29 (1.15-1.43)	1.56 (1.40-1.73)	1.94 (1.74-2.16)	2.25 (2.02-2.50)	2.68 (2.39-2.97)	3.03 (2.68-3.34)	3.39 (2.99-3.74)	3.77 (3.30-4.15)	4.30 (3.73-4.73)	4.74 (4.07-5.21)
3-hr	1.36 (1.23-1.50)	1.64 (1.49-1.81)	2.05 (1.85-2.25)	2.38 (2.14-2.61)	2.84 (2.54-3.11)	3.21 (2.87-3.51)	3.61 (3.20-3.94)	4.02 (3.55-4.39)	4.61 (4.02-5.04)	5.08 (4.39-5.55)
6-hr	1.61 (1.46-1.79)	1.94 (1.75-2.15)	2.41 (2.17-2.67)	2.80 (2.52-3.09)	3.36 (3.00-3.69)	3.82 (3.40-4.19)	4.31 (3.81-4.72)	4.83 (4.24-5.28)	5.59 (4.84-6.10)	6.20 (5.32-6.77)
12-hr	1.89 (1.70-2.11)	2.27 (2.04-2.53)	2.80 (2.52-3.13)	3.25 (2.91-3.62)	3.89 (3.46-4.31)	4.42 (3.91-4.89)	4.99 (4.39-5.51)	5.59 (4.88-6.17)	6.46 (5.57-7.12)	7.18 (6.12-7.93)
24-hr	2.20 (2.04-2.38)	2.64 (2.45-2.85)	3.24 (3.01-3.50)	3.73 (3.45-4.02)	4.41 (4.07-4.76)	4.97 (4.57-5.36)	5.55 (5.08-5.98)	6.16 (5.60-6.63)	7.01 (6.33-7.56)	7.69 (6.89-8.30)
2-day	2.56 (2.39-2.75)	3.06 (2.86-3.29)	3.74 (3.48-4.02)	4.28 (3.98-4.60)	5.03 (4.67-5.40)	5.64 (5.21-6.05)	6.26 (5.76-6.73)	6.91 (6.33-7.43)	7.80 (7.08-8.40)	8.50 (7.67-9.19)
3-day	2.74 (2.56-2.95)	3.28 (3.06-3.52)	3.99 (3.72-4.28)	4.55 (4.24-4.88)	5.34 (4.95-5.72)	5.96 (5.52-6.39)	6.60 (6.08-7.08)	7.26 (6.66-7.79)	8.17 (7.43-8.78)	8.87 (8.02-9.56)
4-day	2.93 (2.74-3.14)	3.49 (3.26-3.75)	4.24 (3.95-4.54)	4.83 (4.50-5.17)	5.64 (5.24-6.03)	6.28 (5.82-6.72)	6.94 (6.40-7.43)	7.62 (6.99-8.16)	8.54 (7.78-9.15)	9.24 (8.38-9.94)
7-day	3.48 (3.26-3.73)	4.14 (3.88-4.44)	5.01 (4.68-5.36)	5.70 (5.32-6.10)	6.67 (6.20-7.13)	7.44 (6.90-7.96)	8.24 (7.61-8.82)	9.07 (8.33-9.72)	10.2 (9.30-11.0)	11.1 (10.1-12.0)
10-day	3.96 (3.73-4.22)	4.70 (4.42-5.02)	5.65 (5.31-6.02)	6.40 (6.01-6.82)	7.45 (6.97-7.93)	8.28 (7.72-8.81)	9.14 (8.48-9.73)	10.0 (9.25-10.7)	11.2 (10.3-12.0)	12.2 (11.1-13.0)
20-day	5.49 (5.18-5.83)	6.49 (6.12-6.89)	7.66 (7.21-8.12)	8.57 (8.07-9.08)	9.80 (9.20-10.4)	10.7 (10.1-11.4)	11.7 (10.9-12.4)	12.6 (11.8-13.4)	13.9 (12.8-14.7)	14.8 (13.6-15.8)
30-day	6.87 (6.49-7.26)	8.09 (7.64-8.55)	9.42 (8.89-9.95)	10.4 (9.85-11.0)	11.8 (11.1-12.4)	12.8 (12.0-13.5)	13.8 (12.9-14.6)	14.7 (13.8-15.6)	15.9 (14.9-16.9)	16.9 (15.6-17.9)
45-day	8.75 (8.29-9.22)	10.3 (9.74-10.8)	11.8 (11.2-12.5)	13.0 (12.3-13.7)	14.5 (13.7-15.2)	15.6 (14.7-16.4)	16.6 (15.6-17.5)	17.6 (16.5-18.5)	18.8 (17.6-19.9)	19.7 (18.4-20.8)
60-day	10.6 (10.0-11.1)	12.4 (11.7-13.1)	14.2 (13.4-14.9)	15.5 (14.6-16.3)	17.2 (16.2-18.1)	18.4 (17.4-19.4)	19.6 (18.4-20.7)	20.7 (19.4-21.9)	22.1 (20.7-23.4)	23.1 (21.5-24.4)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

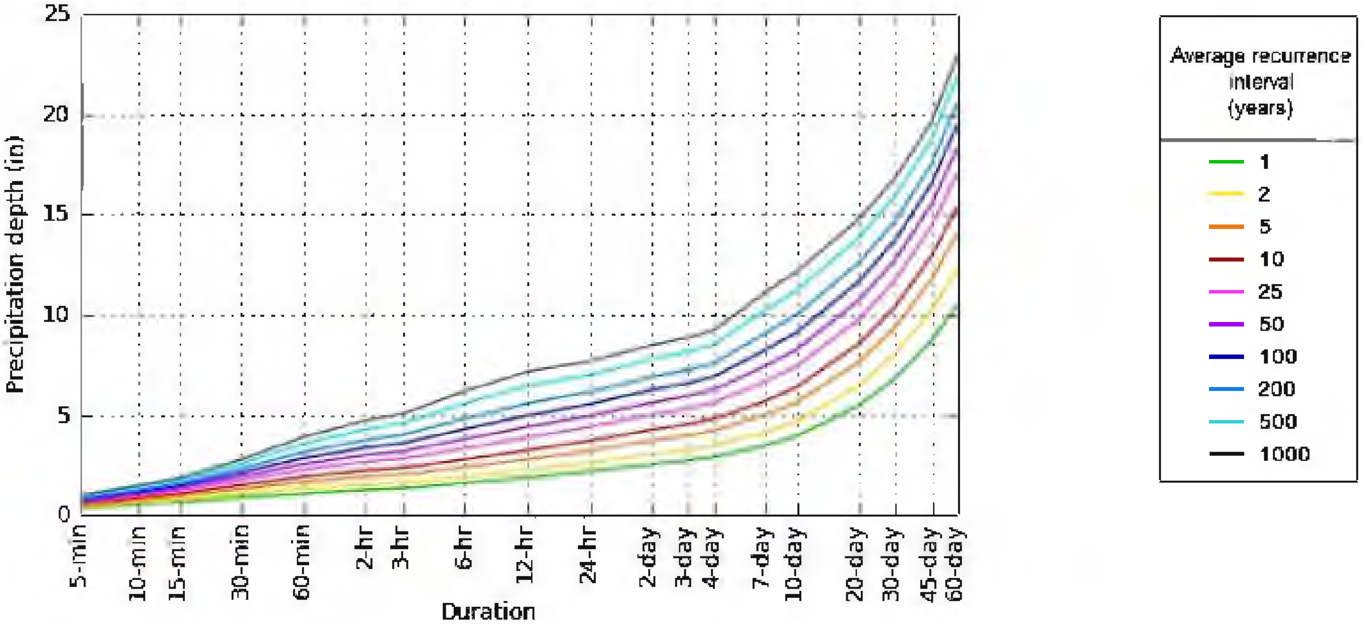
Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

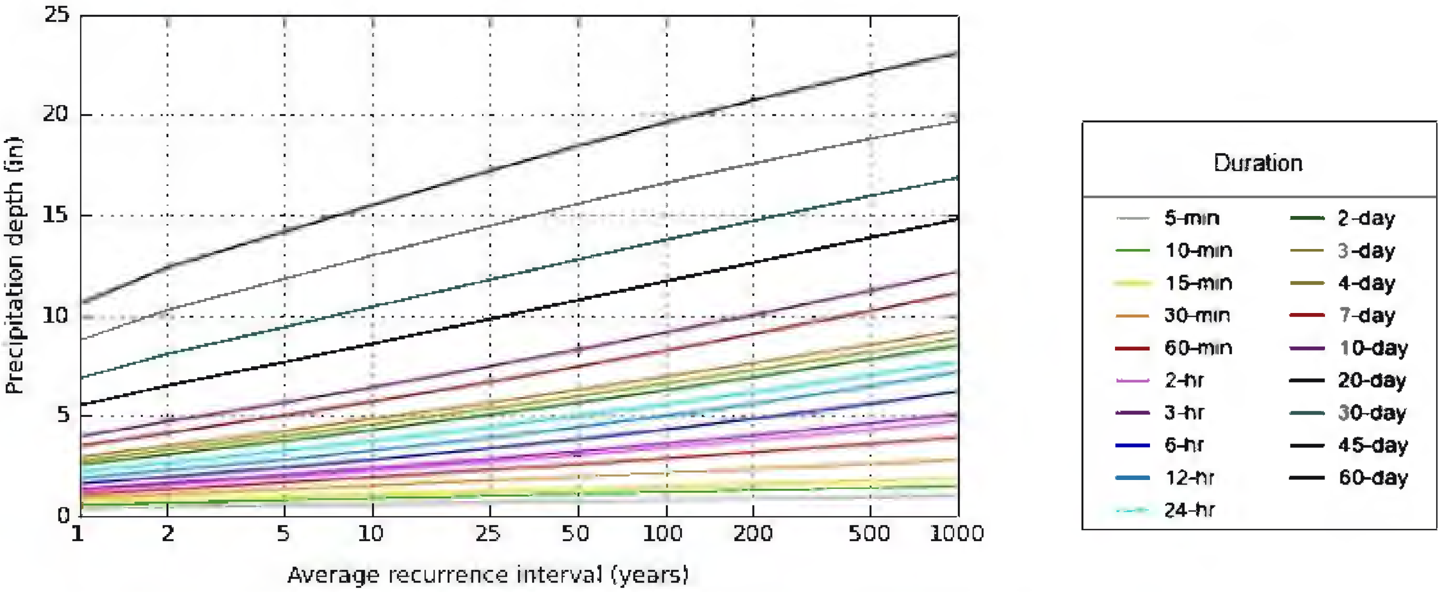
Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 39.8536°, Longitude: -83.3462°



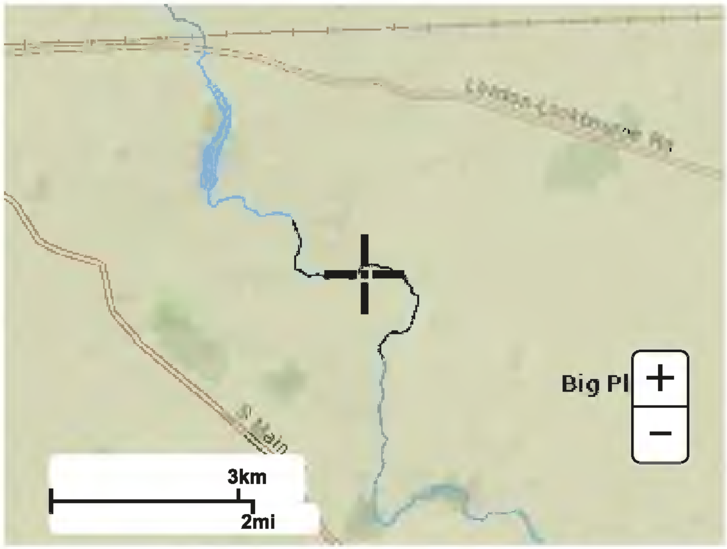


NOAA Atlas 14, Volume 2, Version 3 Created (GMT): Tue Nov 5 17:35:00 2019

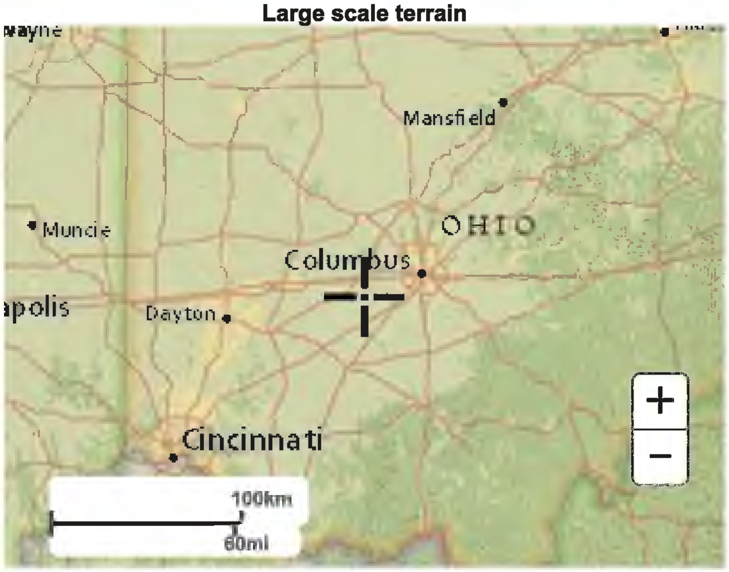
Back to Top

Maps & aerials

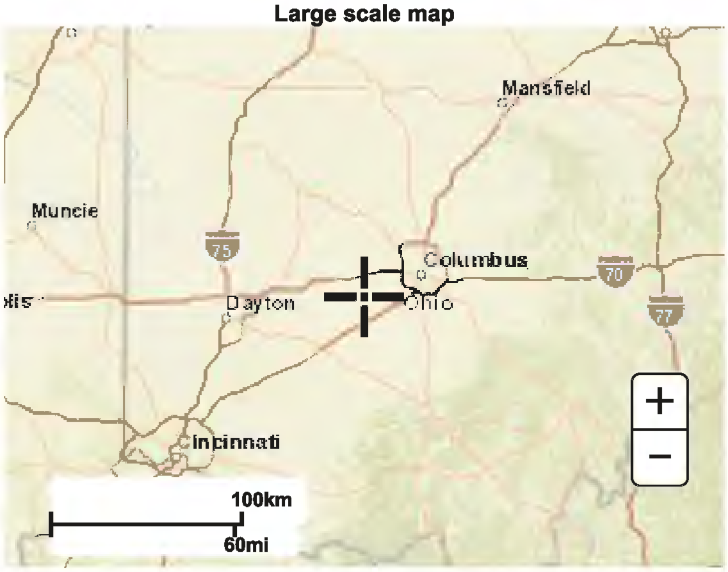
Small scale terrain



Large scale terrain



Large scale map



Large scale aerial

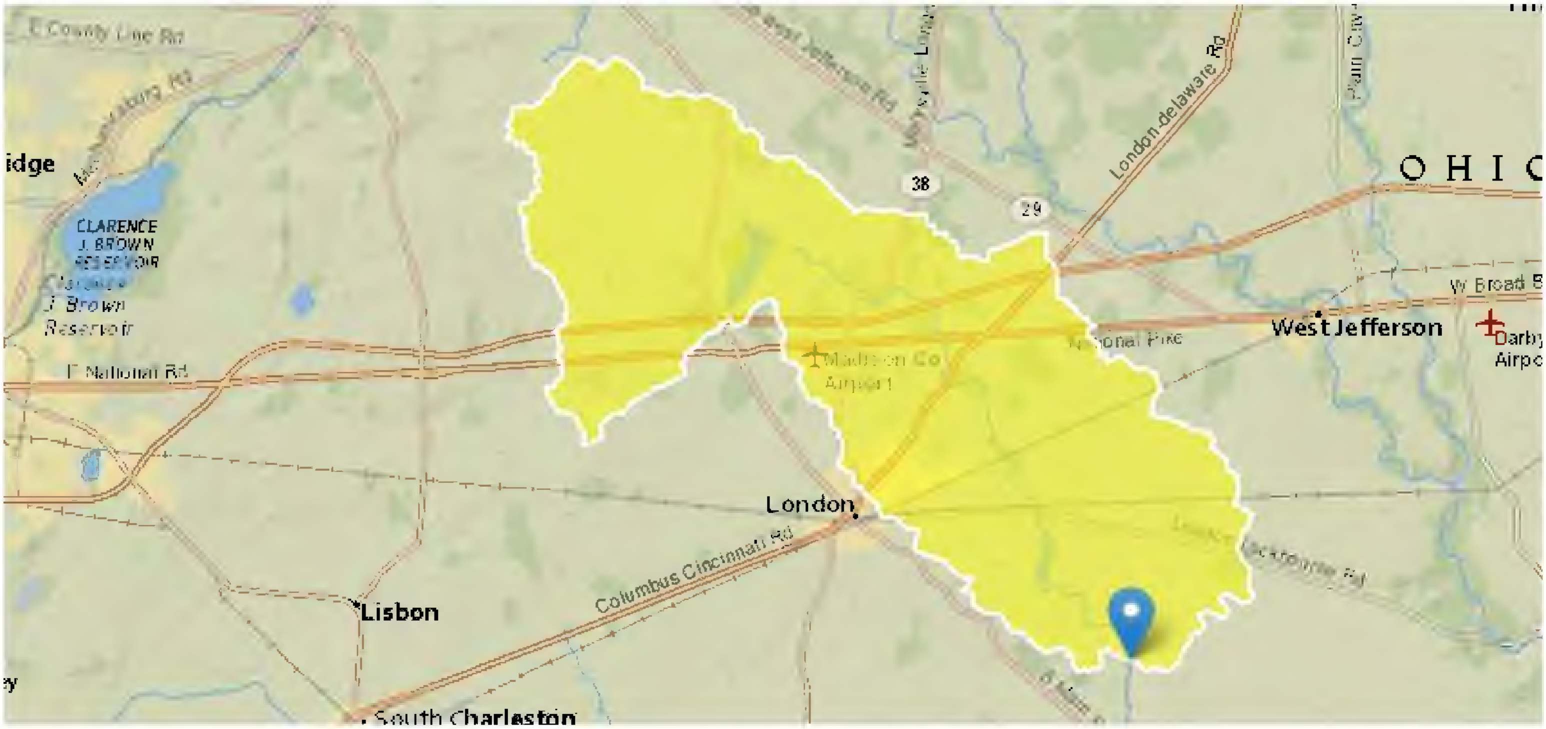
Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

USGS STREAMSTATS REPORT

StreamStats Report

Region ID: OH
Workspace ID: OH20191104152351185000
Clicked Point (Latitude, Longitude): 39.84354, -83.34244
Time: 2019-11-04 10:24:07 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	82.6	square miles
LC92STOR	Percentage of water bodies and wetlands determined from the NLCD	1.29	percent
PRECIP	Mean Annual Precipitation	38.8	inches
FOREST	Percentage of area covered by forest	6.2	percent
LAT_CENT	Latitude of Basin Centroid	39.9297	decimal degrees
STREAM_VARG	Streamflow variability index as defined in WRIR 02-4068, computed from regional grid	0.6	dimensionless
LONG_CENT	Longitude Basin Centroid	83.4352	decimal degrees
OHREGC	Ohio Region C Indicator	0	dimensionless
OHREGA	Ohio Region A Indicator	1	dimensionless

Parameter Code	Parameter Description	Value	Unit
CSL1085LFP	Change in elevation divided by length between points 10 and 85 percent of distance along the longest flow path to the basin divide, LFP from 2D grid	9.74	feet per mi

Monthly Flow Statistics Parameters[Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	1.29	percent	0	19
PRECIP	Mean Annual Precipitation	38.8	inches	34	43.2
FOREST	Percent Forest	6.2	percent	0	99.1
LAT_CENT	Latitude of Basin Centroid	39.9297	decimal degrees	38.68	41.2
STREAM_VARG	Streamflow Variability Index from Grid	0.6	dimensionless	0.25	1.13

Monthly Flow Statistics Flow Report[Low Flow LatLE 41.2 wri02 4068]

PIl: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	SEp
January Mean Flow	131	ft^3/s	16.6	16.6
February Mean Flow	138	ft^3/s	11.9	11.9
March Mean Flow	161	ft^3/s	14	14
April Mean Flow	142	ft^3/s	11.2	11.2
May Mean Flow	96.2	ft^3/s	19.5	19.5
June Mean Flow	63.8	ft^3/s	27	27
July Mean Flow	37	ft^3/s	28.2	28.2
August Mean Flow	27.4	ft^3/s	36.8	36.8
September Mean Flow	16.5	ft^3/s	43.6	43.6
October Mean Flow	18.1	ft^3/s	50.8	50.8
November Mean Flow	46.7	ft^3/s	37.5	37.5
December Mean Flow	84	ft^3/s	21.8	21.8

Monthly Flow Statistics Citations

Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (https://pubs.er.usgs.gov/publication/wri024068)

Annual Flow Statistics Parameters[Low Flow LatLE 41.2 wri02 4068]

/

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	0.12	7422
PRECIP	Mean Annual Precipitation	38.8	inches	34	43.2
LAT_CENT	Latitude of Basin Centroid	39.9297	decimal degrees	38.68	41.2

Annual Flow Statistics Flow Report[Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	SEp
Mean Annual Flow	89.6	ft^3/s	11.4	11.4

Annual Flow Statistics Citations

Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (https://pubs.er.usgs.gov/publication/wri024068)

General Flow Statistics Parameters[Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	1.29	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.6	dimensionless	0.25	1.13
LAT_CENT	Latitude of Basin Centroid	39.9297	decimal degrees	38.68	41.2

General Flow Statistics Flow Report[Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	SEp
Harmonic Mean Streamflow	10.6	ft^3/s	65.9	65.9

General Flow Statistics Citations

Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (https://pubs.er.usgs.gov/publication/wri024068)

Flow Percentile Statistics Parameters[Low Flow LatLE 41.2 wri02 4068]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	0.12	7422
LC92STOR	Percent Storage from NLCD1992	1.29	percent	0	19
STREAM_VARG	Streamflow Variability Index from Grid	0.6	dimensionless	0.25	1.13

/

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
LAT_CENT	Latitude of Basin Centroid	39.9297	decimal degrees	38.68	41.2
LONG_CENT	Longitude of Basin Centroid	83.4352	decimal degrees	80.53	84.6

Flow Percentile Statistics Flow Report[Low Flow LatLE 41.2 wri02 4068]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE	SEp
25th Percentile Flow	11	ft^3/s	29.2	29.2
50th Percentile Flow Median	29.2	ft^3/s	40.3	40.3
75th Percentile Flow	78.9	ft^3/s	47.9	47.9

Flow Percentile Statistics Citations

Koltun, G. F., and Whitehead, M. T.,2002, Techniques for Estimating Selected Streamflow Characteristics of Rural, Unregulated Streams in Ohio: U. S. Geological Survey Water-Resources Investigations Report 02-4068, 50 p (https://pubs.er.usgs.gov/publication/wri024068)

Low-Flow Statistics Parameters[Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.6	dimensionless	0.24	1.12

Low-Flow Statistics Flow Report[Low Flow Region A 2012 5138]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE
1 Day 10 Year Low Flow	0.686	ft^3/s	53.1
7 Day 10 Year Low Flow	0.921	ft^3/s	40
30 Day 10 Year Low Flow	1.53	ft^3/s	35.7
90 Day 10 Year Low Flow	2.64	ft^3/s	29.8

Low-Flow Statistics Citations

Koltun, G.F., and Kula, S.P.,2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012–5138, 195 p. (http://pubs.usgs.gov/sir/2012/5138/)

Flow-Duration Statistics Parameters[Low Flow Region A 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	1	1250

/

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
STREAM_VARG	Streamflow Variability Index from Grid	0.6	dimensionless	0.24	1.12

Flow-Duration Statistics Flow Report[Low Flow Region A 2012 5138]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	SE
80 Percent Duration	6.09	ft^3/s	29.1

Flow-Duration Statistics Citations

Koltun, G.F., and Kula, S.P.,2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012–5138, 195 p. (http://pubs.usgs.gov/sir/2012/5138/)

Probability Statistics Parameters[P zero Flow 2012 5138]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	1	1250
STREAM_VARG	Streamflow Variability Index from Grid	0.6	dimensionless	0.24	1.12

Probability Statistics Flow Report[P zero Flow 2012 5138]

PII: Prediction Interval-Lower, PIu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PC
Probability zero flow 1Day	0.0323	dim	91
Probability zero flow 7Day	0.0151	dim	94
Probability zero flow 30Day	0.00106	dim	97

Probability Statistics Citations

Koltun, G.F., and Kula, S.P.,2013, Methods for estimating selected low-flow statistics and development of annual flow-duration statistics for Ohio: U.S. Geological Survey Scientific Investigations Report 2012–5138, 195 p. (http://pubs.usgs.gov/sir/2012/5138/)

Peak-Flow Statistics Parameters[Peak Flow Full Model Reg A SIR2019 5018]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	82.6	square miles	0.04	5989
OHREGC	Ohio Region C Indicator 1 if in C else 0	0	dimensionless	0	1
OHREGA	Ohio Region A Indicator 1 if in A else 0	1	dimensionless	0	1
CSL1085LFP	Stream Slope 10 and 85 Longest Flow Path	9.74	feet per mi	1.53	516
LC92STOR	Percent Storage from NLCD1992	1.29	percent	0	25.35

/

Peak-Flow Statistics Flow Report[Peak Flow Full Model Reg A SIR2019 5018]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SEp
2 Year Peak Flood	2540	ft^3/s	1350	4790	40.1
5 Year Peak Flood	3960	ft^3/s	2220	7050	37.2
10 Year Peak Flood	5020	ft^3/s	2770	9090	37.6
25 Year Peak Flood	6490	ft^3/s	3560	11800	38.1
50 Year Peak Flood	7660	ft^3/s	4160	14100	37.8
100 Year Peak Flood	8900	ft^3/s	4780	16500	39.6
500 Year Peak Flood	12000	ft^3/s	6420	22600	40.3

Peak-Flow Statistics Citations

Koltun, G.F.,2019, Flood-frequency estimates for Ohio streamgages based on data through water year 2015 and techniques for estimating flood-frequency characteristics of rural, unregulated Ohio streams: U.S. Geological Survey Scientific Investigations Report 2019–5018, 25 p. (https://dx.doi.org/10.3133/sir20195018)

Application Version: 4.3.8

NRCS WEB SOIL SURVEY REPORT

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Madison County, Ohio

September 30, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

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

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

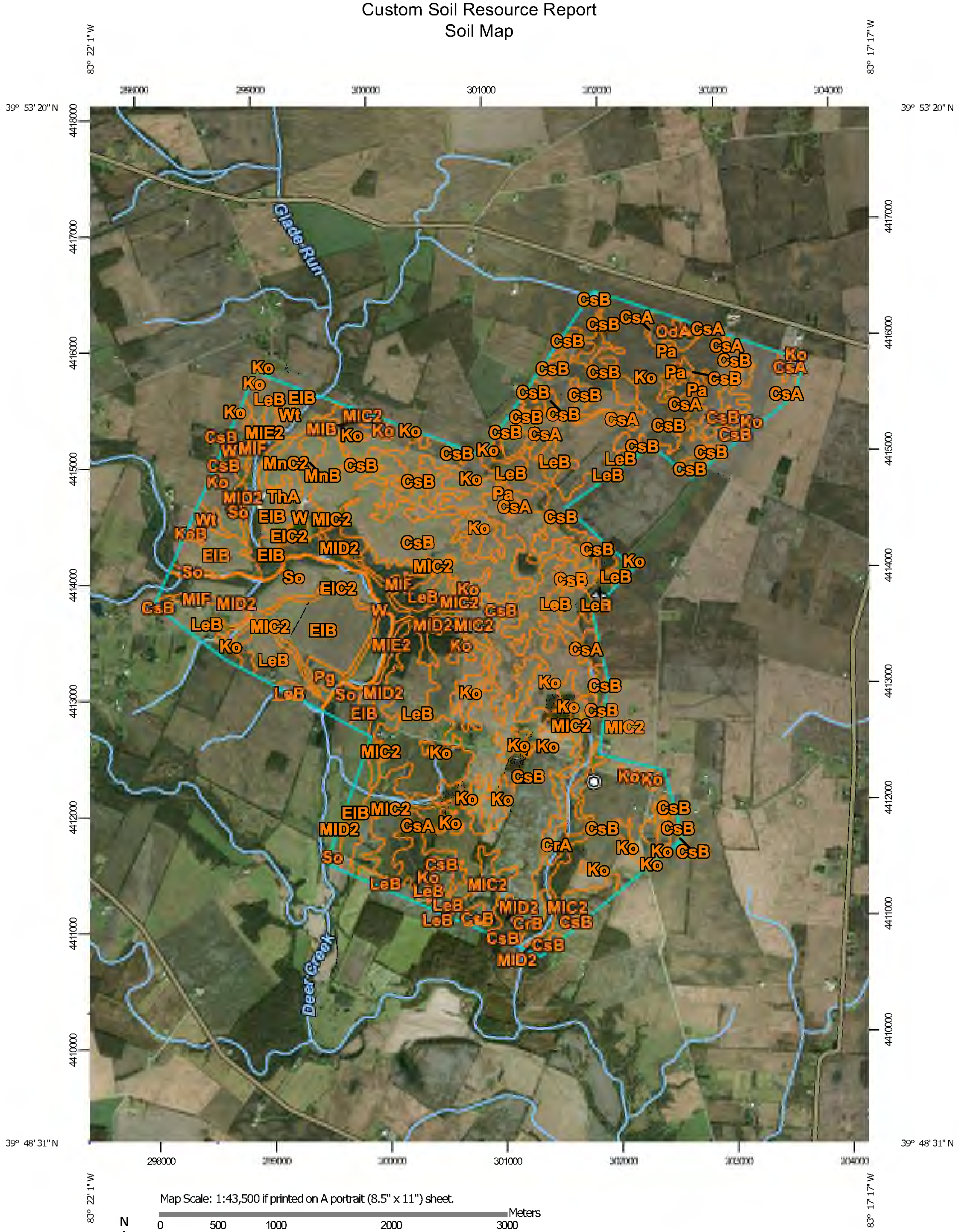
Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:43,500 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 500, 1000, 2000, 3000

Feet: 0, 2000, 4000, 8000, 12000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Madison County, Ohio
Survey Area Data: Version 18, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 5, 2012—Mar 4, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	8.6	0.2%
CrB	Crosby silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	14.1	0.4%
CsA	Crosby-Lewisburg silt loams, 0 to 2 percent slopes	72.2	1.9%
CsB	Crosby-Lewisburg silt loams, 2 to 6 percent slopes	1,239.2	32.3%
ElB	Eldean silt loam, 2 to 6 percent slopes	240.6	6.3%
ElC2	Eldean silt loam, 6 to 12 percent slopes, eroded	22.0	0.6%
KeB	Kendallville silt loam, 2 to 6 percent slopes	1.7	0.0%
Ko	Kokomo silty clay loam, 0 to 2 percent slopes	1,000.0	26.1%
LeB	Lewisburg-Celina silt loams, 2 to 6 percent slopes	397.7	10.4%
MlB	Miamian silt loam, 2 to 6 percent slopes	12.4	0.3%
MlC2	Miamian silt loam, 6 to 12 percent slopes, eroded	252.6	6.6%
MlD2	Miamian silt loam, 12 to 18 percent slopes, eroded	102.5	2.7%
MlE2	Miamian silt loam, 18 to 25 percent slopes, eroded	17.6	0.5%
MlF	Miamian silt loam, 25 to 50 percent slopes	23.7	0.6%
MnB	Miamian-Eldean silt loams, 2 to 6 percent slopes	29.7	0.8%
MnC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, eroded	33.9	0.9%
OdA	Odell-Lewisburg complex, 0 to 2 percent slopes	22.8	0.6%
Pa	Patton silty clay loam, 0 to 2 percent slopes	33.0	0.9%
Pg	Pits, gravel	13.2	0.3%
So	Sloan silty clay loam, frequently flooded	251.3	6.5%
ThA	Thackery variant silt loam, 0 to 2 percent slopes	8.8	0.2%
W	Water	21.1	0.6%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Wt	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	19.0	0.5%
Totals for Area of Interest		**3,837.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

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

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

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

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

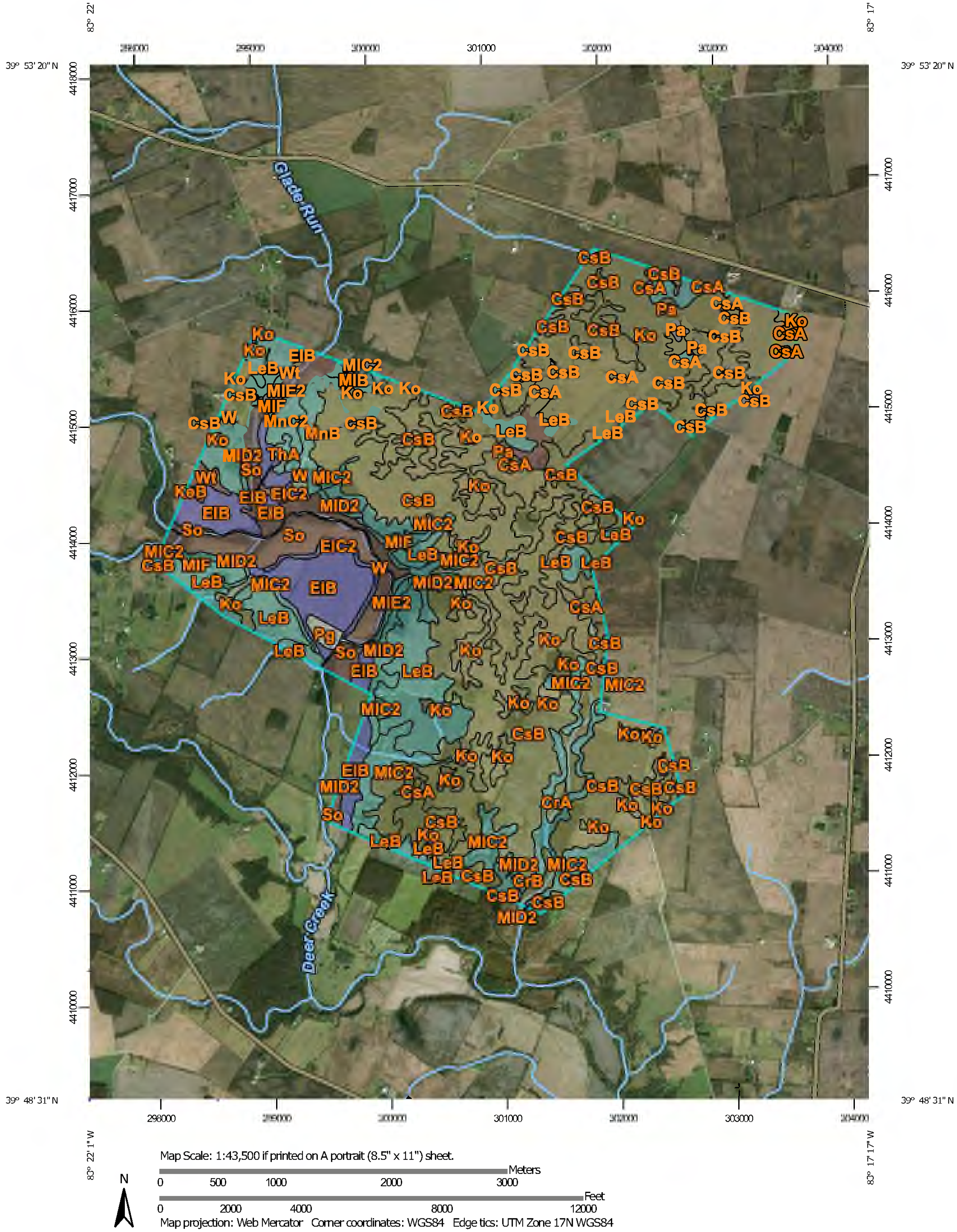
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:43,500 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Madison County, Ohio
Survey Area Data: Version 18, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 5, 2012—Mar 4, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CrA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	C/D	8.6	0.2%
CrB	Crosby silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	C/D	14.1	0.4%
CsA	Crosby-Lewisburg silt loams, 0 to 2 percent slopes	C/D	72.2	1.9%
CsB	Crosby-Lewisburg silt loams, 2 to 6 percent slopes	C/D	1,239.2	32.3%
ElB	Eldean silt loam, 2 to 6 percent slopes	B	240.6	6.3%
ElC2	Eldean silt loam, 6 to 12 percent slopes, eroded	B	22.0	0.6%
KeB	Kendallville silt loam, 2 to 6 percent slopes	C	1.7	0.0%
Ko	Kokomo silty clay loam, 0 to 2 percent slopes	C/D	1,000.0	26.1%
LeB	Lewisburg-Celina silt loams, 2 to 6 percent slopes	C	397.7	10.4%
MlB	Miamian silt loam, 2 to 6 percent slopes	C	12.4	0.3%
MlC2	Miamian silt loam, 6 to 12 percent slopes, eroded	C	252.6	6.6%
MlD2	Miamian silt loam, 12 to 18 percent slopes, eroded	C	102.5	2.7%
MlE2	Miamian silt loam, 18 to 25 percent slopes, eroded	C	17.6	0.5%
MlF	Miamian silt loam, 25 to 50 percent slopes	C	23.7	0.6%
MnB	Miamian-Eldean silt loams, 2 to 6 percent slopes	C	29.7	0.8%
MnC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, eroded	C	33.9	0.9%
OdA	Odell-Lewisburg complex, 0 to 2 percent slopes	C	22.8	0.6%
Pa	Patton silty clay loam, 0 to 2 percent slopes	B/D	33.0	0.9%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Pg	Pits, gravel		13.2	0.3%
So	Sloan silty clay loam, frequently flooded	B/D	251.3	6.5%
ThA	Thackery variant silt loam, 0 to 2 percent slopes	C	8.8	0.2%
W	Water		21.1	0.6%
Wt	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	B/D	19.0	0.5%
Totals for Area of Interest			**3,837.5**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

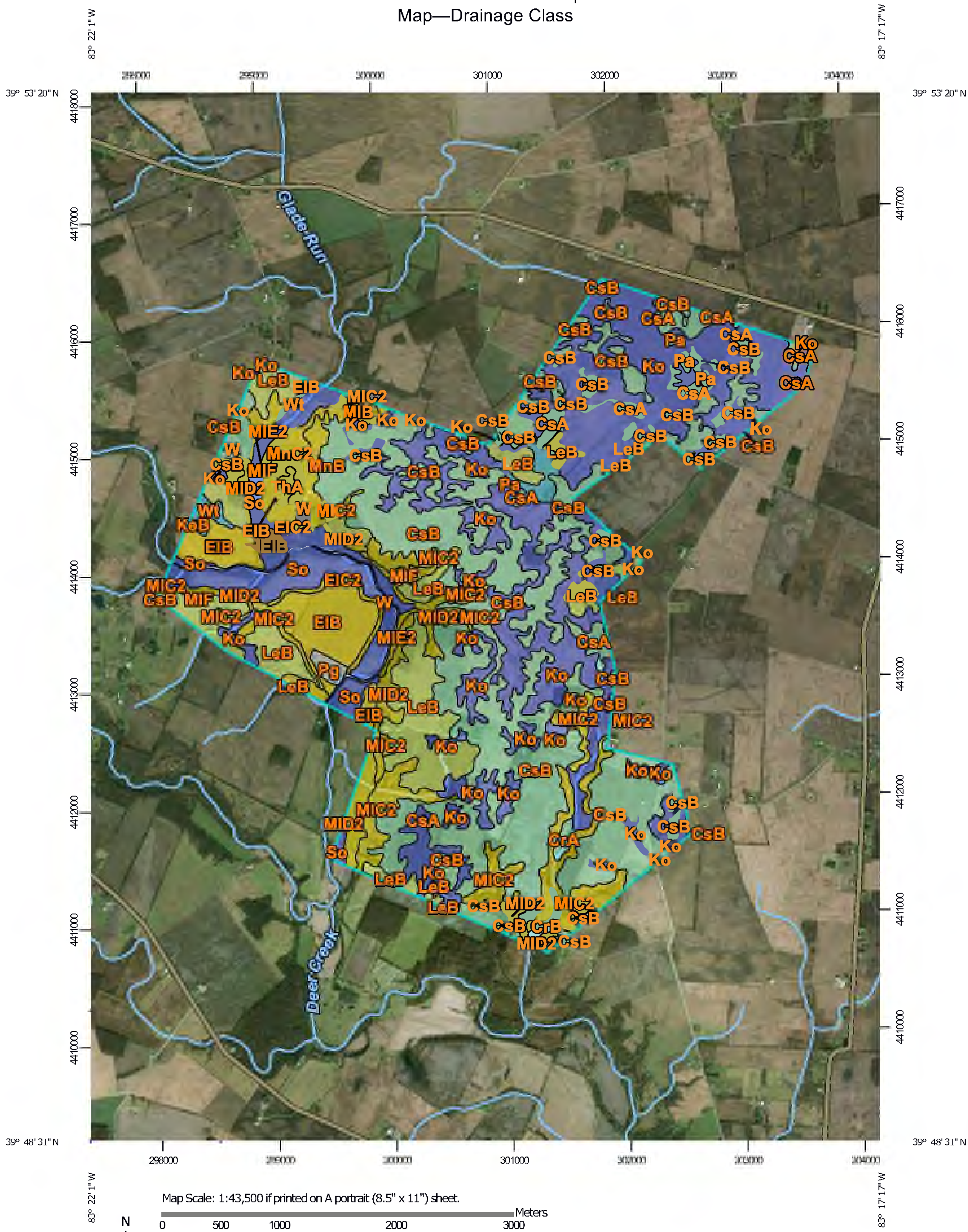
Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Drainage Class

"Drainage class (natural)" refers to the frequency and duration of wet periods under conditions similar to those under which the soil formed. Alterations of the water regime by human activities, either through drainage or irrigation, are not a consideration unless they have significantly changed the morphology of the soil. Seven classes of natural soil drainage are recognized-excessively drained, somewhat excessively drained, well drained, moderately well drained, somewhat poorly drained, poorly drained, and very poorly drained. These classes are defined in the "Soil Survey Manual."

Map—Drainage Class



Map Scale: 1:43,500 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0, 500, 1000, 2000, 3000

Feet: 0, 2000, 4000, 8000, 12000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 17N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- Not rated or not available

Soil Rating Lines

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- Not rated or not available

Soil Rating Points

- Excessively drained
- Somewhat excessively drained
- Well drained
- Moderately well drained
- Somewhat poorly drained
- Poorly drained
- Very poorly drained
- Subaqueous
- Not rated or not available

Water Features

Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Madison County, Ohio
Survey Area Data: Version 18, Sep 16, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 5, 2012—Mar 4, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Table—Drainage Class

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
CrA	Crosby silt loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Somewhat poorly drained	8.6	0.2%
CrB	Crosby silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	Somewhat poorly drained	14.1	0.4%
CsA	Crosby-Lewisburg silt loams, 0 to 2 percent slopes	Somewhat poorly drained	72.2	1.9%
CsB	Crosby-Lewisburg silt loams, 2 to 6 percent slopes	Somewhat poorly drained	1,239.2	32.3%
ElB	Eldean silt loam, 2 to 6 percent slopes	Well drained	240.6	6.3%
ElC2	Eldean silt loam, 6 to 12 percent slopes, eroded	Well drained	22.0	0.6%
KeB	Kendallville silt loam, 2 to 6 percent slopes	Well drained	1.7	0.0%
Ko	Kokomo silty clay loam, 0 to 2 percent slopes	Very poorly drained	1,000.0	26.1%
LeB	Lewisburg-Celina silt loams, 2 to 6 percent slopes	Moderately well drained	397.7	10.4%
MlB	Miamian silt loam, 2 to 6 percent slopes	Well drained	12.4	0.3%
MlC2	Miamian silt loam, 6 to 12 percent slopes, eroded	Well drained	252.6	6.6%
MlD2	Miamian silt loam, 12 to 18 percent slopes, eroded	Well drained	102.5	2.7%
MlE2	Miamian silt loam, 18 to 25 percent slopes, eroded	Well drained	17.6	0.5%
MlF	Miamian silt loam, 25 to 50 percent slopes	Well drained	23.7	0.6%
MnB	Miamian-Eldean silt loams, 2 to 6 percent slopes	Well drained	29.7	0.8%
MnC2	Miamian-Eldean silt loams, 6 to 12 percent slopes, eroded	Well drained	33.9	0.9%
OdA	Odell-Lewisburg complex, 0 to 2 percent slopes	Somewhat poorly drained	22.8	0.6%
Pa	Patton silty clay loam, 0 to 2 percent slopes	Poorly drained	33.0	0.9%

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Pg	Pits, gravel		13.2	0.3%
So	Sloan silty clay loam, frequently flooded	Very poorly drained	251.3	6.5%
ThA	Thackery variant silt loam, 0 to 2 percent slopes	Moderately well drained	8.8	0.2%
W	Water		21.1	0.6%
Wt	Westland silty clay loam, Southern Ohio Till Plain, 0 to 2 percent slopes	Poorly drained	19.0	0.5%
Totals for Area of Interest			**3,837.5**	**100.0%**

Rating Options—Drainage Class

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

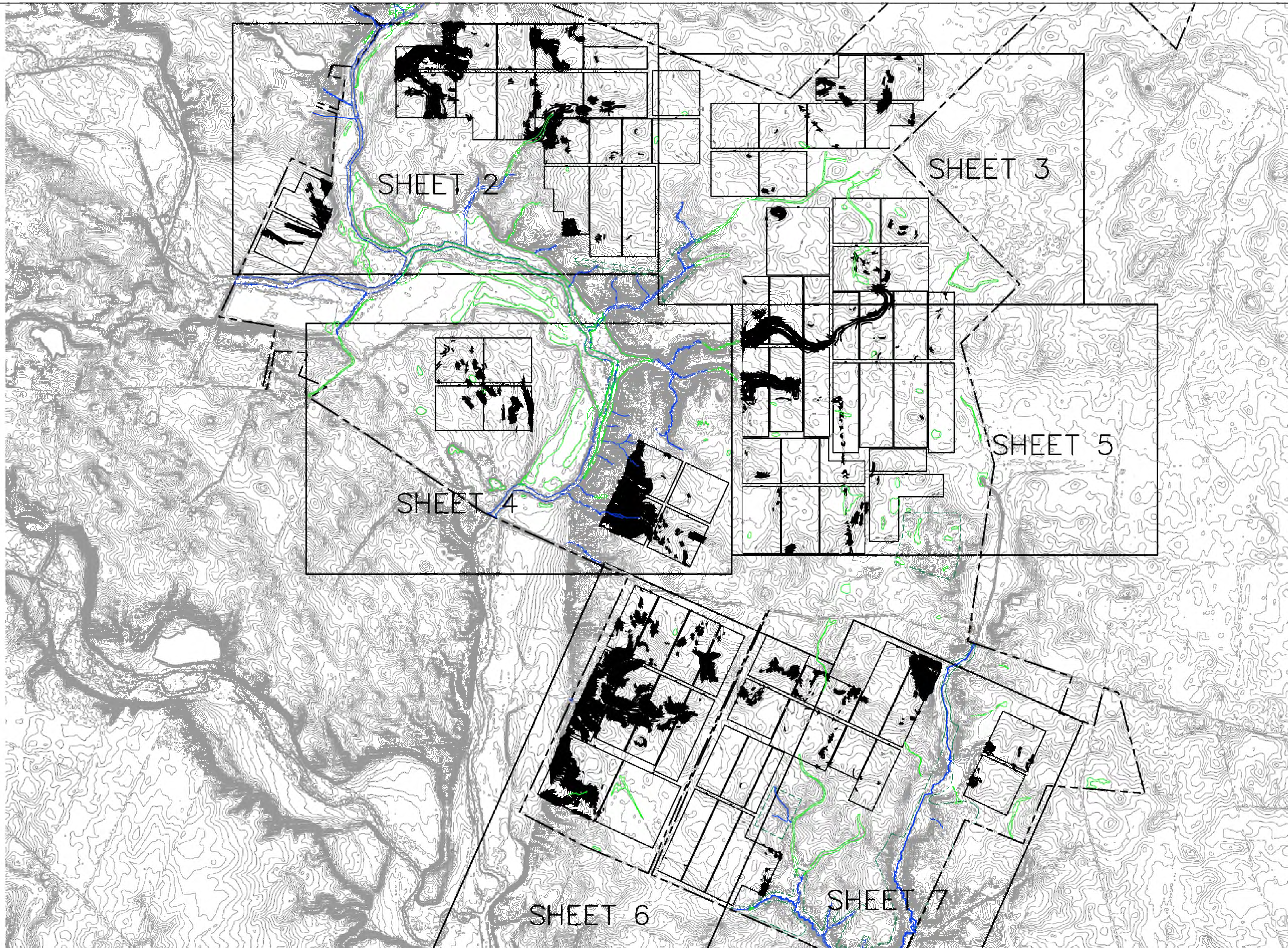
United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

APPENDIX C
DRAWINGS



Cut/Fill Summary

Cut/Fill Summary
2d Area
50097944.88 Sq. Ft.
50097944.88 Sq. Ft.
Cut
82927.17 Cu. Yd.
82927.17 Cu. Yd.
Fill
48466.79 Cu. Yd.
48466.79 Cu. Yd.
Net
34460.38 Cu. Yd.<Cut>
34460.38 Cu. Yd.<Cut>

LEGEND

- PROPERTY LINE
- EXISTING GRADE CONTOURS
- WETLANDS
- WATER LINE
- EXISTING GRADE CONTOURS
- PROPOSED GRADE CONTOURS
- SLOPE 6–15%
- SLOPES GREATER THAN 15%

N

0 750'
SCALE

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR
LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS
MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING KEY MAP

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	1	—
SCALE: AS SHOWN	W.O. NO.	SHT. 1 OF 8	

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS

MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	2	—
SCALE: AS SHOWN	W.O. NO.	SHT. 2 OF 8	

J:\FS-MADISON\dem3mzft_conts-PR-GRADE-NEW.dwg, 12/3/2019 9:18:32 AM, hernandd

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON MADISON COUNTY OHIO

MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	3	—
SCALE	W.O. NO.	SHT. 3 OF 8	
AS SHOWN			

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS

MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	4	—
SCALE: AS SHOWN	W.O. NO.	SHT. 4 OF 8	

NO.	DATE	APPR.	REVISION

NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON — MADISON COUNTY — OHIO

WESTON SOLUTIONS

MUNDELEIN — ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	5	—
SCALE: AS SHOWN	W.O. NO.	SHT. 5 OF 8	

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON MADISON COUNTY OHIO

MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	6	—
SCALE	W.O. NO.	SHT. 6 OF 8	
AS SHOWN			

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS

MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	7	—
SCALE	W.O. NO.	SHT. 7 OF 8	
AS SHOWN			

NO.	DATE	APPR.	REVISION	NO.	DATE	APPR.	REVISION

MADISON SOLAR
FIRST SOLAR

LONDON MADISON COUNTY OHIO

WESTON SOLUTIONS

MUNDELEIN ILLINOIS

CHECKED	DATE	CLIENT APPROVALS	DATE
DES. ENG.			
PROJ. ENG.			
PROJ. MGR.			
APPROVED			
APPROVED		ISSUED FOR	DATE

PRELIMINARY GRADING PLAN

DRAWN	DATE	DWG. NO.	REV. NO.
DCH	NOV. 2019	8	—
SCALE AS SHOWN	W.O. NO.	SHT. 8 OF 8	

APPENDIX D
OHIO EPA TECHNICAL MEMORANDUM

Guidance on Post-Construction Storm Water Controls for Solar Panel Arrays

Background

Although the area under and between ground-mounted solar panel arrays may be covered in vegetation (normally considered pervious), the elevated panels alter the volume, velocity and discharge pattern of storm water runoff and associated pollutants and therefore do require post-construction storm water management under OHC00005 (Part III.G.2.e, pp. 19-27). Paved or gravel roads and support buildings associated with the solar panel array as well as any gravel surfaces under or around the panel arrays must also include post-construction storm water management.

Post-Construction Storm Water Management Options

There are several factors that determine the entire installation's effect on runoff and feasible storm water management options. In some cases, runoff from roads, buildings and the solar panels can be managed through the standard post-construction practices listed in tables 4a and 4b of the CGP. For many facilities, storm water runoff from the solar panels can be simply managed by disconnection to the vegetated ground surface under and between the elevated panels provided 1) an ungraded, uncompacted soil profile exists, 2) dense and healthy vegetation can be maintained over the entire surface, and 3) runoff from the panels can be managed as non-erosive, sheet flow. The disconnection length ($L_{Disconnection}$) provided depends upon the width of the row of solar panels (W_{Panel}) and the width of the open gap width between the panel rows ($W_{Row\ Gap}$) as shown in Figure 1 below.

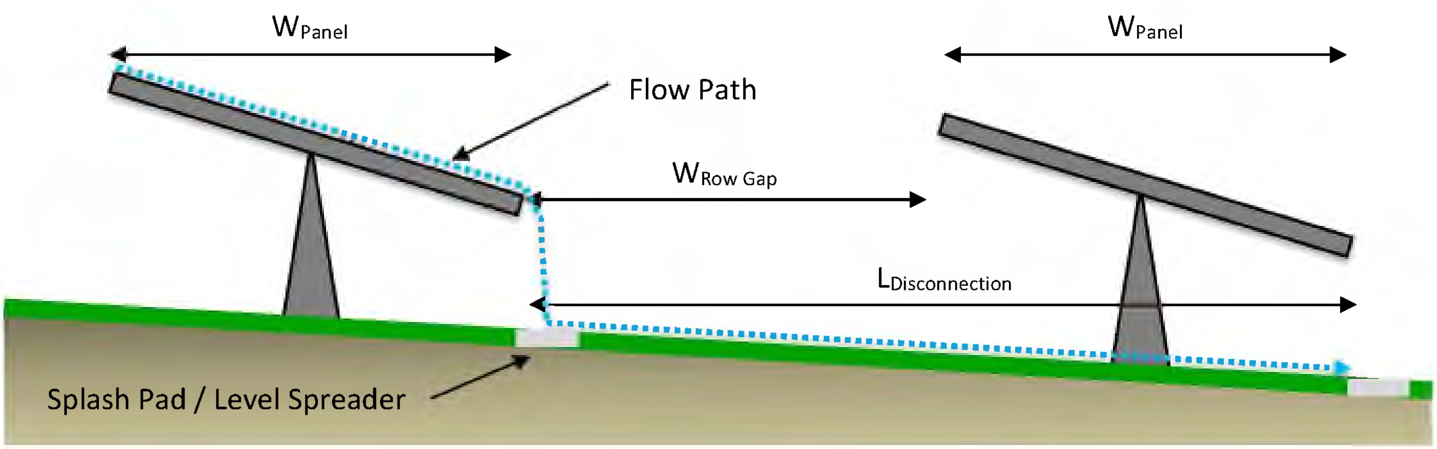


Figure 1: Schematic profile of solar panel array providing impervious area disconnection.

Runoff Reduction Spacing

The Runoff Reduction credit values for impervious area disconnection can be used to determine the $L_{Disconnection}$ needed based upon the W_{Panel}. Where the entire panel area is grass, this can be viewed as a needed ratio of W_{Panel} to $W_{Row\ Gap}$ for the entire length of the panel row.

For panel arrays on Hydrologic Soil Group (HSG) A or B soils and on soils that have been functionally restored, the disconnection length required is two times the solar panel width on a horizontal plane, which equates to a 1:1 spacing ratio. On HSG C or D soils without restoration, the disconnection length required is 3.5 times the solar panel width on a horizontal plane, or a 2.5:1 spacing ratio.

General Permit OHC000005: Guidance on Post-Construction Storm Water Controls for Solar Panel Arrays

Other Design Considerations

- Gravel or paved access roads and equipment pads as well as solar panels that drain onto to them may require traditional practices if impervious disconnection is not feasible.
- This guidance assumes the ground support structure and foundation are minimal (less than five percent of the area), will allow vegetation, and will not disrupt sheet flow. Otherwise, the area underneath the panels may not be included in the disconnection area.
- To limit erosion at the drip edge, it is recommended the panel drip edge be no more than 10 feet above the ground.
- If the panel position is fixed, a narrow stone drip pad may be used to protect the ground surface from erosion and promote sheet flow.
- If the panels track or rotate, the disconnection length shown in the previous diagram will vary and must be shown to be acceptable in all panel positions.
- The Storm Water Pollution Prevention Plan (SW3P) should include typical drawings and calculations for large panel arrays. Specific controls for access roads and other infrastructure must also be detailed.
- Utilize low- and slow-growing grass varieties to reduce compaction and damage from frequent mowing. Include cool-season, warm-season, shade-resistant, and legumes as necessary to develop a dense, year-round groundcover.

References

Maryland Department of the Environment. 2013. *Stormwater Design Guidance – Solar Panel Installation*.

North Carolina Department of Environmental Quality. 2018. S*tormwater Design Manual, E-6 Solar Farms.*

Ohio Department of Natural Resources. 2006 (with updates). *Rainwater and Land Development Manual*.

Ohio Environmental Protection Agency. 2018. *General Permit Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System*. Ohio EPA Permit Number OHC000005. April 23, 2018.

Pennsylvania Department of Environmental Protection, Bureau of Clean Water. 2019. *Chapter 102 Permitting for Solar Panel Farms, Frequently Asked Questions*. January 2, 2019.

Contact

For more information, contact Michael Joseph at ***michael.joseph@epa.ohio.gov*** or (614) 644-2001.

TECHNICAL MEMORANDUM

Ohio Environmental Protection Agency

From: Justin Reinhart, PE, Storm Water Technical Assistance

Date: October 15, 2019

Subject: Gravel, synthetic turf and non-typical landcover

This technical memo provides interim technical guidance until the *Rainwater & Land Development* manual is revised and republished.

Gravel, synthetic turf and similar constructed landcover should be considered impervious when evaluating:

1. **whether post-construction controls are required (projects that do not create any impervious surface are not required to provide post-construction BMPs),**
2. **whether the site has existing impervious area to qualify as previously developed area, and**
3. **when calculating Rv = 0.05 + 0.9(i), where "i" represents the fraction of impervious surface.**

Neither the NPDES Construction General Permit #OHC00005 (CGP) nor the current *Rainwater and Land Development* (RLD) manual provide an explicit definition of impervious surface. As described in the document *Post-Construction Storm Water Q&A - Water Quality Volume* (10/2018), Ohio EPA considers impervious cover as an "area that will be unvegetated such as rooftops, paved or gravel roads and parking lots, sidewalks, detention basins and open water." This guidance derives from the ASCE/WEF Manual of Practice (1998) discussion that "operationally, for mature urban areas, watershed imperviousness can be defined as the fraction of watershed that is unvegetated."

This singular criterion can be used to differentiate pervious and impervious surface as it relates to the effect of construction activities on water quality and receiving streams. Vegetation is an indicator of soil structure that has or is capable of developing infiltration and evapotranspiration rates correlating to a volumetric runoff coefficient (Rv) near 0.05. As described in the *Soil Management* provisional practice of the RLD manual, vigorous vegetation is both a necessary factor in maintaining infiltrating soils and is a result or product of healthy soil. Area disturbed by construction activity, regardless of the final landcover, can be rendered impervious through clearing, grading, compaction, and filling.

Gravel, synthetic turf and similar landcovers are usually placed on a graded, compacted subgrade where the topsoil has been excavated (and often geotextile material used) to form a stable foundation. Although the surface of these landcovers, unlike concrete or asphalt pavement, can be somewhat porous, the lack of infiltration at the subgrade and evapotranspiration at the surface results in a Rv more equivalent to impervious pavement. Additionally, surface grading or subsurface drainage systems are usually included for rapid drainage.

Post-Construction Controls on Gravel and Synthetic Turf

Loose gravel or synthetic turf covers do contain void space within the structure that could be utilized to provide extended detention of the Water Quality Volume (WQv) as a variation of permeable pavement.

 Date: 10/15/2019

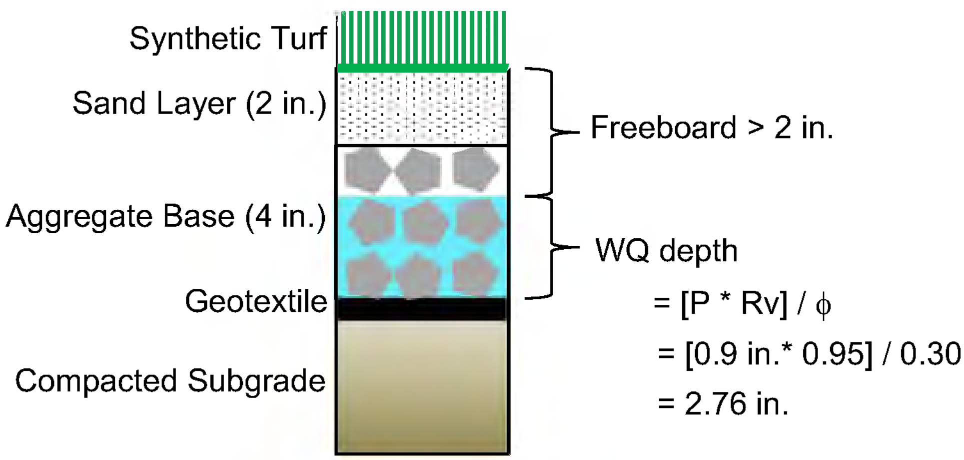
Subject: Gravel, synthetic turf and non-typical landcover under NPDES Permit #OHC00005

These projects should be pre-approved by Ohio EPA and designed per the applicable specifications of the permeable pavement RLD standard as well as the following criteria:

- The area must be subject to direct rainfall only and receive no additional runoff from adjacent areas.
- The area must not be subject high traffic surface loadings or high-risk pollutants.
- The extended detention requirements must still be met. This will require an outlet structure configured to meet the 1) the 24-hour minimum WQv drain times and 2) not discharge more than the first half of the WQv in less than one-third of the drain time.
- A sand filter/ choker course is recommended.
- The aggregate layer must be clean, rinsed and free of silts and fines and consist of poorly or tightly graded aggregate (e.g. AASHTO #57, #4 or #2) or coarse sand. Well graded or gap grade aggregates such as ODOT 304 do not apply.
- The top of the water quality volume must be 2" or more from the surface.
- As referenced in the permeable pavement standard, a porosity (ϕ) of 0.30 is recommended for aggregate and 0.25 for coarse sand. This value accounts for the required additional 20% sediment storage.
- Areas with the potential to be paved over in the future should not be considered.

Where these criteria are not met, a standard Table 4a or 4b practice should be utilized.

Example: Schematic section view of a synthetic turf installation (not to scale)



REFERENCES

ASCE/WEF. 1998. Urban Runoff Quality Management. WEF Manual of Practice No. 23. ASCE Manual and Report on Engineering Practice No. 87. Water Environment Federation, Alexandria, VA and American Society of Civil Engineers, Reston, VA.

Ohio EPA. 2018. General Permit Authorization for Storm Water Discharges Associated with Construction Activity under the National Pollutant Discharge Elimination System. Ohio EPA Permit Number OHC000005. Ohio Environmental Protection Agency. Columbus, OH

Pitt, R. 1999. Small Storm Hydrology and Why it is Important for the Design of Stormwater Control Practices. in Advances in Modeling the Management of Stormwater Impacts, Volume 7. (Edited by W. James). CHI, Guelph, Ontario and Lewis Publishers/CRC Press.

Schuler, T. 1987. Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs. Washington Metropolitan Council of Governments. Washington D.C.

STC. 2017. Guidelines for Synthetic Turf Base Systems. Synthetic Turf Council. Forest Hill, MD.

BEFORE THE OHIO POWER SITING BOARD

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Madison County, Ohio	))))))	**Case No. 19-1823-EL-BGN**

NOTICE OF FILING RESPONSES TO STAFF DATA REQUESTS

Big Plain Solar, LLC hereby provides notice that it is filing a copy of its September 10, 2020 response to Staff's verbal data request; December 4, 2020 responses to Staff's November 20, 2020 Data Requests #1-24; and December 4, 2020 response to Staff's December 2, 2020 Data Request #25.

Respectfully submitted,

/s/ Anna Sanyal

Michael J. Settineri (0073369), Counsel of Record
Anna Sanyal (0089269)
Mark A. Hylton (0088384)
Vorys, Sater, Seymour and Pease LLP
52 E. Gay Street
P.O. Box 1008
Columbus, Ohio 43216-1008
614-464-5462
614-719-5146 (fax)
mjsettineri@vorys.com
aasanyal@vorys.com
mahylton@vorys.com
(Each is willing to accept service via email)

Attorneys for Big Plain Solar, LLC

CERTIFICATE OF SERVICE

The Public Utilities Commission of Ohio's e-filing system will electronically serve notice of the filing of this document on the parties referenced on the service list of the docket card who have electronically subscribed to the case. In addition, the undersigned certifies that a courtesy copy of the foregoing document is also being served (via electronic mail) on the 21st day of December 2020 upon all persons/entities listed below:

Jodi Bair *Counsel for Staff of the Ohio Power Siting Board*	jodi.bair@ohioattorneygeneral.gov
Robert Dove *Counsel for Thomas A Coughlin and TDC Farms, LLC*	rdove@keglerbrown.com
Chad Ensley *Counsel for Ohio Farm Bureau Federation*	cendsley@ofbf.org

/s/ Anna Sanyal
Anna Sanyal (0089269)

VORYS

Vorys, Sater, Seymour and Pease LLP
Legal Counsel

52 East Gay Street
P.O. Box 1008
Columbus, Ohio 43216-1008

614.464.6400 | www.vorys.com

Founded 1909

Michael J. Settineri
Direct Dial (614) 464-5462
Direct Fax (614) 719-5146
Email mjsettineri@vorys.com

September 10, 2020

VIA E-MAIL

Andrew Conway
Ohio Power Siting Board
180 E. Broad Street
Columbus, OH 43215-3793

Re: Case No. 19-1823-EL-BGN
Response to Data Request

Dear Andrew:

Staff for the Ohio Power Siting Board has previously verbally requested that Big Plain Solar, LLC provide Staff with the results of any additional geotechnical surveys completed for the project. Attached as a response to that verbal request, please find a September 4, 2020 Preliminary Geotechnical Engineering Report prepared by Terracon Consultants, Inc.

Please call with any questions.

Very truly yours,

/s/ Michael J. Settineri

Michael J. Settineri
Counsel for Big Plain Solar, LLC

MJS/jaw
Enclosure

9/04/2020 37073865

Preliminary Geotechnical Engineering Report

Madison Solar Facility
Madison County, Ohio
September 4, 2020
Terracon Project No. N4205246

Prepared for:
First Solar, Inc
Houston, Texas

Prepared by:
Terracon Consultants, Inc.
Columbus, Ohio

Environmental ■ Facilities ■ Geotechnical ■ Materials

September 4, 2020

First Solar, Inc
11757 Katy Freeway, 4th Floor
Houston, Texas 77079

Attn: Mr. Justin Walters, P.E.
P: (602) 376-0565
E: Justin.Walters@firstsolar.com

Re: Preliminary Geotechnical Engineering Report
Madison Solar Facility
Fairfield Township
Madison County, Ohio
Terracon Project No. N4205246

Dear Mr. Walters:

We have completed the Preliminary Geotechnical Engineering services for the above referenced project. This study was performed in general accordance with Terracon Proposal No. PN4205246 dated June 17, 2020.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Jamal Tahat, MSc.
Geotechnical Project Manager

Yogesh S. Rege, P.E.
Senior Principal, Geotechnical Department Manager

Mike K. Klein, P.E.
Senior Geotechnical Engineer

SME Review by Arin Barkataki, P.E.

REPORT TOPICS

Note: This report was originally delivered in a web-based format. For more interactive features, please view your project online at client.terracon.com.

ATTACHMENTS

Note: Refer to each individual Attachment for a listing of contents.

Preliminary Geotechnical Engineering Report

Madison Solar Facility
Fairfield Township
Madison County, Ohio
Terracon Project No. N4205246
September 4, 2020

INTRODUCTION

This report presents the results of our subsurface exploration and preliminary geotechnical engineering services performed for the proposed Madison Solar Facility project located in Madison County, Ohio. The purpose of these services is to provide information and preliminary geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Contributory risk components
- Site preparation and earthwork
- Preliminary foundation design and construction
- Seismic considerations
- Preliminary pile embedment analysis
- Access roadways

The subsurface exploration scope of services for this project included the advancement of 16 borings to a depth ranging from 20 to 40 feet below existing site grades.

Maps showing the site and test boring locations are shown in the **EXPLORATION PLAN** attachments. The results of the field exploration and laboratory testing performed on soil samples obtained from the site during both the current and previous field explorations are included in the **EXPLORATION RESULTS** section.

SITE CONDITIONS

The following description of site conditions is derived from our site visit in association with the field exploration and our review of publicly available geologic and topographic maps.

Item	Description
Parcel Information	The project site is located north and south of Big Plain-Circleville Road southeast of London in Madison County, Ohio. The approximate coordinates of this 2,080 acres parcel are 39°50'56.14"N, 83°19'46.12"W See **SITE LOCATION PLAN**.
Existing Improvements	Mostly undeveloped parcel used for agriculture, farming with some residential dwelling structures.
Current Ground Cover	Agricultural fields with wooded areas, several drainage features and several water bodies.
Existing Topography	Based on observations during our site visit, the project site appeared to be relatively level to gently sloping with ground surface elevations across the sites ranging from about 950 to 990 feet (based on Google Earth). A final grading plan was not available as of this report's preparation. However, we anticipate the proposed developments will generally follow the existing site grades.

Our initial understanding of the project was provided in our proposal and was discussed during project planning. A period of collaboration has transpired since the project was initiated, and our final understanding of the project conditions is as follows:

Item	Description
Project Description	We understand that the project site is being considered for development of a photovoltaic (PV) solar power facility. The power facility is also anticipated to include invertors, transformers, switchgear and buried or overhead power lines.

Item	Description
Proposed Structures	The steel pile foundations for the solar array are anticipated to consist of wide flange steel piles (W6x9 or similar). In addition, we understand the inverters may also be supported on wide flange steel piles, while transformers, and other appurtenant equipment is anticipated to be supported on shallow spread or mat foundations. Other various aspects of the project include overhead or underground electrical circuits and pads for electrical equipment such as switchgear, transformers, and inverters. As part of the proposed development, a collector substation and an interconnection substation will be constructed including self-contained structures to be supported on spread footings and other electrical equipment to be supported on mat foundations or drilled shafts.
Finished Floor Elevation	Not provided, however, we anticipate finished grade will be within ±3 feet of existing grade.
Maximum Loads (Estimated by Terracon)	The actual loads for this project were not available at the issuance of this report. Therefore, loads from similar projects were used for the pile foundation analysis in this study. ■ Downward: 1 to 7 kips ■ Lateral 1 to 2 kips ■ Uplift: 0.5 to 3 kips (does not include frost heave loads) ■ Moments: 0.1 to 30 kip-ft. ■ O&M Building: Maximum wall loads of 2 kips per foot Substation structures and equipment loads: To be determined (TBD).
Building Construction	We understand the solar structures will be supported on driven steel piles, although other foundation options will be considered, and equipment structures will be supported on mat foundations.
Grading	We understand that where possible, it is desirable to minimize grading, without extensive earthwork or treatment of in-situ soils. Therefore, we anticipate that the solar field final grades will generally follow the existing site grades with nominal grading. (i.e. cut/fill up to 3 feet) Final slope angles no steeper than 3H:1V (Horizontal: Vertical) nor taller than 5 feet are anticipated.
Access Roads	We understand that access road cross sections used for construction of the project will be the responsibility of the EPC, and that only post construction traffic with an allowable rut depth of 2 inches is what we are to design for in this report. We anticipate low-volume, aggregate-surfaced and native soil access roads will have a maximum vehicle load of 30,000 lbs. and will travel over the access roads only once per week.
Estimated Start of Construction	Unknown at the issuance of this report.

GEOTECHNICAL CHARACTERIZATION

Terracon performed a review of available geologic information of the project site. The purpose of this records review was to attempt to establish the extent of the surface and any geological hazards (underground mining, karst, liquefaction, slope instability, etc.) on the property and the depth to these hazards.

SITE GEOLOGY

The project area is located within the glaciated area of Ohio, with the soils being formed in glacial till deposits. Glacial till is a heterogeneous mixture of clay, silt, sand, gravel and rock fragments, which was deposited by glacial ice advancing over bedrock or other glacial deposits. It is believed that glacial till in Madison County is a product of the Illinoian and late Wisconsinan Glaciation. Glacial till typically becomes more compact with depth within the soil profile.

BEDROCK

According to the USGS mapping bedrock at the boring locations with rocks of Silurian Age and known to consist of generally dolomite. **Geological Map of Ohio** can be found in the **Site Location and Exploration Plans** section of the report. Terracon borings did not encounter bedrock within the deepest boring depth of 40 feet.

Based on the USGS Geological map of Ohio, geological hazards that would be detrimental to the development of the site with the proposed improvements were not encountered during our review.

SUBSURFACE SOIL CONDITIONS

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting and our understanding of the project. Conditions encountered at each exploration point are indicated on the individual logs. The individual logs can be found in the **Exploration Results** section of this report.

The surface layer at the site generally consisted of topsoil approximately 6 to 12 inches thick. Beneath this surficial layer subsurface profile consisted of predominately native cohesive soil with some occasional layers of native granular soils to the depths explored. The native cohesive soil encountered generally exhibited medium stiff to hard consistency, and the native granular soil encountered generally exhibited loose to very dense relative density.

Conditions encountered at each boring location are indicated on the individual boring logs. Stratification boundaries on the logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Details for each of the borings can be found in the attachment.

The subsurface conditions at the boring locations can be generalized as follows:

Layer	Layer Name (Typical depths layers extend)	General Description
1	Topsoil (Up to 1-foot bgs)	Topsoil (due to prior use of the site for agricultural purposes, tilled soils with high organic content should be anticipated to depths deeper than the topsoil depths noted on the logs)
2	Clay (5 to 40 feet bgs)	Lean Clay, Lean Clay with Sand, Sandy Lean Clay, Sandy Lean Clay with Gravel, Gravelly Lean Clay with Sand, Sandy Fat Clay
3	Sand (6 to 30 feet bgs)	Clayey Sand, Silty Clayey Sand, Clayey Sand with Gravel, Silty Sand with Gravel and Well Graded Sand with Silt and Gravel
4	Gravel (Up to 30 feet bgs)	Clayey Gravel with Sand

bgs – below ground surface

GROUNDWATER CONDITIONS

The borings were observed while drilling for the presence and level of groundwater. The depth to groundwater was observed at depths ranging from 5 to 29 feet below existing ground surface in the borings. Groundwater was not encountered in borings B-20-7 and B-20-8. A summary of the groundwater depths is listed in the following table:

Boring - ID	Observed Groundwater Level While Drilling (feet bgs)	Observed Groundwater Level after Completion of Drilling (feet bgs)	Final Boring depth (feet bgs)
B-20-1	6.0	5.0	30
B-20-2	6.0	No Water Encountered	30
B-20-3	13.5	12.5	30
B-20-4	18.5	17.0	30
B-20-5	14.0	20.0	30
B-20-6	28.5	27.5	40
B-20-7	No Water Encountered	No Water Encountered	30
B-20-8	No Water Encountered	No Water Encountered	30
B-20-9	20.0	24.5	30
B-20-10	13.5	21.5	30
B-20-11	13.5	No Water Encountered	30
B-20-12	13.5	21.0	30
B-20-13	9.5	No Water Encountered	20
B-20-14	13.5	29.0	30
B-20-15	13.5	No Water Encountered	20
B-20-16	23.5	12.5	38.9

Boring - ID	Observed Groundwater Level While Drilling (feet bgs)	Observed Groundwater Level after Completion of Drilling (feet bgs)	Final Boring depth (feet bgs)

bgs – below ground surface

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels indicated on the boring logs. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

In addition to the groundwater level measurements made in the soil borings, six soil borings (B-20-2, -11, -8, -12, -14, and -16) were converted to monitoring wells which were then measured over a sixteen day period (from August 3 to August 18, 2020). **Groundwater Monitoring Well Location Plan** can be found in the **Site Location and Exploration Plans** section of the report. The measurements reported to the nearest tenth of a foot are summarized in the following table.

Well - ID	August 3, 2020 (bgs)	August 10, 2020 (bgs)	August 18, 2020 (bgs)
Well-1	9.8	9.8	9.9
Well-2	11.5	8.4	10.8
Well-3	14.8	14.8	15.0
Well-4	8.6	8.9	9.3
Well-5	9.9	10.1	10.5
Well-6	8.8	9.0	9.5

FROST CONSIDERATIONS

The soils on this site are frost susceptible, and small amounts of water within the soil can affect the performance of the foundation slabs. Exterior slabs should be anticipated to heave during winter months. If frost action needs to be eliminated in critical areas, we recommend the use of non-frost susceptible (NFS) fill or structural slabs (for instance, structural stoops in front of building doors). Placement of NFS material in large areas may not be feasible; however, the following recommendations are provided to help reduce potential frost heave:

- Provide surface drainage away from the building and slabs, and toward the site storm drainage system.
- Install drains around the perimeter of the building, stoops, below exterior slabs and access roadways, and connect them to the storm drainage system.
- Grade clayey subgrades, so groundwater potentially perched in overlying more permeable subgrades, such as sand or aggregate base, slope toward a site drainage system.

- Place NFS fill as backfill beneath slabs and access roadways critical to the project.
- Place a 3 horizontal to 1 vertical (3H:1V) transition zone between NFS fill and other soils.
- Place NFS materials in critical sidewalk areas.

As an alternative to extending NFS fill to the full frost depth, consideration can be made to placing extruded polystyrene or cellular concrete under a buffer of at least 2 feet of NFS material. More information about the frost depth are presented in the **frost heave potential** section of this report

SEISMIC CONSIDERATIONS

The seismic design requirements for structures are based on Seismic Design Category. Site Classification is required to determine the Seismic Design Category for a structure. The Site Classification is based on the upper 100 feet of the site profile defined by a weighted average value of either shear wave velocity, standard penetration resistance, or undrained shear strength in accordance with Section 20.4 of ASCE 7 and the International Building Code (IBC). Based on the soil properties encountered at the site and as described on the exploration logs and results, it is our professional opinion that the **Seismic Site Classification is D**. Subsurface explorations at this site were extended to a maximum depth of 40 feet. The site properties below the boring depth to 100 feet were estimated based on our experience and knowledge of geologic conditions of the general area. Additional deeper borings or geophysical testing may be performed to confirm the conditions below the current boring depth.

CORROSIVITY

Corrosivity test results performed on samples collected from bulk samples throughout the site. These values may be used to estimate potential corrosive characteristics of the on-site soils with respect to contact with the various underground materials which will be used for project construction. Location of the samples and the test result are included in our results of corrosion analysis included in the appendix of this report.

These test results are provided to assist in determining the type and degree of corrosion protection that may be required. We recommend that a certified corrosion engineer be retained to analyze the need for corrosion protection and to design appropriate protective measures, if required.

As discussed in Section 10.7.5 of the AASHTO LRFD Bridge Manual, 8th Edition, 2017, the following soil or site conditions should be considered as indicative of potential deterioration or corrosion situation for steel piles:

- Soil electrical resistivity less than 2,000 ohm-cm
- pH less than 5.5
- pH between 5.5 and 8.5 with high organic content

- Sulfate concentration greater than 1,000 ppm (mg/kg)

GEOTECHNICAL OVERVIEW

The site could be developed for the proposed construction of a solar PV facility based upon geotechnical conditions encountered at the site provided that the findings and preliminary geotechnical engineering recommendations presented in this report are incorporated into project design and construction. It should be noted that the exploration locations were performed at large distances from each other, therefore actual conditions may vary from those encountered. The General Comments section provides an understanding of the report limitations.

CONTRIBUTORY RISK COMPONENTS

ITEM	DESCRIPTION
Supplemental Exploration and Services	Additional soil test borings should be performed to adequately explore the site as part of a design-level study. Additionally, a full-scale pile load testing (PLT) program should be considered as the project design progresses. The results of a full scale PLT program in conjunction with soil test boring/test pit results are often successful in reducing the design embedment depth when compared to designs solely based on explorative results and analytical methods.
Soil Conditions	Project site subsurface profile consisted of predominately native cohesive soil with some occasional layers of native granular soils to the depths explored. The surface layer at the site generally consists of topsoil approximately 6 to 12 inches thick. Due to prior use of the site for agricultural purposes, tilled soils with high organic content should be anticipated to depths deeper than the topsoil depths noted on the logs. As part of final design study, we recommend performing test pits across the site to determine the depth of these tilled horizon. These soils are not considered suitable for subgrade support or reuse as fill material.
Liquefaction	Sands located below the groundwater table can be subject to liquefaction, a phenomenon characterized by sudden loss of strength and collapse under seismic loading. Settlement can be observed at the surface where significant volume loss occurs in sand layers beneath the surface. Based on the subsurface profile encountered at the project site and very low anticipated ground accelerations as indicated by USGS Seismic Design Maps, our preliminary assessment is that liquefaction should not be expected under an earthquake of the magnitude predicted for the site. However, the potential for liquefaction should be further evaluated through additional site investigation

ITEM	DESCRIPTION
	to provide a better representation of the site and to investigate deeper soil zones in a few locations.
Access	Wet and loose/soft surface conditions due to rainwater will create access issues for vehicles. The site will generally be more accessible in the summer and early fall due to the improved drying conditions. The existing drainage canals have a limited number of crossings, likely designed to facilitate access with agricultural equipment.
Grading	We anticipate very little grading will be required. On-site materials that are used as fill or backfill will likely require drying prior to re-compaction as engineered fill. Alternatively, these materials could be replaced with imported soils containing an appropriate moisture content. We expect localized areas of unsuitable conditions will be encountered prior to placing fill and within the subgrade for roadways and shallow foundations that are planned. Stabilization measures, such as over-excavation and replacement or chemical modification/stabilization, should be expected.
Groundwater	Groundwater is currently at depths of 5.0 to 29.0 feet bgs which is typical for the geologic setting of the project site. Based on our experience in the project area, groundwater levels could approach the surface at times during the design period for the project. Excavations, such as trenches for electrical cable and conduit, will likely encounter groundwater and require dewatering. Excavations for shallow foundations could also encounter groundwater, especially if construction is performed during periods of seasonally high groundwater. While precipitation is relatively constant throughout the year, groundwater levels are expected to be deepest during the late summer due to increased evaporation rates.
Site Drainage	The existing perimeter ditches / canals were likely installed to facilitate farming activities and site access. Filling the drainage canals or destruction of other site drainage systems such as field tiles, will result in increased groundwater levels, softer soils, and generally undesirable subsurface conditions.
Corrosion Hazard	Based on laboratory testing for chemical properties, the site soils have negligible to moderately corrosion range to buried metal per corrosion guideline from U.S Department of Transportation Federal Highway Administration. The soils have a ‘negligible’ classification for sulfate exposure according to ACI Design Manual. The results of our laboratory testing of soil chemical properties (provided in the attachment) are expected to assist a qualified engineer to design corrosion protection for the production piles and other project elements.

ITEM	DESCRIPTION
Excavation Hazards	Based on the results of our borings and our experience with the geology of the project site, we do not expect that very difficult excavation conditions or widespread obstructions will be encountered during construction. As previously noted groundwater is expected to be encountered in excavations. Additionally, we expect general instability in the form of caving, sloughing, and raveling to be encountered in excavations. Excavations will likely require bracing, sloping, and/or other means to create safe and stable working conditions.
Slope Hazards	With the exception of the existing, drainage canals, the site is gently rolling to relatively level. Therefore, some sloughing could occur within the slopes for the existing drainage canals.
Anticipated Pile Drivability	There is a likelihood of encountering some difficulties during pile driving. However, widespread pre-drilling is not anticipated to be required.
General Construction Considerations	Based on our findings the near-surface soils consist of primarily clays and are moisture sensitive and subject to degradation with exposure to moisture. To the extent practical, earthwork should be performed during warmer and drier periods of weather to reduce the amount of necessary subgrade remedial measures for soft and unsuitable conditions beneath access roadways, equipment pads, etc.

Note: The soil properties that can significantly affect the aggressiveness of corrosion to buried metal structures include: pH, oxidation-reduction potential, sulfates, sulfides, total dissolved salts, chlorides, resistivity, and moisture content. These properties were measured, and the results are reported in the attachment. These test results are provided to assist the designers of corrosion protection for the project.

The **General Comments** section provides an understanding of the report limitations.

SOLAR PANEL SUPPORT DESIGN RECOMMENDATIONS

Driven W-Section steel piles may be used for supporting solar panel arrays. The axial capacity of lightly-loaded piles is highly dependent upon near surface conditions and must take into consideration environmental and other factors such as frost heave and ground disturbance that would reduce the axial capacity of the near surface soils. Such an analysis is commonly termed a “depth of neglect” analysis, and it includes geotechnical and other factors.

Ground disturbance: The depth of disturbance will depend on near surface conditions during construction and the design life of the project. We recommend a value of 1 foot be applied to this site.

Frost: Lean clay, lean clay with sand, sandy lean clay and gravelly lean clay with sand with fines greater than 15 percent are present across the site. These soils are frost susceptible. If the anchorage/embedment of the foundations and the deadweight of the structure is not sufficient to resist these forces, it can cause uplift of structures. In colder climates, the design to resist frost heave forces exerted on foundations is a critical factor in the foundation design, especially for lightly-loaded structures such as solar panel arrays. Pile lengths will need to be long enough to counteract potential heave forces in the seasonal frost zone. Based on our review of soil samples and published soil maps of the area, we recommend that a frost heave adfreeze stress of 1,500 psf acting along the pile perimeter to a depth of 2 feet below the ground surface be considered for calculating the potential frost heave force. The factor of safety against frost heave forces should be determined based on discussions between the owner/developer, contractor, and design engineer taking into consideration the acceptable level or risk, initial capital expenditure, and the long-term maintenance program. Thawing soils typically have significantly less strength than frozen or fully thawed soils. The design skin friction and lateral soil resistance should use lower strength parameters to account for the reduced capacity of the thawing soils within the frost zone. The values provided in the design tables below have already taken into account the reduction due to fully thawed soil conditions.

GEOTECHNICAL AXIAL CAPACITY

The following preliminary geotechnical parameters based on preliminary borings can be used to estimate the capacity of driven W-section pile foundations. These values should also be suitable to prepare a full-scale pile load testing program which is recommended as part of the overall project design. Final design values will vary from the preliminary estimates below. We recommend a factor of safety of 2 for the ultimate skin friction and ultimate end bearing capacity.values.

Layer (feet)	Ultimate Unit Skin Friction (psf)	Ultimate End Bearing Capacity (lbs)
0 - 2[1]	--	--
2 - 8	500	---
8 – 15	700	200

1. Depth to ignore due to frost heave
2.

The axial tensile (pull-out) capacity can be developed from skin friction while the axial compressive capacity can be developed from skin friction and end bearing. The above indicated allowable skin friction is appropriate for uplift and compressive loading. The skin friction perimeter can be calculated using the perimeter of the pile which equals twice the sum of the flange width and web depth. The end bearing is applicable for piles founded at depths greater than the depths indicated on the tables above. The upper 2 feet of soil should be neglected when calculating skin friction due to the frost heave depth.

Piles should have a minimum center-to-center spacing of at least 3 times their largest cross-sectional dimension to prevent reduction in the axial capacities due to group effects. If the piles are designed using the above parameters, settlements are not anticipated to exceed 1 inch.

GEOTECHNICAL LATERAL CAPACITY

The parameters in the following table can be used for a preliminary analysis of the lateral capacity of driven steel piles in support of solar panel arrays.

Depth (feet bgs)	Soil Type	Effective Unit Weight γ, (pcf)	Friction Angle, Φ	Undrained Shear Strength (ksf)	Soil Modulus, k (pci)	ε_{50}	P-Multiplier
0 - 2	Sand (Reese)	120	32	--	Default	--	0.7
2 - 5	Sand (Reese)	120	32	--	Default	--	1.0
5[1] - 15	Stiff Clay Without Free Water	58	---	2	Default		1.0

These parameters are based on correlations with SPT results, published values, and our experience with similar soil types. A P-multiplier of 0.7 should be applied to the upper 2 feet of loose and cultivated, near-surface soils to account for potential strength losses due to frost depth, construction disturbance, seasonal effects, and other factors. These values should be considered approximate.

SHALLOW FOUNDATIONS

We suggest that a "turned down" concrete slab-on-grade type foundation system be considered for relatively lightly loaded equipment pads that can tolerate movements due to frost heave action of the site soils.

For the heavily loaded structures that are sensitive to movement we recommend reinforced concrete mat/slab foundation should be considered. Also, for heavy equipment loads or slabs that are highly sensitive to movements, a deep foundation system consisting of drilled shaft foundation can be considered.

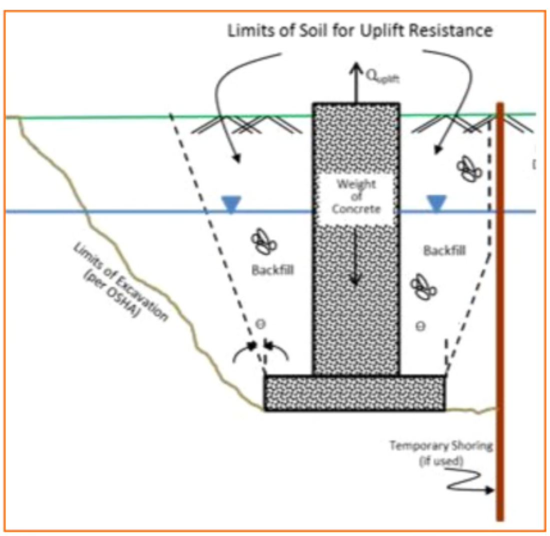
DESIGN PARAMETERS – COMPRESSIVE LOADS

Item	Description
Maximum Net Allowable Bearing pressure [1, 2]	3,000 psf (soils are primarily medium dense to very stiff)
Required Bearing Stratum [3]	Native soils: at least stiff cohesive soils or at least medium dense granular soils Structural fill
Minimum Foundation Dimensions	Columns: 30 inches Continuous: 18 inches
Ultimate Passive Resistance [4] **(equivalent fluid pressures)**	300 pcf (cohesive soils/backfill) 390 pcf (granular soils/backfill)
Ultimate Coefficient of Sliding Friction [5]	0.40
Minimum Embedment below Finished Grade [6]	36 inches
Estimated Total Settlement from Structural Loads [2]	Less than about 1 inch
Estimated Differential Settlement [2, 7]	About 1/2 of total settlement

Item	Description
1.	The maximum net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. An appropriate factor of safety has been applied. Values assume that exterior grades are no steeper than 20% within 10 feet of structure.
2.	Values provided are for maximum loads noted in **Project Description**.
3.	Unsuitable or soft soils should be over-excavated and replaced per the recommendations presented below.
4.	Use of passive earth pressures require the sides of the excavation for the spread footing foundation to be nearly vertical and the concrete placed neat against these vertical faces or that the footing forms be removed and compacted structural fill be placed against the vertical footing face. Passive resistance should be neglected in the uppermost 24 inches below grade.
5.	Can be used to compute sliding resistance where foundations are placed on suitable soil/materials. Should be neglected for foundations subject to net uplift conditions.
6.	Embedment necessary to minimize the effects of frost and/or seasonal water content variations. For sloping ground, maintain depth below the lowest adjacent exterior grade within 5 horizontal feet of the structure.
7.	Differential settlements are estimated over a span of 50 feet.

DESIGN PARAMETERS - UPLIFT LOADS

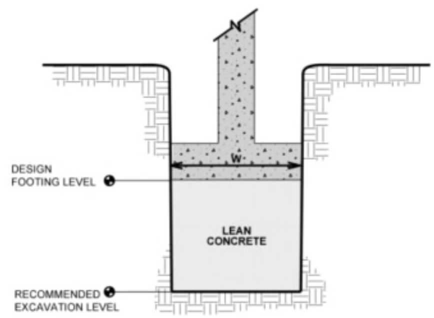
Uplift resistance of spread footings can be developed from the effective weight of the footing and the overlying soils. As illustrated on the subsequent figure, the effective weight of the soil prism defined by diagonal planes extending up from the top of the perimeter of the foundation to the ground surface at an angle, θ, of 20 degrees from the vertical can be included in uplift resistance. The maximum allowable uplift capacity should be taken as a sum of the effective weight of soil plus the dead weight of the foundation, divided by an appropriate factor of safety. A maximum total unit weight of 120 pcf should be used for the backfill. This unit weight should be reduced to 58 pcf for portions of the backfill or natural soils below the groundwater elevation.



FOUNDATION CONSTRUCTION CONSIDERATIONS

As noted in **Earthwork**, the footing excavations should be evaluated under the direction of the Geotechnical Engineer. The base of all foundation excavations should be free of water and loose soil, prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Care should be taken to prevent wetting or drying of the bearing materials during construction. Excessively wet or dry material or any loose/disturbed material in the bottom of the footing excavations should be removed/reconditioned before foundation concrete is placed.

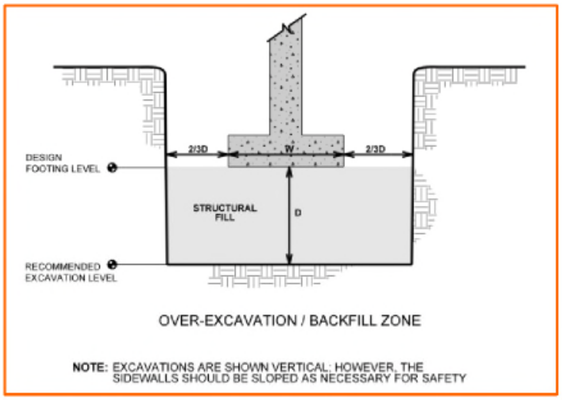
If unsuitable bearing soils are encountered at the base of the planned footing excavation, the excavation should be extended deeper to suitable soils, and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. This is illustrated on the sketch below.



LEAN CONCRETE BACKFILL

NOTE: EXCAVATIONS ARE SHOWN VERTICAL; HOWEVER, THE SIDEWALLS SHOULD BE SLOPED AS NECESSARY FOR SAFETY

Over-excavation for structural fill placement below footings should be conducted as shown below. Over-excavation for compacted structural fill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of over-excavation depth below footing base elevation. The over-excavation should then be backfilled up to the footing base elevation with granular structural fill material placed in lifts of 8 inches or less in loose thickness (4 inches or less if using hand-guided compaction equipment) and compacted according to the recommendations provided in **Earthwork**.



For a turned-down concrete slab, we recommend that "footings" at the edges of the slab bear upon or within at least medium stiff or loose native soils or new structural fill at a depth of at least 3 feet below exterior grade for frost depth considerations.

The slab should be supported directly on new base course material consisting of free draining granular material. We recommend a minimum 6-inch thick free draining granular base, such as relatively clean, well-graded crushed limestone. This material will serve as a leveling course, a capillary moisture break, help provide load distribution, and expedite construction. Care will be necessary to avoid contaminating this layer with soil prior to slab placement.

During earthwork procedures, care should be taken to maintain the subgrade moisture content prior to construction of the slab. If the subgrade should become desiccated, the affected material should be removed, or these materials should be scarified, moistened, and re-compacted prior to floor slab placement.

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations refer to the ACI Design Manual.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will support equipment sensitive to moisture. When conditions warrant the use of a vapor retarder, the slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

For design under "point loading" conditions, a subgrade modulus of 110 pci is recommended.

MAT FOUNDATION

We understand the main foundation component in the array area will include driven pile foundations for support of solar arrays; however, some lightly-loaded, inverter structures are typically required across the site. In general, small, lightly-loaded, inverter structures may be supported on driven piles or isolated mat foundation systems.

Mat foundations could be considered for supporting heavy equipment loads or structures that are sensitive to movements. Subgrades for mat foundations should be prepared following the recommendation presented in the **Earthwork** section above**.** We recommend that mat foundations should be supported on a minimum 18-inch thick free draining granular base, such as relatively clean, well-graded crushed limestone.

If unsuitable bearing soils are encountered in footing excavations, the excavations should be extended deeper to suitable soils (at least stiff consistency or medium dense relative density) and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The footings could also bear on properly compacted backfill extending down to the suitable soils. Over-excavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of over excavation depth below footing base elevation. The over excavation should then be backfilled up to the footing base elevation with structural fill placed in lifts of 8 inches or less in loose thickness and compacted to at least 98 percent of the material's maximum dry density (ASTM D 698). A summary of the design parameters is listed in the table below

MAT/SLAB DESIGN PARAMETERS

Item	Description
Slab Support [1]	Minimum 18 inches of free-draining (less than 6% passing the U.S. No. 200 sieve) crushed aggregate compacted to at least 95% of ASTM D 698 [2, 3]
Estimated Modulus of Subgrade Reaction [2]	110 pounds per square inch per inch (psi/in) for point loads (
Minimum Width	3.5 feet
Modulus Correction Factor [4]	$k_c=k((b+1)/2b)^2$
Maximum Design Contact Stress	2,500 psf
Total Estimated Settlement	1 inch or less
Differential Settlement	¾-inch over 4 feet

Item	Description

1. Floor slabs should be structurally independent of building footings or walls to reduce the possibility of floor slab cracking caused by differential movements between the slab and foundation.
2. Modulus of subgrade reaction is an estimated value based upon our experience with the subgrade condition, the requirements noted in **Earthwork**, and the floor slab support as noted in this table. It is provided for point loads. For large area loads the modulus of subgrade reaction would be lower.
3. Free-draining granular material should have less than 5% fines (material passing the No. 200 sieve). Other design considerations such as cold temperatures and condensation development could warrant more extensive design provisions.
4. It is common to reduce the k-value to account for dimensional effects of large loaded areas. Where k_c is the corrected or design modulus value and b is the mat width (short dimension) or tributary loaded area.

If exposed to the exterior grade, the sides of the mat foundation should be backfilled with compacted soil and consideration should also be made with regard to frost protection. A minimum 3.0 feet foundation embedment should be used for frost protection as indicated in the above table.

If lateral load resistance is required, an allowable coefficient of friction between the bottom of the concrete mat and the underlying granular structural fill can be assumed to be 0.3. This value includes a theoretical safety factor of about 1.5 against sliding. It is recommended that passive pressure resistance along the sides of the foundation be neglected.

FOUNDATION CONSTRUCTION CONSIDERATIONS

Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted prior to construction.

Based upon the subsurface conditions determined from the geotechnical explorations, subgrade soils exposed during construction are anticipated to be relatively workable depending on the weather. If earthwork is completed during the wet season, we recommend extra precautionary measures to protect subgrade soils due to presence of onsite soft/loose soil which are sensitive to moisture fluctuation. This could include diversion of surface runoff around exposed soils and draining of ponded water on the site. If unstable, soft/loose or wet subgrade conditions develop during construction, suitable methods of stabilization will be required such as chemical treatment, undercutting/replacement and use of geotextile fabric as recommended in the **Earthwork** section above.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations to the completed subgrade.

DEEP FOUNDATION

Our recommendations provided below are based on the subsurface information encountered near boring locations Boring B-20-6 and Boring B-20-16. If the location of the new substation and equipment pad areas change, we should be consulted prior to the design and construction of foundations.

It is anticipated that some of the substation structures/appurtenances will be supported on deep foundation systems such as drilled shaft/pier foundation elements. It is recommended that each drilled shaft element be at least 18 inches in diameter. Based on our subsurface findings near the Boring B-20-6 and Boring B-20-16, it is recommended that drilled shaft lengths should be at least 3 times the shaft diameter or 10 feet minimum and should be terminated within native cohesive soil of at least stiff consistency.

It is recommended that the drilled shaft design should incorporate a factor of safety of 3.0 for end bearing and 2.5 for side resistance, when subjected to axial compression loading situation. A factor of safety of 3.0 is recommended for side resistance against uplift loading situation. Soil parameters for axial design of drilled shaft using computer program SHAFT are provided in the following section.

Drilled shaft length may need to be adjusted (increased) to resist the lateral loads and moments acting at or near the ground surface elevation (structural loads). Soil Parameters and Models for Lateral Load Analyses of Drilled Shafts are also provided below for detailed lateral load analyses of drilled shaft foundation.

Based on the encountered subsurface conditions, laboratory test results, and field penetration test results, generalized engineering properties have been provided at Borings B-20-6 and B-20-16, as shown in the following table:

SHAFT AND LPILE DESIGN PARAMETERS

Soil Layer Number	Soil Type	Depth to Bottom of Layer (1) (feet)	Effective Unit Weight (pcf)	Un-drained Shear Strength (ksf)	Adhesion Factor		Strain E_{50}	K-Value (pci)	Bearing Capacity Factors	
									N_q	N_c (3)
1 (2)	Stiff Clay w/o Free Water (Reese)	10	120	2.0	0.55		0.008	650	--	8
2	Stiff Clay w/o Free Water (Reese)	40	57.6	3.0	0.55		0.005	1000	--	8

Notes:

(1) Depth referenced to existing ground surface.

(2) The side resistance of the uppermost 3 feet of the soil should be ignored due to the potential for disturbance caused during the drilled shaft construction.

(3) Bearing capacity factor N_c=8 is based on drill shaft constructed using temporary dry casing method, if drill shaft is constructed using slurry displacement method then the reduced value of Nc=7 should be used.

The following additional construction considerations, during the drilled shaft installations, should be followed:

- It is anticipated that drilled shafts can be constructed by using temporary dry casing method due to presence of cohesive soils, however; if groundwater seepage or caving condition occur, the slurry-displacement method should be used.
- The actual bearing elevation at each drilled shaft location should be determined in the field during construction through inspection by an authorized representative of the geotechnical engineer.
- If effective dewatering is not practical, concrete should be placed at the bottom of the excavation by pumping or by using a tremie pipe.
- To facilitate pier construction, concrete should be on-site and ready for placement as pier excavations are completed.
- It is recommended that no completed drilled shaft holes be left open overnight without being filled with concrete.

EARTHWORK

Grading plans were not available at the time of this report. Based on the available information, we have assumed that earthwork for the project will include clearing and grubbing, minimal (less than 3ft) excavation and filling for solar arrays, trenching for cables and conduits, cutting and filling to achieve roadway grade, and excavations for stormwater management. The earthwork described in the following sections is preliminary in nature and intended for planning general site grading in the solar array areas, access roadways, drainage, and equipment structure areas (such as the transformer pad areas).

SITE PREPARATION

It is recommended that areas of proposed slab-on-grade or mat foundation structures be stripped of any tilled soil, topsoil, peat/muck, or soft/loose overburden soils containing organic matter. In access roadway, solar array and new fill areas of the site, the tilled soils/topsoil will create difficult access issues, particularly when soil possess high moisture content. These materials can be modified to increase their strength and any planned approaches to improve the strength of these soils should be tested. Please note, that any soil placed over topsoil/tilled soils will settle with time with the magnitude of the settlement being directly related to the thickness of these types of soils. Therefore, any materials consisting of topsoil, tilled soils, vegetation and organic matter should be stripped and wasted off site or could be re-spread in landscaped areas after completion of grading operations. Stripping depths between our boring locations and across the site could vary considerably. We recommend actual stripping depths be evaluated by a representative of Terracon prior to construction by excavating test pits and during construction to aid in preventing removal of excess material.

Existing drainage and field tiles associated with agricultural activities may be present across the site. As much as possible, these drainage features should be preserved to maintain surface and subsurface drainage of the site.

Removal and/or relocation of any “to be abandoned” utilities should also be performed prior to rough site grading activities. We would anticipate removal and relocation, or re-routing, of any existing utilities that may currently exist within the footprint of the proposed development area would interfere with new construction. Where abandoned underground pipes are located beneath any mat or shallow foundations, they should be fully grouted if left in place. Excavations created due to utility relocations should be backfilled with structural fill material, placed and compacted in accordance with the recommendations provided in the following paragraphs, or with lean concrete or flowable fill if lean concrete or controlled density fill (CDF) is used as backfill. The contractor should refer to all of the new build Mechanical-Electrical-Plumbing (MEP) and foundation drawings to confirm that concrete backfill materials will not conflict with any new item installations or construction.

After performing the site grading activities associated with cutting/filling the site to design grade; and prior to placing structural fill in areas to receive fill, the subgrade should be proof-rolled to aid in locating soft or loose areas. Proof-rolling of cohesive soils should be accomplished with a fully loaded, tandem axle dump truck or other suitable pneumatic tired equipment weighing at least 20-tons. Granular soils should be proof-rolled with several passes of a vibratory roller (minimum dead weight of 8 tons on the drum) to help densify those soils. Based on conditions encountered in the borings, significant measures for subgrade stabilization should be anticipated.

Any soft or yielding areas encountered within the new fill areas, solar array areas, substation and access road areas during proof-rolling operations should be undercut to expose firm stable soils or re-worked in place to a suitable acceptable condition. Chemical modification of the subgrade in the access road locations may be an alternative to removal, though any planned modification should be tested prior to implementation. It should be noted that an undercut depth somewhat greater than normal may be needed if the construction occurs during periods of inclement weather. The actual amount of undercut would need to be determined in the field during construction and is dependent on the subsurface conditions encountered, weather conditions and equipment used in the construction. Chemical stabilization is generally considered to be more cost effective than undercut and replacement of large areas.

Once the foundation excavation is made, the exposed subgrade soils should be examined by geotechnical personnel to determine that the suitable bearing materials have been encountered. If unsuitable soils are encountered, these soils should either be undercut to expose suitable soils or stabilized in place. Should the excavation expose materials that can be stabilized with #2 stone or durable dump-rock prior, provisions should be made to “drain” these materials to a nearby storm sewer or other drainage outlet. Any #2 stone or dump rock should be suitably choked-off at the top so as to prevent overlying finer grained materials from migrating into this open-graded material.

Native soils exposed at or within 18 inches below the slab subgrade level which do not meet low volume change material requirements should be undercut and replaced with suitable low volume change material structural fill to provide for a minimum 18-inch thick layer of suitable subgrade. Alternately, the top 18-inches of the subgrade should be chemically stabilized.

The rough soil subgrade elevation should be established with quality controlled cohesive or granular fill placed and compacted in accordance with requirements provided in section **Fill Material Types** and section **Fill Compaction Requirements**.

FILL MATERIAL TYPES

Structural fill should meet the following material property requirements:

Fill Type [1]	USCS Classification	Acceptable Location for Placement
Lean Clay	CL (LL<40)	All Locations and Elevations
Fat Clay and moderate plasticity clays	CH (LL>50) and CL with 40<LL<50	>1.5 feet below the finished subgrade elevation
Well Graded Granular	GW[2]	All Locations and Elevations
Low Volume Change Material[3]	CL or GW[2] and (LL<40 & PI<22)	All Locations and Elevations
On-site Soils	CL, SC, CH	Onsite CL and SC native soils appear suitable for use as engineered fill after drying provided they are tested during construction. During wet season, it will be extremely difficult to dry the soils to suitable moisture condition, thereby making it very difficult to achieve specified compaction. Use of on-site soils as structural fill should meet the requirements for "acceptable location for placement" indicated above. CH soils are not acceptable as structural fill.

1. New structural fill should consist of approved materials that are free of organic matter, peat, debris and rock fragments larger than 3 inches in any dimension. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Similar to Ohio DOT aggregate base or crushed limestone aggregate or granular material such as sand, gravel, or crushed stone containing at least 18% low plasticity fines.
3. Low plasticity cohesive soil or granular soil having at least 18% low plasticity fines.

FILL COMPACTION REQUIREMENTS

Engineered fill should meet the following compaction requirements.

Item	Description
Fill Lift Thickness (Structural Areas)	8-inches or less in loose thickness if heavy self-propelled compaction equipment is used. 4 to 6 inches or less if hand compaction equipment is used.
Compaction Requirements[1] (Structural Areas)	Minimum 98% of the material's Standard Proctor maximum dry density (ASTM D698)
Compaction Requirements (Landscape Areas)	Minimum 95% of the material's Standard Proctor maximum dry density (ASTM D 698) provided long-term plans do not include a structure in these areas.

Item	Description
Moisture Content – Cohesive Soil (Low Plasticity)	Within ±3% of optimum moisture content (OMC) as determined by the Standard Proctor test at the time of placement and compaction
Moisture Content[2] – Granular Material	Workable Moisture Levels

1. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.
2. Specifically, moisture levels should be maintained low enough to allow for satisfactory compaction to be achieved without the cohesionless fill material pumping when proof-rolled.
3. All materials to be used as engineered fill should be tested in the laboratory to determine their suitability and compaction characteristics.

FILL MATERIAL CONSIDERATIONS

In the areas of the proposed solar array panels, fill material may not be needed. These areas should only be receiving driven steel piles for solar panel support and the subgrade should only be prepared in a manner to minimize erosion and provide a stable surface for installation of driven piles.

Where proposed equipment structures are located, structural fill should be placed over a stable subgrade prepared and proof rolled as discussed above. The soils to be used as structural fill should be free of organics, roots, or other deleterious materials. The fill should be non-plastic granular material containing less than 12 percent fines (material passing the No. 200 sieve).

Some manipulation of the moisture content (such as wetting, drying) may be required during the filling operation to obtain the required degree of compaction. The manipulation of the moisture content is highly dependent on weather conditions and site drainage conditions. A sufficient number of density tests should be performed to confirm the required compaction of the fill material.

CONSTRUCTION CONSIDERATIONS

It is anticipated that excavations for the proposed construction can be accomplished with conventional earthmoving equipment. Tracked equipment should be considered in areas of the site where wet surface soil conditions are present to help reduce rutting and disturbance of the near surface soils.

Particular attention should be given to the methods for subgrade drainage in consideration of the wet conditions observed on site. The gravel access road should not be recessed into the existing subgrade without methods to drain the subgrade moisture. Roads should incorporate subgrade drainage methods. Maintenance activities should be increased onsite to address the development of rutting in a timely manner. The risk of damaging the underlaying geogrid layers and/or rutting the subgrade soils is significantly increased if delays in grading and other maintenance activities result in the progression of rutting beyond the original design assumptions. More frequent maintenance will be required in areas subject to turning traffic.

We understand the construction of new gravel access roads above grade may inhibit the surface flow drainage capabilities of the site. The use of open graded aggregate on above grade portions of the gravel access roads can be considered as a means of allowing some water flow across the above grade gravel access roads. Based on our observation of roadway performance on previous similar projects, open graded aggregate may be used in above grade portions of the gravel access roads, provided they are fractured/angular and our recommendations for subgrade drainage are implemented. The open graded aggregate will be less stable than aggregate base course, therefore additional thickness and frequency of maintenance activities should be expected. Open graded aggregates are more stable if confined, therefore exposed gravel layer edges may need to be widened to develop stability at the wheel path. Terracon has not performed any surface flow drainage analysis to determine the effect of the open graded aggregate on site drainage, nor do we guarantee that the open graded aggregate will facilitate surface drainage.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the access roads. Construction traffic over the completed subgrade should be avoided to the extent practical. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become desiccated, saturated, or disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and re-compacted prior to access road construction.

The individual contractors are responsible for designing and constructing stable, temporary excavations (including utility trenches) as required to maintain stability of both the excavation sides and bottom. Excavations should be sloped or shored in the interest of safety following local, and federal regulations, including current OSHA excavation and trench safety standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; proof-rolling; placement and compaction of controlled compacted fills; backfilling of excavations to the completed subgrade.

UTILITY TRENCH BACKFILL

All trench excavations should be made with sufficient working space to permit construction, including backfill placement and compaction. If utility trenches are backfilled with relatively clean granular material, they should be capped with at least 18 inches of low plasticity cohesive fill in non-pavement areas to reduce the infiltration and conveyance of surface water through the trench backfill.

Compaction requirements for bedding and backfilling around utilities may need to be adjusted to the pipe material type and the pipe manufacturer bedding and backfill material recommendation. If utility trenches in non-pavement areas are backfilled with relatively clean granular material, they should be capped with at least 18 inches of cohesive fill to reduce the infiltration and conveyance of surface water through the trench backfill. Granular backfill is recommended for use as backfill in utility trenches in areas beneath pavements.

SITE DRAINAGE

During the dry season, the site should generally remain relatively workable in that since there is little rainfall, the soils stay dry. However, during the wet season, there is frequent heavy rain from thunderstorms. This will make getting the surface soils dry to remain workable will be difficult. Also, during the rainy season, since the near surface soils are silty and clayey, they will be susceptible to erosion if not adequately protected from run off of the heavy rains. Until vegetation to established on the exposed surface soils, they will remain susceptible to erosion even if construction is otherwise complete.

As indicted previously, the existing drainage and field tiles associated with agricultural activities may be present across the site. As much as possible, these drainage features should be preserved to maintain surface and subsurface drainage of the site.

During construction the contractor may want to consider implementing a program to lower groundwater to facilitate access and mobilization around the site. If such a program is implemented, groundwater levels should be lowered to a depth of at least two feet below the surface of any vibratory compaction operations.

EARTHWORK CONSTRUCTION CONSIDERATIONS

Shallow excavations for the proposed structure are anticipated to be accomplished with conventional construction equipment. Upon completion of filling and grading, care should be taken to maintain the subgrade water content prior to construction of slabs. Construction traffic over the completed subgrades should be avoided. The site should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. Any water that collects over, or adjacent to, construction areas should be promptly removed. If the subgrade freezes, desiccates, saturates, or is disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted, prior to slab construction. All these processes should be observed by Terracon.

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean Terracon is assuming any responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

CONSTRUCTION OBSERVATION AND TESTING

The earthwork efforts should be monitored under the direction of the Geotechnical Engineer. Field density tests should be conducted during placement and compaction of engineered fill. The testing frequency should be in accordance with the following table.

Fill Placement Area	Recommended Testing Frequency (ASTM D6938)
Solar Arrays	Each vertical foot of fill placed should be tested at a frequency of 1 test per every 20,000 square feet of fill placed, or a minimum of 1 test per solar array block quadrant per vertical foot of fill placed
Utility Trench Backfill	Each vertical foot of fill placed should be tested at an interval of every 100 linear feet of fill placed

The Geotechnical Engineer may require additional tests as considered necessary to check on the uniformity of compaction. No additional layers of fill should be placed until the field density test results indicate that the specified density has been obtained.

In areas of foundation excavations, the bearing subgrade should be evaluated under the direction of the Geotechnical Engineer. In the event unanticipated conditions are encountered, the Geotechnical Engineer should prescribe mitigation options.

In addition to the documentation of the essential parameters necessary for construction, the continuation of the Geotechnical Engineer into the construction phase of the project provides the continuity to maintain the Geotechnical Engineer’s evaluation of subsurface conditions, including assessing variations and associated design changes.

ACCESS ROADWAYS

GENERAL ROADWAYS COMMENTS

On most project sites, the site grading is accomplished relatively early in the construction phase. However, as construction proceeds, excavations are made into these areas, rainfall and surface water saturates some areas, heavy construction traffic disturbs the subgrade and many surface irregularities are filled in with loose soils to improve trafficability temporarily. As a result, the roadways subgrades should be carefully evaluated as the time of construction.

We recommend the moisture content and density of the upper 12 inches of the subgrade be evaluated and the road subgrades be proof-rolled. Areas not in compliance with the required ranges of moisture or density should be moisture conditioned and recompacted. Particular attention should be paid to anticipated high traffic areas and to areas where backfilled trenches are located. Areas where unsuitable conditions are located should be repaired by removing and replacing the materials with properly compacted fills.

During to precipitation events, the subgrade soils become extremely wet causing areas of the site with ponding water. Similar conditions should be anticipated during construction if it occurs during wet season. Therefore, it will be very important to not cut off the surface drainage characteristics of the site by construction of recessed gravel access roads. Additionally, the existing clay drainage tiles should be preserved to maintain the subsurface drainage and additional subsurface drainage measures installed. The gravel access roads should not be constructed below the existing grade and that positive drainage away from the gravel roadway subgrade soils should be maintained.

After proof-rolling and repairing subgrade deficiencies, the entire subgrade should be scarified and compacted as recommended in **Earthwork** section to provide a uniform subgrade for gravel road construction. Areas that appear severely desiccated following site stripping may require further undercutting and moisture conditioning. If a significant precipitation event occurs after the evaluation or if the surface becomes disturbed, the subgrade should be reviewed by qualified personnel immediately prior to application of the gravel surfacing. The subgrade should be in its finished form at the time of final review.

We understand that the proposed gravel access road will be primarily used by light duty maintenance vehicles. We recommend the proposed gravel access roads should have minimum 8” to 12” thick aggregate base course over the final prepared subgrade. These are not meant for construction trafficking, which will require significantly thicker sections.

DRAINAGE

The proposed gravel access road should be sloped to provide rapid drainage of surface water. Water allowed to pond on or adjacent to the road could saturate the subgrade and contribute to premature road deterioration. In addition, the road subgrade should be graded to provide positive drainage within the granular base section. Appropriate sub-drainage or connection to a suitable daylight outlet should be provided to remove water from the granular subbase.

MAINTENANCE

Crushed stone surfaced roadways, regardless of the section thickness or subgrade preparation measures, will require on-going maintenance and repairs to keep them in a serviceable condition. It is not practical to design a gravel section of sufficient thickness that on-going maintenance will not be required. This is due to the porous nature of the gravel that will allow precipitation and surface water to infiltrate and soften the subgrade soils, and the limited near surface strength of unconfined gravel that makes it susceptible to rutting. When potholes, ruts, depressions or yielding subgrades develop, they must be addressed as soon as possible to avoid major repairs.

Typical repairs could consist of placing additional gravel in ruts or depressed areas. In some cases, complete removal of distressed portions of the existing section will be required along with replacement of the roadway section. Potholes and depressions should not be filled by blading adjacent ridges or high areas into the depressed areas. New material should be added to depressed areas as they develop. Failure to make timely repairs will result in more rapid deterioration of the roadways, making more extensive repairs necessary.

GENERAL COMMENTS

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Natural variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence or collaboration through this system are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly impact excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety, and cost estimating including, excavation support, and dewatering requirements/design are the responsibility of others. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

ATTACHMENTS

SITE LOCATION AND EXPLORATION PLANS

Contents:

Note: All attachments are one page unless noted above.

EXPLORATION AND TESTING PROCEDURES

FIELD EXPLORATION

Number of Explorations	Type of Exploration	Depth or Description [1]	Planned Location
B-20-1, B-20-2, B-20-3, B-20-4, B-20-5, B-20-7, B-20-8, B-20-9, B-20-10, B-20-11, B-20-12, B-20-14	SPT Borings	30	Planned overhead electric collection line support structures and Array area
B-20-6 and B-20-16		40	Planned Substation
B-20-13 and B-20-15		20	Array areas

1. Below ground surface.

Boring Layout and Elevations: We used handheld GPS equipment and existing site features to locate borings with an estimated horizontal accuracy of +/-10 feet as shown on the attached **Exploration Plan**.

Subsurface Exploration Procedures: We advanced soil borings with a track-mounted drill rig using rotary wash techniques. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. Soil sampling was performed using a standard 2-inch outer diameter split barrel sampling spoon that was driven into the ground by a 140-pound rope and cathead operated safety hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the middle 12 inches of a 24-inch sampling interval or the last 12 inches of an 18-inch sampling interval was recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. The samples were placed in appropriate containers, taken to our soil laboratory for testing, and classified by a geotechnical engineer. In addition, we observed and recorded groundwater levels during sampling.

Our exploration team prepared field boring logs as part of standard drilling operations including sampling depths, penetration distances, and other relevant sampling information. Field logs included visual classifications of materials encountered during drilling, and our interpretation of subsurface conditions between samples. Final boring logs, prepared from field logs, represent the geotechnical engineer's interpretation, and include modifications based on observations and laboratory tests.

LABORATORY TESTING

The project engineer reviewed the field data and assigned various laboratory tests to better understand the engineering properties of the various soil strata as necessary for this project. Procedural standards noted below are for reference to methodology in general. In some cases, variations to methods are applied because of local practice or professional judgment. Standards noted below include reference to other, related standards. Such references are not necessarily applicable to describe the specific test performed.

- ASTM D2216 Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- ASTM D4318 Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
- ASTM D422 Standard Test Method for Particle-Size Analysis of Soils
- ASTM D698 Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

Our laboratory testing program also included examination of soil samples by an engineer. Based on observation and test data, the engineer classified the soil samples in accordance with the **Unified Soil Classification System** (ASTM D2487).

Corrosion Testing: Bulk soil samples were collected from 1 to 4 feet bgs at five locations at the project site during the original preliminary study and sent to Terracon's office for corrosivity testing. The testing included water-soluble sulfate ion content in soil in accordance with ASTM C1580 presented in percent by weight, water-soluble chloride ion content in accordance with ASTM D512 presented in percent by weight, pH in accordance with ASTM D4972, Sulfides in accordance with ASTM D4658, Oxidation Reduction Potential in accordance with ASTM G200, and electrical resistivity using the "soil box" method in accordance with ASTM G187. The results of the corrosion testing are presented in the **Exploration Results** section.

DATA SOURCES:
ESRI WMS - World Topographic, Streets

Site Boundary

Project No.:	N4205246
Date:	August, 2020
Drawn By:	JNT
Reviewed By:	YSR

Terracon
800 Morrison Road Gahanna , Ohio 43230
PH. (614) 328-5150 terracon.com

SITE LOCATION PLAN

MADISON SOLAR FACILITY

First Solar, Inc.
350 Washington Street, Suite 6800
Tempe, Arizona 85281

Site Boundary

Boring Location

DATA SOURCES:
ESRI WMS - World Topographic, Streets

Miles

0 0.25 0.5 1

Project No.:	N4205246
Date:	August, 2020
Drawn By:	JNT
Reviewed By:	YSR

Terracon

800 Morrison Road Gahanna , Ohio 43230

PH. (614) 328-5150 terracon.com

EXPLORATION PLAN

MADISON SOLAR FACILITY

First Solar, Inc.
350 Washington Street, Suite 6800
Tempe, Arizona 85281

Site Boundary

DATA SOURCES:
ESRI WMS - World Topographic, Streets

Miles
0 0.25 0.5 1

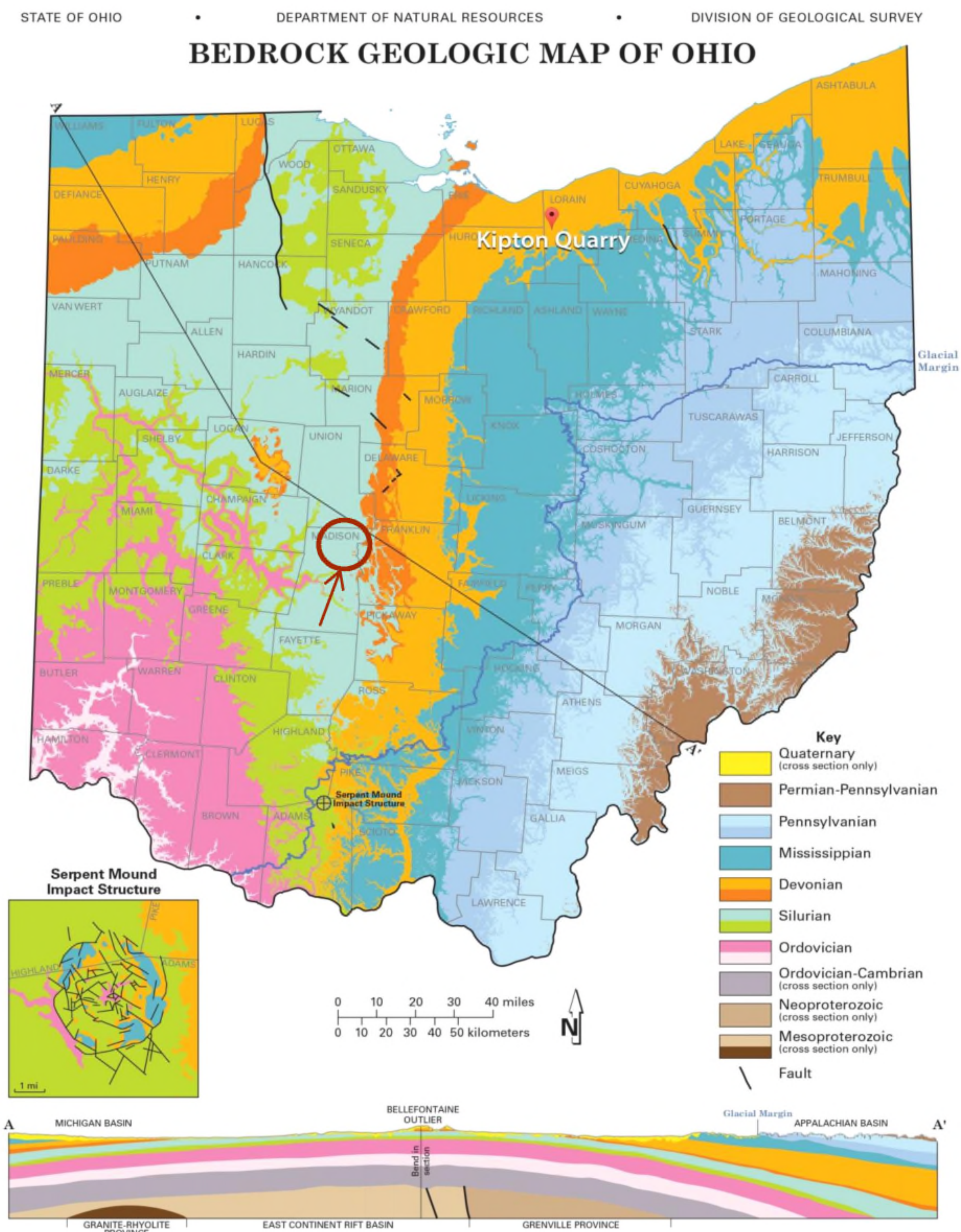
Project No.:	N4205246
Date:	August, 2020
Drawn By:	JNT
Reviewed By:	YSR

Terracon
800 Morrison Road Gahanna, Ohio 43230
PH. (614) 328-5150 terracon.com

GROUNDWATER MONITORING WELLS LOCATION PLAN

MADISON SOLAR FACILITY

First Solar, Inc.
350 Washington Street, Suite 6800
Tempe, Arizona 85281



Recommended citation: Ohio Division of Geological Survey, 2006, Bedrock geologic map of Ohio: Ohio Department of Natural Resources, Division of Geological Survey Map BG-1, generalized page-size version with text, 2 p., scale 1:2,000,000.

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

EXPLORATION RESULTS

Contents:

Note: All attachments are one page unless noted above.

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

Madison Solar Farm ■ London, OH

Terracon Project No. N4205246

Terracon GeoReport

SAMPLING	WATER LEVEL	FIELD TESTS
Grab Sample Standard Penetration Test	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.	N — Standard Penetration Test Resistance (Blows/Ft.) (HP) — Hand Penetrometer (T) — Torvane (DCP) — Dynamic Cone Penetrometer UC — Unconfined Compressive Strength (PID) — Photo-Ionization Detector (OVA) — Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

LOCATION AND ELEVATION NOTES

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance		CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance		
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength Qu, (tsf)**	**Standard Penetration or N-Value Blows/Ft.**
Very Loose	0 - 3	Very Soft	less than 0.25	0 - 1
Loose	4 - 9	Soft	0.25 to 0.50	2 - 4
Medium Dense	10 - 29	Medium Stiff	0.50 to 1.00	4 - 8
Dense	30 - 50	Stiff	1.00 to 2.00	8 - 15
Very Dense	> 50	Very Stiff	2.00 to 4.00	15 - 30
		Hard	> 4.00	> 30

RELEVANCE OF SOIL BORING LOG

The soil boring logs contained within this document are intended for application to the project as described in this document. Use of these soil boring logs for any other purpose may not be appropriate.

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]				Soil Classification	
				Group Symbol	**Group Name** [B]
Coarse-Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	Cu ≥ 4 and 1 ≤ Cc ≤ 3 [E]	GW	Well-graded gravel [F]
			Cu < 4 and/or [Cc<1 or Cc>3.0] [E]	GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH	GM	Silty gravel [F, G, H]
			Fines classify as CL or CH	GC	Clayey gravel [F, G, H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	Cu ≥ 6 and 1 ≤ Cc ≤ 3 [E]	SW	Well-graded sand [I]
			Cu < 6 and/or [Cc<1 or Cc>3.0] [E]	SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH	SM	Silty sand [G, H, I]
			Fines classify as CL or CH	SC	Clayey sand [G, H, I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A"	CL	Lean clay [K, L, M]
			PI < 4 or plots below "A" line [J]	ML	Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OL	Organic clay [K, L, M, N]
					Organic silt [K, L, M, O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line	CH	Fat clay [K, L, M]
			PI plots below "A" line	MH	Elastic Silt [K, L, M]
		Organic:	Liquid limit - oven dried / Liquid limit - not dried < 0.75	OH	Organic clay [K, L, M, P]
					Organic silt [K, L, M, Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor			PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

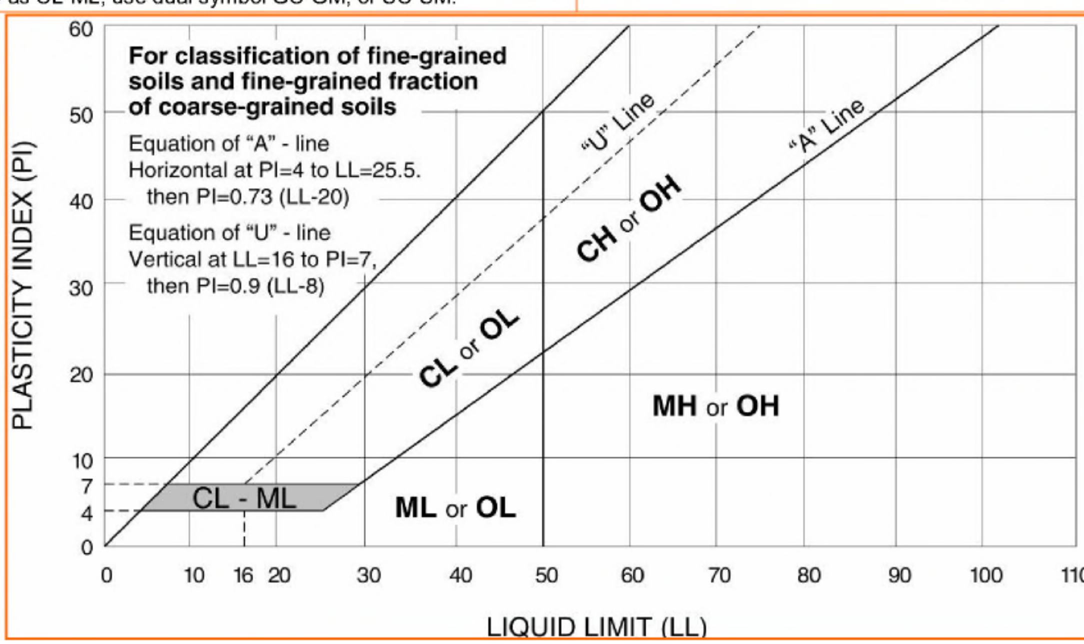
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



BORING LOG NO. B-20-1

PROJECT: Madison Solar Facility

**CLIENT: First Solar Electric (California), Inc
Tempe, AZ**

**SITE: Big Plain Circleville Road
London, OH**

LOCATION See Exploration Plan

Latitude: 39.8483° Longitude: -83.3444°

Approximate Surface Elev.: 941 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)
0.7	**TOPSOIL (8.0")**	940.5+/-
6.0	**CLAYEY SAND WITH GRAVEL (SC)**, brown, moist, medium dense	935+/-
8.5	**SILTY SAND WITH GRAVEL (SM)**, brown, moist, medium dense wet at 6.0'	932.5+/-
	CLAYEY SAND WITH GRAVEL (SC), brown, moist, medium dense	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1-2.5		Split spoon	8	5-8-8 N=16	4.5 (HP)	22.5		41-17-24	19
2.5		Bulk				6.9		27-14-13	43
3.5-5		Split spoon	18	10-11-12 N=23	-				
5	▽ While sampling								
6	▽ At completion of drilling								
6-7.5		Split spoon	16	11-10-13 N=23	-	11.6		NP	12
8.5-10		Split spoon	18	9-11-9 N=20	3.5 (HP)	17.8		27-15-12	44
13.5-15		Split spoon	18	5-7-9 N=16	3.0 (HP)				
18.5-20		Split spoon	18	4-6-7 N=13	4.5 (HP)				
23.5-25		Split spoon	18	8-11-12 N=23	4.5 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Bulk sample recovered at surface depth.

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020

Boring Completed: 07-25-2020

Drill Rig: CME55 (#759)

Driller: J. Williams

Project No.: N4205246

BORING LOG NO. B-20-1

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8483° Longitude: -83.3444°

Approximate Surface Elev.: 941 (Ft.) +/-

GRAPHIC LOG	DEPTH / MATERIAL DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND WITH GRAVEL (SC), brown, moist, medium dense *(continued)*										
	30.0 — 911+/-	30		X	18	4-9-11 N=20	-				
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with bentonite chips after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-2

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8547° Longitude: -83.3537°

Approximate Surface Elev.: 945.5 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7	**TOPSOIL (8.0")**	945+/-										
	CLAYEY SAND WITH GRAVEL (SC), brown, moist, medium dense to dense				Split spoon	8	5-5-8 N=13	4.5 (HP)	4.9		31-14-17	25
					Bulk				3.2		25-14-11	32
			5		Split spoon	18	17-14-20 N=34	-				
6.0		939.5+/-		▽								
	SILTY SAND WITH GRAVEL (SM), brown, wet, medium dense				Split spoon	15	9-11-12 N=23	-	13.1		NP	15
8.5		937+/-										
	WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM), brown, wet, medium dense to dense		10		Split spoon	18	5-7-9 N=16	-	12.8		NP	10
			15		Split spoon	18	11-15-18 N=33	-				
			20		Split spoon	6	4-6-6 N=12	-				
23.5		922+/-										
	SANDY LEAN CLAY (CL), trace silt, gray, moist, very stiff to hard		25		Split spoon	14	4-6-13 N=19	2.0 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Bulk sample recovered at surface depth.

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-2

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8547° Longitude: -83.3537°

Approximate Surface Elev.: 945.5 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), trace silt, gray, moist, very stiff to hard *(continued)*										
				X	18	11-17-19 N=36	-				
	30.0 915.5+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Monitoring well installed at 29.0'.

WATER LEVEL OBSERVATIONS

While sampling

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-3

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8606° Longitude: -83.3463°

Approximate Surface Elev.: 955.5 (Ft.) +/-

DEPTH (Ft.)	Description	ELEVATION (Ft.)
0.7	**TOPSOIL (8.0")**	955+/-
6.0	**SANDY LEAN CLAY (CL)**, trace gravel, brown, moist, stiff	949.5+/-
13.5	**CLAYEY SAND (SC)**, trace gravel, brown, moist, loose to medium dense	942+/-
23.5	**WELL GRADED SAND WITH SILT AND GRAVEL (SW-SM)**, brown, wet, medium dense	932+/-
	CLAYEY SAND (SC), trace gravel, brown, wet, medium dense	

RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
14	5-5-5 N=10	4.0 (HP)	23.8		46-18-28	62
			20.9		36-16-20	64
18	3-4-6 N=10	1.75 (HP)				
18	6-7-7 N=14	2.75 (HP)	11.1		22-11-11	48
14	3-4-5 N=9	3.5 (HP)	12.9		22-13-9	50
10	2-5-5 N=10	-				
18	7-10-10 N=20	-				
10	12-14-15 N=29	-				

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Bulk sample recovered at surface depth.

WATER LEVEL OBSERVATIONS
- ▽ *While sampling*
- ▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-24-2020	Boring Completed: 07-24-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-3

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8606° Longitude: -83.3463°

Approximate Surface Elev.: 955.5 (Ft.) +/-

GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY SAND (SC), trace gravel, brown, wet, medium dense *(continued)*										
	28.5 — 927+/-										
	LEAN CLAY WITH SAND (CL), trace gravel, gray, moist, very stiff			X	18	6-9-15 N=24	4.0 (HP)				
	30.0 — 925.5+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

At completion of drilling

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-24-2020	Boring Completed: 07-24-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-4

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8605° Longitude: -83.3364°

Approximate Surface Elev.: 984.5 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	Description	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7	984+/-	**TOPSOIL (8.0")**										
		SANDY LEAN CLAY (CL), trace gravel, trace silt, brown to gray, moist, stiff to very stiff			Split spoon	10	5-8-9 N=17	4.5 (HP)	11.8		28-14-14	54
					Bulk				14.1		29-14-15	68
			5		Split spoon	18	6-8-10 N=18	4.5 (HP)				
					Split spoon	18	7-11-14 N=25	4.5 (HP)	10.6		24-13-11	59
			10		Split spoon	18	7-11-12 N=23	4.5 (HP)	10.9		22-11-11	56
			15		Split spoon	18	5-5-8 N=13	2.5 (HP)				
				▽ (While sampling)								
18.5	966+/-			▽ (At completion of drilling)								
		SANDY LEAN CLAY WITH GRAVEL (CL), gray, moist, medium stiff to very stiff	20		Split spoon	18	3-3-3 N=6	3.0 (HP)				
			25		Split spoon	18	6-9-13 N=22	4.5 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Bulk sample recovered at surface depth.

WATER LEVEL OBSERVATIONS
- ▽ *While sampling*
- ▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-24-2020	Boring Completed: 07-24-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-4

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.8605° Longitude: -83.3364° Approximate Surface Elev.: 984.5 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY WITH GRAVEL (CL), gray, moist, medium stiff to very stiff *(continued)*										
	30.0 — 954.5+/-	30		X	4	7-12-14 N=26	-				
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic - 91.4% ER

Classification by: I. McGougan

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-24-2020	Boring Completed: 07-24-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-5

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8564° Longitude: -83.3353°

Approximate Surface Elev.: 985.5 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**TOPSOIL (10.0")**	984.5+/-										
	SANDY LEAN CLAY (CL), trace gravel, brown to gray, moist, stiff to very stiff				X	10	4-5-6 N=11	3.0 (HP)	15.6		31-14-17	62
					Hand auger				14.3		33-14-19	69
			5		X	18	6-7-7 N=14	4.5 (HP)				
					X	18	5-7-10 N=17	3.5 (HP)	15.8		28-14-14	62
13.5		972+/-	10		X	8	8-12-13 N=25	3.5 (HP)	14.5		26-14-12	61
18.5	**LEAN CLAY (CL)**, trace sand, gray and brown, moist, very stiff	967+/-	15	While sampling	X	18	6-8-8 N=16	4.0 (HP)				
	LEAN CLAY WITH SAND (CL), trace gravel, gray, moist, stiff to very stiff		20	At completion of drilling	X	18	4-5-8 N=13	4.5 (HP)				
			25		X	18	4-5-6 N=11	3.0 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
- While sampling
- At completion of drilling

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-24-2020	Boring Completed: 07-24-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-5

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.8564° Longitude: -83.3353° Approximate Surface Elev.: 985.5 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY WITH SAND (CL), trace gravel, gray, moist, stiff to very stiff *(continued)*										
				X	18	5-7-10 N=17	3.0 (HP)				
	30.0 / 955.5+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-24-2020	Boring Completed: 07-24-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-6

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8575° Longitude: -83.3235°

Approximate Surface Elev.: 985 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7	**TOPSOIL (8.0")**	984.5+/-										
	CLAYEY SAND (SC), trace sand, brown to gray mottled, moist, soft to medium stiff, loose, trace of organics					6	2-2-3 N=5	2.0 (HP)	23.4		58-17-41	46
									16.0		37-16-21	64
			5			18	2-2-2 N=4	1.0 (HP)				
6.0		979+/-										
	SANDY LEAN CLAY (CL), trace gravel, dark brown to gray, moist, stiff to very stiff					18	3-4-6 N=10	4.5 (HP)	12.6		24-13-11	67
			10			18	4-7-7 N=14	4.5 (HP)	11.1		22-12-10	63
			15			18	7-8-11 N=19	4.5 (HP)				
18.5		966.5+/-										
	LEAN CLAY (CL), trace sand, trace gravel, gray, moist, medium stiff		20			18	2-3-4 N=7	3.25 (HP)				
			25			18	3-4-3 N=7	1.25 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: M. Evener

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

At completion of drilling

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-23-2020	Boring Completed: 07-23-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-6

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8575° Longitude: -83.3235°

Approximate Surface Elev.: 985 (Ft.) +/-

GRAPHIC LOG	DEPTH / MATERIAL DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), trace sand, trace gravel, gray, moist, medium stiff *(continued)*		▽ While sampling; ▽ At completion of drilling								
	28.5 — 956.5+/-										
	SANDY LEAN CLAY (CL), trace gravel, gray, moist, very stiff to hard			X	18	7-9-12 N=21	2.0 (HP)				
		30									
				X	18	5-7-9 N=16	2.25 (HP)				
		35									
				X	18	13-20-21 N=41	4.5 (HP)				
	40.0 — 945+/-	40									
	Boring Terminated at 40 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: M. Evener

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-23-2020	Boring Completed: 07-23-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-7

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8489° Longitude: -83.3295°

Approximate Surface Elev.: 972 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)
0.5	**TOPSOIL (6.0")**	971.5+/-
13.5	**SANDY LEAN CLAY (CL)**, trace gravel, brown to gray, moist, stiff to very stiff	958.5+/-
18.5	**GRAVELLY LEAN CLAY WITH SAND (CL)**, gray, moist, hard	953.5+/-
	LEAN CLAY WITH SAND (CL), trace gravel, gray, moist, very stiff to hard possible boulder/cobble at 23.5' to 25'	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1–2.5		Split spoon	12	5-7-12 N=19	3.0 (HP)	19.2		30-14-16	59
2.5–3		Bag				12.0		30-14-16	66
3.5–5		Split spoon	18	8-10-12 N=22	4.5 (HP)				
6–7.5		Split spoon	18	6-9-15 N=24	3.0 (HP)	14.4		26-13-13	69
8.5–10		Split spoon	18	4-7-7 N=14	4.5 (HP)	11.6		23-12-11	67
13.5–15		Split spoon	3	19-17-19 N=36	4.5 (HP)				
18.5–20		Split spoon	18	5-7-19 N=26	4.5 (HP)				
23.5–25		Split spoon	0	45-50-40 N=90	-				

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: M. Evener

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water was not encountered during drilling
Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-23-2020	Boring Completed: 07-23-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-7

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8489° Longitude: -83.3295°

Approximate Surface Elev.: 972 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY WITH SAND (CL), trace gravel, gray, moist, very stiff to hard *(continued)*										
				X		10-16-24 N=40	4.5 (HP)				
	30.0 / 942+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: M. Evener

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water was not encountered during drilling

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-23-2020	Boring Completed: 07-23-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-8

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8484° Longitude: -83.3215°

Approximate Surface Elev.: 978.5 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**TOPSOIL (10.0")**	977.5+/-										
	LEAN CLAY WITH SAND (CL), trace gravel, brown to gray, moist, stiff to very stiff				X	18	6-6-7 N=13	1.5 (HP)	15.9		36-15-21	73
									16.7		33-15-18	70
			5		X	18	8-9-10 N=19	4.5 (HP)				
6.0		972.5+/-										
	SANDY LEAN CLAY (CL), trace gravel, brown to gray, moist, stiff to very stiff				X	18	7-9-14 N=23	4.5 (HP)	13.3		22-13-9	51
			10		X	18	7-13-16 N=29	4.5 (HP)	11.9		25-13-12	62
			15		X	18	6-7-7 N=14	4.5 (HP)				
			20		X	18	3-4-8 N=12	4.5 (HP)				
23.5		955+/-										
	GRAVELLY LEAN CLAY WITH SAND (CL), gray, moist, hard		25		X	6	8-13-23 N=36	-				

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: M. Evener

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Water was not encountered during drilling

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-8

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8484° Longitude: -83.3215°

Approximate Surface Elev.: 978.5 (Ft.) +/-

GRAPHIC LOG	DEPTH / DESCRIPTION / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	GRAVELLY LEAN CLAY WITH SAND (CL), gray, moist, hard *(continued)* poor recovery possible boulder/cobble between 23.5' to 25.0' 28.5 — 950+/-										
	LEAN CLAY WITH SAND (CL), trace gravel, gray, moist, hard 30.0 — 948.5+/-	30		X	14	41-28-25 N=53	4.5 (HP)				
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: M. Evener

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:
Monitoring well installed at 30.0'.

WATER LEVEL OBSERVATIONS

Water was not encountered during drilling

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-9

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8425° Longitude: -83.3301°

Approximate Surface Elev.: 978.5 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
1.0	**TOPSOIL (12.0")**, significant organics/roots noted at 0.0' - 1.0'	977.5+/-										
	SANDY FAT CLAY (CH), trace sand, trace gravel, brown, moist, medium stiff to stiff				Split spoon	6	5-6-7 N=13	4.5 (HP)	20.4		56-20-36	53
					Hand sample				21.0		43-16-27	73
3.5		975+/-										
	SANDY LEAN CLAY (CL), trace sand, brown, moist, stiff		5		Split spoon	18	3-3-5 N=8	2.25 (HP)				
					Split spoon	16	4-5-8 N=13	4.0 (HP)	14.1		24-13-11	63
8.5		970+/-										
	CLAYEY GRAVEL WITH SAND (GC), trace sand, brown, moist, medium dense		10		Split spoon	5	7-7-5 N=12	4.5 (HP)	14.0		26-13-13	37
			15		Split spoon	10	4-6-7 N=13	2.5 (HP)				
			20	▽ While sampling	Split spoon	18	3-4-7 N=11	2.0 (HP)				
			25	▽ At completion of drilling	Split spoon	18	3-5-8 N=13	4.0 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: M. Bishop

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-22-2020	Boring Completed: 07-22-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-9

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.8425° Longitude: -83.3301° Approximate Surface Elev.: 978.5 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	CLAYEY GRAVEL WITH SAND (GC), trace sand, brown, moist, medium dense *(continued)*										
				X	18	7-12-14 N=26	4.5 (HP)				
	30.0 948.5+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: M. Bishop

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

At completion of drilling

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-22-2020	Boring Completed: 07-22-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-10

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8381° Longitude: -83.3334°

Approximate Surface Elev.: 975 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.8	**TOPSOIL (10.0")**	974+/-										
	CLAYEY SAND (SC), trace sand, brown, moist, medium dense					7	5-7-7 N=14	4.5 (HP)	18.4		51-17-34	44
									13.0		32-14-18	61
						18	9-10-14 N=24	4.5 (HP)				
			5									
						18	4-6-10 N=16	2.75 (HP)	15.6		21-13-8	50
8.5		966.5+/-										
	LEAN CLAY WITH SAND (CL), trace sand, brown, moist, stiff to very stiff					18	6-7-13 N=20	4.5 (HP)	14.3		24-15-9	73
			10									
	trace gravel, turning to gray at 13.5'			▽		18	6-8-11 N=19	4.5 (HP)				
			15									
						18	10-5-7 N=12	3.0 (HP)				
			20	▽								
						18	3-4-7 N=11	2.5 (HP)				
			25									

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-10

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8381° Longitude: -83.3334°

Approximate Surface Elev.: 975 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY WITH SAND (CL), trace sand, brown, moist, stiff to very stiff *(continued)*										
	30.0 / 945+/-	30		X	5	7-11-14 N=25	4.5 (HP)				
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

While sampling

At completion of drilling

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-11

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8366° Longitude: -83.3215°

Approximate Surface Elev.: 983 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7 **TOPSOIL (8.0")**	982.5+/-										
LEAN CLAY WITH SAND (CL), trace sand, brown, moist, very stiff, significant organic				Split spoon	12	5-7-10 N=17	4.5 (HP)	17.3		40-17-23	78
				Grab				14.7		34-15-19	72
3.5	979.5+/-										
LEAN CLAY WITH SAND (CL), brown to gray, moist, very stiff		5		Split spoon	18	9-10-11 N=21	4.5 (HP)				
6.0	977+/-										
SANDY LEAN CLAY (CL), brown to gray, moist, very stiff				Split spoon	18	9-9-13 N=22	4.5 (HP)	12.8		23-12-11	61
		10		Split spoon	18	8-10-17 N=27	4.5 (HP)	13.5		27-14-13	60
			▽								
turning stiff between 13.5' to 20'		15		Split spoon	7	7-5-7 N=12	4.5 (HP)				
				Split spoon	18	2-4-6 N=10	2.25 (HP)				
20.0	963+/-	20									
GRAVELLY LEAN CLAY WITH SAND (CL), gray, moist, stiff											
		25		Split spoon	18	4-12-19 N=31	4.5 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-26-2020	Boring Completed: 07-26-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-11

PROJECT: Madison Solar Facility

**CLIENT: First Solar Electric (California), Inc
Tempe, AZ**

**SITE: Big Plain Circleville Road
London, OH**

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.8366° Longitude: -83.3215° Approximate Surface Elev.: 983 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	GRAVELLY LEAN CLAY WITH SAND (CL), gray, moist, stiff *(continued)*										
	30.0 / 953+/-	30		X	18	32-33-34 N=67	4.5 (HP)				
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings and bentonite chips upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Monitoring well installed at 26.5'.

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-26-2020	Boring Completed: 07-26-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-12

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.834° Longitude: -83.3146°

Approximate Surface Elev.: 982 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
TOPSOIL (10.0") 0.8	981+/-										
SANDY FAT CLAY (CH), brown, moist, stiff					4	4-5-6 N=11	2.5 (HP)	29.1		53-17-36	59
								23.3		55-17-38	73
		5			5	3-3-6 N=9	3.25 (HP)				
6.0	976+/-										
SANDY LEAN CLAY (CL), trace gravel, brown to gray, moist, stiff to very stiff					12	2-2-5 N=7	1.0 (HP)	29.3		36-16-20	66
		10			18	3-5-7 N=12	4.5 (HP)	16.5		27-14-13	69
			▽ (While sampling)								
		15			18	3-5-8 N=13	4.5 (HP)				
		20			18	3-12-13 N=25	2.25 (HP)				
			▽ (At completion of drilling)								
		25			18	2-3-6 N=9	1.75 (HP)				

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- ▽ *While sampling*
- ▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-26-2020	Boring Completed: 07-26-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-12

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.834° Longitude: -83.3146°

Approximate Surface Elev.: 982 (Ft.) +/-

GRAPHIC LOG	DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), trace gravel, brown to gray, moist, stiff to very stiff *(continued)*										
				X	18	4-8-12 N=20	4.5 (HP)				
	30.0 / 952+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with auger cuttings upon completion.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-26-2020	Boring Completed: 07-26-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-13

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8282° Longitude: -83.3234°

Approximate Surface Elev.: 959.5 (Ft.) +/-

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7	**TOPSOIL (8.0")**	959+/-										
	SANDY FAT CLAY (CH), trace gravel, brown, moist, stiff to very stiff, contains silt, orange iron deposits noted				Split spoon	6	4-7-7 N=14	4.5 (HP)	18.4		52-17-35	50
					Hand auger				14.4		38-15-23	61
			5		Split spoon	18	10-13-15 N=28	4.5 (HP)				
6.0		953.5+/-										
	LEAN CLAY WITH SAND (CL), trace sand, trace gravel, brown to gray, moist, very stiff				Split spoon	18	9-12-14 N=26	3.5 (HP)	17.8		27-14-13	72
8.5		951+/-										
	SILTY CLAYEY SAND (SC-SM), gray, moist, medium dense		10	▽	Split spoon	18	3-5-7 N=12	0 (HP)	18.1		18-12-6	47
			15		Split spoon	18	3-4-6 N=10	1.5 (HP)				
20.0		939.5+/-	20		Split spoon	4	7-7-9 N=16	2.0 (HP)				
	Boring Terminated at 20 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-26-2020	Boring Completed: 07-26-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-14

PROJECT: Madison Solar Facility

**CLIENT: First Solar Electric (California), Inc
Tempe, AZ**

**SITE: Big Plain Circleville Road
London, OH**

LOCATION See Exploration Plan

Latitude: 39.8296° Longitude: -83.3309°

Approximate Surface Elev.: 958 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7	**TOPSOIL (8.0")**	957.5+/-										
	CLAYEY SAND (SC), brown to gray, moist, medium dense					10	4-5-8 N=13	4.5 (HP)	20.1		59-16-43	42
									20.5		47-15-32	60
						18	3-3-5 N=8	1.5 (HP)				
6.0		952+/-	5									
	SANDY LEAN CLAY (CL), trace gravel, brown to gray, moist, stiff					18	4-5-7 N=12	4 (HP)	13.8		25-12-13	63
						18	6-6-8 N=14	4.5 (HP)	13.0		25-13-12	59
			10									
	turning very soft at 13.5'			▽		16	1-1-2 N=3	1.5 (HP)				
			15									
	turning stiff at 18.5'					18	3-5-7 N=12	1.5 (HP)				
			20									
	turning very stiff below 23.5'					18	4-7-10 N=17	2.5 (HP)				
			25									

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ While sampling

▽ At completion of drilling

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-14

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

GRAPHIC LOG	LOCATION See Exploration Plan Latitude: 39.8296° Longitude: -83.3309° Approximate Surface Elev.: 958 (Ft.) +/- DEPTH / ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), trace gravel, brown to gray, moist, stiff *(continued)*										
			▽	X	18	4-6-9 N=15	3.5 (HP)				
	30.0 / 928+/-	30									
	Boring Terminated at 30 Feet										

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

Monitoring well installed at 30.0'.

WATER LEVEL OBSERVATIONS

▽ *While sampling*

▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-15

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc Tempe, AZ

SITE: Big Plain Circleville Road London, OH

LOCATION See Exploration Plan

Latitude: 39.8341° Longitude: -83.3358°

Approximate Surface Elev.: 956.5 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.7	**TOPSOIL (8.0")**	956+/-										
	SANDY LEAN CLAY (CL), trace gravel, gray and brown, moist, stiff to very stiff					6	5-8-13 N=21	4.5 (HP)	20.7		47-18-29	65
									11.6		31-13-18	66
						18	6-8-10 N=18	3.0 (HP)				
			5									
						18	4-5-8 N=13	3.5 (HP)	14.7		22-11-11	61
						18	6-9-13 N=22	4.5 (HP)	12.1		23-12-11	61
			10									
				▽								
						18	3-3-11 N=14	2.5 (HP)				
			15									
18.5		938+/-										
	GRAVELLY LEAN CLAY WITH SAND (CL), gray, moist, stiff, contains sandstone gravel fragments					18	4-6-8 N=14	1.5 (HP)				
20.0		936.5+/-	20									
	Boring Terminated at 20 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While sampling*

Water was not encountered at completion

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-16

PROJECT: Madison Solar Facility

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

SITE: Big Plain Circleville Road
London, OH

LOCATION See Exploration Plan

Latitude: 39.8608° Longitude: -83.331°

Approximate Surface Elev.: 986.5 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)
0.8	**TOPSOIL (10.0")**	985.5+/-
3.5	**SANDY FAT CLAY (CH)**, trace gravel, gray to brown, moist, medium stiff	983+/-
	SANDY LEAN CLAY (CL), trace gravel, gray to brown, moist, stiff to very stiff	

WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	Split spoon	8	3-4-4 N=8	3.5 (HP)	25.8		58-17-41	56
	Hand sample				19.5		37-14-23	68
	Split spoon	18	6-6-9 N=15	3.5 (HP)				
	Split spoon	18	4-7-8 N=15	4.5 (HP)	13.3		23-12-11	63
	Split spoon	18	7-10-14 N=24	4.5 (HP)	11.6		24-12-12	58
▽ While sampling								
	Split spoon	18	6-5-7 N=12	4.0 (HP)				
	Split spoon	18	2-3-6 N=9	4.5 (HP)				
▽ At completion of drilling								
	Split spoon	18	4-6-7 N=13	3.0 (HP)				

DEPTH (Ft.): 5, 10, 15, 20, 25

Stratification lines are approximate. In-situ, the transition may be gradual.
Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
▽ *While sampling*
▽ *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	

BORING LOG NO. B-20-16

PROJECT: Madison Solar Facility

**CLIENT: First Solar Electric (California), Inc
Tempe, AZ**

**SITE: Big Plain Circleville Road
London, OH**

LOCATION See Exploration Plan

Latitude: 39.8608° Longitude: -83.331°

Approximate Surface Elev.: 986.5 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	RECOVERY (In.)	FIELD TEST RESULTS	LABORATORY HP (tsf)	WATER CONTENT (%)	DRY UNIT WEIGHT (pcf)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), trace gravel, gray to brown, moist, stiff to very stiff *(continued)*											
			30		X	18	6-8-13 N=21	4.5 (HP)				
33.5		953+/-										
	SANDY LEAN CLAY WITH GRAVEL (CL), brown, moist, very stiff wet sandy seam encountered between 33.5' - 35.0'		35		X	18	4-8-18 N=26	-				
38.9		947.5+/-				4	50/4"	4.5 (HP)				
	Boring Terminated at 38.9 Feet											

Stratification lines are approximate. In-situ, the transition may be gradual.

Classification by: I. McGougan

Hammer Type: Automatic - 91.4% ER

Advancement Method:
3.25" HSA

Abandonment Method:
Boring backfilled with soil cuttings after delayed water levels were measured.

See Exploration and Testing Procedures for a description of field and laboratory procedures used and additional data (If any).

See Supporting Information for explanation of symbols and abbreviations.

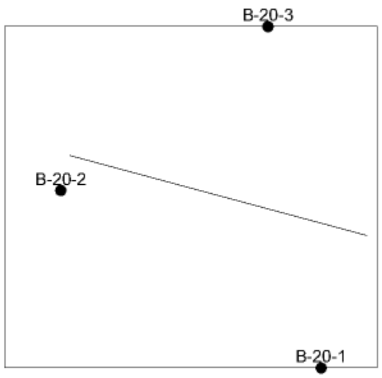
Notes:

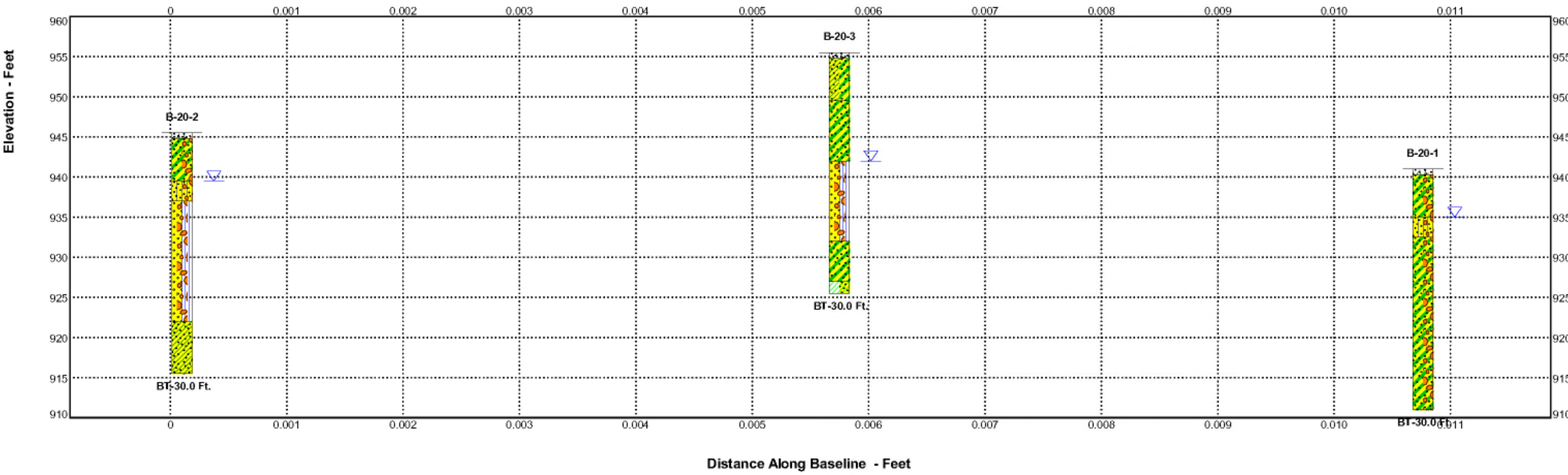
WATER LEVEL OBSERVATIONS

- *While sampling*
- *At completion of drilling*

Terracon
800 Morrison Rd
Gahanna, OH

Boring Started: 07-25-2020	Boring Completed: 07-25-2020
Drill Rig: CME55 (#759)	Driller: J. Williams
Project No.: N4205246	





Explanation

Moisture Content — %w
Sampling (See General Notes)
B-20-1 — Borehole Number
LL PL — Liquid and Plastic Limits
Borehole Lithology
AR BT — Borehole Termination Type

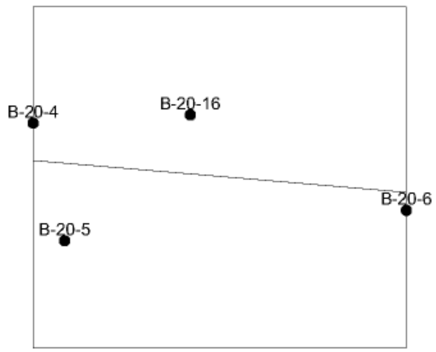
Water Level Reading at time of drilling.

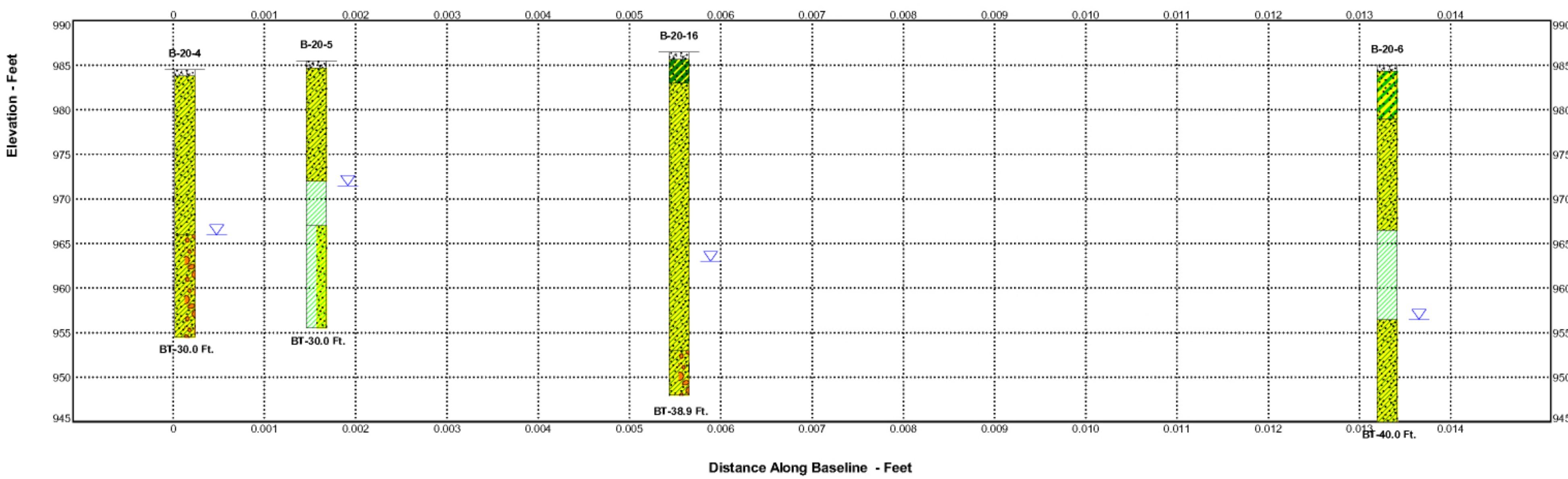
Water Level Reading after drilling.

Topsoil; Clayey Sand with Gravel; Silty Sand with Gravel; Well-graded Sand with Silt and Gravel; Sandy Lean Clay; Sandy Lean Clay/Clayey Sand; Clayey Sand; Lean Clay with Sand

NOTES:
See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: N4205246	Terracon 800 Morrison Rd Gahanna, OH	**SUBSURFACE PROFILE**
Date: 8/13/2020		MADISON SOLAR FACILITY BIG PLAIN CIRCLEVILLE ROAD LONDON, OH
Scale: Not to scale		





Explanation

B-20-4 — Borehole Number
Moisture Content — %w
LL PL — Liquid and Plastic Limits
Sampling (See General Notes)
Borehole Lithology
AR / BT — Borehole Termination Type

Water Level Reading at time of drilling.
Water Level Reading after drilling.

Topsoil | Sandy Lean Clay | Sandy Lean Clay with Gravel | Lean Clay | Lean Clay with Sand | Clayey Sand | Sandy Fat Clay

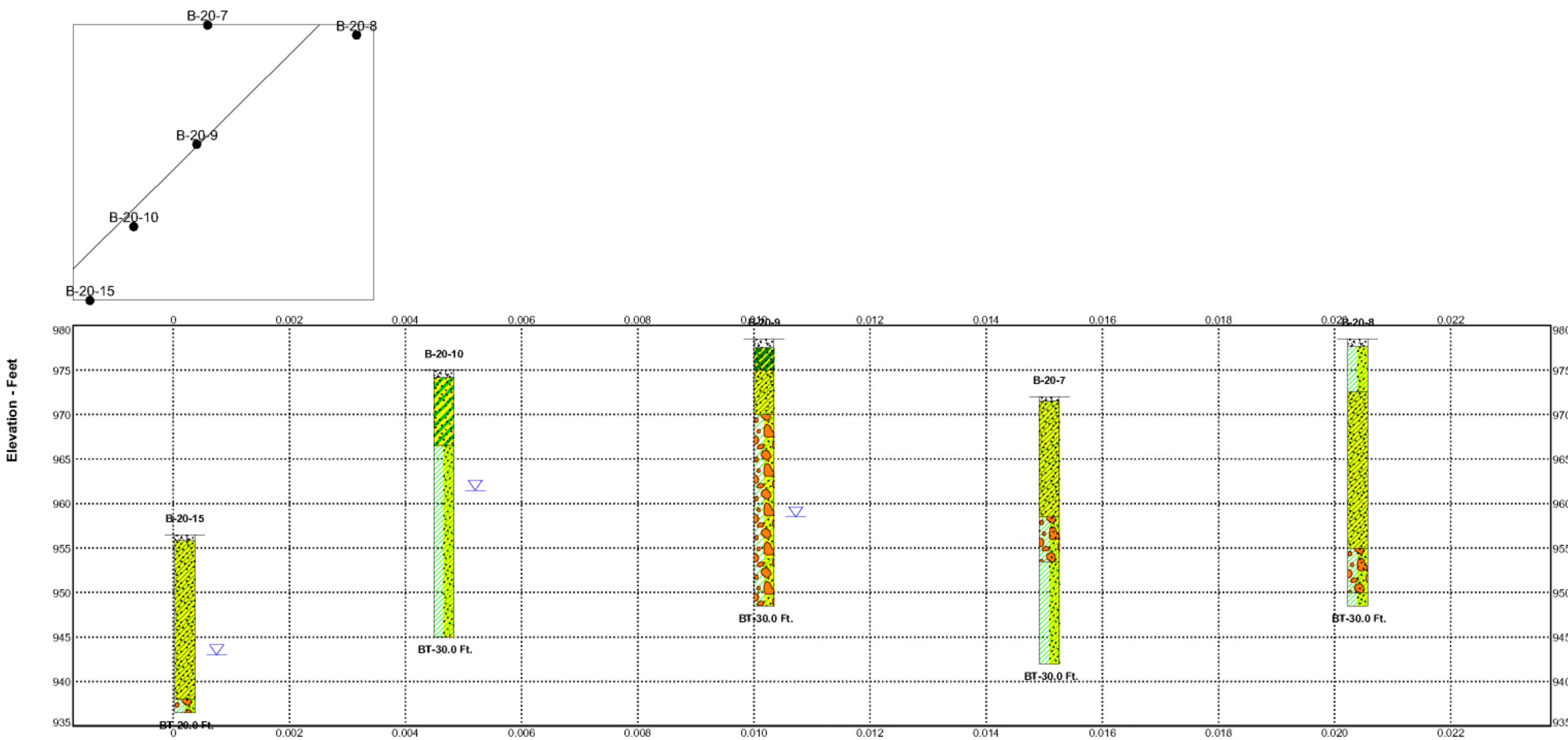
NOTES:
See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: N4205246
Date: 8/13/2020
Scale: Not to scale

Terracon
800 Morrison Rd
Gahanna, OH

SUBSURFACE PROFILE

MADISON SOLAR FACILITY
BIG PLAIN CIRCLEVILLE ROAD
LONDON, OH



Topsoil | Sandy Lean Clay | Gravelly Lean Caly with Sand | Lean Clay with Sand | Sandy Fat Clay | Clayey Gravel with Sand | Clayey Sand

Explanation

B-20-7 — Borehole Number
Moisture Content — %w
LL PL — Liquid and Plastic Limits
Sampling (See General Notes)
Borehole Lithology
AR BT — Borehole Termination Type
Water Level Reading at time of drilling.
Water Level Reading after drilling.

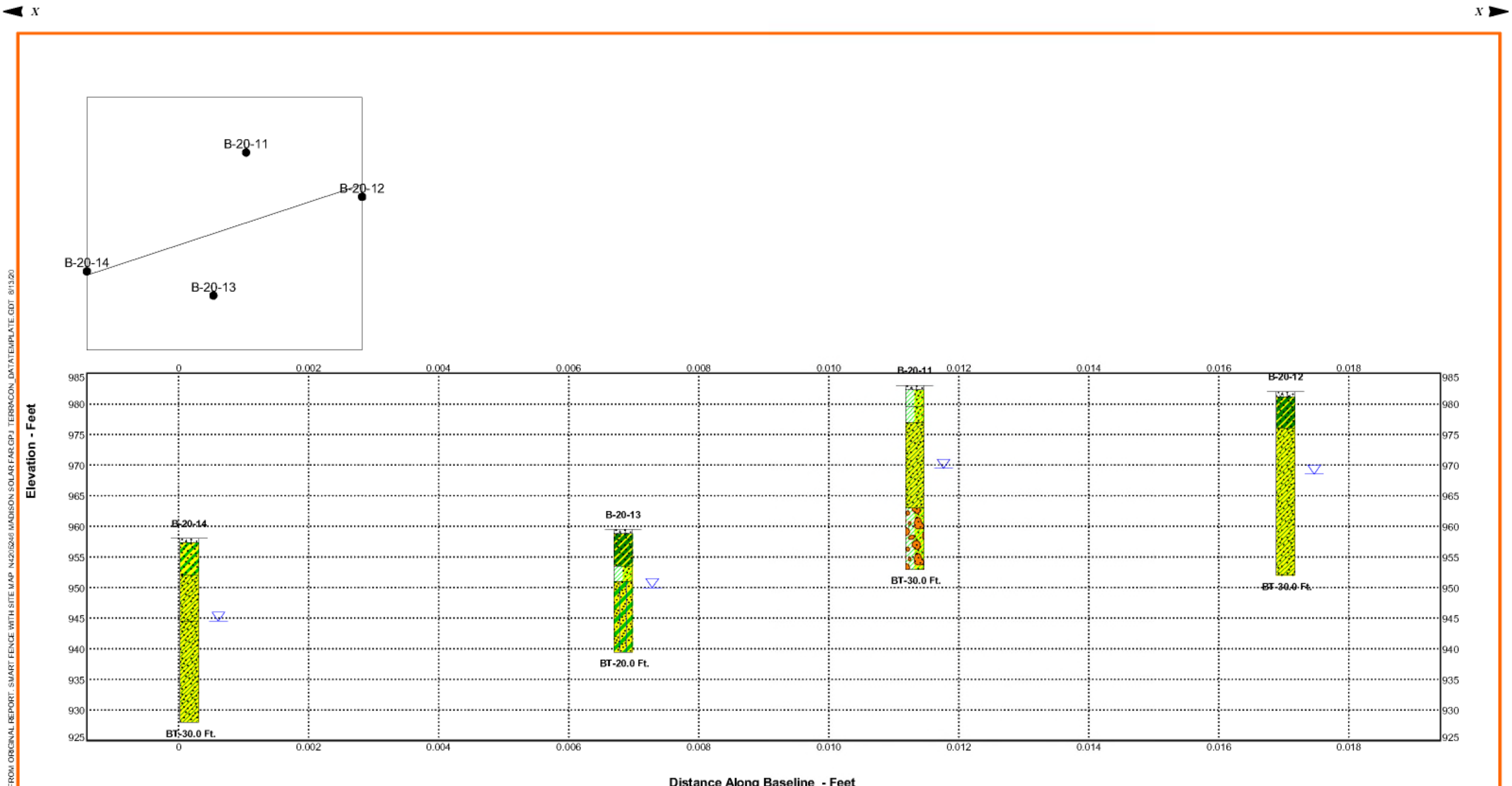
NOTES:
See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: N4205246
Date: 8/13/2020
Scale: Not to scale

Terracon
800 Morrison Rd
Gahanna, OH

SUBSURFACE PROFILE

MADISON SOLAR FACILITY
BIG PLAIN CIRCLEVILLE ROAD
LONDON, OH



Topsoil | Lean Clay with Sand | Sandy Lean Clay | Gravelly Lean Caly with Sand | Sandy Fat Clay | Silty Clayey Sand | Clayey Sand

Explanation

B-20-11 — Borehole Number

Moisture Content — %w

LL PL — Liquid and Plastic Limits

Sampling (See General Notes)

Borehole Lithology

AR / BT — Borehole Termination Type

Water Level Reading at time of drilling.

Water Level Reading after drilling.

NOTES:

See Exploration Plan for orientation of soil profile.
See General Notes in Supporting Information for symbols and soil classifications.
Soils profile provided for illustration purposes only.
Soils between borings may differ
AR - Auger Refusal
BT - Boring Termination

Project No.: N4205246	
Date: 8/13/2020	
Scale: Not to scale	

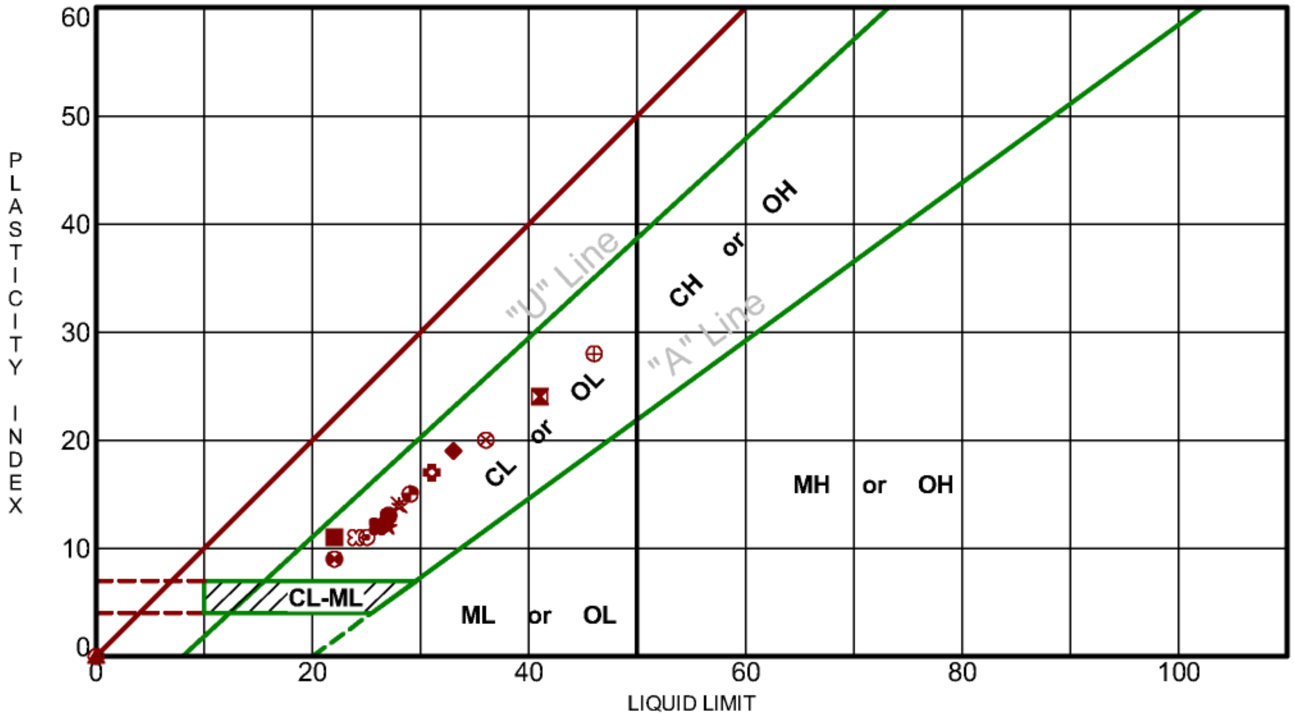
Terracon
800 Morrison Rd
Gahanna, OH

SUBSURFACE PROFILE

MADISON SOLAR FACILITY
BIG PLAIN CIRCLEVILLE ROAD
LONDON, OH

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
B-20-1	0 - 5	27	14	13	42.9	SC	CLAYEY SAND with GRAVEL
B-20-1	1 - 2.5	41	17	24	19.2	SC	CLAYEY SAND with GRAVEL
B-20-1	6 - 7.5	NP	NP	NP	12.4	SM	SILTY SAND with GRAVEL
B-20-1	8.5 - 10	27	15	12	44.3	SC	CLAYEY SAND with GRAVEL
B-20-2	0 - 5	25	14	11	31.7	SC	CLAYEY SAND with GRAVEL
B-20-2	1 - 2.5	31	14	17	24.9	SC	CLAYEY SAND with GRAVEL
B-20-2	6 - 7.5	NP	NP	NP	15.4	SM	SILTY SAND with GRAVEL
B-20-2	8.5 - 10	NP	NP	NP	9.9	SW-SM	WELL-GRADED SAND with SILT and GRAVEL
B-20-3	0 - 5	36	16	20	64.1	CL	SANDY LEAN CLAY
B-20-3	1 - 2.5	46	18	28	62.2	CL	SANDY LEAN CLAY
B-20-3	6 - 7.5	22	11	11	47.8	SC	CLAYEY SAND
B-20-3	8.5 - 10	22	13	9	49.9	SC	CLAYEY SAND
B-20-4	0 - 5	29	14	15	67.5	CL	SANDY LEAN CLAY
B-20-4	1 - 2.5	28	14	14	53.6	CL	SANDY LEAN CLAY
B-20-4	6 - 7.5	24	13	11	58.7	CL	SANDY LEAN CLAY
B-20-4	8.5 - 10	22	11	11	55.9	CL	SANDY LEAN CLAY
B-20-5	0 - 5	33	14	19	68.9	CL	SANDY LEAN CLAY
B-20-5	1 - 2.5	31	14	17	62.2	CL	SANDY LEAN CLAY
B-20-5	6 - 7.5	28	14	14	62.1	CL	SANDY LEAN CLAY
B-20-5	8.5 - 10	26	14	12	60.6	CL	SANDY LEAN CLAY

PROJECT: Madison Solar Facility

PROJECT NUMBER: N4205246

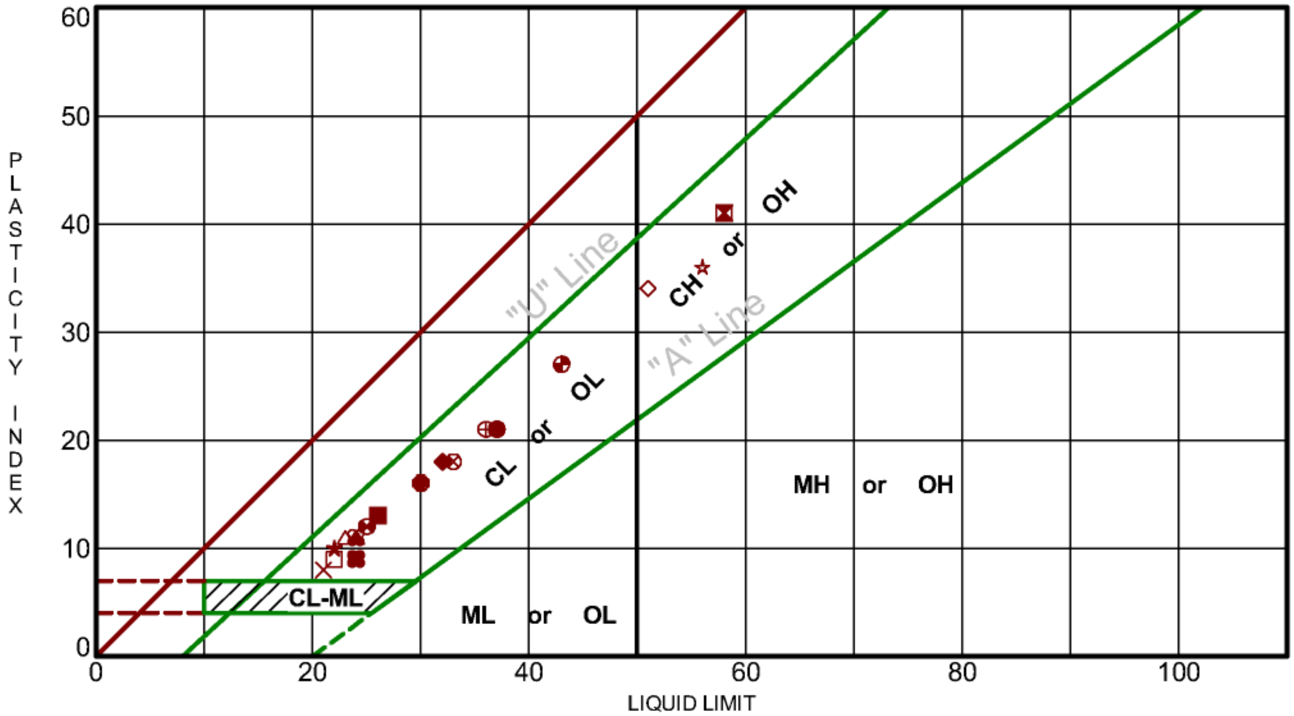
SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-20-6	0 - 5	37	16	21	64.3	CL	SANDY LEAN CLAY
⊠	B-20-6	1 - 2.5	58	17	41	46.4	SC	CLAYEY SAND
▲	B-20-6	6 - 7.5	24	13	11	66.7	CL	SANDY LEAN CLAY
★	B-20-6	8.5 - 10	22	12	10	63.1	CL	SANDY LEAN CLAY
⊙	B-20-7	0 - 5	30	14	16	65.7	CL	SANDY LEAN CLAY
✤	B-20-7	1 - 2.5	30	14	16	58.9	CL	SANDY LEAN CLAY
○	B-20-7	6 - 7.5	26	13	13	68.6	CL	SANDY LEAN CLAY
△	B-20-7	8.5 - 10	23	12	11	66.8	CL	SANDY LEAN CLAY
⊗	B-20-8	0 - 5	33	15	18	70.1	CL	LEAN CLAY with SAND
⊕	B-20-8	1 - 2.5	36	15	21	73.0	CL	LEAN CLAY with SAND
□	B-20-8	6 - 7.5	22	13	9	51.1	CL	SANDY LEAN CLAY
◉	B-20-8	8.5 - 10	25	13	12	61.6	CL	SANDY LEAN CLAY
◕	B-20-9	0 - 5	43	16	27	72.7	CL	LEAN CLAY with SAND
☆	B-20-9	1 - 2.5	56	20	36	53.3	CH	SANDY FAT CLAY
✿	B-20-9	6 - 7.5	24	13	11	62.6	CL	SANDY LEAN CLAY
■	B-20-9	8.5 - 10	26	13	13	37.5	GC	CLAYEY GRAVEL with SAND
◆	B-20-10	0 - 5	32	14	18	61.5	CL	SANDY LEAN CLAY
◇	B-20-10	1 - 2.5	51	17	34	44.5	SC	CLAYEY SAND
×	B-20-10	6 - 7.5	21	13	8	49.8	SC	CLAYEY SAND
▪	B-20-10	8.5 - 10	24	15	9	73.0	CL	LEAN CLAY with SAND

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

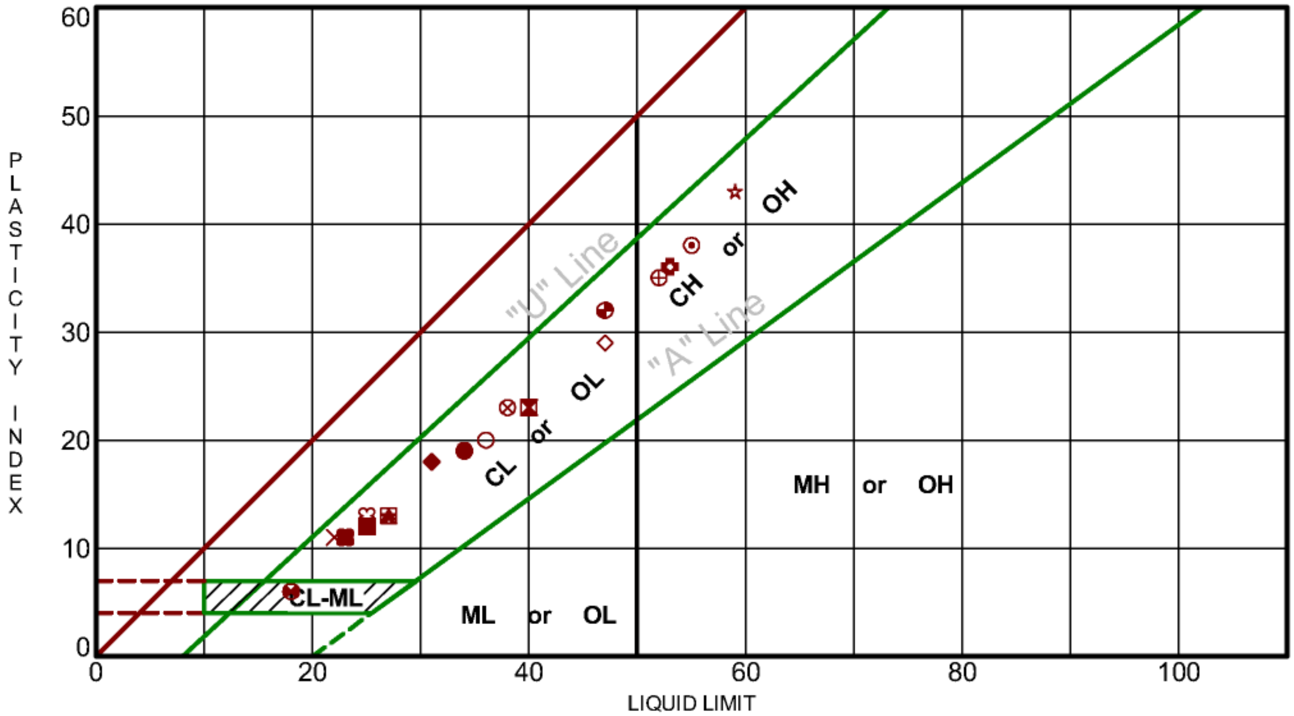
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	B-20-11	0 - 5	34	15	19	72.2	CL	LEAN CLAY with SAND
⊠	B-20-11	1 - 2.5	40	17	23	78.5	CL	LEAN CLAY with SAND
▲	B-20-11	6 - 7.5	23	12	11	61.4	CL	SANDY LEAN CLAY
★	B-20-11	8.5 - 10	27	14	13	59.8	CL	SANDY LEAN CLAY
⊙	B-20-12	0 - 5	55	17	38	72.8	CH	FAT CLAY with SAND
✤	B-20-12	1 - 2.5	53	17	36	59.3	CH	SANDY FAT CLAY
○	B-20-12	6 - 7.5	36	16	20	65.8	CL	SANDY LEAN CLAY
△	B-20-12	8.5 - 10	27	14	13	69.2	CL	SANDY LEAN CLAY
⊗	B-20-13	0 - 5	38	15	23	60.6	CL	SANDY LEAN CLAY
⊕	B-20-13	1 - 2.5	52	17	35	50.0	CH	SANDY FAT CLAY
□	B-20-13	6 - 7.5	27	14	13	72.2	CL	LEAN CLAY with SAND
◕	B-20-13	8.5 - 10	18	12	6	47.5	SC-SM	SILTY, CLAYEY SAND
◕	B-20-14	0 - 5	47	15	32	59.7	CL	SANDY LEAN CLAY
☆	B-20-14	1 - 2.5	59	16	43	41.6	SC	CLAYEY SAND
✿	B-20-14	6 - 7.5	25	12	13	63.1	CL	SANDY LEAN CLAY
■	B-20-14	8.5 - 10	25	13	12	59.3	CL	SANDY LEAN CLAY
◆	B-20-15	0 - 5	31	13	18	65.5	CL	SANDY LEAN CLAY
◇	B-20-15	1 - 2.5	47	18	29	64.7	CL	SANDY LEAN CLAY
×	B-20-15	6 - 7.5	22	11	11	61.1	CL	SANDY LEAN CLAY
■	B-20-15	8.5 - 10	23	12	11	61.3	CL	SANDY LEAN CLAY

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

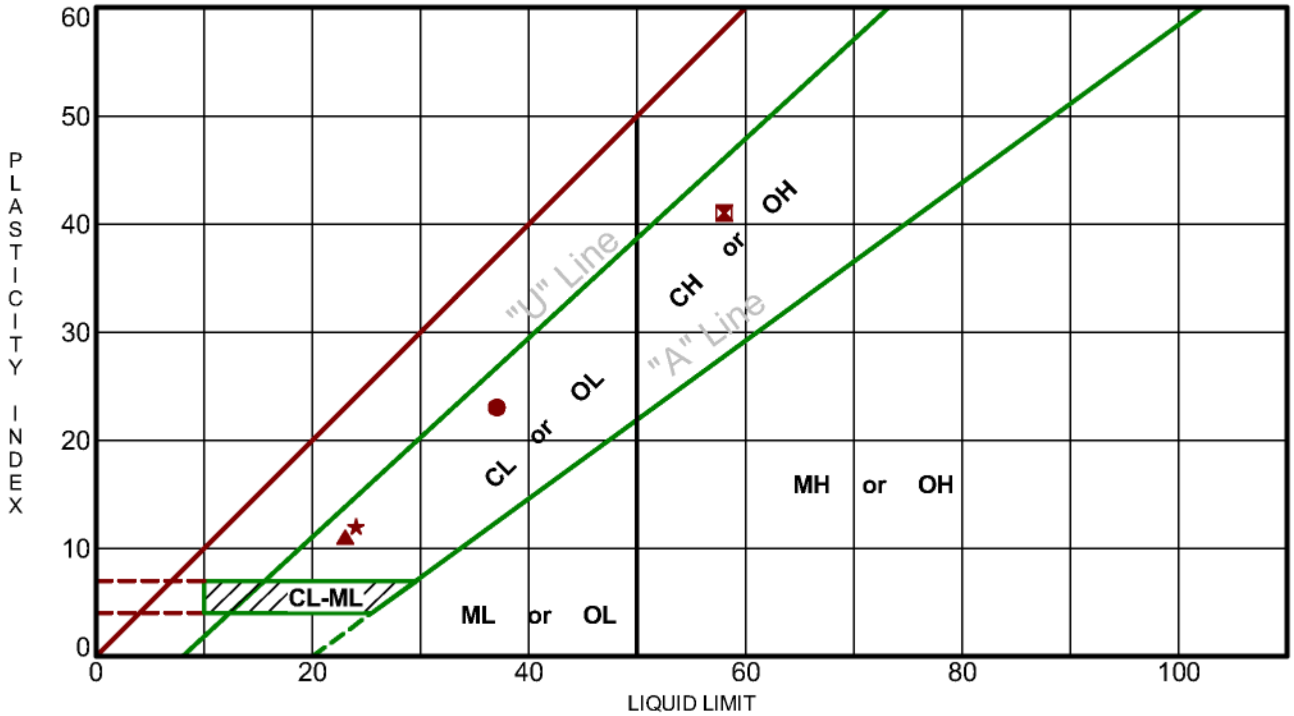
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-20-16	0 - 5	37	14	23	67.5	CL	SANDY LEAN CLAY
⊠	B-20-16	1 - 2.5	58	17	41	56.2	CH	SANDY FAT CLAY
▲	B-20-16	6 - 7.5	23	12	11	62.8	CL	SANDY LEAN CLAY
★	B-20-16	8.5 - 10	24	12	12	58.4	CL	SANDY LEAN CLAY

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

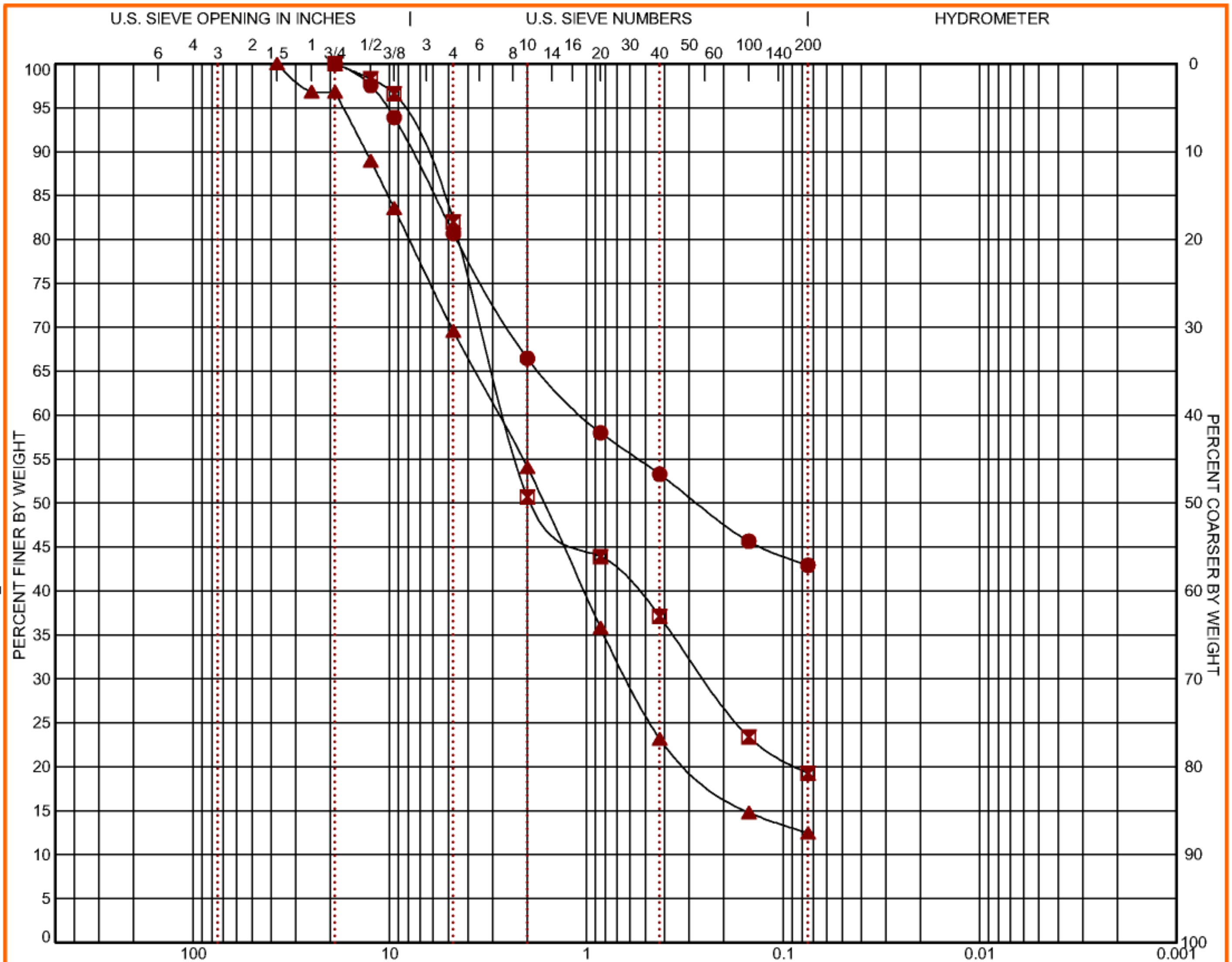
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-1**	**39.84834 / -83.34441**	**0 - 5**	**0.0**	**19.4**	**37.7**		**42.9**	
⊠	**B-20-1**	**39.84834 / -83.34441**	**1 - 2.5**	**0.0**	**18.0**	**62.8**		**19.2**	
▲	**B-20-1**	**39.84834 / -83.34441**	**6 - 7.5**	**0.0**	**30.5**	**57.1**		**12.4**	

GRAIN SIZE

	●	⊠	▲
D_{60}	1.044	2.589	2.79
D_{30}		0.248	0.619
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_c			3.80
C_u			77.19

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/4"	100.0	3/4"	100.0	1 1/2"	100.0
1/2"	97.51	1/2"	98.26	1"	96.78
3/8"	93.87	3/8"	96.57	3/4"	96.78
#4	80.64	#4	81.99	1/2"	88.92
#10	66.44	#10	50.64	3/8"	83.53
#20	57.97	#20	43.89	#4	69.55
#40	53.25	#40	37.08	#10	54.03
#100	45.62	#100	23.38	#20	35.78
#200	42.9	#200	19.24	#40	23.16
				#100	14.77
				#200	12.45

SOIL DESCRIPTION

- ● CLAYEY SAND with GRAVEL (SC)
- ⊠ CLAYEY SAND with GRAVEL (SC)
- ▲ SILTY SAND with GRAVEL (SM)

REMARKS

- ● Location: N E Elevation: 941
- ⊠ Location: N E Elevation: 941
- ▲ Location: N E Elevation: 941

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

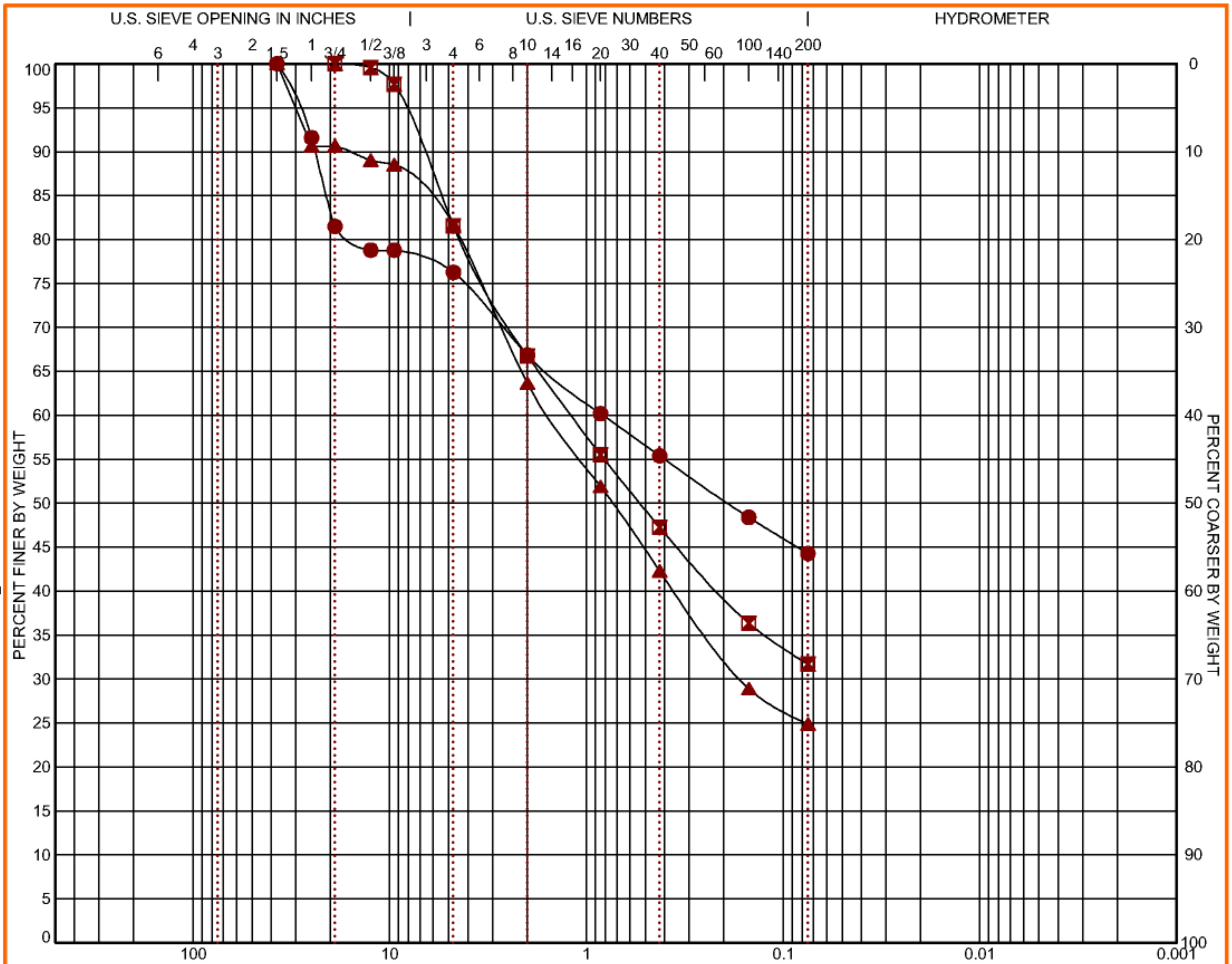
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-1**	**39.84834 / -83.34441**	**8.5 - 10**	**0.0**	**23.8**	**32.0**		**44.3**	
⊠	**B-20-2**	**39.85471 / -83.35374**	**0 - 5**	**0.0**	**18.5**	**49.9**		**31.7**	
▲	**B-20-2**	**39.85471 / -83.35374**	**1 - 2.5**	**0.0**	**18.3**	**56.8**		**24.9**	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.83	1.197	1.536
D_{30}			0.164
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1 1/2"	100.0	3/4"	100.0	1 1/2"	100.0
1"	91.56	1/2"	99.55	1"	90.62
3/4"	81.45	3/8"	97.68	3/4"	90.62
1/2"	78.76	#4	81.54	1/2"	89.01
3/8"	78.76	#10	66.73	3/8"	88.49
#4	76.23	#20	55.52	#4	81.65
#10	66.82	#40	47.23	#10	63.62
#20	60.16	#100	36.33	#20	51.88
#40	55.36	#200	31.65	#40	42.24
#100	48.36			#100	28.89
#200	44.27			#200	24.86

SOIL DESCRIPTION

●	CLAYEY SAND with GRAVEL (SC)
⊠	CLAYEY SAND with GRAVEL (SC)
▲	CLAYEY SAND with GRAVEL (SC)

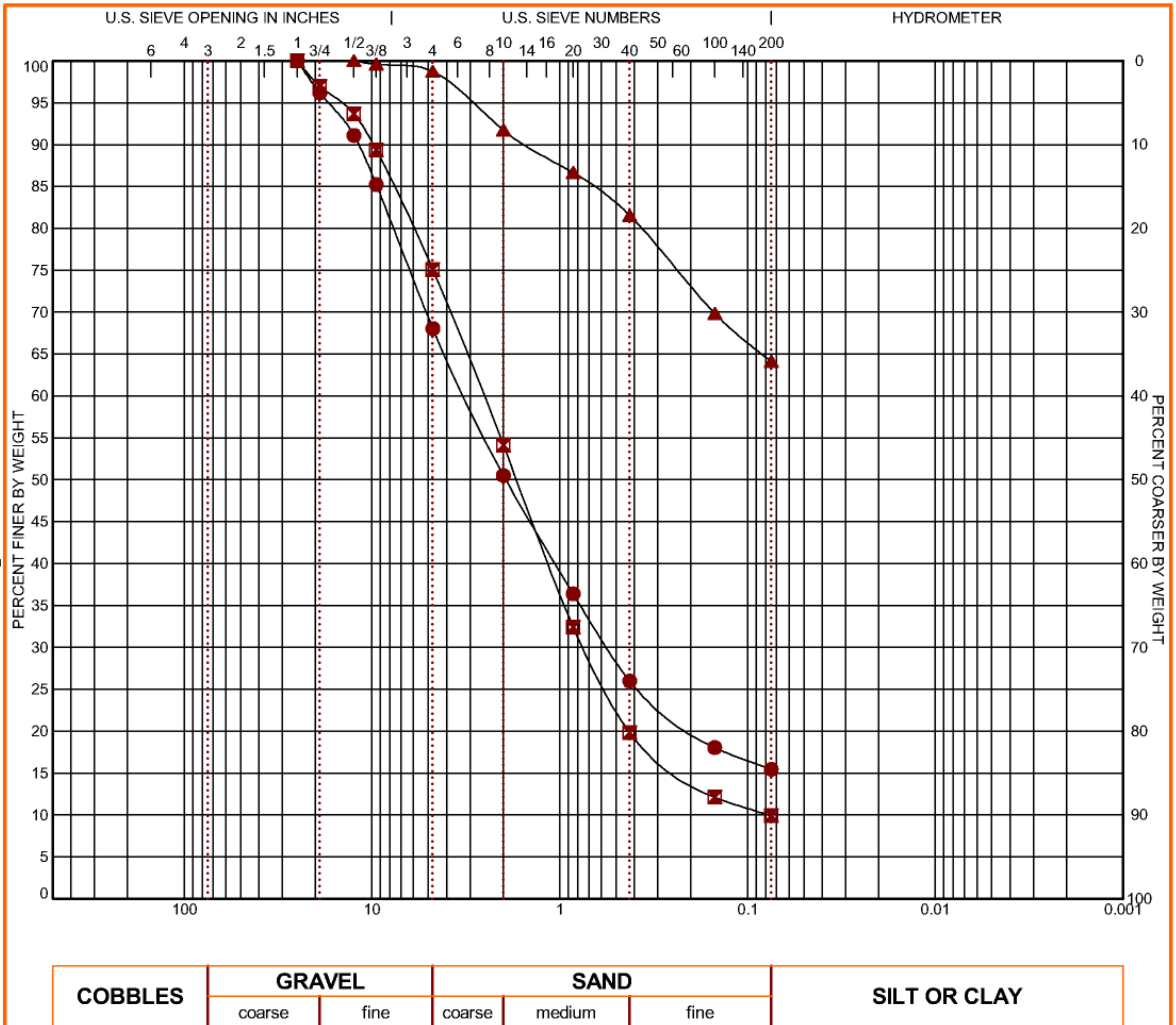
REMARKS

●	Location: N E Elevation: 941
⊠	Location: N E Elevation: 945.5
▲	Location: N E Elevation: 945.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-2**	**39.85471 / -83.35374**	**6 - 7.5**	**0.0**	**32.0**	**52.6**		**15.4**	
⊠	**B-20-2**	**39.85471 / -83.35374**	**8.5 - 10**	**0.0**	**24.9**	**65.2**		**9.9**	
▲	**B-20-3**	**39.86059 / -83.34631**	**0 - 5**	**0.0**	**1.3**	**34.6**		**64.1**	

GRAIN SIZE

	●	⊠	▲
D_{60}	3.199	2.55	
D_{30}	0.557	0.745	
D_{10}		0.078	

COEFFICIENTS

	●	⊠	▲
C_C		2.80	
C_U		32.82	

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1"	100.0	1"	100.0	1/2"	100.0
3/4"	96.16	3/4"	96.96	3/8"	99.59
1/2"	91.08	1/2"	93.67	#4	98.72
3/8"	85.19	3/8"	89.34	#10	91.7
#4	68.02	#4	75.07	#20	86.63
#10	50.48	#10	54.11	#40	81.51
#20	36.35	#20	32.4	#100	69.83
#40	25.96	#40	19.79	#200	64.09
#100	18.02	#100	12.1		
#200	15.42	#200	9.89		

SOIL DESCRIPTION

●	SILTY SAND with GRAVEL (SM)
⊠	WELL-GRADED SAND with SILT and GRAVEL (SW-SM)
▲	SANDY LEAN CLAY (CL)

REMARKS

●	Location: N E Elevation: 945.5
⊠	Location: N E Elevation: 945.5
▲	Location: N E Elevation: 955.5

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

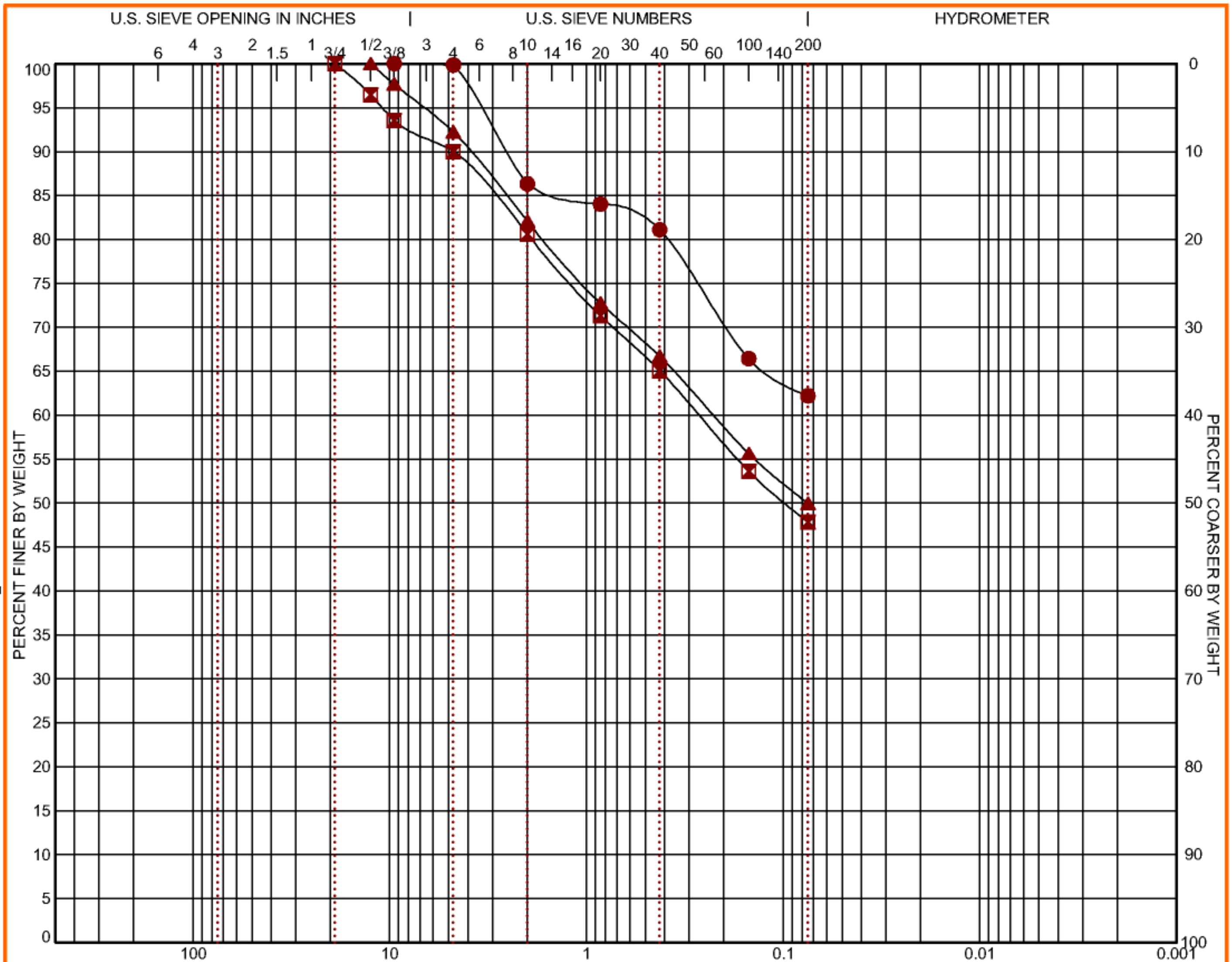
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-3**	**39.86059 / -83.34631**	**1 - 2.5**	**0.0**	**0.1**	**37.7**		**62.2**	
⊠	**B-20-3**	**39.86059 / -83.34631**	**6 - 7.5**	**0.0**	**10.0**	**42.2**		**47.8**	
▲	**B-20-3**	**39.86059 / -83.34631**	**8.5 - 10**	**0.0**	**7.8**	**42.3**		**49.9**	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.269	0.227
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/4"	100.0	1/2"	100.0
#4	99.85	1/2"	96.43	3/8"	97.66
#10	86.3	3/8"	93.54	#4	92.2
#20	83.99	#4	90.0	#10	82.04
#40	81.08	#10	80.6	#20	72.71
#100	66.41	#20	71.27	#40	66.69
#200	62.19	#40	65.04	#100	55.61
		#100	53.59	#200	49.94
		#200	47.81		

SOIL DESCRIPTION

- ● SANDY LEAN CLAY (CL)
- ⊠ CLAYEY SAND (SC)
- ▲ CLAYEY SAND (SC)

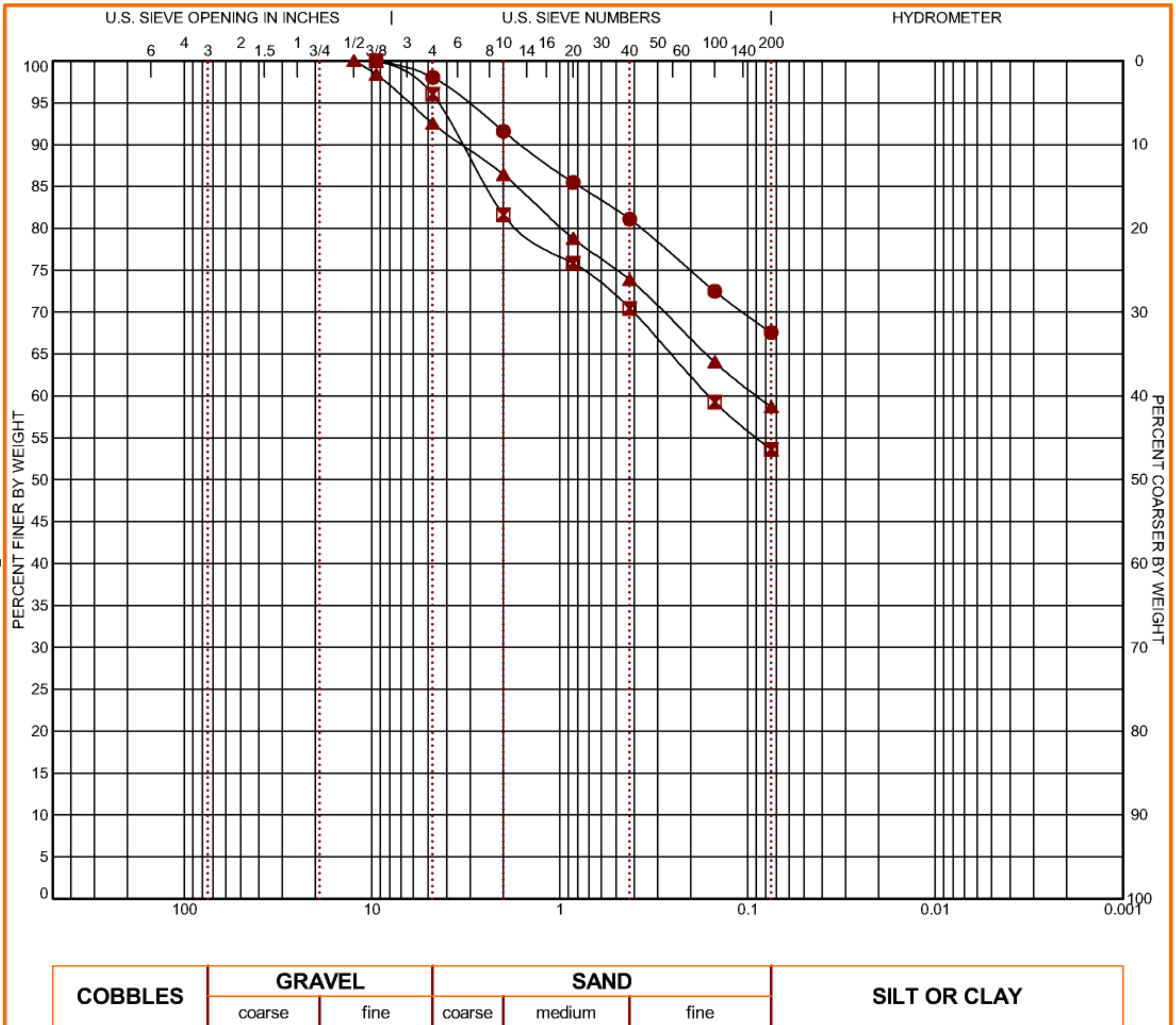
REMARKS

- ● Location: N E Elevation: 955.5
- ⊠ Location: N E Elevation: 955.5
- ▲ Location: N E Elevation: 955.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-4**	**39.86053 / -83.33644**	**0 - 5**	**0.0**	**2.0**	**30.5**		**67.5**	
⊠	**B-20-4**	**39.86053 / -83.33644**	**1 - 2.5**	**0.0**	**4.0**	**42.4**		**53.6**	
▲	**B-20-4**	**39.86053 / -83.33644**	**6 - 7.5**	**0.0**	**7.5**	**33.8**		**58.7**	

GRAIN SIZE	●	⊠	▲
D_{60}		0.161	0.089
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	1/2"	100.0
#4	98.0	#4	95.97	3/8"	98.36
#10	91.57	#10	81.57	#4	92.5
#20	85.44	#20	75.78	#10	86.39
#40	81.07	#40	70.44	#20	78.75
#100	72.47	#100	59.26	#40	73.84
#200	67.53	#200	53.57	#100	64.01
				#200	58.66

	SOIL DESCRIPTION
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

	REMARKS
●	Location: N E Elevation: 984.5
⊠	Location: N E Elevation: 984.5
▲	Location: N E Elevation: 984.5

PROJECT: Madison Solar Facility

PROJECT NUMBER: N4205246

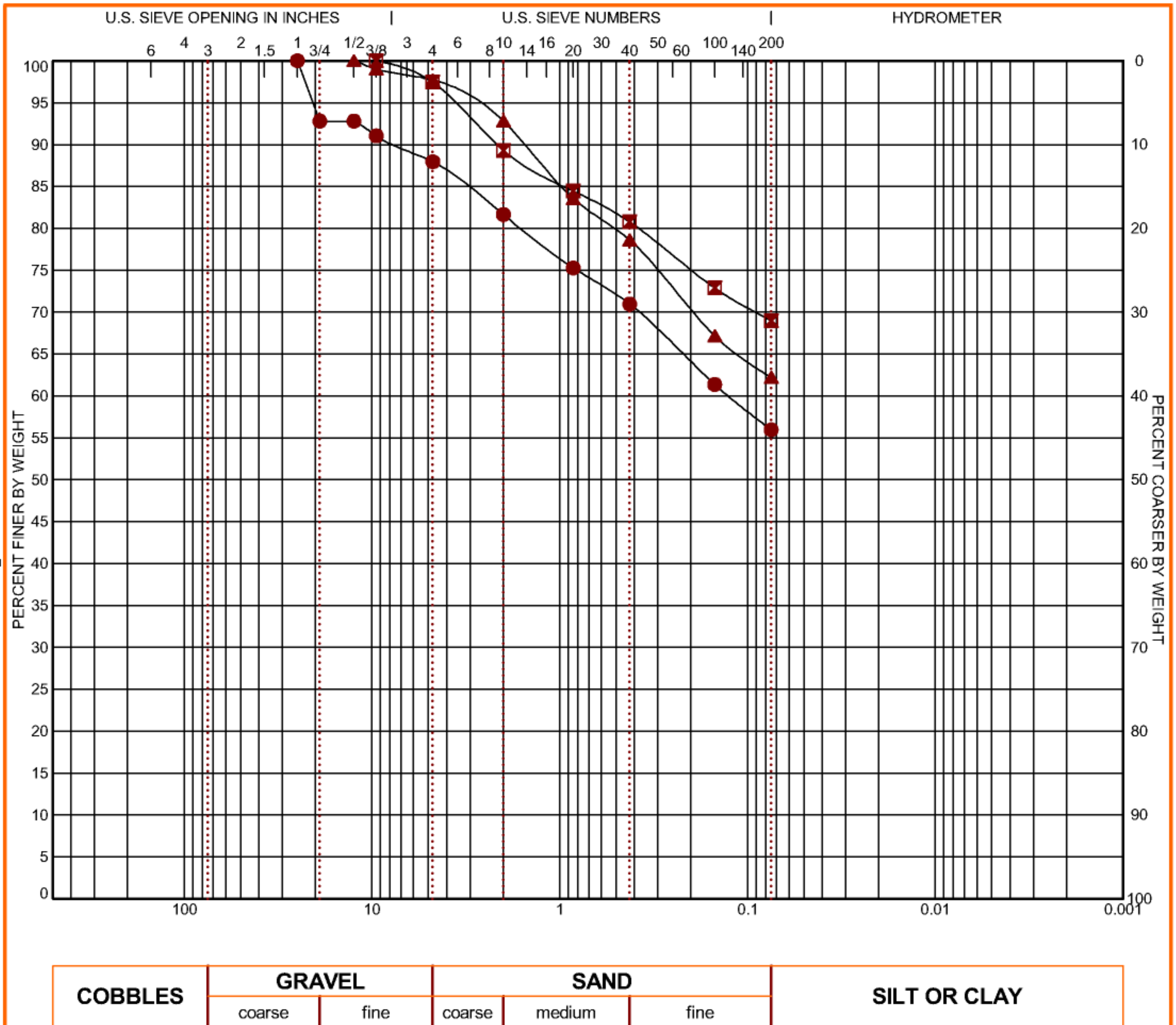
SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-4	39.86053 / -83.33644	8.5 - 10	0.0	12.1	32.0		55.9	
⊠	B-20-5	39.85643 / -83.33534	0 - 5	0.0	2.6	28.5		68.9	
▲	B-20-5	39.85643 / -83.33534	1 - 2.5	0.0	2.3	35.5		62.2	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.126		
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1"	100.0	3/8"	100.0	1/2"	100.0
3/4"	92.78	#4	97.43	3/8"	99.02
1/2"	92.78	#10	89.28	#4	97.7
3/8"	91.02	#20	84.41	#10	92.78
#4	87.92	#40	80.73	#20	83.53
#10	81.62	#100	72.86	#40	78.57
#20	75.24	#200	68.94	#100	67.16
#40	70.94			#200	62.17
#100	61.35				
#200	55.94				

SOIL DESCRIPTION

●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS

●	Location: N E Elevation: 984.5
⊠	Location: N E Elevation: 985.5
▲	Location: N E Elevation: 985.5

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

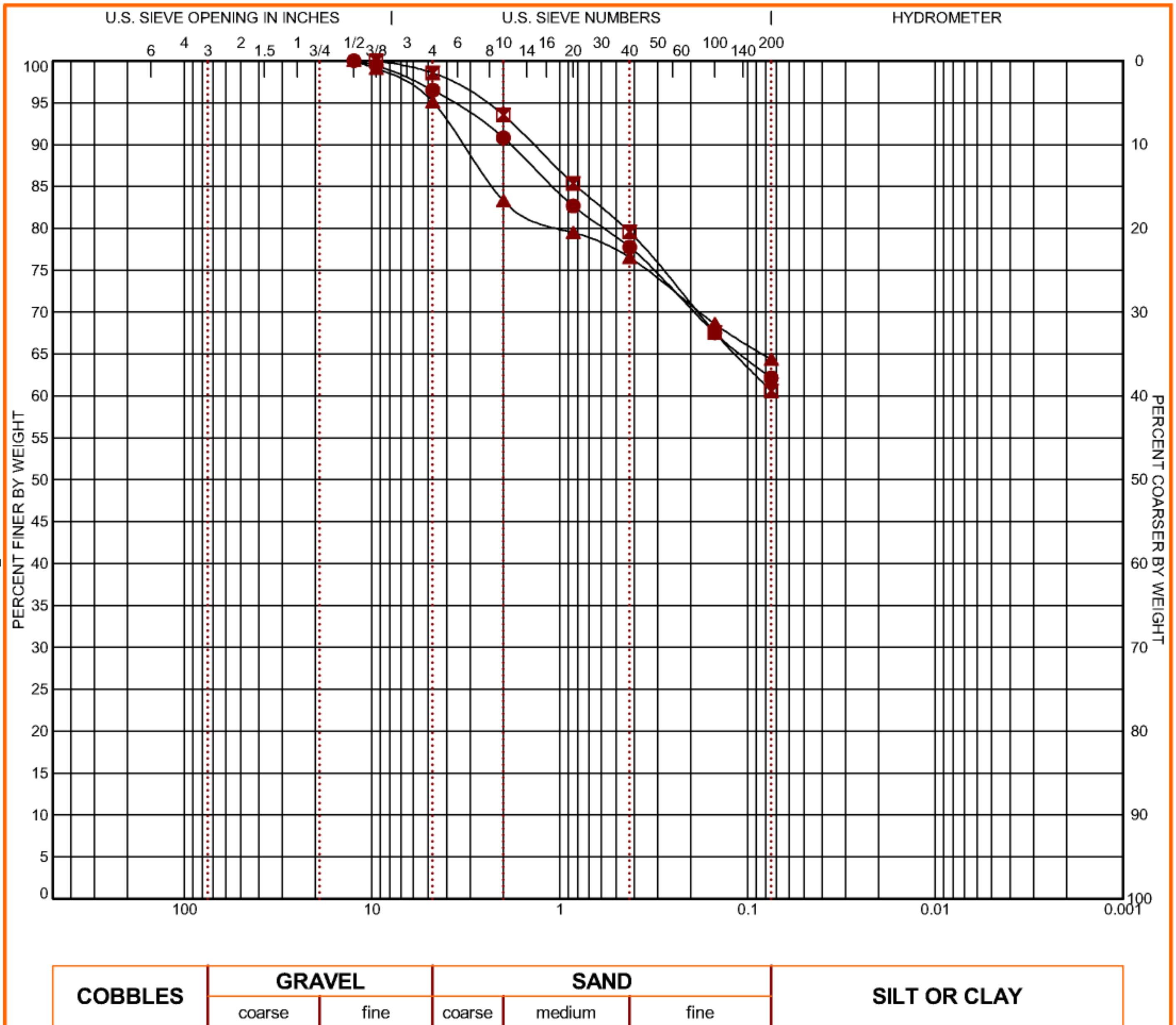
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-5	39.85643 / -83.33534	6 - 7.5	0.0	3.5	34.3		62.1	
⊠	B-20-5	39.85643 / -83.33534	8.5 - 10	0.0	1.5	37.9		60.6	
▲	B-20-6	39.85749 / -83.32347	0 - 5	0.0	4.9	30.7		64.3	

GRAIN SIZE

	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	3/8"	100.0	1/2"	100.0
3/8"	99.41	#4	98.53	3/8"	99.05
#4	96.47	#10	93.51	#4	95.09
#10	90.79	#20	85.34	#10	83.25
#20	82.65	#40	79.53	#20	79.46
#40	77.72	#100	67.57	#40	76.49
#100	67.51	#200	60.58	#100	68.58
#200	62.13			#200	64.35

SOIL DESCRIPTION

- ● SANDY LEAN CLAY (CL)
- ⊠ SANDY LEAN CLAY (CL)
- ▲ SANDY LEAN CLAY (CL)

REMARKS

- ● Location: N E Elevation: 985.5
- ⊠ Location: N E Elevation: 985.5
- ▲ Location: N E Elevation: 985

PROJECT: Madison Solar Facility

PROJECT NUMBER: N4205246

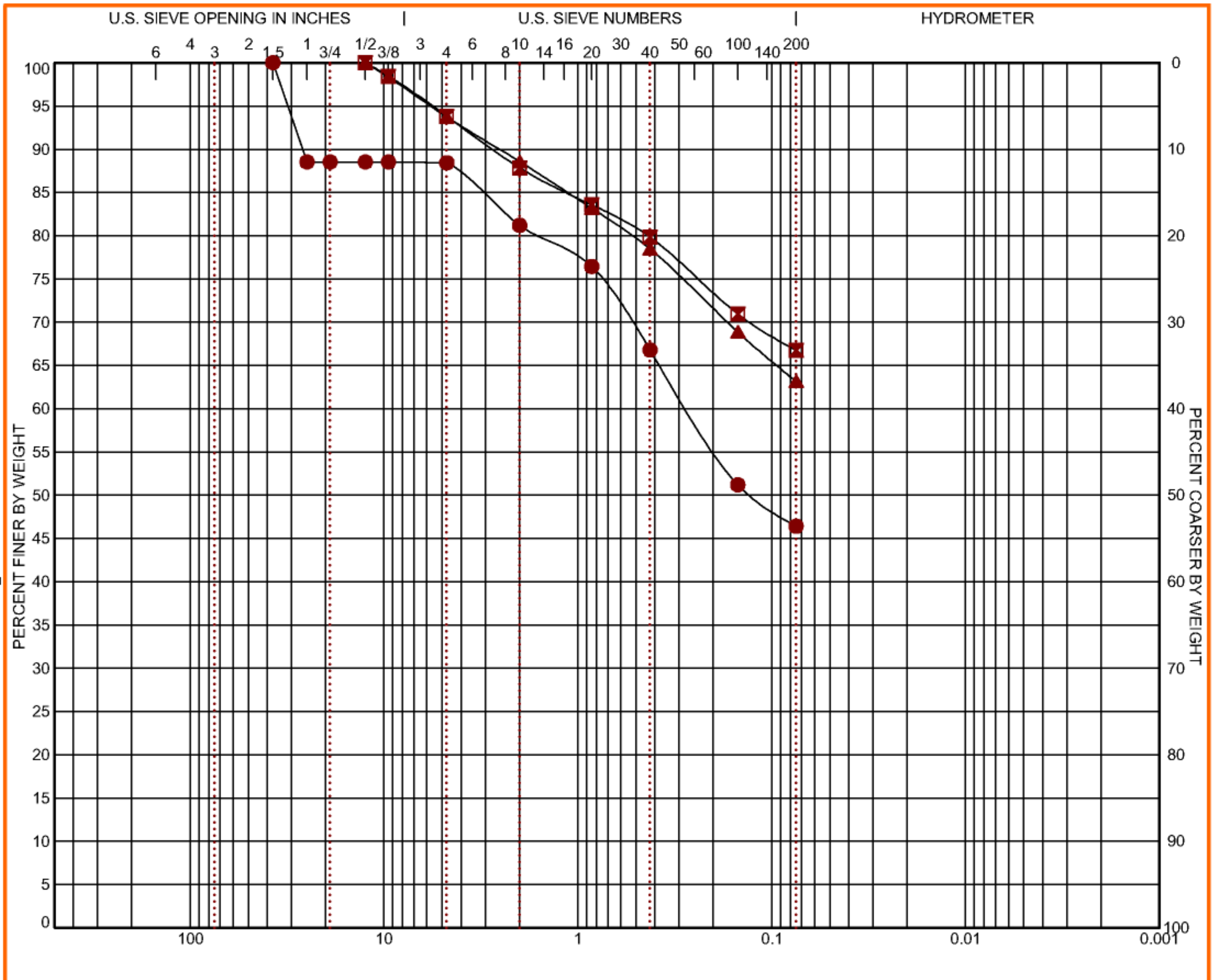
SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-6	39.85749 / -83.32347	1 - 2.5	0.0	11.6	42.0		46.4	
⊠	B-20-6	39.85749 / -83.32347	6 - 7.5	0.0	6.2	27.1		66.7	
▲	B-20-6	39.85749 / -83.32347	8.5 - 10	0.0	6.3	30.6		63.1	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.27		
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1 1/2"	100.0	1/2"	100.0	1/2"	100.0
1"	88.51	3/8"	98.43	3/8"	98.31
3/4"	88.51	#4	93.8	#4	93.71
1/2"	88.51	#10	87.82	#10	88.56
3/8"	88.51	#20	83.54	#20	83.15
#4	88.41	#40	79.81	#40	78.43
#10	81.17	#100	70.92	#100	68.85
#20	76.41	#200	66.72	#200	63.12
#40	66.76				
#100	51.18				
#200	46.39				

SOIL DESCRIPTION

●	CLAYEY SAND (SC)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS

●	Location: N E Elevation: 985
⊠	Location: N E Elevation: 985
▲	Location: N E Elevation: 985

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

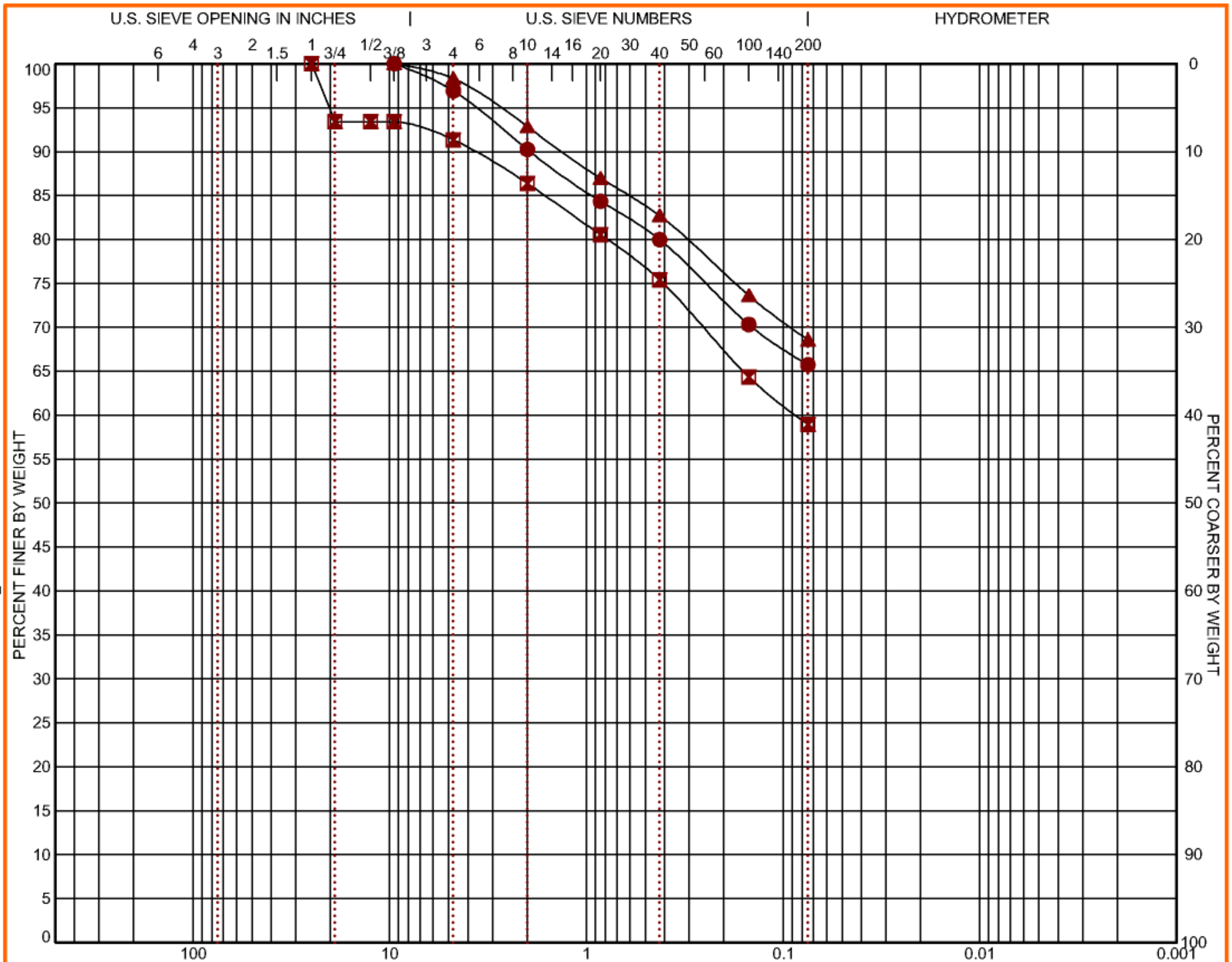
PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 73191029-GRAIN SIZE-USCS 1 N4205246 MADISON SOLAR FAR.GPJ TERRACON_DATATEMPLATE.GDT 8/12/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-7	39.84893 / -83.32948	0 - 5	0.0	3.1	31.2		65.7	
⊠	B-20-7	39.84893 / -83.32948	1 - 2.5	0.0	8.7	32.4		58.9	
▲	B-20-7	39.84893 / -83.32948	6 - 7.5	0.0	1.7	29.7		68.6	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.086	
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	1"	100.0	3/8"	100.0
#4	96.9	3/4"	93.39	#4	98.3
#10	90.22	1/2"	93.39	#10	92.83
#20	84.32	3/8"	93.39	#20	86.95
#40	79.95	#4	91.33	#40	82.69
#100	70.3	#10	86.36	#100	73.6
#200	65.72	#20	80.51	#200	68.55
		#40	75.36		
		#100	64.33		
		#200	58.92		

SOIL DESCRIPTION

- ● SANDY LEAN CLAY (CL)
- ⊠ SANDY LEAN CLAY (CL)
- ▲ SANDY LEAN CLAY (CL)

REMARKS

- ● Location: N E Elevation: 972
- ⊠ Location: N E Elevation: 972
- ▲ Location: N E Elevation: 972

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

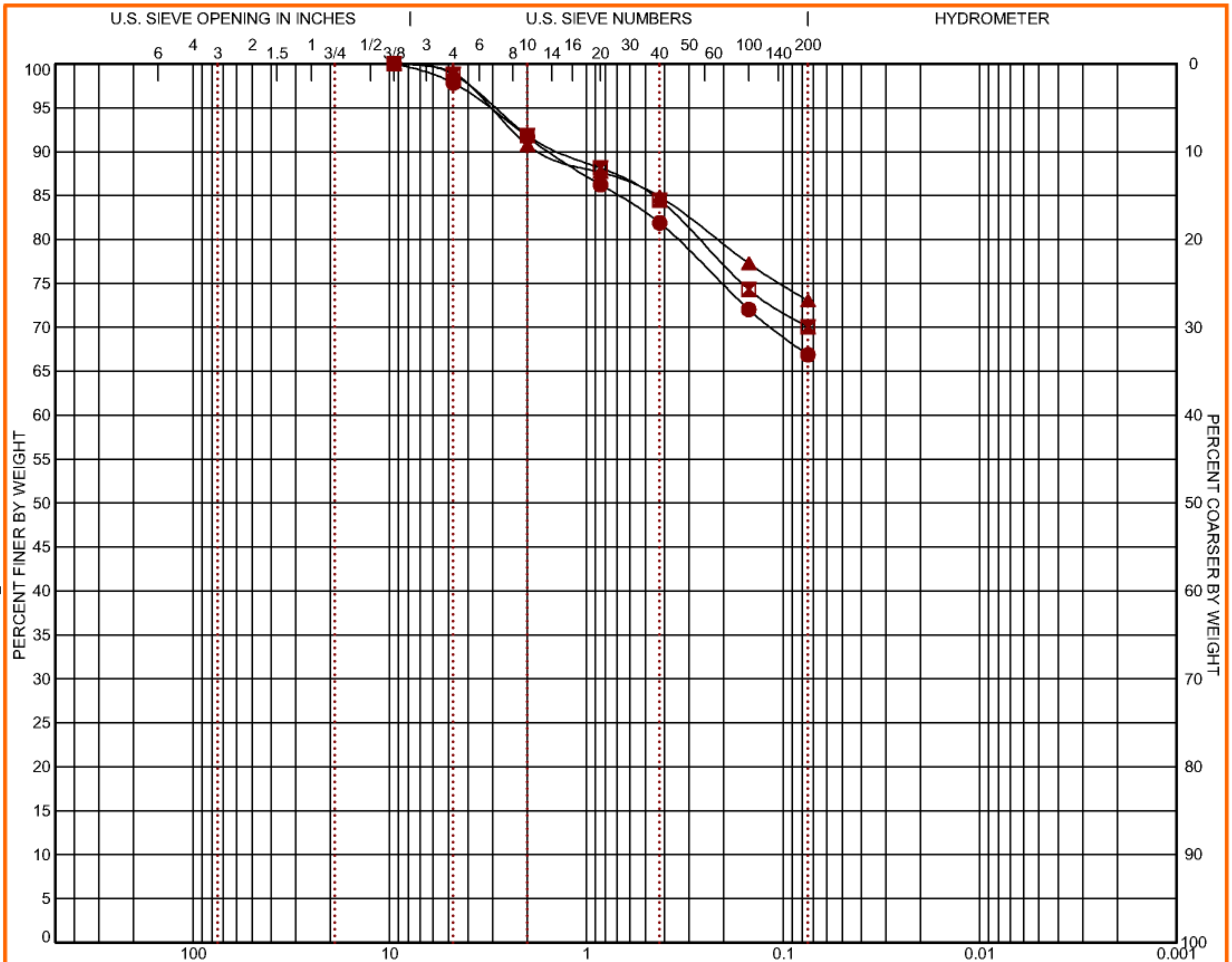
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-7**	**39.84893 / -83.32948**	**8.5 - 10**	**0.0**	**2.2**	**30.9**		**66.8**	
⊠	**B-20-8**	**39.84840 / -83.32148**	**0 - 5**	**0.0**	**1.2**	**28.7**		**70.1**	
▲	**B-20-8**	**39.84840 / -83.32148**	**1 - 2.5**	**0.0**	**0.9**	**26.0**		**73.0**	

GRAIN SIZE

	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

●		⊠		▲	
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	97.79	#4	98.78	#4	99.05
#10	91.66	#10	91.83	#10	90.72
#20	86.19	#20	88.1	#20	87.62
#40	81.86	#40	84.47	#40	84.83
#100	72.01	#100	74.28	#100	77.24
#200	66.85	#200	70.05	#200	73.02

SOIL DESCRIPTION

●	SANDY LEAN CLAY (CL)
⊠	LEAN CLAY with SAND (CL)
▲	LEAN CLAY with SAND (CL)

REMARKS

●	Location: N E Elevation: 972
⊠	Location: N E Elevation: 978.5
▲	Location: N E Elevation: 978.5

PROJECT: Madison Solar Facility

PROJECT NUMBER: N4205246

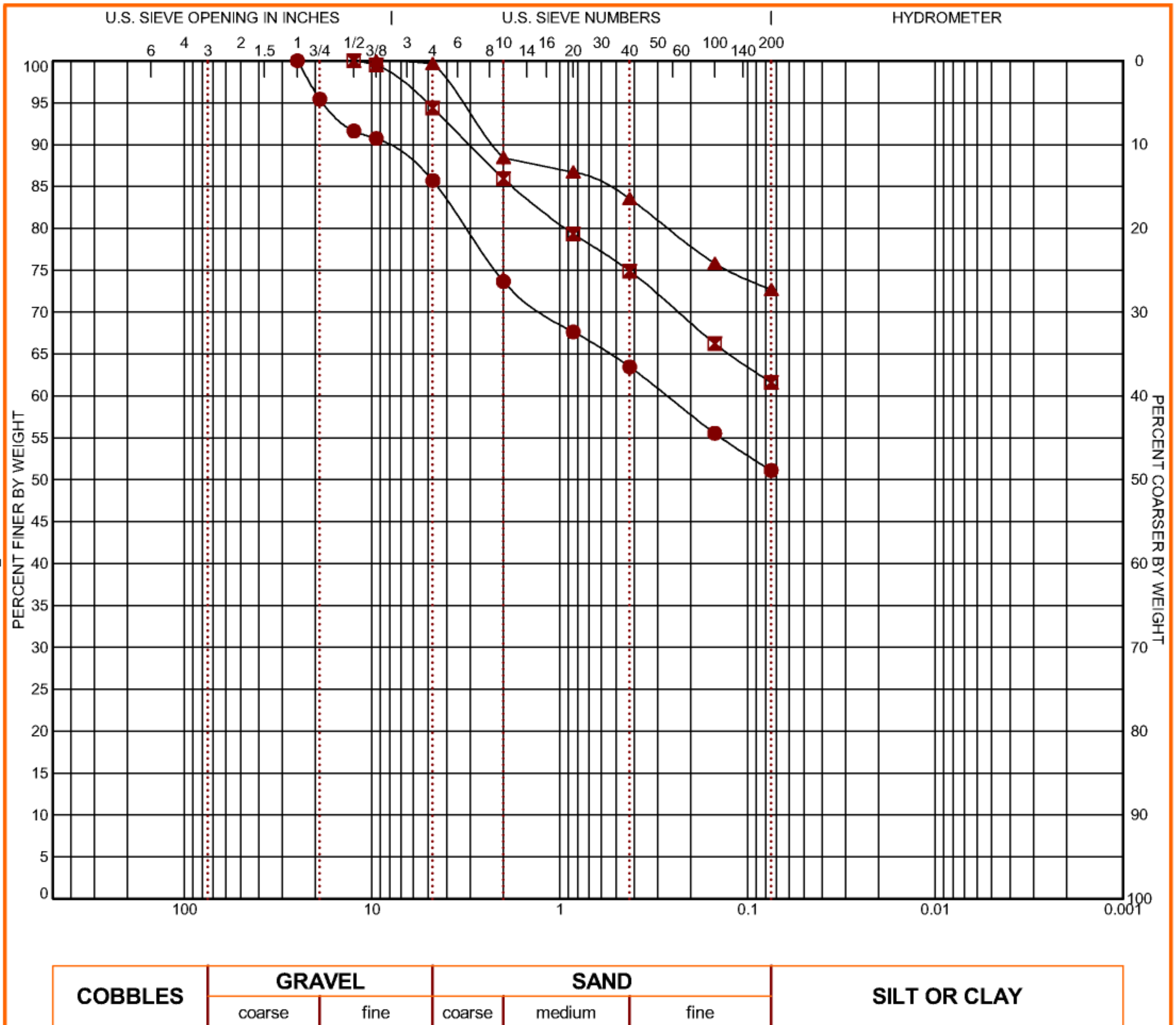
SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-8	39.84840 / -83.32148	6 - 7.5	0.0	14.3	34.6		51.1	
⊠	B-20-8	39.84840 / -83.32148	8.5 - 10	0.0	5.6	32.8		61.6	
▲	B-20-9	39.84253 / -83.33006	0 - 5	0.0	0.4	27.0		72.7	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.27		
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1"	100.0	1/2"	100.0	3/8"	100.0
3/4"	95.41	3/8"	99.46	#4	99.64
1/2"	91.6	#4	94.36	#10	88.39
3/8"	90.71	#10	85.92	#20	86.68
#4	85.68	#20	79.32	#40	83.52
#10	73.63	#40	74.88	#100	75.8
#20	67.61	#100	66.24	#200	72.67
#40	63.44	#200	61.57		
#100	55.52				
#200	51.08				

SOIL DESCRIPTION

●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	LEAN CLAY with SAND (CL)

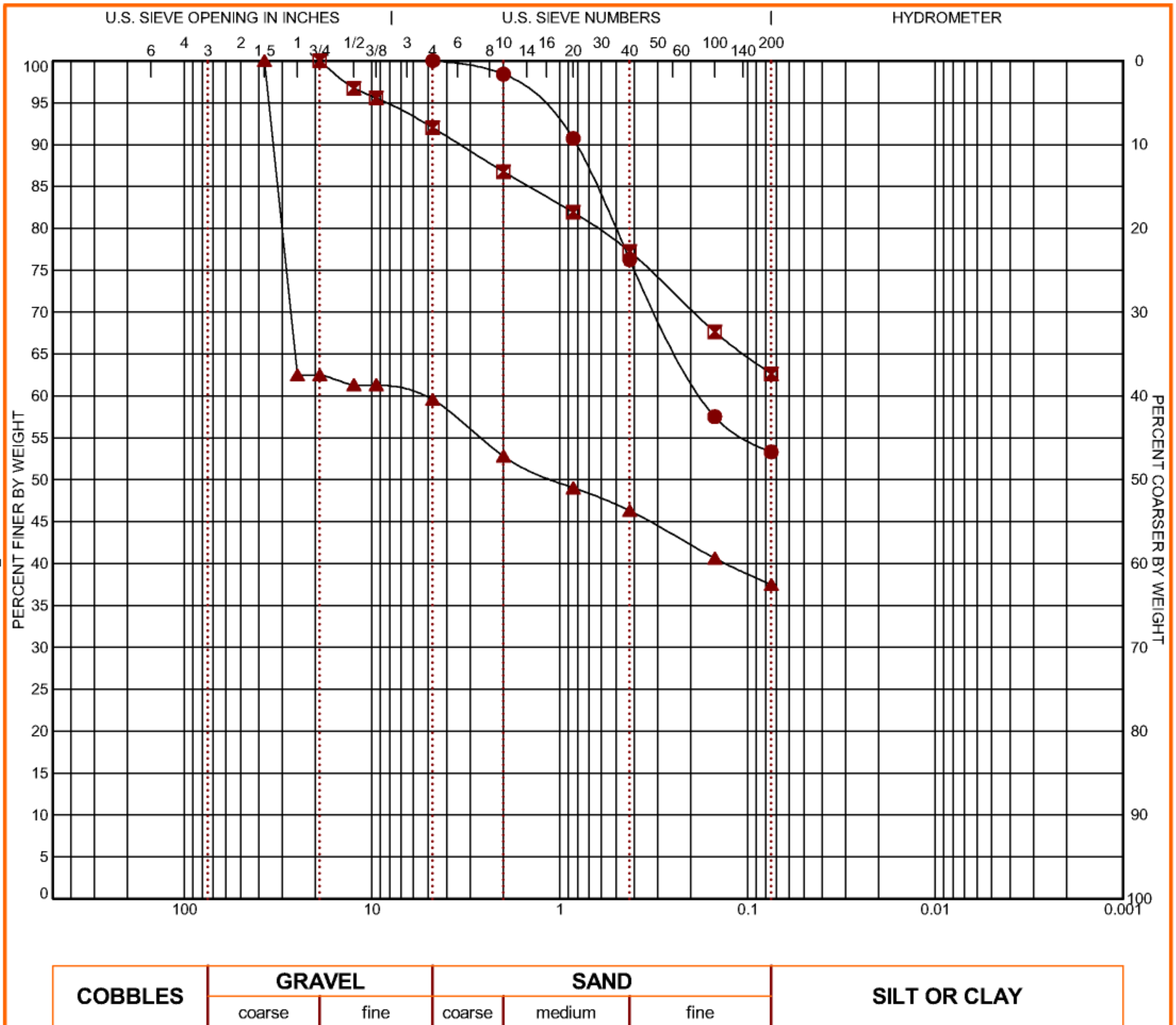
REMARKS

●	Location: N E Elevation: 978.5
⊠	Location: N E Elevation: 978.5
▲	Location: N E Elevation: 978.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-9**	**39.84253 / -83.33006**	**1 - 2.5**	**0.0**	**0.0**	**46.7**		**53.3**	
⊠	**B-20-9**	**39.84253 / -83.33006**	**6 - 7.5**	**0.0**	**8.0**	**29.4**		**62.6**	
▲	**B-20-9**	**39.84253 / -83.33006**	**8.5 - 10**	**0.0**	**40.4**	**22.1**		**37.5**	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.172		5.68
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
#4	100.0	3/4"	100.0	1 1/2"	100.0
#10	98.39	1/2"	96.72	1"	62.47
#20	90.7	3/8"	95.53	3/4"	62.47
#40	76.23	#4	92.0	1/2"	61.29
#100	57.49	#10	86.73	3/8"	61.29
#200	53.29	#20	81.88	#4	59.55
		#40	77.2	#10	52.77
		#100	67.63	#20	49.01
		#200	62.62	#40	46.28
				#100	40.61
				#200	37.46

SOIL DESCRIPTION

- ● SANDY FAT CLAY (CH)
- ⊠ SANDY LEAN CLAY (CL)
- ▲ CLAYEY GRAVEL with SAND (GC)

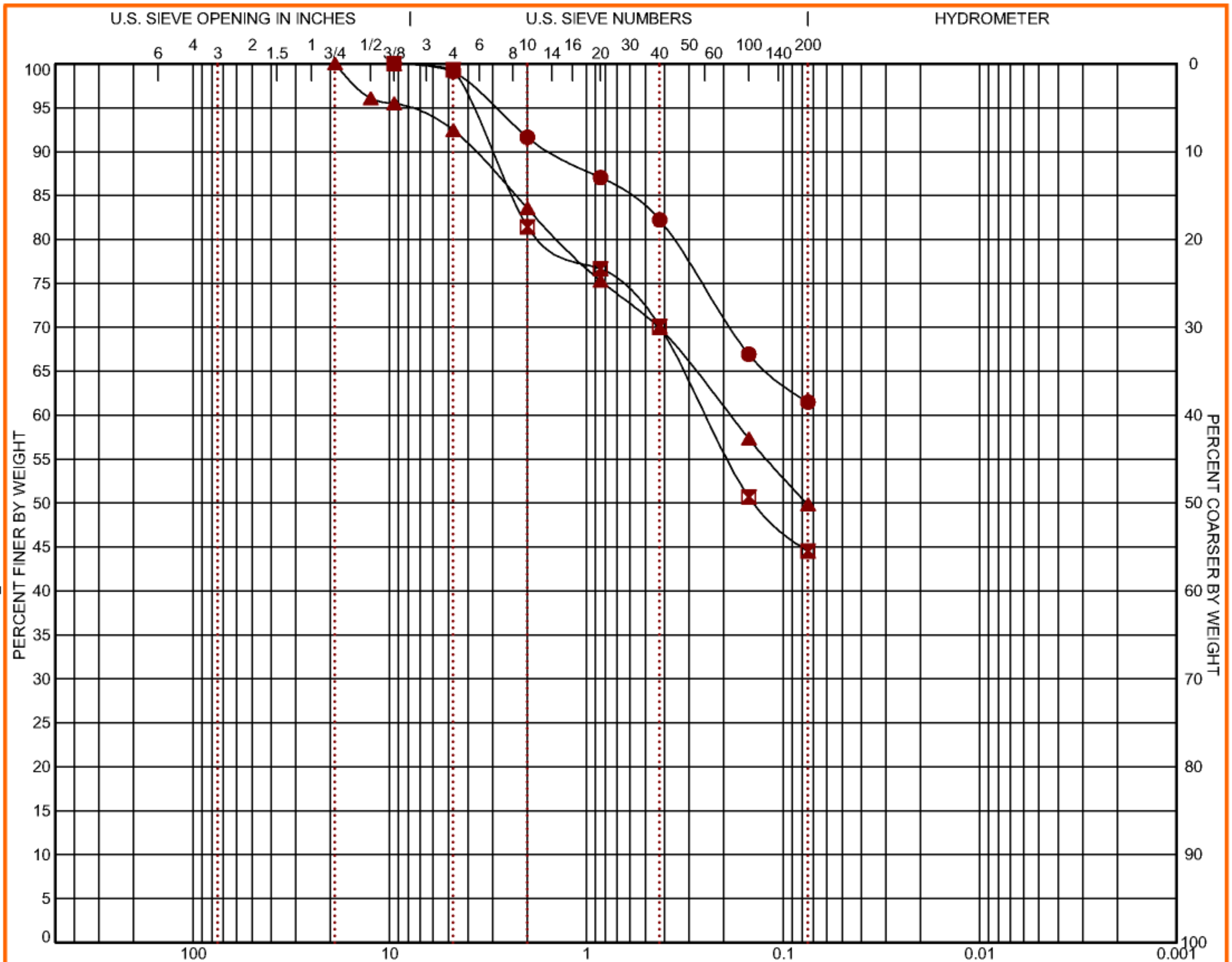
REMARKS

- ● Location: N E Elevation: 978.5
- ⊠ Location: N E Elevation: 978.5
- ▲ Location: N E Elevation: 978.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-10	39.83811 / -83.33344	0 - 5	0.0	0.9	37.6		61.5	
⊠	B-20-10	39.83811 / -83.33344	1 - 2.5	0.0	0.7	54.8		44.5	
▲	B-20-10	39.83811 / -83.33344	6 - 7.5	0.0	7.6	42.6		49.8	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.247	0.188
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	3/4"	100.0
#4	99.1	#4	99.3	1/2"	96.05
#10	91.61	#10	81.42	3/8"	95.46
#20	87.02	#20	76.61	#4	92.4
#40	82.19	#40	70.11	#10	83.51
#100	66.91	#100	50.66	#20	75.24
#200	61.47	#200	44.5	#40	69.85
				#100	57.31
				#200	49.81

SOIL DESCRIPTION

●	SANDY LEAN CLAY (CL)
⊠	CLAYEY SAND (SC)
▲	CLAYEY SAND (SC)

REMARKS

●	Location: N E Elevation: 975
⊠	Location: N E Elevation: 975
▲	Location: N E Elevation: 975

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

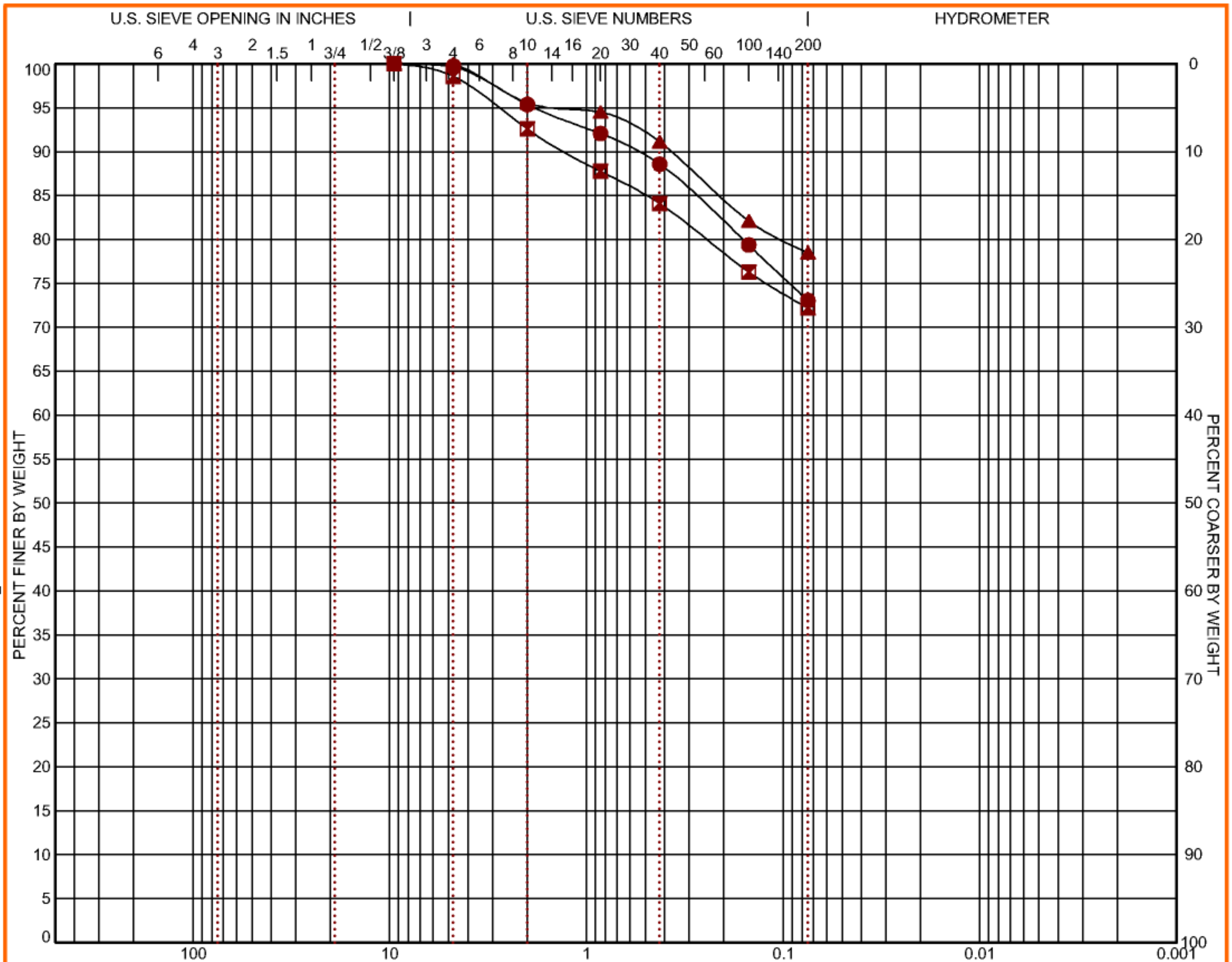
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-10	39.83811 / -83.33344	8.5 - 10	0.0	0.3	26.7		73.0	
⊠	B-20-11	39.83664 / -83.32147	0 - 5	0.0	1.5	26.4		72.2	
▲	B-20-11	39.83664 / -83.32147	1 - 2.5	0.0	0.0	21.5		78.5	

GRAIN SIZE

	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	99.71	#4	98.54	#4	99.96
#10	95.35	#10	92.55	#10	95.53
#20	92.04	#20	87.73	#20	94.48
#40	88.54	#40	84.06	#40	91.08
#100	79.34	#100	76.26	#100	82.07
#200	73.03	#200	72.19	#200	78.45

SOIL DESCRIPTION

- ● LEAN CLAY with SAND (CL)
- ⊠ LEAN CLAY with SAND (CL)
- ▲ LEAN CLAY with SAND (CL)

REMARKS

- ● Location: N E Elevation: 975
- ⊠ Location: N E Elevation: 983
- ▲ Location: N E Elevation: 983

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

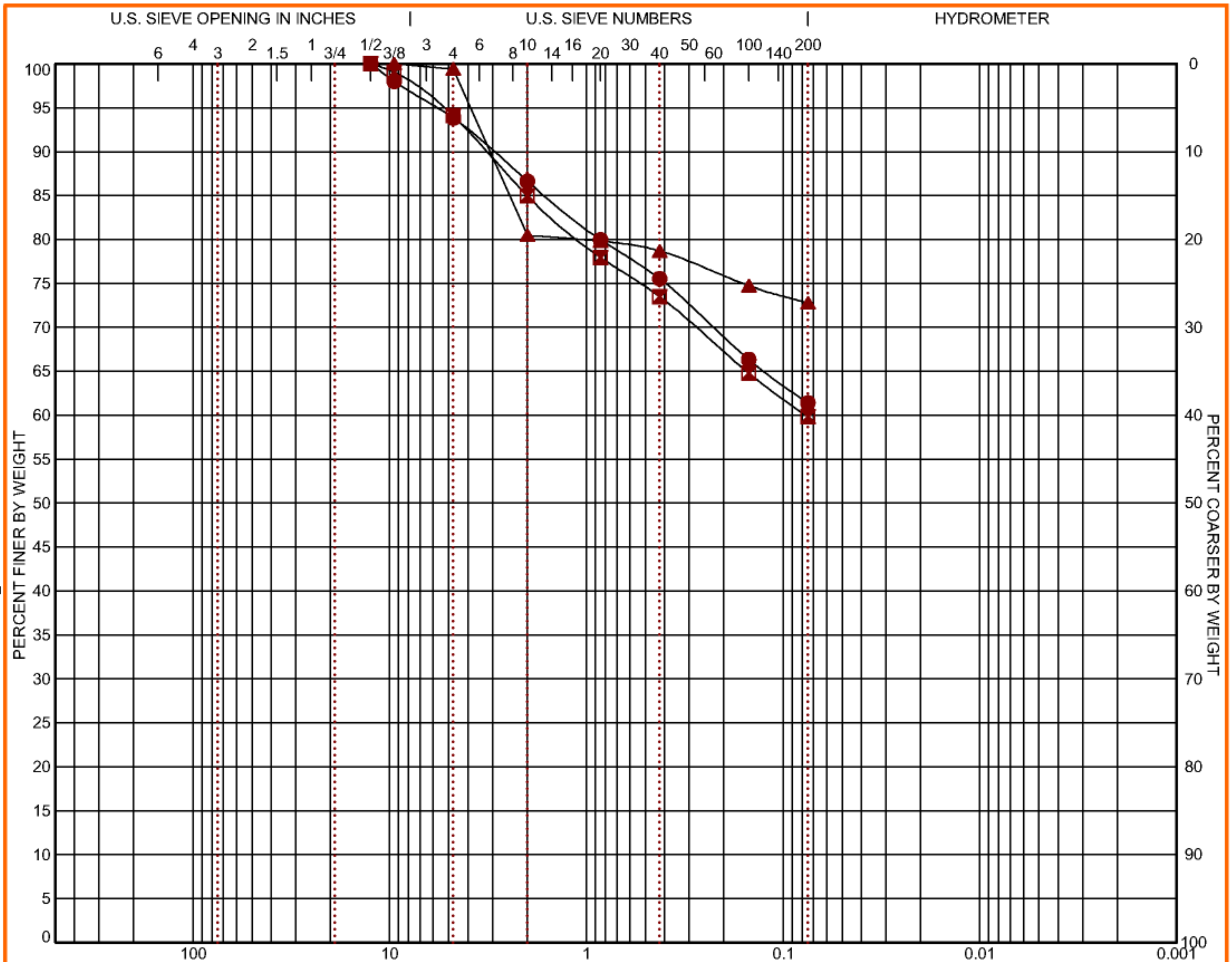
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-11	39.83664 / -83.32147	6 - 7.5	0.0	6.2	32.4		61.4	
⊠	B-20-11	39.83664 / -83.32147	8.5 - 10	0.0	5.9	34.3		59.8	
▲	B-20-12	39.83402 / -83.31460	0 - 5	0.0	0.6	26.6		72.8	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.077	
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
1/2"	100.0	1/2"	100.0	3/8"	100.0
3/8"	97.98	3/8"	99.02	#4	99.4
#4	93.81	#4	94.07	#10	80.44
#10	86.6	#10	84.93	#20	79.8
#20	79.94	#20	77.91	#40	78.66
#40	75.5	#40	73.47	#100	74.7
#100	66.31	#100	64.77	#200	72.77
#200	61.38	#200	59.79		

SOIL DESCRIPTION

- ● SANDY LEAN CLAY (CL)
- ⊠ SANDY LEAN CLAY (CL)
- ▲ FAT CLAY with SAND (CH)

REMARKS

- ● Location: N E Elevation: 983
- ⊠ Location: N E Elevation: 983
- ▲ Location: N E Elevation: 982

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

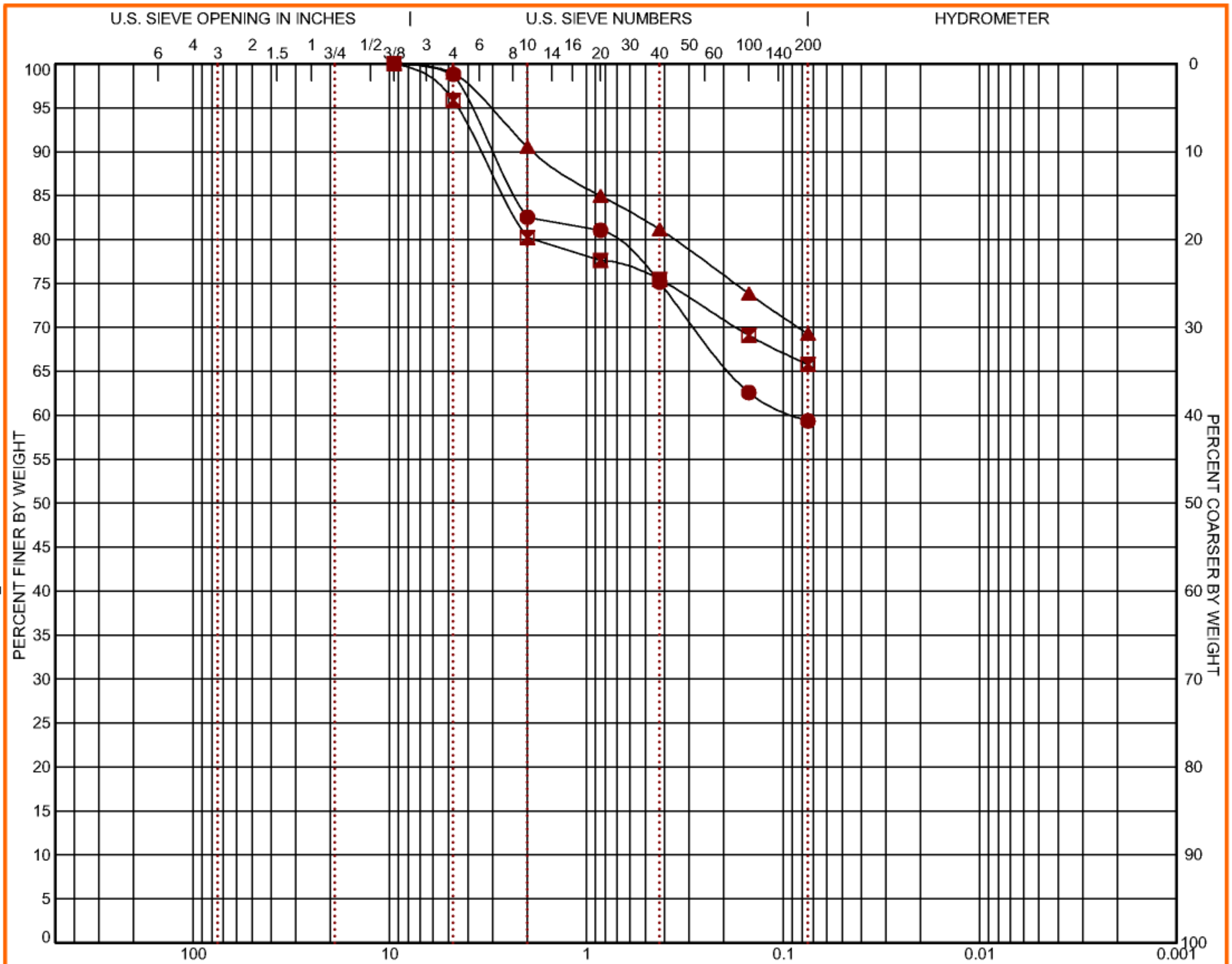
Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-12	39.83402 / -83.31460	1 - 2.5	0.0	1.2	39.5		59.3	
⊠	B-20-12	39.83402 / -83.31460	6 - 7.5	0.0	4.2	30.1		65.8	
▲	B-20-12	39.83402 / -83.31460	8.5 - 10	0.0	1.0	29.8		69.2	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.087		
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	98.78	#4	95.84	#4	98.97
#10	82.51	#10	80.17	#10	90.49
#20	81.02	#20	77.6	#20	84.94
#40	75.12	#40	75.42	#40	81.12
#100	62.57	#100	69.07	#100	73.83
#200	59.32	#200	65.77	#200	69.21

SOIL DESCRIPTION

- ● SANDY FAT CLAY (CH)
- ⊠ SANDY LEAN CLAY (CL)
- ▲ SANDY LEAN CLAY (CL)

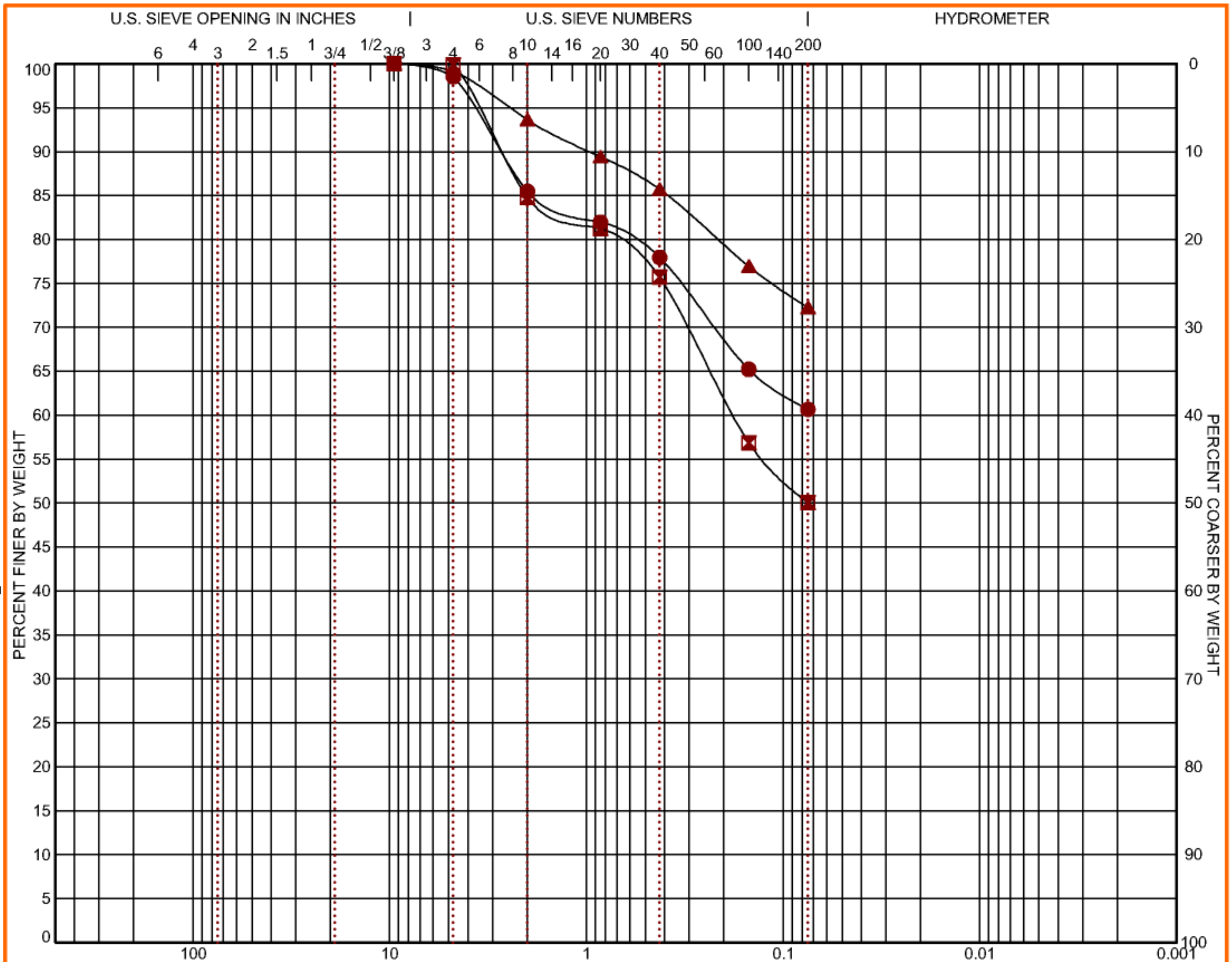
REMARKS

- ● Location: N E Elevation: 982
- ⊠ Location: N E Elevation: 982
- ▲ Location: N E Elevation: 982

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-13	39.82818 / -83.32341	0 - 5	0.0	1.5	37.9		60.6	
⊠	B-20-13	39.82818 / -83.32341	1 - 2.5	0.0	0.1	49.9		50.0	
▲	B-20-13	39.82818 / -83.32341	6 - 7.5	0.0	0.9	26.9		72.2	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.179	
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	98.51	#4	99.89	#4	99.1
#10	85.44	#10	84.77	#10	93.59
#20	81.93	#20	81.19	#20	89.4
#40	77.92	#40	75.66	#40	85.69
#100	65.19	#100	56.86	#100	76.91
#200	60.63	#200	50.0	#200	72.21

SOIL DESCRIPTION

- ● SANDY LEAN CLAY (CL)
- ⊠ SANDY FAT CLAY (CH)
- ▲ LEAN CLAY with SAND (CL)

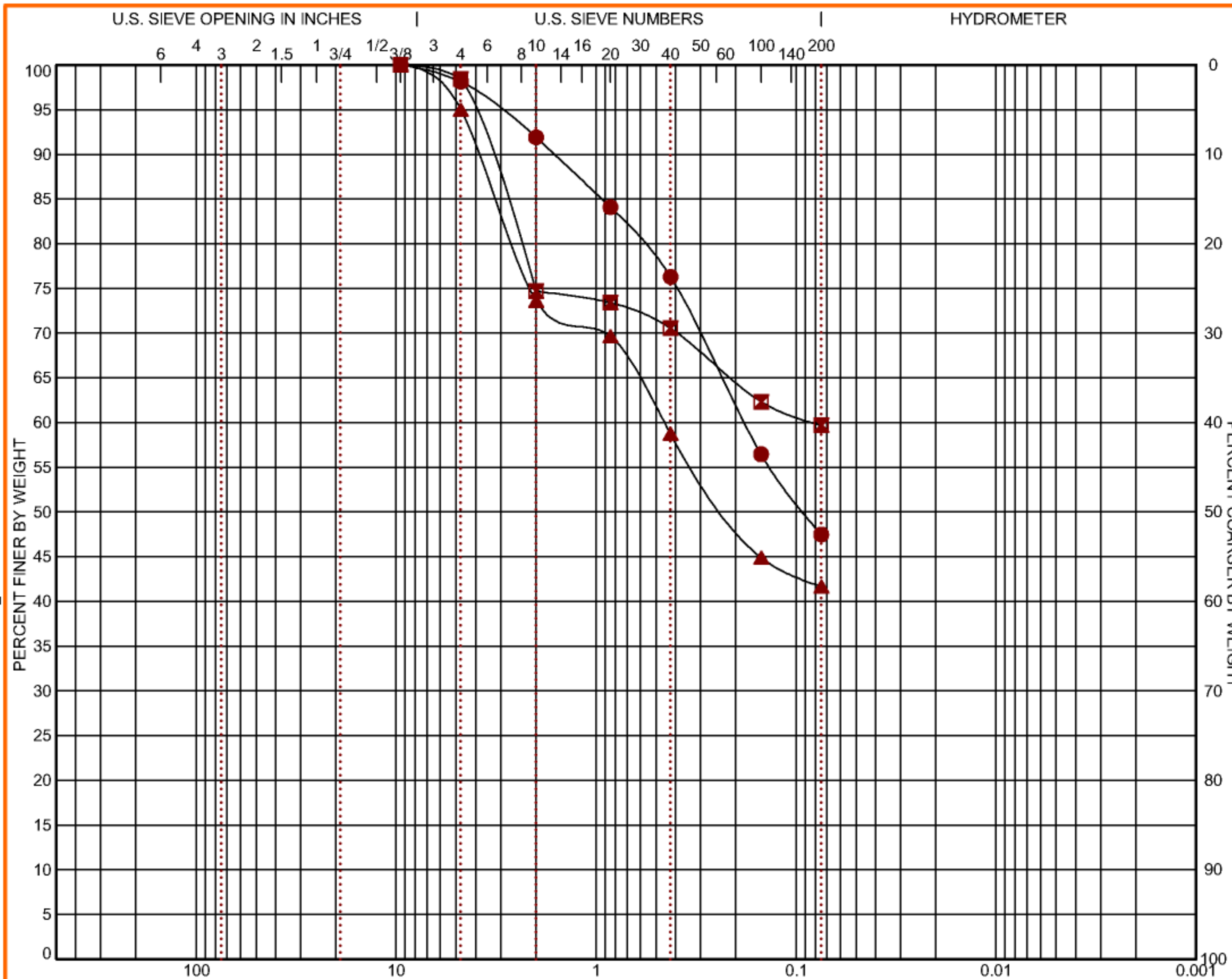
REMARKS

- ● Location: N E Elevation: 959.5
- ⊠ Location: N E Elevation: 959.5
- ▲ Location: N E Elevation: 959.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-13	39.82818 / -83.32341	8.5 - 10	0.0	1.9	50.6		47.5	
⊠	B-20-14	39.82961 / -83.33090	0 - 5	0.0	1.6	38.8		59.7	
▲	B-20-14	39.82961 / -83.33090	1 - 2.5	0.0	5.0	53.3		41.6	

GRAIN SIZE

	●	⊠	▲
D_{60}	0.181	0.082	0.462
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/8"	100.0	3/8"	100.0
#4	98.1	#4	98.44	#4	94.97
#10	91.88	#10	74.64	#10	73.56
#20	84.06	#20	73.38	#20	69.62
#40	76.27	#40	70.52	#40	58.68
#100	56.43	#100	62.29	#100	44.87
#200	47.45	#200	59.65	#200	41.64

SOIL DESCRIPTION

●	SILTY, CLAYEY SAND (SC-SM)
⊠	SANDY LEAN CLAY (CL)
▲	CLAYEY SAND (SC)

REMARKS

●	Location: N E Elevation: 959.5
⊠	Location: N E Elevation: 958
▲	Location: N E Elevation: 958

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

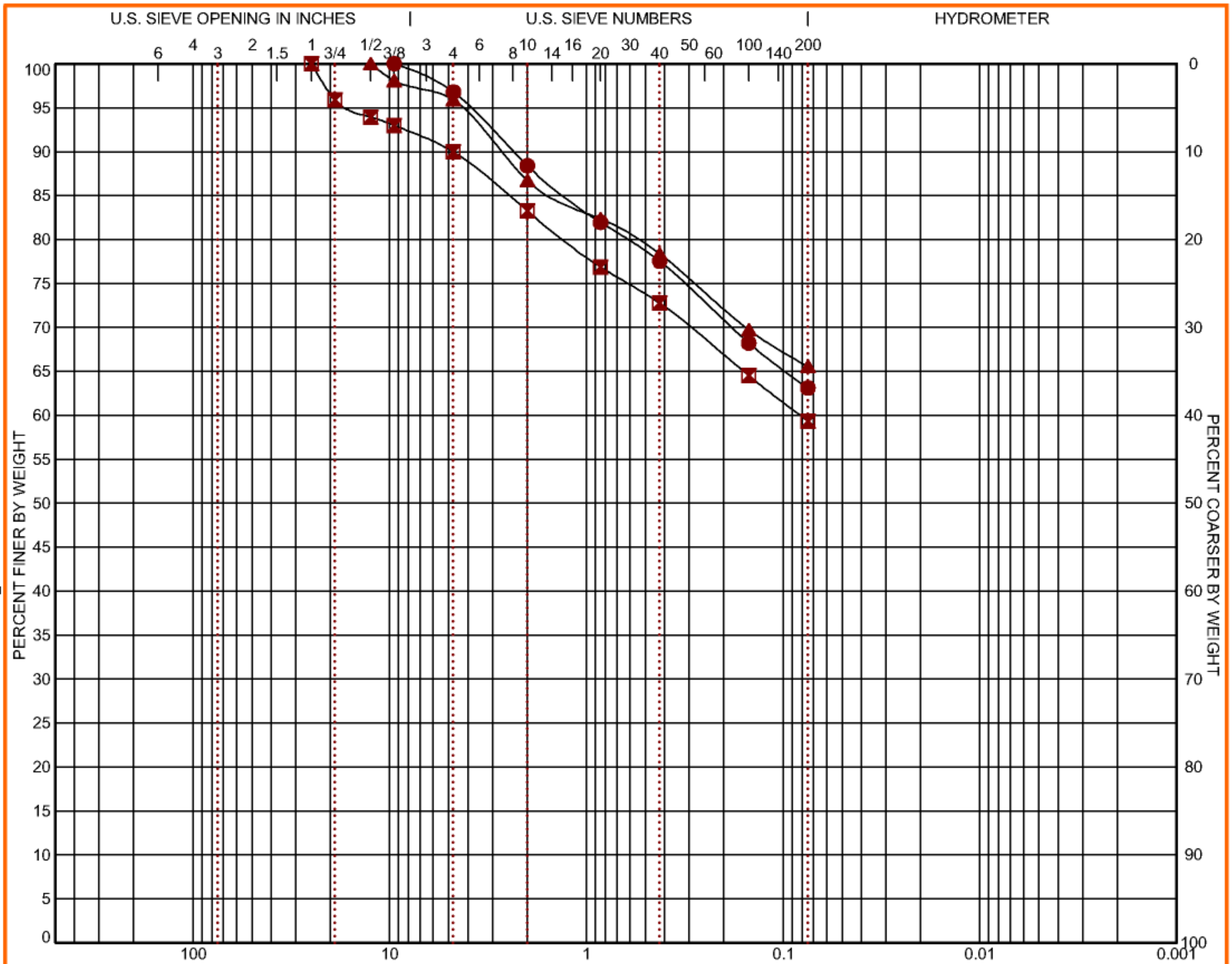
PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. 73191029-GRAIN SIZE-USCS 1 N4205246 MADISON SOLAR FAR.GPJ TERRACON_DATATEMPLATE.GDT 8/12/20

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-14	39.82961 / -83.33090	6 - 7.5	0.0	3.2	33.7		63.1	
⊠	B-20-14	39.82961 / -83.33090	8.5 - 10	0.0	10.0	30.6		59.3	
▲	B-20-15	39.83415 / -83.33579	0 - 5	0.0	4.1	30.3		65.5	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.082	
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	1"	100.0	1/2"	100.0
#4	96.77	3/4"	95.86	3/8"	98.07
#10	88.37	1/2"	93.93	#4	95.88
#20	81.93	3/8"	92.96	#10	86.67
#40	77.51	#4	89.95	#20	82.33
#100	68.2	#10	83.22	#40	78.34
#200	63.08	#20	76.83	#100	69.71
		#40	72.74	#200	65.53
		#100	64.48		
		#200	59.32		

SOIL DESCRIPTION

●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

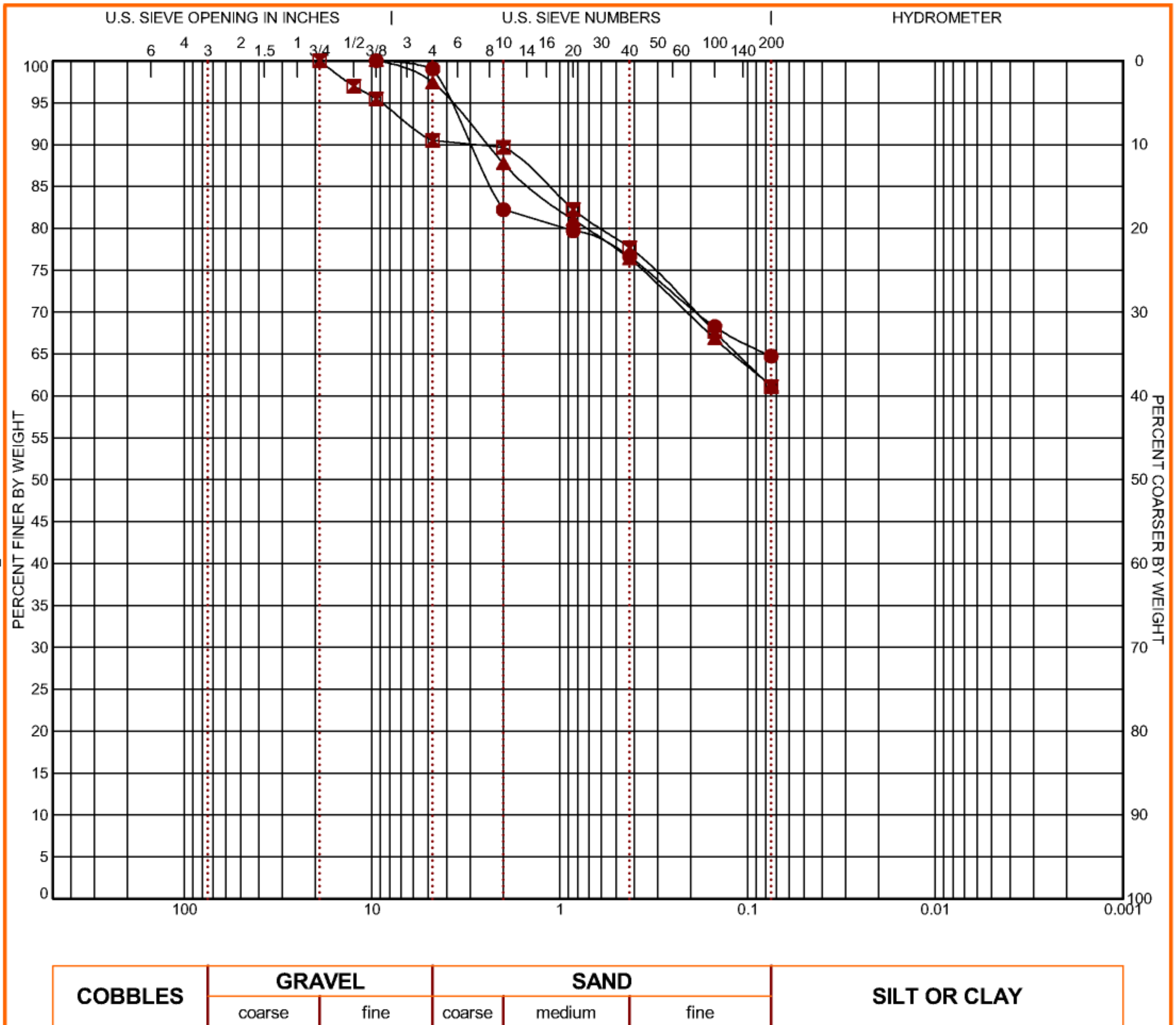
REMARKS

●	Location: N E Elevation: 958
⊠	Location: N E Elevation: 958
▲	Location: N E Elevation: 956.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-15	39.83415 / -83.33579	1 - 2.5	0.0	1.0	34.3		64.7	
⊠	B-20-15	39.83415 / -83.33579	6 - 7.5	0.0	9.5	29.4		61.1	
▲	B-20-15	39.83415 / -83.33579	8.5 - 10	0.0	2.6	36.1		61.3	

GRAIN SIZE	●	⊠	▲
D_{60}			
D_{30}			
D_{10}			

COEFFICIENTS	●	⊠	▲
C_c			
C_u			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/4"	100.0	3/8"	100.0
#4	99.01	1/2"	96.97	#4	97.39
#10	82.19	3/8"	95.42	#10	87.72
#20	79.67	#4	90.46	#20	81.0
#40	76.57	#10	89.65	#40	76.32
#100	68.24	#20	82.24	#100	66.81
#200	64.72	#40	77.65	#200	61.25
		#100	67.66		
		#200	61.06		

SOIL DESCRIPTION	
●	SANDY LEAN CLAY (CL)
⊠	SANDY LEAN CLAY (CL)
▲	SANDY LEAN CLAY (CL)

REMARKS	
●	Location: N E Elevation: 956.5
⊠	Location: N E Elevation: 956.5
▲	Location: N E Elevation: 956.5

PROJECT: Madison Solar Facility

PROJECT NUMBER: N4205246

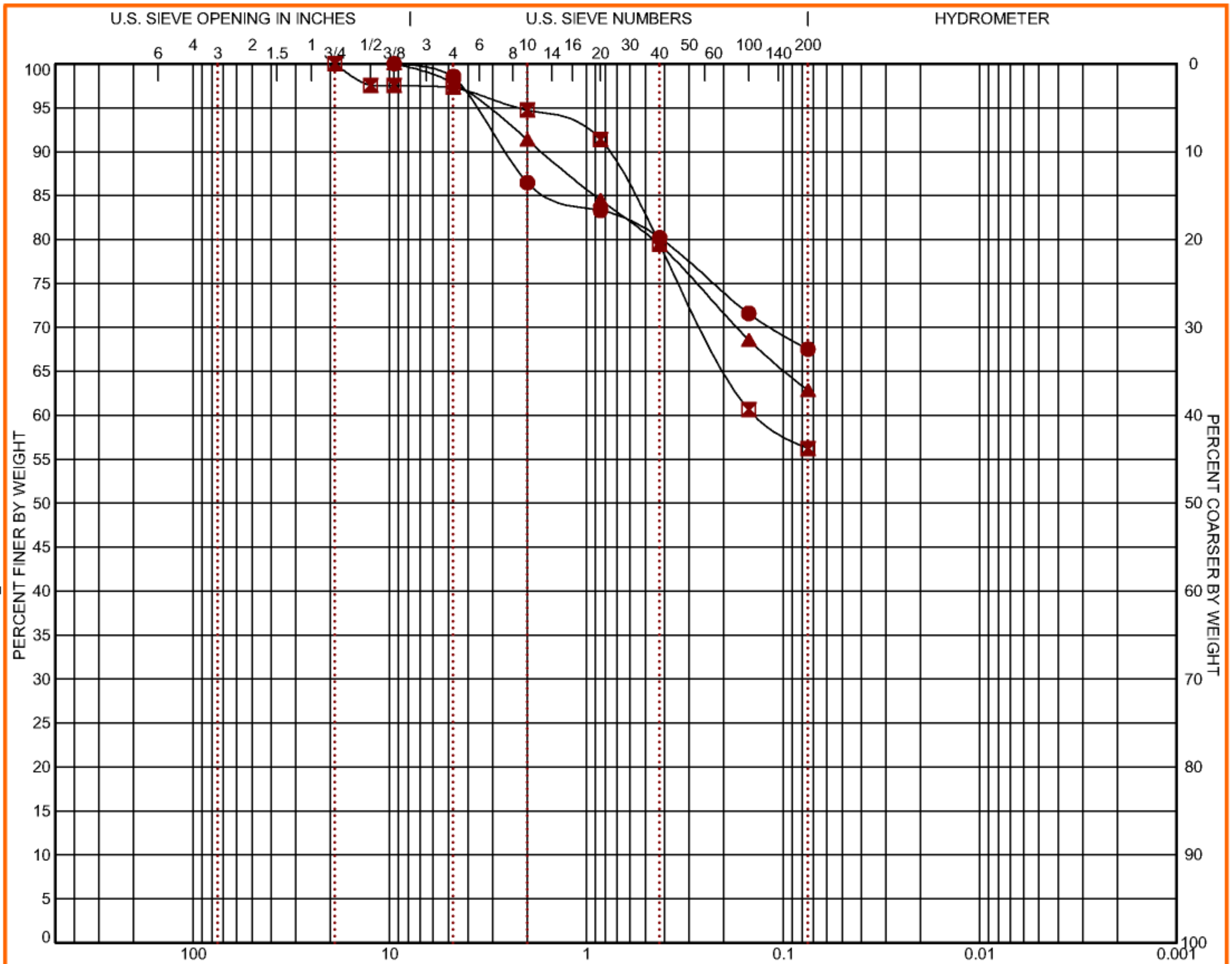
SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	**B-20-16**	**39.86082 / -83.33098**	**0 - 5**	**0.0**	**1.5**	**31.0**		**67.5**	
⊠	**B-20-16**	**39.86082 / -83.33098**	**1 - 2.5**	**0.0**	**2.7**	**41.1**		**56.2**	
▲	**B-20-16**	**39.86082 / -83.33098**	**6 - 7.5**	**0.0**	**2.2**	**35.0**		**62.8**	

GRAIN SIZE

	●	⊠	▲
D_{60}		0.136	
D_{30}			
D_{10}			

COEFFICIENTS

	●	⊠	▲
C_C			
C_U			

● Sieve	● % Finer	⊠ Sieve	⊠ % Finer	▲ Sieve	▲ % Finer
3/8"	100.0	3/4"	100.0	3/8"	100.0
#4	98.55	1/2"	97.53	#4	97.79
#10	86.44	3/8"	97.53	#10	91.32
#20	83.28	#4	97.31	#20	84.45
#40	80.17	#10	94.7	#40	79.33
#100	71.57	#20	91.37	#100	68.56
#200	67.51	#40	79.43	#200	62.81
		#100	60.62		
		#200	56.21		

SOIL DESCRIPTION

- ● SANDY LEAN CLAY (CL)
- ⊠ SANDY FAT CLAY (CH)
- ▲ SANDY LEAN CLAY (CL)

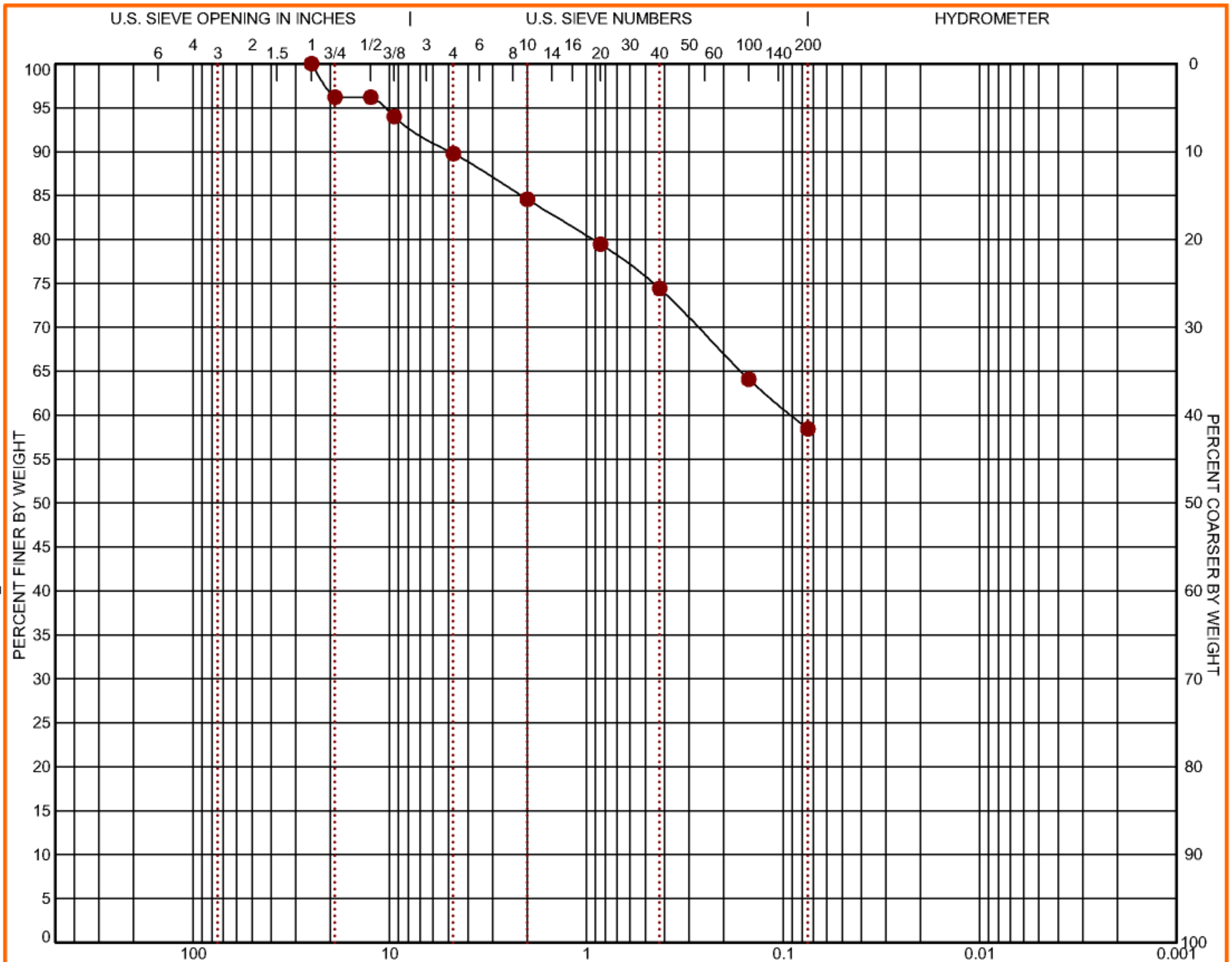
REMARKS

- ● Location: N E Elevation: 986.5
- ⊠ Location: N E Elevation: 986.5
- ▲ Location: N E Elevation: 986.5

PROJECT: Madison Solar Facility	Terracon 800 Morrison Rd Gahanna, OH	PROJECT NUMBER: N4205246
SITE: Big Plain Circleville Road London, OH		CLIENT: First Solar Electric (California), Inc Tempe, AZ

GRAIN SIZE DISTRIBUTION

ASTM D422 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	LATITUDE/LONGITUDE	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY
●	B-20-16	39.86082 / -83.33098	8.5 - 10	0.0	10.3	31.3		58.4	

GRAIN SIZE

	●		
D_{60}	0.091		
D_{30}			
D_{10}			

COEFFICIENTS

	●		
C_C			
C_U			

●					
Sieve	% Finer	Sieve	% Finer	Sieve	% Finer
1"	100.0				
3/4"	96.18				
1/2"	96.18				
3/8"	93.98				
#4	89.74				
#10	84.54				
#20	79.43				
#40	74.39				
#100	64.07				
#200	58.42				

SOIL DESCRIPTION

● SANDY LEAN CLAY (CL)

REMARKS

● Location: N E
Elevation: 986.5

PROJECT: Madison Solar Facility

SITE: Big Plain Circleville Road
London, OH

Terracon
800 Morrison Rd
Gahanna, OH

PROJECT NUMBER: N4205246

CLIENT: First Solar Electric (California), Inc
Tempe, AZ

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Terracon GeoReport

Client

First Solar Electric (California), Inc
Tempe, AZ

Project

Madison Solar Farm

Sample Submitted By: Terracon (N4) **Date Received:** 8/7/2020 **Lab No.:** 20-0887

Results of Corrosion Analysis

Sample Number	--	--	--	--
Sample Location	B-20-1	B-20-2	B-20-3	B-20-4
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, ASTM G 51	7.93	8.42	7.79	8.35
Water Soluble Sulfate (SO4), ASTM C 1580 (ppm)	171	92	156	163
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (ppm)	55	58	70	48
Red-Ox, ASTM G 200, (mV)	+688	+687	+685	+690
Total Salts, AWWA 2540, (mg/kg)	1187	1204	1495	902
Resistivity (Saturated), ASTM G 187, (ohm-cm)	3082	2680	2345	2412

Analyzed By: Trisha Campo

Trisha Campo
Chemist

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Terracon GeoReport

Client
First Solar Electric (California), Inc
Tempe, AZ

Project
Madison Solar Farm

Sample Submitted By: Terracon (N4) **Date Received:** 8/7/2020 **Lab No.: 20-0887**

Results of Corrosion Analysis

Sample Number	--	--	--	--
Sample Location	B-20-5	B-20-6	B-20-7	B-20-8
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, ASTM G 51	8.41	8.38	7.64	8.44
Water Soluble Sulfate (SO4), ASTM C 1580 (ppm)	145	160	126	148
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (ppm)	55	43	68	68
Red-Ox, ASTM G 200, (mV)	+691	+690	+692	+690
Total Salts, AWWA 2540, (mg/kg)	1086	861	782	865
Resistivity (Saturated), ASTM G 187, (ohm-cm)	2345	2412	3350	2881

Analyzed By: Trisha Campo

Trisha Campo
Chemist

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Terracon GeoReport

Client
First Solar Electric (California), Inc
Tempe, AZ

Project
Madison Solar Farm

Sample Submitted By: Terracon (N4) **Date Received:** 8/7/2020 **Lab No.: 20-0887**

Results of Corrosion Analysis

Sample Number	--	--	--	--
Sample Location	B-20-9	B-20-10	B-20-11	B-20-12
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, ASTM G 51	8.11	8.34	8.31	7.64
Water Soluble Sulfate (SO4), ASTM C 1580 (ppm)	31	185	93	175
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (ppm)	60	40	53	45
Red-Ox, ASTM G 200, (mV)	+685	+687	+686	+688
Total Salts, AWWA 2540, (mg/kg)	1068	851	1198	1260
Resistivity (Saturated), ASTM G 187, (ohm-cm)	2144	2613	2881	1407

Analyzed By: [signature]
Trisha Campo
Chemist

750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

First Solar Electric (California), Inc
Tempe, AZ

Project

Madison Solar Farm

Sample Submitted By: Terracon (N4) **Date Received:** 8/7/2020 **Lab No.: 20-0887**

Results of Corrosion Analysis

Sample Number	--	--	--	--
Sample Location	B-20-13	B-20-14	B-20-15	B-20-16
Sample Depth (ft.)	0.0-5.0	0.0-5.0	0.0-5.0	0.0-5.0
pH Analysis, ASTM G 51	8.03	7.56	8.26	8.34
Water Soluble Sulfate (SO4), ASTM C 1580 (ppm)	155	153	137	20
Sulfides, AWWA 4500-S D, (mg/kg)	Nil	Nil	Nil	Nil
Chlorides, ASTM D 512, (ppm)	50	45	60	70
Red-Ox, ASTM G 200, (mV)	+686	+688	+690	+691
Total Salts, AWWA 2540, (mg/kg)	1131	1439	963	995
Resistivity (Saturated), ASTM G 187, (ohm-cm)	2211	1876	2546	2412

Analyzed By: Trisha Campo

Trisha Campo
Chemist

comply with appropriate safety rules. Only the Site Supervisor/Foremen is to coordinate communication with Regulatory Agency Personnel.

7.2 Documentation

The Site Supervisor/Foremen shall record the frac-out event in his or her daily log. The log will include the following:

1. Details on the release event, including an estimate of the amount of bentonite released;
2. The location time and duration of release;
3. The size of the area impacted; and,
4. The success of the clean-up action.

The log report shall also include the:

5. Name and telephone number of person reporting;
6. Photographs of the release upon discovery and after cleanup;
7. Date;
8. How the release occurred;
9. The type of activity that was occurring around the area of the frac-out;
10. Description of any sensitive areas, and
    a. Their location in relation to the frac-out.
11. Description of the methods used to clean up or secure the site; and,
12. A listing of the current permits obtained for the project.

8.0 Project Completion and Clean-Up

8.1 Disposition of Materials

1. All materials and any rubbish-construction debris shall be removed from the construction zone at the end of each workday;
2. Sump pits at bore entry and exits will be filled and returned to natural grade; and
3. All protective measures (fiber rolls, straw bale, silt fence, etc.) will be removed unless otherwise specified by the Site Supervisor/Foremen.

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Madison County, Ohio	))))))	**Case No. 19-1823-EL-BGN**

BIG PLAIN SOLAR, LLC'S DECEMBER 4, 2020 RESPONSES TO STAFF'S NOVEMBER 20, 2020 DATA REQUESTs #1-24 and DECEMBER 2, 2020 DATA REQUEST #25

Water Impacts, Ohio Adm.Code 4906-4-08(A)(4)

1. Referring to Figure 7 of Exhibit F, it appears that there are at least 5 wells within the project area. Please explain how Big Plain Solar, LLC will either avoid, employ mitigation measures, or cap well locations that would be impacted by solar equipment.

   Response: Wells may be used as water sources during construction. Unused wells will be avoided and/or capped pursuant to any local requirements/standards.

2. Please explain how during the detailed engineering phase, Big Plain Solar, LLC will confirm whether the nearest solar components to each well within the project area meets or exceeds any applicable minimum isolation distances outlined in Ohio Adm.Code 3701-28-7.

   Response: First Solar Series 6 modules and associated tracker and racking/post structures are not expected to be a potential source of contamination as per the Isolation Distances in Ohio Adm.Code 3701-28-7(J), Table 1.

Wind Velocity, Ohio Adm.Code 4906-4-08(A)(6)

3. Please explain how Big Plain Solar, LLC will, during the detailed engineering phase, minimize any potential damage from high wind velocities by proper structural design of the project support equipment at sufficient depths based on the site-specific soil conditions to preclude any adverse influence from high wind velocities.

   Response: The EPC Contractor will perform a detailed geotechnical study of the site to understand existing representative soil conditions. This data, along with publicly-available and on-site weather data, will be used for the structural design basis for the module tracker system. Posts and structures will be designed to withstand maximum wind speeds plus a design safety factor, both through sufficient embedment depths and through appropriate sizing of posts and trackers.

4. Please indicate any wind loading precautions (such as stowing) or wind equipment ratings that will be included in the final project design.

Response: During periods of sustained excessive wind, Operations and Maintenance will stow trackers at a 0° tilt as necessary. Trackers will be designed to withstand maximum wind speeds at all available tilt angles, however.

5. Referring page 61 of the Application, will Big Plain Solar, LLC design its solar panel equipment to meet a specific building code. If so, please indicate which code or standard.

   Response: Various codes and standards for construction of the facility will be outlined in the EPC Contractor's scope of work. These include standards and recommendations from various institutions including (but not limited to) the following:

   - *ACI - American Concrete Institute*
   - *AISC - American Institute of Steel Construction*
   - *AISI – American Iron and Steel Institute*
   - *ANSI - American National Standards Institute,*
   - *ASCE - American Society of Civil Engineers*
   - *ASTM - American Society for Testing and Materials*
   - *IBC - International Building Code*
   - *ICEA - Insulated Cable Engineers Association*
   - *IEC - International Electrotechnical Commission*
   - *IEEE - Institute of Electrical and Electronics Engineers*
   - *ISA – Instrumentation Society of America*
   - *NEC - National Electrical Code*
   - *NEMA - National Electrical Manufacturers Association*
   - *NFPA – National Fire Protection Association*
   - *NESC - National Electrical Safety Code*
   - *NETA - National Electrical Testing Association*
   - *OSHA - Occupational Safety and Health Act*
   - *UL – Underwriter's Laboratories*

<u>Setbacks</u>

6. On page 98 of the Application, Big Plain Solar LLC indicates that three structures (a) one residence (b) a barn, and (c) a shed may be removed for construction and operation of the solar farm. Please provide the address and or latitude/longitude of these structures.

   Response: All three structures (i.e. residence, barn and shed) are located on the same property. The address for that property is 6665 Big Plan Circleville Road, London OH 43140.

7. Please indicate the setbacks from (a) solar components (b) any central inverter, and (b) the solar project fence to a nonparticipating property line, or to a public road, or to nonparticipating residence.

   Response: As noted at page 20, Section 4906-4-04 of the Application, PV panels will be sited at least 50 feet from a non-participating parcel and access roads will be sited at least five feet from a non-participating parcel. No setbacks are proposed for central inverters. The Applicant expects the project fence to be at least 10 feet from a non-participating parcel and 50 feet from a public road.

8. Please provide a large-scale aerial map that depicts all inhabited residential dwellings adjacent to the project area that have a direct, unobstructed line-of-sight view to the project boundaries. Identify on the map which receptors are participating and non-participating, as well as any nearby roads and highways.

   Response: This map is being developed and will be provided to Staff separately when complete.

Decommissioning, Ohio Adm.Code 4906-4-06(F)(5)
Run-off and leachates from fuels and solid wastes, Ohio Adm.Code 4906-4-07(C)(3)(d)(v)
Proposed method of storage and disposal of wastes, Ohio Adm.Code 4906-4-07(D)(2)(b)

9. Have the solar panels under consideration by Big Plain Solar LLC passed the US EPA's Toxicity Characteristic Leaching Procedure (TCLP) test?

   Response: TCLP testing has found that, even under very unlikely and conservative scenarios modeling a total release of cadmium telluride CdTe from broken PV Modules, the modeled estimated concentrations of Cd were found to be below health screening and background levels, and below expected common levels found in agricultural fertilizers. A strong preference, however, is given to recycling CdTe modules at their end-of-life to the greatest extent possible.

10. Referring to section 2.4 of the Decommissioning Plan (Exhibit O). Will the solar panels be checked for toxicity or hazardous materials (e.g. RCRA listing), or acceptability of the solid waste facility prior to decommissioning?

    Response: The solar panels are tested by the manufacturer using U.S. EPA Method 1311 Toxicity Characteristic Leaching Procedure (TCLP) and classified as federal non-hazardous waste at end-of-life.

11. According to Section 3 of the Decommissioning Plan (Exhibit O), the Application states the following: "No later than the beginning of the tenth year of each lease's term, the Applicant will deliver to the property owner a payment bond or a letter of credit issued by a credit worthy bonding company or financial institution, as applicable, in an amount equal to one hundred ten percent (110%) of the Reclamation Estimate, less any other financial assurance that the Applicant has provided to any government agency for restoration of the property covered by the lease." Staff would recommend that the decommissioning funds in this scenario be posted in the form of a performance bond where the company is the Principal, the insurance company is the Surety, and the Ohio Power Siting Board is the Obligee. Please indicate the Applicant's understanding and commitment to provide this to Staff and indicate when this would be provided.

    Response: While the Applicant understands performance bonds have been provided with the Board as obligee, any commitment of this nature will be addressed after review of the Staff Report in the proceeding.

12. Page 38 of the Application states the following: "Specifically, six months prior to the beginning of the tenth year of each lease's term, the Applicant will retain an independent

demolition contractor with solar experience to provide a good faith estimate of the total cost to decommission the Facility including restoring any changes made to the property (the Reclamation Estimate)." Staff would recommend that the Applicant retain an independent, registered professional engineer, licensed to practice engineering in the state of Ohio to estimate the total cost of decommissioning facility. Please indicate the Applicant's understanding and commitment to provide this to Staff and indicate when this would be provided.

Response: While the Applicant understands the use of an independent professional engineer is common to estimate decommissioning costs, and would anticipate utilizing an independent professional engineer for that task, any commitment of this nature will be addressed after review of the Staff Report in the proceeding.

Ecological Impacts

13. Prior to issuance of the staff report please provide a frac-out contingency plan detailing monitoring, environmental specialist presence, containment measures, cleanup, and restoration.

    Response: A copy of the frac-out plan is attached.

14. Has Big Plain Solar, LLC initiated coordination with OEPA and USACE for wetland and stream impact permitting? What type(s) of wetland and steam fill permitting is anticipated for the project?

    Response: A combined field visit with OEPA and USACE was held on January 22, 2020. An AJD was received from USACE on June 23, 2020. Impacts to Waters of the U.S. have been avoided and no permit approvals will be required from USACE. The project is currently drafting a permit application to OEPA for impacts to state waters. Coordination is ongoing with both agencies.

15. The project proposes impacts to wetlands and streams where these resources overlap with portions of the solar arrays. In past applications, proposals have been able to work around wetlands and streams within the solar array. Staff would recommend that the applicant revise their proposal in order to avoid impacts to wetlands and streams within the solar arrays, including a 25 ft. buffer around surface water resources. Further, Staff would recommend that the boundaries of streams and wetlands within and immediately adjacent to the construction limits of disturbance be surrounded by silt/exclusionary fencing to demarcate avoidance areas. Please provide feedback on the applicant's option of the feasibility of this recommendation. If the applicant does not find this to be a practical recommendation, please provide a detailed explanation of why.

    Response: Impacts are proposed to agricultural watercourses and farmed wetlands (low quality wetlands outside USACE jurisdiction). Waters of the U.S. as defined in the June 23, 2020 AJD will be avoided and the Applicant believes it is feasible to accommodate a 25-foot buffer around those surface water resources as well as installing the silt/exclusionary fencing to demarcate avoidance areas.

16. Not counting HDD and overhead line crossing as impacts, are all stream impacts limited to streams WC-07, WC-15, and WC-16? If not, please provide details on other stream impacts.

Response: WC-07 is located in the laydown yard and will be avoided during construction. WC-15 and WC-16 are located within the arrays and will be permanently impacted by driven piles. Impact calculations also include impacts to WC-19 from driven piles.

17. Please provide an area total for each type of wetland impact (for example 5 acres for panels, 2 acres for access roads, etc.).

Response: Below is a summary table of wetland and stream impact based on Facility components. This information was summarized from Table 08-5 of the Certificate Application. Note, the impacts below account for the relocated substation presented in the supplemental Footprint Modification Memo submitted to OPSB on November 30, 2020 which resulted in an overall reduction in wetland and stream impacts.

	Wetland		Stream	
	Temporary	Permanent	Temporary	Permanent
Access Road	0.02	0.1	>0.01	0.0
Buried Collection Line	0.14	0.0	0.02	0.0
Overhead Collection Line	0.0	0.15	>0.01	0.06
PV Panel Array[1]	0.0	7.94	0.0	0.07
Laydown Yard	0.0	0.0	0.31	0.0

[1] Although the PV panels will be placed over 7.94 acres of wetlands, the actual footprint of the impact will be limited to the locations of the support piles for the panels and will result in a physical permanent disturbance of 10.6 square feet.

18. Application materials provide different numbers for proposed acreage of tree clearing, please clarify.

Response: Facility construction may require the clearing or permanent disturbance of 8.4 acres of tree stands located in wooded fencerow and woodland communities. Specifically, up to 3.7 acres of wooded fencerow and 4.7 acres of woodland habitat may be cleared, as detailed in Table 08-4 of the Certificate Application. The value presented in Exhibit K should be 8.4 acres of tree clearing, not 0.13 acre.

19. Staff would recommend that Big Plain Solar, LLC take steps to prevent establishment and/or further propagation of noxious weeds identified in Ohio Adm. Code Chapter 901:5-37. Please detail how the applicant would accomplish this.

Response: The Facility Site will be monitored for noxious weed species identified by Ohio Adm. Code Chapter 901:5-37. If noxious weeds are identified within the fenceline, they will be removed either manually or chemically with herbicide. Herbicide application will be conducted at a frequency sufficient to prevent seed set and will be applied by a licensed professional in accordance to manufacturer instructions.

Ohio Historic Preservation Office

20. Please update the status of any/all correspondence with OHPO to date.

    Response: MOUs for archaeological and architectural resources are being reviewed internally by Big Plain Solar and will be provided to OPSB Staff when finalized with SHPO.

21. When does Big Plain Solar LLC anticipate it will receive final concurrence from the OHPO on specific avoidance or mitigation measures for impacts from the project on archaeological and historic/architecture sites as outlined in OHPO's letter to the applicant's cultural resources consultant dated September 1, 2020?

    Response: Big Plain Solar, LLC has been in recent contact with SHPO and is circulating drafts of MOUs before submittal to SHPO. The Project expects concurrence from SHPO in Q1 2021.

Economics

22. Does Big Plain Solar LLC intend to seek governmental funding or incentives, such as tax abatements, investment tax credits, or production tax credits?

    Response: The Applicant may avail itself of all available funding, incentives or tax abatements including the PILOT referenced at pages 30-31 of the Application and the federal Investment Tax Credit for Solar.

23. Can Big Plain Solar LLC provide an estimate of which materials and equipment used for construction and maintenance of the facility will be purchased from companies located in Ohio?

    Response: While materials and equipment will be purchased from companies located in Ohio, the Applicant is unable to provide an estimate at this time.

24. Please provide the inputs from the "Project Data" section of the JEDI model that was used to evaluate the economic impact of this project. A screenshot of this information will suffice.

    Response: This information will be provided separately to Staff.

Electric gird interconnection, OAC 4906-4-05(B)

25. In Exhibit M of the Application the PJM 'Revised Generation Interconnection System Impact Study Report' for queue AD1-081 of November 2018, Attachment 5 (Dynamic Simulation Analysis) page 21/39, indicates that the solar farm project is reactive deficient and that additional capacitive reactive compensation is required. Please explain how Big Plain Solar, LLC plans to address capacitive reactive compensation.

    Response: The Applicant will design the project to provide for +/- 0.95 power factor.

A REPORT FOR
ENVIRONMENTAL SERVICES

Big Plain Solar

Fraction Release (Frac-Out) Contingency Plan

JUNE 25, 2020

PREPARED FOR:

First Solar Dev., LLC.
11757 Katy Fwy. Ste. 400
Houston, TX 77079

PREPARED BY: Westwood

Westwood

Fraction Release (Frac-Out) Contingency Plan

Big Plain Solar Project Madison County, Ohio

Prepared For:

First Solar Dev., LLC.
11757 Katy Fwy. Ste. 400
Houston, TX 77079

Prepared By:

Westwood Professional Services
12701 Whitewater Drive, Suite 300
Minnetonka, MN 55343
(952) 937-5150

Project Number: R0015438.00
Date: June 25, 2020

Table of Contents

1.0 Introduction and Purpose

Big Plain Solar, LLC (the Applicant), an affiliate of First Solar, Inc., is proposing the construction of the Big Plain Solar Project (Project), a photovoltaic solar-powered electric generation facility in Madison County, Ohio. The Applicant is requesting a Certificate of Environmental Compatibility and Public Need (Certificate) per Ohio Administrative Code (OAC) Chapter 4906-4.

The purpose of this document is to address the requirements stated in OAC Chapter 4906-4-08 B-2-b-ii.Approval of the Certificate is contingent on meeting requirements detailed in OAC Chapter 4906-4. OAC Chapter 4906-4-08 B-2-b-ii requires an inadvertent release of fraction drilling fluids (frac-out) contingency plan for stream and wetland crossings that are proposed using horizontal directional drilling.

Directional boring operations are frequently used to install underground linear infrastructure such as electrical cabling and pipe because it minimizes disturbances to the surrounding surface. This is an alternative to open trenching or ditching operations

The directional boring process uses liquids under high pressures to remove a slurry of soil cuttings as directional boring progress underground. A frac-out is the condition where drilling mud is released through fractured bedrock or soil into the surrounding rock and sand and travels toward the surface. Because drilling muds consist largely of a bentonite clay-water mixture, they are not classified as toxic or hazardous substances. However, if this sediment is released into water bodies, bentonite and cuttings have the potential to adversely impact fish and invertebrates. While drilling fluid seepage associated with a frac-out is most likely to occur near the bore entry and exit points where the drill head is shallow, frac-outs can occur in any location along a directional bore.

This Fraction Release Frac-Out Contingency Plan (FCP) establishes operational procedures and responsibilities for the prevention, containment, and cleanup of frac-outs associated with the proposed directional drilling for the Big Plain Solar Project. All personnel and Sub-Contractors responsible for the work will adhere to this plan during the directional drilling process.

The specific objectives of this plan are to:

1. Minimize the potential for a frac-out associated with directional drilling activities;
2. Provide for the timely detection of frac-outs;
3. Protect the environmentally sensitive wetlands, watercourses, riverbed and associated riparian areas and associated species;
4. Ensure an organized, timely, and "minimum-impact" response in the event of a frac-out and release of drilling bentonite by all responsible personnel; and

   Ensure that all appropriate notifications are made immediately to the customer, management and safety personnel.
5. Provide for a mechanism to document and monitor frac-outs and releases of drilling bentonite

2.0 Description of Work

Drilling operations will monitor drilling pressure and operations will be halted by the drill rig operators immediately upon detection of a drop in drilling pressure, decrease in drilling fluid return volume, drilling fluid pooling, or other evidence of a frac-out. The clean-up of all spills shall begin immediately. Management & Ohio Environmental Protection Agency's (OEPA) 24-hour Emergency Spill Hotline (1-800-282-9378) shall be notified immediately of any spills and shall be consulted regarding clean-up procedures. A spill kit shall be onsite and used if a frac-out occurs. A vacuum truck and containment materials, such as straw bales, shall also be on-site prior to and during all operations. The Site Supervisor will be immediately notified. In the event of a frac-out, the on-site foreman/supervisor will conduct an evaluation of the situation and direct recommended mitigation actions, based on the following guidelines:

1. If it determined to be a minor frac-out that is easily contained, has not reached the surface, and is not threatening sensitive resources, drilling operations may resume after use of a leak stopping compound or redirection of the bore;
2. If the frac-out has reached the surface, any material contaminated with Bentonite shall be removed by hand to a depth of 2-feet, contained, and properly disposed of. The drilling contractor shall be responsible for ensuring that the bentonite is either properly disposed of at an approved disposal facility or properly recycled in an approved manner. The Site Supervisor shall notify and take any necessary follow-up response actions in coordination with agency representatives. The Site Supervisor will coordinate the mobilization of equipment stored at off-site locations (e.g., vacuum trucks) on an as-needed basis.

3.0 Site Supervisor/Foremen Responsibilities

The Site Supervisor/Foremen has overall responsibility for implementing this FCP. The Site Supervisor/Foremen will ensure that all employees are trained prior to all drilling. The Site Supervisor/Foremen shall be notified immediately when a frac-out is detected. The Site Supervisor/Foremen will be responsible for ensuring that the OEPA is aware of the frac-out, coordinating personnel, response, cleanup, regulatory agency notification and coordination to ensure proper clean-up, disposal of recovered material and timely reporting of the incident. The Site Supervisor/Foremen shall ensure all waste materials are properly containerized, labeled, and removed from the site to an approved disposal facility by personnel experienced in the removal, transport and disposal of drilling mud.

The Site Supervisor/Foremen shall be familiar with all aspects of the drilling activity, the contents of this FCP and the conditions of approval under which the activity is permitted to take place. The Site Supervisor/Foremen shall have the authority to stop work and commit the resources (personnel and equipment) necessary to implement this plan. The Site Supervisor/Foremen shall assure that a copy of this plan is available onsite and accessible to all construction personnel. The Site Supervisor/Foremen shall ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out, prior to commencement of drilling operations.

4.0 Equipment

The Site Supervisor shall ensure that:

1. All equipment and vehicles are checked and maintained daily to prevent leaks of hazardous materials;
2. Spill kits and spill containment materials are available onsite at all times and that the equipment is in good working order;
3. Equipment required to contain and clean up a frac-out release will either be available at the work site or readily available at an offsite location within 15- minutes of the bore site; and
4. If equipment is required to be operated near a riverbed, absorbent pads and plastic sheeting for placement beneath motorized equipment shall be used to protect the riverbed from engine fluids.

5.0 Training

Prior to directional boring operations, the Site Supervisor/Foremen shall ensure that the crew members receive training in the following:

1. The provisions of this FCP, equipment maintenance and site specific permit and monitoring requirements;
2. Inspection procedures for release prevention and containment equipment and materials;
3. Contractor/crew obligation to immediately stop the drilling operation upon first evidence of the occurrence of a frac-out and to immediately report any frac-out releases;
4. Contractor/crew member responsibilities in the event of a release;
5. Operation of release prevention and control equipment and the location of release control materials, as necessary and appropriate; and
6. Protocols for communication with agency representatives who might be on-site during the clean-up effort.

6.0 Drilling Procedures

The following procedures shall be followed each day, prior to the start of work. The FCP shall be available onsite during all construction. The Site Supervisor/Foremen shall be onsite at any time that drilling is occurring or is planned to occur. The Site Supervisor/Foremen shall ensure that a Job Briefing meeting is held at the start of each day of drilling to review the appropriate procedures to be followed in case of a frac-out. Questions shall be answered and clarification given on any point over which the drilling crew or other project staff has concerns.

Drilling pressures shall be closely monitored so they do not exceed those needed to penetrate the formation. Pressure levels shall be monitored randomly by the operator. Pressure levels shall be set at a minimum level to prevent frac-outs. During the pilot bore, maintain the drilled annulus. Cutters and reamers will be pulled back into previously-drilled sections after each new joint of pipe is added.

Exit and entry pits shall be enclosed by silt fences and straw. A spill kit shall be onsite and used if a frac-out occurs. A vacuum truck shall be readily available onsite prior to and during all drilling operations. Containment materials (Straw, silt fencing, sand bags, frac-out spill kits, etc.) shall be staged onsite at locations where they are readily available and easily mobilized for immediate use in the event of a frac out. If necessary, barriers such as straw bales or sedimentation fences shall be constructed between the bore site and the edge of the water source prior to drilling to prevent released bentonite material from reaching the water.

Once the drill rig is in place and drilling begins, the drill operator shall stop work whenever the pressure in the drill rig drops, or there is a lack of returns in the entrance pit. At this time the Site Supervisor/Foremen shall be informed of the potential frac-out. The Site Supervisor/Foremen and the drill rig operator(s) shall work to coordinate the likely location of the frac-out. The location of the frac-out shall be recorded and notes made on the location and measures taken to address the concern.

Water containing mud, silt, bentonite, or other pollutants from equipment washing or other activities, shall not be allowed to enter a lake, flowing stream or any other water source. The bentonite used in the drilling process shall be either disposed of at an approved disposal facility or recycled in an approved manner. Other construction materials and wastes shall be recycled, or disposed of, as appropriate.

The following subsections shall be adhered to when addressing a frac-out situation.

6.1 Vac-Truck

A vacuum truck shall be staged at a location from which it can be mobilized and relocated so that any place along the drill shot can be reached by the apparatus within 10 minutes of a frac-out.

6.2 Field Response to Frac-Out Occurrence

The response of the field crew to a frac-out release shall be immediate and in accordance with procedures identified in this FCP. All appropriate emergency actions that do not pose additional threats to sensitive resources will be taken, as follows:

1. Directional boring will stop immediately;
2. The bore stem will be pulled back to relieve pressure on frac-out;
3. The Site Supervisor/Foremen will be notified to ensure that management and the regulators are notified, adequate response actions are taken and notifications made;
4. The Site Supervisor/Foremen shall evaluate the situation and recommend the type and level of response warranted, including the level of notification required;

5. If the frac-out is minor, easily contained, has not reached the surface and is not threatening sensitive resources, a leak stopping compound shall be used to block the frac-out. If the use of leak stopping compound is not fully successful, the bore stem shall be redirected to a new location along the desired drill path where a frac-out has not occurred;
6. If the frac-out has reached the surface, any material contaminated with Bentonite shall be removed by hand, to a depth of 2-feet, contained and properly disposed of, as required by law. A dike or berm may be constructed around the frac-out to entrap released drilling fluid, if necessary. Clean sand shall be placed and the area returned to pre-project contours; and
7. If a frac-out occurs, reaches the surface and becomes widespread, the Site Supervisor/Foremen shall authorize a readily accessible vacuum truck and bulldozer stored off-site to be mobilized. The vacuum truck may be either positioned at either end of the line of the drill so that the frac-out can be reached by crews on foot, or may be pulled by a bulldozer, so that contaminated soils can be vacuumed up.

6.3 Response Close-out Procedures

When the release has been contained and cleaned up, response closeout activities will be conducted at the direction of the Site Supervisor/Foremen and shall include the following:

1. The recovered drilling fluid will either be recycled or hauled to an approved facility for disposal. No recovered drilling fluids will be discharged into streams, storm drains or any other water source;
2. All frac-out excavation and clean-up sites will be returned to pre-project contours using clean fill, as necessary; and
3. All containment measures (fiber rolls, straw bale, etc.) will be removed, unless otherwise specified by the Site Supervisor/Foremen.

6.4 Construction Re-start

For small releases not requiring external notification, drilling may continue, if 100 percent containment is achieved through the use of a leak stopping compound or redirection of the bore and the clean-up crew remains at the frac-out location throughout the construction period.

For releases requiring external notification and/or other agencies, construction activities will not restart without prior approval from the Ohio EPA.

6.5 Bore Abandonment

Abandonment of the bore will only be required when all efforts to control the frac-out within the existing directional bore *have* failed.

7.0 Notification Procedures

7.1 Regulatory Agency Personnel Communication

All employees and subcontractors will adhere to the following protocols when permitting Regulatory Agency Personnel arrive on site. Regulatory Agency Personnel will be required to

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Madison County, Ohio	**))))))**	**Case No. 19-1823-EL-BGN**

BIG PLAIN SOLAR, LLC'S DECEMBER 7, 2020 RESPONSE TO STAFF'S DECEMBER 7, 2020 DATA REQUEST # 27

<u>Ecological Impacts/Environmental Permitting</u>

27. As a follow up to the response to question 15, are the farmed wetlands jurisdictional to the OEPA under the isolated wetland permitting?

    Response: Yes the farmed wetlands are jurisdictional to the OEPA under the isolated wetland permit. We met OEPA and USACE in a joint site visit to discuss the project and wetland permitting requirements. We have remained in contact with these two agencies regarding wetland permitting.

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Madison County, Ohio	**))))))**	**Case No. 19-1823-EL-BGN**

BIG PLAIN SOLAR, LLC'S DECEMBER 7, 2020 SUPPLEMENTAL RESPONSE TO STAFF'S NOVEMBER 20, 2020 DATA REQUEST #8

Setbacks

8. Please provide a large-scale aerial map that depicts all inhabited residential dwellings adjacent to the project area that have a direct, unobstructed line-of-sight view to the project boundaries. Identify on the map which receptors are participating and non-participating, as well as any nearby roads and highways.

   Response: The attached map accounts for topography and screening elements such as structures and vegetation that at least partially screen views of the proposed project. This analysis was based on the existing conditions of the area surrounding the proposed project and no assumptions were made regarding future land use or screening measures.

Madison Solar Project

Fairfield and Oak Run Townships, Madison County, Ohio

Figure 1. Adajcent Residences Line of Sight Analysis

Public Road

Parcel Boundary

Adjacent Residence

Non-Participating - Obstructed Line of Sight

Non-Participating - Partially Obstructed Line of Sight

Non-Participating - Unobstructed Line of Sight

Participating - Unobstructed Line of Sight

Project Area

Notes: **1.** Basemap: OSIP 2019 Madison County. **2.** This map was generated in ArcMap on December 4, 2020. **3.** This is a color graphic. Reproduction in grayscale may misrepresent the data.

N
W
E
S

edr

www.edrdpc.com

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Madison County, Ohio	**))))))**	**Case No. 19-1823-EL-BGN**

BIG PLAIN SOLAR, LLC'S DECEMBER 11, 2020 RESPONSE TO STAFF'S NOVEMBER 20, 2020 DATA REQUEST # 26

Electric gird interconnection, OAC 4906-4-05(B)

26. Would capacitive reactive compensation be addressed in either the future separate application to the OPSB for the gen-tie line/POI switchyard, or the Interconnection Service Agreement, or the Interconnection Construction Service Agreement?

    Response: Capacitive reactive compensation will be addressed in the ISA and ICSA.

In the Matter of the Application of Big Plain Solar, LLC for a Certificate of Environmental Compatibility and Public Need to Construct a Solar-Powered Electric Generation Facility in Madison County, Ohio	**))))))**	**Case No. 19-1823-EL-BGN**

BIG PLAIN SOLAR, LLC'S DECEMBER 17, 2020 RESPONSE TO STAFF'S DECEMBER 11, 2020 DATA REQUEST # 27-28

<u>Decommissioning</u>

28. Appendix A (Reclamation Cost Estimate) from Exhibit O was not included in the Application. Please provide Appendix A (Reclamation Cost Estimate).

Response: Appendix A has not been prepared at this time as per the Decommissioning Plan, Exhibit O, the estimate will not be required until the 10 year of each lease's term. See the language from Exhibit O below.

29. What is the estimated total cost to decommission Madison Solar Farm excluding the salvage value of the solar equipment?

Response: As explained further in detail in Exhibit O, Big Plain Solar will provide financial assurance in an amount sufficient to ensure restoration of the Project land to its previous conditions, to the extent feasible, in accordance with its Reclamation Plan. Specifically, six months prior to the beginning of the tenth year of each lease's term, Big Plain Solar will retain an independent demolition contractor with solar experience to provide a good faith estimate of the total cost to decommission the Facility including restoring any changes made to the property (the "Reclamation Estimate"). The Reclamation Estimate will not include an offset for the salvage value of the Facility.