APPLICATION

TO THE

OHIO POWER SITING BOARD

FOR A

CERTIFICATE OF ENVIRONMENTAL COMPATIBILITY AND PUBLIC NEED FOR

SOUTH BRANCH SOLAR

Hancock County, Ohio

Case No. 21-0669-EL-BGN

south branch solar

Submitted by: South Branch Solar, LLC

Volume 1

July 2021

BEFORE
THE OHIO POWER SITING BOARD

In the Matter of the Application of **South Branch Solar, LLC** for a Certificate of Environmental Compatibility and Public Need for a Solar Facility Located in Hancock County, Ohio.)	Case No. 21-0669-EL-BGN

AFFIDAVIT OF CHIEF DEVELOPMENT OFFICER OF LEEWARD RENEWABLE ENERGY, LLC

STATE OF TEXAS :
: ss.
COUNTY OF DALLAS :

I, Andrew Flanagan, being duly sworn and cautioned, state that I am over 18 years of age and competent to testify to the matters stated in this affidavit and further state the following based upon my personal knowledge:

1. I am the Chief Development Officer of Leeward Renewable Energy, LLC ("Leeward"), which indirectly owns 100% of South Branch Solar, LLC ("South Branch"). I am making this statement in my capacity as an officer of Leeward and not in my individual capacity.

2. South Branch's Application to the Ohio Power Siting Board for a Certificate of Environmental Compatibility and Public Need to develop, construct, and operate an up to 205 MW solar-powered electric facility was prepared and reviewed by Leeward employees that are the primary individuals in charge of the development of the South Branch Application on whom I reasonably rely as subject matter experts.

3. To the best of my knowledge, information, and belief, the information and materials contained in the above-referenced Application are true and accurate.

4. To the best of my knowledge, information, and belief, the above-referenced Application is complete.

Andrew Flanagan
Chief Development Officer
Leeward Renewable Energy, LLC

Sworn to before and signed in my presence this 19th day of July 2021.

Alexandria D. Palmer
Notary Public

NOTARY PUBLIC STATE OF TEXAS
ALEXANDRIA D PALMER
Notary ID #128579821
My Commission Expires
May 24, 2025

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ACRONYM AND ABBREVIATION LIST

$	dollar
$/kWac	dollars per kilowatt, on an alternating current basis
AC	alternating current
AED	Automated External Defibrillator
AEP	American Electric Power
amsl	above mean sea level
ANSI	American National Standards Institute
APE	Area of Potential Effect
the Applicant	South Branch Solar, LLC
Application	Application for a Certificate of Environmental Compatibility and Public Need
BMP	Best Management Practice
Board	Ohio Power Siting Board
Certificate	Certificate of Environmental Compatibility and Public Need
CFR	Code of Federal Regulations
CPR	Cardiopulmonary Resuscitation
dB	decibels
dbA	A-weighted decibels
dbh	diameter at breast height
DC	direct current
EAP	Emergency Action Plan
EMF	electromagnetic field
ESRI	Environmental Systems Research Institute
FAA	Federal Aviation Administration
FEMA	Federal Emergency Management Agency
FTE	full-time equivalent
gpd	gallons per day
HDD	horizontal directional drilling
HHEI	Headwater Habitat Evaluation Index
I-75	Interstate 75
IEEE	Institute of Electrical and Electronics Engineers
kV	kilovolt
kW	kilowatt
kWac	kilowatt-alternating current
kWh/m^2/day	kilowatt-hours per square meter per day
Leeward	Leeward Renewable Energy, LLC
L_{Aeq}	average continuous sound level
MW	megawatts
MWh	megawatt-hour
NEC	National Electrical Code
NESC	National Electrical Safety Code
NFPA	National Fire Protection Association

NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWP	Nationwide Permit
O&M	operations and maintenance
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
ODOT	Ohio Department of Transportation
OHI	Ohio Historic Inventory
Ohio EPA	Ohio Environmental Protection Agency
OHPO	Ohio Historic Preservation Office
OPBS	Ohio Power Siting Board
ORAM	Ohio Rapid Assessment Method
ORC	Ohio Revised Code
PILOT	payments in lieu of tax
PJM	PJM Interconnection, LLC
POI	point of interconnection
the Project	South Branch Solar
the Project Area	approximately 1,000 acres in Washington Township, Hancock County, Ohio proposed for South Branch Solar
Project Substation	new 138-kV step-up substation
PV	photovoltaic
Q	quarter
ROW	right-of-way
RUMA	Road Use and Maintenance Agreement
SCADA	supervisory control and data acquisition
South Branch	South Branch Solar, LLC
SPCC Plan	Spill Prevention Control and Countermeasures Plan
the Study Area	the area evaluated for wetlands or surface waters, consisting of the Project Area plus 100 feet
SWPPP	Stormwater Pollution Prevention Plan
TCLP	Toxicity Characteristics Leaching Procedure
UL	Underwriter's Laboratory
US-224	United States Route 224
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
Utility Switchyard	AEP-owned switchyard
VIA	Visual Impact Assessment
VSA	Visual Study Area

Executive Summary

South Branch Solar, LLC (South Branch) is pleased to present this Application for approval of an up to 205 MW solar electric generation facility in Washington Township, Hancock County (Project). The developer's parent company, Leeward Renewable Energy, has a deep and successful track record of renewable energy development, with 22 projects in operation across nine states and growing. The Application addresses each of the substantive requirements of Ohio Administrative Code Chapter 4906-4. It also directly reflects engagement with nearby residents, local officials, and other community stakeholders to develop a project that is mutually beneficial for South Branch and the community. This engagement directly shaped the Application that follows in specific, tangible ways.

South Branch incorporated features into the Project design that will integrate well with the surrounding landscape and uses. The Project will not be visible from much of the surrounding area and will incorporate a robust landscaping plan for further screening, will be quiet, and will not generate odors, emissions, or waste. And the significant annual revenue generated to local taxing entities by the Project will help to consistently fund excellent local schools and services, which in turn support a strong, thriving community.

Nearby landowners and residents are keen to ensure that stormwater runoff and potential damage to drain tile within the Project Area do not negatively impact their properties. As a result, the Application incorporates a thoughtful and comprehensive stormwater management strategy, along with a specific drain tile complaint resolution process to ensure that any issues are promptly addressed. In addition, the Project has contracted with a local drain tile expert with personal experience working on the drain tile systems within the Project Area and on adjacent properties to help identify tile locations prior to construction and support any needed repair. This local expert will also be available to work with neighbors should drain tile issues or complaints arise.

The Application also incorporates alterations to the Project layout presented at the Public Information Meeting in response to feedback from the community. These changes include increasing the Project's distance from the Village of Arcadia and the exclusion of Project features nearby certain neighboring residences. Concerns from neighbors about maintaining the rural character of the landscape of the community resulted in enhanced vegetative screening. The use of landscaping and the wire-woven agricultural-style fencing is also proposed to help preserve the character of the rural agricultural setting. Indeed, the Project will be far less impactful to surrounding neighbors than many other accepted uses.

The Project will also utilize a robust ground cover of native grasses and pollinator plants to absorb precipitation, provide species habitat, minimize the need for herbicides, and filter stormwater to reduce the potential for erosion and sedimentation. This approach to vegetation within the Project Area will also help to facilitate the long-term health of the soil. After the Project is decommissioned, the land can return to productive agricultural use.

4906-4-01 Purpose and Scope

(A) REQUIREMENTS FOR FILING OF CERTIFICATE APPLICATIONS

South Branch Solar, LLC (the Applicant or South Branch) is proposing construction and operation of South Branch Solar (the Project), a photovoltaic (PV) solar generation facility with up to 205 megawatts (MW) of nameplate capacity within an area of approximately 1,000 acres in Washington Township, Hancock County, Ohio (the Project Area). The Applicant is a wholly owned subsidiary of Leeward Renewable Energy, LLC (Leeward). The materials contained in this Application for a Certificate of Environmental Compatibility and Public Need (the Application) are prepared in accordance with the requirements for the filing of standard certificate applications for electric generation facilities, as prescribed in Chapter 4906-4 of the Ohio Administrative Code (OAC).

(B) WAIVERS

The Ohio Power Siting Board (OPSB or Board) may, upon an application or motion filed by a party, waive any requirement of its rules other than a requirement mandated by statute. By motion filed separate from the Application, the Applicant requested a waiver, in part, from the provisions of OAC 4906-4-08(D)(2) through (4), which requires the study of impacts to cultural resources within 10 miles of the Project Area. The waiver request seeks to reduce the cultural resources study area to 2 miles and the visual impact study area to 5 miles, due to the reduced visual impact of solar facilities in comparison to wind turbines or other tall facilities.

4906-4-02 Project Summary and Applicant Information

(A) SUMMARY OF THE PROPOSED PROJECT

The Applicant seeks a Certificate of Environmental Compatibility and Public Need (Certificate) to construct and operate the Project, an up to 205 MW solar PV facility proposed in Washington Township, Hancock County, Ohio (Figures 02-1 and 02-2). The Project – located entirely within the Project Area – will consist of solar panel generators as well as access roads, 34.5-kilovolt (kV) electrical collector cables, five meteorological stations, an Operations and Maintenance (O&M) building, a supervisory control and data acquisition (SCADA) system, and electrical equipment associated with the point of interconnection (POI) to the existing electrical transmission grid. The POI included in this Application (which can accommodate most of the Project's capacity) is illustrated on the layout drawing provided in Appendix A and is a direct connection to the existing American Electric Power (AEP) 138-kV overhead electric transmission line that extends through the Project Area. A new 138-kV step-up substation that will include the main power transformer (the Project Substation) will be constructed adjacent to a new AEP-owned switchyard (Utility Switchyard), which will allow the Project's electricity to be looped into the existing 138-kV transmission line. A second off-site POI that can accept the Project's full capacity will be the subject of a separate OPSB filing. Additional information regarding this off-site POI is provided in Section 4906-4-05 of this Application.

(1) General Purpose of the Project

The general purpose of the Project is to maximize energy production from solar resources to deliver renewable electricity to the Ohio bulk power transmission system to serve the needs of electric utilities and their customers. The electricity generated by the Project will be transmitted to the existing electrical transmission grid operated by PJM

Interconnection, LLC (PJM).[1] The Project will also support employment opportunities throughout the region and state, particularly during construction, as well as provide annual payments in lieu of tax (PILOT) revenues to the community.

(2) Project Description

The Project will be located within an area of approximately 1,000 acres of private property in Hancock County. The Project Area primarily consists of agricultural land, characterized by relatively flat topography, with elevations ranging between 780 and 805 feet above mean sea level (amsl). Existing transportation and utility corridors cross and/or adjoin the Project Area. All Project components reflected in this Application, including the POI to the existing grid, will be located within the Project Area. As noted above, a separate filing will be made with the OPSB for a second, off-site POI.

The Project's PJM interconnect applications specify a total electrical generation capacity of up to 205 MW. The Project will consist of conventional PV solar panels affixed to single-axis metal racking designed for tracking the sun. The solar panel technology for the Project will be one of two basic types: crystalline or thin-film. While the specific module has not yet been selected, Bloomberg New Energy Finance "Tier I" solar panel supplier/manufacturer modules will be used for the Project. At a capacity of up to 205 MW alternating current (AC), the Project will use approximately 500,000 modules.

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[1] PJM is the regional independent transmission organization that coordinates movement of wholesale electricity in all or part of 13 states (including Ohio) and the District of Columbia. Its name results from its origin serving Pennsylvania (P), New Jersey (J), and Maryland (M).

Electrical collection at a voltage of 34.5 kV will be used to transmit generated electricity from the solar inverters to the Project Substation, where it will be stepped up to 138 kV and transmitted to the Utility Switchyard for connection to the existing electrical grid. Both will be located adjacent to the existing AEP Ebersole-Fostoria Central 138-kV transmission line, as shown in Appendix A.

Additional details for the Project are provided in Section 4906-4-03(B)(2) of this Application.

(3) Site Suitability

The Project site selection process, as it affirms site suitability, is described in greater detail in Section 4906-4-04. An analysis of the Project Area demonstrated that it meets all factors necessary to support a viable solar energy facility. The proposed site has a regionally competitive solar resource, strong electrical transmission characteristics, good access, compatible land use, and few culturally- or environmentally sensitive areas.

The general location of the Project was selected based on consideration of a range of key characteristics that are required for a successful PV solar facility. Once the general location was selected, additional scrutiny of a range of issues was undertaken prior to initiating the engineering and environmental activities necessary for completion of the OPSB Application, as further discussed in Section 4906-4-04.

The key characteristics of the proposed Project Area that make it suitable for Project development are outlined in Table 02-1.

TABLE 02-1
PROJECT AREA CHARACTERISTICS

Key Attribute	Project Area Characteristics
Adequate Size	Appropriate parcel area is available to accommodate up to 205 MW of solar electric generation.
Compatible Land Use	The Project Area is predominantly non-wooded, relatively flat, agricultural land.
Solar Resource Suitability	Resource mapping indicates that the Project Area has adequate solar resources.
Access to Transmission	The existing 138-kV electric transmission system extends through and near the Project Area and provides adequate access both from a physical standpoint and in terms of its ability to accept the Project's electricity.
Site Accessibility	The Project Area is served by an existing network of public roads.
Limited Culturally Sensitive Resources	The Project is not expected to result in significant adverse impacts to culturally sensitive resources.
Limited Sensitive Environmental Resources	The Project is not expected to result in significant adverse impacts to ecological resources.

(4) Project Schedule

The Project schedule is based on the submission of this Application by July 2021, the issuance of the OPSB Certificate in Quarter (Q) 2 of 2022, and anticipated commencement of construction as early as Q4 of 2022. Commercial operation would be as early as Q1 of 2024.

Any delay in the issuance of the Certificate could have a significant negative commercial impact on the Project's planned operations and could therefore jeopardize the Project's ability to provide renewable energy to the Ohio electrical grid. Delays would also adversely impact local communities by delaying the receipt of PILOT benefits, including revenue to local schools.

(B) ADDITIONAL INFORMATION

(1) Description of Future Plans/Plans for Future Additions

The Applicant has no plans for development of additional capacity at this site beyond 205 MW.

(2) Applicant Information

The Applicant is a wholly owned affiliate of Leeward. Leeward is a leading North American renewable energy producer, dedicated to sustainable power production. Leeward, headquartered in Dallas, Texas, currently owns and operates renewable energy facilities across nine states, with a total installed capacity of more than 2,000 MW. The Applicant currently plans to develop, construct, own, and operate the Project over its entire operating life.

4906-4-03 Project Description and Schedule

(A) DETAILED DESCRIPTION OF THE PROJECT AREA

(1) Project Map

Figure 03-1 identifies: the proposed Project Area; proposed Project features; major population centers and administrative boundaries; major transportation routes and electric transmission corridors; named rivers, streams, and other bodies of water; and major institutions, parks, and recreational areas within a 2-mile radius of the Project Area.

(a) The Proposed Project

Figure 03-1 illustrates the primary components of the Project, including fence lines, PV module areas, electrical collection system, inverters, access roads, Project Substation, Utility Switchyard, O&M building, and laydown yards contained within the Project Area. While the Applicant expects that the final layout will remain substantially similar to this layout, due to ongoing technological innovations in the solar industry, continued engineering and survey work, public feedback, and communications throughout the Certificate process, the precise locations of these features are subject to change. Although this layout is subject to change in the final design, all Project components will be located within the Project Area and will be subject to the various conditions and constraints laid out in this Application, as well as any conditions that are incorporated by the OPSB into the Certificate.

(b) Population Centers and Administrative Boundaries

The Project is proposed in Washington Township, Hancock County, Ohio. The Project is approximately 3 miles southwest of the City of Fostoria and 5 miles northeast of the City of Findlay. The Village of Arcadia lies along the southern boundary of the Project Area.

(c) Transportation Routes and Gas and Electric Transmission Corridors

The Project is generally bounded by Township Road 257 to the east; the Village of Arcadia to the south; Township Road 249 to the west; and Township Road 226 to the north. Multiple roads cross the Project Area, including State Route 12; County Roads 218 and 109; and Township Roads 243, 254, and 256. Other nearby major routes include State Route 18 and 613; U.S. Route 224 (US-224); and Interstate 75 (I-75). A Norfolk Southern railroad line runs southwest-northeast along the southeastern boundary of the Project Area. Fostoria Metropolitan Airport is located approximately 5.5 miles northeast of the Project Area.

AEP's Fostoria Central substation is located approximately 1.5 miles east of the Project Area. The existing AEP Ebersole-Fostoria Central 138-kV line crosses the Project Area in a southwest-northeast orientation and the AEP 345-kV overhead transmission line crosses the Project area in a southwest-northeast orientation a little farther north.

(d) Named Rivers, Streams, Lakes, and Reservoirs

There are two named rivers and streams within 2 miles of the Project Area. The South Branch of the Portage River flows northwest through southwestern portions of the Project Area. The East Branch of the Portage River lies east of the

Project Area, along the outskirts of the City of Fostoria, flowing north-northwest to its convergence with the South Branch of the Portage River. Several unnamed tributaries to these named rivers cross the Project Area, as further discussed in Section 4906-4-08(B).

(e) Major Institutions, Parks, and Recreation Areas

There are no designated Historic or Scenic resources within 2 miles of the Project Area. The closest public resource is the Aeraland Recreational Area, an approximately 75-acre Hancock County park, which is located 0.6-mile northwest of the Project Area, along the South Branch of the Portage River. This park includes picnic areas, hiking trails, soccer fields, and Goose Lake. Other recreational resources located within 2 miles of the Project Area include the Arcadia Community Center, a public facility that includes playground equipment, basketball courts, softball fields, and a rentable building; the Fostoria Country Club, a private golf, tennis, and banquet facility; and two recreational reservoirs, Veterans Memorial Reservoir Park and Fostoria Reservoir Park. Local schools, churches, and recreational areas are also located in the Village of Arcadia, within approximately 0.75-mile of the Project Area.

(2) Project Area

The approximately 1,000-acre Project Area includes portions of 16 properties within Washington Township, Hancock County, as shown in Table 03-1.

TABLE 03-1
AREA OF PROPERTY USED FOR PROJECT

Status of Property	Number of Properties	Approximate Acreage
To be purchased	15	950
To be leased	1	38

In addition to the properties summarized in Table 03-1, the Applicant is discussing the potential development of a Road Use and Maintenance Agreement (RUMA) with Hancock County for use of local roadways during construction and for the installation of collection lines within the road right-of-way (ROW), which is approximately 1.3 miles along Township Road 218.

The Project Area is illustrated on Figure 03-2, with the proposed Project layout overlain within the boundaries of the Project Area. Additional detail is provided on Figure 03-3 and in Appendix A.

(B) PROPOSED PROJECT DESCRIPTION

As shown on Figure 03-2, all proposed Project components addressed in this Application are situated within the approximately 1,000-acre Project Area. The following sections describe key aspects of the proposed Project.

(1) Project Details

(a) Generation Units

Generation equipment for the up to 205 MW capacity is anticipated to include approximately 500,000 monocrystalline bifacial or thin-film PV panels, mounted on single-axis trackers and installed in linear arrays. Polycrystalline or thin-film panels may be used depending on final procurement of equipment and equipment availability prior to construction. Representative solar panels under consideration are provided in Appendix B; technological innovation could dictate the use of an alternate panel as identified during the final procurement process. In all instances, the selected panels will have a demonstrated track record and have been safety tested to confirm Toxicity Characteristics Leaching Procedure (TCLP) testing criteria are met. Reputable vendors, with established performance records, will be selected with a good track record of supplying reliable technology and equipment. All equipment will follow applicable industry code(s) such as those associated with the Underwriter's Laboratory (UL), Institute of Electrical and Electronics Engineers (IEEE), National Electrical Code (NEC), National Electrical Safety Code (NESC), and American National Standards Institute (ANSI).

The panels will operate continuously but will not produce electricity during nighttime hours. The annual net capacity factor for the up to 205 MW proposed Project is estimated to be 22 to 24 percent. The Project will generate approximately 395,000 to 430,000 megawatt-hours (MWh) of electricity each year. Throughout an average year, the Project will produce sufficient power to supply approximately 33,000 households.[2] Heat rate is not applicable to solar energy facilities.

As shown in Figure 03-3, the solar PV panels will be positioned in areas located throughout the Project Area that have been selected to avoid and/or minimize potential impacts to natural resources to the greatest extent practicable.

For the up to 205 MW generating capacity, approximately 500,000 PV panels will be installed in linear arrays in a generally north-south orientation across

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[2] U.S. Energy Information Administration. Frequently Asked Questions. https://www.eia.gov/tools/faqs/faq.php?id=97&t=3. 17 May 2021.

the Project Area. The arrays will generally face east and west and track the sun throughout each day. Each array will consist of panels mounted on fixed vertical post pilings that will be driven into the ground to a depth of approximately 7 to 10 feet. The vertical axis will be no more than 8.5 feet off the ground, with panels arranged in a double portrait orientation. At maximum tilt, the top of the panels will be no taller than approximately 15 feet above the ground.

(b) Wind Turbine Blade Dimensions

This section is not applicable, as the proposed Project does not include the installation of any wind turbine equipment.

(c) Fuel Quantity and Quality

This section is not applicable, as the Project will solely use energy from the sun to generate electricity.

(d) Pollutant Emissions

This section is not applicable, as no emissions result from the generation of electricity using PV solar technology.

(e) Water Volume Requirement

Solar panels generate electricity without the use of water. Therefore, no water is treated or discharged, other than associated with the anticipated septic system associated with the O&M building, which will be similar or less than flow associated with a single-family home. It is anticipated that the O&M building will also include development of a well for sanitary uses, also similar or less than demand associated with a single-family home. No module washing is planned during operations, as rainfall amounts are considered adequate to clean the modules.

(2) Description of Construction Method and Project Components

The primary steps for Project construction include the following: 1) locating and mapping drain tiles that extend outside of Project Area and reroute as needed to minimize impact; 2) installation of stormwater, erosion control, and vegetative protection measures; 3) securing the perimeter of the construction area; 4) vegetation clearing; 5) minor earthwork and grading, as necessary; 6) access road construction; and 7) installation of equipment such as pilings, racking, panels, inverters, and electrical cables, meteorological stations, and other electrical equipment. Prior to construction, a survey crew will locate the equipment locations, roads, and fence corners. Information about key Project components is provided below, including a discussion of general construction and reclamation methods; materials, colors, and textures of surfaces; and dimensions.

(a) Generation Equipment

Following the installation of access roads, the installation of foundations and racking will commence. Thereafter, PV module, electrical collection, inverter, and transformer installation will begin, as well as construction of the high voltage Project Substation and the Utility Switchyard. Limited site preparation may be necessary to accommodate PV panel module installation via grading due to localized variability in topography, although generally the panels will follow the existing ground contours. Due to the minimal topographic relief across the Project Area, the need for grading is expected to be minimal; therefore, it will tend to minimize the need for intensive restoration work to return soil conditions to future agricultural readiness. Where grading is necessary, topsoil will be segregated and redistributed following grading activities to maintain soil productivity.

PV panel modules will be approximately 4-feet-wide by 7.5-feet-long. The panels will be secured on steel racking and support structures affixed to single-axis solar tracking systems, with up to two modules stacked end-to-end, centered on the horizontal crossbar of the tracker, for a total width of approximately 15 feet. The panels will rotate up to 60 degrees in either direction from horizontal, centered along the horizontal crossbar of the tracker. The height of the crossbar will be no more than 8.5 feet. Under the flat conditions found across most of the Project Area, panels will reach approximately 15 feet off the ground when at their maximum tilt.

Single-axis solar tracking system designs vary by manufacturer; however, they generally consist of a series of mechanically linked horizontal steel support beams, with a drive train system usually located in the center of the rows, dividing the array into two sides. Rows are aligned north to south and the PV panels pivot, tracking the sun's motion from east to west throughout the day. Manufacturer's specifications for representative PV panels and racking systems under consideration are provided in Appendix B. Technological innovation could dictate the use of an alternative racking system as identified during the final procurement process.

The racking and panels are supported on steel piles that will be driven into the ground to a depth generally between 7 and 10 feet. Geotechnical test borings have confirmed the adequacy of this pile depth (see Appendix C). Based on test borings, it is anticipated that pile driving will be used for solar panel installation within the Project Area. Single pile lengths are anticipated for pile driving that do not require welding of pile sections.

Upon completion of the installation of access roads, piles, steel racking, and panels, disturbed soils will be de-compacted via tilling to prepare for the establishment of vegetation. Vegetation will be established per the Vegetation Management Plan in Appendix D. All permanent or temporary stabilization associated with the Project will be completed to meet the requirements of Ohio Environmental Protection Agency (Ohio EPA) Permit No. OHC000005[3] as reflected in the preliminary Stormwater Management Plan provided in Appendix E.

The generation equipment to be used by the Project are solar panels mounted on metal racking. The racking will include piles that will be driven into the ground in long rows or "arrays." A typical racking post is approximately 17.5 feet long; depending on ground conditions, it will be driven to a depth of 7 to 10 feet below the ground surface. A standard solar racking post is approximately 6 inches across and 4 inches wide with an I-beam type of shape.

In general, the arrays will follow the contours of the land, although some rough grading may occur. The arrays will be grouped in clusters throughout the Project Area, as shown in Figure 03-3, with a minimum distance from arrays to the nearest non-participating residence of 160 feet. Other setbacks integrated into the

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[3] Ohio EPA (April 23, 2018). *General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System.* Retrieved from Ohio EPA: https://www.epa.ohio.gov/portals/35/permits/OHC000005/Final_OHC000005.pdf

Project layout are further discussed in Section 4906-4-08(C). The racking system will employ single-axis tracking that will be oriented in north-south rows, with the panels rotating from east to west throughout the day to maximize solar capture.

PV panels are installed on the racking system in either a landscape (horizontal) or portrait (vertical) orientation. The modules are affixed to the racking with clips. The modules will be connected using direct current (DC) cables that can either be buried in a trench or attached to the racking system. The DC cables gather at the ends of the racking systems in combiner boxes to transmit the cables to the inverter/transformer locations within each cluster of arrays.

The Project Area will be enclosed within 7-foot-tall woven-wire fencing, consistent with the agricultural character of the region, and locked gates to provide for equipment security and public safety. The exact placement of Project components is subject to change prior to construction; however, all components will be located within the Project Area. Final engineering efforts will determine the exact location of all equipment based on such factors as equipment model selection, drain tile information, and geotechnical studies.

(b) Storage Facilities

While the Project is under construction, fuel used by the construction equipment will be stored within appropriate containment in designated laydown areas, in accordance with local, state, and federal regulations. PV solar structures generate electricity without the use of fuel or water, and without generating waste. As such, the Project does not include any significant facilities for fuel, waste, water, or other storage.

Oil used for transformer cooling and insulation at the Project Substation and/or Utility Switchyard may be stored within an aboveground storage tank, which will likely exceed 1,320 gallons. Per federal regulations (40 Code of Federal Regulations [CFR] Part 112), a tank of this size would require preparation of a Spill Prevention Control and Countermeasures Plan (SPCC Plan). Oil that is removed from the transformers during maintenance activities will be disposed of in compliance with applicable local, state, and federal regulations. Other on-site storage at the O&M building may include hydraulic oil, stored in plastic jugs or 55-gallon drums on secondary containment pallets, and potentially a double-walled fuel tank with additional secondary containment for maintenance vehicle use.

(c) Processing Facilities

Solar panels generate electricity without the use of fuel, with minimal water, and without generating waste; therefore, no associated processing facilities are proposed.

(d) Water Supply and Discharge

No Project components will use significant quantities of water or discharge significant quantities of wastewater. An onsite well is expected to be used to provide potable water to employees and others at the Project, with a capacity similar to or less than a single-family residence. Prior to development of the water supply system, a permit from the local health district will be obtained pursuant to OAC 3701-28-03(A). A septic system, sized for a small office setting, is expected to be installed for wastewater disposal. Prior to the construction of any septic system, the Applicant will obtain an Ohio EPA wastewater permit-to-install, and any other required state and/or local permits. Stormwater discharge is discussed in Section 4906-4-07(C).

(e) Transmission Facilities

The transmission facilities proposed in association with the Project within this Application are the new onsite Project Substation and Utility Switchyard enabling the POI to the existing AEP Ebersole-Fostoria Central 138-kV transmission line that extends through the Project Area. The interconnection facilities are further discussed in Section 4906-4-03(B)(2)(g) and in Section 4906-4-05 of this Application.

(f) Electric Collection Lines

The electrical collection system primarily will be installed underground, although cable trays could be used where ground conditions warrant. Aboveground collection could be incorporated where the use of shared structures is possible along Township Road 218 (where existing overhead utility lines extend within the road ROW). Final engineering and procurement will help to determine the design and construction method for the electrical collection system.

Underground AC collection systems from the inverter skids to the Project Substation will be installed in trenches or plowed into place at a depth of at least 36 inches below grade. During all trench excavations, the topsoil and subsoil will be removed and stockpiled separately. Once the cables are laid in the trench, the area will be backfilled with subsoil, followed by topsoil. Trenching or plowing using this method is preferred for installation of buried collection lines (except where features such as roads or streams may require the use of boring techniques, as discussed below), as it results in a minimal ground disturbance area.

If these methods are not feasible for installation due to site conditions, trenching via backhoe may be used in some circumstances. Installation of collection lines via backhoe will result in soil disturbance averaging approximately 15 feet in width to accommodate machinery and backfill/spoil storage, which is wider than associated with other trenching or plowing methods.

Where underground collector lines must traverse features such as existing roads or streams, the use of boring techniques may be selected to avoid disturbance of the feature to be crossed. This could involve a jack-and-bore or horizontal directional drilling (HDD) technique, as further discussed in Section 4906-4-07(C)(2)(c).

For locations where cable trays may be used, if ground conditions warrant, subsurface ground disturbance would not be necessary. In the limited roadside area where aboveground installation could occur, shared structures with existing overhead utilities in the ROW would be expected.

Any damaged drain tile lines will be assessed for prompt repair per the Drain Tile Mitigation Plan in Appendix F. All areas adjacent to the open trench will be restored to original grade and surface condition, and these areas will be revegetated in accordance with the Vegetation Management Plan (Appendix D).

(g) Substations and Transformers

The preliminary Project design illustrates inverters and transformers proposed throughout the Project Area (as shown in Appendix A). A skid supported by piles or a gravel pad, approximately 15-feet-wide by 30-feet-long, will provide the foundation for the inverters, transformer, equipment cabinet, and associated SCADA system. Inverter structures will be approximately 25-feet-long, 7-feet-wide, and 7-feet-tall.

Manufacturer's specifications for representative inverters under consideration are provided in Appendix B.

Inverters will transmit medium voltage electricity through collection lines to the Project Substation (as shown on Figure 03-1 and Appendix A). The Project Substation, located just north of the existing 138-kV overhead electric transmission line extending through the Project Area, will house the transformers and necessary infrastructure to increase the electricity voltage from 34.5 kV to 138 kV, and will be adjacent to the Utility Switchyard. At 138 kV, electricity will be transmitted from the Utility Switchyard to the existing electric transmission infrastructure within the Project Area. Additional information is provided in Section 4906-6-05. The Project Substation and Utility Switchyard addressed in this Application will both be designed according to regional utility practices, PJM Standards, Reliability First Organization Standards, the NEC, and the Rural Utility Service Code. The area within the Project Substation and Utility Switchyard will be graveled to minimize vegetation growth and reduce fire risk. The Project Substation and Utility Switchyard are expected to be enclosed by a 7-foot-tall chain link fence; barbed wire will not be used, except if required by the interconnecting utility. Fence panels typically will be 10-feet-wide and made from galvanized steel. The Project Substation and Utility Switchyard will contain concrete foundations for large equipment, a main power transformer, circuit breakers, surge arrestors, insulators, electrical bus-work, and lighting necessary to meet various electric codes and standards.

(h) Meteorological Stations

The Project will include five meteorological stations, with slender monitoring equipment up to 15 feet in height. These will be mounted adjacent to inverters and will be used to measure various aspects of the weather, including solar irradiance and wind speed.

(i) Roads

As shown on Figure 03-3, entrances for the Project are located off Township Roads 243, 254, and 257 and County Road 109, public roadways that extend through the Project Area, and allow for access to each solar panel array; the location of these entrances could be modified in the final design. Access roads will be within the Project Area, gravel surfaced, and up to 16-feet-wide along straight portions of the road, with greater width along curves and at internal road intersections. Approximately 17.6 miles of access road are illustrated on Figure 03-3.

During construction, access road installation and use could result in temporary soil disturbance of up to approximately 25 feet in width within the Project Area. Road construction will involve topsoil stripping. Stripped topsoil will be stockpiled along the road corridor for use during site restoration. Following removal of the topsoil, subsoil will be graded, compacted, and surfaced with gravel or crushed stone to a depth later to be determined. A geotextile fabric or grid may be installed beneath the road surface, if necessary, to provide additional support.

Once construction is complete, temporarily disturbed areas will be restored and revegetated. Rock construction entrances will be installed to reduce dirt and sediment on area public roads. The surrounding roadway network is anticipated to support construction-related traffic.

(j) Construction Laydown Areas

Temporary laydown areas, used for placement of materials during construction, will be located within the Project Area boundaries, as shown on Figure 03-1. In addition to the designated laydown areas, laydown will occur within other Project layout areas. The laydown areas will be used for material and equipment storage, construction worker parking, and construction management trailer placement. No lighting is proposed within the laydown areas, although it could be added as needed should safety or vandalism issues be identified.

No additional tree clearing will be conducted for these temporary workspaces. The laydown areas will be stripped of topsoil, and erosion and sediment control measures will be implemented. Woodchips or construction matting may be used to cover the laydown areas; no gravel use is anticipated. Temporary areas will be restored using de-compaction following completion of construction, if not used for other Project installations. Topsoil will then be redistributed, and the area will be reseeded per the specifications of the Vegetation Management Plan (Appendix D).

Details regarding erosion and sediment control Best Management Practices (BMPs) consistent with the Ohio Department of Natural Resources (ODNR) Ohio Rainwater and Land Development Manual will be incorporated in the Stormwater

Pollution Prevention Plan (SWPPP) that will be prepared prior to construction; controls will be installed prior to work in each particular area; a preliminary stormwater plan is provided in Appendix E. The BMPs will be removed once soils are appropriately stabilized.

(k) Security

Array areas will be entirely enclosed by a 7-foot-tall woven-wire agricultural fence. Fence panels will be approximately 10-feet-wide and made from galvanized steel supported on wood posts. Gates will be used for operations and maintenance and/or emergency access. “No Trespassing” signs will be posted along the fence, and the access gates will remain locked at all times when not in use by the Applicant or its authorized contractors. Minimal downlit security lighting will be used at the Project entrances, Project Substation, Utility Switchyard, O&M building, and inverters.

The O&M building will be approximately 50-feet-long by 50-feet-wide and up to 15-feet-tall and located approximately 650 feet east of Township Road 254, proximate to the Project Substation, as shown on Figure 03-1. Adjacent parking and staging, subject to future design details, is anticipated to be in proximate upland area. Parking is expected to be up to 1,000 square feet in size. The exterior of the O&M building will consist of metal siding, of similar look and material as a pole barn. The O&M building facilities may potentially include an on-site well and septic system to accommodate normal business office usage. Construction of the O&M building will follow all applicable building codes.

The Project will use a SCADA system, which allows remote control and monitoring of the status of Project's operating status. The monitoring system provides status views of electrical and mechanical data, operation and fault status, meteorological data, and grid station data.

(l) Other Installations

No other installations are associated with the Project, other than stormwater and erosion control features. During construction, BMPs will be implemented that meet the requirements of Ohio EPA Permit No. OHC000005. Permanent stormwater and erosion control measures, as reflected in Appendix E, are anticipated to be minimal and will consist primarily of grassed filtration swales. These measures will be reassessed upon development of the Project's final design.

(3) Description of New Transmission Facilities

Interconnection studies have been completed for an up to 205-MW facility in this location. The full generating capacity would involve interconnection to the existing Fostoria Central 138-kV substation via an off-site POI, as further discussed in Section 4906-4-05; this off-site POI will be the subject of a separate filing with the OPSB. This Application incorporates a direct POI within the Project Area to the existing AEP Ebersole-Fostoria Central 138-kV transmission line via the proposed Project Substation and Utility Switchyard (as shown on Figure 03-3). Additional details regarding the interconnection queue positions and PJM review are provided in Section 4906-4-05(B).

(4) Map of Project Site

Figure 03-3 illustrates the proposed Project on an aerial photograph overlain with the Project layout, showing surrounding road names, utility corridors, and major features of the proposed Project.

(C) DETAILED PROJECT SCHEDULE

(1) Schedule

The Project schedule is shown in Figure 03-4. The planning stages have been underway since March 2020. During that time, the Applicant has been actively working with local landowners and evaluating potential layout refinements, as well as making appropriate changes to the Project's queue position with PJM. The goal is initiation of construction as early as October 2022, to allow electricity to be provided to the electric grid as early as January 2024.

(2) Construction Sequence

Project construction is anticipated to proceed in the following sequence, with multiple activities being performed concurrently:

- Location and rerouting of drain tile, as appropriate;
- Installation of stormwater and erosion control measures;
- Securing the perimeter of the areas in which construction will occur;
- Clearing portions of the Project Area, as necessary, particularly in locations where PV arrays, access roads, and other equipment will be installed;
- Survey, layout, and staking of access roads and equipment locations;
- Grading access roads and any other minor areas requiring topographic adjustments;

- Constructing access roads;
- Installing piles and racking for PV panel support;
- Installing PV panels;
- Installing the electrical collector system;
- Construction of the Project Substation and Utility Switchyard;
- Installing inverters;
- Installing meteorological stations;
- Commissioning and energizing the Project;
- Completing final grading and drainage augmentations and repairs; and
- Completing restoration activities.

Installation of PV module foundations, access roads, and collection lines is described in Section 4906-4-3(B)(2). Once construction is complete, temporarily disturbed areas will be restored, which will include removal of excess road material, rock removal in agricultural areas, de-compaction of soil, and restoring areas to their approximate pre-construction contours. Exposed soils in the Project Area will be stabilized by seeding, mulching, and/or plantings per the Vegetation Management Plan (Appendix D).

(3) Delays

Certain delays in the development of the Project may have a material, adverse effect on the Applicant's efforts to secure financing for the Project's construction by the planned in-service date. The in-service date is dependent upon the Applicant's ability to timely acquire PV panels, racking, inverters, and transformers. Timely acquisition of these components could affect the in-service date for the Project. Considerable costs would be incurred if delays prevent the Project from meeting deadlines for incentive programs, such as the Federal Investment Tax Credit for Solar, and procurement-related milestones. Delays would also impact local communities by delaying the receipt of PILOT benefits, including revenue to local schools.

4906-4-04 Project Area Selection and Site Design

(A) SITE SELECTION PROCESS

The Applicant has experience understanding energy markets and areas of potential energy demand, as well as assessing suitability for locations of solar facilities.

(1) Description of Study Area

The proximity to the bulk power transmission system, available electrical injection capability, and site conditions are the main site selection criteria utilized for solar power projects.

As depicted in Figure 04-1, bulk power transmission lines exist within the vicinity of the Project Area. The transmission lines in the area are owned and operated by AEP within the PJM regional transmission organization footprint. To establish a generation facility, the electrical grid must be able to accommodate a new facility's generating capacity at a selected POI (the location on the specified transmission line or infrastructure where the Project will transmit power to the greater electric grid). The capacity of the nearby transmission lines and costs of upgrades to accommodate a new POI were evaluated, and it was determined that an up to 205-MW solar facility was viable in the general area of the proposed Project.

General topography and land use characteristics of the Project Area were also considered. The land in the immediate area is characterized with open spaces and is primarily used for agriculture, which is suitable for hosting a utility-scale solar power project. Ideal solar development areas are flat with limited variations in topography. Initial site visits provided visual verification that the predominant land use in the study area is agricultural, making this location compatible with solar project development.

Proximity to major transportation routes and supply chains were also reviewed to ensure accessibility. State Route 12 and several county and township roads extend within the Project Area. State Route 613/18 and US-224 are located approximately 1.2 miles north and 3.3 miles south of the Project Area, respectively. These roads provide accessibility for emergency medical services, as well as the transportation of Project components, construction equipment, and staff.

(2) Map of Study Area

An assemblage of land that would accommodate layout for the desired facility size is necessary. After a suitable geographic area was established, based on specific conditions pertaining to the local electrical transmission system, the Applicant identified a group of willing landowners proximate to suitable POIs that met the various other siting criteria listed in this section. Figure 04-2 illustrates the Project Area and constraints considered.

(3) Siting Criteria

The Applicant considered the following criteria in selecting and evaluating the Project study area:

- <u>Adequate Solar Resource</u> – The Applicant determined through an initial screening process using the National Renewable Energy Laboratory (NREL) National Solar Radiation Database that global horizontal irradiance was likely to be at a level of 4.1 kilowatt-hours per square meter per day(kWh/m^2/day).[4]

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[4] Sengupta, M., Xie, Y., Lopez, A., Habte, A., Maclaurin, G., & Shelby, J. (2018). The National Solar Radiation Data Base. *Renewable and Sustainable Energy Reviews*, 89 (June), 51 – 60.

Solar irradiance was determined to be adequate to support the development of the Project.

- Adequate Access to the Bulk Power Transmission System – The Applicant determined that the system interconnection and upgrades to accommodate the interconnection could be attained at a reasonable cost. This determination was made via internal assessments and subsequent interconnection requests filed with PJM. See Section 4906-4-05 of this Application for additional details.
- Site Accessibility – The Project Area is served by an existing network of public roads, which will facilitate component delivery, construction, and operation and maintenance activities. See Section 4906-4-06(F)(3) for more information regarding site accessibility.
- Appropriate Geotechnical Conditions – The Applicant determined that geotechnical conditions are suitable for the development of a solar facility. Preliminary desktop data was used to analyze the site for suitable geotechnical conditions in identifying the Project Area. As work to develop a layout progressed, preliminary field geotechnical work, as further discussed in Section 4904-4-08(A)(5), informed Project design.
- Distance from Airports – Solar panels are typically compatible with airports, and many airports have successfully implemented solar panels within airport boundaries. Nonetheless, airports were considered during the siting process. The proposed Project is sited approximately 5.5 miles from the nearest public-use airport, Fostoria Metropolitan Airport. See Section 4906-4-07(E) of this Application for additional detail on aviation facilities.

- Compatible Land Use – The Project Area consists predominantly of rural agricultural land, which is compatible with the proposed Project. See Section 4906-4-08(C) of this Application for more information on land use.
- Topography – The Project Area is relatively flat, which more easily accommodates the installation of solar panels.
- Cultural Resources – Based on desktop and literature review during selection of the Project Area, the Project Area was anticipated to have minimal impact to cultural resources. Once the Project Area was selected, additional studies were completed to confirm that no effect on archaeological or historical resources is anticipated, as reflected in Section 4906-4-08(D) of this Application.
- Limited Sensitive Ecological Resources – To support selection of the Project Area, preliminary desktop evaluations indicated that the Project Area had adequate capability of avoiding impacts to sensitive ecological resources. As site layout work progressed, field surveys, delineations, and consultation with applicable agencies, as further discussed in Section 4906-4-08(B) of this Application, informed Project design.

Once the Applicant determined that the Project Area was suitable for development of a solar power facility, various siting factors and constraints were identified and evaluated to appropriately site the Project components. These efforts are discussed in detail below in Section 4906-4-04(B).

(4) Process for Identifying the Proposed Site

The Project was first considered by the Applicant in 2020. The Project and its study area were then subjected to an evaluation in accordance with minimum siting criteria.

The Applicant then initiated contact with potential participating landowners, identifying specific parcels as the Project Area, for which real estate agreements were pursued. More detailed assessments to review characteristics of the Project Area on a desktop basis were undertaken at that time, as noted above.

(5) Factors in Selecting the Proposed Site

The evaluation of the Project study area in accordance with the Applicant's key site selection characteristics identified that the Project was extremely suitable for its intended purpose, as outlined above.

The Applicant is not presenting for consideration any alternative locations for the Project; the only proposed location for the Project is the Project Area.

(B) PROJECT LAYOUT DESIGN

With the results of the evaluation described above confirming the Project Area is favorable for the proposed Project, the Applicant continued with more detailed environmental and other studies, as well as Project engineering design, to support the OPSB Application for the Project. Due to ongoing technological innovations in the solar industry, continuing detailed engineering and survey work, public feedback, and communications during the OPSB process, the layout of Project components is subject to change. Although the layout is subject to change, all components, including the fence lines, PV panel arrays, electrical collector system, inverters, access roads, O&M building, Project Substation, Utility Switchyard, and laydown yards, will remain within the Project Area and continue to meet the various constraints identified below.

(1) Constraint Map

Figure 04-2 provides constraint mapping completed as part of the Critical Issues Assessment for the Project. Additional studies have been completed to refine the layout as Project design has progressed (e.g., formal wetland delineation, preliminary geotechnical surveys, sound level analysis), as reflected in Section 4906-4-08.

(2) Project Layout Criterion

The Applicant conducted detailed assessments that identified and defined the siting factors and constraints discussed below, adjusting layout design iterations as appropriate.

- <u>Equipment Flexibility</u> – As stated in Section 4906-4-03, representative models of panels, racking, and inverters are provided in Appendix B. Ongoing technological innovations could dictate the use of an alternate equipment model as identified during the final procurement process. All models selected will be analyzed for suitability in terms of the various siting constraints and confirmed to meet OPSB conditions. The equipment selection is subject to internal analysis of costs and availability of equipment during the procurement process, but will, in all events, meet the criteria noted in Section 4906-4-03(B)(1).
- <u>Minimizing Noise Impacts</u> – The preliminary Project layout is designed to minimize noise impacts to non-participating sensitive receptors, consistent with OPSB guidelines, which generally require that operational energy

facility impacts be 5 decibels (dB) or less over measured ambient on an average continuous sound level (LAeq) basis at non-participating receptors. Additional information regarding noise is provided in Section 4906-4-08(A)(3).

- Minimizing Impact to Agriculture – Agricultural use is the predominant land use within the Project Area. The Applicant has designed the Project to minimize impacts to active agricultural land primarily by co-locating collection lines and access roads where practicable to minimize areas of direct ground disturbance. In addition, the Project Area can be fully restored to agricultural use upon decommissioning, as appropriate. The ability of the Project Area to support future agricultural uses will be enhanced by the opportunity to lie fallow throughout the life of the Project, vegetated by low-growing pollinator and other native species in certain areas. To minimize impacts to soil and drainage, which can affect agricultural uses, the Applicant has, and will continue to, work with landowners, soil and water conversation district information, a local drain tile consultant, and Hancock County representatives to identify the location of known drain tiles across the Project Area. Data will be aggregated and will be continued for use in informing final design. The Project's Drain Tile Mitigation Plan (Appendix F) identifies information currently known, as well as avoidance measures and procedures for repair of drain tile. For additional information on agricultural land, see Section 4906-4-08(E) of this Application.

- Minimizing Impact to Wetlands, Streams, and Ecological Resources – The Project is located entirely on private land, and there are expected to be no impacts to recreational areas, parks, wildlife areas, nature preserves, or other conservation areas. Wetland and stream delineations have been completed, and floodplain mapping has been reviewed to avoid and minimize resource impacts, as reflected in Section 4906-4-08(A)(4)(e). Consultation has occurred with both the United States Fish and Wildlife Service (USFWS) and ODNR to confirm measures necessary such that no federal or state listed species are negatively impacted by the Project, as further discussed in Section 4906-4-08(B)(1)(c). Minimizing the need for tree clearing has been a consideration for layout and design; the limited tree clearing will be completed from October 1 through March 31 to avoid potential impacts to listed bat species.
- Minimizing Archaeological and Historic Structure Impacts – No cultural resources or historic landmarks requiring avoidance, additional investigation, or mitigation were identified within the Project Area. Additional information regarding cultural resources is provided in Section 4906-4-08(D).
- Affirming Suitable Geotechnical Conditions – Geotechnical conditions across the Project Area were further assessed, as discussed in Section 4906-4-08(A)(5) and were found to be generally suitable for solar development. Geotechnical conditions will continue to be further

considered in the final design to ensure proper engineering details of Project components.

- <u>Respecting Landowner Considerations</u> – The Applicant has and will continue to meet with landowners and other members of the community to review the Project's details and seek reasonable ways to mitigate prospective concerns. For instance, after gathering feedback from the public during the Public Information Meeting held on June 24, 2021, and community outreach leading up to it, several key changes have been made to the Project layout and landscaping plan. For example, the Applicant significantly increased the distance of the Project from the Village of Arcadia, in response to concerns pertaining to potential visual effect, which resulted in removing Project features from approximately 8.25 acres within the Project Area. Similarly, feedback regarding potential visual concerns from residents in the vicinity of the intersection of County Road 109 and Township Road 254 has resulted in excluding Project features from another approximately 2.75-acre portion of the Project Area. The Applicant is currently exploring opportunities to utilize such areas for the benefit of the community (e.g., development of a pollinator garden or similar use to enhance visual appeal). Concerns from neighbors about maintaining the rural character of the landscape of the community resulted in proposed enhanced vegetative screening, as reflected in Section 4906-4-8(D)(4). Landowner and community feedback has also reinforced that a careful approach to identification and maintenance of drain tiles (as reflected in

Appendix F), and a thoughtful stormwater management strategy (as reflected in Appendix E), are also considered critical to the Project's layout design.

- Facilitating Access and Electric Collector Line Efficiency – The Project layout has considered opportunities to co-locate access roadways and collector lines to minimize ground-disturbing elements of the Project.
- Maximizing Solar Output – Of key importance is the purpose of the Project, which is to capture solar energy efficiently. The Project layout reflects opportunities to maximize solar output.

Based on local considerations, minimal setbacks were identified for the layout, as detailed in Section 4906-4-08(C); as noted above, locations within the Project layout have been identified where such setbacks have been further enhanced.

(3) Comments Received

In addition to ongoing public outreach by the Applicant, a Public Information Meeting was held on June 24, 2021. To the extent feasible, health precautions were taken, including selection of a large venue with ventilation to allow for appropriate social distancing. A total of 30 attendees signed in, with at least 40 additional people in attendance. The information displayed during the meeting is included in the Public Involvement Program, provided as Appendix G.

During the meeting, the majority of questions and comments received focused on concerns about decommissioning, drain tile, stormwater management, visual impacts, and concerns associated with maintaining the potential for future agricultural use. Each of these issues is addressed in the Application in the appropriate sections.

The Applicant will continue to coordinate with local residents and officials throughout the permitting process and will continue to coordinate as the Project is constructed, commissioned, and operated, as outlined in the Public Involvement Program (Appendix G).

4906-4-05 Electric Grid Interconnection

(A) INTERCONNECTION TO THE REGIONAL ELECTRIC POWER SYSTEM

To interconnect new generation facilities to the electric transmission grid, the Project owner must obtain approval from PJM. PJM is a regional transmission organization that coordinates the movement of wholesale electricity in all of Ohio and all or parts of surrounding states. The interconnection process includes completion of a series of studies by PJM that determine the transmission upgrades required for the project to interconnect to the PJM grid reliably. The Feasibility Study, the System Impact Study, and the Facilities Study are completed to provide developers with increasingly more refined information regarding the scope of any required upgrades, completion deadlines, and implementation costs. The OPSB requires that at least the Feasibility Study and System Impact Study be submitted with the Application. Both are provided in Appendix H.

The Project will deliver power to the existing 138-kV electrical grid. This Application reflects a Project Substation and Utility Switchyard with a POI within the Project Area into the existing 138-kV Ebersole-Fostoria transmission line, which extends across the Project Area. The existing transmission line and proposed POI reflected in this Application are shown on Figure 03-3. A POI to the nearby Fostoria Central 138-kV Substation, which would accommodate the Project's full energy output, will be the subject of a separate OPSB filing and is, therefore, not addressed in this Application. Should this off-site POI be authorized, the Project Substation and Utility Switchyard reflected in this Application would not be constructed; instead, a step-up substation (which would be addressed in the OPSB filing for the off-site POI) would be positioned in proximity to the off-site interconnection route and the interconnection would terminate at an existing substation (i.e., Fostoria Central). Under this scenario, the area previously occupied by impervious surfaces associated with the Project Substation and Utility Switchyard may be used for generation equipment instead. As shown in Figure 05-1, alternatives are under consideration as potential routes to reach the Fostoria Central 138-kV Substation from the Project Area. Alternatives shown on Figure 05-1 are:

- Extending along Township Road 218 from the northeastern portion of the Project Area; and
- Extending along the existing rail Norfolk-Southern right-of-way from the southeastern portion of the Project Area.

Other options or refinements may be identified prior to the separate filing with OPSB and would be reflected in that filing. The length of the proposed off-site interconnection selected will determine the type of filing provided to the OPSB. However, in all instances, the off-site interconnection will be designed to avoid and minimize impacts to the environment and the community.

The Project will utilize 34.5-kV electrical collector lines within the Project Area to gather power from the solar inverters. As shown on Figure 03-2, power will be stepped up from 34.5-kV to 138-kV in the Project Substation, located east of County Road 254 and north of the existing transmission line. The connection to the existing electrical grid will be facilitated by the adjacent proposed utility-owned, developer-funded Utility Switchyard.

(B) INTERCONNECTION REQUESTS

An application for an up to 205-MW facility was initially filed with PJM in August 2017 and given a queue position of AD1-070; at the time, it was anticipated to be a wind energy facility. This application assesses an interconnection into the existing Fostoria Central 138-kV substation, located approximately 1.5 miles to the east of the Project Area. Upon further analysis of the area and consideration of resources, the planned facility was converted in 2020 to a solar facility. The Feasibility Study for queue position AD1-070 was completed in January 2018, and the System Impact Study was completed in December 2019. These studies are available here:

- https://www.pjm.com/pub/planning/project-queues/feas_docs/ad1070_fea.pdf
- https://www.pjm.com/pub/planning/project-queues/impact_studies/ad1070_imp.pdf

As noted above, the off-site interconnection for this queue position will be the subject of a separate OPSB filing.

The proposed interconnection reflected in this Application, for 129.6-MW of solar facility capacity tapping directly into the existing Ebersole-Fostoria Central 138-kV transmission line, was filed with PJM in 2020 and given queue position AF2-375. The Feasibility Study for queue position AF2-375 was completed in July 2020, and the System Impact Study was completed in February 2021. These studies are available here:

- https://www.pjm.com/pub/planning/project-queues/feas_docs/af2375_fea.pdf
- https://www.pjm.com/pub/planning/projectqueues/impact_studies/af2375_imp.pdf

Pending OPSB approval of the off-site interconnection, energy generation from the Project would be restricted to the approximately 130-MW capacity of the on-site POI.

Additional filings with PJM were made in association with the POI to the existing Fostoria Center 138-kV substation, in July 2020 (queue position AG1-076) and March 2021 (queue position AG2-579). Although the energy output to the grid from the Project does not change as a result of these filings (energy output remains at up to 205 MW at any one moment in time), these filings align the capacity injection rights of the Project with the PJM class average capacity injection rights of a single-axis tracking solar facility. The Feasibility Study for queue position AG1-076 was completed in January 2021 (and can be found here:

https://www.pjm.com/pub/planning/project-queues/feas_docs/ag1076_fea.pdf).

The Feasibility Study for queue position AG2-579 is underway.

The PJM studies completed thus far are also provided in Appendix H. Generation Interconnection Facilities Study Reports and draft Interconnection Agreements for queue position AF2-375 and AD1-070 are expected by December 2021.

4906-4-06 Economic Impact and Public Interaction

(A) OWNERSHIP

The Applicant will develop, construct, own, and operate the proposed Project. The Applicant will own all the equipment, structures, and on-site improvements associated with the Project, with the exception of the Utility Switchyard and appurtenances which will facilitate connection into the existing Ebersole-Fostoria 138-kV transmission line. The Applicant possesses development rights for all land within the Project Area via purchase option or easement agreement.

(B) CAPITAL AND INTANGIBLE COSTS

(1) Estimated Capital and Intangible Costs

The total estimated capital and intangible costs of the Project are expected to be approximately [redacted] dollars per kilowatt-alternating current ($/kWac), inclusive of intangible costs and dependent on the final module, racking, and inverter suppliers and modules selected. These costs are broken down in Table 06-1.

TABLE 06-1
ESTIMATED CAPITAL AND INTANGIBLE COSTS

Description	**Cost ($/kWac)**
Tangible Costs	
PV Panels and Racking	[redacted]
Balance of Plant & Civil	[redacted]
Substation and Utility Switchyard	[redacted]
Interconnection Upgrades	[redacted]
Total Tangible Costs	[redacted]
Intangible Costs	
Legal, Development, Financing, and Other Costs	[redacted]
Total Capital Expenses	[redacted]

(2) Capital Cost Comparison

Project installation costs compiled by Lazard's 2020 Levelized Cost of Energy Analysis – Version 14.0 indicate that the capital costs of the Project are consistent with recent industrial trends. Lazard indicates that solar facilities installed in 2020 using PV technology had a capital cost between 825 and 975 $/kWac. The Applicant anticipates comparable capital costs, averaging [redacted] $/kWac. Capital cost variation reflects individual facility parameters such as solar resource, terrain, scale, climate, local labor, and proximity to equipment suppliers.

(3) Present Worth and Annualized Capital Costs for Alternates

Capital costs for the Project will include development costs, construction design and planning, equipment costs, and construction related costs. The costs will be incurred within a year or two of start of construction. Therefore, a present worth analysis is essentially the same as the costs presented above. As there are no alternatives to the Project under consideration, the capital cost information presented is limited to the Project.

No Project configuration alternates are presently being considered and, thus, no comparison can be developed.

(C) OPERATION AND MAINTENANCE EXPENSES

(1) Estimated Annual Operation and Maintenance Expenses

For the first two years of commercial operation, the annual O&M cost of the Project is expected to be approximately $[redacted], or [redacted] $/kWac. These costs include O&M expenses associated with the solar units and balance of plant features, as well as site maintenance and unplanned maintenance reserves.

(2) Operation and Maintenance Expenses Comparison

O&M costs for this Project, not including costs for taxes or land leases, should not be substantially different than O&M costs for other U.S. solar facilities at 14 $/kWac. O&M costs are an important component of the overall cost of solar energy projects and can vary between facilities. Similar to capital costs, annual operations and maintenance expenses vary across geographies and by project scale. Key activities include monitoring and supervision, grid regulation, corrective maintenance, preventative maintenance, and site maintenance.

Modern solar facilities frequently reflect lower O&M costs than industry reports indicate. Industry competition and consolidation of O&M providers has led to significant cost reductions as the solar industry continues to mature.

(3) Present Worth and Annualized Operation and Maintenance Expenses

The annual O&M costs outlined above will be subject to real and inflationary increases. Therefore, these costs are expected to increase with inflation throughout the life of the Project. The present value of the O&M costs per kW, using an inflation rate of 2 percent and assuming a 7 percent discount rate, is approximately 585 $/kWac. The Applicant is not considering any alternate O&M regime or Project technology configurations at this time.

(D) COST OF DELAYS

A delay in Project schedule during the permitting process, based purely on the lost revenue from the solar facility, and assuming a power price similar to other comparable solar facilities, is likely to be greater than $1,000,000 per month. Depending on the length of the delay, it is possible that the Applicant could lose the value of the federal tax credits, which would inflict additional financial burden. Delays would also impact local communities by delaying the receipt of PILOT benefits, including revenue to local schools.

(E) ECONOMIC IMPACT

The proposed Project is expected to generate local and statewide economic benefits. The following sections provide an overview of potential construction- and operation-related economic impacts including estimated payroll, employment, tax revenues, and regional economic benefits. These estimates were developed using Project-specific information and an economic model. Economic impacts and the model are discussed further in the economic impact study prepared for this Project (Appendix H).

(1) Estimated Construction and Operation Payroll

Project construction is proposed to begin in September 2022, with construction activities expected to extend through December 2023. Based on the results of the economic analysis, construction of the Project is estimated to result in on-site employment of approximately 420 full-time equivalent (FTE) positions that may be filled by Ohio residents, with an estimated total of approximately $31.3 million in payroll earnings.[5] These earnings are one-time payments expected to occur during construction.

The results of the economic analysis indicate that the Project's O&M will result in 9 on-site FTE positions with combined estimated earnings of approximately $1.3 million. These payroll earnings are annual estimates that will continue for the life of the Project. Most of the identified FTE positions are expected to be filled by Ohio residents,

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[5] One FTE job equates to one full-time job for one year or 2,080-hour units of labor. Part-time or temporary jobs constitute a fraction of a job. For example, if an engineer works just 3 months on a construction project, that would be considered one-quarter of an FTE job. FTEs are also sometimes referred to as job-years.

and all FTE workers will reside in Ohio. Estimated construction and operation payroll is discussed in more detail in Appendix I.

(2) Estimated Construction and Operation Employment

Project construction is expected to begin in September 2022, with construction activities expected to extend through December 2023. The economic analysis estimates that Project construction will result in on-site employment of approximately 420 FTE positions, the majority of which are expected to be filled by Ohio residents. Certain resources, particularly those focused on project management and commissioning, have greater potential to come from outside the state, remaining only for the duration of their employment.

The results of the economic analysis indicate that the Project's O&M will provide direct employment for 9 FTE workers, most of whom are expected to reside in Ohio. This is an annual employment estimate that will continue for the life of the Project. Project employment is discussed in more detail in Appendix I.

(3) Estimated Increase in Local Revenue

Solar energy projects in the State of Ohio can be exempted from tangible personal property and real property tax payments if they meet certain conditions (as discussed in Appendix I). The Applicant anticipates that it will meet these conditions and, instead, make annual PILOT in accordance with Ohio Revised Code (ORC) 5727.75.

The Applicant anticipates that it will make payments in lieu of real and personal property taxes, with the Project estimated to generate significant payments during its first year of operation, and each year thereafter. Based on an assumption of a PILOT of $9,000/MW for 205 MW, it is estimated that the Project will generate $1,845,000 in revenue annually for Hancock County and other beneficiaries, based on the millage distributions associated with each of the 16 land parcels under site control.

(4) Estimated Economic Impact

Construction and operation of the proposed Project will have a positive effect on local commercial activities in the local area. The largest share of the overall construction costs consists of the purchase of the solar modules. Expenditures related to this construction component are expected to occur outside the state of Ohio. Balance-of-plant and development and other costs are two other broad categories of costs that would have the potential to occur in-state. Balance-of-plant activities include materials, labor, and other costs. The materials portion includes concrete, rebar, and other construction materials, as well as the electrical components and cabling required to prepare the site and install the facility. The labor component includes the site work, foundations, electrical, and other associated labor needed to construct the Project. Development and other costs include legal fees, engineering, site certificates, and other miscellaneous expenditures. Shares of these expenditures are expected to be made locally, within Hancock County and elsewhere in Ohio. This local spending will generate economic activity and support jobs and income elsewhere in the local and regional economies.

The Project will also provide direct operation-related employment and Project-related operations expenditures will generate economic benefits in the local economy. Typical local operation-related expenditures include vehicle-related expenditures, such as fuel costs, site maintenance, replacement parts and equipment, lodging, dining, and procurement of miscellaneous supplies.

Potential regional economic impacts of Project construction and operation were evaluated using the economic model. The results of this analysis are presented in Appendix I and may be summarized as follows:

- Project construction will result in on-site employment of approximately 420 FTE positions that will be filled by Ohio residents, including jobs associated with road construction, drainage, foundations and other civil work, electrical work, and other on-site tasks needed to construct the plant, as well as construction-related service jobs.
- Construction of the Project will also support employment, income, and output elsewhere in the state, with indirect and induced impacts expected to support 650 jobs in Ohio. Overall, construction of the Project is expected to support 1,072 total jobs in Ohio and approximately $72.7 million in earnings, with total economic output of approximately $179 million.
- Once operational, the Project will directly employ a total of 9 FTE, all of whom will reside in Ohio. Project O&M will also support employment, earnings, and output elsewhere in the state, with indirect and induced impacts expected to support 12 jobs in Ohio. Overall, operation of the Project is expected to support 21 total jobs in Ohio and approximately $2.1 million in earnings, with total output of approximately $7.1 million. These annual average impacts are expected to occur over the life of Project operation.

(F) RESPONSIBILITY TO THE PUBLIC

As described above, changes to the current Project layout may occur, but any such changes will not alter the Project Area, will not require agreements for additional properties, and will not impact new property owners or create additional impacts for existing adjacent property owners.

(1) Program for Public Interaction

Throughout the development process, the Applicant has interacted with multiple landowners, including those within and neighboring the Project Area, as well as local officials and community organizations. Information has also been shared through direct landowner mailings, and through a Public Information Meeting held on June 24, 2021. The Applicant will continue to make general information about solar power and specific information about the proposed Project available to community members, elected officials, the media, and local civic organizations during the Application process. Notifications for public hearings will be distributed as part of the Application process, and pre-construction and pre-operation notification will be distributed at least seven days prior to the commencement of construction or operation per the Public Involvement Program (Appendix G).

The Project website, www.southbranchsolar.com, provides an additional opportunity for residents to learn more about the Project and engage with Project representatives. The Project website also contains information applicable to the OPSB public participation and permitting processes, the Public Information Meeting, and Project maps. Project contact information is also provided on the Project website.

If questions or complaints arise during construction or operation of the Project, they can be submitted to the Applicant through the process outlined in the Complaint

Resolution Plan (Appendix J), and submitting the complaint information by mail, phone, or electronically. Complaints received will be recorded by an Applicant representative in a complaint logbook. The Applicant will follow up with complainants via phone within two business days, excluding holidays, with even more rapid responses planned for complaints relating to drain tiles, as reflected in Appendix J. The Applicant is committed to resolving complaints within 30 days of receipt, unless extenuating circumstances require a longer time period, or it is determined that the complaint is unresolvable. A copy of the complaint logbook will be submitted to the OPSB on the 15th day of the month throughout construction and the initial 5 years of operation.

(2) Liability Compensation Plans

The limits of the insurance policy described will, at a minimum, insure against claims of $1,000,000 per occurrence and $2,000,000 in the aggregate. In addition, the Application will acquire and maintain throughout the construction, operation, and decommissioning period, at its sole cost, Umbrella Coverage against claims and liability for personal injury, death, and property damage arising from Project activities. The limits of the excess liability insurance will, at a minimum, insure against claims of $1,000,000 per occurrence and $10,000,000 in the aggregate.

(3) Impact to Roads and Bridges

The Project is expected to have only very modest impacts on roads, bridges, and traffic. During the construction phase, impacts to local traffic are expected to be minimal due to the low volume of existing traffic near the Project Area. Traffic will consist of construction equipment and flatbed or tractor-trailer equipment delivery, multi-axel dump trucks, and conventional pickup trucks or automobiles for workers. Most vehicles will be legal weight and dimensions; however, some overweight/oversize vehicles may be required for the delivery of switchgear or substation transformers.

Delivery routes have not been finalized, but it is likely that delivery of Project components will be via I-75 and State Routes 613 and 12. Local roadway conditions, based on preliminary reconnaissance, were categorized as good or fair. Overhead clearance was also assessed along local roadways. Nothing was noted as posing a hazard, although due to narrowness, use of Township Road 256 will be avoided. In addition, to avoid the potential for unnecessary traffic impact to the Village of Arcadia, Project construction will not use portions of Township Road 254 south of the Project entrance of off Township Road 254. In response to feedback from the community, all construction traffic pertaining to vehicles with a gross vehicle weight exceeding 8,500 pounds will not be permitted to enter the municipal limits of the Village of Arcadia.

Overhead cables will be assessed prior to construction. If an obstruction is noted, utility providers can temporarily or permanently raise the cable and/or move the poles. Therefore, overhead cables are not considered a limiting factor for roadway use. No other obstructions were noted along potential transportation routes to and from the Project Area, such as bridges or overhanging structures that could lead to height or weight restrictions.

Should road conditions change in the future, mitigation techniques will be identified for use on an as-needed basis. Once identified, final transportation routes on local roads will be monitored during construction to ensure safe and drivable conditions for both local and Project traffic. Following completion of construction activities, roadways will be repaired to, or as close as reasonably practicable, pre-construction conditions. Requirements for roadway repairs and improvements will be coordinated with the Hancock County Engineer, which could include development of a written plan, such as a RUMA.

(4) Transportation Permits

Prior to construction, the selected transportation provider will obtain all necessary permits from the Ohio Department of Transportation (ODOT) and County Engineer. Most vehicles used for Project construction and operation meet current legal dimensions and weight (see Appendix K). Therefore, very few transportation-related permits are anticipated. Special Hauling Permits may be required for the delivery of switchgear and substation transformers. Additional permits will be required for driveway access along county roads and crossings of roads and county-maintained ditches by buried collection lines. These permits will be obtained from the county engineers or ODOT, as required.

The Applicant will continue to coordinate with the Hancock County Engineer for appropriate reviews of planned activities as well as details pertaining to traffic control during the construction of the Project. The Transportation Management Plan, provided as Appendix K, will be finalized following final design and prior to construction.

(5) Plan for Decommissioning

A Decommissioning Plan is included as Appendix L and includes details on decommissioning activities, site restoration, cost estimates, and financial assurance. The Applicant will notify OPSB Staff 30 days prior to the commencement of decommissioning activities. Decommissioning activities will include the removal of panels, meteorological stations, inverters, electrical equipment, racking, scrap, piles, access roads, electrical collection lines, and fencing. Some components may remain in place, such as electrical collection lines buried at least 36 inches underground (unless specified otherwise by the landowner or future use) or the Project Substation and Utility Switchyard, if other agreements necessitate their continued use. Additionally, depending on the future land use, agreements may specify other components that can remain in place (e.g., access roads). Support piles that cannot be removed will be cut and removed to at least 48 inches below grade, or at bedrock if higher than 48 inches. Equipment that is removed from the Project Area will be salvaged or recycled to the greatest extent practicable. Other waste materials that hold no value or cannot be recycled will be disposed of via a licensed solid waste disposal facility. Following the completion of decommissioning activities, the site will be graded and de-compacted as necessary to allow the site to be converted to pre-construction land uses. Decommissioning of the Project, including the removal of materials and site restoration, is expected to require approximately 8 months.

An initial decommissioning cost estimate is provided in the Decommissioning Plan (Appendix L). The decommissioning cost estimate will be updated prior to construction, and every 5 years thereafter. If the total decommissioning cost (decommissioning cost minus salvage value) becomes a net positive number, the Applicant will post financial assurance in an amount consistent with the decommissioning cost estimate. Upon each re-evaluation, the financial assurance amount will be adjusted to be consistent with the current total decommissioning cost.

4906-4-07 Air, Water, Solid Waste, and Aviation Regulations

(A) COMPLIANCE WITH APPLICABLE REGULATIONS

This section provides an assessment of the environmental effects, specifically relating to air quality, water quality, and waste generation/disposal associated with the Project.

(B) AIR QUALITY

(1) Preconstruction

(a) Ambient Air Quality

The Project does not require any pre-construction air permits. Therefore, this section does not apply.

(b) Pollution Control Equipment

PV solar panels generate electricity without releasing emissions; therefore, no air pollution control equipment is required for the Project.

(c) State and Federal Performance Standards

PV solar panels generate electricity without releasing emissions; therefore, federal and state programs applicable to emissions sources do not apply. The Applicant will control fugitive dust using BMPs, as described in Section 4906-4-07(B)(2).

(d) Required Permits

No air permit is required for the Project.

(e) Air Monitoring Stations and Major Source Mapping

Air monitoring stations and major source mapping are not applicable to solar projects.

(f) Compliance Plans

Solar facilities generate electricity without generating emissions, and an air permit is not required for the Project. However, fugitive dust can be generated during construction; therefore, the Applicant will control fugitive dust using BMPs as described in Section 4906-4-07(B)(2).

(2) Construction

BMPs will be implemented to minimize dust generated during construction activities. Exposed/disturbed areas will be minimized to the greatest extent practicable and restored/stabilized per the requirements of Ohio EPA Permit No. OHC000005 (Appendix E). During construction, water, or a dust suppressant such as calcium carbonate will be applied on Project access roads and unpaved transportation routes, as needed. Any unanticipated construction related dust problems will be identified and promptly reported to the construction management and contractor. Should any complaints regarding dust generation be received via the complaint resolution process, the Applicant will work to resolve them as quickly as practicable. All construction vehicles will be maintained in good working condition to minimize construction-related emissions.

(3) Operation

(a) Description of Air Monitoring Plans

Air monitoring plans are not applicable to solar energy projects.

(b) Estimated Air Concentration Isopleths

Air concentration isopleths are not applicable to solar energy projects.

(c) Potential Failure of Air Pollution Control Equipment

Air pollution control equipment is not applicable to solar energy projects.

(C) WATER QUALITY

The Project will use a limited amount of water, likely from a small well developed in proximity to the O&M building within the Project Area. The Project does not have any wastewater requirements other the anticipated septic system use associated with the O&M building. Considerations for water quality primarily pertain to stormwater management, and any Water Quality Certification review necessary in association with unavoidable wetland impact and associated permitting. Details for the various Project phases are provided in the sections below.

(1) Preconstruction

(a) Required Permits

Prior to construction, the Project will obtain coverage under the general National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges associated with construction (Ohio EPA's Construction General Permit OHC000005). It is also anticipated that wetland impacts will be either avoided or qualified to receive coverage under the United States Army Corps of Engineers (USACE) Nationwide Permit (NWP) program and/or the Ohio Isolated Wetland Permit program, and that no individual Water Quality Certification will be required (as it will, instead, be integrated into the NWP, to the extent applicable). Permitting requirements will be verified pending final design, and the necessary permits will be obtained.

(b) Location of Survey Data Sources

No new surface sources will be utilized by the Project; therefore, no monitoring or gauging stations have been used to collect preconstruction survey data. Standard engineering design and BMPs will be utilized to minimize impacts associated with on-site stormwater. Impervious surfaces will be limited and consist of access and gravel pads to accommodate inverters, the O&M building, the Project Substation, and Utility Switchyard. Stormwater flows will have no discernible effect on surface or groundwater quality.

(c) Description of Data Sampling Stations and Reporting Procedures

Since there are no monitoring stations, this section is not applicable.

(d) Water Quality of Receiving Stream

The Project will not discharge into streams or water bodies; therefore, this section is not applicable.

(e) Water Discharge Permit Information

No water discharge permitting is required prior to construction, other than confirmation of coverage under the Ohio EPA construction general permit.

(2) Construction

(a) Location of Monitoring Equipment

Stormwater runoff and minor amounts of dewatering are the only discharges associated with the Project during construction. The Project will hire an independent contractor to provide portable sanitary waste units during construction. Therefore, no monitoring or gauging stations will be utilized during construction.

(b) Aquatic Discharges

Water discharges that would influence aquatic resources are not anticipated to occur during Project construction. Stormwater flows, and any dewatering discharge, will be treated using appropriate velocity dissipation and sediment control measures.

Should HDD be used during construction, a contingency plan will be developed to prevent "frac-out" (inadvertent release of non-toxic drilling fluids) (Frac-Out Contingency Plan); a preliminary plan is provided as Appendix M. During work that may occur at environmentally sensitive areas such as streams, environmental oversight will be provided by a specialist, as noted in Appendix M.

Construction has the potential for minimal, localized impacts to groundwater. Soil compaction caused by construction equipment could limit surface water infiltration to groundwater. When soils are compressed, the pore spaces within the soils are decreased, which reduces water percolation. Construction of access roads will result in minor increases in stormwater runoff that other would have infiltrated into the ground at the road locations. Potential stormwater discharges will be addressed through the Applicant's general stormwater permit.

(c) Mitigation Plans

The Applicant will obtain a "General Permit Authorization for Storm Water Discharges Associated with Construction Activity" (also known as a Permit No. OHC000005).[6] To meet NPDES requirements, a qualified engineer will utilize the final Project layout to develop a SWPPP. The SWPPP will identify potential sources of pollution that may reasonably be expected to affect the quality of stormwater discharges associated with construction activities. If applicable, the SWPPP will clearly identify all activities that will be authorized under Section 401

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[6] Ohio EPA, 2018. *General Permit Authorization for Storm Water Discharges Associated with Construction Activity Under the National Pollutant Discharge Elimination System.* April 23, 2018. Retrieved from Ohio EPA: https://www.epa.ohio.gov/portals/35/permits/OHC000005/Final_OHC000005.pdf

of the Clean Water Act and be subject to an anti-degradation review. The SWPPP will also describe and ensure the implementation of BMPs that reduce pollutants in storm water discharges during construction. A preliminary Stormwater Management Plan is provided as Appendix E that includes identification of BMPs.

BMPs based on evaluation of topography, flow direction, and locations of soil disturbing activities, will be used to protect topsoil and adjacent resources and to minimize soil erosion, whether the erosion is caused by water or wind. Practices may include containment of excavated material, protection of exposed soil, stabilization of restored material, implementation of rock pads at construction exits, and treating stockpiles to control fugitive dust. These practices and those described in the Ohio EPA document "Guidance on Post-Construction Storm Water Controls for Solar Panel Arrays" will also mitigate any potential impacts that soil compaction could have on infiltration of rain and snowmelt, thereby further reducing any potential impact to groundwater recharge.[7] Other BMPs may be implemented, as necessary, to comply with OHC000005. BMPs will be reassessed upon receipt of the final Project layout during SWPPP preparation to ensure compliance with Ohio law.

On-site investigations were conducted to establish the locations of streams and wetlands. The Project components were sited to avoid impacts to these resources to the maximum extent practicable. Panels, inverters, the O&M building, the Project Substation, and Utility Switchyard will be placed outside of wetland and waterbody

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[7] Ohio EPA, 2019. Guidance on Post-Construction Storm Water Controls for Solar Panel Arrays. Ohio Environmental Protection Agency, Division of Surface Water. October 2019.

features. One road will require a stream crossing (which will be permitted and constructed in accordance with applicable federal and state regulations and standards), and three collection lines involve stream crossings (although one may be overhead on shared infrastructure). If stream crossings for collection lines are not constructed through the use of HDD or similar techniques, the impacts will be temporary in nature and overseen by an environmental inspector to confirm the work is completed in accordance with applicable federal and state regulations and standards.

Equipment restrictions, herbicide use restrictions, and erosion and sediment control measures will also be utilized to reduce adverse impacts to water quality, surface water hydrology, and aquatic organisms. See Section 4906-4-08(B)(2)(b) for additional details regarding wetlands and waterbodies.

Should HDD construction be used, BMPs associated with the HDD Contingency Plan (Appendix M) will be followed.

(d) Changes in Flow Patterns and Erosion

It is anticipated that the Project will not result in significant changes in flow patterns anticipated. The Project's additional impervious surfaces will be limited to a total of approximately 100 acres in various locations within the approximately 1,000-acre Project Area. The Project's impervious surfaces (associated with access roads; transformer and inverter pads; the O&M building; the Project Substation; and Utility Switchyard) total approximately 10 percent of the Project Area. The panels are not considered impervious, as opportunities for rainfall to reach the ground below and between panels within the array area will continue to exist.

Stormwater calculations and design will determine the need for control measures based on existing soil and surface conditions to prevent Project runoff from impacting water resources or surrounding land uses. A preliminary Stormwater Management Plan is provided as Appendix E.

(e) Description of Monitoring Equipment

Because no water discharges are anticipated to occur in association with Project construction, with the exception of stormwater runoff and dewatering, no monitoring stations are proposed.

(3) Operation

(a) Location of Monitoring Equipment

No monitoring or monitoring equipment is proposed in association with the Project, as measurable impacts on water quality are not anticipated. Stormwater management will use appropriate BMPs.

(b) Water Pollution Control Equipment and Treatment Process

No water pollution control equipment or treatment processes are proposed for the Project; therefore, this section is not applicable.

The proposed Project will not result in wide-scale conversion of land to impervious surfaces. While PV panels themselves are impervious, they are disconnected from the ground surface and allow rainwater to fall from the panel and permeate into the underlying surface. Impervious surfaces found at the site will include the Project Substation, Utility Switchyard, O&M building, inverter and inverter pad, and access roads. The Applicant will perform pre- and post-construction stormwater calculations to determine if post-construction BMPs are required based on requirements contained in Ohio EPA's Permit No. OHC000005. A preliminary Stormwater Management Plan is provided as Appendix E. Per the preliminary Project layout, post-construction BMPs for the impervious surface across the Project Area are anticipated to be minimal. The post-construction storm water calculations will be re-evaluated prior to submission of the final Project layout to reflect final design, consistent with applicable requirements.

As noted in 4906-4-03(2)(b), oil utilized for the cooling and insulation of transformers at the Project Substation and/or Utility Switchyard may be stored within an aboveground storage tank, which will likely exceed 1,320 gallons, within the substation footprint. Per federal regulations (40 CFR Part 112), should the tank exceed 1,320 gallons, an SPCC Plan will be prepared prior to the tank's placement onsite. Oil that is removed from the transformers during maintenance activities will be disposed per the applicable local, state, and federal regulations.

(c) Issuance of Required Permits

No operating permits are anticipated to be required.

(d) Quantitative Flow Diagram

A quantitative flow diagram is not provided, as no operational discharge or leachate will occur other than stormwater runoff and sanitary sewage. Note that the selected panels will be confirmed to meet TCLP criteria.

(e) Water Conservation

As a solar energy facility, the Project uses no water for the generation of electricity; therefore, the Project reflects an excellent means of water conservation. The only Project component anticipated to require water sources will be the O&M

building, through the expected use of an onsite well. Staff operating out of the O&M building will use water at a rate comparable to a typical small business or office. The Project will incorporate water conservation practices by including installation of modern, efficient water fixtures for all water usage, and by regular maintenance to keep water fixtures in proper working order. Washing of the modules is not planned.

Overall, when compared to conventional coal and nuclear power, there are considerable water conservation benefits to solar energy. According to a study by NREL, the total life cycle water use is lower for PV panels than other generation technologies.[8]

(D) SOLID WASTE

(1) Preconstruction

(a) Debris and Solid Waste

No on-site structures are proposed to be demolished prior to construction of the Project.

(b) Waste Management Plan

No formal waste management plan is required, as no preconstruction demolition is planned.

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[8] Meldrun, J., Nettles-Anderson, Heath, S., Heath, G., & Macknick, J. (March 12, 2013). Life cycle water use for electricity generation: a review and harmonization of literature estimates. *Environmental Research Letters*, 8(1). doi:015031.

(2) Construction

(a) Debris and Solid Waste

During Project construction, very limited amounts of non-hazardous, solid waste (an estimated 25,000 cubic yards), which will be reused, recycled, or disposed of accordance with applicable requirements. These non-hazardous, solid wastes may include-e package-related materials, such as crates, nails, boxes, containers, and packing materials, damaged or otherwise unusable parts or materials, and occasional litter and miscellaneous debris generated by workers. Construction of the Project will not generate any hazardous wastes. Non-hazardous, solid waste that is not reused or recycled will be disposed of in a sanitary landfill.

(b) Waste Management Plan

Solid waste that can be neither recycled nor reused will be stored in on-site containers for disposal. Temporary collection areas may exist within each construction area, with larger dumpsters stored within the laydown yards. All waste will be removed from the Project work areas by licensed contractors in accordance with applicable regulatory requirements and managed in licensed facilities. Used automotive fluids resulting from constructions vehicles and universal waste, if any, will be handled, managed, and disposed of in accordance with federal, state, and local regulations and requirements.

(3) Operations

(a) Solid Waste

Operation of the Project will generate only exceedingly small amounts of non-hazardous, solid waste, which will be reused, recycled, or be disposed of accordance with applicable requirements. The O&M building will generate solid wastes comparable to a typical small business office. These non-hazardous, solid wastes are expected to be of the same general nature as those generated during construction, but in far smaller quantities. Operation of the Project will not generate any hazardous wastes.

(b) Waste Management Plan

The O&M building will use a local solid waste disposal and recycling service. Non-hazardous, solid waste that is not reused or recycled may be accumulated in small amounts in appropriate trash receptacles prior to disposal, will not require any treatment, and will be disposed of in a sanitary landfill.

(4) Licenses and Permits

No new solid waste treatment or disposal facility is proposed as part of this Project or will be necessitated as a result of the construction or operation of this Project. All wastes generated will be trucked off-site by an appropriately licensed contractor.

(E) AVIATION

(1) Surrounding Air Navigation Facilities

As shown in Figure 07-1, the closest public air navigation facility is the Fostoria Metropolitan Airport, located more than 5.5 miles northeast of the Project Area. There are several small, private airfields with designated Federal Aviation Administration (FAA) codes in closer proximity to the Project Area. The closest, Rutter Field, is located 1 mile south of the Project Area. All airports within 5 miles of the Project Area have been notified of the proposed Project.

(2) Federal Aviation Administration Filings

There is no need for an aeronautical study with respect to the Project as no part of the Project will be tall enough to obstruct air traffic and the Project is not located "in the vicinity" of a federally obligated airport. The nearest federally obligated airport is the Fostoria Metropolitan Airport, approximately 5.5 miles northeast of the Project Area. All parts of the Project will be lower than 200 feet in height and no component will exceed the slope ratio of a proximate airport. A preliminary analysis, using the FAA's online screening tool, indicates that the proposed Project will likely not exceed any notice criteria. However, out of an abundance of caution, several Form 7460-1 were filed with the FAA, and Determinations of No Hazard were received.

In addition to the potential for obstruction, reflectivity or glare is a concern criterion from the FAA regarding solar facilities. PV modules for this Project will use anti-reflective glass coating and are designed to absorb the light, reducing the potential for glare. Due to the distance from airports, no FAA requirement for a glare analysis is anticipated. More information on potential glare from the Project, including to airports, can be found in the discussion in Section 4906-4-08(D)(4).

4906-4-08 Health and Safety, Land Use, and Ecological Information

This section presents information about the Project regarding health and safety; ecology; land use; community development; cultural and aesthetic qualities; public responsibility; and agricultural district land.

(A) HEALTH AND SAFETY

(1) Equipment Safety

(a) Public Safety Equipment

To protect safety of the public, the Applicant will implement measures to limit access to the Project during construction and operation. During construction, temporary, highly visible mesh fencing will be used around staging and storage areas. Signage will be placed around active and inactive construction areas warning of potential dangers and discouraging entrance by members of the public. The Transportation Management Plan (Appendix K) identifies safety measures that will be implemented near public roads. For example, personnel exposed to public vehicular traffic will be provided with and will wear warning vests or other suitable reflective or high-visibility garments. Lighting, which will be downlit wherever feasible, will be used as necessary for safe operation of equipment, to provide adequate lighting for active work areas, and for security to protect Project components and equipment.

In addition, electronic security systems and remote monitoring will be employed. Motion and switch-activated downlit lighting will be located at Project entrances, the O&M building, and near inverters. Lighting will also be required within the Project Substation and Utility Switchyard. Per the Public Involvement

Program (Appendix G), South Branch's complaint resolution process and contact information will be readily available to address public inquiries, safety concerns, or complaints regarding the Project.

(b) Equipment Reliability

The solar panels and related equipment are expected to be highly reliable. Reputable vendors with established performance records and a good track record of supplying reliable technology and equipment will be selected. Solar panel models will be Bloomberg New Energy Finance "Tier I" solar panel supplier/manufacturer modules that have been safety tested to confirm TCLP testing criteria are met. All equipment will follow applicable industry code(s) such as those associated with the UL, IEEE, NEC, NESC, and ANSI.

(c) Safety Standards

The equipment used for the Project will be certified to comply with applicable industry safety standards (e.g., applicable provides of UL, IEEE, NEC, NESC, ANSI), and the selected panels will have confirmed that TCLP testing criteria are met. Although the specific equipment selected for use in the Project will be identified later, representative specification sheets reflecting equipment standards are provided in Appendix B. Internal setbacks, defined by the Applicant, are discussed in Section 4906-4-08(C)(2) of this Application, although the setbacks are not specifically related to safety.

(d) Public Access

There will be no public access. As the Project will be located on private property and will be fenced, the public would encounter the Project only by trespassing. To further restrict public access, an approximately 7-foot-tall woven agricultural-style fence will be installed around the Project. During operation, security of the Project Area will be maintained by a combination of perimeter security fencing, controlled access gates, electronic security systems, and potentially remote monitoring. Additionally, "No Trespassing" and "High Voltage Equipment" signs will be placed around the fence perimeter, warning the public of the potential hazards within the fenced Project Area. Downward-facing lighting that is switch or motion activated will be installed at Project entrances, the O&M building, and near inverters for additional safety and security; lighting will also provide security for the Project Substation and Utility Switchyard. Remote monitoring and security cameras will be installed at the Project.

(e) Fire Protection, Safety, and Emergency Plans

A Project-specific Health and Safety Plan will be developed and followed during Project construction and operation. The Health and Safety Plan will include an emergency action plan (EAP) and will identify preventive measures to reduce emergency occurrences and actions to address medical emergencies, fires, or spills, as necessary. The Applicant will coordinate with first responders prior to construction to ensure that the first responders are familiar with the EAP and the general layout of the Project. A map denoting the location of safety muster points, office locations, first aid kits, and spill kits will be available onsite for contractor review and use. Fire suppressants, spill kits, and first aid kits will be available in vehicles and construction equipment in case of inadvertent release of fluids or fire during both Project construction and operation. All personnel will undergo a safety training program. Depending on their position, training may include site orientation, first aid/cardiopulmonary resuscitation (CPR)/automated external defibrillator (AED), qualified electrical worker (National Fire Protection Association [NFPA] 70E), and equipment-specific training. The Applicant will maintain communication with emergency responders regarding the EAP throughout the life of the Project.

(2) Impact of Air Pollution Control Equipment Failures

No air pollution is generated by solar energy generating facilities; therefore, this section is not applicable.

(3) Noise

A noise assessment has been conducted to evaluate potential noise impacts from the Project. The assessment examined current background sound levels, modeled results of sound levels from the Project on nearby residences and other potential noise-sensitive resources, and provided typical sound levels from construction activities. The Noise Evaluation is included as Appendix N and summarized below.

(a) Construction Noise

The Noise Evaluation (Appendix N) identifies sound levels for commonly used construction equipment for solar facilities, assuming no attenuation from trees or terrain. Table 6 in the Noise Evaluation identifies the sound level at 15 meters (50 feet) from construction equipment; given that construction equipment might operate close to the Project property boundaries, this is considered to represent potential Project-related sound at property boundaries. Table 6 in the Noise Evaluation identifies that the loudest sound at this distance for any type of equipment used onsite is estimated to be 100 A-weighted decibels (dBA). However, construction activities will be short in duration, and most construction will be set back significantly from the Project Area boundaries.

The Noise Evaluation presents the expected typical construction equipment noise levels for the Project at various distances. The closest nonparticipating residence is approximately 30 feet away from the boundary of the Project Area and at least 160 feet from any proposed solar arrays. While construction is occurring at this nearest property boundary, the sound level is expected to be approximately 94 dBA, reducing further with additional distance. Increased sound levels due to construction of the Project will be temporary, and louder activities would be limited to daytime hours. In addition, not all construction activities would necessarily be occurring in a given area at one time. The impacts from specific activities are considered below.

(i) Blasting Activities

No blasting activities are anticipated for the construction or operation of the Project and, thus, no noise emissions are anticipated from blasting.

(ii) Operation of Earth Moving Equipment

Equipment used for earth moving is anticipated to be consistent with general construction equipment used on a variety of infrastructure projects. Noise emission levels associated with earth moving equipment, including backhoes, dozers, graders, and loaders, are included in the Noise Evaluation (Appendix N). As panels are set back at least 160 feet from residences, and activities in any one area are completed in a relative short duration, noise impacts from earth moving equipment are anticipated to be minimal.

(iii) Driving of Piles, Rock Breaking or Hammering, and Horizontal Directional Drilling

Pile drivers will be used to install the metal posts that hold the racking system for the PV panels. The sound level of these drivers is expected to be similar to other general construction equipment with a nominal sound level of approximately 100 dBA at 50 feet. See Appendix N for sound levels associated with this equipment. As solar panels are set back at least 160 feet from non-participating residences, and pile driving activities in any one area are completed in a relatively short duration, noise impacts from pile driving are anticipated to be intermittent and temporary.

(iv) Erection of Structures

The equipment used to erect structures is anticipated to be consistent with general construction equipment used on a variety of infrastructure projects. The O&M building is the only structure proposed for the Project and will be approximately 1,300 feet from the nearest non-participating residence. Due to the distance and limited duration of construction, noise impacts associated with erection of structures are expected to be minimal.

(v) Truck Traffic

Truck traffic will be necessary to accommodate delivery of Project components during construction. Deliveries will occur relatively infrequently and will be during regular working hours. Once deliveries have reached the Project Area, transportation of materials will follow access roads that are primarily set back from non-participating sensitive receptors. Noise impacts from truck traffic are expected to be minimal.

(vi) Installation of Equipment

Table 6 of Appendix N presents the maximum sound pressure levels for various pieces of equipment at 15 meters (50 feet) away. Table 7 of Appendix N presents construction sound levels as a function of distance and shows that sound levels during Project construction at non-participating residences range from 55 dBA to 94 dBA.

(b) Operational Noise

Compared to other types of power generation facilities, potential noise impacts from a PV solar energy project are limited. Typically, the Project only operates during daylight hours, when background ambient levels are generally higher and listener disruption is less likely. As the Project may have the ability to operate at night to provide reactive power to the grid, nighttime Project sound levels were also evaluated. The following sections address the operational noise anticipated in association with the Project.

(i) Generating Equipment

A detailed operational noise model was developed based on the Project layout. Sound sources in the model include inverters, transformers, and tracker motors. These equipment sound levels were developed from measurements of similar equipment or vendor specifications. The representative equipment sound levels were used to develop a three-dimensional sound model based on ISO 9613-2, a standard for propagation of sound outdoors. Figure 08-1 illustrates surrounding residences and anticipated sound levels to be produced by the Project. Based on the sound model, daytime operation of the Project will not increase sound levels over ambient levels at non-participating property boundaries by more than 1 dBA. This is well below the accepted OPSB standard.

Typical operation of similar PV solar facilities suggests that the inverters will not operate at night. However, the Project maintains the ability to operate at night to provide reactive power to the grid. Therefore, the Noise Evaluation conservatively assumed that nighttime operation could occur. Not only is nighttime operation of the Project expected to be infrequent, but modeling indicates that it will not increase sound over ambient levels at even the closest non-participating residence. This is also well below the accepted OPSB standard.

(ii) Processing Equipment

There is no processing equipment associated with the Project. Therefore, this section is not applicable.

(iii) Associated Road Traffic

Traffic during operations is limited and will primarily be associated with operations personnel traveling to and from the Project Area and will not be a significant source of noise. Traffic within the Project Area will be dispersed and associated with occasional maintenance activities and inspections. Noise from associated traffic is expected to be minimal.

(c) Noise-Sensitive Areas with One Mile

The approximately 1,000-acre Project Area is located in a rural setting, with the Project Area and immediate surroundings dominated by active agricultural fields. Scattered residences are located along local roadways, and the more densely developed Village of Arcadia is located immediately south of the Project Area. Approximately 344 residential structures are located within a 1-mile radius of the Project Area (approximately 57 percent of which are located in the Village of Arcadia). Aeraland Recreation Area is located approximately 0.5-mile north of the Project Area. There are several institutional establishments in the Village of Arcadia located within 1 mile of the Project Area, including Arcadia School. There are no nursing homes or hospitals known to be located within 1 mile of the Project Area.

There are no sites listed by the National Register of Historic Places (NRHP) within the Project Area. Publicly available mapping shows there are no NRHP sites within 1 mile of the Project Area. NRHP-listed resources are further discussed in Section 4906-4-08(D).

The modeled sound contours illustrated in Figure 08-1 indicate the anticipated received sound levels from the Project at noise-sensitive locations within 1 mile of the Project Area. As can be seen, sound levels reduce considerably with distance from the Project. At the closest non-participating residences, the Project will not increase sound levels by more than 1 dBA during the day, and there will be no increase over ambient sound levels during nighttime. With the low Project sound contribution at even the closest receivers, locations farther from the Project Area, for example, farther south within the Village of Arcadia, will have even less influence from the Project. Project sound level impacts are well below the accepted OPSB standard for energy facility sound contributions. See Section 4906-4-08(D)(3) of this Application for additional information on impacts to proximate recreational areas.

(d) Noise Mitigation Measures

(i) Construction Noise

Construction noise is difficult to control because of the mobile nature of its sources and the flexibility of schedule inherent in most construction work. However, construction is also temporary in nature. To mitigate noise during construction as much as reasonably possible, the Applicant will employ best management practices for the construction industry, such as proper maintenance of tools and equipment and the implementation of sound mufflers or silencers, where feasible. The Applicant will work with the local community to advise residents of periods when sustained construction activity is expected. The Applicant will implement a Complaint Resolution Program, provided as Appendix J, to address any complaints received.

Construction will occur between the hours of 7:00 a.m. and 7:00 p.m. or until dusk, when sunset occurs after 7:00 p.m., Monday through Saturday. Limited construction that does not contribute to excess noise at sensitive receptors may occur outside these hours. Pile driving operations will be limited to 8:00 a.m. to 7:00 p.m., Monday through Saturday. These extended pile driving hours will increase efficiency and reduce the total number of days necessary for pile-driving activity. As most construction occurs during normal working hours, noise impacts are expected to be minimal. Setbacks will assist in the mitigation of construction sound, as the Project Area will be at least 30 feet from non-participating sensitive receptors.

By scheduling the construction effort to be as efficient as practicable, sound associated with construction activity will be minimized as the duration of the construction effort is minimized.

Based on the temporary nature of the construction noise, no adverse long-term effects are anticipated.

(ii) Operational Noise

During operation, setbacks have been implemented that will reduce sound impacts from the Project, including a minimum setback of 160 feet between the arrays and non-participating receptors. Representative equipment was modeled and is not anticipated to increase daytime ambient sound levels at non-participating sensitive receptors by more than 1 dBA. Routine maintenance of the Project, such as mowing, typically will be completed between 7:00 a.m. and 7:00 p.m. Occasional maintenance activities during nighttime hours may be necessary to maximize energy collection during the day. These activities will be limited in nature and scope and are not anticipated to produce excessive noise or disturbance.

(e) Existing Ambient Conditions

Existing ambient conditions were measured at locations surrounding the Project Area, as described in additional detail in Appendix N. Three monitoring locations were selected within the Project Area (as shown on Figure 08-1). Weeklong measurements were collected from April 9 to 19, 2021, using Rion NL-52s, ANSI S1.4 Type 1 sound level meters. Statistical metrics were collected in 1-hour increments over the 7-day survey period. The average sound levels for each monitoring location (daytime and nighttime) are provided in Table 08-1;[9] further information is provided in Appendix N.

TABLE 08-1
AMBIENT SOUND SURVEY RESULTS

Monitoring Location	Time Period	Sound Level, L_{Aeq} (dBA)
Location 1	Day	50
	Night	46
Location 2	Day	52
	Night	51

(4) Water

(a) Construction and Operation Impacts

A summary of groundwater resources in Hancock County is provided as Figure 08-2. With no active water wells in the Project Area, as shown on Figure 08-3, and as water bearing units in the Project Area appear to be a minimum of 50 feet below ground surface, it is unlikely that the construction and operation of the Project will impact public and private water supplies. The Applicant will use this information and will coordinate with landowners to further identify specific well locations, and any necessary avoidance or mitigation measures.

The Project is expected to require minimal water usage during construction (approximately 20,000 gallons per day [gpd]), primarily for dust control and vegetation watering. During operation, water needs will also be minimal, estimated as approximately 200 gpd associated with such activities as sanitary uses and

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[9] Data that represented false readings or artificially high levels, such as wind speeds above 5 meters per second, thunderstorms anomalous events, or interactions with equipment by people or animals, were omitted from the sound data sets.

vegetation watering. Final design will determine whether these minimal water needs will be met through agreements with existing landowners, will be trucked in, or may be supplied via an onsite domestic well. Such water demands would be periodic and not continuous. Given the low demand, no significant impact to water bodies or other water resources is expected as a result of the Project.

No water discharge will be associated with the Project other than stormwater. Drain tiles that extend through the Project Area are expected to continue to function as well. As further described in Appendix E, during construction, temporary measures will be used to control storm flows and allow for settling prior to discharge. Once the Project's construction is completed, the relatively small area of ground disturbance associated with Project components is not expected to require stormwater management measures. However, as a part of final design, the need for such controls will be evaluated, and implemented as required in accordance with the Ohio Rainwater and Land Development manual, as addressed in Appendix E.

The Project Area lies within the South Branch Portage River watershed, with the South Branch Portage River crossing several non-contiguous portions of the Project Area as it flows north. An unnamed tributary to the South Branch Portage River flows west across the Project Area. Protection measures to ensure water quality is not affected are addressed in Section 4906-4-08(B).

Known groundwater well logs and water protection areas in locations surrounding the Project Area are shown on Figure 08-3. ODNR has record of 203 water wells drilled within one mile of the Project Area. As shown on Figure 08-3, there are no water protection areas within 1 mile of the Project Area.

Although residents in Hancock County rely on municipal water and private groundwater wells for potable use, no groundwater wells were identified by ODNR within the Project Area. Project construction is not expected to impact groundwater. The Project's low water demand is not expected to impact existing well users. In addition, the Project will protect surrounding wells from potential impact during construction and operation by implementing BMPs. This will include identification of proximate well locations and careful monitoring of construction activities in those locations. Project construction and operational staff will receive training on emergency procedures to ensure prompt and efficient response in the event of an issue that could influence a well or groundwater quality.

(b) Impact of Pollution Control Equipment Failure

The water pollution control to be employed by the Project will be the use of BMPs during construction to control stormwater and wash waters, and design of the septic system to meet applicable standards. Therefore, no impact to public or private water supplies is expected as a result of water pollution control equipment failures.

(c) Proximate Water Sources

Figure 08-3 identifies the locations of known water wells and drinking water source protection areas within the Project Area. Development within proximity of the Project Area is primarily supplied by municipal water and by private groundwater water wells. No water wells were identified within the Project Area;

203 water wells were identified within 1 mile of the Project Area. Of these, a total of eight wells were identified within 500 feet of the Project Area, ranging in distance from 20 to 450 feet. Each is classified as either a residential well or "null" according to ODNR records, with installation dates ranging from 1952 to 2016. Well depths range from 73 to 100 feet, considerably below the depth of Project pile driving. Information provided with regard to the well ratings range from 7 to 100 gallons per minute. Construction drawings will show the location of these wells, and BMPs will be used during construction to prevent activities that could impact groundwater quality or well production.

(d) Compliance with Water Source Protection Plans

Figure 08-3 shows known groundwater well logs, sole-source aquifers, and drinking water source protection areas within and proximate to the Project Area. As shown, there are no water protection areas within or near the Project Area.

The Project does not constitute a use that is restricted within management zones. The Applicant will require only minimal water and will employ BMPs throughout construction to ensure that existing well users are not affected, water quality standards are met, and erosion and sedimentation is minimized. Employing BMPs will ensure safety and mitigate impacts to area water sources.

(e) Potential for Flooding

Figure 08-4 illustrates that there is no area of minimal flood hazard, as defined by the Federal Emergency Management Agency (FEMA), within or near the Project Area. Therefore, the Project is not expected to increase potential for flooding.

(5) Geological Features

(a) Site Geology

The Project Area is located within Hancock County, Ohio. The approximate centroid of the Project Area is located at a latitude of 41.125730° north and a longitude of 83.507022° west. Figure 08-5 illustrates the existing oil and gas well locations mapped by ODNR as located on or within proximity to the Project Area; as shown, there are three inactive oil wells within the Project Area. In addition, according to ODNR mapping, there are two wells identified as active within the Project Area; however, both are listed with a status of "Not Drilled" and do not show any historical production.[10] ODNR has a record of 76 oil and gas wells within one mile of the Project Area. Most of these wells are listed as historical production wells, as part of the Findlay Consolidated Oil and Gas Field.

The Project Area is in the Fostoria Lake-Plain Shoals of the Maumee Lake Plains in the Huron-Erie Lake Plains physiographic region of Ohio, in northwestern Ohio. This physiographic region is characterized by low relief hillocks and shallow closed depressions of the Defiance Moraine that has been lightly eroded by Lake Maumee. Sandy areas are common.[11] The underlying bedrock is limestone and dolomite. This region has soils that are highly fertile, but poorly drained. As shown on Figure 02-1, the overall area is relatively flat, with the noted elevation extremes occurring along the river valleys that traverse the area. Some local features include sand dunes and terminal moraines left over from glaciation. Soils vary across the

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[10] ODNR 2021. Ohio Oil & Gas Wells Mapper, ODNR Division of Oil & Gas. Accessed June 30, 2021. https://gis.ohiodnr.gov/MapViewer/?config=oilgaswells.

[11] ODNR 2021. Ohio Geology Interactive Map, ODNR Division of Geological Survey, Accessed June 30, 2021.

region, including poorly drained clay, well-drained sands, as well as areas of more fertile soils. This region generally has a humid continental climate with cold winters and hot summers, although a small area directly adjacent to the lake (not near the Project Area) has slightly more moderate winters.

The Project Area has low relief, with an approximate high elevation of 805 feet amsl in the southeastern portion, and a low elevation of 780 feet amsl in the northeastern portion. No mapped karst features have been identified within or proximate to the Project Area.[12] Preliminary geotechnical investigations were completed for the Project in May 2021, consisting of seven widely spaced borings explored within the Project Area. The Preliminary Geotechnical Engineering Report is provided as Appendix C.

The report concludes that the Project Area appears to be geotechnically suitable for PV solar development. It has been recommended that the Project be designed to meet seismic requirements for a Class D setting. The soil and rock conditions indicate favorability for pile-supported arrays, and ancillary equipment supported on shallow foundations. No difficult excavation conditions or need for blasting were noted.

(b) Soils and Soil Suitability

Review of the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Web Soil Survey and the Soil Survey of Hancock County, Ohio indicates that the Project Area is comprised of three soil

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[12] ODNR 2021. Karst Interactive Map, ODNR Division of Geological Survey. Accessed June 30, 2021. [Karst Interactive Map Viewer (ohiodnr.gov).](Karst Interactive Map Viewer (ohiodnr.gov))

series, as shown on Figure 08-6. Table 08-2 presents a summary of the soil properties and characteristics, in order of their prevalence within the Project Area. Additional information detailing each soil unit is provided below, in the order of prevalence within the Project Area.

TABLE 08-2
SOIL PROPERTIES AND CHARACTERISTICS

Series Soils	Depth Below Surface (inches)	Drainage Class	Runoff Class	Soil pH	Potential Frost Action
Pewamo	0 – 56	Very Poor	Negligible	5.6 – 8.4	High
Blount	0 – 79	Somewhat Poor	High	4.5 – 8.4	High
Glynwood	0 – 80	Moderately Well	High	4.5 – 8.4	Moderate

Pewamo series soil (PmA) covers approximately 33 percent of the Project Area. The Pewamo series consists of deep, dark-colored soils that are poorly drained. They are nearly level and located on the till plain. Pewamo series soils have a seasonal high-water table. The available moisture capacity is high, and permeability is moderately slow.

Blount series soils (Blg1A1, Blg2A1, and Blg1B1) cover approximately 27 percent of the Project Area. The Blount series consists of very deep, somewhat poorly drained soils on wave-worked till plains, till plains, and near-shore zones (relict). Depth to the top of a perched seasonal high-water table ranges from 0.5 to 2 feet in normal years. Permeability is slow to very slow. These soils are well suited to agricultural use.

Glynwood series soils (GsB, Gwg1B1, and Gwg5C2) covers approximately 26 percent of the Project Area. The Glynwood series consists of very deep, moderately well drained soils on ground moraines and end moraines. The depth to the top of an intermittent perched high-water table ranges from 1 to 2 feet between January and April in normal years. Permeability is slow to very slow. These soils are well suited to agricultural use.

Figure 08-6 illustrates the predominant soils present within the Project Area; the soils are expected to be suitable for Project use.

The Project does not have stringent requirements for subsurface conditions. The Project should not require significant amounts of backfill because the land is generally level, and the arrays will largely follow the existing terrain with little grading needed. When required, trenches are expected to be backfilled with the excavated material, placed in shallow level layers, and compacted, as appropriate. Based on the relatively shallow bedrock found in the area, minimal settling is anticipated.

(c) Geotechnical Evaluation Plan

A Preliminary Geotechnical Engineering Investigation (Appendix C) was conducted for the Project Area in May 2021, which included exploration of seven widely spaced borings. No significant constraints were identified, and the Project Area was determined to be suitable for the Project. Additional geotechnical investigations will occur as a part of final engineering design prior to Project construction.

(6) Wind Velocity

The Project will be engineered and installed to withstand typical high-wind occurrences, as defined by the local wind speed requirements in the structure design codes. These codes have safety factors built into them as well. The solar arrays are tightly secured to steel piles that are driven approximately 7 to 10 feet deep into the ground. The Project is designed using Risk Category 1 maps and is based on the maximum expected three-second gust from the building codes. The module tracker system also has a wind stow mode; when high winds are detected, the modules are moved to a position that lowers the structural loads. The wind stow velocity is typically set below the maximum design wind speed as a precaution.

Average hourly wind speed is presented in Table 08-3, based upon data collected at Findlay Airport (located approximately 10 miles southwest of the Project Area) over the period from 2016 through 2020.

TABLE 08-3
AVERAGE HOURLY WIND SPEEDS

Average Hourly Wind Speed (miles per hour (mph))	National Weather Service Threat Description	Percent of Time
Calms	Non-Threatening [a]	7.7
1.1 – 4.7	Non-Threatening	5.8
4.7 – 8.1	Non-Threatening	26.1
8.1 – 12.7	Non-Threatening	31.2
12.7 – 19.7	Non-Threatening	22.3
19.7 – 24.8	Very Low [b]	5.3
24.8 – 33.6	Very Low to Low [c]	1.5
>33.6	--	0.1

[a] "No Discernable Threat to Life and Property from High Wind." The sustained wind speeds are non-threatening; "breezy" conditions may still be present.

[b] "A Very Low Threat to Life and Property from High Wind." "Breezy" to "Windy" conditions. Sustained wind speeds around 20 mph, or frequent gusts of 25 to 30 mph.

[c] "A Low Threat to Life and Property from High Wind." "Windy" conditions. Sustained wind speeds of 21 to 25 mph, or frequent gusts of 30 to 35 mph.

Note that "Moderate" would be consistent with a wind advisory, and "High" and greater winds would be consistent with a high wind warming.

Source:
https://www.weather.gov/mlb/seasonal_wind_threat#:~:text=Sustained%20wind%20speeds%20around%2020,of%2025%20to%2030%20mph.&text=%22%20No%20Discernable%20Threat%20to%20Life,loose%20objects%20are%20blown%20about.

(7) Blade Shear

This requirement does not apply to the Project because it is not a wind energy facility.

(8) Ice Throw

This requirement does not apply to the Project because it will not include any unenclosed, moving parts that could potentially throw ice.

(9) Shadow Flicker

This requirement does not apply to the Project because it does not include any wind turbines, and the Project will not include any moving parts that could potentially produce shadow flicker at any habitable residence.

(10) Radio and TV Reception

The Project is not expected to have any material impact on radio or television reception because it lacks tall structures and will generate only very weak electromagnetic fields (EMFs) that will dissipate rapidly within a short distance. EMFs generated by PV arrays are similar in nature to electrical appliances and wiring found in most homes and buildings.[13] In a study of three solar arrays in Massachusetts, electric field levels measured along the boundary were not elevated above background.[14] The Applicant is not aware of any research indicating that the Project has the potential to interfere with radio or television reception.

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[13] Massachusetts Department of Energy Resources, et al. *Clean Energy Results: Questions and Answers, Ground-Mounted Solar Photovoltaic Systems* June 2015.

[14] Massachusetts Clean Energy Center. *Study of Acoustic and EMF Levels from Solar Photovoltaic Projects*. December 2012.

(11) Radar Interference

The Project is not expected to have any material impact on military or civilian radar systems because it lacks tall structures that could potentially block radar signals. It will also only generate very weak EMFs that will dissipate rapidly within a short distance.[15] The Applicant is not aware of any research indicating that the Project has the potential to interfere with any radar systems.

(12) Navigable Airspace Interference

The Project is not expected to have any material impact on navigable airspace because it lacks tall structures that could potentially interfere with flight paths and is not immediately proximate to airports (the closest airport is Rutter Airport, a small, private air strip approximately 1 mile southeast of the Project Area). The tallest structure on the Project Area will be the substation lightning mast that will be approximately 70 feet above ground level and adjacent to structures of similar (and taller) height, such as the existing approximately 100-foot-tall 138-kV transmission line into which the Project is proposed to interconnect. The balance of the Project is approximately 15-feet-tall. Determinations of No Hazard to Air Navigation have been received from the FAA.

In addition, glare is not anticipated to interfere with navigable airspace. PV solar technology absorbs light from the sun rather than reflecting it, so glare off the PV solar panels is not anticipated to have a material impact. See Section 4906-4-08(D)(4)) for a discussion of the potential for glare from the Project, including to airports. The Applicant

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[15] Federal Aviation Administration. *Technical Guidance for Evaluating Selected Solar Technologies on Airports*. Version 1.1. April 2018.

is not aware of any research indicating that the Project has the potential to interfere with any navigable airspace.

(13) Communications Interference

When the line-of-sight between two microwave transmitters is blocked, microwave communication signals may be affected.[16] The Project is not expected to have any adverse impact on microwave communication paths because it lacks structures with the potential to block those paths.[17] The tallest Project structure within the Project Area will be the substation lightning mast, which will be approximately 70 feet above ground level, adjacent to existing structures of greater height; the Project Substation and Utility Switchyard will also be proximate to the taller existing overhead electric transmission line. The balance of the Project will be 15 feet tall or less and, therefore, will not interfere with microwave transmissions.

(B) ECOLOGICAL RESOURCES

(1) Ecological Information

(a) Resources within One-Half Mile

Figure 08-7 shows an area one-half mile from the Project Area indicating: Project features; undeveloped woodlots, or vacant tracts of land subjected to past or present surface mining activities, excluding game preserves or areas in active agricultural use; wildlife areas, nature preserves, and other conservation areas; surface bodies of water and wetlands; and highly erodible soils and slopes of 12 percent or greater. As can be seen, the majority of the Project Area is in active

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[16] Polisky, L.E. 2005. White Paper: Identifying and Avoiding Radio Frequency Interference for Wind Turbine Facilities. Prepared for Comsearch, Ashburn Virginia. March 2005.

[17] NREL. 2017a. Global Horizontal Solar Resource for Ohio. Produced for the U.S. Department of Energy. April 4, 2017.

agricultural use, and steep slopes located within the Project Area are primarily localized around the stream corridors that traverse the area.

(b) Wetland and Surface Water Survey

A Wetland and Stream Delineation Report has been completed for the Project and is provided in Appendix O. As specified in 4906-4-08(B)(1)(b), the field investigation focused on the vegetation, wetlands, and surface waters located within 100 feet of the Project's potential construction impact areas (the Study Area).

The field investigation identified two small wetlands and five stream segments (three of which are associated with South Branch Portage River, one is an unnamed perennial stream, and the remaining is an intermittent stream) within the Study Area. Wetland MMA, isolated in a small woodlot surrounded by agricultural land, is approximately 1.0 acre in size and includes forested and emergent habitat. Wetland MMB is approximately 0.84-acre and includes forested habitat adjacent to the South Branch Portage River. Figure 08-8 illustrates the Study Area, with delineated wetland and stream resources identified.

In addition to identifying aquatic resources throughout the Study Area using mapping resources and field confirmation, preliminary data was collected to initiate the evaluation of identified wetlands using the Ohio Rapid Assessment Method (ORAM). ORAM scores provide a functional assessment of wetland quality, with Category 3 wetlands being of the highest quality and Category 1 wetlands being of the lowest quality. No Category 3 wetlands were documented during the field investigations; both delineated wetlands were classified as Category 2.

Preliminary data were also recorded to initiate the evaluation of identified stream feature quality using the Ohio Headwater Habitat Evaluation Index (HHEI) scoring method. This method yields a numerical score that indicates the probable existing aquatic life use of each stream. HHEI scoring classifies streams from Class III (indicating the highest quality) to Class I (indicating the lowest quality) of headwater stream habitat. Based on the evaluation conducted, all the five delineated stream segments were determined to have HHEI scores high enough to be considered Class III waterbodies, largely based on the bank-to-bank dimensions.

(c) Species Literature Survey

Consultation with the USFWS and ODNR began in February 2021 (Appendix P). In a letter dated March 2, 2020, the USFWS identified the Project Area as within the range of the federally listed, endangered Indiana bat (*Myotis sodalis*) and the federally listed, threatened northern long-eared bat (*Myotis septentrionalis*). USFWS noted that unavoidable tree clearing of trees 3 inches or greater diameter at breast height (dbh) should only occur between October 1 and March 31 to avoid impact to these species and requested that additional coordination be undertaken for the siting of this Project.

The Project layout has been developed to avoid tree clearing to the maximum extent practicable (see Figure 08-9). The Applicant has received concurrence from USFWS that, as long as the previously identified seasonal tree clearing restrictions are followed for the approximately 4 acres of necessary tree clearing, no further action should be required to minimize impact to listed species.

Correspondence from the ODNR (Appendix P) was received on May 7, 2021. As was the case with the USFWS, ODNR noted the Project Area is within the range of the Indiana bat and northern long-eared bat, in addition to the state-listed little brown bat (*Myotis lucifugus*) and tricolored bat (*Perimyotis subflavus*). ODNR requested additional desktop review, as well as recommending conservation of trees and a seasonal clearing restriction (October 1 to March 31) if suitable habitat must be cleared. The Applicant has committed to this seasonal clearing restriction.

A number of freshwater mussels were also identified in ODNR's letter. The Project will require one road crossing of the small, unnamed perennial tributary to the South Branch Portage River, and collection line crossings of other streams within the Project Area. Based upon an evaluation of drainage area using StreamStats, only the South Branch Portage River itself has a sufficiently sized watershed to require consideration for mussel habitat; none of the on-site streams are listed in Appendix A of the Ohio Mussel Survey Protocol. Should in-water work occur within the South Branch Portage River, the need for mussel surveys will be considered. However, the Project's collection line crossing of one segment of this stream is expected to use HDD or similar techniques to avoid the need for in-water work.

The western banded killifish (*Fundulus diaphanus*) is noted as occurring within the vicinity of the Project. Streams within the Project Area have been substantially degraded by agricultural practices (including channelization, removal of canopy, siltation, and agricultural runoff). Western banded killifish prefer low-gradient streams with clear water, abundant aquatic vegetation, and substrates of sand, marl, or organic debris free of silt. Furthermore, the stream is a very small perennial stream. Therefore, impacts to the western banded killifish are not anticipated.

ODNR identified the Kirtland's snake (*Clonophis kirtlandii*, state-listed as threatened) as having a range that includes the Project Area, but also indicated based on the location and type of habitat within the Project Area that the Project is unlikely to impact this species.

The black-crowned night-heron (*Nycticorax nycticorax*) and the least bittern (*Ixobrychus exilis*) were also identified as potential occurring within this area of Ohio. Both prefer wetland and waterbody habitats that are not present within the Project Area. Therefore, neither species are anticipated to be present or impacted by the Project.

The northern harrier (*Circus cyaneus*, state-listed as endangered) was identified by ODNR as a common migrant and winter species in the Project Area. Nesters were noted to be much rarer, although they occasionally breed in large marshes and grasslands. ODNR stated that construction should avoid this type of habitat between May 15 and August 1 to avoid impacts to northern harrier if such areas exist within the Project Area. The Project Area does not include large marshes or natural grasslands/pasture. Therefore, the noted construction restrictions are not anticipated to be warranted.

ODNR also noted a partnership between the ODNR Division of Wildlife and the Ohio Pollinator Habitat Initiative aimed at creating and enhancing pollinator habitat at solar power installations. A Project Assessment Form was provided along with planting recommendations for developing pollinator habitat during the operation of the Project. The Project intends to utilize pollinator-friendly plantings as a part of its landscape plan as a means to provide visually appealing groundcover, habitat opportunities, and a diversity of low-growing vegetation that will preserve and benefit the ability of the Project Area to return to agricultural uses in future, if desired.

ODNR confirmation regarding the above information is provided in Appendix P.

(d) Species Field Survey

Plant and animal life were surveyed during the wetland delineation activities conducted in April 2021.

As shown on Figure 08-10, the predominant ecological community present within the Project Area is managed agricultural lands. The remainder of the Project Area is comprised of developed, forested, and shrub scrub land.

(i) Flora

A survey was conducted of representative plant species present within the Project Area. At the time of the field visits, most the Project Area consisted of active agricultural fields in row crops. Three additional ecological communities were observed in much smaller quantities and include: developed areas (existing transportation and utility ROWs), forest, and scrub shrub land. A list of plant species noted on and adjacent to the Project Area during the field visits is provided in Table 08-4.

TABLE 08-4
VEGETATION RECORDED ON AND ADJACENT TO THE STUDY AREA

Common Name	Scientific Name	Strata	Ecological Community[1]
Ash-leaf maple	*Acer negundo*	Tree/Shrub	Forested
Red maple	*Acer rubrum*	Tree/Shrub	Forested
Silver maple	*Acer saccharinum*	Tree/Shrub	Forested
Sugar maple	*Acer saccharum*	Tree/Shrub	Forested
Ohio buckeye	*Aesculus glabra*	Shrub	Forested
Early yellowrocket	*Barbarea vulgaris*	Herb	Forested
Beggarticks	*Bidens spp.*	Herb	Agricultural
Shoreline sedge	*Carex hyalinolepis*	Herb	Forested
Lakebank sedge	*Carex lacustris*	Herb	Forested
Shellbark hickory	*Carya lacinosa*	Tree/Shrub	Forested
Shagbark hickory	*Carya ovata*	Tree/Shrub	Forested
Common hackberry	*Celtis occidentalis*	Tree/Shrub	Forested
Silky dogwood	*Cornus amomum*	Shrub	Forested
Gray dogwood	*Cornus racemosa*	Shrub	Forested
Hawthorn	*Crataegus spp.*	Shrub	Forested
Queen Anne’s lace	*Daucus carota*	Herb	Agricultural, Developed
Large crabgrass	*Digitaria sanguinalis*	Herb	Agricultural, Developed
Cutleaf teasel	*Dipsacus laciniatus*	Herb	Agricultural
Trout lily	*Erythronium americanum*	Herb	Forested
Common horsetail	*Equisetum arvense*	Herb	Agricultural
White ash	*Fraxinus americana*	Tree/Shrub	Forested
Green ash	*Fraxinus pennsylvanica*	Tree/Shrub	Forested
Sticky-willy	*Galium aparine*	Herb	Forested
Honey locust	*Gleditsia triacanthos*	Tree/Shrub	Forested, Scrub Shrub
Black walnut	*Juglans nigra*	Tree	Forested
Perennial ryegrass	*Lolium perenne*	Herb	Agricultural, Developed
Amur honeysuckle	*Loinicera maackii*	Shrub	Forested
Osage orange	*Maclura pomifera*	Tree/Shrub	Forested

Common Name	Scientific Name	Strata	Ecological Community[1]
Pennsylvania smartweed	*Persicaria pensylvanica*	Herb	Agricultural
Reed canary grass	*Phalaris arundinacea*	Herb	Agricultural, Developed
Creeping phlox	*Phlox subulata*	Herb	Forested
American sycamore	*Platanus occidentalis*	Tree	Forested
Grass (Maintained lawn/roadside)	*Poa spp.*	Herb	Agricultural, Developed
American hop hornbeam	*Ostrya virginiana*	Three/Shrub	Forested
Eastern cottonwood	*Populus deltoides*	Tree	Forested
Black cherry	*Prunus serotina*	Tree/Shrub	Forested
White Oak	*Quercus alba*	Tree	Forested
Burr oak	*Quercus macrocarpa*	Tree	Forested
Chinquapin Oak	*Quercus muehlenbergii*	Tree	Forested
Red oak	*Quercus rubra*	Tree/Shrub	Forested
Multiflora rose	*Rosa multiflora*	Shrub	Forested
Allegheny blackberry	*Rubus allegheniensis*	Herb/Shrub	Forested/Scrub Shrub
Black raspberry	*Rubus occidentalis*	Herb/Shrub	Forested
Tall fescue	*Schedonorus arundinaceus*	Herb	Agricultural, Developed
Giant foxtail	*Setaria faberi*	Herb	Agricultural
Goldenrod	*Solidago sp.*	Herb	Agricultural, Developed, Forested, Scrub Shrub
Asters	*Symphyotrichum spp.*	Herb	Agricultural, Developed
Dandelion	*Taraxacum officinale*	Herb	Agricultural, Developed
American basswood	*Tilia americana*	Tree	Forested
Eastern poison ivy	*Toxicodendron radicans*	Vine	Agricultural, Developed, Forested
Winter wheat	*Triticum aestivum*	Herb	Agricultural
Red clover	*Trifolium pratense*	Herb	Agricultural, Developed
White clover	*Trifolium repens*	Herb	Agricultural, Developed
American elm	*Ulmus americana*	Tree/Shrub	Forested
Slippery elm	*Ulmus rubra*	Tree/Shrub	Forested

Common Name	Scientific Name	Strata	Ecological Community[1]
Wild grape	*Vitis spp.*	Vine	Forested
Prickly ash	*Zanthoxylum americanum*	Shrub	Forested
[1] Ecological communities are mapped on Figure 08-10.			

Agricultural fields are located throughout the Project Area and make up the majority of the land use within the Project Area. The agricultural land is maintained as active row crop planted with either soybean (*Glycine max*) or corn (*Zea mays*). A large portion of the agricultural fields were planted with winter wheat (*Triticum aestivum*) at the time of the study.

Two overhead electric transmission line ROW cut east-west through the Project Area. There is no notable difference in habitat type within the agricultural fields where the lines are located.

The Project Area contains several relatively small areas of mid-successional deciduous forest. Typical trees and shrubs found in forested areas include red maple (*Acer rubrum*), sugar maple (*Acer saccharum*), shagbark hickory (*Carya ovata*), honey locust (*Gleditsia triacanthos*), northern red oak (*Quercus rubra*), and slippery elm (*Ulmus rubra*). Herbaceous vegetation and shrubs consist of multiflora rose (*Rosa multiflora*), Allegheny blackberry (*Rubus allegheniensis*), black raspberry (*Rubus occidentalis*), Amur honeysuckle (*Lonicera maackii*), and dogwoods (*Cornus spp.*). Hedgerows and forested areas bordering the agricultural fields are similarly vegetated.

Developed areas make up a small portion of the Project Area and consist of paved roads, vegetated road shoulders, and utility right-of-way corridors. Vegetation within these areas contains a mix of upland grasses, goldenrods (*Solidago spp.*), clovers (*Trifolium spp.*), Queen Anne's lace (*Daucus carota*), dandelion (*Taraxacum officinale*), and other common species.

Wetlands have been identified within the Project Area and are described in Section 4906-4-08(B)(1)(b).

(ii) Fauna

An assessment of wildlife species and habitat was conducted within the Project Area in April 2021. Table 08-5 lists wildlife species observed during field investigations through direct observation or sign, as well as identified as likely through desktop review. Land use of the Project Area is largely agricultural with small areas of forest, wetland, and riparian corridors, which generally provide moderate to good quality wildlife habitat.

TABLE 08-5
WILDLIFE SPECIES RECORDED ON AND ADJACENT TO THE STUDY AREA

Common Name	Latin Binomial	Classification
Red-winged blackbird	*Agelaius phoeniceus*	Bird
Wood duck	*Aix sponsa*	Bird
Mallard	*Anas platyrhynchos*	Bird
Great blue heron	*Ardea herodias*	Bird
Canada goose	*Branta canadensis*	Bird
Red-tailed hawk	*Buteo jamaicensis*	Bird
Coyote	*Canis latrans*	Mammal
Northern cardinal	*Cardinalis cardinalis*	Bird
Turkey vulture	*Cathartes aura*	Bird

Common Name	Latin Binomial	Classification
Killdeer	*Charadrius vociferous*	Bird
Northern flicker	*Colaptes auratus*	Bird
American crow	*Corvus brachyrhynchos*	Bird
Blue jay	*Cyanocitta cristata*	Bird
Downy woodpecker	*Dryobates pubescens*	Bird
Pileated woodpecker	*Dryocopus pileatus*	Bird
Gray treefrog	*Hyla chrysoscelis*	Amphibian
Green frog	*Lithobates clamitans*	Amphibian
Woodchuck	*Marmota monax*	Mammal
White-tailed deer	*Odocoileus virginianus*	Mammal
Raccoon	*Procyon lotor*	Mammal
Western chorus frog	*Pseudacris triseriata*	Amphibian
Eastern grey squirrel	*Sciurus carolinensis*	Mammal
Field sparrow	*Spizella pusilla*	Bird
Eastern chipmunk	*Tamias striatus*	Mammal
American robin	*Turdus migratorius*	Bird
Red fox	*Vulpes vulpes*	Mammal
Mourning dove	*Zenaida macroura*	Bird

Common avian species are likely utilizing the Project Area for nesting in spring and summer months. Migratory bird species are also likely utilizing the Project Area for foraging during spring and fall migration periods; non-migratory resident species may also be present.

Mammals utilizing the Project Area include herbivorous species such as white-tailed deer (*Odocoileus virginianus*) and eastern gray squirrels (*Sciurus carolinensis*), and omnivores such as raccoons (*Procyon lotor*). Tracks and scat suggest the presence of coyotes (*Canis latrans*) within the Project Area, and a red fox pup (*Vulpes vulpes*) was observed during field investigations. Shagbark hickory and shellbark hickory trees are present in woodlots and along field edges in the Project Area and the exfoliating bark observed on these trees has the potential to provide roosting habitat for tree-roosting bat species.

Common reptiles and amphibian species would be expected to occur within the Project Area. Gray treefrog (*Hyla chrysoscelis*) and Western chorus frog (*Pseudacirs triseriata*) calls were heard during field investigations, and green frogs (*Lithobates clamitans*) were observed along stream corridors. The extensive upland agricultural habitat present throughout the Project Area would generally be considered poor habitat for many reptiles and amphibians (e.g., salamander and turtle species).

Few invertebrate species (i.e., insects) were observed during the site visit, but it is likely that many common invertebrate species such as these would be present within the Project Area during warmer months.

(e) Additional Ecological Studies

No additional ecological studies, beyond the wetland delineation and wildlife and vegetation surveys discussed in the previous sections have been completed in support of the Project. If determined necessary, future studies will be completed, and results will be provided to USFWS, ODNR, and OPSB, as applicable.

(2) Construction Ecological Impacts

(a) Anticipated Construction Impacts

There are no construction-related impacts to recreational areas, parks, wildlife areas, nature preserves, or other conservation areas anticipated in association with the Project, as none have been identified within 0.4-mile.

Because tree clearing restrictions protective of listed bat species (from October 1 through March 31) will be implemented, consideration will be given to the need for mussel surveys if warranted. Other noted species are not anticipated to be present. No impacts to federal or state-listed plant or animal species are anticipated to occur.

Through careful design and avoidance measures, the Applicant anticipates no impact to delineated wetlands and minimal impact to streams within the Project Area. When work occurs near environmentally sensitive areas, such as wetlands or streams, the Applicant will assign a qualified environmental specialist to be present during such activities. One stream crossing is proposed for road access that will involve less than 0.1 acre of impact. Additionally, two underground collection line crossings will be installed across streams; if appropriate, HDD or similar techniques will be used to avoid and minimize impacts. A third collection line crossing of the intermittent stream is expected to share existing overhead structures. An HDD Contingency Plan was developed pursuant to OAC 4906-4-08(B)(2)(b)(ii) and is included as Appendix M.

(b) Construction Mitigation

Site restoration and stabilization of disturbed soils

Restoration activities are anticipated to include the following:

- Soil above the underground collection lines will be restored to preconstruction contours as necessary and allowed to regenerate naturally.
- Disturbed soils within the Project's fence line will be reseeded with a low-growth, native seed mix to stabilize exposed soils and control sedimentation and erosion.
- The laydown yards will be de-compacted, topsoil redistributed, and seeded with a low-growth, native seed mix to stabilize exposed soils and control sedimentation and erosion.

All waste material and debris will be stockpiled in designated locations. Each stockpile will be transported offsite to either a recycling center, when feasible, or to an approved landfill depending on the material type. Debris will be broken down into manageable sizes to aid in their transportation.

As described in Appendix E, to minimize surface water runoff during construction, BMPs will be implemented, and stormwater controls will be kept in place through the completion of construction and removed once permanent stabilization measures have been installed.

The objectives of reclamation and revegetation are to allow for the efficient establishment of vegetation within the Project Area. In excavated areas, topsoil and subsoil will be segregated and separately backfilled, and soil will be treated, as necessary, to preserve approximate pre-construction capability.

HDD Inadvertent Return (frac out) Contingency Plan

Three underground collection line crossings will be installed across streams; HDD or similar techniques may be used when installing collection lines across perennial streams, to avoid the need for direct impacts. An HDD Contingency Plan was developed and is included as Appendix M. As noted in the plan, an environmental specialist would be present for such activities as an additional assurance that continencies would be effectively met.

Methods to demarcate surface waters and wetlands during construction

The boundaries of streams and wetlands within and immediately adjacent to the construction limits of disturbance will be demarcated by silt/exclusionary fencing to clearly indicate avoidance areas. These will also be marked on final construction documents. Other sensitive resources will be marked as "Environmentally Sensitive Areas" on final construction documents. All contractors and subcontractors working onsite will be provided with training to understand the significance of the types of indicators used, and the importance of staying within defined limits of work areas.

Inspection procedures for erosion control measures

As noted previously, the Applicant will seek coverage for the Project under Ohio EPA Permit No. OHC000005. The permit requires development of a SWPPP for erosion control and stormwater management, and requires the regular inspection of erosion control measures, as described below. Preliminary considerations for stormwater management are addressed in Appendix E.

Erosion and sediment control measures will be inspected by a qualified individual through the construction phase to assure that they are functioning properly. These features will be inspected until 70 percent permanent vegetated cover has been established across disturbed areas. Disturbed areas and areas used for storage of materials that are exposed to precipitation will be inspected for evidence of, or the potential for, pollutants entering the drainage system. Locations where vehicles enter or exit the Project Area will be inspected for evidence of offsite vehicle tracking. Inspections will be conducted at least once every 7 calendar days, and within 24 hours after any storm event with 0.5-inch or greater of rain. The inspection frequency may be reduced to once every month if the Project Area is temporarily stabilized and runoff is unlikely due to weather conditions such as snow, ice, or frozen ground.

Following each inspection, the qualified inspector will complete and sign a checklist and inspection report. At a minimum, the inspection report will include:

- The inspection date;
- Names, titles, and qualifications of personnel making the inspection;

- Weather information for the period since the last inspection (or since commencement of construction activity if the first inspection) including a best estimate of the beginning of each storm event, duration of each storm event, approximate amount of rainfall for each storm event (in inches), and whether any discharges occurred;
- Weather information and a description of any discharge occurring at the time of the inspection;
- Locations of any BMPs that need to be maintained; and
- Any corrective actions recommended.

The inspection report will be distributed to the contractor, and any corrective actions will be promptly addressed by onsite staff to ensure permit compliance.

Following site stabilization, a notice of termination form will be submitted to the Ohio EPA, in accordance with NPDES permit requirements. For three years following the submittal of a notice termination form, the Applicant will maintain a record summarizing the results of the SWPPP inspections described above, including the name(s) and qualifications of personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the SWPPP, and a signed certification as to whether the Project is in compliance with the SWPPP.

Measures to protect vegetation

The Project Area consists primarily of active agricultural land. Therefore, limited trees exist in small clumps or linear features along the fringe of active agricultural areas. The limited tree clearing proposed will be completed from October 1 through March 31. Other measures to protect vegetation include identifying sensitive areas such as wetlands where no disturbance or vehicular activities will be allowed; limiting areas of disturbance to the smallest size practicable; preserving mature trees to the maximum extent practicable; educating the construction workers on respecting and adhering to the physical boundaries of off-limit areas; and employing BMPs during construction. A benefit of the Project is that ground disturbance will be extremely limited due to the existing relatively flat terrain, and existing ground cover can remain in place. Following construction activities, temporarily disturbed areas will be re-established with native vegetation. Seed mixes for the Project will incorporate suggestions from ODNR and Ohio Pollinator Habitat Initiative to reestablish vegetative cover in these areas. Refer to the Vegetation Management Plan (Appendix D) for more information.

Options for clearing methods and disposal of brush

Approximately 4 acres of tree clearing is anticipated for the Project. The limited tree clearing will be completed from October 1 through March 31 to avoid potential impacts to listed bat species. Disposal of cleared trees and shrubs will likely consist of chipping or grinding, then using as woodchips for temporary ground cover or mulch. Offsite transport of woody material is not anticipated; however, if necessary, such disposal will be completed by a qualified contractor in accordance with local, state, and federal regulations.

<u>Avoidance measures for state or federally listed and protected species and their habitats</u>

Based on consultations with ODNR and USFWS, as confirmed by field surveys, and given the anticipated use of HDD or similar techniques for collection line crossings of perennial streams and implementation of seasonal clearing restrictions for trees greater than or equal to 3 inches dbh, it is unlikely that any state or federally listed species will be impacted by the Project. No post-construction wildlife monitoring is proposed. Coordination letters are included in Appendix P.

The Applicant will contact OPSB Staff and the applicable federal or state agency within 24 hours if federal or state listed species are encountered during construction activities. Construction activities that could adversely impact the identified plants or animals will be halted until an appropriate course of action has been agreed upon by the Applicant, OPSB Staff, and other applicable agencies.

(3) Operational Ecological Impact

(a) Impact of Operation and Maintenance

Aside from minor disturbances associated with routine maintenance and occasional repair activities, no additional disturbance to plants, vegetative communities, wetlands, or surface waters is anticipated from Project operation. The Project will not result in physical disturbances or impacts to recreational areas, parks, wildlife areas, nature preserves, or other conservation areas, as identified in Section 4906-4-08(B)(1)(a).

(b) Operation and Maintenance Mitigation

Once operational, no additional ecological impacts from the Project are anticipated. The Applicant has sited the Project to avoid wetlands and streams to the maximum extent practicable, and no additional impacts to these resources are anticipated following construction.

Vegetation management efforts such as fertilization, mulching, pruning mowing, and herbicide application will be required for continued maintenance of the Project Area. Mowing activities will occur regularly within the first three years, to discourage the establishment of invasive species. If herbicide application is required, it will be applied by qualified, commercially licensed contractors in compliance with state requirements governing use, distribution, and record-keeping. The Applicant is considering grazing as a form of natural vegetation management to restrict the spread of non-native species, prevent excess litter accumulation, improve forage production, and accelerate decomposition and nutrient cycling. Additional information on grazing and other vegetation management methods and impacts are provided in the Vegetation Management Plan (Appendix D). Definitive plans for grazing as vegetation management have not yet been made and would be contingent on a willing community partner and the development of an amendable agreement between the Applicant and partner.

The potential for direct impacts to wildlife from Project operations is low. Because no significant operational impacts to these resources are anticipated, no mitigation measures are proposed.

(c) Post-Construction Monitoring of Wildlife Impacts

No post-construction monitoring for wildlife impacts is proposed at this time.

(C) LAND USE AND COMMUNITY DEVELOPMENT

(1) Existing Land Use

(a) Land Use Mapping

Figure 08-10 presents land use within a 1-mile radius of the Project Area, showing the proposed Project, surrounding incorporated areas, and population centers. Indicated land uses include:

- Residential;
- Commercial;
- Industrial;
- Infrastructure;
- Institutional;
- Recreational;
- Agricultural; and
- Vacant.

As outlined in Table 08-6, and shown on Figure 08-10, the area surrounding the Project Area covers approximately 8,650 acres and is primarily in agricultural use, with intermittent forested area.

TABLE 08-6
LAND USE WITHIN 1 MILE OF THE PROJECT AREA

Land Use	Approximate Acreage	Percentage of Total Area
Agricultural	7,050.2	81.5
Commercial	9.6	0.1
Industrial	18.2	0.2
Infrastructure	701.1	8.2
Institutional	26.4	0.3
Recreational	81.7	0.9
Residential	225.3	2.6
Vacant	536.5	6.2
Total	**8,649**	**100.0**

There are scattered residences located proximate to the Project Area in most directions, with a more densely settled area reflected by the Village of Arcadia to the south. Within the 5-mile study area, additional sensitive land uses include hospitals, churches, schools, libraries, several industrial facilities, and various recreational facilities. None are located within 0.25-mile of the Project Area, and most are located more than 1.5 miles away.

(b) Existing Structures

Although OAC 4906-4-08(C)(1)(b)(i) requires only those structures within 1,500 feet of Project-generating equipment to be identified, due to potential layout adjustments that may occur, the location and underlying parcel status of all structures, conservatively measured 1,500 feet from the boundary of the Project Area, have been identified. There are 353 structures (17 of them transmission towers, 137 of them residences, and the remainder various outbuildings) within 1,500 feet of the Project Area (Figure 08-11). For each of these structures, Table 08-7 identifies the structure type; distance to the Project Area; and underlying parcel status.

TABLE 08-7
STRUCTURES WITHIN 1,500 FEET OF PROPOSED PROJECT AREA

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
Garage	32	Non-Participating	No
Silo	34	Non-Participating	No
Garage	39	Participating	No
Outbuilding	39	Non-Participating	No
House	43	Non-Participating	No
House	43	Non-Participating	No
Outbuilding	48	Participating	No
House	49	Non-Participating	No
Garage	50	Non-Participating	No
House	53	Non-Participating	No
House	55	Non-Participating	No
House	56	Non-Participating	No
Outbuilding	58	Non-participating	No
Barn	58	Non-Participating	No
House	59	Non-Participating	No
Barn	61	Non-Participating	No
Outbuilding	65	Non-Participating	No
House	65	Non-Participating	No
House	67	Non-Participating	No
House	68	Non-Participating	No
House	72	Non-Participating	No
House	75	Participating	No
House	76	Non-Participating	No
Silo	78	Non-Participating	No
Garage	82	Non-Participating	No
Silo	83	Non-Participating	No
Barn	83	Participating	No
Outbuilding	85	Non-Participating	No
Outbuilding	87	Non-Participating	No
Garage	89	Non-Participating	No
House	92	Non-Participating	No
House	95	Non-Participating	No
House	100	Non-Participating	No
House	104	Non-Participating	No
House	106	Non-Participating	Yes
House	109	Non-Participating	No
Outbuilding	111	Non-Participating	No
Outbuilding	112	Non-Participating	No
Garage	112	Non-Participating	No
Barn	113	Non-Participating	No
House	114	Non-Participating	Yes
Garage	115	Non-Participating	No
Garage	121	Non-Participating	No

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
House	129	Non-Participating	No
Garage	135	Non-Participating	No
Barn	147	Participating	No
Silo	148	Non-Participating	No
Barn	151	Non-Participating	No
Garage	158	Non-Participating	No
Barn	160	Non-Participating	No
Barn	161	Non-Participating	No
Barn	164	Participating	No
House	164	Non-Participating	No
Outbuilding	165	Non-Participating	No
Silo	165	Non-Participating	No
Outbuilding	168	Non-Participating	Yes
Barn	171	Non-Participating	No
House	174	Non-Participating	No
Silo	176	Non-Participating	No
Outbuilding	177	Non-Participating	No
Silo	180	Non-Participating	No
Silo	188	Participating	No
Barn	193	Non-Participating	No
Barn	195	Non-Participating	No
Barn	195	Participating	No
Barn	198	Non-Participating	Yes
Barn	199	Non-Participating	No
House	199	Non-Participating	No
Garage	208	Non-Participating	No
House	208	Non-Participating	Yes
Silo	210	Non-Participating	No
Barn	212	Non-Participating	Yes
Barn	218	Participating	No
Barn	226	Non-Participating	No
Outbuilding	230	Non-Participating	No
House	230	Non-Participating	No
House	232	Non-Participating	Yes
House	238	Non-Participating	Yes
Barn	241	Non-Participating	No
Outbuilding	241	Non-Participating	Yes
House	256	Non-Participating	Yes
Outbuilding	270	Non-Participating	No
Barn	289	Non-Participating	No
House	290	Non-Participating	No
Garage	296	Non-Participating	No
Outbuilding	300	Non-Participating	No
House	303	Participating	No
House	304	Non-Participating	No
House	305	Non-Participating	No

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
Outbuilding	308	Non-Participating	No
Outbuilding	311	Non-Participating	No
House	315	Non-Participating	No
Garage	345	Non-Participating	No
House	365	Non-Participating	No
Garage	369	Non-Participating	No
Garage	370	Non-Participating	No
House	372	Non-Participating	No
Outbuilding	374	Non-Participating	No
Garage	383	Non-Participating	No
Outbuilding	395	Non-Participating	No
House	416	Non-Participating	No
House	441	Non-Participating	No
House	443	Non-Participating	Yes
House	444	Non-Participating	No
Barn	450	Non-Participating	Yes
House	452	Non-Participating	Yes
House	457	Non-Participating	Yes
House	467	Non-Participating	Yes
Garage	470	Non-Participating	Yes
Garage	470	Non-Participating	Yes
House	483	Non-Participating	Yes
House	496	Non-Participating	Yes
Garage	501	Non-Participating	No
House	502	Non-Participating	No
Barn	512	Non-Participating	No
House	518	Non-Participating	Yes
Outbuilding	519	Non-Participating	Yes
Outbuilding	524	Non-Participating	Yes
House	525	Non-Participating	No
Silo	533	Non-Participating	No
Barn	538	Non-Participating	No
House	546	Non-Participating	Yes
House	552	Non-Participating	Yes
Garage	559	Non-Participating	Yes
Silo	560	Non-Participating	No
House	562	Non-Participating	Yes
Outbuilding	567	Non-Participating	No
House	569	Non-Participating	Yes
Garage	572	Non-Participating	Yes
Outbuilding	572	Non-Participating	Yes
Garage	576	Non-Participating	Yes
House	579	Non-Participating	Yes
House	579	Non-Participating	No
Outbuilding	583	Non-Participating	Yes
House	586	Non-Participating	Yes

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
Barn	593	Non-Participating	No
Garage	605	Non-Participating	No
Barn	609	Non-Participating	No
Outbuilding	612	Non-Participating	No
Garage	614	Non-Participating	Yes
House	617	Non-Participating	Yes
Barn	625	Non-Participating	No
Outbuilding	626	Non-Participating	No
Barn	627	Non-Participating	No
Barn	630	Non-Participating	No
Barn	634	Non-Participating	No
Outbuilding	636	Non-Participating	No
Barn	638	Non-Participating	Yes
Barn	643	Non-Participating	Yes
House	644	Non-Participating	Yes
Barn	645	Non-Participating	No
Barn	648	Non-Participating	No
House	649	Non-Participating	Yes
Barn	650	Non-Participating	No
House	659	Non-Participating	Yes
House	666	Non-Participating	No
Silo	676	Non-Participating	No
Barn	681	Non-Participating	No
House	682	Non-Participating	No
House	683	Non-Participating	No
Barn	688	Non-Participating	No
House	689	Non-Participating	Yes
Barn	692	Non-Participating	No
Garage	696	Non-Participating	Yes
Silo	700	Non-Participating	No
Outbuilding	702	Non-Participating	No
Garage	710	Non-Participating	Yes
Barn	719	Non-Participating	No
Garage	719	Non-Participating	Yes
House	721	Non-Participating	No
Silo	721	Non-Participating	No
Outbuilding	723	Non-Participating	No
Barn	724	Non-Participating	No
Barn	734	Non-Participating	No
Outbuilding	738	Non-Participating	Yes
Barn	739	Non-Participating	No
Garage	744	Non-Participating	Yes
Outbuilding	744	Non-Participating	No
Barn	745	Non-Participating	No
Outbuilding	760	Non-Participating	Yes
Barn	762	Non-Participating	Yes

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
House	770	Non-Participating	Yes
House	775	Non-Participating	Yes
House	778	Non-Participating	No
House	779	Non-Participating	Yes
Garage	783	Non-Participating	No
House	783	Non-Participating	Yes
House	790	Non-Participating	Yes
House	797	Non-Participating	Yes
House	806	Non-Participating	Yes
Garage	807	Non-Participating	Yes
House	808	Non-Participating	No
Barn	816	Non-Participating	Yes
House	816	Non-Participating	Yes
Barn	823	Non-Participating	No
House	824	Non-Participating	Yes
Barn	825	Non-Participating	No
Silo	834	Non-Participating	No
Barn	837	Non-Participating	Yes
Outbuilding	838	Non-Participating	No
Outbuilding	851	Non-Participating	Yes
Barn	851	Non-Participating	No
Silo	855	Non-Participating	No
Barn	858	Non-Participating	No
Outbuilding	863	Non-Participating	No
Tank	878	Non-Participating	No
House	882	Non-Participating	No
House	891	Non-Participating	No
House	891	Non-Participating	No
Outbuilding	891	Non-Participating	No
House	897	Non-Participating	No
Billboard	901	Non-Participating	No
Silo	906	Non-Participating	No
Barn	916	Non-Participating	No
House	922	Non-Participating	Yes
Garage	925	Non-Participating	Yes
House	927	Non-Participating	Yes
House	928	Non-Participating	No
House	931	Non-Participating	Yes
Barn	933	Non-Participating	Yes
House	934	Non-Participating	Yes
Barn	936	Non-Participating	No
Silo	938	Non-Participating	No
Garage	939	Non-Participating	Yes
Barn	940	Non-Participating	No
Barn	960	Non-Participating	No
House	964	Non-Participating	Yes

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
Garage	966	Non-Participating	No
House	969	Non-Participating	No
Barn	972	Non-Participating	No
House	977	Non-Participating	Yes
Barn	978	Non-Participating	No
House	982	Non-Participating	No
Garage	995	Non-Participating	Yes
Apartment	1,002	Non-Participating	Yes
House	1,005	Non-Participating	Yes
House	1,007	Non-Participating	Yes
Commercial	1,007	Non-Participating	Yes
Apartment	1,037	Non-Participating	Yes
Barn	1,055	Non-Participating	No
House	1,071	Non-Participating	Yes
House	1,073	Non-Participating	No
House	1,085	Non-Participating	Yes
House	1,088	Non-Participating	No
Outbuilding	1,089	Non-Participating	No
Outbuilding	1,099	Non-Participating	Yes
Barn	1,105	Non-Participating	No
Barn	1,105	Non-Participating	Yes
Barn	1,113	Non-Participating	Yes
Outbuilding	1,114	Non-Participating	Yes
Barn	1,116	Non-Participating	Yes
Outbuilding	1,126	Non-Participating	Yes
Barn	1,138	Non-Participating	Yes
Barn	1,146	Non-Participating	Yes
Barn	1,149	Non-Participating	Yes
Barn	1,150	Non-Participating	No
Tank	1,151	Non-Participating	Yes
Garage	1,170	Non-Participating	Yes
Barn	1,172	Non-Participating	No
Barn	1,174	Non-Participating	Yes
House	1,180	Non-Participating	Yes
House	1,180	Non-Participating	Yes
Outbuilding	1,182	Non-Participating	Yes
Garage	1,184	Non-Participating	Yes
House	1,190	Non-Participating	Yes
House	1,192	Non-Participating	Yes
Barn	1,199	Non-Participating	No
House	1,200	Non-Participating	Yes
House	1,201	Non-Participating	Yes
House	1,202	Non-Participating	Yes
House	1,203	Non-Participating	Yes
House	1,205	Non-Participating	Yes
Barn	1,205	Non-Participating	Yes

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
House	1,214	Non-Participating	Yes
House	1,219	Non-Participating	Yes
Barn	1,227	Non-Participating	No
House	1,229	Non-Participating	No
Barn	1,230	Non-Participating	Yes
House	1,233	Non-Participating	Yes
House	1,235	Non-Participating	No
House	1,241	Non-Participating	Yes
Garage	1,244	Non-Participating	No
House	1,245	Non-Participating	Yes
Outbuilding	1,251	Non-Participating	No
Barn	1,265	Non-Participating	No
House	1,275	Non-Participating	No
House	1,301	Non-Participating	Yes
House	1,312	Non-Participating	No
House	1,313	Non-Participating	No
Garage	1,324	Non-Participating	Yes
House	1,328	Non-Participating	Yes
House	1,329	Non-Participating	Yes
House	1,331	Non-Participating	No
Outbuilding	1,333	Non-Participating	Yes
House	1,335	Non-Participating	Yes
House	1,335	Non-Participating	Yes
House	1,337	Non-Participating	Yes
House	1,337	Non-Participating	Yes
House	1,339	Non-Participating	Yes
House	1,340	Non-Participating	Yes
House	1,342	Non-Participating	No
House	1,346	Non-Participating	Yes
House	1,357	Non-Participating	Yes
Barn	1,364	Non-Participating	No
Garage	1,365	Non-Participating	No
Garage	1,374	Non-Participating	Yes
House	1,377	Non-Participating	Yes
House	1,389	Non-Participating	Yes
Outbuilding	1,391	Non-Participating	Yes
House	1,394	Non-Participating	Yes
Garage	1,394	Non-Participating	No
House	1,396	Non-Participating	Yes
Garage	1,401	Non-Participating	Yes
Garage	1,406	Non-Participating	Yes
Garage	1,410	Non-Participating	Yes
Outbuilding	1,414	Non-Participating	Yes
Barn	1,416	Non-Participating	Yes
Garage	1,419	Non-Participating	Yes
House	1,421	Non-Participating	No

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status	Within Village of Arcadia (Y/N)
House	1,424	Non-Participating	No
Garage	1,426	Non-Participating	Yes
Barn	1,426	Non-Participating	Yes
Barn	1,439	Non-Participating	Yes
Outbuilding	1,445	Non-Participating	Yes
Barn	1,455	Non-Participating	Yes
Garage	1,473	Non-Participating	Yes
House	1,481	Non-Participating	Yes
Garage	1,481	Non-Participating	Yes
House	1,483	Non-Participating	No
House	1,484	Non-Participating	Yes
Barn	1,486	Non-Participating	Yes
House	1,491	Non-Participating	Yes
Barn	1,492	Non-Participating	Yes
Barn	1,493	Non-Participating	No
House	1,497	Non-Participating	Yes
Barn	1,499	Non-Participating	No

A similar approach was used to identify, as required by OAC 4906-4-08(C)(1)(b)(ii), structures located within 250 feet of a non-generating Project component. Therefore, Table 08-8 conservatively identifies information about structures located within 250 feet of the Project Area boundary (Figure 08-12). There are 91 structures (11 of them transmission towers, 28 residences, and the remainder various outbuildings) within 250 feet of the Project Area. These reflect a subset of those identified in Table 08-8.

TABLE 08-8
STRUCTURES WITHIN 250 FEET OF PROPOSED PROJECT AREA

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status
Garage	32	Non-Participating
Silo	34	Non-Participating
Garage	39	Non-Participating
Outbuilding	39	Non-Participating
House	43	Non-Participating
House	43	Non-Participating
Outbuilding	48	Participating
House	49	Non-Participating

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status
Garage	50	Non-Participating
House	53	Non-Participating
House	55	Non-Participating
House	56	Non-Participating
Outbuilding	58	Non-participating
Barn	58	Non-Participating
House	59	Non-Participating
Barn	61	Non-Participating
Outbuilding	65	Non-Participating
House	65	Non-Participating
House	67	Non-Participating
House	68	Non-Participating
House	72	Non-Participating
House	75	Participating
House	76	Non-Participating
Silo	78	Non-Participating
Garage	82	Non-Participating
Silo	83	Non-Participating
Barn	83	Non-Participating
Outbuilding	85	Non-Participating
Outbuilding	87	Non-Participating
Garage	89	Non-Participating
House	92	Non-Participating
House	95	Non-Participating
House	100	Non-Participating
House	104	Non-Participating
House	106	Non-Participating
House	109	Non-Participating
Outbuilding	111	Non-Participating
Outbuilding	112	Non-Participating
Garage	112	Non-Participating
Barn	113	Non-Participating
House	114	Non-Participating
Garage	115	Non-Participating
Garage	121	Non-Participating
House	129	Non-Participating
Garage	135	Non-Participating
Barn	147	Participating
Silo	148	Non-Participating
Barn	151	Non-Participating
Garage	158	Non-Participating
Barn	160	Non-Participating
Barn	161	Participating
Barn	164	Participating
House	164	Non-Participating
Outbuilding	165	Non-Participating

Structure Type	Distance to Project Area (feet)	Underlying Parcel Status
Silo	165	Non-Participating
Outbuilding	168	Non-Participating
Barn	171	Non-Participating
House	174	Non-Participating
Silo	176	Non-Participating
Outbuilding	177	Non-Participating
Silo	180	Non-Participating
Silo	188	Participating
Barn	193	Non-Participating
Barn	195	Non-Participating
Barn	195	Participating
Barn	198	Non-Participating
Barn	199	Non-Participating
House	199	Non-Participating
Garage	208	Non-Participating
House	208	Non-Participating
Silo	210	Non-Participating
Barn	212	Non-Participating
Barn	218	Participating
Barn	226	Non-Participating
Outbuilding	230	Non-Participating
House	230	Non-Participating
House	232	Non-Participating
House	238	Non-Participating
Barn	241	Non-Participating
Outbuilding	241	Non-Participating

(c) Land Use Impacts

Project-related impacts to land use were calculated by overlaying components on an aerial image and parcel data, resulting in quantifiable impacts associated with each component. The impact areas or lengths for all Project components were aggregated, andused to estimate temporary and permanent impact areas. All land use impacts from solar panels are considered permanent for the life of the Project (after which the Project Area would be capable of returning to agricultural uses). For linear components, such as access roads and collection lines, the applicable impact widths were multiplied by the lengths to create an area of impact. Finally, the separate areas of impact for each Project component were added together, resulting in the temporary, permanent, and total areas of impact associated with each component. As shown on Figure 08-10, and summarized in Table 08-9, the Project Area is primarily currently in active agricultural use.

TABLE 08-9
LAND USE IMPACTS

Project Element	Temporary Disturbance (acres)	Permanent Alteration* (acres)
Agricultural		
Array Areas (includes solar panels, inverter pads, etc.)	0	709.5
Collector System (outside of array areas)	12.0	0
Project Substation	0	8.6
O&M Building	0	0.1
Access Roads	0	81.5
Laydown	20.0	0
Infrastructure		
Array Areas (includes solar panels, inverter pads, etc.)	0	1.9
Collector System (outside of array areas)	18.9	0
Project Substation	0	1.3
Access Roads	0	3.5
Laydown	0.1	0
Vacant		
Array Areas (includes solar panels, inverter pads, etc.)	0	0.5
Access Roads	0	0.2

*For the life of the Project; following Project use the Project Area would be capable of returning to agricultural uses.
Note: Impact areas for each component overlap with each other, so the total cannot be derived by summing its parts.

The proposed location of Project-related features will result in the permanent alteration during the life of the Project of approximately 810 acres of land from its current use. Due to careful topsoil management during construction, little creation of areas of impervious or compacted soils, careful drainage and stormwater management, the use of native plantings including pollinator species, and the control of invasive or noxious weeds, the Project Area could be readily returned to agricultural uses at the end of the Project's life, should it be desired. No impacts to land use are anticipated outside the Project Area.

(d) Structures to be Removed or Relocated

No existing structures will be removed or relocated to support the Project.

(2) Wind Farm Maps

This requirement is not applicable to the Project because it does not include wind turbines.

(a) Distance from Easements

This requirement is not applicable to the Project because it does not include wind turbines.

(b) Property Setbacks

This requirement is not applicable to the Project because it does not include wind turbines.

(3) Setback Waivers

This requirement is not applicable to the Project because it does not include wind turbines.

(a) Content of Waiver

This requirement is not applicable to the Project because it does not include wind turbines.

(b) Required Signature

This requirement is not applicable to the Project because it does not include wind turbines.

(c) Recordation of Waiver

This requirement is not applicable to the Project because it does not include wind turbines.

(4) Land Use Plans

(a) Formally Adopted Plans for Future Use

The Project Area is located within Washington Township in Hancock County. The Project Area lies adjacent to the north of the Village of Arcadia. Each of these communities have adopted plans to guide future land use. These plans are summarized below:

- **Access Management Regulations for Hancock County, Ohio:** These regulations were adopted for the purposes of promoting traffic safety and efficiency, maintaining proper traffic capacity and traffic flow, reducing vehicular collision frequency, minimizing the future expenditure of public revenues, and improving the design and location of access connections.
- **Zoning Resolution of Washington Township:** This resolution outlines the provisions and restrictions of the various zoning districts within Washington Township, including the agricultural district (A1) within which the Project Area is located. This district is intended to protect and preserve land for agricultural use. Principal uses include farms and farming operations, utility and public service buildings and uses (without storage yards) when operating requirements necessitate

the locating of such buildings within the district to serve the immediate vicinity.

- **Integrated Land Use Plan and Zoning Code Ordinance No. 2008-6 for the Village of Arcadia:** This ordinance regulates and restricts the location and use of buildings, structures, and lands for trade, industry, residence or other specified uses within the incorporated portions of the Village of Arcadia, which are located outside of the Project Area.

None of these documents address large scale solar development.

(b) Applicant Plans for Concurrent or Secondary Use of the Site

The Applicant has no plans for concurrent or secondary uses of the Project Area. Permanent features of the Project are proposed on land being purchased or leased by the Applicant. The Project has been designed to minimize impacts to, and maximize compatibility with, existing uses. Existing land uses on property contiguous to the Project Area, such as agricultural operations and residences, will not be affected by Project operation.

The Applicant is considering grazing as a form of natural vegetation management to restrict the spread of non-native species, prevent excess litter accumulation, improve forage production, and accelerate decomposition and nutrient cycling. Additional information on grazing and other vegetation management methods and impacts are provided in the Vegetation Management Plan (Appendix D). Definitive plans for the use of grazing as vegetation management have not yet been made and are contingent on a willing community partner and the development of an amenable agreement between the Applicant and partner. The Applicant has no other plans for concurrent or secondary uses of the Project Area.

(c) Impact to Regional Development

The regional economy surrounding the Project Area is underpinned, in large part, by the presence of several large manufacturing facilities in Hancock County, with manufacturing services employing more than 25 percent of the county's population. Although reflecting only approximately 2.0 percent of employment in Hancock County, agriculture is a predominant land use feature, with a focus on cash grain and livestock farming. The 5-mile study area around the Project Area is predominantly rural, with the more densely populated settlements of the Village of Arcadia and the Cities of Findlay and Fostoria also located within 5 miles. The regional context within which this Project is proposed is described below, concentrating on five primary aspects: housing; commercial and industrial development; schools; transportation; and other public services and facilities. The compatibility of the Project with the regional developmental plans, outlined in Section 4906-4-08(C)(4)(a), is discussed in Section 4906-4-08(C)(4)(d).

(i) Housing

As further described in Section 4906-4-08(C)(4)(e), the population of Hancock County has significantly increased over the past two decades. Similarly, the regional housing markets have felt the impact of this growing population, with an increase in housing units and a decrease in vacancy rates. The owner-occupied- vacancy rate in the counties within which the 5-mile study area lies is approximately 1.3 percent, comparable to the statewide average of 1.4 percent. The rental vacancy rates in Hancock, Seneca, and Wood counties (2.6, 8.9, and 3.6 percent, respectively), were quite variable and generally bracket the statewide average rental vacancy rate of 4.7 percent.

It is estimated that there were 2,262 housing units within Hancock County that were vacant in 2019.[18] Given these figures, the recent population trend in the region, and the anticipated use of local workers, as described in Section 4906-4-08(C)(4)(e), it is not expected that construction or operation of the Project will have a significant impact on the regional housing market. The Project is also not expected to represent a significant increase in the regional renter population such that it would have a destabilizing effect on existing renters.

(ii) Commercial and Industrial Development

As shown in Table 08-6, the area within 1 mile of the Project Area has limited commercial and industrial development. The Project provides a unique opportunity to provide diversity to the local economy while maintaining consistency with the agricultural

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[18] ACS 2019. American Community Survey 5-Year Data, United States Census Bureau, 2019. Accessed June 30, 2021. https://www.census.gov/data/developers/data-sets/acs-5year/2019.html

use within the Project Area and preserving land for potential future agricultural use.

(iii) Schools

The Project will have significant positive impacts on the local schools, as the Project will have a dramatically positive impact on the local tax base. At the same time, increases in tax revenue generated by the Project will not trigger any corresponding increase in demand for school-related services. As such, the local schools that serve the Project Area should experience a tangible and direct benefit from the Project. No other adverse significant impact on schools or other educational facilities is anticipated. The Project should not have any adverse effect on the surrounding municipalities, as local employees will be hired, to the extent possible. If workers were hired from outside of commuting distance, they would likely stay in regional temporary housing or motels and would not bring their families.

(iv) Transportation

The region surrounding the Project Area features several Interstate highways; U.S. and State highways; and county and local roadways, as well as freight rail lines that are located south of the Project Area. The main transportation routes to the Project Area are US-224, OH-23, and OH-12.

Workers and construction deliveries traveling to and from the Project Area will most likely enter via County Road 109 or Township Road 218. The Project is not expected to cause any substantial disruption to major transportation corridors serving the Project Area or the area within 5-miles.

As indicated in Section 4906-4-07(E)(1), one private airport and one hospital helipad are located within 5 miles of the Project Area. Based on the low visual profile of the Project, no adverse effects to the regional air transportation network are expected from the Project.

(v) Other Public Services and Facilities

The Project is not expected to affect the regional population; therefore, no significant impact on local public services and facilities is anticipated. Local employees will be hired, to the extent possible. Hiring of non-residents will only occur when residents with the required skills are not available or competitive. It is expected that non-residents would commute or stay in regional temporary housing or motels, and not require new housing, and would not bring families that might require family healthcare or additional school facilities.

Workers will commute to the Project Area daily during construction, with only limited visits to the Project Area by operational workers throughout the year. The primary impact on public services from the Project would be a temporary increase in traffic on roads leading to and from the Project Area, due to worker commutes or deliveries during construction.

(d) Compatibility with Current Regional Plans

As discussed in Section 4906-4-08(C)(4)(a), Hancock County, Washington Township, and the Village of Arcadia have adopted regional plans to guide future development; compatibility with these plans is discussed below:

- **Access Management Regulations for Hancock County, Ohio:** If construction or operation of the Project will generate more than 20 percent of the Average Daily Traffic along roads being used, these regulations indicate that a Traffic Impact Study should be completed and submitted to the County Engineer. The Applicant is actively coordinating with the County Engineer, including to develop a RUMA, as discussed in the Transportation Management Plan provided as Appendix K. While the construction process will result in increased traffic on local roadways for a relatively short time, operational support is not anticipated to result in a noticeable effect.
- **Zoning Resolution of Washington Township:** As previously noted, the Project Area is located within the Agricultural (A-1) District. Solar generation is not specifically identified in the zoning resolution. However, the Project provides an opportunity to diversify the local economy in a manner that would preserve and protect the Project Area for potential future agricultural uses in a manner that

other types of development could not. Due to careful topsoil management during construction, minimal creation of impervious cover, careful drainage and stormwater management, the use of native plantings including pollinator species, and the control of invasive or noxious weeds, the Project Area could be readily returned to agricultural uses at the end of the Project's life, should it be desired. Applicable design conditions and constraints within this district, such as avoidance of certain narrow farm roads, have also been incorporated into Project design to the extent practicable.

- **Integrated Land Use Plan and Zoning Code Ordinance No. 20086 for the Village of Arcadia:** The Project Area is not located within the incorporated area of the Village of Arcadia; however, the Project Area abuts the village. Applicable design conditions and constraints for these districts, such as setbacks and landscape mitigation, have been considered and incorporated into Project design to minimize impacts on neighbors and maintain the rural character of the community.

Although none of these documents specifically addresses large-scale solar facilities, the Project is not expected to negatively affect the goals and objectives identified. Considerable agricultural uses will remain within the county, even with conversion of the Project Area to a solar energy generation facility. In fact, the Project will preserve the Project Area in a condition that will allow for future use of agriculture, if desired, for among the following reasons:

- Careful topsoil management during construction will segregate and return existing topsoil to the Project Area;
- The use of piles to support the solar panel arrays limits the amount of impervious area or compacted soil within the Project Area;
- Drain tiles will be identified and their function protected, as outlined in Appendix F, to avoid impact to offsite uses – including agriculture – as well as maintain conditions within the Project Area;
- Stormwater management design and implementation will incorporate BMPs to prevent erosion and sedimentation and control rainwater in a manner consistent with ODNR design standards; and
- The planned use of native and pollinator species to allow the land to lie fallow, with good control of invasive or noxious weeds.

In addition, care is being taken in the design of the Project to implement features (pollinator-friendly vegetation, wire-woven agricultural-style fencing, and landscaping with native species) that will integrate well visually with the surrounding land uses. The Project will not significantly disturb or damage the agricultural viability of the land within the Project Area and will not impact surrounding agricultural uses.

(e) Demographic Characteristics

Population estimates reveal that most communities within 5 miles of the Project Area have experienced little population change over the past decade.[19] Table 08-10 presents the population trends for the State of Ohio and counties within 5 miles of the Project Area. The state population is estimated to have increased by 1.3 percent from 2010 to 2019. The populations in Hancock and Wood Counties are estimated to have increased by 1.4 and 4.2 percent, respectively; while the population in Seneca County decreased by 2.8 percent over the same time.

TABLE 08-10
POPULATION TRENDS

Area	2010 Population	2019 Population Estimate	Percent Change 2010 – 2019
Hancock County	74,782	75,837	1.4
Seneca County	56,745	55,178	-2.8
Wood County	125,488	130,817	4.2
State of Ohio	11,536,504	11,689,100	1.3

Source: U.S. Census Bureau 2010 Decennial Census and 2019 American Community Survey 1-Year Estimates

As shown in Table 08-10, population growth has had little change in most communities surrounding the Project Area including the closest populated areas. Table 08-11 presents population estimates for 2019[20] and projections for 2030 using the population change calculated between 2010 and 2019 for each populated area that lies within 5 miles of the Project Area. Populations within this area

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[19] American Community Survey, 2019 1-Year Estimates. [2019 Data Profiles | American Community Survey | US Census Bureau]

[20] Since the 2020 U.S. Census has not yet been released to the public, the most recent population estimates, from American Community Survey 2019 1-Year Estimates, were used.

experienced a varied history of population growth and decline over the past two decades. The largest changes include Jackson and Loudon Townships in Seneca County, which each experienced an over 14 percent increase in population from 2010 to 2019, and Perry Township in Wood County, which experienced a 11 percent decrease in population over the same time. In the Village of Arcadia, the closest populated area to the Project Area, population growth was relatively unchanged between 2010 to 2019. The estimated total population for the area surrounding the Project Area was calculated by adding the total populations of each populated area that overlaps with the 5-mile study area; as shown in Table 08-11, the overall population of the surrounding area increased by 0.8 percent between 2010 and 2019.

In general, the recent trends experienced by each community are expected to continue regardless of whether the proposed Project is built. Over the next decade, the total population in communities located within 5 miles of the Project is projected to continue to slowly increase.

TABLE 08-11
EXISTING AND PROJECTED POPULATIONS

Populated Place	Population		Percent Change 2010 – 2019	2030 Projected Population
	2010	2019		
Allen Township	2,533	2,628	3.8	2,728
Biglick Township	1,106	1,120	1.3	1,135
Bloom Township (Wood County)	2,609	2,672	2.4	2,737
Cass Township	993	900	-9.4	816

Populated Place	Population		Percent Change 2010 – 2019	2030 Projected Population
	2010	**2019**		
City of Findlay	41,202	41,335	0.3	41,459
City of Fostoria	13,441	13,316	-0.9	13,197
Jackson Township (Seneca County)	1,065	1,221	14.6	1,400
Loudon Township (Seneca County)	2,140	2,447	14.3	2,797
Marion Township	2,759	2,972	7.7	3,201
Perry Township (Wood County)	1,605	1,424	-11.3	1,264
Village of Arcadia	590	588	-0.3	587
Village of Bairdstown (Wood County)	130	134	3.1	130
Village of Bloomdale (Wood County)	678	683	0.7	688
Washington Township	4,440	4,423	-0.4	4,406
Total	**75,291**	**75,863**		**76,545**

Sources: U.S. Census Bureau, 2010 Decennial Census; American Community Survey 1-Year Estimates 2019

Although Project construction employment will be more substantial, it is relatively short-term (approximately16 months) and is not expected to result in the permanent relocation of construction workers to the region. Therefore, the Project should not cause significant population growth within the 5-mile study area. The potential short- and long-term employment opportunities associated with construction and operation of the Project are further discussed in Section 4906-4-06(E)(2).

As outlined in Table 08-12, the population density across those communities that lie, in whole or in part, within 5 miles of the Project Area is low, at less than 1 person per acre. Within pockets of the surrounding area, primarily in the cities and villages, population density is slightly higher.

TABLE 08-12
POPULATION DENSITY

Populated Place	2019 Population	Total Land Area (acre)	2019 Population Density (pp/acre)	Total Land Area (sq. mile)	2019 Population Density (pp/sq. mile)
Allen Township	2,628	14,848	0.2	23.2	113.3
Biglick Township	1,120	23,104	0.1	36.1	31.0
Bloom Township (Wood County)	2,672	22,784	0.1	35.6	75.1
Cass Township	900	15,360	0.1	24.0	37.5
City of Findlay	41,335	12,563	3.3	19.6	2,109
City of Fostoria	13,316	4,826	2.8	7.5	1,776
Jackson Township (Seneca County)	1,221	22,336	0.1	34.9	35.0
Loudon Township (Seneca County)	2,447	21,504	0.1	33.6	72.8
Marion Township	2,972	14,848	0.2	23.2	128.1
Perry Township (Wood County)	1,424	22,528	0.1	35.2	40.5
Village of Arcadia	588	371	1.6	0.6	980
Village of Bairdstown (Wood County)	134	173	0.8	0.3	446.7
Village of Bloomdale (Wood County)	683	429	1.6	0.7	975.7

Populated Place	2019 Population	Total Land Area (acre)	2019 Population Density (pp/acre)	Total Land Area (sq. mile)	2019 Population Density (pp/sq. mile)
Washington Township	4,423	22,650	0.2	35.4	124.9

Source: American Community Survey 1-Year Estimates 2019

The Project is proposed is in a predominantly agricultural and rural residential area. Although the Project will permanently alter approximately 810 acres for the life of the Project (associated with the panels, inverters, roads, and switchyard); the majority of the collector lines are not considered conversion, as they will be underground; where aboveground collection would be used along Township Road 218, it is planned to use existing structures and would also not create new impervious area.

(D) CULTURAL AND ARCHAEOLOGICAL RESOURCES

A History/Architecture Reconnaissance Survey was conducted within a 2-mile area of potential effect (APE) in May 2021. Prior to the field survey, a 5-mile radius was investigated using the Ohio Historic Preservation Office (OHPO) desktop database. Within the 5-mile radius, four NRHP archaeological resources, 40 Ohio Historic Inventory (OHI) structures, four determination of eligibility properties, 15 cemeteries, 43 Ohio Archaeological Inventory sites, and 24 previously conducted cultural resource management surveys were identified. No national historic landmarks were identified within the 5-mile radius.

The field survey, conducted for a 2-mile APE, identified a total of 68 individual resources over 50 years old within the APE. These properties were then evaluated to determine potential eligibility for listing in the NRHP. No previously recorded resources were identified within the APE. Two typical structure types have been documented on OHI forms will be provided in the

History/Architecture Reconnaissance Survey as representative of the area. No structures within the APE were identified as NRHP eligible. The report is currently being prepared and will be submitted to the OHPO for review; it is anticipated that OHPO review will concur that no further study or mitigation will be required.

A Phase I Archaeological Reconnaissance was completed for the Project Area in April 2021. Following the literature review, a field survey of the Project Area was completed, using methods consistent with OHPO guidelines and consultations. The study noted that no finds within the Project Area were considered to be eligible for the NRHP or warranted additional investigation. The Phase I Archaeological Reconnaissance was submitted to the OHPO on May 21, 2021; concurrence was documented from the OHPO on June 21, 2021 that the Project will not have an effect on significant archaeological resources (see Appendix Q).

(1) Landmark Mapping

Figure 08-13 depicts formally adopted land and water recreation areas, recreational trails, scenic routes or byways, and registered landmarks of historic, religious, archaeological, scenic, natural, or other culturally significant resources within 10 miles of the Project Area.

(2) Estimated Impacts on Landmarks

Impacts to historic architectural and archaeological resources are summarized in Section 4906-4-08(D). No direct impacts to historic architectural or archaeological resources are anticipated Impacts to recreational and scenic resources are discussed in Sections 4906-4-08(D)(3) and (4) and in the Visual Impact Assessment (VIA), provided as Appendix R.

(3) Recreational and Scenic Areas

Recreational areas were identified using resources available from ODNR, ODOT, Environmental Systems Research Institute (ESRI) topographic mapping, the Ohio Statewide Imagery Program, and local websites. Existing scenic and recreational areas within a 5-mile radius of the Project Area are depicted on Figure 08-14. Additional details regarding potential visual impacts to these resources from the Project are assessed and described in the VIA (Appendix R).

(4) Visual Impact

A VIA (Appendix R) has been completed by qualified professionals in accordance with standing policies, procedures, and guidelines. The Applicant anticipates receiving a waiver from OAC 4906-4-08(D)(4), which requires that visual impacts to recreational, scenic, and historic resources be evaluated within a 10-mile radius; a 5-mile radius has been evaluated as the visual study area (VSA) for the Project. The VSA encompasses approximately 117.8 square miles, including the Village of Arcadia and portions of the City of Fostoria, City of Findlay, Hancock County, Seneca County, and Wood County.

(a) Project Visibility

As detailed in the VIA (Appendix R), the potential for visibility of significant portions of the Project will be concentrated within the Project Area and the open fields immediately adjacent. The viewshed analysis also suggests that PV panel visibility is highest within 0.5-mile, substantially diminishes between 0.5 and 1.5 miles, and is minimal beyond 1.5 miles. Ground-truthing of the modeled data indicate that visibility will be even more limited than the model would indicate.

(b) Existing Landscape

Landscape types within the VSA were categorized by various features including landform, vegetation, water, and/or land use patterns, in accordance with established visual assessment methods. Approximately 81.6 percent of the VSA and the majority of the Project Area is dominated by cropland/pasture. Given the fact that agricultural land in this region typically offers the greatest potential for long distance views, this landscape type is likely to have the greatest opportunities for views of the Project. However, intervening vegetation, structures (such as residences, buildings, silos, water towers), and topography (including where built features such as the active rail line are associated with berming) limit views. This is particularly true for the Village of Arcadia, where visibility would be possible only from the closest edges of the village. Note that, while the Project Area is characterized as agricultural, the presence of features such as overhead electric transmission lines are existing visual features across the landscape as well.

Additional information on landscape types is included in the VIA (Appendix R).

(c) Landscape Alterations

Construction and operation of the Project will alter the existing landscape; however, the visibility and visual impact of the Project will be limited to landscape immediately proximate to the Project Area.

An evaluation of the potential for solar glare has also been completed for roadway segments and representative discrete locations surrounding the Project

Area. Based on the model, the Project will not cause solar glare at the analyzed locations (Appendix R).

(d) Visual Impacts to Landmarks of Cultural Significance

The VIA reviewed visually sensitive resources within the VSA, including historic properties, scenic resources, public lands, recreational resources, and high use public areas. A total of 53 potentially sensitive resources were identified within 5 miles of the Project Area; of these, only the Fostoria Reservoir and Veterans Memorial Reservoir and Park were identified by the conservative visibility model has having the potential for a view of the Project. Ground-truthing was conducted to indicate whether visibility was likely from these locations (located 2.3 miles and 1.5 miles from the Project Area, respectively). Intervening topography, vegetation, and structures were observed that prevented views of the existing overhead transmission lines that extend across the Project Area. Therefore, based on distance and existing features (predominantly wooded vegetation, as well as intervening structures), the Project is not expected to be directly visible, and even if it were, would not alter the existing visual landscape of these resources.

(e) Photographic Simulations

To illustrate anticipated visual changes associated with the Project, photograph simulations of the Project were developed for four selected viewpoints. These simulations allow a viewer to better evaluate visibility, appearance, and contrast with the existing landscape, with and without vegetative mitigation. The visual simulation methods and results are presented in the VIA (Appendix R). Viewpoints were selected to show representative locations at various distances from the Project from public vantage points near the Project Area. As can be seen, the Project will be visible from locations directly adjacent to the Project Area; landscape screening will be used in such places to soften the visual effect. Where greater distance exists, visibility is less likely and visual effect considerably reduced.

(f) Proposed Mitigation Measures

Project Location and Layout

The Project Area is in a rural, sparsely populated area. To further reduce impacts for residents living in the area, the Applicant designed the Project to account for setbacks to the solar arrays from non-participating sensitive receptors (160 feet) and public road ROWs (60 feet).

Lighting

Lighting during construction is anticipated to be minimal and will be restricted to construction hours (7:00 am to 7:00 pm). To the extent practicable, lighting will be oriented toward the interior of the Project, away from roadways and adjacent residences. Security lighting used during Project operation will be limited to a few critical areas and will consist of motion-activated, downward-facing lights. Motion-activated downlit security lighting will be used at Project entrances, the O&M building, and inverters.

Visual Screening

The introduction of screening will lessen the visual impact of the Project. Native vegetation will be used to blend the Project into the existing landscape, also creating ecological habitat. Visual screening introduces natural, vertical elements that break up the horizontal lines created by the PV arrays and fence line. This screening helps the Project to fall into the background rather than stand out as a foreground element. For additional information, see the Landscape and Lighting Plan and simulations, provided within the VIA (Appendix R).

Materials and Coloration

PV modules use anti-reflective glass and are designed to absorb the light, reducing the potential for glare. Project fencing will be agricultural fencing with wire mesh supported on wooden posts, a type of fencing that is consistent with the agricultural setting. The PV panel racking system allows panel rows to follow topography, limiting the need for landscape alteration.

(E) AGRICULTURAL DISTRICTS

(1) Mapping of Agricultural Land

As shown on Figure 08-16, and outlined in Table 08-6, agricultural land (specifically, cultivated crops) is the dominant land use in the Project Area. Most of the Project Area is in active agricultural use; however, no Agricultural Districts were mapped within the Project Area.

(2) Agricultural Information

(a) Acreage Impacted

Table 08-13 quantifies the proposed temporary and permanent impacts to agricultural land from the proposed Project.

TABLE 08-13
PROPOSED PROJECT IMPACTS TO AGRICULTURAL LAND

Land Use	Temporary Disturbance (acres)	Permanent Alteration* (acres)
Array Areas (includes solar panels, inverter pads, etc.)	0	709.5
Collector System (outside of array areas)	12.0	0
Project Substation	0	8.6
O&M Building	0	0.1
Access Roads	0	81.5
Laydown	20.0	0

* For the life of the Project; following Project use the Project Area would be capable of returning to agricultural uses.

Note: Impact areas overlap with each other, so the total cannot be derived by summing its parts.

(b) Impact of Project Activities

Field Operations

The Project will occupy approximately 800 acres of agricultural land and will take it out of agricultural use for approximately 35 years. Agricultural activities such as plowing, planting, cultivating, spraying, aerial applications, and harvesting, will be halted on the land occupied by the Project for its lifetime. Once the Project has reached the end of its useful life, Project components will be removed, and the underlying Project Area will be restored for potential agricultural use, pursuant to the Decommissioning Plan (Appendix L).

Irrigation

Potential interference with irrigation systems on non-participating parcels is not anticipated. Irrigation systems on participating parcels will be identified via coordination with participating landowners and prior to construction.

Field Drainage Systems

Construction of the Project could result in impacts to drain tile system in the Project Area. The Applicant has contracted with a local expert who has direct experience with this issue as well as specific properties encompassed in the Project Area to support efforts to locate drain tiles in the Project Area. A map of known drain tiles in the Project Area is available for reference in the Drain Tile Mitigation Plan (Appendix F). Some impacts to drain tile likely cannot be avoided; therefore, additional mitigation measures are outlined in Appendix F. All complaints related to drain tile will receive a prompt response.

Overland drainage within the Project Area is not anticipated to be meaningfully altered, as reflected in preliminary stormwater calculations provided in Appendix E. Minimal grading is anticipated, native vegetation will be maintained across the majority of the Project Area (including under arrays), and the Project will follow existing contours to the extent practicable. No mapped floodplains are located within the Project Area. Stormwater controls will be implemented per Ohio EPA Permit No. OHC000005. The preliminary stormwater evaluation reflected in Appendix E indicates that by changing land cover for a majority of the Project Area, both discharge rate and volume decrease from existing conditions. Therefore, the need for a retention basin or treatment train was deemed unnecessary. A grassed infiltration trench may be constructed downstream of the switchyard in order to allow for additional infiltration during large storm event; the need and location will be refined during final construction of that component. During operation, discharge from the Project Area should be similar to existing flow patterns and will not alter drainage patterns.

(c) Agricultural Mitigation Practices

Mitigation practices have been incorporated into the Project design to reduce impacts to agricultural land within the Project Area. These practices will be employed during Project construction, operation, and maintenance.

(i) Drainage Field Tile Systems

Avoidance/minimization of damage to field tile drainage systems

Per the Drain Tile Mitigation Plan (Appendix F), drain tiles will be identified, and any known tiles will be illustrated on final construction drawings. Existing drain tiles will be avoided where practicable (and flagged in the field to facilitate avoidance during construction) or relocated, if necessary. Unavoidable damage to drain tile may occur during construction of the Project. Additional details regarding assessment and repair of damaged tiles are identified below.

Timely repair of damaged field tile systems

The Drain Tile Mitigation Plan identifies the procedures for assessing damaged drain tile for repair. The plan ensures that no adverse impacts to drain tile systems extend outside of the Project Area.

A local drain tile expert will be retained throughout construction, as specified in the Complaint Resolution Plan

(Appendix J), to support the Applicant's commitment for a prompt response to any identified complaints associated with drain tiles. If it is determined that a drain tile main line was impacted, or if there is uncertainty regarding the impacted tile extending outside of the Project Area, repairs will be made to ensure the integrity of the greater drainage system. Following investigation and determination of appropriate actions, repairs will be completed by a qualified contractor in accordance with the Complaint Resolution Plan. In instances where the Applicant is notified of flooding that is actively occurring outside of the Project Area and believed to be resulting from conditions with the Project Area, the Applicant will assess root causes and undertake to remedy them as quickly as possible.

(ii) Topsoil segregation, de-compaction, and restoration

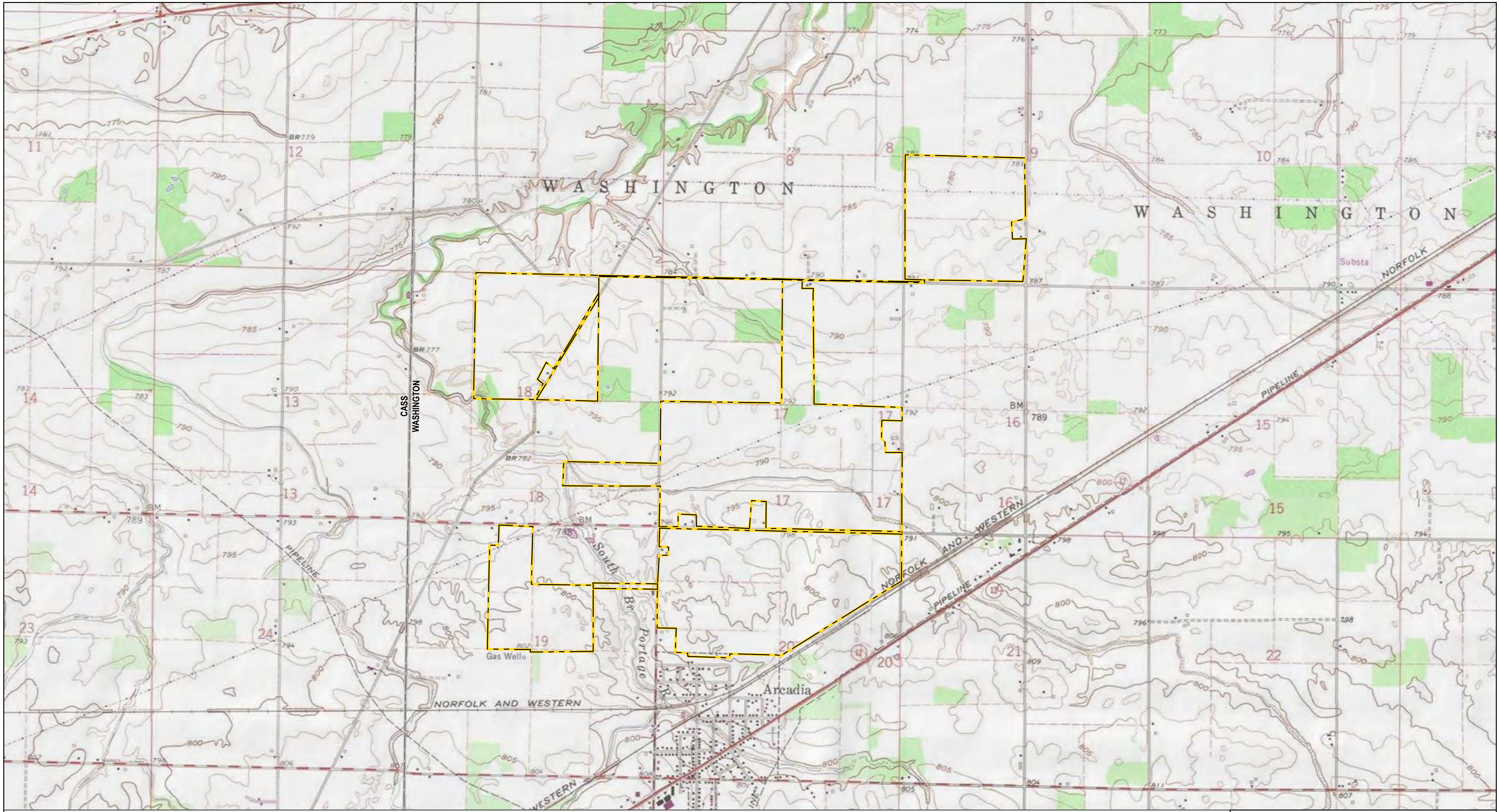
The Applicant will take care to ensure that topsoil will be appropriately segregated and separately backfilled in areas where soil is to be disturbed. Topsoil segregation ensures that vegetation can quickly re-establish following construction and that agricultural production can commence following Project decommissioning. Topsoil that is displaced for laydown yards, workspaces, grading, or access roads will be stockpiled separately so that it can be redistributed prior to final restoration. Similarly, topsoil will be segregated during open trench installation of underground collection lines. Excess materials, such as rock used for entrance pads, will be removed following construction. Upon removal, soil will be de-compacted, regraded, and stabilized with a native, low-growth seed mix. The Project Area has been selected, in part, due to the ability to install Project components with minimal ground disturbance and/or grading. Therefore, relatively little topsoil will be disturbed. Installation of the arrays will not involve topsoil movement. The foundations for the substation, inverter/transformers, and meteorological station, as well as the roadbeds, will involve construction of permanent features requiring removal of topsoil. Temporary impacts to topsoil will occur in association with underground collector system installation.

(iii) Vegetative Cover

Vegetation within the Project Area will be enhanced with a robust, low-growing seed mix consisting primarily of native grasses and other low-maintenance species. Pollinator species will be included in the seed mix where practical. Maintaining this ground cover will absorb precipitation, provide species habitat, eliminate the need for herbicides, and filter stormwater flows to reduce the potential for erosion and sedimentation. As a result, the Project's approach to vegetation within the Project Area is anticipated to facilitate the long-term viability of the land for future agricultural use.

Section 4906-4-02 Figures

- Figure 02-1: Project Location



LEGEND

▭ PROJECT AREA

▭ CITY OR TOWN BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. CITY AND TOWN BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
3. BASE MAP SOURCE: UNITED STATES GEOLOGICAL SURVEY (USGS)

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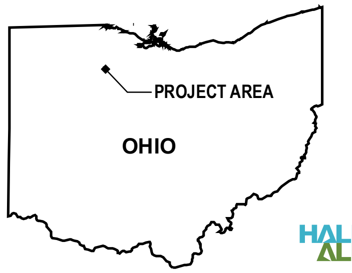

HALEY ALDRICH

Figure 02-1
Project Location

South Branch Solar
Hancock County, Ohio

Section 4906-4-03 Figures

LEGEND

─○─	UNDER 100kV TRANSMISSION LINE
─○─	138kV TRANSMISSION LINE
─○─	345kV TRANSMISSION LINE
─○─	TRANSMISSION LINE, VOLTAGE NOT AVAILABLE
━━	NATURAL GAS PIPELINE
─·─	STREAM OR RIVER
──	ROAD
──	HIGHWAY
🟦	LAKE OR POND
🟦	RESERVOIR
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☐	2-MILE BUFFER OF PROJECT AREA
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3. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD)

5. NATURAL GAS PIPELINES DATA SOURCE: DIGITIZED AT 1:24,000 FROM UNITED STATES DEPARTMENT OF TRANSPORTATION (U.S. DOT) NATIONAL PIPELINE MAPPING SYSTEM (NPMS)

6. STREAMS, RIVERS, AND WATERBODIES DATA SOURCE: USGS NATIONAL HYDROGRAPHY DATASET (NHD)

7. PARKS AND RECREATION DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)

8. CITY AND TOWN BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)

9. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

10. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

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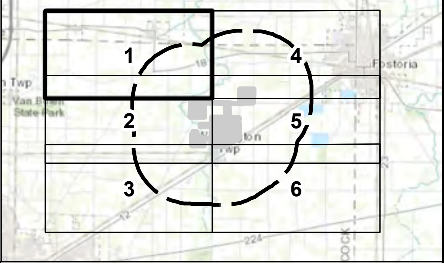

Figure 03-1
Surrounding Area within 2 Miles

Sheet 1 of 6

South Branch Solar
Hancock County, Ohio

LEGEND

—○—	UNDER 100kV TRANSMISSION LINE
—○—	138kV TRANSMISSION LINE
—○—	345kV TRANSMISSION LINE
—○—	TRANSMISSION LINE, VOLTAGE NOT AVAILABLE
━	NATURAL GAS PIPELINE
-·-·-	STREAM OR RIVER
—	ROAD
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6. STREAMS, RIVERS, AND WATERBODIES DATA SOURCE: USGS NATIONAL HYDROGRAPHY DATASET (NHD)

7. PARKS AND RECREATION DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)

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9. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

10. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

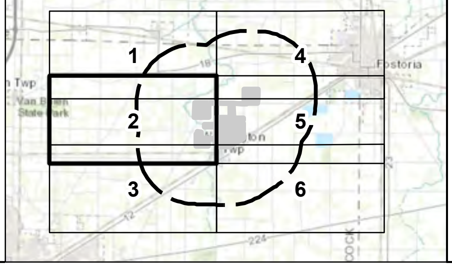
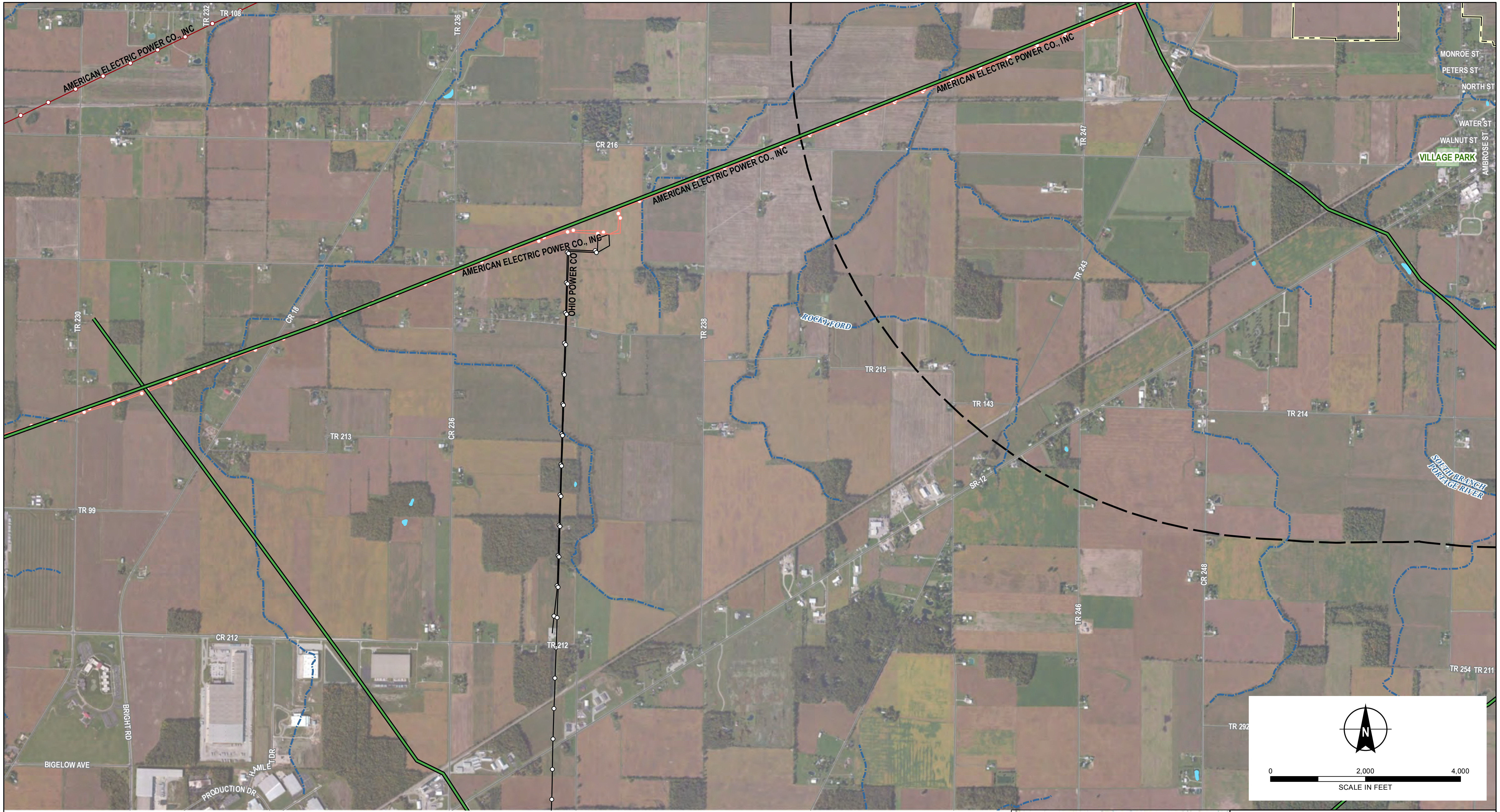


Figure 03-1
Surrounding Area within 2 Miles

Sheet 2 of 6

South Branch Solar
Hancock County, Ohio



LEGEND

- UNDER 100kV TRANSMISSION LINE
- 138kV TRANSMISSION LINE
- 345kV TRANSMISSION LINE
- TRANSMISSION LINE, VOLTAGE NOT AVAILABLE
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HALEY ALDRICH

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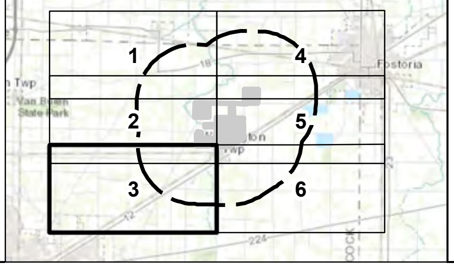
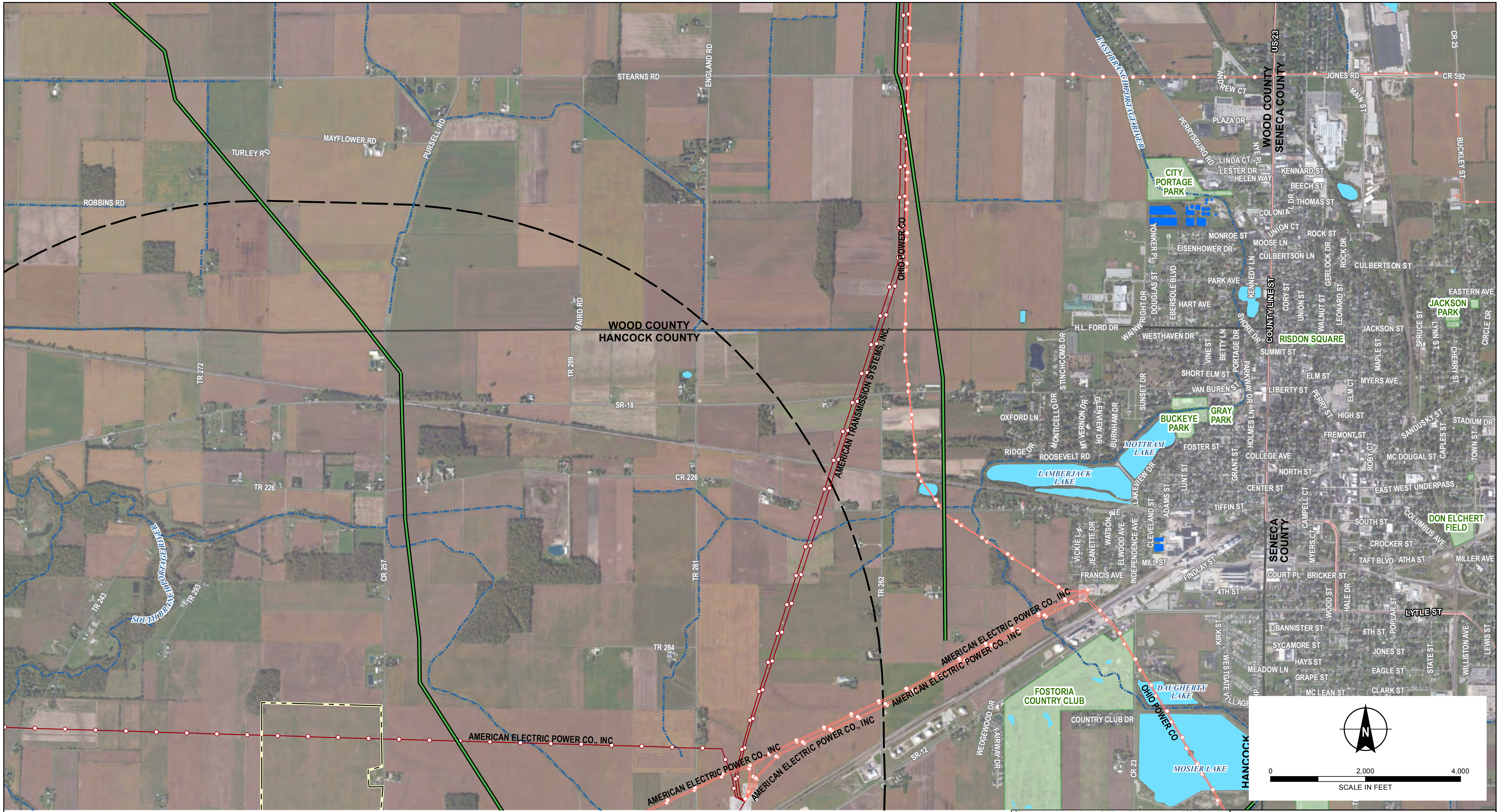


Figure 03-1
Surrounding Area within 2 Miles

Sheet 3 of 6

South Branch Solar
Hancock County, Ohio



LEGEND

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HALEY ALDRICH

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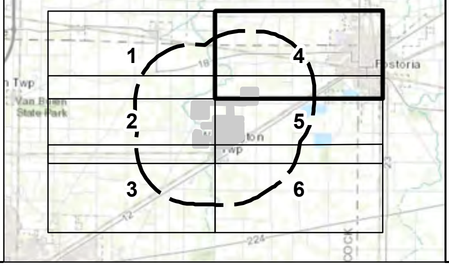
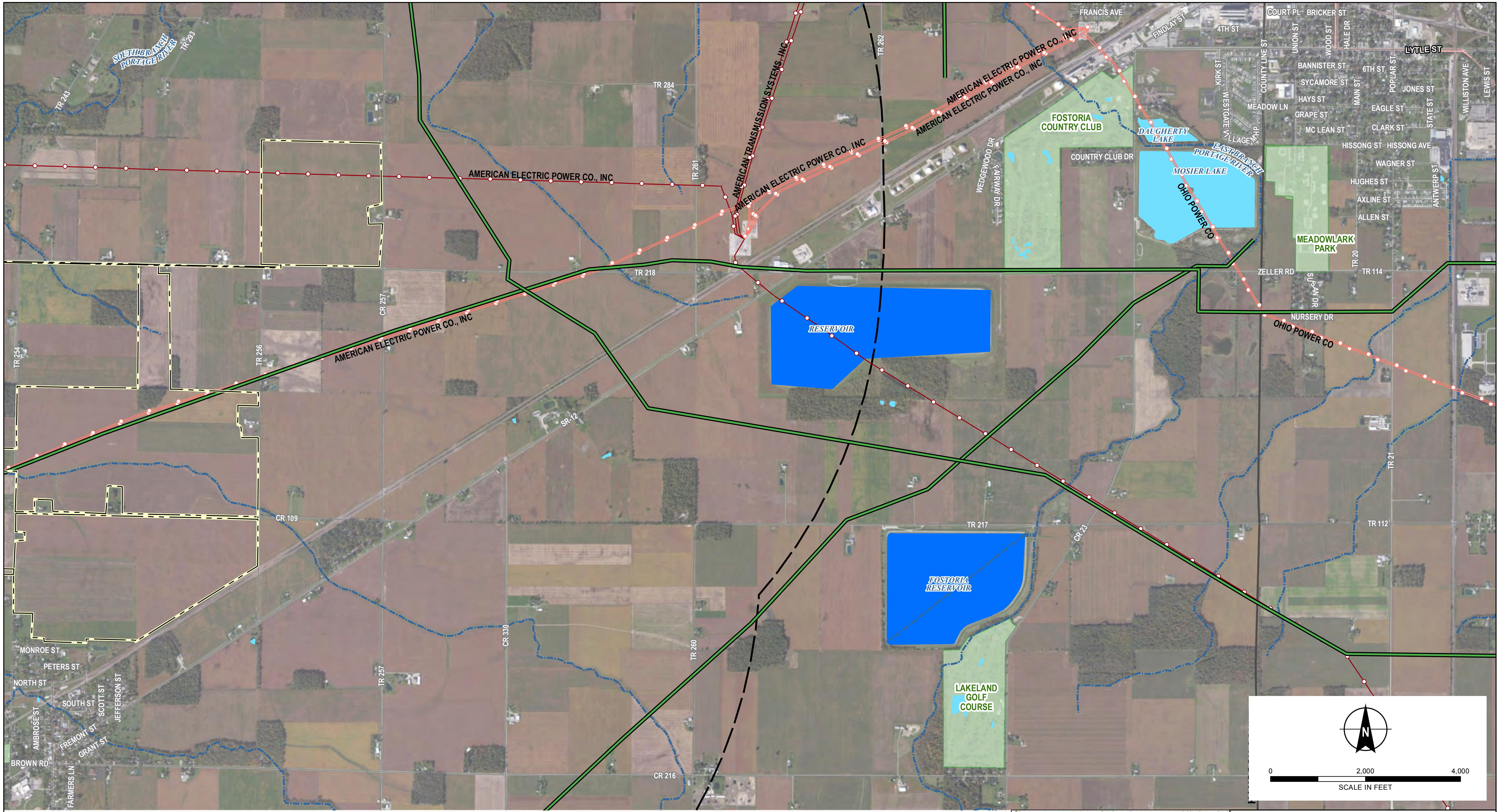


Figure 03-1
Surrounding Area within 2 Miles

Sheet 4 of 6

South Branch Solar
Hancock County, Ohio



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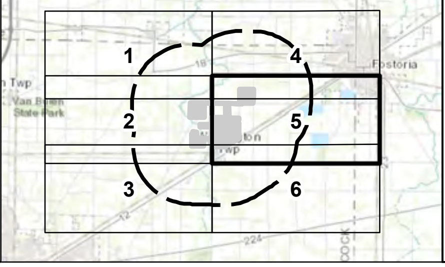

Figure 03-1
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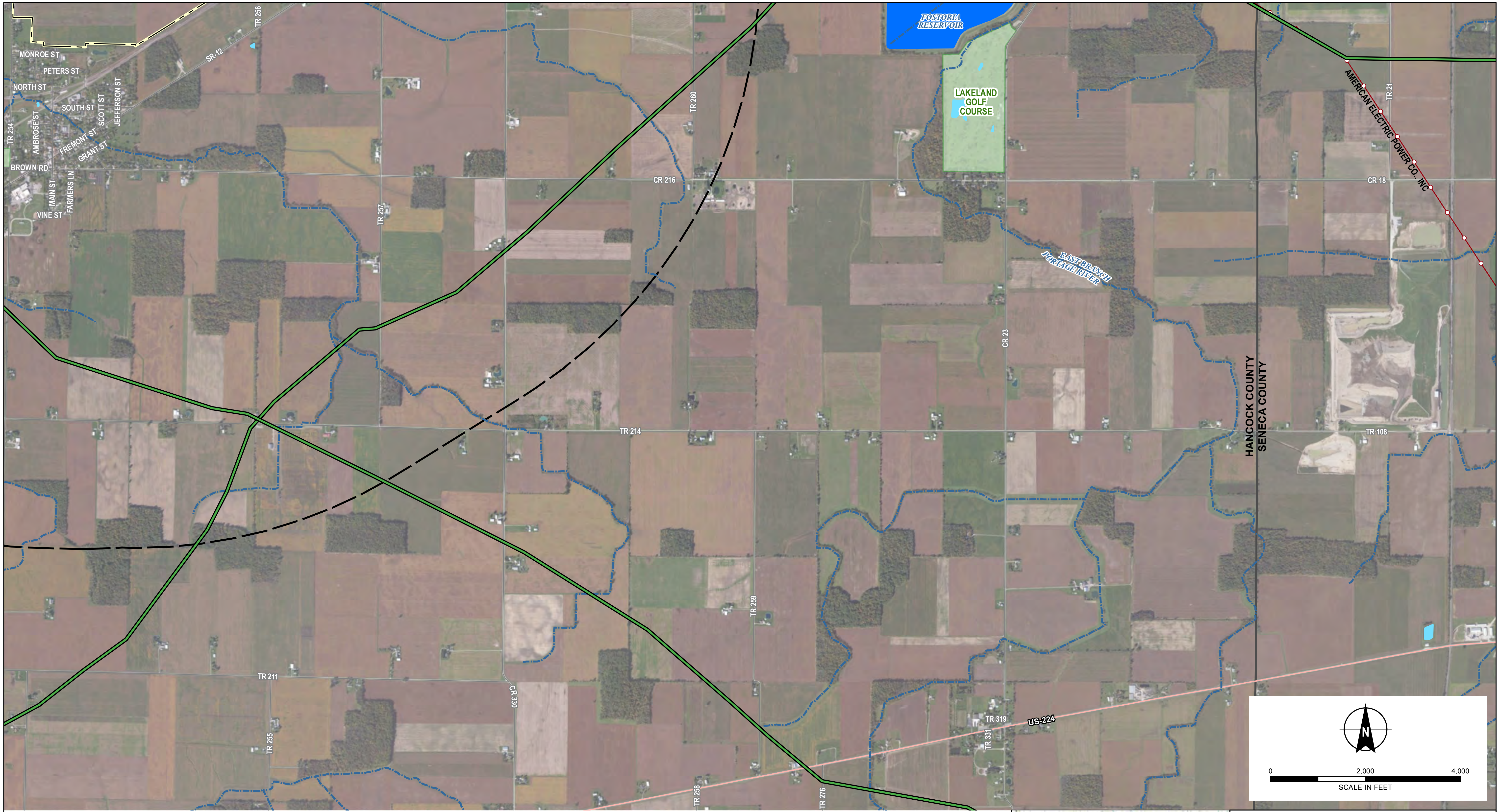
Sheet 5 of 6

South Branch Solar
Hancock County, Ohio



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—	ROAD
—	HIGHWAY
▭	LAKE OR POND
▬	RESERVOIR
🟩	PARK OR RECREATION AREA
▭	PROJECT AREA
▭	2-MILE BUFFER OF PROJECT AREA
▭	CITY OR TOWN BOUNDARY
▭	COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. kV = KILOVOLTS

3. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD)

5. NATURAL GAS PIPELINES DATA SOURCE: DIGITIZED AT 1:24,000 FROM UNITED STATES DEPARTMENT OF TRANSPORTATION (U.S. DOT) NATIONAL PIPELINE MAPPING SYSTEM (NPMS)

6. STREAMS, RIVERS, AND WATERBODIES DATA SOURCE: USGS NATIONAL HYDROGRAPHY DATASET (NHD)

7. PARKS AND RECREATION DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)

8. CITY AND TOWN BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)

9. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

10. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

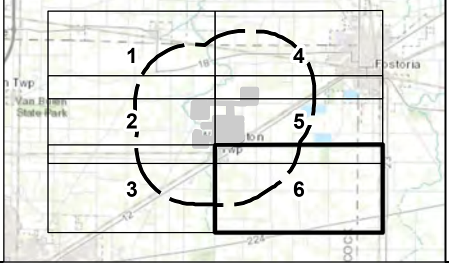

Figure 03-1
Surrounding Area within 2 Miles

Sheet 6 of 6

South Branch Solar
Hancock County, Ohio

LEGEND

- 138kV TRANSMISSION LINE
- 345kV TRANSMISSION LINE
- NATURAL GAS PIPELINE
- STREAM OR RIVER
- ROAD
- LAKE OR POND
- RESERVOIR
- PROJECT AREA
- CITY OR TOWN BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. kV = KILOVOLTS
3. STREAMS, RIVERS, AND WATERBODIES DATA SOURCE: USGS NATIONAL HYDROGRAPHY DATASET (NHD)
4. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD)
5. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. CITY AND TOWN BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

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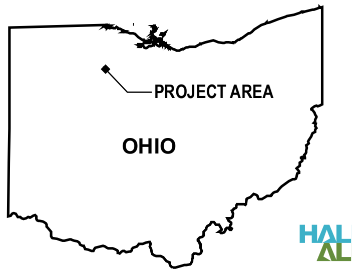
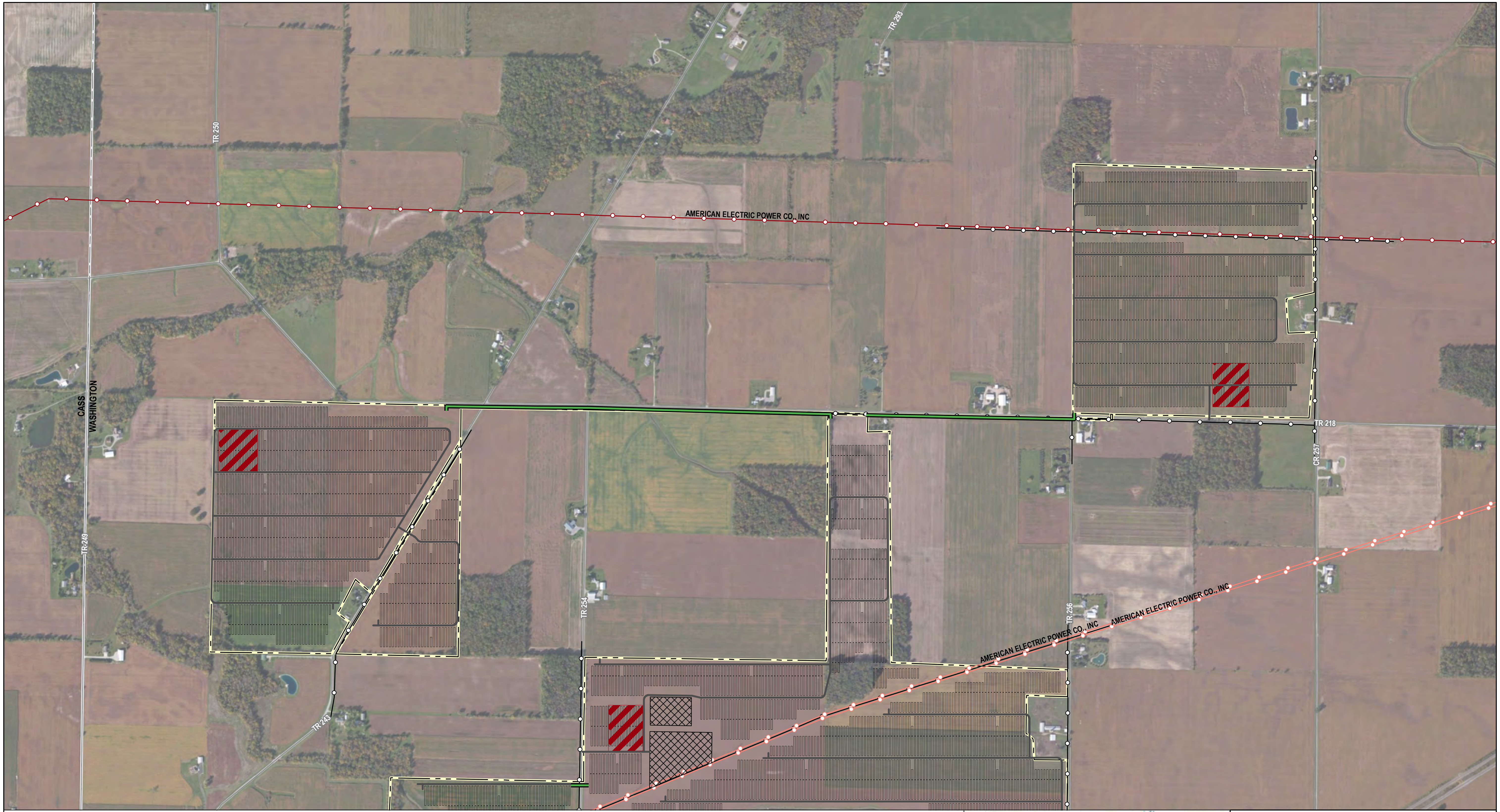
SCALE IN FEET



HALEY ALDRICH

Figure 03-2
Project Area

South Branch Solar
Hancock County, Ohio



LEGEND

- ▬ POTENTIAL COLLECTION LINE
- ▬ POTENTIAL GRAVEL ROAD
- —○— 138 kV TRANSMISSION LINE
- —○— 345kV TRANSMISSION LINE
- —○— TRANSMISSION LINE, UNKNOWN VOLTAGE
- — ROAD
- ☐ POTENTIAL SOLARY ARRAY
- ▨ LAYDOWN AREA
- ▩ SUBSTATION
- ☐ PROJECT AREA
- ☐ TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. kV = KILOVOLTS
3. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD) AND CLIENT
4. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
6. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

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SCALE IN FEET

SHEET INDEX

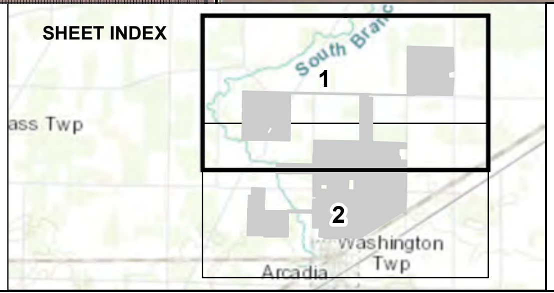
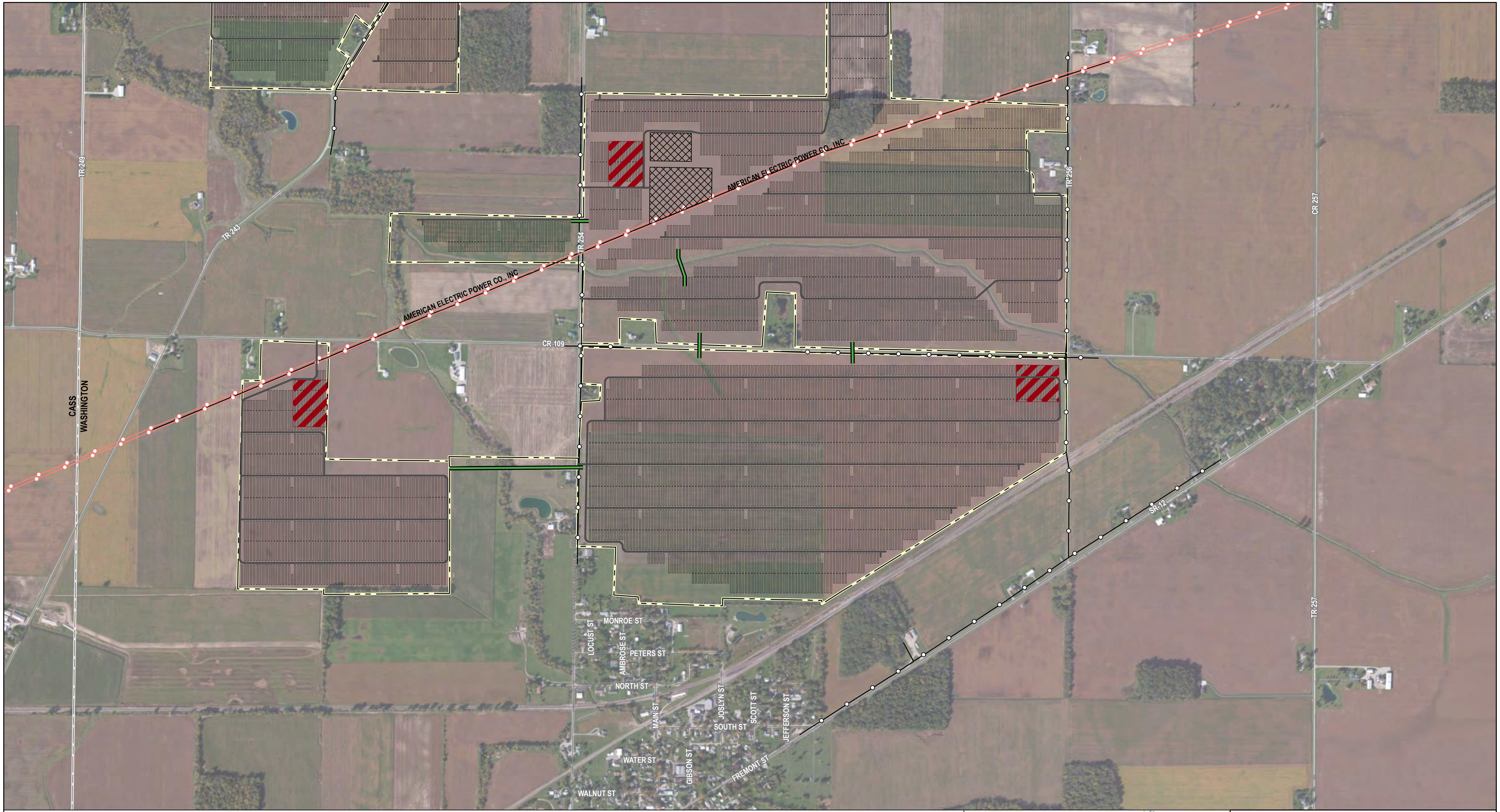


Figure 03-3
Project Layout

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

- ▬ POTENTIAL COLLECTION LINE
- ▬ POTENTIAL GRAVEL ROAD
- —○— 138 kV TRANSMISSION LINE
- —○— 345kV TRANSMISSION LINE
- —○— TRANSMISSION LINE, UNKNOWN VOLTAGE
- — ROAD
- ☐ POTENTIAL SOLARY ARRAY
- ▨ LAYDOWN AREA
- ▦ SUBSTATION
- ☐ PROJECT AREA
- ☐ TOWNSHIP BOUNDARY

NOTES

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5. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
6. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

N

0 1,000 2,000
SCALE IN FEET

SHEET INDEX

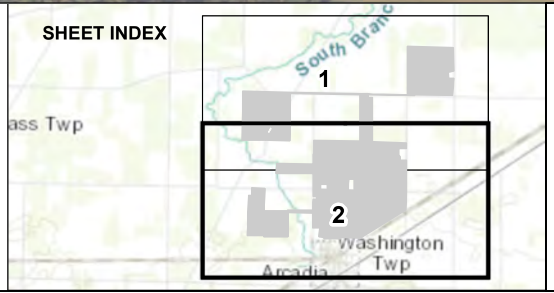
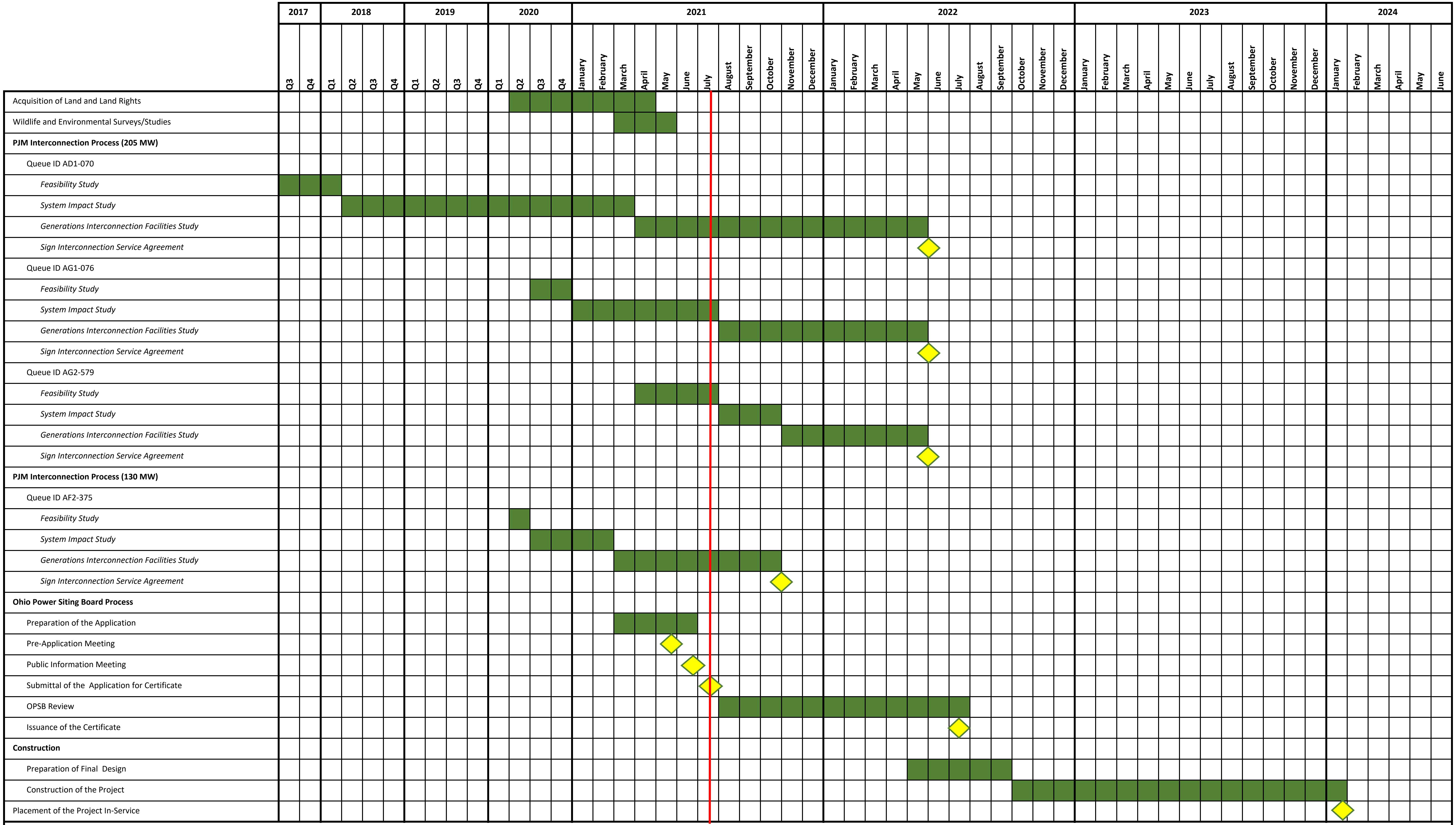


Figure 03-3
Project Layout

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio



	2017		2018				2019				2020				2021												2022												2023												2024					
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	November	December	January	February	March	April	May	June
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Wildlife and Environmental Surveys/Studies																	🟩	🟩	🟩																																					
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System Impact Study				🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩																																							
Generations Interconnection Facilities Study																		🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩																									
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System Impact Study																						🟩	🟩	🟩																																
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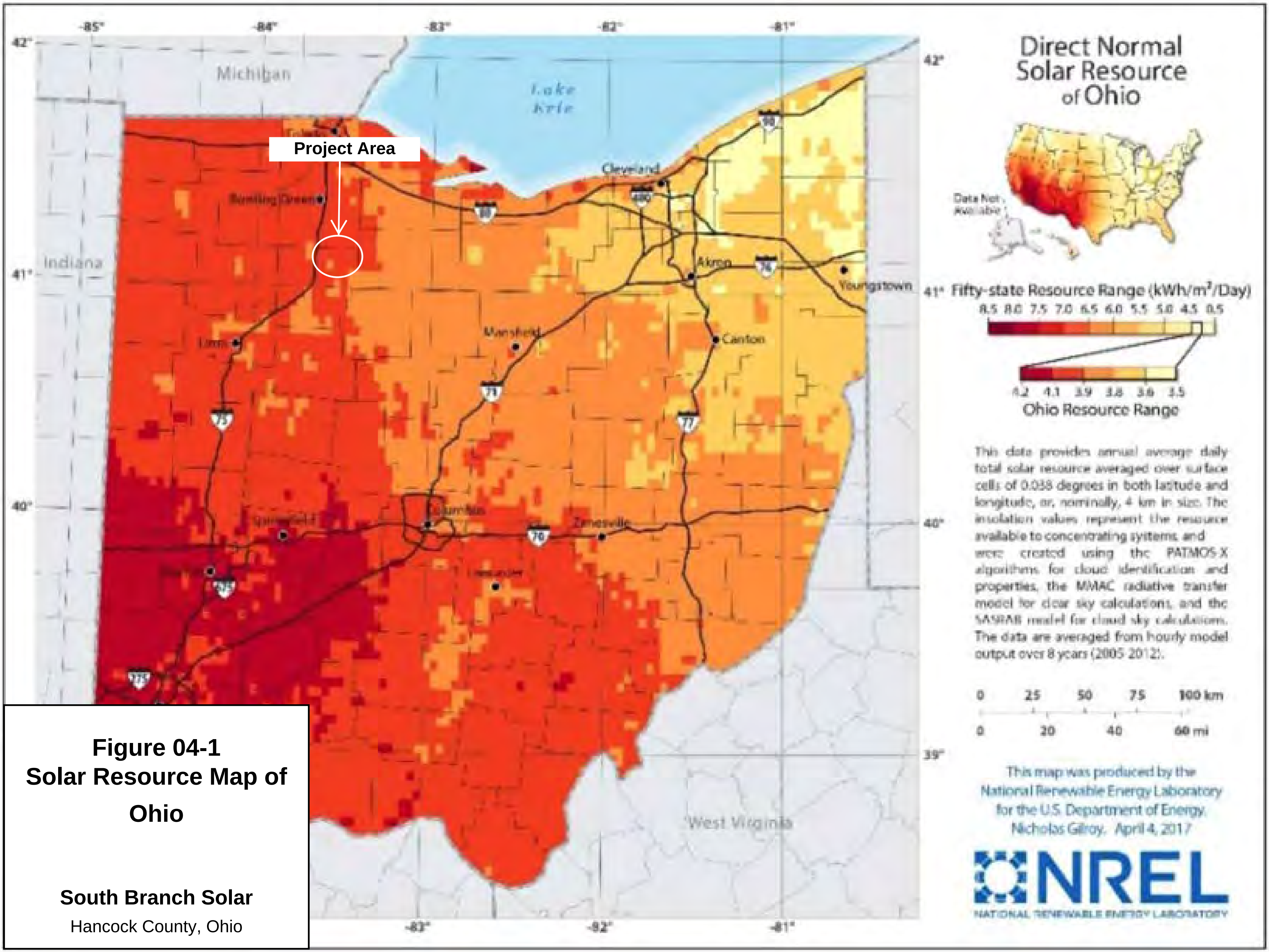
Sign Interconnection Service Agreement																															◆																									
PJM Interconnection Process (130 MW)																																																								
Queue ID AF2-375																																																								
Feasibility Study												🟩																																												
System Impact Study													🟩	🟩	🟩	🟩																																								
Generations Interconnection Facilities Study																	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩																																
Sign Interconnection Service Agreement																								◆																																
Ohio Power Siting Board Process																																																								
Preparation of the Application																	🟩	🟩	🟩	🟩																																				
Pre-Application Meeting																			◆																																					
Public Information Meeting																				◆																																				
Submittal of the Application for Certificate																					◆																																			
OPSB Review																						🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩																							
Issuance of the Certificate																																	◆																							
Construction																																																								
Preparation of Final Design																															🟩	🟩	🟩	🟩	🟩																					
Construction of the Project																																				🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩	🟩					
Placement of the Project In-Service																																																			◆					

Figure 03-4
Project Schedule

South Branch Solar
Hancock County, Ohio

Section 4906-4-04 Figures

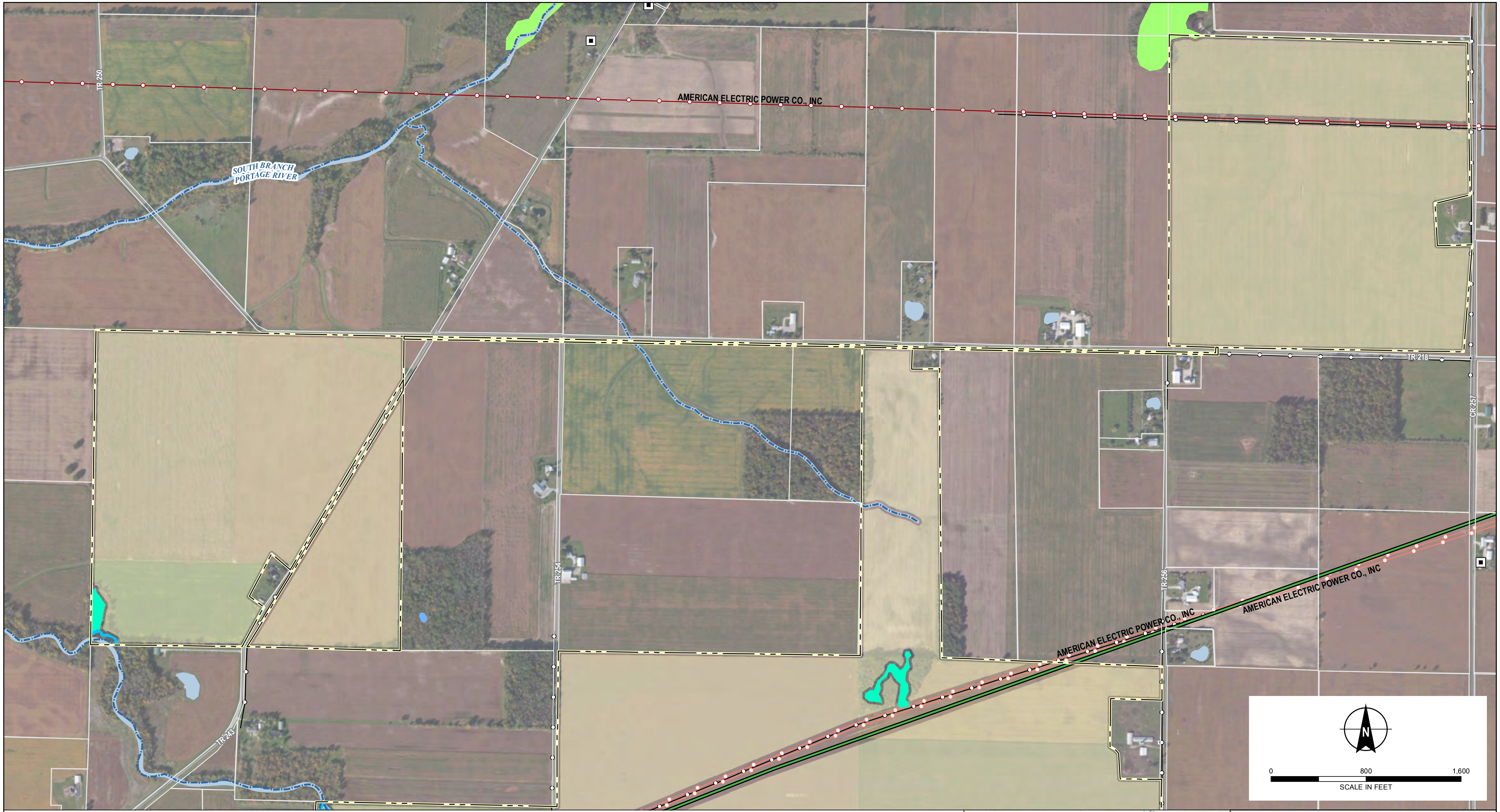


This data provides annual average daily total solar resource averaged over surface cells of 0.038 degrees in both latitude and longitude, or, nominally, 4 km in size. The insolation values represent the resource available to concentrating systems and were created using the PATMOS-X algorithms for cloud identification and properties, the MMAC radiative transfer model for clear sky calculations, and the SASRAB model for cloud sky calculations. The data are averaged from hourly model output over 8 years (2005-2012).

This map was produced by the National Renewable Energy Laboratory for the U.S. Department of Energy. Nicholas Gilroy, April 4, 2017

Figure 04-1
Solar Resource Map of Ohio

South Branch Solar
Hancock County, Ohio



▣	RESIDENCE	🟦	LAKE OR POND	▭	PROJECT AREA
—·—	STREAM OR RIVER	🟩	FRESHWATER FORESTED/SHRUB WETLAND	▭	TOWNSHIP BOUNDARY
—○—	138kV TRANSMISSION LINE	▨	OPEN WATER		
—○—	345kV TRANSMISSION LINE	🟦	DELINEATED STREAM SEGMENT		
—○—	TRANSMISSION LINE, UNKNOWN VOLTAGE	🟩	DELINEATED WETLAND		
━	NATURAL GAS PIPELINE	▭	BUILABLE AREA		
—	ROAD	▭	PARCEL BOUNDARY		

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. NO 1% ANNUAL FLOOD CHANCE HAZARD ZONES REPRESENTING 100-YEAR FLOOD ZONES OR 0.2% ANNUAL FLOOD CHANCE HAZARD ZONES REPRESENTING 500-YEAR FLOOD ZONES PRESENT WITHIN MAP EXTENT AS IDENTIFIED BY AVAILABLE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOODPLAIN GIS DATA.

3. kV = KILOVOLTS

4. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD)

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6. STREAMS, RIVERS, AND WATERBODIES DATA SOURCE: USGS NATIONAL HYDROGRAPHY DATASET (NHD)

7. WETLANDS DATA SOURCE: USFWS NATIONAL WETLANDS INVENTORY (NWI)

8. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

9. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)

10. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

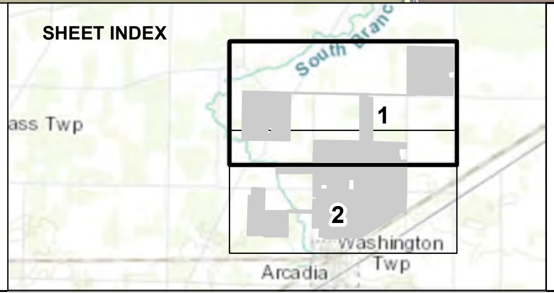
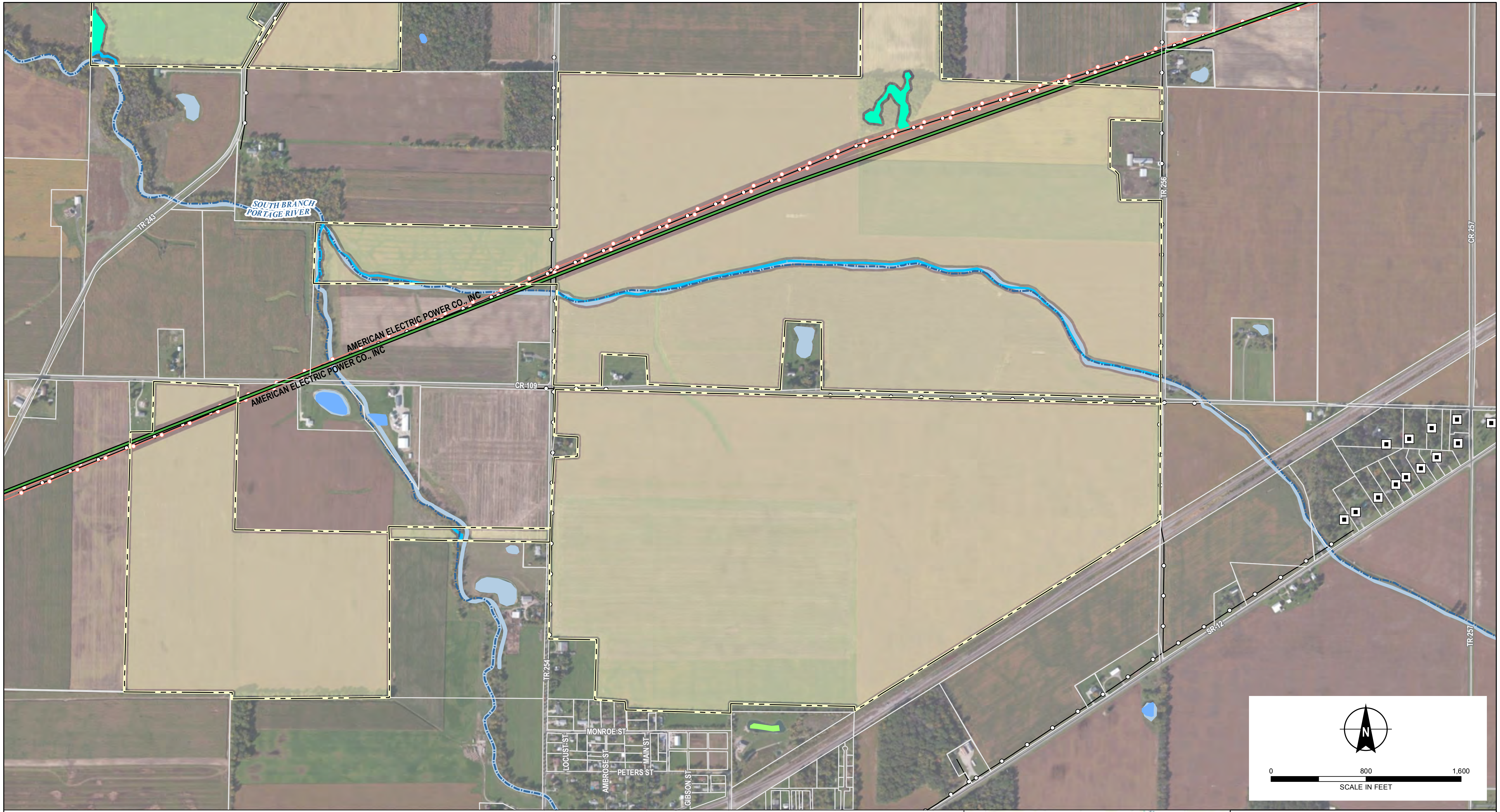


Figure 04-2
Constraint Map

South Branch Solar
Hancock County, Ohio



▣	RESIDENCE	🟦	LAKE OR POND	▭	PROJECT AREA
─·─	STREAM OR RIVER	🟩	FRESHWATER FORESTED/SHRUB WETLAND	▭	TOWNSHIP BOUNDARY
─○─	138kV TRANSMISSION LINE	▨	OPEN WATER		
─○─	TRANSMISSION LINE, UNKNOWN VOLTAGE	🟦	DELINEATED STREAM SEGMENT		
━	NATURAL GAS PIPELINE	🟩	DELINEATED WETLAND		
─	ROAD	🟨	BUILABLE AREA		
		☐	PARCEL BOUNDARY		

NOTES

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9. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)

10. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

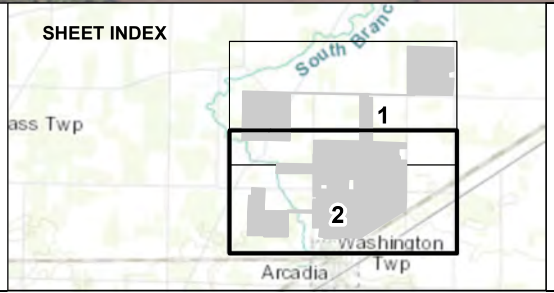
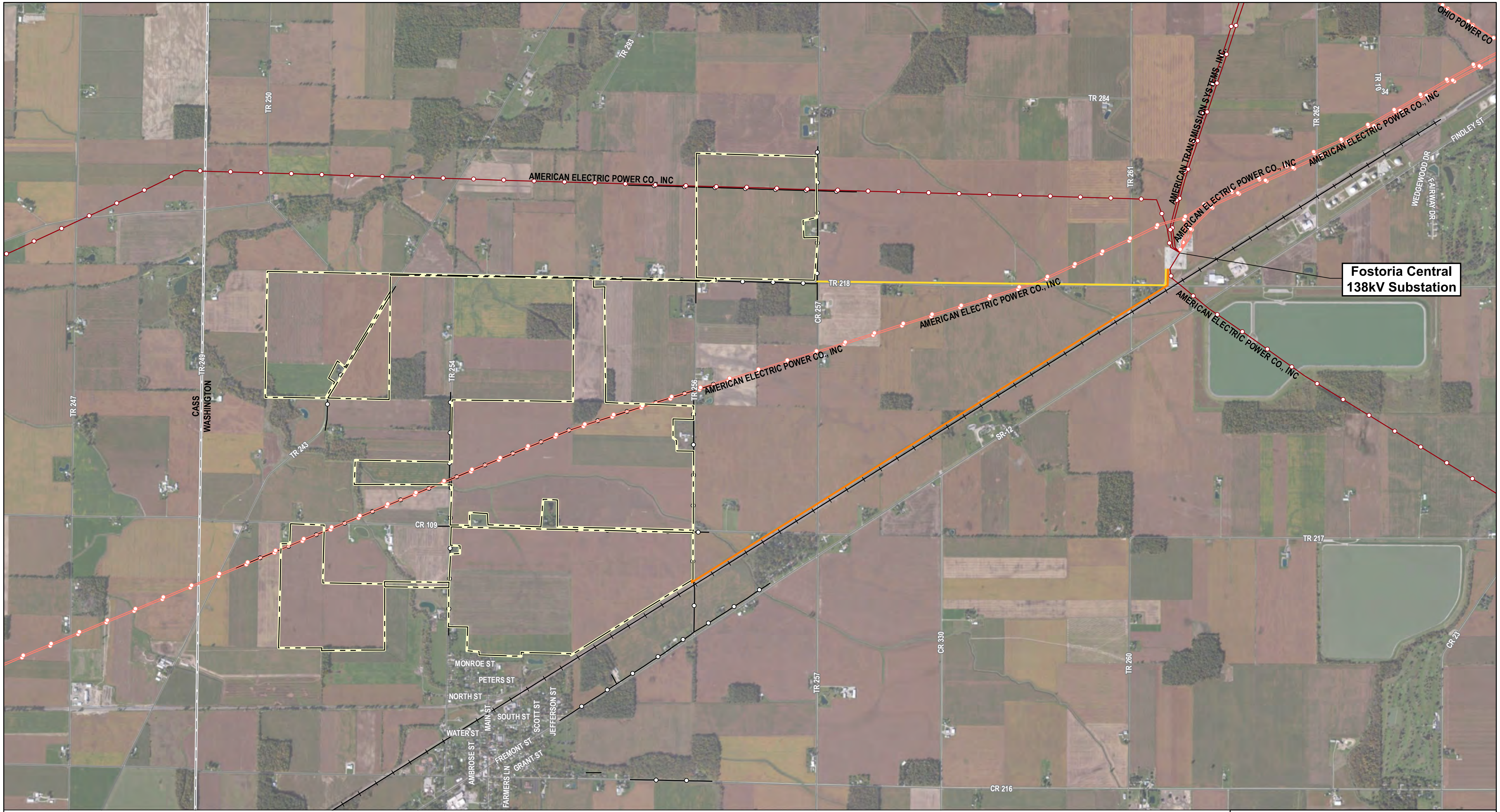


Figure 04-2
Constraint Map

South Branch Solar
Hancock County, Ohio

Section 4906-4-05 Figures

- Figure 05-1: Off-Site Gen-Tie Options



LEGEND

- GEN-TIE OPTION 1
- GEN-TIE OPTION 2
- 138kV TRANSMISSION LINE
- 345kV TRANSMISSION LINE
- TRANSMISSION LINE, UNKNOWN VOLTAGE
- RAILROAD
- ROAD
- PROJECT AREA
- TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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3. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD)
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6. AERIAL IMAGERY SOURCE: ESRI

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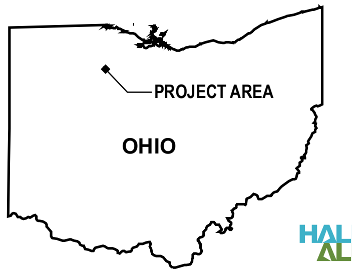


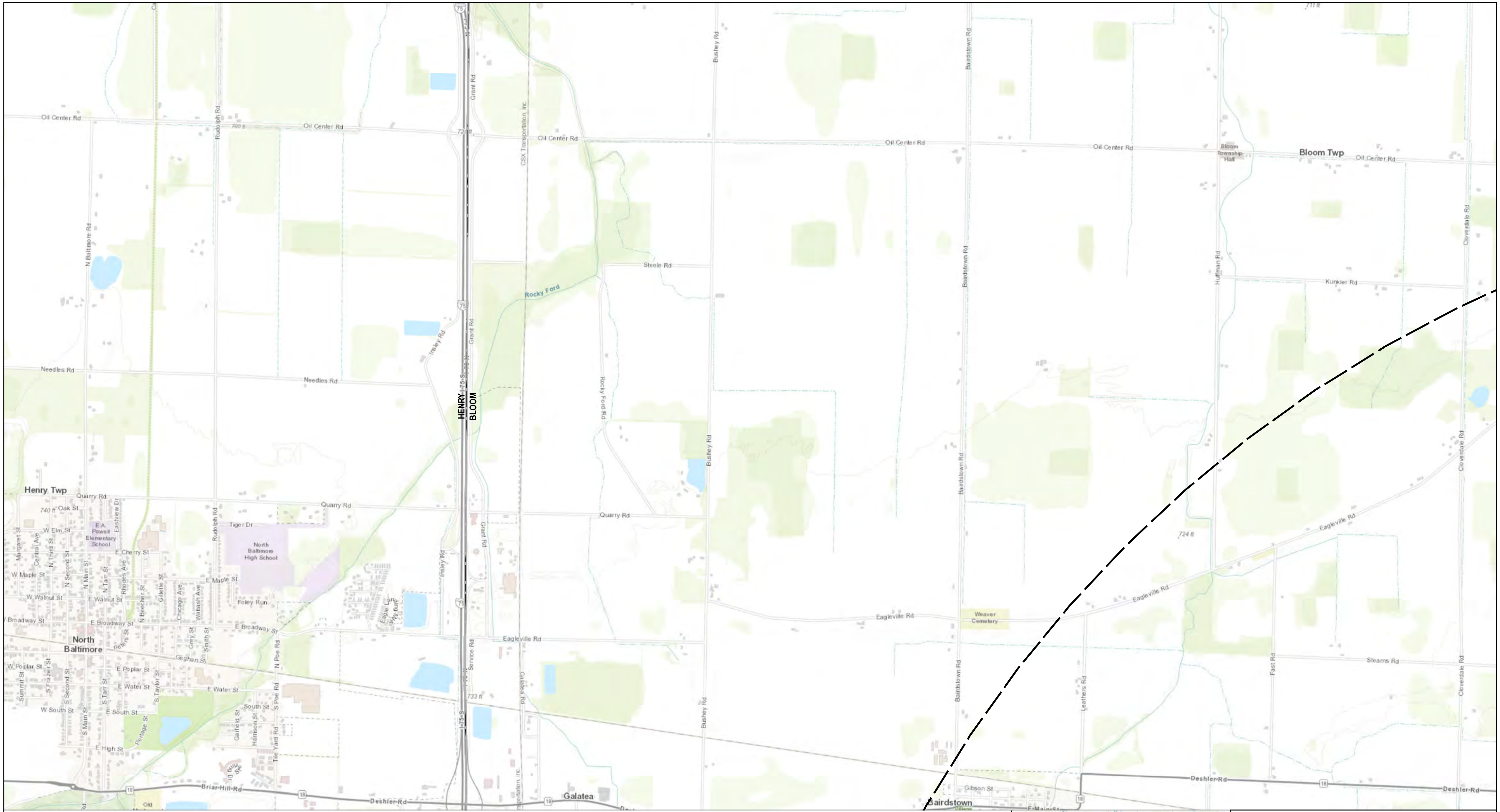
HALEY ALDRICH

Figure 05-1
Off-Site Gen-Tie Options

South Branch Solar
Hancock County, Ohio

Section 4906-4-07 Figures

- Figure 07-1: Air Navigation Facilities



LEGEND

▭ PROJECT AREA

▭ 5-MILE BUFFER OF PROJECT AREA

▭ TOWNSHIP BOUNDARY

▭ COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. NO PUBLIC AIR NAVIGATION FACILITIES ARE LOCATED WITHIN THE 5-MILE BUFFER OF THE PROJECT AREA ACCORDING TO AVAILABLE DATA FROM THE OHIO DEPARTMENT OF TRANSPORTATION (ODOT).
3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

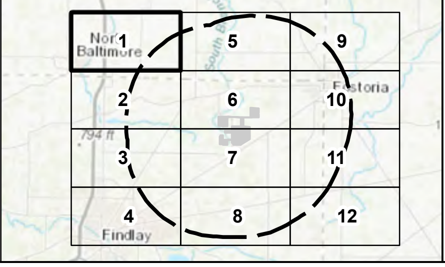
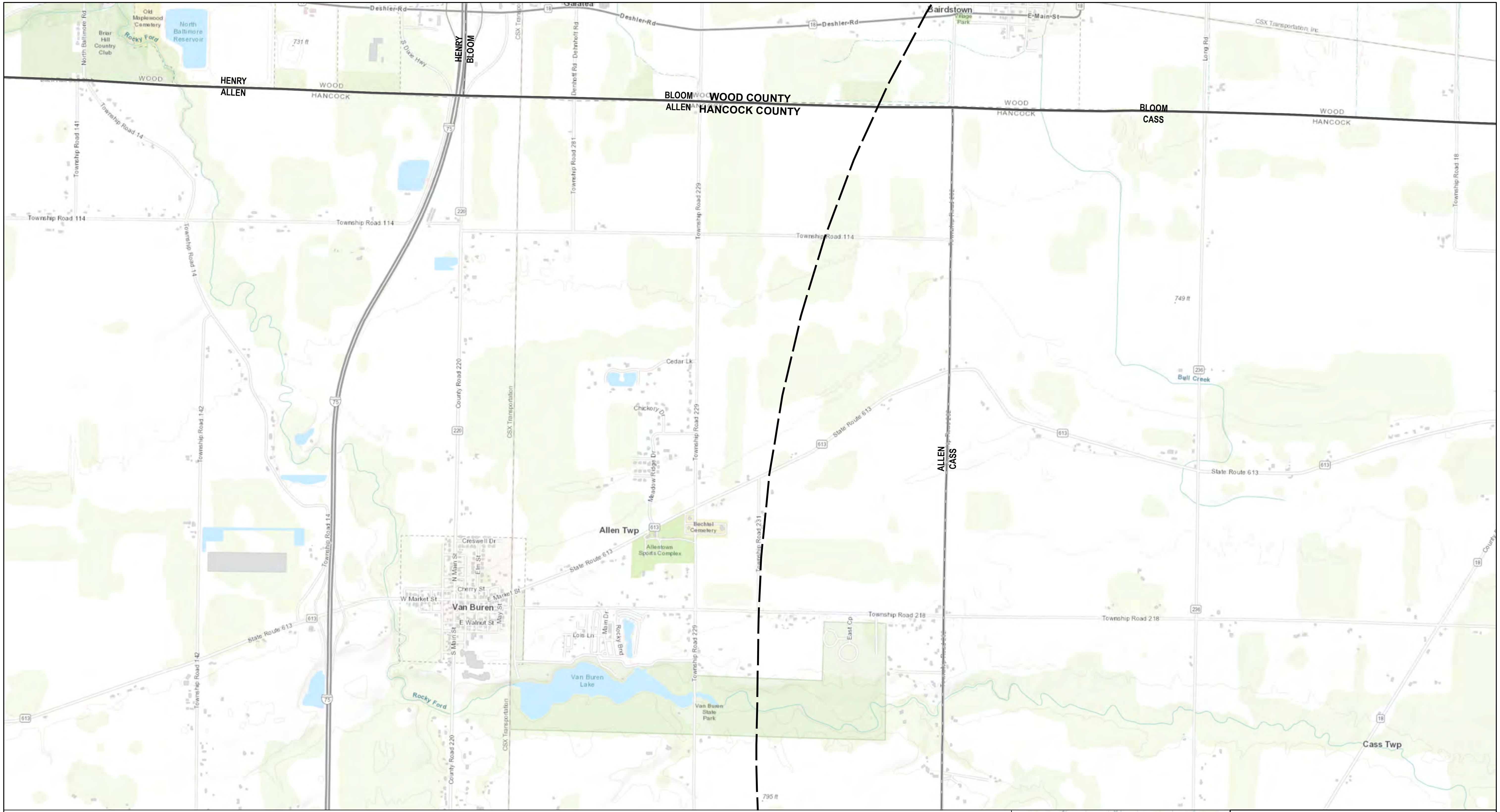


Figure 07-1
Air Navigation Facilities

Sheet 1 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

▭	PROJECT AREA
▭	5-MILE BUFFER OF PROJECT AREA
▭	TOWNSHIP BOUNDARY
▭	COUNTY BOUNDARY

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5. BASE MAP SOURCE: ESRI

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SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

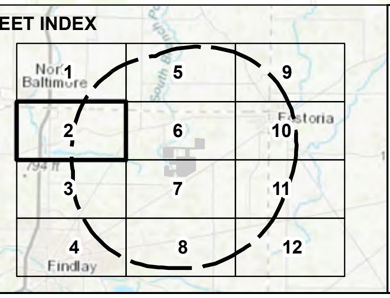
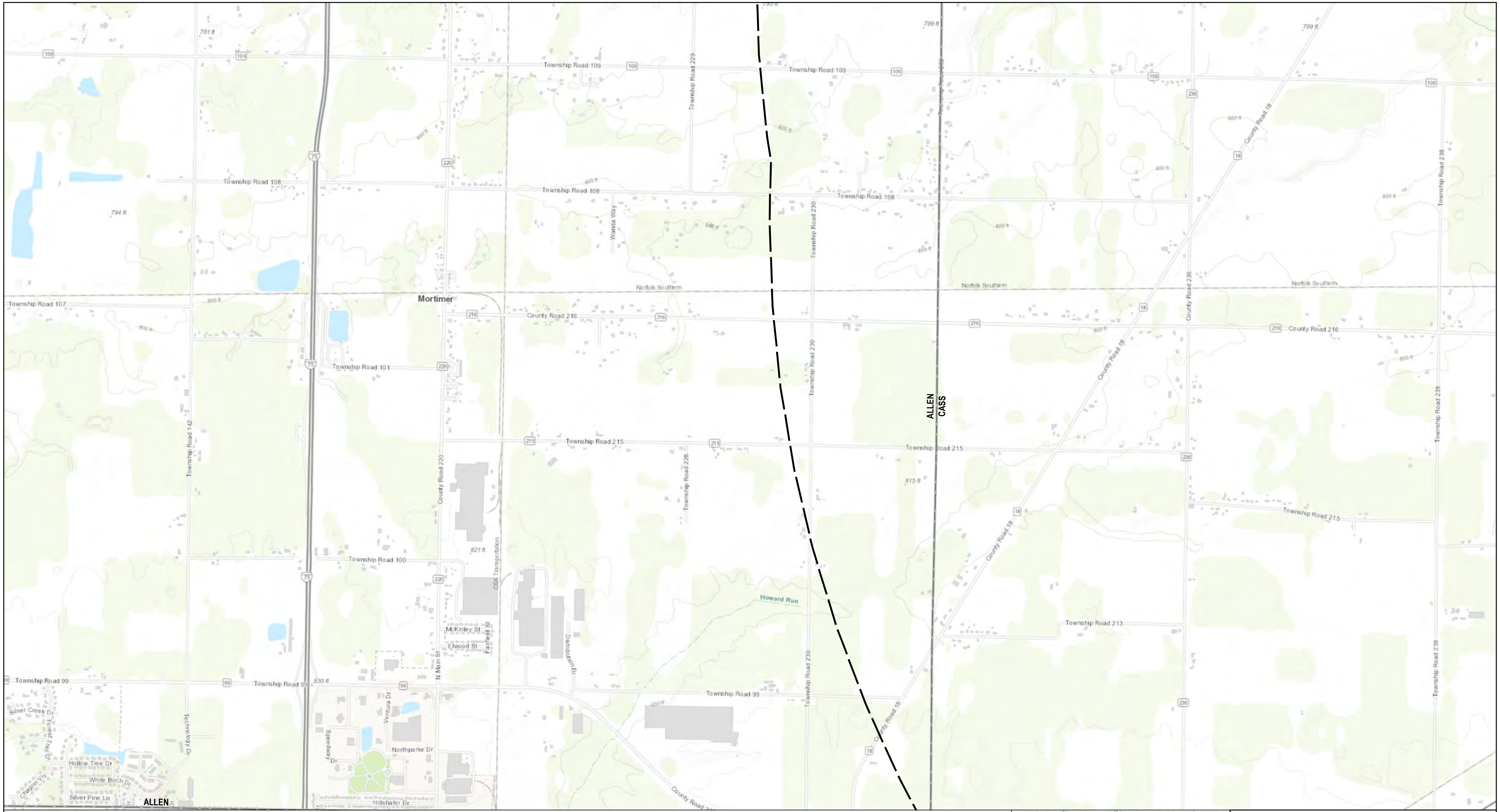


Figure 07-1
Air Navigation Facilities

Sheet 2 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

PROJECT AREA

5-MILE BUFFER OF PROJECT AREA

TOWNSHIP BOUNDARY

COUNTY BOUNDARY

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5. BASE MAP SOURCE: ESRI

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0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

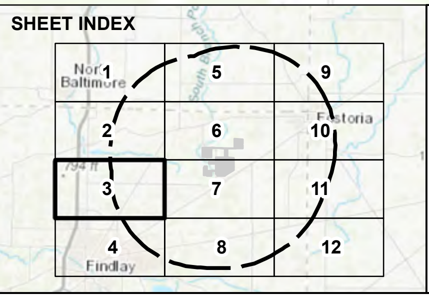
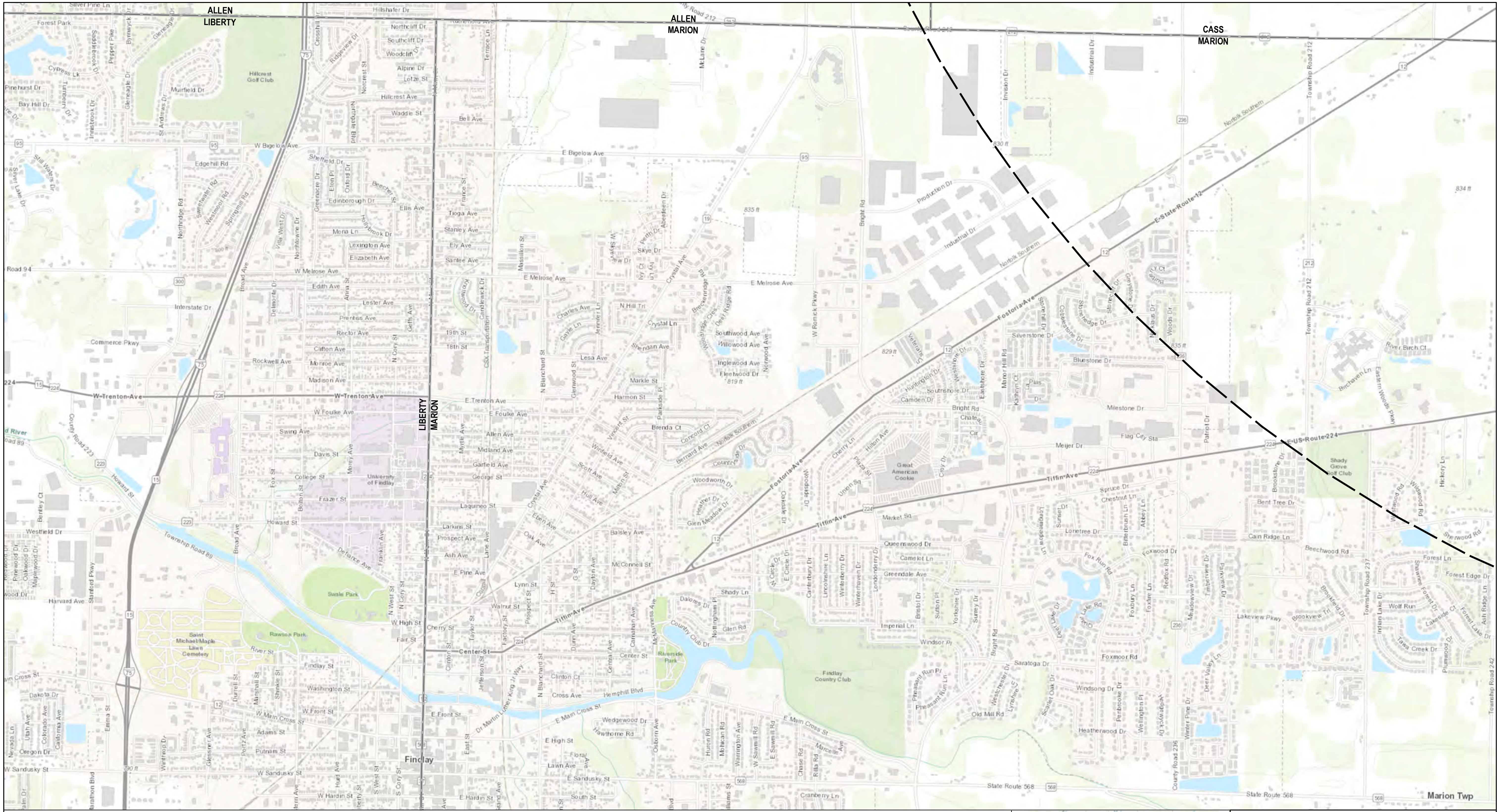


Figure 07-1
Air Navigation Facilities

Sheet 3 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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5. BASE MAP SOURCE: ESRI

0 2,000 4,000

SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

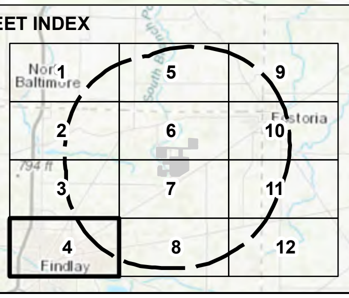
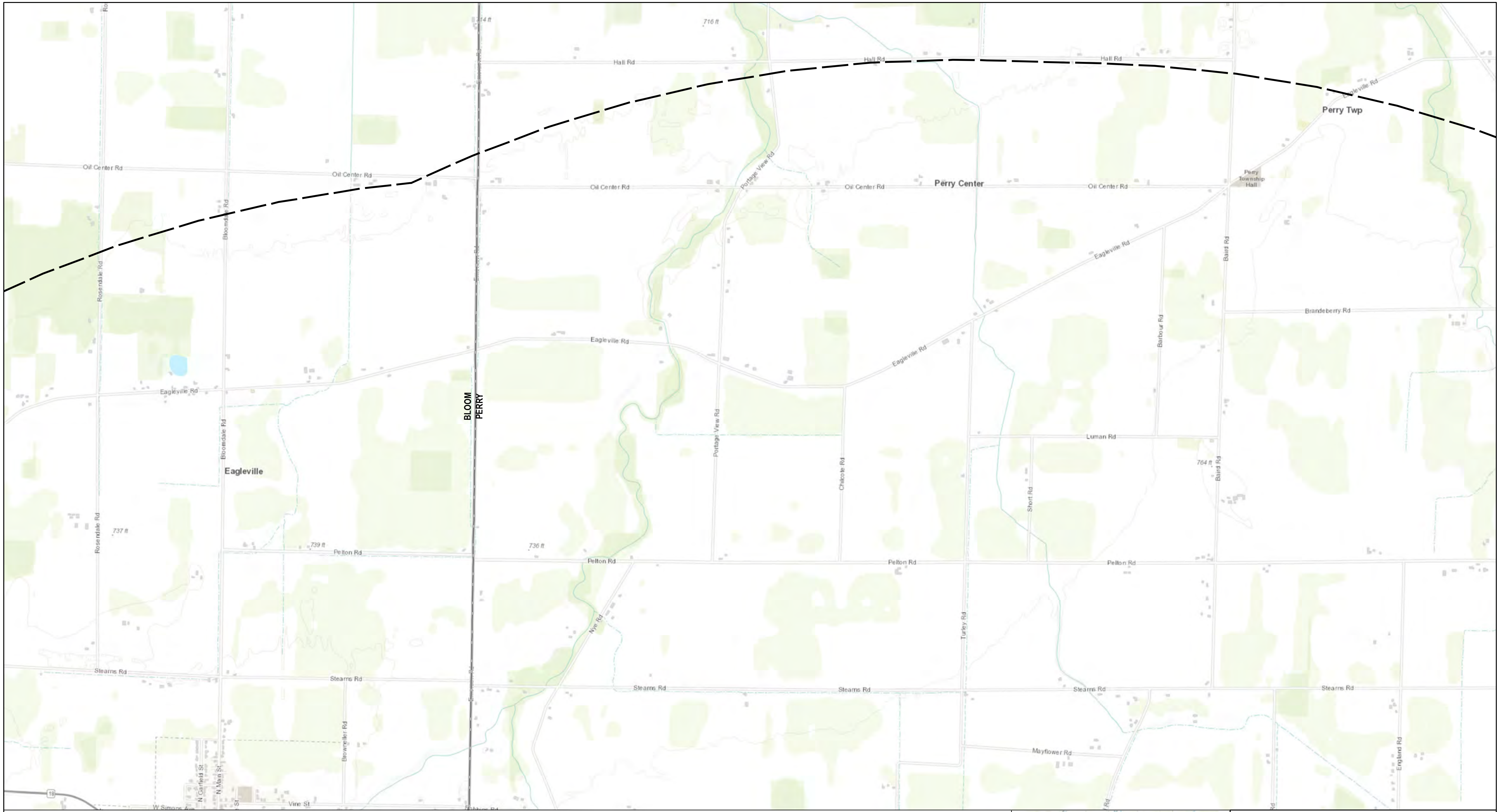


Figure 07-1
Air Navigation Facilities

Sheet 4 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

▭	PROJECT AREA
▭	5-MILE BUFFER OF PROJECT AREA
▭	TOWNSHIP BOUNDARY
▭	COUNTY BOUNDARY

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3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

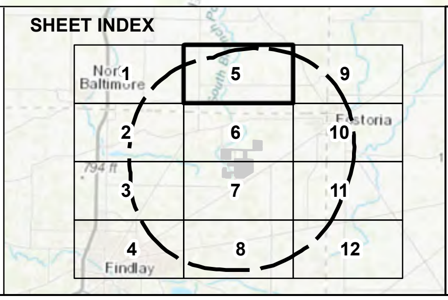
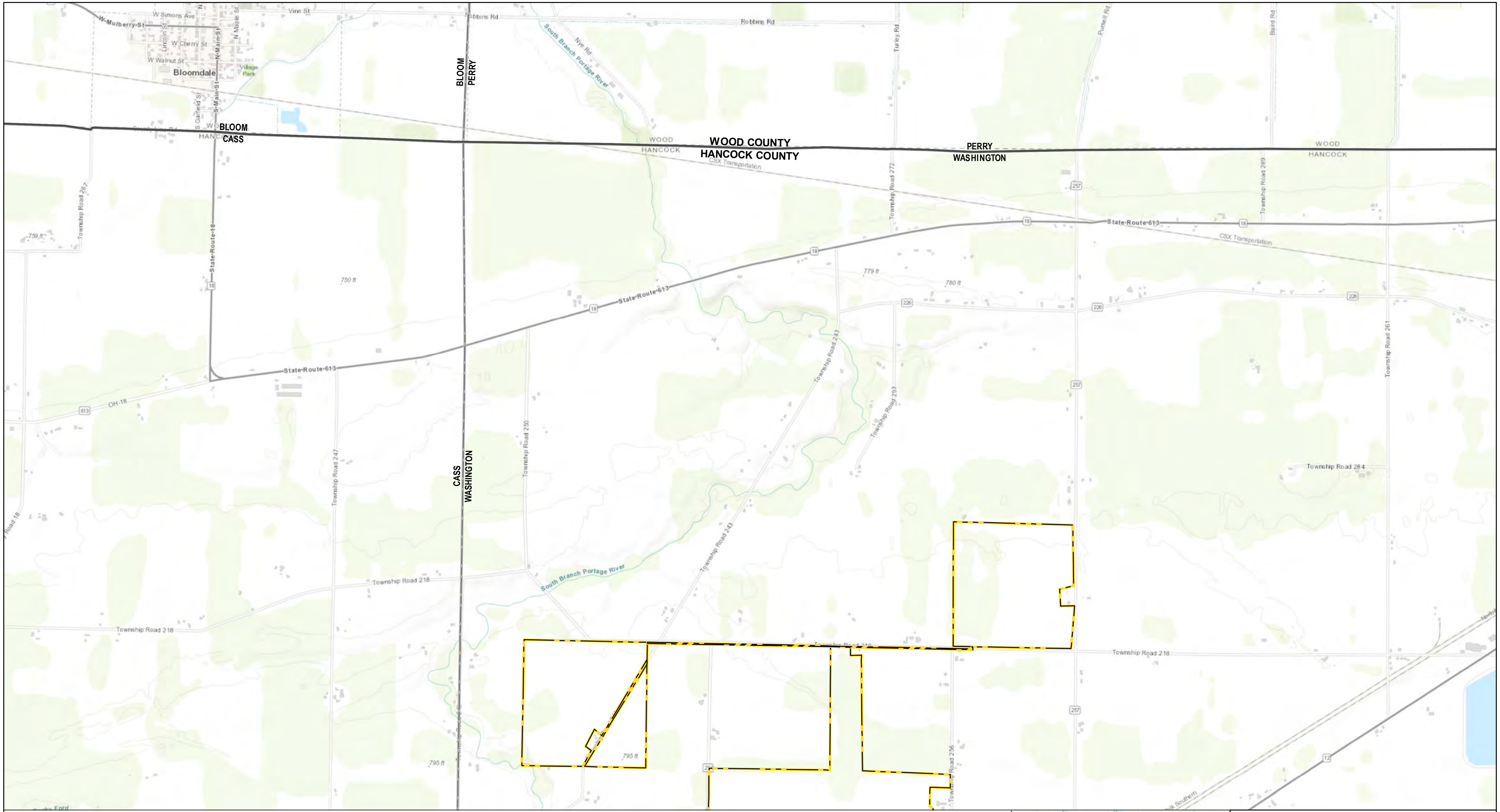


Figure 07-1
Air Navigation Facilities

Sheet 5 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

🟨 PROJECT AREA

5-MILE BUFFER OF PROJECT AREA

TOWNSHIP BOUNDARY

COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. NO PUBLIC AIR NAVIGATION FACILITIES ARE LOCATED WITHIN THE 5-MILE BUFFER OF THE PROJECT AREA ACCORDING TO AVAILABLE DATA FROM THE OHIO DEPARTMENT OF TRANSPORTATION (ODOT).
3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

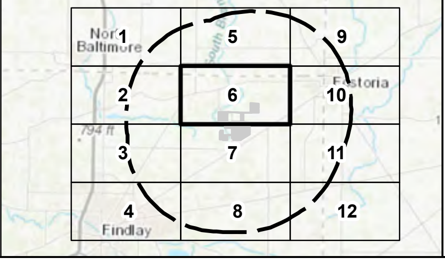
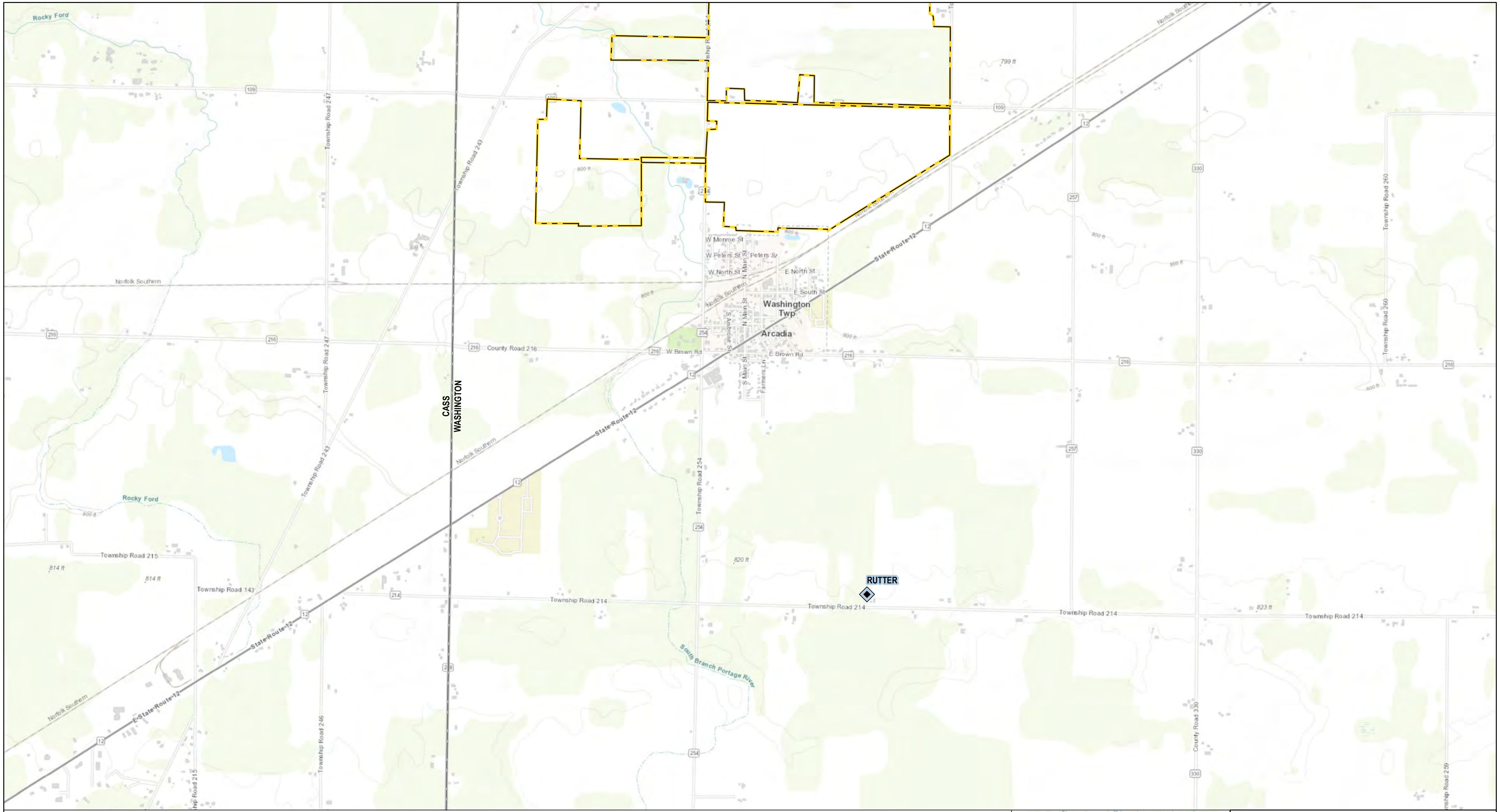


Figure 07-1
Air Navigation Facilities

Sheet 6 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

◆	PRIVATE AVIATION FACILITY
▭	PROJECT AREA
▭	5-MILE BUFFER OF PROJECT AREA
▭	TOWNSHIP BOUNDARY
▭	COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. NO PUBLIC AIR NAVIGATION FACILITIES ARE LOCATED WITHIN THE 5-MILE BUFFER OF THE PROJECT AREA ACCORDING TO AVAILABLE DATA FROM THE OHIO DEPARTMENT OF TRANSPORTATION (ODOT).
3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

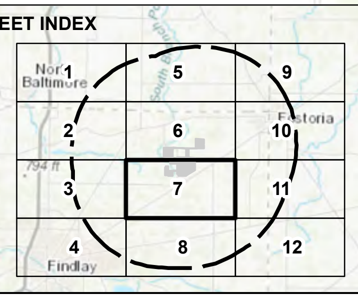
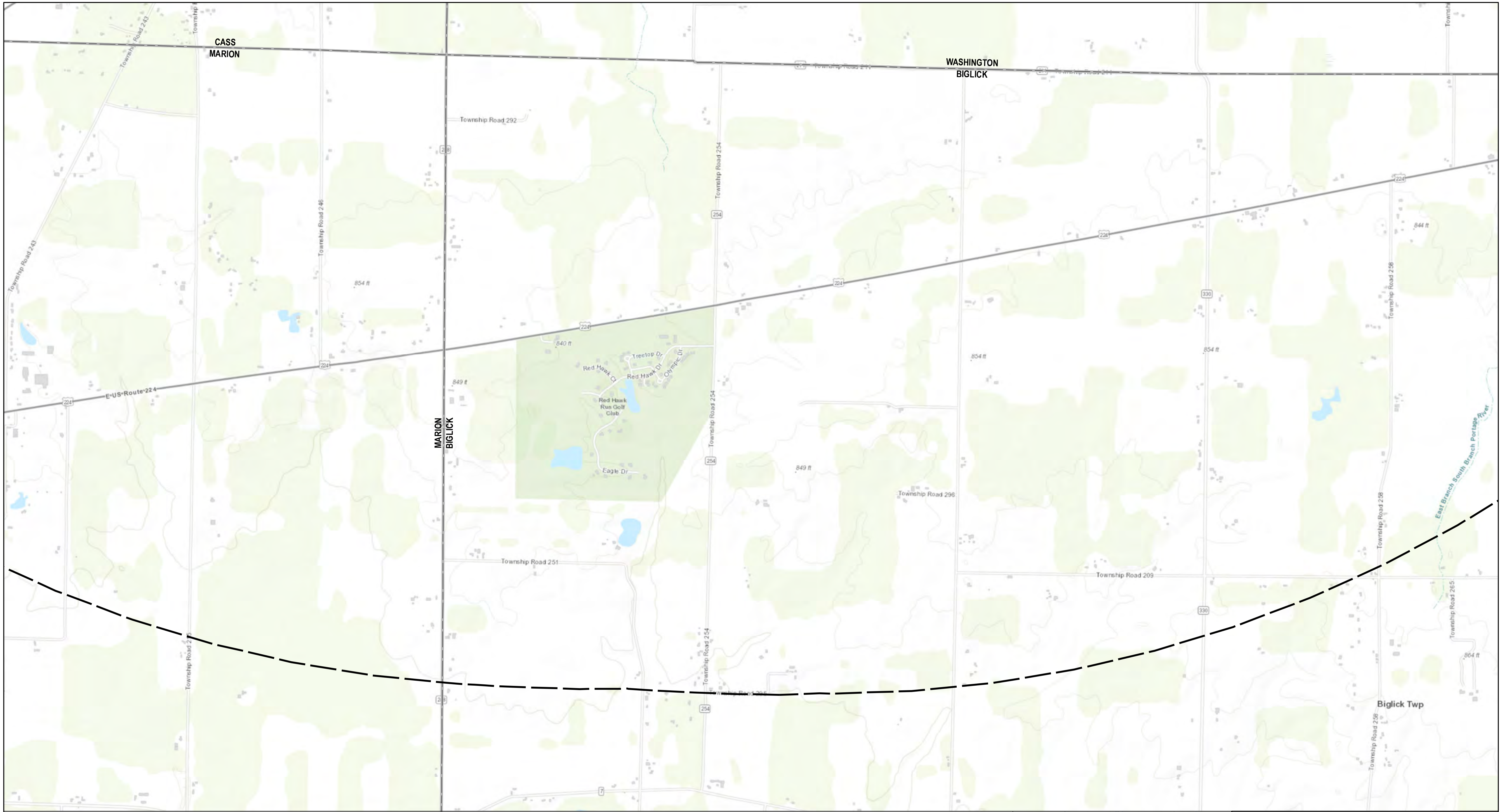


Figure 07-1
Air Navigation Facilities

Sheet 7 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

- 🟨 PROJECT AREA
- ▭ 5-MILE BUFFER OF PROJECT AREA
- ▭ TOWNSHIP BOUNDARY
- ▭ COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

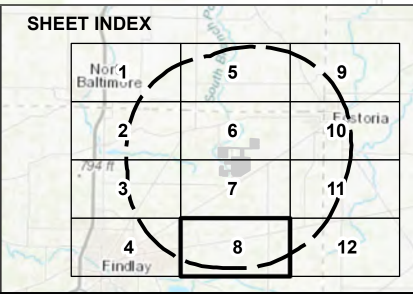
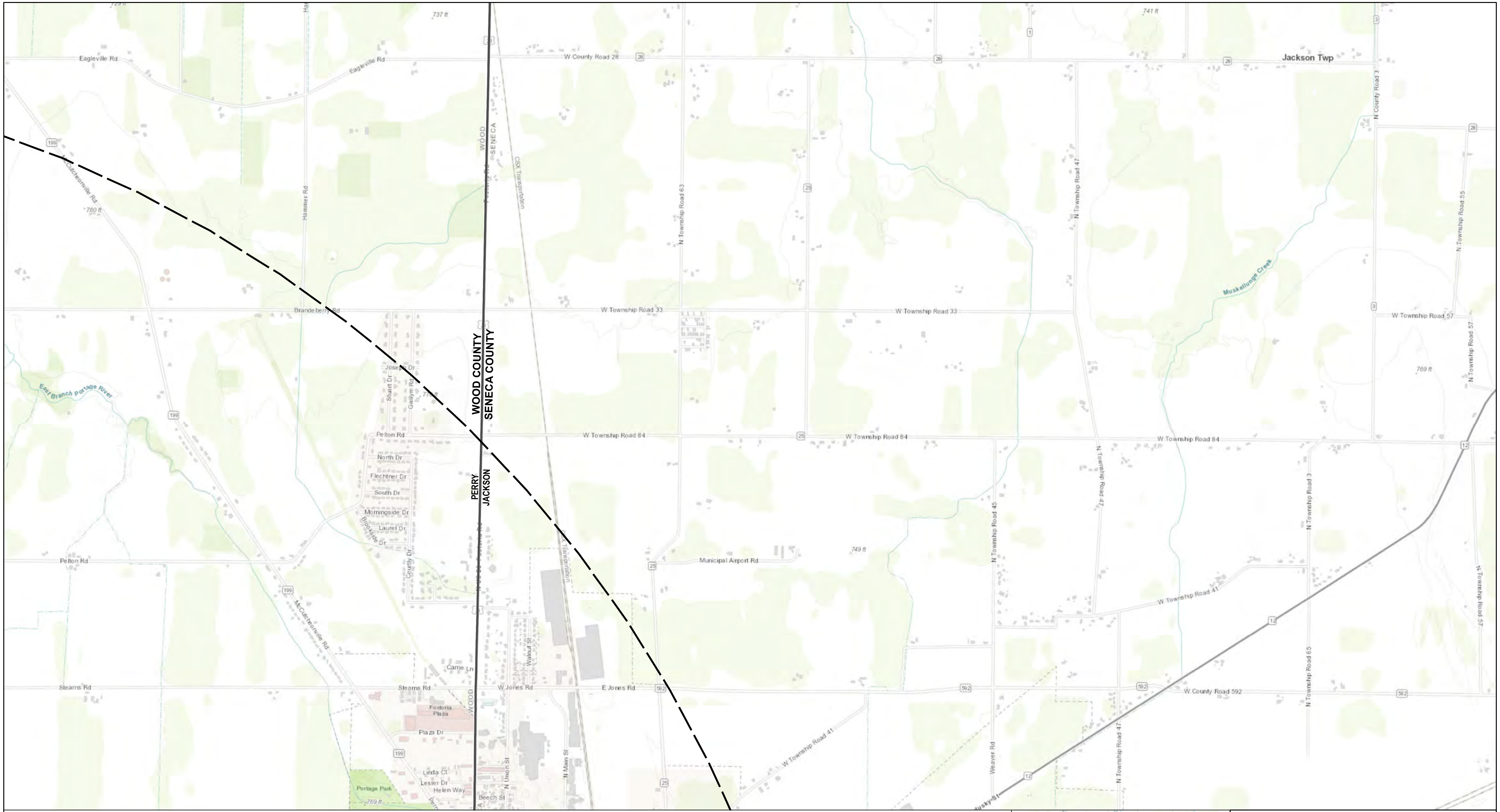


Figure 07-1
Air Navigation Facilities

Sheet 8 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

PROJECT AREA

5-MILE BUFFER OF PROJECT AREA

TOWNSHIP BOUNDARY

COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

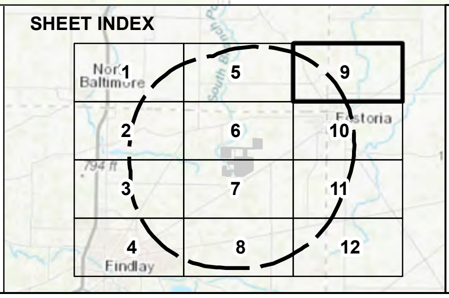
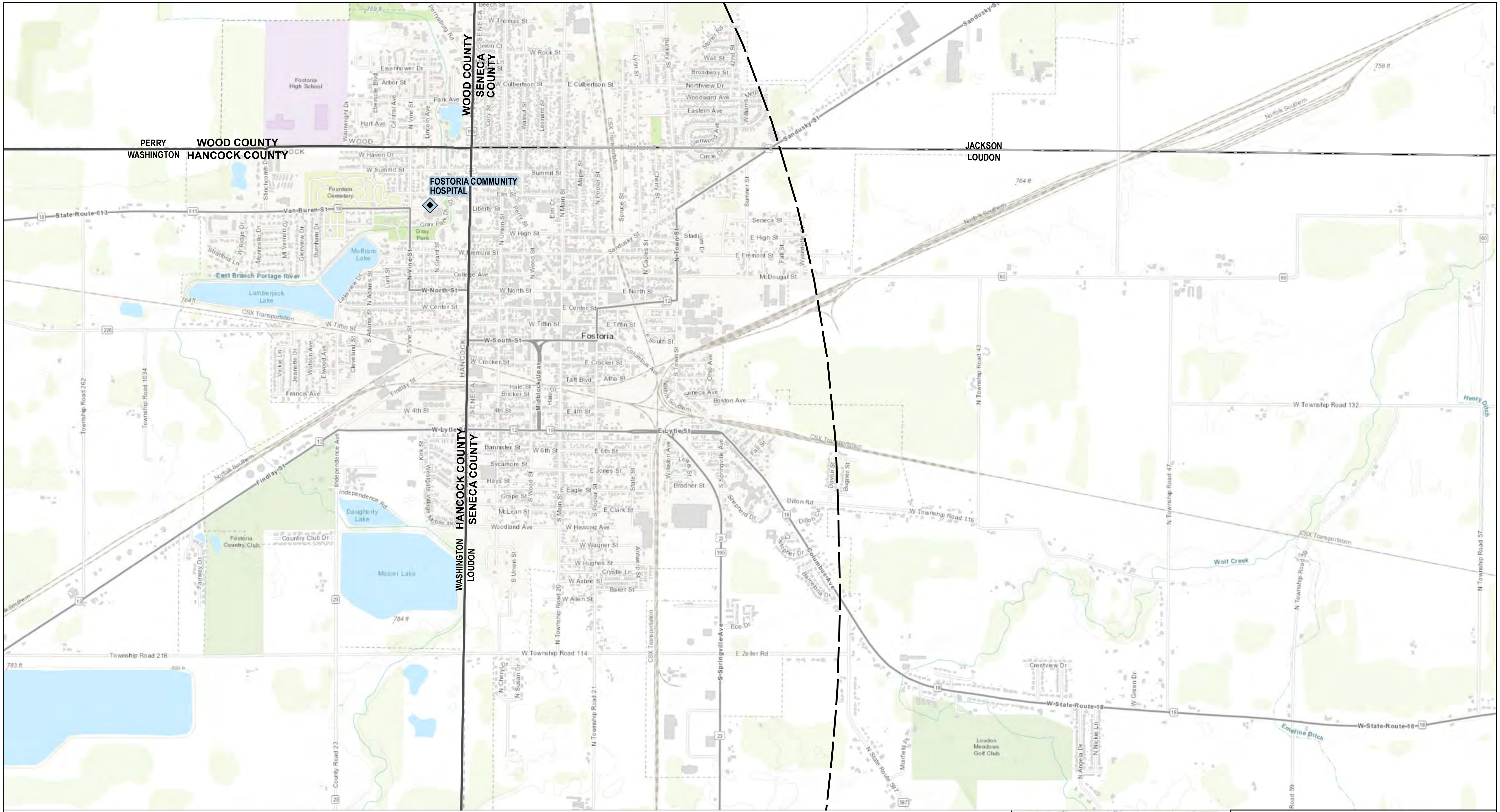


Figure 07-1
Air Navigation Facilities

Sheet 9 of 12

South Branch Solar

Hancock County, Ohio



LEGEND

◆ PRIVATE AVIATION FACILITY

▭ PROJECT AREA

▭ 5-MILE BUFFER OF PROJECT AREA

▭ TOWNSHIP BOUNDARY

▭ COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. NO PUBLIC AIR NAVIGATION FACILITIES ARE LOCATED WITHIN THE 5-MILE BUFFER OF THE PROJECT AREA ACCORDING TO AVAILABLE DATA FROM THE OHIO DEPARTMENT OF TRANSPORTATION (ODOT).
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4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

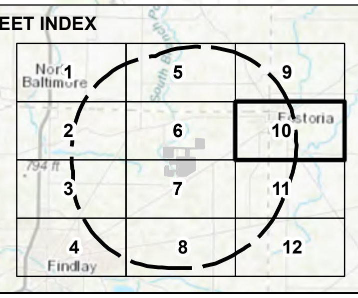
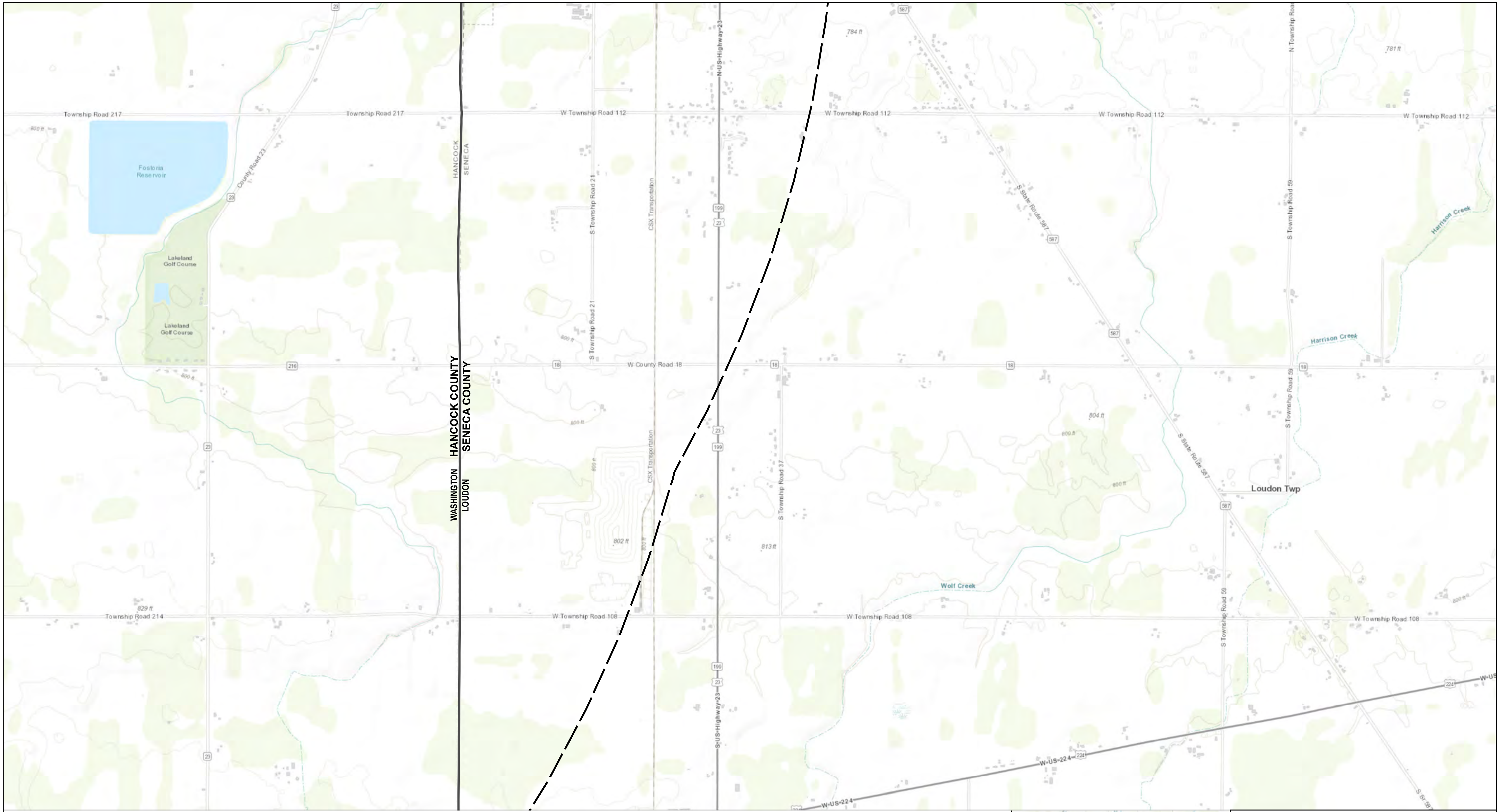


Figure 07-1
Air Navigation Facilities

Sheet 10 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

PROJECT AREA

5-MILE BUFFER OF PROJECT AREA

TOWNSHIP BOUNDARY

COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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5. BASE MAP SOURCE: ESRI

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0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

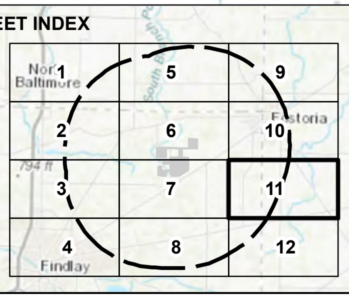
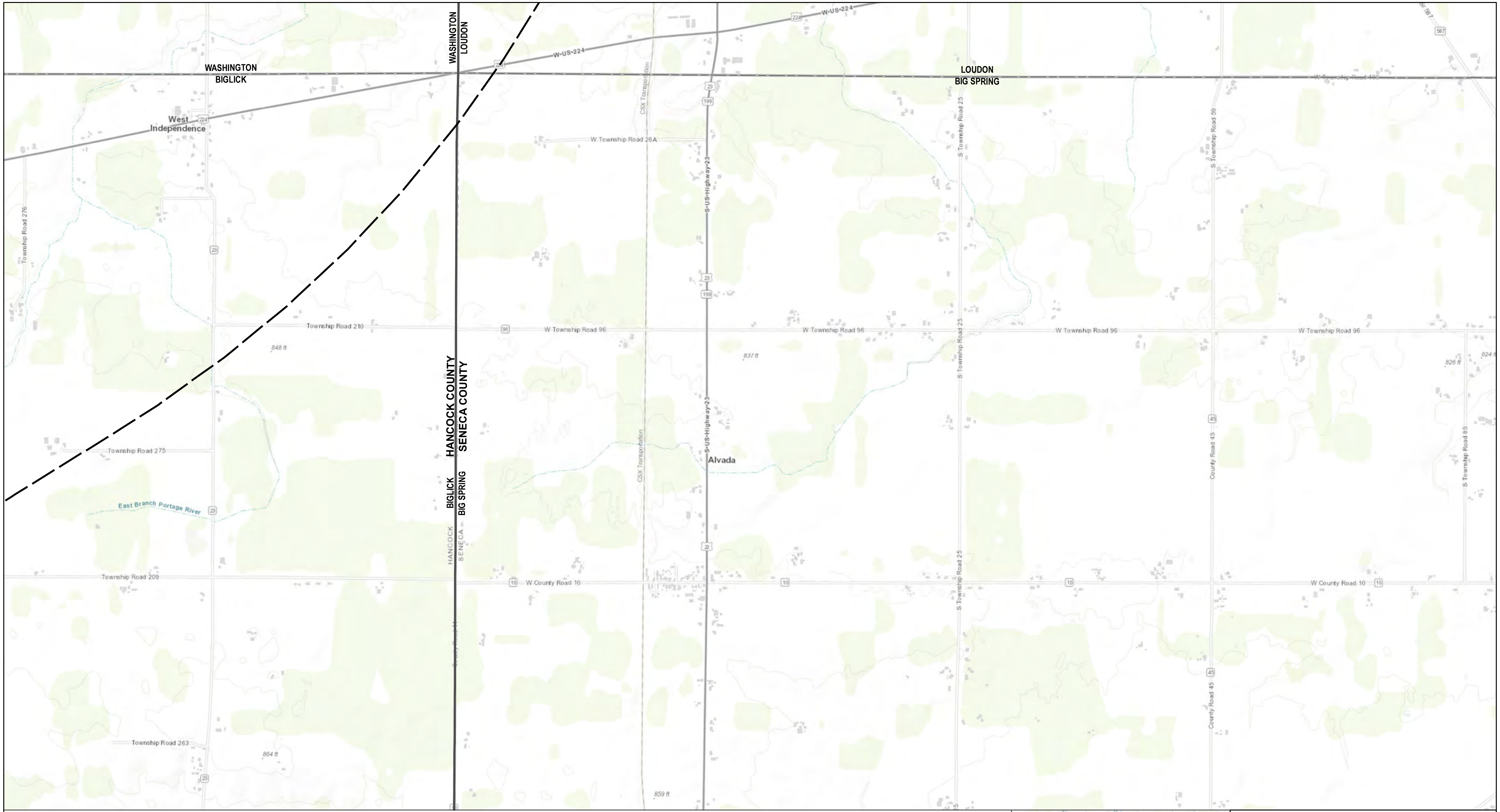


Figure 07-1
Air Navigation Facilities

Sheet 11 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

▭	PROJECT AREA
▭	5-MILE BUFFER OF PROJECT AREA
▭	TOWNSHIP BOUNDARY
▭	COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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4. COUNTY BOUNDARY AND AIRPORT AND HELIPADS DATA SOURCES: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. BASE MAP SOURCE: ESRI

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0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

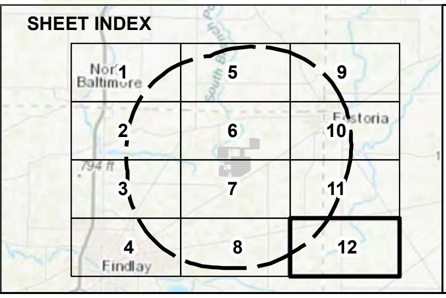
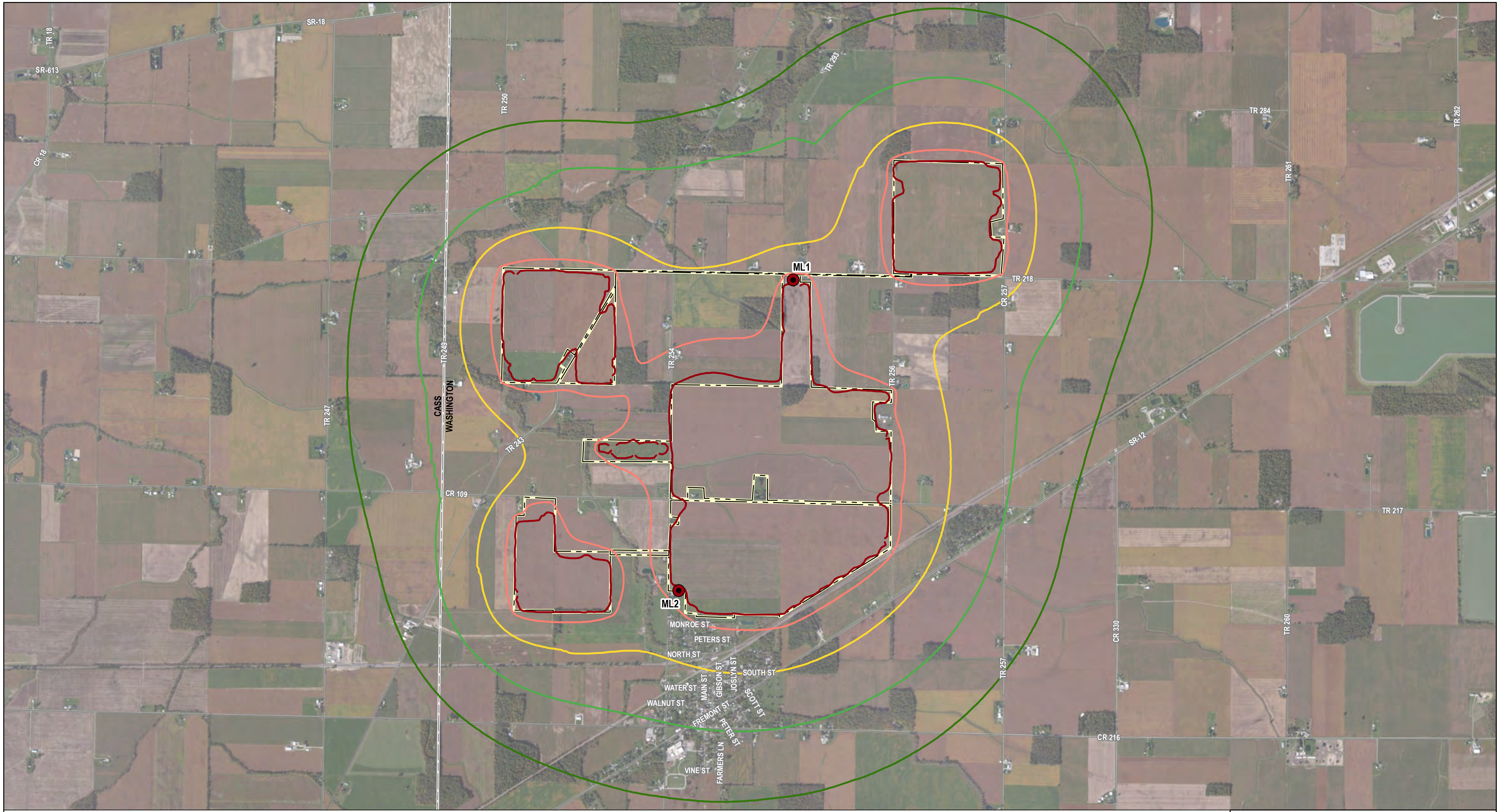


Figure 07-1
Air Navigation Facilities

Sheet 12 of 12

South Branch Solar
Hancock County, Ohio

Section 4906-4-08 Figures



LEGEND

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SOUND LEVELS DATA SOURCE: ACENTECH, 15 JULY 2021
3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
4. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. AERIAL IMAGERY SOURCE: ESRI

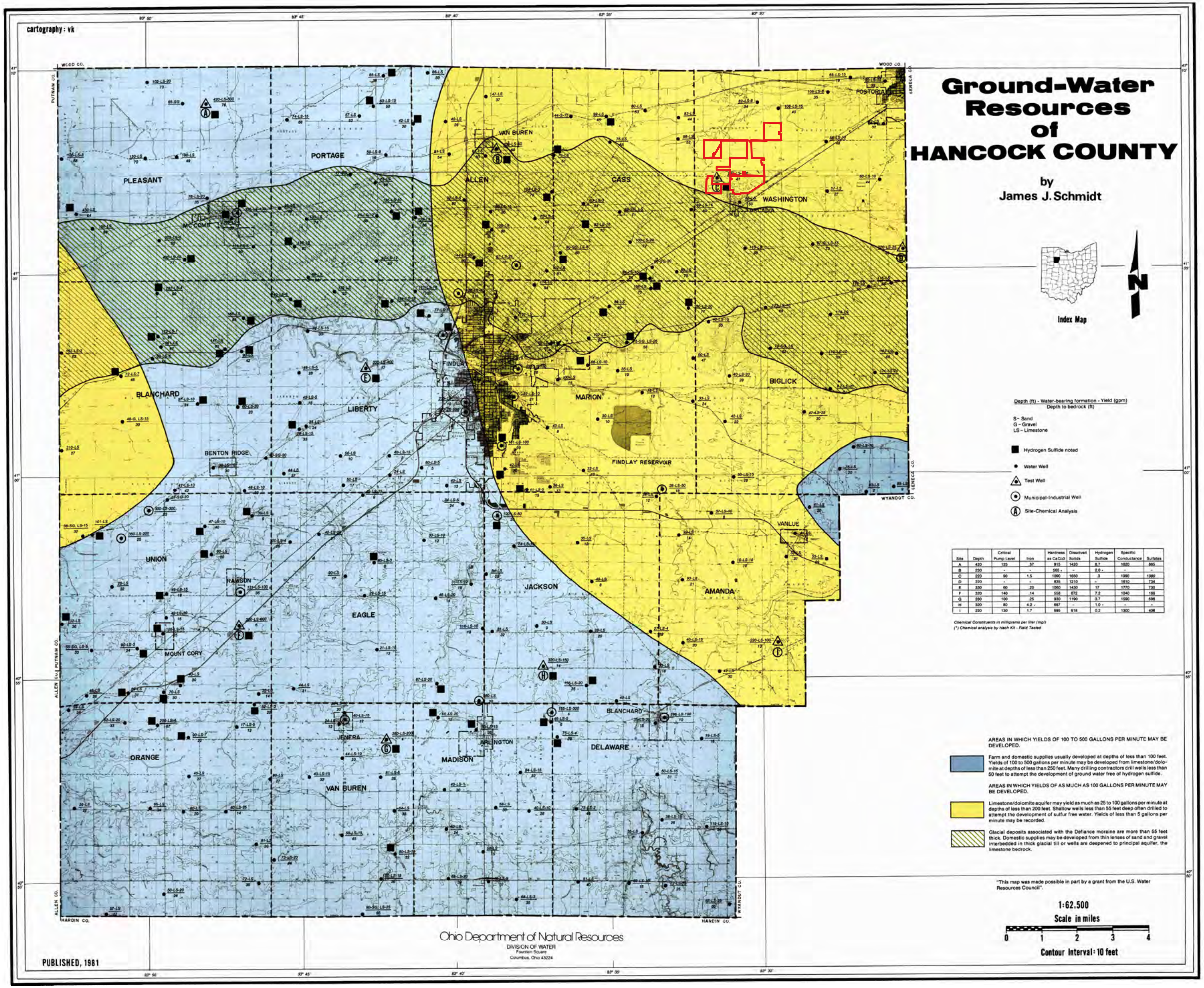
HALEY ALDRICH

Figure 08-1
Received Sound Levels

South Branch Solar
Hancock County, Ohio

LEGEND

🟥 PROJECT AREA



Ground-Water Resources of HANCOCK COUNTY

by
James J. Schmidt

Depth (ft) - Water-bearing formation - Yield (gpm)
Depth to bedrock (ft)

S - Sand
G - Gravel
LS - Limestone

■ Hydrogen Sulfide noted

● Water Well

△ Test Well

⊙ Municipal-Industrial Well

Ⓐ Site-Chemical Analysis

Site	Depth	Critical Pump Level	Iron	Hardness as CaCo3	Dissolved Solids	Hydrogen Sulfide	Specific Conductance	Sulfates
A	420	125	.57	915	1420	8.7	1820	880
B	230	-	-	565 *	-	2.0 *	-	-
C	220	90	1.5	1090	1650	.3	1990	1080
D	220	-	-	835	1210	-	1810	734
E	330	60	.20	1060	1430	17	1770	730
F	320	140	.14	558	672	7.2	1040	186
G	280	100	.25	930	1190	3.7	1590	596
H	320	80	4.2 *	667	-	1.0 *	-	-
I	220	130	1.7	895	918	0.2	1300	406

Chemical Constituents in milligrams per liter (mg/l)
(*) Chemical analysis by Hach Kit - Field Tested

AREAS IN WHICH YIELDS OF 100 TO 500 GALLONS PER MINUTE MAY BE DEVELOPED.

🟦 Farm and domestic supplies usually developed at depths of less than 100 feet. Yields of 100 to 500 gallons per minute may be developed from limestone/dolomite at depths of less than 250 feet. Many drilling contractors drill wells less than 50 feet to attempt the development of ground water free of hydrogen sulfide.

AREAS IN WHICH YIELDS OF AS MUCH AS 100 GALLONS PER MINUTE MAY BE DEVELOPED.

🟨 Limestone/dolomite aquifer may yield as much as 25 to 100 gallons per minute at depths of less than 200 feet. Shallow wells less than 55 feet deep often drilled to attempt the development of sulfur free water. Yields of less than 5 gallons per minute may be recorded.

▨ Glacial deposits associated with the Defiance moraine are more than 55 feet thick. Domestic supplies may be developed from thin lenses of sand and gravel interbedded in thick glacial till or wells are deepened to principal aquifer, the limestone bedrock.

"This map was made possible in part by a grant from the U.S. Water Resources Council".

1:62,500
Scale in miles
0 1 2 3 4
Contour Interval: 10 feet

Ohio Department of Natural Resources
DIVISION OF WATER
Fountain Square
Columbus, Ohio 43224

NOTES

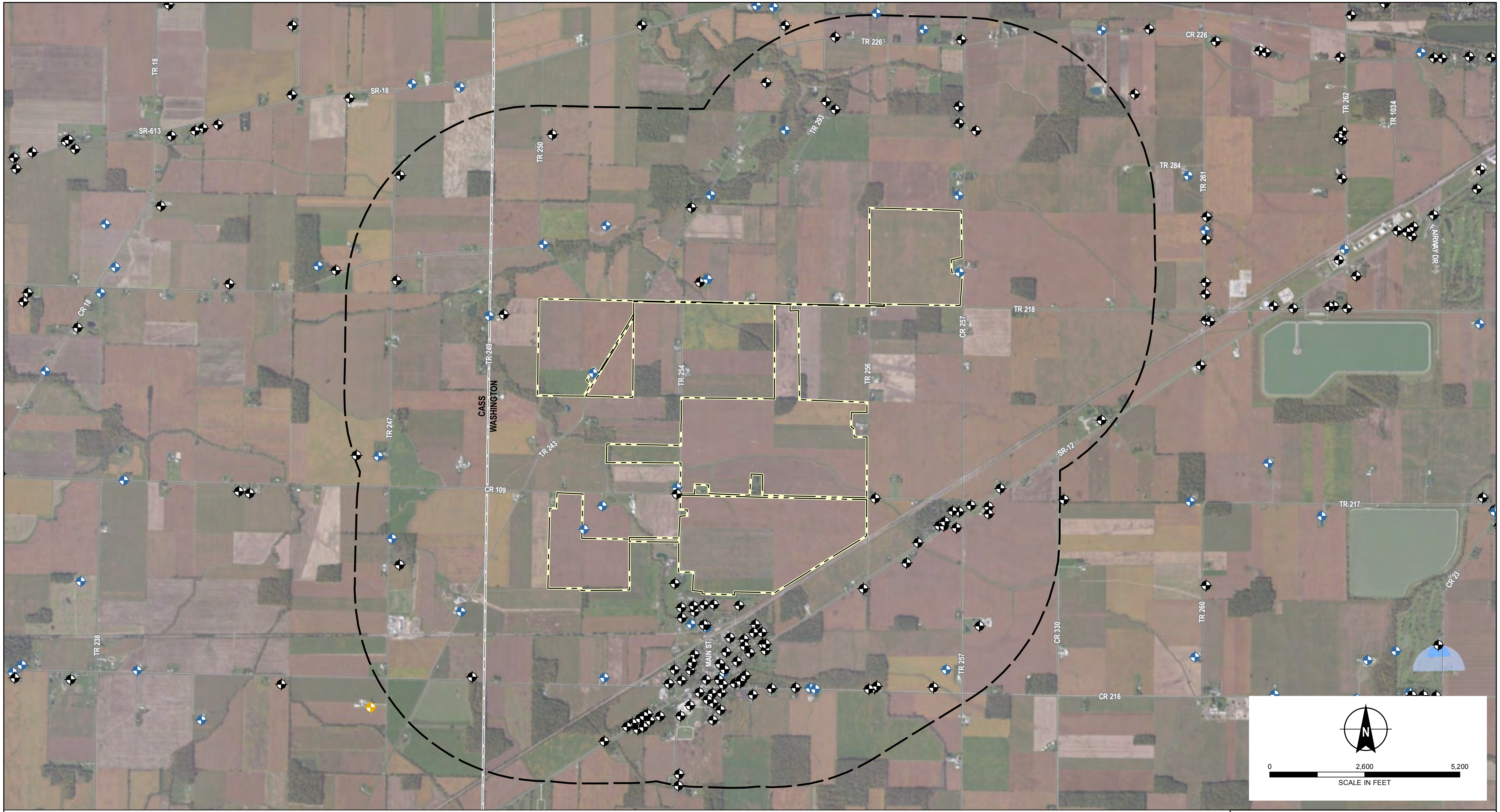
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. GROUNDWATER RESOURCE MAP SOURCE: OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR)

0 2 4
SCALE IN MILES

HALEY ALDRICH

Figure 08-2
Groundwater Resources

South Branch Solar
Hancock County, Ohio

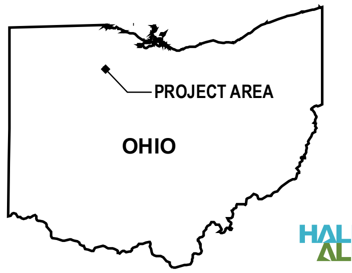


LEGEND

- ● AGRICULTURAL
- ● RESIDENTIAL
- ● OTHER OR UNKNOWN
- ROAD
- ▨ INNER MANAGEMENT ZONE PROTECTION AREA (GROUNDWATER)
- ▨ OUTER MANAGEMENT ZONE PROTECTION AREA
- PROJECT AREA
- 1-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. WATER WELLS DATA SOURCE: OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR)
3. WATER PROTECTION AREAS DATA SOURCE: OHIO ENVIRONMENTAL PROTECTION AGENCY (OEPA)
4. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
5. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. AERIAL IMAGERY SOURCE: ESRI



HALEY ALDRICH

Figure 08-3
Water Wells and Water Protection Areas

South Branch Solar
Hancock County, Ohio

LEGEND

———	ROAD
▭	PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. NO 1% ANNUAL FLOOD CHANCE HAZARD ZONES REPRESENTING 100-YEAR FLOOD ZONES OR 0.2% ANNUAL FLOOD CHANCE HAZARD ZONES REPRESENTING 500-YEAR FLOOD ZONES PRESENT WITHIN MAP EXTENT AS IDENTIFIED BY AVAILABLE FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA) FLOODPLAIN GIS DATA.

3. AERIAL IMAGERY SOURCE: ESRI

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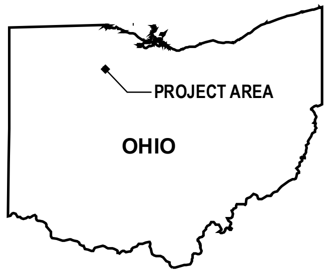
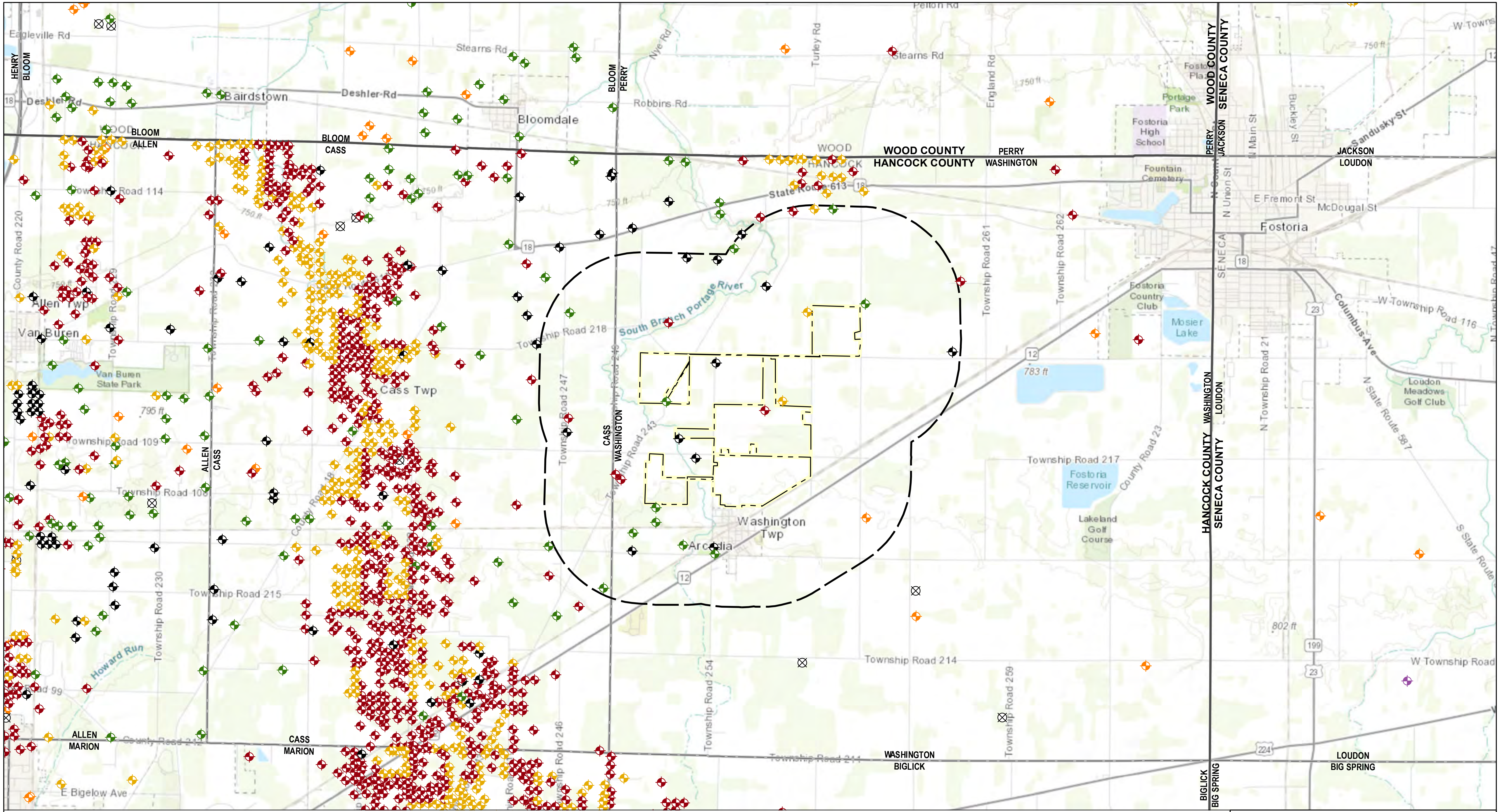
SCALE IN FEET



HALEY ALDRICH

Figure 08-4
Floodplains

South Branch Solar
Hancock County, Ohio



WELL TYPE

- 🟩 GAS
- 🟥 OIL
- ◆ OIL AND GAS
- 🟪 PERMITTED LOCATION
- 🟧 DRY HOLE
- 🟨 PLUGGED
- ⊠ EXPIRED PERMIT

- ▭ PROJECT AREA
- ▭ 1-MILE BUFFER OF PROJECT AREA
- ▭ TOWNSHIP BOUNDARY
- ▭ COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ONLY EXISTING WELLS ARE SHOWN; PERMITTED, NOT YET DRILLED LOCATIONS ARE NOT SHOWN.
3. WELL DATA SOURCE: OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR)
4. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
6. BASE MAP SOURCE: ESRI

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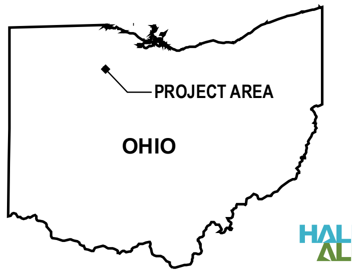
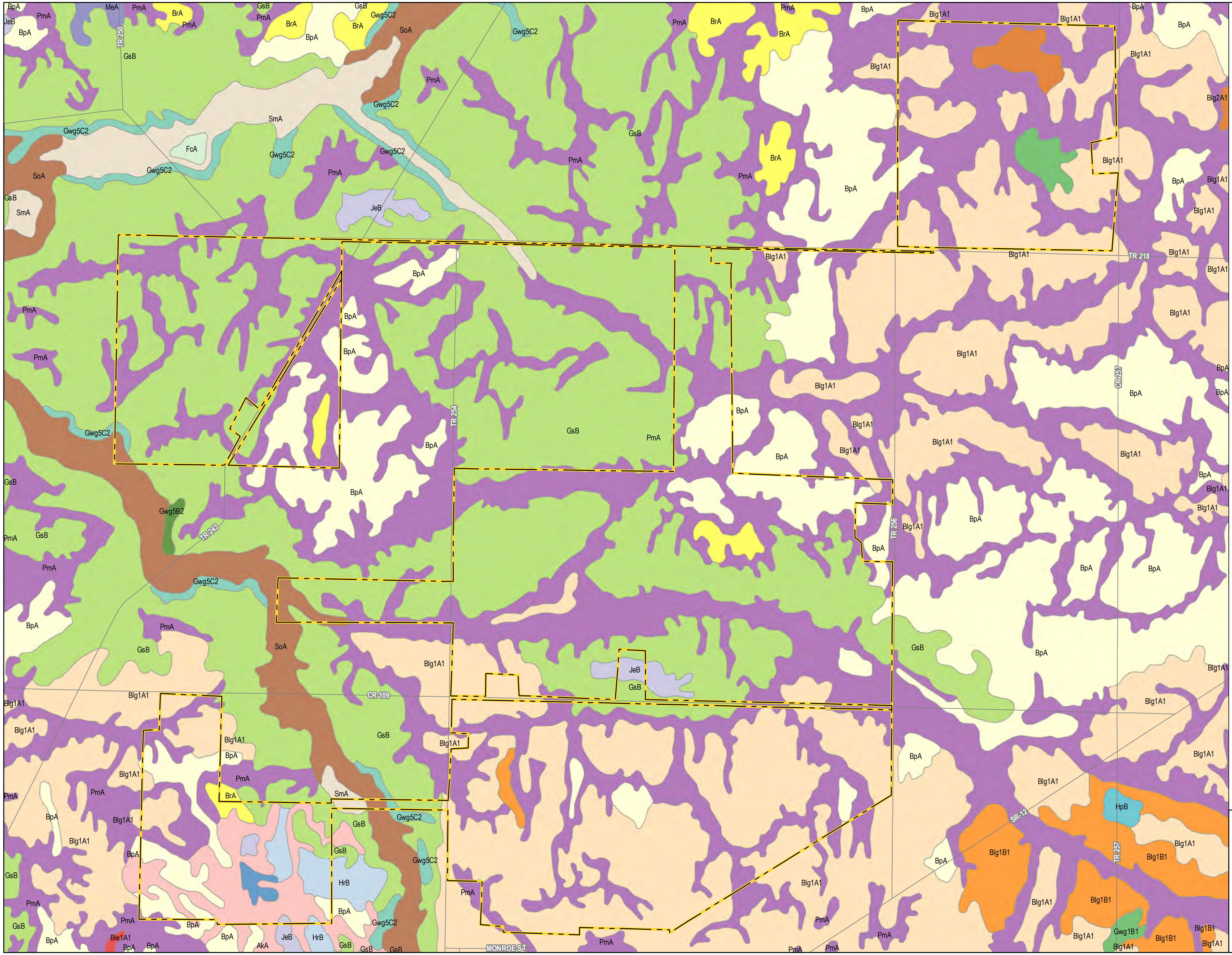
0 5,000 10,000
SCALE IN FEET



HALEY ALDRICH

Figure 08-5
Existing Oil, Gas, and Injection Wells

South Branch Solar
Hancock County, Ohio



LEGEND

——— ROAD

NRCS SOIL TYPE

- 🟥 AkA
- 🟥 Ble1A1
- 🟧 Blg1A1
- 🟧 Blg1B1
- 🟧 Blg2A1
- 🟨 BpA
- 🟨 BrA
- 🟩 FcA
- 🟩 GsB
- 🟩 Gwg1B1
- 🟩 Gwg5B2
- 🟩 Gwg5C2
- 🟦 HpB
- 🟦 HrB
- 🟦 JeA
- 🟪 JeB
- 🟪 MeA
- 🟪 PmA
- 🟫 SmA
- 🟫 SoA
- ▭ PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. SOILS DATA SOURCE: UNITED STATES DEPARTMENT OF AGRICULTURE (USDA) NATURAL RESOURCES CONSERVATION SERVICE (NRCS)
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

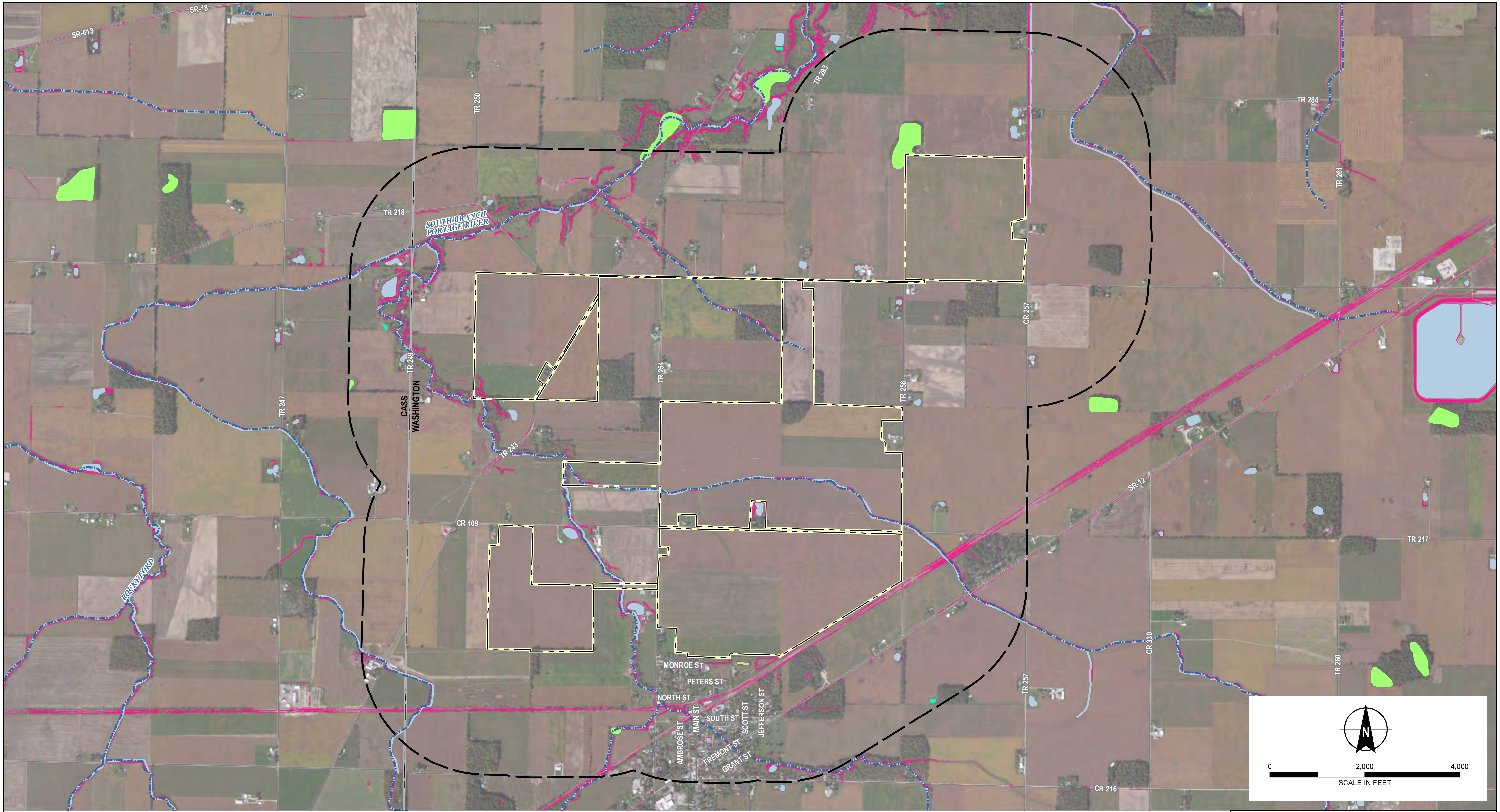
N

0 1,100 2,200
SCALE IN FEET

HALEY ALDRICH

Figure 08-6
Soils

South Branch Solar
Hancock County, Ohio

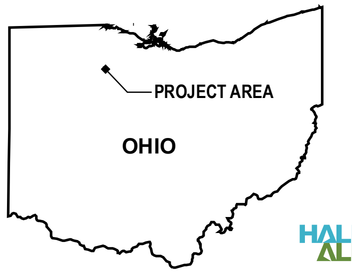


LEGEND

-·-·-	STREAM OR RIVER
—	ROAD
🟩	NWI FRESHWATER EMERGENT WETLAND
🟩	NWI FRESHWATER FORESTED/SHRUB WETLAND
🟦	NWI OPEN WATER
🟥	LAND WITH >12% SLOPE
▭	PROJECT AREA
▭	0.5-MILE BUFFER OF PROJECT AREA
▭	CITY OR TOWN BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. NO HIGHLY ERODIBLE SOILS ARE PRESENT WITHIN MAP EXTENT ACCORDING TO DATA AVAILABLE FROM UNITED STATES DEPARTMENT OF AGRICULTURE (USDA) NATURAL RESOURCES CONSERVATION SERVICE (NRCS).
3. NO CONSERVATION OR WILDLIFE AREAS WITHIN MAP EXTENT ACCORDING TO DATA AVAILABLE FROM UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD).
4. STREAM OR RIVER DATA SOURCE: USGS NATIONAL HYDROGRAPHY DATASET (NHD)
5. WETLANDS DATA SOURCE: USFWS NATIONAL WETLANDS INVENTORY (NWI)
6. CONSERVATION AREAS DATA SOURCE: UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)
7. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
8. AERIAL IMAGERY SOURCE: ESRI



HALEY ALDRICH

Figure 08-7
Natural Resources within One Half Mile

South Branch Solar
Hancock County, Ohio

LEGEND

—	ROAD
🟦	DELINEATED STREAM SEGMENT
🟩	DELINEATED WETLAND
▭	PROJECT AREA
▭	TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DELINEATED STREAMS AND WETLANDS DATA SOURCE: FIELD OBSERVATIONS BY HALEY & ALDRICH.
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
4. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
5. AERIAL IMAGERY SOURCE: ESRI

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SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

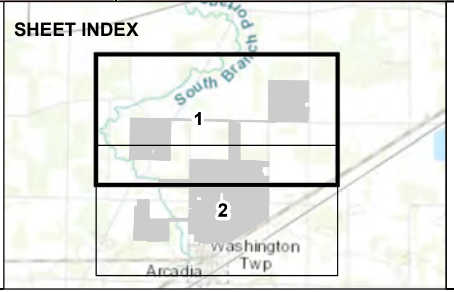
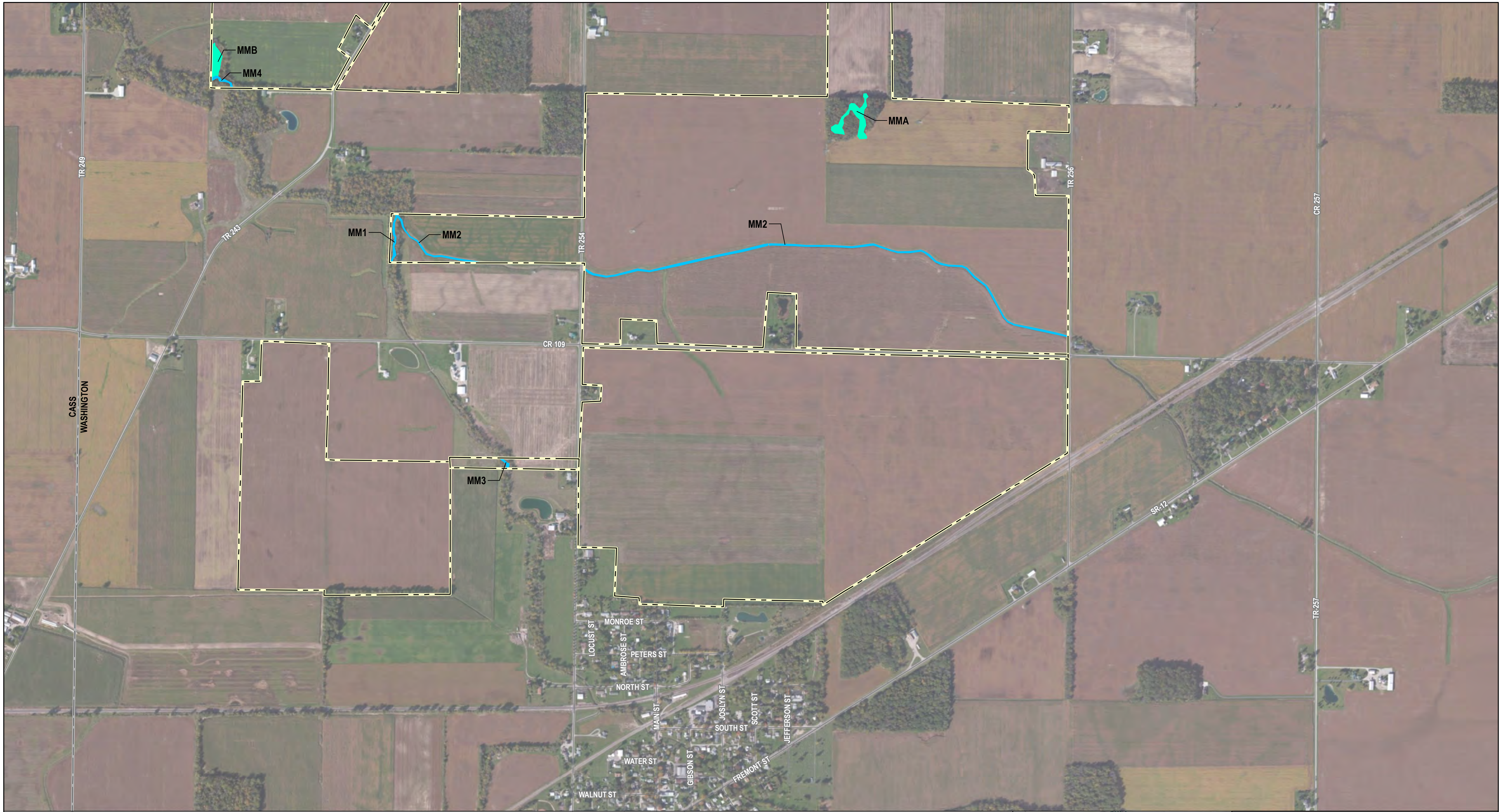


Figure 08-8
Delineated Wetlands

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

- — ROAD
- 🟦 DELINEATED STREAM SEGMENT
- 🟩 DELINEATED WETLAND
- ▭ PROJECT AREA
- ▭ TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. DELINEATED STREAMS AND WETLANDS DATA SOURCE: FIELD OBSERVATIONS BY HALEY & ALDRICH.

3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

4. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)

5. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000

SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

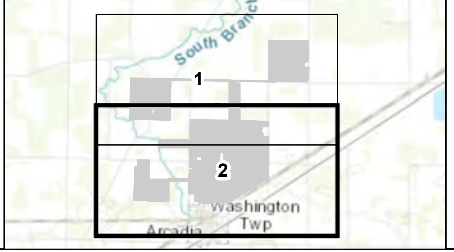
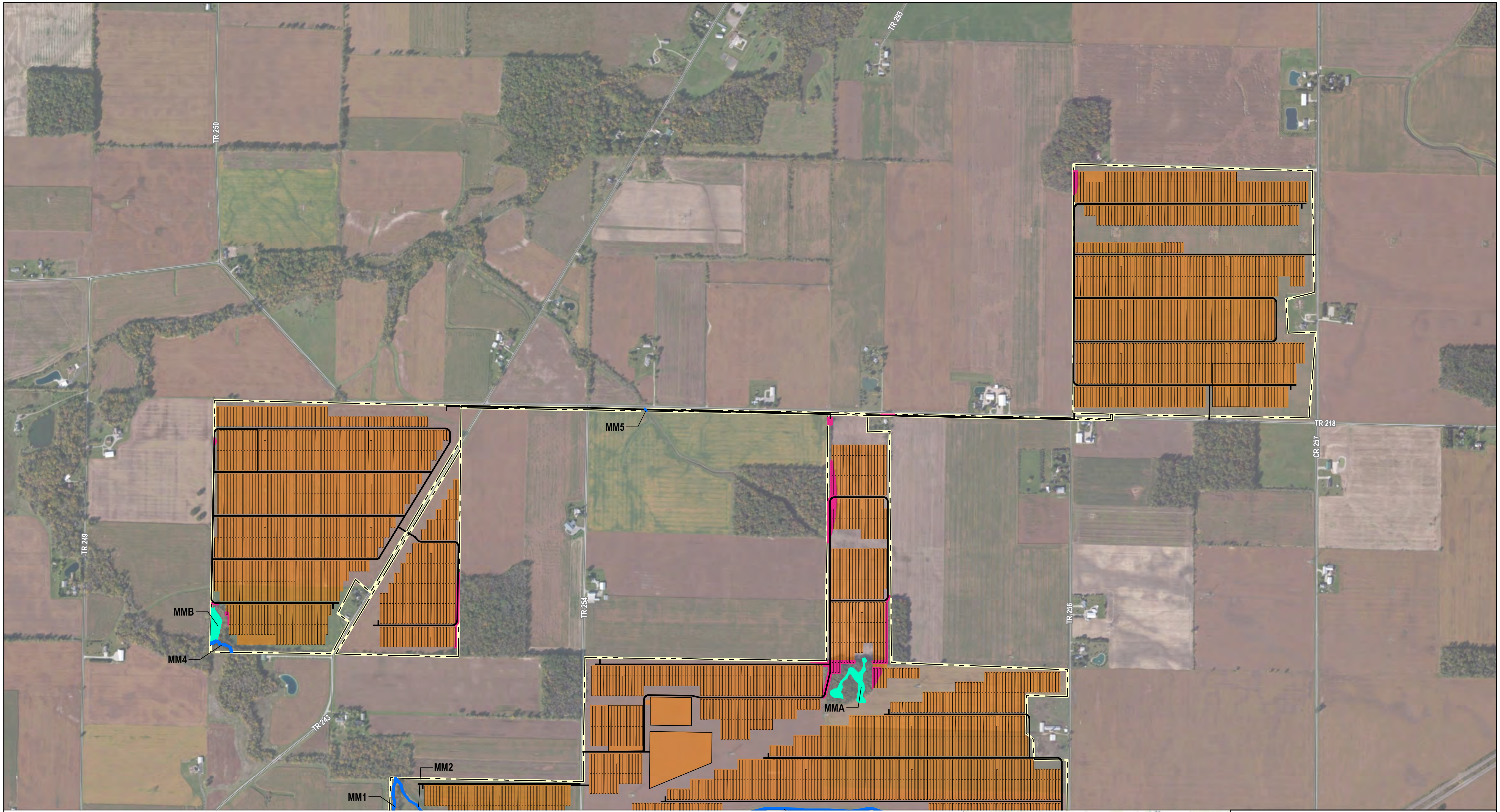


Figure 08-8
Delineated Wetlands

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio



—	PROJECT LAYOUT COMPONENT
-·-	DELINEATED STREAM
—	ROAD
🟩	DELINEATED WETLAND
🟥	TREE CLEARING AREA
🟧	IMPACT AREA
▭	PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DELINEATED STREAMS AND WETLANDS DATA SOURCE: FIELD OBSERVATIONS BY HALEY & ALDRICH.
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
4. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

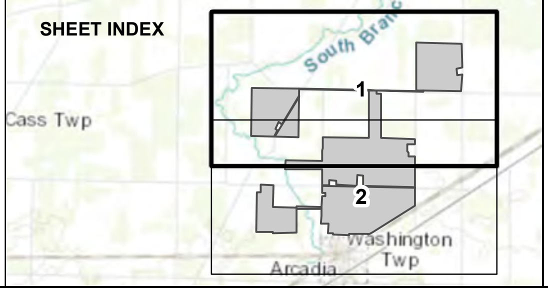
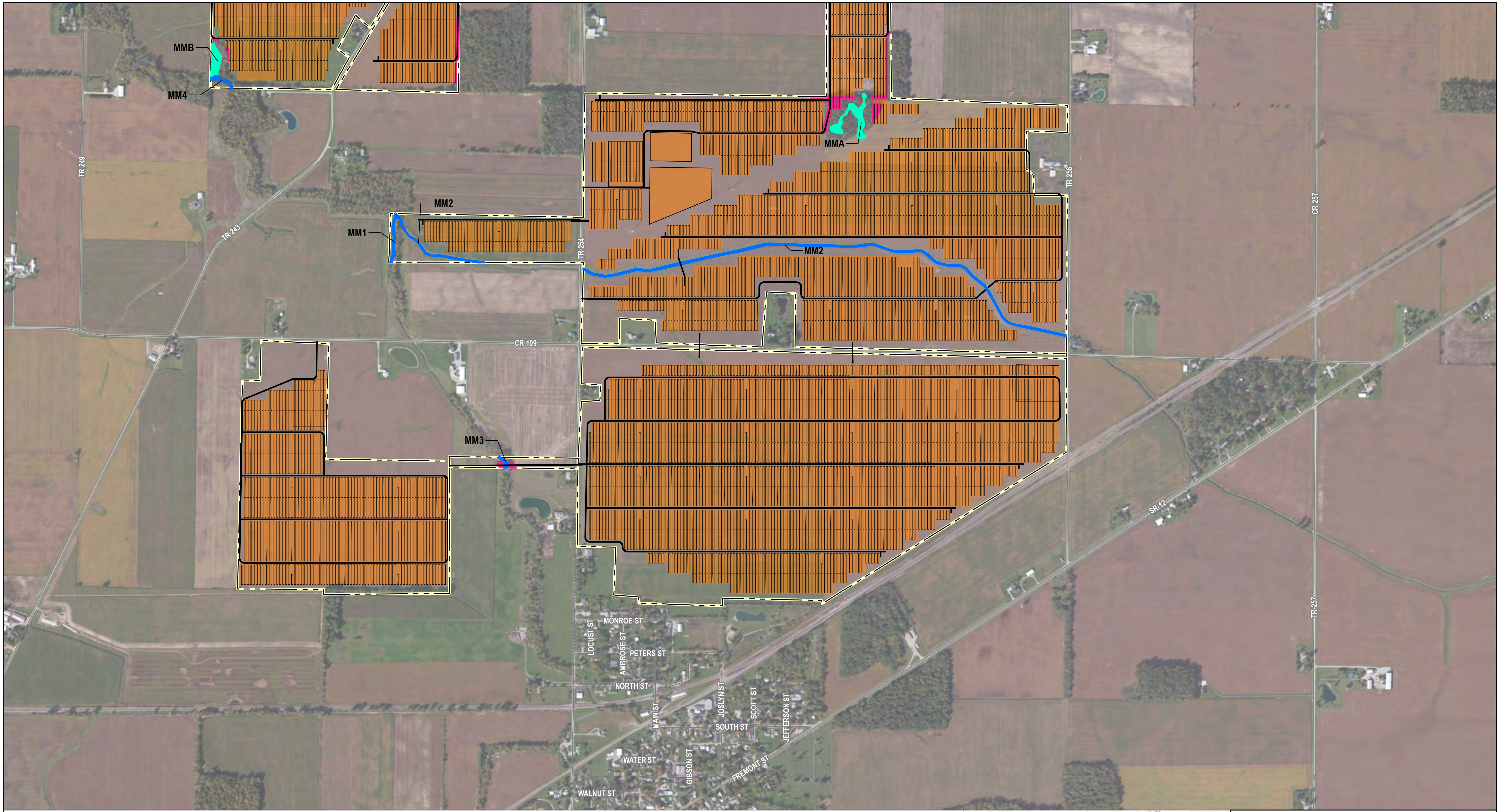


Figure 08-9
Ecological Impacts

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



―	PROJECT LAYOUT COMPONENT
-·-	DELINEATED STREAM
―	ROAD
🟩	DELINEATED WETLAND
🟥	TREE CLEARING AREA
🟧	IMPACT AREA
▭	PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DELINEATED STREAMS AND WETLANDS DATA SOURCE: FIELD OBSERVATIONS BY HALEY & ALDRICH.
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
4. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

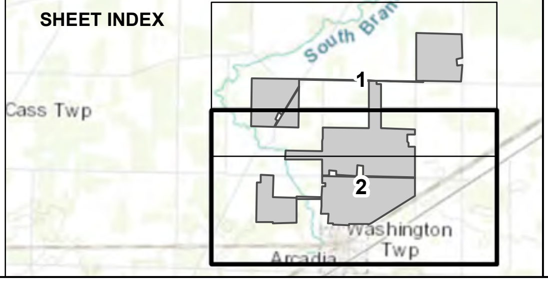
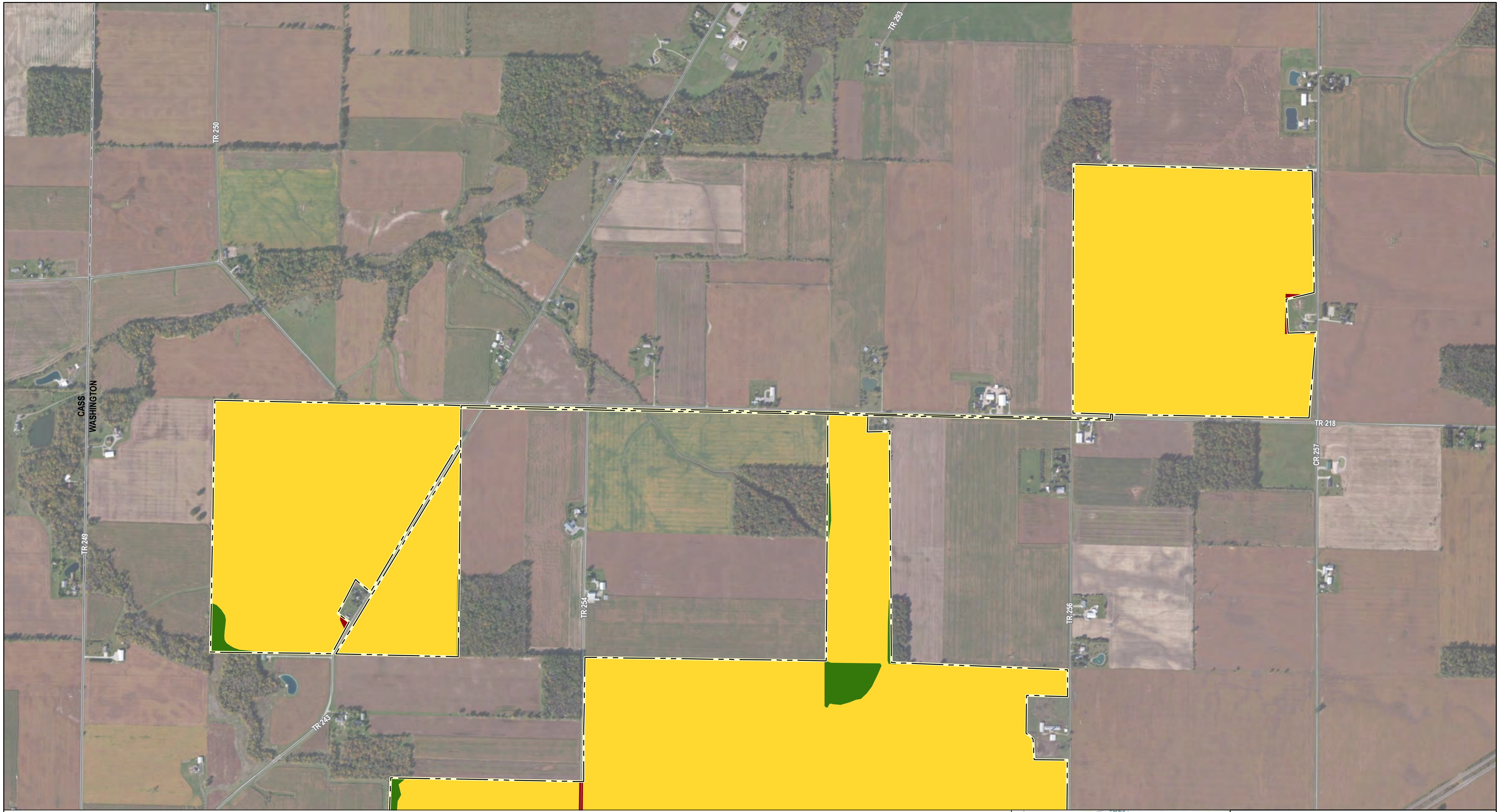


Figure 08-9
Ecological Impacts

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

—— ROAD

LAND COVER TYPE

🟨 AGRICULTURAL

🟥 DEVELOPED

🟩 FORESTED

▭ PROJECT AREA

▭ TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. LAND COVER TYPE DATA SOURCE: FIELD OBSERVATIONS BY HALEY & ALDRICH.
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
4. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
5. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000

SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

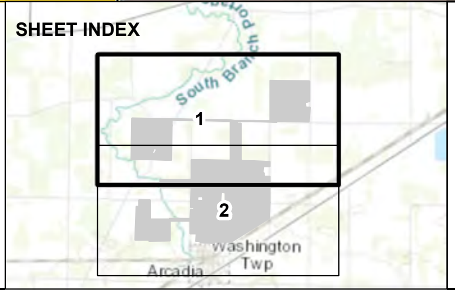
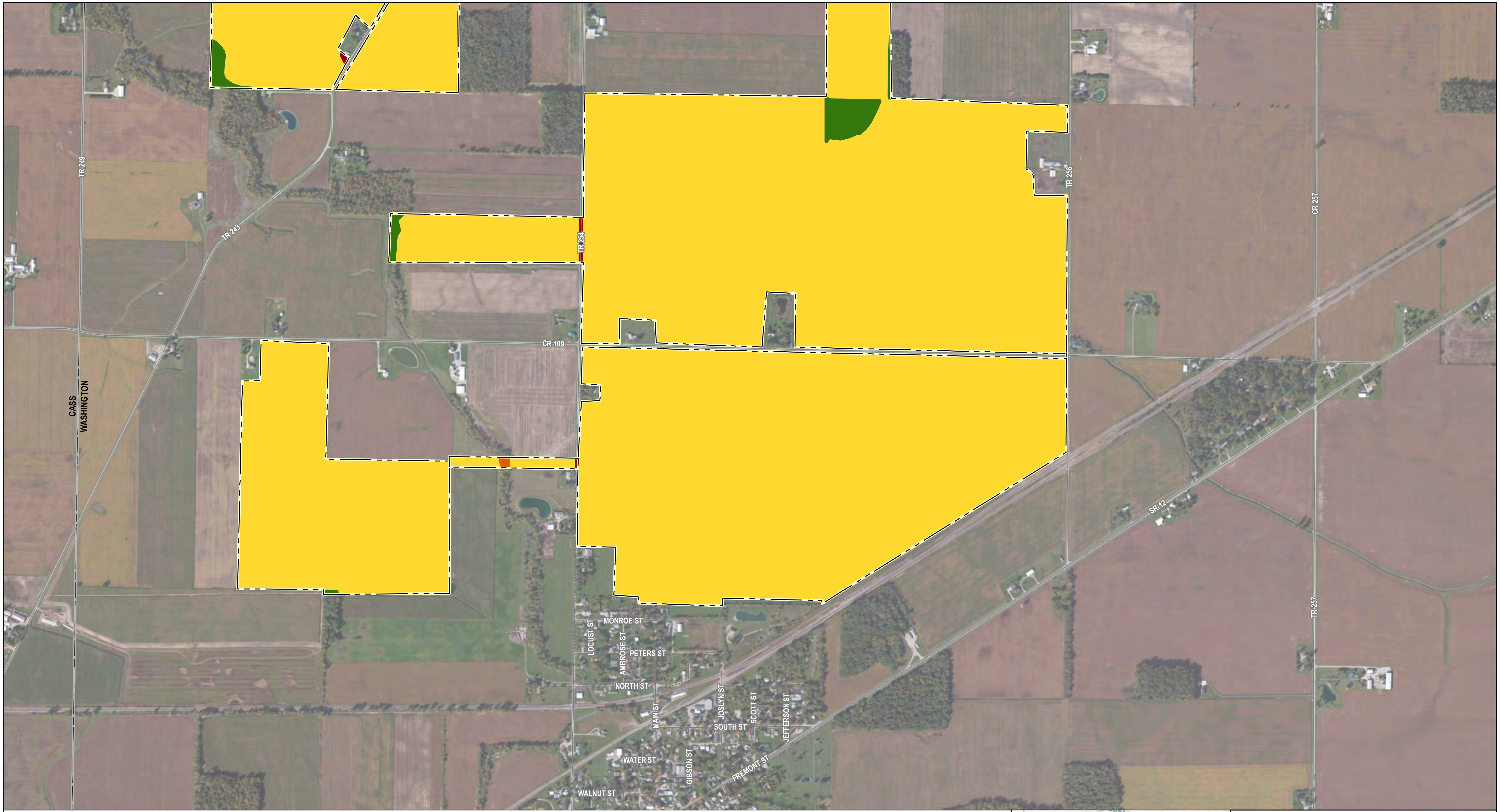


Figure 08-10
Ecological Communities

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

— ROAD

▭ TOWNSHIP BOUNDARY

LAND COVER TYPE

🟨 AGRICULTURAL

🟥 DEVELOPED

🟩 FORESTED

🟧 SHRUB SCRUB

▭ PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. LAND COVER TYPE DATA SOURCE: FIELD OBSERVATIONS BY HALEY & ALDRICH.
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
4. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
5. AERIAL IMAGERY SOURCE: ESRI

N

0 1,000 2,000
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

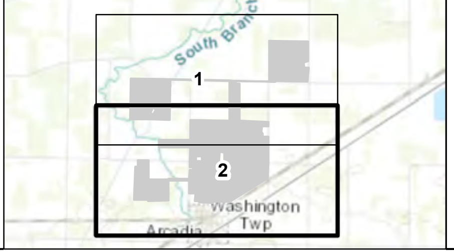
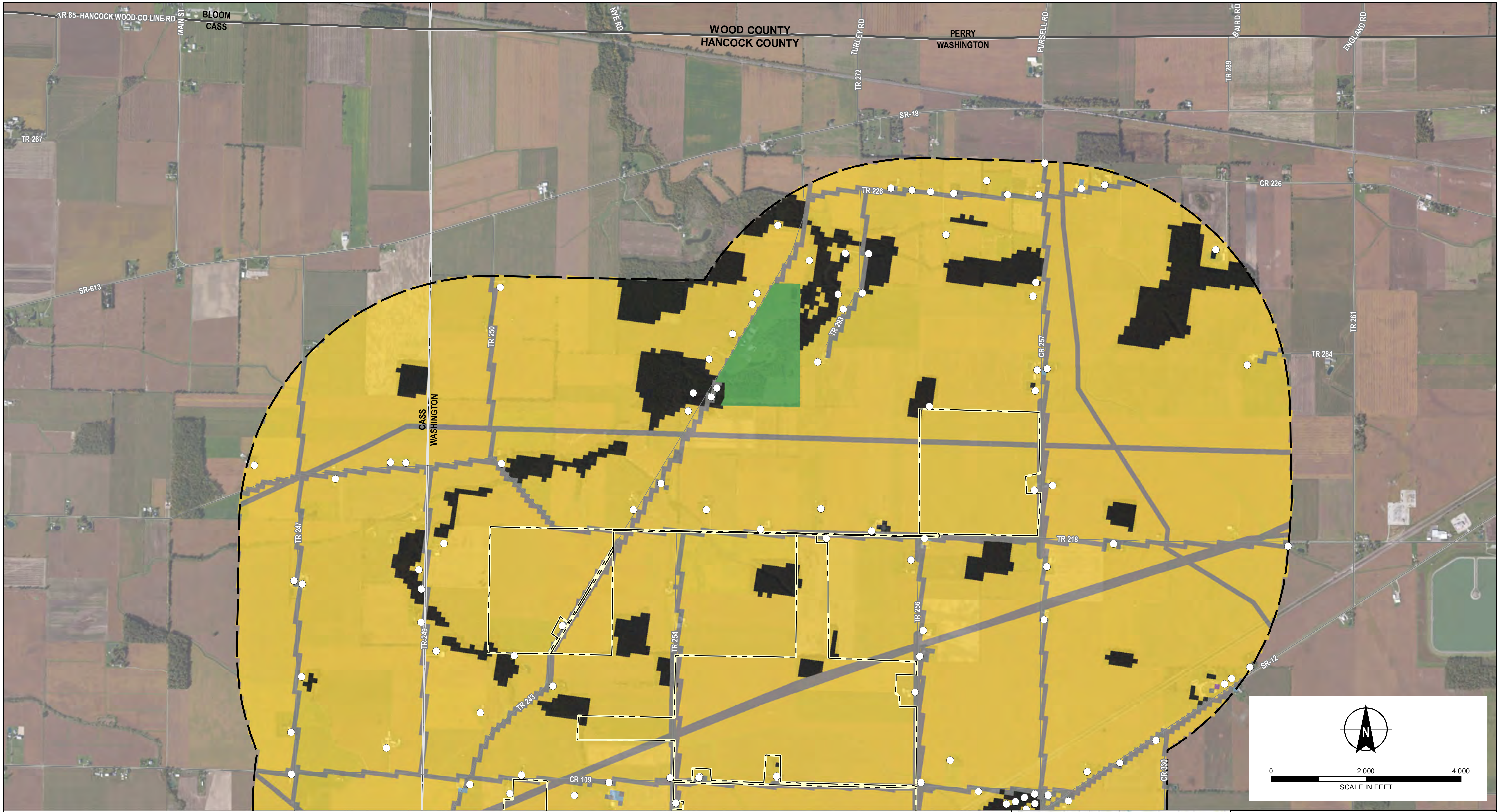


Figure 08-10
Ecological Communities

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

- ◆ SCHOOL
- ○ HOUSE
- ROAD

OPSB LAND COVER CATEGORY

- 🟨 AGRICULTURAL
- 🟪 COMMERCIAL
- 🟥 INDUSTRIAL
- ⬜ INFRASTRUCTURE
- 🟥 INSTITUTIONAL
- 🟩 RECREATIONAL
- 🟦 RESIDENTIAL
- ⬛ VACANT
- PROJECT AREA
- 1-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. LAND COVER DATA SOURCES: ESRI, GREEN COUNTY, OHIO, UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD), USGS NATIONAL LAND COVER DATABASE (NLCD), 2016, AND OBSERVATIONS MADE BASED UPON AERIAL IMAGERY
3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
4. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

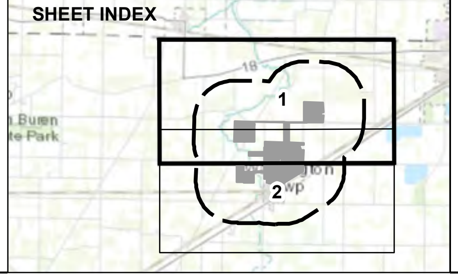
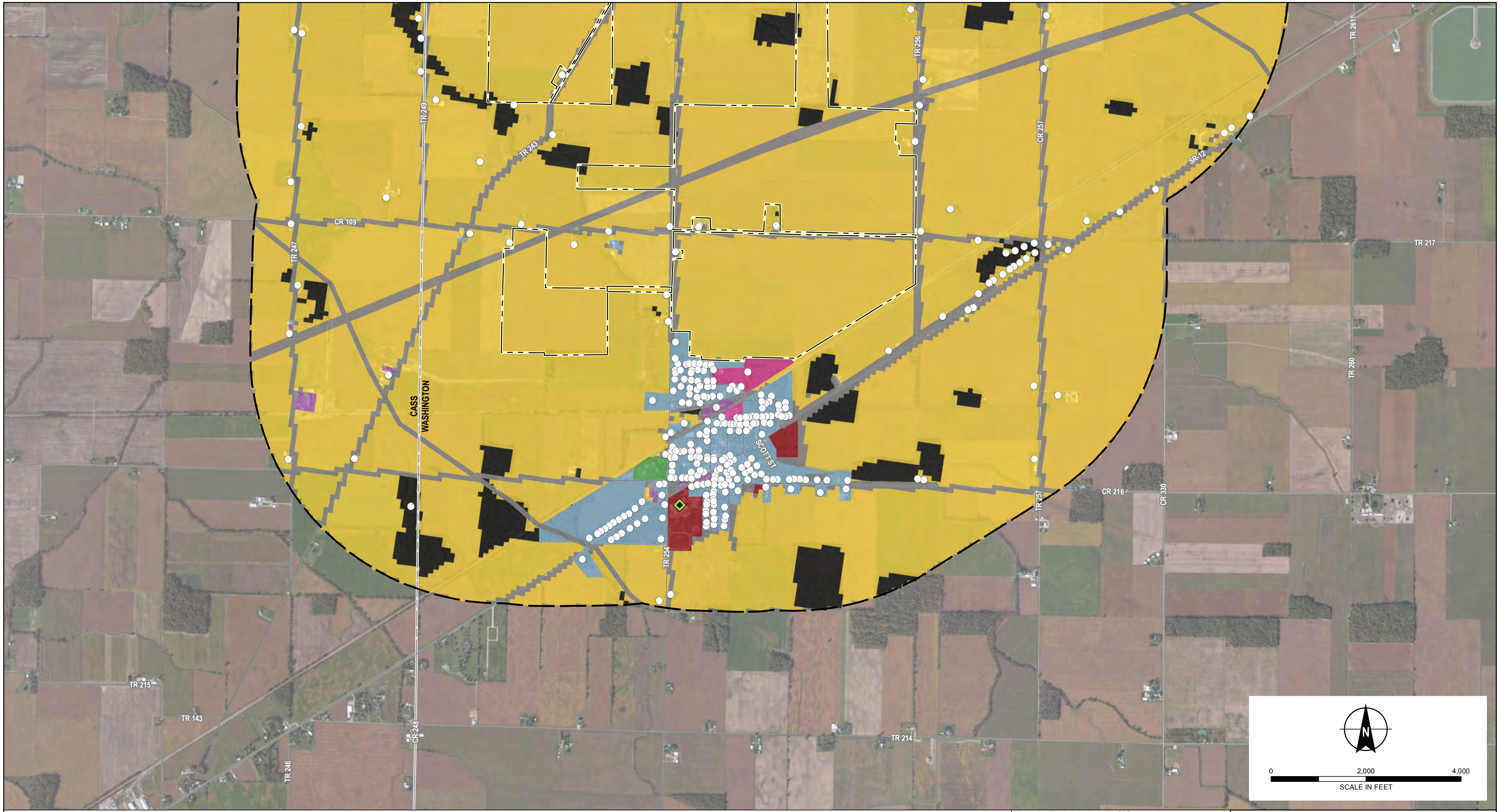


Figure 08-11
Land Use within One Mile

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

◆ SCHOOL
○ HOUSE
— ROAD

OPSB LAND COVER CATEGORY

- AGRICULTURAL
- COMMERCIAL
- INDUSTRIAL
- INFRASTRUCTURE
- INSTITUTIONAL
- RECREATIONAL
- RESIDENTIAL
- VACANT

PROJECT AREA
1-MILE BUFFER OF PROJECT AREA
TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. LAND COVER DATA SOURCES: ESRI, GREEN COUNTY, OHIO, UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD), USGS NATIONAL LAND COVER DATABASE (NLCD), 2016, AND OBSERVATIONS MADE BASED UPON AERIAL IMAGERY
3. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
4. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

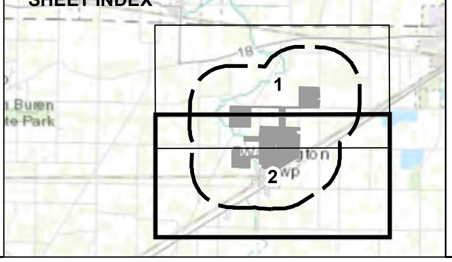
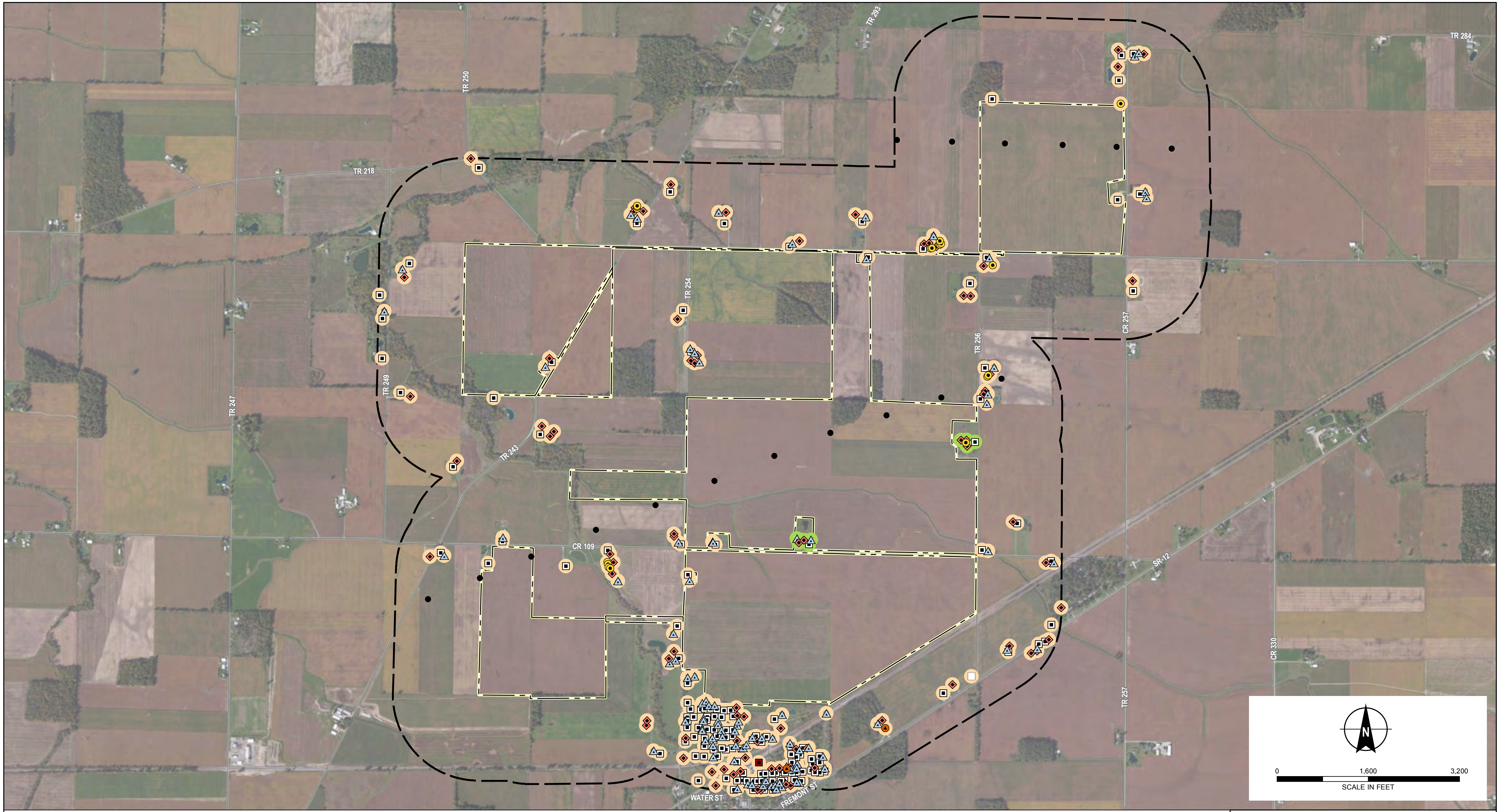


Figure 08-11
Land Use within One Mile

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio

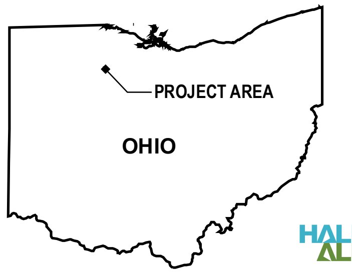


LEGEND

- ▣ RESIDENCE
- △ OUTBUILDING, GARAGE, SHED, OR GAZEBO
- ◆ BARN
- ⊙ SILO
- ■ COMMERICAL BUILDING
- □ BILLBOARD
- ▲ TANK
- ● TRANSMISSION TOWER
- ○ NON-PARTICIPATING
- ○ PARTICIPATING
- — ROAD
- ▭ PROJECT AREA
- ▭ 1500-FT BUFFER OF PROJECT AREA

NOTES

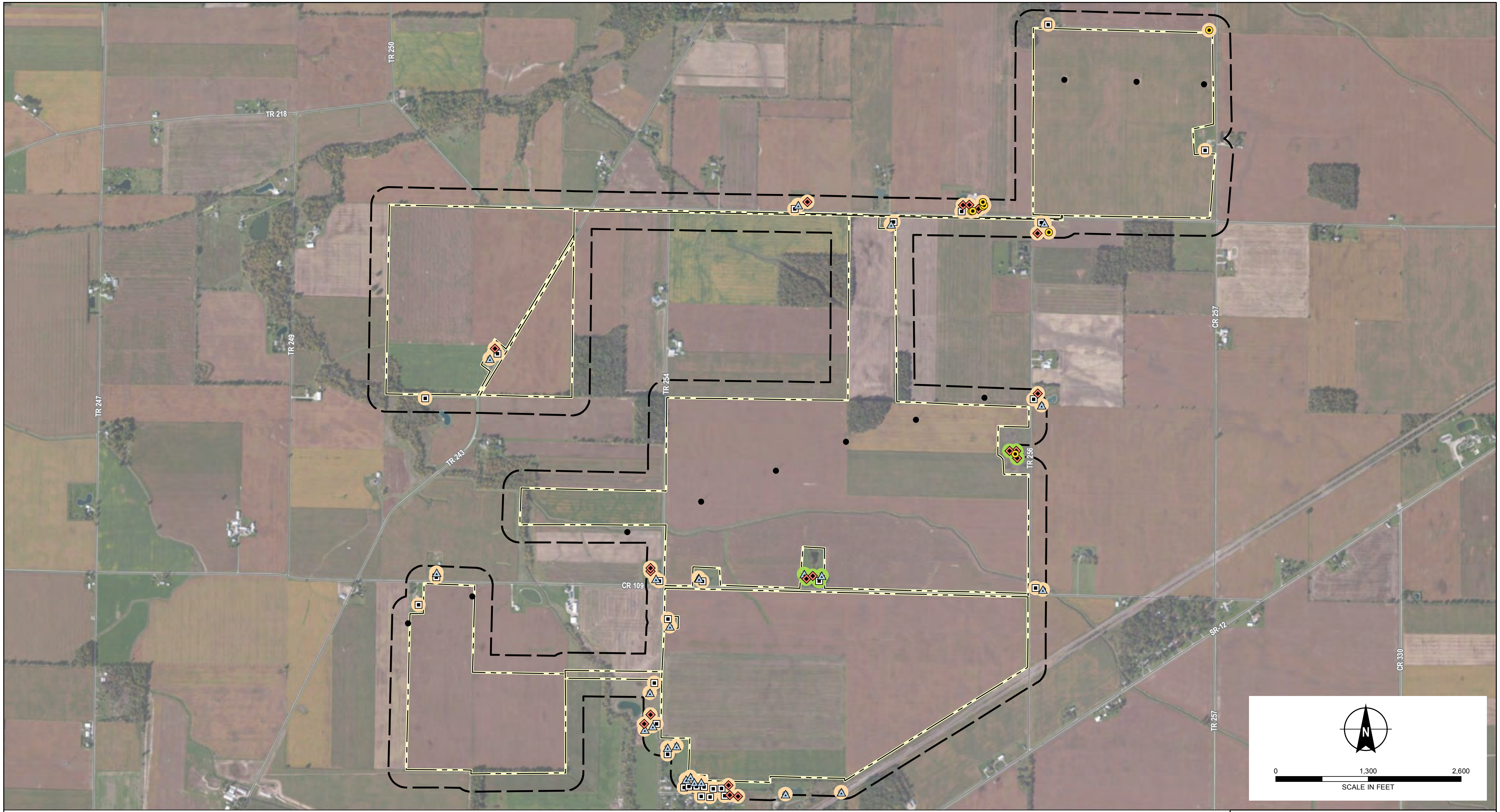
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
3. AERIAL IMAGERY SOURCE: ESRI



HALEY ALDRICH

Figure 08-12
Structures within 1,500 feet of the Project Area

South Branch Solar
Hancock County, Ohio



LEGEND

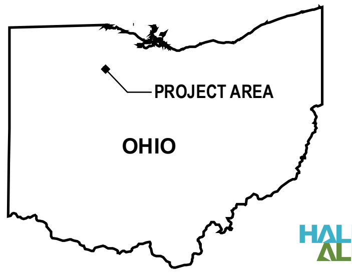
- ▣ RESIDENCE
- △ OUTBUILDING, GARAGE, SHED, OR GAZEBO
- ◆ BARN
- ⊙ SILO
- ● TRANSMISSION TOWER
- ○ NON-PARTICIPATING
- ○ PARTICIPATING
- ― ROAD
- ▭ PROJECT AREA
- ▭ 250-FT BUFFER OF PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.

2. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)

3. AERIAL IMAGERY SOURCE: ESRI



HALEY ALDRICH

Figure 08-13
Structures within 250 feet of the Project Area

South Branch Solar
Hancock County, Ohio

LEGEND

◉	NATIONAL REGISTER OF HISTORIC PLACES BUILDING	🟦	NATIONAL REGISTER HISTORIC DISTRICT
⊙	CEMETERY	🟩	PARK OR RECREATION AREA
— —	HIKING OR WALKING TRAIL	▭	PROJECT AREA
— —	EQUESTRIAN TRAIL	▭	5-MILE BUFFER OF PROJECT AREA
—	ROAD	▭	TOWNSHIP BOUNDARY
—	HIGHWAY	▭	COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. CULTURAL RESOURCES DATA SOURCE: NATIONAL PARK SERVICE (NPS)
3. RECREATION AREAS DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)
4. TRAILS DATA SOURCE: OHIO DEPARTMENT OF NATIONAL RESOURCES (ODNR)
5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

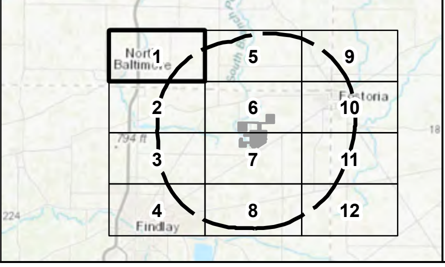
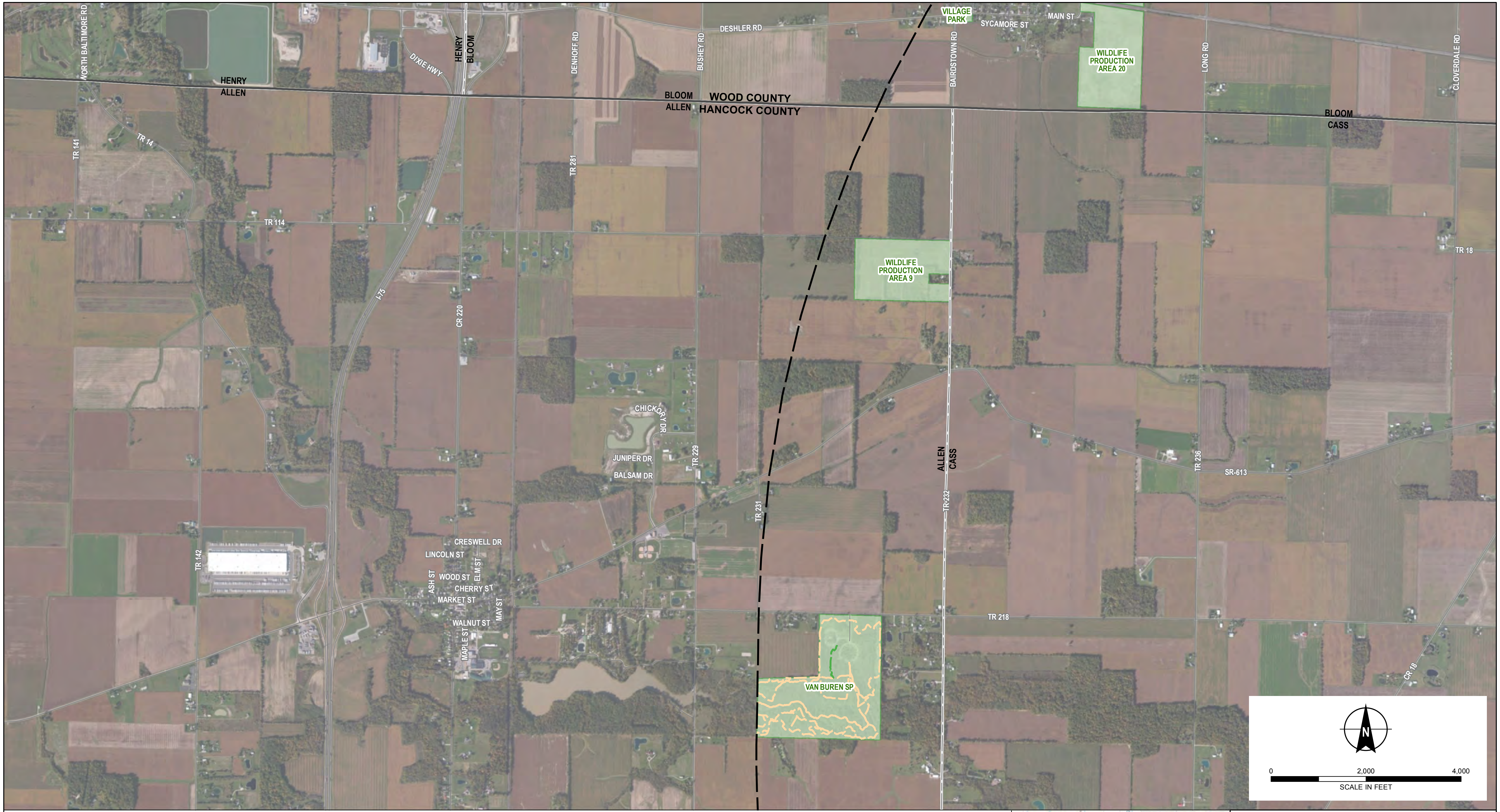


Figure 08-14
Cultural Resources and Recreation Areas

Sheet 1 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- HIKING OR WALKING TRAIL
- EQUESTRIAN TRAIL
- ROAD
- HIGHWAY
- 🟦 NATIONAL REGISTER HISTORIC DISTRICT
- 🟩 PARK OR RECREATION AREA
- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. CULTURAL RESOURCES DATA SOURCE: NATIONAL PARK SERVICE (NPS)
3. RECREATION AREAS DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)
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6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

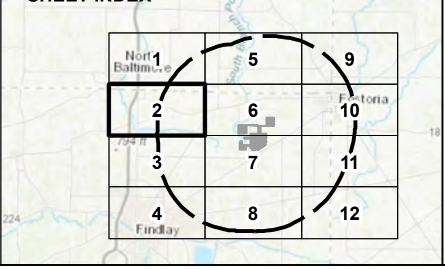
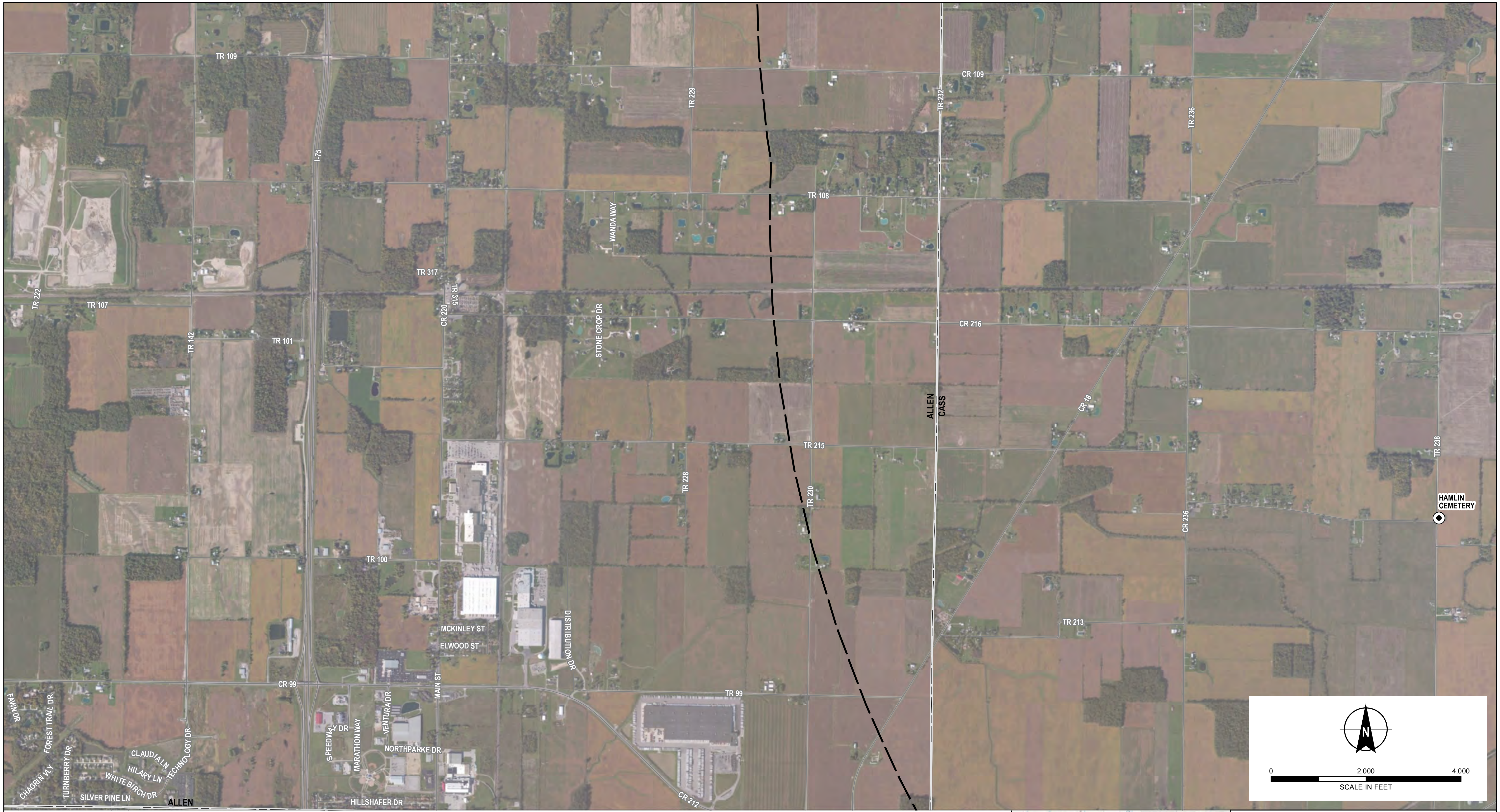


Figure 08-14
Cultural Resources and Recreation Areas

Sheet 2 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

●	NATIONAL REGISTER OF HISTORIC PLACES BUILDING
⊙	CEMETERY
– –	HIKING OR WALKING TRAIL
– –	EQUESTRIAN TRAIL
—	ROAD
—	HIGHWAY
🟦	NATIONAL REGISTER HISTORIC DISTRICT
🟩	PARK OR RECREATION AREA
☐	PROJECT AREA
☐	5-MILE BUFFER OF PROJECT AREA
☐	TOWNSHIP BOUNDARY
☐	COUNTY BOUNDARY

NOTES

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6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

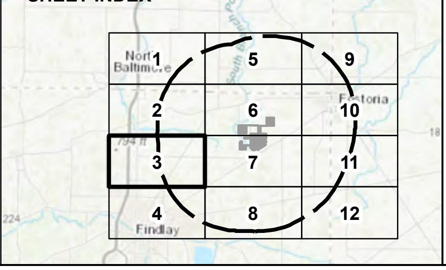
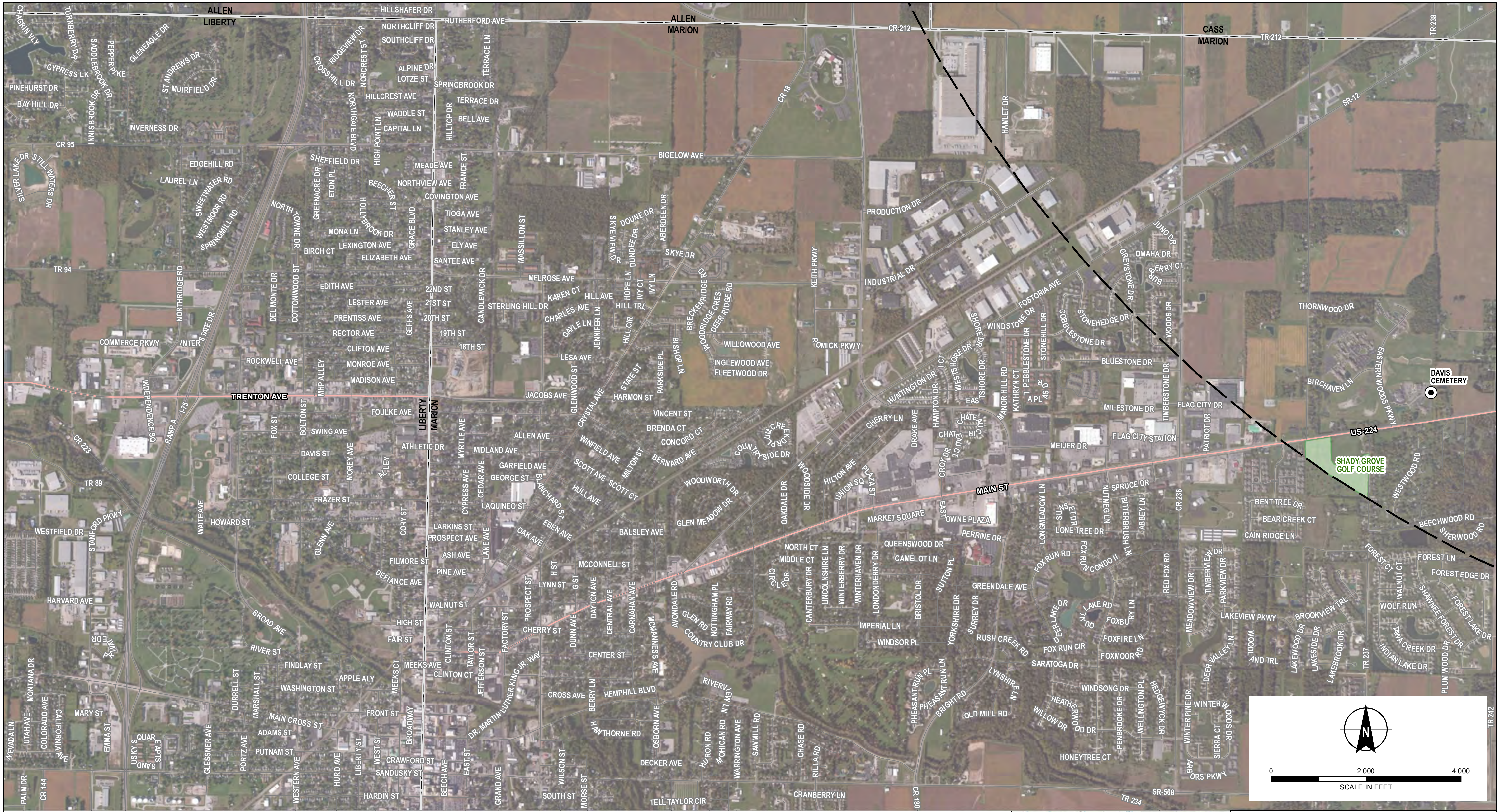


Figure 08-14
Cultural Resources and Recreation Areas

Sheet 3 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- HIKING OR WALKING TRAIL
- EQUESTRIAN TRAIL
- ROAD
- HIGHWAY
- NATIONAL REGISTER HISTORIC DISTRICT
- PARK OR RECREATION AREA
- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

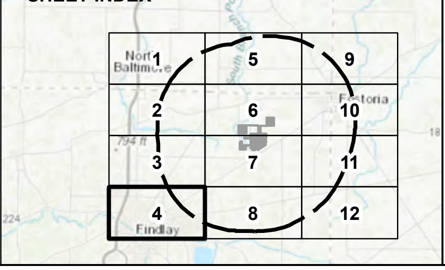

Figure 08-14
Cultural Resources and Recreation Areas

Sheet 4 of 12

South Branch Solar
Hancock County, Ohio

LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- HIKING OR WALKING TRAIL
- EQUESTRIAN TRAIL
- ROAD
- HIGHWAY
- NATIONAL REGISTER HISTORIC DISTRICT
- PARK OR RECREATION AREA
- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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4. TRAILS DATA SOURCE: OHIO DEPARTMENT OF NATIONAL RESOURCES (ODNR)
5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

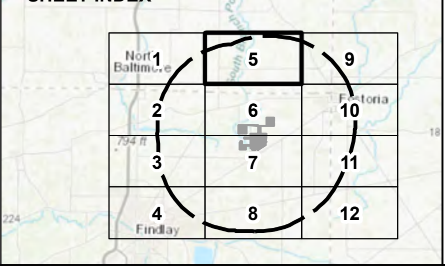

Figure 08-14
Cultural Resources and Recreation Areas

Sheet 5 of 12

South Branch Solar
Hancock County, Ohio

LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- - - HIKING OR WALKING TRAIL
- - - EQUESTRIAN TRAIL
- — ROAD
- — HIGHWAY
- 🟦 NATIONAL REGISTER HISTORIC DISTRICT
- 🟩 PARK OR RECREATION AREA
- ▭ PROJECT AREA
- ▭ 5-MILE BUFFER OF PROJECT AREA
- ▭ TOWNSHIP BOUNDARY
- ▭ COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. CULTURAL RESOURCES DATA SOURCE: NATIONAL PARK SERVICE (NPS)
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5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

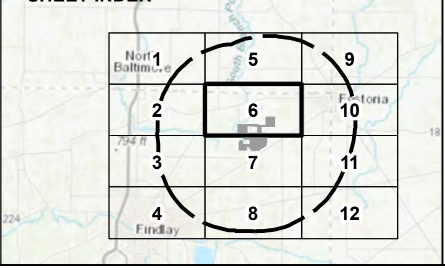

Figure 08-14
Cultural Resources and Recreation Areas

Sheet 6 of 12

South Branch Solar
Hancock County, Ohio

LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- HIKING OR WALKING TRAIL
- EQUESTRIAN TRAIL
- ROAD
- HIGHWAY
- 🟦 NATIONAL REGISTER HISTORIC DISTRICT
- 🟩 PARK OR RECREATION AREA
- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

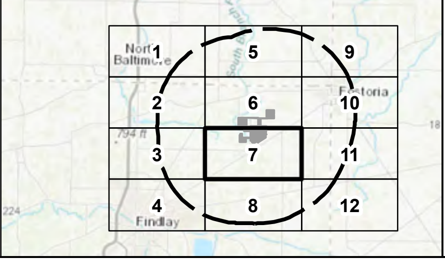

Figure 08-14
Cultural Resources and Recreation Areas

Sheet 7 of 12

South Branch Solar
Hancock County, Ohio

LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- HIKING OR WALKING TRAIL
- EQUESTRIAN TRAIL
- ROAD
- HIGHWAY
- 🟦 NATIONAL REGISTER HISTORIC DISTRICT
- 🟩 PARK OR RECREATION AREA
- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

SHEET INDEX

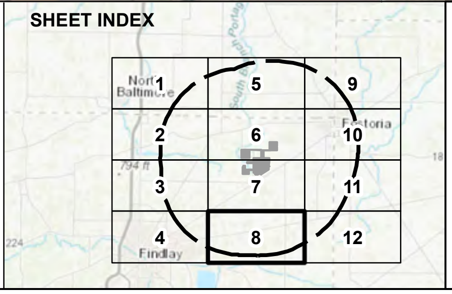


Figure 08-14
Cultural Resources and Recreation Areas

Sheet 8 of 12

South Branch Solar
Hancock County, Ohio

LEGEND

● NATIONAL REGISTER OF HISTORIC PLACES BUILDING

⊙ CEMETERY

– – HIKING OR WALKING TRAIL

– – EQUESTRIAN TRAIL

— ROAD

— HIGHWAY

▭ NATIONAL REGISTER HISTORIC DISTRICT

▭ PARK OR RECREATION AREA

▭ PROJECT AREA

▭ 5-MILE BUFFER OF PROJECT AREA

▭ TOWNSHIP BOUNDARY

▭ COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. CULTURAL RESOURCES DATA SOURCE: NATIONAL PARK SERVICE (NPS)
3. RECREATION AREAS DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)
4. TRAILS DATA SOURCE: OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR)
5. COUNTY BOUNDARY AND ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
6. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

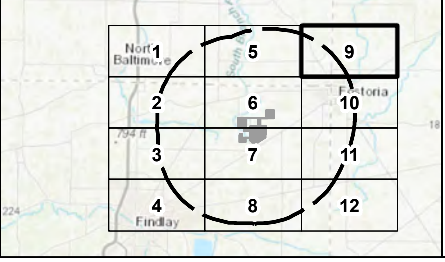
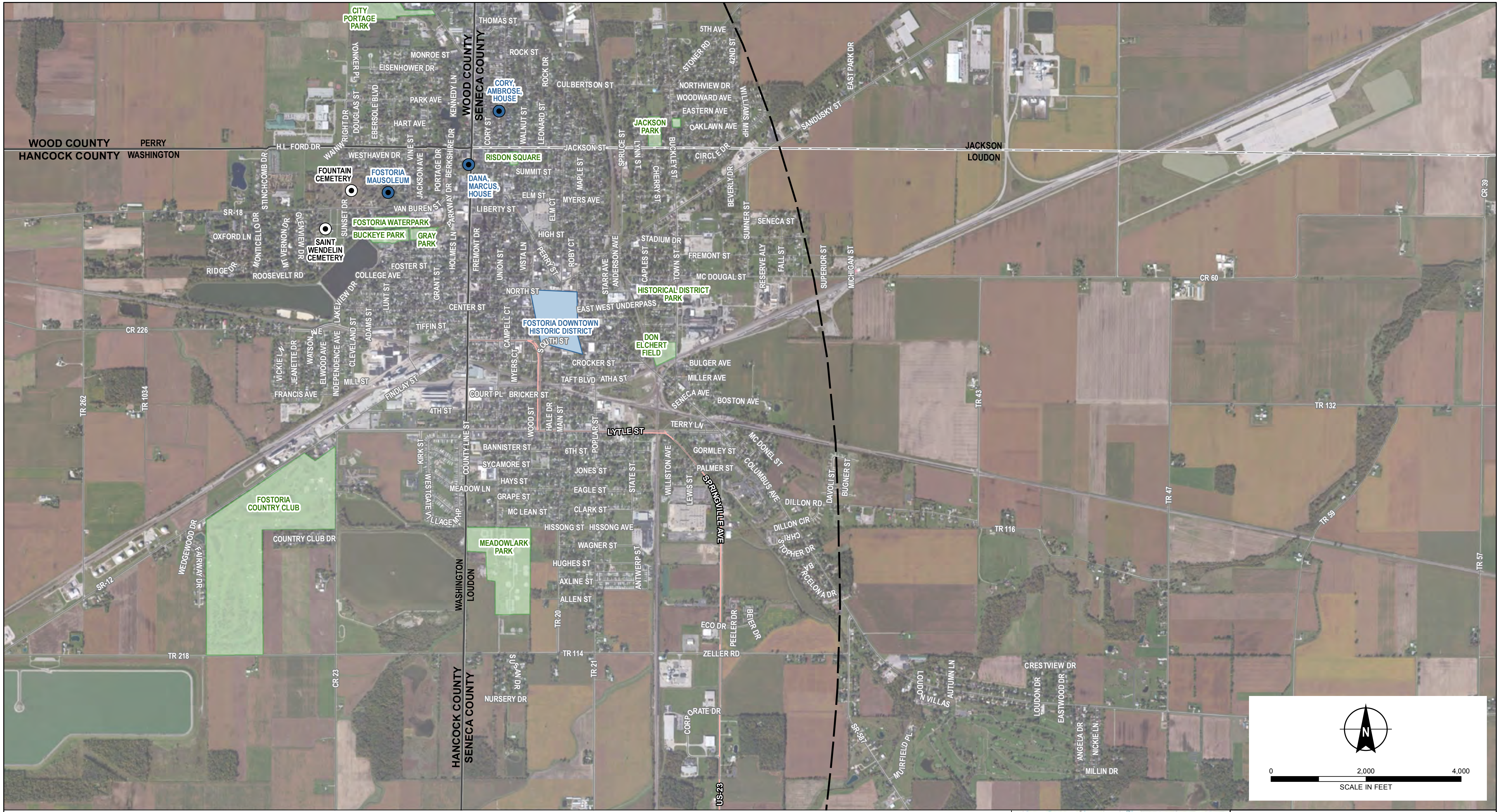


Figure 08-14
Cultural Resources and Recreation Areas

Sheet 9 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

● NATIONAL REGISTER OF HISTORIC PLACES BUILDING

⊙ CEMETERY

HIKING OR WALKING TRAIL

EQUESTRIAN TRAIL

ROAD

HIGHWAY

🟦 NATIONAL REGISTER HISTORIC DISTRICT

🟩 PARK OR RECREATION AREA

PROJECT AREA

5-MILE BUFFER OF PROJECT AREA

TOWNSHIP BOUNDARY

COUNTY BOUNDARY

NOTES

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7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

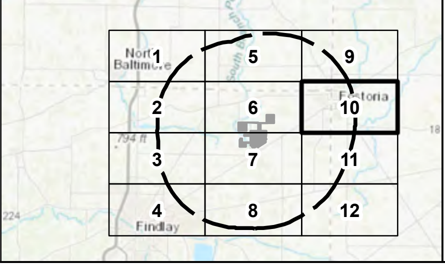

Figure 08-14
Cultural Resources and Recreation Areas

Sheet 10 of 12

South Branch Solar
Hancock County, Ohio

LEGEND

- ● NATIONAL REGISTER OF HISTORIC PLACES BUILDING
- ⊙ CEMETERY
- HIKING OR WALKING TRAIL
- EQUESTRIAN TRAIL
- ROAD
- HIGHWAY
- NATIONAL REGISTER HISTORIC DISTRICT
- PARK OR RECREATION AREA
- PROJECT AREA
- 5-MILE BUFFER OF PROJECT AREA
- TOWNSHIP BOUNDARY
- COUNTY BOUNDARY

NOTES

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7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

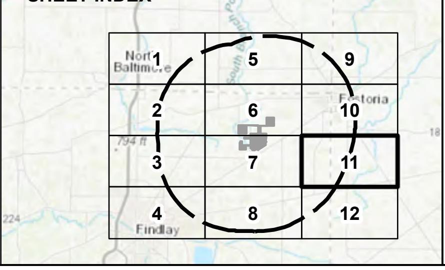
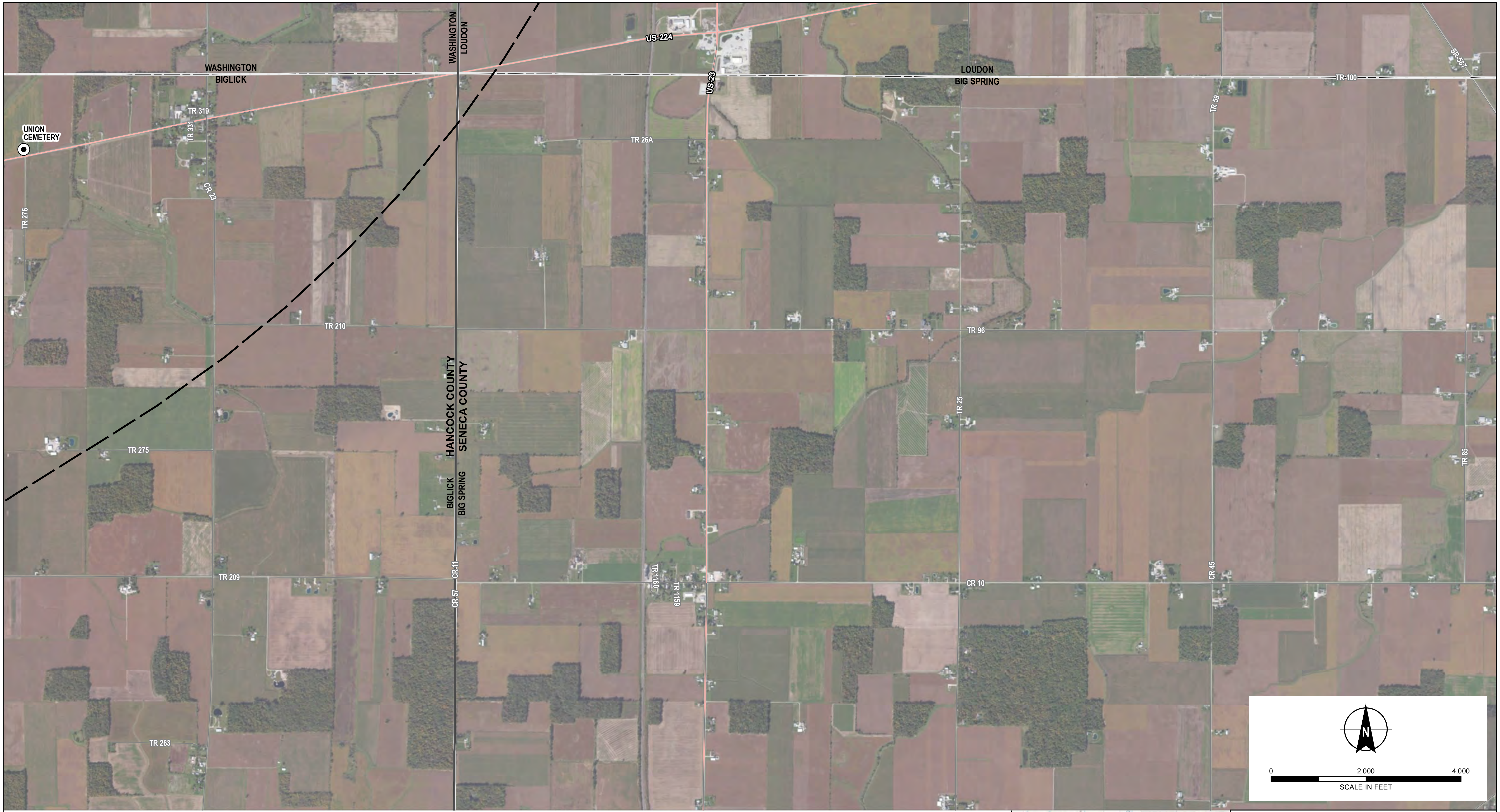


Figure 08-14 Cultural Resources and Recreation Areas

Sheet 11 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

● NATIONAL REGISTER OF HISTORIC PLACES BUILDING

⊙ CEMETERY

HIKING OR WALKING TRAIL

EQUESTRIAN TRAIL

ROAD

HIGHWAY

🟦 NATIONAL REGISTER HISTORIC DISTRICT

🟩 PARK OR RECREATION AREA

PROJECT AREA

5-MILE BUFFER OF PROJECT AREA

TOWNSHIP BOUNDARY

COUNTY BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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3. RECREATION AREAS DATA SOURCE: ESRI AND UNITED STATES GEOLOGICAL SURVEY (USGS) PROTECTED AREAS DATABASE (PAD)
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7. AERIAL IMAGERY SOURCE: ESRI

HALEY ALDRICH

SHEET INDEX

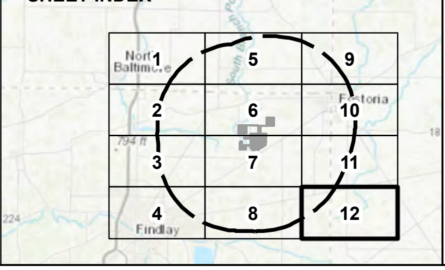
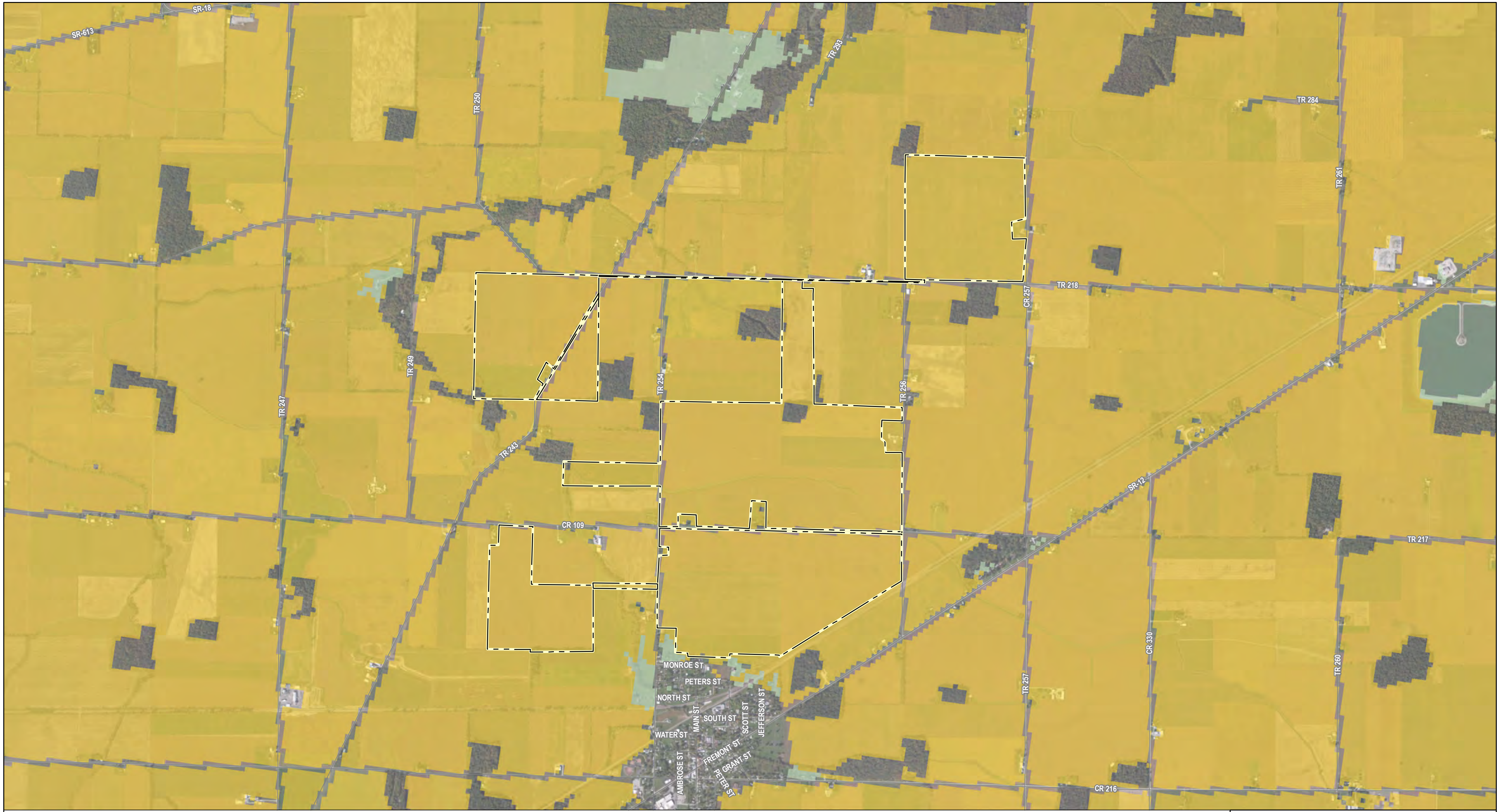


Figure 08-14
Cultural Resources and Recreation Areas

Sheet 12 of 12

South Branch Solar
Hancock County, Ohio



LEGEND

- — ROAD
- 🟩 HAY/PASTURE
- 🟨 CULTIVATED CROPS
- ▭ PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. LAND COVER DATA SOURCE: UNITED STATES GEOLOGICAL SURVEY (USGS) NATIONAL LAND COVER DATABASE (NLCD), 2016
3. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
4. CITY AND TOWN BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
5. AERIAL IMAGERY SOURCE: ESRI

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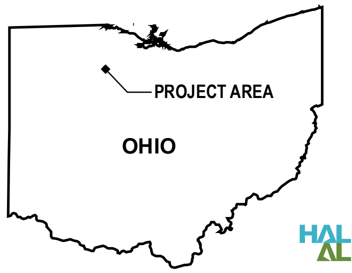
0 2,000 4,000
SCALE IN FEET



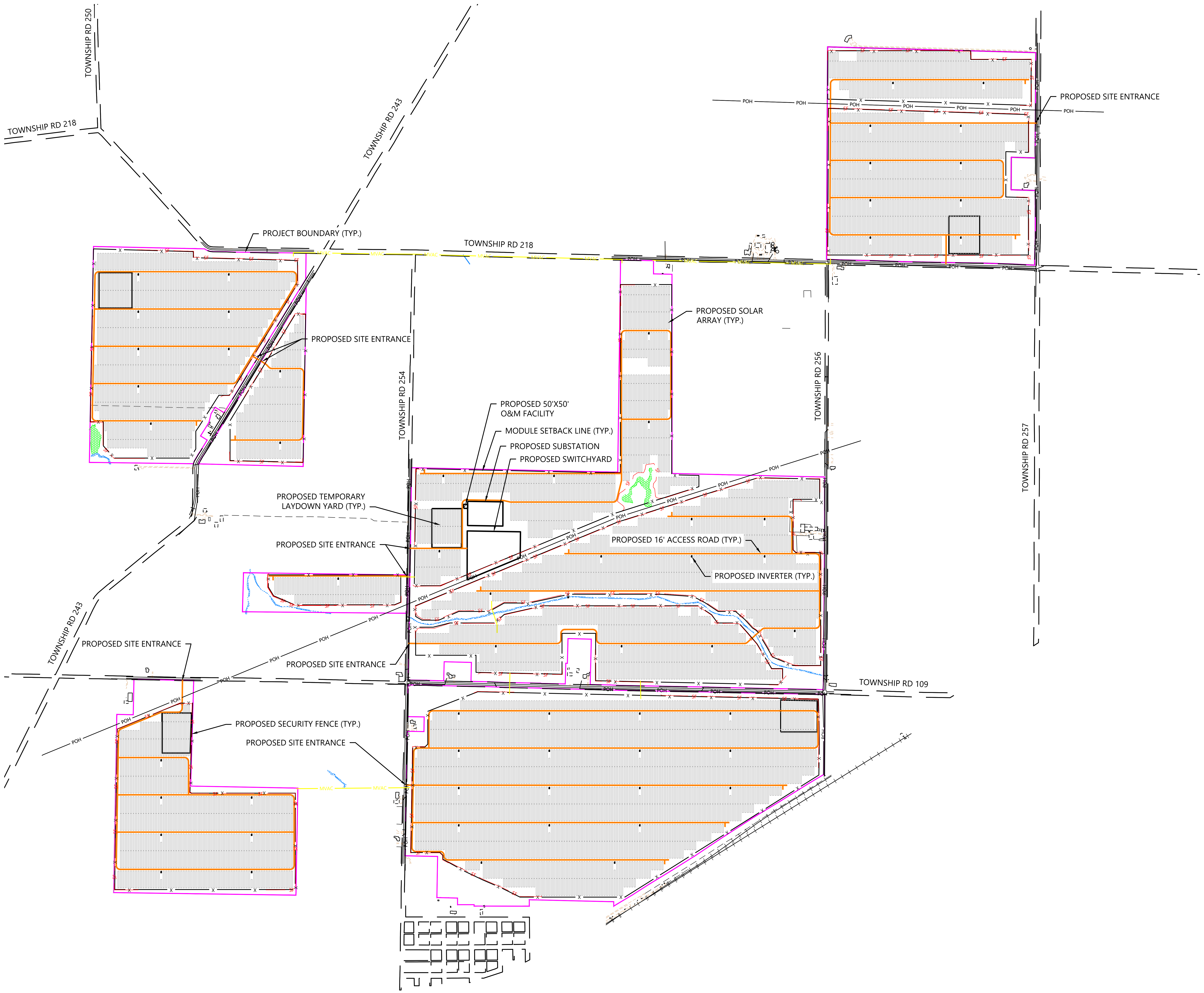
HALEY ALDRICH

Figure 08-15
Agricultural Land

South Branch Solar
Hancock County, Ohio

APPENDIX A

PRELIMINARY PROJECT PERMITTING LAYOUT



LEGEND:

	PROJECT BOUNDARY
	SECTION LINES
	RIGHT-OF-WAY LINES
	EASEMENT LINES
	EX. TREELINE
	EX. PAVED ROAD
	EX. GRAVEL ROAD
	EX. DRIVEWAY
	EX. RAILROAD
X	EX. FENCE LINE
POH	EX. OVERHEAD POWER
	PROPOSED SOLAR ARRAY
	PROPOSED ACCESS ROAD
X	PROPOSED SECURITY FENCE
SF	PROPOSED SILT FENCE
▭	PROPOSED ELECTRICAL EQUIPMENT
MVAC	PROPOSED COLLECTION
	PROPOSED LAYDOWN YARD
▭	PROPOSED SUBSTATION/SWITCHYARD
▨	PROPOSED O&M FACILITY
🟩	DELINEATED WETLANDS
🟦	DELINEATED STREAMS

SYSTEM SPECIFICATIONS	
SYSTEM SIZE - MWDC	270.37
SYSTEM SIZE - MWAC	205
DC/AC (AT INVERTER)	1.32
MODULE MODEL	LONGI LR5 72HBD-540M
MODULE RATING (W)	540
MODULE QUANTITY	500,688
STRINGS (27 MODULES PER STRING)	18,544
INVERTER QUANTITY	60

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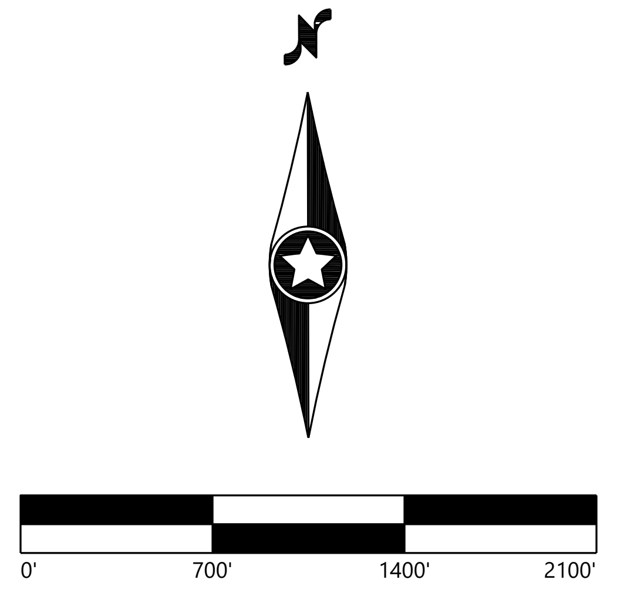

South Branch Solar

Hancock County, OH

Overall Site Plan

NOT FOR CONSTRUCTION

DATE: 07/14/2021

SHEET: C.100

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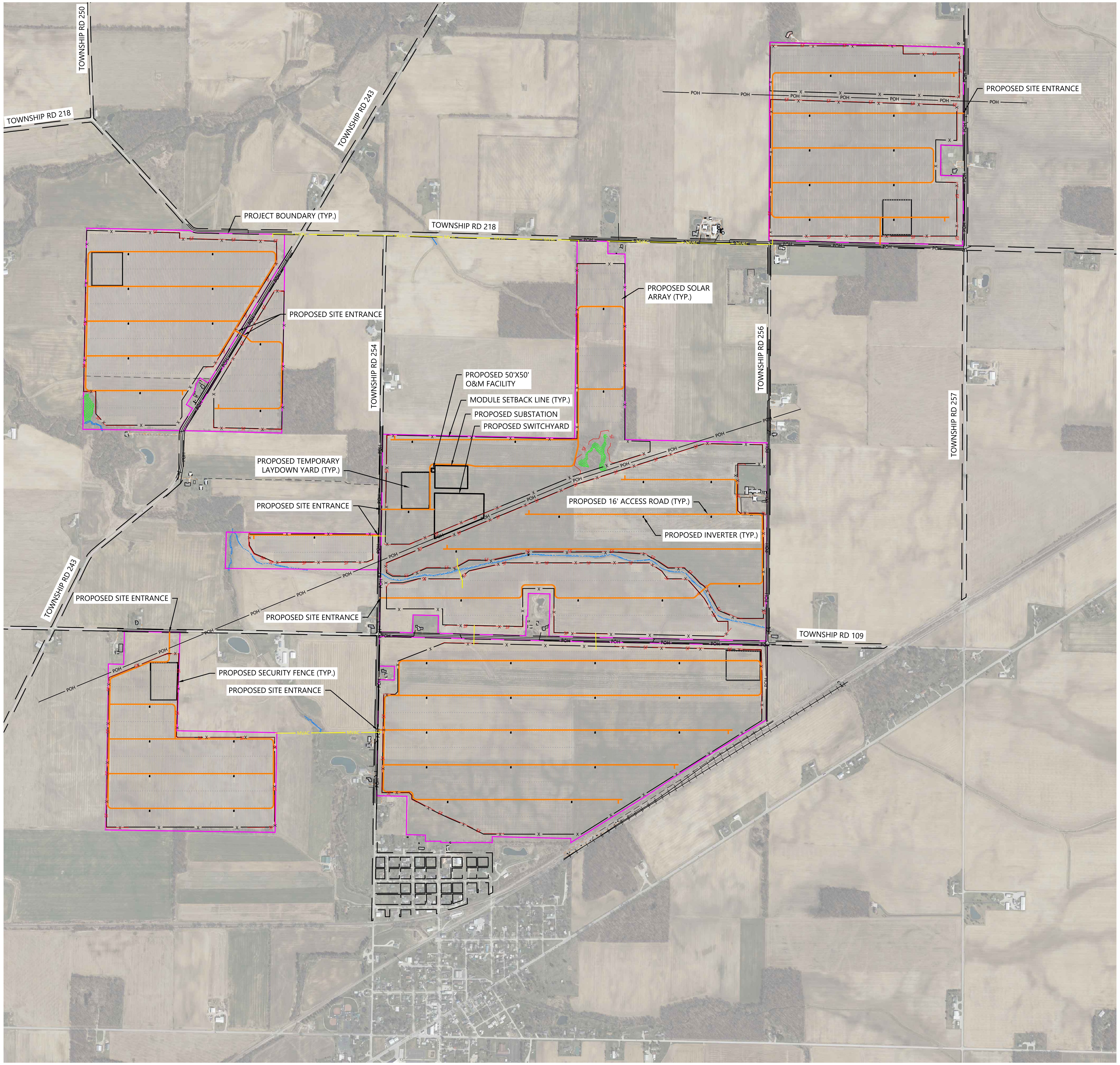

LEGEND:

▬	PROJECT BOUNDARY
— — —	SECTION LINES
— — —	RIGHT-OF-WAY LINES
- - - - -	EASEMENT LINES
︶︶︶	EX. TREELINE
═══	EX. PAVED ROAD
= = =	EX. GRAVEL ROAD
= = =	EX. DRIVEWAY
┼┼┼┼	EX. RAILROAD
—— X ——	EX. FENCE LINE
—— POH ——	EX. OVERHEAD POWER
▯▯▯▯▯	PROPOSED SOLAR ARRAY
▬	PROPOSED ACCESS ROAD
—— X ——	PROPOSED SECURITY FENCE
—— SF ——	PROPOSED SILT FENCE
▭	PROPOSED ELECTRICAL EQUIPMENT
—— MVAC ——	PROPOSED COLLECTION
▨	PROPOSED LAYDOWN YARD
▭	PROPOSED SUBSTATION/SWITCHYARD
▩	PROPOSED O&M FACILITY
🟩	DELINEATED WETLANDS
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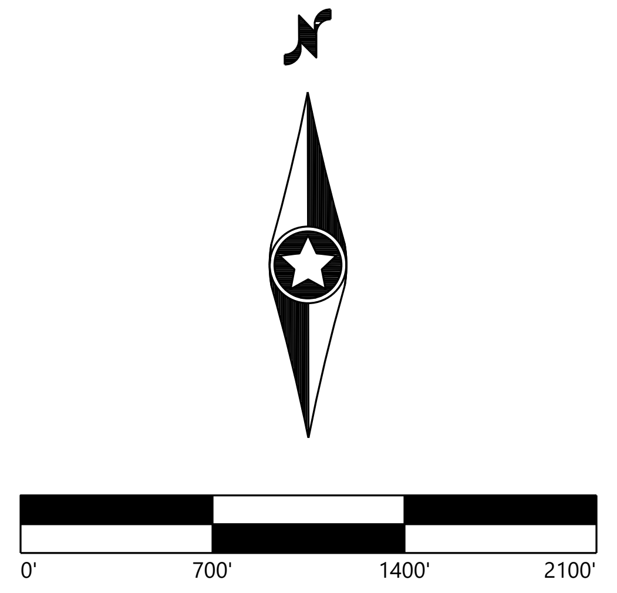

South Branch Solar

Hancock County, OH

Overall Site Plan

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DATE: 07/14/2021

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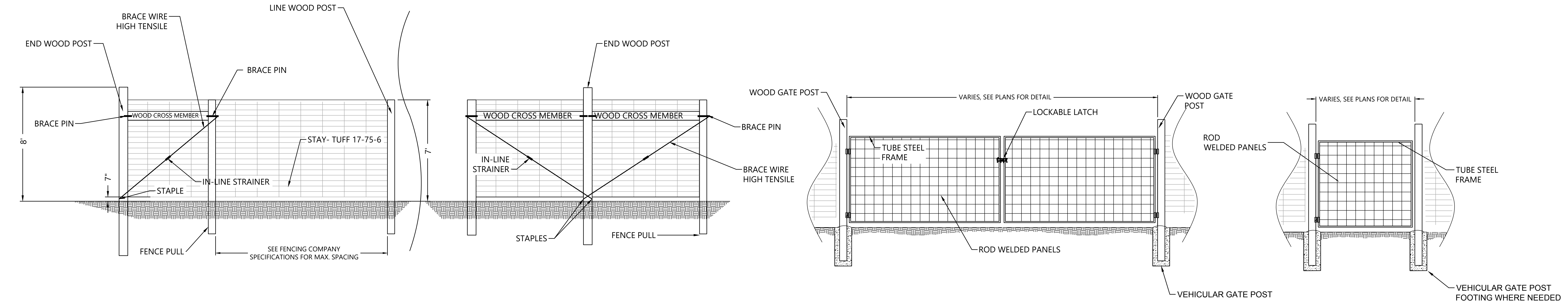


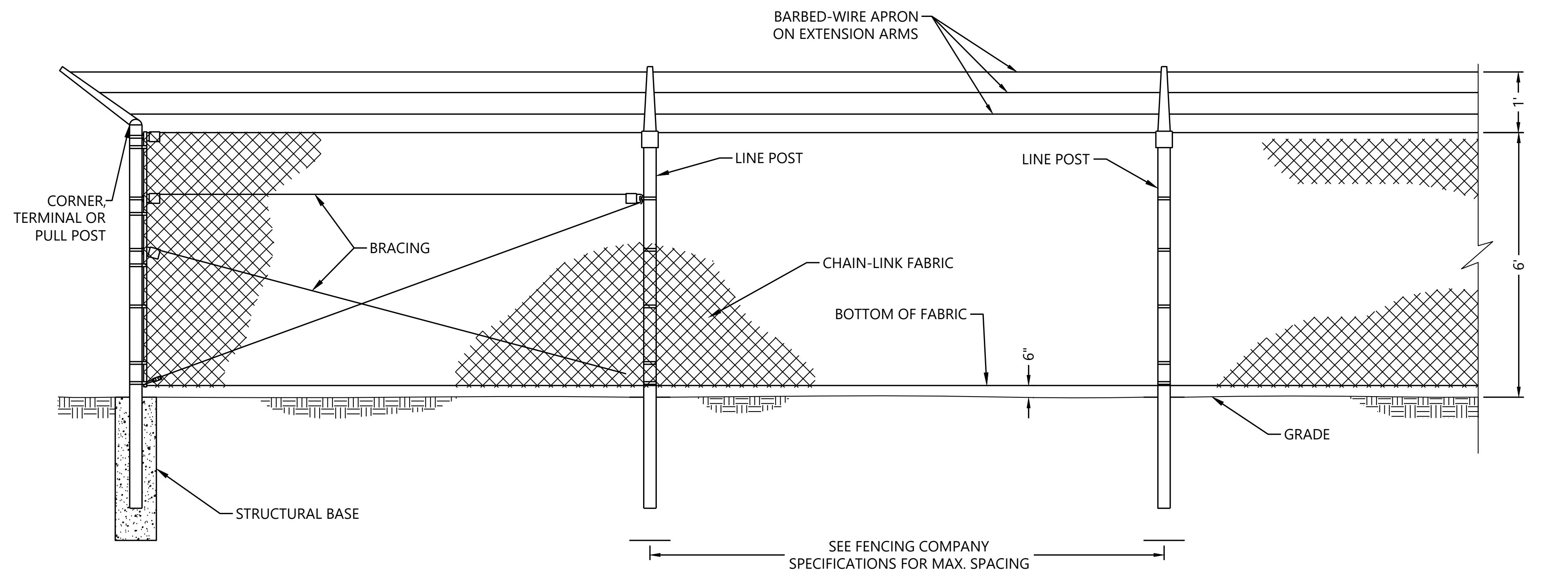
AGRICULTURAL SECURITY FENCE DETAIL - ARRAY

DRIVE GATES

MAN GATES

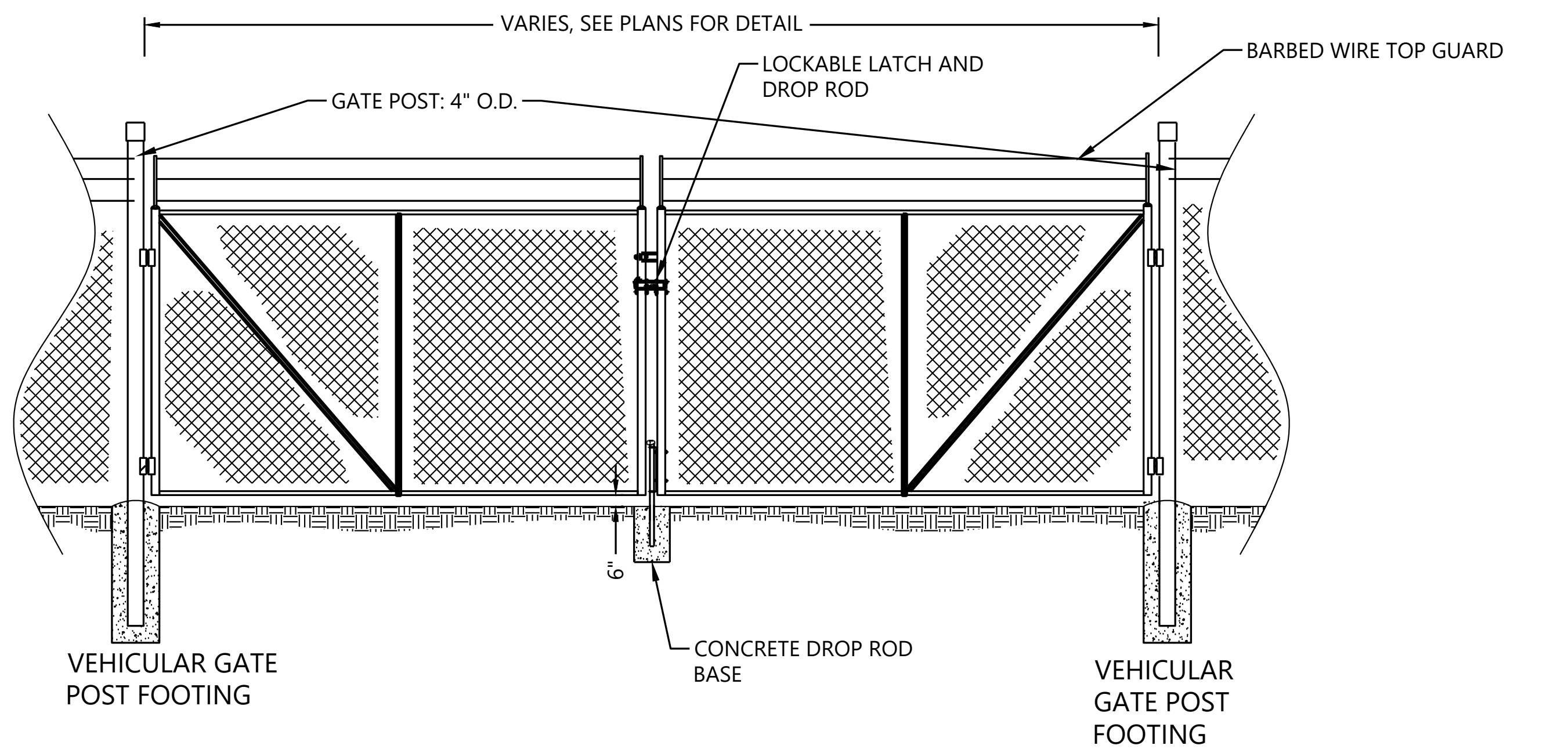
NOTES:
1. STRUCTURAL DESIGN TO BE PROVIDED BY FENCE SUPPLIER
2. DIMENSIONS AND INFORMATION SHOWN ABOVE ARE FROM FENCE SUPPLIER. FOR SECURITY FENCE SPECIFICATIONS PLEASE SEE INFORMATION PROVIDED BY FENCE SUPPLIER.

AGRICULTURAL SECURITY FENCE DETAIL - ARRAY (NOT TO SCALE) WF01



NOTES:
1. FENCE AND GATE TYPE TO BE APPROVED BY OWNER PRIOR TO CONSTRUCTION
2. STRUCTURAL DESIGN TO BE PROVIDED BY FENCE SUPPLIER
3. DIMENSIONS AND INFORMATION SHOWN ABOVE ARE FOR REFERENCE ONLY. ACTUAL DIMENSIONS AND INFORMATION TO BE PROVIDED BY MANUFACTURER/SUPPLIER

Westwood TYPICAL CHAIN-LINK SECURITY FENCE DETAIL - SUBSTATION AND SWITCHYARD (NOT TO SCALE)
LAST REVISED: 07/16/13
FN01



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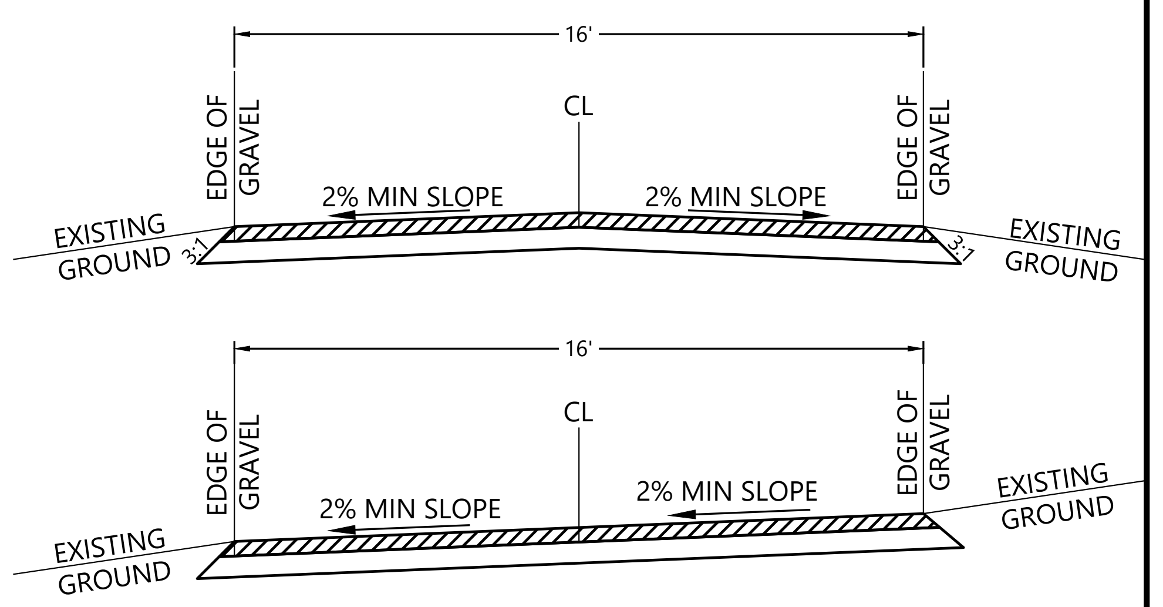
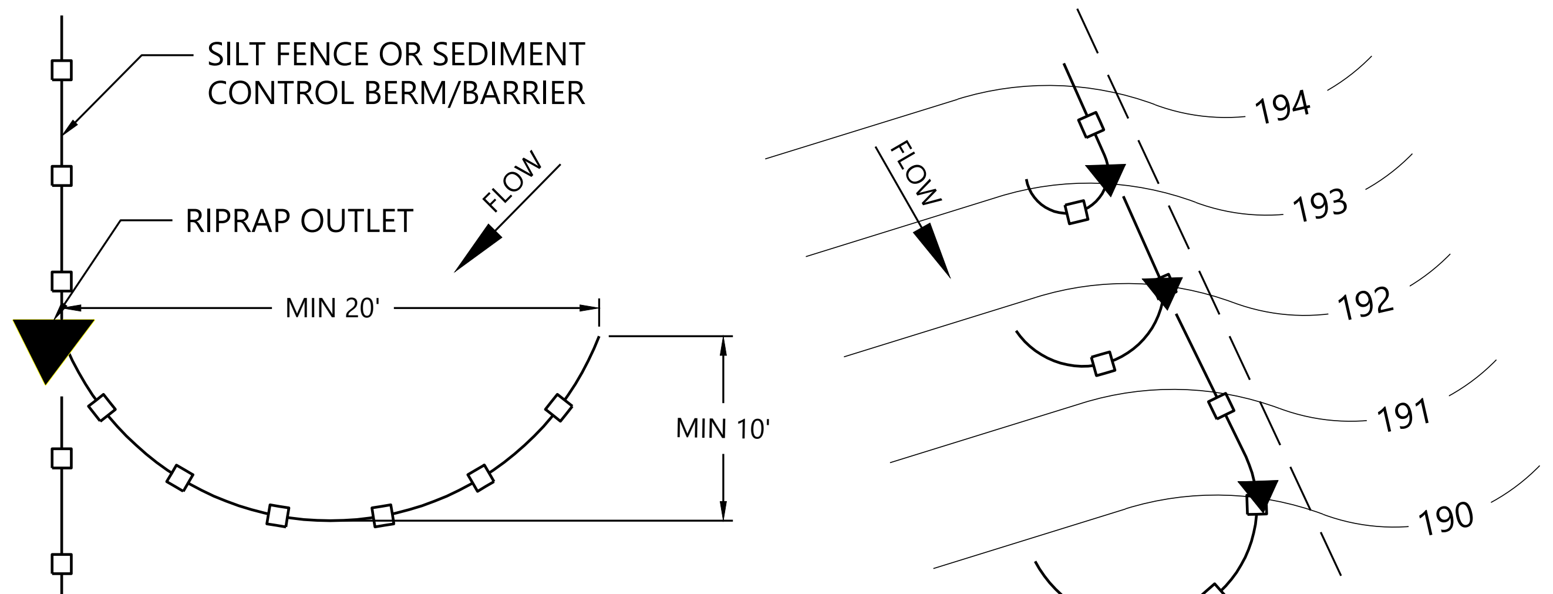
Westwood TYPICAL CHAIN-LINK SECURITY SWING GATE - SUBSTATION AND SWITCHYARD
LAST REVISED: 09/14/15
FN05



PERIMETER/INTERIOR ACCESS ROADWAY

NOTES:
1. CONTRACTOR SHALL CONSTRUCT CROSS-SLOPE ROAD SECTION WHERE ACCESS ROADS ARE CONSTRUCTED ON A SIDE SLOPE, AND WHERE OTHERWISE NOTED ON PLANS, TO ENSURE THAT RUNOFF IS DISTRIBUTED AS SHEET FLOW TO ROADSIDE BUFFERS.

Westwood TYPICAL SOLAR ACCESS ROAD (NOT TO SCALE) RD01



PROJECT SITE LIMITS

Slope	Max J-Hook Spacing (ft)
2:1	25
3:1	50
4:1	75
5:1 OR FLATTER	100

APPLICATION NOTES:
1. INSTALL J-HOOKS WHENEVER THE SILT FENCE/SEDIMENT BARRIER IS INSTALLED AT AN ANGLE OF 30 DEGREES OR GREATER FROM PARALLEL TO CONTOURS.
2. ADHERE TO J-HOOK SPACING REQUIREMENTS ACCORDING TO SURFACE SLOPE DETAILED IN LEFT TABLE.
3. WHERE MINIMUM HOOK DIMENSIONS SHOWN ABOVE CANNOT BE ACHIEVED, NARROWER HOOKS MAY BE USED WITH HIGHER FREQUENCY SPACING. WHERE PONDING DEPTH BEGINS TO EXCEED 1.5 FEET OR THE BARRIER AND RIPRAP OUTLET OTHERWISE FAIL TO PROVIDE CONTROL, FREQUENCY AND SIZING OF J-HOOKS MUST BE ADJUSTED TO REMEDY THE ISSUE.

INSTALLATION NOTES:
1. INSTALL J-HOOK LOCATED IMMEDIATELY DOWN GRADIENT FROM THE RIPRAP OUTLET TO ENSURE THE WATER IS NOT DIVERTED TO THE LOWEST AREAS WHERE A COMPLEX SLOPE EXISTS.
2. UP-GRADIENT BARRIER AND J-HOOK ARE ONE CONTINUOUS BARRIER.
3. START DOWN-GRADIENT BARRIER AS CLOSE AS POSSIBLE TO THE UP-GRADIENT J-HOOK.
4. TOP OF BARRIER ELEVATIONS AT THE END OF J-HOOK NEED TO BE HIGHER THAN THE TOP OF BARRIER ELEVATIONS AT THE MIDDLE OF J-HOOK.
5. TOP OF BARRIER ELEVATIONS AT THE MIDDLE OF J-HOOK NEED TO BE HIGHER THAN THE RIPRAP OUTLET ELEVATIONS.

Westwood J-HOOK DETAIL 06

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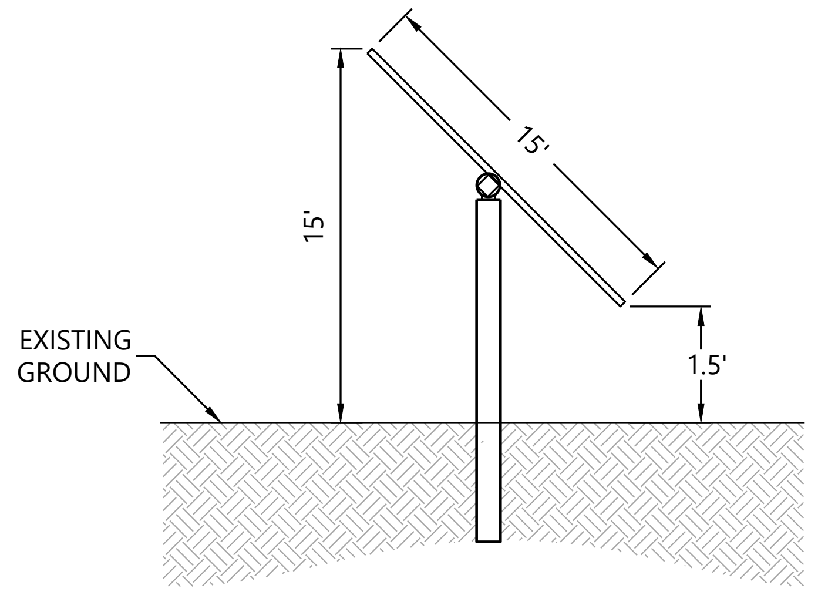
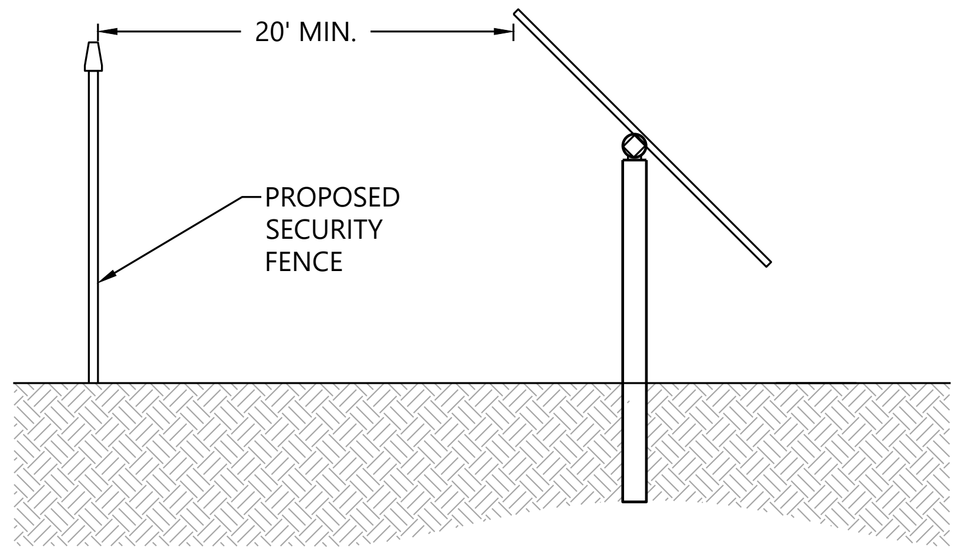
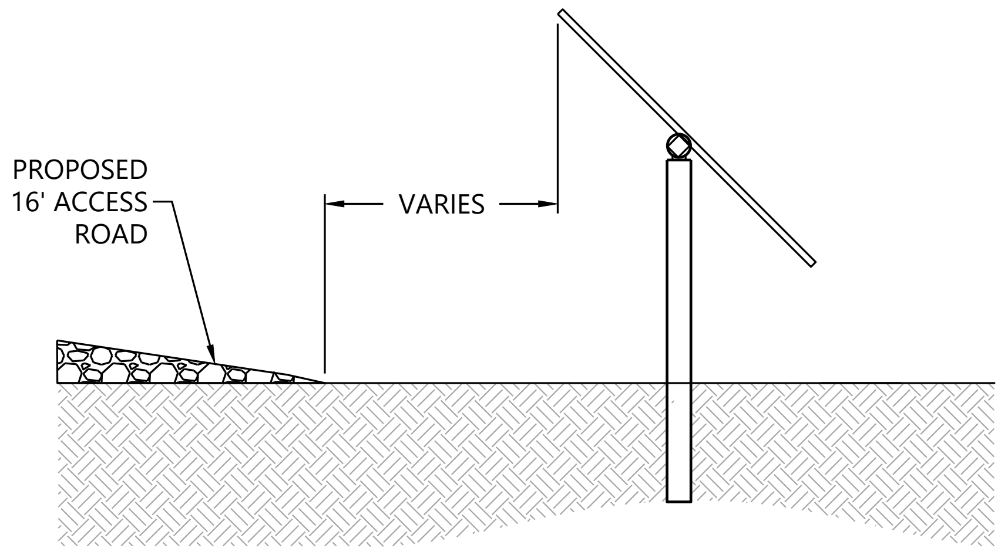


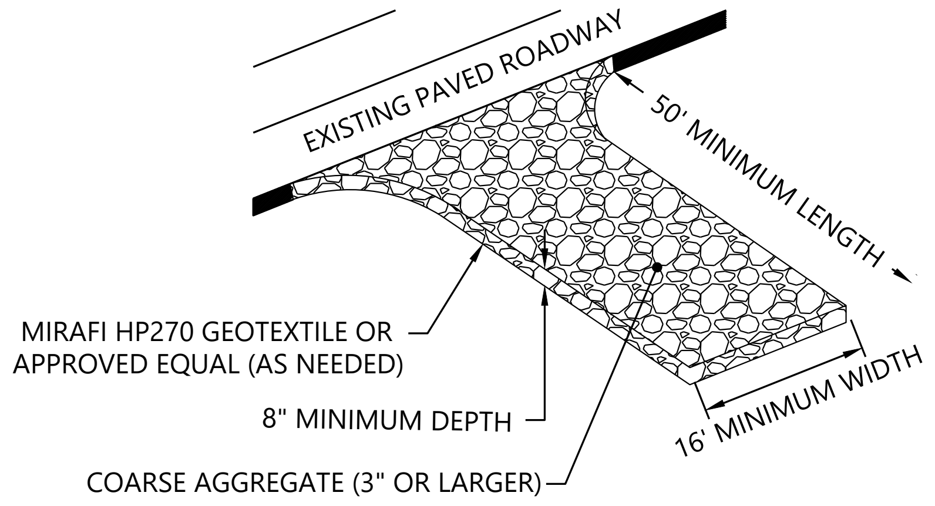
Westwood | STANDARD TRACKER DIMENSIONS | TR01



Westwood | TYPICAL TRACKER TO FENCE SPACING | TR02



Westwood | TYPICAL TRACKER TO ROAD SPACING | TR03



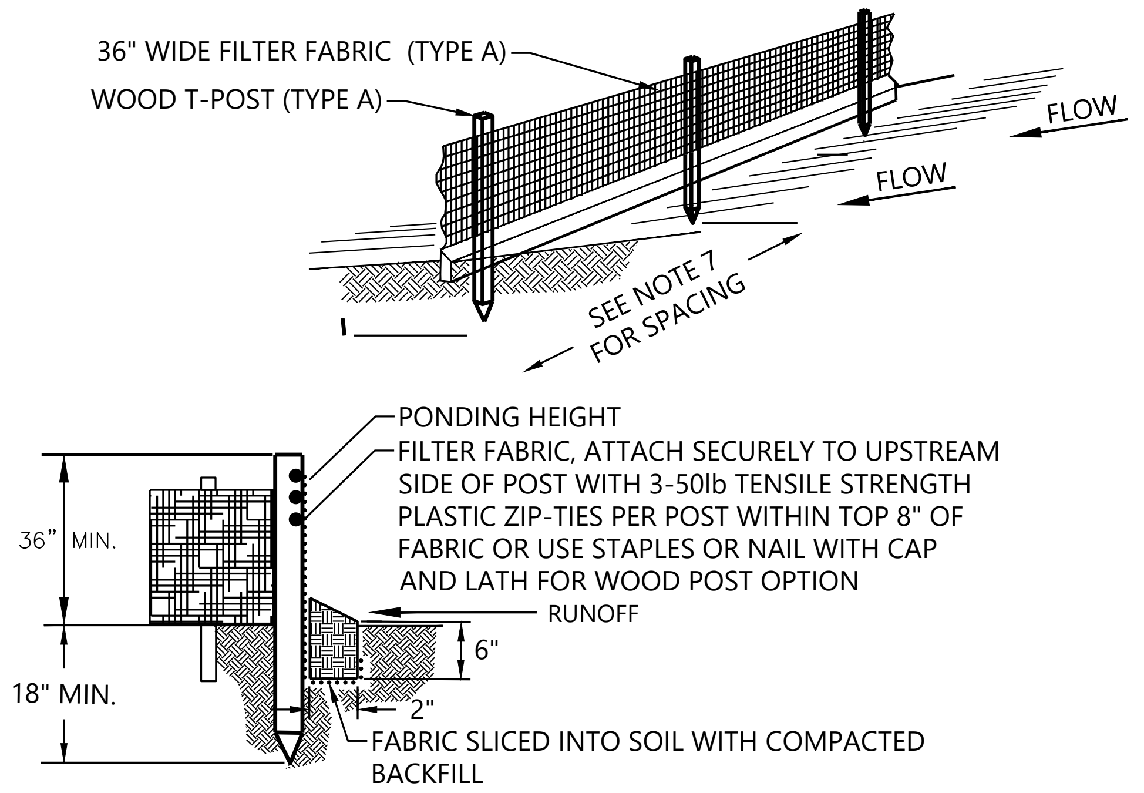
NOTES:

ROCK CONSTRUCTION ENTRANCE SHOULD CONTAIN MAXIMUM SIDE SLOPES OF 4:1. ROCK ENTRANCE SHOULD BE INSPECTED AND MAINTAINED REGULARLY. ROCK ENTRANCE LENGTH MAY NEED TO BE EXTENDED IN CLAY SOILS.

Westwood | STANDARD ROCK CONSTRUCTION ENTRANCE | 03

SILT FENCE DETAIL

TRENCH WITH NATIVE BACKFILL



NOTES:

1. INSTALL J-HOOKS ALONG SILT FENCE ACCORDING TO DETAIL 06 SHEET.
2. INSPECT AND REPAIR FENCE AFTER EACH STORM EVENT AND REMOVE SEDIMENT WHEN ACCUMULATED TO 1/3 THE HEIGHT OF THE FABRIC OR MORE.
3. REMOVED SEDIMENT SHALL BE DEPOSITED TO AN AREA THAT WILL NOT CONTRIBUTE SEDIMENT OFF-SITE AND CAN BE PERMANENTLY STABILIZED.
4. SILT FENCE SHALL BE PLACED ON SLOPE CONTOURS TO MAXIMIZE PONDING EFFICIENCY.
5. ALL ENDS OF THE SILT FENCE SHALL BE WRAPPED UPSLOPE SO THE ELEVATION OF THE BOTTOM OF FABRIC IS HIGHER THAN "PONDING HEIGHT".
6. 6' O.C. MAX SPACING WHERE TYPE A SILT FENCE REQUIRED.
7. REFER TO THE PROJECT EROSION, SEDIMENT AND POLLUTION CONTROL PLAN FOR ADDITIONAL GUIDANCE.

Westwood | SILT FENCE (NOT TO SCALE) | 02 | SD1 SD1C

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Construction Details - 2

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DATE: 07/14/2021

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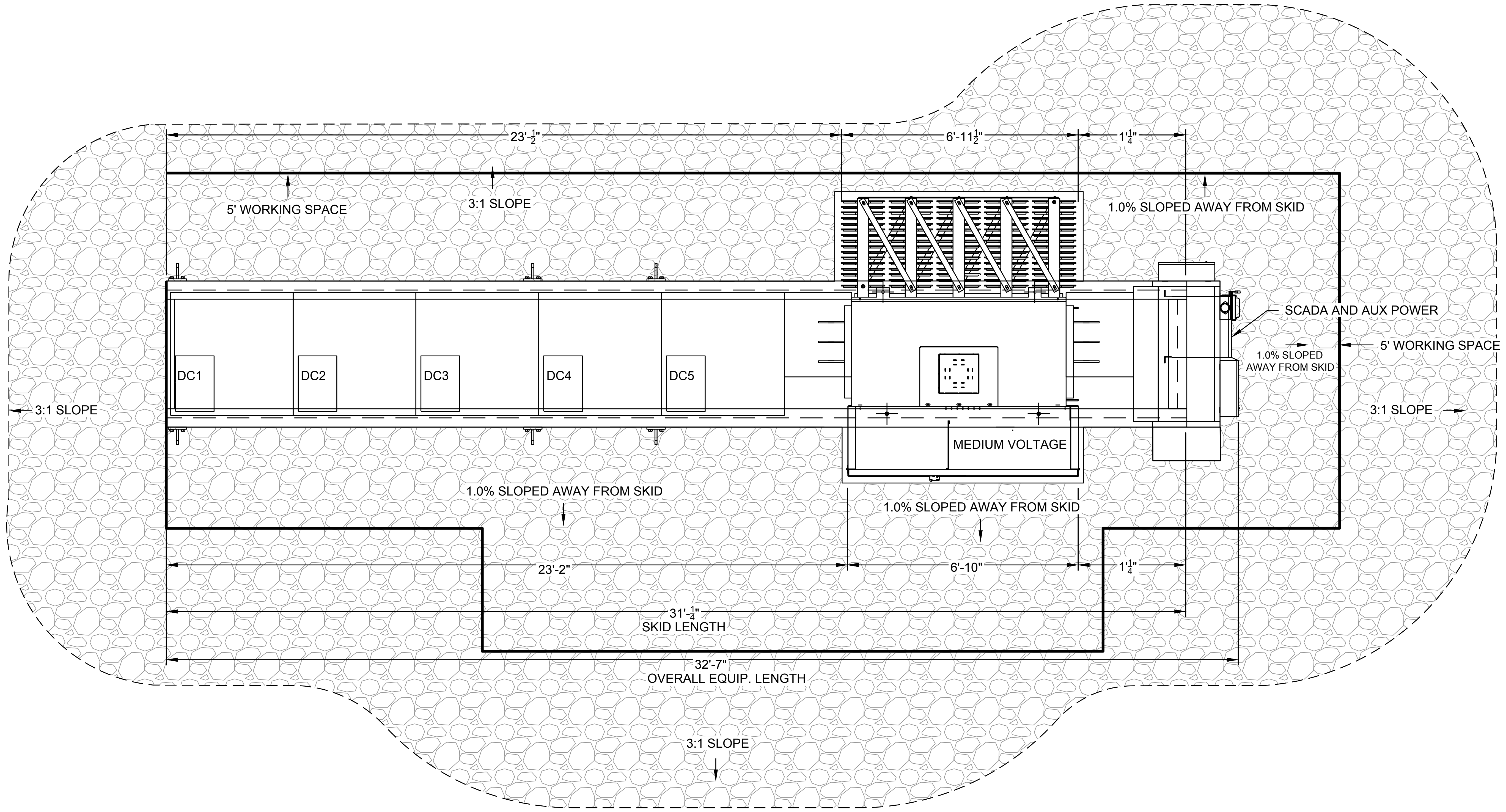
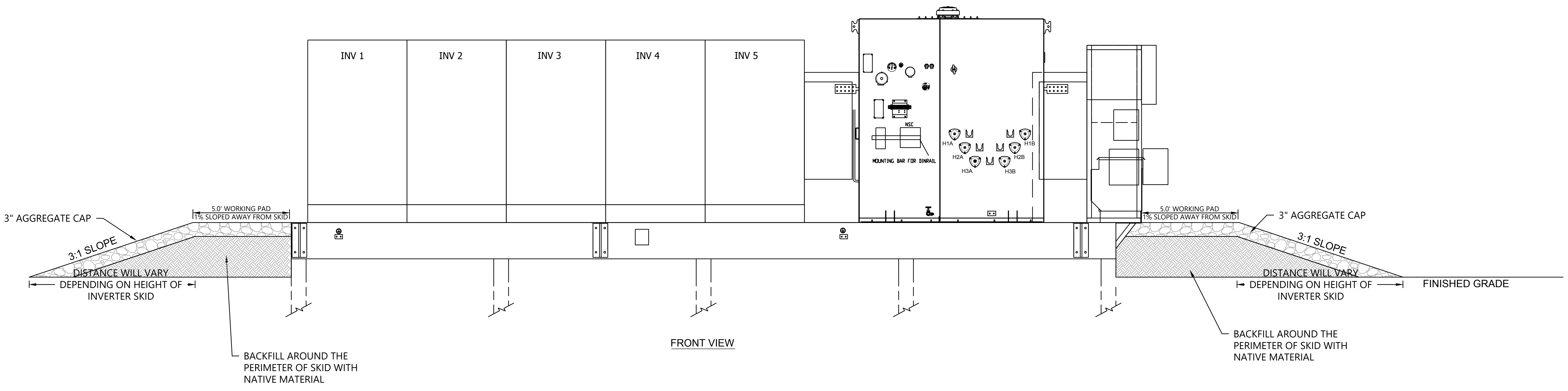


PLAN VIEW



FRONT VIEW

NOTES:
1. WORKING PAD AROUND INVERTER SKID TO BE CONSTRUCTED WITH NATIVE MATERIAL USED AS FILL OVERLAID WITH A 3" AGGREGATE CAP. WORKING PAD TO BE CONSTRUCTED ON SIDES OF INVERTER SKID THAT HAVE OPENINGS TO CABINETS AND EQUIPMENT SWITCHES THAT ARE GREATER THAN 5' IN HEIGHT FROM SITE FINISHED GRADE
2. BACKFILL TO BE INSTALLED AFTER ALL CONDUIT ROUTING HAS BEEN COMPLETED AND APPROVED
3. FILL TO BE COMPACTED TO 90% COMPACTION PER ASTM D698

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South Branch Solar
Hancock County, OH

Construction Details - 3

NOT FOR CONSTRUCTION

DATE: 07/14/2021

SHEET: C.602

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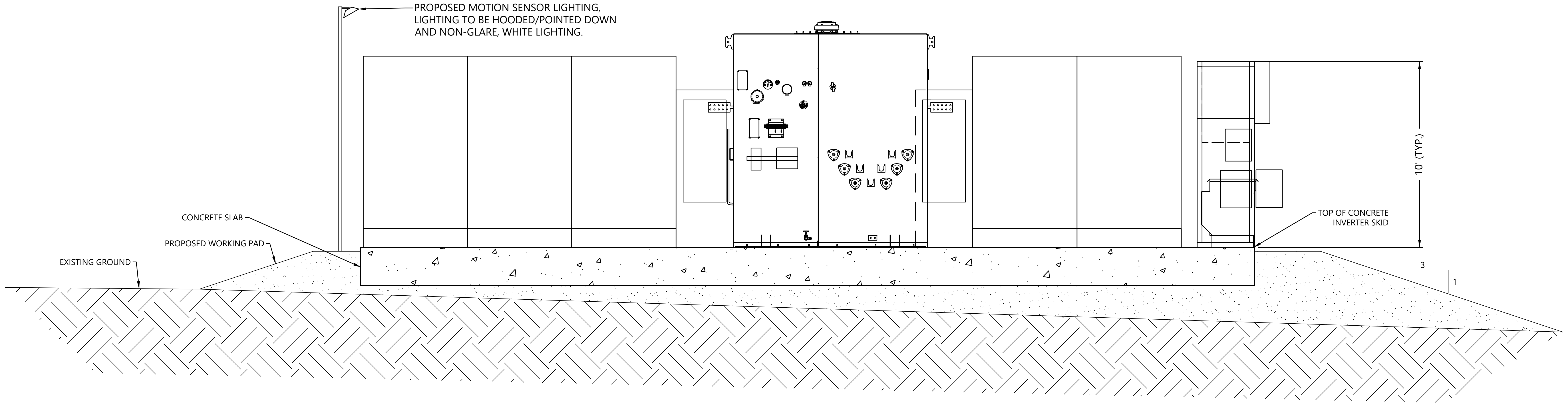
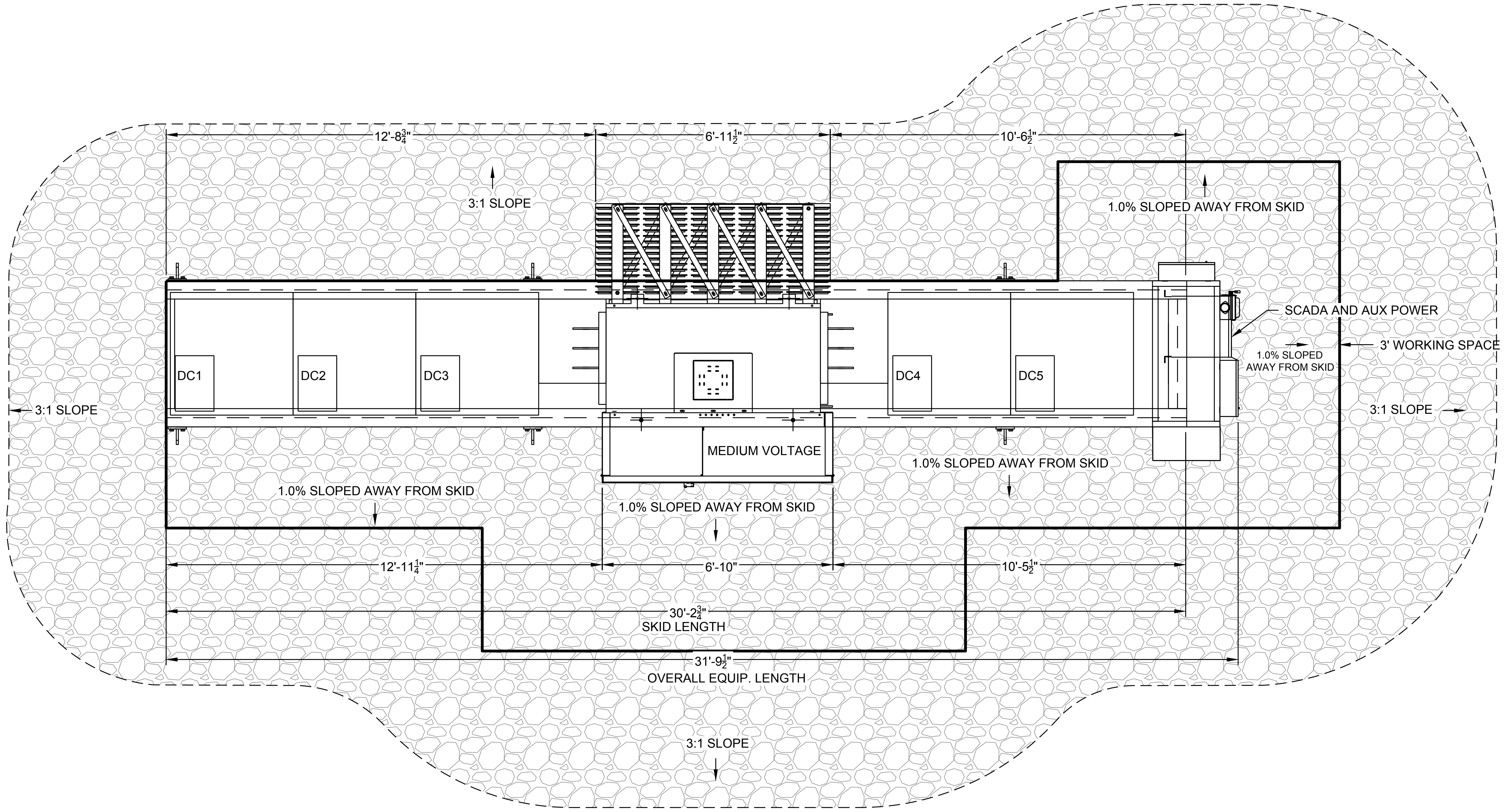


FRONT VIEW



SIDE VIEW

NOTES:
1. WORKING PAD TO BE CONSTRUCTED ON SIDES OF INVERTER SKID THAT HAVE OPENINGS TO CABINETS AND EQUIPMENT SWITCHES THAT ARE GREATER THAN 6' IN HEIGHT FROM SITE FINISHED GRADE
2. BACKFILL TO BE INSTALLED AFTER ALL CONDUIT ROUTING HAS BEEN COMPLETED AND APPROVED.
3. SOIL SHALL BE BACKFILLED AROUND INVERTER PAD IF A WORKING SURFACE IS NEEDED FOR ELECTRICAL EQUIPMENT.
4. DIMENSIONS SHOWN ARE CONCEPTUAL IN NATURE AND MIGHT CHANGE WITH FINAL DESIGN.

Westwood

TYPICAL SOLAR INVERTER ON CONCRETE SLAB

LAST REVISED:
09/29/15

TRK01

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DATE: 07/14/2021

SHEET: C.603

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APPENDIX B

MANUFACTURER’S EQUIPMENT SPECIFICATIONS

Hi-MO 5

LR5-72HBD

520~545M

- Based on M10-182mm wafer, best choice for ultra-large power plants
- Advanced module technology delivers superior module efficiency
  - M10 Gallium-doped Wafer
  - Smart Soldering
  - 9-busbar Half-cut Cell
- Globally validated bifacial energy yield
- High module quality ensures long-term reliability

12 12-year Warranty for Materials and Processing

30 30-year Warranty for Extra Linear Power Output

Complete System and Product Certifications

IEC 61215, IEC 61730, UL 61730

ISO 9001:2008: ISO Quality Management System

ISO 14001: 2004: ISO Environment Management System

TS62941: Guideline for module design qualification and type approval

OHSAS 18001: 2007 Occupational Health and Safety

LONGi

TÜV SÜD C US CE

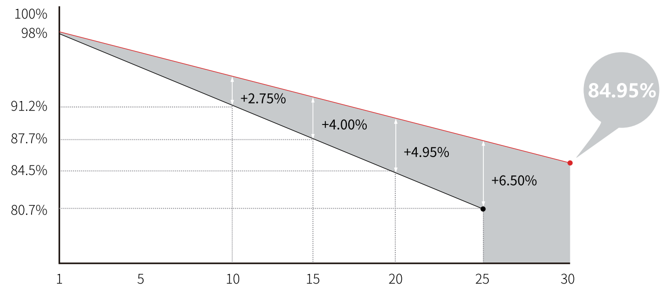
Hi-MO 5

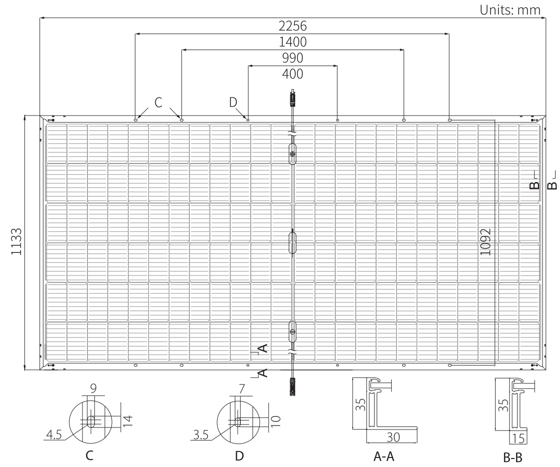
LR5-72HBD 520~545M

21.3% MAX MODULE EFFICIENCY	**0~+5W** POWER TOLERANCE	**<2%** FIRST YEAR POWER DEGRADATION	**0.45%** YEAR 2-30 POWER DEGRADATION	**HALF-CELL** Lower operating temperature

Additional Value

30-Year Power Warranty





Mechanical Parameters

Cell Orientation	144 (6×24)
Junction Box	IP68, three diodes
Output Cable	4mm², positive 400 / negative 200mm length can be customized
Glass	Dual glass, 2.0mm coated tempered glass
Frame	Anodized aluminum alloy frame
Weight	32.3kg
Dimension	2256×1133×35mm
Packaging	31pcs per pallet / 155pcs per 20' GP / 558pcs per 40' HC

Electrical Characteristics STC : AM1.5 1000W/m² 25°C

Test uncertainty for Pmax: ±3%

Power Class	**520**	**525**	**530**	**535**	**540**	**545**
Maximum Power (Pmax/W)	520	525	530	535	540	545
Open Circuit Voltage (Voc/V)	48.90	49.05	49.20	49.35	49.50	49.65
Short Circuit Current (Isc/A)	13.57	13.65	13.71	13.78	13.85	13.92
Voltage at Maximum Power (Vmp/V)	41.05	41.20	41.35	41.50	41.65	41.80
Current at Maximum Power (Imp/A)	12.67	12.75	12.82	12.90	12.97	13.04
Module Efficiency(%)	20.3	20.5	20.7	20.9	21.1	21.3

Operating Parameters

Operational Temperature	-40°C ~ +85°C
Power Output Tolerance	0 ~ +5 W
Voc and Isc Tolerance	±3%
Maximum System Voltage	DC1500V (IEC/UL)
Maximum Series Fuse Rating	30A
Nominal Operating Cell Temperature	45±2°C
Protection Class	Class II
Fire Rating	UL type 29
Bifaciality	70±5%

Mechanical Loading

Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

Temperature Ratings (STC)

Temperature Coefficient of Isc	+0.050%/°C
Temperature Coefficient of Voc	-0.284%/°C
Temperature Coefficient of Pmax	-0.350%/°C

LONGi

Floor 19, Lujiazui Financial Plaza, Century Avenue
826, Pudong Shanghai, China
Tel: +86-21-80162606
Web: en.longi-solar.com

Specifications included in this datasheet are subject to change without notice. LONGi reserves the right of final interpretation. (20200104V12)

NX Gemini

Two-in-Portrait Smart Solar Tracker

The NX Gemini™ two-in-portrait (2P) solar tracker optimizes lifetime value and performance, helping project developers and asset owners get the most from their power plant. Ideally suited for sites with challenging soils, high winds, and irregular boundaries, the ruggedized 2P tracker features a patent-pending distributed drive system for maximum stability in extreme weather, eliminating the need for dampers and producing virtually zero energy losses associated with stowing.

Capitalize with Highest Power Density Solar Tracker

NX Gemini's flexible 2P module configuration allows for the maximum number of modules per foundation, requiring only 60 meters and seven foundation posts to provide support for up to 120 modules on four 1500-volt strings. With the lowest number of foundations per megawatts on the solar tracker market today, NX Gemini helps reduce tracker installation costs on difficult sites.

Pair with TrueCapture and Bifacial for Maximum Performance

The 2P tracker can be equipped with either monofacial or bifacial PV modules and integrated with the entire Nextracker software ecosystem, including the TrueCapture™ advanced smart control and energy yield enhancement platform. Incorporated into the NX Gemini design is the field-proven innovations found in NX Horizon™, such as independent-row architecture, intelligent control systems and wireless communications.

> The Nextracker team has always collaborated with us during their product development process, resulting in trackers that are faster to build, compatible for more sites and easier to maintain. NX Gemini is a strong tracker option for sites with challenging topography and geotechnical conditions.
>
> – **George Hershman**, President, Swinerton Renewable Energy

Features and Benefits

Industry-leading
2P design with 7 foundations points per 120 module row

Ideal
for challenging soils

Bifacial-optimized
for maximum performance

Patent-pending
distributed drive system for maximum stability in high winds

TrueCapture ready
gain up to **6%** more energy

Special rotation
feature for high velocity module installation

Installer-friendly array height with construction rotation feature for faster, easier installation

GENERAL AND MECHANICAL

Tracking type	Horizontal single-axis, independent row
String voltage	1,500 V_{DC}
Typical row size	112 - 120 modules, depending on module string length
Drive type	NX patent-pending self-locking, distributed drive
Motor type	48 V brushless DC motor
Array height	Rotation axis elevation 1.9 to 2.5 m / 6'2" to 8'2"
Ground coverage ratio (GCR)	Typical range 28-50%
Modules supported	Mounting options available for most utility-scale crystalline modules
Bifacial features	Available with optimized central torque tube gap
Tracking range of motion	±50°
Operating temperature range	Array powered: -20°C to 55°C (-4°F to 131°F) AC powered: -40°C to 55°C (-40°F to 131°F)
Module configuration	2 in portrait. 4 x 1,500 strings per standard tracker. Partial length trackers available.
Module attachment	Self-grounding, electric tool-actuated fasteners standard. Clamping system optional.
Materials	Galvanized steel
Allowable wind speed	Configurable up to 235 kph (145 mph) 3-second gust
Wind protection	Intelligent wind stowing with self-locking, distributed drive system for maximum array stability in all wind conditions
Foundations	Standard W8 section foundation posts. Typically ~160 piers / MW.

ELECTRONICS AND CONTROLS

Solar tracking method	Astronomical algorithm with backtracking. TrueCapture™ upgrades available for terrain adaptive backtracking and diffuse tracking mode
Control electronics	NX tracker controller with inbuilt inclinometer and backup battery
Communications	Zigbee wireless communications to all tracker rows and weather stations via network control units (NCUs)
Nighttime stow	Yes
Power supply	ARRAY POWERED: NX Integrated DC pre-combiner & power supply AC POWERED: Customer-provided AC circuit

INSTALLATION, OPERATIONS AND SERVICE

PE stamped structural calculations and drawings	Included
Onsite training and system commissioning	Included
Installation requirements	Simple assembly using swaged fasteners and bolted connections. No field cutting, drilling or welding.
Monitoring	NX Data Hub™ centralized data aggregation and monitoring
Module cleaning compatibility	Compatible with virtually all standard cleaning systems
DC string monitoring	Available with array-powered option
Warranty	10-year structural, 5-year drive and control components
Codes and standards	UL 3703 / UL 2703 / IEC 62817

SG3425UD-MV/ SG3600UD-MV

New

SUNGROW
Clean power for all

Turnkey Station for North America 1500 Vdc System - MV Transformer Integrated

HIGH YIELD

- Advanced three-level technology, max. efficiency 98.9%
- Full power operation at 45 ℃ (113 ℉)
- Effective cooling, wide operation temperature
- Max. DC/AC ratio up to 2.0

SAVED INVESTMENT

- Low transportation and installation cost due to 20-foot container size design
- DC-coupled storage interface and charging power from the grid, low system cost
- Integrated MV transformer and LV auxiliary power supply
- Q at night optional

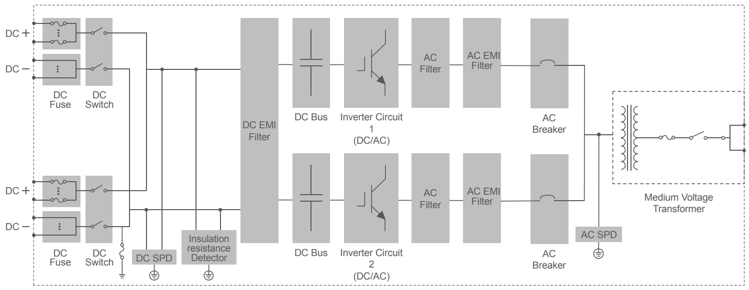
SMART O&M

- Integrated current, voltage and MV parameters monitoring function for online analysis and trouble shooting
- Modular design, easy for maintenance

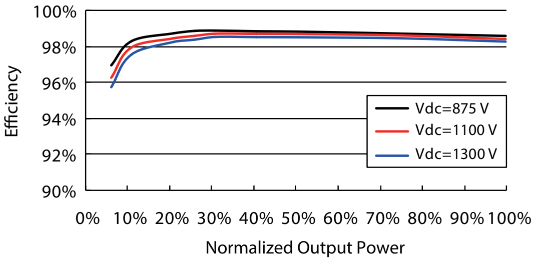
GRID SUPPORT

- Compliance with standards:UL 1741,UL 1741 SA, IEEE 1547, Rule 21 and NEC code
- Low / High voltage ride through (L/HVRT), L/HFRT, soft start/stop
- Active & reactive power control and power ramp rate control

CIRCUIT DIAGRAM



EFFICIENCY CURVE (SG3425UD)



SG3425UD-MV/SG3600UD-MV

Type designation	SG3425UD-MV	SG3600UD-MV
Input (DC)		
Max. PV input voltage	1500 V	
Min. PV input voltage / Startup input voltage	875 V / 915 V	915 V / 955 V
Available DC fuse sizes	250A, 315A, 400A, 450A, 500A	
MPP voltage range	875 – 1300 V	915 – 1300 V
No. of independent MPP inputs	1	
No. of DC inputs	20 (optional: 22 / 24 / 26 / 28)	
Max. DC short-circuit current	10000 A	
PV array configuration	Negative grounding or floating	
Output (AC)		
AC output power	3425 kVA @ 45 ℃ (113 ℉), 3083 kVA @ 50 ℃ (122 ℉)	3600 kVA @ 45 ℃ (113 ℉), 3240 kVA @ 50 ℃ (122 ℉)
Nominal grid frequency / Grid frequency range	50 Hz / 45 – 55 Hz, 60 Hz / 50 – 65 Hz	
Harmonic (THD)	< 3 % (at nominal power)	
Power factor at nominal power / Adjustable power factor	> 0.99 / 0.8 leading - 0.8 lagging	
Efficiency		
Inverter Max. efficiency	98.9 %	
Inverter CEC efficiency	98.5 %	
Transformer		
Transformer rated power	3425 kVA	3600 kVA
Transformer max. power	3425 kVA	3600 kVA
LV / MV voltage	0.6 kV / (12 – 35) kV	0.63 kV / (12 – 35) kV
Transformer vector	Dy1 or Dy11	
Transformer cooling type	ONAN (Optional: KNAN)	
Protection		
DC input protection	Load break switch + fuse	
Inverter output protection	Circuit breaker	
AC MV output protection	Load break switch + fuse	
Overvoltage protection	DC Type II / AC Type II	
Grid monitoring / Ground fault monitoring	Yes / Yes	
Insulation monitoring	Yes	
Overheat protection	Yes	
General Data		
Dimensions (W*H*D)	6058 * 2896 * 2438 mm 238.5'' * 114.0'' * 96.0''	
Weight	18000 kg 39683.2 lbs	
Degree of protection	NEMA 4X(Electronic for Inverter) / NEMA 3R(Others)	
Auxiliary power supply	5kVA, 120Vac/240Vac; Optional: 30kVA, 480Vac/277Vac	
Operating ambient temperature range	-35 to 60 ℃ (> 45 ℃ derating) / optional: -40 to 60 ℃ (> 45 ℃ derating) -22 to 140 ℉ (> 113 ℉ derating) / optional: -40 to 140 ℉ (> 113 ℉ derating)	
Allowable relative humidity range	0 - 100 %	
Cooling method	Temperature controlled forced air cooling	
Max. operating altitude	1000 m (Standard) / > 1000 m (Customized) (3280.8 ft (standard) / > 3280.8 ft (Customized))	
DC-coupled storage interface	Optional	
Charging power from the grid	Optional	
Communication	Standard: RS485, Ethernet; Optional: optical fiber	
Compliance	UL 1741, IEEE 1547, UL1741 SA, NEC 2017, CSA C22.2 No.107.1-01	
Grid support	Q at night function (optional), L/HVRT, L/HFRT, Active & reactive power control and power ramp rate control, Volt-var, Frequency-watt	

APPENDIX C

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT

June 14, 2021
Revised July 16, 2021

Project No. 20220345.001A/DEN21R126862REV

Mr. Bill Branca, PE
Senior Director - Development
Leeward Renewable Energy Development
6688 N. Central Expressway, Suite 500
Dallas, TX 75206

Subject: **Preliminary Geotechnical Engineering Report**
South Branch Solar Project
Hancock County, Ohio

Dear Mr. Branca,

Kleinfelder is pleased to present this preliminary report summarizing the geotechnical investigation for the South Branch Solar project. The purpose of the geotechnical investigation is to characterize the subsurface conditions and provide geotechnical recommendations in support of a permit application South Branch Solar Project. The recommendations presented in this report are subject to the limitations presented herein. In addition, the brief by the Geotechnical Business Association (GBA, Appendix C) provides additional information regarding data interpretation and industry-standard limitations of a geotechnical investigation.

We appreciate the opportunity to provide geotechnical engineering services on this project. Should you have any questions, please contact Nathan Pilcher at 303.278.7920.

Respectfully submitted,

KLEINFELDER, INC.

Nathan Pilcher, PE
Program Manager

James M. Beideman, PE (OH)
Program Manager

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO
KLEINFELDER PROJECT NO. 20220345.001A

July 16, 2021

ONLY THE CLIENT OR ITS DESIGNATED REPRESENTATIVES MAY USE THIS DOCUMENT AND ONLY FOR THE SPECIFIC PROJECT FOR WHICH THIS REPORT WAS PREPARED.

A Report Prepared for:

Mr. Bill Branca, PE
Senior Director - Development
Leeward Renewable Energy Development
6688 N. Central Expressway, Suite 500
Dallas, TX 75206

PRELIMINARY GEOTECHNICAL ENGINEERING REPORT
SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

Prepared by:

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JAMES MICHAEL BEIDEMAN
PE.77525
07-16-2021

Kleinfelder Project No. 20220345.001A
July 16, 2021

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1 INTRODUCTION

This report presents the results of Kleinfelder's preliminary geotechnical investigation for the proposed South Branch photovoltaic (PV) solar electric generation facility, which will be located approximately nine miles northeast of the village of Arcadia in Hancock County, Ohio. The location of the Project is shown on **Figure 1.** Kleinfelder's services were performed in general accordance with our proposal dated April 19, 2021. We understand that Leeward Renewable Energy Development (Client) will submit this preliminary report as part of a permit application.

The scope of Kleinfelder's preliminary geotechnical investigation consists of subsurface exploration, laboratory testing, engineering analysis, and preparation of this preliminary report. The purpose of Kleinfelder's geotechnical engineering services are to provide preliminary design and construction recommendations for the PV array foundations, equipment pads, access roads, site preparation, and general earthwork. This preliminary geotechnical investigation is in support of the permit application. Additional geotechnical investigation components, such as test pits, field electrical resistivity (ER), pile load testing, and additional laboratory testing will be completed in Fall 2021 and summarized in a final geotechnical report.

The conclusions and recommendations presented in this report are based on the limited subsurface information encountered in our explorations, our site observations, and our experience with similar developments. The recommendations contained in this report are subject to the provisions and requirements outlined in the Limitations section of this report.

1.1 PROJECT DESCRIPTION

We understand that the Project will include the installation of ground-mounted solar PV arrays consisting of PV panels attached to a single-axis tracker (SAT) system. The arrays will be supported on driven steel piles, typically fabricated from wide-flange beams. Maximum axial and lateral loads are expected to be on the order of two to three kips.

Other components installed at the Site will include overhead and underground electrical conductors, inverters, transformers, and other electrical components, to be supported on piles, slabs-on-grade, or combinations of slabs and piles. Additional site development will also include access roadways for construction and maintenance purposes as well as perimeter fencing.

Finished site grades were not provided at the time this report was prepared. Kleinfelder anticipates grading within the solar array field will be limited. Earthwork cuts and fills of no more than approximately two feet are expected for equipment pads. Utility trenches are not anticipated to exceed four feet in depth.

1.2 SCOPE OF WORK

Kleinfelder's preliminary geotechnical investigation in support of permit application for South Branch Solar Project includes seven exploratory borings at the proposed array locations, laboratory testing and recommendations for earthwork, frost heave and PV array foundations. It is understood that additional exploratory borings will be performed during the final design phase of the project.

2 FIELD EXPLORATION & LABORATORY TESTING

2.1 FIELD EXPLORATION

Subsurface conditions at the Site were explored with seven soil test borings with the limits of the proposed array on May 4, 2021. It is our understanding that additional geotechnical investigation components, such as test pits, electrical resistivity (ER) surveys, pile load testing, and remaining exploratory borings at the array and substation locations will be performed in the Fall of 2021 as part of the final design. The approximate exploratory boring locations are presented on **Figure 1.**

Prior to Kleinfelder's field exploration, the exploration locations were cleared for underground utilities through the Ohio 811 system. Kleinfelder staked the boring locations in the field using a handheld GPS unit with an accuracy of approximately 16 feet. Kleinfelder geotechnical staff observed drilling and test pit operations, collected soil samples, and reviewed the subsurface conditions logged in each boring and test pit. Kleinfelder visually classified the observed soils in general accordance with ASTM D2488 and the Unified Soil Classification System. Keys to the soil descriptions and symbols used to describe the subsurface conditions encountered are presented in Appendix A.

2.1.1 Soil Test Borings

Seven soil test borings were advanced with an Acker Rebel track-mounted drill rig using hollow stem auger drilling techniques to depth of approximately 20 feet below the ground surface (bgs). Soil samples were collected with a standard 1.4-inch I.D., 2-inch O.D., split-tube sampler. The sampler was first seated six inches, then driven an additional 18-inches with blows of a 140-pound auto-hammer falling 30 inches. Standard Penetration Tests (SPTs) were performed at 2.5-foot intervals for the first 10 feet and at five-foot intervals thereafter, in general accordance with ASTM D1586. Standard Penetration Test data (SPT N-values) along with pocket penetrometer reading on SPT samples were used to estimate the in-situ soil strength and density. Soil samples were collected at each test interval. Groundwater observations were recorded during drilling, upon completion of drilling, and prior to backfilling the borings. All soil test borings were excavated to their target depths. The borings were backfilled with cuttings from the drill operations. Logs of the borings are presented in Appendix A.

2.1.2 Laboratory Testing

Laboratory testing was performed on selected samples to evaluate physical and engineering properties of the soils. The laboratory testing included the following tests performed in general accordance with the referenced standards:

- Moisture Content (ASTM D2216);
- Grain Size Distribution (passing 200) (ASTM D1140); and
- Atterberg Limits (ASTM D4318);

Laboratory testing results are shown on the boring logs presented in Appendix A. A summary table and laboratory test results are included in Appendix B.

2.2 RECOMMENDATIONS FOR ADDITIONAL FIELD EXPLORATION

Kleinfelder recommends the following additional field explorations be completed during the design phase to confirm and refine the design recommendations:

- Additional exploratory borings at the array and substation locations;
- Field electrical resistivity testing (ASTM G57);
- Test pits; and
- Pile load testing.

2.3 RECOMMENDATIONS FOR ADDITIONAL LABORATORY TESTING

Additional geotechnical laboratory testing such as moisture content, grain size analysis, and Atterberg limit should be performed to evaluate engineering and physical properties of the soil. In addition, the following testing are recommended to complete a geotechnical investigation of the project.

- Resistance Value (R-Value) of Treated and Untreated Bases, Subbases and Basement Soils (AASHTO T190);
- Maximum Dry Unit Weight and Optimum Moisture Content Determinations (ASTM D168);
- Direct Shear Test (ASTM D3080);
- Thermal Resistivity (ASTM 5334); and
- Soil Chemistry:
  - pH of Soils (AASHTO T289),
  - Electrical Resistivity (AASHTO T288),
  - Sulfate Content (AASHTO T290),
  - Chloride Content (AASHTO T291),

- Sulfide Content (SM 4500-S2-D), and
- Oxidation Reduction Potential (SM 2580 B Mod.).

3 SITE DESCRIPTION AND GEOLOGICAL SETTING

3.1 SITE DESCRIPTION

The project site consists of approximately 1,300 acres of predominantly undeveloped farmland. Review of aerial and satellite photography from 1994 through 2020 indicates the Site has remained mostly undeveloped agricultural land. The topography of the Site is relatively flat. Ground cover at the time of our investigation primarily consisted of harvested crops. The access roads surrounding the project site were paved with asphaltic concrete. Densely wooded trees were located south of Boring B-4. Other than the structure located north of Boring B-8, there is no residential or commercial buildings inside the project parcel. Satellite images from 1994 did not show any previous development at the project site. It is possible that abandoned underground structures, such as foundations, may exist in the area. Overhead power lines are running along the surrounding access roads; however, no overhead utility line crossing was encountered through the project parcels.

3.2 GEOTECHNICAL DESKTOP STUDY

A limited geotechnical desktop study was performed to identify the project site's geologic setting and karst features. Published mapping and articles from the USGS and Ohio Division of Geologic Survey were reviewed for this analysis.

3.2.1 Geologic Setting

3.2.1.1 Surficial Geology

A review of the Quaternary Geology Map published by the Ohio Division of Geologic Survey indicates the presence of several surficial geologic units across the Site. These geologic units are known to have originated from the Wisconsinan-age. **Figure 2** shows the project site overlain on the surficial geology. More detailed descriptions of these units have been presented in

Table 3-1 below:

Table 3-1. Surficial Geologic Units

Geologic Unit	Unit Symbol	Description
Lake-planed moraine	L	Massive or laminated silt with thin sand partings. In some area carbonated cemented concentration occurs. This geologic unit may also contain localized clay, sand, and gravel. Placed throughout the map area as lowland surface deposit.
End moraine	M	This geologic unit composed of till, an unsorted, unstratified mixture of clay, silt, sand, and coarser fragments. This layer is generally 100 feet thick which also may contain lenses or masses of stratified sand and gravel. Underlain depressions and boulders are common.

3.2.1.2 Bedrock Geology

Based on the Bedrock Geology map published by the Ohio Division of Geologic Survey, the Site is underlain by Lockport Dolomite (Sl) from Upper and Lower Silurian age. According to the US Geological Survey (USGS), dolomite is a dominant bedrock unit present in the map area. This geologic unit is mostly variegated white to shades of gray, finely to coarsely crystalline with medium to massive beds. **Figure 3** shows the project site overlain on the regional bedrock geology.

3.2.1.3 Relative Risk of Karst Feature

Based on the *Karst in the United States: A Digital Map Compilation*, by Weary, D.J., US Geological Survey Open-File Report 2014-1156, the project site is mapped within an area that is known to be comprised of flat-lying beds of carbonate rocks (such as dolomite) beneath an overburden of non-carbonate material. A review of the "Probable Karst areas of Ohio" map published by the Ohio Department of Natural Resources (ODNR) indicates that the project site is underlain by Silurian and Devonian age carbonate bedrock overlain by more than 20 feet of glacial drift and/or alluvium in the general vicinity of the site. The Karst Interactive Map (https://gis.ohiodnr.gov/website/dgs/karst_interactivemap/) maintained by ODNR does not show any karst features within the limits of the site. Kleinfelder representatives did not observe indications of karst features such as depressions, vugs, or voids during the field investigation. Based on this information, the relative risk of encountering karst features at the project site is considered low.

3.3 SUBSURFACE CONDITIONS

The following description provides a general summary of the subsurface conditions encountered during the field exploration and further identified by the laboratory testing program. A more detailed description can be found on the Boring Logs presented in Appendix A.

The topsoil encountered at the Site generally consists of silt with various amount of sand and clay and gravel. Approximately six inches to three feet of topsoil were observed at the test borings. Planted crops were encountered during field exploration at Borings B-4, B-6, and B-8. The subsurface conditions consist of medium stiff to hard lean clay (CL) with various amounts of sand to a maximum observed depth of 20 feet.

Engineering properties of the soils were evaluated using field and laboratory testing and are included in Appendix B. Atterberg limits tests performed on selected samples of the soils indicated liquid limit (LL) values ranging from 25 to 46 and plasticity index (PI) values ranging from 10 to 27.

3.3.1 Groundwater

Groundwater was not observed during the subsurface exploration, though seepage was encountered at a depth of 14 ft below ground surface (bgs) in Boring B-1. Some fluctuation in groundwater levels can occur with climatic and seasonal variations. Fluctuation of the groundwater level, localized zones of perched water, and increased soil moisture content should be anticipated during and following rain events. Therefore, subsurface water conditions at other times may be different from those described in this report.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL CONCLUSIONS

The preliminary conclusions and recommendations presented below are based on the subsurface conditions observed in the explorations, laboratory test results, engineering analyses, and our experience with similar utility-scale PV solar projects. Based on the results of our limited field exploration and laboratory testing, the Site appears to be geotechnically suitable for PV solar development. The preliminary information collected in our subsurface investigation indicate that the soil and rock conditions are favorable for pile supported arrays. Ancillary equipment may be supported on shallow foundations. Aggregate access roads will likely require regular maintenance during construction with low lying areas where water collects requiring stabilization, which is typical for solar site development. The following recommendations in addition to the supplement site investigation and testing will provide the information required to develop the final site design.

4.2 EARTHWORK

4.2.1 Subgrade Preparation

Initial site work should consist of grubbing and stripping of vegetation, demolition, and removal of existing structures and other deleterious materials. Deleterious material should be removed for offsite disposal in accordance with local laws and regulations.

Subgrades below roadways, equipment pads, and areas planned for structural fill placement should be evaluated by an experienced geotechnical engineer or their representative prior to construction. Areas should be proof rolled with a loaded dump truck (minimum 18-kip axle load). Areas that express excessive rutting or pumping should be undercut and backfilled with structural fill per the following paragraphs. The excavations should extend horizontally beyond the construction limits, extending outward one foot for every one foot of excavation.

We recommend native soils below structural fill, equipment pads, spread foundations, and access roadways be scarified, moisture conditioned to zero to three percent above optimum moisture content, and recompacted a minimum of eight inches below the structural fill, access road subgrade, or base of concrete.

Preparation of the tilled or disturbed soils should be completed as required to facilitate array installation equipment access and will likely include levelling and compaction of the existing soil.

4.2.2 Excavation and Trenching

We anticipate that the site soils can be excavated using conventional heavy-duty construction equipment. Our borings did not encounter bedrock, boulders, or other layers anticipated to present difficult excavation conditions at typical utility installation depths.

All excavations must comply with applicable local, state, and federal safety regulations including the current OSHA Excavation and Trench Safety Standards. OSHA soil type and allowable sloping must be made in the field by the contractor's OSHA-qualified "competent person" whenever personnel exposure is anticipated. Construction site safety is the responsibility of the contractor, who shall also be solely responsible for the means, methods, and sequencing of construction operations.

4.2.3 Structural Fill

Structural fill is defined as any fill that will support structural elements. Structural fill will be required for backfill of utilities and for site-grading fill. All structural fill must be free of sod, rubbish, topsoil, frozen soil, and other deleterious materials. The onsite soils are generally suitable for reuse as structural fill, provided they are properly moisture conditioned to maintain workability. Imported Structural fill materials should consist of a non-expansive, mainly granular material as specified in the table below.

Table 4-1. Imported Fill Criteria

Gradation Requirements	
Standard Sieve Size	Percent Passing
3 inches	100
3/4 inch	80 - 100
No. 200	10 - 35
Plasticity Requirements (Atterberg Limits)	
Liquid Limit	30 or less
Plasticity Index	12 or less

The native materials encountered during Kleinfelder's evaluation were generally fine-grained (i.e., greater than 50 percent passing the No. 200 sieve) with higher liquid limits and plasticity indices than listed in Table 4-1. The in-situ moisture content of tested onsite soils ranged from about 15 to 31 percent. Fine-grained soils with elevated liquid limits and plastic indices are moisture sensitive and can be difficult to dry out to achieve compaction requirements.

A sample of any imported fill material should be submitted to the geotechnical engineer for approval and testing at least one week prior to stockpiling at the Site. Structural fill should be placed according to the recommendations in Section 4.2.4.

4.2.4 Fill Placement and Compaction

Structural fill should be placed in loose lifts and in thicknesses appropriate for the compaction equipment being used. However, in no case should loose-lift thickness exceed eight inches. Structural fill should be compacted to the specifications presented in Table 4-2.

Table 4-2. Compaction Specifications

Fill Location	Minimum Percent Compaction (ASTM D698)	Moisture Content
Foundation and Roadway Subgrade Preparation or Site Grading	95%	0 to 3%

4.2.5 Construction in Wet or Cold Weather

During construction, the Site should be graded such that surface water can drain readily away from excavations. Any water should be promptly pumped out or otherwise removed since water may accumulate in excavations or on subgrade surfaces. These wet areas should be allowed to dry before resuming construction. The use of berms, ditches, and similar means may be used to prevent stormwater from entering the work area and to convey any water off-site efficiently.

If earthwork is performed during the winter months when freezing may occur, no grading fill, structural fill, or other fill should be placed on frosted or frozen ground, nor should frozen material be placed as fill. Frozen ground should be allowed to thaw or be completely removed prior to placement of fill. A good practice is to cover the compacted fill with a “blanket” of loose fill to help prevent the compacted fill from freezing.

4.2.6 Construction Testing and Observation

Field testing and construction observation should take place under the direction of a qualified geotechnical engineer. Furthermore, the opinions and recommendations expressed in a geotechnical report are based on interpretation of limited information obtained from the field exploration. Therefore, it is common to find that actual site conditions differ from those indicated in the report. The geotechnical engineer should remain involved throughout the project to evaluate such differing conditions as they appear, and to modify or add to the geotechnical recommendations, as necessary.

4.2.7 Surface Drainage and Final Site Grading

Positive drainage away from structures is essential to the performance of foundations and roads and should be provided during the life of the facility.

Consideration should be given to improving the slope and surface drainage of areas that have ponding of surface water and/or poor surface drainage near slab foundations or roads.

4.3 SEISMIC SITE CLASS

Based on the soil conditions encountered in the borings and our knowledge of geologic conditions in the area of the site, a Site Class of ‘D’ is considered appropriate. From our research, the 2017 Ohio Building Code is currently being utilized, which is based on the 2015 International Building Code and the ASCE 7-10 Minimum Design Loads for Buildings and Other Structures. The seismic design parameters, based on a latitude/longitude of 41.128332°/-83.515784° as determined in ASCE 7-10 from the ATC Hazards by Location website (hazards.atcouncil.org), are summarized below in Table 4-3.

Table 4-3. Seismic Design Parameters

Design Parameter	Recommended Value
Site Class	D
PGA	0.074
PGA_M	0.118
S_s	0.139
S_1	0.057
F_a	1.6
F_v	2.4
S_{MS}	0.223
S_{M1}	0.136
S_{DS}	0.149
S_{D1}	0.091

The typical soil profile encountered in our borings ranged from medium stiff to hard lean clay with sand.

It is our opinion that overall, the soil profile presents negligible risk of liquefaction due to the presence of stiff clays and low seismicity at the Site.

4.4 FROST HEAVE CONSIDERATIONS

We recommend a frost depth of approximately 36 inches be considered for the project site. Due to the presence, depth and thickness of the lean clay layer encountered in the majority of the Site, in combination with the depth to groundwater encountered at the Site, we anticipate the risk of frost action to be low to moderate.

4.5 PV ARRAY FOUNDATIONS

Typical foundations used for PV arrays, such as driven steel piles, drilled piers, helical piers, ballasts, or footings will likely be feasible for use for this project. We have assumed driven steel piles are preferred.

The following preliminary design values for evaluation of axial and lateral pile capacity are based on the findings of our limited field investigation, laboratory testing, and our experience in the area. Based on the soils encountered at the Site and potential frost-heave considerations, we recommend all PV support piles have a minimum driven depth of at least seven feet below grade. Greater depths may be required to achieve structural requirements.

4.5.1 Axial Capacity

Axial capacity of driven piles may be estimated based on the perimeter of the pile and embedment depth. The perimeter of a wide-flange beam should be taken as twice the sum of the flange width and web depth. We recommend the upper one foot of soil be neglected for the skin friction component of axial capacity.

Kleinfelder evaluated the skin friction of the piles based on the exploration and testing results presented in this report (Appendices A and B). The ultimate skin friction of driven pile foundations can be taken as 460 psf. Thus, the nominal axial load capacity of the driven piles for PV racking in the upper 15 feet can be calculated using the following formula:

$$Q_{ult} = 460\text{psf} * P * (L\text{-}1\text{ft})$$

Where: Q_{ult} = ultimate (nominal) axial capacity (pounds)
P = perimeter equal to twice the section depth plus twice the flange width (ft)
L = embedment depth (ft), neglecting the upper 1ft

For design of piles, we recommend a factor of safety of at least 2 for evaluation of allowable skin friction, or a resistance factor of 0.6 for design using load and resistance factored design (LRFD).

For piles in compression, end bearing can be considered additive to the skin friction. Ultimate end bearing pressure can be taken as 7,500 psf, calculated based on the box end area of the pile. For evaluation of allowable end pressure, we recommend a factor of safety of 2.5. For LRFD, we recommend a maximum a resistance factor of 0.5. The above values can be used to estimate the capacity of piles for both refusal and non-refusal installations.

4.5.2 Lateral Capacity

Lateral load response of pile foundations can be calculated with the computer program L-Pile, created by Ensoft, Inc. The stiffness of the pile and the stress-strain properties of the surrounding soils determine the lateral resistance of the foundation. Recommended L-Pile input parameters for the clay soils encountered are included below in Table 4-4. As shown in the table, the upper foot of soil should be neglected for lateral capacity.

Table 4-4: L-Pile Input Parameters

Parameter	Design Value
Soil Type	Stiff Clay w/o Free Water
Effective Unit Weight (pcf)	125
Undrained Cohesion (psf)	750

Kleinfelder developed these parameters from the results of the field and laboratory testing (Appendices A and B). These parameters can be used for the full depth of pile embedment. We assumed pile width will be up to seven inches for our preliminary analysis. If wider piles are requested, Kleinfelder can provide additional recommendations as part of our final geotechnical evaluation.

4.5.3 Refusal Considerations

We recommend that all PV support piles have a minimum driven depth of at least seven feet, although greater depths may be required to achieve structural requirements. Refusal is defined as no advancement after driving the piles at full power (minimum 830 Joules) for at least 30 seconds. Piles that refuse and require additional embedment depth should be withdrawn and the pile location predrilled. Predrilled pile holes should be backfilled with compacted granular material. Compaction should be completed by tamping with a heavy tamping bar with at least three lifts.

4.6 ACCESS ROADS

At typical solar sites, access roads are heavily used during construction, but see very low traffic volumes during the life of the installation thereafter. Vehicle types are anticipated to vary significantly, from lightly to heavily loaded trucks and construction equipment. Access road sections are typically designed based on post-construction traffic volumes, with the assumption that localized improvements and/or frequent maintenance of the roads will occur during construction. Gravel-surfaced or soil access roads are typical for these facilities.

Near surface soils encountered in the explorations were predominately lean clay with various amounts of sand with medium plasticity. These soils are considered fair to poor subgrade for roads, and the strength of the subgrade will be highly influenced by moisture content. Based on the soil type encountered, we estimate these soils to have a field CBR value of 5 for road section design.

Performance of gravel-surface roads is greatly influenced by moisture in the subgrade soils. High subgrade moisture contents will increase the frequency and depth of rutting and ponding on the wearing surface. The use of subgrade stabilization (e.g., lime or cement fly-ash) or a geotextile separation fabric (e.g., Tensar BX1100 geogrid or equivalent) can improve support qualities and may be appropriate for high-traffic areas. A geotextile can also reduce rutting and maintain strength of a gravel surface course.

Based on AASHTO design criteria for low-volume roads, we recommend a minimum wearing surface of ten inches of aggregate for a traffic load of five trucks per weekday for a year during construction. Traffic after construction is anticipated to be very limited, mainly consisting of pick-up trucks and rare heavy trucks for maintenance operations. These traffic volumes are too small for typical road design methods, and the primary concern will be access. Therefore, we recommend a wearing surface of a minimum of 6 inches of aggregate. This recommendation is not additional to the “during construction” section. The 6-inch section can be achieved through grading and spot-filling of ruts and other thin or warn areas in the roads.

A road-wearing surface should consist of imported granular material that meets the requirements of the Ohio Department of Transportation *Construction and Material Specifications* (2019) Section 703.04, Aggregate for Asphalt Concrete Base. An increased thickness of granular material may be required in isolated areas to achieve stability.

We recommend the roads be designed with cross-slope to promote drainage, and, where possible, with ditches to help drain water from the road and convey off-site.

Road alignments should be properly prepared by stripping all vegetation, organic soil, and deleterious materials and scarified and recompacted to a minimum depth of eight inches below final subgrade elevation. The road alignment should be proof rolled with a fully loaded truck with a minimum of 18 kip per axle loading. Areas that deflect, rut, or pump should be further excavated, moisture conditioned, and recompacted, or stabilized. The limit for deflection or rutting could be defined as less than two inches of rutting, less than half inches of deflection, and no pumping.

Regular maintenance including grading and the addition of gravel should be anticipated during the facility construction because truck and heavy equipment traffic will be frequent. After construction, traffic volumes are anticipated to be very low, and mainly related to facility maintenance operations.

5 LIMITATIONS

This work was performed in a manner consistent with that level of care and skill ordinarily exercised by other members of Kleinfelder’s profession practicing in the same locality, under similar conditions and at the date the services are provided. Our conclusions, opinions, and recommendations are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. Kleinfelder makes no other representation, guarantee, or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by Leeward Renewable Energy Development and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

The work performed was based on project information provided by Client. If Client does not retain Kleinfelder to review any plans and specifications, including any revisions or modifications to the plans and specifications, Kleinfelder assumes no responsibility for the interpretation or implementation of our recommendations. In addition, if there are any changes in the field to the plans and specifications, Client must obtain written approval from Kleinfelder’s engineer that such changes do not affect our recommendations. Failure to do so will vitiate Kleinfelder’s recommendations.

Kleinfelder offers various levels of investigative and engineering services to suit the varying needs of different clients. Although risk can never be eliminated, more detailed and extensive studies yield more information, which may help understand and manage the level of risk. Since detailed study and analysis involves greater expense, our clients participate in determining levels of service, which provide information for their purposes at acceptable levels of risk. Client and key members of the design team should discuss the issues covered in this report with Kleinfelder, so that the issues are understood and applied in a manner consistent with the owner’s budget, tolerance of risk and expectations for future performance and maintenance.

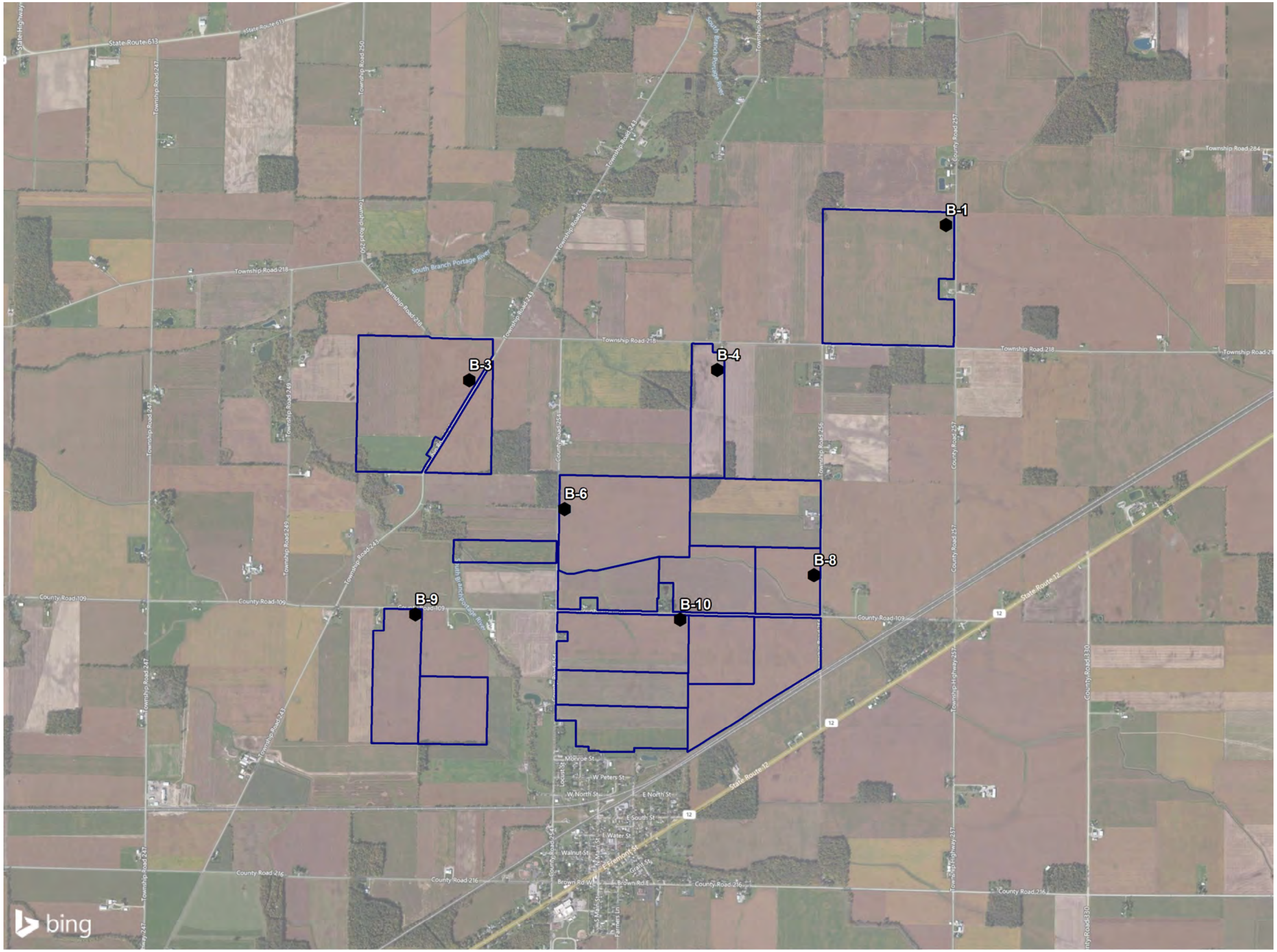
The scope of services for this subsurface exploration and geotechnical report did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

This report, and any future addenda or reports regarding this site, may be made available to bidders to supply them with only the data contained in the report regarding subsurface conditions and laboratory test results at the point and time noted. Bidders may not rely on interpretations, opinions, recommendations, or conclusions contained in the report. Because of the limited nature of any subsurface study, the contractor may encounter conditions during construction which differ from those presented in this report. In such event, the contractor should promptly notify the owner so that Kleinfelder's Geotechnical Engineer can be contacted to confirm those conditions. We recommend the contractor describe the nature and extent of the differing conditions in writing and that the construction contract include provisions for dealing with differing conditions. Contingency funds should be reserved for potential problems during foundation construction.

FIGURES

PLOTTED: 6/4/2021 12:45:06 PM BY: MPalmer

GIS FILE PATH: \\azrgisstorp01\Working_clients_Automated_Exploration Plans



VICINITY MAP

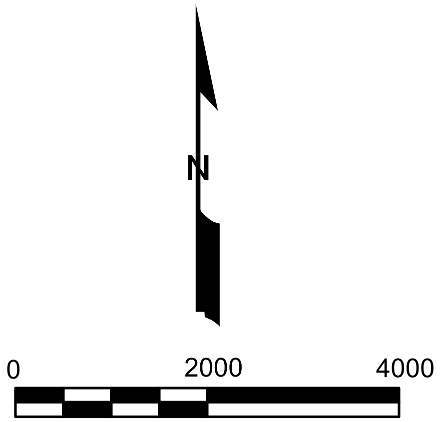
NOT TO SCALE

NOTE:
BASE MAPPING AND VICINITY MAP CREATED FROM LAYERS COMPILED BY ESRI PRODUCTS AND 2021 MICROSOFT CORPORATION.
COORDINATE SYSTEM: NAD 1983 2011 STATEPLANE OHIO NORTH FIPS 3401

LEGEND

⬢ SOIL BORING

▭ APPROXIMATE SITE BOUNDARY



1 " = 2000 SCALE IN FEET

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PROJECT NO.
20220345.001A

DRAWN BY: MAP

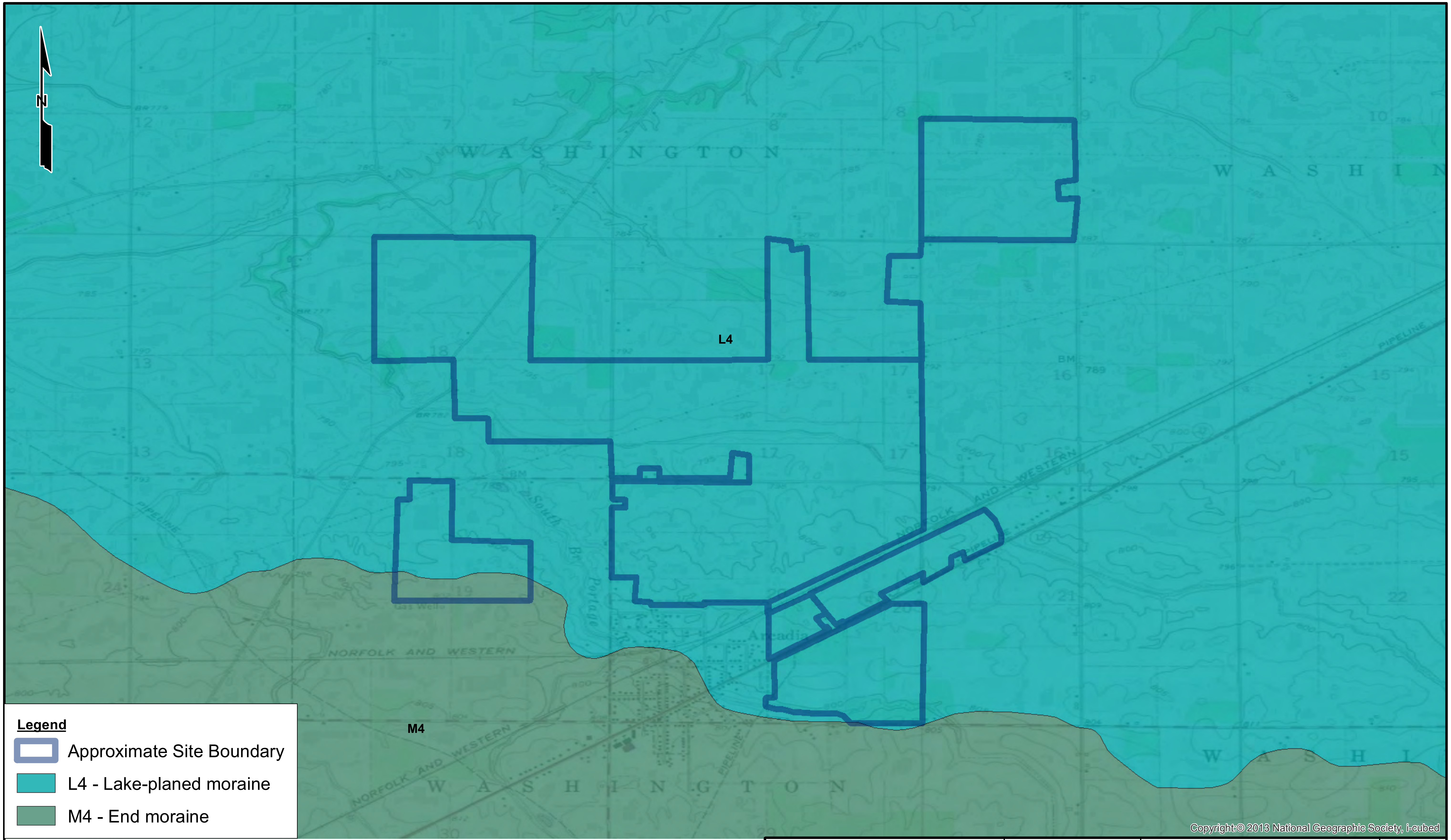
CHECKED BY: JA

DATE: 05-27-2021

EXPLORATION LOCATION PLAN
AND VICINITY MAP

South Branch Solar
Hancock County, Ohio

FIGURE
1



0 1,000 2,000 4,000
Feet

REFERENCE
"Quaternary Geology 500K - Geologic Units"
Published by : Ohio Department of Natural Resources -
Division of Geological Survey

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PROJECT NO.20220345.001A	
DRAWN:	6/4/2021
DRAWN BY:	AL
CHECKED BY:	MM
FILE NAME:	
Figure 2 - Surficial Geology	

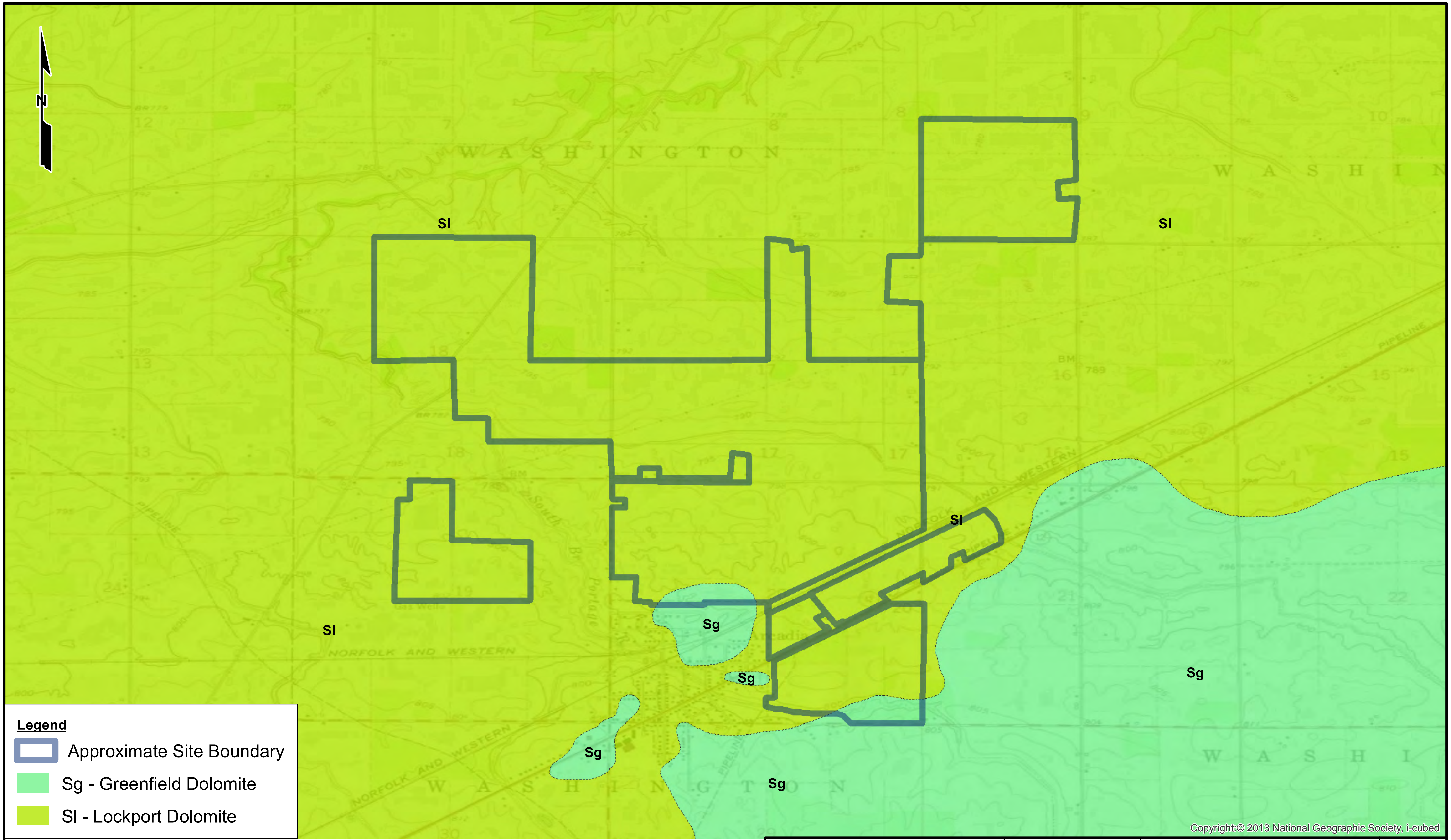
SURFICIAL GEOLOGY MAP

South Branch Solar
Hancock County, Ohio

FIGURE
2

Document Path: \\azrgisstorp01\Working_clients\Leeward Renewable Energy LLC\20220345.001A - Sunset Ridge Solar\MXD\Figure 2 - Surficial Geology.mxd

Document Path: \\azrgisstorp01\Working_clients\Leeward Renewable Energy LLC\20220345.001A - Sunset Ridge Solar\MXD\Figure 3 - Bedrock Geology.mxd



Copyright:© 2013 National Geographic Society, i-cubed

0 1,000 2,000 4,000
Feet

REFERENCE
"Bedrock Geology 24K - Geologic Units"
Published by : Ohio Department of Natural Resources - Division of Geological Survey

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PROJECT NO.20220345.001A
DRAWN: 6/4/2021
DRAWN BY: AL
CHECKED BY: MM
FILE NAME:
Figure 3 - Bedrock Geology

BEDROCK GEOLOGY MAP

South Branch Solar
Hancock County, Ohio

FIGURE
3

APPENDIX A.

SOIL BORING LOGS

SAMPLE/SAMPLER TYPE GRAPHICS

◪ STANDARD PENETRATION SPLIT SPOON SAMPLER (2 in. (50.8 mm.) outer diameter and 1-3/8 in. (34.9 mm.) inner diameter)

GROUND WATER GRAPHICS

- ▽ WATER LEVEL (level where first observed)
- ▼ WATER LEVEL (level after exploration completion)
- ▼ WATER LEVEL (additional levels after exploration)
- ≋ OBSERVED SEEPAGE

NOTES

- The report and graphics key are an integral part of these logs. All data and interpretations in this log are subject to the explanations and limitations stated in the report.
- Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual or differ from those shown.
- No warranty is provided as to the continuity of soil or rock conditions between individual sample locations.
- Logs represent general soil or rock conditions observed at the point of exploration on the date indicated.
- In general, Unified Soil Classification System designations presented on the logs were based on visual classification in the field and were modified where appropriate based on gradation and index property testing.
- Fine grained soils that plot within the hatched area on the Plasticity Chart, and coarse grained soils with between 5% and 12% passing the No. 200 sieve require dual USCS symbols, ie., GW-GM, GP-GM, GW-GC, GP-GC, GC-GM, SW-SM, SP-SM, SW-SC, SP-SC, SC-SM.
- If sampler is not able to be driven at least 6 inches then 50/X indicates number of blows required to drive the identified sampler X inches with a 140 pound hammer falling 30 inches.

ABBREVIATIONS

PID - Photoionization Detector

UNIFIED SOIL CLASSIFICATION SYSTEM (ASTM D 2487)

COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	**GRAVELS** (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVEL WITH <5% FINES	Cu≥4 and 1≤Cc≤3	●	**GW**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			Cu<4 and/ or 1>Cc>3	○	**GP**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH 5% TO 12% FINES	Cu≥4 and 1≤Cc≤3	●▥	**GW-GM**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				●▨	**GW-GC**	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
			Cu<4 and/ or 1>Cc>3	○▥	**GP-GM**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE FINES
				○▨	**GP-GC**	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE CLAY FINES
		GRAVELS WITH > 12% FINES		○▥	**GM**	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
				○▨	**GC**	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
				▨▥	**GC-GM**	CLAYEY GRAVELS, GRAVEL-SAND-CLAY-SILT MIXTURES
	SANDS (Half or more of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH <5% FINES	Cu≥6 and 1≤Cc≤3	⁘	**SW**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			Cu<6 and/ or 1>Cc>3	∴	**SP**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH 5% TO 12% FINES	Cu≥6 and 1≤Cc≤3	⁘▥	**SW-SM**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				⁘▨	**SW-SC**	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
			Cu<6 and/ or 1>Cc>3	∴▥	**SP-SM**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE FINES
				∴▨	**SP-SC**	POORLY GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE CLAY FINES
		SANDS WITH > 12% FINES		∴▥	**SM**	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
				▨	**SC**	CLAYEY SANDS, SAND-GRAVEL-CLAY MIXTURES
				▨▥	**SC-SM**	CLAYEY SANDS, SAND-SILT-CLAY MIXTURES

FINE GRAINED SOILS (Half or more of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid Limit less than 50)	▥	**ML**	INORGANIC SILTS AND VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, SILTS WITH SLIGHT PLASTICITY
		▨	**CL**	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		▨▥	**CL-ML**	INORGANIC CLAYS-SILTS OF LOW PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
		☰	**OL**	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid Limit 50 or greater)	▥	**MH**	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
		▨	**CH**	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
		〰	**OH**	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY

NOTE: USE MATERIAL DESCRIPTION ON THE LOG TO DEFINE A GRAPHIC THAT MAY NOT BE PROVIDED ON THIS LEGEND.

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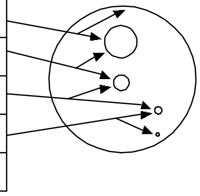
PROJECT NO.: 20220345.001A		GRAPHICS KEY	FIGURE
DRAWN BY:	MAP	South Branch Solar Hancock County, Ohio	A-1
CHECKED BY:	MM		
DATE:	6/1/2021		

GRAIN SIZE

DESCRIPTION		SIEVE SIZE	GRAIN SIZE	APPROXIMATE SIZE
Boulders		>12 in. (304.8 mm.)	>12 in. (304.8 mm.)	Larger than basketball-sized
Cobbles		3 - 12 in. (76.2 - 304.8 mm.)	3 - 12 in. (76.2 - 304.8 mm.)	Fist-sized to basketball-sized
Gravel	coarse	3/4 -3 in. (19 - 76.2 mm.)	3/4 -3 in. (19 - 76.2 mm.)	Thumb-sized to fist-sized
	fine	#4 - 3/4 in. (#4 - 19 mm.)	0.19 - 0.75 in. (4.8 - 19 mm.)	Pea-sized to thumb-sized
Sand	coarse	#10 - #4	0.079 - 0.19 in. (2 - 4.9 mm.)	Rock salt-sized to pea-sized
	medium	#40 - #10	0.017 - 0.079 in. (0.43 - 2 mm.)	Sugar-sized to rock salt-sized
	fine	#200 - #40	0.0029 - 0.017 in. (0.07 - 0.43 mm.)	Flour-sized to sugar-sized
Fines		Passing #200	<0.0029 in. (<0.07 mm.)	Flour-sized and smaller



SECONDARY CONSTITUENT

	AMOUNT	
Term of Use	Secondary Constituent is Fine Grained	Secondary Constituent is Coarse Grained
Trace	<5%	<15%
With	≥5 to <15%	≥15 to <30%
Modifier	≥15%	≥30%

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

CEMENTATION

DESCRIPTION	FIELD TEST
Weakly	Crumbles or breaks with handling or slight finger pressure
Moderately	Crumbles or breaks with considerable finger pressure
Strongly	Will not crumble or break with finger pressure

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT - N_{60} (# blows / ft)	Pocket Pen (tsf)	UNCONFINED COMPRESSIVE STRENGTH (Q_u)(psf)	VISUAL / MANUAL CRITERIA
Very Soft	<2	PP < 0.25	<500	Thumb will penetrate more than 1 inch (25 mm). Extrudes between fingers when squeezed.
Soft	2 - 4	0.25 ≤ PP <0.5	500 - 1000	Thumb will penetrate soil about 1 inch (25 mm). Remolded by light finger pressure.
Medium Stiff	4 - 8	0.5 ≤ PP <1	1000 - 2000	Thumb will penetrate soil about 1/4 inch (6 mm). Remolded by strong finger pressure.
Stiff	8 - 15	1 ≤ PP <2	2000 - 4000	Can be imprinted with considerable pressure from thumb.
Very Stiff	15 - 30	2 ≤ PP <4	4000 - 8000	Thumb will not indent soil but readily indented with thumbnail.
Hard	>30	4 ≤ PP	>8000	Thumbnail will not indent soil.

REACTION WITH HYDROCHLORIC ACID

DESCRIPTION	FIELD TEST
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT-N_{60} (# blows/ft)	MODIFIED CA SAMPLER (# blows/ft)	CALIFORNIA SAMPLER (# blows/ft)	RELATIVE DENSITY (%)
Very Loose	<4	<4	<5	0 - 15
Loose	4 - 10	5 - 12	5 - 15	15 - 35
Medium Dense	10 - 30	12 - 35	15 - 40	35 - 65
Dense	30 - 50	35 - 60	40 - 70	65 - 85
Very Dense	>50	>60	>70	85 - 100

FROM TERZAGHI AND PECK, 1948

PLASTICITY

DESCRIPTION	LL		PI
Non-Plastic	NP	Either the LL or the PI (or both) may be used to describe the soil plasticity. The ranges of numbers shown here do not imply that the LL ranges correlate with the PI ranges for all soils.	NP
Low	< 30		< 15
Medium	30 - 50		15 - 25
High	> 50		> 25

LL is from Casagrande, 1948. PI is from Holtz , 1959.

STRUCTURE

DESCRIPTION	CRITERIA
Stratified	Alternating layers of varying material or color with layers at least 1/4-in. thick, note thickness.
Laminated	Alternating layers of varying material or color with the layer less than 1/4-in. thick, note thickness.
Fissured	Breaks along definite planes of fracture with little resistance to fracturing.
Slickensided	Fracture planes appear polished or glossy, sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness.

ANGULARITY

DESCRIPTION	CRITERIA
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20220345.001A	SOIL DESCRIPTION KEY	FIGURE
	DRAWN BY: MAP CHECKED BY: MM DATE: 6/1/2021	South Branch Solar Hancock County, Ohio	A-2

Date Begin - End:	5/04/2021	**Drilling Company:**	Terra Testing		**BORING LOG B-1**
Logged By:	D. Huntsman	**Drill Crew:**	B. Kirkpatrick		
Hor.-Vert. Datum:	WGS 1984 - Not Available	**Drilling Equipment:**	Acker Rebel	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	55°F Cloudy	**Exploration Diameter:**	6 in. O.D.		

Latitude: 41.14372°
Longitude: -83.48910°
Approximate Ground Surface Elevation (ft.): 780
Surface Condition: Bare Earth

FIELD EXPLORATION							LABORATORY RESULTS							
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			TOPSOIL: Sandy SILT, subrounded, low plasticity to medium plasticity, light brown, moist, medium stiff, homogeneous, with roots		BC=1 2 3 4 PP=2.5	6"								
			Lean CLAY with Sand (CL): medium plasticity, light brown multicolored reddish yellow, moist, stiff, iron oxide staining, trace gravel, subangular		BC=4 4 5 7 PP=2.25	8"	CL	20.5			71	46	27	
775	5													
			- very stiff below 5.5 feet		BC=7 10 13 14 PP=4.5	15"								
					BC=8 10 12 13 PP=4.5	22"	CL	16.4			75	32	15	
			- color gradually changes to gray starting at 9.5 feet to 10 feet											
770	10													
	≈		- light gray below 13.5 feet		BC=14 10 12 16 PP=4.5	16"								
765	15													
			- 1/16 inch fine sand seams spaced about 0.25 ft below 17.5 feet		BC=7 7 8 10 PP=4.5	12"								
760	20													
755	25													

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
≈ Seepage was observed at approximately 14 ft. below ground surface at the end of drilling.

GENERAL NOTES:
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 14.3 ft. below ground surface.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20220345.001A		BORING LOG B-1	BORING
DRAWN BY:	DH	South Branch Solar Hancock County, Ohio	B-1
CHECKED BY:	MM		
DATE:	6/1/2021		PAGE: 1 of 1

BORING LOG B-3

Date Begin - End:	5/04/2021	**Drilling Company:**	Terra Testing
Logged By:	D. Huntsman	**Drill Crew:**	B. Kirkpatrick
Hor.-Vert. Datum:	WGS 1984 - Not Available	**Drilling Equipment:**	Acker Rebel
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger
Weather:	50°F Cloudy	**Exploration Diameter:**	6 in. O.D.

Hammer Type - Drop: 140 lb. Auto - 30 in.

FIELD EXPLORATION

Latitude: 41.13515°
Longitude: -83.52262°
Approximate Ground Surface Elevation (ft.): 785
Surface Condition: Bare Earth

Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		TOPSOIL: Sandy Lean CLAY, subrounded, medium plasticity, light brown, moist, homogeneous											
		Lean CLAY with Sand (CL): medium plasticity, light brown multicolored reddish yellow, moist, stiff, homogeneous, iron oxide staining, trace gravel, subangular	◣	BC=4 3 5 6 PP=3.25	9"								
			◣	BC=7 7 6 8 PP=2.0	10"								
780	5												
		- very stiff at 5.5 feet	◣	BC=8 7 7 11 PP=3.25	8"	CL	21.3			76	39	18	
		- hard below 7.5 feet	◣	BC=15 16 18 18 PP=2.25	22"								
775	10												
			◣	BC=18 27 25 24 PP=4.5	18"								
		- gray, wet, trace gravel, subangular below 14.5 feet											
770	15												
		- light gray, very stiff below 18.8 feet	◣	BC=7 9 13 14 PP=3.75	21"								
765	20												
760	25												

LABORATORY RESULTS

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 5.6 ft. below ground surface.

KLEINFELDER
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PROJECT NO.: 20220345.001A	BORING LOG B-3	BORING	B-3
DRAWN BY: DH	South Branch Solar Hancock County, Ohio		
CHECKED BY: MM			
DATE: 6/1/2021		PAGE: 1 of 1	

Date Begin - End:	5/04/2021	**Drilling Company:**	Terra Testing		**BORING LOG B-4**
Logged By:	D. Huntsman	**Drill Crew:**	B. Kirkpatrick		
Hor.-Vert. Datum:	WGS 1984 - Not Available	**Drilling Equipment:**	Acker Rebel	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	63°F Cloudy	**Exploration Diameter:**	6 in. O.D.		

			FIELD EXPLORATION				LABORATORY RESULTS						
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Latitude: 41.13585° Longitude: -83.50514° Approximate Ground Surface Elevation (ft.): 791 Surface Condition: Crops Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
790			**TOPSOIL**: Silty SAND, subrounded, low plasticity, yellow, moist, homogeneous, with roots **Sandy Lean CLAY (CL)**: low to medium plasticity, light brown multicolored reddish yellow, moist, hard, homogeneous, iron oxide staining, trace gravel, fine to coarse sand, subangular	◣	BC=1 3 4 7 PP=2.25	14"	CL	19.0			63	25	10	
	5			◣	BC=19 22 26 25 PP=4.5	12"								
785				◣	BC=21 22 26 28 PP=3.75	24"								
	10		- very stiff below 7.5 feet	◣	BC=10 12 12 13 PP=4.5	16"	CL	16.0			75	33	17	
780														
	15		- mottled pink-light gray color below 14 feet	◣	BC=13 14 12 11 PP=1.75	14"								
775														
	20			◣	BC=11 14 13 16 PP=2.5	24"								
770														
	25													
765														

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
Estimated crop damage:
Cuttings damage area: 8 ft * 4 ft = 32 sq ft
Track width = 1.7 ft
Track path = 385 ft * 2 tracks
Track area = 1.7 ft * 2 * 385 ft = 1309 sq ft
Total = 1341
FS = 1.2
FS * Total = 1609 sq ft
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 13.5 ft. below ground surface.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20220345.001A	BORING LOG B-4	BORING
	DRAWN BY: DH	South Branch Solar Hancock County, Ohio	B-4
	CHECKED BY: MM		
	DATE: 6/1/2021		PAGE: 1 of 1

BORING LOG B-6

Date Begin - End: 5/04/2021
Logged By: D. Huntsman
Hor.-Vert. Datum: WGS 1984 - Not Available
Plunge: -90 degrees
Weather: 63°F Cloudy
Drilling Company: Terra Testing
Drill Crew: B. Kirkpatrick
Drilling Equipment: Acker Rebel
Drilling Method: Hollow Stem Auger
Exploration Diameter: 6 in. O.D.
Hammer Type - Drop: 140 lb. Auto - 30 in.

Latitude: 41.12833°
Longitude: -83.51578°
Approximate Ground Surface Elevation (ft.): 791
Surface Condition: Crops

		FIELD EXPLORATION					LABORATORY RESULTS							
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
790			**TOPSOIL**: Sandy SILT, subrounded, low plasticity, pink multicolored reddish yellow, moist, stiff, with roots and grass		BC=3 3 5 6 PP=2.75	12"								
			Lean CLAY with Sand (CL): medium plasticity, reddish yellow multicolored pink, moist, stiff, iron oxide staining, trace silt, subangular sand		BC=3 4 4 6 PP=1.25	14"	CL	30.5			72	44	20	
	5													
785			- very stiff below 5.5 feet		BC=8 8 11 12 PP=4.0	14"								
			- hard below 8 feet		BC=12 15 16 20 PP=3.25	24"	CL	19.3			77	35	18	
	10													
780														
			- very stiff below 13 feet - trace gravel below 14 feet - light gray color below 14.9 feet		BC=6 11 12 13 PP=3.75	18"								
	15													
775														
					BC=6 6 7 11 PP=2.25	14"								
	20													
770														
	25													
765														

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
Estimated crop damage:
Track width = 1.7 ft
Track path = 18 ft * 2 tracks = 36 ft
Track area = 36 ft * 1.7 ft = 61.2 sq ft
Cuttings damage = 4 ft * 3 ft = 12 sq ft
Total = 73.2 sq ft
1.2 * total = 87.8 sq ft
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 6.5 ft. below ground surface.

BORING LOG B-8

Date Begin - End: 5/04/2021
Logged By: D. Huntsman
Hor.-Vert. Datum: WGS 1984 - Not Available
Plunge: -90 degrees
Weather: 50°F Cloudy
Drilling Company: Terra Testing
Drill Crew: B. Kirkpatrick
Drilling Equipment: Acker Rebel
Drilling Method: Hollow Stem Auger
Exploration Diameter: 6 in. O.D.
Hammer Type - Drop: 140 lb. Auto - 30 in.

Latitude: 41.12495°
Longitude: -83.49813°
Approximate Ground Surface Elevation (ft.): 795
Surface Condition: Crops

			FIELD EXPLORATION				LABORATORY RESULTS							
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			TOPSOIL: Sandy Lean CLAY with Silt, subangular, low to medium plasticity, light brown, moist, stiff, homogeneous		BC=3 5 5 5 PP=4.0	10"								
			Lean CLAY with Sand (CL): low to medium plasticity, reddish yellow multicolored light gray, moist, very stiff, iron oxide staining, subangular sand		BC=36 35 15 9 PP=1.25	14"								Auger chattering from 2.7 to 3 ft, possible cobble
790	5				BC=4 7 9 6 PP=2.75	12"	CL	22.4			82	42	27	
			- hard, trace gravel, subangular below 8 feet		BC=14 16 19 21 PP=1.75	14"								
785	10													
			- very stiff below 12.5 feet		BC=15 13 12 16 PP=4.5	9"								
780	15		- light gray color below 14.8 feet											
					BC=9 12 11 13 PP=3.0	8"								
775	20													
770	25													

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.
GENERAL NOTES:
Estimated crop damage:
Cuttings damage = 7 ft * 7 ft = 49 sq ft
Track width = 1.7 ft * 2 tracks
Track path = 24 ft
Track damage = 1.7ft * 2 * 24 ft = 81.6 sq ft
Path = 1.5 ft * 25 ft = 37.5 sq ft
Total = 168.1 sq ft
FS = 1.2
FS * Total = 201.7 sq ft
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 14.2 ft. below ground surface.

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PROJECT NO.: 20220345.001A		BORING LOG B-8	BORING
DRAWN BY:	DH	South Branch Solar Hancock County, Ohio	B-8
CHECKED BY:	MM		
DATE:	6/1/2021		PAGE: 1 of 1

BORING LOG B-9

Date Begin - End:	5/04/2021	**Drilling Company:**	Terra Testing		
Logged By:	D. Huntsman	**Drill Crew:**	B. Kirkpatrick		
Hor.-Vert. Datum:	WGS 1984 - Not Available	**Drilling Equipment:**	Acker Rebel	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	45°F Cloudy	**Exploration Diameter:**	6 in. O.D.		

Latitude: 41.12261°
Longitude: -83.52623°
Approximate Ground Surface Elevation (ft.): 794
Surface Condition: Bare Earth

		FIELD EXPLORATION					LABORATORY RESULTS							
Approximate Elevation (feet)	Depth (feet)	Graphical Log	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
			TOPSOIL: Clayey SILT with Sand, low plasticity, light brown, moist, homogeneous		BC=4 3 4 4 PP=2.25	12"								
			Lean CLAY with Sand (CL): low plasticity to medium plasticity, light brown multicolored reddish yellow, moist, stiff, iron oxide staining											
790					BC=4 5 5 8 PP=1.75	12"	CL	25.8			78	39	21	
	5		- hard below 5 feet		BC=9 11 15 16 PP=4.5	14"								
			- pink, subangular sand, homogeneous below 7 feet											
785					BC=9 12 14 19 PP=4.5	20"	CL	16.4			73	38	20	
	10													
780			- light gray color, very stiff below 14 feet		BC=8 11 10 12 PP=1.75	20"								
	15													
775					BC=4 5 9 13 PP=2.75	20"								
	20													
770														
	25													
765														

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 8.7 ft. below ground surface.

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20220345.001A		BORING LOG B-9	BORING
DRAWN BY:	DH	South Branch Solar Hancock County, Ohio	B-9
CHECKED BY:	MM		
DATE:	6/1/2021		PAGE: 1 of 1

Date Begin - End:	5/04/2021	**Drilling Company:**	Terra Testing		**BORING LOG B-10**
Logged By:	D. Huntsman	**Drill Crew:**	B. Kirkpatrick		
Hor.-Vert. Datum:	WGS 1984 - Not Available	**Drilling Equipment:**	Acker Rebel	**Hammer Type - Drop:**	140 lb. Auto - 30 in.
Plunge:	-90 degrees	**Drilling Method:**	Hollow Stem Auger		
Weather:	63°F Cloudy	**Exploration Diameter:**	6 in. O.D.		

Latitude: 41.12251°
Longitude: -83.50755°
Approximate Ground Surface Elevation (ft.): 799
Surface Condition: Bare Earth

		FIELD EXPLORATION				LABORATORY RESULTS							
Approximate Elevation (feet)	Depth (feet)	Lithologic Description	Sample Type	Blow Counts(BC)= Uncorr Blows/6 in. Pocket Pen(PP)= tsf	Recovery (NR=No Recovery)	USCS Symbol	Water Content (%)	Dry Unit Wt. (pcf)	Passing #4 (%)	Passing #200 (%)	Liquid Limit	Plasticity Index (NP=NonPlastic)	Additional Tests/ Remarks
		TOPSOIL: Sandy SILT with Gravel, subrounded, low plasticity, reddish yellow multicolored pink, moist, homogeneous	◣	BC=1 2 3 5 PP=2.0	9"								
795		**Lean CLAY with Sand (CL)**: medium plasticity, light brown multicolored reddish yellow, moist, very stiff, homogeneous, iron oxide staining, trace gravel, subangular	◣	BC=6 12 13 13 PP=4.5	17"								
	5	- hard below 5.5 feet	◣	BC=21 18 23 19 PP=4.5	8"	CL	14.8			71	33	17	
790		- very stiff below 8 feet	◣	BC=17 18 15 15 PP=4.5	15"								
	10	- light gray below 10 feet											
785	15		◣	BC=6 9 9 10 PP=3.25	10"								
780	20		◣	BC=9 12 11 12 PP=2.75	17"								
775	25												
770													

The boring was terminated at approximately 20 ft. below ground surface. The boring was backfilled with auger cuttings on May 04, 2021.

GROUNDWATER LEVEL INFORMATION:
Groundwater was not observed during drilling or after completion.

GENERAL NOTES:
The exploration elevation is approximate and was estimated using Google Earth.
A Garmin GPSMAP64s GPS unit was used to locate the exploration with an accuracy of 5 meters.
Caving was observed at a depth of 13.9 ft. below ground surface.

KLEINFELDER Bright People. Right Solutions.	PROJECT NO.: 20220345.001A	BORING LOG B-10	BORING
	DRAWN BY: DH CHECKED BY: MM DATE: 6/1/2021	South Branch Solar Hancock County, Ohio	B-10 PAGE: 1 of 1

APPENDIX B.

LABORATORY TEST RESULTS: INDEX TESTING

Exploration ID	Depth (ft.)	Sample Description	Water Content (%)	Dry Unit Wt. (pcf)	Sieve Analysis (%)			Atterberg Limits			Additional Tests
					Passing 3/4"	Passing #4	Passing #200	Liquid Limit	Plastic Limit	Plasticity Index	
B-1	3.0	LEAN CLAY WITH SAND (CL)	20.5				71	46	19	27	
B-1	8.0	LEAN CLAY WITH SAND (CL)	16.4				75	32	17	15	
B-3	5.5	LEAN CLAY WITH SAND (CL)	21.3				76	39	21	18	
B-4	0.5	SANDY LEAN CLAY (CL)	19.0				63	25	15	10	
B-4	8.0	LEAN CLAY WITH SAND (CL)	16.0				75	33	16	17	
B-6	3.0	LEAN CLAY WITH SAND (CL)	30.5				72	44	24	20	
B-6	8.0	LEAN CLAY WITH SAND (CL)	19.3				77	35	17	18	
B-8	5.5	LEAN CLAY WITH SAND (CL)	22.4				82	42	15	27	
B-9	3.0	LEAN CLAY WITH SAND (CL)	25.8				78	39	18	21	
B-9	8.0	LEAN CLAY WITH SAND (CL)	16.4				73	38	18	20	
B-10	5.5	LEAN CLAY WITH SAND (CL)	14.8				71	33	16	17	

Refer to the Geotechnical Evaluation Report or the supplemental plates for the method used for the testing performed above.
NP = NonPlastic

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PROJECT NO.:
20220345.001A
DRAWN BY: MAP
CHECKED BY: MM
DATE: 6/1/2021

LABORATORY TEST
RESULT SUMMARY

South Branch Solar
Hancock County, Ohio

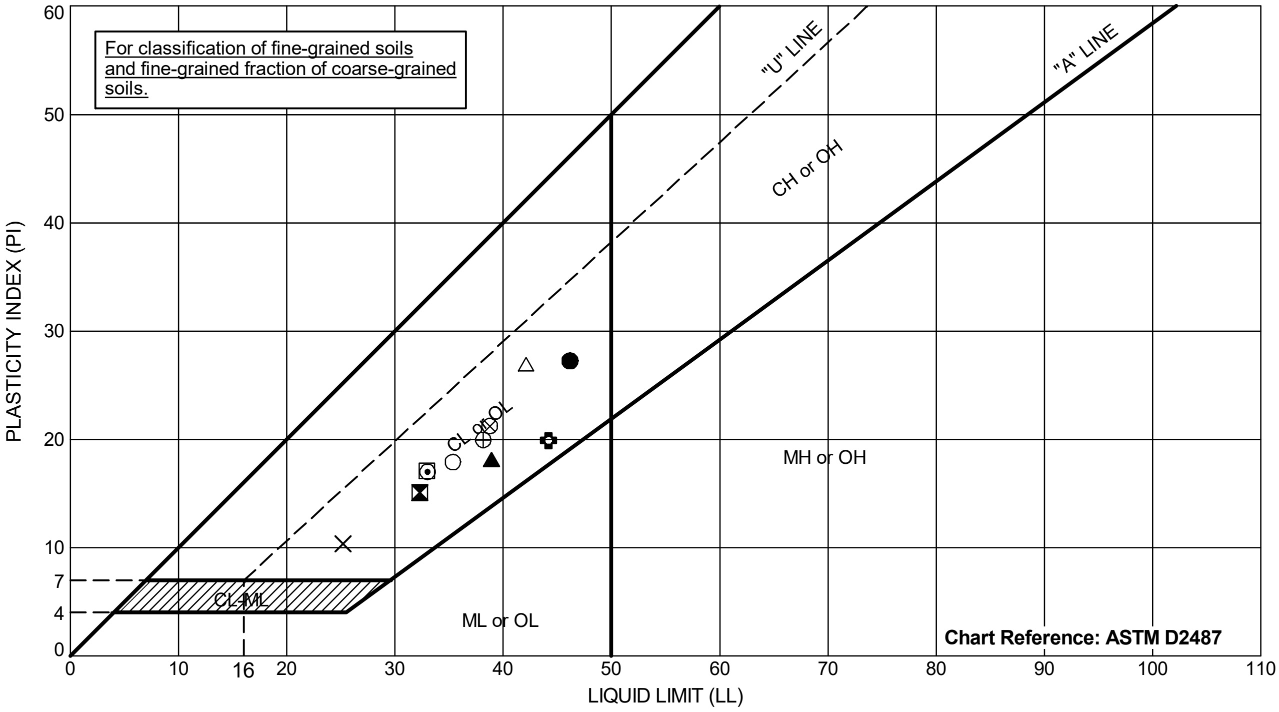
TABLE
B-1

PLOTTED: 06/04/2021 12:54 PM BY: MPalmer

OFFICE FILTER: GOLDEN

PROJECT NUMBER: 20220345.001A

gINT FILE: Klf_gint_master_2022
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2022.GLB [_KLF_ATTERBERG (ASTM)]



	Exploration ID	Depth (ft.)	Sample Description	Passing #200	LL	PL	PI
●	B-1	3	LEAN CLAY with SAND (CL)	71	46	19	27
⧗	B-1	8	LEAN CLAY with SAND (CL)	75	32	17	15
▲	B-3	5.5	LEAN CLAY with SAND (CL)	76	39	21	18
×	B-4	0.5	SANDY LEAN CLAY (CL)	63	25	15	10
⊙	B-4	8	LEAN CLAY with SAND (CL)	75	33	16	17
✿	B-6	3	LEAN CLAY with SAND (CL)	72	44	24	20
○	B-6	8	LEAN CLAY with SAND (CL)	77	35	17	18
△	B-8	5.5	LEAN CLAY with SAND (CL)	82	42	15	27
⊗	B-9	3	LEAN CLAY with SAND (CL)	78	39	18	21
⊕	B-9	8	LEAN CLAY with SAND (CL)	73	38	18	20
□	B-10	5.5	LEAN CLAY with SAND (CL)	71	33	16	17

Testing performed in general accordance with ASTM D4318.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
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PROJECT NO.:
20220345.001A

DRAWN BY: MAP

CHECKED BY: MM

DATE: 6/1/2021

ATTERBERG LIMITS

South Branch Solar
Hancock County, Ohio

FIGURE

B-2

APPENDIX C.
GBA DOCUMENT

Important Information about This

Geotechnical-Engineering Report

Subsurface problems are a principal cause of construction delays, cost overruns, claims, and disputes.

While you cannot eliminate all such risks, you can manage them. The following information is provided to help.

The Geoprofessional Business Association (GBA) has prepared this advisory to help you – assumedly a client representative – interpret and apply this geotechnical-engineering report as effectively as possible. In that way, clients can benefit from a lowered exposure to the subsurface problems that, for decades, have been a principal cause of construction delays, cost overruns, claims, and disputes. If you have questions or want more information about any of the issues discussed below, contact your GBA-member geotechnical engineer. Active involvement in the Geoprofessional Business Association exposes geotechnical engineers to a wide array of risk-confrontation techniques that can be of genuine benefit for everyone involved with a construction project.

Geotechnical-Engineering Services Are Performed for Specific Purposes, Persons, and Project

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical-engineering study conducted for a given civil engineer will not likely meet the needs of a civil-works constructor or even a different civil engineer. Because each geotechnical-engineering study is unique, each geotechnical-engineering report is unique, prepared *solely* for the client. *Those who rely on a geotechnical-engineering report prepared for a different client can be seriously misled.* No one except authorized client representatives should rely on this geotechnical-engineering report without first conferring with the geotechnical engineer who prepared it. *And no one – not even you – should apply this report for any purpose or project except the one originally contemplated.*

Read this Report in Full

Costly problems have occurred because those relying on a geotechnical-engineering report did not read it *in its entirety*. Do not rely on an executive summary. Do not read selected elements only. *Read this report in full.*

You Need to Inform Your Geotechnical Engineer about Change

Your geotechnical engineer considered unique, project-specific factors when designing the study behind this report and developing the confirmation-dependent recommendations the report conveys. A few typical factors include:

- the client's goals, objectives, budget, schedule, and risk-management preferences;
- the general nature of the structure involved, its size, configuration, and performance criteria;
- the structure's location and orientation on the site; and
- other planned or existing site improvements, such as retaining walls, access roads, parking lots, and underground utilities.

Typical changes that could erode the reliability of this report include those that affect:

- the site's size or shape;
- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light-industrial plant to a refrigerated warehouse;
- the elevation, configuration, location, orientation, or weight of the proposed structure;
- the composition of the design team; or
- project ownership.

As a general rule, *always* inform your geotechnical engineer of project changes – even minor ones – and request an assessment of their impact. *The geotechnical engineer who prepared this report cannot accept responsibility or liability for problems that arise because the geotechnical engineer was not informed about developments the engineer otherwise would have considered.*

This Report May Not Be Reliable

Do not rely on this report if your geotechnical engineer prepared it:

- for a different client;
- for a different project;
- for a different site (that may or may not include all or a portion of the original site); or
- before important events occurred at the site or adjacent to it; e.g., man-made events like construction or environmental remediation, or natural events like floods, droughts, earthquakes, or groundwater fluctuations.

Note, too, that it could be unwise to rely on a geotechnical-engineering report whose reliability may have been affected by the passage of time, because of factors like changed subsurface conditions; new or modified codes, standards, or regulations; or new techniques or tools. *If your geotechnical engineer has not indicated an "apply-by" date on the report, ask what it should be*, and, in general, *if you are the least bit uncertain* about the continued reliability of this report, contact your geotechnical engineer before applying it. A minor amount of additional testing or analysis – if any is required at all – could prevent major problems.

Most of the "Findings" Related in This Report Are Professional Opinions

Before construction begins, geotechnical engineers explore a site's subsurface through various sampling and testing procedures. *Geotechnical engineers can observe actual subsurface conditions only at those specific locations where sampling and testing were performed.* The data derived from that sampling and testing were reviewed by your geotechnical engineer, who then applied professional judgment to form opinions about subsurface conditions throughout the site. Actual sitewide-subsurface conditions may differ – maybe significantly – from those indicated in this report. Confront that risk by retaining your geotechnical engineer to serve on the design team from project start to project finish, so the individual can provide informed guidance quickly, whenever needed.

This Report's Recommendations Are Confirmation-Dependen

The recommendations included in this report – including any options or alternatives – are confirmation-dependent. In other words, *they are not final*, because the geotechnical engineer who developed them relied heavily on judgment and opinion to do so. Your geotechnical engineer can finalize the recommendations *only after observing actual subsurface conditions* revealed during construction. If through observation your geotechnical engineer confirms that the conditions assumed to exist actually do exist, the recommendations can be relied upon, assuming no other changes have occurred. *The geotechnical engineer who prepared this report cannot assume responsibility or liability for confirmation-dependent recommendations if you fail to retain that engineer to perform construction observation.*

This Report Could Be Misinterpreted

Other design professionals' misinterpretation of geotechnical-engineering reports has resulted in costly problems. Confront that risk by having your geotechnical engineer serve as a full-time member of the design team, to:

- confer with other design-team members,
- help develop specifications,
- review pertinent elements of other design professionals' plans and specifications, and
- be on hand quickly whenever geotechnical-engineering guidance is needed.

You should also confront the risk of constructors misinterpreting this report. Do so by retaining your geotechnical engineer to participate in prebid and preconstruction conferences and to perform construction observation.

Give Constructors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can shift unanticipated-subsurface-conditions liability to constructors by limiting the information they provide for bid preparation. To help prevent the costly, contentious problems this practice has caused, include the complete geotechnical-engineering report, along with any attachments or appendices, with your contract documents, *but be certain to note conspicuously that you've included the material for informational purposes only*. To avoid misunderstanding, you may also want to note that "informational purposes" means constructors have no right to rely on the interpretations, opinions, conclusions, or recommendations in the report, but they may rely on the factual data relative to the specific times, locations, and depths/elevations referenced. Be certain that constructors know they may learn about specific project requirements, including options selected from the report, *only* from the design drawings and specifications. Remind constructors that they may perform their own studies if they want to, and *be sure to allow enough time* to permit them to do so. Only then might you be in a position to give constructors the information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions. Conducting prebid and preconstruction conferences can also be valuable in this respect.

Read Responsibility Provisions Closely

Some client representatives, design professionals, and constructors do not realize that geotechnical engineering is far less exact than other engineering disciplines. That lack of understanding has nurtured unrealistic expectations that have resulted in disappointments, delays, cost overruns, claims, and disputes. To confront that risk, geotechnical engineers commonly include explanatory provisions in their reports. Sometimes labeled "limitations," many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. *Read these provisions closely*. Ask questions. Your geotechnical engineer should respond fully and frankly.

Geoenvironmental Concerns Are Not Covered

The personnel, equipment, and techniques used to perform an environmental study – e.g., a "phase-one" or "phase-two" environmental site assessment – differ significantly from those used to perform a geotechnical-engineering study. For that reason, a geotechnical-engineering report does not usually relate any environmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. *Unanticipated subsurface environmental problems have led to project failures*. If you have not yet obtained your own environmental information, ask your geotechnical consultant for risk-management guidance. As a general rule, *do not rely on an environmental report prepared for a different client, site, or project, or that is more than six months old.*

Obtain Professional Assistance to Deal with Moisture Infiltration and Mol

While your geotechnical engineer may have addressed groundwater, water infiltration, or similar issues in this report, none of the engineer's services were designed, conducted, or intended to prevent uncontrolled migration of moisture – including water vapor – from the soil through building slabs and walls and into the building interior, where it can cause mold growth and material-performance deficiencies. Accordingly, ***proper implementation of the geotechnical engineer's recommendations will not of itself be sufficient to prevent moisture infiltration.*** Confront the risk of moisture infiltration by including building-envelope or mold specialists on the design team. ***Geotechnical engineers are not building-envelope or mold specialists.***

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APPENDIX D

VEGETATION MANAGEMENT PLAN

south branch solar

Vegetation Management Plan

South Branch Solar
Hancock County, Ohio

July 2021

Table of Contents

Attachments

1 – South Branch Solar Seed Mixes

2 – Preliminary Ohio Pollinator Habitat Initiative Assessment Form

3 – Ohio Invasive Plant Species

4 – Prohibited Invasive Weeds

1. Goals and Objectives

South Branch Solar, LLC (South Branch) is proposing an up to 205-megawatt solar energy facility, South Branch Solar (the Project), on approximately 1,000 acres within Washington Township, Hancock County, Ohio (the Project Area). This Vegetation Management Plan (the Plan) is developed to guide site preparation, vegetation installation, and long-term management of overall new Project, both within and outside of the Project fence line. The vegetation success will be achieved through Best Management Practices, including proper initial installation, management of invasive species and noxious weeds, and the control of erosion and sedimentation.

This Plan has been developed to ensure establishment and maintenance of stable vegetative cover that facilitates efficient Project operation, provides ecological benefits, stabilizes soils, reduces stormwater runoff through conversion of row crops to meadow, and complies with applicable regulations and required permits.

The revegetation and mitigation strategy developed for the Project restores and maintains ecological function to the Project Area subsequent to construction. The seed mixes specified in Attachment 1 are selected for their capability in supporting pollinator habitat, increasing species diversity, and provide visual mitigation. Ohio Pollinator Habitat Initiative (OPHI) guidelines to establish pollinator habitat were used to develop vegetation schemes. See Attachment 2 for a preliminary suitability rating of the Project's vegetation plan using the Ohio Solar Site Pollinator Habitat Planning and Assessment Form; this will be updated based on the Project's final design.

Site conditions affecting vegetation cultivation are variable. The Plan is intended to be a dynamic document that will be evaluated and updated in response to changing environmental conditions. Initial installation of vegetation is envisioned to be completed by the Project's construction contractor (the Contractor), in accordance with this Plan, South Branch approvals, and other regulatory requirements.

2. Vegetation/Seed Installation

The primary revegetation method to be used for the Project is seeding. Additionally, in selected locations, trees, and shrubs will be installed for visual screening and ecological buffer restoration. The Project Area will be revegetated following the installation of all solar panels and associated infrastructure. Objectives for plant species selection, establishment, and maintenance include:

- Maintain at least 80% vegetation cover of the species seeded and planted;
- Improve species diversity by installing and encouraging the development of native plant species;
- Minimize the presence of common noxious weed and invasive plant species; and
- Meet Project operational criteria regarding limitation of mature vegetation height that would cause undue shading effect.

2.1 VEGETATION/SEED MIX SELECTION

Species selection for Project Area revegetation was based on an evaluation of available state, regional, and local resources, as well as an inventory of natural and physical resources. Resources also used to guide species selection alternatives included Ohio Eco-Region mapping, the OPHI, Natural Resources Conservation Service (NRCS) soil survey data, topographic survey mapping, geographic information system (GIS) mapping, and U.S. Fish and Wildlife Service National Wetlands Inventory (NWI) mapping.

2.1.1 Vegetation/Seed Mix Type

The proposed vegetation establishment method is seeding. The seed mix to be utilized will be compatible for use within the solar panel arrays and all operational areas of the Project Area. Any proposed modifications or exceptions to the recommended seed mix shall be submitted by the Contractor in writing to South Branch. All exceptions must be authorized in writing in accordance with Plan procedures and prior to installation.

2.1.2 Seed Source and Certification

Sourcing of all native and/or beneficial seed will be local; a reasonable effort should be made to procure seed stock of regionally local genetic provenance. Species shall be true to scientific name and in accordance with specified purity and germination requirements. The installer must provide seed manufacturer or supplier certification tags complying with state agriculture department labeling requirements. The installer must submit seed certification tags and seed manufacturer's state agriculture department growers' certification to South Branch for review.

2.2 SOIL TESTING AND EVALUATION

Soils will be tested prior to seeding by a certified lab to determine nutrient levels and soil chemistry, and to produce cultural recommendations for the establishment of naturalized vegetation.

It is anticipated that construction will result in some degree of soil compaction within the Project Area. Following the completion of construction, in-place soil compaction measurements will be performed to assess the extent of soil density in areas designated for revegetation and to determine best practices for soil decompaction.

2.2 SEED INSTALLATION

2.2.1 Installation Schedule

Seed installation timing is dependent on the completion of construction in any given area. If construction is completed in the spring, allow for seeding during the time the soil is frost-free and workable, generally April 15 through June 15. For spring or fall seeding, apply seed at the specified rate for the seed mix per acre of pure live seed (PLS) with an added 20 to 30 pounds per acre of seasonally appropriate cereal grain or cover crop. Fall seeding period is September 1 through October 15. Dormant fall seeding may also be used when construction is completed outside of the optimal fall seeding schedule. Dormant seeding rates are increased for both the native and/or beneficial seed mix and the cover crop. Dormant seeding rate is double the standard application rate and may be modified to suit the seed mix. Re-seeding of mix and/or appropriate cover crop the following spring may be necessary to assure successful germination and establishment.

2.2.2 Soil Preparation

Soil decompaction, if found to be necessary, will be tailored to soil texture, soil moisture level, seasonal period, and specific site considerations such as avoidance of underground cables and utilities.

Decompaction will be planned in coordination with vegetation establishment and management requirements. Decompaction efforts will limit surface soil disturbance, avoid damage to or homogenization of soil structure, and will be performed without causing further soil compaction.

Prior to seeding, surface soil will be scarified, as necessary, to incorporate a portion of the surface vegetation into the soil and to level uneven surfaces. The desired result is to roughen the soil surface to enhance soil contact with the seed without disturbing soil structure or enhancing germination of existing weed seeds in the soil. If seed will be installed through existing vegetation, that vegetation must be mown to the level of the root crown, assessed to determine a weed pressure rating, and potentially treated multiple times with an herbicide two to three months before seeding operation.

2.2.3 Seeding

Seeding will be accomplished using a calibrated mechanical seed drill or broadcast seeding equipment capable of metering seed of various size and weight. Hydroseed methods will not be used for native or naturalized-type seed mixes. A bulking agent may be used, as needed, to create an even flow of seed. If broadcast seeding is used, light raking or rolling of the installed seed bed may be needed to ensure good soil-seed contact.

2.3 INSTALLATION OF VEGETATIVE BUFFERS

Trees and shrubs will be installed for the purpose of visually screening the Project Area and restoring ecological buffers. These materials will be planted in accordance with the Project's Landscape and Lighting Plan.

2.3.1 Tree and Shrub Planting

Proper establishment is critical to attaining the survival and long-term health of the vegetative buffers. At the time of installation, all underground utilities will be marked prior to digging in order to assure safe installation and determine any areas where the presence of underground utilities may impact the intended landscape buffering layout.

Trees and shrubs (collectively referred to as trees) will be planted during the fall season or in the cycle of dormancy. For deciduous species, this period occurs between leaf drop in fall and bud break in spring. In the case of conifers and broadleaf evergreen species, trees will be installed during the optimal planting period, early spring or early fall. In preparing for planting, each tree pit will be sized a minimum of 2.5 times the size of the root ball, but no deeper than the original planting depth; trunk flare will be visible at finished grade. To prevent unnecessary stress and damage to the trees, installers will be directed to maneuver the tree by the root ball or container only, and never by the trunk. The root ball will be placed in the tree pit on undisturbed soil and installed plumb or straight from all viewpoints. The tree pit will be backfilled with native soil and amended as needed based on soil testing. Soil backfill will be applied gradually and watered in to remove air pockets. Tree staking will be used when the planting location is exposed to high winds, for evergreen trees, or to support bare-root trees. Stakes are only beneficial for a short period of time and will be removed the following growing season, after one calendar year has elapsed.

At the time of planting, the surface of the planting pit disturbed area will be mulched immediately in order to retain moisture and insulate tree roots from extreme temperatures. Acceptable mulch material may be leaf litter, clean straw, shredded bark, compost or -well composted wood chips, spread evenly to a maximum depth of 3 inches. Mulching will be avoided within 3 inches of the root flare and piling mulch against the trunk or lower branches into a cone-shape will be avoided, as these practices can cause decreased soil-gas exchange, bark tissue damage, and harbor pests and disease. Soil disturbance within the planting area that does not receive mulch will be seeded with the buffer seed mix. Over time, native herbaceous vegetation growth will cover the mulched tree pits.

Watering is necessary at planting time and during the establishment period to ensure survival and improve growth rates. Immediately following planting, trees will be irrigated with 2 to 3 gallons of water per inch of caliper diameter, as measured from a height of approximately 6 inches from the ground, above the root flare. Water will be applied to the mulched areas over the root ball. Slow-release watering bags or temporary drip-irrigation systems may be used during the establishment period. During the first month following installation, trees should receive the equivalent of one inch of rain per week by natural precipitation or by artificial irrigation.

During the first year or establishment period, new trees may require up to 30 gallons, and shrubs up to 10 gallons, of total water per week. Supplemental watering may also be required during prolonged periods of heat or drought conditions. Watering schedules will be adjusted to account for current environmental conditions, such as recent rainfall, humidity, high winds, and cloud cover. Watering will occur early in the morning or after sundown to limit evaporation, sun scorch, and transplant shock.

2.3.2 Establishment Pruning

Pruning will be performed only to remove faults, such as dead, diseased or damaged branches, or to improve structure where the interest of public safety is affected.

3. Vegetation Management

Vegetation management is meant to evolve with vegetation maturation. Initial management will be more intensive in order to assure development and establishment of the preferred vegetation community. Subsequent management will focus on vegetation community maintenance, with regular inspection and evaluation. The following section outlines the proposed cycle of vegetation management for vegetation within the Project Area.

3.1 VEGETATION ASSESSMENT CRITERIA

Criteria used to describe the essential vegetation conditions include absolute cover and relative cover of species seeded and planted. Absolute cover describes the percentage of total vegetation coverage of the ground surface by any plant species, based on visual assessment within sample plots. Relative cover is the percentage of seeded and planted species' coverage relative to all species within the same plot. Essential vegetation coverage goals are discussed in Section 4.1. At full establishment, the coverage requirement for essential vegetation is 95%.

3.2 ESTABLISHMENT PERIOD

Initial vegetation management is critical in establishing the desired plant community. Properly establishing vegetation within the Project Area will reduce the future intensity of management needed to maintain the community and keep invasive species at bay.

3.2.1 Early Establishment Period – Installation through Year 1

The primary goals of the early establishment period are to cultivate healthy vegetation coverage and to limit weed growth or weed migration within the Project Area. Once the designated seed cover crop and/or seed mix has germinated, periodic monitoring combined with mowing and proactive weed control methods will be used to support successful establishment of desired plants. Monitoring will be performed to identify and document where the removal of undesirable plants is needed and to evaluate where reseeding may be used to improve desirable species coverage. Methods used for controlling weeds, undesirable species growth, and undesirable migration during the establishment period will include mowing and targeted herbicide use, per manufacturer instructions and in compliance with Ohio Environmental Protection Agency (Ohio EPA) regulations. Successful practices will be monitored and documented for use in guiding management operations during and following the establishment period. This documentation will support future refinement of the Plan.

Mowing timing and frequency will be guided by environmental factors, such as temperatures and rainfall amounts, and ground cover growth rates. However, the first mowing will take place before April 15, to prevent ground-nesting birds from using areas likely to be mowed. The first mowing is used to provide initial weed suppression and will be scheduled prior to new vegetation seed production. This initial mowing will be performed to a height of 6 inches to 8 inches by a flail-type mower to mulch and retain vegetation debris. Vegetation may be removed as needed after cutting to prevent excessive buildup of thatch in selective areas where debris build-up may suppress plant establishment. Mowing practices will be prescribed as supported by establishment period monitoring. In the first growing season, a second mowing will be required in the fall, after native and/or beneficial plants have finished blooming. Mowing will be performed to a height of 6 inches. Specialized mowing equipment will be used in array areas and similar limited spaces that are inaccessible to reach with standard large-scale mowing equipment. Equipment types may include closed- and side- or front-mount mowing decks, low-profile zero-turn mowers, and fully automated utility-scale autonomous mowing systems. Mowing equipment will be cleaned prior to and between uses to prevent the spread of undesirable seeds. Mowing and herbicide use may be employed more frequently during the first year to control undesirable plants.

3.2.2 Continued Establishment Period – Year 1 through Year 2

The goals of the continued establishment period are to cultivate a mature stand of vegetation that meets the seed mix species diversity to minimize weed competition. Continued periodic monitoring will guide maintenance practices and control measures. During the second growing season (April) if possible, the Project Area will be mowed to a minimum height of 6 inches to cut back previous season's growth and to stimulate new growth for preferred species. Four weeks after initial mowing, the Project Area will be evaluated to identify and document species for removal, identify bare areas in need of reseeding, and species diversity development.

Areas of dense undesirable vegetation found to cover a substantial portion of the surface area of the new vegetation stand will be mown very short, to a height of 4 inches or less.

Vegetation management practices will become more targeted and precise during this period in order to support maturing vegetation and to significantly reduce weed and invasive species occurrences. Reseeding will be provided in bare ground areas and in sparse plant coverage areas to promote vegetation establishment.

Reseeding will be performed within the spring or fall seeding periods, as listed in Section 2.2. Bare ground areas will be lightly raked to remove thatch build up, overseeded by broadcast methods, and lightly tamped, raked or rolled to ensure seed contact with soil. Seeded areas will be mulched with straw, meadow-hay cut from the Project Area or a biodegradable blanket to retain moisture on the soil surface and to facilitate germination.

Noxious weeds or invasive species found to persist after mowing will be spot treated with herbicide. Protective measures should be taken to prevent herbicide from drifting onto desired plants.

3.2.3 Post Establishment Period – Year 3 and Long-Term Maintenance

By Year 3 it is anticipated that vegetation will be well established with spot mowing and herbicide treatment used for control of noxious weeds or invasive species. Mowing will likely occur at least twice per year, typically in early spring and late fall. Periodic monitoring and evaluation will continue as a basis for guiding maintenance practices and for future modifications to the Plan.

3.3 CONTROLLING INVASIVE SPECIES

South Branch will take steps to prevent establishment and/or further propagation of noxious weeds identified in Ohio Administrative Code Chapter 901:5-37 during implementation of any pollinator-friendly plantings. Management of invasive species will be responsive to changing conditions within the Project Area. Monitoring once per month during the growing season

(April-September) while vegetation is in the establishment phase (first two years) will be conducted to inform further maintenance practice, scheduling of maintenance, and appropriate mowing or herbicide specifications. The presence of weeds is expected to diminish as the Project Area vegetation becomes established, but persistent noxious weeds and invasive species may require spot-treatment with herbicides in addition to mowing, to control spreading.

A record will be kept of weeds or invasive plants treated, location within the Project Area treated with herbicide, the method and amount of product used, and the dates of application. Herbicide and pesticide use must be performed by qualified, commercially licensed contractors in compliance with state requirements governing use, distribution, and record-keeping for all phases of vegetation management. This will allow the Contractor and/or South Branch to evaluate the success of treatment and improve effectiveness of future applications.

3.4 CONTROLLING COMPETING NATIVE VEGETATION

Seeds and root stock from many different species exist within the Project Area soil. Other species can also migrate into the Project Area via seed dispersed by wind, animals, water flow or by vegetative runners. Undesired vegetation should be removed via mowing, herbicide treatment or hand pulling. A qualified contractor must be engaged to perform selective species control and removal work. Minimum contractor qualifications must include documented experience of similar work and trade- or professional-certifications specific to plant and vegetation management science.

3.5 CONTROLLING OF WOODY GROWTH

Woody vegetation is generally capable of growing to heights that can create shade, which will not only interfere with the function of the solar panels, but also shade out the desired plant community. Except where established for screening purposes, woody vegetation will be removed, and herbicide(s) applied.

Where trunk size exceeds 0.5 inch in diameter, trunks will be cut 1 inch from grade and the stump will be treated with a systemic herbicide basal application.

3.6 ONGOING MAINTENANCE STANDARDS AND PRACTICES

Project vegetation will continue to require annual evaluation after establishment of desired vegetation is complete. To maintain the desired herbaceous vegetation community, the Project Area must be managed regularly.

Mowing will be performed as needed to prevent shading of panels and provide access to the Project and related infrastructure. The first mowing will likely take place before April 15, when most birds are expected to nest, to prevent nesting birds from using areas likely to be mowed. At a minimum, unless conditions require otherwise, mowing will occur every other year in late fall or early spring. Mulching-type mow equipment will be used to limit thatch buildup that is detrimental to plant growth. Mulcher-shredder machines may be employed, on a less frequent schedule, to periodically cut, collect, and remove excess plant debris. These operations will be performed in late winter or early spring to allow recently dropped seeds to germinate more readily.

The mowing schedule will be cycled so the entire Project Area will not be mowed at one time, to maintain general flora and fauna habitat, and specifically to support high-quality pollinator habitat, according to the Ohio Department of Transportation's Statewide Roadside Pollinator Habitat Program Restoration Guidelines and Best Management Practices. Mowing will be staggered by a minimum of two weeks and limited to one-quarter or one-half of the Project Area in order to leave vegetation standing for pollinator food and shelter during the growing season.

3.7 ALTERNATIVE MAINTENANCE STRATEGIES: GRAZING

Grazing may be utilized as an alternative management technique to limit the occurrence of undesirable woody and herbaceous plants, noxious weeds, and invasive species. While grazing is best utilized in grass-dominant forage areas, it can also assist with spot control of areas where undesirable species are dominating the landscape. Sheep are the preferred grazing livestock. Regardless of the livestock used, grazing management will require a detailed plan, including paddock layout plans, and routine observation and documentation.

Areas for grazing should be identified and mapped and should not occur where livestock will have access to a natural water feature or where the ground is perpetually wet and susceptible to erosion from trampling. Grazing should not occur on steep sites for similar concerns of eroding soils and exposing the bare ground to invasive or undesirable seed. The area selected will be divided into grazing units (an area of land that will support grazing animals for the forage season). According to the United States Department of Agricultural (USDA)-NRCS – Grazing Management Plan, each unit shall be fenced into four equal parts, preferably as close to square as possible to encourage even foraging. These parts will provide grazing rotation for one unit, with each of the four areas being grazed for one week in the 4-week rotation.

Each unit would require a water source. These sources should be mobile and provided towards the center of the paddock so as not to cause focused wear and die back around the trough, that would allow weeds to establish in bare areas in the site. Providing water every 600-800 feet encourages animals to keep moving instead of loitering around a single water source. If water cannot be provided towards the center of a paddock it should be located at the center of the fence line.

Typically, grazing should not begin until vegetation has reached a minimum of 10 inches in height and should occur before vegetation reaches 18 inches in height. Livestock should be removed when vegetation reaches a uniform height of 6 inches. Assessment should be made at the end of each grazing week to determine if this uniformity is met or if additional mowing or grazing will be required to meet maintenance goals. If herbicides are needed to control an invasive infestation it should be timed appropriately as to not cause harm to the grazers. At the end of the grazing season, time should be allotted after last grazing and before killing frost to allow plants time for regrowth and vigor. Throughout the grazing season the response of vegetation to grazing should be documented and strategies adjusted to meet goals of the management plan.

3.8 MAINTENANCE FOR VISUAL MITIGATION VEGETATION

In addition to proper maintenance within the Project Area fence lines, maintenance will also be required for plant materials installed for the purpose of visual mitigation along the periphery of the array. Herbaceous vegetation will be managed similarly to the array areas inside fence line. Woody vegetation, trees, and shrubs will require an independent maintenance schedule to ensure that the plantings become established and reach their intended size and form to meet the screening requirements.

3.8.1 Monitoring for Pests and Disease

Seasonally, plant materials will be inspected for physical damage, insect infestation, fungus or disease. Treatment plans will extend through the growing season. If pests or disease are observed to be present, a certified arborist will be engaged as necessary to develop a strategy to restore the health of the tree. Adjacent vegetation will be monitored throughout treatment to ensure the identified problem is contained.

Documentation will be kept of all treatments administered, including strategy, timing, and follow up needs. Replacement plantings for dead trees and shrubs will be made during the next growing season or the period optimal to each species to enhance survival. Diseased or damaged trees and shrubs will be evaluated and treated to alleviate the identified problem or removed and replaced when treatment is not a viable option.

3.8.2 Fertilization, Pruning, and Replacement Protocol

Continued monitoring and maintenance will improve the longevity of the plant materials and allow proper establishment of the natural vegetative buffers. Following the first year, fertilization will be conducted twice annually for two years with a slow-release fertilizer applied to the mulch area over the root ball. Regular pruning will be used to manage tree health, develop structure, reduce risk, and provide clearance to structures.

Pruning for form will be consistent with each species’ natural growth habit and be performed on an as-needed basis under the direction of a certified arborist. Trees with greater than 50% crown die-back will be evaluated for removal and replacement. When replacing trees or shrubs, they will be replaced with the same or functionally similar species of the same caliper and size as initially installed in order to maintain the effectiveness of the visual screening.

4. Vegetation Quality Targets

Evaluation is an important step in vegetation maintenance. Since each planting area has a unique ecology and each plant species has different requirements, it is important to review and document which species are thriving, or even dominating, and which are not. Evaluation also identifies which prescribed maintenance techniques have been most successful. Ongoing evaluation will help inform future management and assure a diverse, desirable plant community.

4.1 BASIS AND GOALS FOR VEGETATION COVERAGE

The scheduled target for the installation contractor is to have 80% vegetation coverage established by the end of the first growing season of the site development construction. In order to comply with Ohio EPA – National Pollutant Discharge Elimination System (NPDES) permit requirements and the project stormwater pollution prevention plan (SWP3), all disturbed soil areas must be stabilized with at least 70% uniform perennial (permanent) vegetative coverage to achieve stabilization. Once permanent vegetation is fully established, approximately 36 months post installation, it is anticipated that the site will achieve 95% uniform vegetative cover. With establishment of the desired native and/or beneficial plant community, habitat will be created for local wildlife, pollinators, and other beneficial insects.

4.2 MANAGEMENT GOALS FOR WEEDS, INVASIVE PLANTS, AND INSECTS

Invasive plant and insect species regulated prohibited by the State of Ohio (Attachments 3 and 4) and noxious weeds designated by the USDA NRCS will be controlled by a vigilant management and monitoring plan with the goal of maintaining full eradication status for these species within the Project Area. Invasive and undesirable or weed plant species will be controlled by mowing or herbicide treatment at a frequency sufficient to prevent seed development or vegetative migration. Assessment and treatment of invasive species, including pest and weed infestations, will be administered through an integrated pest management plan developed during the establishment period as informed by successful establishment methods, as an amendment to the Plan. As a secondary goal, preferred plants, beneficial insects, and volunteer plant species that are integral to provide or to support habitat, will be protected. Care will be taken to protect preferred plants and to minimize negative effects on beneficial insects; this may be accomplished by using control methods that are not harmful to desirable plant and insect species.

5. References

Ohio Department of Agriculture:
https://agri.ohio.gov/wps/portal/gov/oda/divisions/plant-health/invasive-pests/invasive-plants

Ohio Laws and Rules: Invasive Species List http://codes.ohio.gov/oac/901%3A5-30

Ohio Laws and Rules: Prohibited Noxious Weeds http://codes.ohio.gov/oac/901%3A5-37

Ohio Department of Transportation:
https://www.davey.com/media/1619374/1_odot_statewide_roadside_pollinator_habitat_restoration_guide.pdf

Ohio Pollinator Habitat Initiative
http://www.ophi.info/home.html

USDA Natural Resource Conservation Service: Ohio
https://www.nrcs.usda.gov/wps/portal/nrcs/oh/home/

USDA Web Soil Survey
https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm

United States Environmental Protection Agency: Level III Ecoregion of Ohio
https://www.epa.gov/eco-research/ecoregion-download-files-state-region-5

US Fish and Wildlife Service: National Wetlands Inventory
https://www.fws.gov/wetlands/data/mapper.html

Xerces Society: https://www.xerces.org/sites/default/files/2018-05/15-025_02_XercesSoc_HabitatInstallGuide_Pennsylvania_ConservationCover327_web.pdf

Attachment 1
South Branch Solar Seed Mixes

Within the Array Areas:

Botanical Name	**Common Name**	**% by Weight**
Bouteloua curtipendula	Side-Oats Grama	29.00
Bouteloua gracilis	Blue Grama	5.00
Bromus kalmii	Prairie Brome	4.00
Elymus trachycaulus	Slender Wheat Grass	6.00
Koeleria macrantha	Junegrass	1.00
Schizachyrum scoparium	Little Bluestem	22.00
Sporobolus compositus	Rough Dropseed	1.00
Sporobolus heterolepis	Prairie Dropseed	1.00
Carex bicknelli	Bicknell's Sedge	1.00
Total Graminoids		**70.00**
Achillea millefolium	Yarrow	0.15
Agastache foeniculum	Anise Hyssop	0.15
Allium stallatum	Prairie Onion	0.50
Amorpha canascens	Leadplant	2.00
Asclepis syriaca	Common Milkweed	1.50
Asclepia tuberosa	Butterfly Milkweed	1.25
Chamaechrista fasciculata	Partridge Pea	6.00
Coreopsis palmata	Prairire Coreopsis	0.15
Dalea candida	White Prairie Clover	4.00
Calea purpurea	Purple Prairie Clover	6.75
Echinacea angustifolia	Narrow-leaved Coneflower	0.25
Helianthis pauciflorus	Stiff Sunflower	0.25
Lezpedeza paitata	Roundhead Lespedeza	1.00
Liatris aspera	Rough Blazing Star	0.25
Penstemon graniflorus	Showy Penstemon	0.50
Potentilla arguta	Prairie Cinquefoil	0.15
Ratibida columnifera	Long-headed Coneflower	1.25
Rudbecki hirta	Black Eyed Susan	1.50
Solidago nemoralis	Gray Goldenrod	0.25
Solidago rigida	Stiff Goldenrod	0.40
Symphyotrichum laeve	Smooth Blue Aster	0.25
Symphyotrichum oolentangiense	Sky Blue Aster	0.60
Tradescantia ohioensis	Ohio Spiderwort	0.15
Verbena stricta	Hoary Vervain	0.50
Zizia aptera	Heart-leaf Golden Alexanders	0.25
Total Forbs		**30.00**
TOTAL		**100.00**

Within Buffer Areas:

Botanical Name	**Common Name**	**% by Weight**
Schizachyrum scoparium	Little Bluestem	39.700
Total Graminoids		**39.70**
Chamaecrista fasciculata	Patridge Pea	10.00
Coreopsis lanceolata	Lanceleaf Coreopsis	8.00
Echinacea purpurea	Purple Coneflower	8.00
Heliopsis helianthoides	Oxeye Sunflower	6.00
Liatris spicata	Marsh Blazing Star	3.00
Penstemon digitalis	Tall White Beardtongue	3.00
Monarda fistulosa	Wild Bergamot	2.60
Geum canadense	White Avens	2.10
Zizia aurea	Golden Alexanders	2.00
Pycanthemum tenuifolium	Narrowleaf Mountainmint	1.60
Asclepis syriaca	Common Milkweed	1.50
Asclepia tuberosa	Butterfly Milkweed	1.50
Agastache foeniculum	Anise Hyssop	1.00
Aster laevis	Smooth Blue Aster	1.00
Aster lateriflorus	Calico Aster	1.00
Lezpedeza paitata	Roundhead Lespedeza	1.00
Senna hebecarpa	Wild Senna	1.00
Tradescantia ohioensis	Ohio Spiderwort	1.00
Penstemon hirsutus	Hairy Beardtongue	0.70
Solidago juncea	Early Goldenrod	0.70
Solidago nemoralis	Gray Goldenrod	0.70
Eupatorium perfoliatum	Boneset	0.50
Rudbeckia fulgida var. fulgida	Orange Coneflower	0.50
Veronia noveboracensis	New York Ironweed	0.50
Scutellaria incana	Hoary Skullcap	0.20
Veronicastrum virginicum	Culver’s Root	0.20
Total Forbs		**60.30**
TOTAL		**100.00**

Attachment 2
Preliminary Ohio Pollinator Habitat Initiative Assessment Form

Ohio Solar Site Pollinator Habitat Planning and Assessment Form

1. Percent of total site planted with native or beneficial introduced flowering plants.

☑ 25-50%	10 points
☐ 51-75%	20 points
☐ 76-100%	30 points

2. Flowering plant diversity in site perimeter & buffer area (species with more than 1% cover).

☐ 9-12 species	5 points
☑ 13-16 species	10 points
☐ 17-20 species	15 points
☐ 20+ species	20 points
☐ Site specific Milkweed included @2,000 pls/ac minimum	10 points

* *If no boxes were selected in questions 1 or 2 then your site does not meet criteria to be considered as an OPHI Solar Pollinator Habitat. However, OPHI can work with you on ways to increase the pollinator score of your site.*

3. Flowering plant seed mixes and plantings to be used.
Native species local to the site are preferred; otherwise species native to Ohio are encouraged.

☑ Includes only native plant species	15 points
☐ Includes native and beneficial introduced plant species	10 points
☐ Includes only beneficial introduced plant species	5 points

4. Flowering plant diversity in rows & under solar array.

☐ 4-6	5 points
☑ 7+	10 points
■ Site specific Milkweed included @2,000 pls/ac minimum	10 points

5. Seasons with at least 3 blooming species. Check all that apply.

☑ Spring *(April – May)*	5 points
☑ Summer *(June – August)*	5 points
☑ Fall *(September – October)*	5 points

6. Available habitat components within ¼ mile of site. Check all that apply.

☑ Native grasses	2 points
☑ Trees and shrubs	2 points
☑ Forest edge habitat	2 points
☐ Cavity nesting sites	2 points
☐ Clean perennial water sources	2 points

7. Planned vegetative buffers adjacent to the solar site. Check all that apply.

☑ Site has planned buffer adjacent to solar site	5 points
☑ Buffer is at least 30 feet wide as measured from array fencing or edge of flower plantings	5 points
☐ Buffer is at least 50 feet wide as measured from array fencing or edge of flower plantings	10 points
☐ Buffer includes flowering Shrubs/trees and other shrubs/trees that provide food for wildlife	5 points

8. Habitat site preparation prior to implementation.

☑ Measures taken to control weeds and invasive species prior to seeding/planting.	10 points
☑ Appropriate soil preparation done to reduce erosion And enhance germination/growth	5 points
☐ None	-10 points

9. Planned management practices for areas designated as part of the pollinator habitat site. Check all that apply.

☑ Detailed establishment and management plan developed for site	10 points
☐ Mowing follows OPHI mowing schedule for monarchs each year	5 points
☐ Mowing is staggered over a 2 week period	5 points
☐ Signage indicating site is wildlife & pollinator-friendly	5 points
☐ Creation of habitat features (e.g., boxes, pass-through tunnels, bee hotels)	5 points
☐ Long-term monitoring plan developed that includes re-certification as Solar Site Pollinator Habitat	10 points

10. Insecticide risk. Check if applicable.
Communication with adjacent landowners about the project and possible impacts of their insecticide use is critical

☑ Site is adjacent to land (within 120 ft.) where insecticides are used	-20 points
☐ Planned on-site insecticide use (including pre-treated seeds/plants	-40 points

Total Points: 81

Provides High Quality Pollinator Habitat	**>85**
Meets OPHI Solar Pollinator Habitat Standards	**70-84**

Site Owner/Operator: South Branch Solar, LLC

Project Location: Washington Township, OH

Project Size (acres): 1,000

Planned Source of Seeds: to be determined

Planned Seeding Date:

Habitat & Vegetation Consultant:

Refer to www.ophi.info for more information regarding solar pollinator habitat development.

Version 1 - March 2018
Developed by the OPHI Solar Pollinator Program Advisory Team

Attachment 3
Ohio Invasive Plant Species

Identified by Ohio State Administrative Code and effective 2021. For a current list please use the website referenced in Section 5 References, for Ohio Laws and Rules.

- *Ailanthus altissima*, tree-of-heaven
- *Alliaria petiolata*, garlic mustard
- *Berberis vulgaris*, common barberry
- *Butomus umbellatus*, flowering rush
- *Celastrus orbiculatus*, oriental bittersweet
- *Centaurea stoebe* ssp. *Micranthos*, spotted
- knapweed
- *Dipsacus fullonum*, common teasel
- *Dipsacus laciniatus*, cutleaf teasel
- *Egeria densa* Brazilian, elodea
- *Elaeagnus angustifolia*, Russian olive
- *Elaeagnus umbellata*, autumn olive
- *Epilobium hirsutum*; hairy willow herb
- *Frangula alnus*, glossy buckthorn
- *Heracleum mantegazzianum*, giant hogweed
- *Hesperis matronlis*, dame's rocket
- *Hydrilla verticillata*, hydrilla
- *Hydrocharis morsus-ranae*, European frog-bit
- *Lonicera japonica*, Iapanese honeysuckle
- *Lonicera maackii*, amur honeysuckle
- *Lonicera morrowii*, Morrow's honeysuckle
- *Lonicera tatarica*, tatarian honeysuckle
- *Lythrum salicaria*, purple loosestrife
- *Lythrum virgatum*, European wand loosestrife
- *Microstegium vimineum*, Japanese stiltgrass
- *Myriophyllum aquaticum*, parrotfeather
- *Myriophyllum spicatum*, Eurasian water-milfoil
- *Nymphoides peltata*, yellow floating heart
- *Phragmites australis*, common reed
- *Potamogeton crispus*, curly-leaved pondweed
- *Pueraria montana* var. *lobate*, kudzu
- *Ranunculus ficaria*, fig buttercup/lesser celandine
- *Rhamnus cathartica*, European buckthorn
- *Rosa multiflora*; multiflora rose
- *Trapa natans*, water chestnut
- *Typha angustifolia*, narrow-leaved cattail
- *Typha* x *glauca*, hybrid cattail
- *Vincetoxicum nigrum*, black dog-strangling vine, black swallowwort

Attachment 4
Prohibited Invasive Weeds

Identified by Ohio State Administrative Code and effective 2021. For a current list please use website referenced in Section 5, for Ohio Laws and Rules.

- Shatter cane, *Sorghum bicolor*
- Russian thistle, *Salsola kali* var. *tenuifolia*
- Johnsongrass, *Sorghum halepense*
- Wild parsnip, *Pastinaca sativa*
- Grapevines, *Vitis* spp., when growing in groups of one hundred or more and not pruned, sprayed, cultivated, or otherwise maintained for two consecutive years
- Canada thistle, *Cirsium arvense*
- Poison hemlock, *Conium maculatum*.
- Cressleaf groundsel, *Senecio glabellus*
- Musk thistle, *Carduus nutans*
- Purple loosestrife, *Lythrum salicaria*
- Mile-A-Minute, Weed *Polygonum perfoliatum*
- Giant Hogweed, *Heracleum mantegazzianum*
- Apple of Peru, *Nicandra physalodes*
- Marestail, *Conyza canadensis*
- Kochia, *Bassia scoparia*
- Palmer amaranth, *Amaranthus palmeri*
- Kudzu, *Pueraria montana* var*. lobata*
- Japanese knotweed, *Polygonum cuspidatum*
- Yellow Groove Bamboo, *Phyllostachys*
- *aureasculata*), when the plant has spread from its original premise of planting and is not being maintained
- Field bindweed, *Convolvulus arvensis*
- Heart-podded hoary cress, *Lepidium draba* sub*. draba*
- Hairy whitetop or ballcress, *Lepidium appelianum*
- Perennial sowthistle, *Sonchus arvensis*
- Russian knapweed, *Acroptilon repens*
- Leafy spurge, *Euphorbia esula*
- Hedge bindweed, *Calystegia sepium*
- Serrated tussock, *Nassella trichotoma*
- Columbus grass, *Sorghum* x *almum*
- Musk thistle, *Carduus nutans*
- Forage Kochia, *Bassia prostrata*
- Water Hemp, *Amaranthus tuberculatus*

APPENDIX E

STORMWATER MANAGEMENT REPORT

PRELIMINARY STORMWATER MANAGEMENT REPORT

South Branch Solar Project

Hancock County, Ohio

JULY 2021

PREPARED FOR:

Leeward Renewable Energy, LLC
6688 N. Central Expressway Suite 500
Dallas, Texas 75206

PREPARED BY:

Westwood

Preliminary Stormwater Management Report

South Branch Solar Project

Hancock County, Ohio

Prepared For:

Leeward Renewable Energy, LLC
6688 N. Central Expressway Suite 500
Dallas, Texas 75206

Prepared By:

Westwood
12701 Whitewater Drive, Suite 300
Minnetonka, MN 55343
(952) 937-5150

Project Number: R0031696.00
Date: July 13, 2021

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Exhibits

Appendices

Introduction

The purpose of this report is to summarize the proposed stormwater management for the South Branch Solar Project ("the project"). This report was prepared to meet state requirements and is intended for submittal to these agencies for permitting review and approval.

The project site is proposed on approximately 1,000 acres and is located just north of the village of Arcadia in Hancock County, Ohio. The site's current landcover is primarily agricultural row crops with one small, wooded area.

The proposed use of the site will be a solar facility consisting of 740 acres of solar modules and 43 acres of new impervious surface including gravel access roads and associated solar infrastructure. The proposed site under the solar modules will be converted to meadow conditions within the fenced boundary around the proposed impervious surfaces. Due to the area between and beneath the panels being vegetated, panels are typically not considered an impervious surface. Treatment BMPs will be utilized in areas where necessary to treat runoff.

HydroCAD modeling software was used to quantify existing and proposed runoff, as well as existing and proposed volume.

The analysis shows that the proposed site meets the requirements of the state. Minimal grading will be proposed on site and existing drainage patterns will be maintained.

Data Sources

TABLE 1: DATA SOURCES

Task	Format	Source	Use
Elevation	2.5-foot DEM	OGRIP	Model Elevations
Elevation	Flown LiDAR	Westwood	Model Elevations
Crop Data	Shapefile	USDA 2013 Crop Data Layer	Landcover
Soils	Shapefile	USGS SSURGO Dataset	Curve Numbers
Precipitation	PDF File	NOAA Atlas 14	Design Storms
Site Boundary	Sunset Ridge Solar.kmz	Leeward Renewable Energy, LLC	Define Model Extents
2014 Aerial Photography	ArcGIS Map Service	USDA FSA	Reference

Site Conditions

Site Location

The project area is located just north of the village of Arcadia in Hancock County, Ohio.

Historical Use

A review of aerial photographs shows that the site is currently used and has historically been used for agricultural purposes with the exception of one small, wooded area.

Topography Description

The existing topographic information used in this analysis was a blend of LiDAR flown by Westwood, and data obtained from the survey prepared by the Ohio Geographically Referenced Information Program (OGRIP). OGRIP Flown LiDAR files were used for onsite elevations. The site is generally flat with slopes of up to 3% across a majority of the fence boundary, with the exception of areas near drainage ditches and channelized areas where slopes can exceed 8%.

Drainage Patterns

Onsite runoff is split into 42 drainage areas based on discharge locations and existing low areas. Drainage areas are shown on Exhibits 5 and 6.

Discharge Locations

Discharge locations exist for each drainage area. In some cases, discharge is considered sheet flow, in others there is a concentrated flow discharging offsite. Discharge locations are shown on Exhibits 5 and 6.

Soils

Soils data was downloaded from SSURGO and can be found in Exhibit 3. The site consists primarily of Hydrologic Soil Groups (HSGs) C/D and D soils with smaller areas of HSG B/D. Soils belonging to dual HSGs B/D and C/D were modeled as D soils in the pre-post analysis for the most conservative approach. Type D soils have high runoff potential and low infiltration rates.

Stormwater Management Requirements

A review of the Guidance on Post-Construction Storm Water Controls for Solar Panel Arrays and the Ohio NPDES Stormwater Requirements shows the following requirements for the proposed site:

- According to the Guidance on Post-Construction Storm Water Controls for Solar Panel Arrays:
  - For many facilities, storm water runoff from the solar panels can be simply managed by disconnection to the vegetated ground surface under and between elevated panels provided an ungraded, compacted soil profile exists, dense and healthy vegetation can be maintained over the entire surface, and runoff from the panels can be managed as non-erosive sheet flow.
  - 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 creates a 1:1 spacing ratio.
- According to the Ohio NPDES Permit:

- Water quality volume equivalent to the volume of runoff from a 0.90-inch rainfall for the site must be treated to ensure compliance with Ohio's Water Quality Standards in OAC Chapter 3745-1.
- An additional volume equal to 20 percent of the water quality volume shall be incorporated into the BMP design for sediment storage.
- The size of structural post-construction practices used to capture and treat the water quality volume can be reduced by incorporating runoff reducing practices into the design of the sites drainage system, including impervious surface.

Methodology

Existing and proposed conditions are modeled in HydroCAD software. HydroCAD is a widely accepted hydrologic and hydraulic modeling package based on TR-20 unit hydrograph equations. It models stormwater runoff discharge rates and velocities from ponds, culverts, outlet control structures, and stream reaches.

Hydrology

Curve Number Methodology, based on the NRCS-TR 55 method, was used in the modeling for predicting direct runoff. Curve numbers were assigned by reviewing the soil and landcover for each drainage area.

Time of concentrations were calculated for each drainage area in HydroCAD using the lag method. The lag method uses the hydraulic length (distance traveled by a drop of water from the most distant part of the subcatchment to the outlet point) and the average land slope (average slope of entire watershed). The overall curve number for the site along with the lag information is used to get the time of concentration for the site.

Atlas 14 precipitation and distribution data for the 10-year, and 100-year 24-hour storm events were used as input for the analysis (Appendix A).

Existing Conditions

The existing site primarily consists of agricultural row crops with limited woodlots occurring in some areas. Cover for the analysis was determined using the USDA 2013 Crop Data Layer and aerial photos. Curve numbers were assigned based on the landcover and soil types, see table below for summary.

TABLE 2: EXISTING CONDITIONS COVER

Hydrologic Soil Group	Landcover	
	Row Crops	Woods
D*	89	77

*Soils belonging to HSG B/D and C/D were modeled as HSG D.

Proposed Conditions

The use of the site will be a solar farm with a substation pad, switchyard, O&M, and associated access roads/equipment. The site will consist of approximately 740 acres of solar modules mounted above grade on a racking system and 43 acres of gravel access roads and electrical equipment/impervious pads. Minimal grading is proposed below the array and existing drainage patterns will be maintained (Exhibit 6). The proposed site will consist of meadow grass, wooded area, gravel access roads, equipment pads, and the solar array. See the table below for a summary of proposed condition curve numbers.

TABLE 3: PROPOSED CONDITIONS COVER

Hydrologic Soil Group	Landcover			
	Meadow Conditions	Woods	Gravel Access Road	Impervious
D*	78	77	96	98

*Soils belonging to HSG B/D C/D were modeled as HSG D.

Proposed Stormwater Management

Solar panel and impervious surface disconnection will be sufficient to treat stormwater runoff in these areas through a low impact development (LID) approach, which will reduce the runoff volumes and rates from pre-development conditions. The proposed management will consist of a vegetative filter under the proposed panels and throughout the site.

The proposed site layout has minimized the proposed impervious surfaces and will consist of solar panels, gravel roads and other electrical equipment. Solar panels have a unique runoff characteristic, not like buildings or roads, but a fully-disconnected impervious surface. The runoff generated from the solar panels will flow to the edge of the panels and be allowed to drip onto the pervious surface below.

All areas below the panels will be seeded with a vegetated filter consisting of a low-maintenance grass seed mix, which will be selected in consultation with local agricultural authorities. This vegetated filter acts as a permanent BMP and allows for runoff, sediment, and other pollutants to be infiltrated or captured by the vegetation.

A majority of the site contains soils of HSGs C/D and D, which would normally require a larger spacing ratio than panels on soils of HSG A and B. However, it has been confirmed with the EPA that heavy tilling is considered restoration. Therefore, heavy tilling will be used in areas containing soils HSG C and C/D in order to functionally restore soils and maintain 1:1 spacing for solar panels in these areas.

Drainage area 10 contains a moderate amount of added impervious surface in proposed conditions due to the addition of a switchyard. However, runoff from drainage area 10 flows through a gas line easement and back onsite into drainage area 14, allowing runoff from this switchyard to be treated through disconnection. A grass filtration trench may be constructed downstream of the switchyard in drainage area 10 in order to allow runoff to infiltrate and overtop the trench, flowing through the easement and into drainage area 14 when the filtration trench is full during larger storm events.

All areas onsite are able to be treated by disconnection and runoff reduction via sheet flow over vegetated filter, which is proposed in post-construction conditions. The need for retention basins and treatment trains were evaluated and deemed unnecessary due to the disconnection of impervious surfaces and reduction in runoff and runoff volume through the conversion from row crop to meadow.

Water Quantity/Runoff Analysis

The site is split into 42 drainage areas based on varying discharge points to analyze peak discharge rates and runoff volumes. The site discharges in all directions. HydroCAD modeling software was used to complete the hydraulic modeling of the onsite flow conditions within the fenced area. Tables 4 and 5 show a summary of the runoff rates and volumes for each event at the site discharge locations. Calculations are included in Appendices B and C.

TABLE 4: RUNOFF RATE SUMMARY

Drainage Area	Total Area (ac)	10-year Storm			100-year Storm		
		Existing Runoff (cfs)	Proposed Runoff (cfs)	% Runoff Reduction from Existing to Propposed Conditions	Existing Runoff (cfs)	Proposed Runoff (cfs)	% Runoff Reduction from Existing to Propposed Conditions
1	34.46	76.07	41.54	45	123.42	80.20	35
2	15.36	29.57	16.05	46	48.33	31.18	35
3	17.27	31.57	17.05	46	51.73	33.20	36
4	57.04	72.07	36.69	49	119.98	72.84	39
5	6.57	11.01	6.33	43	18.11	12.14	33
6	28.12	52.35	28.23	46	85.69	54.95	36
7	22.44	22.56	12.98	42	39.43	26.12	34
8	17.13	33.33	19.60	41	54.44	37.34	31
9	17.97	30.39	17.69	42	50.00	33.87	32
10	13.37	41.73	33.46	20	66.33	56.85	14
11	9.63	20.83	10.62	49	33.83	20.91	38
12	65.17	70.35	35.03	50	117.87	69.95	41
13	6.85	20.97	10.90	48	33.37	21.15	37
14	31.25	70.78	38.47	46	114.67	74.34	35
15	21.41	33.96	16.83	50	56.01	33.58	40
16	37.39	98.67	50.93	48	158.41	99.51	37
17	10.25	23.82	13.02	45	38.53	25.09	35
18	9.57	25.56	14.11	45	41.01	27.01	34

Drainage Area	Total Area (ac)	10-year Storm			100-year Storm		
		Existing Runoff (cfs)	Proposed Runoff (cfs)	% Runoff Reduction from Existing to Proppoosed Conditions	Existing Runoff (cfs)	Proposed Runoff (cfs)	% Runoff Reduction from Existing to Proppoosed Conditions
19	67.43	100.15	52.61	47	165.78	103.50	38
20	136.84	164.77	83.72	49	275.02	166.18	40
21	2.56	7.28	3.77	48	11.63	7.35	37
22	5.62	12.55	6.39	49	20.35	12.59	38
23	8.15	20.50	11.24	45	33.01	21.58	35
24	7.39	21.20	11.76	45	33.86	22.43	34
25	5.76	14.63	8.01	45	23.55	15.40	35
26	22.34	35.62	18.89	47	58.72	37.02	37
27	3.58	10.23	5.66	45	16.35	10.80	34
28	4.83	13.73	7.61	45	21.94	14.52	34
29	5.10	14.17	8.34	41	22.68	15.64	31
30	31.72	51.03	27.13	47	84.14	53.06	37
31	31.44	44.76	23.23	48	74.20	45.75	38
32	10.01	19.13	10.35	46	31.27	20.09	36
33	26.41	45.14	24.19	46	74.21	47.24	36
34	7.71	4.56	4.47	41	12.25	8.49	31
35	10.40	5.79	5.71	44	16.58	11.06	33
36	12.09	6.71	6.60	44	19.21	12.73	34
37	7.64	4.60	4.42	40	11.99	8.45	30
38	15.08	8.09	8.05	46	24.85	15.81	36
39	18.26	9.96	9.88	45	29.65	19.24	35
40	12.25	6.66	6.63	46	19.94	12.89	35
41	28.20	15.07	15.05	47	46.58	29.50	37
42	24.93	12.44	12.42	50	41.94	24.78	41

TABLE 5: RUNOFF VOLUME SUMMARY

Drainage Area	Total Area (ac)	10-year Storm			100-year Storm		
		Existing Runoff Volume (ac-ft)	Proposed Runoff Volume (ac-ft)	% Runoff Volume Reduction from Existing to Proppoosed Conditions	Existing Runoff Volume (ac-ft)	Proposed Runoff Volume (ac-ft)	% Runoff Volume Reduction from Existing to Proppoosed Conditions
1	34.46	6.31	4.10	35	11.09	8.25	26
2	15.36	2.81	1.82	35	4.93	3.67	26
3	17.27	3.16	2.04	35	5.54	4.12	26
4	57.04	10.32	6.64	36	18.15	13.38	26
5	6.57	1.20	0.81	32	2.11	1.61	23
6	28.12	5.14	3.33	35	9.03	6.71	26
7	22.44	3.58	2.48	31	6.54	5.08	22
8	17.13	3.13	2.13	32	5.50	4.23	23
9	17.97	3.28	2.22	32	5.76	4.41	23
10	13.37	2.46	2.09	15	4.32	3.86	11
11	9.63	1.76	1.09	38	3.10	2.23	28
12	65.17	11.73	7.50	36	20.63	15.14	27
13	6.85	1.26	0.78	38	2.21	1.60	28
14	31.25	5.73	3.72	35	10.06	7.49	26
15	21.41	3.90	2.40	38	6.85	4.91	28
16	37.39	6.86	4.26	38	12.06	8.70	28
17	10.25	1.88	1.22	35	3.30	2.46	26
18	9.57	1.76	1.14	35	3.09	2.30	25
19	67.43	12.26	7.92	35	21.55	15.95	26
20	136.84	24.73	15.87	36	43.47	32.01	26
21	2.56	0.47	0.29	38	0.83	0.60	28
22	5.62	1.03	0.64	38	1.81	1.30	28
23	8.15	1.50	0.97	35	2.63	1.96	26

Drainage Area	Total Area (ac)	10-year Storm			100-year Storm		
		Existing Runoff Volume (ac-ft)	Proposed Runoff Volume (ac-ft)	% Runoff Volume Reduction from Existing to Proppposed Conditions	Existing Runoff Volume (ac-ft)	Proposed Runoff Volume (ac-ft)	% Runoff Volume Reduction from Existing to Proppposed Conditions
24	7.39	1.36	0.88	35	2.39	1.78	25
25	5.76	1.06	0.69	35	1.86	1.38	26
26	22.34	4.07	2.63	35	7.15	5.30	26
27	3.58	0.66	0.43	35	1.16	0.86	25
28	4.83	0.89	0.58	35	1.56	1.16	25
29	5.10	0.94	0.64	32	1.65	1.27	23
30	31.72	5.78	3.74	35	10.16	7.53	26
31	31.44	5.71	3.68	36	10.04	7.42	26
32	10.01	1.83	1.19	35	3.22	2.39	26
33	26.41	4.82	3.12	35	8.47	6.28	26
34	2.47	0.45	0.31	32	0.80	0.61	23
35	3.54	0.65	0.42	35	1.14	0.85	25
36	3.84	0.71	0.46	35	1.24	0.93	25
37	1.99	0.37	0.25	32	0.64	0.50	23
38	9.16	1.67	1.08	35	2.93	2.18	26
39	8.38	1.54	1.00	35	2.70	2.01	26
40	5.91	1.08	0.70	35	1.90	1.41	26
41	17.84	3.25	2.10	35	5.71	4.23	26
42	27.43	4.90	3.11	37	8.62	6.29	27

As shown in the tables above, the change in land cover from row crops and woods to meadow reduces runoff rates in most drainage areas by more than 40% and 30% for the 10-year storm and 100-year storm events, respectively. The runoff volume in most drainage areas is reduced by more than 30% and 20% for the 10-year storm and 100-year storm events, respectively.

Water Quality Analysis

The Ohio NPDES Permit instructs on finding the required water quality volume for areas onsite that may not be properly treated through surface disconnection and sheet flow over vegetated filter. The following equations can be used to calculate the water quality volume:

$Rv = 0.05 + 0.9i$ (Equation 1)

$WQv = Rv * P * A/12$ (Equation 2)

Where:

WQv = water quality volume in acre-feet

Rv = the volumetric flow runoff coefficient calculated using Equation 1

P = 0.9 inch precipitation depth

A = area draining into the BMP in acres

i = fraction of post-construction impervious surface

An additional volume equal to 20% of the water quality volume should be incorporated into the BMP for sediment storage, therefore any water quality volume value should be multiplied by 1.2 to obtain minimum storage requirements for these treatment BMPs.

Due to all areas onsite being treated through disconnection and runoff reduction, basins and treatment trains are not required for the current design. This water quality analysis section is included for future reference.

Construction Stormwater Management

A separate Construction Stormwater Pollution Prevention Plan (SWP3) should be prepared for the project. During construction conditions, higher runoff rates and volumes can be expected than the fully vegetated final condition. To account for this, dewatering should be anticipated as needed until vegetation has fully established on the site. This may include pumping of temporary swales and diversions. Once the site has been stabilized, sediment will need to be removed from any permanent basins on site. Using temporary seed/mulch at the onset of construction can greatly reduce the amount of erosion and re-grading/basin cleanout on solar sites.

The separate SWP3 will be provided at a later date, however some temporary erosion and sediment control Best Management Practices (BMPs) are included in Appendix E for reference only.

Conclusion

By improving the landcover for a majority of the site, the runoff requirements are met by decreasing both discharge rate and volume. The proposed project discharges in a manner similar to the existing flow pattern in all modeled storm events and does not alter drainage patterns.

If changes to the proposed design are made, the analysis should be reviewed to ensure that all assumptions are still valid. Based on experience on other similar projects, the overall site is suitable for the planned development.

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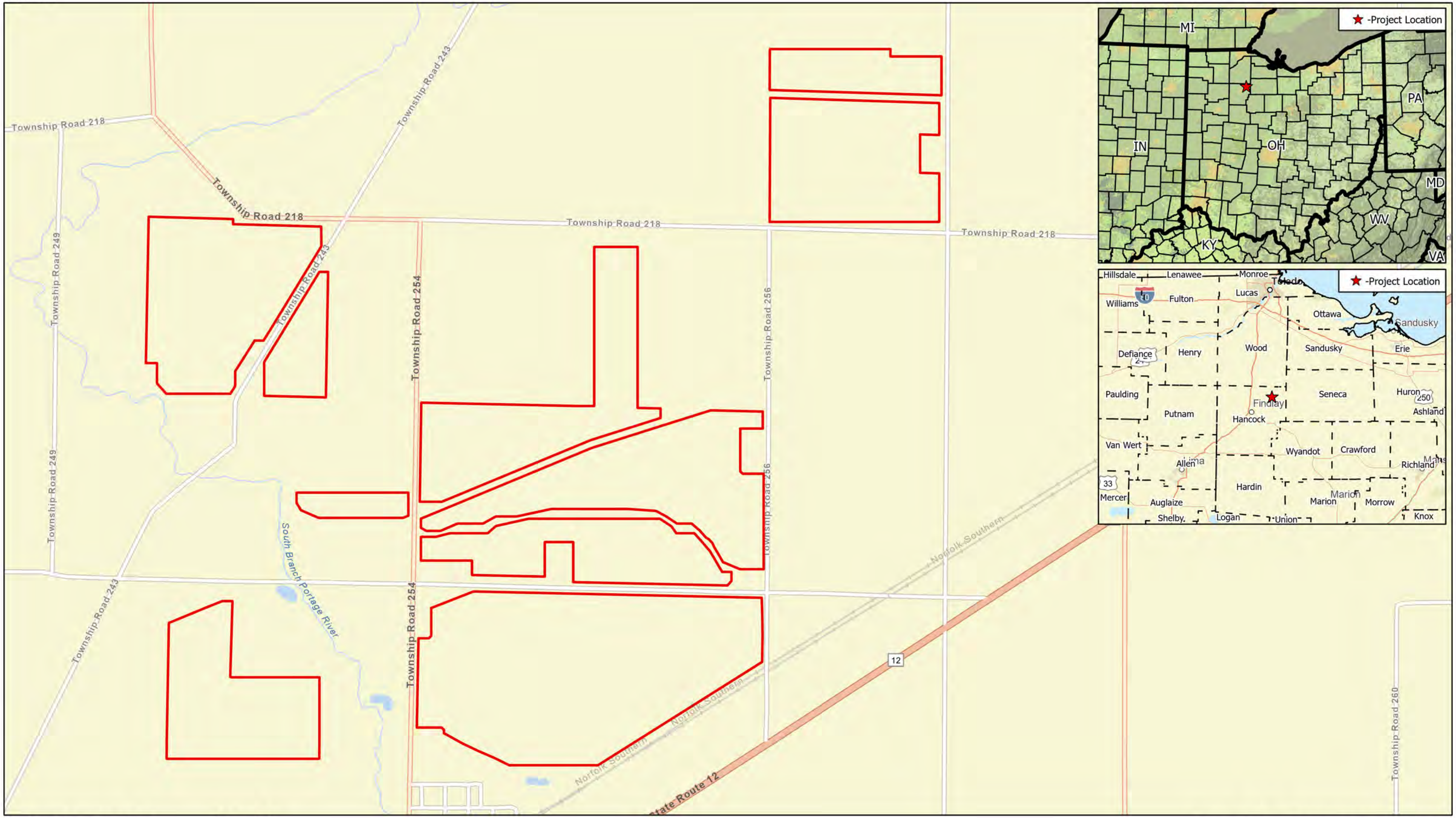
Exhibits



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

🟥 Project Fenceline

▭ County Boundary

N

0 0.25 Miles

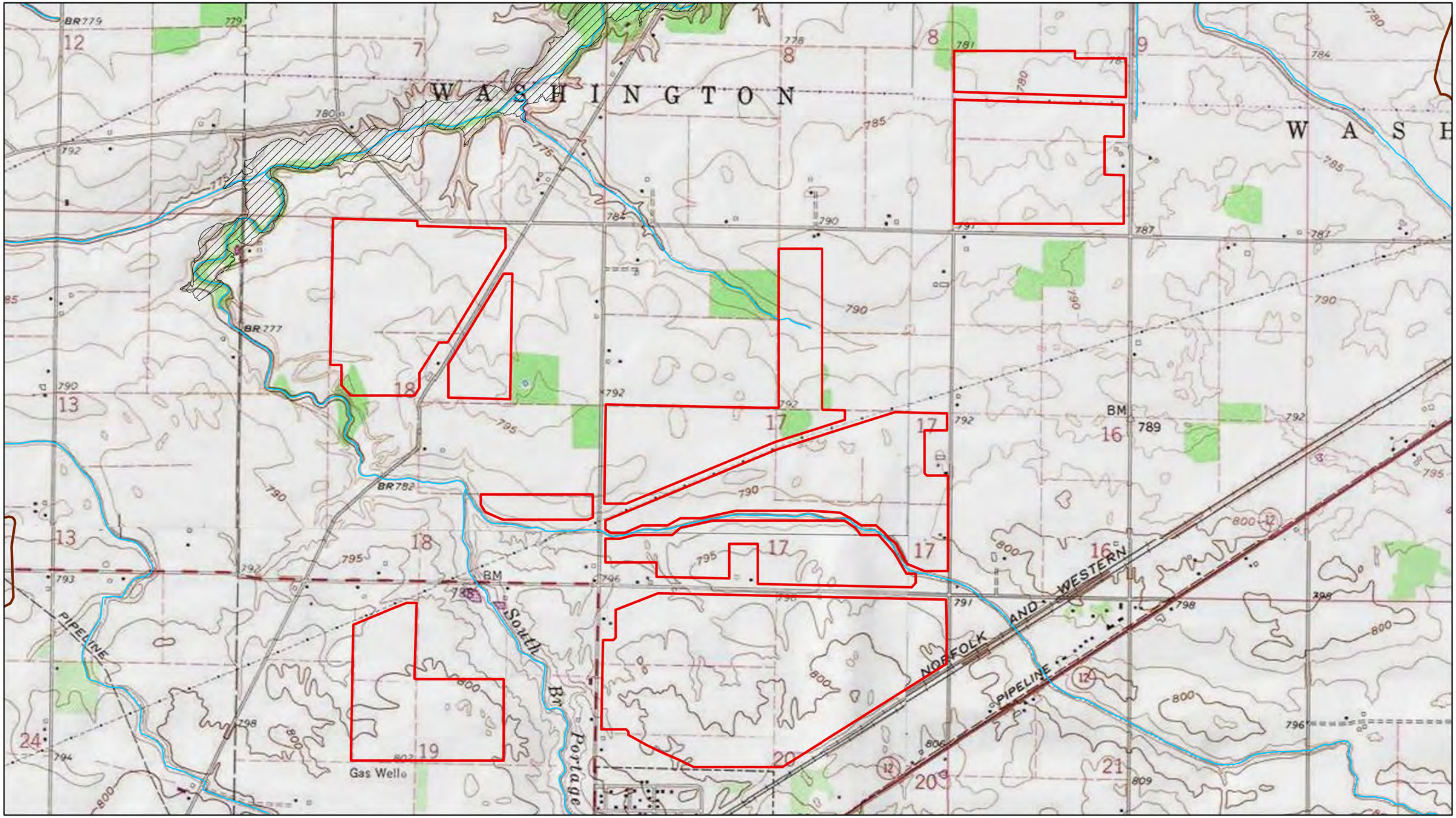
South Branch Solar

Hancock County, Ohio

Exhibit 1: Location Map

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Location Map - Location Map | 7/13/2021 3:08 PM | GAPolverari



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Legend

🟥 Project Fenceline

— NHD Flowline

▨ FEMA Zone A

⬚ County Boundary

🟫 HUC-12 Boundary

N

0 0.25 Miles

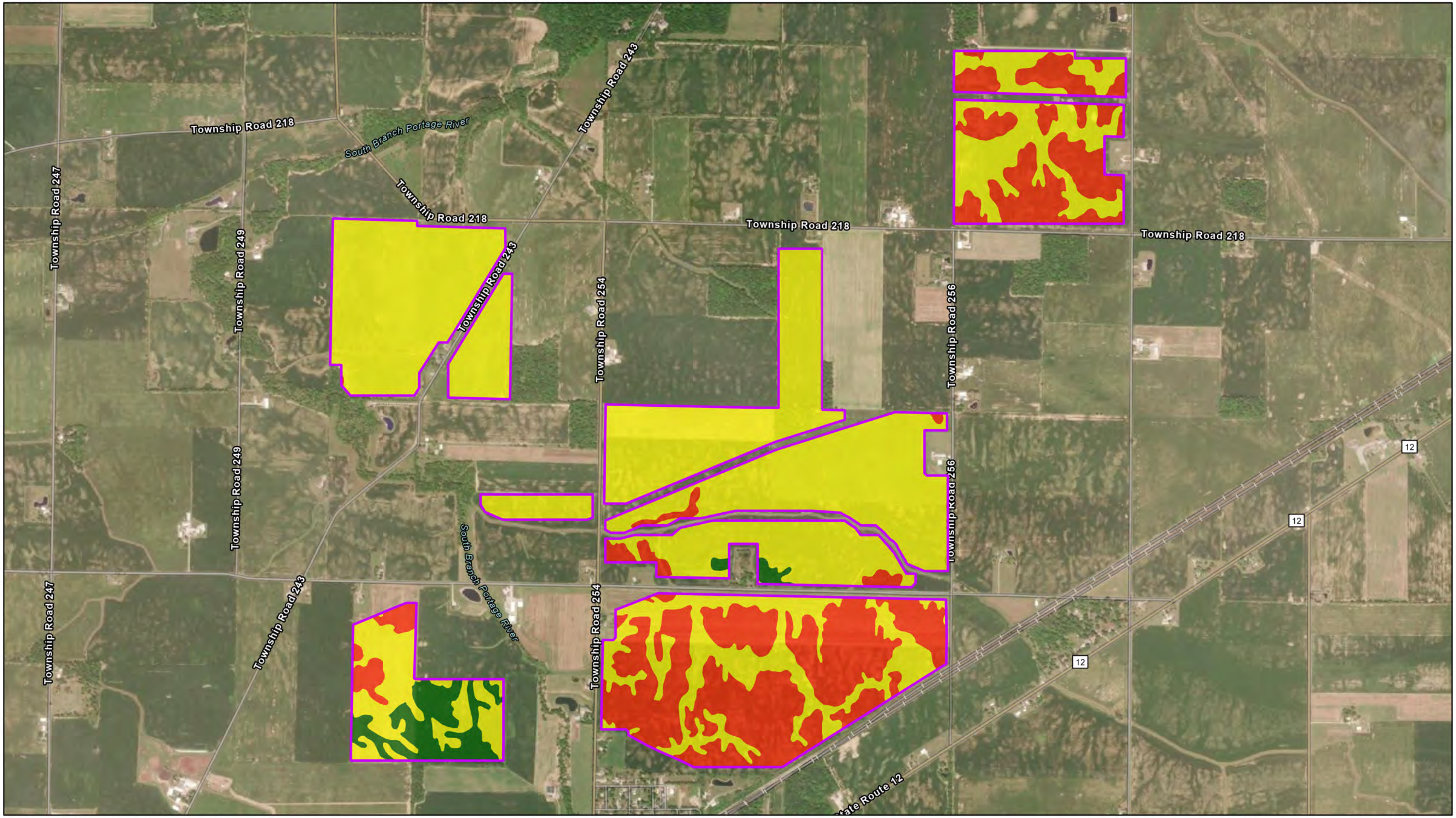
South Branch Solar

Hancock County, Ohio

Exhibit 2: Base Map

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Base Map - Base Map | 7/13/2021 3:09 PM | GAPolverari



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

☐	Project Fenceline	Hydrologic Soil Group	
⬚	County Boundary	🟩 B/D	🟨 C/D
			🟥 D

N

0 0.25 Miles

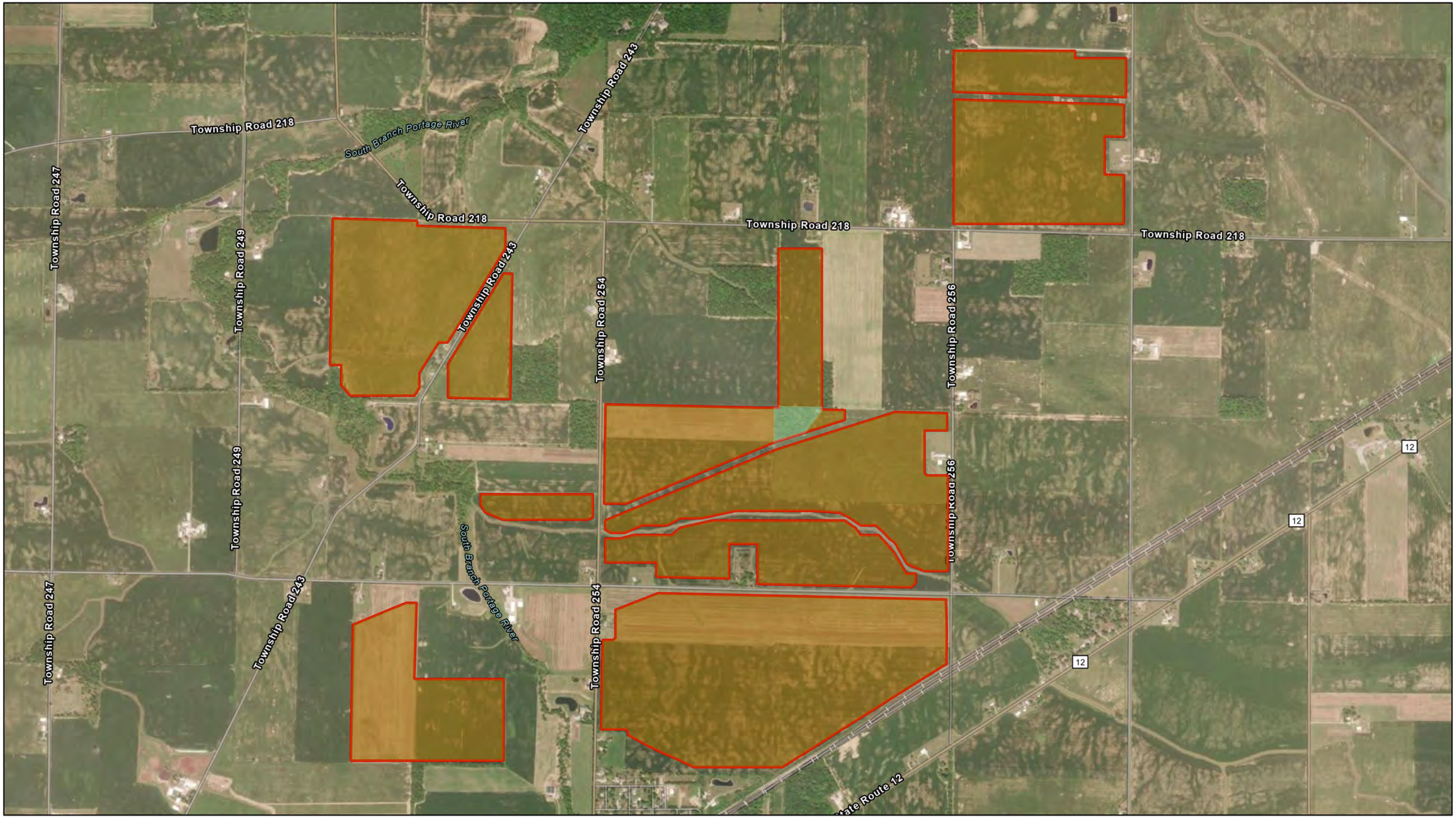
South Branch Solar

Hancock County, Ohio

Exhibit 3: Soils Map

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Soils Map - Soils Map | 7/13/2021 3:13 PM | GAPolverari



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

🟥 Project Fenceline

⬚ County Boundary

Landcover

🟫 Row Crops

🟩 Forest

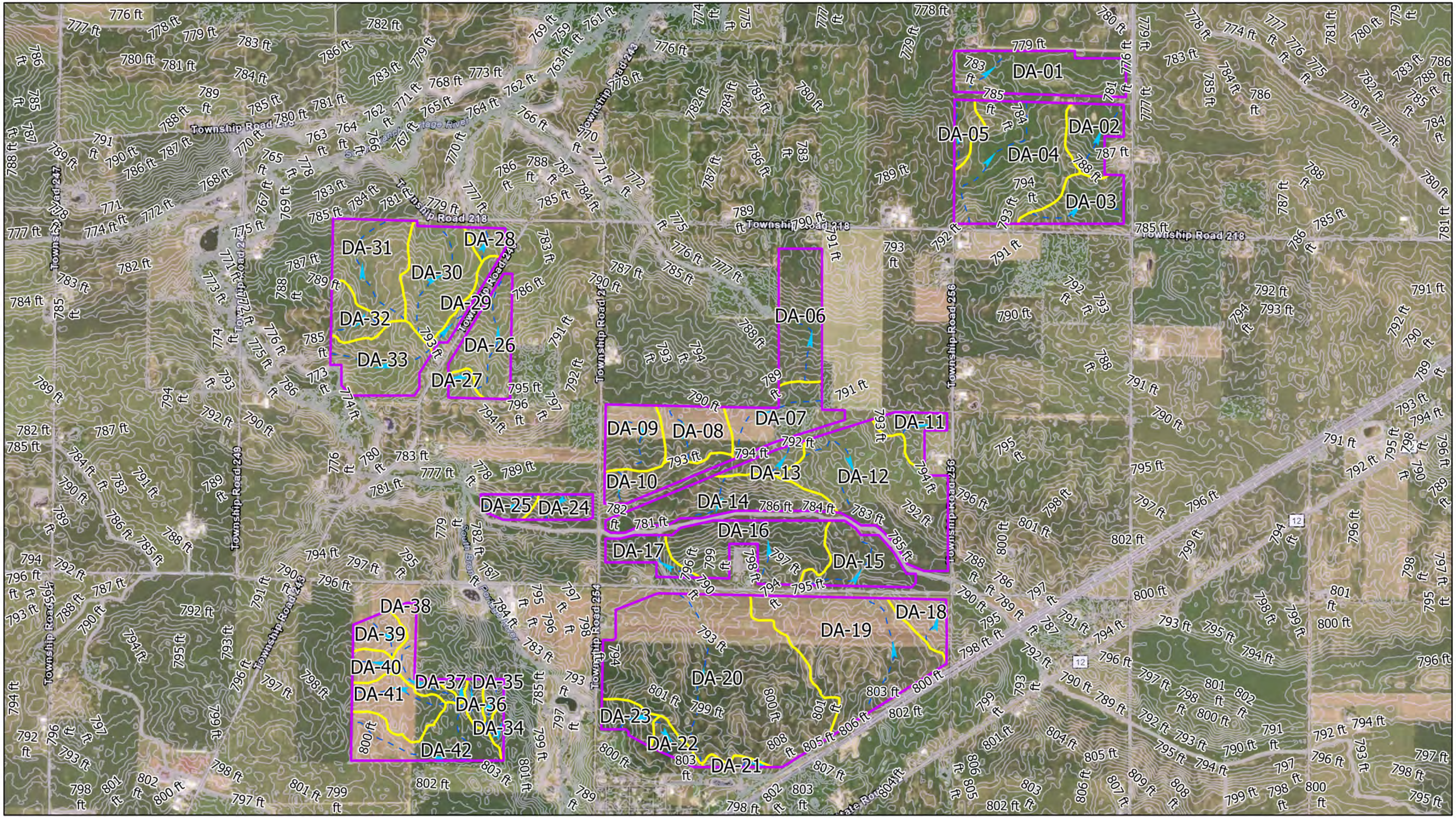
South Branch Solar

Hancock County, Ohio

Exhibit 4: Landcover Map

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Landcover - Landcover | 7/13/2021 3:10 PM | GAPolverari



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Legend

- ▭ Project Fenceline
- ▭ Existing Drainage Area
- ⇢ Onsite Flowpath
- — 1-foot Contours

N

0 0.25 Miles

South Branch Solar

Hancock County, Ohio

Exhibit 5: Drainage Map-Existing

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Existing Drainage Map - Existing Drainage Map | 7/13/2021 3:15 PM | GAPolverari

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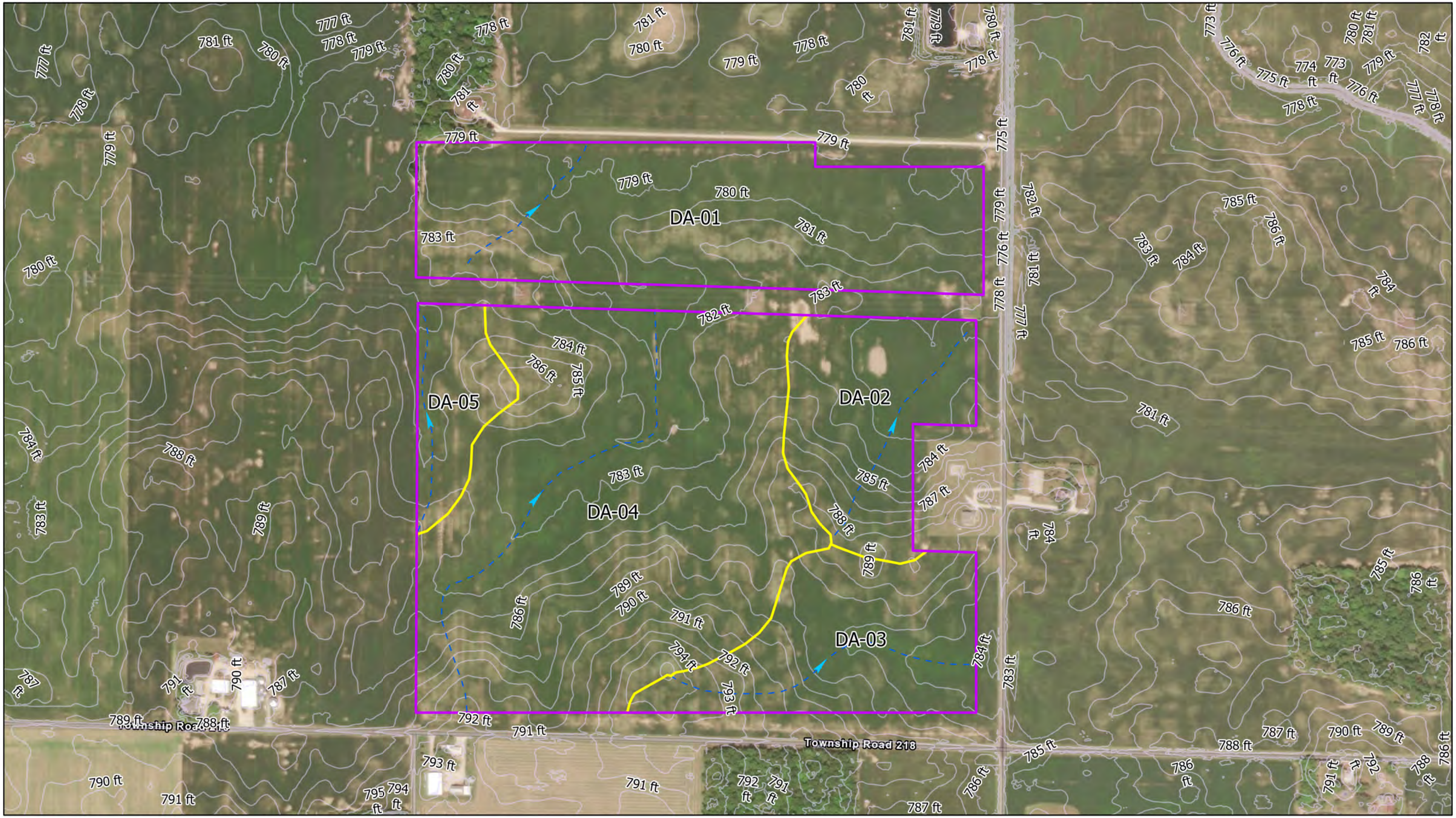

Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

- 🟪 Project Fenceline
- 🟨 Existing Drainage Area
- ➝ Onsite Flowpath
- — 1-foot Contours

South Branch Solar

Hancock County, Ohio

Exhibit 5A: Drainage Map-Existing

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Existing Drainage MapA - Existing Drainage Map | 7/13/2021 3:16 PM | GAPolverari

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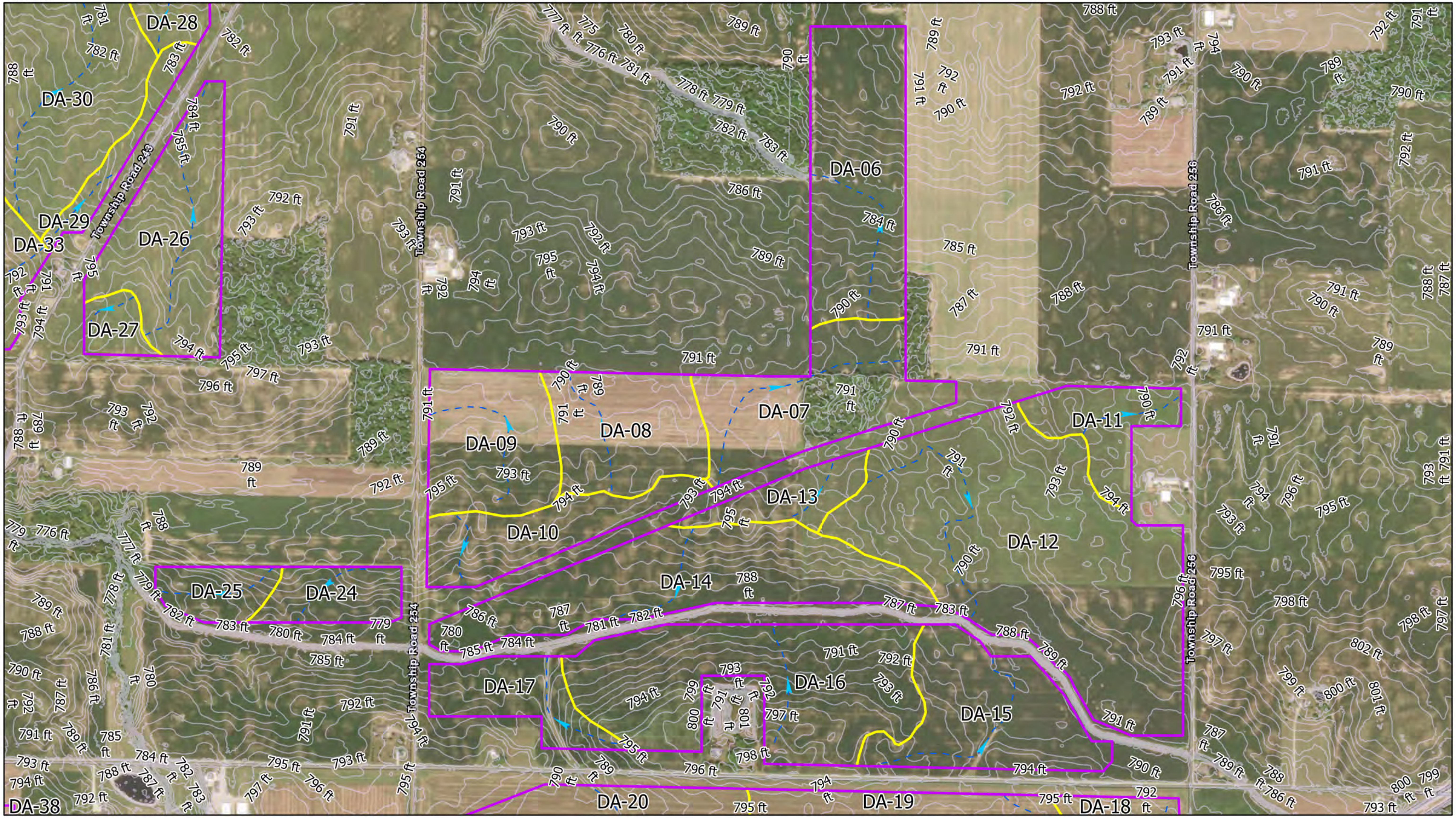

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Legend

▭ Project Fenceline	Onsite Flowpath
▭ Existing Drainage Area	1-foot Contours

N

0 600 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 5B: Drainage Map-Existing

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
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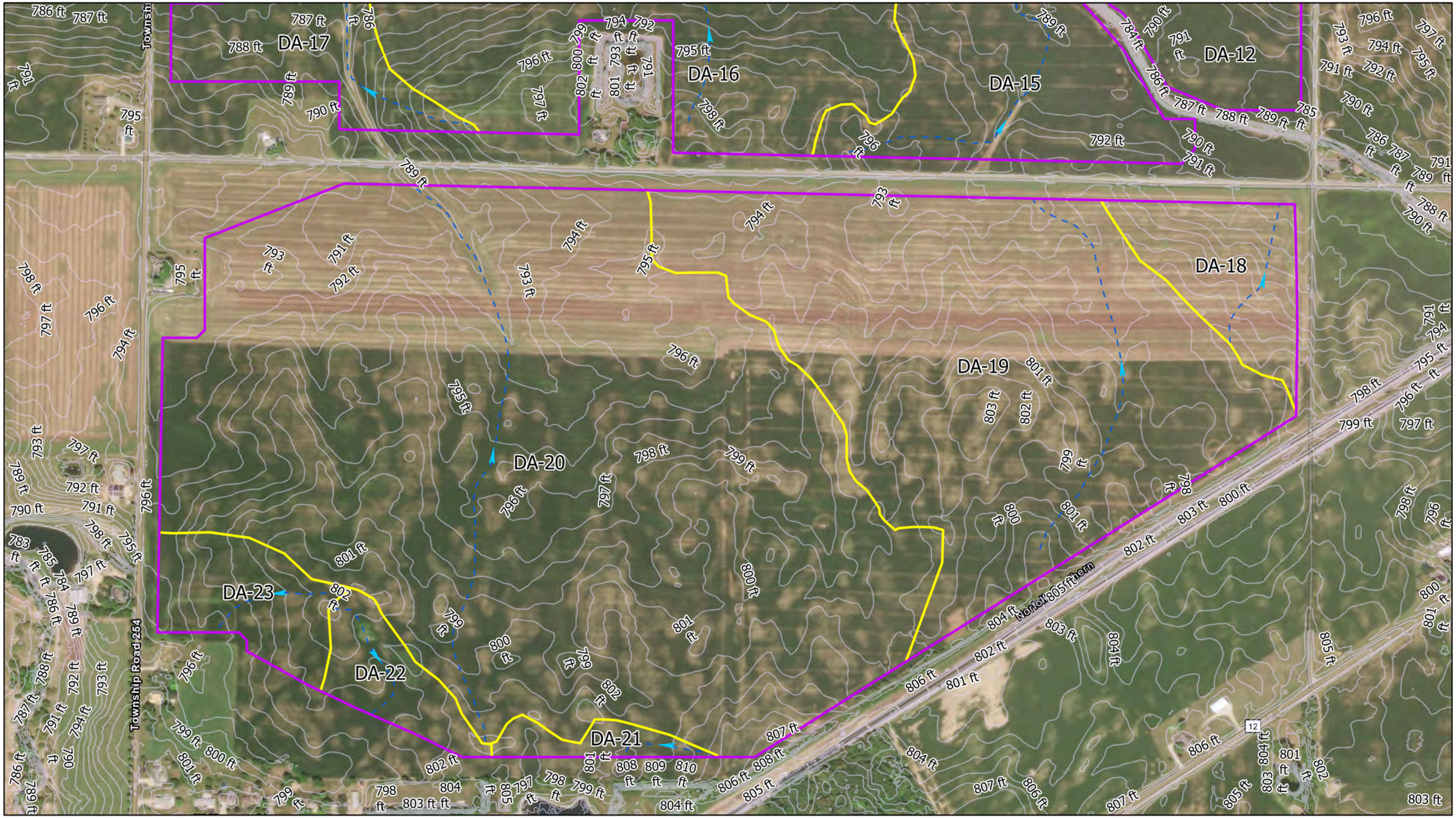

Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

- Project Fenceline
- Existing Drainage Area
- Onsite Flowpath
- 1-foot Contours

N

0 400 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 5C: Drainage Map-Existing

July 13, 2021

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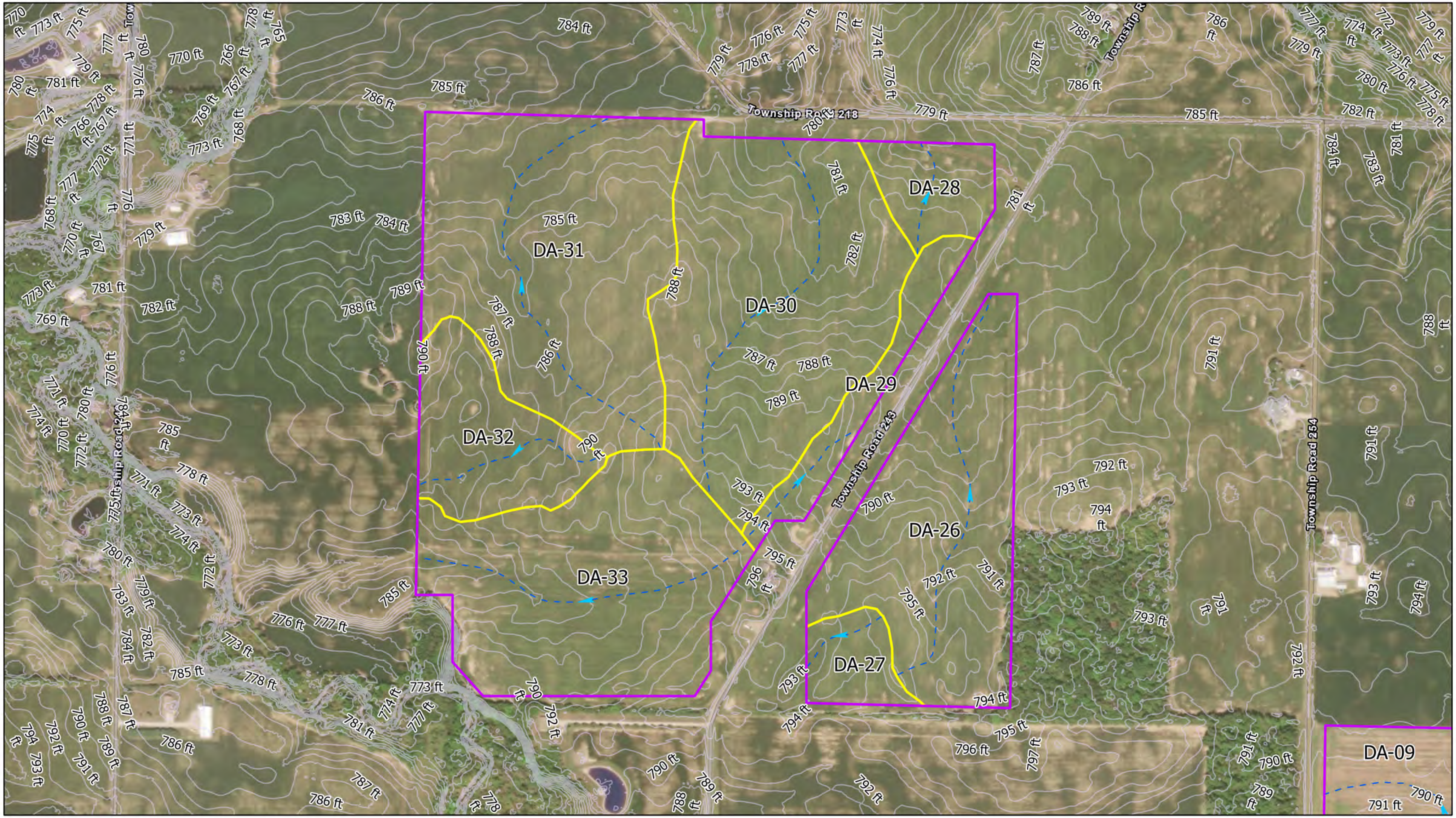
Existing Drainage MapC - Existing Drainage Map 7/13/2021 3:17 PM | GAPolverari



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

- ▭ Project Fenceline
- ▭ Existing Drainage Area
- ➤ Onsite Flowpath
- — 1-foot Contours

N

Feet
0 400

South Branch Solar

Hancock County, Ohio

Exhibit 5D: Drainage Map-Existing

July 13, 2021

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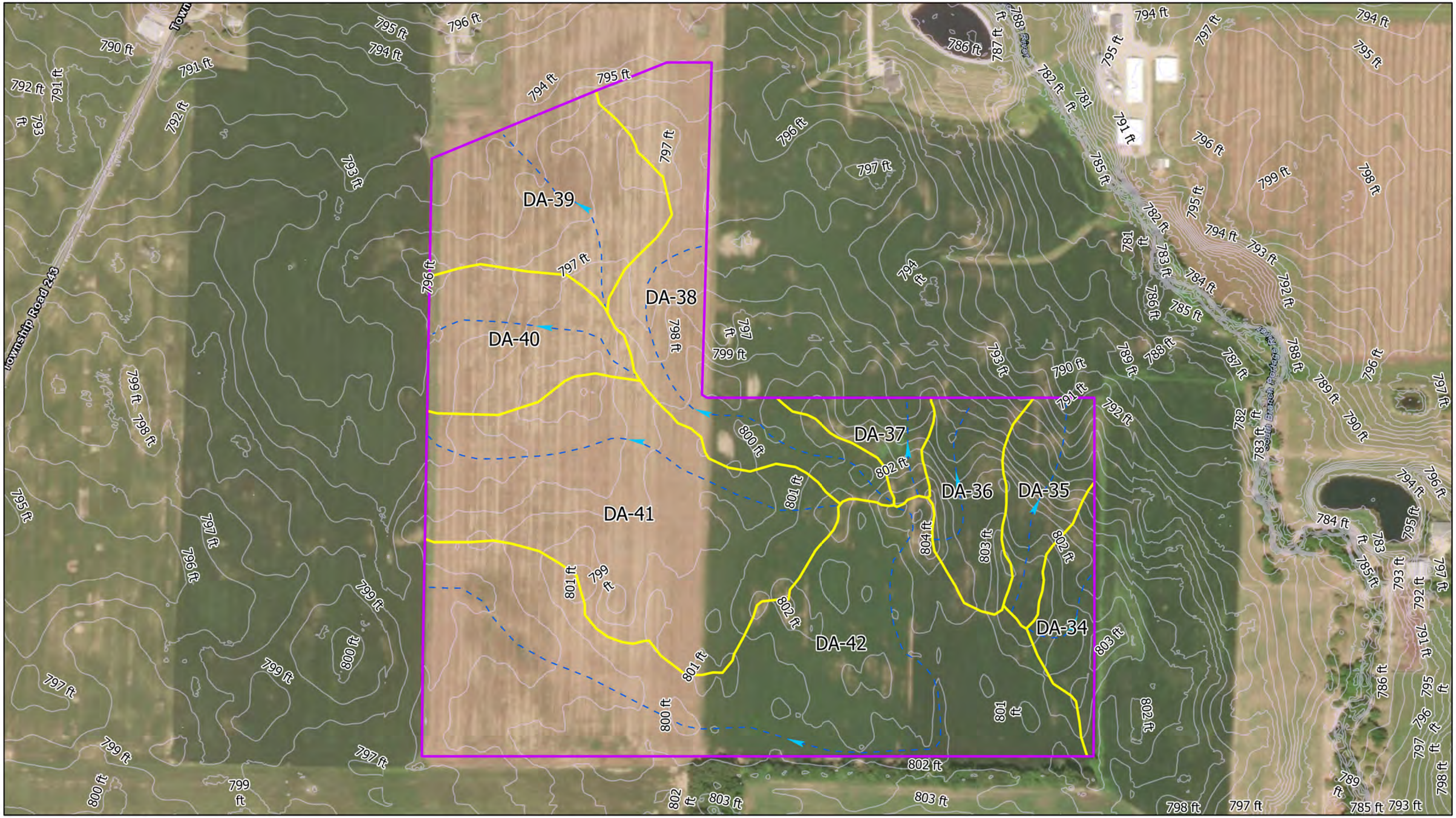
Existing Drainage MapD - Existing Drainage Map | 7/13/2021 3:18 PM | GAPolverari



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

▭	Project Fenceline
▭	Existing Drainage Area
- - ➤	Onsite Flowpath
—	1-foot Contours

N

0 300 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 5E: Drainage Map-Existing

July 13, 2021

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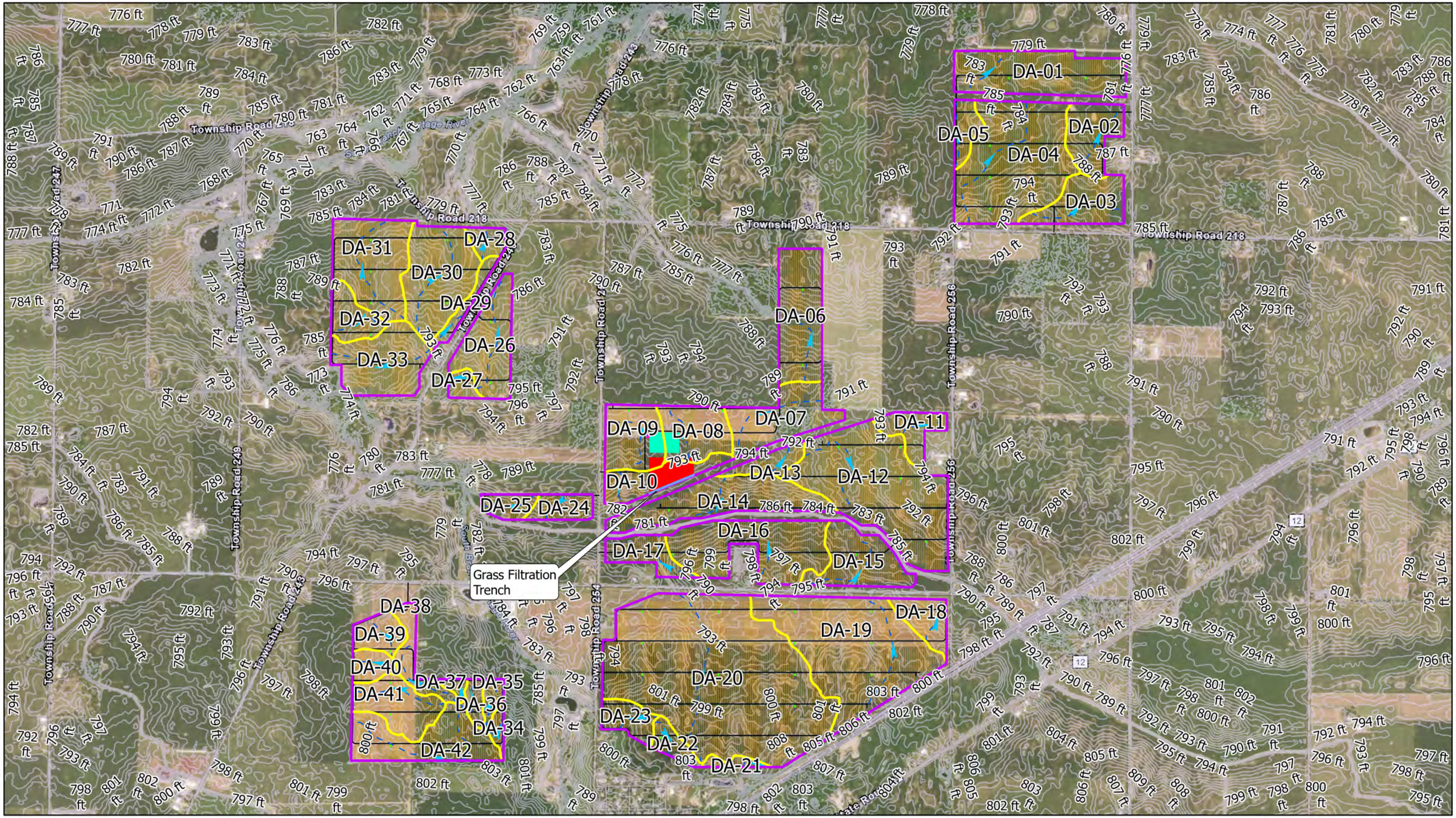
Existing Drainage MapE - Existing Drainage Map | 7/13/2021 3:19 PM | GAPolverari



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

- ▭ Project Fenceline
- ▭ Proposed Drainage Area
- ➤ Onsite Flowpath
- ■ Access Roads
- 🟩 Inverters
- ▨ Solar Array
- ■ O&M
- ■ Substation
- 🟥 Switchyard
- ■ Grass Filtration Trench
- — 1-foot Contours

N

0 0.25 Miles

South Branch Solar

Hancock County, Ohio

Exhibit 6: Drainage Map-Proposed

July 14, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Proposed Drainage Map - Proposed Drainage Map | 7/14/2021 8:15 AM | GAPolverari

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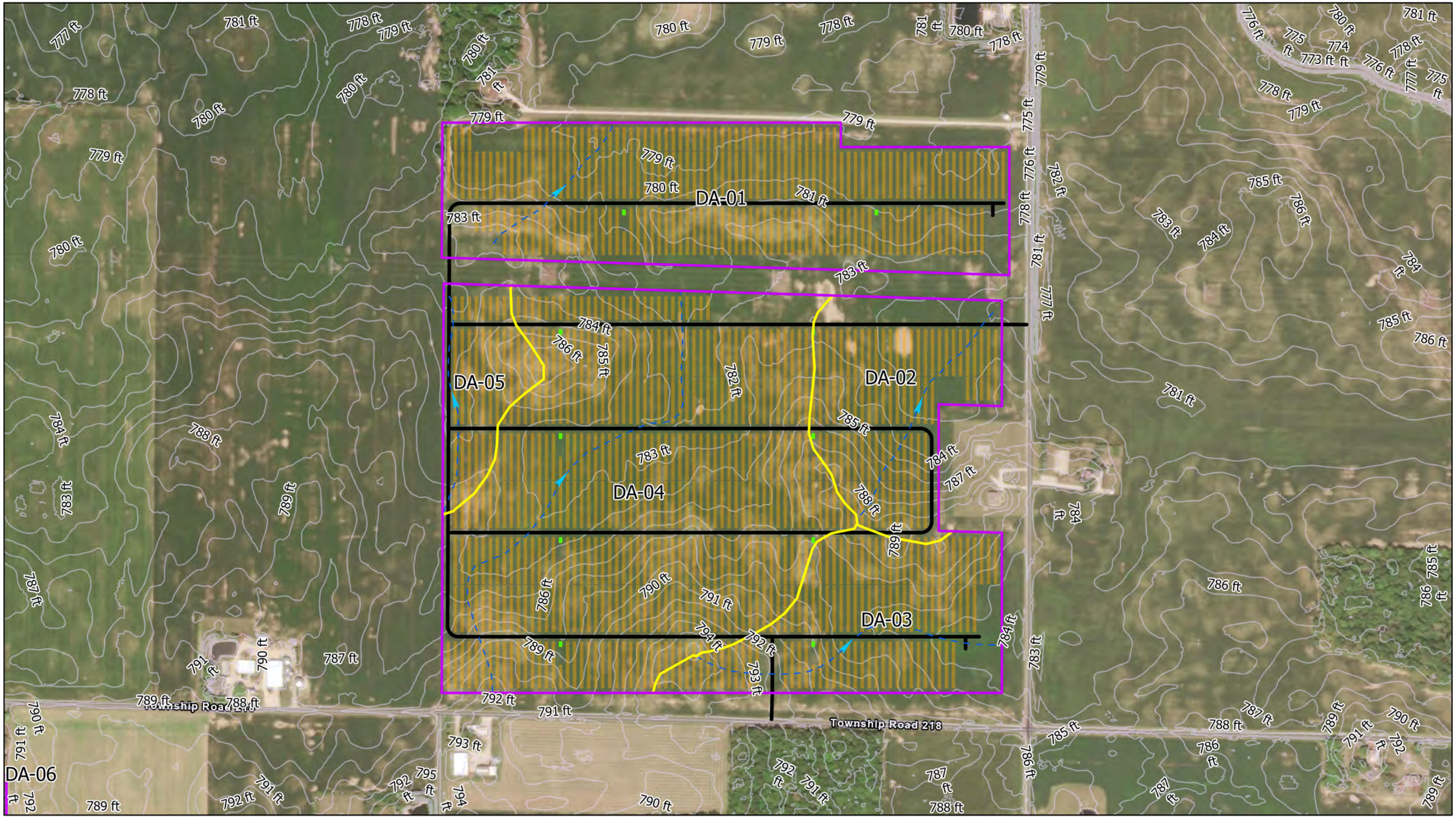

Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

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Legend

☐	Project Fenceline	🟩	Inverters	🟥	Switchyard
☐	Proposed Drainage Area	🟧	Solar Array	—	1-foot Contours
→	Onsite Flowpath	🟪	O&M		
■	Access Roads	🟦	Substation		

N

Feet
0 400

South Branch Solar

Hancock County, Ohio

Exhibit 6A: Drainage Map-Proposed

July 13, 2021

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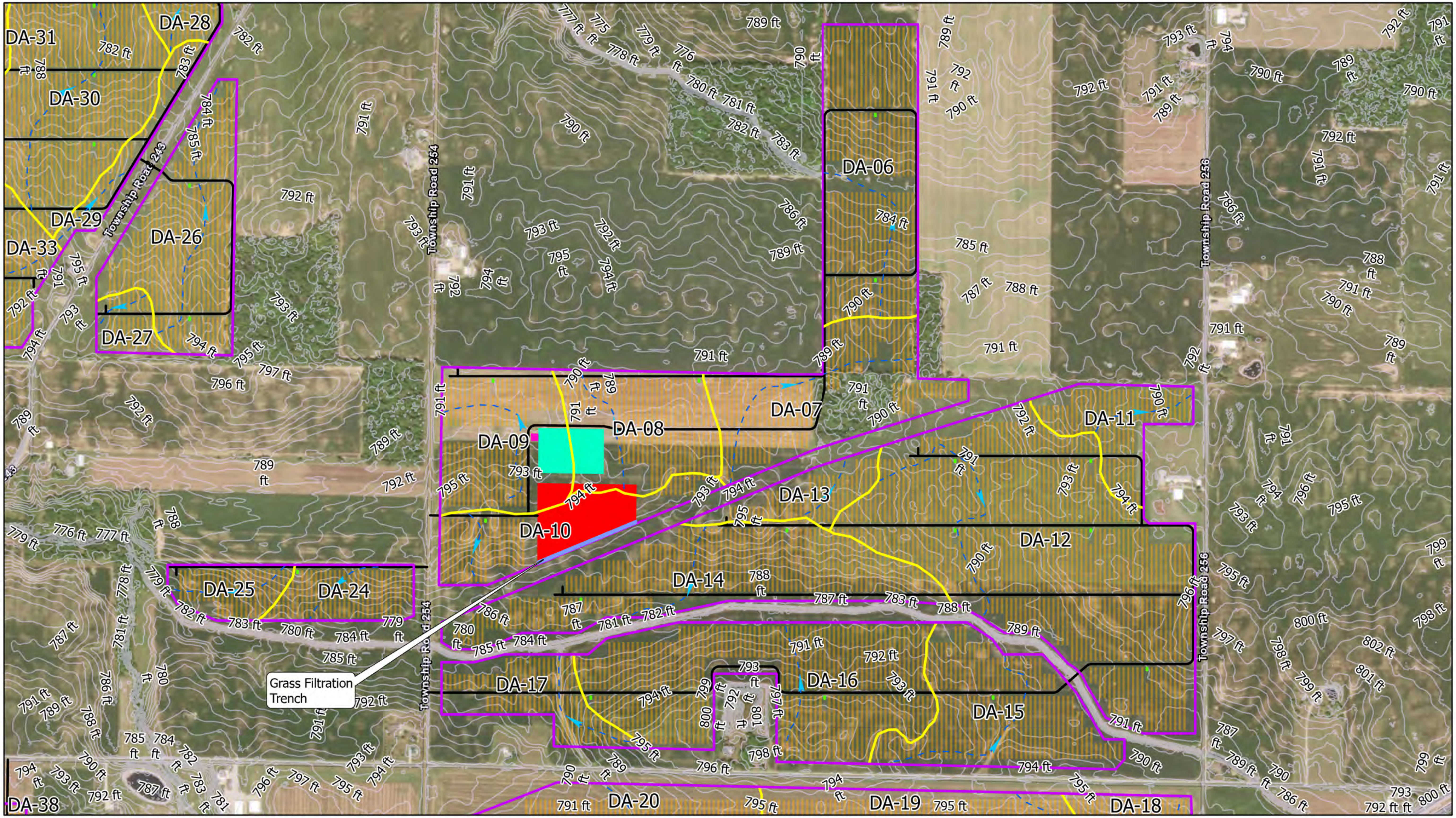
Proposed Drainage MapA - Proposed Drainage Map | 7/13/2021 3:37 PM | GAPolverari



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Legend

- ☐ Project Fenceline
- ☐ Proposed Drainage Area
- → Onsite Flowpath
- ■ Access Roads
- 🟩 Inverters
- ■ Solar Array
- ■ O&M
- ■ Substation
- 🟥 Switchyard
- ■ Grass Filtration Trench
- — 1-foot Contours

N

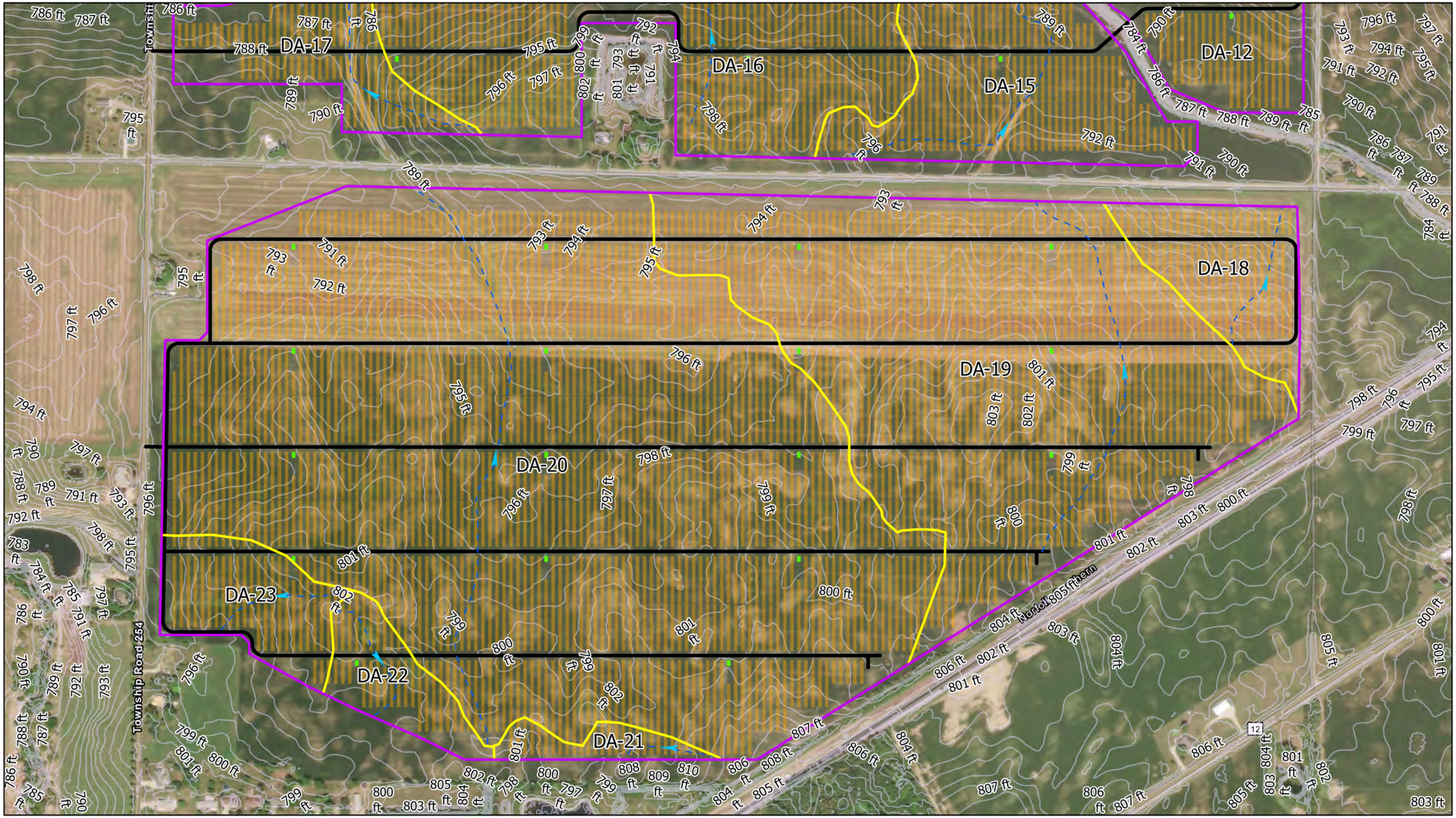
0 600 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 6B: Drainage Map-Proposed

July 14, 2021



Data Source(s): Westwood (2021); Esri WMS Basemap Imagery (Accessed 2021); USGS (2021); FEMA (2021); USDA (2021)

Legend

▭	Project Fenceline
▭	Proposed Drainage Area
→	Onsite Flowpath
■	Access Roads
🟩	Inverters
🟧	Solar Array
■	O&M
■	Substation
🟥	Switchyard
—	1-foot Contours

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N
0 400 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 6C: Drainage Map-Proposed

July 13, 2021

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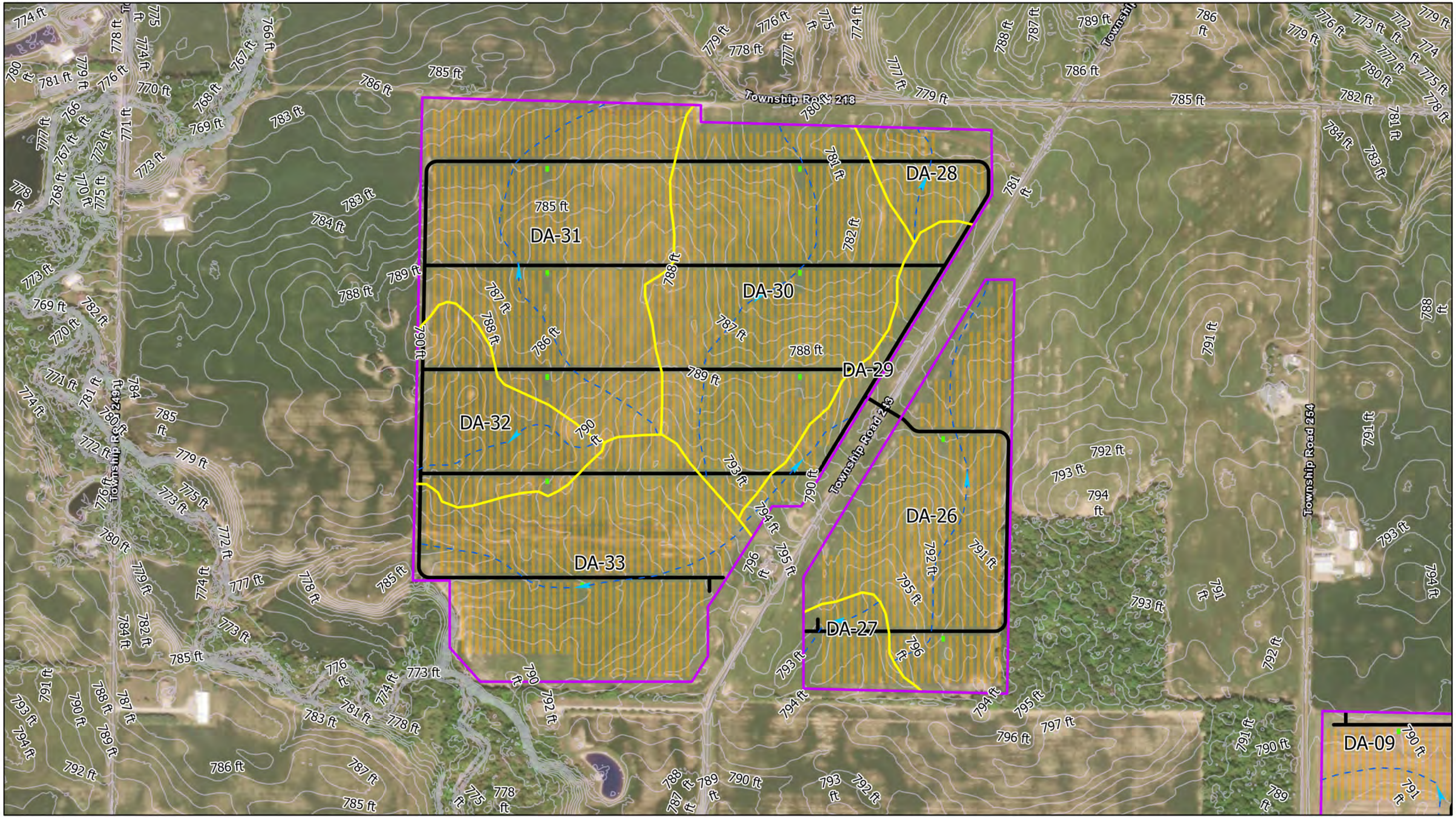

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Legend

☐	Project Fenceline	🟩	Inverters	🟥	Switchyard
☐	Proposed Drainage Area	🟧	Solar Array	—	1-foot Contours
➤	Onsite Flowpath	🟪	O&M		
■	Access Roads	🟦	Substation		

N

0 400 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 6D: Drainage Map-Proposed

July 13, 2021

N:\0031696.00_GIS_Working\Hydro Exhibits\SWMP\South Branch Solar.aprx
Proposed Drainage MapD - Proposed Drainage Map | 7/13/2021 3:39 PM | GAPolverari

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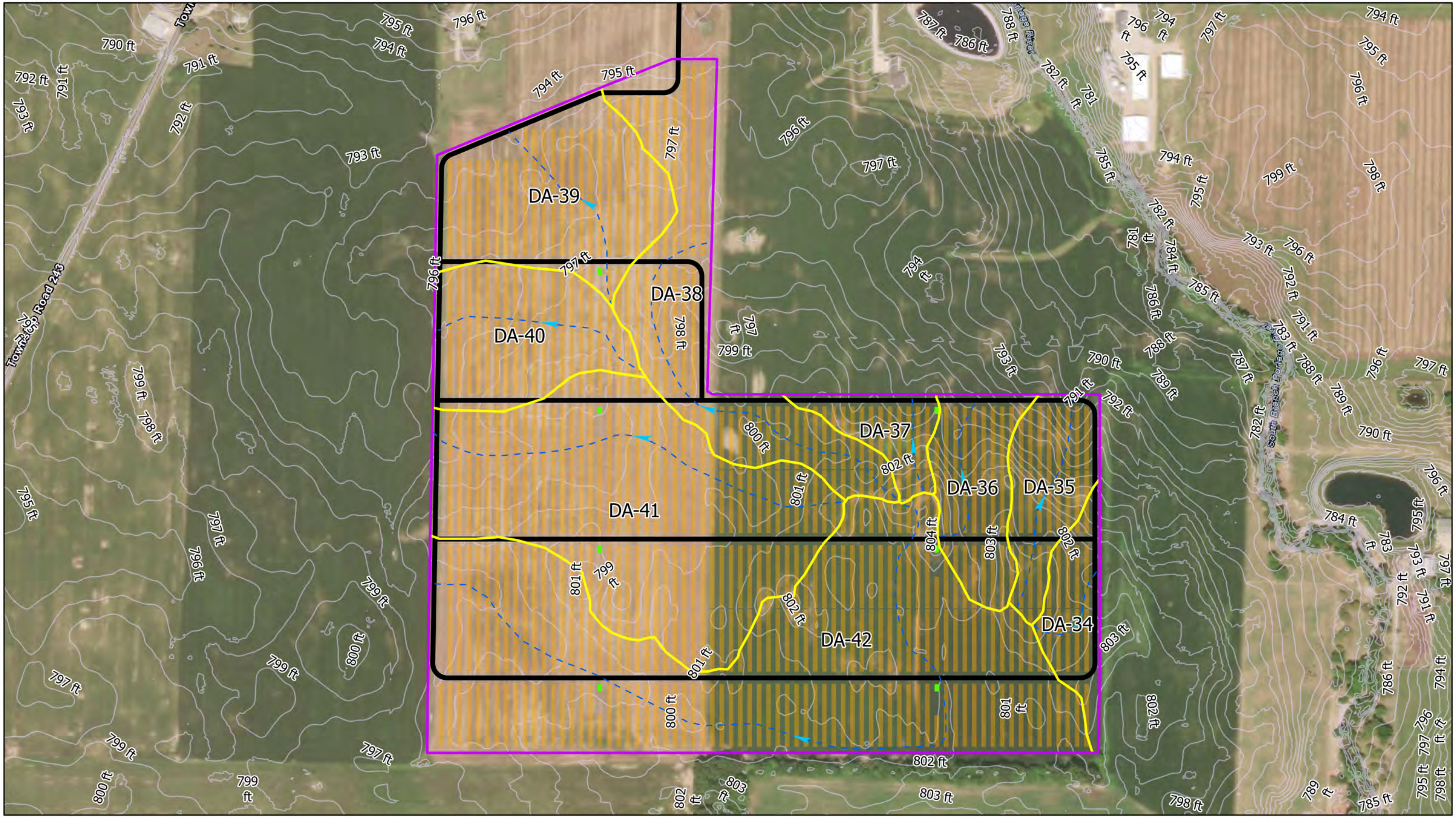

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Legend

- ▭ Project Fenceline
- ▭ Proposed Drainage Area
- → Onsite Flowpath
- ■ Access Roads
- 🟩 Inverters
- ▨ Solar Array
- ■ O&M
- ■ Substation
- 🟥 Switchyard
- — 1-foot Contours

N

0 300 Feet

South Branch Solar

Hancock County, Ohio

Exhibit 6E: Drainage Map-Proposed

July 13, 2021

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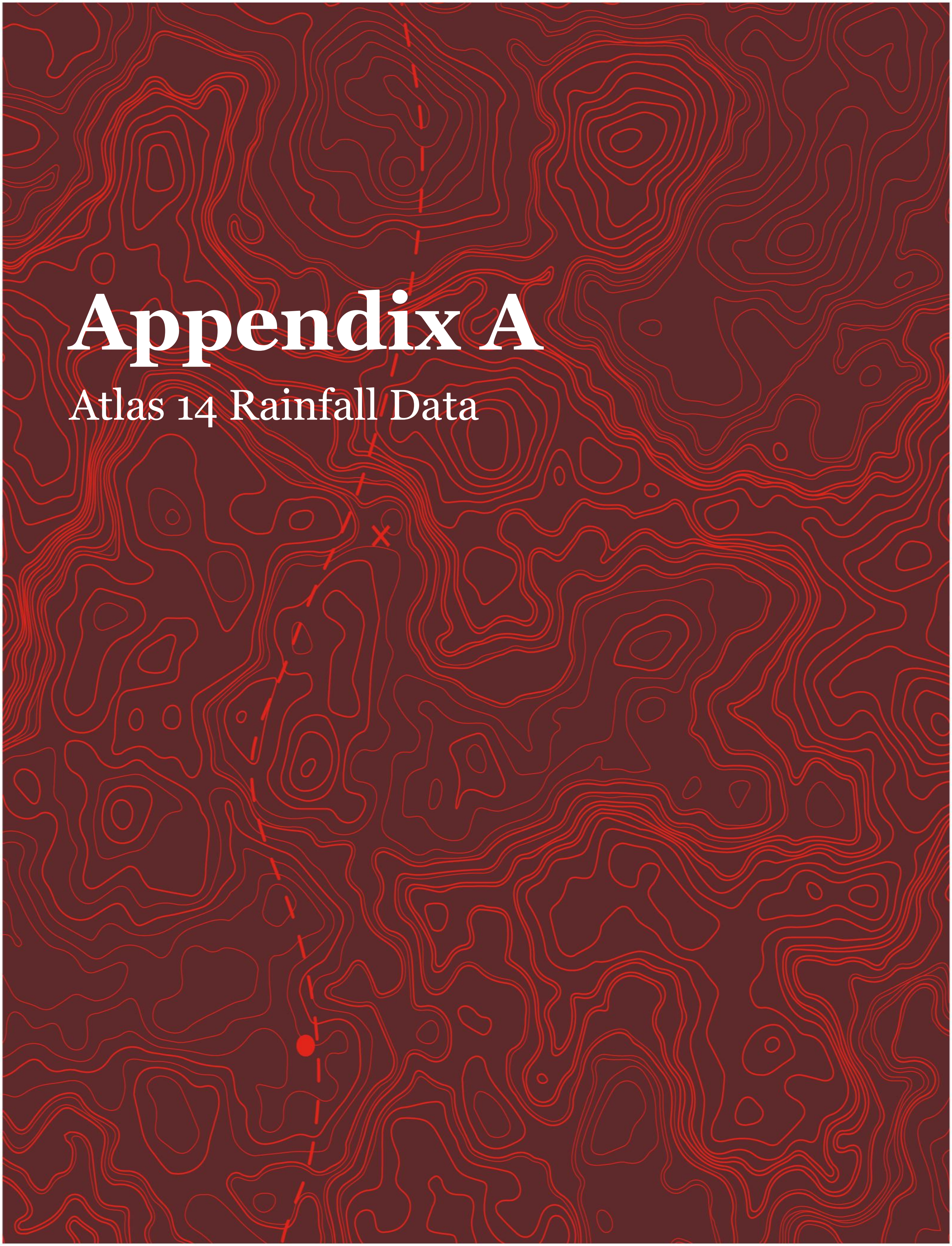
Proposed Drainage MapE - Proposed Drainage Map | 7/13/2021 3:40 PM | GAPolverari



Appendix A

Atlas 14 Rainfall Data

NOAA Atlas 14, Volume 2, Version 3
Location name: Arcadia, Ohio, USA*
Latitude: 41.1251°, Longitude: -83.5125°
Elevation: 786.7 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	**0.337** (0.303-0.374)	**0.400** (0.360-0.445)	**0.479** (0.431-0.532)	**0.543** (0.486-0.602)	**0.623** (0.556-0.690)	**0.686** (0.609-0.758)	**0.748** (0.660-0.826)	**0.812** (0.712-0.895)	**0.898** (0.780-0.993)	**0.961** (0.828-1.07)
10-min	**0.523** (0.471-0.582)	**0.625** (0.562-0.694)	**0.745** (0.669-0.827)	**0.838** (0.750-0.929)	**0.953** (0.850-1.06)	**1.04** (0.923-1.15)	**1.13** (0.994-1.24)	**1.21** (1.06-1.34)	**1.32** (1.15-1.46)	**1.40** (1.21-1.55)
15-min	**0.641** (0.578-0.713)	**0.764** (0.687-0.849)	**0.915** (0.822-1.02)	**1.03** (0.923-1.14)	**1.18** (1.05-1.30)	**1.29** (1.14-1.42)	**1.40** (1.23-1.54)	**1.51** (1.32-1.66)	**1.65** (1.43-1.82)	**1.75** (1.51-1.94)
30-min	**0.848** (0.764-0.943)	**1.02** (0.919-1.14)	**1.25** (1.13-1.39)	**1.43** (1.28-1.59)	**1.66** (1.48-1.84)	**1.84** (1.63-2.03)	**2.02** (1.78-2.23)	**2.20** (1.93-2.42)	**2.44** (2.12-2.70)	**2.62** (2.26-2.91)
60-min	**1.04** (0.933-1.15)	**1.25** (1.13-1.39)	**1.57** (1.41-1.75)	**1.82** (1.63-2.02)	**2.16** (1.92-2.39)	**2.42** (2.15-2.68)	**2.70** (2.38-2.98)	**2.98** (2.62-3.29)	**3.38** (2.93-3.73)	**3.68** (3.17-4.08)
2-hr	**1.21** (1.10-1.34)	**1.46** (1.33-1.63)	**1.84** (1.67-2.04)	**2.15** (1.94-2.38)	**2.58** (2.31-2.85)	**2.92** (2.61-3.22)	**3.29** (2.92-3.63)	**3.67** (3.23-4.06)	**4.22** (3.67-4.67)	**4.66** (4.01-5.16)
3-hr	**1.28** (1.17-1.42)	**1.55** (1.41-1.71)	**1.95** (1.77-2.15)	**2.27** (2.06-2.50)	**2.73** (2.46-3.00)	**3.11** (2.77-3.40)	**3.51** (3.11-3.85)	**3.93** (3.45-4.31)	**4.53** (3.93-4.97)	**5.01** (4.30-5.51)
6-hr	**1.50** (1.37-1.65)	**1.80** (1.65-1.98)	**2.26** (2.06-2.48)	**2.64** (2.39-2.89)	**3.19** (2.87-3.48)	**3.65** (3.27-3.98)	**4.14** (3.68-4.52)	**4.68** (4.12-5.11)	**5.47** (4.72-5.97)	**6.11** (5.22-6.70)
12-hr	**1.73** (1.59-1.90)	**2.08** (1.90-2.28)	**2.59** (2.37-2.84)	**3.02** (2.75-3.31)	**3.65** (3.30-3.97)	**4.17** (3.74-4.53)	**4.74** (4.22-5.15)	**5.36** (4.73-5.83)	**6.27** (5.43-6.82)	**7.01** (6.00-7.65)
24-hr	**2.02** (1.87-2.18)	**2.42** (2.25-2.62)	**3.00** (2.79-3.24)	**3.48** (3.22-3.76)	**4.17** (3.84-4.50)	**4.74** (4.34-5.12)	**5.34** (4.85-5.79)	**5.99** (5.39-6.50)	**6.91** (6.14-7.55)	**7.67** (6.73-8.43)
2-day	**2.35** (2.20-2.51)	**2.81** (2.63-3.01)	**3.46** (3.23-3.70)	**3.98** (3.72-4.26)	**4.74** (4.40-5.07)	**5.36** (4.94-5.74)	**6.01** (5.51-6.47)	**6.71** (6.09-7.24)	**7.69** (6.88-8.37)	**8.49** (7.52-9.29)
3-day	**2.52** (2.37-2.69)	**3.01** (2.83-3.22)	**3.69** (3.46-3.94)	**4.25** (3.97-4.53)	**5.03** (4.68-5.37)	**5.67** (5.25-6.08)	**6.35** (5.82-6.83)	**7.06** (6.42-7.63)	**8.07** (7.24-8.80)	**8.89** (7.88-9.77)
4-day	**2.70** (2.54-2.88)	**3.22** (3.04-3.43)	**3.93** (3.69-4.18)	**4.51** (4.22-4.80)	**5.32** (4.96-5.68)	**5.98** (5.55-6.41)	**6.68** (6.14-7.19)	**7.42** (6.76-8.03)	**8.45** (7.60-9.24)	**9.29** (8.24-10.2)
7-day	**3.18** (3.00-3.38)	**3.79** (3.57-4.01)	**4.58** (4.31-4.85)	**5.22** (4.91-5.54)	**6.12** (5.72-6.51)	**6.84** (6.36-7.30)	**7.60** (7.01-8.14)	**8.38** (7.67-9.03)	**9.48** (8.56-10.3)	**10.4** (9.24-11.4)
10-day	**3.63** (3.44-3.85)	**4.31** (4.08-4.56)	**5.15** (4.87-5.44)	**5.82** (5.49-6.16)	**6.75** (6.35-7.16)	**7.50** (7.01-7.96)	**8.26** (7.67-8.81)	**9.04** (8.34-9.68)	**10.1** (9.23-10.9)	**11.0** (9.93-11.9)
20-day	**4.99** (4.75-5.25)	**5.88** (5.59-6.19)	**6.89** (6.55-7.26)	**7.69** (7.31-8.10)	**8.77** (8.31-9.24)	**9.61** (9.07-10.1)	**10.4** (9.81-11.0)	**11.3** (10.5-12.0)	**12.4** (11.5-13.2)	**13.2** (12.2-14.2)
30-day	**6.20** (5.93-6.51)	**7.29** (6.97-7.65)	**8.45** (8.07-8.86)	**9.34** (8.91-9.79)	**10.5** (10.00-11.0)	**11.4** (10.8-12.0)	**12.3** (11.6-12.9)	**13.1** (12.3-13.8)	**14.2** (13.2-15.1)	**14.9** (13.9-16.0)
45-day	**7.96** (7.62-8.33)	**9.34** (8.93-9.76)	**10.7** (10.2-11.2)	**11.7** (11.2-12.3)	**13.1** (12.5-13.7)	**14.0** (13.4-14.7)	**15.0** (14.2-15.7)	**15.9** (15.0-16.7)	**17.0** (16.0-18.0)	**17.8** (16.7-18.9)
60-day	**9.63** (9.21-10.1)	**11.3** (10.8-11.8)	**12.8** (12.3-13.4)	**14.0** (13.4-14.6)	**15.5** (14.8-16.2)	**16.6** (15.8-17.4)	**17.6** (16.7-18.5)	**18.6** (17.6-19.5)	**19.8** (18.7-20.9)	**20.7** (19.4-21.9)

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

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

Please refer to NOAA Atlas 14 document for more information.

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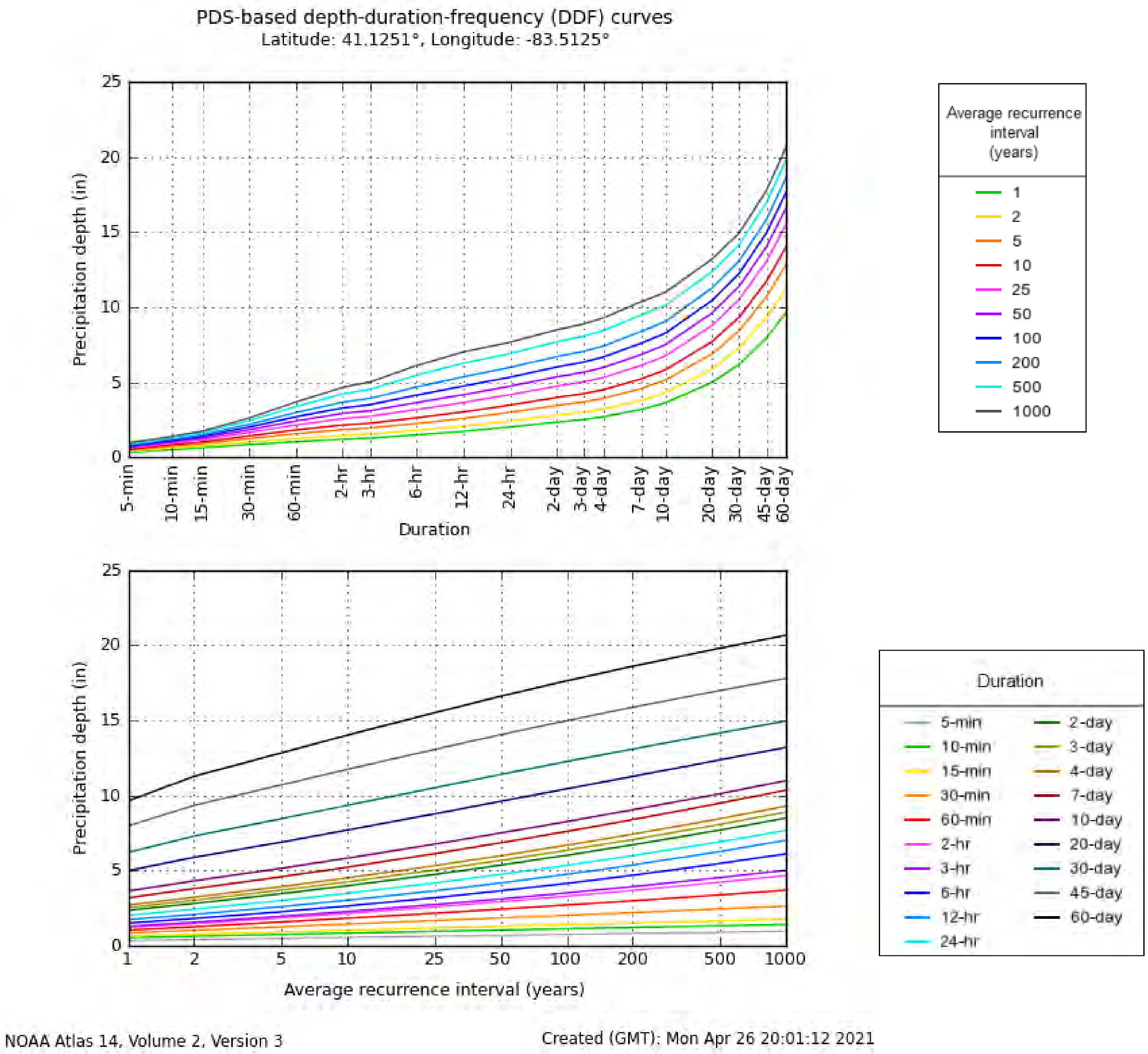
PF graphical



PDS-based depth-duration-frequency (DDF) curves
Latitude: 41.1251°, Longitude: -83.5125°

NOAA Atlas 14, Volume 2, Version 3

Created (GMT): Mon Apr 26 20:01:12 2021

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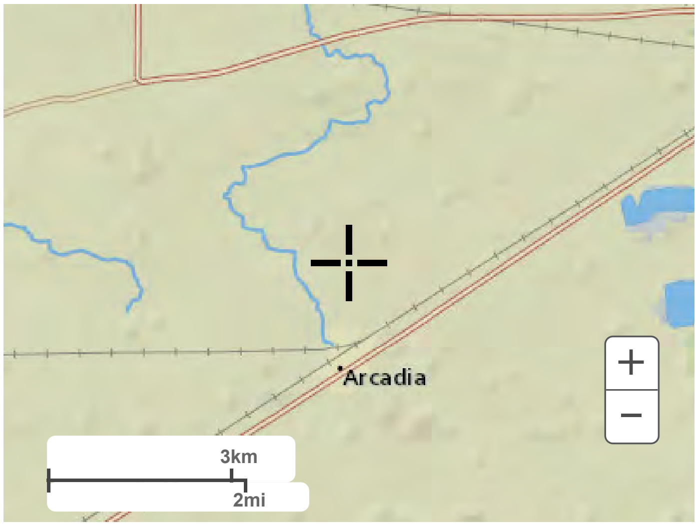
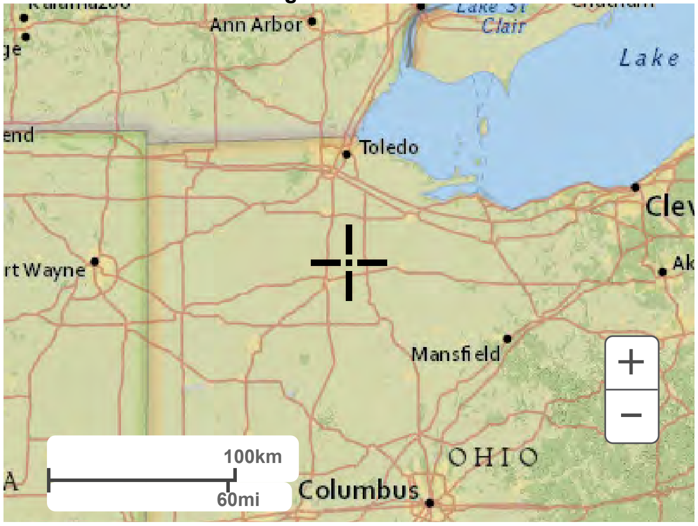
Maps & aerials

Small scale terrain

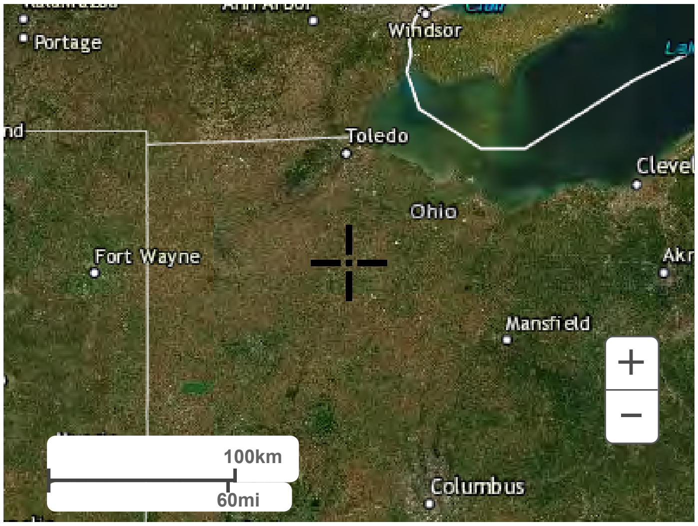


Large scale terrain



Large scale map

Large scale aerial



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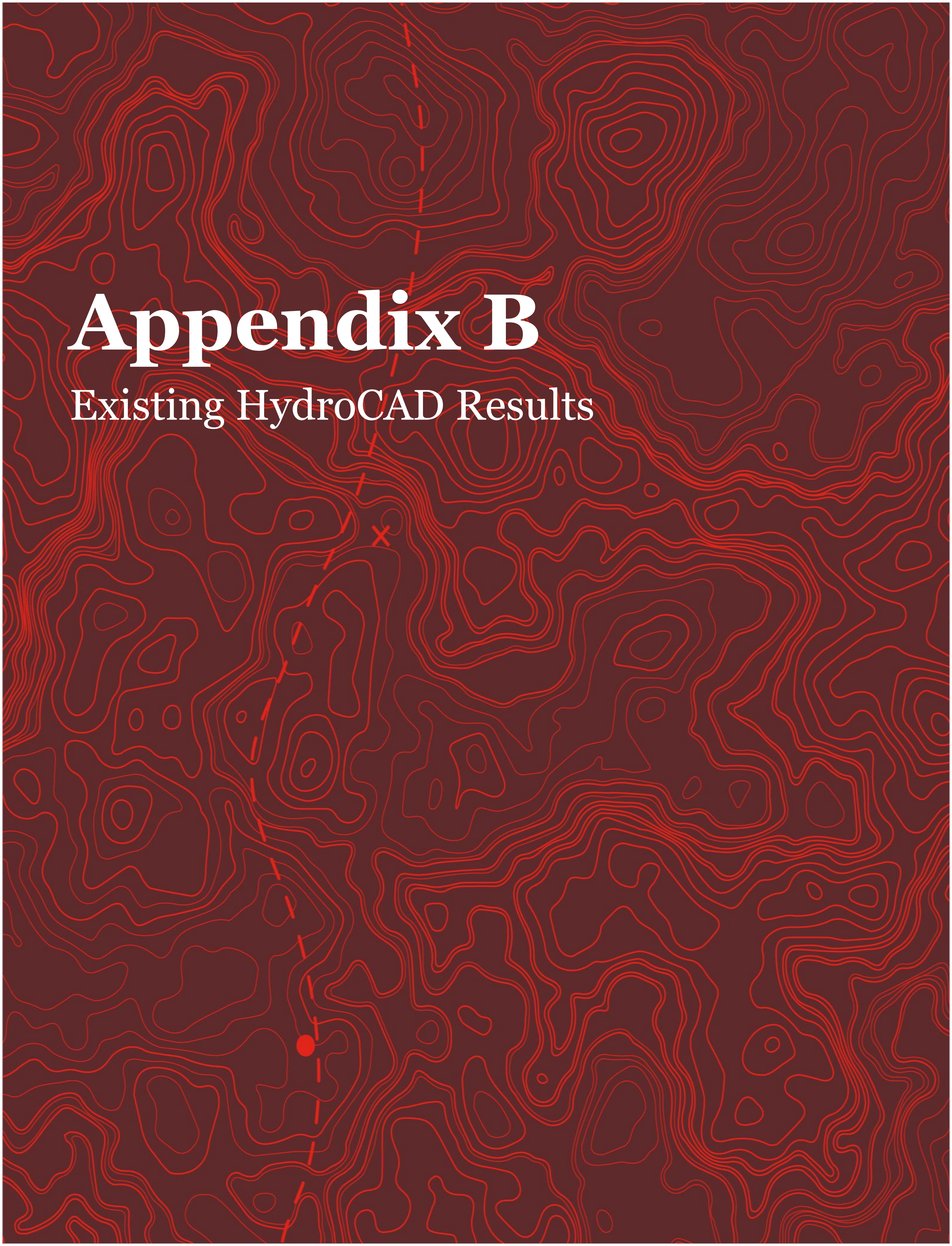
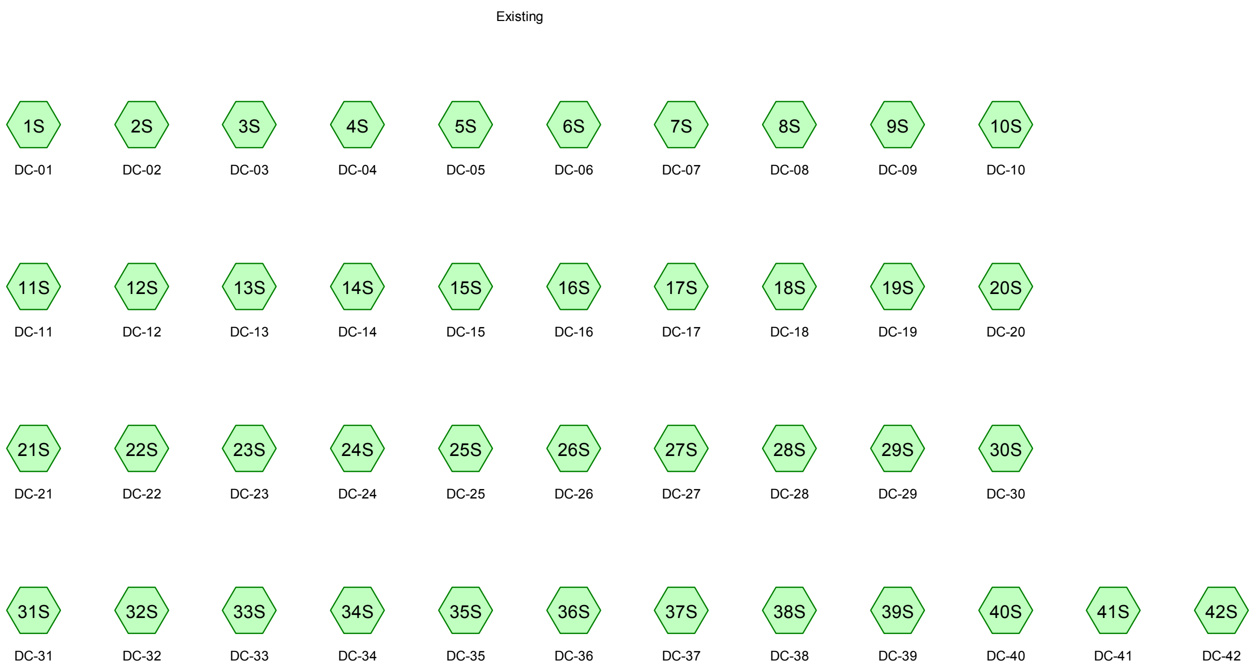
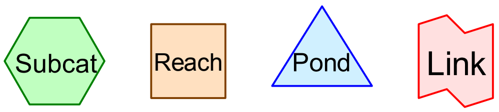


Appendix B

Existing HydroCAD Results





Routing Diagram for 2021-07-12 Pre Post Analysis
Prepared by Westwood Professional Services, Inc., Printed 7/13/2021
HydroCAD® 10.00-22 s/n 03363 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
864.650	89	Row crops, straight row, Good, HSG D (1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 22S, 23S, 24S, 25S, 26S, 27S, 28S, 29S, 30S, 31S, 32S, 33S, 34S, 35S, 36S, 37S, 38S, 39S, 40S, 41S, 42S)
5.740	77	Woods, Good, HSG D (7S)
870.390	**89**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
870.390	HSG D	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 22S, 23S, 24S, 25S, 26S, 27S, 28S, 29S, 30S, 31S, 32S, 33S, 34S, 35S, 36S, 37S, 38S, 39S, 40S, 41S, 42S
0.000	Other	
870.390		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	864.650	0.000	864.650	Row crops, straight row, Good	1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S, 10S, 11S, 12S, 13S, 14S, 15S, 16S, 17S, 18S, 19S, 20S, 21S, 22S, 23S, 24S, 25S, 26S, 27S, 28S, 29S, 30S, 31S, 32S, 33S, 34S, 35S, 36S, 37S, 38S, 39S, 40S, 41S, 42S
0.000	0.000	0.000	5.740	0.000	5.740	Woods, Good	7S
0.000	**0.000**	**0.000**	**870.390**	**0.000**	**870.390**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DC-01 Runoff Area=34.460 ac 0.00% Impervious Runoff Depth>2.20"
Flow Length=777' Slope=0.0061 '/' Tc=24.3 min CN=89 Runoff=76.07 cfs 6.313 af

Subcatchment 2S: DC-02 Runoff Area=15.360 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=1,134' Slope=0.0066 '/' Tc=31.6 min CN=89 Runoff=29.57 cfs 2.808 af

Subcatchment 3S: DC-03 Runoff Area=17.270 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=1,407' Slope=0.0077 '/' Tc=34.8 min CN=89 Runoff=31.57 cfs 3.155 af

Subcatchment 4S: DC-04 Runoff Area=57.040 ac 0.00% Impervious Runoff Depth>2.17"
Flow Length=2,342' Slope=0.0048 '/' Tc=66.2 min CN=89 Runoff=72.07 cfs 10.323 af

Subcatchment 5S: DC-05 Runoff Area=6.570 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=1,011' Slope=0.0033 '/' Tc=40.8 min CN=89 Runoff=11.01 cfs 1.198 af

Subcatchment 6S: DC-06 Runoff Area=28.120 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=1,305' Slope=0.0072 '/' Tc=33.9 min CN=89 Runoff=52.35 cfs 5.138 af

Subcatchment 7S: DC-07 Runoff Area=22.440 ac 0.00% Impervious Runoff Depth>1.91"
Flow Length=1,699' Slope=0.0026 '/' Tc=77.9 min CN=86 Runoff=22.56 cfs 3.579 af

Subcatchment 8S: DC-08 Runoff Area=17.130 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=933' Slope=0.0050 '/' Tc=31.1 min CN=89 Runoff=33.33 cfs 3.132 af

Subcatchment 9S: DC-09 Runoff Area=17.970 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=1,141' Slope=0.0041 '/' Tc=40.3 min CN=89 Runoff=30.39 cfs 3.277 af

Subcatchment 10S: DC-10 Runoff Area=13.370 ac 0.00% Impervious Runoff Depth>2.21"
Flow Length=539' Slope=0.0150 '/' Tc=11.6 min CN=89 Runoff=41.73 cfs 2.458 af

Subcatchment 11S: DC-11 Runoff Area=9.630 ac 0.00% Impervious Runoff Depth>2.20"
Flow Length=705' Slope=0.0048 '/' Tc=25.3 min CN=89 Runoff=20.83 cfs 1.764 af

Subcatchment 12S: DC-12 Runoff Area=65.170 ac 0.00% Impervious Runoff Depth>2.16"
Flow Length=1,973' Slope=0.0023 '/' Tc=83.4 min CN=89 Runoff=70.35 cfs 11.732 af

Subcatchment 13S: DC-13 Runoff Area=6.850 ac 0.00% Impervious Runoff Depth>2.21"
Flow Length=447' Slope=0.0100 '/' Tc=12.2 min CN=89 Runoff=20.97 cfs 1.259 af

Subcatchment 14S: DC-14 Runoff Area=31.250 ac 0.00% Impervious Runoff Depth>2.20"
Flow Length=909' Slope=0.0086 '/' Tc=23.2 min CN=89 Runoff=70.78 cfs 5.727 af

Subcatchment 15S: DC-15 Runoff Area=21.410 ac 0.00% Impervious Runoff Depth>2.19"
Flow Length=1,487' Slope=0.0050 '/' Tc=45.1 min CN=89 Runoff=33.96 cfs 3.899 af

Subcatchment 16S: DC-16 Runoff Area=37.390 ac 0.00% Impervious Runoff Depth>2.20"
Flow Length=803' Slope=0.0135 '/' Tc=16.8 min CN=89 Runoff=98.67 cfs 6.864 af

```
Subcatchment 17S: DC-17                         Runoff Area=10.250 ac  0.00% Impervious  Runoff Depth>2.20"
                   Flow Length=1,004'  Slope=0.0113 '/'  Tc=21.9 min  CN=89  Runoff=23.82 cfs  1.879 af

Subcatchment 18S: DC-18                          Runoff Area=9.520 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=700'  Slope=0.0114 '/'  Tc=16.3 min  CN=89  Runoff=25.43 cfs  1.748 af

Subcatchment 19S: DC-19                         Runoff Area=67.430 ac  0.00% Impervious  Runoff Depth>2.18"
               Flow Length=1,812'  Slope=0.0055 '/'  Tc=50.4 min  CN=89  Runoff=100.15 cfs  12.262 af

Subcatchment 20S: DC-20                        Runoff Area=136.840 ac  0.00% Impervious  Runoff Depth>2.17"
               Flow Length=2,632'  Slope=0.0050 '/'  Tc=71.2 min  CN=89  Runoff=164.77 cfs  24.728 af

Subcatchment 21S: DC-21                          Runoff Area=2.560 ac  0.00% Impervious  Runoff Depth>2.20"
                        Flow Length=456'  Slope=0.0075 '/'  Tc=14.3 min  CN=89  Runoff=7.28 cfs  0.470 af

Subcatchment 22S: DC-22                          Runoff Area=5.620 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=680'  Slope=0.0051 '/'  Tc=23.9 min  CN=89  Runoff=12.55 cfs  1.030 af

Subcatchment 23S: DC-23                          Runoff Area=8.150 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=660'  Slope=0.0079 '/'  Tc=18.7 min  CN=89  Runoff=20.50 cfs  1.495 af

Subcatchment 24S: DC-24                          Runoff Area=7.390 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=621'  Slope=0.0129 '/'  Tc=14.0 min  CN=89  Runoff=21.20 cfs  1.358 af

Subcatchment 25S: DC-25                          Runoff Area=5.760 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=816'  Slope=0.0115 '/'  Tc=18.4 min  CN=89  Runoff=14.63 cfs  1.057 af

Subcatchment 26S: DC-26                         Runoff Area=22.340 ac  0.00% Impervious  Runoff Depth>2.19"
                   Flow Length=1,867'  Slope=0.0074 '/'  Tc=44.5 min  CN=89  Runoff=35.62 cfs  4.069 af

Subcatchment 27S: DC-27                          Runoff Area=3.580 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=431'  Slope=0.0070 '/'  Tc=14.2 min  CN=89  Runoff=10.23 cfs  0.658 af

Subcatchment 28S: DC-28                          Runoff Area=4.810 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=519'  Slope=0.0092 '/'  Tc=14.3 min  CN=89  Runoff=13.67 cfs  0.884 af

Subcatchment 29S: DC-29                          Runoff Area=5.010 ac  0.00% Impervious  Runoff Depth>2.20"
                     Flow Length=650'  Slope=0.0118 '/'  Tc=15.1 min  CN=89  Runoff=13.92 cfs  0.920 af

Subcatchment 30S: DC-30                         Runoff Area=31.720 ac  0.00% Impervious  Runoff Depth>2.19"
                   Flow Length=1,857'  Slope=0.0074 '/'  Tc=44.3 min  CN=89  Runoff=51.03 cfs  5.778 af

Subcatchment 31S: DC-31                         Runoff Area=31.440 ac  0.00% Impervious  Runoff Depth>2.18"
                   Flow Length=2,025'  Slope=0.0056 '/'  Tc=54.6 min  CN=89  Runoff=44.76 cfs  5.710 af

Subcatchment 32S: DC-32                         Runoff Area=10.010 ac  0.00% Impervious  Runoff Depth>2.19"
                     Flow Length=922'  Slope=0.0046 '/'  Tc=32.1 min  CN=89  Runoff=19.13 cfs  1.830 af

Subcatchment 33S: DC-33                         Runoff Area=26.410 ac  0.00% Impervious  Runoff Depth>2.19"
                   Flow Length=1,580'  Slope=0.0072 '/'  Tc=39.5 min  CN=89  Runoff=45.14 cfs  4.818 af
```

```
Subcatchment 34S: DC-34                        Runoff Area=2.420 ac   0.00% Impervious   Runoff Depth>2.21"
                        Flow Length=374'   Slope=0.0083 '/'   Tc=11.6 min   CN=89   Runoff=7.55 cfs  0.445 af

Subcatchment 35S: DC-35                        Runoff Area=3.490 ac   0.00% Impervious   Runoff Depth>2.20"
                       Flow Length=720'   Slope=0.0184 '/'   Tc=13.2 min   CN=89   Runoff=10.25 cfs  0.641 af

Subcatchment 36S: DC-36                        Runoff Area=3.780 ac   0.00% Impervious   Runoff Depth>2.21"
                       Flow Length=539'   Slope=0.0154 '/'   Tc=11.4 min   CN=89   Runoff=11.90 cfs  0.695 af

Subcatchment 37S: DC-37                        Runoff Area=1.910 ac   0.00% Impervious   Runoff Depth>2.21"
                         Flow Length=324'   Slope=0.0199 '/'   Tc=6.7 min   CN=89   Runoff=7.33 cfs  0.352 af

Subcatchment 38S: DC-38                        Runoff Area=9.120 ac   0.00% Impervious   Runoff Depth>2.19"
                     Flow Length=1,450'   Slope=0.0055 '/'   Tc=42.1 min   CN=89   Runoff=15.02 cfs  1.662 af

Subcatchment 39S: DC-39                        Runoff Area=8.310 ac   0.00% Impervious   Runoff Depth>2.20"
                       Flow Length=745'   Slope=0.0054 '/'   Tc=25.0 min   CN=89   Runoff=18.11 cfs  1.522 af

Subcatchment 40S: DC-40                        Runoff Area=5.880 ac   0.00% Impervious   Runoff Depth>2.20"
                       Flow Length=761'   Slope=0.0046 '/'   Tc=27.5 min   CN=89   Runoff=12.19 cfs  1.076 af

Subcatchment 41S: DC-41                       Runoff Area=17.820 ac   0.00% Impervious   Runoff Depth>2.19"
                     Flow Length=1,457'   Slope=0.0048 '/'   Tc=45.3 min   CN=89   Runoff=28.17 cfs  3.245 af

Subcatchment 42S: DC-42                       Runoff Area=27.390 ac   0.00% Impervious   Runoff Depth>2.14"
                    Flow Length=2,779'   Slope=0.0025 '/'   Tc=105.2 min   CN=89   Runoff=24.89 cfs  4.895 af

              Total Runoff Area = 870.390 ac   Runoff Volume = 157.850 af   Average Runoff Depth = 2.18"
                                          100.00% Pervious = 870.390 ac     0.00% Impervious = 0.000 ac
```

Summary for Subcatchment 1S: DC-01

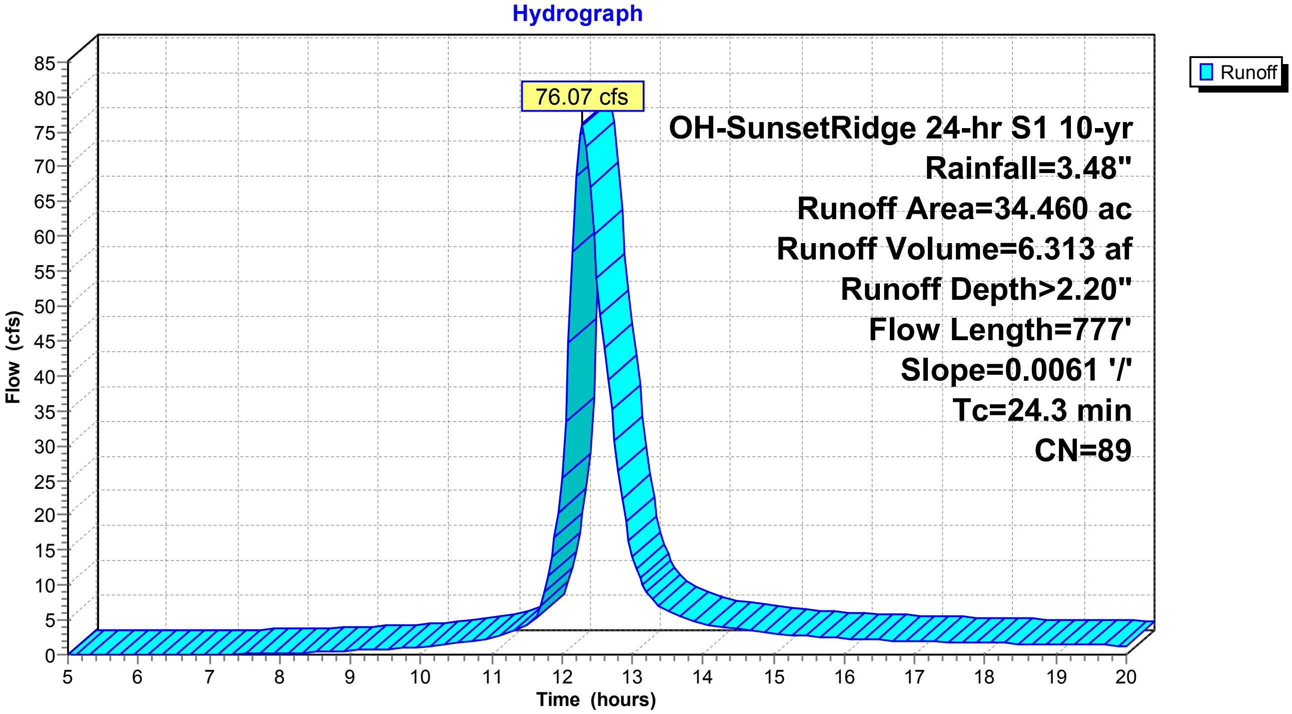
Runoff = 76.07 cfs @ 12.29 hrs, Volume= 6.313 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
34.460	89	Row crops, straight row, Good, HSG D
34.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	777	0.0061	0.53		**Lag/CN Method,**

Subcatchment 1S: DC-01



Summary for Subcatchment 2S: DC-02

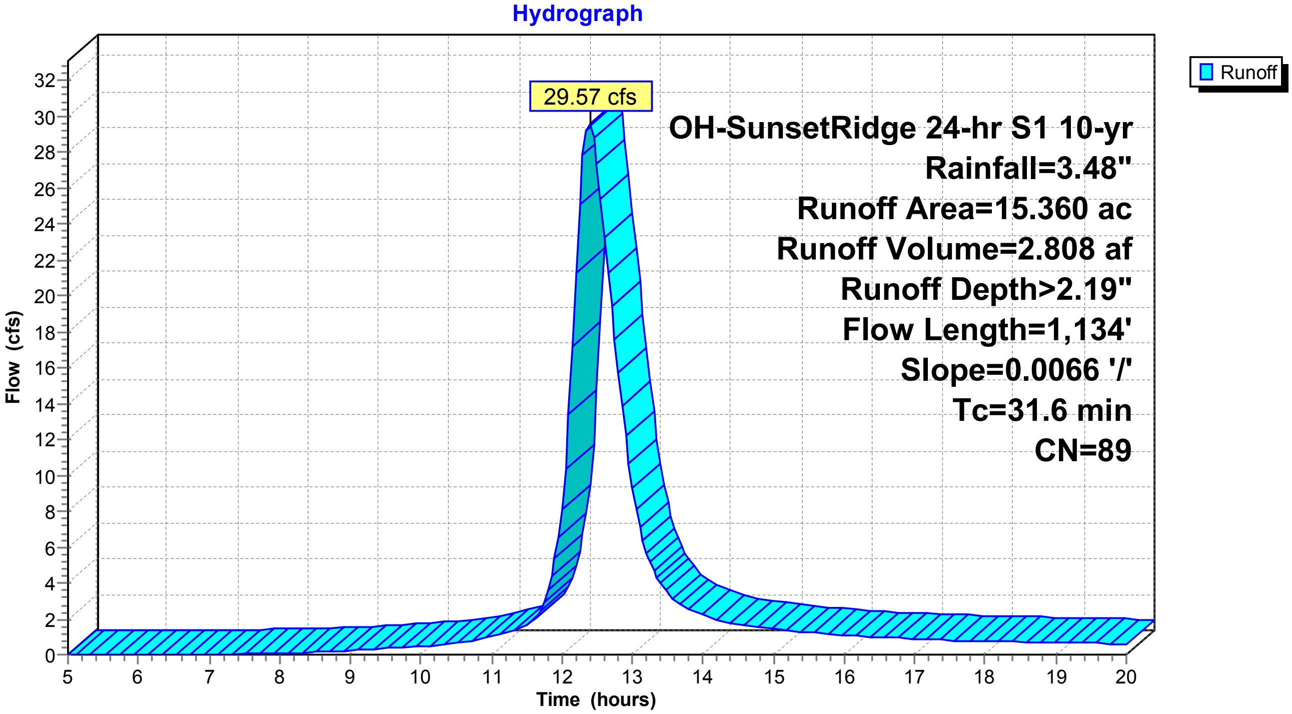
Runoff = 29.57 cfs @ 12.39 hrs, Volume= 2.808 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
15.360	89	Row crops, straight row, Good, HSG D
15.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.6	1,134	0.0066	0.60		**Lag/CN Method,**

Subcatchment 2S: DC-02



Summary for Subcatchment 3S: DC-03

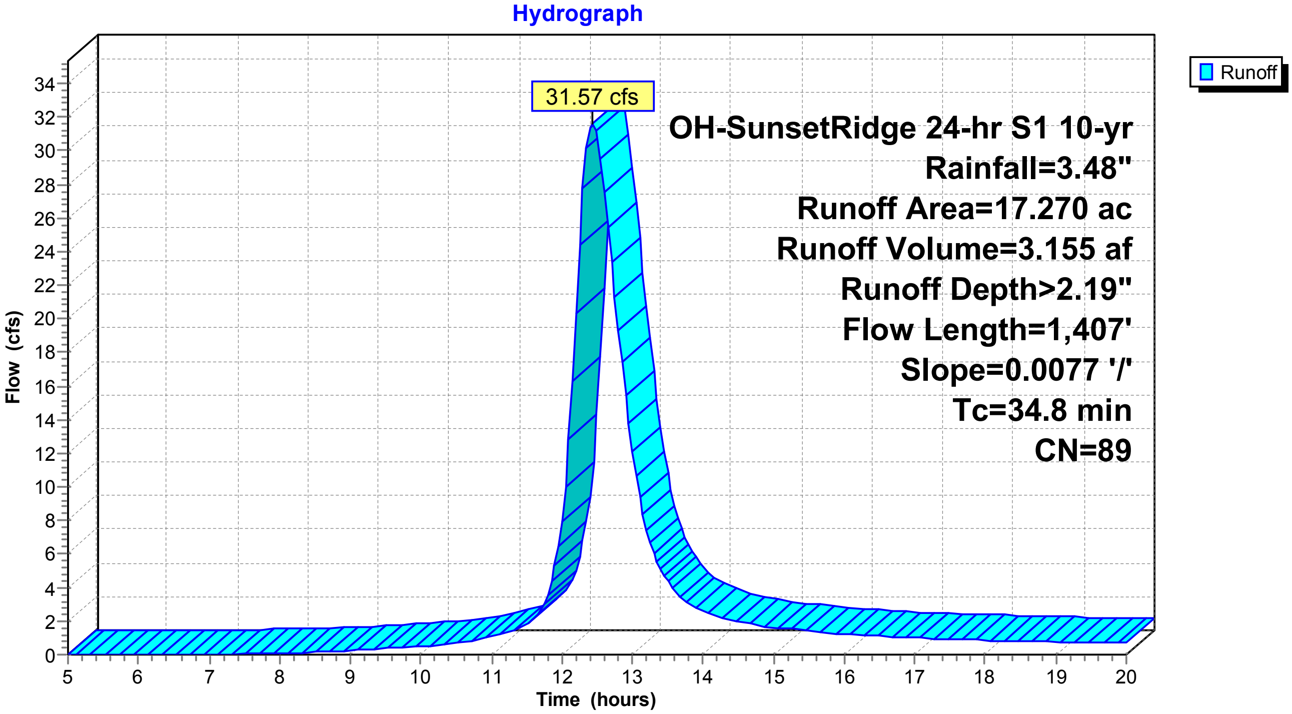
Runoff = 31.57 cfs @ 12.43 hrs, Volume= 3.155 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
17.270	89	Row crops, straight row, Good, HSG D
17.270		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.8	1,407	0.0077	0.67		**Lag/CN Method,**

Subcatchment 3S: DC-03



Summary for Subcatchment 4S: DC-04

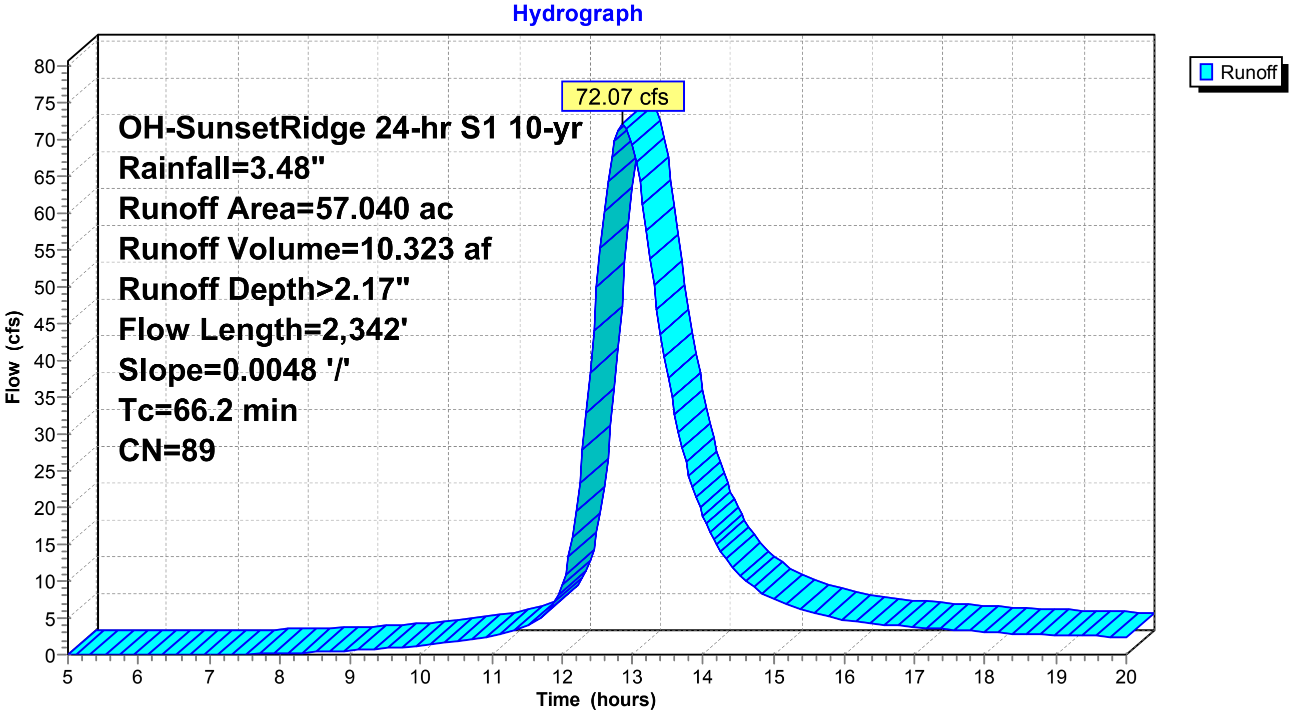
Runoff = 72.07 cfs @ 12.86 hrs, Volume= 10.323 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
57.040	89	Row crops, straight row, Good, HSG D
57.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.2	2,342	0.0048	0.59		**Lag/CN Method,**

Subcatchment 4S: DC-04



Summary for Subcatchment 5S: DC-05

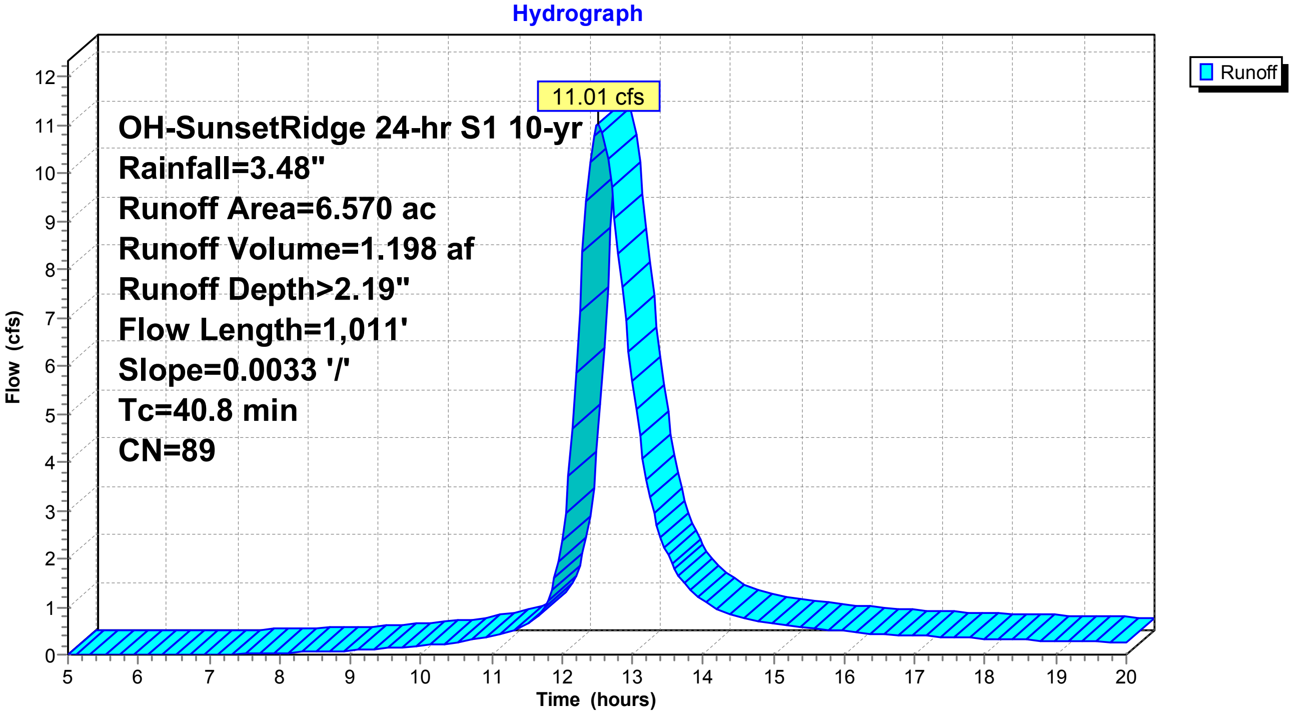
Runoff = 11.01 cfs @ 12.52 hrs, Volume= 1.198 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
6.570	89	Row crops, straight row, Good, HSG D
6.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.8	1,011	0.0033	0.41		**Lag/CN Method,**

Subcatchment 5S: DC-05



Summary for Subcatchment 6S: DC-06

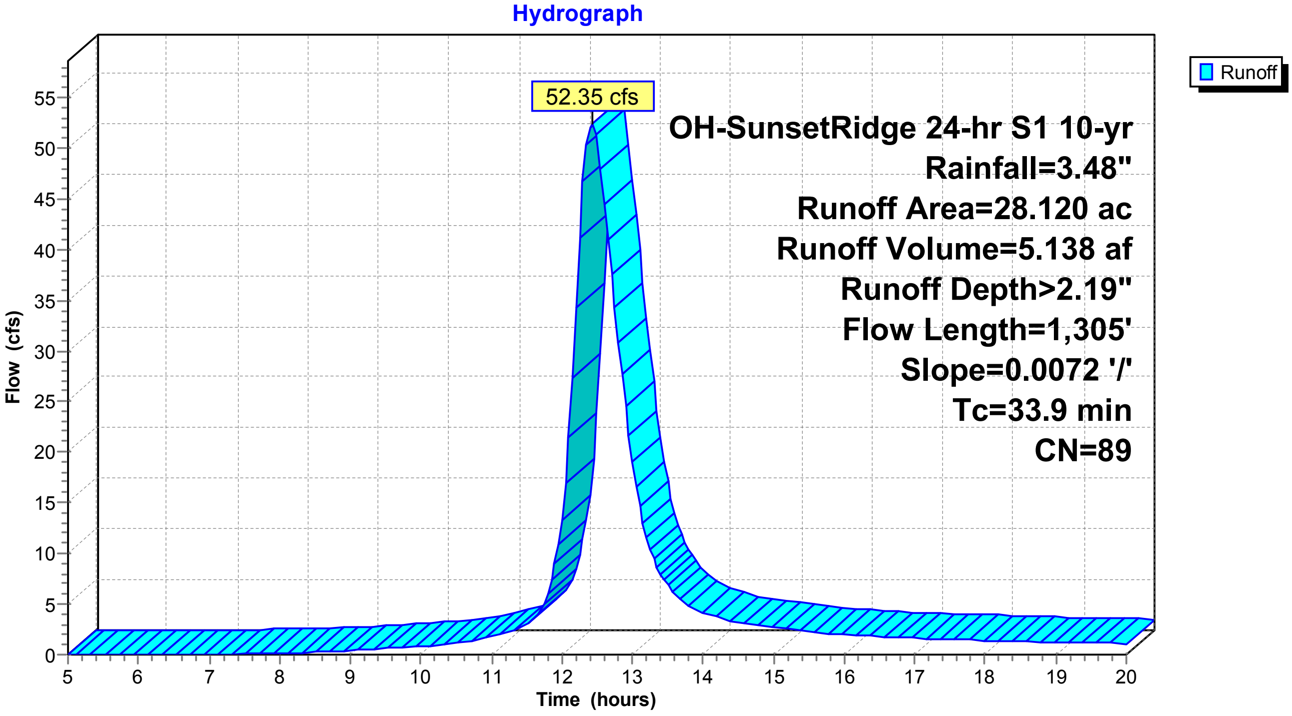
Runoff = 52.35 cfs @ 12.42 hrs, Volume= 5.138 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
28.120	89	Row crops, straight row, Good, HSG D
28.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.9	1,305	0.0072	0.64		**Lag/CN Method,**

Subcatchment 6S: DC-06



Summary for Subcatchment 7S: DC-07

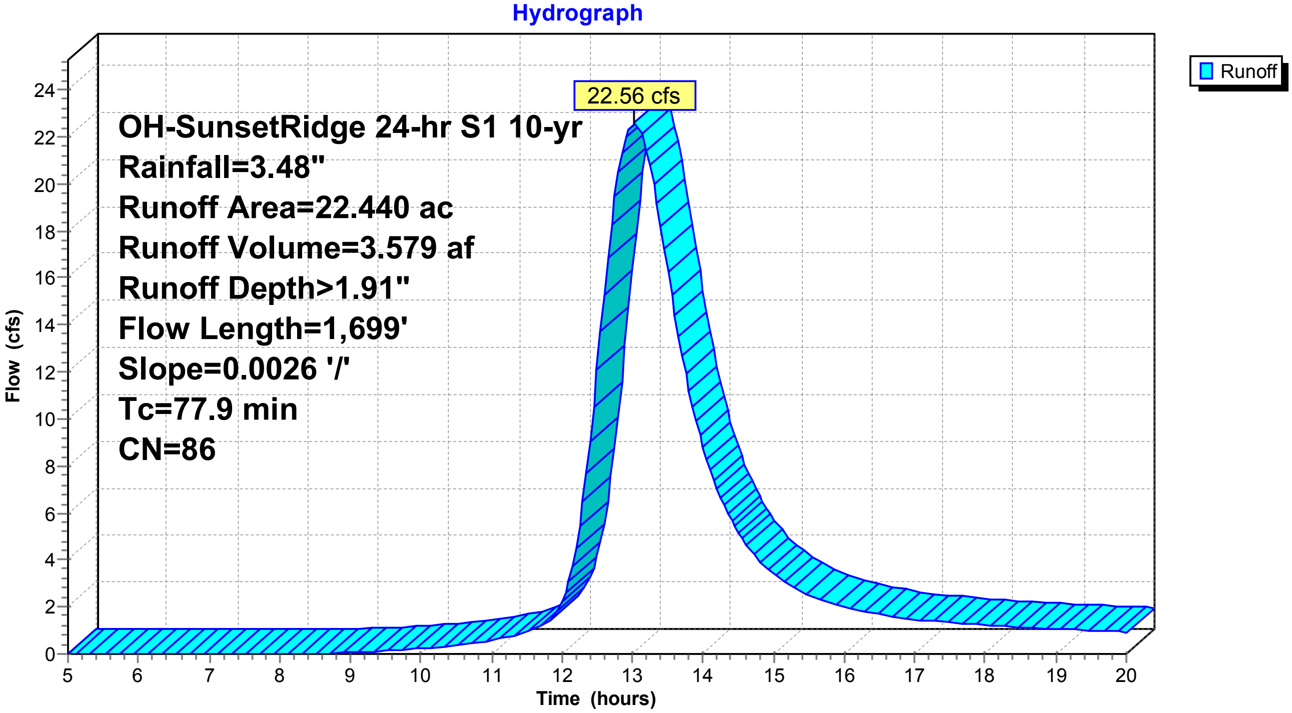
Runoff = 22.56 cfs @ 13.03 hrs, Volume= 3.579 af, Depth> 1.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
16.700	89	Row crops, straight row, Good, HSG D
5.740	77	Woods, Good, HSG D
22.440	86	Weighted Average
22.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.9	1,699	0.0026	0.36		**Lag/CN Method,**

Subcatchment 7S: DC-07



Summary for Subcatchment 8S: DC-08

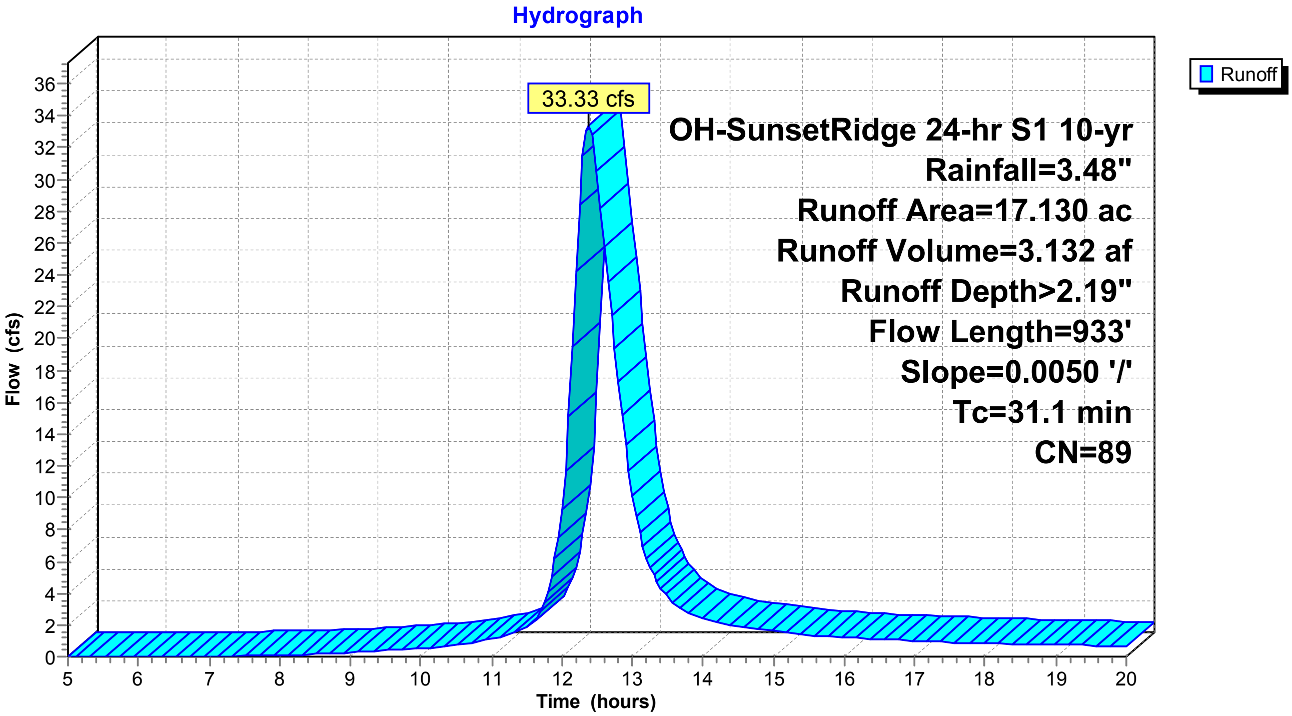
Runoff = 33.33 cfs @ 12.38 hrs, Volume= 3.132 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
17.130	89	Row crops, straight row, Good, HSG D
17.130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.1	933	0.0050	0.50		**Lag/CN Method,**

Subcatchment 8S: DC-08



Summary for Subcatchment 9S: DC-09

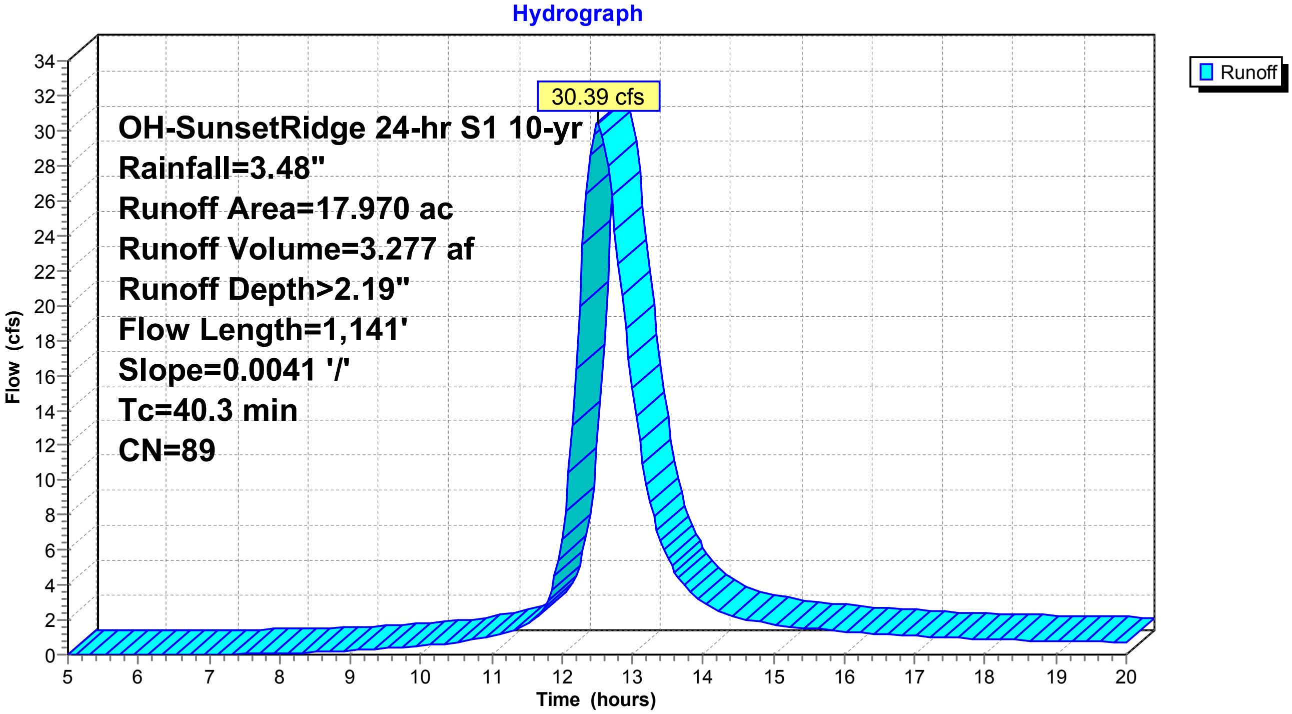
Runoff = 30.39 cfs @ 12.51 hrs, Volume= 3.277 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
17.970	89	Row crops, straight row, Good, HSG D
17.970		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.3	1,141	0.0041	0.47		**Lag/CN Method,**

Subcatchment 9S: DC-09



Summary for Subcatchment 10S: DC-10

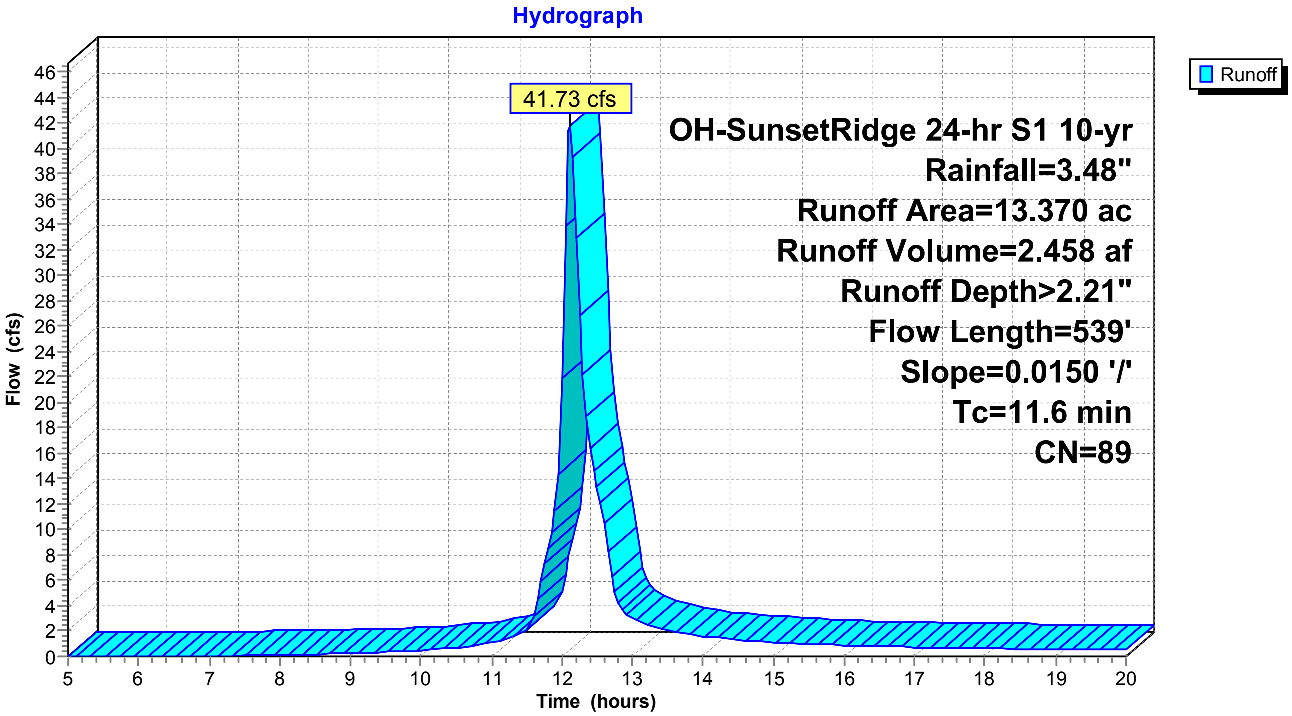
Runoff = 41.73 cfs @ 12.11 hrs, Volume= 2.458 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
13.370	89	Row crops, straight row, Good, HSG D
13.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	539	0.0150	0.78		**Lag/CN Method,**

Subcatchment 10S: DC-10



Summary for Subcatchment 11S: DC-11

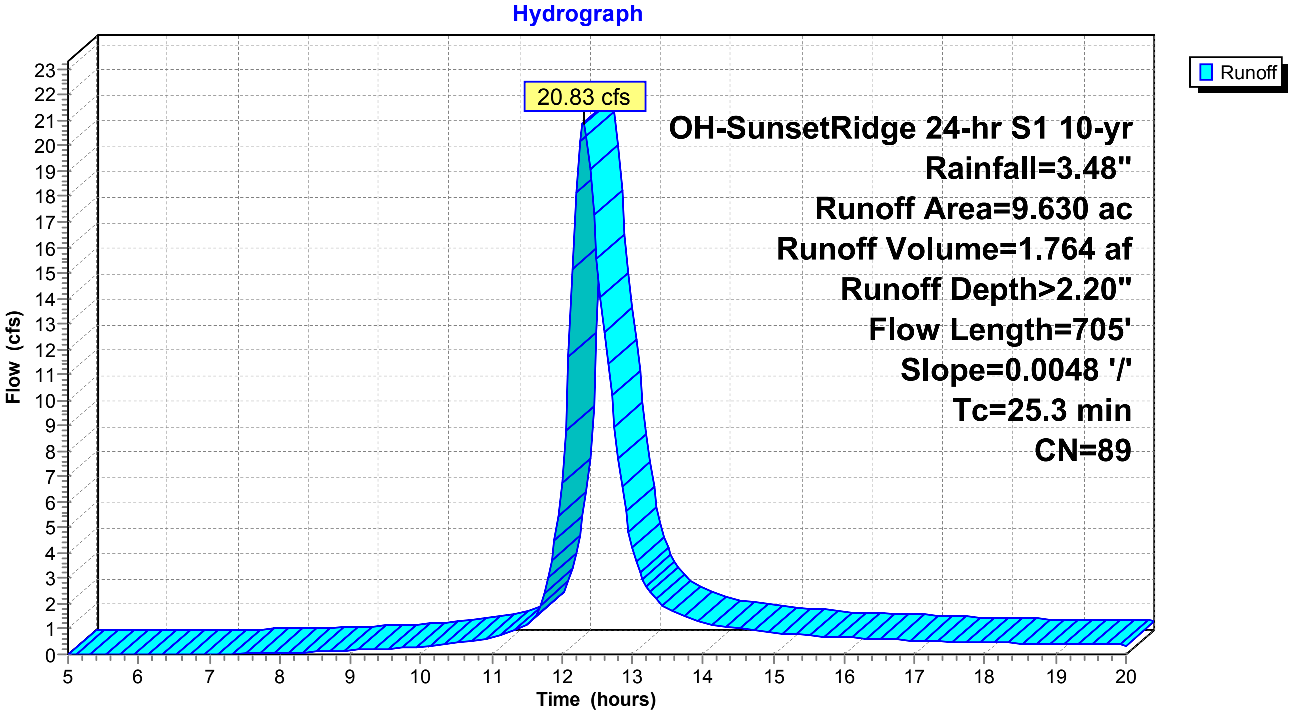
Runoff = 20.83 cfs @ 12.30 hrs, Volume= 1.764 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
9.630	89	Row crops, straight row, Good, HSG D
9.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.3	705	0.0048	0.46		**Lag/CN Method,**

Subcatchment 11S: DC-11



Summary for Subcatchment 12S: DC-12

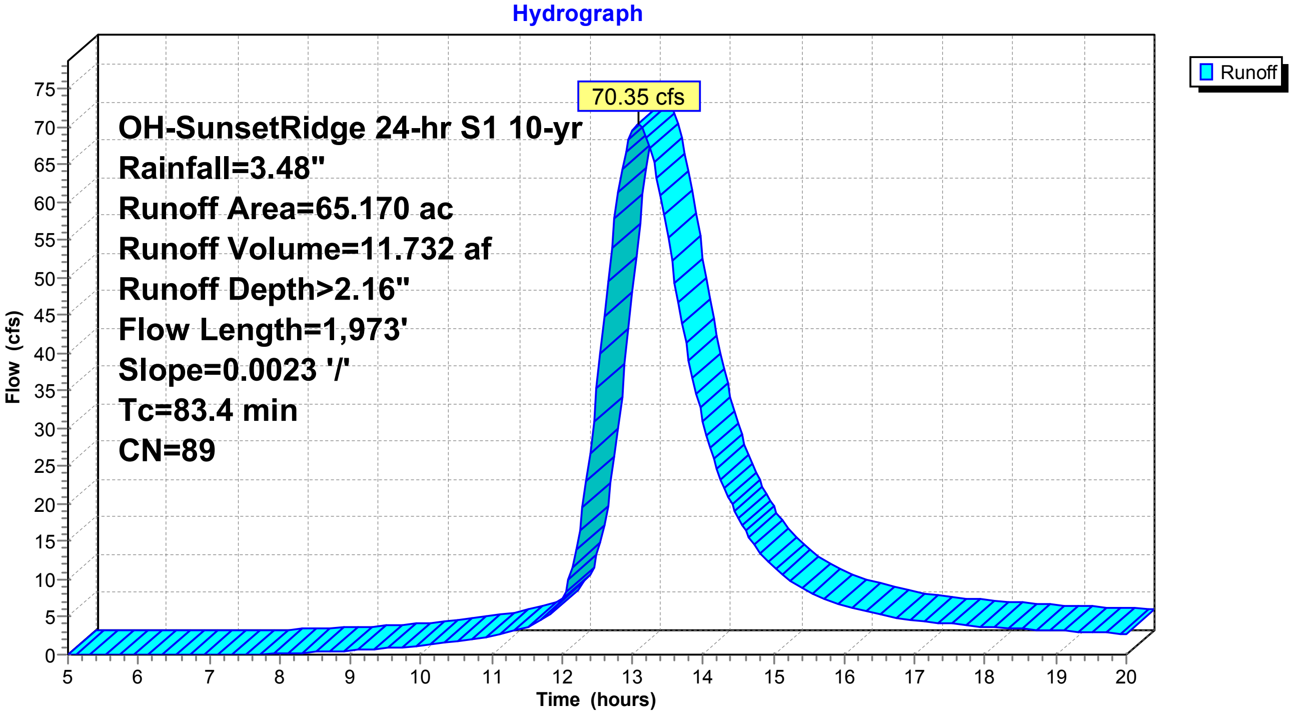
Runoff = 70.35 cfs @ 13.07 hrs, Volume= 11.732 af, Depth> 2.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
65.170	89	Row crops, straight row, Good, HSG D
65.170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
83.4	1,973	0.0023	0.39		**Lag/CN Method,**

Subcatchment 12S: DC-12



Summary for Subcatchment 13S: DC-13

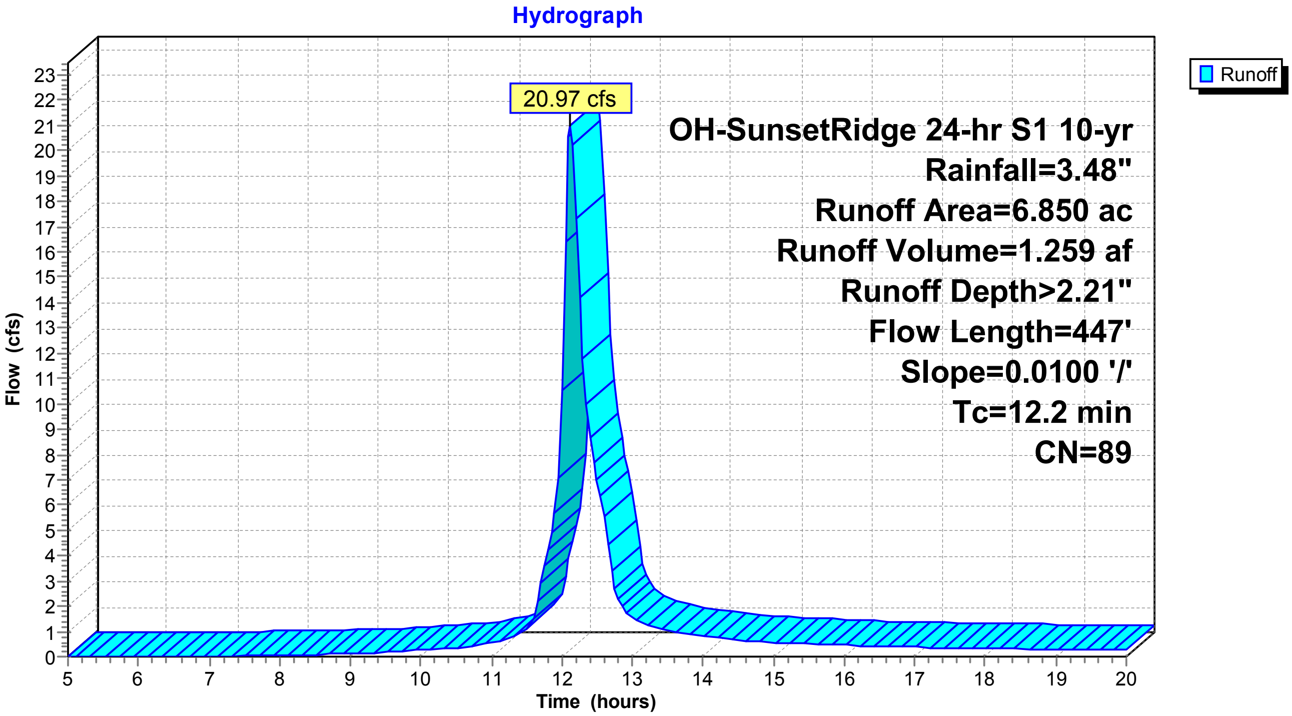
Runoff = 20.97 cfs @ 12.12 hrs, Volume= 1.259 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
6.850	89	Row crops, straight row, Good, HSG D
6.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	447	0.0100	0.61		**Lag/CN Method,**

Subcatchment 13S: DC-13



Summary for Subcatchment 14S: DC-14

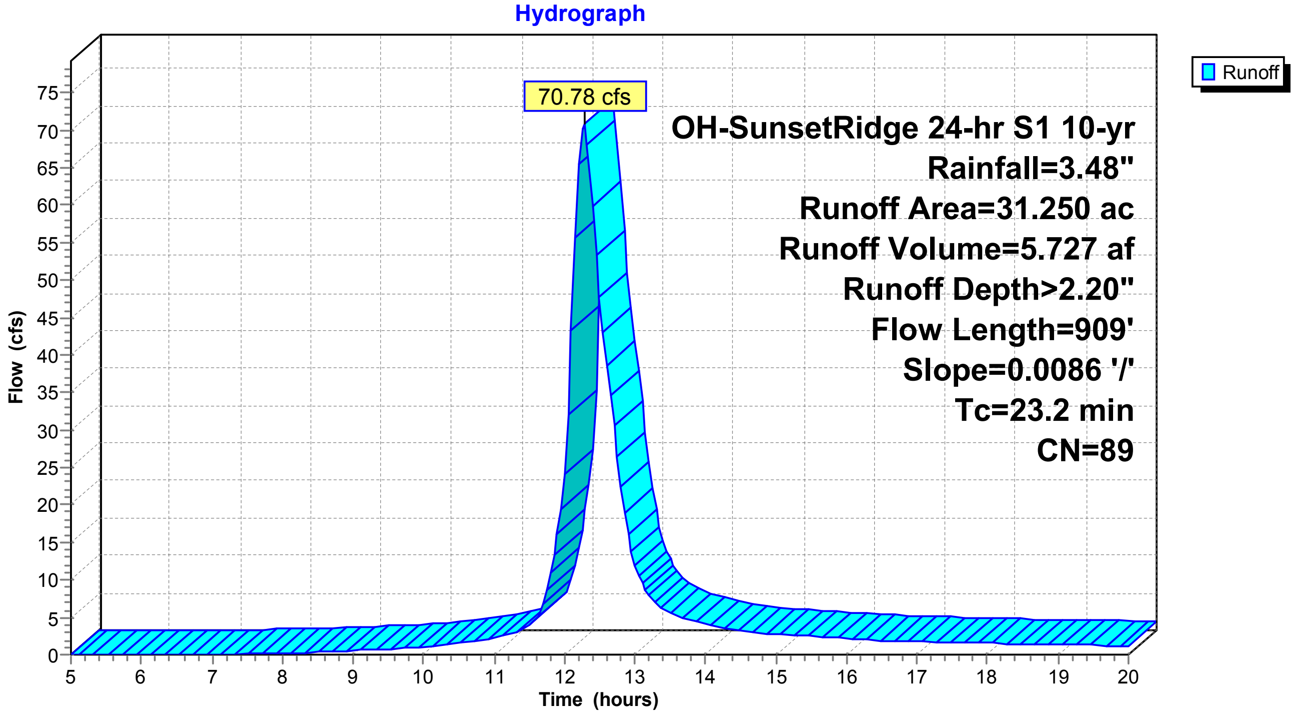
Runoff = 70.78 cfs @ 12.27 hrs, Volume= 5.727 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
31.250	89	Row crops, straight row, Good, HSG D
31.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	909	0.0086	0.65		**Lag/CN Method,**

Subcatchment 14S: DC-14



Summary for Subcatchment 15S: DC-15

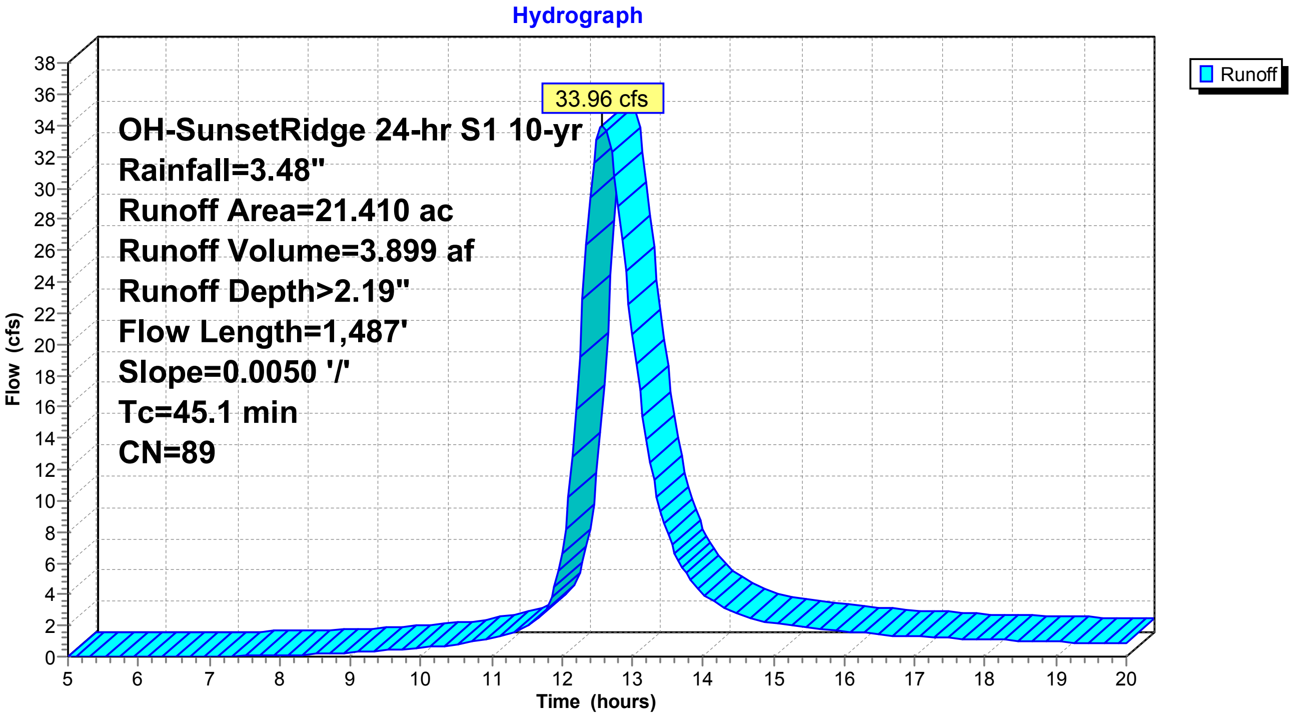
Runoff = 33.96 cfs @ 12.58 hrs, Volume= 3.899 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
21.410	89	Row crops, straight row, Good, HSG D
21.410		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.1	1,487	0.0050	0.55		**Lag/CN Method,**

Subcatchment 15S: DC-15



Summary for Subcatchment 16S: DC-16

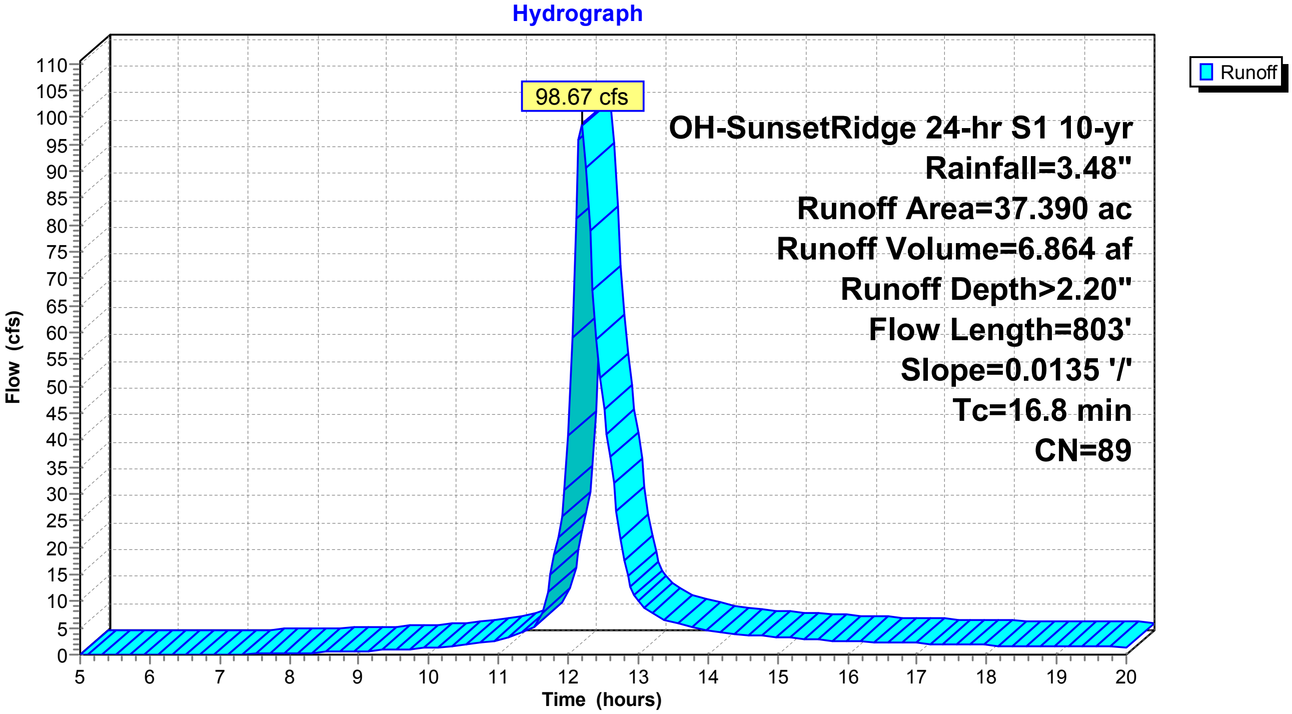
Runoff = 98.67 cfs @ 12.19 hrs, Volume= 6.864 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
37.390	89	Row crops, straight row, Good, HSG D
37.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	803	0.0135	0.80		**Lag/CN Method,**

Subcatchment 16S: DC-16



Summary for Subcatchment 17S: DC-17

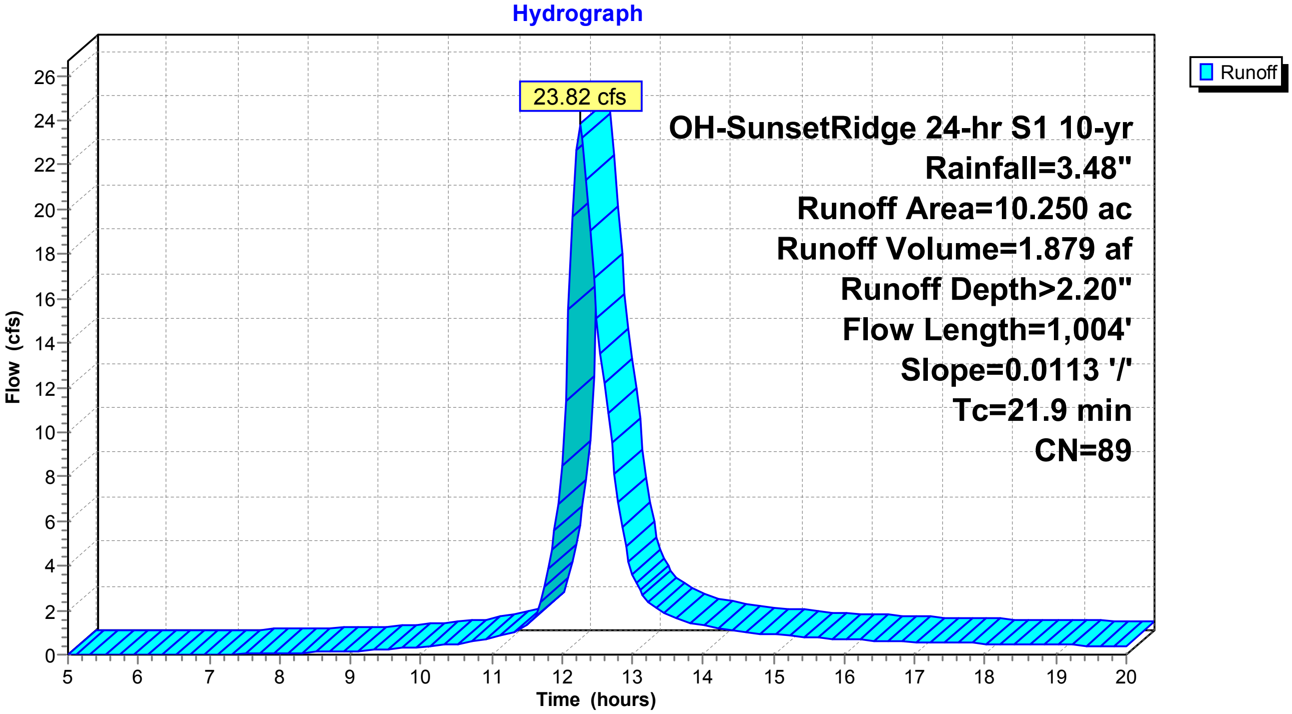
Runoff = 23.82 cfs @ 12.26 hrs, Volume= 1.879 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
10.250	89	Row crops, straight row, Good, HSG D
10.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	1,004	0.0113	0.76		**Lag/CN Method,**

Subcatchment 17S: DC-17



Summary for Subcatchment 18S: DC-18

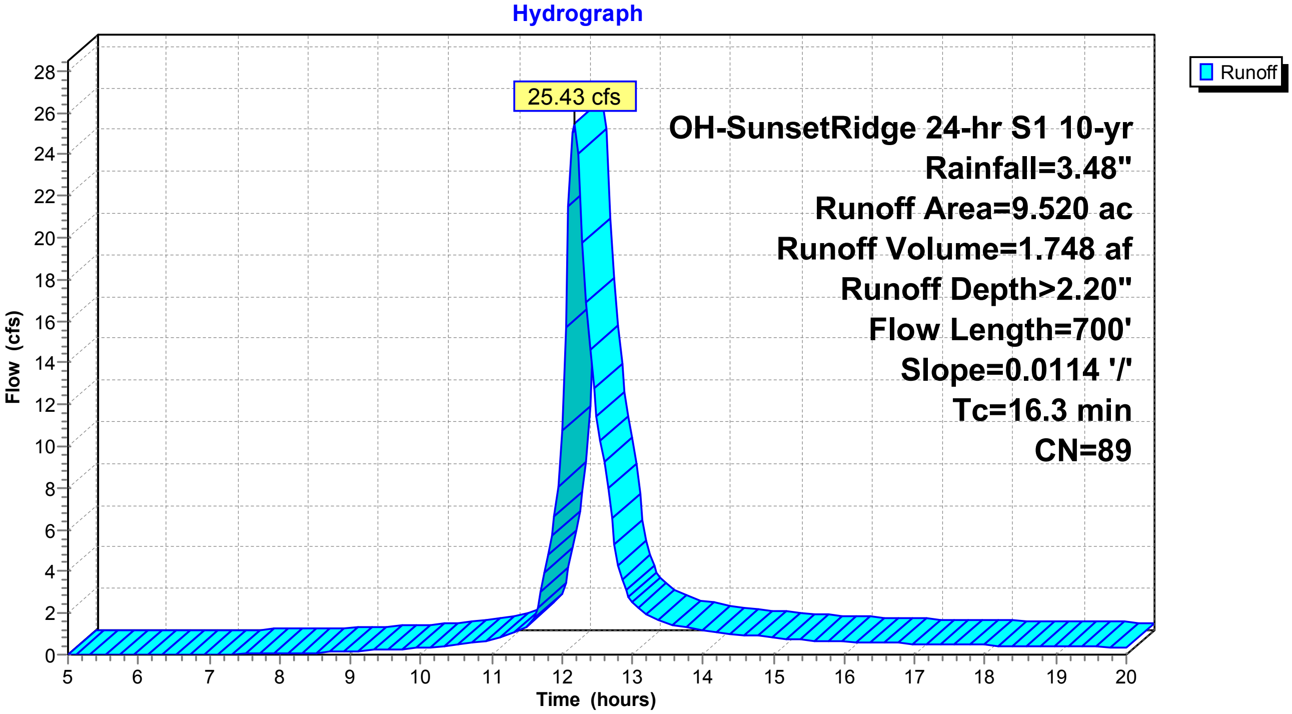
Runoff = 25.43 cfs @ 12.18 hrs, Volume= 1.748 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
9.520	89	Row crops, straight row, Good, HSG D
9.520		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	700	0.0114	0.71		**Lag/CN Method,**

Subcatchment 18S: DC-18



Summary for Subcatchment 19S: DC-19

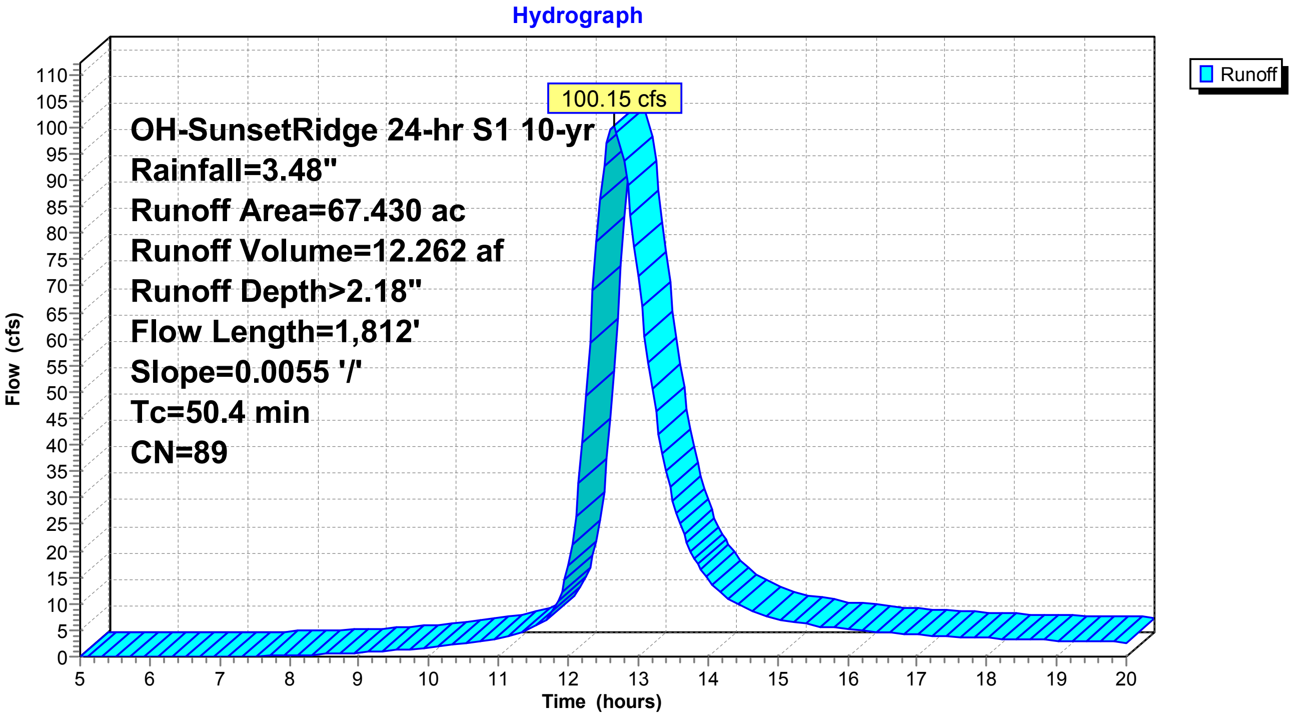
Runoff = 100.15 cfs @ 12.65 hrs, Volume= 12.262 af, Depth> 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
67.430	89	Row crops, straight row, Good, HSG D
67.430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.4	1,812	0.0055	0.60		**Lag/CN Method,**

Subcatchment 19S: DC-19



Summary for Subcatchment 20S: DC-20

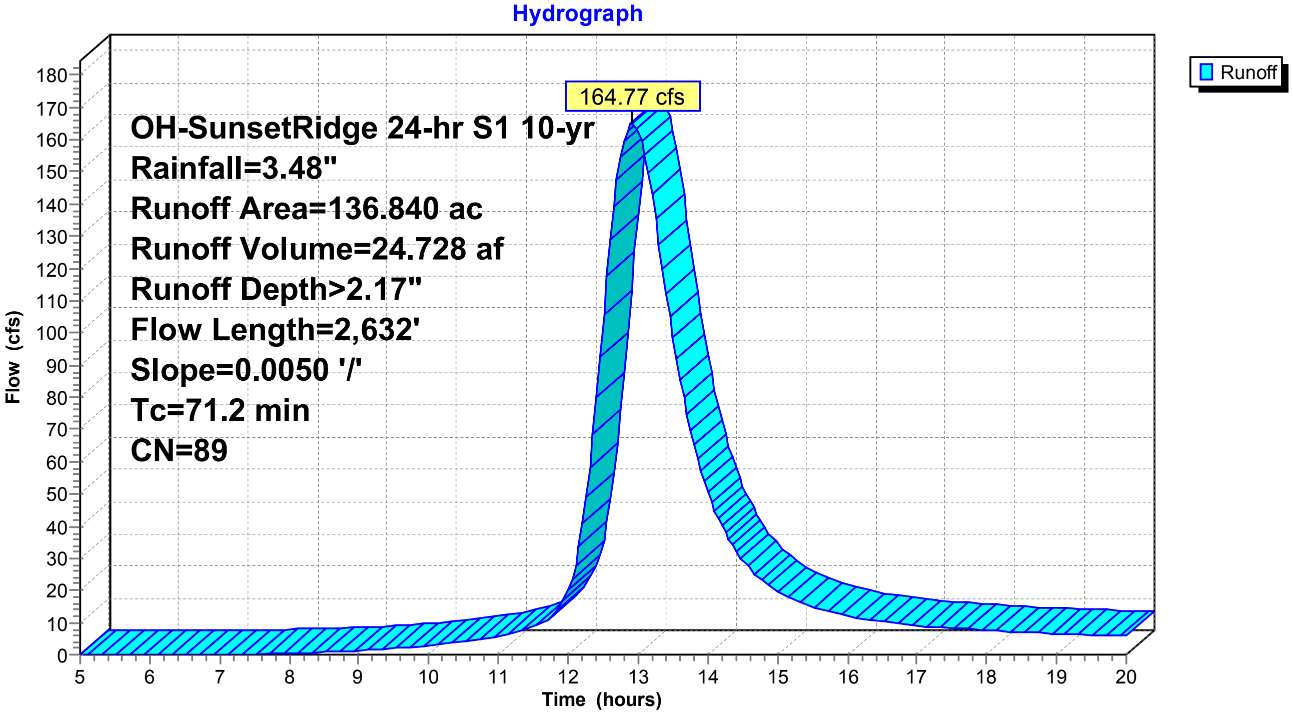
Runoff = 164.77 cfs @ 12.91 hrs, Volume= 24.728 af, Depth> 2.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
136.840	89	Row crops, straight row, Good, HSG D
136.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
71.2	2,632	0.0050	0.62		**Lag/CN Method,**

Subcatchment 20S: DC-20



Summary for Subcatchment 21S: DC-21

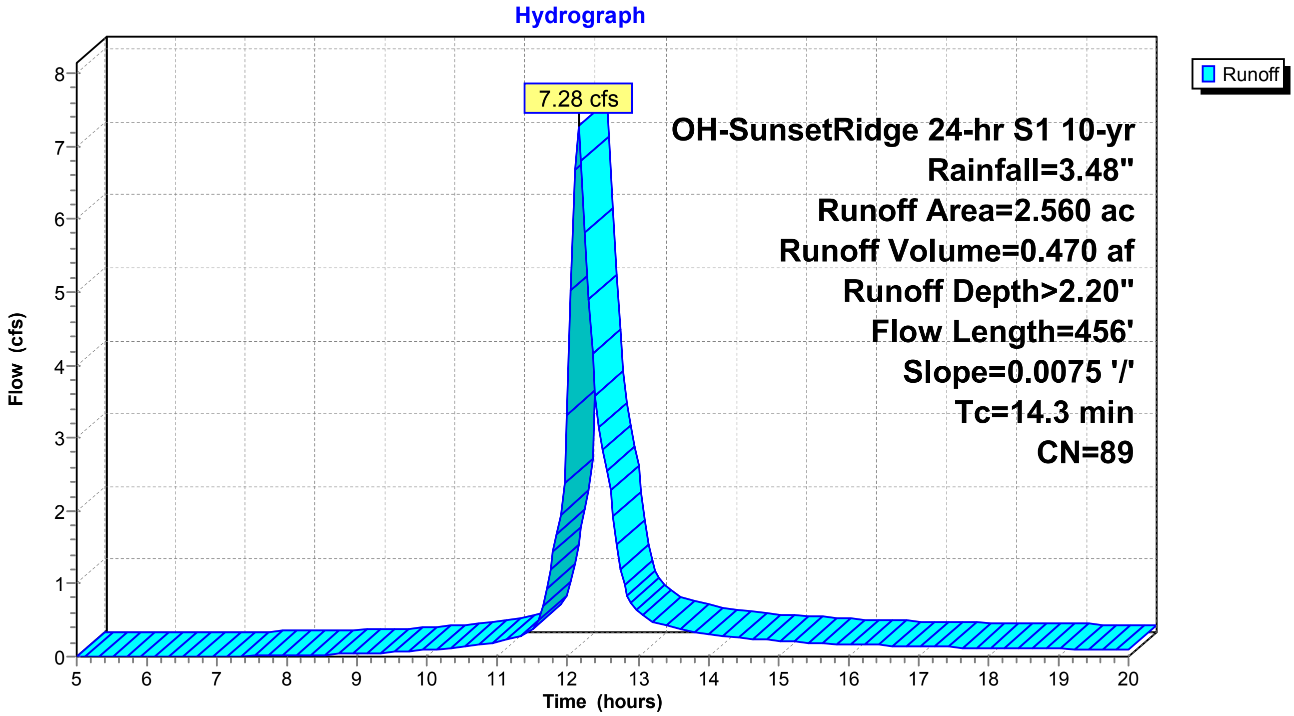
Runoff = 7.28 cfs @ 12.15 hrs, Volume= 0.470 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
2.560	89	Row crops, straight row, Good, HSG D
2.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	456	0.0075	0.53		**Lag/CN Method,**

Subcatchment 21S: DC-21



Summary for Subcatchment 22S: DC-22

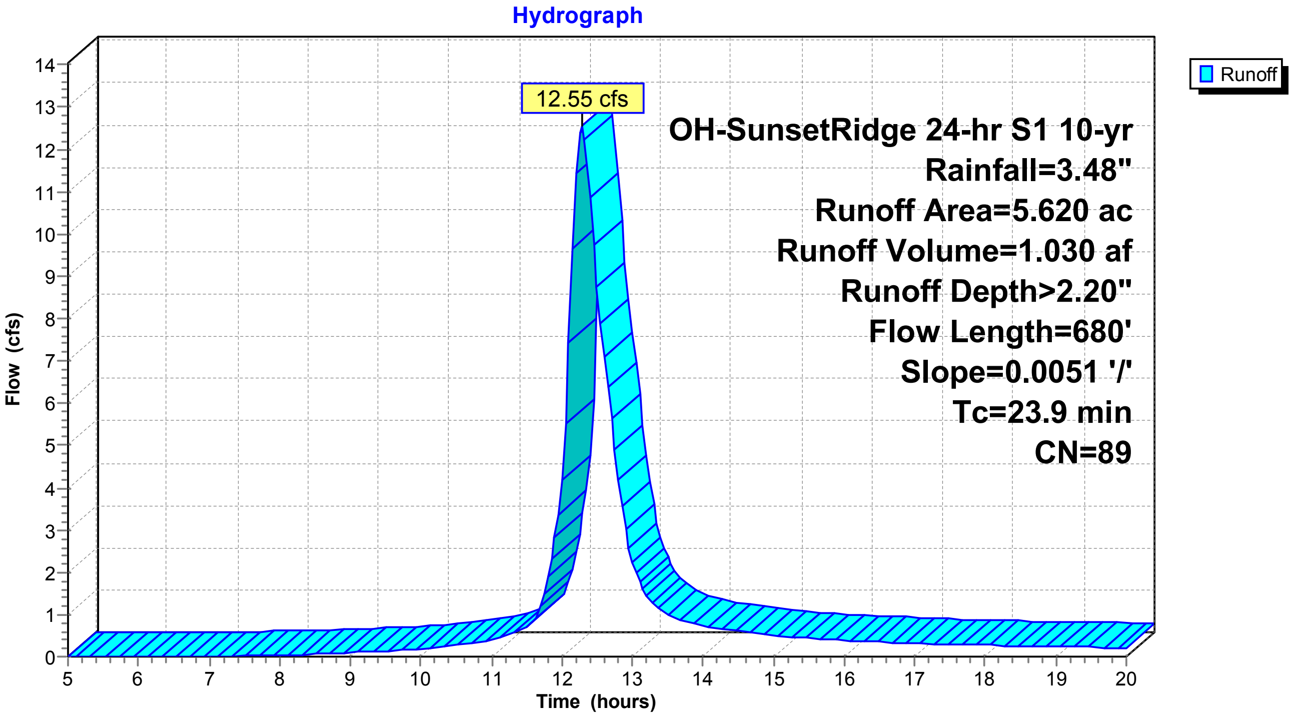
Runoff = 12.55 cfs @ 12.28 hrs, Volume= 1.030 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.620	89	Row crops, straight row, Good, HSG D
5.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.9	680	0.0051	0.47		**Lag/CN Method,**

Subcatchment 22S: DC-22



Summary for Subcatchment 23S: DC-23

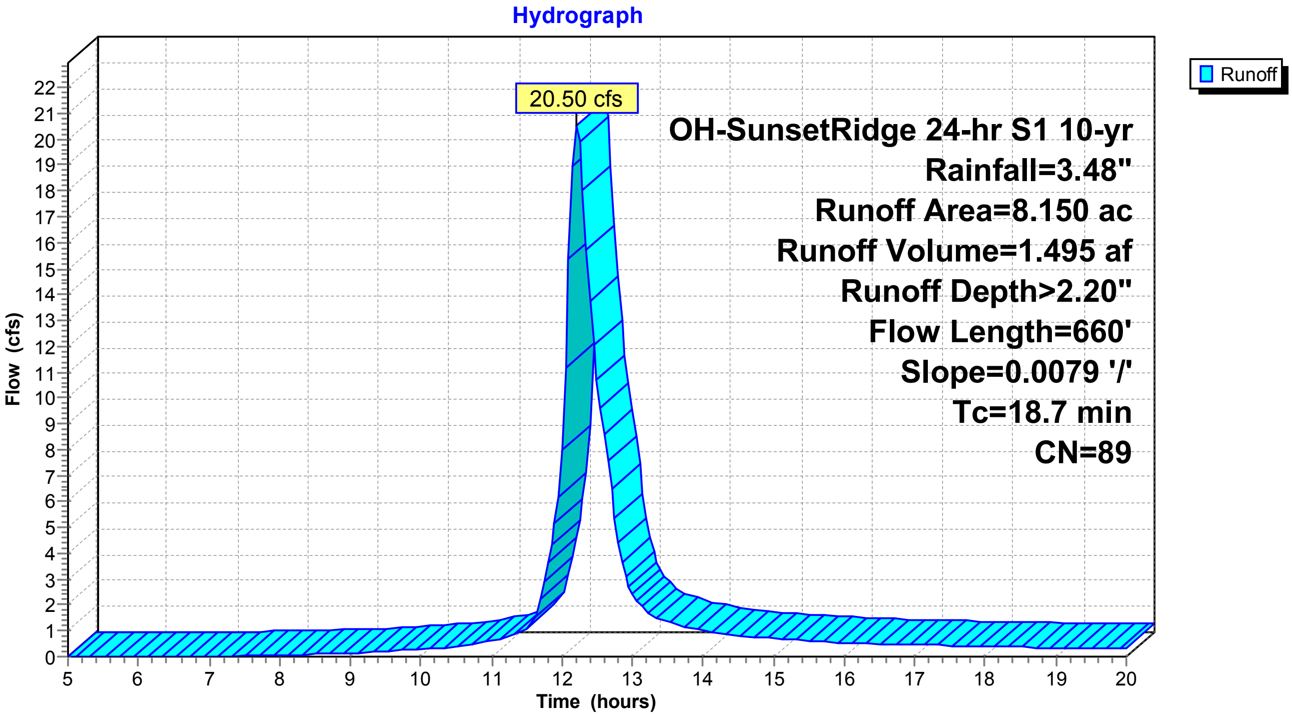
Runoff = 20.50 cfs @ 12.21 hrs, Volume= 1.495 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
8.150	89	Row crops, straight row, Good, HSG D
8.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	660	0.0079	0.59		**Lag/CN Method,**

Subcatchment 23S: DC-23



Summary for Subcatchment 24S: DC-24

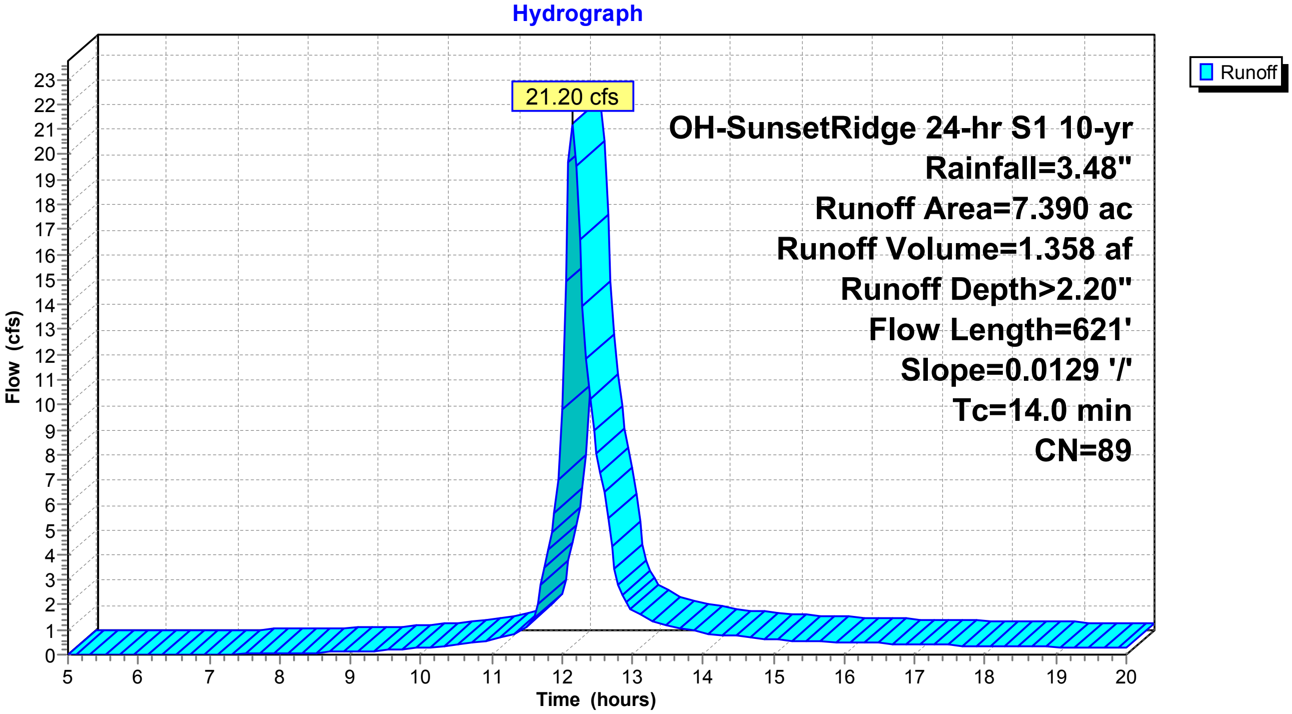
Runoff = 21.20 cfs @ 12.15 hrs, Volume= 1.358 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
7.390	89	Row crops, straight row, Good, HSG D
7.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	621	0.0129	0.74		**Lag/CN Method,**

Subcatchment 24S: DC-24



Summary for Subcatchment 25S: DC-25

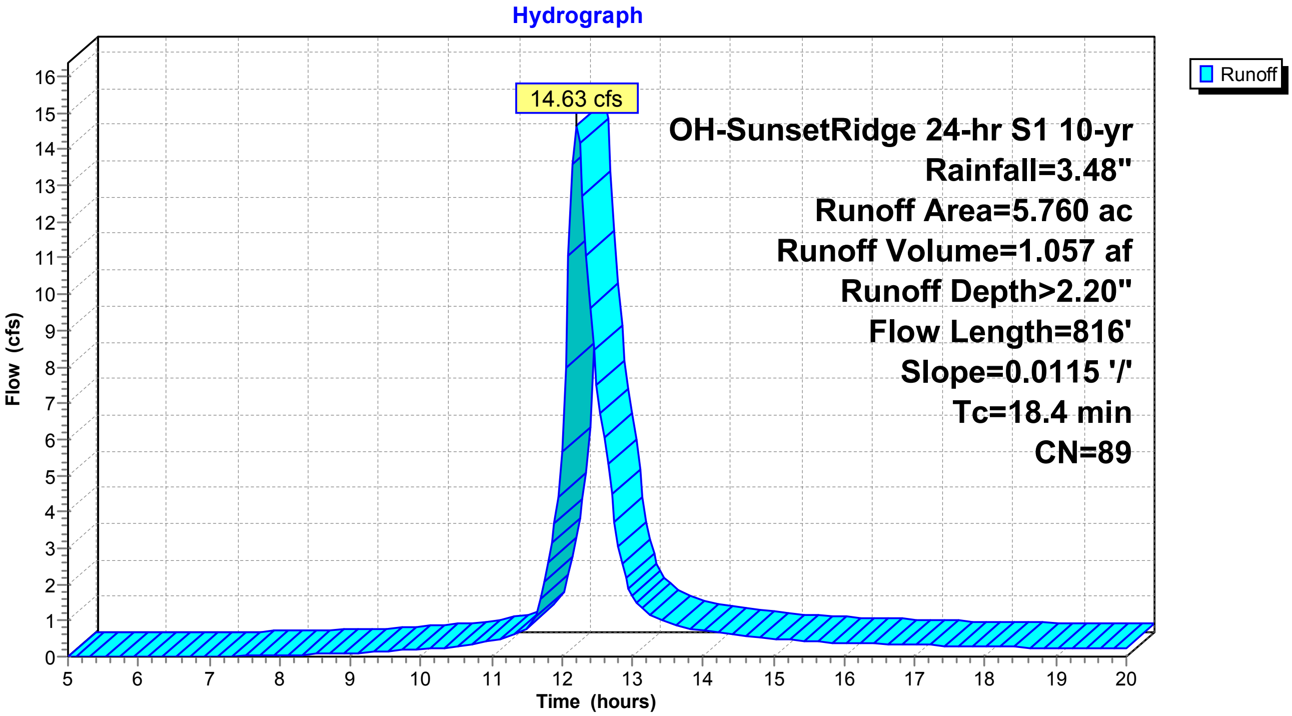
Runoff = 14.63 cfs @ 12.21 hrs, Volume= 1.057 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.760	89	Row crops, straight row, Good, HSG D
5.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	816	0.0115	0.74		**Lag/CN Method,**

Subcatchment 25S: DC-25



Summary for Subcatchment 26S: DC-26

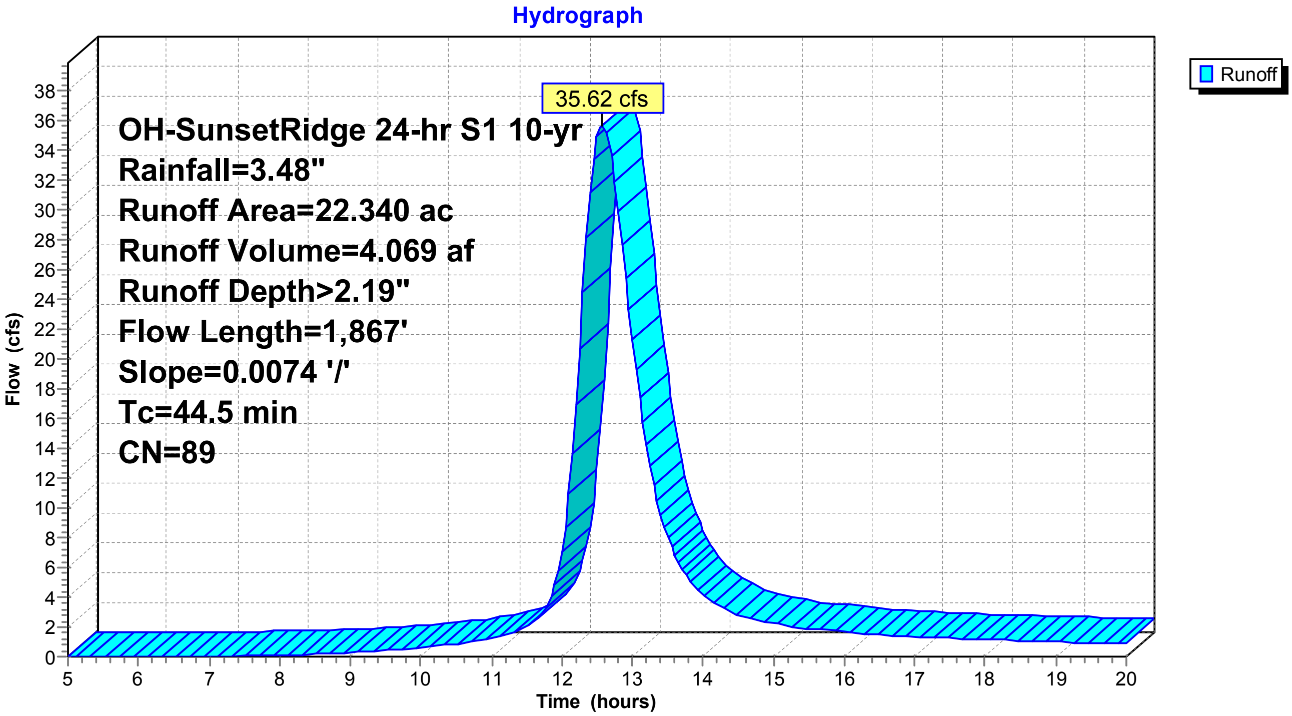
Runoff = 35.62 cfs @ 12.58 hrs, Volume= 4.069 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
22.340	89	Row crops, straight row, Good, HSG D
22.340		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.5	1,867	0.0074	0.70		**Lag/CN Method,**

Subcatchment 26S: DC-26



Summary for Subcatchment 27S: DC-27

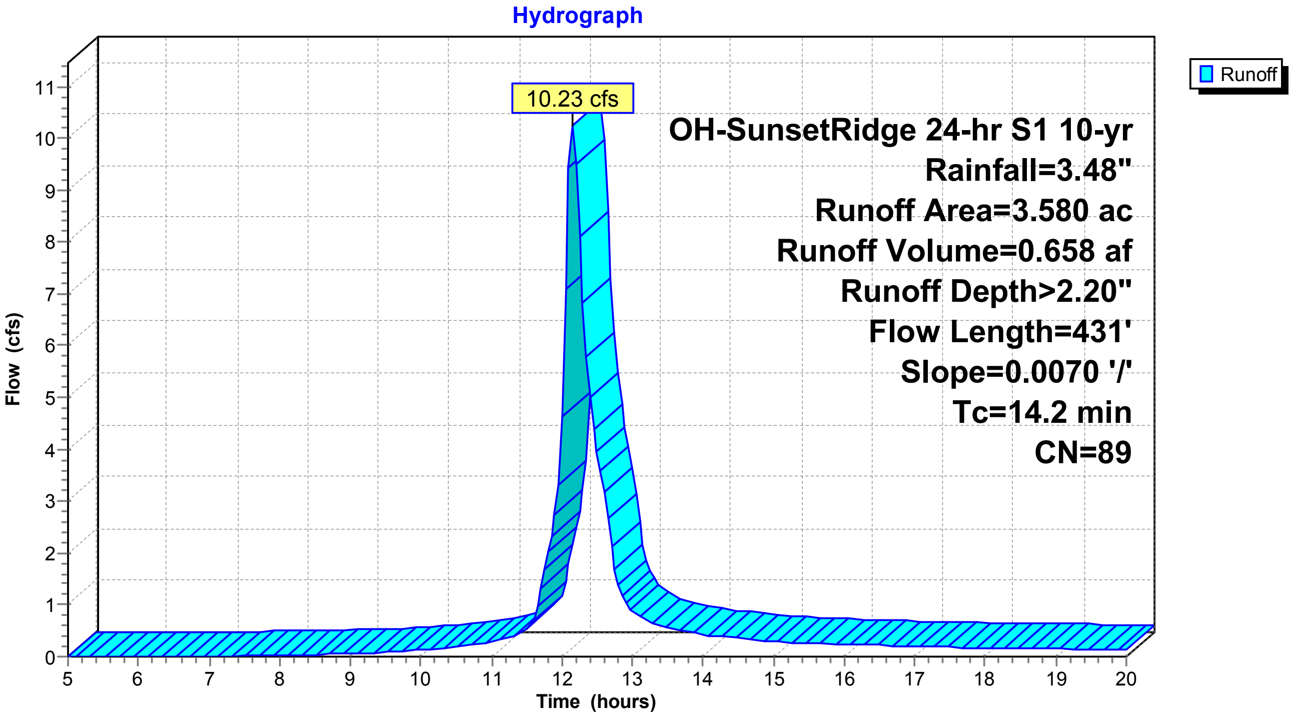
Runoff = 10.23 cfs @ 12.15 hrs, Volume= 0.658 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
3.580	89	Row crops, straight row, Good, HSG D
3.580		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	431	0.0070	0.51		**Lag/CN Method,**

Subcatchment 27S: DC-27



Summary for Subcatchment 28S: DC-28

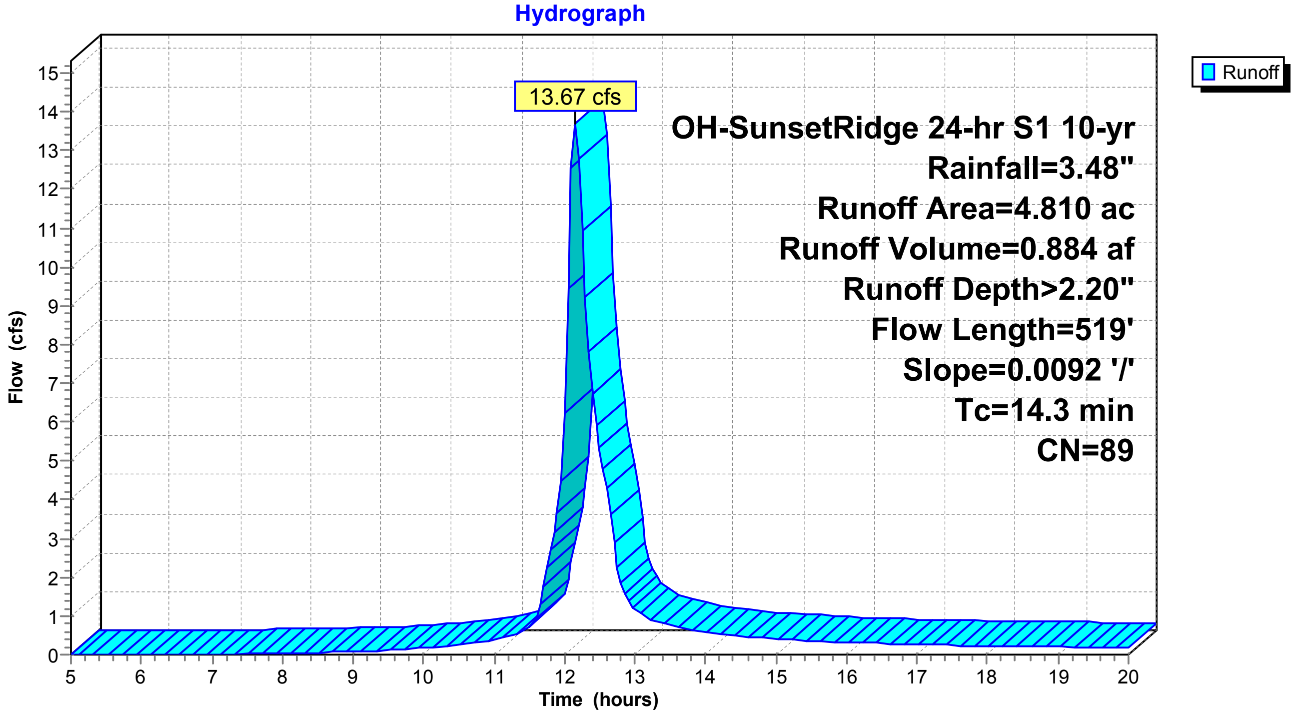
Runoff = 13.67 cfs @ 12.15 hrs, Volume= 0.884 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
4.810	89	Row crops, straight row, Good, HSG D
4.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	519	0.0092	0.60		**Lag/CN Method,**

Subcatchment 28S: DC-28



Summary for Subcatchment 29S: DC-29

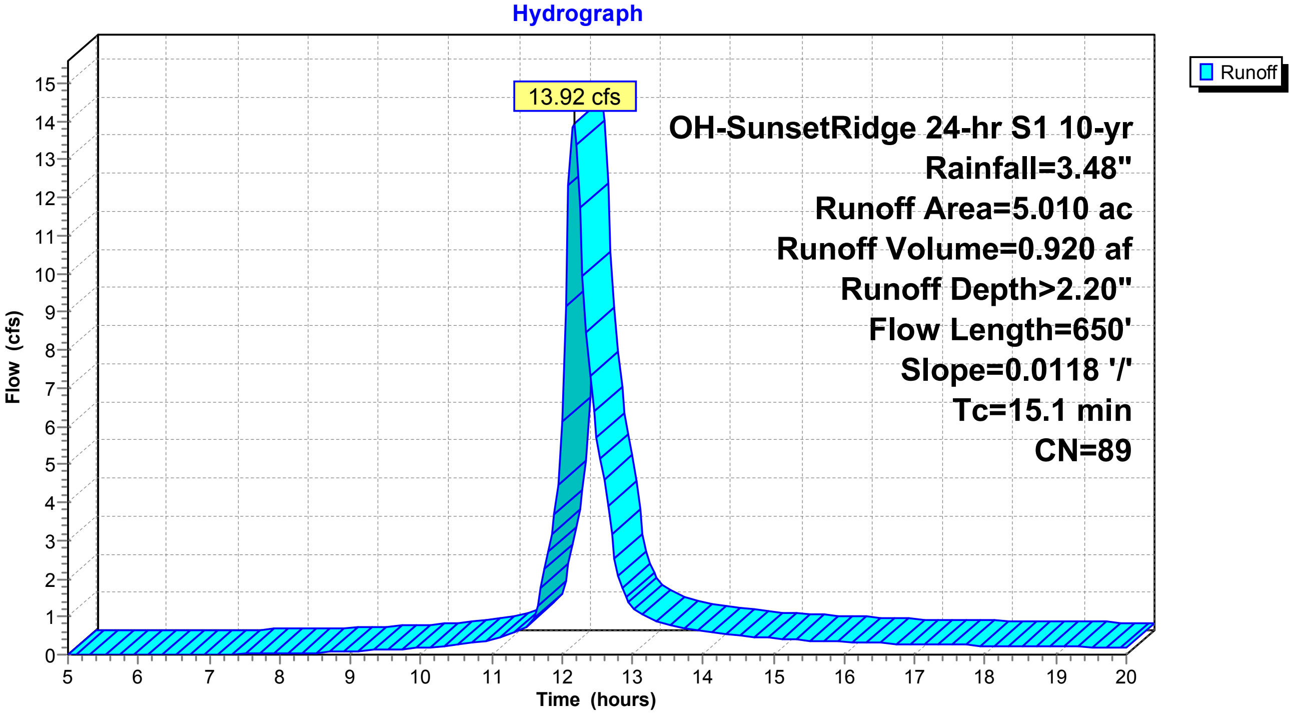
Runoff = 13.92 cfs @ 12.16 hrs, Volume= 0.920 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.010	89	Row crops, straight row, Good, HSG D
5.010		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	650	0.0118	0.72		**Lag/CN Method,**

Subcatchment 29S: DC-29



Summary for Subcatchment 30S: DC-30

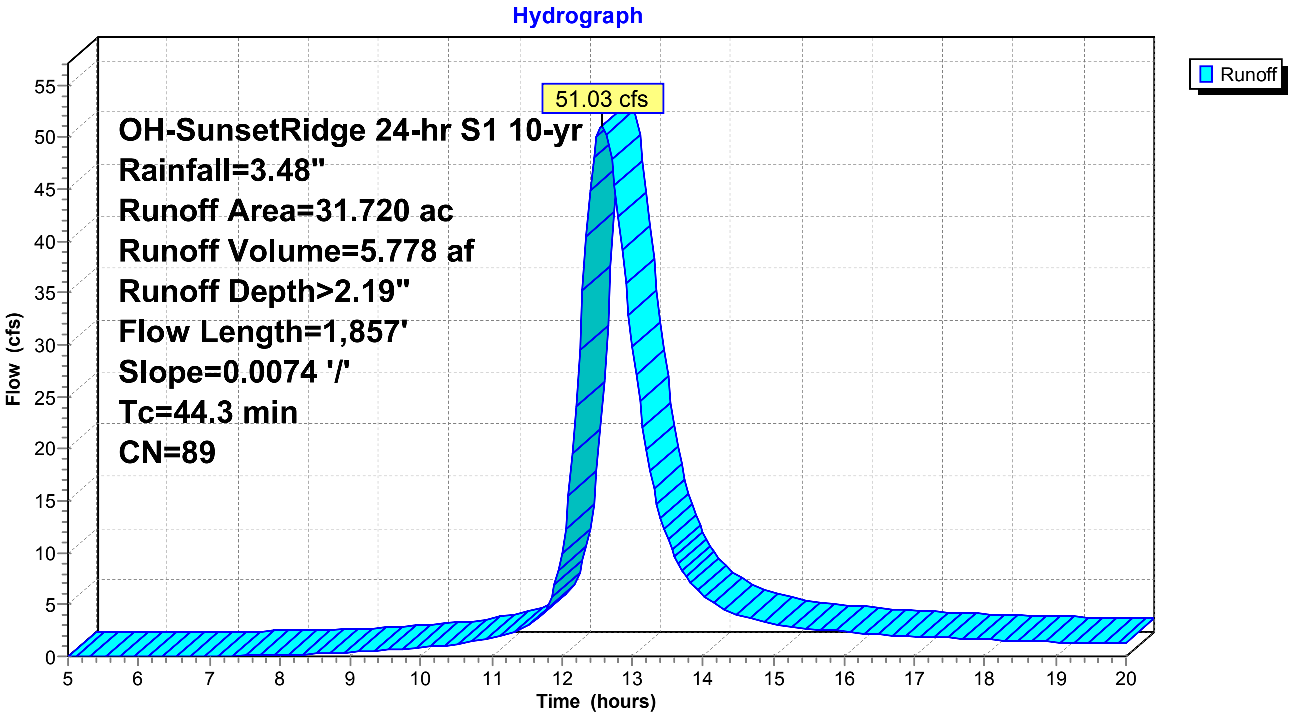
Runoff = 51.03 cfs @ 12.56 hrs, Volume= 5.778 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
31.720	89	Row crops, straight row, Good, HSG D
31.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.3	1,857	0.0074	0.70		**Lag/CN Method,**

Subcatchment 30S: DC-30



Summary for Subcatchment 31S: DC-31

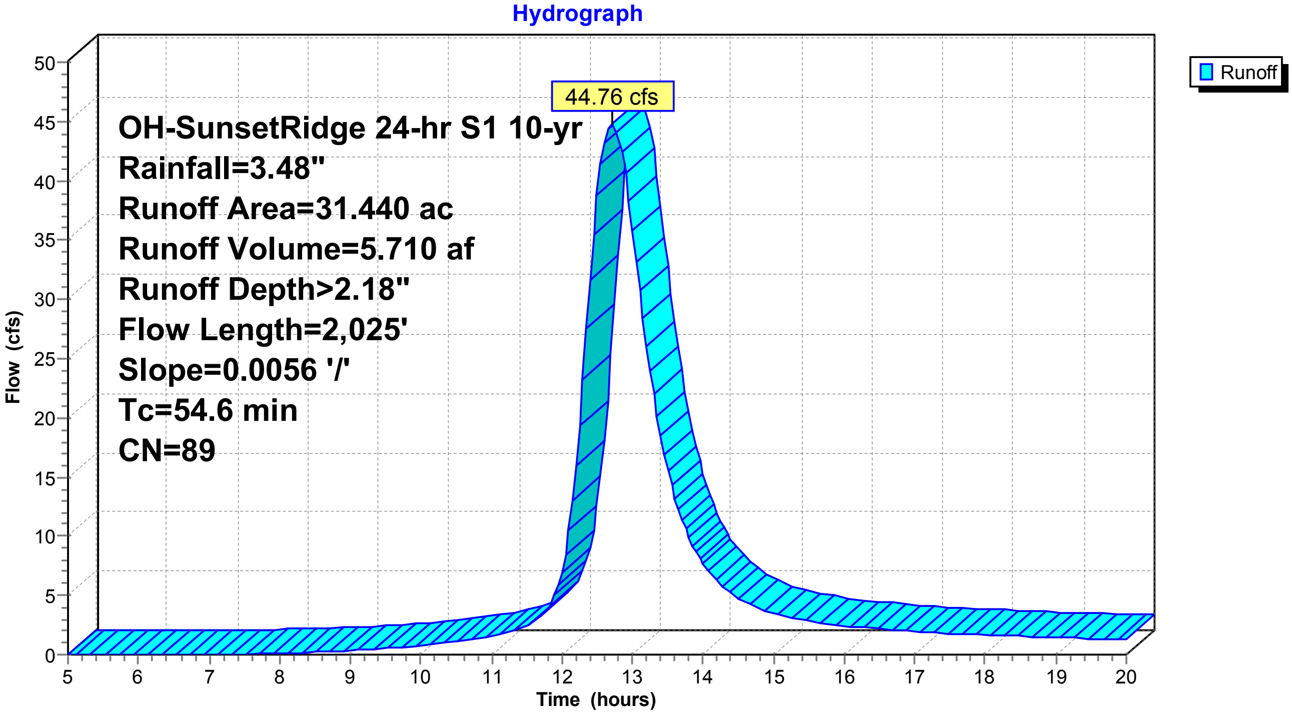
Runoff = 44.76 cfs @ 12.70 hrs, Volume= 5.710 af, Depth> 2.18"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
31.440	89	Row crops, straight row, Good, HSG D
31.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.6	2,025	0.0056	0.62		**Lag/CN Method,**

Subcatchment 31S: DC-31



Summary for Subcatchment 32S: DC-32

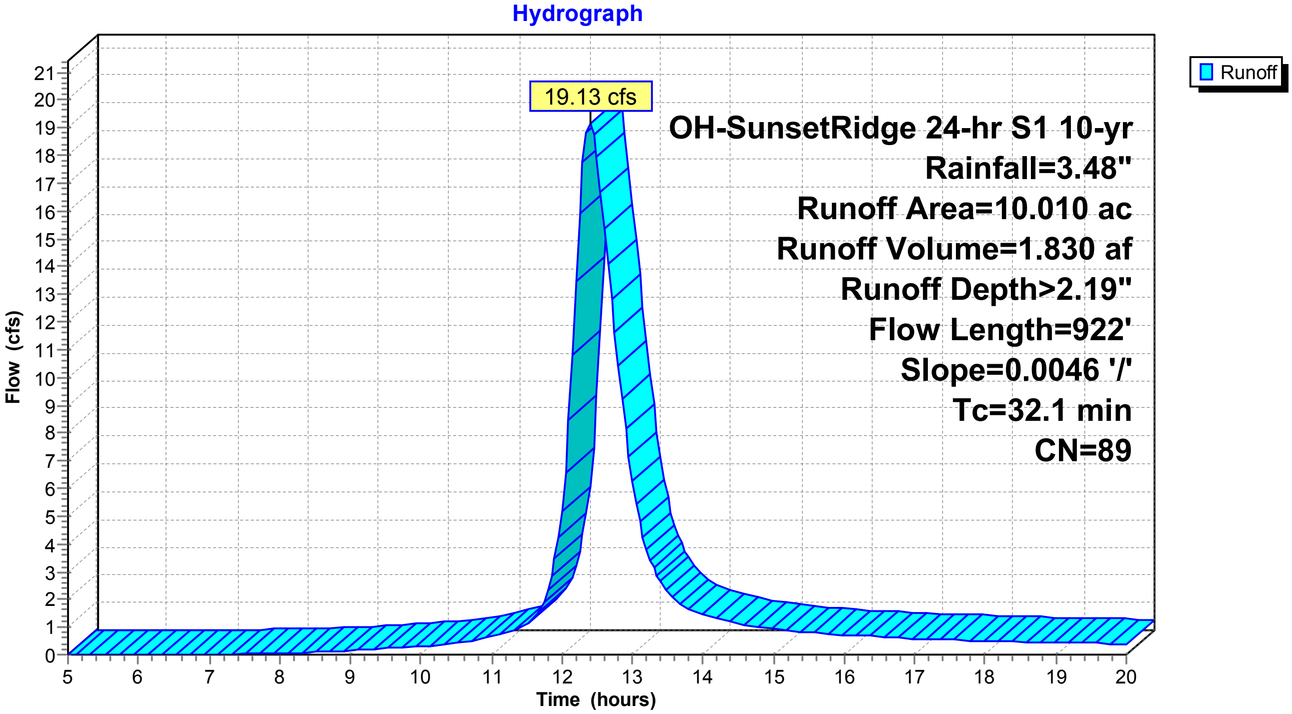
Runoff = 19.13 cfs @ 12.40 hrs, Volume= 1.830 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
10.010	89	Row crops, straight row, Good, HSG D
10.010		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.1	922	0.0046	0.48		**Lag/CN Method,**

Subcatchment 32S: DC-32



Summary for Subcatchment 33S: DC-33

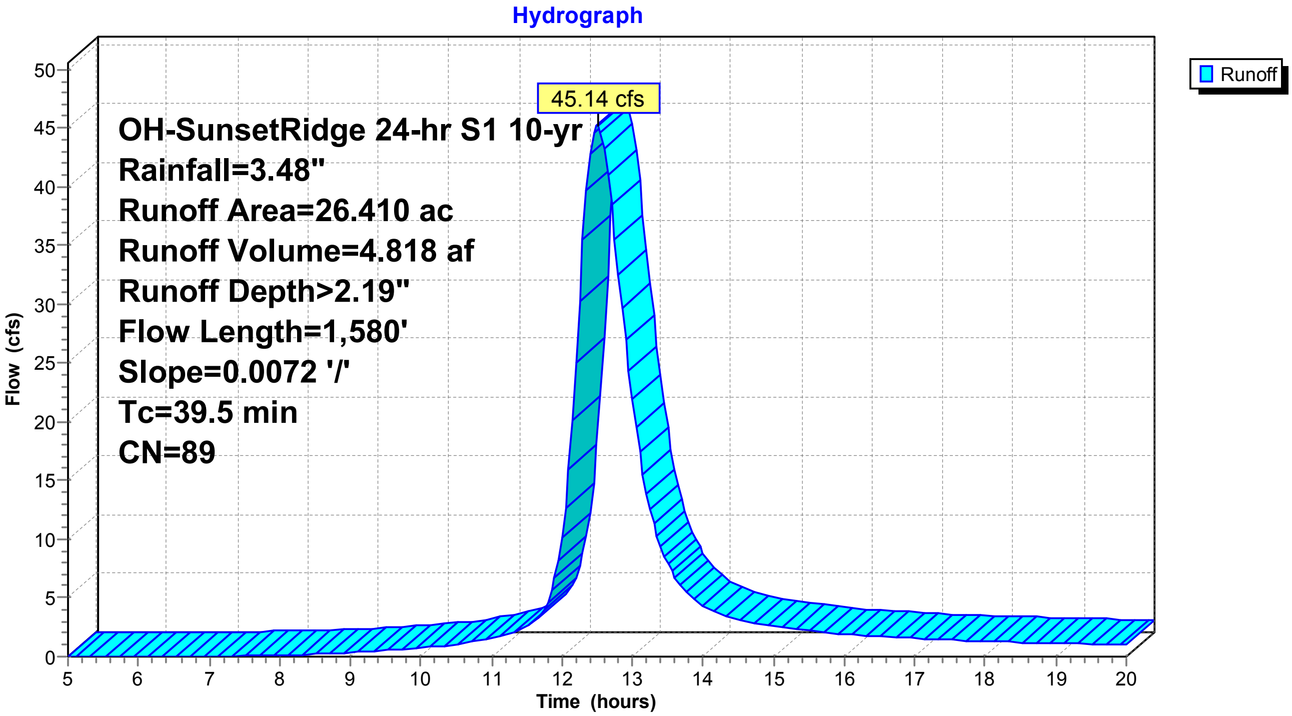
Runoff = 45.14 cfs @ 12.50 hrs, Volume= 4.818 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
26.410	89	Row crops, straight row, Good, HSG D
26.410		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.5	1,580	0.0072	0.67		**Lag/CN Method,**

Subcatchment 33S: DC-33



Summary for Subcatchment 34S: DC-34

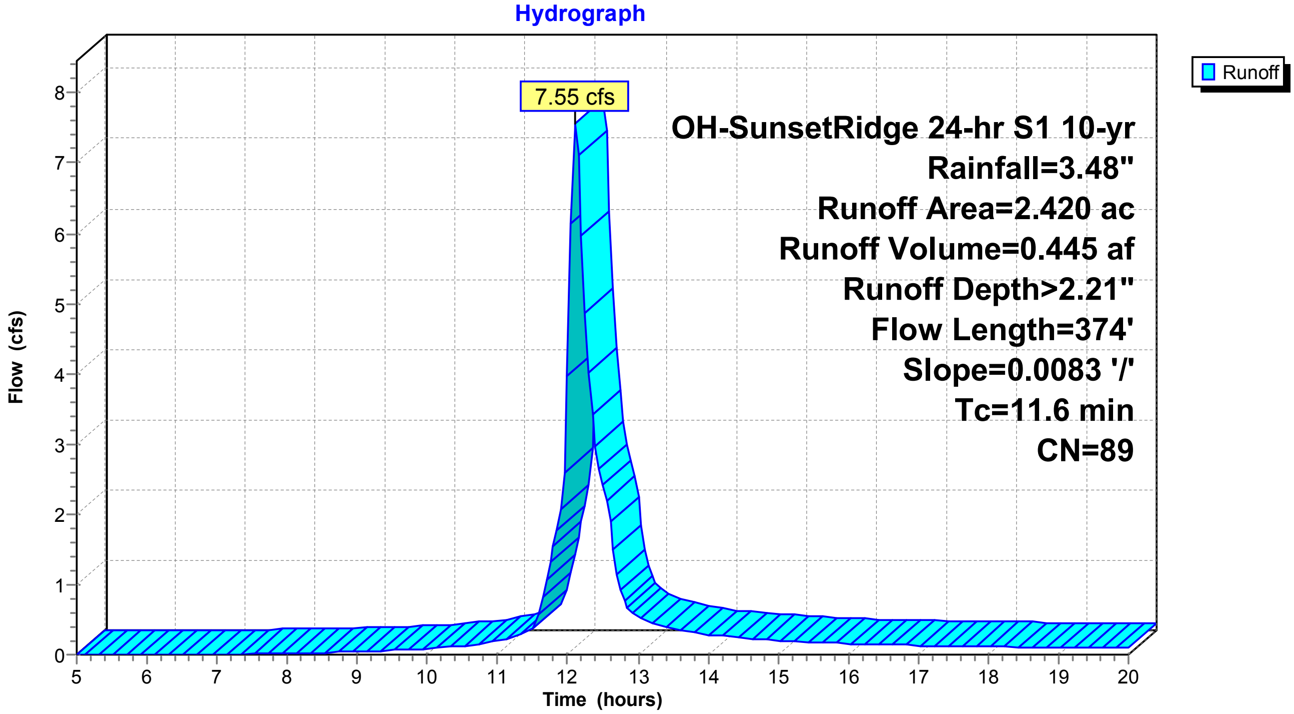
Runoff = 7.55 cfs @ 12.11 hrs, Volume= 0.445 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
2.420	89	Row crops, straight row, Good, HSG D
2.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	374	0.0083	0.54		**Lag/CN Method,**

Subcatchment 34S: DC-34



Summary for Subcatchment 35S: DC-35

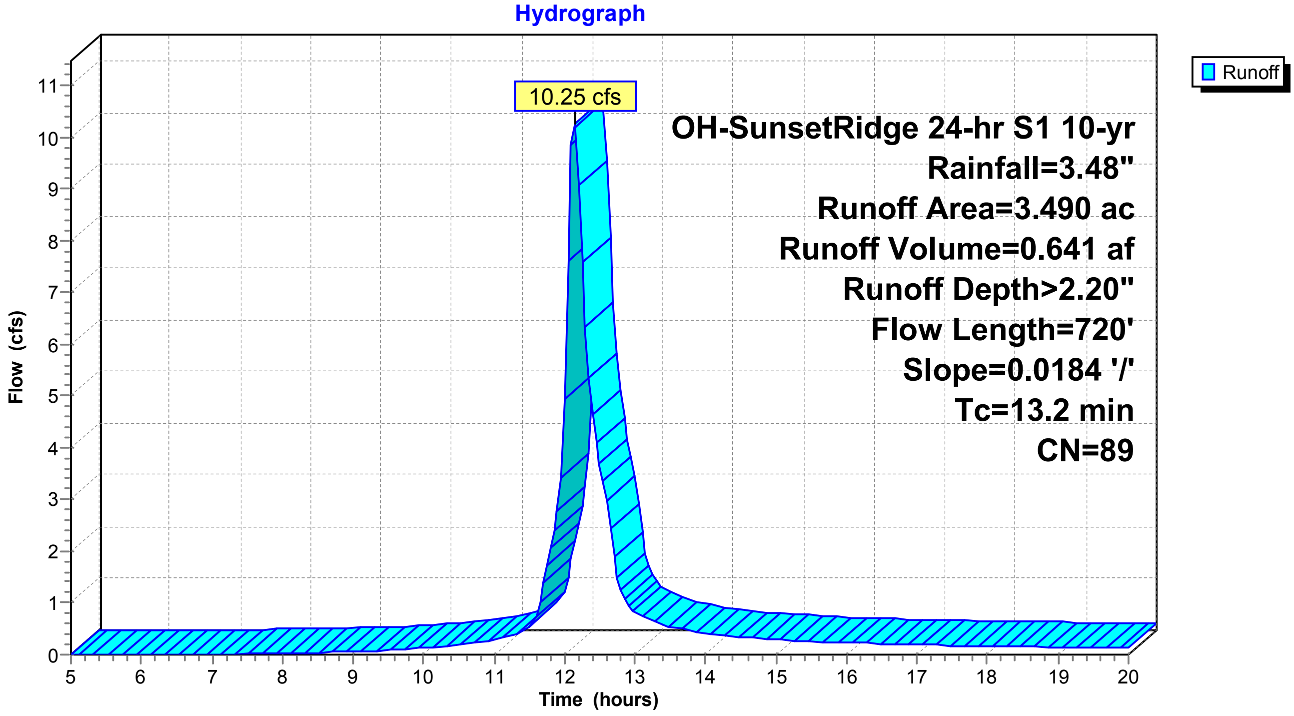
Runoff = 10.25 cfs @ 12.14 hrs, Volume= 0.641 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
3.490	89	Row crops, straight row, Good, HSG D
3.490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.2	720	0.0184	0.91		**Lag/CN Method,**

Subcatchment 35S: DC-35



Summary for Subcatchment 36S: DC-36

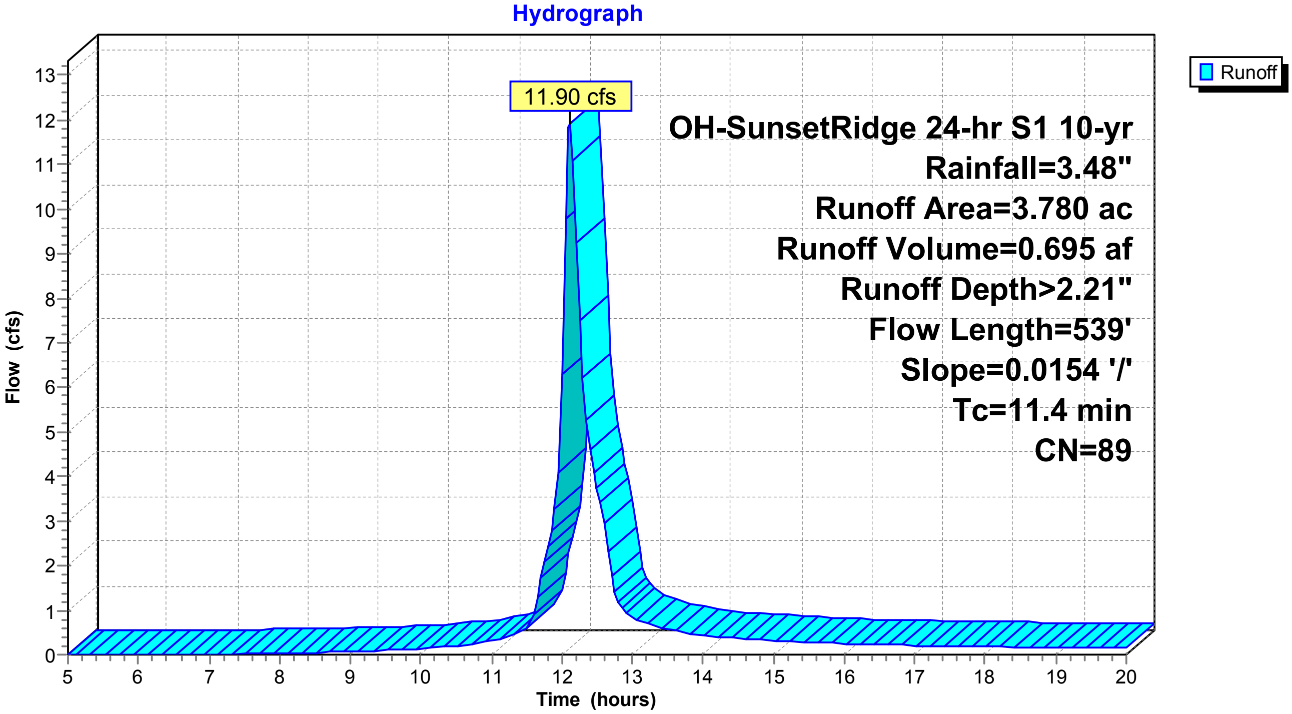
Runoff = 11.90 cfs @ 12.11 hrs, Volume= 0.695 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
3.780	89	Row crops, straight row, Good, HSG D
3.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	539	0.0154	0.79		**Lag/CN Method,**

Subcatchment 36S: DC-36



Summary for Subcatchment 37S: DC-37

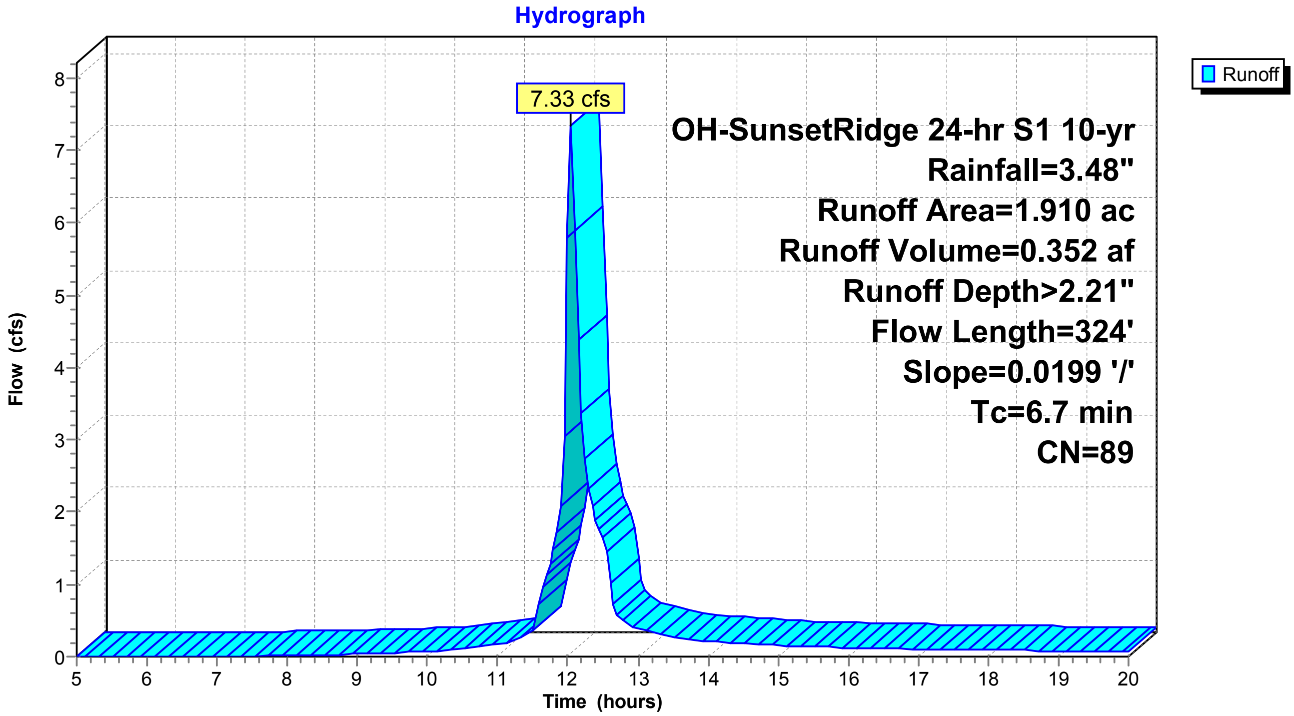
Runoff = 7.33 cfs @ 12.05 hrs, Volume= 0.352 af, Depth> 2.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
1.910	89	Row crops, straight row, Good, HSG D
1.910		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	324	0.0199	0.81		**Lag/CN Method,**

Subcatchment 37S: DC-37



Summary for Subcatchment 38S: DC-38

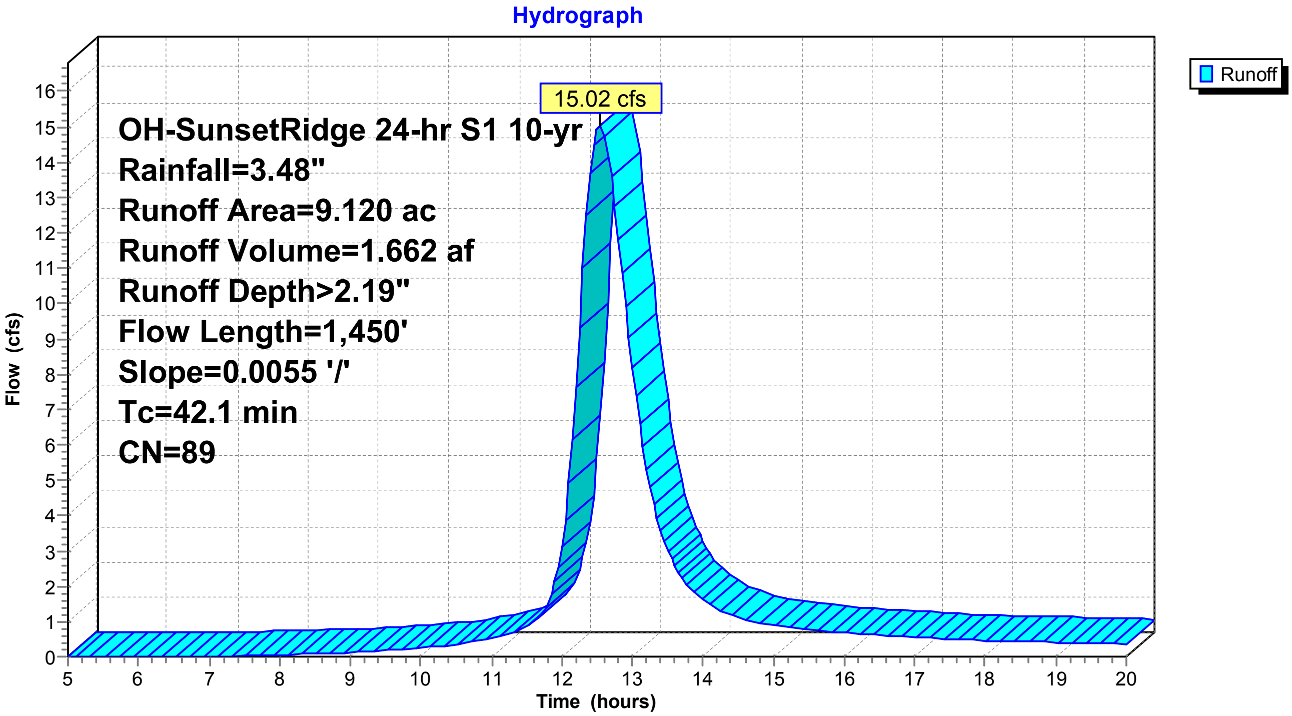
Runoff = 15.02 cfs @ 12.54 hrs, Volume= 1.662 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
9.120	89	Row crops, straight row, Good, HSG D
9.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.1	1,450	0.0055	0.57		**Lag/CN Method,**

Subcatchment 38S: DC-38



Summary for Subcatchment 39S: DC-39

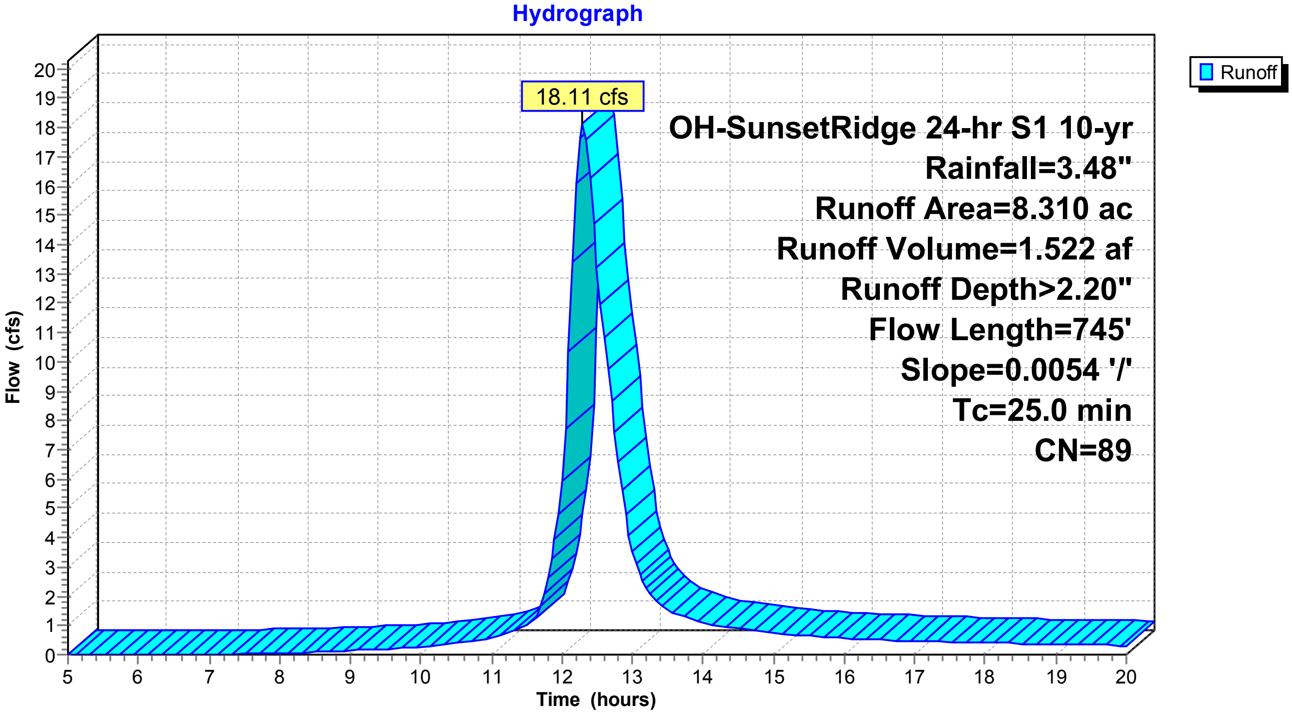
Runoff = 18.11 cfs @ 12.30 hrs, Volume= 1.522 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
8.310	89	Row crops, straight row, Good, HSG D
8.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	745	0.0054	0.50		**Lag/CN Method,**

Subcatchment 39S: DC-39



Summary for Subcatchment 40S: DC-40

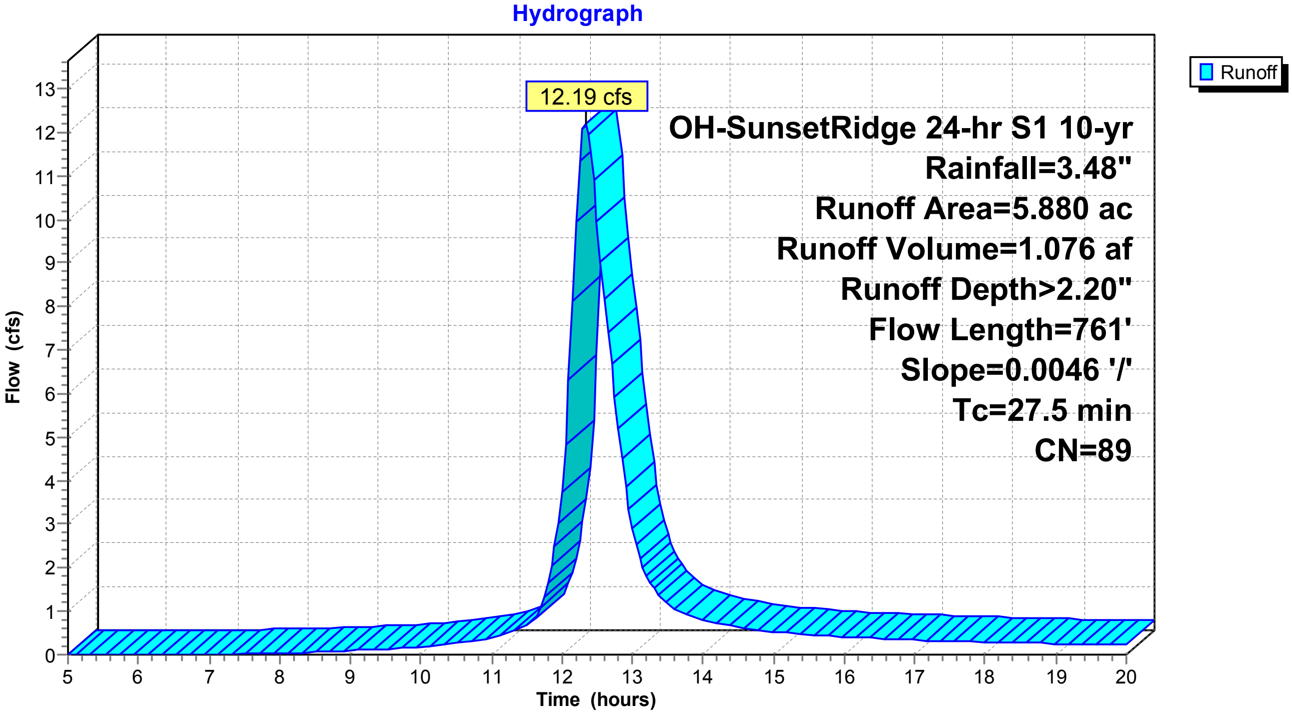
Runoff = 12.19 cfs @ 12.33 hrs, Volume= 1.076 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.880	89	Row crops, straight row, Good, HSG D
5.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.5	761	0.0046	0.46		**Lag/CN Method,**

Subcatchment 40S: DC-40



Summary for Subcatchment 41S: DC-41

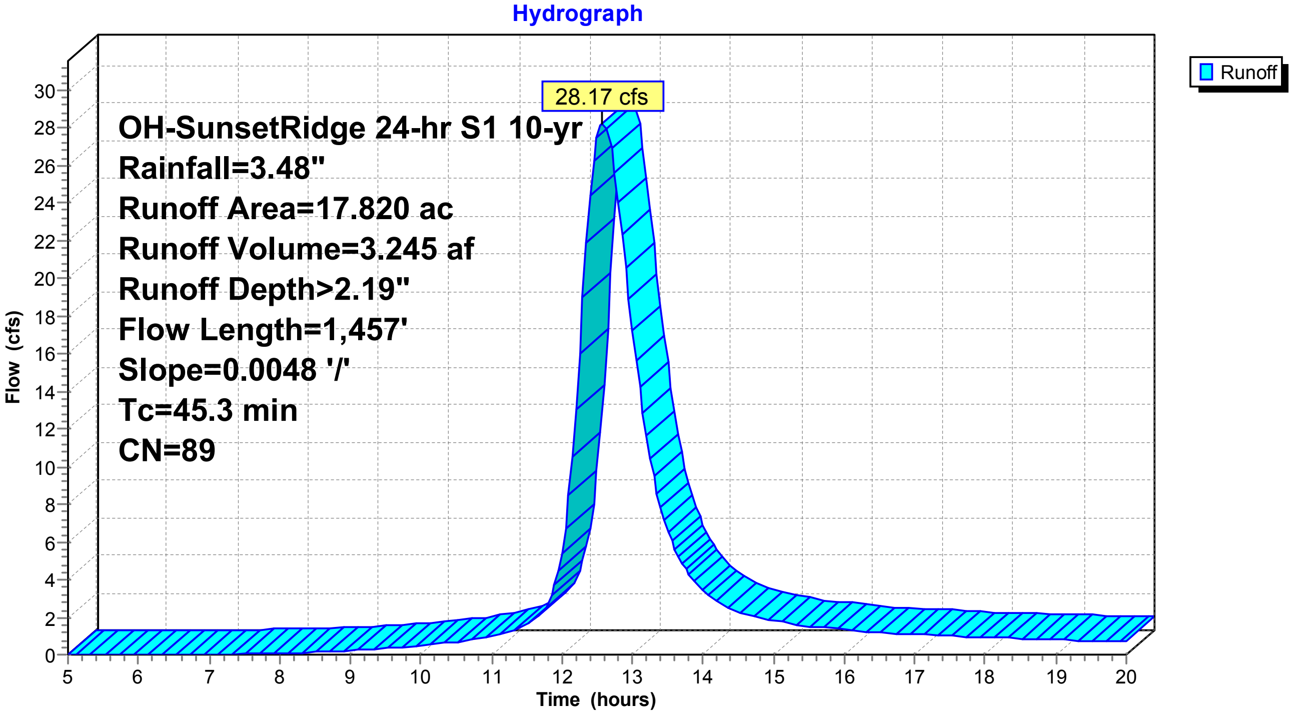
Runoff = 28.17 cfs @ 12.58 hrs, Volume= 3.245 af, Depth> 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
17.820	89	Row crops, straight row, Good, HSG D
17.820		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.3	1,457	0.0048	0.54		**Lag/CN Method,**

Subcatchment 41S: DC-41



Summary for Subcatchment 42S: DC-42

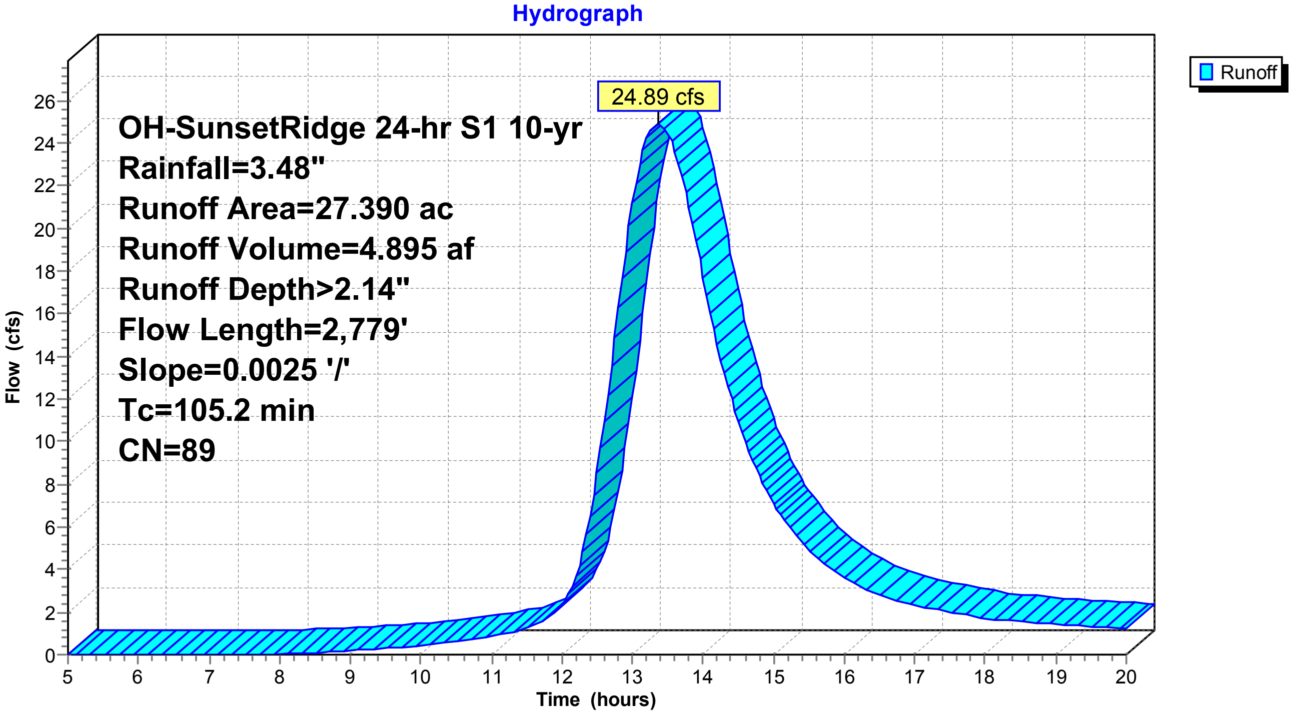
Runoff = 24.89 cfs @ 13.37 hrs, Volume= 4.895 af, Depth> 2.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
27.390	89	Row crops, straight row, Good, HSG D
27.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
105.2	2,779	0.0025	0.44		**Lag/CN Method,**

Subcatchment 42S: DC-42



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DC-01 Runoff Area=34.460 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=777' Slope=0.0061 '/' Tc=24.3 min CN=89 Runoff=123.42 cfs 11.091 af

Subcatchment 2S: DC-02 Runoff Area=15.360 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=1,134' Slope=0.0066 '/' Tc=31.6 min CN=89 Runoff=48.33 cfs 4.934 af

Subcatchment 3S: DC-03 Runoff Area=17.270 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=1,407' Slope=0.0077 '/' Tc=34.8 min CN=89 Runoff=51.73 cfs 5.543 af

Subcatchment 4S: DC-04 Runoff Area=57.040 ac 0.00% Impervious Runoff Depth>3.82"
Flow Length=2,342' Slope=0.0048 '/' Tc=66.2 min CN=89 Runoff=119.98 cfs 18.148 af

Subcatchment 5S: DC-05 Runoff Area=6.570 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=1,011' Slope=0.0033 '/' Tc=40.8 min CN=89 Runoff=18.11 cfs 2.105 af

Subcatchment 6S: DC-06 Runoff Area=28.120 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=1,305' Slope=0.0072 '/' Tc=33.9 min CN=89 Runoff=85.69 cfs 9.028 af

Subcatchment 7S: DC-07 Runoff Area=22.440 ac 0.00% Impervious Runoff Depth>3.50"
Flow Length=1,699' Slope=0.0026 '/' Tc=77.9 min CN=86 Runoff=39.43 cfs 6.543 af

Subcatchment 8S: DC-08 Runoff Area=17.130 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=933' Slope=0.0050 '/' Tc=31.1 min CN=89 Runoff=54.44 cfs 5.503 af

Subcatchment 9S: DC-09 Runoff Area=17.970 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=1,141' Slope=0.0041 '/' Tc=40.3 min CN=89 Runoff=50.00 cfs 5.759 af

Subcatchment 10S: DC-10 Runoff Area=13.370 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=539' Slope=0.0150 '/' Tc=11.6 min CN=89 Runoff=66.33 cfs 4.317 af

Subcatchment 11S: DC-11 Runoff Area=9.630 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=705' Slope=0.0048 '/' Tc=25.3 min CN=89 Runoff=33.83 cfs 3.099 af

Subcatchment 12S: DC-12 Runoff Area=65.170 ac 0.00% Impervious Runoff Depth>3.80"
Flow Length=1,973' Slope=0.0023 '/' Tc=83.4 min CN=89 Runoff=117.87 cfs 20.629 af

Subcatchment 13S: DC-13 Runoff Area=6.850 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=447' Slope=0.0100 '/' Tc=12.2 min CN=89 Runoff=33.37 cfs 2.211 af

Subcatchment 14S: DC-14 Runoff Area=31.250 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=909' Slope=0.0086 '/' Tc=23.2 min CN=89 Runoff=114.67 cfs 10.060 af

Subcatchment 15S: DC-15 Runoff Area=21.410 ac 0.00% Impervious Runoff Depth>3.84"
Flow Length=1,487' Slope=0.0050 '/' Tc=45.1 min CN=89 Runoff=56.01 cfs 6.853 af

Subcatchment 16S: DC-16 Runoff Area=37.390 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=803' Slope=0.0135 '/' Tc=16.8 min CN=89 Runoff=158.41 cfs 12.057 af

Subcatchment 17S: DC-17 Runoff Area=10.250 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=1,004' Slope=0.0113 '/' Tc=21.9 min CN=89 Runoff=38.53 cfs 3.301 af

Subcatchment 18S: DC-18 Runoff Area=9.520 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=700' Slope=0.0114 '/' Tc=16.3 min CN=89 Runoff=40.80 cfs 3.070 af

Subcatchment 19S: DC-19 Runoff Area=67.430 ac 0.00% Impervious Runoff Depth>3.84"
Flow Length=1,812' Slope=0.0055 '/' Tc=50.4 min CN=89 Runoff=165.78 cfs 21.551 af

Subcatchment 20S: DC-20 Runoff Area=136.840 ac 0.00% Impervious Runoff Depth>3.81"
Flow Length=2,632' Slope=0.0050 '/' Tc=71.2 min CN=89 Runoff=275.02 cfs 43.474 af

Subcatchment 21S: DC-21 Runoff Area=2.560 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=456' Slope=0.0075 '/' Tc=14.3 min CN=89 Runoff=11.63 cfs 0.826 af

Subcatchment 22S: DC-22 Runoff Area=5.620 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=680' Slope=0.0051 '/' Tc=23.9 min CN=89 Runoff=20.35 cfs 1.809 af

Subcatchment 23S: DC-23 Runoff Area=8.150 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=660' Slope=0.0079 '/' Tc=18.7 min CN=89 Runoff=33.01 cfs 2.627 af

Subcatchment 24S: DC-24 Runoff Area=7.390 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=621' Slope=0.0129 '/' Tc=14.0 min CN=89 Runoff=33.86 cfs 2.385 af

Subcatchment 25S: DC-25 Runoff Area=5.760 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=816' Slope=0.0115 '/' Tc=18.4 min CN=89 Runoff=23.55 cfs 1.857 af

Subcatchment 26S: DC-26 Runoff Area=22.340 ac 0.00% Impervious Runoff Depth>3.84"
Flow Length=1,867' Slope=0.0074 '/' Tc=44.5 min CN=89 Runoff=58.72 cfs 7.151 af

Subcatchment 27S: DC-27 Runoff Area=3.580 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=431' Slope=0.0070 '/' Tc=14.2 min CN=89 Runoff=16.35 cfs 1.155 af

Subcatchment 28S: DC-28 Runoff Area=4.810 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=519' Slope=0.0092 '/' Tc=14.3 min CN=89 Runoff=21.85 cfs 1.552 af

Subcatchment 29S: DC-29 Runoff Area=5.010 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=650' Slope=0.0118 '/' Tc=15.1 min CN=89 Runoff=22.28 cfs 1.616 af

Subcatchment 30S: DC-30 Runoff Area=31.720 ac 0.00% Impervious Runoff Depth>3.84"
Flow Length=1,857' Slope=0.0074 '/' Tc=44.3 min CN=89 Runoff=84.14 cfs 10.155 af

Subcatchment 31S: DC-31 Runoff Area=31.440 ac 0.00% Impervious Runoff Depth>3.83"
Flow Length=2,025' Slope=0.0056 '/' Tc=54.6 min CN=89 Runoff=74.20 cfs 10.036 af

Subcatchment 32S: DC-32 Runoff Area=10.010 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=922' Slope=0.0046 '/' Tc=32.1 min CN=89 Runoff=31.27 cfs 3.215 af

Subcatchment 33S: DC-33 Runoff Area=26.410 ac 0.00% Impervious Runoff Depth>3.85"
Flow Length=1,580' Slope=0.0072 '/' Tc=39.5 min CN=89 Runoff=74.21 cfs 8.466 af

Subcatchment 34S: DC-34 Runoff Area=2.420 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=374' Slope=0.0083 '/' Tc=11.6 min CN=89 Runoff=12.01 cfs 0.781 af

Subcatchment 35S: DC-35 Runoff Area=3.490 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=720' Slope=0.0184 '/' Tc=13.2 min CN=89 Runoff=16.35 cfs 1.126 af

Subcatchment 36S: DC-36 Runoff Area=3.780 ac 0.00% Impervious Runoff Depth>3.87"
Flow Length=539' Slope=0.0154 '/' Tc=11.4 min CN=89 Runoff=18.91 cfs 1.220 af

Subcatchment 37S: DC-37 Runoff Area=1.910 ac 0.00% Impervious Runoff Depth>3.88"
Flow Length=324' Slope=0.0199 '/' Tc=6.7 min CN=89 Runoff=11.50 cfs 0.617 af

Subcatchment 38S: DC-38 Runoff Area=9.120 ac 0.00% Impervious Runoff Depth>3.84"
Flow Length=1,450' Slope=0.0055 '/' Tc=42.1 min CN=89 Runoff=24.74 cfs 2.921 af

Subcatchment 39S: DC-39 Runoff Area=8.310 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=745' Slope=0.0054 '/' Tc=25.0 min CN=89 Runoff=29.40 cfs 2.674 af

Subcatchment 40S: DC-40 Runoff Area=5.880 ac 0.00% Impervious Runoff Depth>3.86"
Flow Length=761' Slope=0.0046 '/' Tc=27.5 min CN=89 Runoff=19.84 cfs 1.891 af

Subcatchment 41S: DC-41 Runoff Area=17.820 ac 0.00% Impervious Runoff Depth>3.84"
Flow Length=1,457' Slope=0.0048 '/' Tc=45.3 min CN=89 Runoff=46.53 cfs 5.703 af

Subcatchment 42S: DC-42 Runoff Area=27.390 ac 0.00% Impervious Runoff Depth>3.77"
Flow Length=2,779' Slope=0.0025 '/' Tc=105.2 min CN=89 Runoff=41.88 cfs 8.610 af

Total Runoff Area = 870.390 ac Runoff Volume = 277.670 af Average Runoff Depth = 3.83"
100.00% Pervious = 870.390 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DC-01

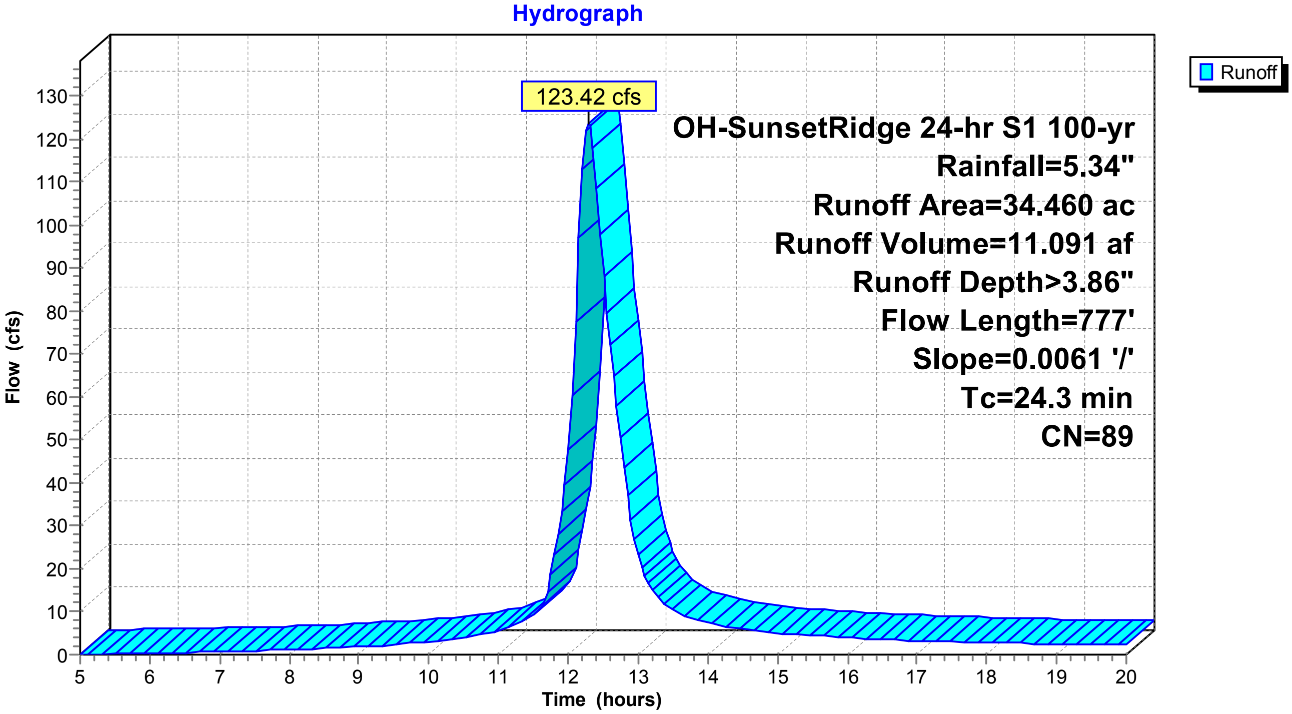
Runoff = 123.42 cfs @ 12.28 hrs, Volume= 11.091 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
34.460	89	Row crops, straight row, Good, HSG D
34.460		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.3	777	0.0061	0.53		**Lag/CN Method,**

Subcatchment 1S: DC-01



Summary for Subcatchment 2S: DC-02

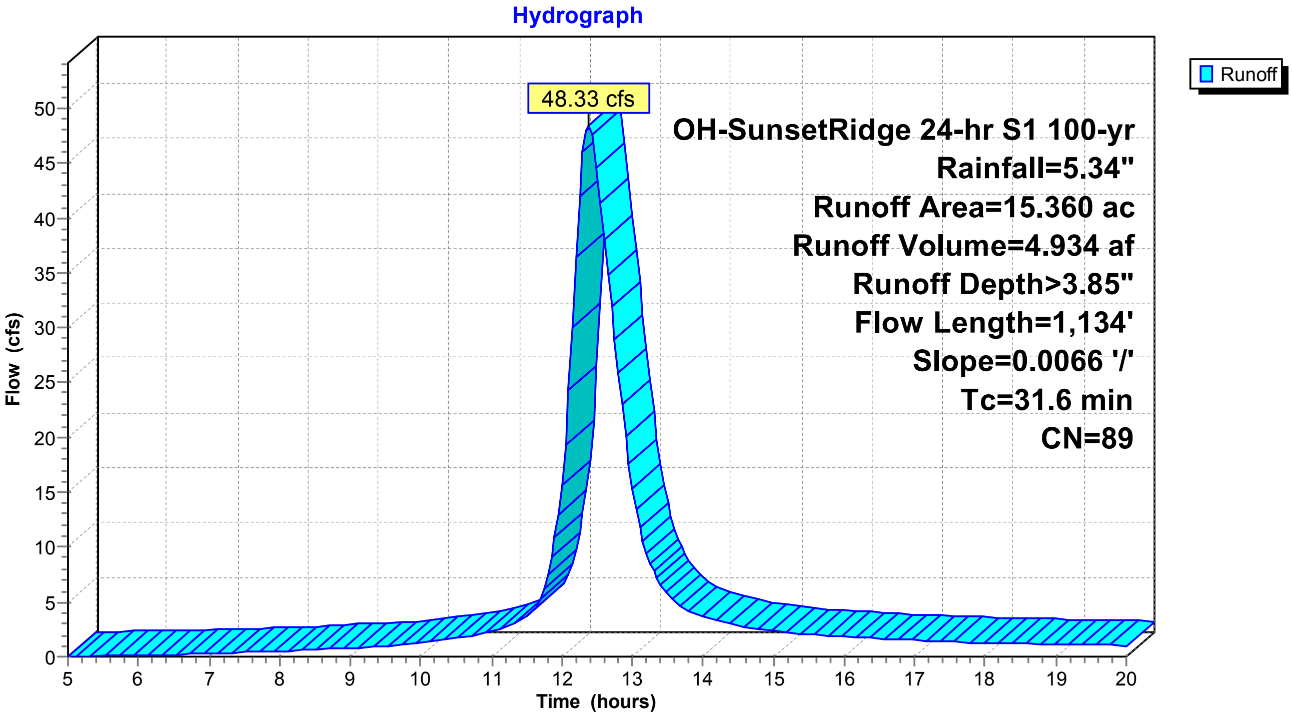
Runoff = 48.33 cfs @ 12.38 hrs, Volume= 4.934 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
15.360	89	Row crops, straight row, Good, HSG D
15.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.6	1,134	0.0066	0.60		**Lag/CN Method,**

Subcatchment 2S: DC-02



Summary for Subcatchment 3S: DC-03

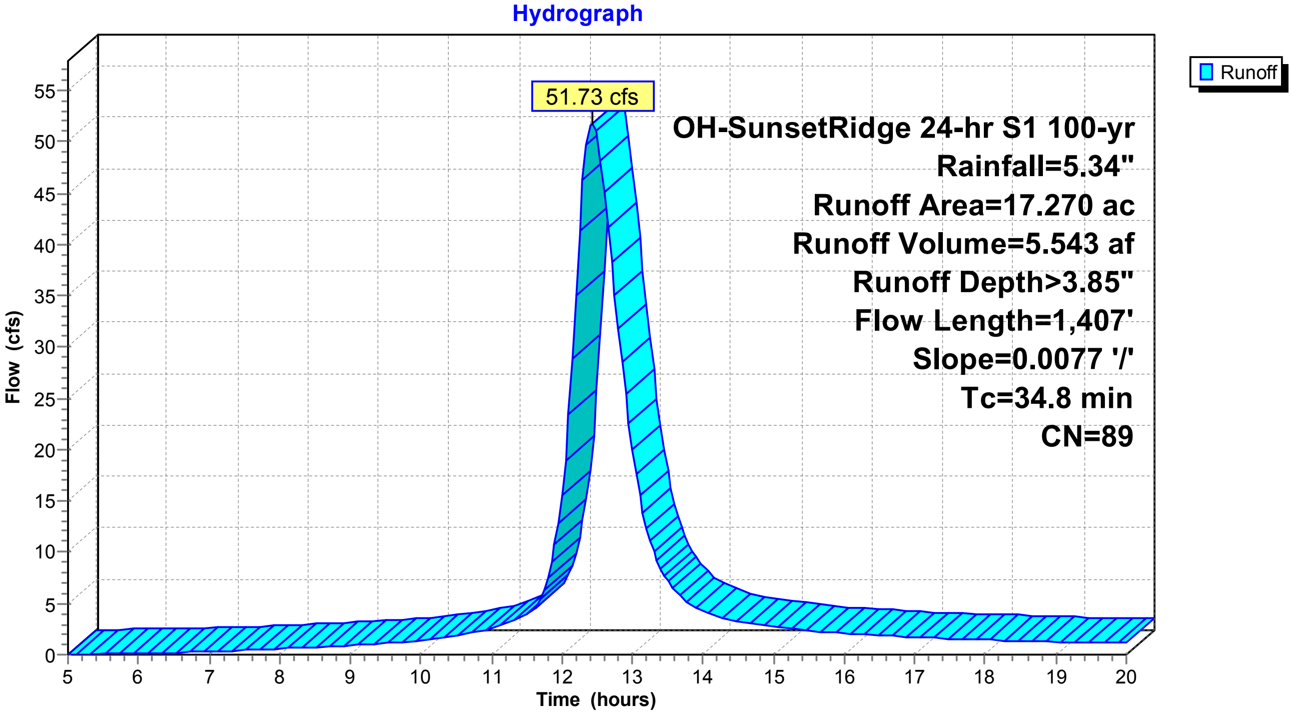
Runoff = 51.73 cfs @ 12.43 hrs, Volume= 5.543 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
17.270	89	Row crops, straight row, Good, HSG D
17.270		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.8	1,407	0.0077	0.67		**Lag/CN Method,**

Subcatchment 3S: DC-03



Summary for Subcatchment 4S: DC-04

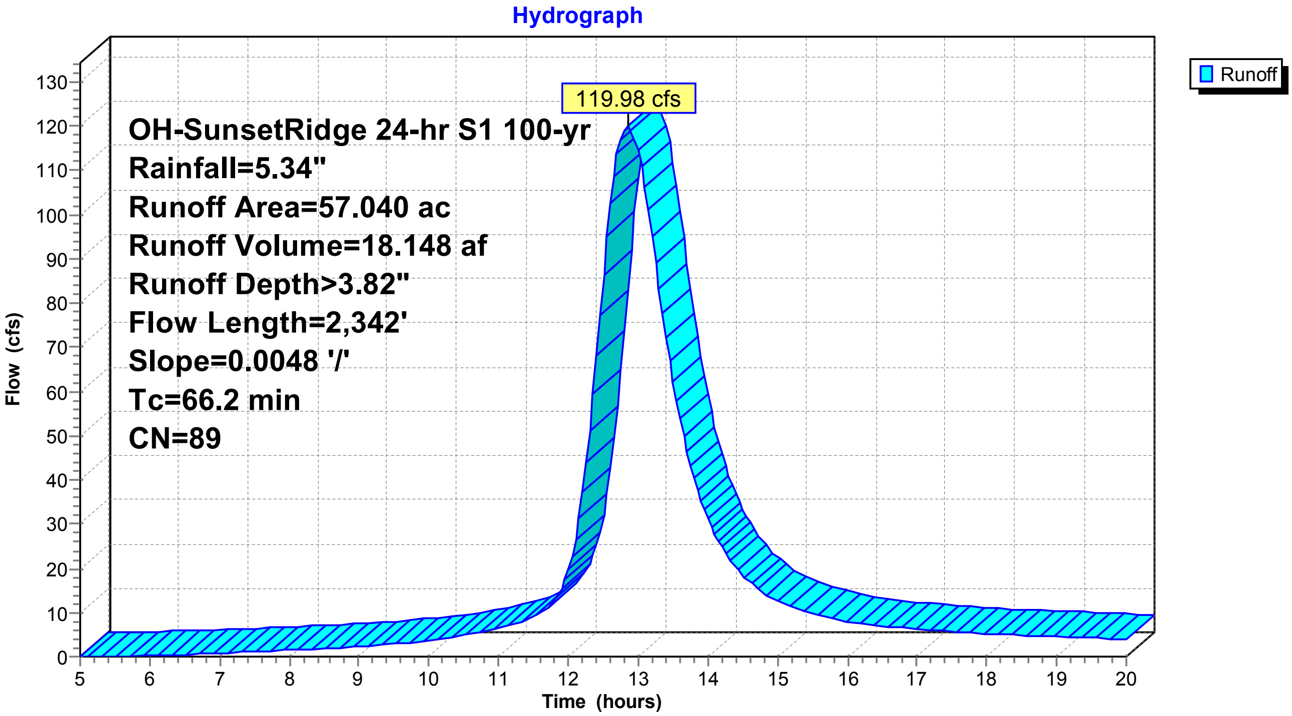
Runoff = 119.98 cfs @ 12.86 hrs, Volume= 18.148 af, Depth> 3.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
57.040	89	Row crops, straight row, Good, HSG D
57.040		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.2	2,342	0.0048	0.59		**Lag/CN Method,**

Subcatchment 4S: DC-04



Summary for Subcatchment 5S: DC-05

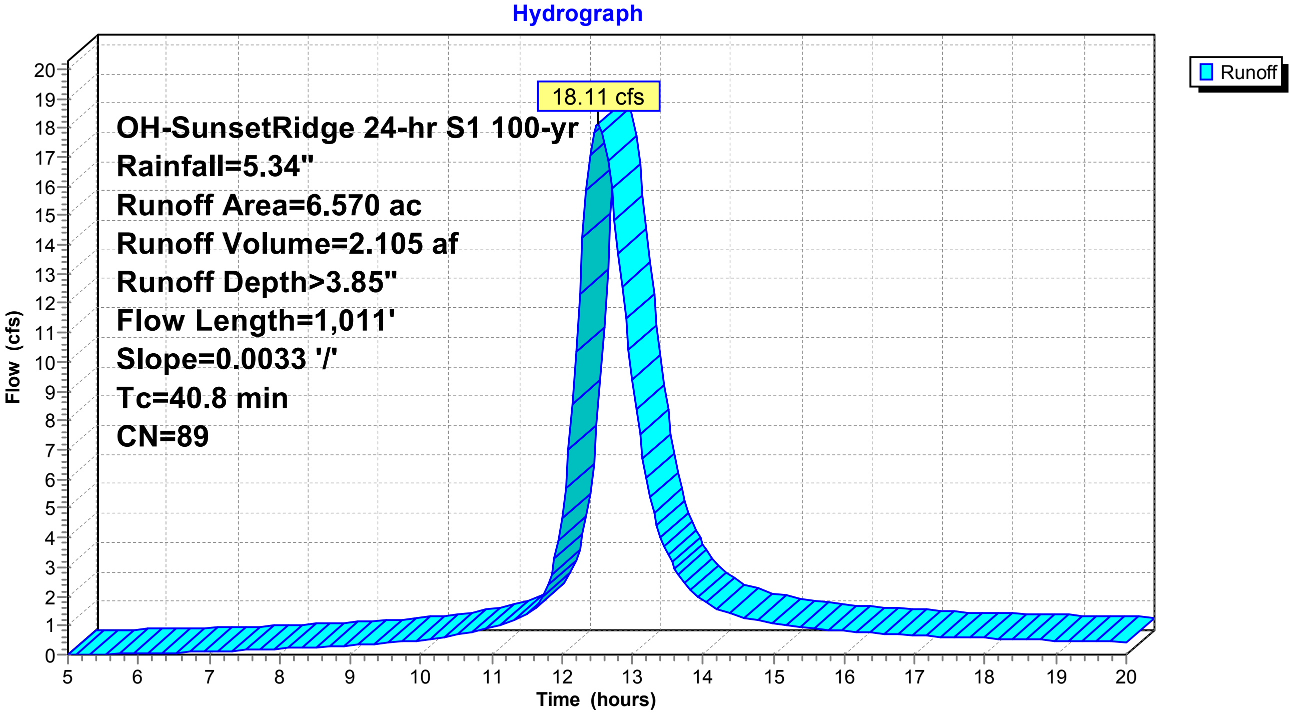
Runoff = 18.11 cfs @ 12.51 hrs, Volume= 2.105 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
6.570	89	Row crops, straight row, Good, HSG D
6.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.8	1,011	0.0033	0.41		**Lag/CN Method,**

Subcatchment 5S: DC-05



Summary for Subcatchment 6S: DC-06

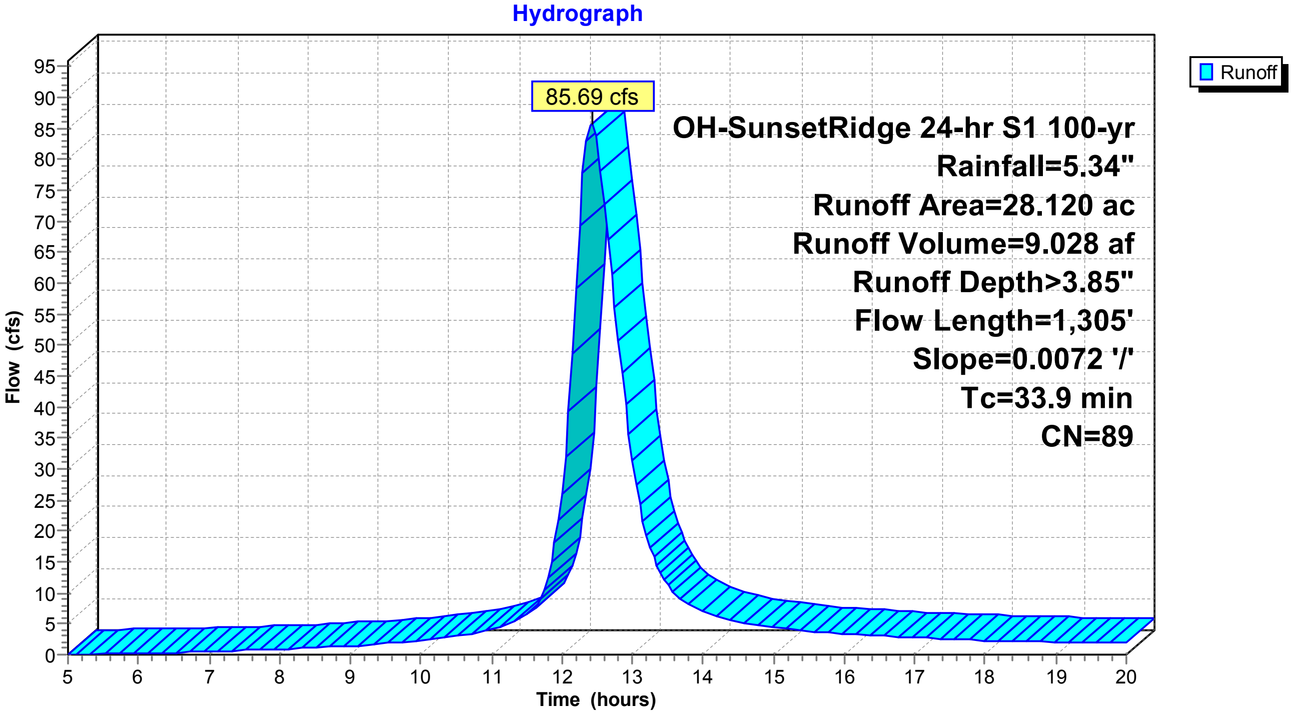
Runoff = 85.69 cfs @ 12.42 hrs, Volume= 9.028 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
28.120	89	Row crops, straight row, Good, HSG D
28.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.9	1,305	0.0072	0.64		**Lag/CN Method,**

Subcatchment 6S: DC-06



Summary for Subcatchment 7S: DC-07

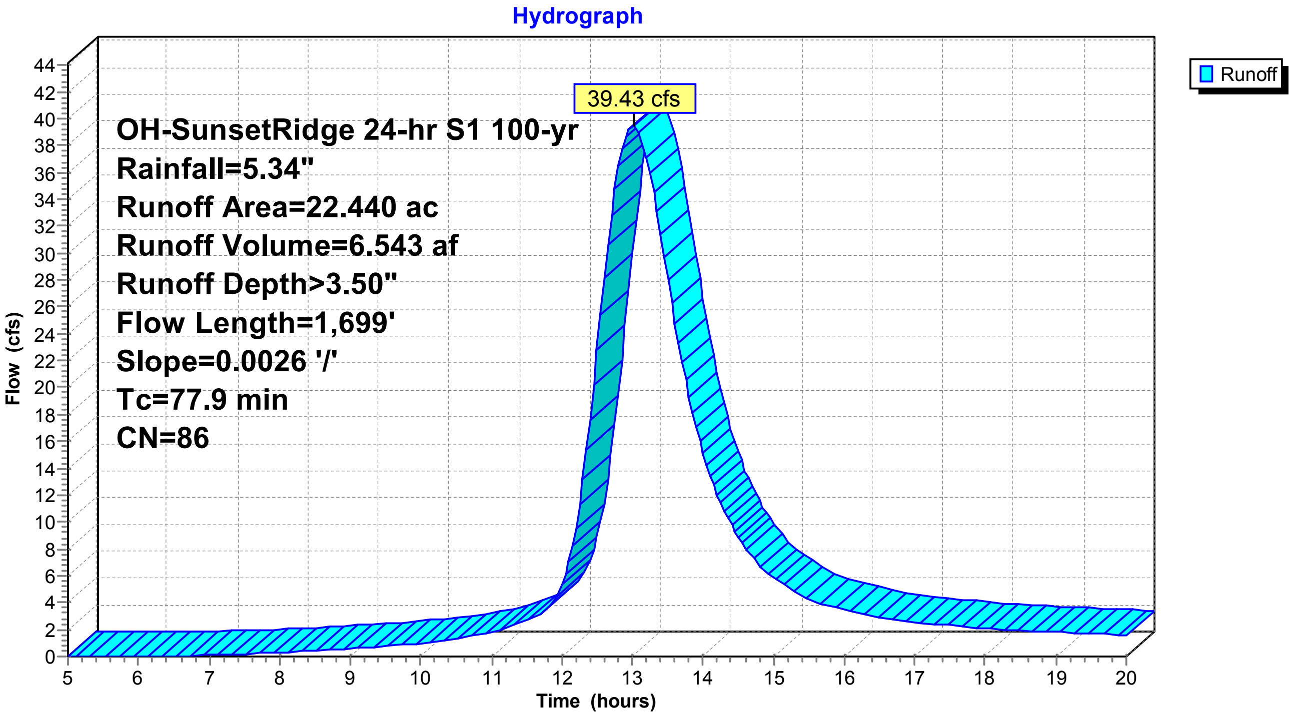
Runoff = 39.43 cfs @ 13.02 hrs, Volume= 6.543 af, Depth> 3.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
16.700	89	Row crops, straight row, Good, HSG D
5.740	77	Woods, Good, HSG D
22.440	86	Weighted Average
22.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.9	1,699	0.0026	0.36		**Lag/CN Method,**

Subcatchment 7S: DC-07



Summary for Subcatchment 8S: DC-08

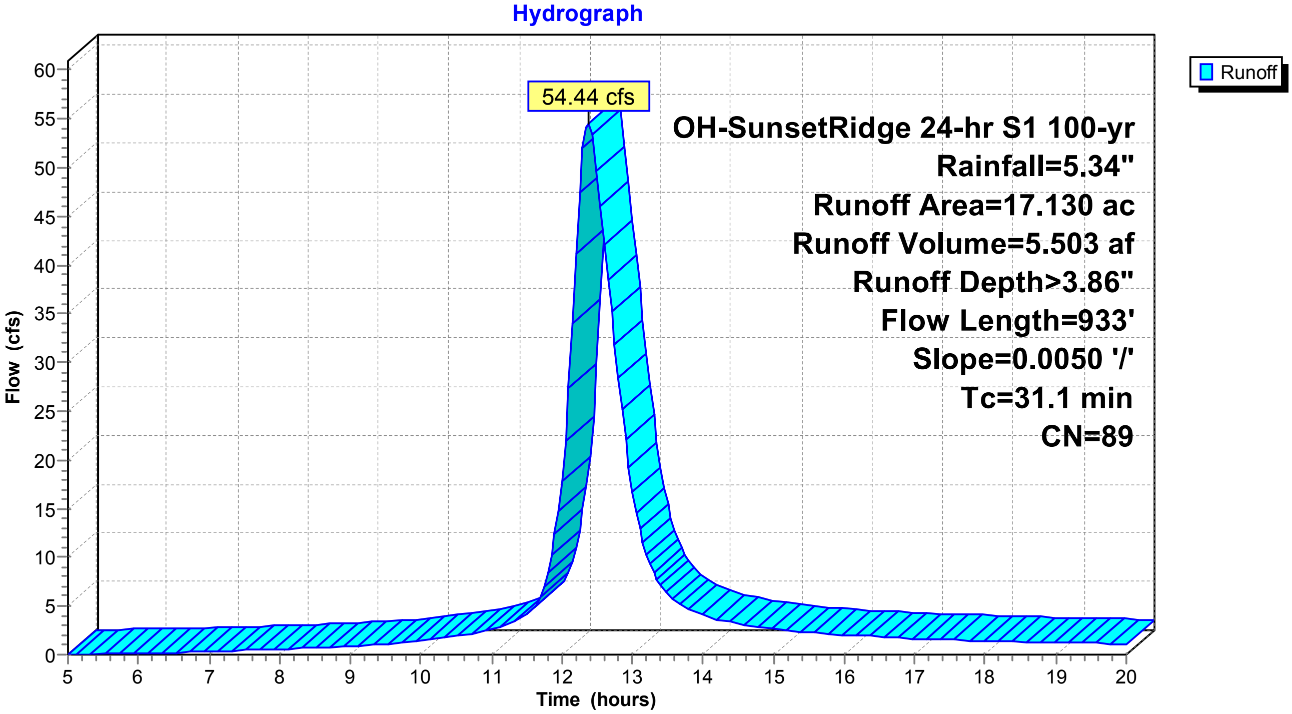
Runoff = 54.44 cfs @ 12.38 hrs, Volume= 5.503 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
17.130	89	Row crops, straight row, Good, HSG D
17.130		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.1	933	0.0050	0.50		**Lag/CN Method,**

Subcatchment 8S: DC-08



Summary for Subcatchment 9S: DC-09

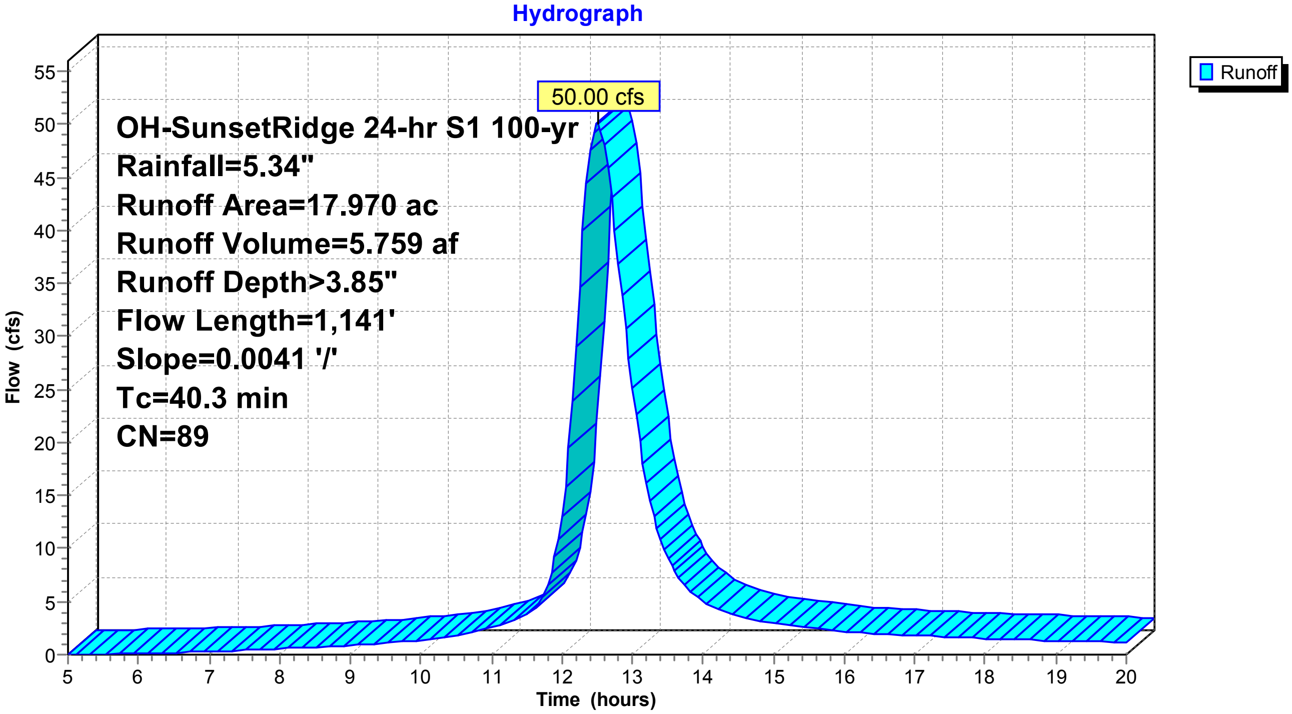
Runoff = 50.00 cfs @ 12.50 hrs, Volume= 5.759 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
17.970	89	Row crops, straight row, Good, HSG D
17.970		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
40.3	1,141	0.0041	0.47		**Lag/CN Method,**

Subcatchment 9S: DC-09



Summary for Subcatchment 10S: DC-10

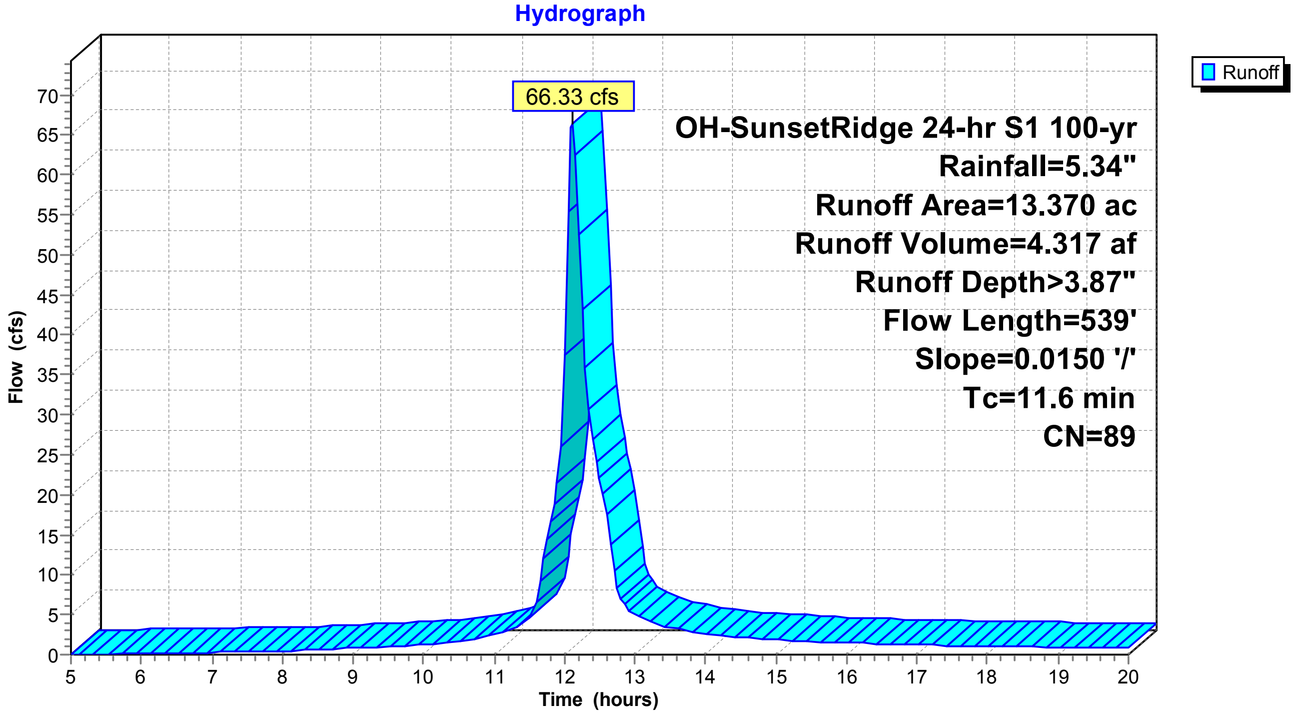
Runoff = 66.33 cfs @ 12.11 hrs, Volume= 4.317 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
13.370	89	Row crops, straight row, Good, HSG D
13.370		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	539	0.0150	0.78		**Lag/CN Method,**

Subcatchment 10S: DC-10



Summary for Subcatchment 11S: DC-11

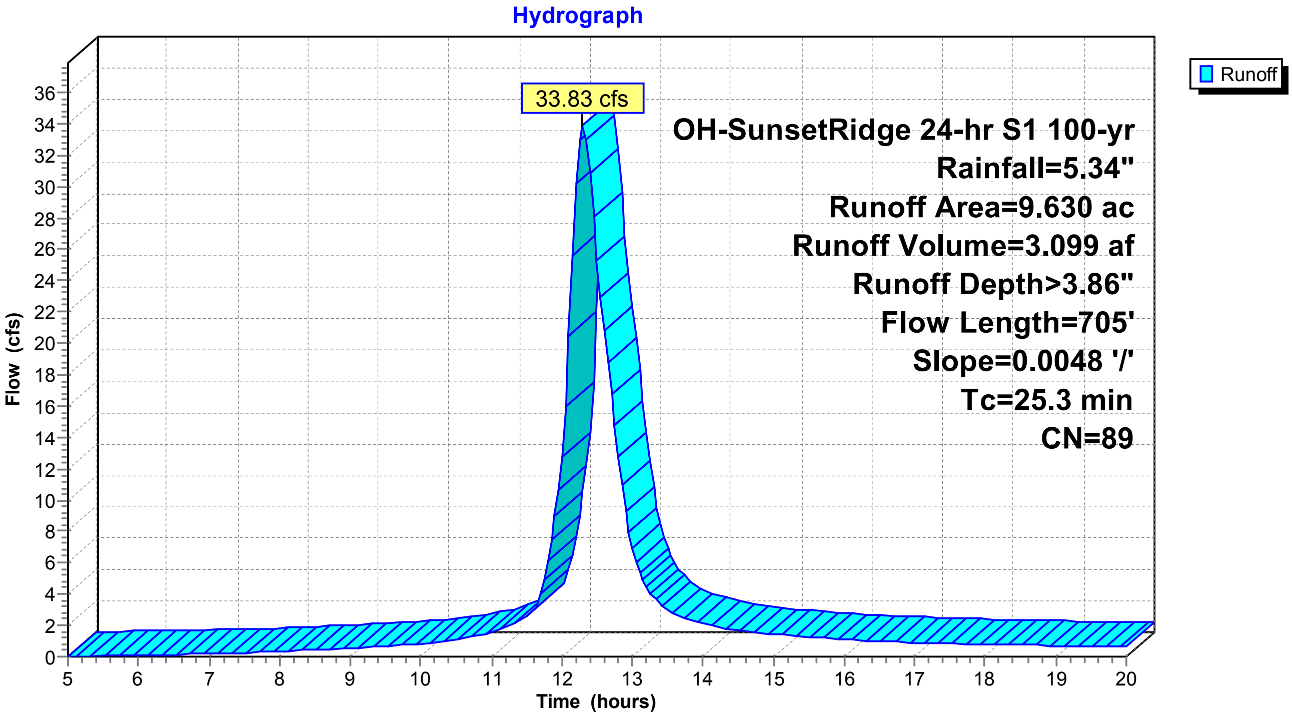
Runoff = 33.83 cfs @ 12.30 hrs, Volume= 3.099 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
9.630	89	Row crops, straight row, Good, HSG D
9.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.3	705	0.0048	0.46		**Lag/CN Method,**

Subcatchment 11S: DC-11



Summary for Subcatchment 12S: DC-12

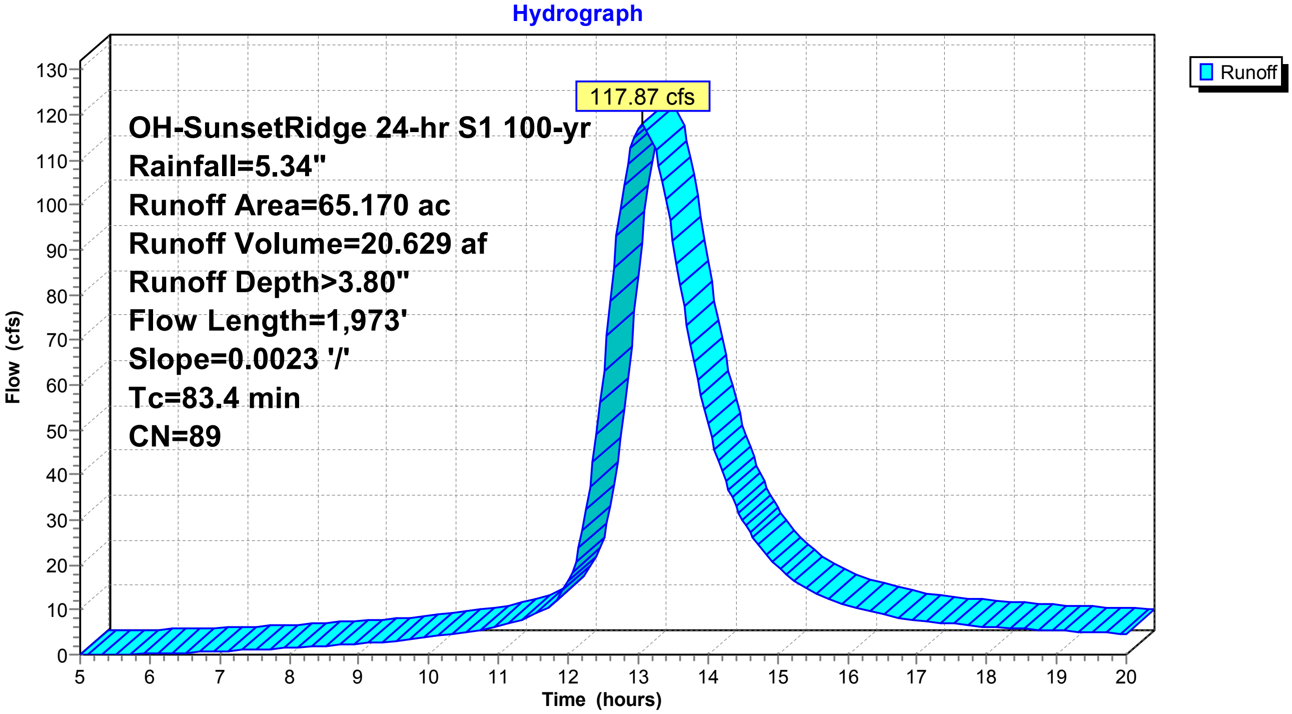
Runoff = 117.87 cfs @ 13.06 hrs, Volume= 20.629 af, Depth> 3.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
65.170	89	Row crops, straight row, Good, HSG D
65.170		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
83.4	1,973	0.0023	0.39		**Lag/CN Method,**

Subcatchment 12S: DC-12



Summary for Subcatchment 13S: DC-13

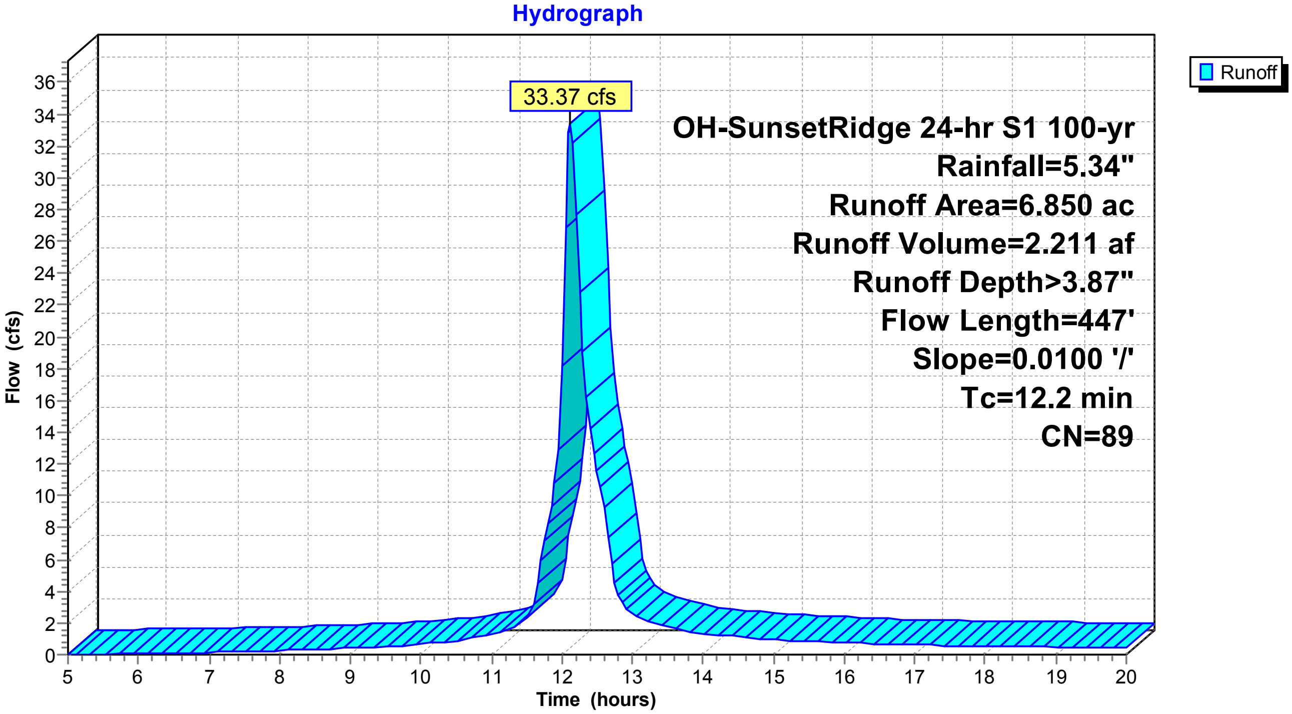
Runoff = 33.37 cfs @ 12.12 hrs, Volume= 2.211 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
6.850	89	Row crops, straight row, Good, HSG D
6.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	447	0.0100	0.61		**Lag/CN Method,**

Subcatchment 13S: DC-13



Summary for Subcatchment 14S: DC-14

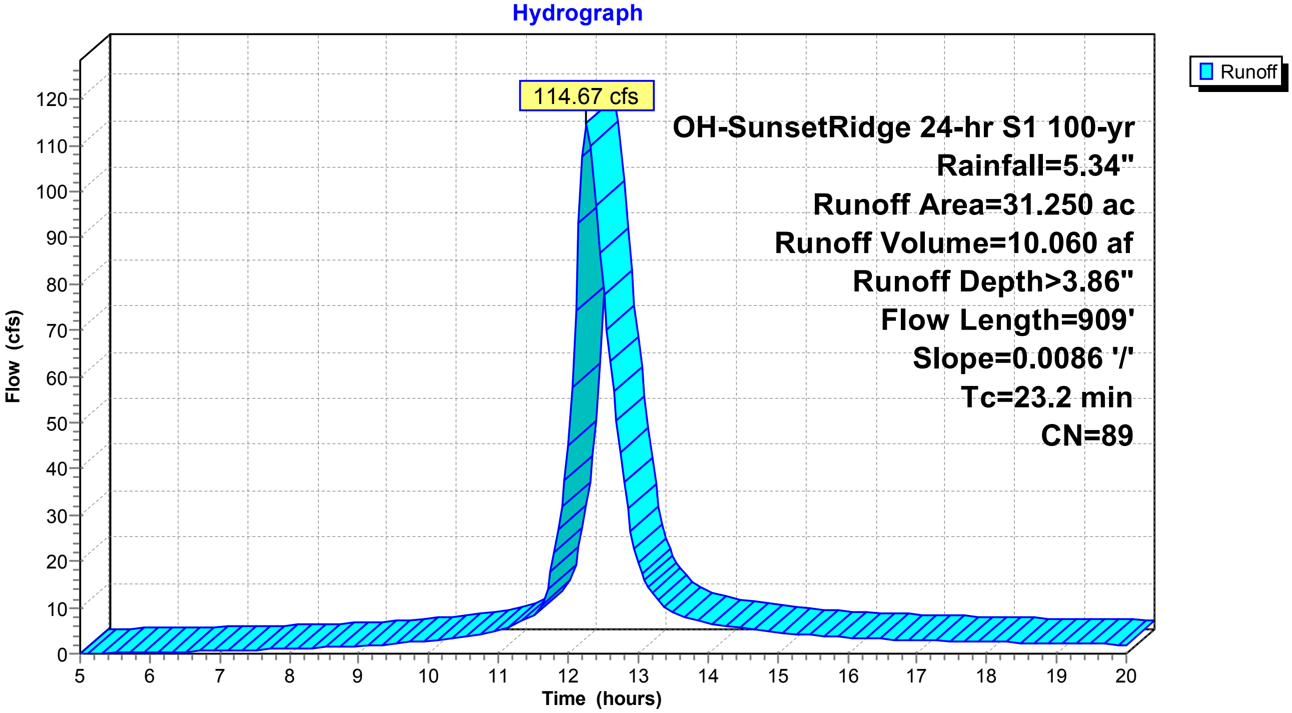
Runoff = 114.67 cfs @ 12.27 hrs, Volume= 10.060 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
31.250	89	Row crops, straight row, Good, HSG D
31.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.2	909	0.0086	0.65		**Lag/CN Method,**

Subcatchment 14S: DC-14



Summary for Subcatchment 15S: DC-15

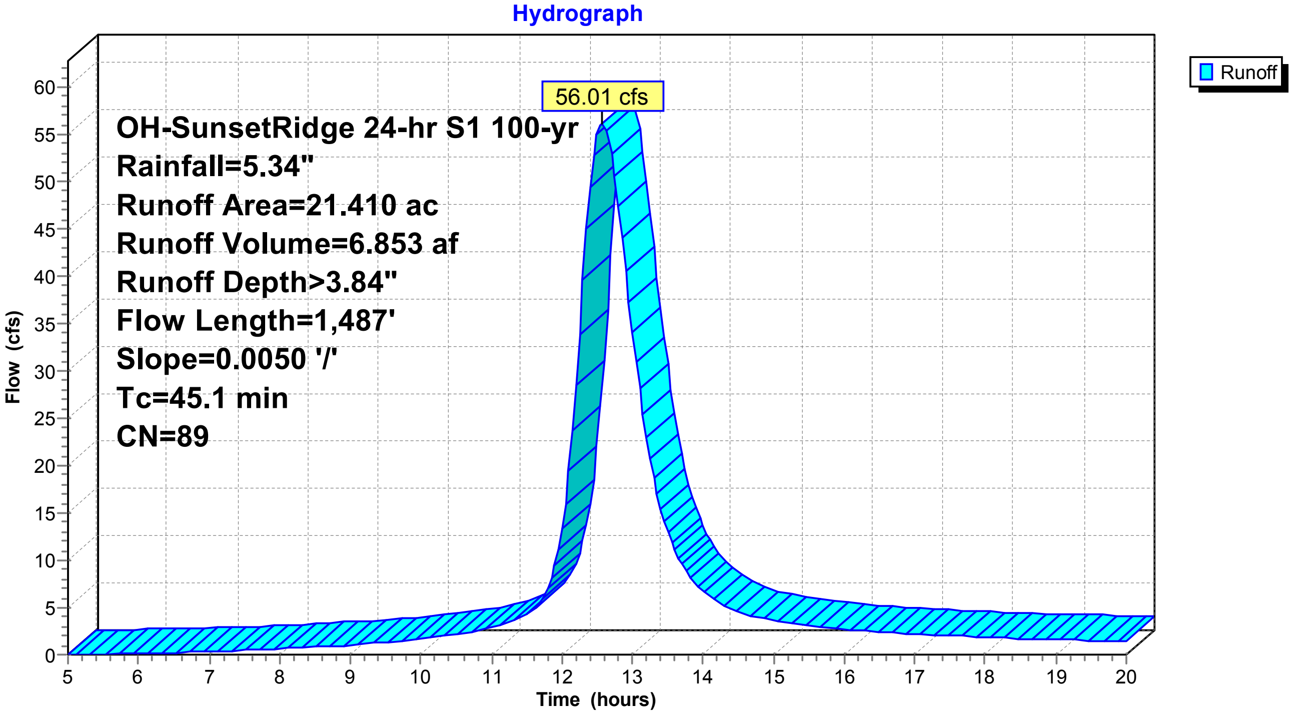
Runoff = 56.01 cfs @ 12.57 hrs, Volume= 6.853 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
21.410	89	Row crops, straight row, Good, HSG D
21.410		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.1	1,487	0.0050	0.55		**Lag/CN Method,**

Subcatchment 15S: DC-15



Summary for Subcatchment 16S: DC-16

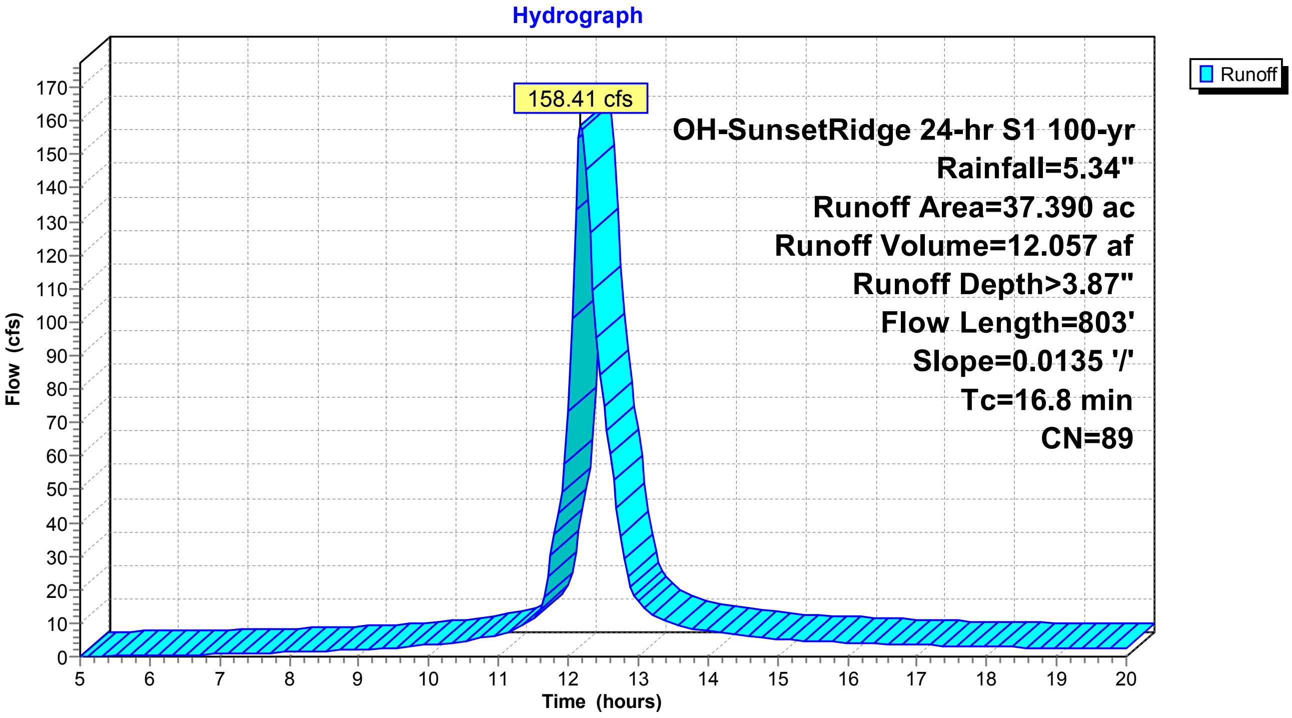
Runoff = 158.41 cfs @ 12.18 hrs, Volume= 12.057 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
37.390	89	Row crops, straight row, Good, HSG D
37.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	803	0.0135	0.80		**Lag/CN Method,**

Subcatchment 16S: DC-16



Summary for Subcatchment 17S: DC-17

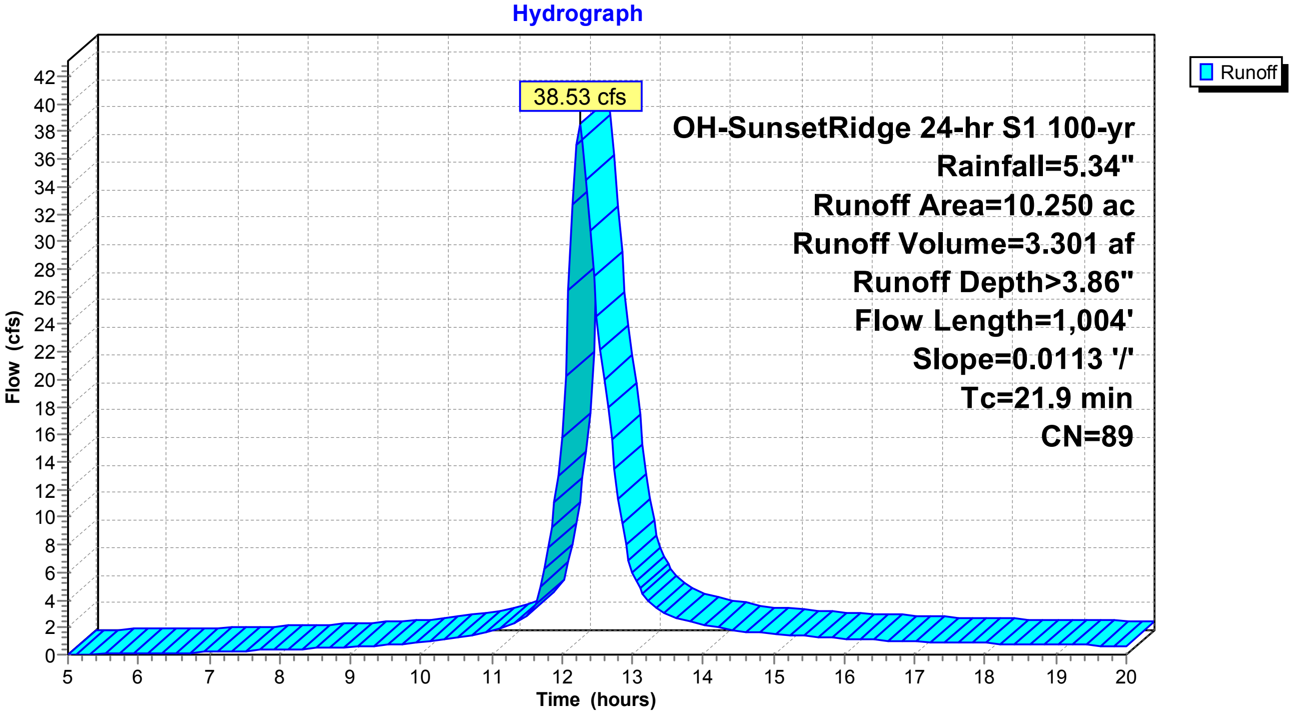
Runoff = 38.53 cfs @ 12.25 hrs, Volume= 3.301 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
10.250	89	Row crops, straight row, Good, HSG D
10.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
21.9	1,004	0.0113	0.76		**Lag/CN Method,**

Subcatchment 17S: DC-17



Summary for Subcatchment 18S: DC-18

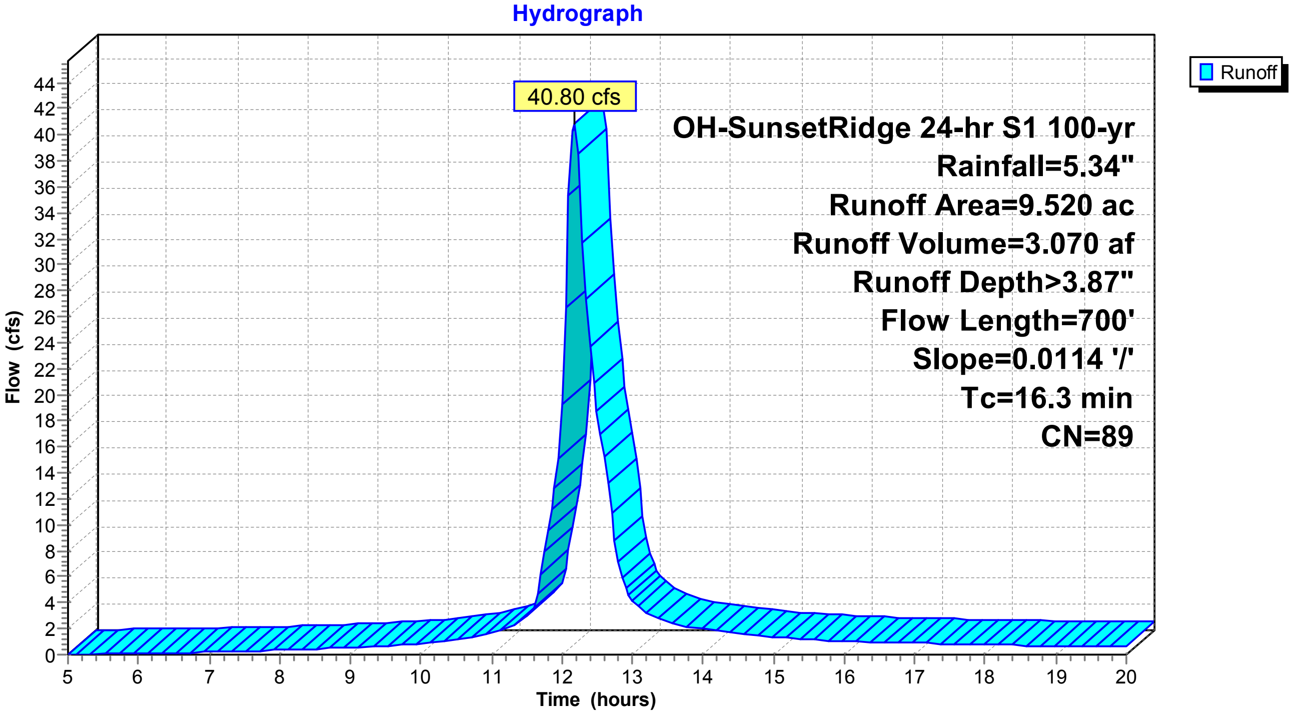
Runoff = 40.80 cfs @ 12.18 hrs, Volume= 3.070 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
9.520	89	Row crops, straight row, Good, HSG D
9.520		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.3	700	0.0114	0.71		**Lag/CN Method,**

Subcatchment 18S: DC-18



Summary for Subcatchment 19S: DC-19

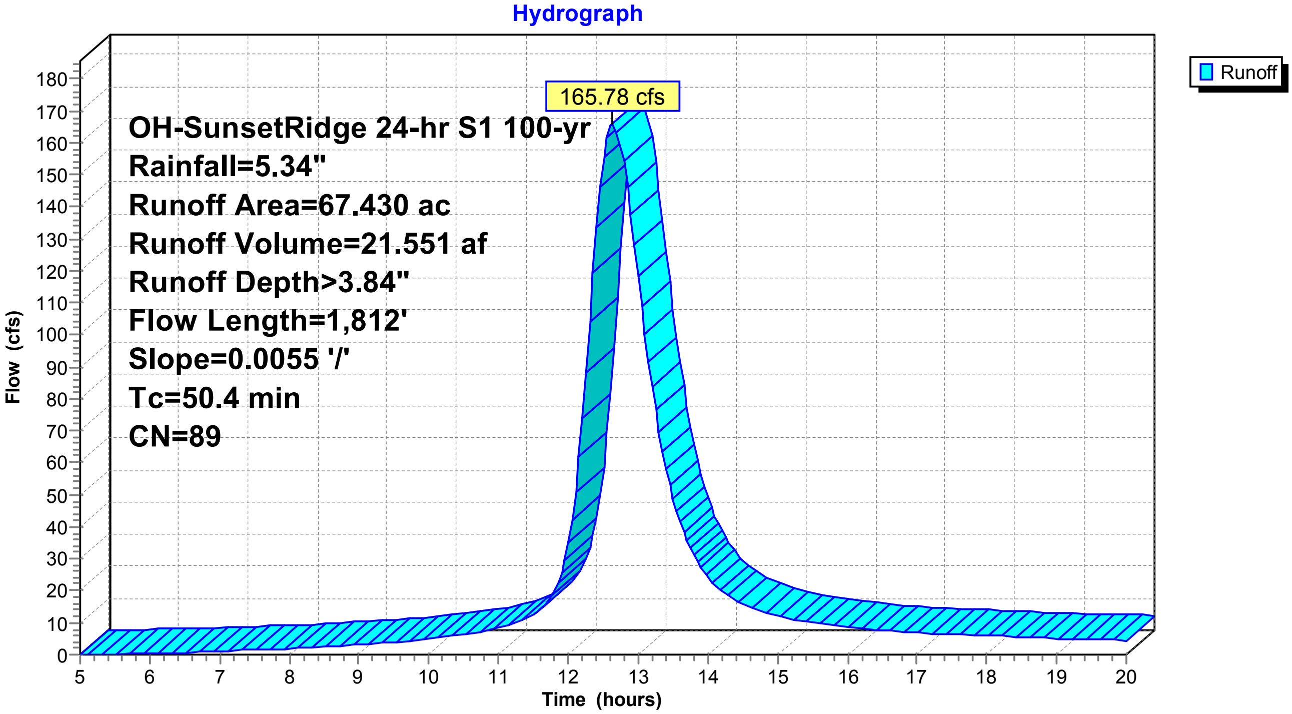
Runoff = 165.78 cfs @ 12.63 hrs, Volume= 21.551 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
67.430	89	Row crops, straight row, Good, HSG D
67.430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
50.4	1,812	0.0055	0.60		**Lag/CN Method,**

Subcatchment 19S: DC-19



Summary for Subcatchment 20S: DC-20

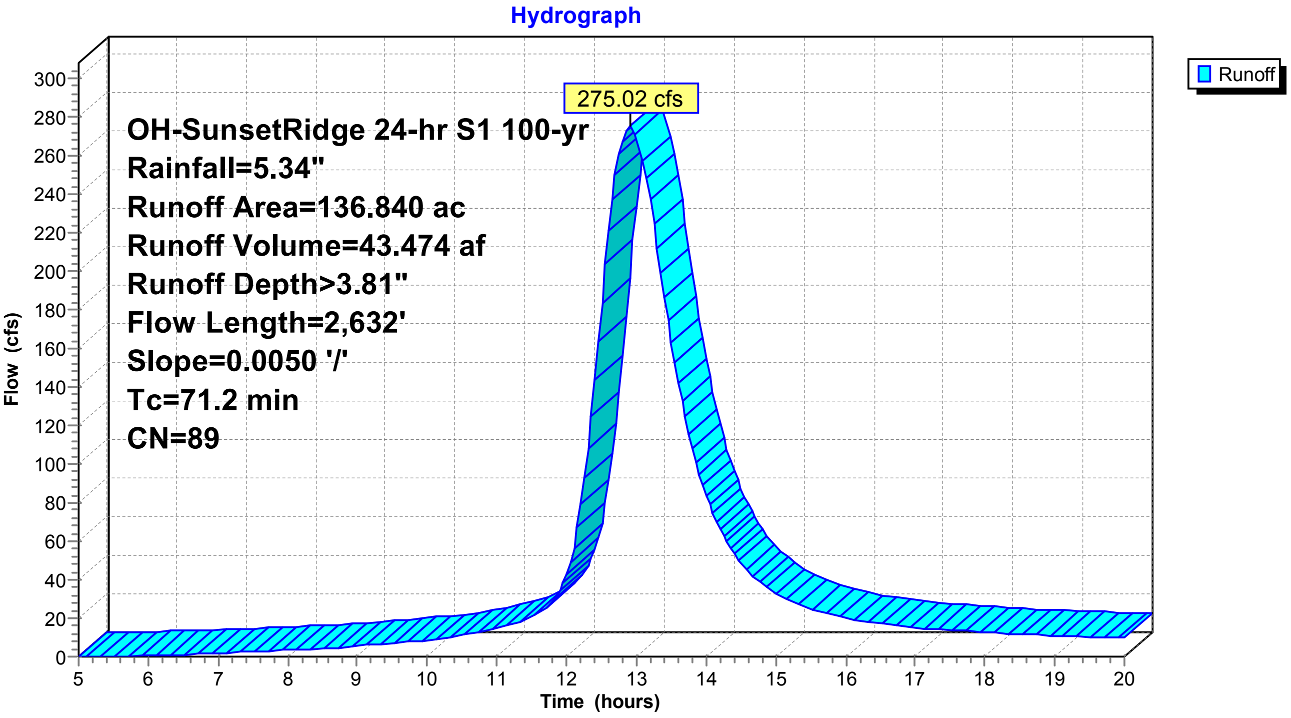
Runoff = 275.02 cfs @ 12.91 hrs, Volume= 43.474 af, Depth> 3.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
136.840	89	Row crops, straight row, Good, HSG D
136.840		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
71.2	2,632	0.0050	0.62		**Lag/CN Method,**

Subcatchment 20S: DC-20



Summary for Subcatchment 21S: DC-21

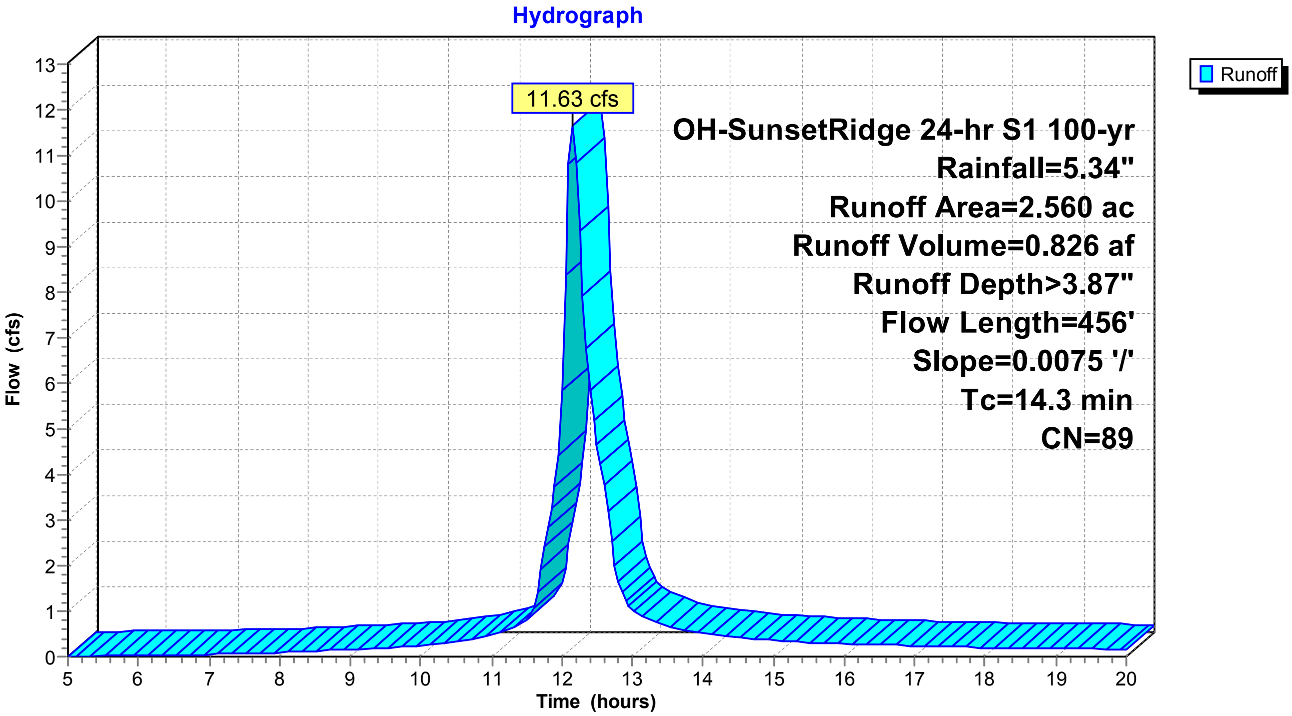
Runoff = 11.63 cfs @ 12.15 hrs, Volume= 0.826 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
2.560	89	Row crops, straight row, Good, HSG D
2.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	456	0.0075	0.53		**Lag/CN Method,**

Subcatchment 21S: DC-21



Summary for Subcatchment 22S: DC-22

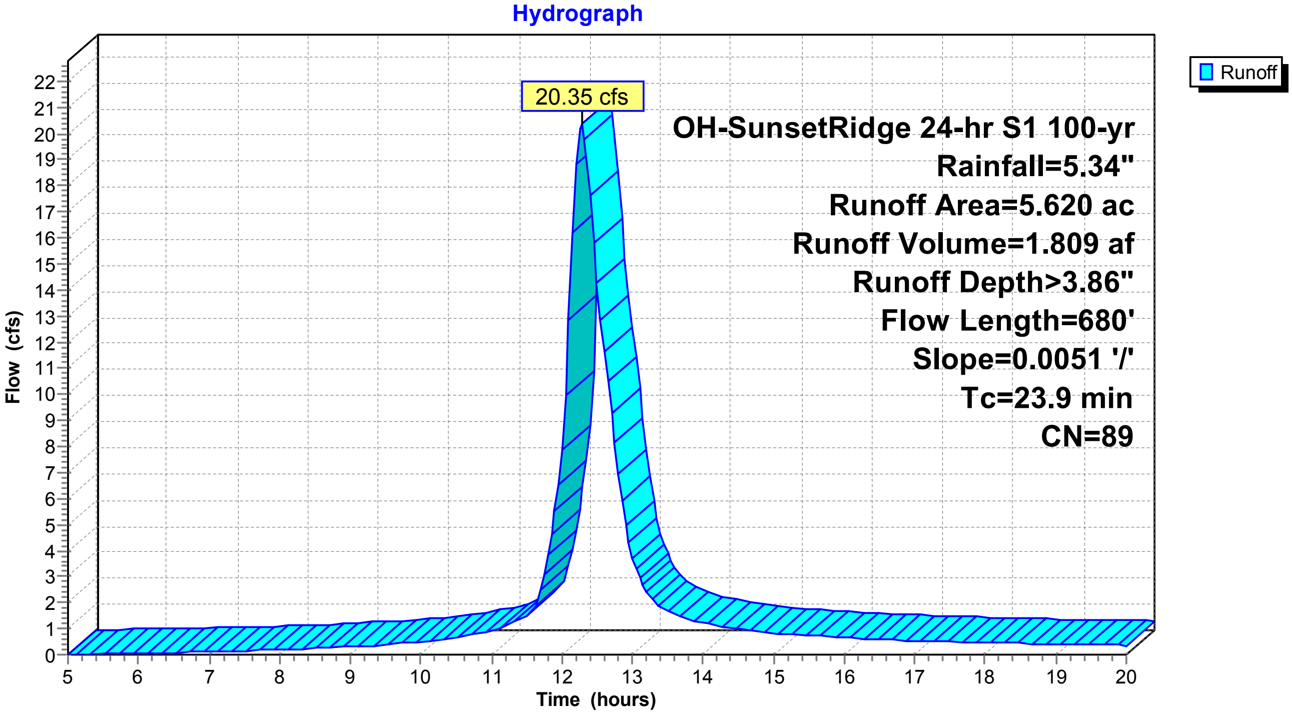
Runoff = 20.35 cfs @ 12.28 hrs, Volume= 1.809 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.620	89	Row crops, straight row, Good, HSG D
5.620		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.9	680	0.0051	0.47		**Lag/CN Method,**

Subcatchment 22S: DC-22



Summary for Subcatchment 23S: DC-23

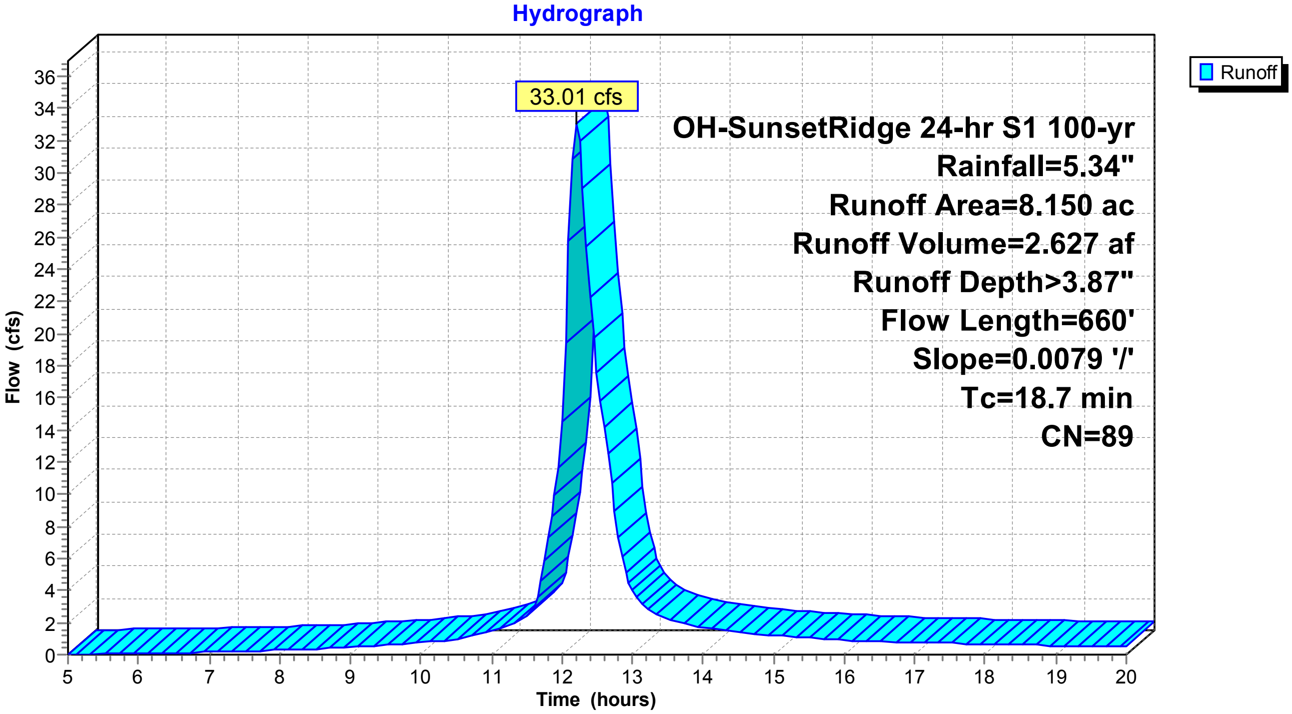
Runoff = 33.01 cfs @ 12.21 hrs, Volume= 2.627 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
8.150	89	Row crops, straight row, Good, HSG D
8.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.7	660	0.0079	0.59		**Lag/CN Method,**

Subcatchment 23S: DC-23



Summary for Subcatchment 24S: DC-24

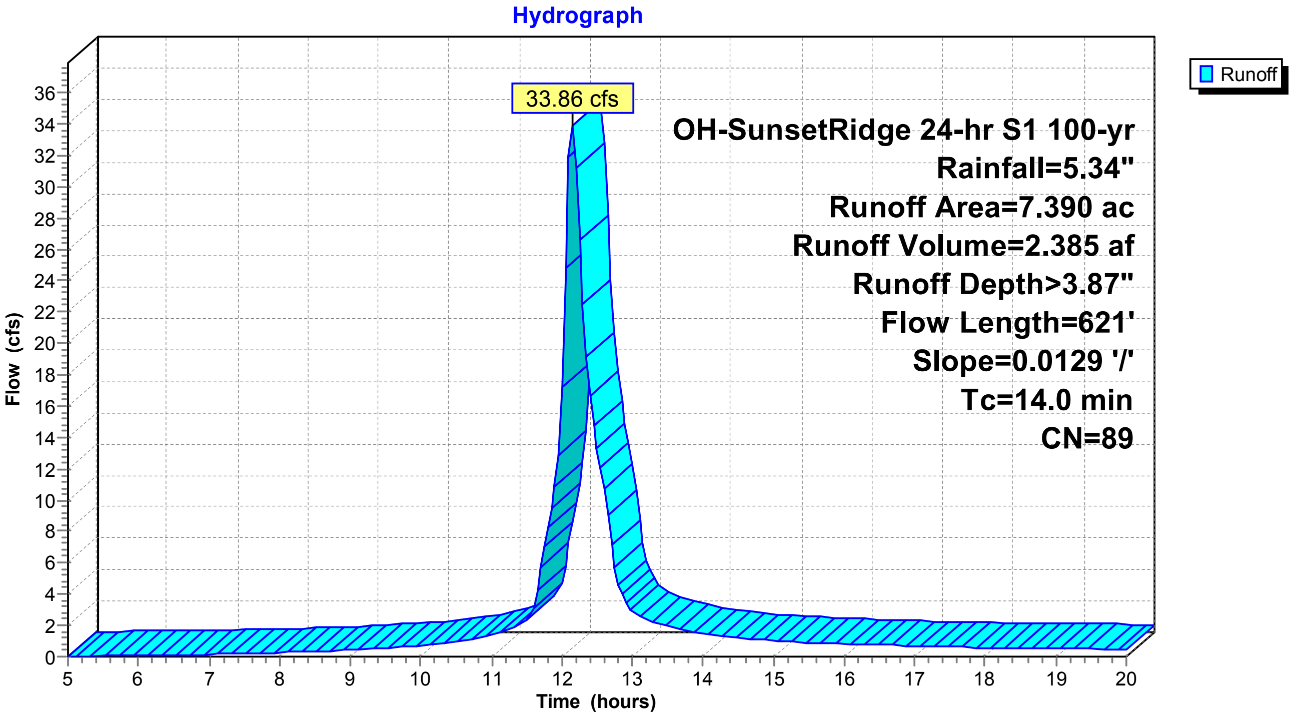
Runoff = 33.86 cfs @ 12.15 hrs, Volume= 2.385 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
7.390	89	Row crops, straight row, Good, HSG D
7.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.0	621	0.0129	0.74		**Lag/CN Method,**

Subcatchment 24S: DC-24



Summary for Subcatchment 25S: DC-25

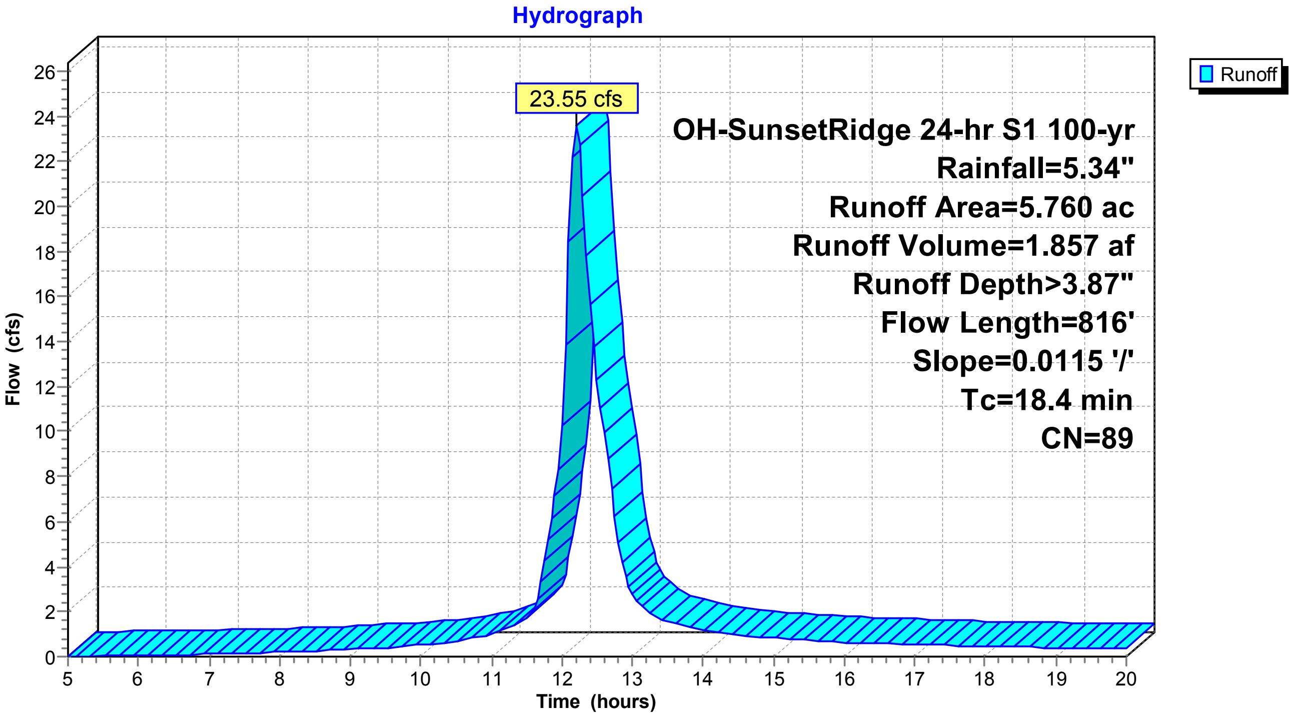
Runoff = 23.55 cfs @ 12.21 hrs, Volume= 1.857 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.760	89	Row crops, straight row, Good, HSG D
5.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.4	816	0.0115	0.74		**Lag/CN Method,**

Subcatchment 25S: DC-25



Summary for Subcatchment 26S: DC-26

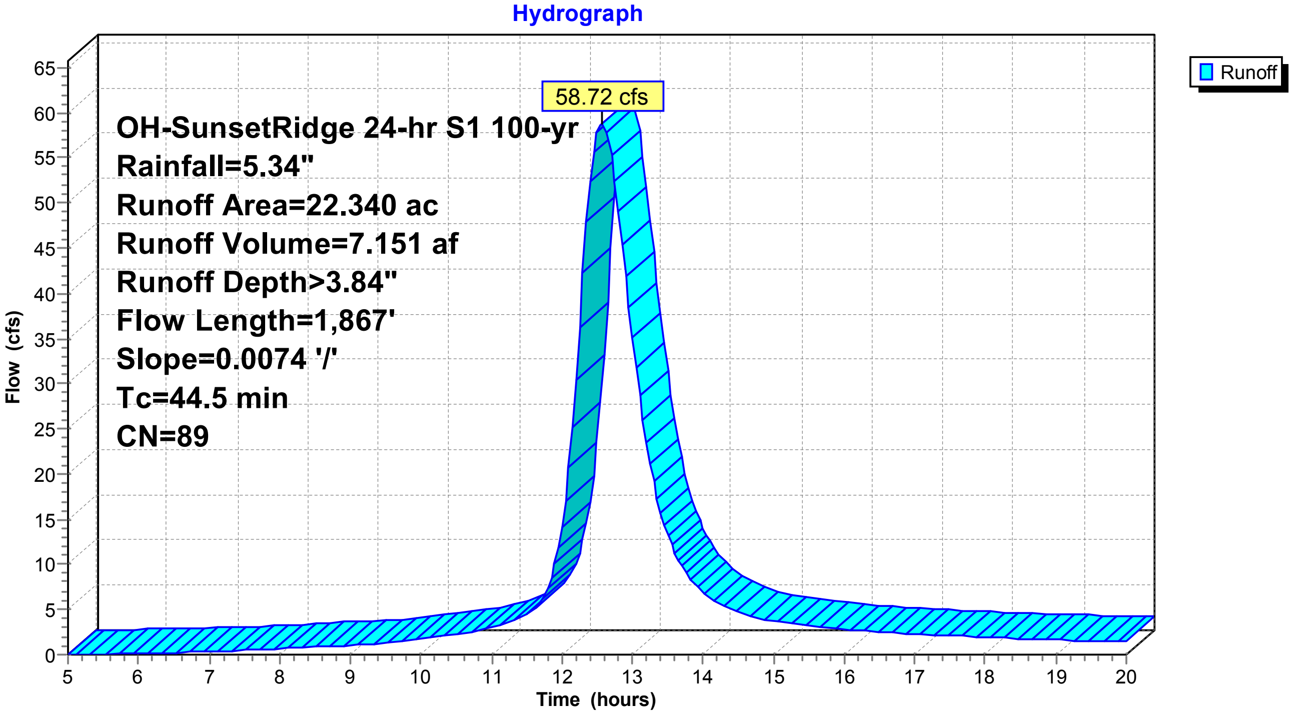
Runoff = 58.72 cfs @ 12.57 hrs, Volume= 7.151 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
22.340	89	Row crops, straight row, Good, HSG D
22.340		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.5	1,867	0.0074	0.70		**Lag/CN Method,**

Subcatchment 26S: DC-26



Summary for Subcatchment 27S: DC-27

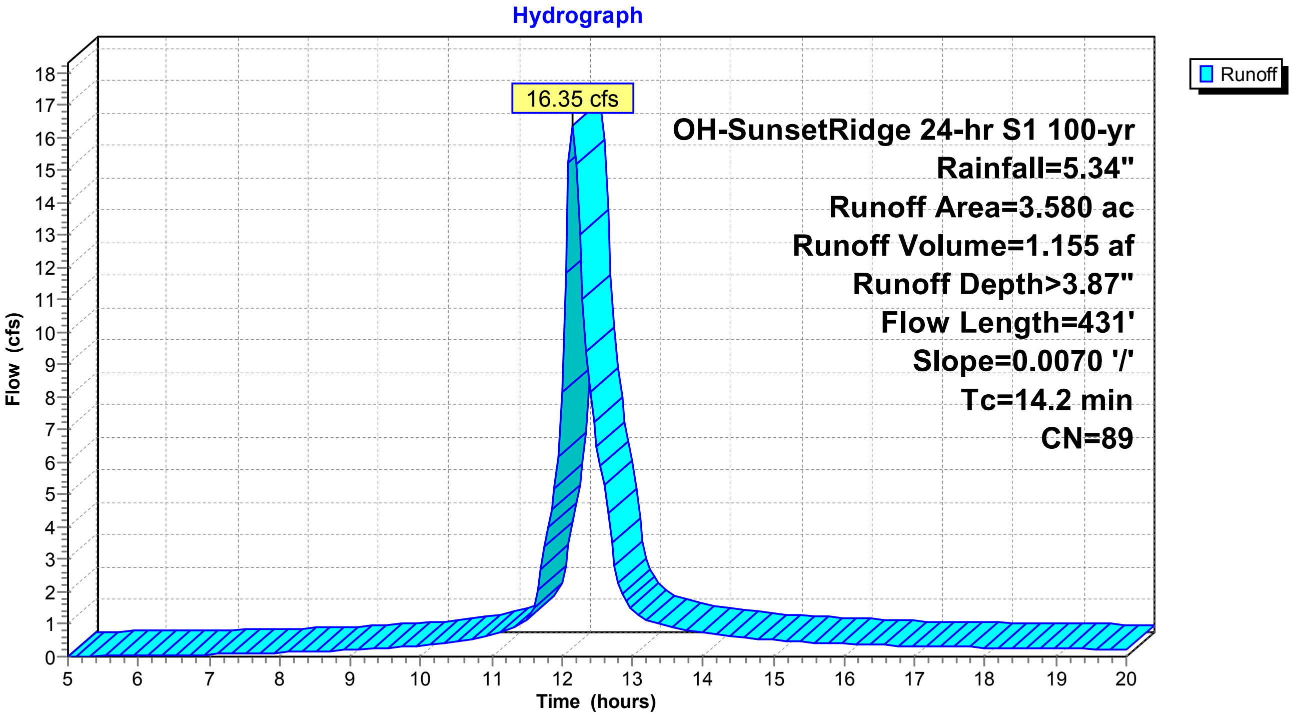
Runoff = 16.35 cfs @ 12.15 hrs, Volume= 1.155 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
3.580	89	Row crops, straight row, Good, HSG D
3.580		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.2	431	0.0070	0.51		**Lag/CN Method,**

Subcatchment 27S: DC-27



Summary for Subcatchment 28S: DC-28

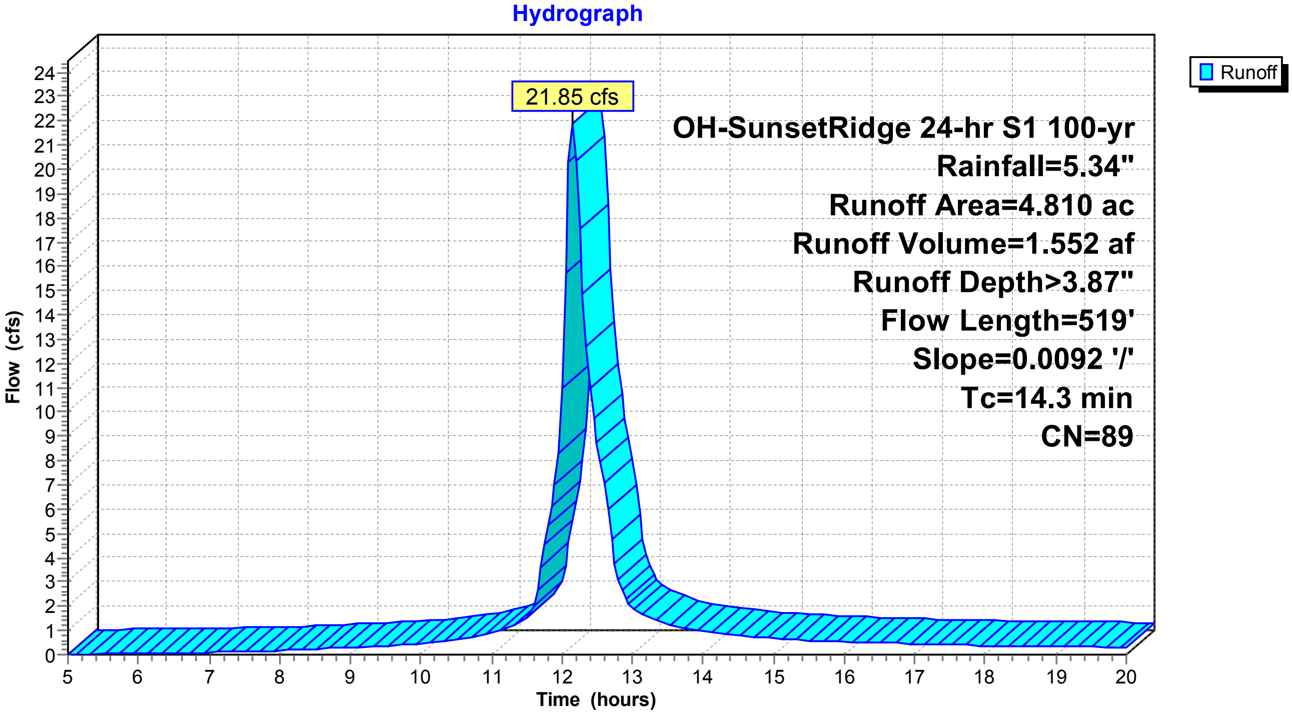
Runoff = 21.85 cfs @ 12.15 hrs, Volume= 1.552 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
4.810	89	Row crops, straight row, Good, HSG D
4.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
14.3	519	0.0092	0.60		**Lag/CN Method,**

Subcatchment 28S: DC-28



Summary for Subcatchment 29S: DC-29

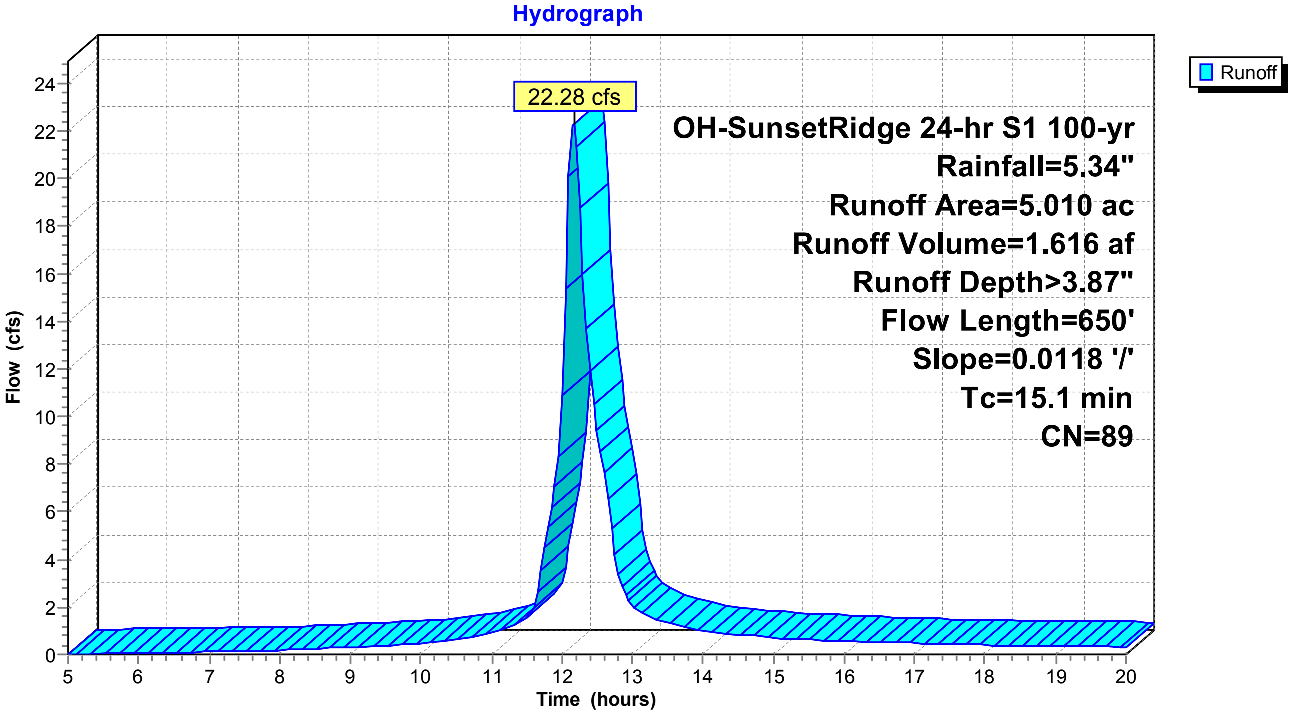
Runoff = 22.28 cfs @ 12.16 hrs, Volume= 1.616 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.010	89	Row crops, straight row, Good, HSG D
5.010		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	650	0.0118	0.72		**Lag/CN Method,**

Subcatchment 29S: DC-29



Summary for Subcatchment 30S: DC-30

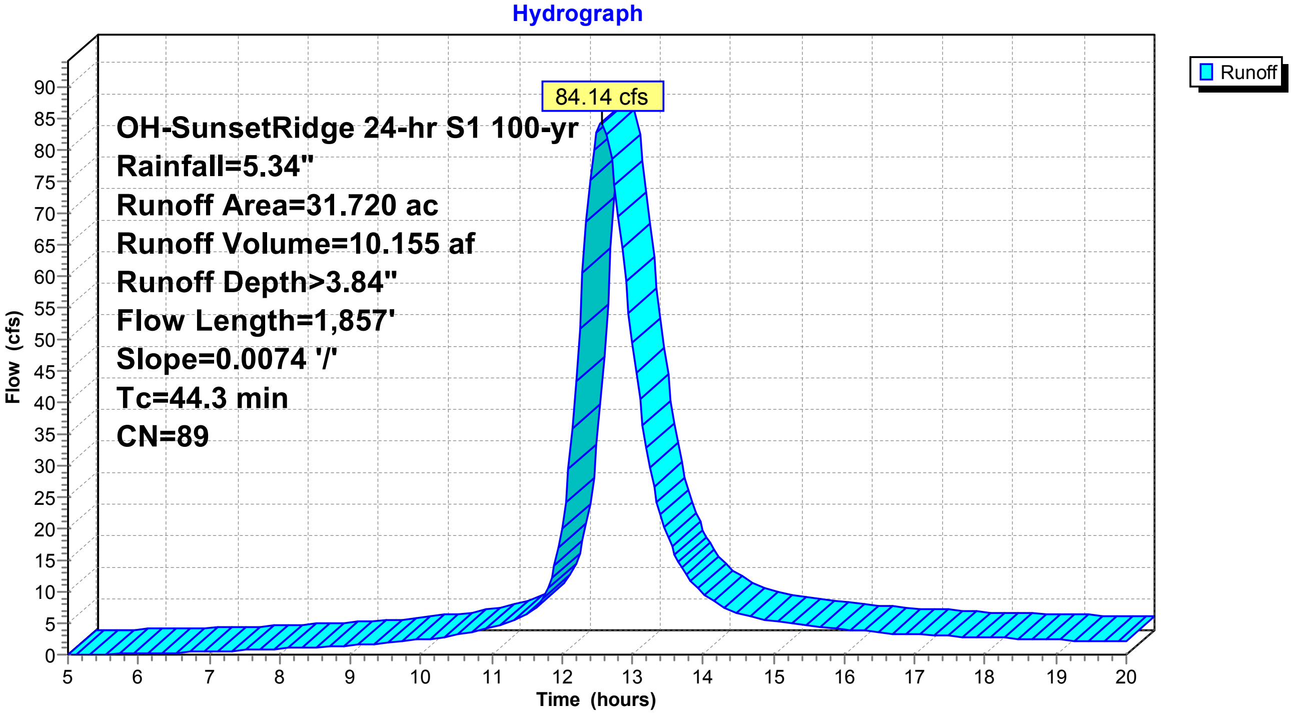
Runoff = 84.14 cfs @ 12.56 hrs, Volume= 10.155 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
31.720	89	Row crops, straight row, Good, HSG D
31.720		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.3	1,857	0.0074	0.70		**Lag/CN Method,**

Subcatchment 30S: DC-30



Summary for Subcatchment 31S: DC-31

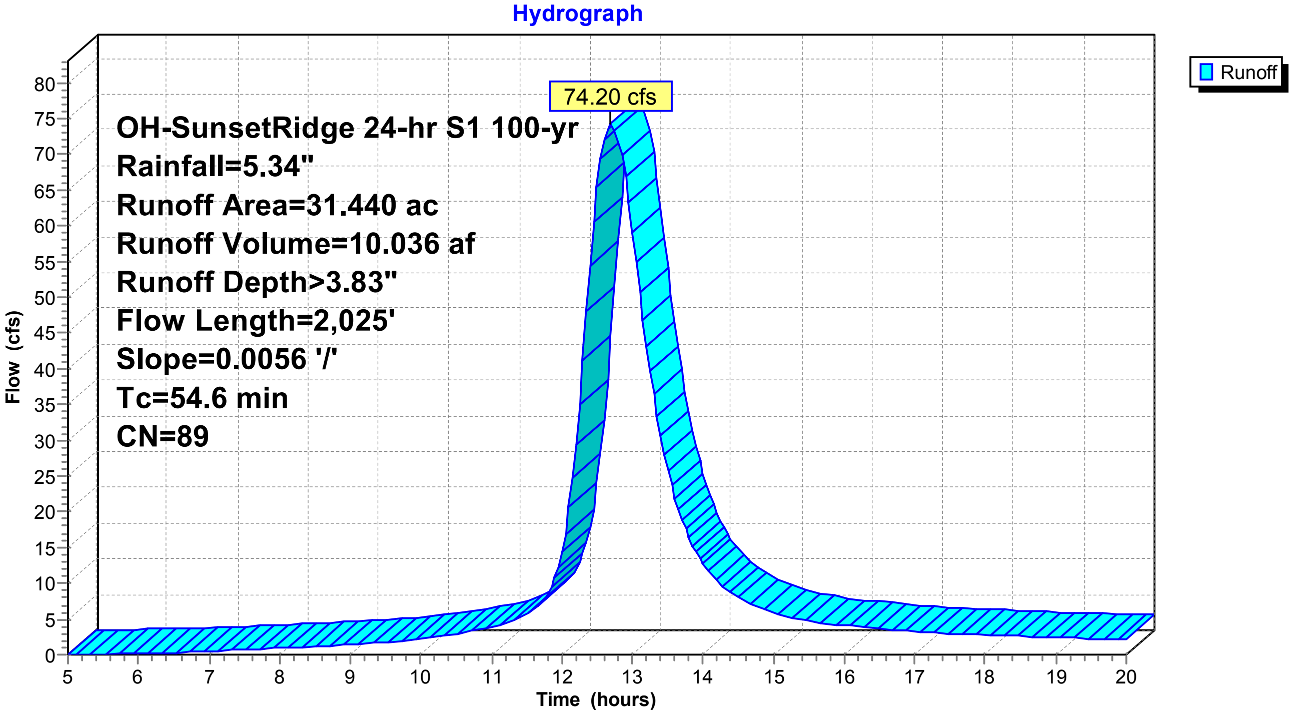
Runoff = 74.20 cfs @ 12.70 hrs, Volume= 10.036 af, Depth> 3.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
31.440	89	Row crops, straight row, Good, HSG D
31.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
54.6	2,025	0.0056	0.62		**Lag/CN Method,**

Subcatchment 31S: DC-31



Summary for Subcatchment 32S: DC-32

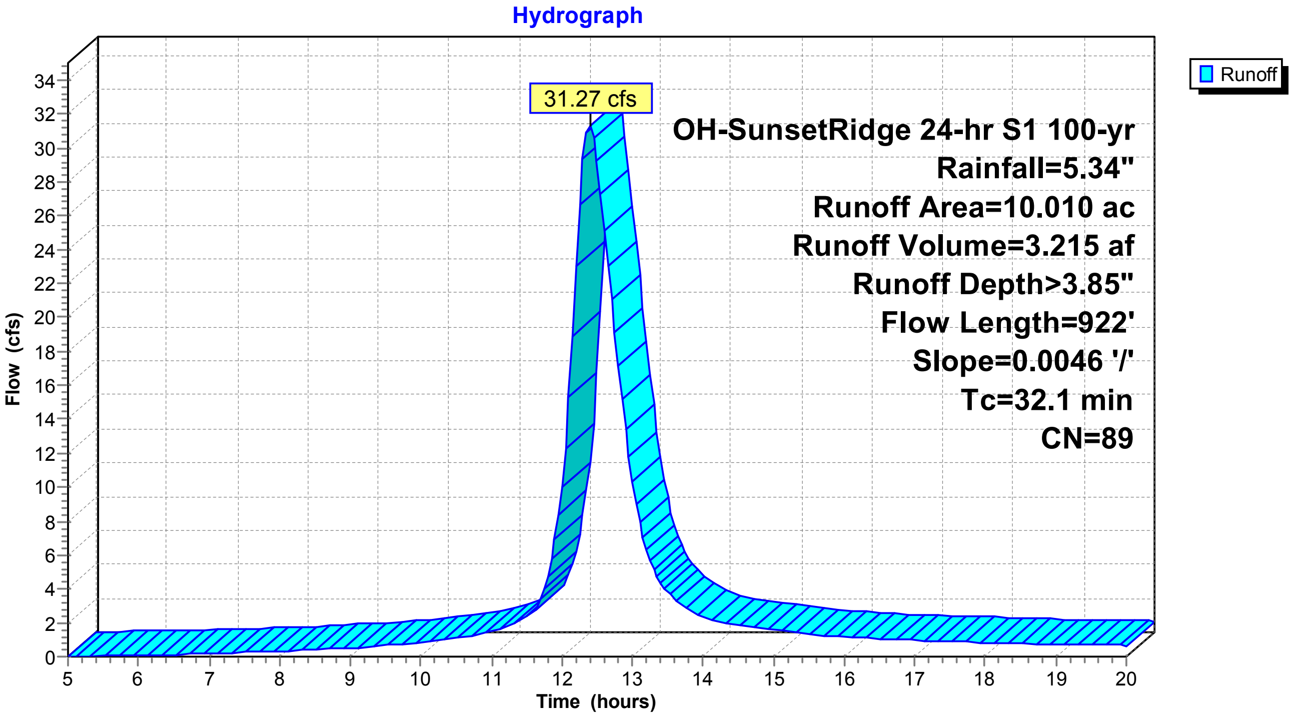
Runoff = 31.27 cfs @ 12.39 hrs, Volume= 3.215 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
10.010	89	Row crops, straight row, Good, HSG D
10.010		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.1	922	0.0046	0.48		**Lag/CN Method,**

Subcatchment 32S: DC-32



Summary for Subcatchment 33S: DC-33

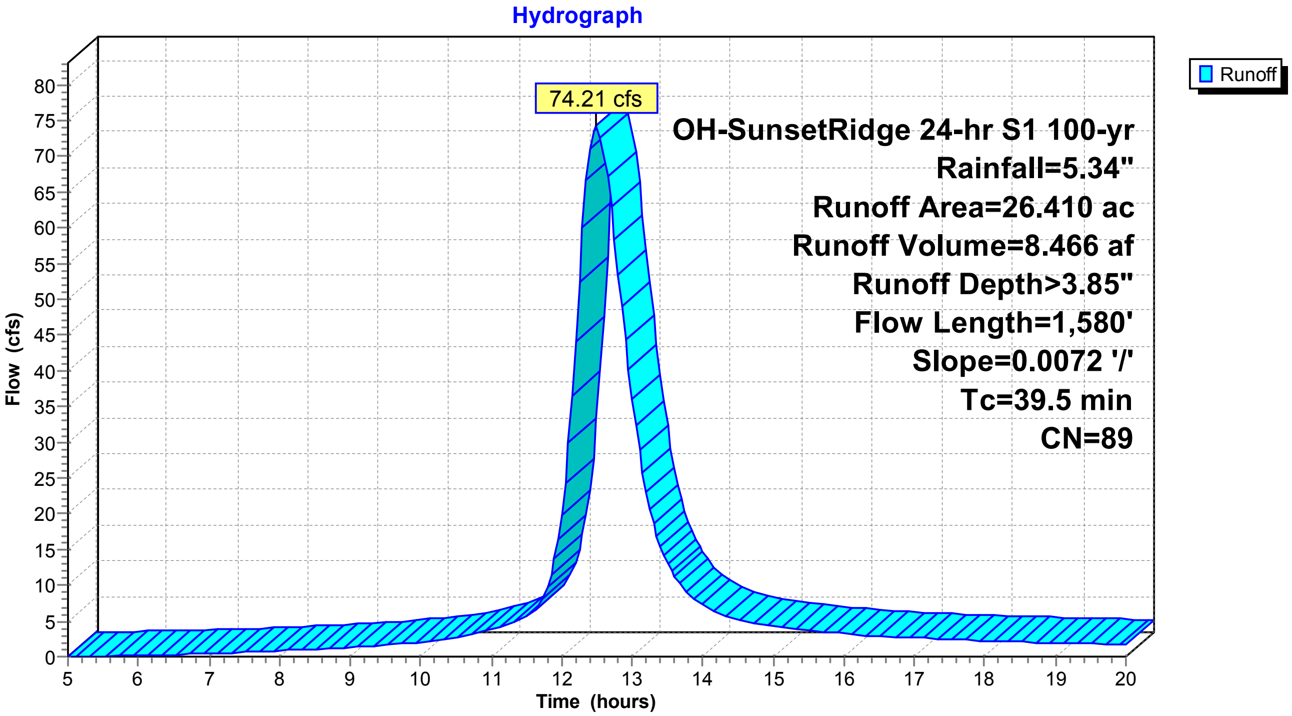
Runoff = 74.21 cfs @ 12.49 hrs, Volume= 8.466 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
26.410	89	Row crops, straight row, Good, HSG D
26.410		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.5	1,580	0.0072	0.67		**Lag/CN Method,**

Subcatchment 33S: DC-33



Summary for Subcatchment 34S: DC-34

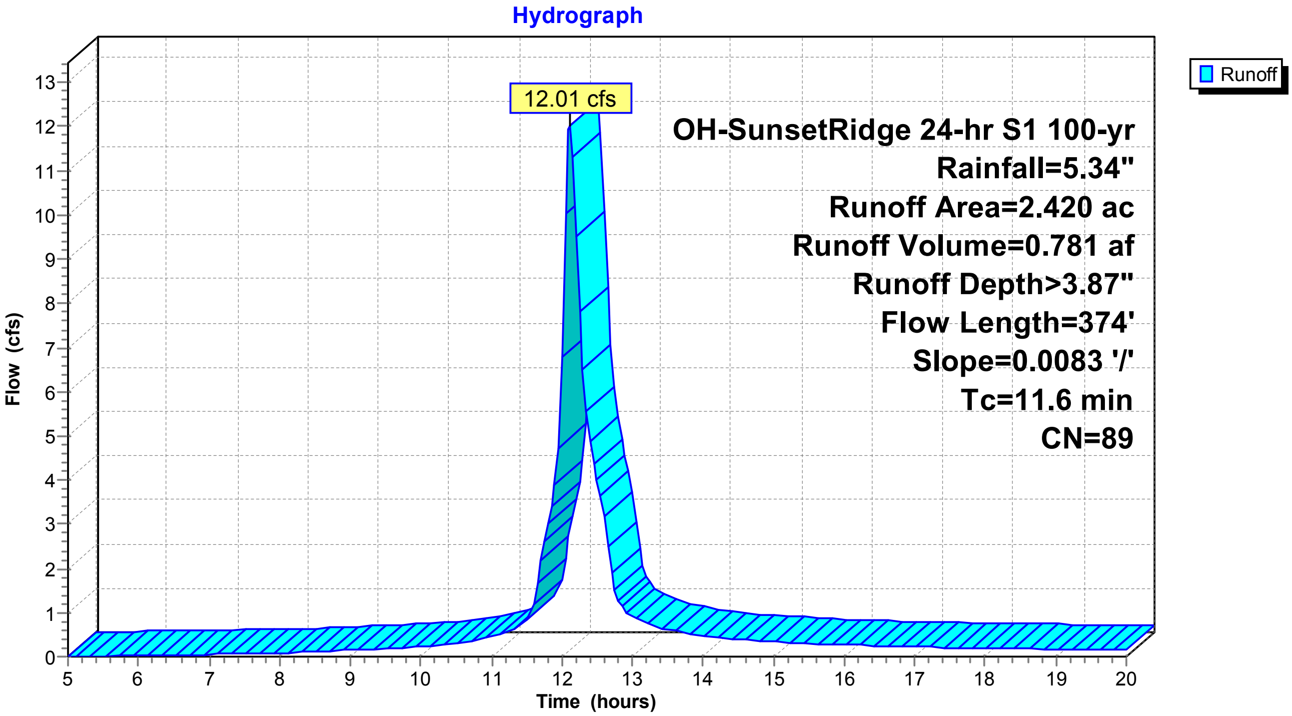
Runoff = 12.01 cfs @ 12.11 hrs, Volume= 0.781 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
2.420	89	Row crops, straight row, Good, HSG D
2.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.6	374	0.0083	0.54		**Lag/CN Method,**

Subcatchment 34S: DC-34



Summary for Subcatchment 35S: DC-35

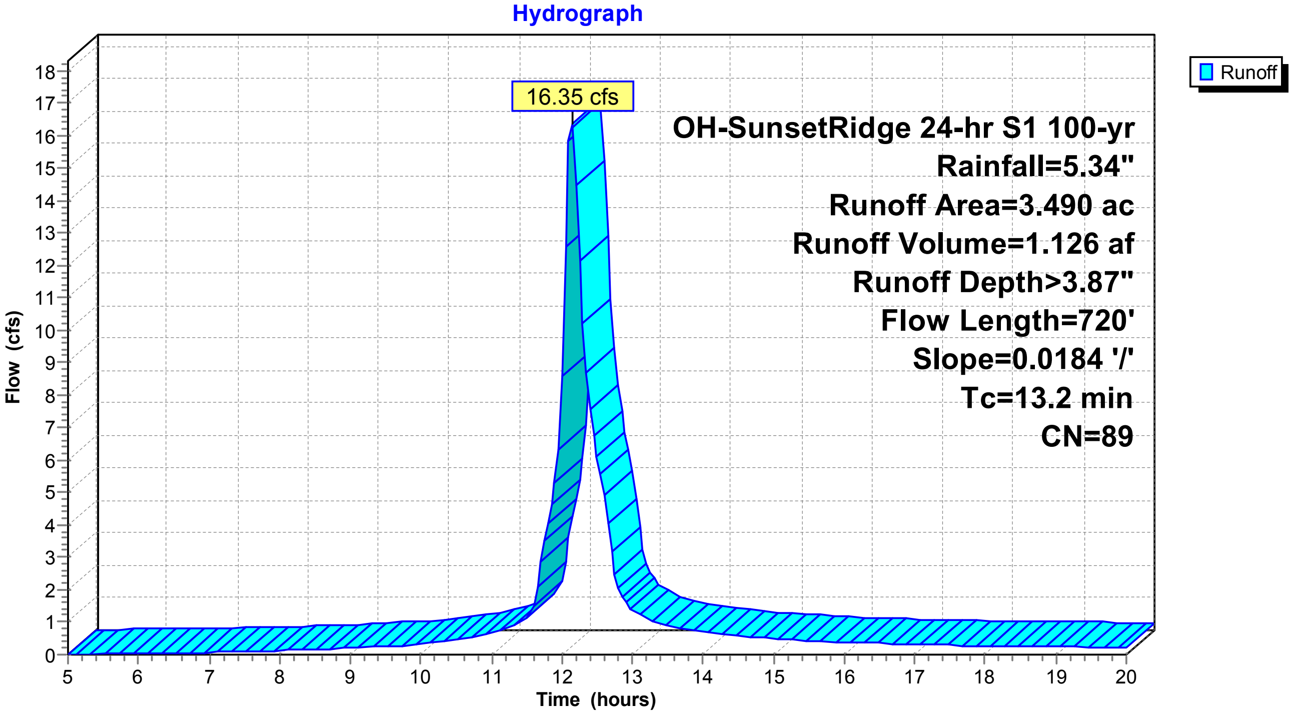
Runoff = 16.35 cfs @ 12.13 hrs, Volume= 1.126 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
3.490	89	Row crops, straight row, Good, HSG D
3.490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.2	720	0.0184	0.91		**Lag/CN Method,**

Subcatchment 35S: DC-35



Summary for Subcatchment 36S: DC-36

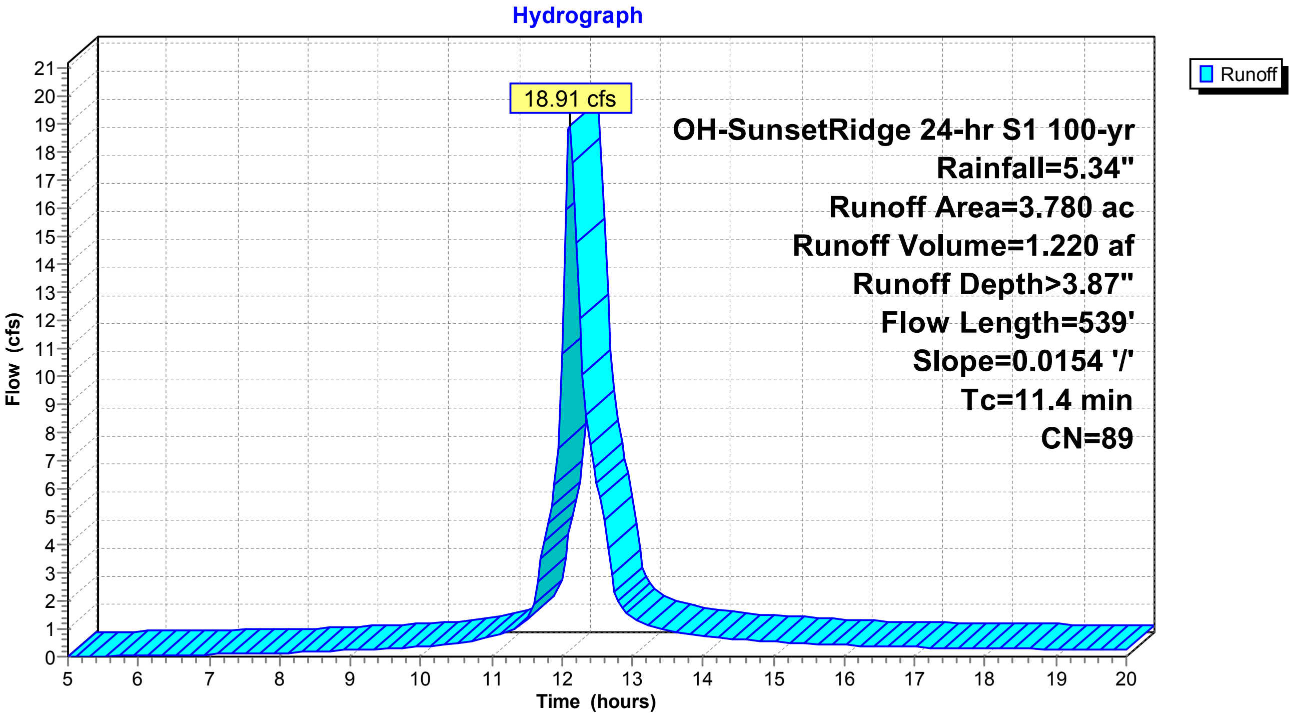
Runoff = 18.91 cfs @ 12.11 hrs, Volume= 1.220 af, Depth> 3.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
3.780	89	Row crops, straight row, Good, HSG D
3.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.4	539	0.0154	0.79		**Lag/CN Method,**

Subcatchment 36S: DC-36



Summary for Subcatchment 37S: DC-37

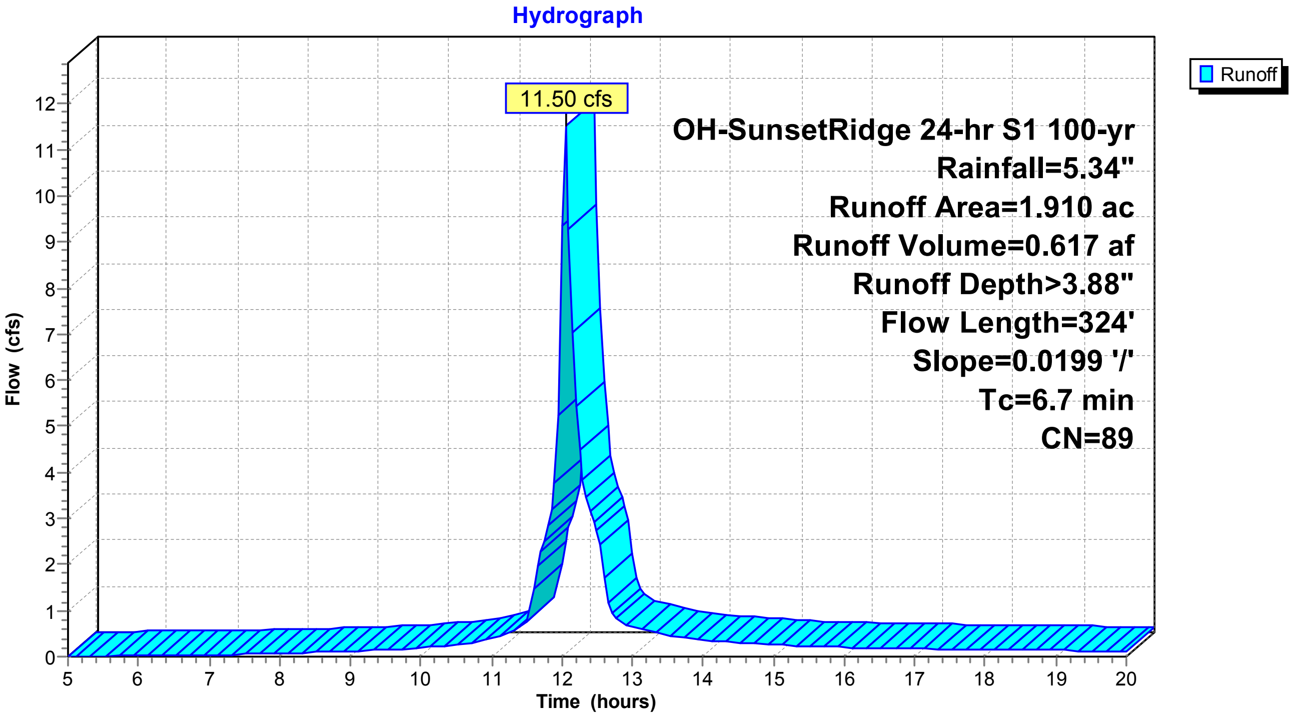
Runoff = 11.50 cfs @ 12.05 hrs, Volume= 0.617 af, Depth> 3.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
1.910	89	Row crops, straight row, Good, HSG D
1.910		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.7	324	0.0199	0.81		**Lag/CN Method,**

Subcatchment 37S: DC-37



Summary for Subcatchment 38S: DC-38

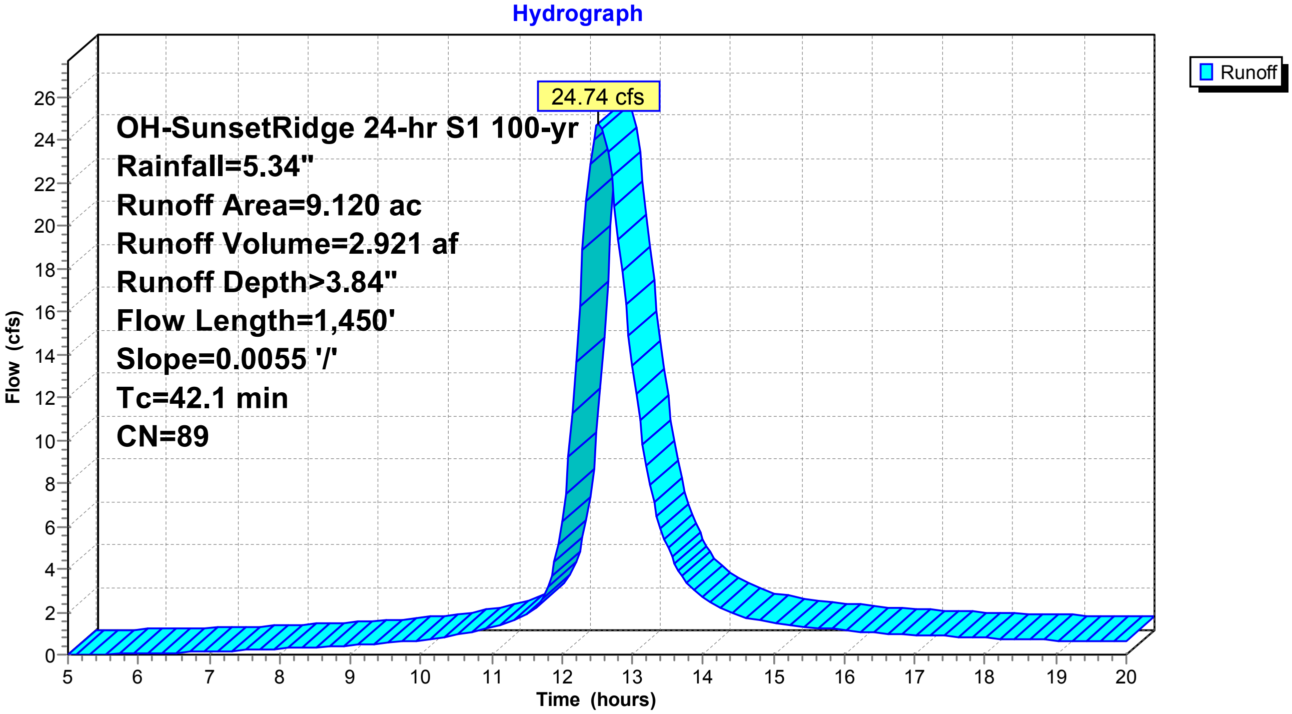
Runoff = 24.74 cfs @ 12.53 hrs, Volume= 2.921 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
9.120	89	Row crops, straight row, Good, HSG D
9.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
42.1	1,450	0.0055	0.57		**Lag/CN Method,**

Subcatchment 38S: DC-38



Summary for Subcatchment 39S: DC-39

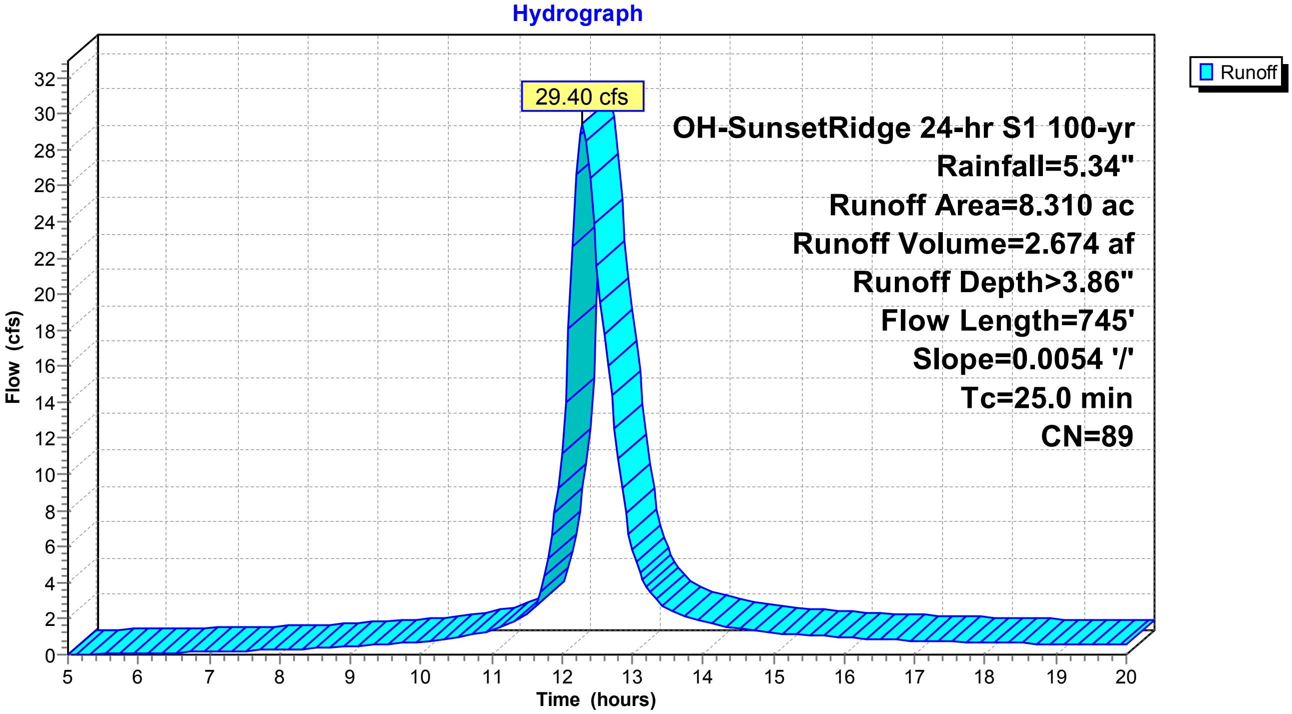
Runoff = 29.40 cfs @ 12.29 hrs, Volume= 2.674 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
8.310	89	Row crops, straight row, Good, HSG D
8.310		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.0	745	0.0054	0.50		**Lag/CN Method,**

Subcatchment 39S: DC-39



Summary for Subcatchment 40S: DC-40

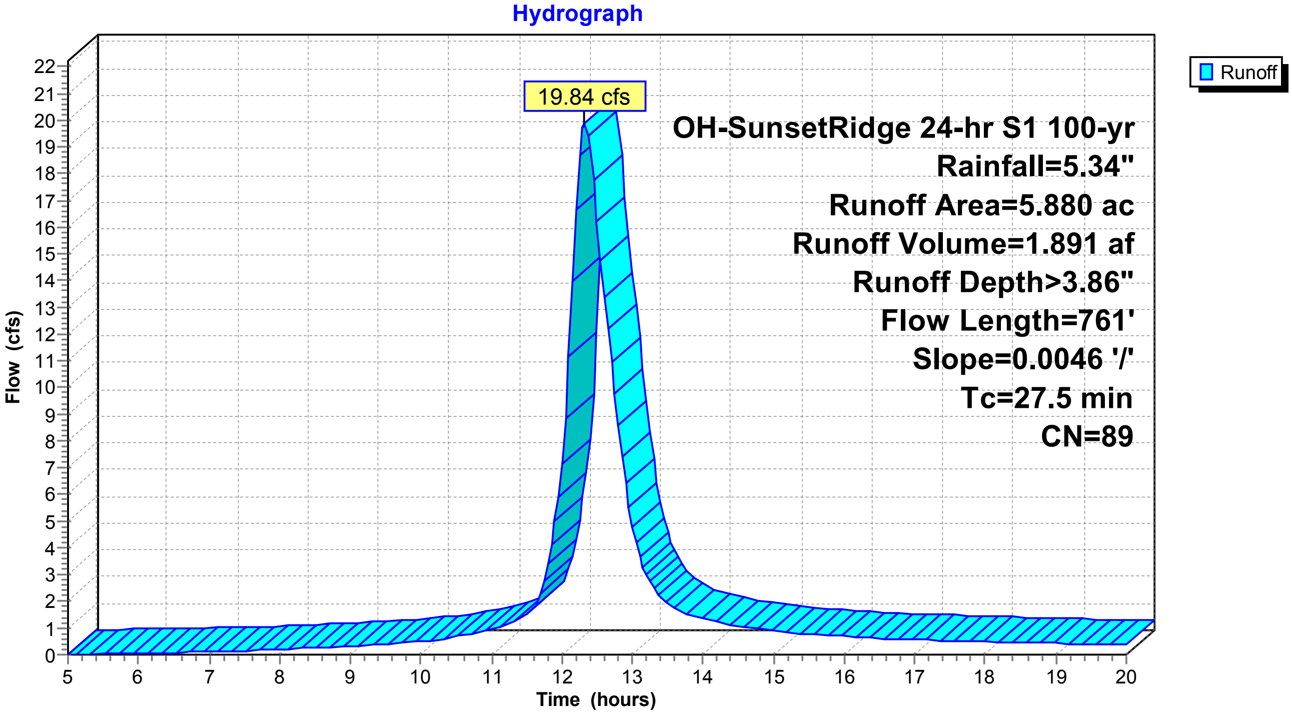
Runoff = 19.84 cfs @ 12.33 hrs, Volume= 1.891 af, Depth> 3.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.880	89	Row crops, straight row, Good, HSG D
5.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.5	761	0.0046	0.46		**Lag/CN Method,**

Subcatchment 40S: DC-40



Summary for Subcatchment 41S: DC-41

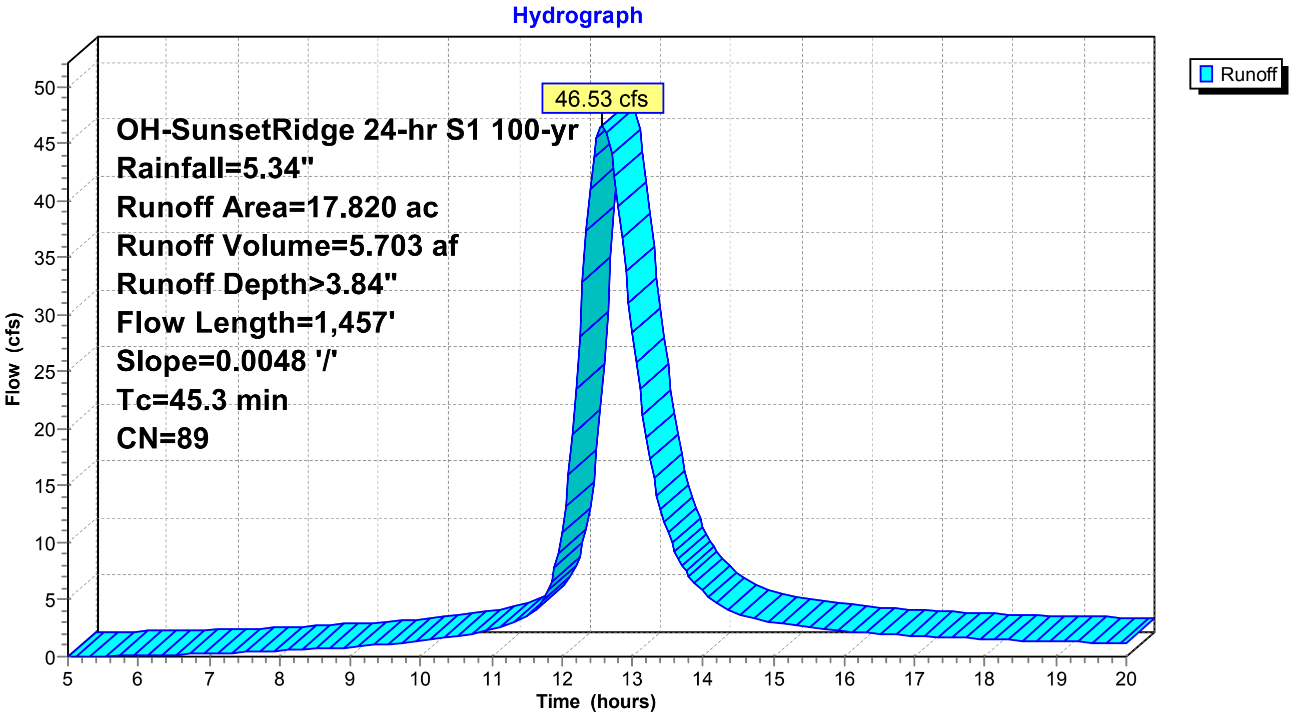
Runoff = 46.53 cfs @ 12.57 hrs, Volume= 5.703 af, Depth> 3.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
17.820	89	Row crops, straight row, Good, HSG D
17.820		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.3	1,457	0.0048	0.54		**Lag/CN Method,**

Subcatchment 41S: DC-41



Summary for Subcatchment 42S: DC-42

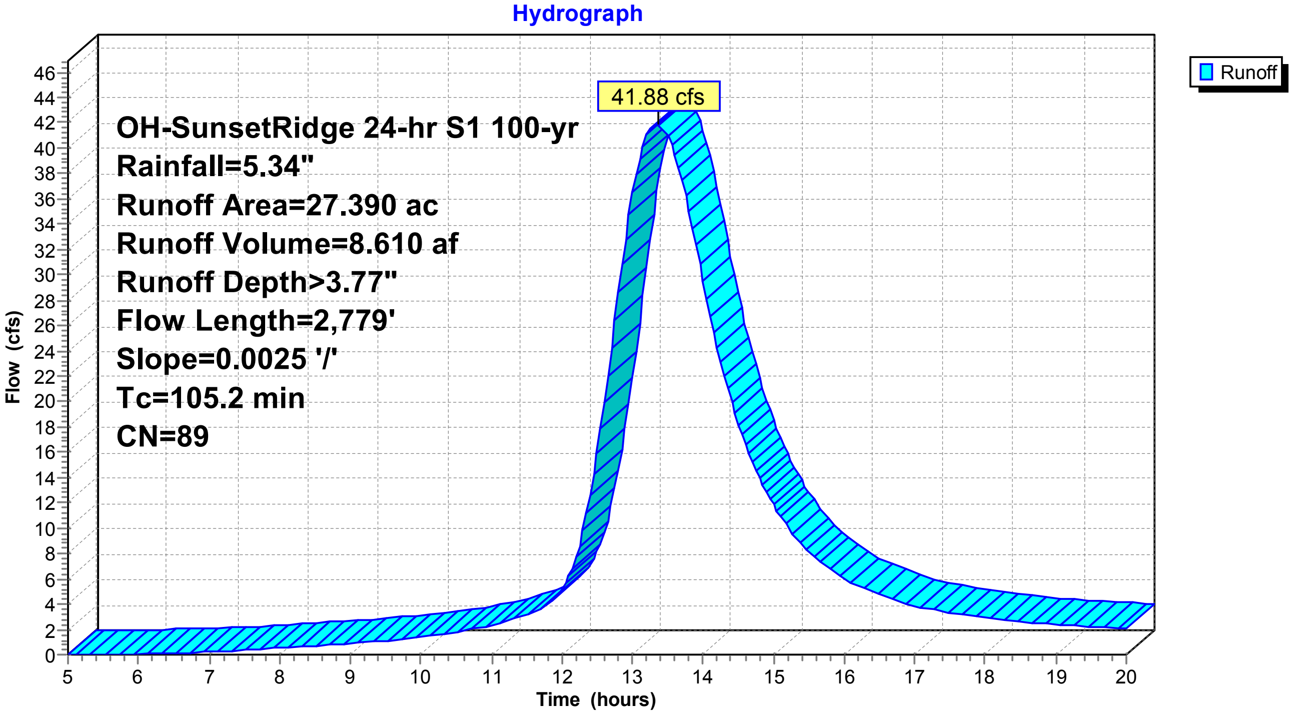
Runoff = 41.88 cfs @ 13.35 hrs, Volume= 8.610 af, Depth> 3.77"

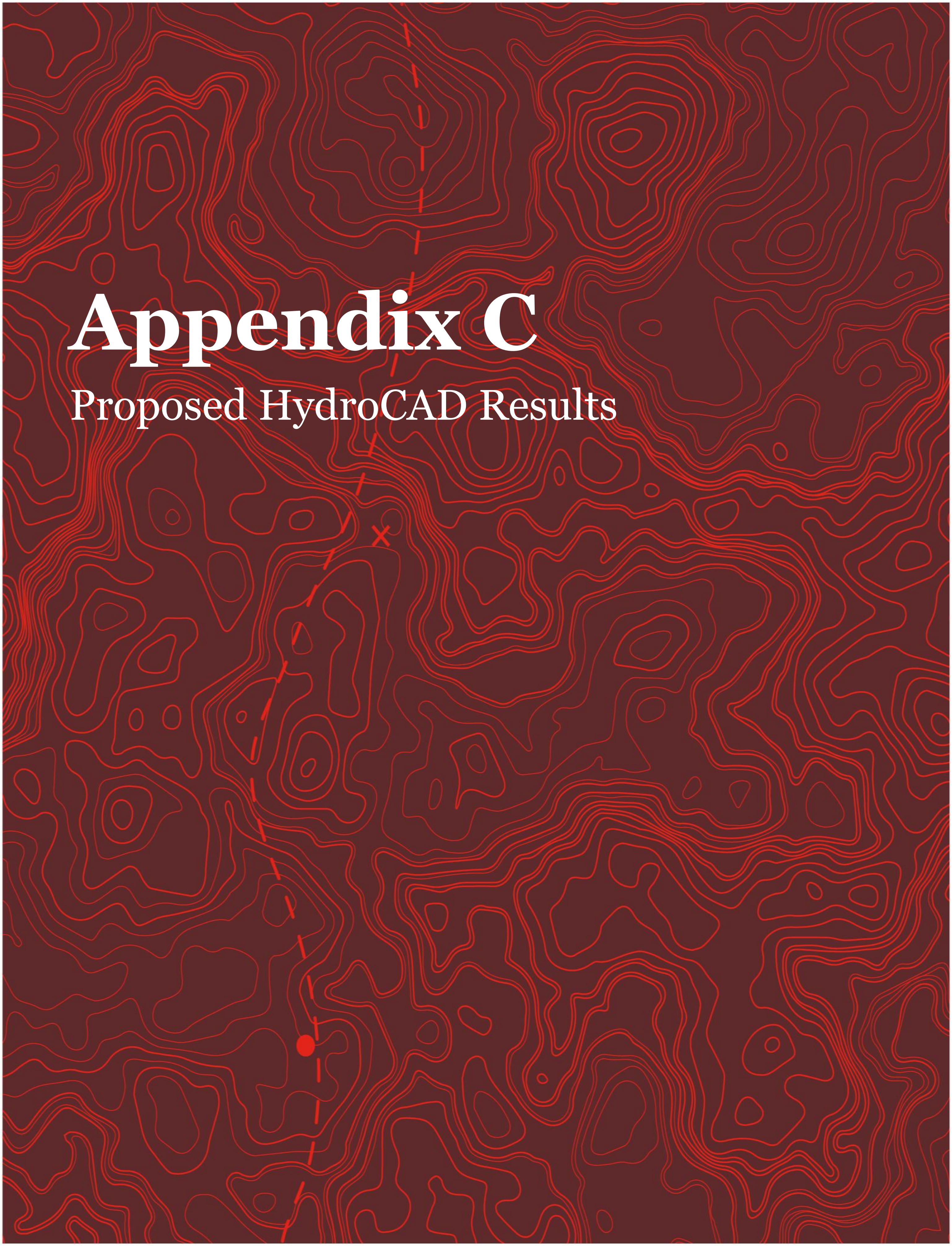
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
27.390	89	Row crops, straight row, Good, HSG D
27.390		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
105.2	2,779	0.0025	0.44		**Lag/CN Method,**

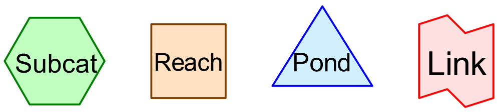
Subcatchment 42S: DC-42





Appendix C

Proposed HydroCAD Results



Routing Diagram for 2021-07-12 Pre Post Analysis
Prepared by Westwood Professional Services, Inc., Printed 7/13/2021
HydroCAD® 10.00-22 s/n 03363 © 2018 HydroCAD Software Solutions LLC

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
34.140	96	Gravel surface, HSG D (43S, 44S, 45S, 46S, 47S, 48S, 49S, 50S, 51S, 52S, 53S, 54S, 55S, 56S, 57S, 58S, 59S, 60S, 61S, 62S, 64S, 65S, 66S, 67S, 68S, 69S, 70S, 71S, 72S, 73S, 74S, 75S, 76S, 77S, 78S, 79S, 80S, 81S, 82S, 83S, 84S)
821.220	78	Meadow, non-grazed, HSG D (43S, 44S, 45S, 46S, 47S, 48S, 49S, 50S, 51S, 52S, 53S, 54S, 55S, 56S, 57S, 58S, 59S, 60S, 61S, 62S, 63S, 64S, 65S, 66S, 67S, 68S, 69S, 70S, 71S, 72S, 73S, 74S, 75S, 76S, 77S, 78S, 79S, 80S, 81S, 82S, 83S, 84S)
9.290	98	Unconnected pavement, HSG D (43S, 44S, 45S, 46S, 48S, 50S, 51S, 52S, 54S, 56S, 57S, 58S, 61S, 62S, 64S, 66S, 68S, 72S, 73S, 74S, 75S, 79S, 81S, 83S, 84S)
5.740	77	Woods, Good, HSG D (49S)
870.390	**79**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
870.390	HSG D	43S, 44S, 45S, 46S, 47S, 48S, 49S, 50S, 51S, 52S, 53S, 54S, 55S, 56S, 57S, 58S, 59S, 60S, 61S, 62S, 63S, 64S, 65S, 66S, 67S, 68S, 69S, 70S, 71S, 72S, 73S, 74S, 75S, 76S, 77S, 78S, 79S, 80S, 81S, 82S, 83S, 84S
0.000	Other	
870.390		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	34.140	0.000	34.140	Gravel surface	43S, 44S, 45S, 46S, 47S, 48S, 49S, 50S, 51S, 52S, 53S, 54S, 55S, 56S, 57S, 58S, 59S, 60S, 61S, 62S, 64S, 65S, 66S, 67S, 68S, 69S, 70S, 71S, 72S, 73S, 74S, 75S, 76S, 77S, 78S, 79S, 80S, 81S, 82S, 83S, 84S
0.000	0.000	0.000	821.220	0.000	821.220	Meadow, non-grazed	43S, 44S, 45S, 46S, 47S, 48S, 49S, 50S, 51S, 52S, 53S, 54S, 55S, 56S, 57S, 58S, 59S, 60S, 61S, 62S, 63S, 64S, 65S, 66S, 67S, 68S, 69S, 70S, 71S, 72S, 73S, 74S, 75S, 76S, 77S, 78S, 79S, 80S, 81S, 82S, 83S, 84S
0.000	0.000	0.000	9.290	0.000	9.290	Unconnected pavement	43S, 44S, 45S, 46S, 48S, 50S, 51S, 52S, 54S, 56S, 57S, 58S, 61S, 62S, 64S, 66S, 68S, 72S, 73S, 74S, 75S, 79S, 81S, 83S, 84S
0.000	0.000	0.000	5.740	0.000	5.740	Woods, Good	49S
0.000	**0.000**	**0.000**	**870.390**	**0.000**	**870.390**	**TOTAL AREA**	

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 43S: DC-01 Runoff Area=34.460 ac 0.03% Impervious Runoff Depth>1.43"
Flow Length=777' Slope=0.0061 '/' Tc=34.3 min CN=79 Runoff=41.54 cfs 4.101 af

Subcatchment 44S: DC-02 Runoff Area=15.360 ac 0.07% Impervious Runoff Depth>1.42"
Flow Length=1,134' Slope=0.0066 '/' Tc=44.6 min CN=79 Runoff=16.05 cfs 1.821 af

Subcatchment 45S: DC-03 Runoff Area=17.270 ac 0.06% Impervious Runoff Depth>1.42"
Flow Length=1,407' Slope=0.0077 '/' Tc=49.1 min CN=79 Runoff=17.05 cfs 2.044 af

Subcatchment 46S: DC-04 Runoff Area=57.040 ac 0.04% Impervious Runoff Depth>1.40"
Flow Length=2,342' Slope=0.0048 '/' Tc=93.5 min CN=79 Runoff=36.69 cfs 6.635 af

Subcatchment 47S: DC-05 Runoff Area=6.570 ac 0.00% Impervious Runoff Depth>1.48"
Flow Length=1,011' Slope=0.0033 '/' Tc=55.8 min CN=80 Runoff=6.33 cfs 0.812 af

Subcatchment 48S: DC-06 Runoff Area=28.120 ac 0.04% Impervious Runoff Depth>1.42"
Flow Length=1,305' Slope=0.0072 '/' Tc=47.8 min CN=79 Runoff=28.23 cfs 3.330 af

Subcatchment 49S: DC-07 Runoff Area=22.440 ac 0.00% Impervious Runoff Depth>1.33"
Flow Length=1,699' Slope=0.0026 '/' Tc=101.3 min CN=78 Runoff=12.98 cfs 2.481 af

Subcatchment 50S: DC-08 Runoff Area=17.130 ac 11.68% Impervious Runoff Depth>1.49"
Flow Length=933' Slope=0.0050 '/' Tc=41.2 min UI Adjusted CN=80 Runoff=19.60 cfs 2.130 af

Subcatchment 51S: DC-09 Runoff Area=17.970 ac 12.97% Impervious Runoff Depth>1.49"
Flow Length=1,141' Slope=0.0041 '/' Tc=53.4 min UI Adjusted CN=80 Runoff=17.69 cfs 2.224 af

Subcatchment 52S: DC-10 Runoff Area=13.370 ac 34.93% Impervious Runoff Depth>1.87"
Flow Length=539' Slope=0.0150 '/' Tc=13.4 min CN=85 Runoff=33.46 cfs 2.087 af

Subcatchment 53S: DC-11 Runoff Area=9.630 ac 0.00% Impervious Runoff Depth>1.36"
Flow Length=705' Slope=0.0048 '/' Tc=36.9 min CN=78 Runoff=10.62 cfs 1.092 af

Subcatchment 54S: DC-12 Runoff Area=65.170 ac 0.03% Impervious Runoff Depth>1.38"
Flow Length=1,973' Slope=0.0023 '/' Tc=117.7 min CN=79 Runoff=35.03 cfs 7.500 af

Subcatchment 55S: DC-13 Runoff Area=6.850 ac 0.00% Impervious Runoff Depth>1.37"
Flow Length=447' Slope=0.0100 '/' Tc=17.7 min CN=78 Runoff=10.90 cfs 0.783 af

Subcatchment 56S: DC-14 Runoff Area=31.250 ac 0.03% Impervious Runoff Depth>1.43"
Flow Length=909' Slope=0.0086 '/' Tc=32.7 min CN=79 Runoff=38.47 cfs 3.721 af

Subcatchment 57S: DC-15 Runoff Area=21.410 ac 0.05% Impervious Runoff Depth>1.35"
Flow Length=1,487' Slope=0.0050 '/' Tc=65.6 min CN=78 Runoff=16.83 cfs 2.402 af

Subcatchment 58S: DC-16 Runoff Area=37.390 ac 0.03% Impervious Runoff Depth>1.37"
Flow Length=803' Slope=0.0135 '/' Tc=24.4 min CN=78 Runoff=50.93 cfs 4.261 af

```
Subcatchment 59S: DC-17                     Runoff Area=10.250 ac  0.00% Impervious  Runoff Depth>1.43"
                      Flow Length=1,004'  Slope=0.0113 '/'  Tc=30.9 min  CN=79  Runoff=13.02 cfs  1.221 af

Subcatchment 60S: DC-18                      Runoff Area=9.520 ac  0.00% Impervious  Runoff Depth>1.43"
                        Flow Length=700'  Slope=0.0114 '/'  Tc=23.1 min  CN=79  Runoff=14.03 cfs  1.138 af

Subcatchment 61S: DC-19                     Runoff Area=67.430 ac  0.03% Impervious  Runoff Depth>1.41"
                      Flow Length=1,812'  Slope=0.0055 '/'  Tc=71.1 min  CN=79  Runoff=52.61 cfs  7.915 af

Subcatchment 62S: DC-20                    Runoff Area=136.840 ac  0.04% Impervious  Runoff Depth>1.39"
                   Flow Length=2,632'  Slope=0.0050 '/'  Tc=100.5 min  CN=79  Runoff=83.72 cfs  15.869 af

Subcatchment 63S: DC-21                      Runoff Area=2.560 ac  0.00% Impervious  Runoff Depth>1.37"
                          Flow Length=456'  Slope=0.0075 '/'  Tc=20.8 min  CN=78  Runoff=3.77 cfs  0.292 af

Subcatchment 64S: DC-22                      Runoff Area=5.620 ac  0.18% Impervious  Runoff Depth>1.36"
                          Flow Length=680'  Slope=0.0051 '/'  Tc=34.7 min  CN=78  Runoff=6.39 cfs  0.638 af

Subcatchment 65S: DC-23                      Runoff Area=8.150 ac  0.00% Impervious  Runoff Depth>1.43"
                        Flow Length=660'  Slope=0.0079 '/'  Tc=26.4 min  CN=79  Runoff=11.24 cfs  0.973 af

Subcatchment 66S: DC-24                      Runoff Area=7.390 ac  0.14% Impervious  Runoff Depth>1.44"
                        Flow Length=621'  Slope=0.0129 '/'  Tc=19.7 min  CN=79  Runoff=11.76 cfs  0.884 af

Subcatchment 67S: DC-25                      Runoff Area=5.760 ac  0.00% Impervious  Runoff Depth>1.43"
                          Flow Length=816'  Slope=0.0115 '/'  Tc=26.0 min  CN=79  Runoff=8.01 cfs  0.688 af

Subcatchment 68S: DC-26                     Runoff Area=22.340 ac  0.04% Impervious  Runoff Depth>1.41"
                      Flow Length=1,867'  Slope=0.0074 '/'  Tc=62.8 min  CN=79  Runoff=18.89 cfs  2.631 af

Subcatchment 69S: DC-27                      Runoff Area=3.580 ac  0.00% Impervious  Runoff Depth>1.44"
                          Flow Length=431'  Slope=0.0070 '/'  Tc=20.0 min  CN=79  Runoff=5.66 cfs  0.428 af

Subcatchment 70S: DC-28                      Runoff Area=4.810 ac  0.00% Impervious  Runoff Depth>1.44"
                          Flow Length=519'  Slope=0.0092 '/'  Tc=20.2 min  CN=79  Runoff=7.58 cfs  0.575 af

Subcatchment 71S: DC-29                      Runoff Area=5.010 ac  0.00% Impervious  Runoff Depth>1.50"
                          Flow Length=650'  Slope=0.0118 '/'  Tc=20.7 min  CN=80  Runoff=8.20 cfs  0.627 af

Subcatchment 72S: DC-30                     Runoff Area=31.720 ac  0.03% Impervious  Runoff Depth>1.41"
                      Flow Length=1,857'  Slope=0.0074 '/'  Tc=62.5 min  CN=79  Runoff=27.13 cfs  3.736 af

Subcatchment 73S: DC-31                     Runoff Area=31.440 ac  0.03% Impervious  Runoff Depth>1.41"
                      Flow Length=2,025'  Slope=0.0056 '/'  Tc=77.0 min  CN=79  Runoff=23.23 cfs  3.682 af

Subcatchment 74S: DC-32                     Runoff Area=10.010 ac  0.10% Impervious  Runoff Depth>1.42"
                        Flow Length=922'  Slope=0.0046 '/'  Tc=45.3 min  CN=79  Runoff=10.35 cfs  1.187 af

Subcatchment 75S: DC-33                     Runoff Area=26.410 ac  0.04% Impervious  Runoff Depth>1.42"
                      Flow Length=1,580'  Slope=0.0072 '/'  Tc=55.7 min  CN=79  Runoff=24.19 cfs  3.119 af
```

```
Subcatchment 76S: DC-34                      Runoff Area=2.420 ac   0.00% Impervious   Runoff Depth>1.50"
                         Flow Length=374'   Slope=0.0083 '/'   Tc=15.9 min   CN=80   Runoff=4.47 cfs  0.304 af

Subcatchment 77S: DC-35                      Runoff Area=3.490 ac   0.00% Impervious   Runoff Depth>1.44"
                         Flow Length=720'   Slope=0.0184 '/'   Tc=18.6 min   CN=79   Runoff=5.71 cfs  0.418 af

Subcatchment 78S: DC-36                      Runoff Area=3.780 ac   0.00% Impervious   Runoff Depth>1.44"
                         Flow Length=539'   Slope=0.0154 '/'   Tc=16.1 min   CN=79   Runoff=6.60 cfs  0.453 af

Subcatchment 79S: DC-37                      Runoff Area=1.910 ac   0.52% Impervious   Runoff Depth>1.51"
                          Flow Length=324'   Slope=0.0199 '/'   Tc=9.1 min   CN=80   Runoff=4.42 cfs  0.240 af

Subcatchment 80S: DC-38                      Runoff Area=9.120 ac   0.00% Impervious   Runoff Depth>1.41"
                       Flow Length=1,450'   Slope=0.0055 '/'   Tc=59.5 min   CN=79   Runoff=8.05 cfs  1.075 af

Subcatchment 81S: DC-39                      Runoff Area=8.310 ac   0.12% Impervious   Runoff Depth>1.43"
                         Flow Length=745'   Slope=0.0054 '/'   Tc=35.2 min   CN=79   Runoff=9.88 cfs  0.989 af

Subcatchment 82S: DC-40                      Runoff Area=5.880 ac   0.00% Impervious   Runoff Depth>1.43"
                         Flow Length=761'   Slope=0.0046 '/'   Tc=38.8 min   CN=79   Runoff=6.63 cfs  0.699 af

Subcatchment 83S: DC-41                     Runoff Area=17.820 ac   0.06% Impervious   Runoff Depth>1.41"
                     Flow Length=1,457'   Slope=0.0048 '/'   Tc=63.9 min   CN=79   Runoff=15.05 cfs  2.098 af

Subcatchment 84S: DC-42                     Runoff Area=27.390 ac   0.04% Impervious   Runoff Depth>1.36"
                    Flow Length=2,779'   Slope=0.0025 '/'   Tc=148.5 min   CN=79   Runoff=12.42 cfs  3.104 af

           Total Runoff Area = 870.390 ac   Runoff Volume = 102.407 af   Average Runoff Depth = 1.41"
                                      98.93% Pervious = 861.100 ac     1.07% Impervious = 9.290 ac
```

Summary for Subcatchment 43S: DC-01

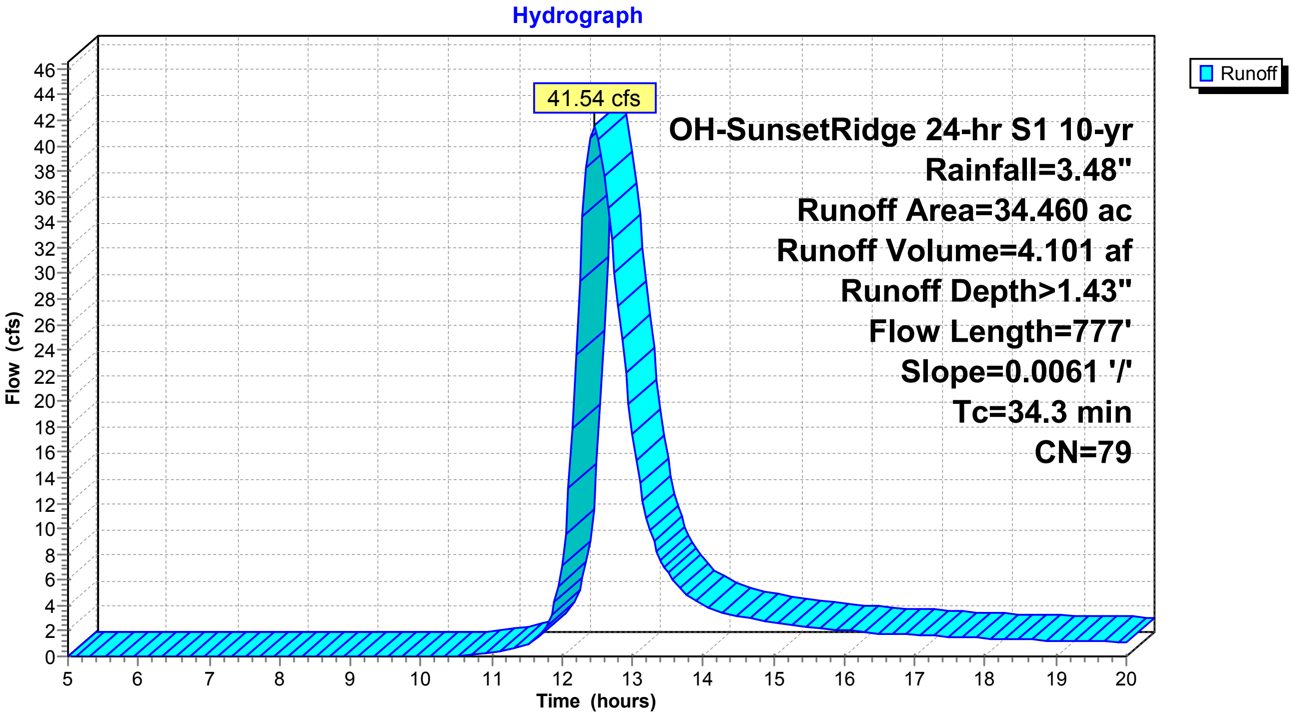
Runoff = 41.54 cfs @ 12.46 hrs, Volume= 4.101 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
33.420	78	Meadow, non-grazed, HSG D
1.030	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
34.460	79	Weighted Average
34.450		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	777	0.0061	0.38		**Lag/CN Method,**

Subcatchment 43S: DC-01



Summary for Subcatchment 44S: DC-02

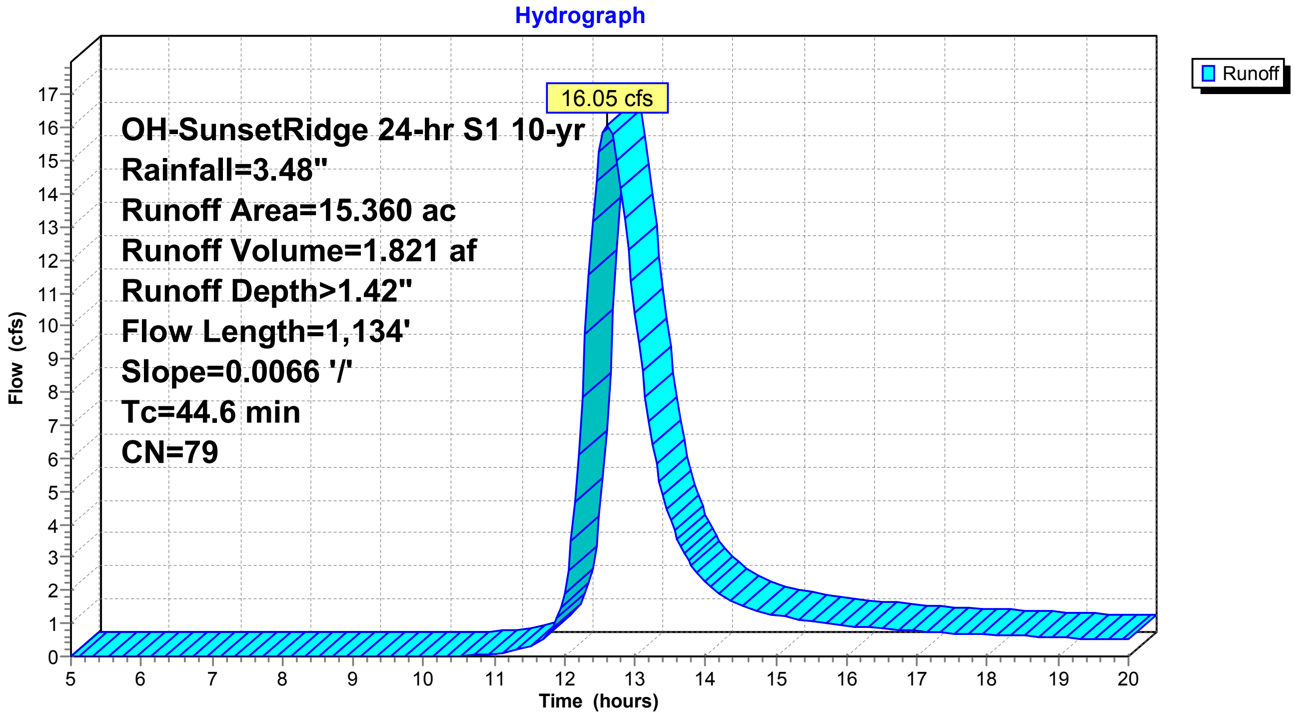
Runoff = 16.05 cfs @ 12.61 hrs, Volume= 1.821 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
14.560	78	Meadow, non-grazed, HSG D
0.790	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
15.360	79	Weighted Average
15.350		99.93% Pervious Area
0.010		0.07% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.6	1,134	0.0066	0.42		**Lag/CN Method,**

Subcatchment 44S: DC-02



Summary for Subcatchment 45S: DC-03

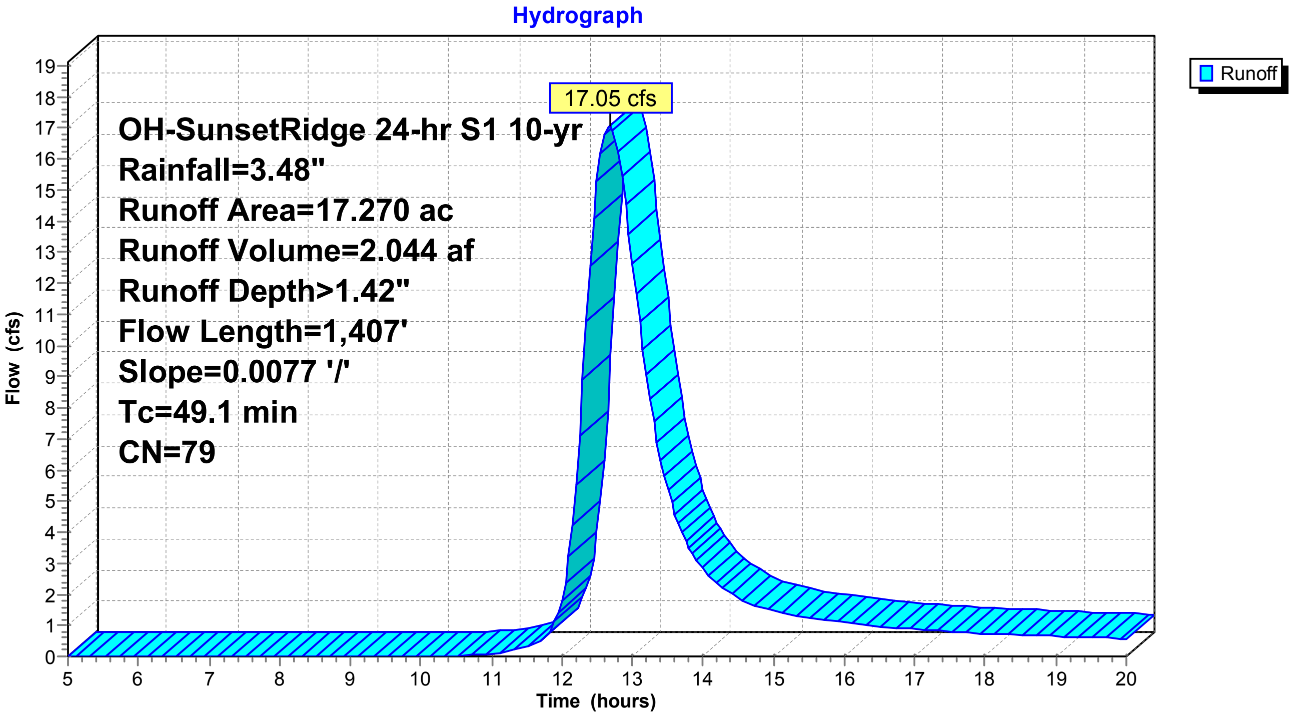
Runoff = 17.05 cfs @ 12.67 hrs, Volume= 2.044 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
16.660	78	Meadow, non-grazed, HSG D
0.600	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
17.270	79	Weighted Average
17.260		99.94% Pervious Area
0.010		0.06% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.1	1,407	0.0077	0.48		**Lag/CN Method,**

Subcatchment 45S: DC-03



Summary for Subcatchment 46S: DC-04

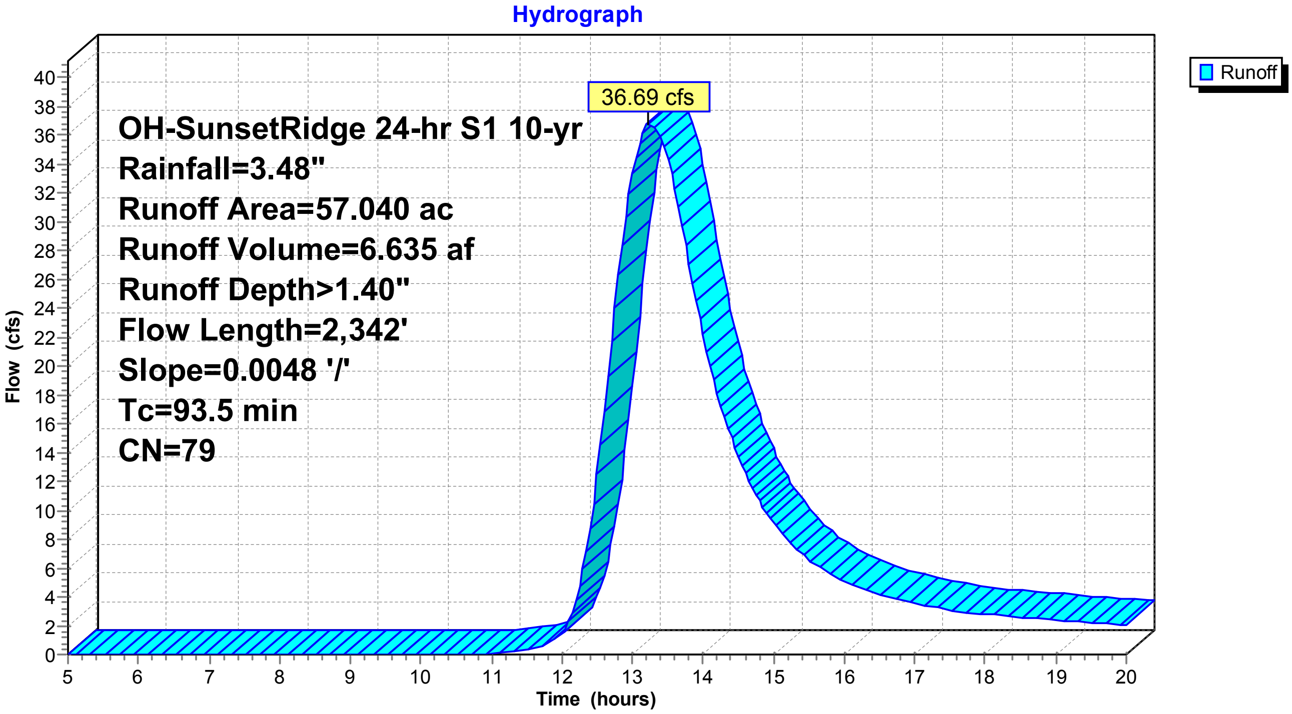
Runoff = 36.69 cfs @ 13.23 hrs, Volume= 6.635 af, Depth> 1.40"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
54.730	78	Meadow, non-grazed, HSG D
2.290	96	Gravel surface, HSG D
0.020	98	Unconnected pavement, HSG D
57.040	79	Weighted Average
57.020		99.96% Pervious Area
0.020		0.04% Impervious Area
0.020		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
93.5	2,342	0.0048	0.42		**Lag/CN Method,**

Subcatchment 46S: DC-04



Summary for Subcatchment 47S: DC-05

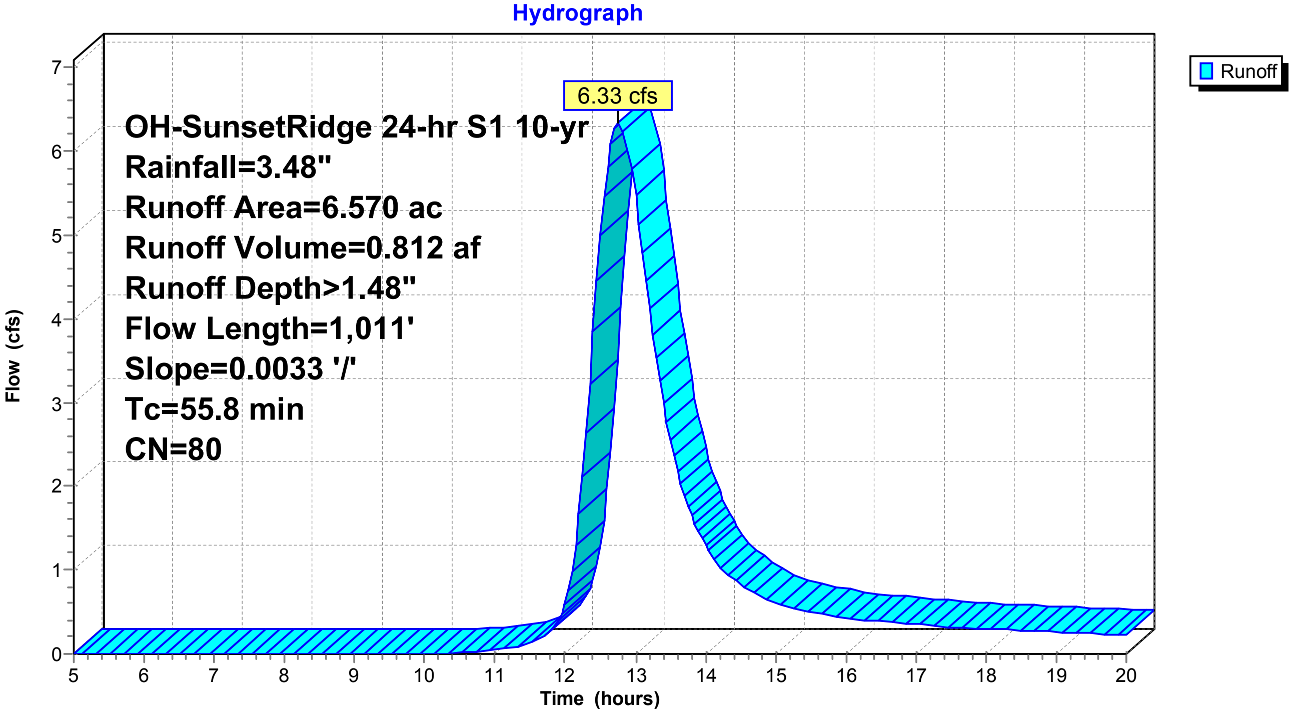
Runoff = 6.33 cfs @ 12.76 hrs, Volume= 0.812 af, Depth> 1.48"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
6.020	78	Meadow, non-grazed, HSG D
0.550	96	Gravel surface, HSG D
6.570	80	Weighted Average
6.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	1,011	0.0033	0.30		**Lag/CN Method,**

Subcatchment 47S: DC-05



Summary for Subcatchment 48S: DC-06

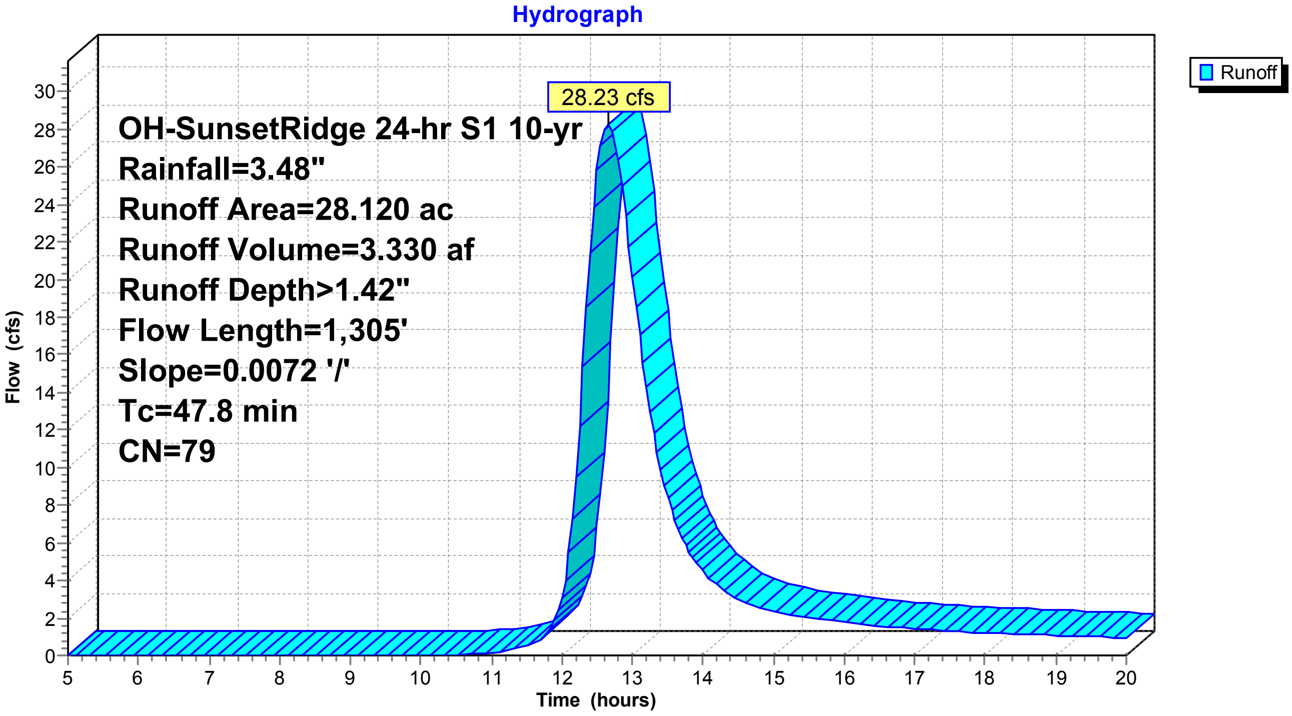
Runoff = 28.23 cfs @ 12.65 hrs, Volume= 3.330 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
26.760	78	Meadow, non-grazed, HSG D
1.350	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
28.120	79	Weighted Average
28.110		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.8	1,305	0.0072	0.46		**Lag/CN Method,**

Subcatchment 48S: DC-06



Summary for Subcatchment 49S: DC-07

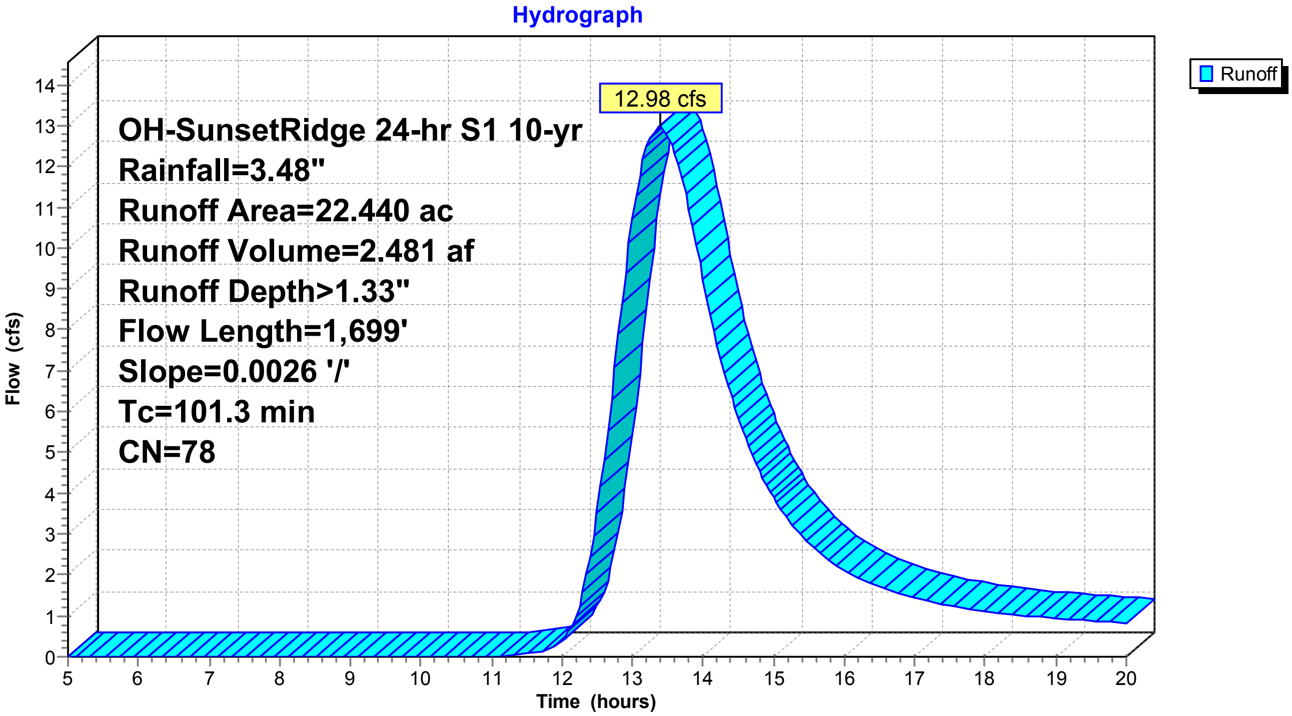
Runoff = 12.98 cfs @ 13.39 hrs, Volume= 2.481 af, Depth> 1.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
15.930	78	Meadow, non-grazed, HSG D
5.740	77	Woods, Good, HSG D
0.770	96	Gravel surface, HSG D
22.440	78	Weighted Average
22.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
101.3	1,699	0.0026	0.28		**Lag/CN Method,**

Subcatchment 49S: DC-07



Summary for Subcatchment 50S: DC-08

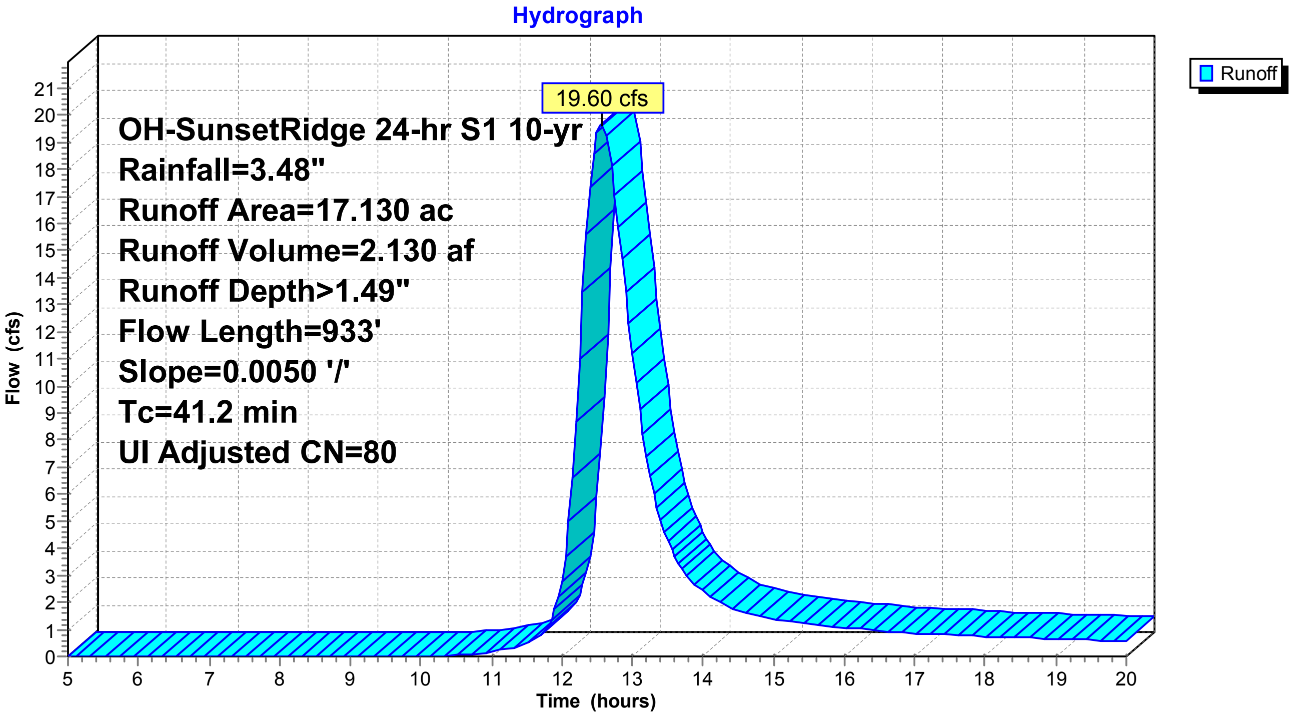
Runoff = 19.60 cfs @ 12.56 hrs, Volume= 2.130 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Adj	Description
14.400	78		Meadow, non-grazed, HSG D
0.730	96		Gravel surface, HSG D
2.000	98		Unconnected pavement, HSG D
17.130	81	80	Weighted Average, UI Adjusted
15.130			88.32% Pervious Area
2.000			11.68% Impervious Area
2.000			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.2	933	0.0050	0.38		**Lag/CN Method,**

Subcatchment 50S: DC-08



Summary for Subcatchment 51S: DC-09

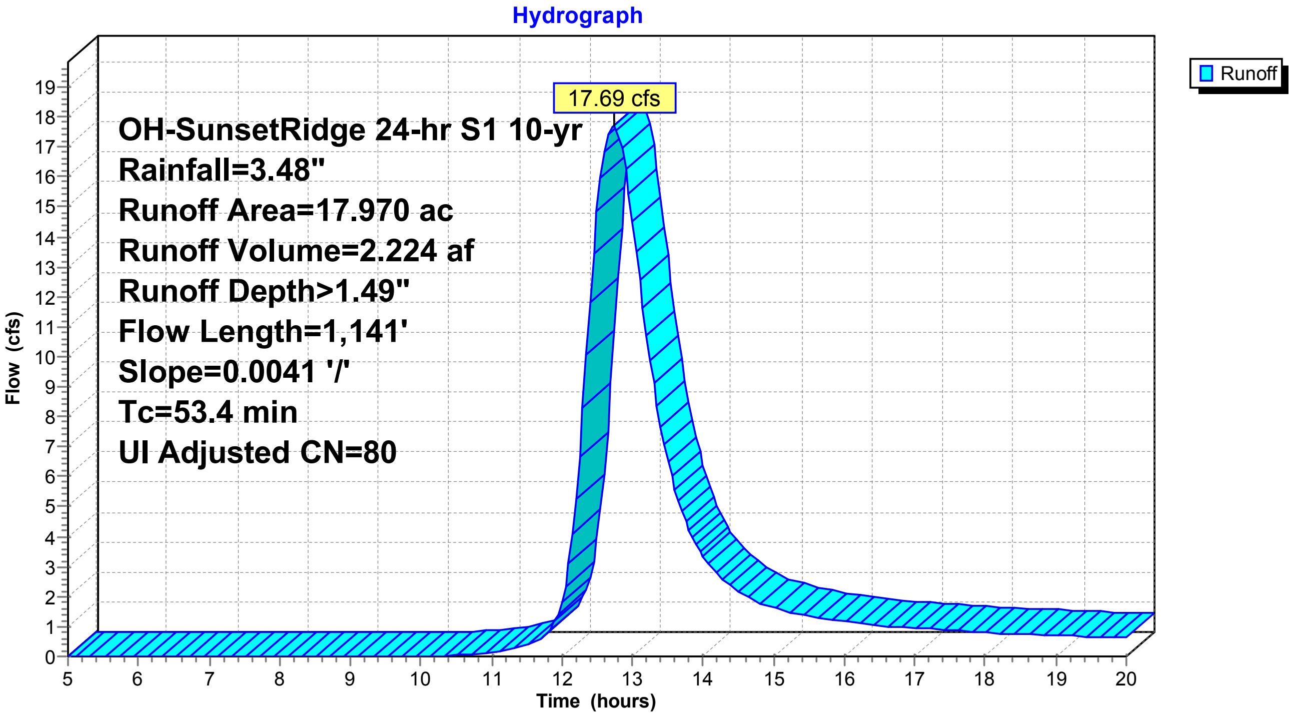
Runoff = 17.69 cfs @ 12.73 hrs, Volume= 2.224 af, Depth> 1.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Adj	Description
15.030	78		Meadow, non-grazed, HSG D
0.610	96		Gravel surface, HSG D
2.330	98		Unconnected pavement, HSG D
17.970	81	80	Weighted Average, UI Adjusted
15.640			87.03% Pervious Area
2.330			12.97% Impervious Area
2.330			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
53.4	1,141	0.0041	0.36		**Lag/CN Method,**

Subcatchment 51S: DC-09



Summary for Subcatchment 52S: DC-10

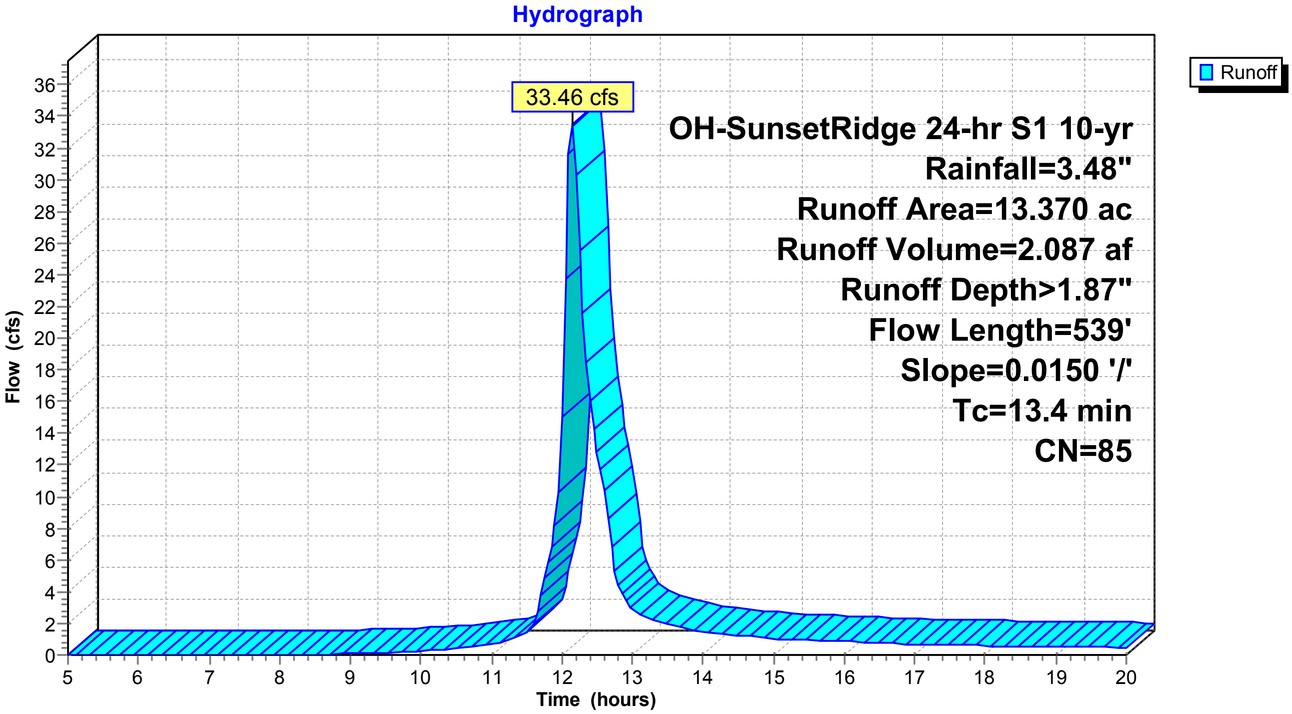
Runoff = 33.46 cfs @ 12.14 hrs, Volume= 2.087 af, Depth> 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
8.460	78	Meadow, non-grazed, HSG D
0.240	96	Gravel surface, HSG D
4.670	98	Unconnected pavement, HSG D
13.370	85	Weighted Average
8.700		65.07% Pervious Area
4.670		34.93% Impervious Area
4.670		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	539	0.0150	0.67		**Lag/CN Method,**

Subcatchment 52S: DC-10



Summary for Subcatchment 53S: DC-11

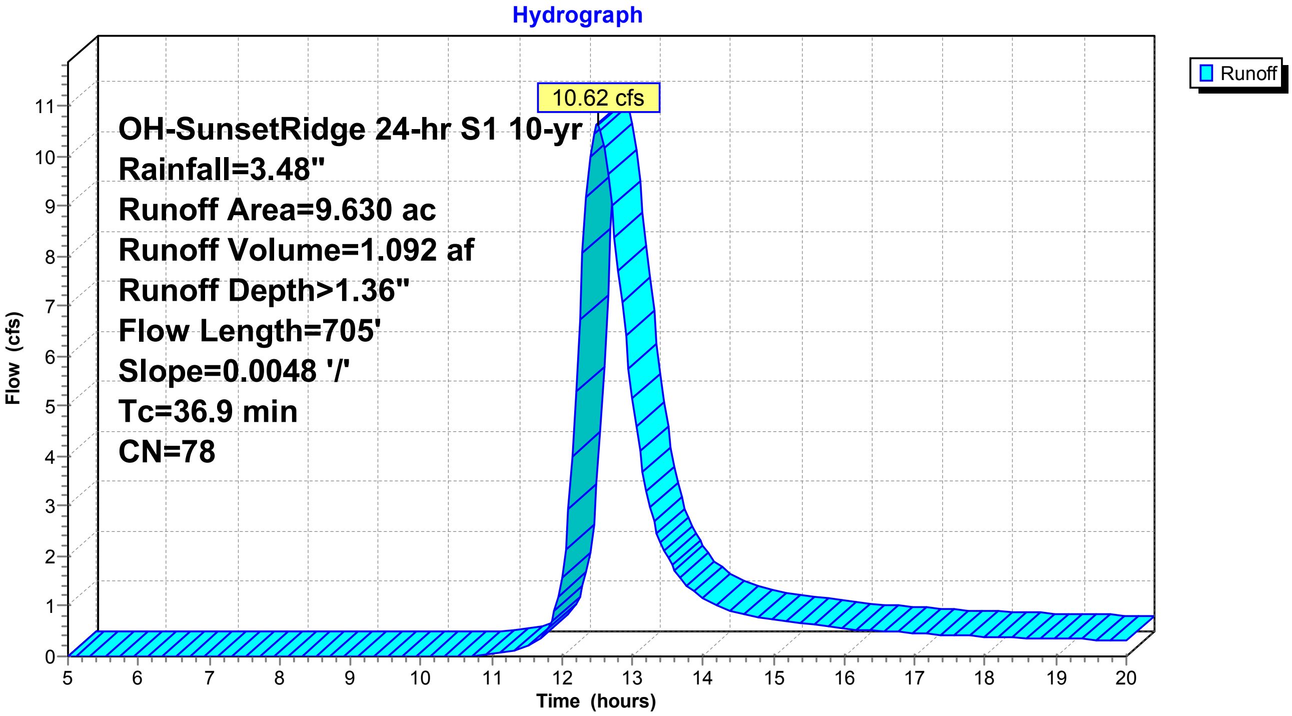
Runoff = 10.62 cfs @ 12.51 hrs, Volume= 1.092 af, Depth> 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
9.410	78	Meadow, non-grazed, HSG D
0.220	96	Gravel surface, HSG D
9.630	78	Weighted Average
9.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.9	705	0.0048	0.32		**Lag/CN Method,**

Subcatchment 53S: DC-11



Summary for Subcatchment 54S: DC-12

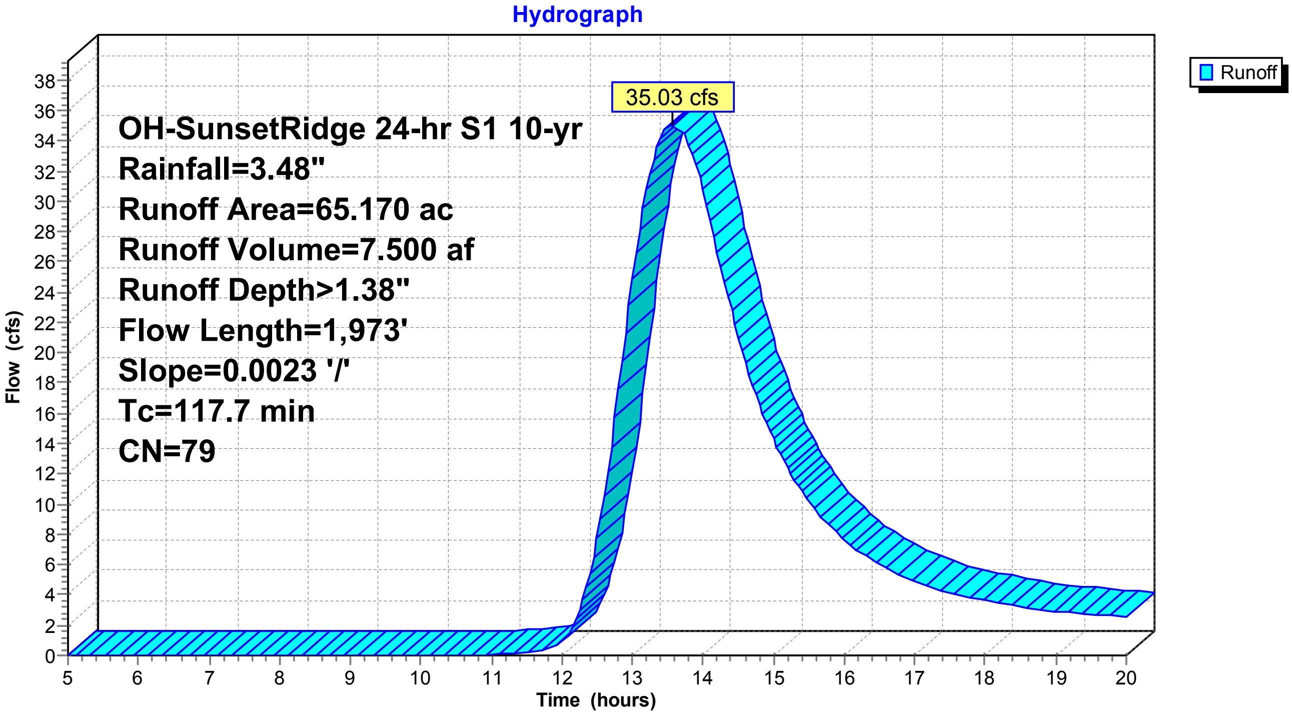
Runoff = 35.03 cfs @ 13.56 hrs, Volume= 7.500 af, Depth> 1.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
62.510	78	Meadow, non-grazed, HSG D
2.640	96	Gravel surface, HSG D
0.020	98	Unconnected pavement, HSG D
65.170	79	Weighted Average
65.150		99.97% Pervious Area
0.020		0.03% Impervious Area
0.020		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
117.7	1,973	0.0023	0.28		**Lag/CN Method,**

Subcatchment 54S: DC-12



Summary for Subcatchment 55S: DC-13

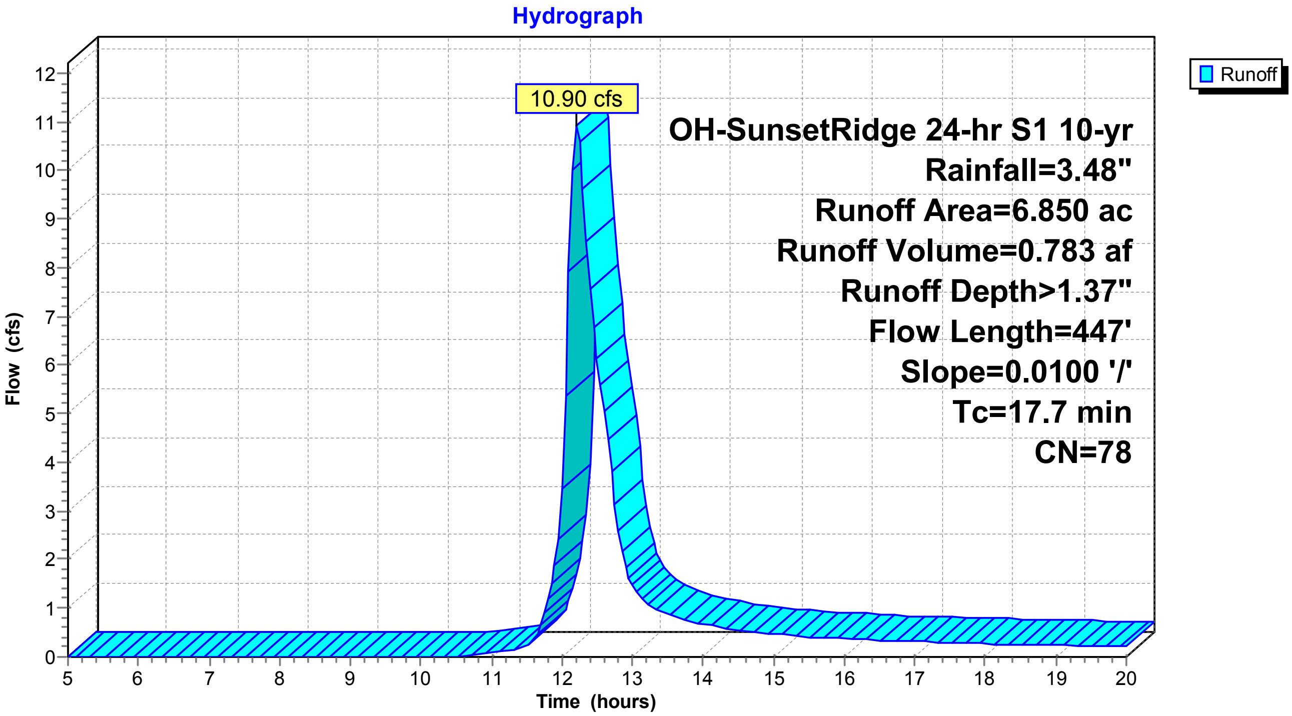
Runoff = 10.90 cfs @ 12.21 hrs, Volume= 0.783 af, Depth> 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
6.800	78	Meadow, non-grazed, HSG D
0.050	96	Gravel surface, HSG D
6.850	78	Weighted Average
6.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7	447	0.0100	0.42		**Lag/CN Method,**

Subcatchment 55S: DC-13



Summary for Subcatchment 56S: DC-14

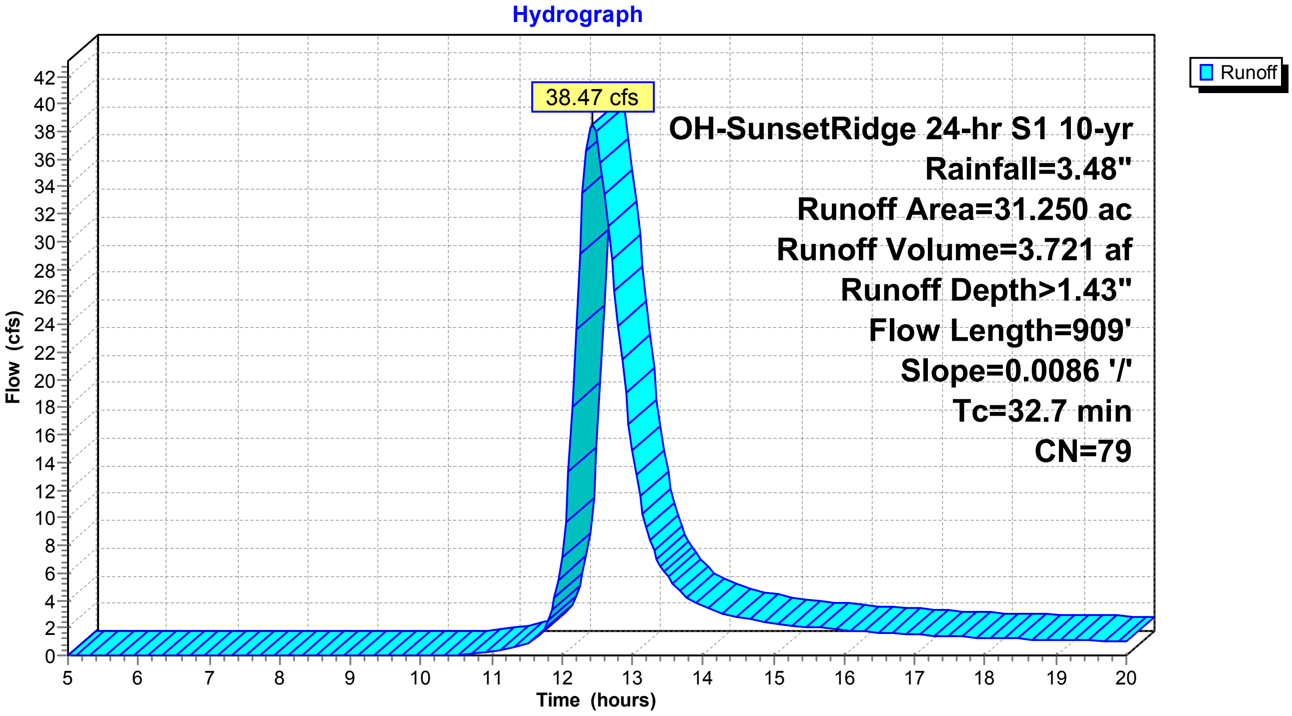
Runoff = 38.47 cfs @ 12.43 hrs, Volume= 3.721 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
30.020	78	Meadow, non-grazed, HSG D
1.220	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
31.250	79	Weighted Average
31.240		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	909	0.0086	0.46		**Lag/CN Method,**

Subcatchment 56S: DC-14



Summary for Subcatchment 57S: DC-15

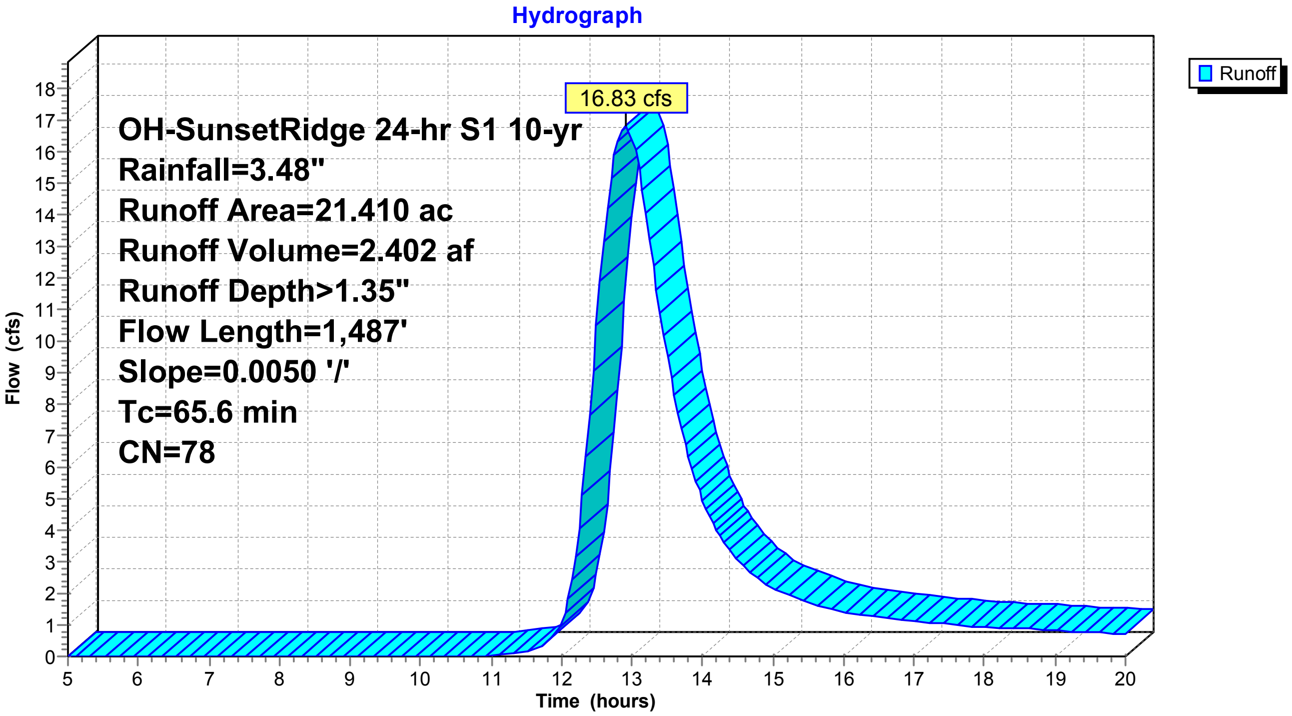
Runoff = 16.83 cfs @ 12.90 hrs, Volume= 2.402 af, Depth> 1.35"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
21.060	78	Meadow, non-grazed, HSG D
0.340	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
21.410	78	Weighted Average
21.400		99.95% Pervious Area
0.010		0.05% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
65.6	1,487	0.0050	0.38		**Lag/CN Method,**

Subcatchment 57S: DC-15



Summary for Subcatchment 58S: DC-16

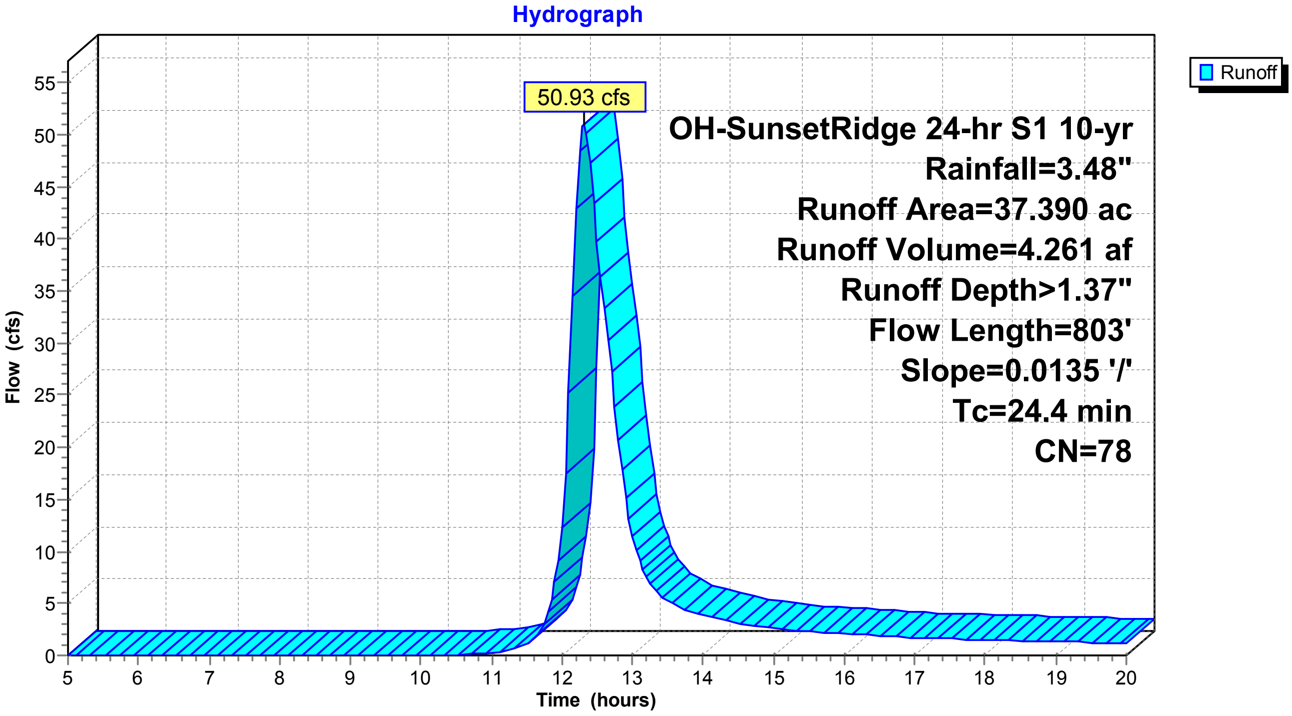
Runoff = 50.93 cfs @ 12.31 hrs, Volume= 4.261 af, Depth> 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
36.430	78	Meadow, non-grazed, HSG D
0.950	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
37.390	78	Weighted Average
37.380		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.4	803	0.0135	0.55		**Lag/CN Method,**

Subcatchment 58S: DC-16



Summary for Subcatchment 59S: DC-17

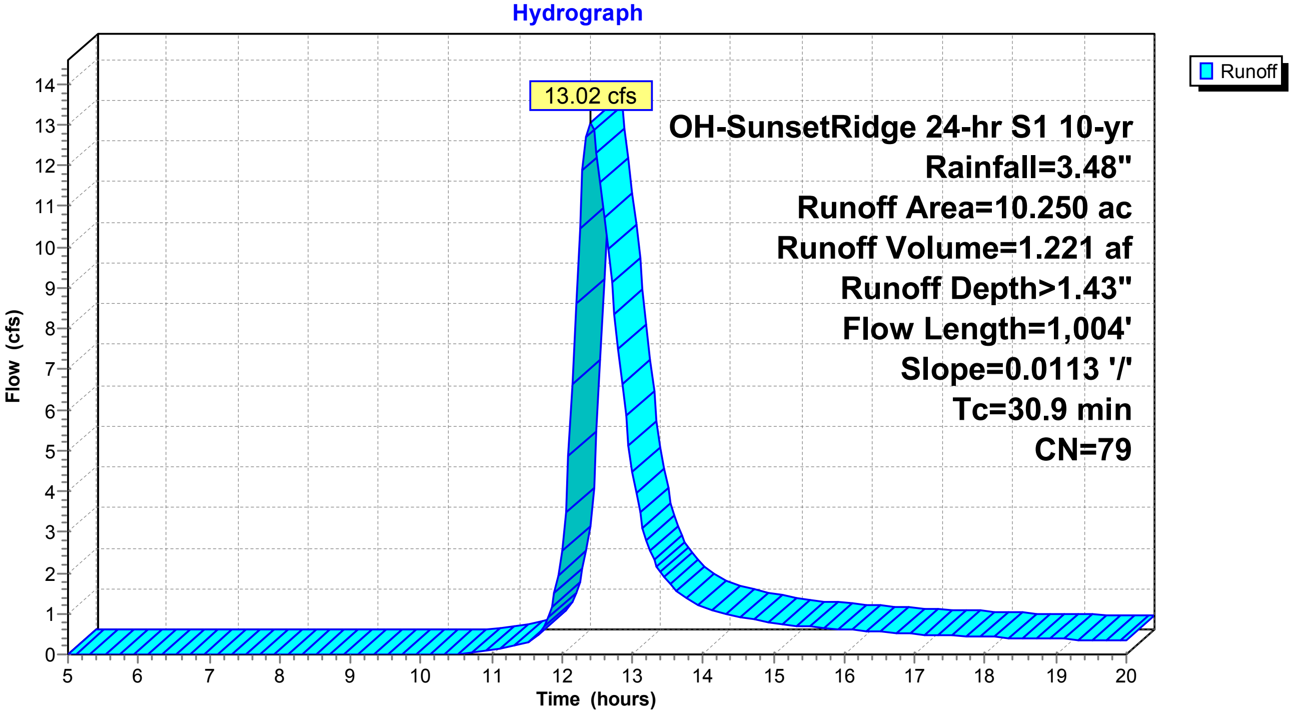
Runoff = 13.02 cfs @ 12.41 hrs, Volume= 1.221 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
9.880	78	Meadow, non-grazed, HSG D
0.370	96	Gravel surface, HSG D
10.250	79	Weighted Average
10.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.9	1,004	0.0113	0.54		**Lag/CN Method,**

Subcatchment 59S: DC-17



Summary for Subcatchment 60S: DC-18

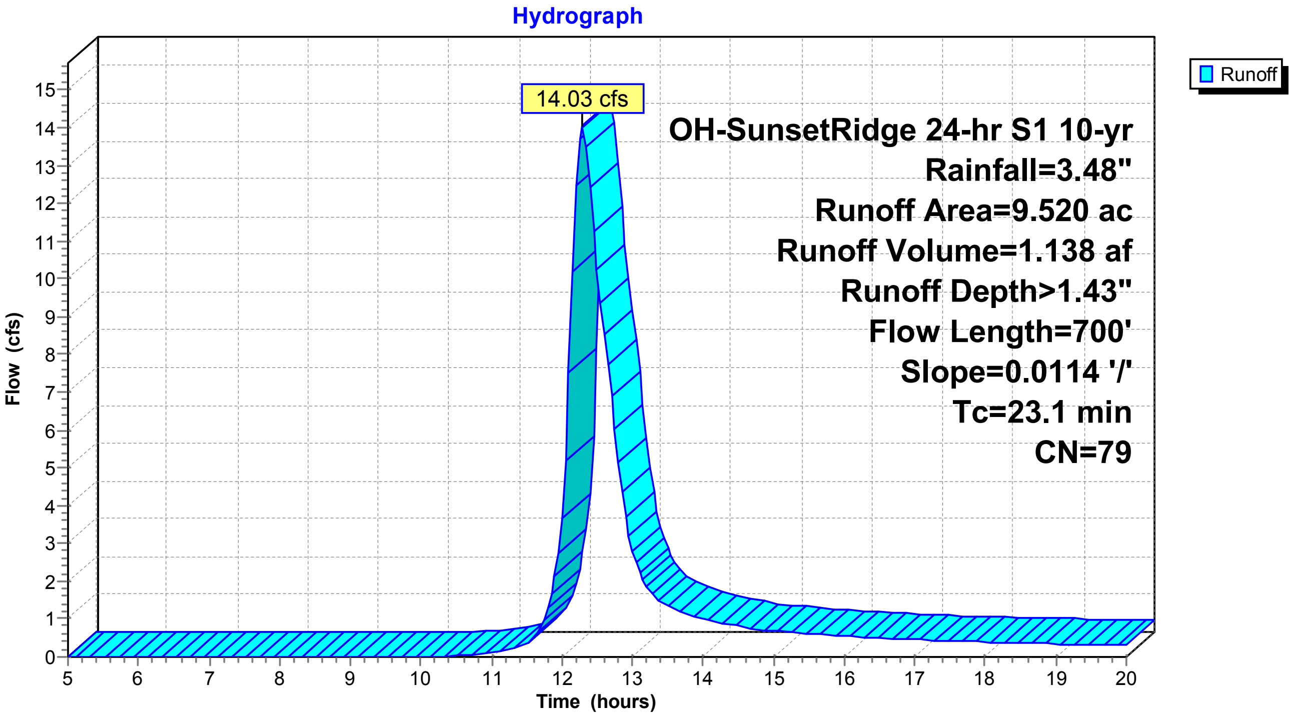
Runoff = 14.03 cfs @ 12.29 hrs, Volume= 1.138 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
8.980	78	Meadow, non-grazed, HSG D
0.540	96	Gravel surface, HSG D
9.520	79	Weighted Average
9.520		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.1	700	0.0114	0.51		**Lag/CN Method,**

Subcatchment 60S: DC-18



Summary for Subcatchment 61S: DC-19

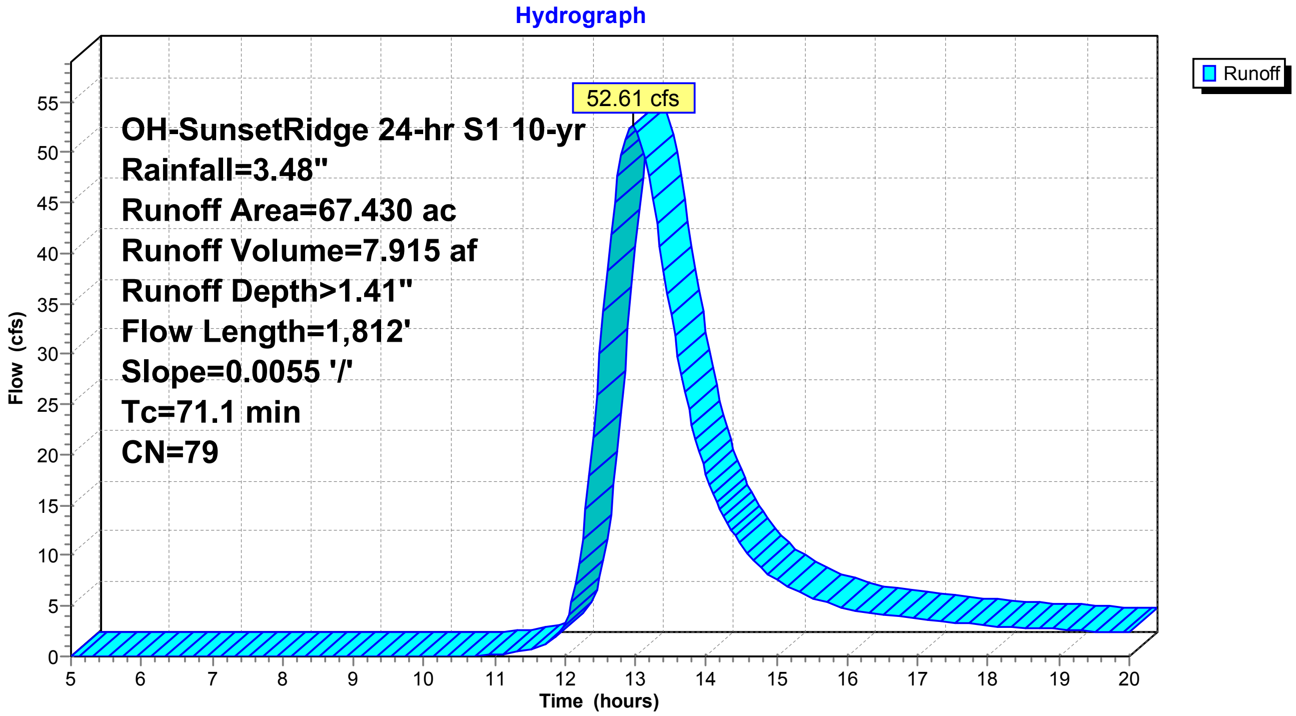
Runoff = 52.61 cfs @ 12.96 hrs, Volume= 7.915 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
65.130	78	Meadow, non-grazed, HSG D
2.280	96	Gravel surface, HSG D
0.020	98	Unconnected pavement, HSG D
67.430	79	Weighted Average
67.410		99.97% Pervious Area
0.020		0.03% Impervious Area
0.020		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
71.1	1,812	0.0055	0.42		**Lag/CN Method,**

Subcatchment 61S: DC-19



Summary for Subcatchment 62S: DC-20

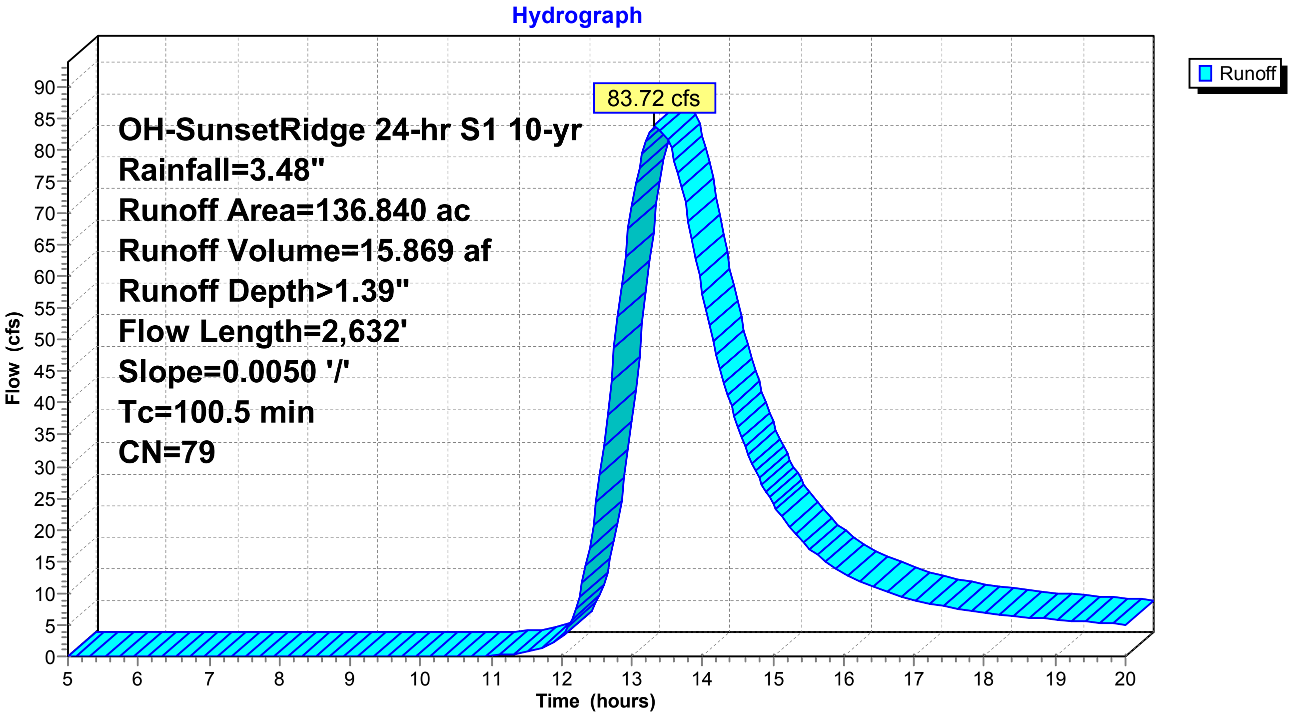
Runoff = 83.72 cfs @ 13.32 hrs, Volume= 15.869 af, Depth> 1.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
131.500	78	Meadow, non-grazed, HSG D
5.290	96	Gravel surface, HSG D
0.050	98	Unconnected pavement, HSG D
136.840	79	Weighted Average
136.790		99.96% Pervious Area
0.050		0.04% Impervious Area
0.050		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.5	2,632	0.0050	0.44		**Lag/CN Method,**

Subcatchment 62S: DC-20



Summary for Subcatchment 63S: DC-21

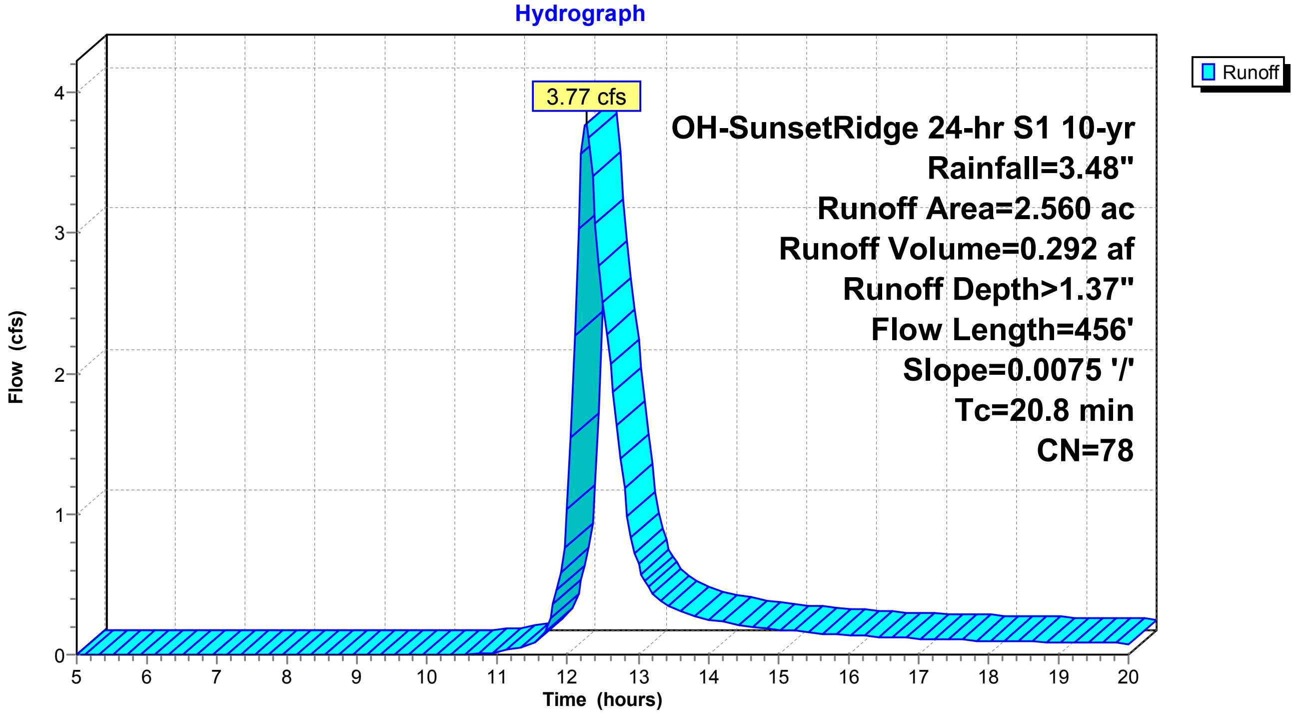
Runoff = 3.77 cfs @ 12.26 hrs, Volume= 0.292 af, Depth> 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
2.560	78	Meadow, non-grazed, HSG D
2.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	456	0.0075	0.37		**Lag/CN Method,**

Subcatchment 63S: DC-21



Summary for Subcatchment 64S: DC-22

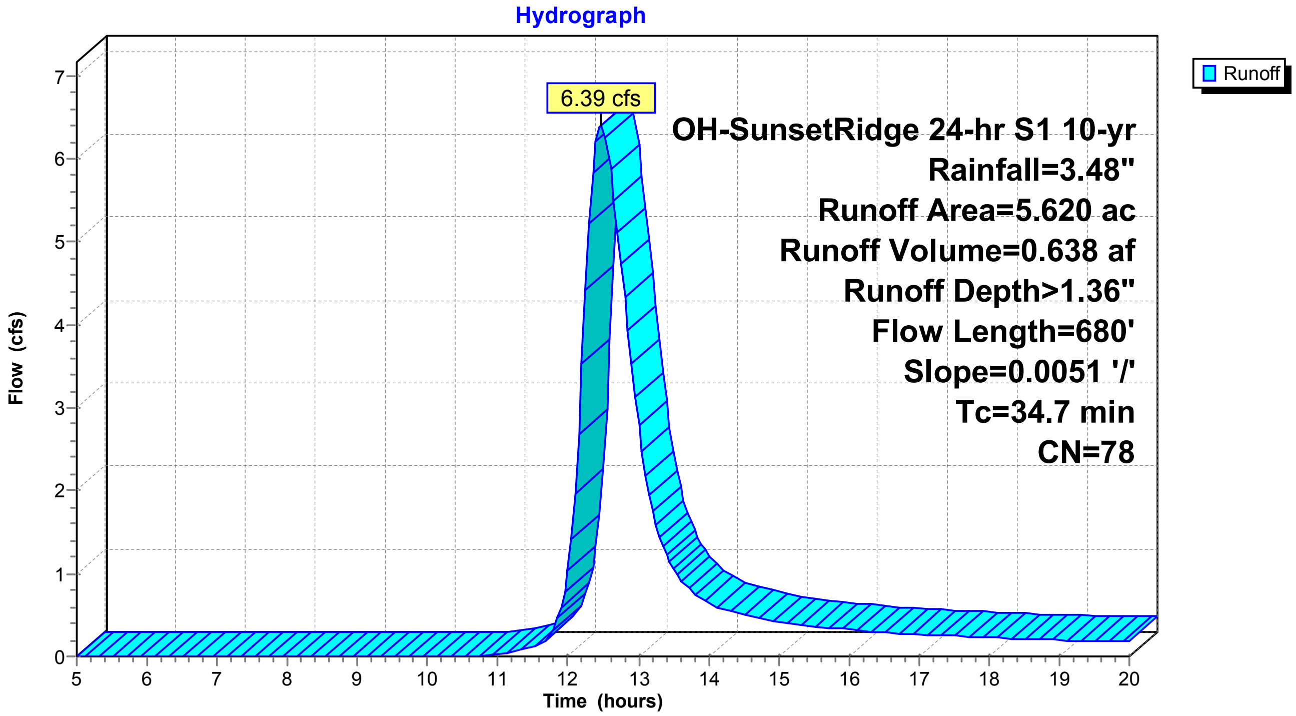
Runoff = 6.39 cfs @ 12.47 hrs, Volume= 0.638 af, Depth> 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.480	78	Meadow, non-grazed, HSG D
0.130	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
5.620	78	Weighted Average
5.610		99.82% Pervious Area
0.010		0.18% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.7	680	0.0051	0.33		**Lag/CN Method,**

Subcatchment 64S: DC-22



Summary for Subcatchment 65S: DC-23

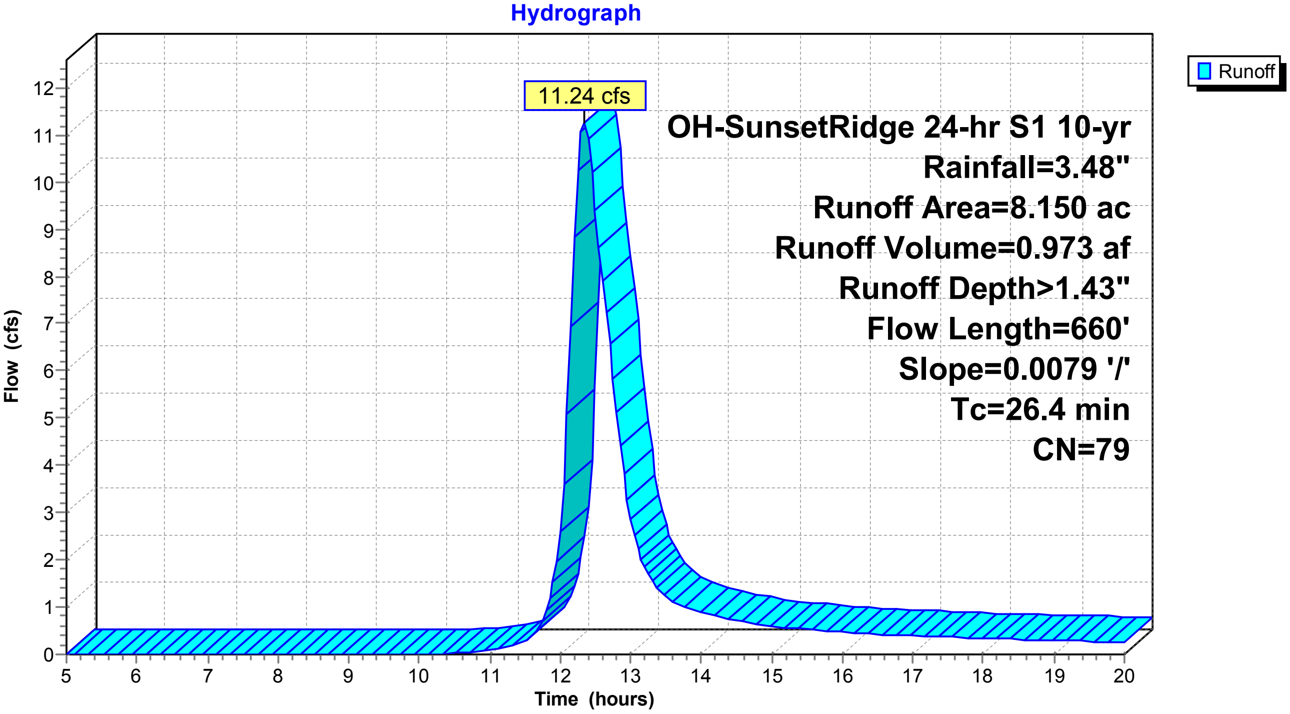
Runoff = 11.24 cfs @ 12.34 hrs, Volume= 0.973 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
7.520	78	Meadow, non-grazed, HSG D
0.630	96	Gravel surface, HSG D
8.150	79	Weighted Average
8.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	660	0.0079	0.42		**Lag/CN Method,**

Subcatchment 65S: DC-23



Summary for Subcatchment 66S: DC-24

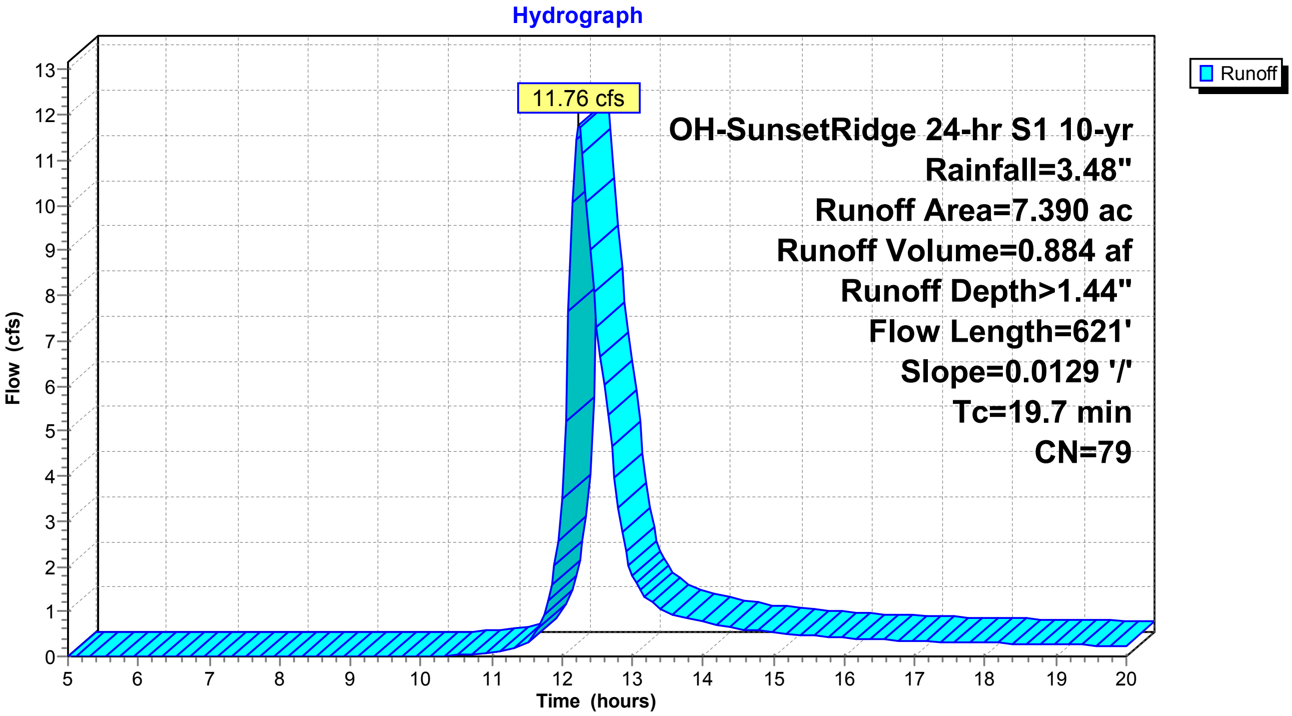
Runoff = 11.76 cfs @ 12.24 hrs, Volume= 0.884 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
7.060	78	Meadow, non-grazed, HSG D
0.320	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
7.390	79	Weighted Average
7.380		99.86% Pervious Area
0.010		0.14% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	621	0.0129	0.53		**Lag/CN Method,**

Subcatchment 66S: DC-24



Summary for Subcatchment 67S: DC-25

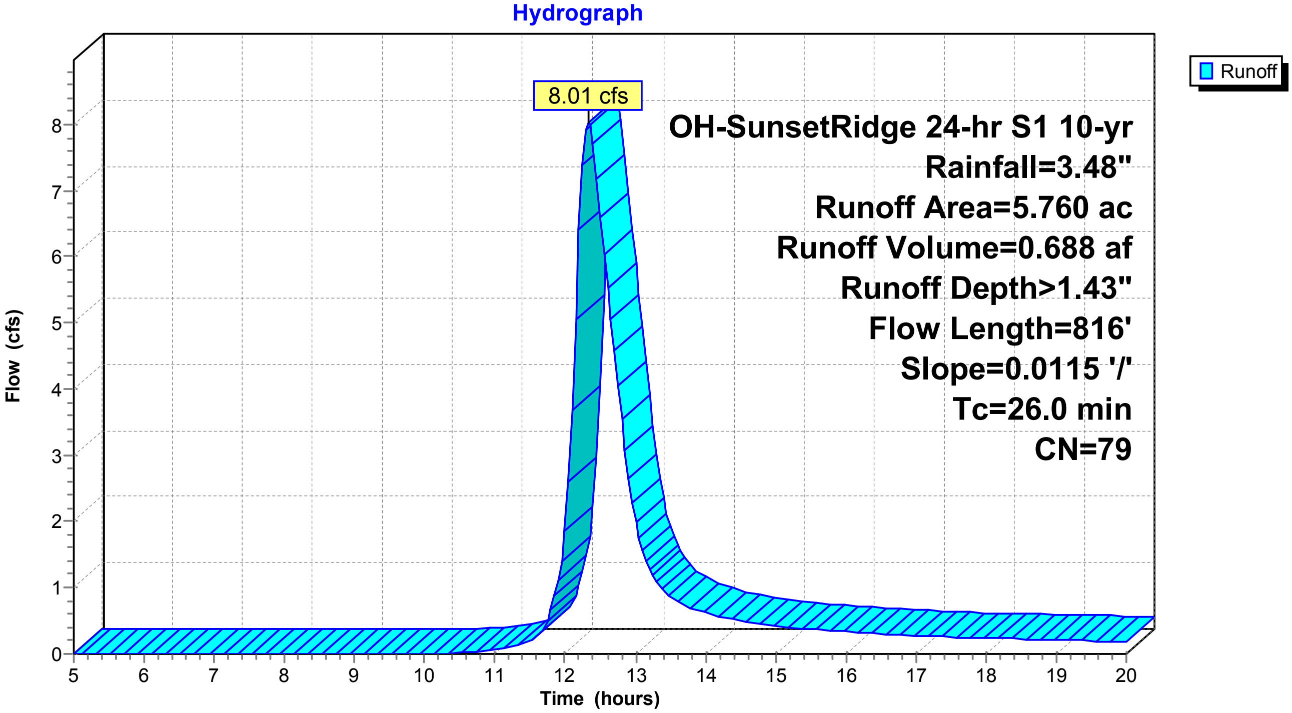
Runoff = 8.01 cfs @ 12.34 hrs, Volume= 0.688 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.430	78	Meadow, non-grazed, HSG D
0.330	96	Gravel surface, HSG D
5.760	79	Weighted Average
5.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.0	816	0.0115	0.52		**Lag/CN Method,**

Subcatchment 67S: DC-25



Summary for Subcatchment 68S: DC-26

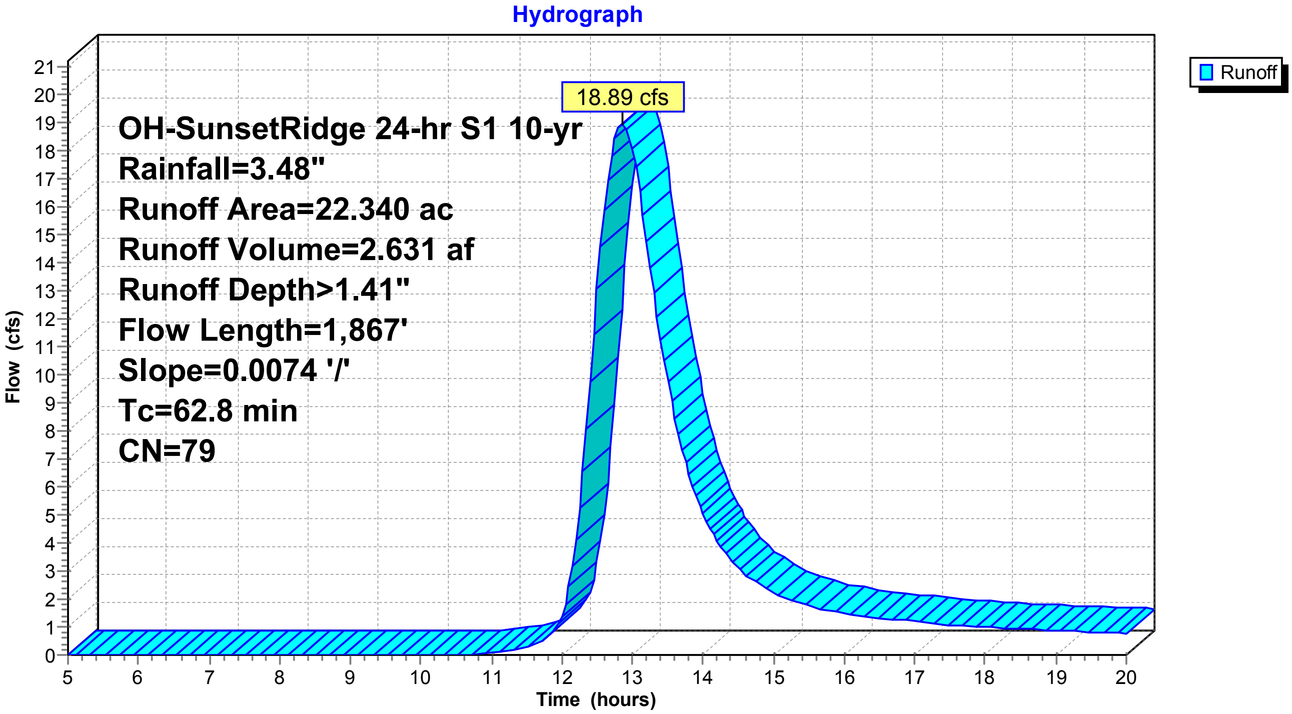
Runoff = 18.89 cfs @ 12.86 hrs, Volume= 2.631 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
21.620	78	Meadow, non-grazed, HSG D
0.710	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
22.340	79	Weighted Average
22.330		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8	1,867	0.0074	0.50		**Lag/CN Method,**

Subcatchment 68S: DC-26



Summary for Subcatchment 69S: DC-27

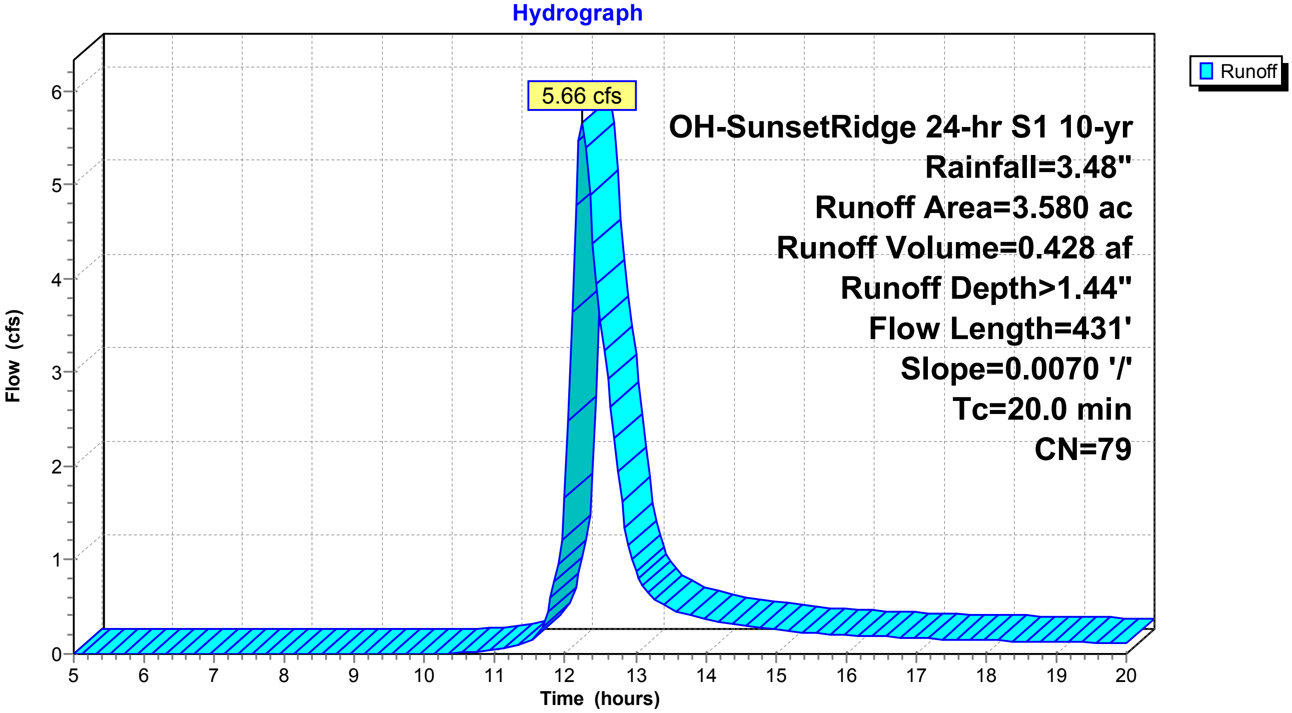
Runoff = 5.66 cfs @ 12.24 hrs, Volume= 0.428 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
3.420	78	Meadow, non-grazed, HSG D
0.160	96	Gravel surface, HSG D
3.580	79	Weighted Average
3.580		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	431	0.0070	0.36		**Lag/CN Method,**

Subcatchment 69S: DC-27



Summary for Subcatchment 70S: DC-28

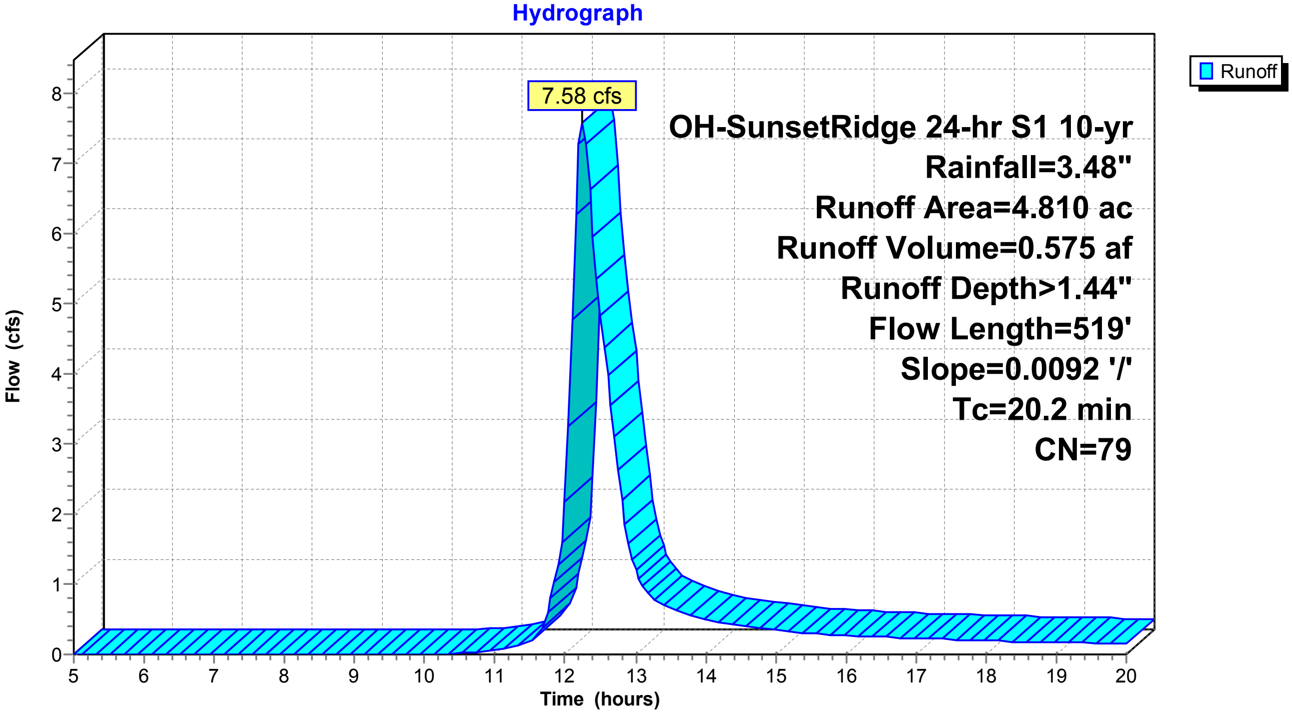
Runoff = 7.58 cfs @ 12.25 hrs, Volume= 0.575 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
4.520	78	Meadow, non-grazed, HSG D
0.290	96	Gravel surface, HSG D
4.810	79	Weighted Average
4.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	519	0.0092	0.43		**Lag/CN Method,**

Subcatchment 70S: DC-28



Summary for Subcatchment 71S: DC-29

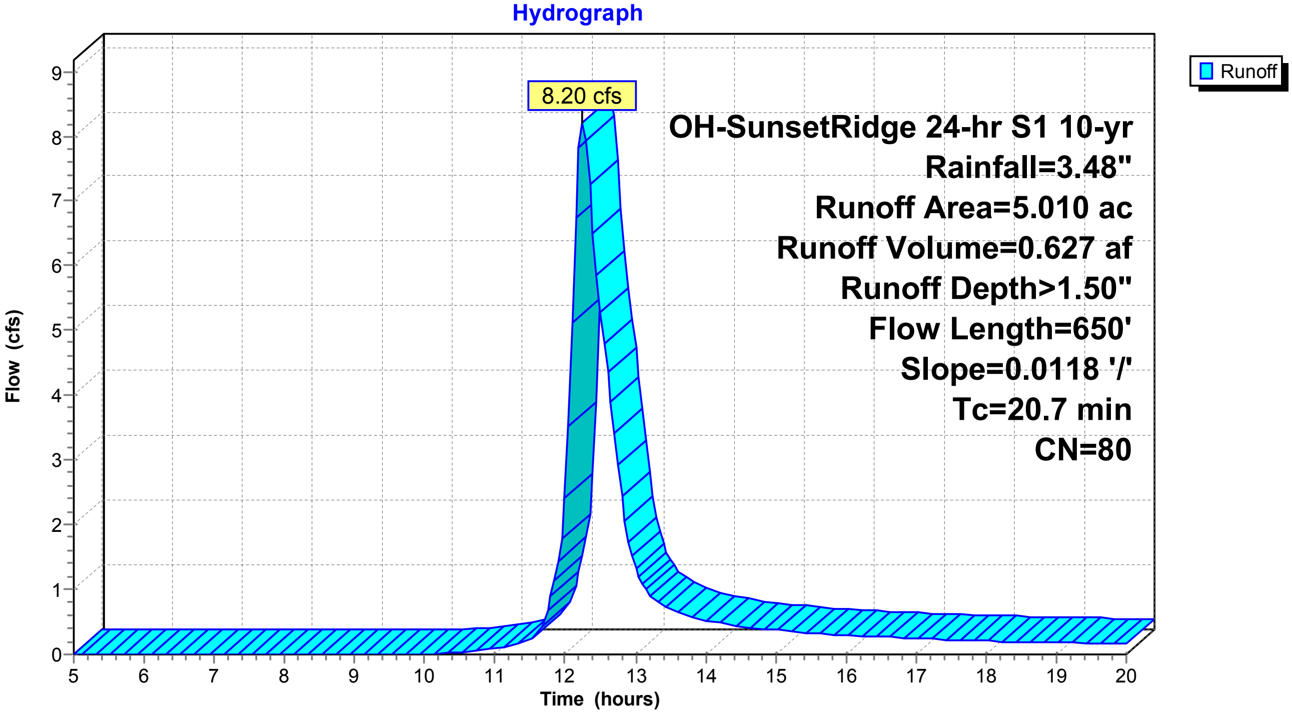
Runoff = 8.20 cfs @ 12.25 hrs, Volume= 0.627 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
4.320	78	Meadow, non-grazed, HSG D
0.690	96	Gravel surface, HSG D
5.010	80	Weighted Average
5.010		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	650	0.0118	0.52		**Lag/CN Method,**

Subcatchment 71S: DC-29



Summary for Subcatchment 72S: DC-30

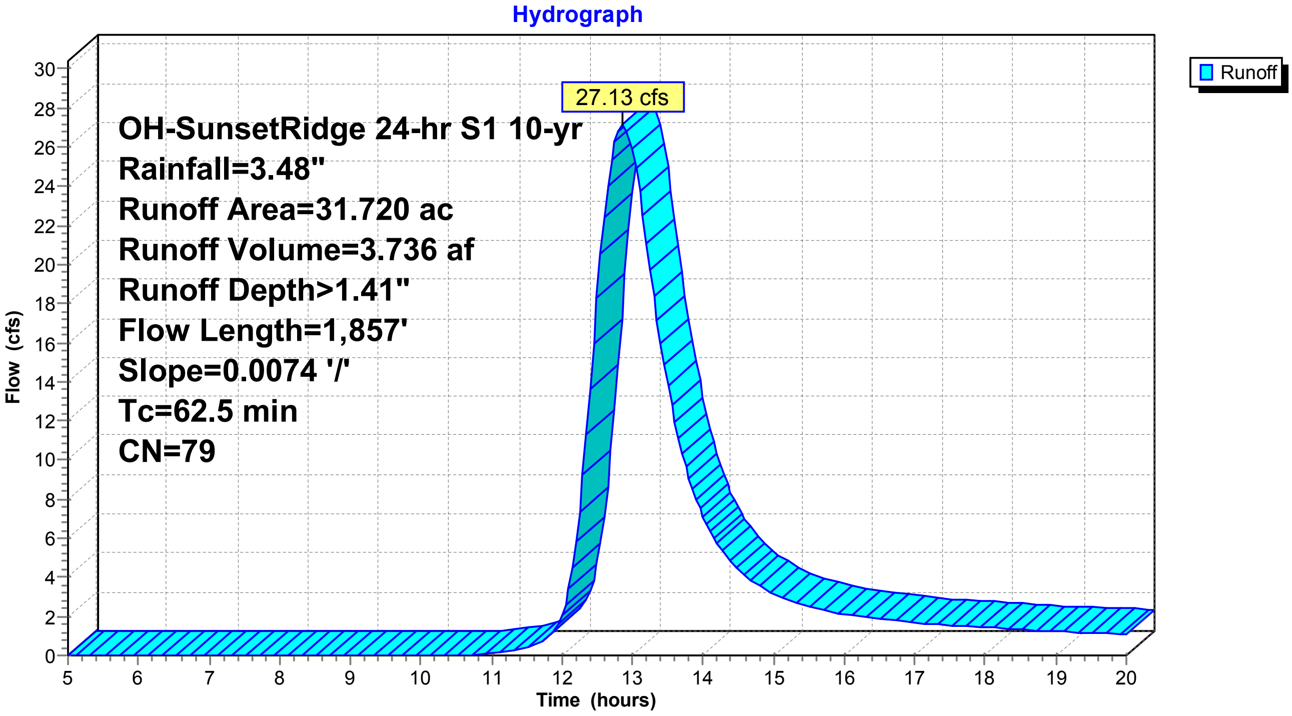
Runoff = 27.13 cfs @ 12.86 hrs, Volume= 3.736 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
30.590	78	Meadow, non-grazed, HSG D
1.120	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
31.720	79	Weighted Average
31.710		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.5	1,857	0.0074	0.50		**Lag/CN Method,**

Subcatchment 72S: DC-30



Summary for Subcatchment 73S: DC-31

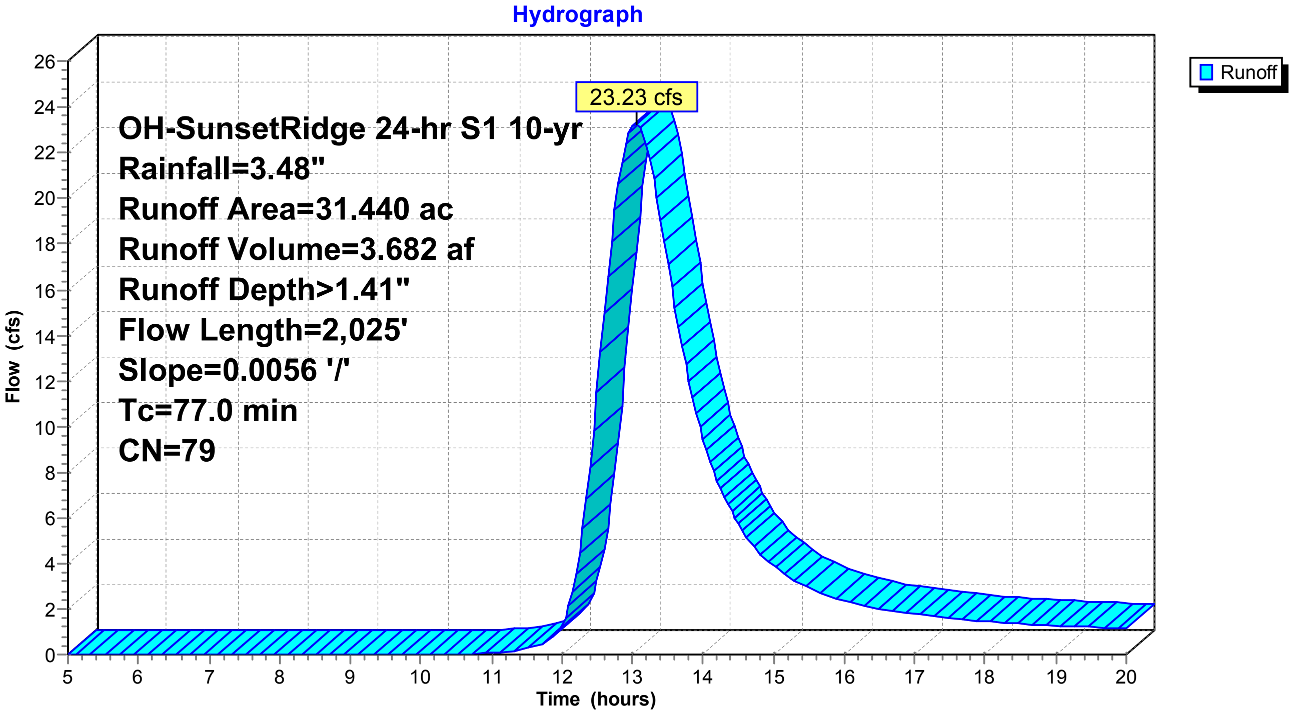
Runoff = 23.23 cfs @ 13.05 hrs, Volume= 3.682 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
30.110	78	Meadow, non-grazed, HSG D
1.320	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
31.440	79	Weighted Average
31.430		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.0	2,025	0.0056	0.44		**Lag/CN Method,**

Subcatchment 73S: DC-31



Summary for Subcatchment 74S: DC-32

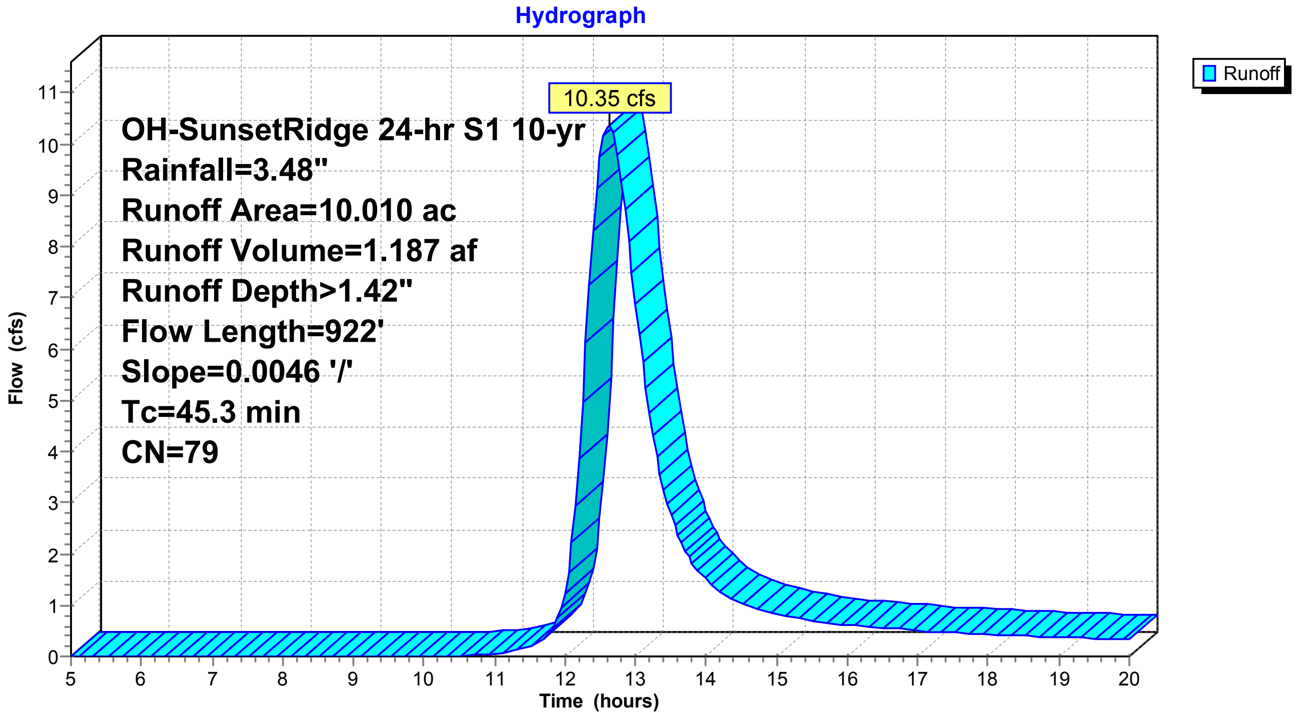
Runoff = 10.35 cfs @ 12.63 hrs, Volume= 1.187 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
9.370	78	Meadow, non-grazed, HSG D
0.630	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
10.010	79	Weighted Average
10.000		99.90% Pervious Area
0.010		0.10% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.3	922	0.0046	0.34		**Lag/CN Method,**

Subcatchment 74S: DC-32



Summary for Subcatchment 75S: DC-33

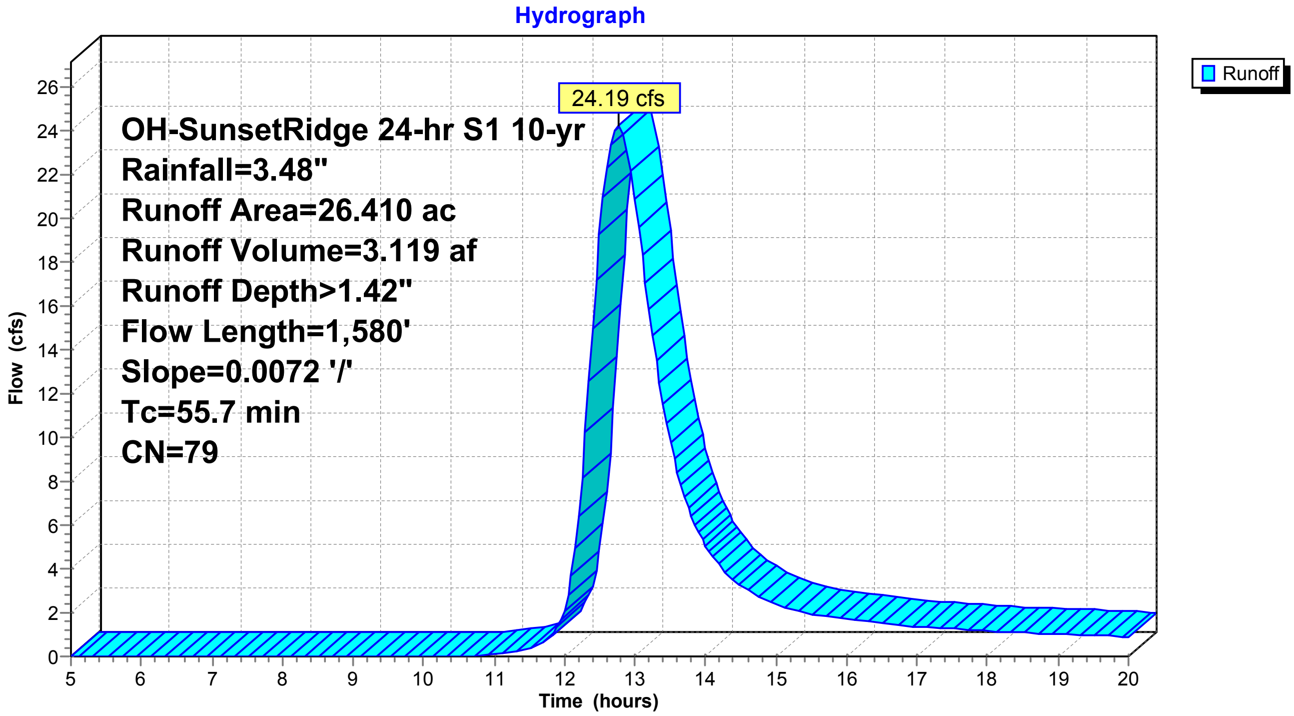
Runoff = 24.19 cfs @ 12.77 hrs, Volume= 3.119 af, Depth> 1.42"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
25.550	78	Meadow, non-grazed, HSG D
0.850	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
26.410	79	Weighted Average
26.400		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.7	1,580	0.0072	0.47		**Lag/CN Method,**

Subcatchment 75S: DC-33



Summary for Subcatchment 76S: DC-34

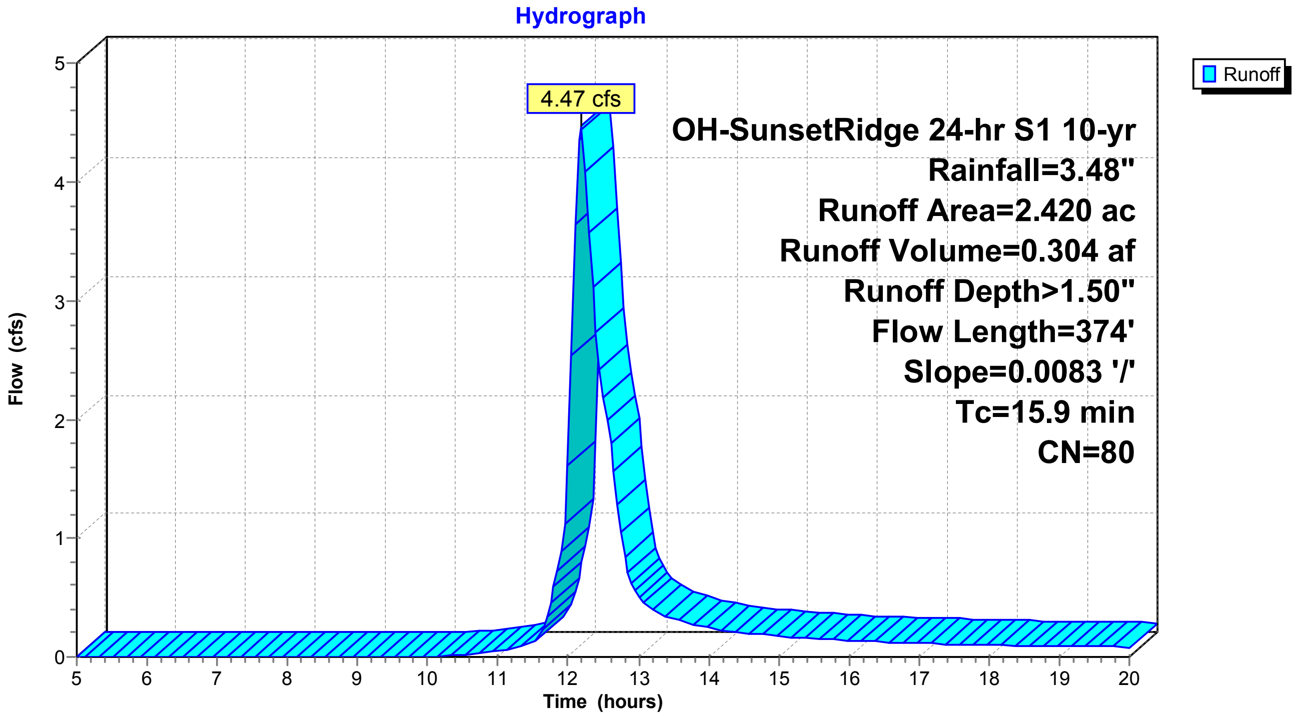
Runoff = 4.47 cfs @ 12.19 hrs, Volume= 0.304 af, Depth> 1.50"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
2.110	78	Meadow, non-grazed, HSG D
0.310	96	Gravel surface, HSG D
2.420	80	Weighted Average
2.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	374	0.0083	0.39		**Lag/CN Method,**

Subcatchment 76S: DC-34



Summary for Subcatchment 77S: DC-35

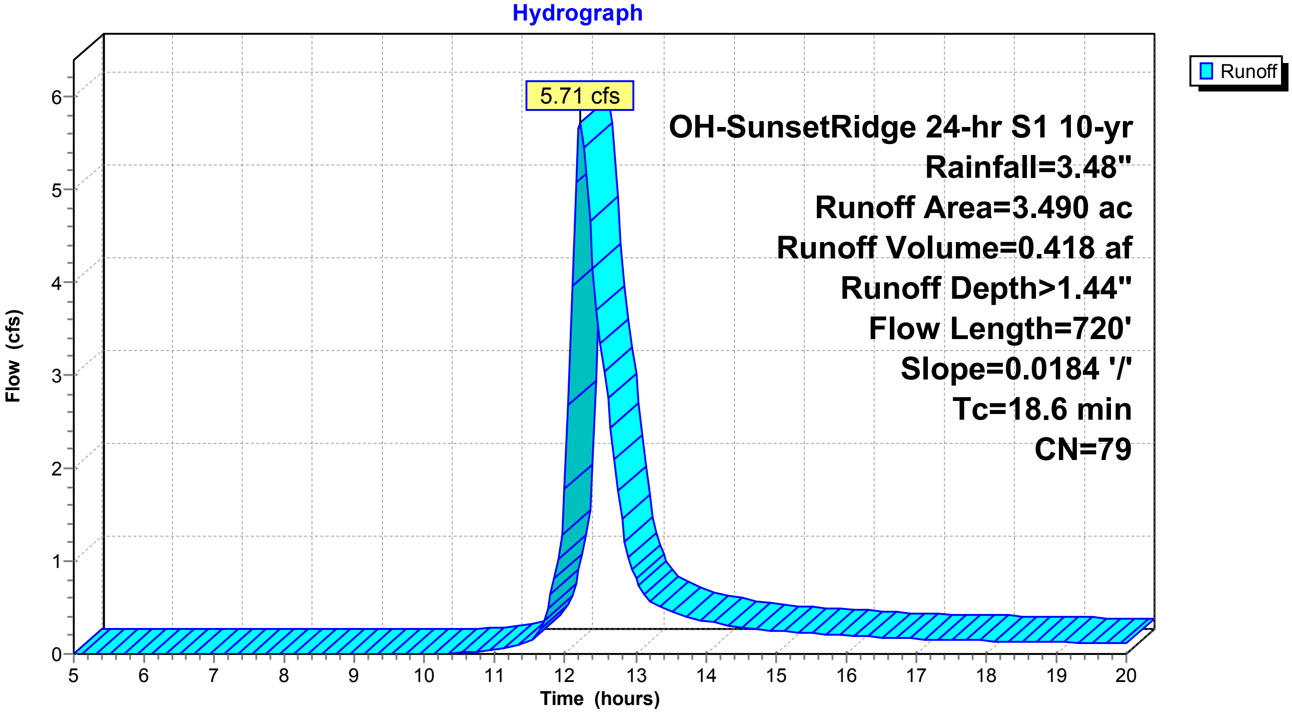
Runoff = 5.71 cfs @ 12.23 hrs, Volume= 0.418 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
3.260	78	Meadow, non-grazed, HSG D
0.230	96	Gravel surface, HSG D
3.490	79	Weighted Average
3.490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	720	0.0184	0.65		**Lag/CN Method,**

Subcatchment 77S: DC-35



Summary for Subcatchment 78S: DC-36

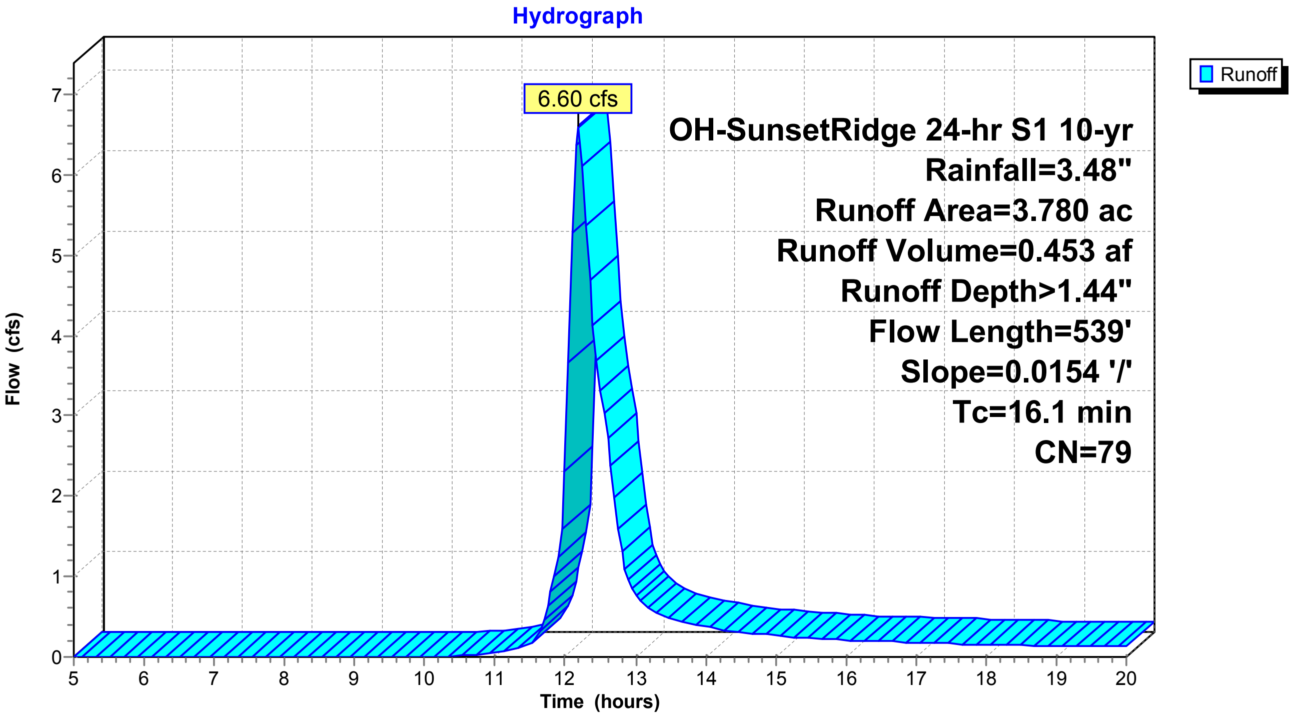
Runoff = 6.60 cfs @ 12.19 hrs, Volume= 0.453 af, Depth> 1.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
3.580	78	Meadow, non-grazed, HSG D
0.200	96	Gravel surface, HSG D
3.780	79	Weighted Average
3.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	539	0.0154	0.56		**Lag/CN Method,**

Subcatchment 78S: DC-36



Summary for Subcatchment 79S: DC-37

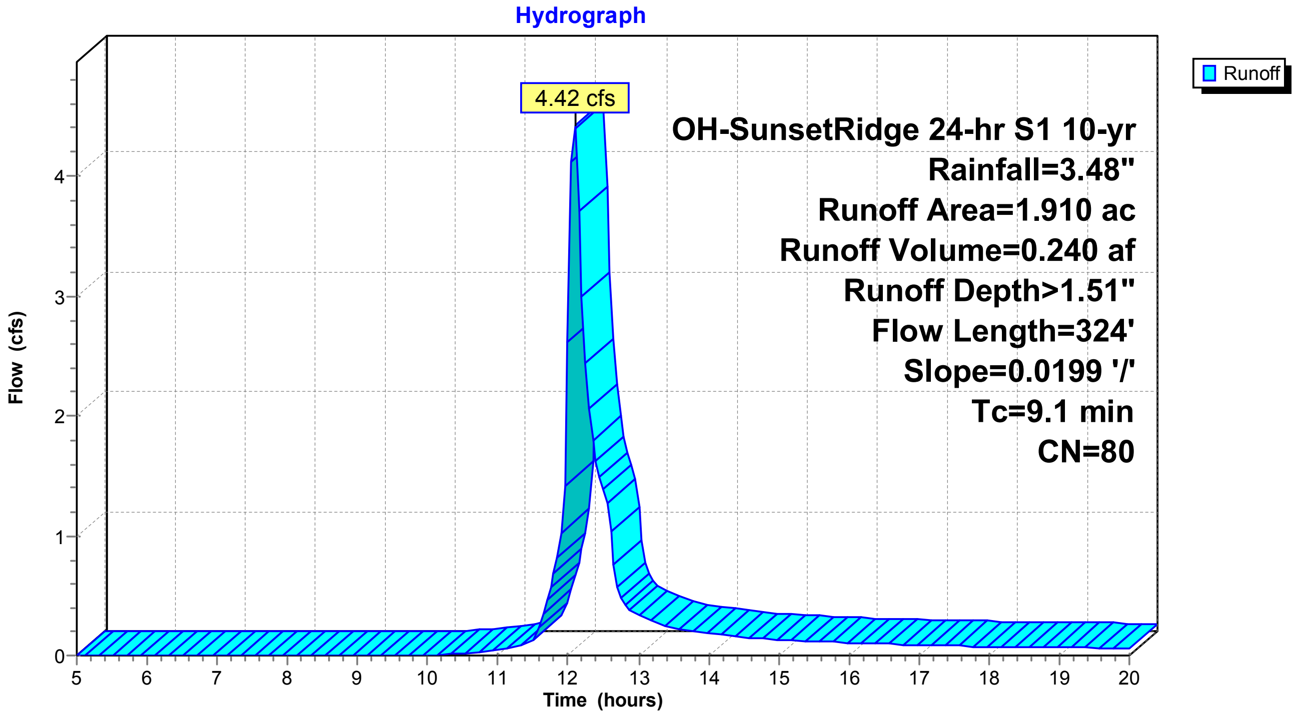
Runoff = 4.42 cfs @ 12.09 hrs, Volume= 0.240 af, Depth> 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
1.720	78	Meadow, non-grazed, HSG D
0.180	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
1.910	80	Weighted Average
1.900		99.48% Pervious Area
0.010		0.52% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	324	0.0199	0.59		**Lag/CN Method,**

Subcatchment 79S: DC-37



Summary for Subcatchment 80S: DC-38

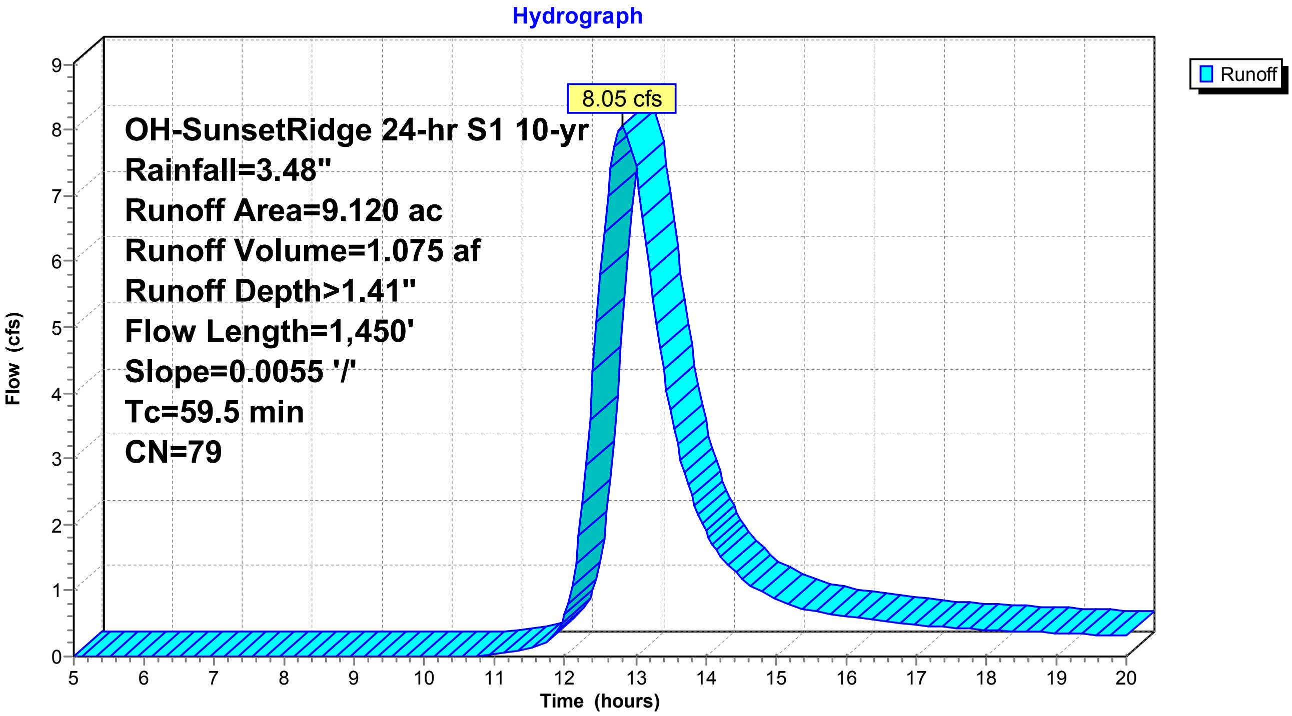
Runoff = 8.05 cfs @ 12.82 hrs, Volume= 1.075 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
8.500	78	Meadow, non-grazed, HSG D
0.620	96	Gravel surface, HSG D
9.120	79	Weighted Average
9.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
59.5	1,450	0.0055	0.41		**Lag/CN Method,**

Subcatchment 80S: DC-38



Summary for Subcatchment 81S: DC-39

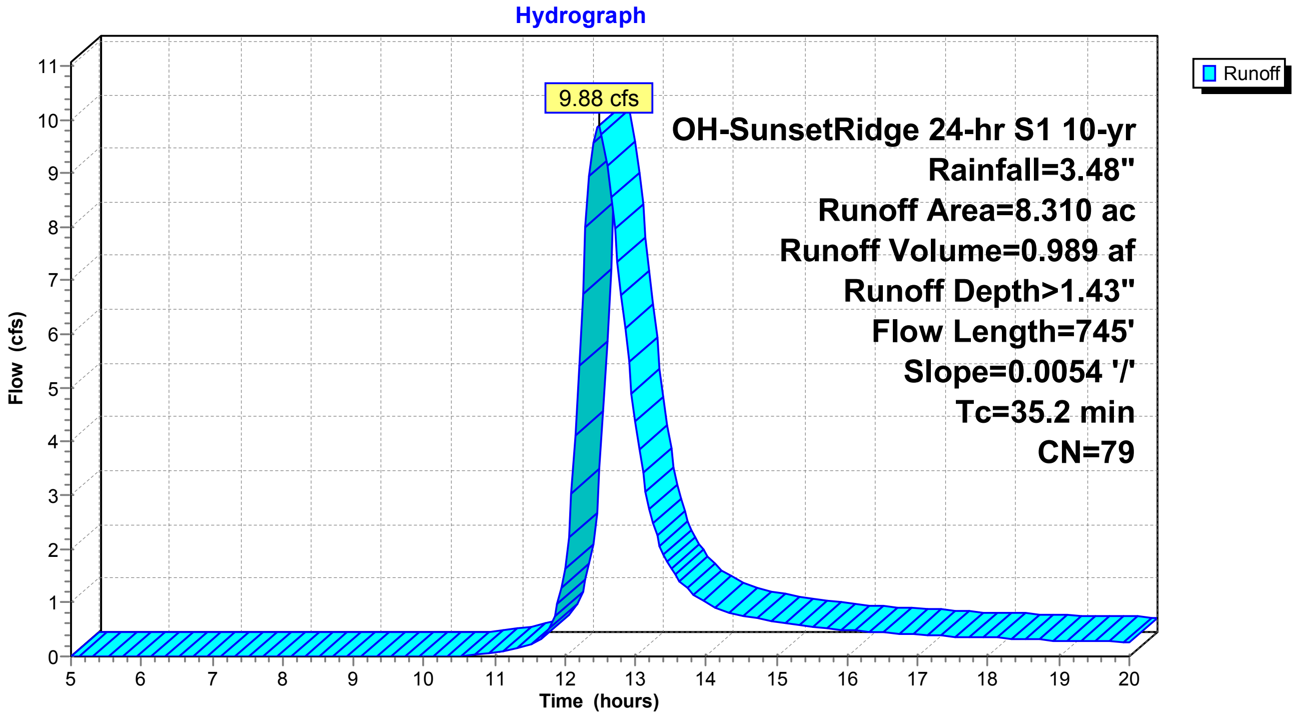
Runoff = 9.88 cfs @ 12.48 hrs, Volume= 0.989 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
7.740	78	Meadow, non-grazed, HSG D
0.560	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
8.310	79	Weighted Average
8.300		99.88% Pervious Area
0.010		0.12% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.2	745	0.0054	0.35		**Lag/CN Method,**

Subcatchment 81S: DC-39



Summary for Subcatchment 82S: DC-40

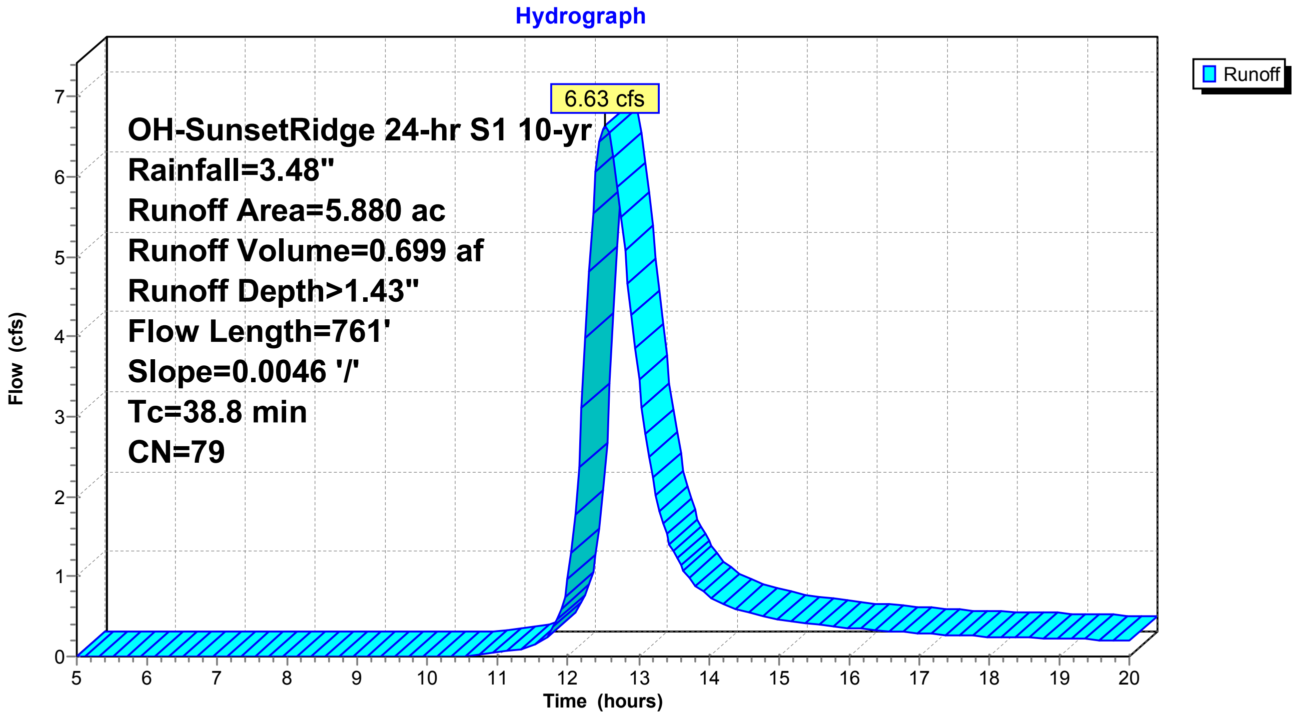
Runoff = 6.63 cfs @ 12.53 hrs, Volume= 0.699 af, Depth> 1.43"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
5.580	78	Meadow, non-grazed, HSG D
0.300	96	Gravel surface, HSG D
5.880	79	Weighted Average
5.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.8	761	0.0046	0.33		**Lag/CN Method,**

Subcatchment 82S: DC-40



Summary for Subcatchment 83S: DC-41

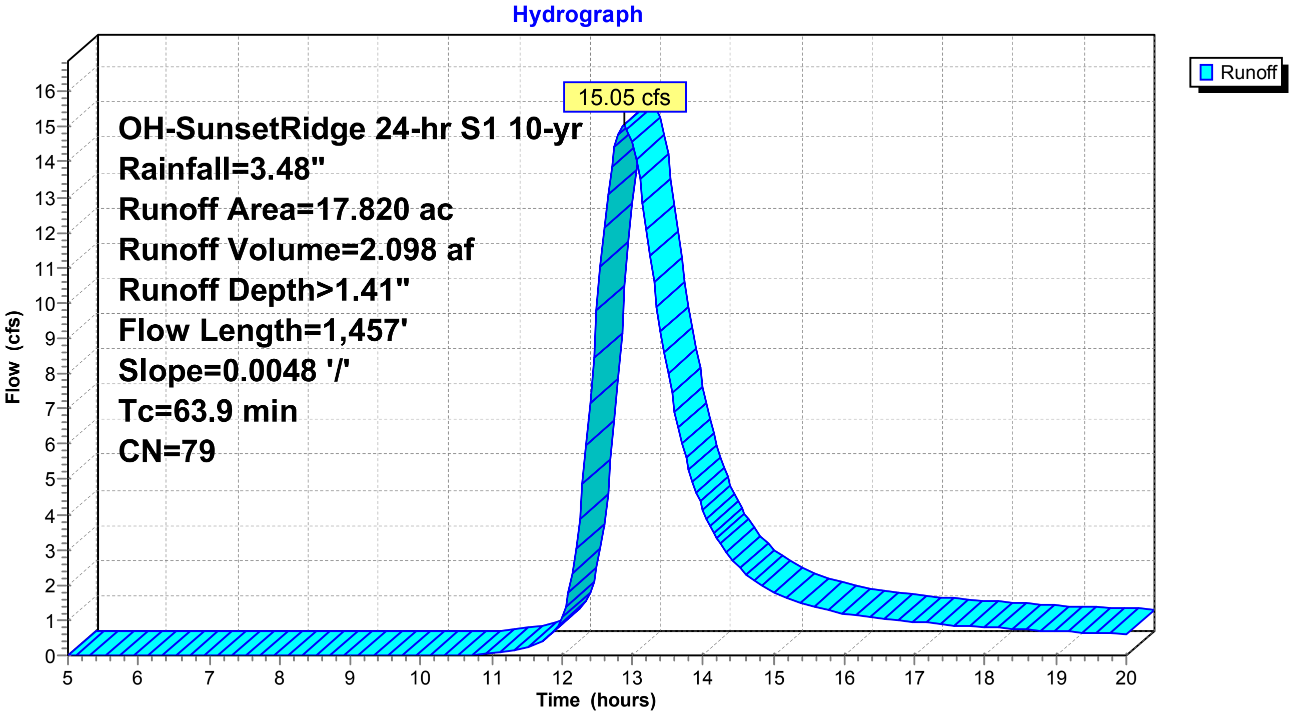
Runoff = 15.05 cfs @ 12.87 hrs, Volume= 2.098 af, Depth> 1.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
17.090	78	Meadow, non-grazed, HSG D
0.720	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
17.820	79	Weighted Average
17.810		99.94% Pervious Area
0.010		0.06% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
63.9	1,457	0.0048	0.38		**Lag/CN Method,**

Subcatchment 83S: DC-41



Summary for Subcatchment 84S: DC-42

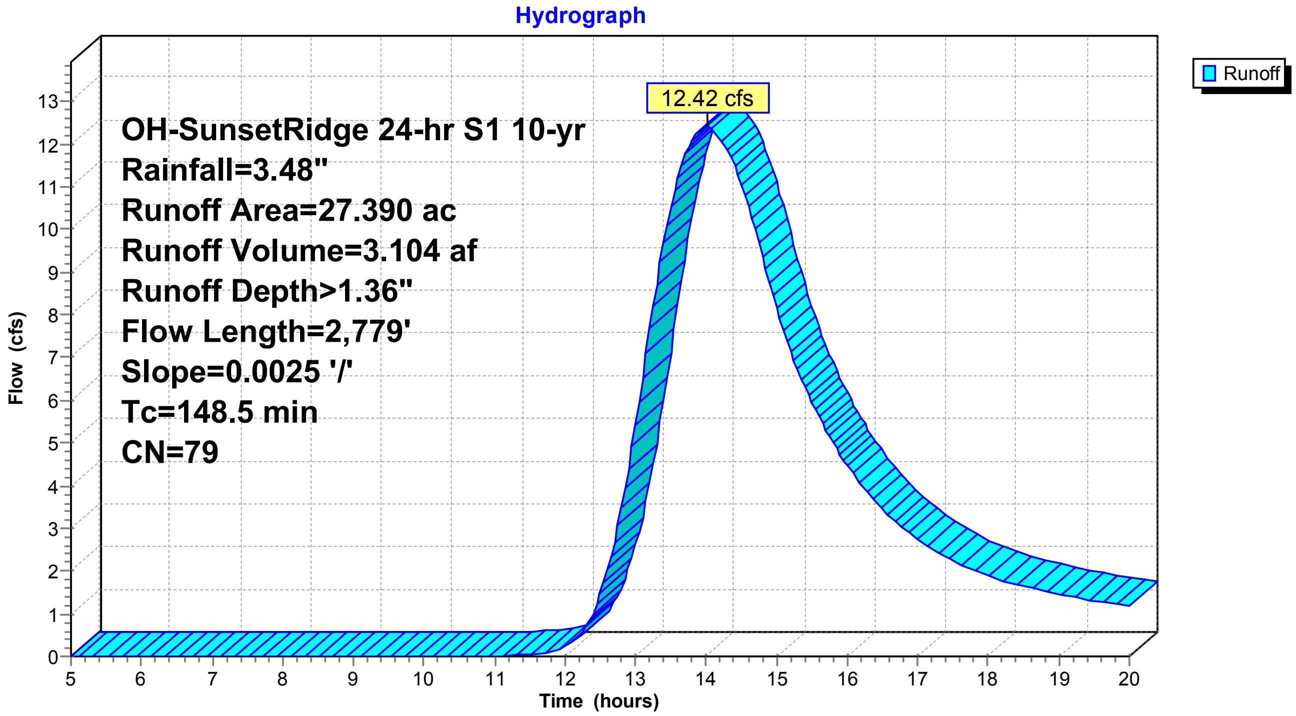
Runoff = 12.42 cfs @ 14.02 hrs, Volume= 3.104 af, Depth> 1.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 10-yr Rainfall=3.48"

Area (ac)	CN	Description
26.400	78	Meadow, non-grazed, HSG D
0.980	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
27.390	79	Weighted Average
27.380		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
148.5	2,779	0.0025	0.31		**Lag/CN Method,**

Subcatchment 84S: DC-42



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 43S: DC-01 Runoff Area=34.460 ac 0.03% Impervious Runoff Depth>2.87"
Flow Length=777' Slope=0.0061 '/' Tc=34.3 min CN=79 Runoff=80.20 cfs 8.253 af

Subcatchment 44S: DC-02 Runoff Area=15.360 ac 0.07% Impervious Runoff Depth>2.86"
Flow Length=1,134' Slope=0.0066 '/' Tc=44.6 min CN=79 Runoff=31.18 cfs 3.666 af

Subcatchment 45S: DC-03 Runoff Area=17.270 ac 0.06% Impervious Runoff Depth>2.86"
Flow Length=1,407' Slope=0.0077 '/' Tc=49.1 min CN=79 Runoff=33.20 cfs 4.116 af

Subcatchment 46S: DC-04 Runoff Area=57.040 ac 0.04% Impervious Runoff Depth>2.81"
Flow Length=2,342' Slope=0.0048 '/' Tc=93.5 min CN=79 Runoff=72.84 cfs 13.380 af

Subcatchment 47S: DC-05 Runoff Area=6.570 ac 0.00% Impervious Runoff Depth>2.95"
Flow Length=1,011' Slope=0.0033 '/' Tc=55.8 min CN=80 Runoff=12.14 cfs 1.613 af

Subcatchment 48S: DC-06 Runoff Area=28.120 ac 0.04% Impervious Runoff Depth>2.86"
Flow Length=1,305' Slope=0.0072 '/' Tc=47.8 min CN=79 Runoff=54.95 cfs 6.705 af

Subcatchment 49S: DC-07 Runoff Area=22.440 ac 0.00% Impervious Runoff Depth>2.72"
Flow Length=1,699' Slope=0.0026 '/' Tc=101.3 min CN=78 Runoff=26.12 cfs 5.080 af

Subcatchment 50S: DC-08 Runoff Area=17.130 ac 11.68% Impervious Runoff Depth>2.96"
Flow Length=933' Slope=0.0050 '/' Tc=41.2 min UI Adjusted CN=80 Runoff=37.34 cfs 4.225 af

Subcatchment 51S: DC-09 Runoff Area=17.970 ac 12.97% Impervious Runoff Depth>2.95"
Flow Length=1,141' Slope=0.0041 '/' Tc=53.4 min UI Adjusted CN=80 Runoff=33.87 cfs 4.414 af

Subcatchment 52S: DC-10 Runoff Area=13.370 ac 34.93% Impervious Runoff Depth>3.47"
Flow Length=539' Slope=0.0150 '/' Tc=13.4 min CN=85 Runoff=56.85 cfs 3.862 af

Subcatchment 53S: DC-11 Runoff Area=9.630 ac 0.00% Impervious Runoff Depth>2.78"
Flow Length=705' Slope=0.0048 '/' Tc=36.9 min CN=78 Runoff=20.91 cfs 2.231 af

Subcatchment 54S: DC-12 Runoff Area=65.170 ac 0.03% Impervious Runoff Depth>2.79"
Flow Length=1,973' Slope=0.0023 '/' Tc=117.7 min CN=79 Runoff=69.95 cfs 15.141 af

Subcatchment 55S: DC-13 Runoff Area=6.850 ac 0.00% Impervious Runoff Depth>2.80"
Flow Length=447' Slope=0.0100 '/' Tc=17.7 min CN=78 Runoff=21.15 cfs 1.597 af

Subcatchment 56S: DC-14 Runoff Area=31.250 ac 0.03% Impervious Runoff Depth>2.88"
Flow Length=909' Slope=0.0086 '/' Tc=32.7 min CN=79 Runoff=74.34 cfs 7.488 af

Subcatchment 57S: DC-15 Runoff Area=21.410 ac 0.05% Impervious Runoff Depth>2.75"
Flow Length=1,487' Slope=0.0050 '/' Tc=65.6 min CN=78 Runoff=33.58 cfs 4.912 af

Subcatchment 58S: DC-16 Runoff Area=37.390 ac 0.03% Impervious Runoff Depth>2.79"
Flow Length=803' Slope=0.0135 '/' Tc=24.4 min CN=78 Runoff=99.51 cfs 8.699 af

Subcatchment 59S: DC-17 Runoff Area=10.250 ac 0.00% Impervious Runoff Depth>2.88"
Flow Length=1,004' Slope=0.0113 '/' Tc=30.9 min CN=79 Runoff=25.09 cfs 2.458 af

Subcatchment 60S: DC-18 Runoff Area=9.520 ac 0.00% Impervious Runoff Depth>2.88"
Flow Length=700' Slope=0.0114 '/' Tc=23.1 min CN=79 Runoff=26.87 cfs 2.288 af

Subcatchment 61S: DC-19 Runoff Area=67.430 ac 0.03% Impervious Runoff Depth>2.84"
Flow Length=1,812' Slope=0.0055 '/' Tc=71.1 min CN=79 Runoff=103.50 cfs 15.948 af

Subcatchment 62S: DC-20 Runoff Area=136.840 ac 0.04% Impervious Runoff Depth>2.81"
Flow Length=2,632' Slope=0.0050 '/' Tc=100.5 min CN=79 Runoff=166.18 cfs 32.013 af

Subcatchment 63S: DC-21 Runoff Area=2.560 ac 0.00% Impervious Runoff Depth>2.80"
Flow Length=456' Slope=0.0075 '/' Tc=20.8 min CN=78 Runoff=7.35 cfs 0.596 af

Subcatchment 64S: DC-22 Runoff Area=5.620 ac 0.18% Impervious Runoff Depth>2.78"
Flow Length=680' Slope=0.0051 '/' Tc=34.7 min CN=78 Runoff=12.59 cfs 1.303 af

Subcatchment 65S: DC-23 Runoff Area=8.150 ac 0.00% Impervious Runoff Depth>2.88"
Flow Length=660' Slope=0.0079 '/' Tc=26.4 min CN=79 Runoff=21.58 cfs 1.957 af

Subcatchment 66S: DC-24 Runoff Area=7.390 ac 0.14% Impervious Runoff Depth>2.89"
Flow Length=621' Slope=0.0129 '/' Tc=19.7 min CN=79 Runoff=22.43 cfs 1.778 af

Subcatchment 67S: DC-25 Runoff Area=5.760 ac 0.00% Impervious Runoff Depth>2.88"
Flow Length=816' Slope=0.0115 '/' Tc=26.0 min CN=79 Runoff=15.40 cfs 1.383 af

Subcatchment 68S: DC-26 Runoff Area=22.340 ac 0.04% Impervious Runoff Depth>2.85"
Flow Length=1,867' Slope=0.0074 '/' Tc=62.8 min CN=79 Runoff=37.02 cfs 5.299 af

Subcatchment 69S: DC-27 Runoff Area=3.580 ac 0.00% Impervious Runoff Depth>2.89"
Flow Length=431' Slope=0.0070 '/' Tc=20.0 min CN=79 Runoff=10.80 cfs 0.861 af

Subcatchment 70S: DC-28 Runoff Area=4.810 ac 0.00% Impervious Runoff Depth>2.89"
Flow Length=519' Slope=0.0092 '/' Tc=20.2 min CN=79 Runoff=14.46 cfs 1.157 af

Subcatchment 71S: DC-29 Runoff Area=5.010 ac 0.00% Impervious Runoff Depth>2.98"
Flow Length=650' Slope=0.0118 '/' Tc=20.7 min CN=80 Runoff=15.36 cfs 1.244 af

Subcatchment 72S: DC-30 Runoff Area=31.720 ac 0.03% Impervious Runoff Depth>2.85"
Flow Length=1,857' Slope=0.0074 '/' Tc=62.5 min CN=79 Runoff=53.06 cfs 7.525 af

Subcatchment 73S: DC-31 Runoff Area=31.440 ac 0.03% Impervious Runoff Depth>2.83"
Flow Length=2,025' Slope=0.0056 '/' Tc=77.0 min CN=79 Runoff=45.75 cfs 7.420 af

Subcatchment 74S: DC-32 Runoff Area=10.010 ac 0.10% Impervious Runoff Depth>2.86"
Flow Length=922' Slope=0.0046 '/' Tc=45.3 min CN=79 Runoff=20.09 cfs 2.389 af

Subcatchment 75S: DC-33 Runoff Area=26.410 ac 0.04% Impervious Runoff Depth>2.85"
Flow Length=1,580' Slope=0.0072 '/' Tc=55.7 min CN=79 Runoff=47.24 cfs 6.280 af

Subcatchment 76S: DC-34 Runoff Area=2.420 ac 0.00% Impervious Runoff Depth>2.98"
Flow Length=374' Slope=0.0083 '/' Tc=15.9 min CN=80 Runoff=8.32 cfs 0.602 af

Subcatchment 77S: DC-35 Runoff Area=3.490 ac 0.00% Impervious Runoff Depth>2.89"
Flow Length=720' Slope=0.0184 '/' Tc=18.6 min CN=79 Runoff=10.90 cfs 0.840 af

Subcatchment 78S: DC-36 Runoff Area=3.780 ac 0.00% Impervious Runoff Depth>2.89"
Flow Length=539' Slope=0.0154 '/' Tc=16.1 min CN=79 Runoff=12.53 cfs 0.911 af

Subcatchment 79S: DC-37 Runoff Area=1.910 ac 0.52% Impervious Runoff Depth>2.99"
Flow Length=324' Slope=0.0199 '/' Tc=9.1 min CN=80 Runoff=8.11 cfs 0.476 af

Subcatchment 80S: DC-38 Runoff Area=9.120 ac 0.00% Impervious Runoff Depth>2.85"
Flow Length=1,450' Slope=0.0055 '/' Tc=59.5 min CN=79 Runoff=15.74 cfs 2.166 af

Subcatchment 81S: DC-39 Runoff Area=8.310 ac 0.12% Impervious Runoff Depth>2.87"
Flow Length=745' Slope=0.0054 '/' Tc=35.2 min CN=79 Runoff=19.08 cfs 1.990 af

Subcatchment 82S: DC-40 Runoff Area=5.880 ac 0.00% Impervious Runoff Depth>2.87"
Flow Length=761' Slope=0.0046 '/' Tc=38.8 min CN=79 Runoff=12.83 cfs 1.406 af

Subcatchment 83S: DC-41 Runoff Area=17.820 ac 0.06% Impervious Runoff Depth>2.85"
Flow Length=1,457' Slope=0.0048 '/' Tc=63.9 min CN=79 Runoff=29.46 cfs 4.225 af

Subcatchment 84S: DC-42 Runoff Area=27.390 ac 0.04% Impervious Runoff Depth>2.75"
Flow Length=2,779' Slope=0.0025 '/' Tc=148.5 min CN=79 Runoff=24.74 cfs 6.276 af

Total Runoff Area = 870.390 ac Runoff Volume = 206.173 af Average Runoff Depth = 2.84"
98.93% Pervious = 861.100 ac 1.07% Impervious = 9.290 ac

Summary for Subcatchment 43S: DC-01

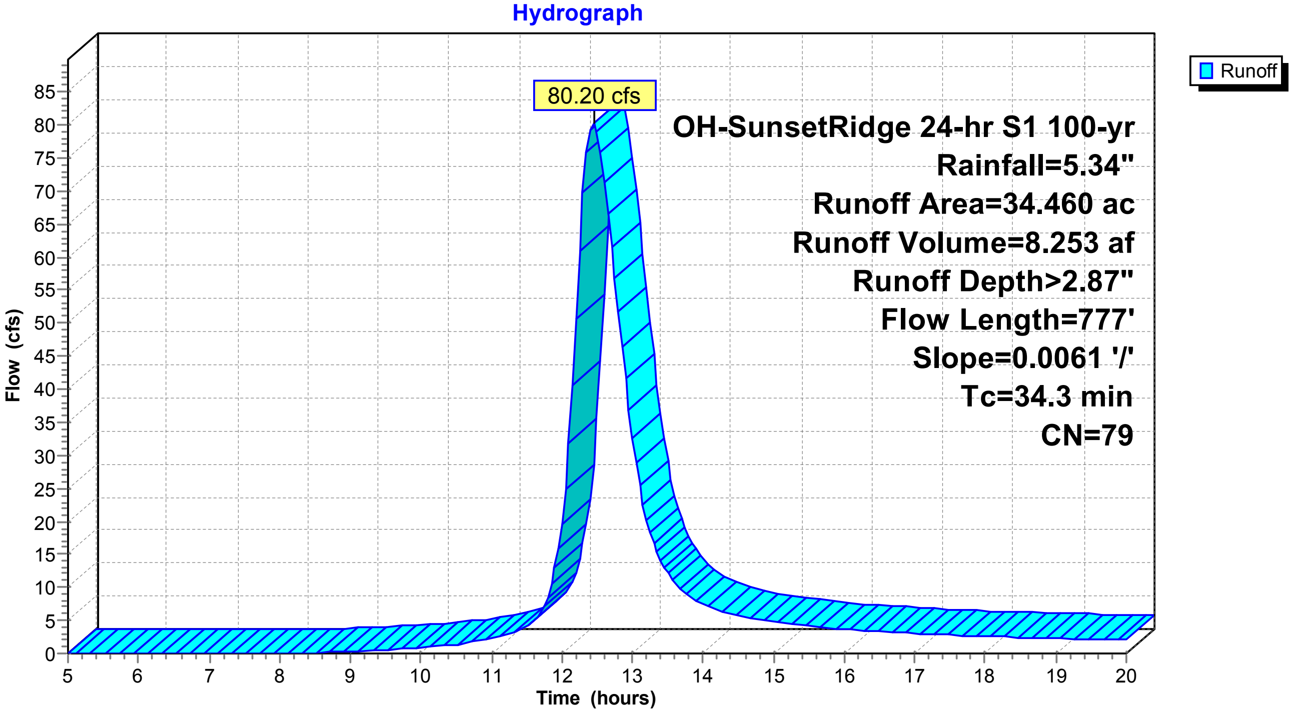
Runoff = 80.20 cfs @ 12.44 hrs, Volume= 8.253 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
33.420	78	Meadow, non-grazed, HSG D
1.030	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
34.460	79	Weighted Average
34.450		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	777	0.0061	0.38		**Lag/CN Method,**

Subcatchment 43S: DC-01



Summary for Subcatchment 44S: DC-02

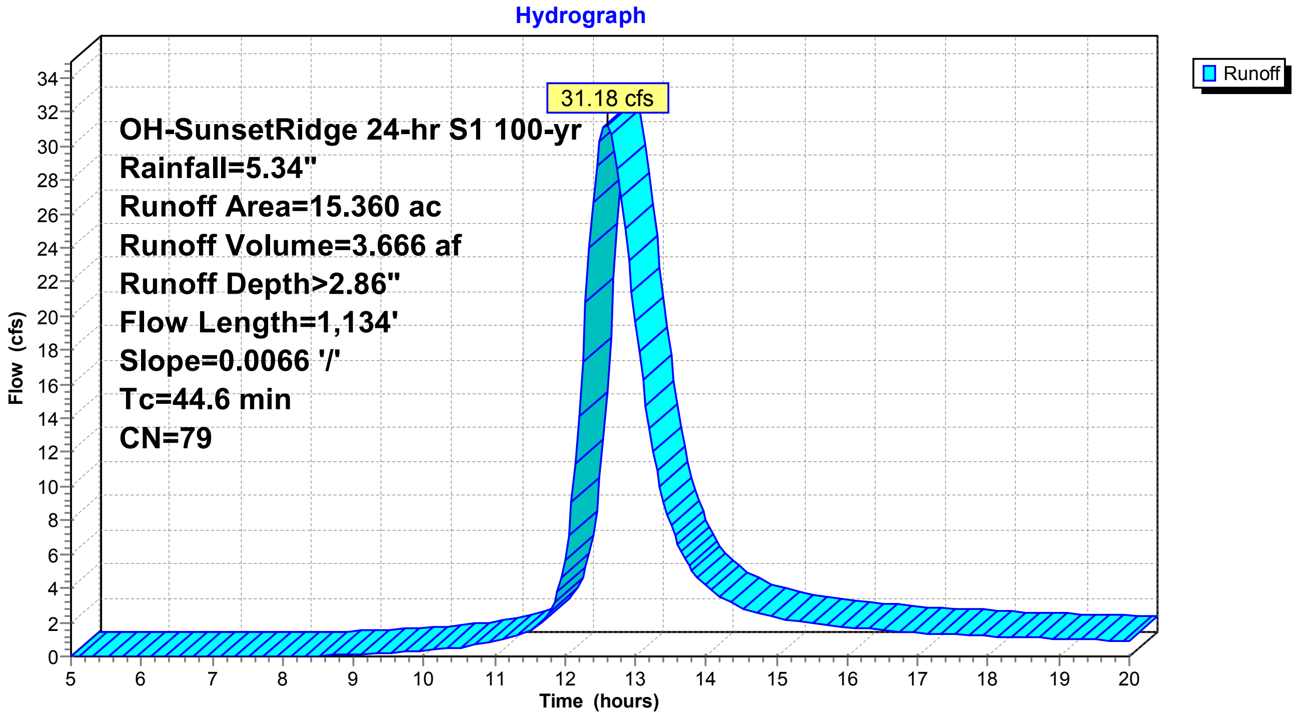
Runoff = 31.18 cfs @ 12.59 hrs, Volume= 3.666 af, Depth> 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
14.560	78	Meadow, non-grazed, HSG D
0.790	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
15.360	79	Weighted Average
15.350		99.93% Pervious Area
0.010		0.07% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.6	1,134	0.0066	0.42		**Lag/CN Method,**

Subcatchment 44S: DC-02



Summary for Subcatchment 45S: DC-03

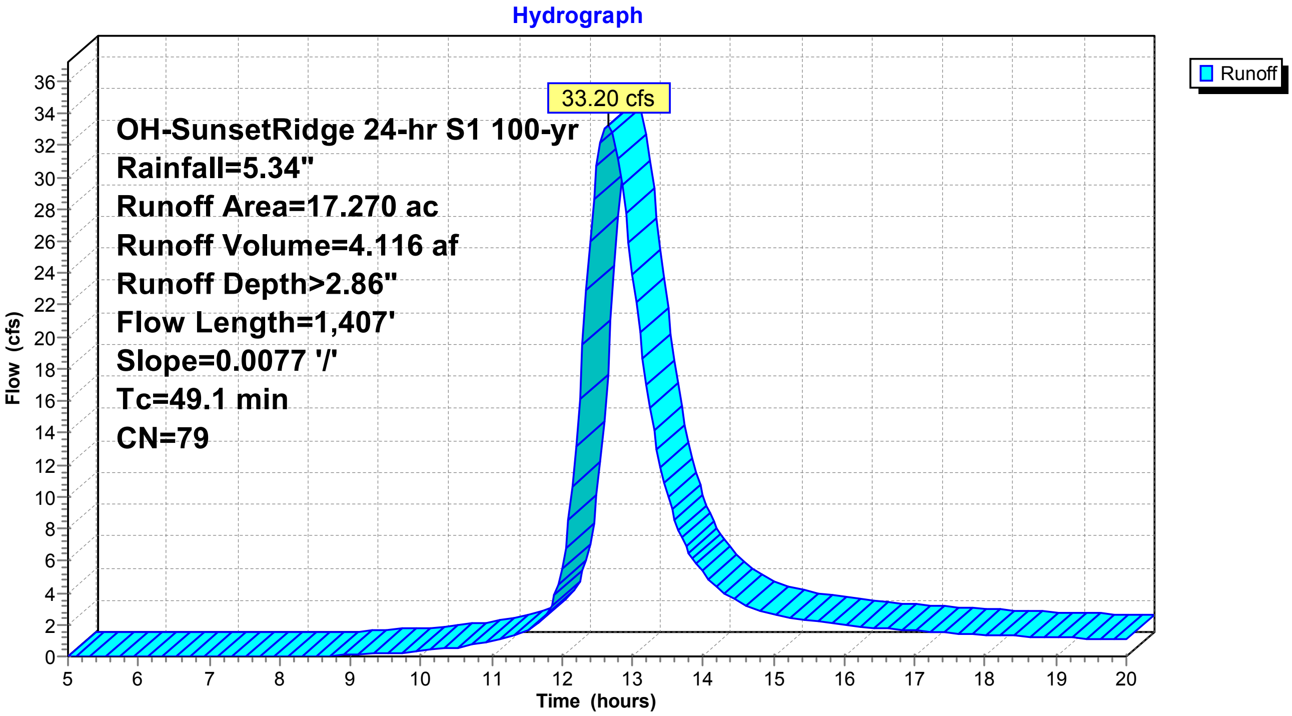
Runoff = 33.20 cfs @ 12.65 hrs, Volume= 4.116 af, Depth> 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
16.660	78	Meadow, non-grazed, HSG D
0.600	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
17.270	79	Weighted Average
17.260		99.94% Pervious Area
0.010		0.06% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.1	1,407	0.0077	0.48		**Lag/CN Method,**

Subcatchment 45S: DC-03



Summary for Subcatchment 46S: DC-04

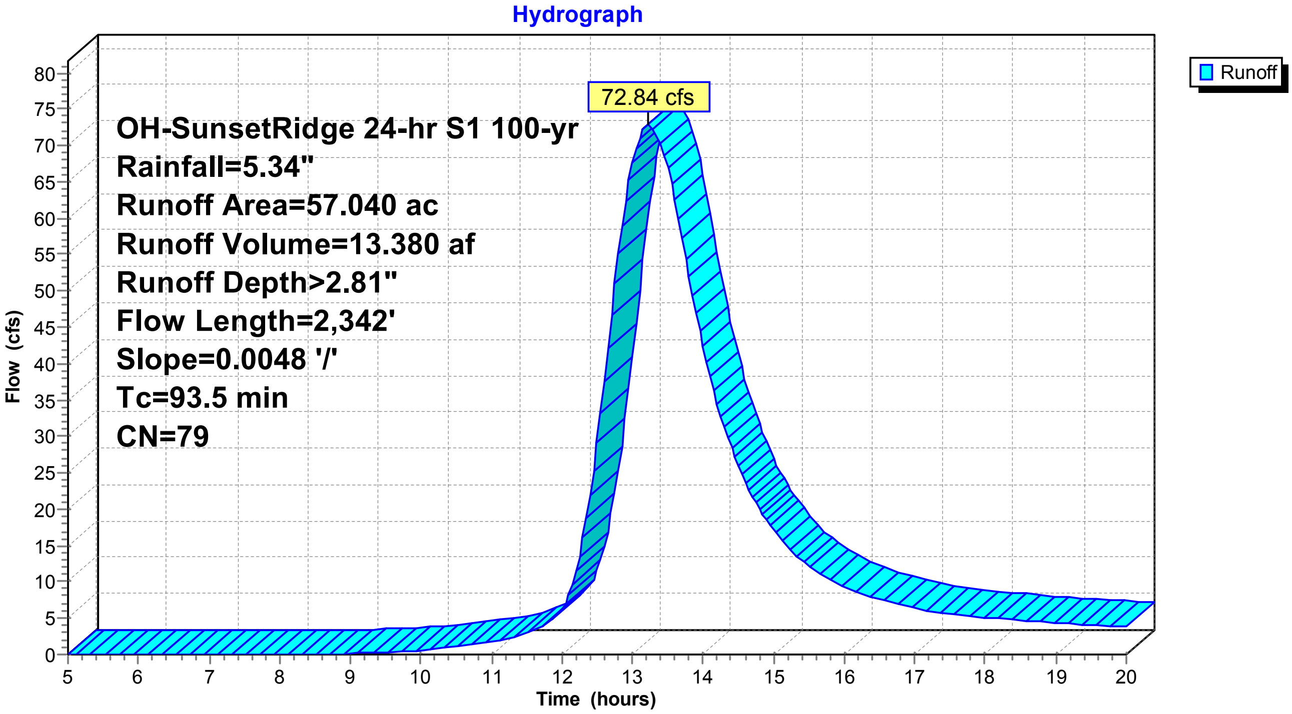
Runoff = 72.84 cfs @ 13.21 hrs, Volume= 13.380 af, Depth> 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
54.730	78	Meadow, non-grazed, HSG D
2.290	96	Gravel surface, HSG D
0.020	98	Unconnected pavement, HSG D
57.040	79	Weighted Average
57.020		99.96% Pervious Area
0.020		0.04% Impervious Area
0.020		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
93.5	2,342	0.0048	0.42		**Lag/CN Method,**

Subcatchment 46S: DC-04



Summary for Subcatchment 47S: DC-05

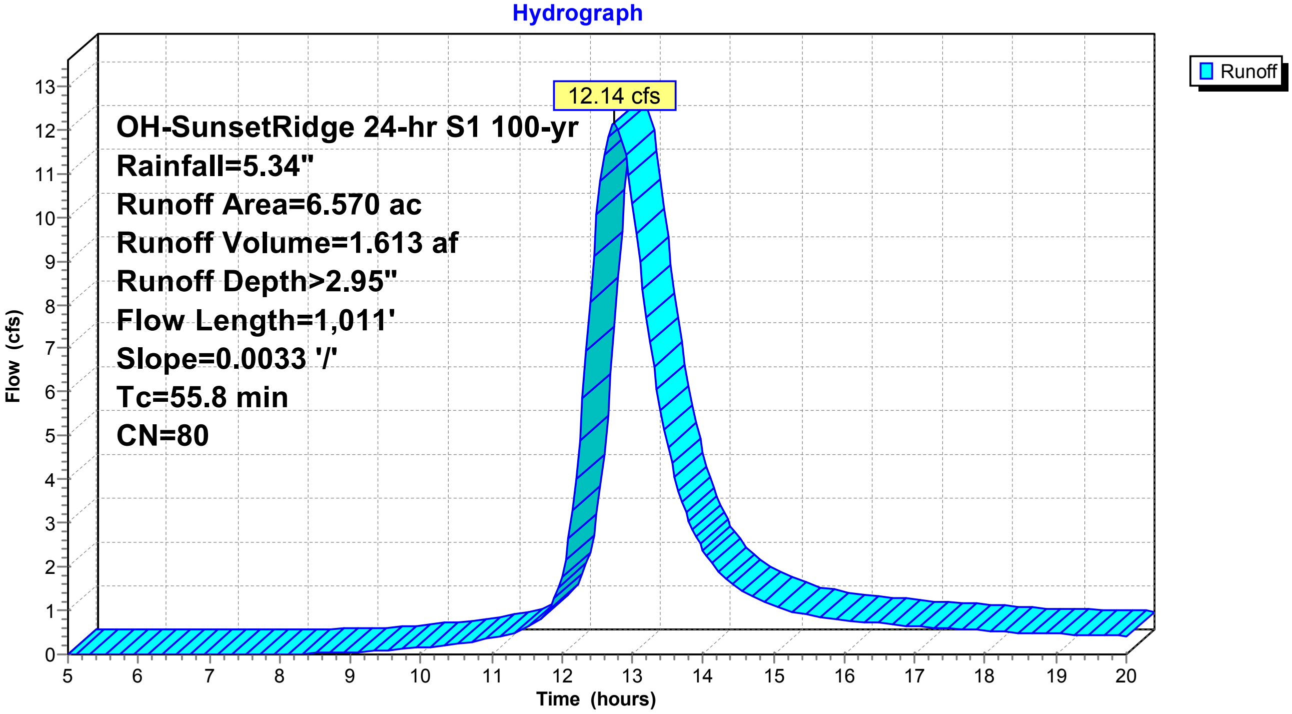
Runoff = 12.14 cfs @ 12.74 hrs, Volume= 1.613 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
6.020	78	Meadow, non-grazed, HSG D
0.550	96	Gravel surface, HSG D
6.570	80	Weighted Average
6.570		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.8	1,011	0.0033	0.30		**Lag/CN Method,**

Subcatchment 47S: DC-05



Summary for Subcatchment 48S: DC-06

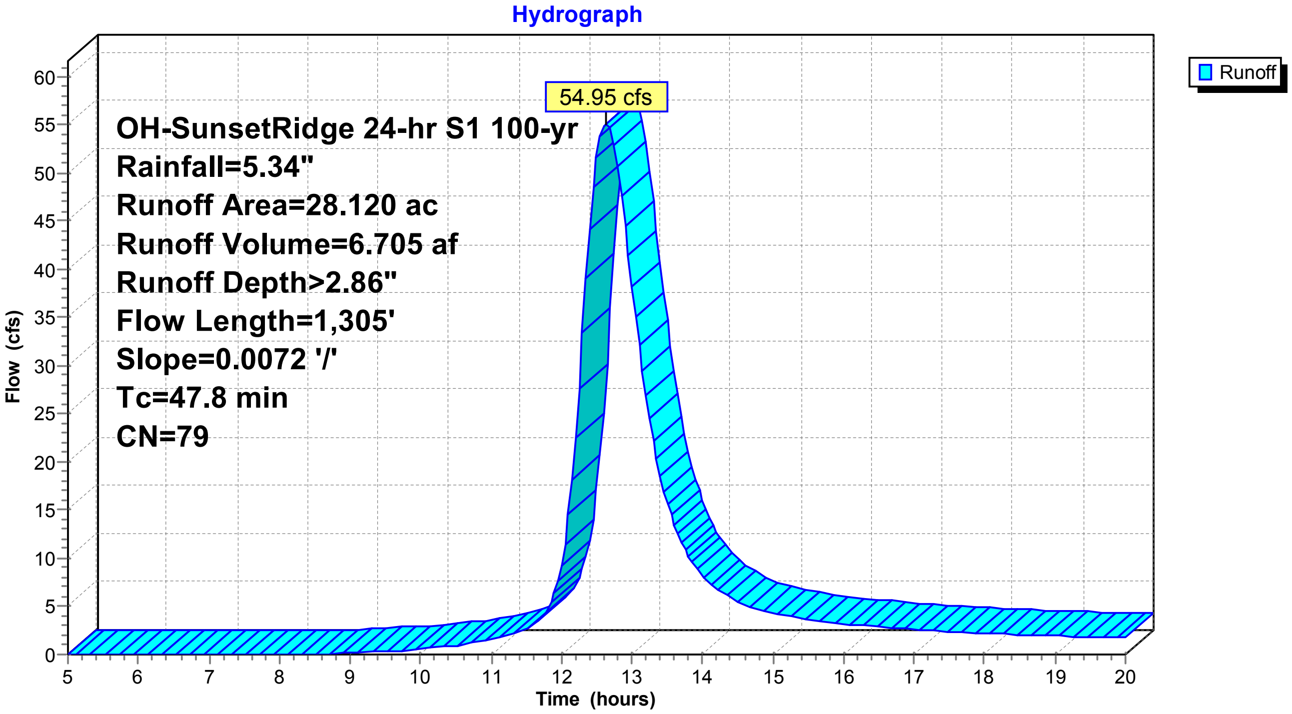
Runoff = 54.95 cfs @ 12.63 hrs, Volume= 6.705 af, Depth> 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
26.760	78	Meadow, non-grazed, HSG D
1.350	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
28.120	79	Weighted Average
28.110		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
47.8	1,305	0.0072	0.46		**Lag/CN Method,**

Subcatchment 48S: DC-06



Summary for Subcatchment 49S: DC-07

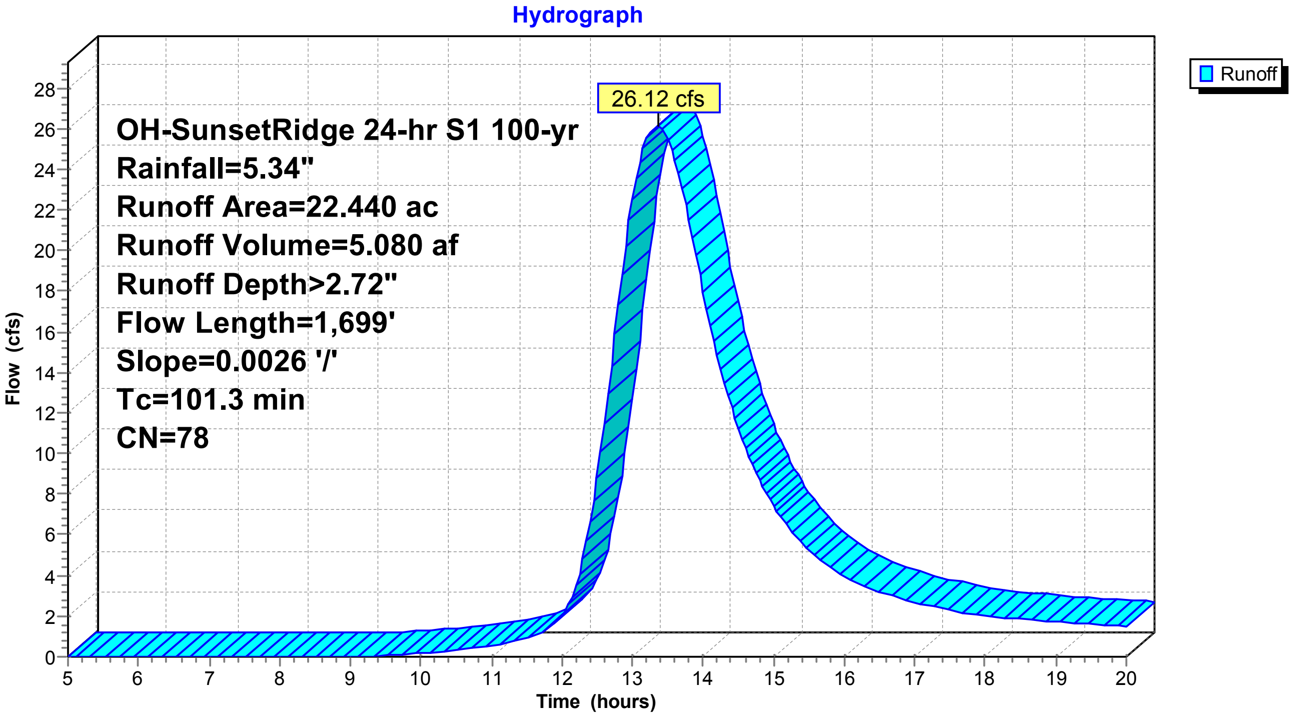
Runoff = 26.12 cfs @ 13.37 hrs, Volume= 5.080 af, Depth> 2.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
15.930	78	Meadow, non-grazed, HSG D
5.740	77	Woods, Good, HSG D
0.770	96	Gravel surface, HSG D
22.440	78	Weighted Average
22.440		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
101.3	1,699	0.0026	0.28		**Lag/CN Method,**

Subcatchment 49S: DC-07



Summary for Subcatchment 50S: DC-08

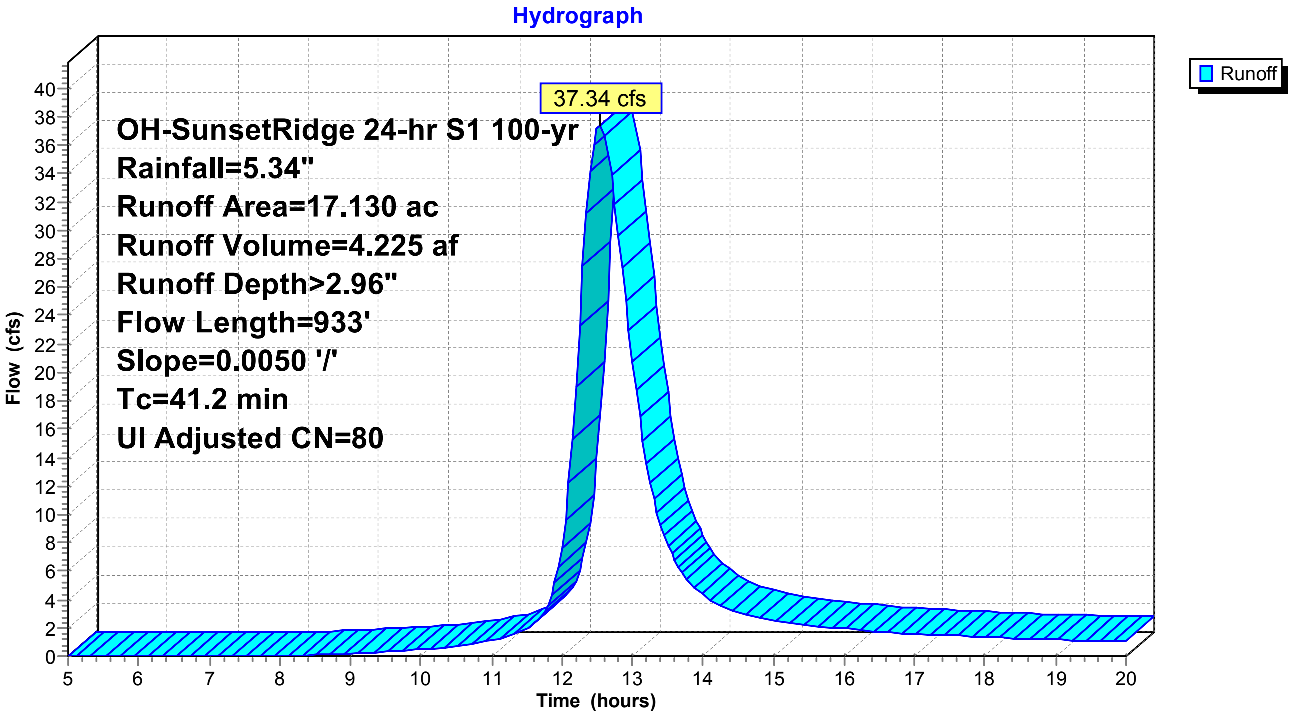
Runoff = 37.34 cfs @ 12.54 hrs, Volume= 4.225 af, Depth> 2.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Adj	Description
14.400	78		Meadow, non-grazed, HSG D
0.730	96		Gravel surface, HSG D
2.000	98		Unconnected pavement, HSG D
17.130	81	80	Weighted Average, UI Adjusted
15.130			88.32% Pervious Area
2.000			11.68% Impervious Area
2.000			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
41.2	933	0.0050	0.38		**Lag/CN Method,**

Subcatchment 50S: DC-08



Summary for Subcatchment 51S: DC-09

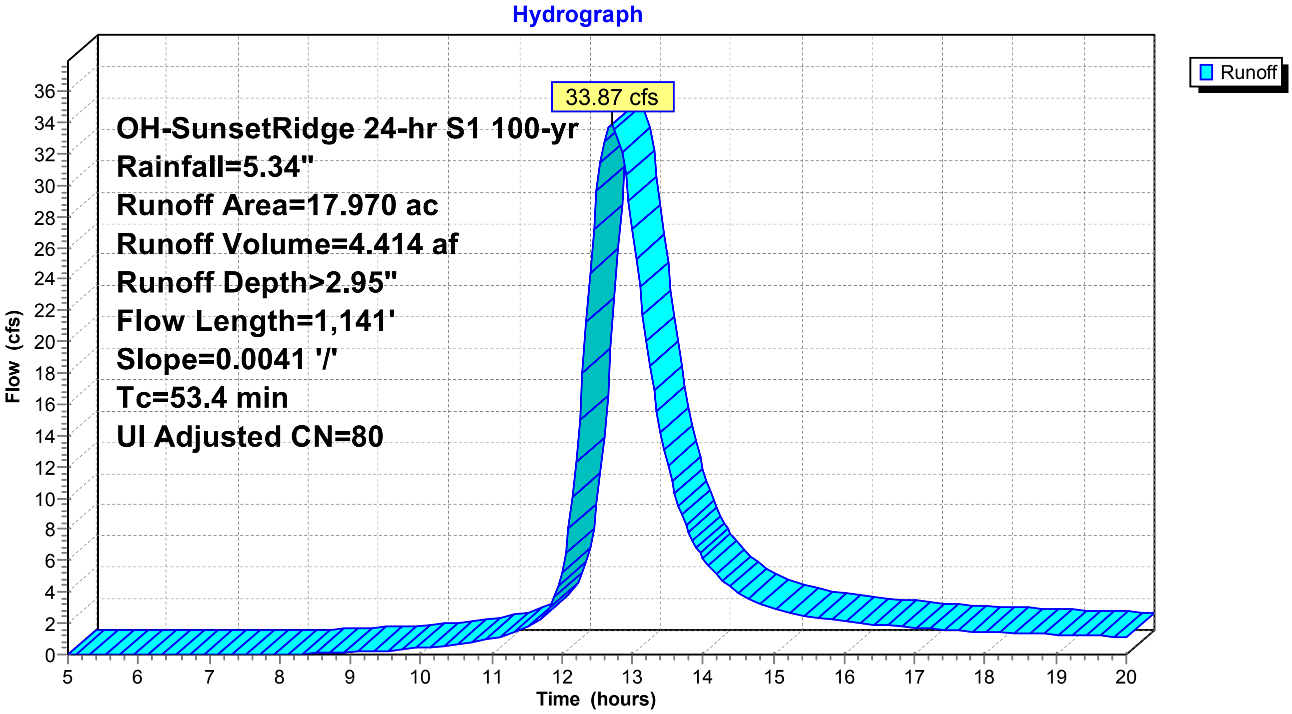
Runoff = 33.87 cfs @ 12.71 hrs, Volume= 4.414 af, Depth> 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Adj	Description
15.030	78		Meadow, non-grazed, HSG D
0.610	96		Gravel surface, HSG D
2.330	98		Unconnected pavement, HSG D
17.970	81	80	Weighted Average, UI Adjusted
15.640			87.03% Pervious Area
2.330			12.97% Impervious Area
2.330			100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
53.4	1,141	0.0041	0.36		**Lag/CN Method,**

Subcatchment 51S: DC-09



Summary for Subcatchment 52S: DC-10

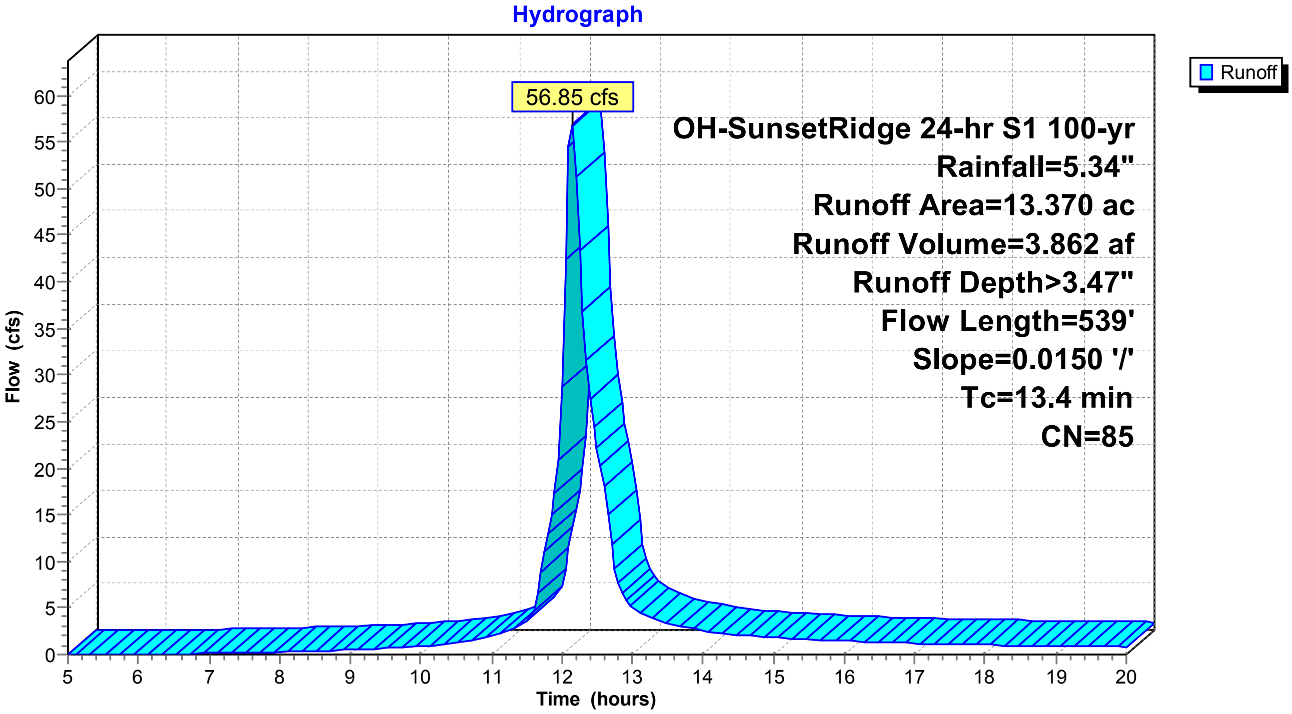
Runoff = 56.85 cfs @ 12.14 hrs, Volume= 3.862 af, Depth> 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
8.460	78	Meadow, non-grazed, HSG D
0.240	96	Gravel surface, HSG D
4.670	98	Unconnected pavement, HSG D
13.370	85	Weighted Average
8.700		65.07% Pervious Area
4.670		34.93% Impervious Area
4.670		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.4	539	0.0150	0.67		**Lag/CN Method,**

Subcatchment 52S: DC-10



Summary for Subcatchment 53S: DC-11

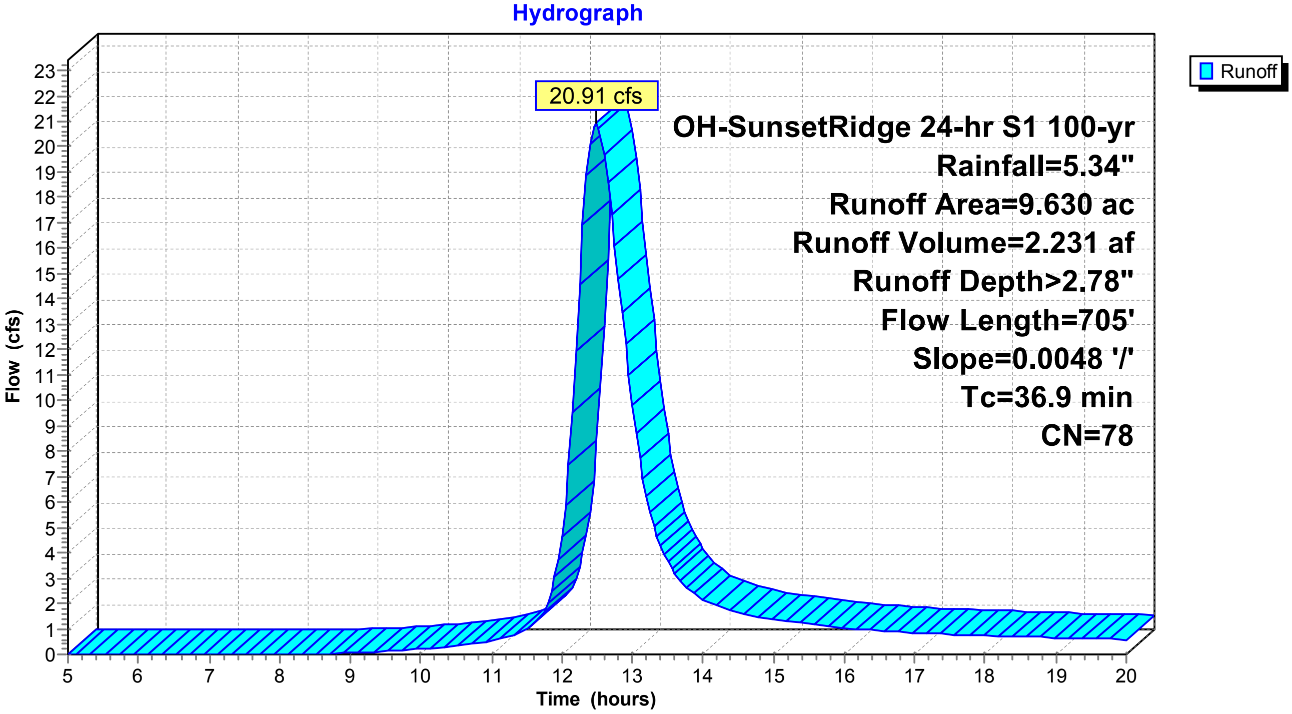
Runoff = 20.91 cfs @ 12.49 hrs, Volume= 2.231 af, Depth> 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
9.410	78	Meadow, non-grazed, HSG D
0.220	96	Gravel surface, HSG D
9.630	78	Weighted Average
9.630		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
36.9	705	0.0048	0.32		**Lag/CN Method,**

Subcatchment 53S: DC-11



Summary for Subcatchment 54S: DC-12

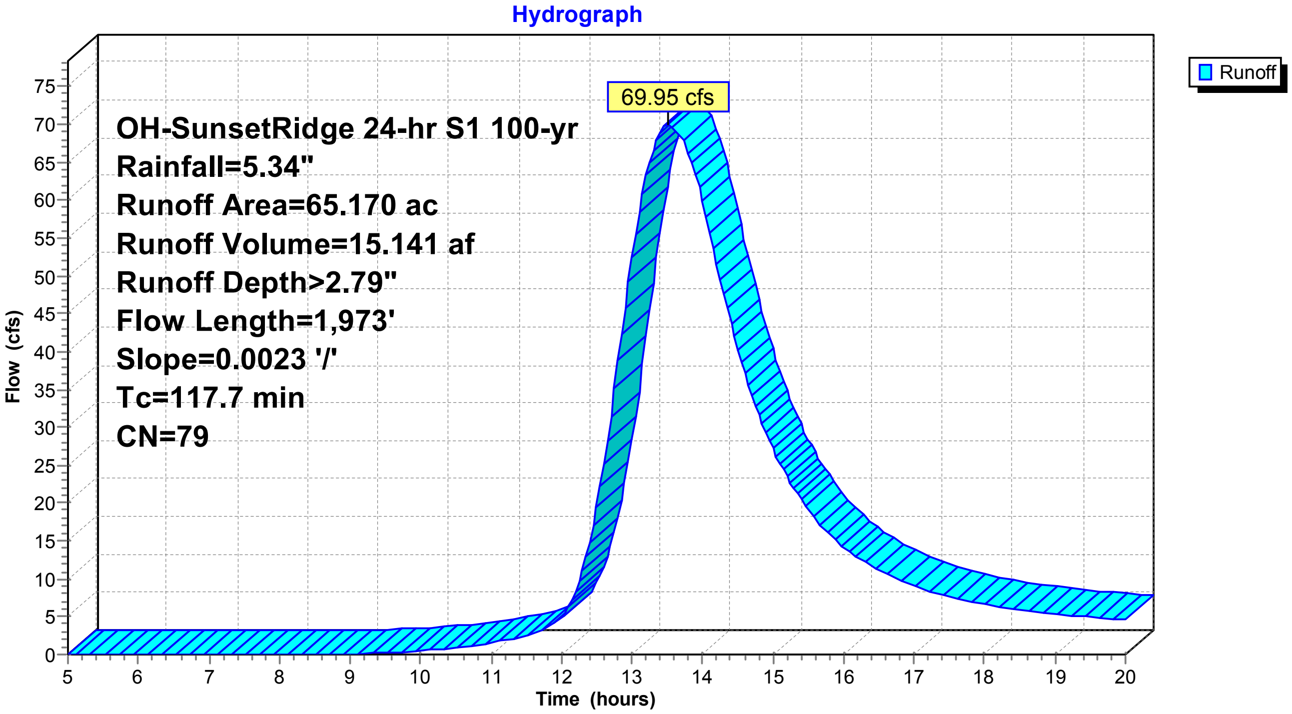
Runoff = 69.95 cfs @ 13.50 hrs, Volume= 15.141 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
62.510	78	Meadow, non-grazed, HSG D
2.640	96	Gravel surface, HSG D
0.020	98	Unconnected pavement, HSG D
65.170	79	Weighted Average
65.150		99.97% Pervious Area
0.020		0.03% Impervious Area
0.020		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
117.7	1,973	0.0023	0.28		**Lag/CN Method,**

Subcatchment 54S: DC-12



Summary for Subcatchment 55S: DC-13

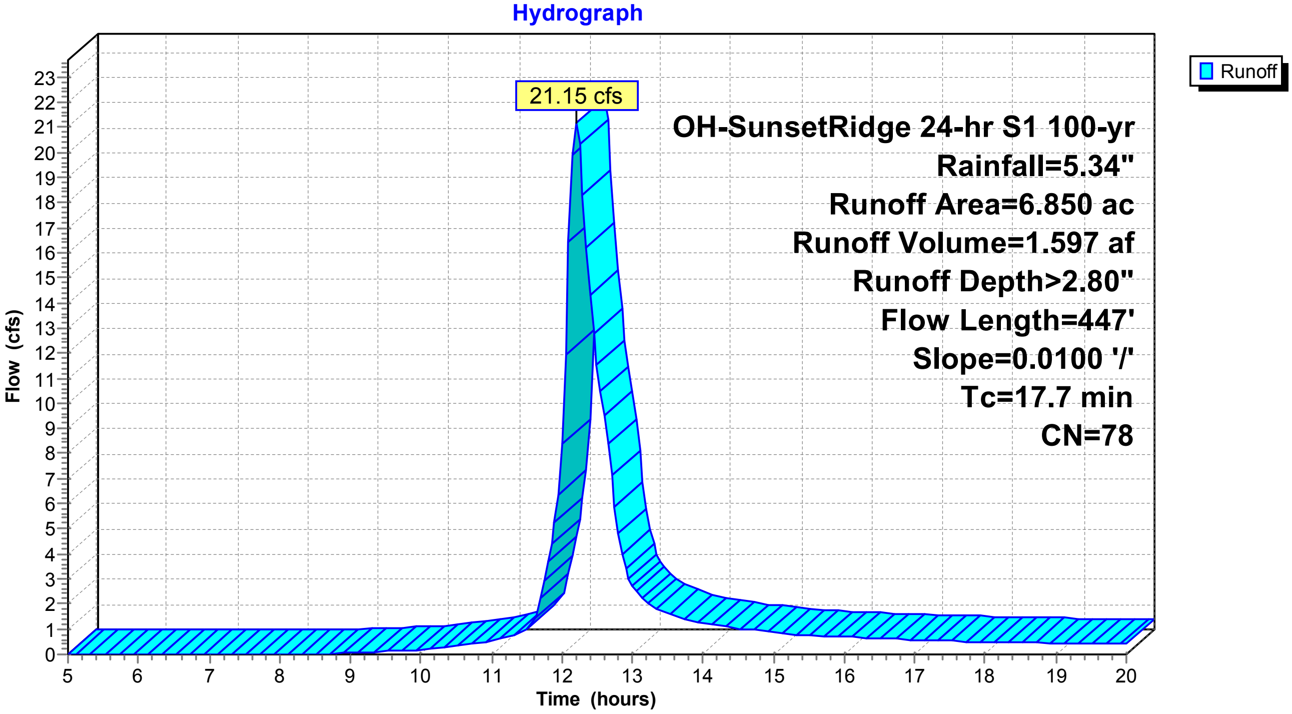
Runoff = 21.15 cfs @ 12.21 hrs, Volume= 1.597 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
6.800	78	Meadow, non-grazed, HSG D
0.050	96	Gravel surface, HSG D
6.850	78	Weighted Average
6.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
17.7	447	0.0100	0.42		**Lag/CN Method,**

Subcatchment 55S: DC-13



Summary for Subcatchment 56S: DC-14

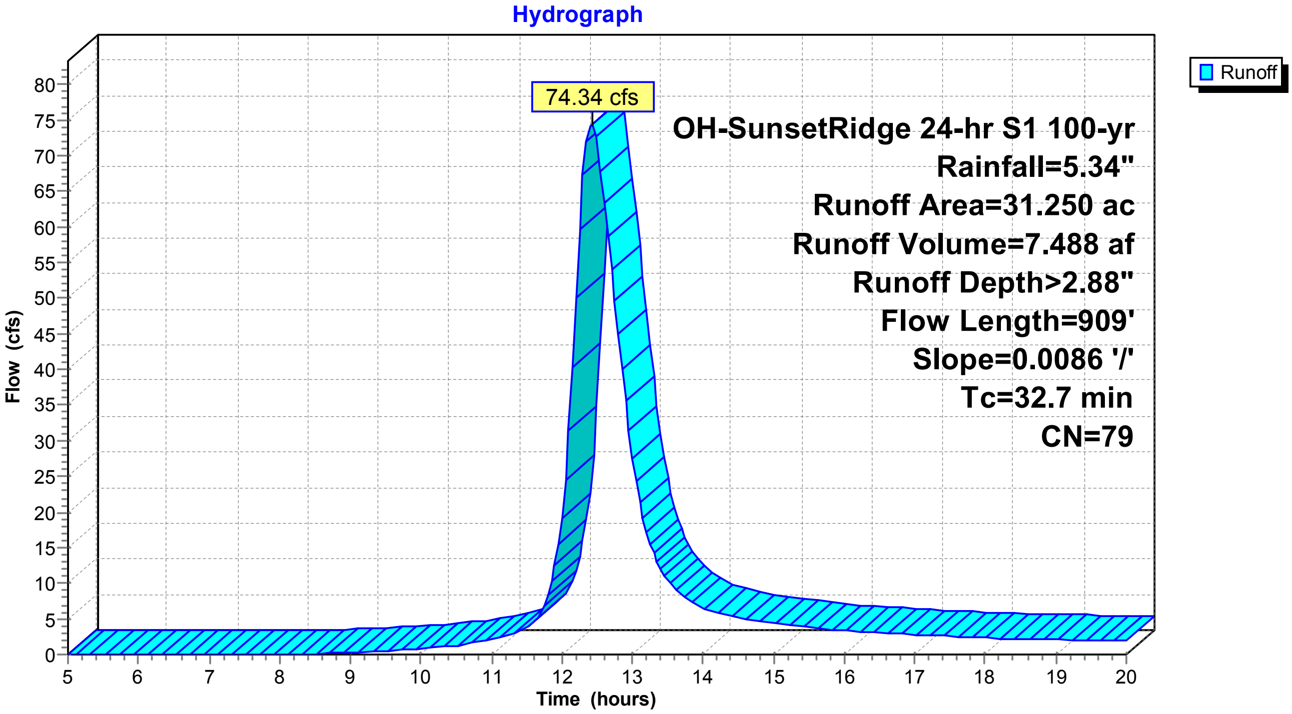
Runoff = 74.34 cfs @ 12.42 hrs, Volume= 7.488 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
30.020	78	Meadow, non-grazed, HSG D
1.220	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
31.250	79	Weighted Average
31.240		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
32.7	909	0.0086	0.46		**Lag/CN Method,**

Subcatchment 56S: DC-14



Summary for Subcatchment 57S: DC-15

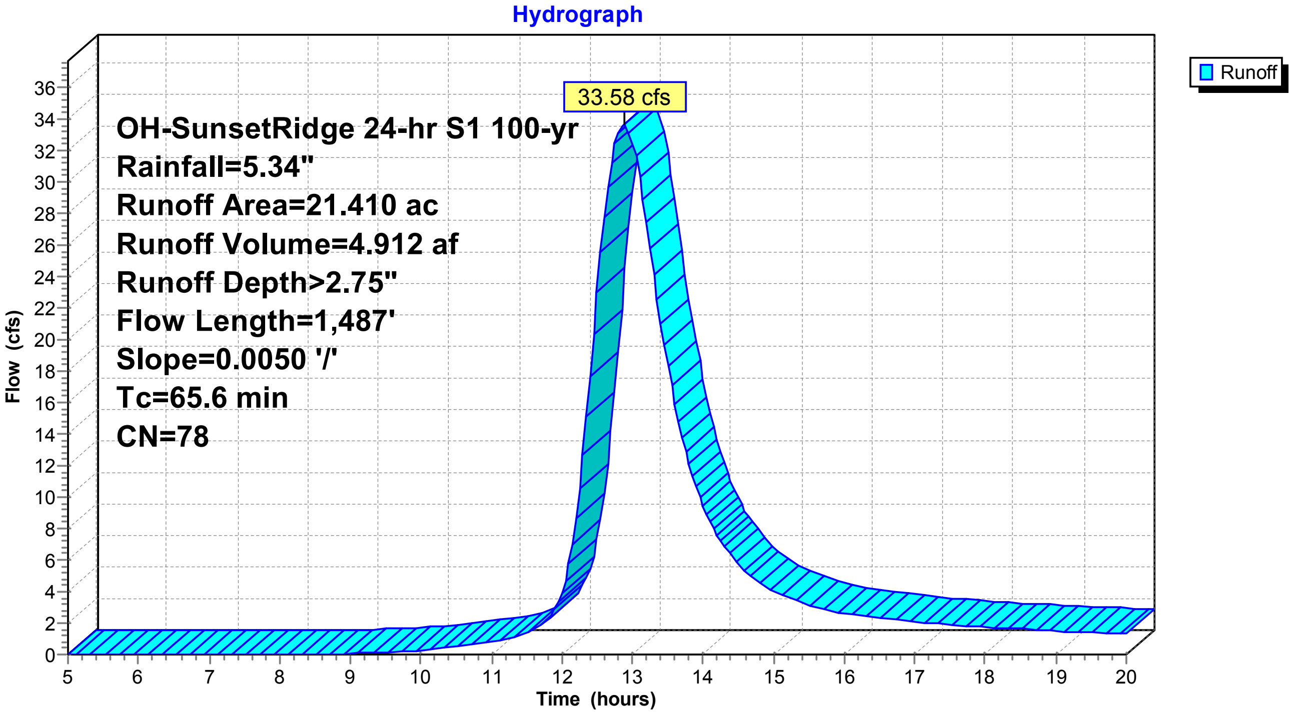
Runoff = 33.58 cfs @ 12.88 hrs, Volume= 4.912 af, Depth> 2.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
21.060	78	Meadow, non-grazed, HSG D
0.340	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
21.410	78	Weighted Average
21.400		99.95% Pervious Area
0.010		0.05% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
65.6	1,487	0.0050	0.38		**Lag/CN Method,**

Subcatchment 57S: DC-15



Summary for Subcatchment 58S: DC-16

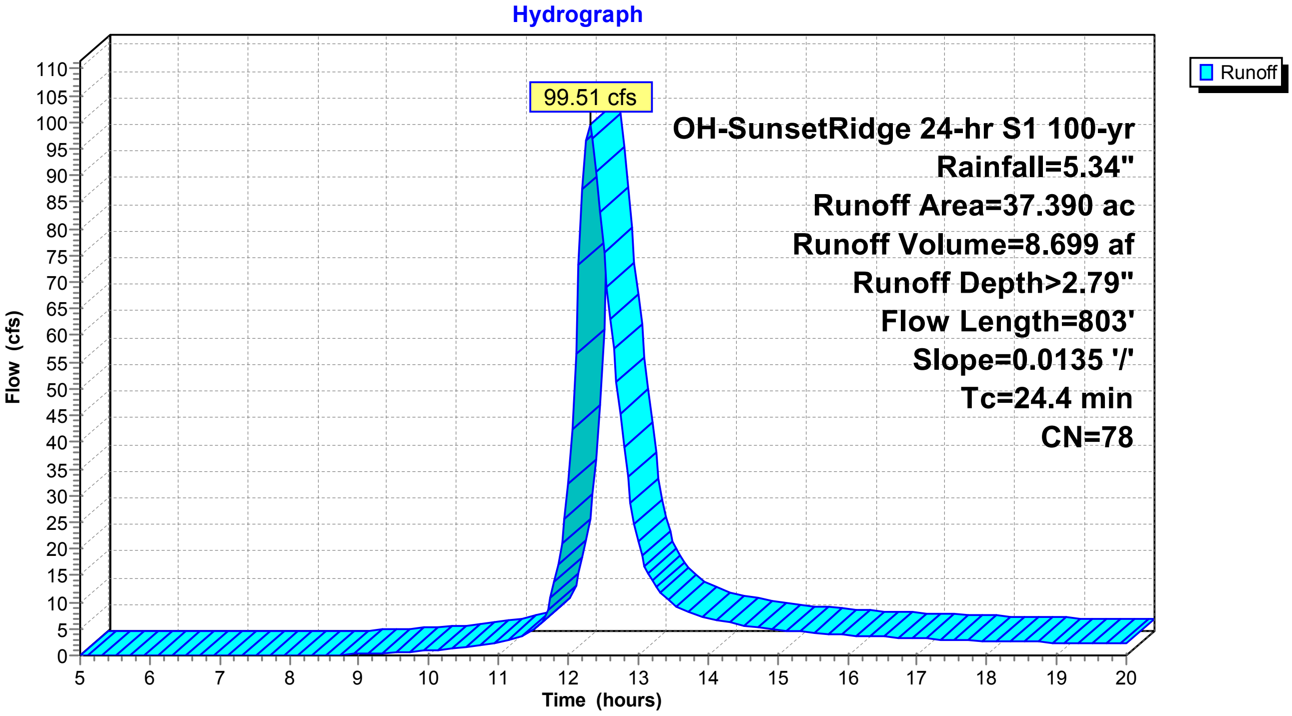
Runoff = 99.51 cfs @ 12.30 hrs, Volume= 8.699 af, Depth> 2.79"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
36.430	78	Meadow, non-grazed, HSG D
0.950	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
37.390	78	Weighted Average
37.380		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
24.4	803	0.0135	0.55		**Lag/CN Method,**

Subcatchment 58S: DC-16



Summary for Subcatchment 59S: DC-17

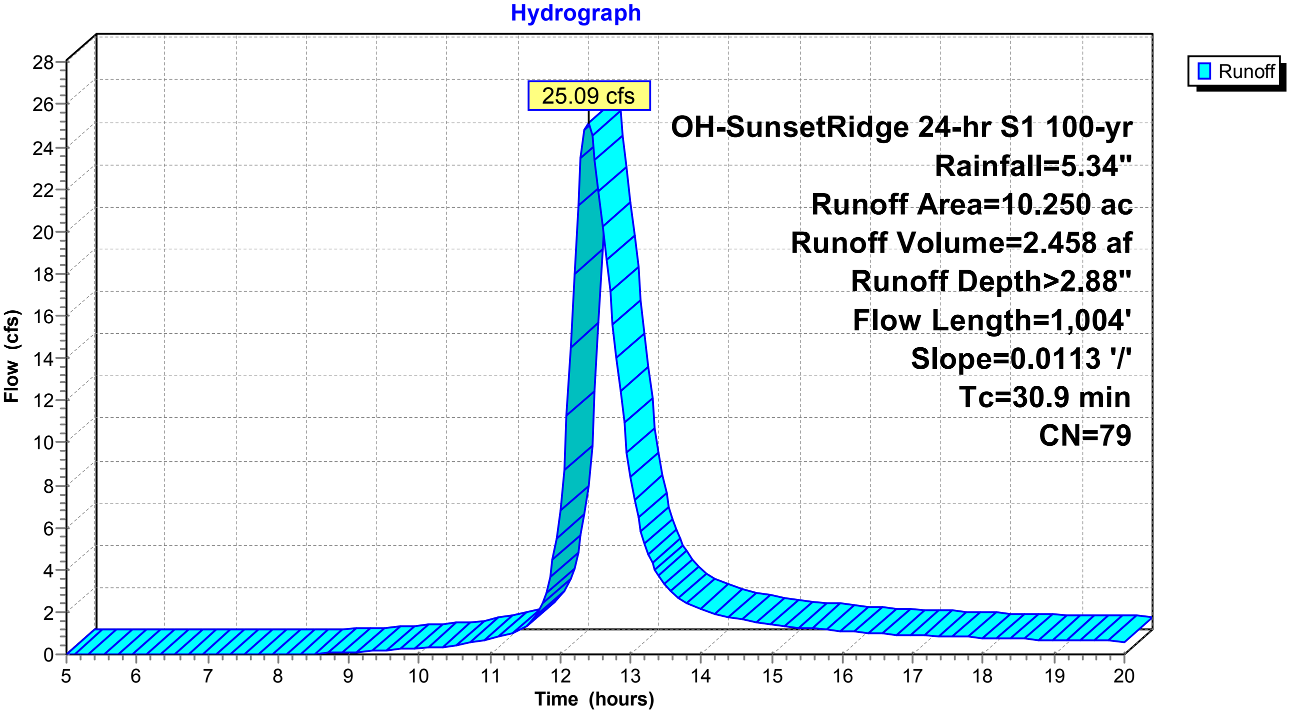
Runoff = 25.09 cfs @ 12.39 hrs, Volume= 2.458 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
9.880	78	Meadow, non-grazed, HSG D
0.370	96	Gravel surface, HSG D
10.250	79	Weighted Average
10.250		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
30.9	1,004	0.0113	0.54		**Lag/CN Method,**

Subcatchment 59S: DC-17



Summary for Subcatchment 60S: DC-18

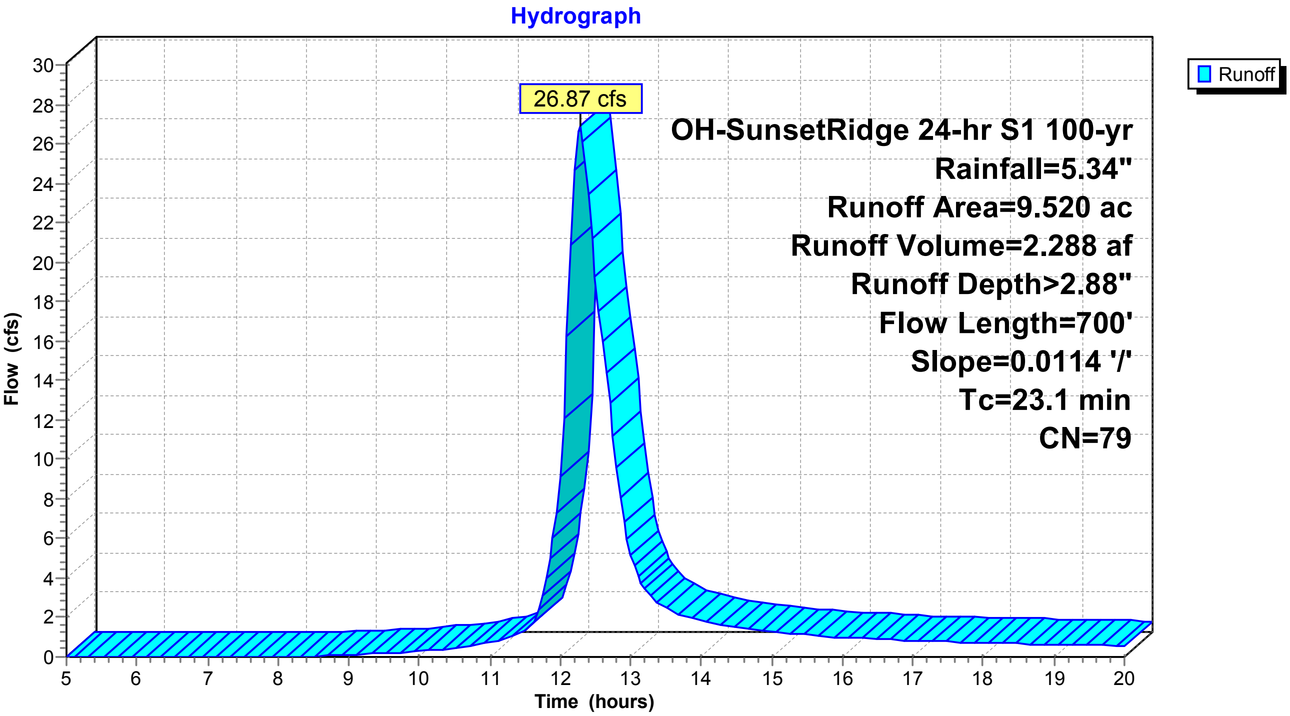
Runoff = 26.87 cfs @ 12.28 hrs, Volume= 2.288 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
8.980	78	Meadow, non-grazed, HSG D
0.540	96	Gravel surface, HSG D
9.520	79	Weighted Average
9.520		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
23.1	700	0.0114	0.51		**Lag/CN Method,**

Subcatchment 60S: DC-18



Summary for Subcatchment 61S: DC-19

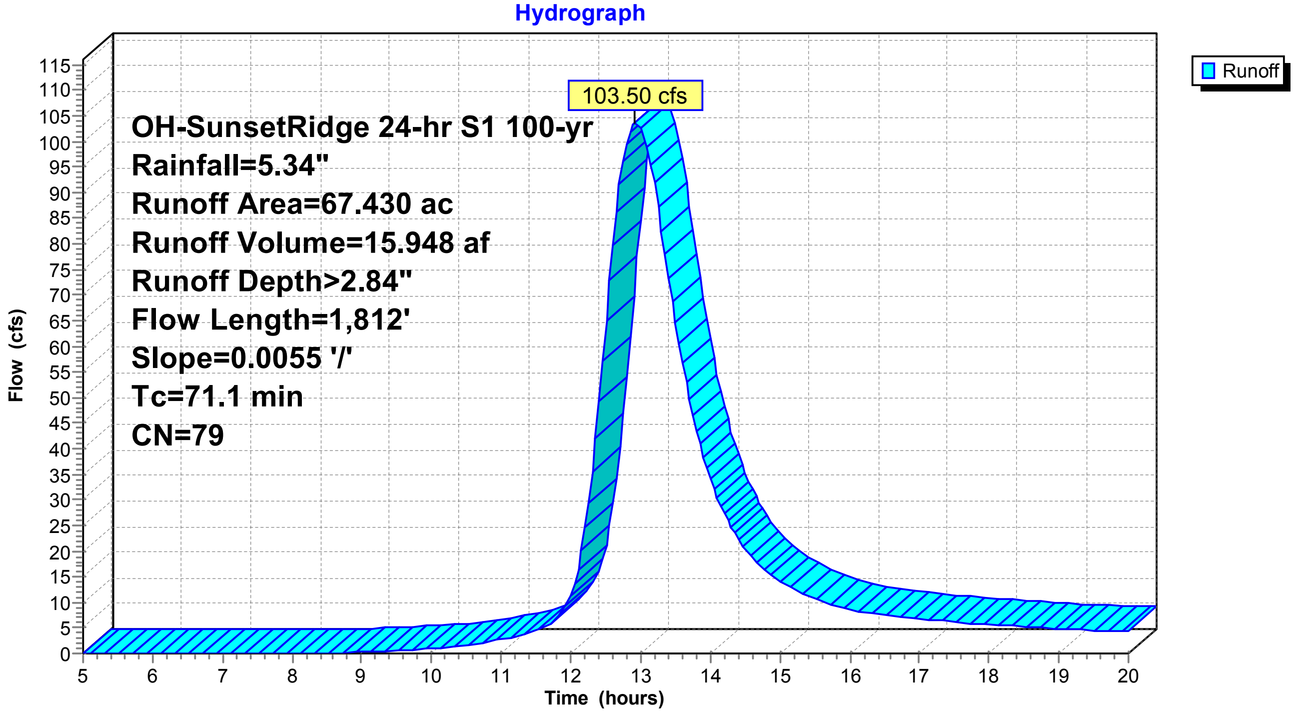
Runoff = 103.50 cfs @ 12.93 hrs, Volume= 15.948 af, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
65.130	78	Meadow, non-grazed, HSG D
2.280	96	Gravel surface, HSG D
0.020	98	Unconnected pavement, HSG D
67.430	79	Weighted Average
67.410		99.97% Pervious Area
0.020		0.03% Impervious Area
0.020		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
71.1	1,812	0.0055	0.42		**Lag/CN Method,**

Subcatchment 61S: DC-19



Summary for Subcatchment 62S: DC-20

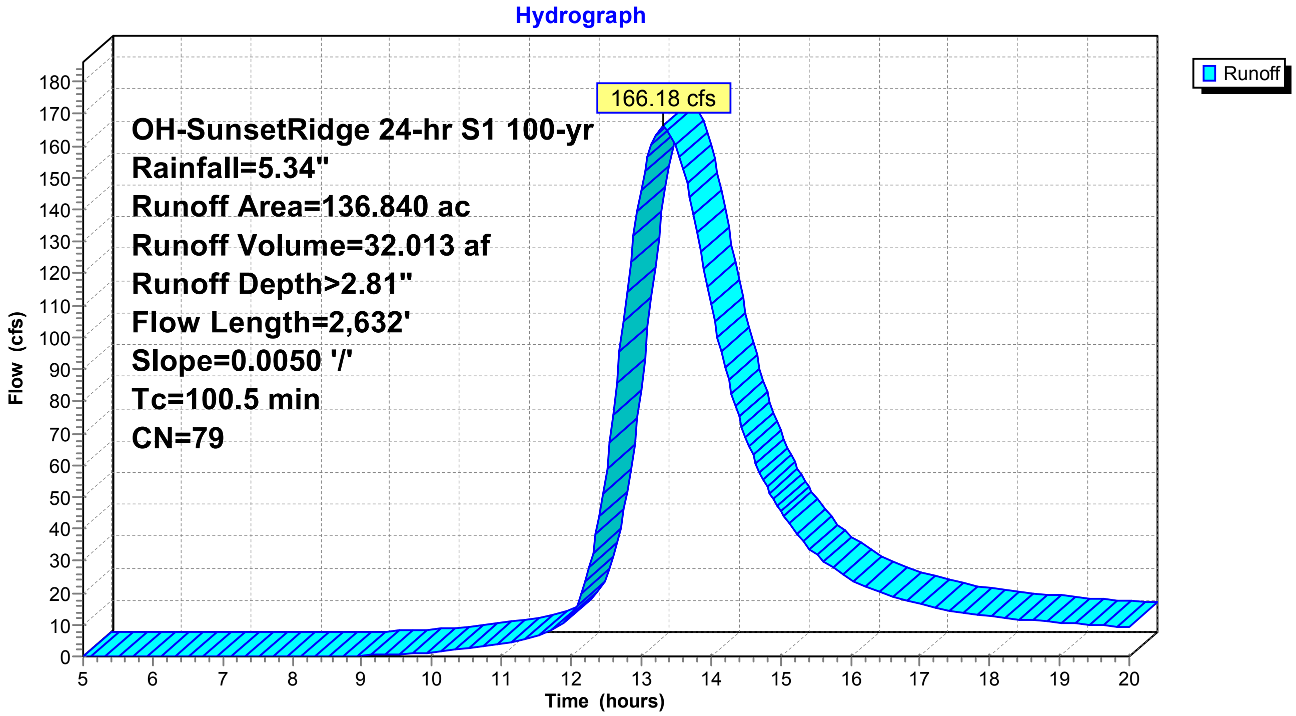
Runoff = 166.18 cfs @ 13.30 hrs, Volume= 32.013 af, Depth> 2.81"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
131.500	78	Meadow, non-grazed, HSG D
5.290	96	Gravel surface, HSG D
0.050	98	Unconnected pavement, HSG D
136.840	79	Weighted Average
136.790		99.96% Pervious Area
0.050		0.04% Impervious Area
0.050		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
100.5	2,632	0.0050	0.44		**Lag/CN Method,**

Subcatchment 62S: DC-20



Summary for Subcatchment 63S: DC-21

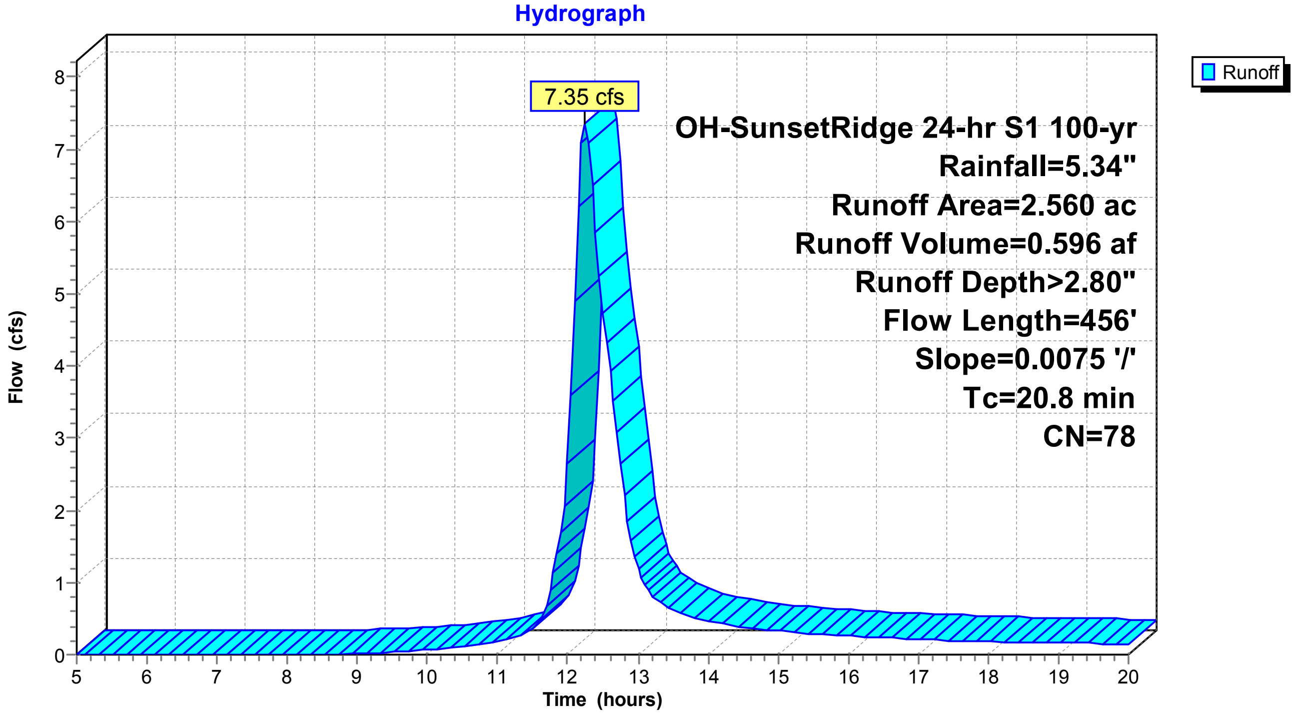
Runoff = 7.35 cfs @ 12.25 hrs, Volume= 0.596 af, Depth> 2.80"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
2.560	78	Meadow, non-grazed, HSG D
2.560		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.8	456	0.0075	0.37		**Lag/CN Method,**

Subcatchment 63S: DC-21



Summary for Subcatchment 64S: DC-22

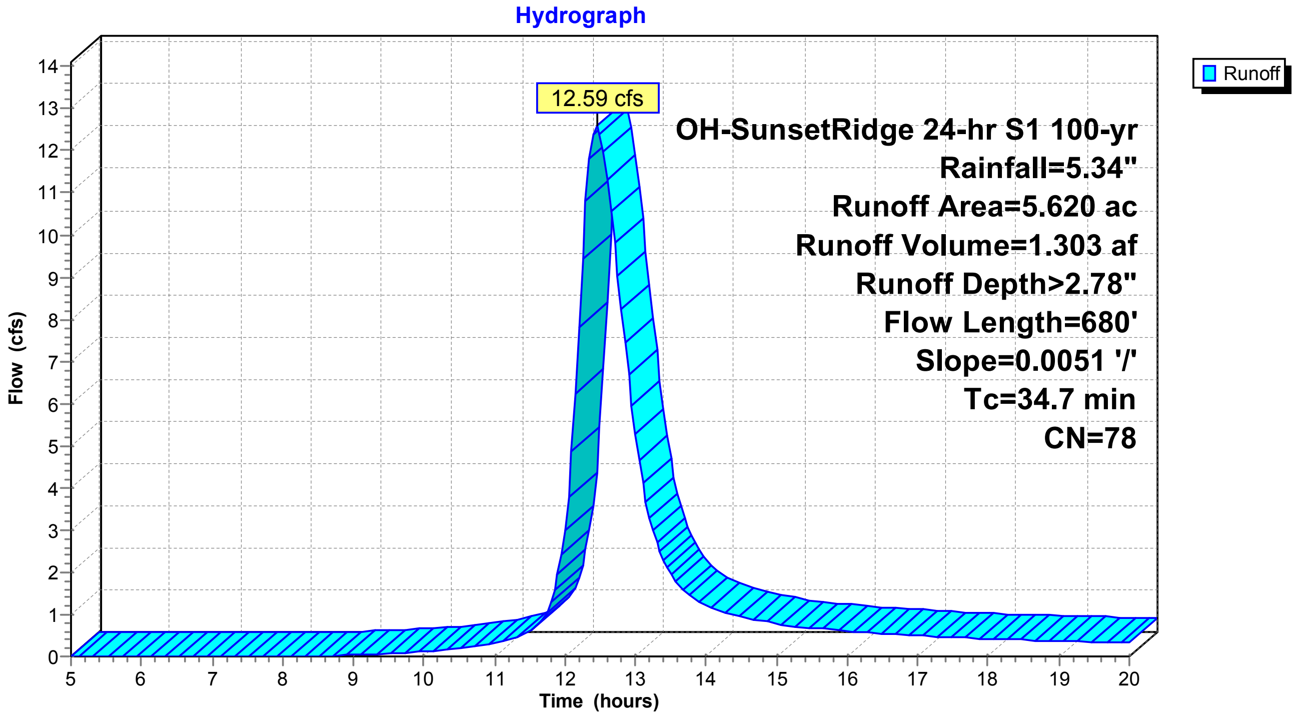
Runoff = 12.59 cfs @ 12.45 hrs, Volume= 1.303 af, Depth> 2.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.480	78	Meadow, non-grazed, HSG D
0.130	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
5.620	78	Weighted Average
5.610		99.82% Pervious Area
0.010		0.18% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.7	680	0.0051	0.33		**Lag/CN Method,**

Subcatchment 64S: DC-22



Summary for Subcatchment 65S: DC-23

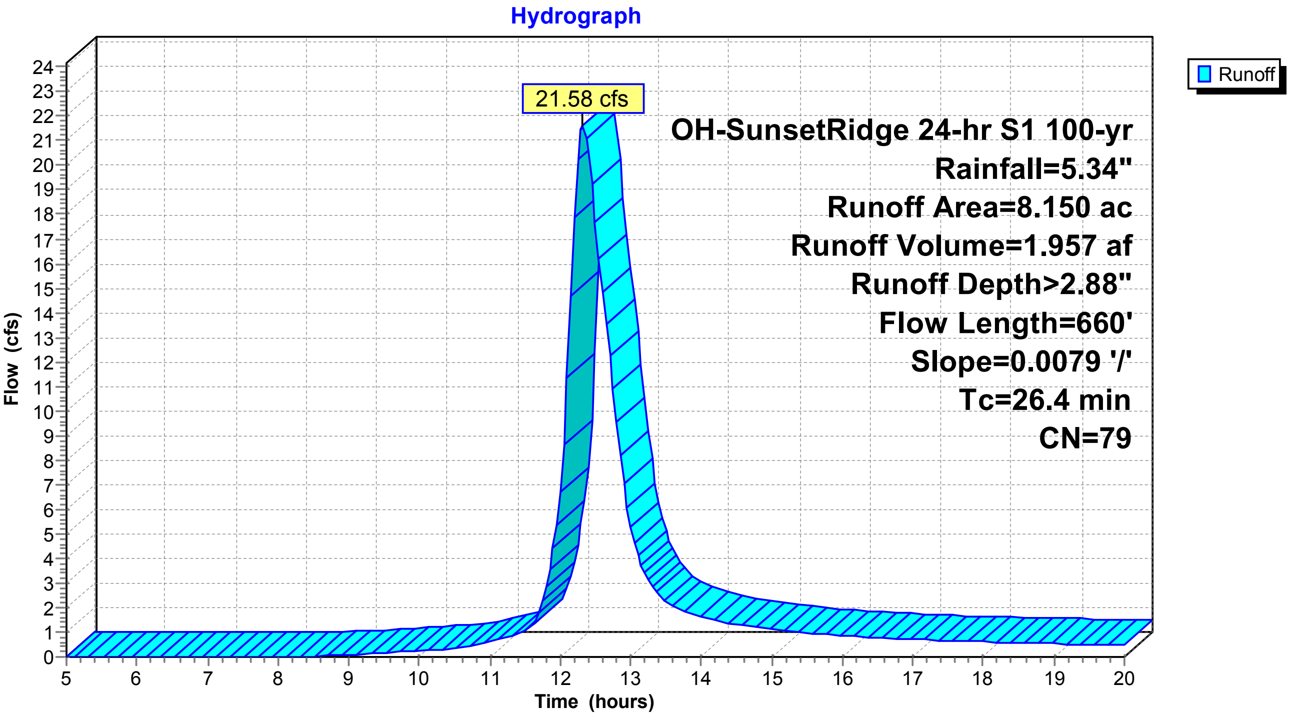
Runoff = 21.58 cfs @ 12.33 hrs, Volume= 1.957 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
7.520	78	Meadow, non-grazed, HSG D
0.630	96	Gravel surface, HSG D
8.150	79	Weighted Average
8.150		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.4	660	0.0079	0.42		**Lag/CN Method,**

Subcatchment 65S: DC-23



Summary for Subcatchment 66S: DC-24

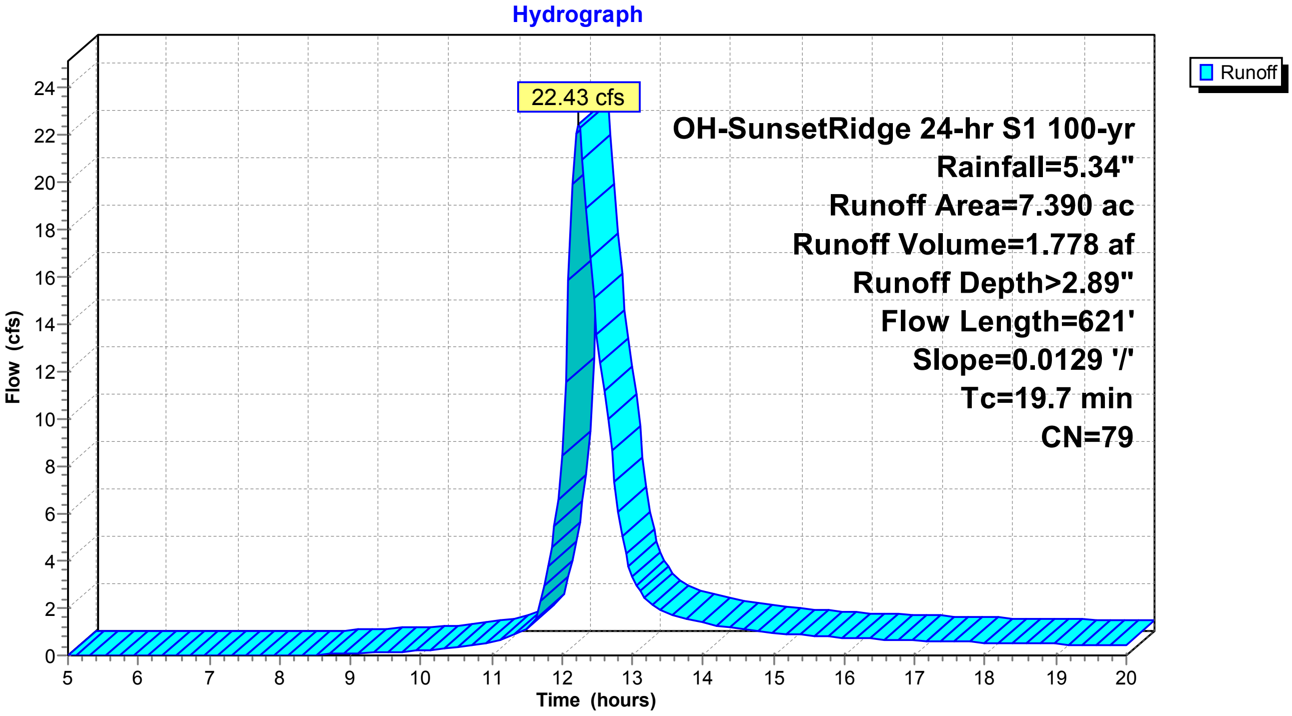
Runoff = 22.43 cfs @ 12.23 hrs, Volume= 1.778 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
7.060	78	Meadow, non-grazed, HSG D
0.320	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
7.390	79	Weighted Average
7.380		99.86% Pervious Area
0.010		0.14% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
19.7	621	0.0129	0.53		**Lag/CN Method,**

Subcatchment 66S: DC-24



Summary for Subcatchment 67S: DC-25

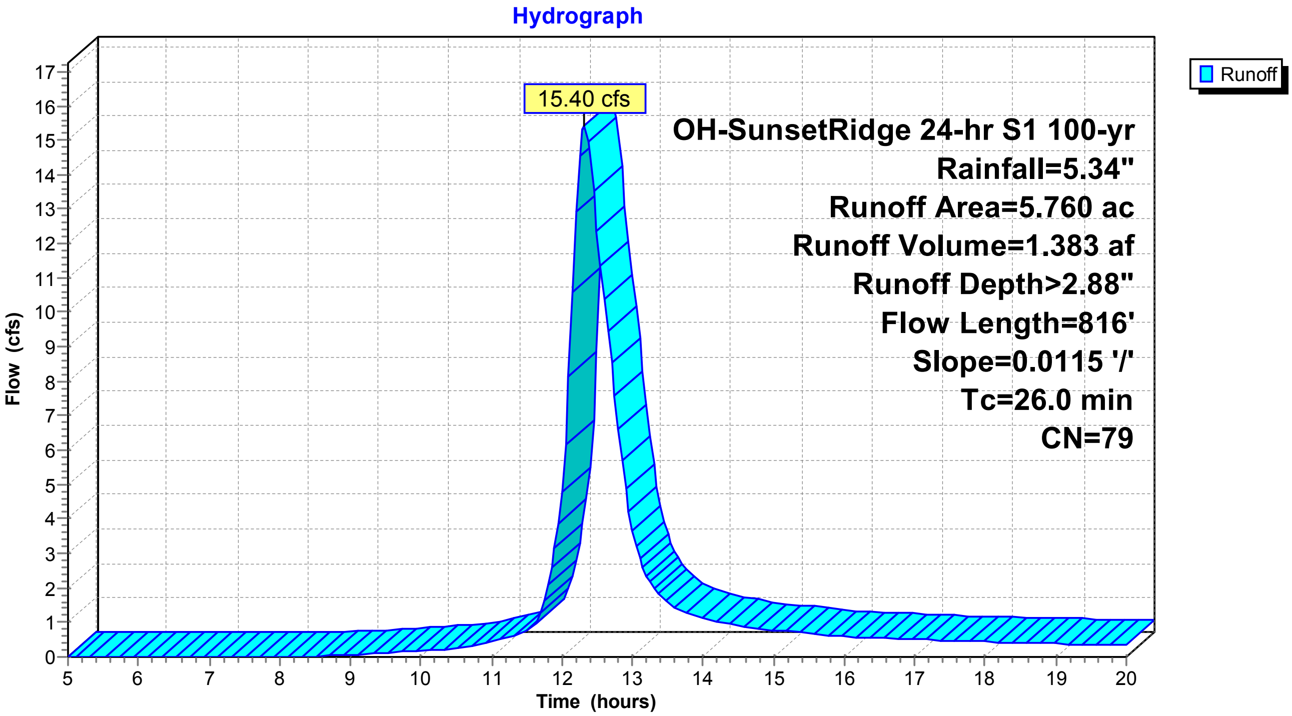
Runoff = 15.40 cfs @ 12.32 hrs, Volume= 1.383 af, Depth> 2.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.430	78	Meadow, non-grazed, HSG D
0.330	96	Gravel surface, HSG D
5.760	79	Weighted Average
5.760		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.0	816	0.0115	0.52		**Lag/CN Method,**

Subcatchment 67S: DC-25



Summary for Subcatchment 68S: DC-26

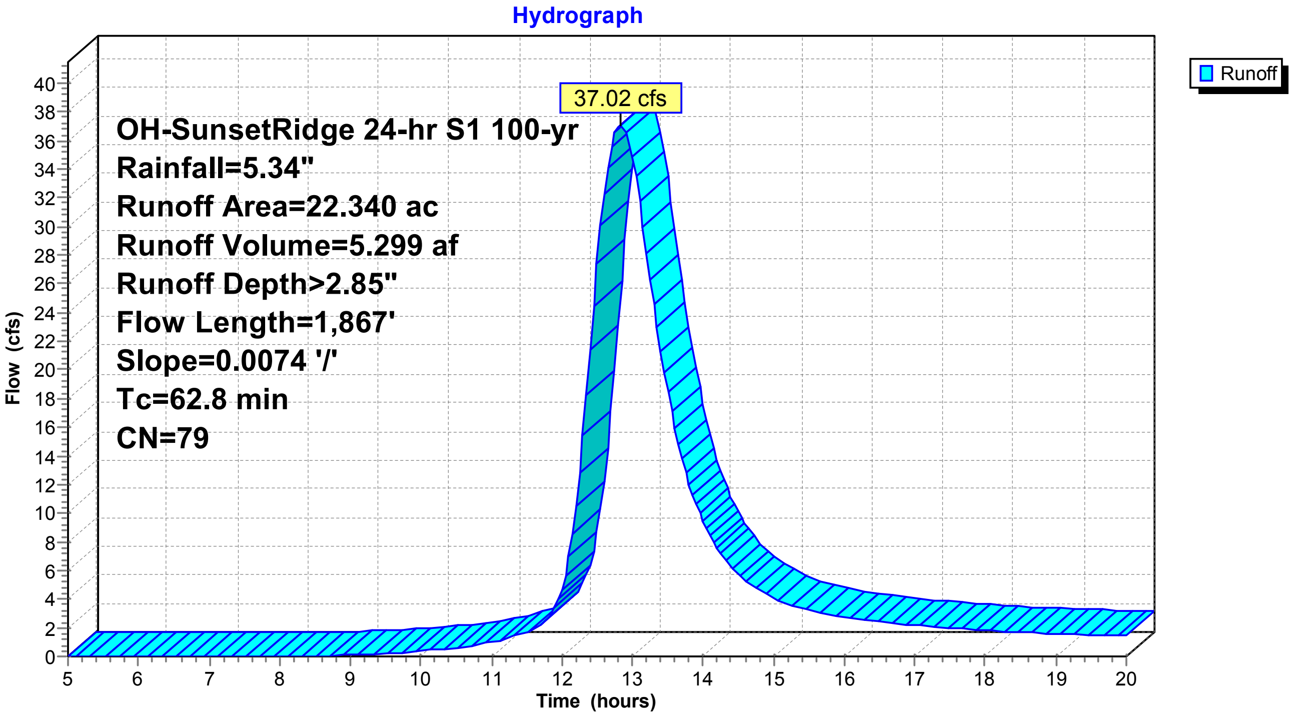
Runoff = 37.02 cfs @ 12.83 hrs, Volume= 5.299 af, Depth> 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
21.620	78	Meadow, non-grazed, HSG D
0.710	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
22.340	79	Weighted Average
22.330		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.8	1,867	0.0074	0.50		**Lag/CN Method,**

Subcatchment 68S: DC-26



Summary for Subcatchment 69S: DC-27

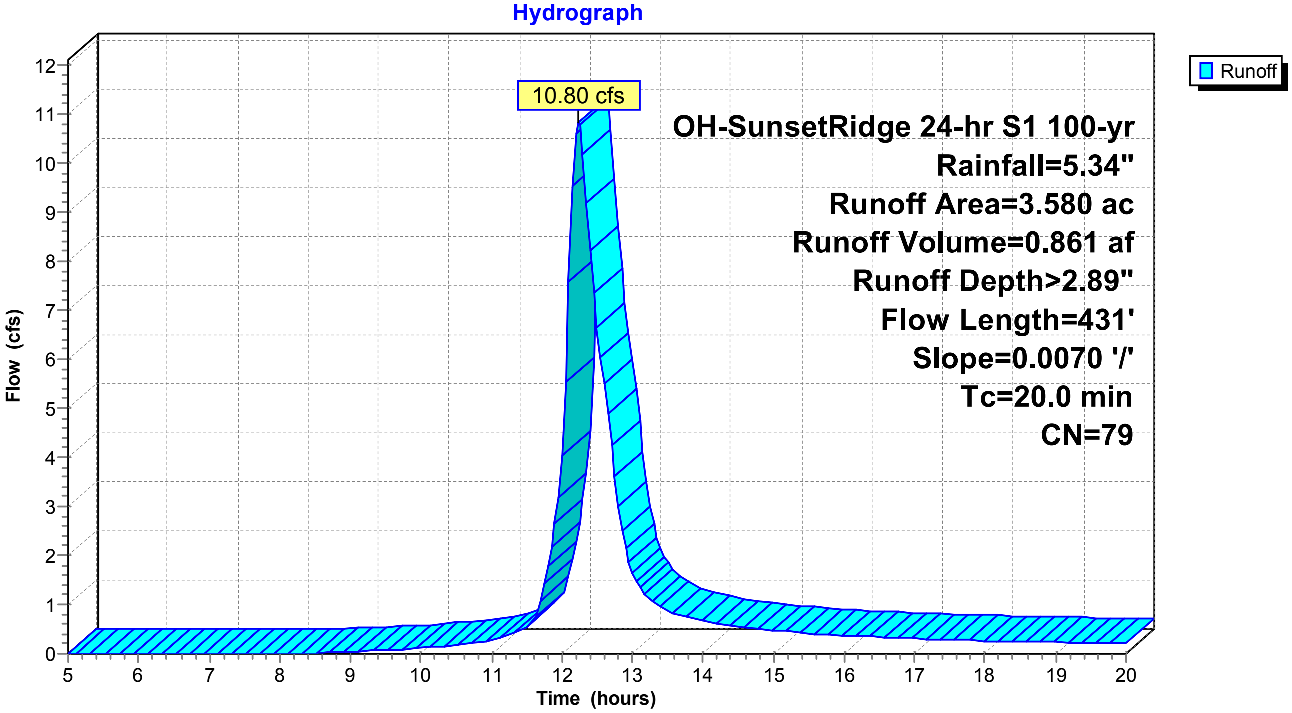
Runoff = 10.80 cfs @ 12.24 hrs, Volume= 0.861 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
3.420	78	Meadow, non-grazed, HSG D
0.160	96	Gravel surface, HSG D
3.580	79	Weighted Average
3.580		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.0	431	0.0070	0.36		**Lag/CN Method,**

Subcatchment 69S: DC-27



Summary for Subcatchment 70S: DC-28

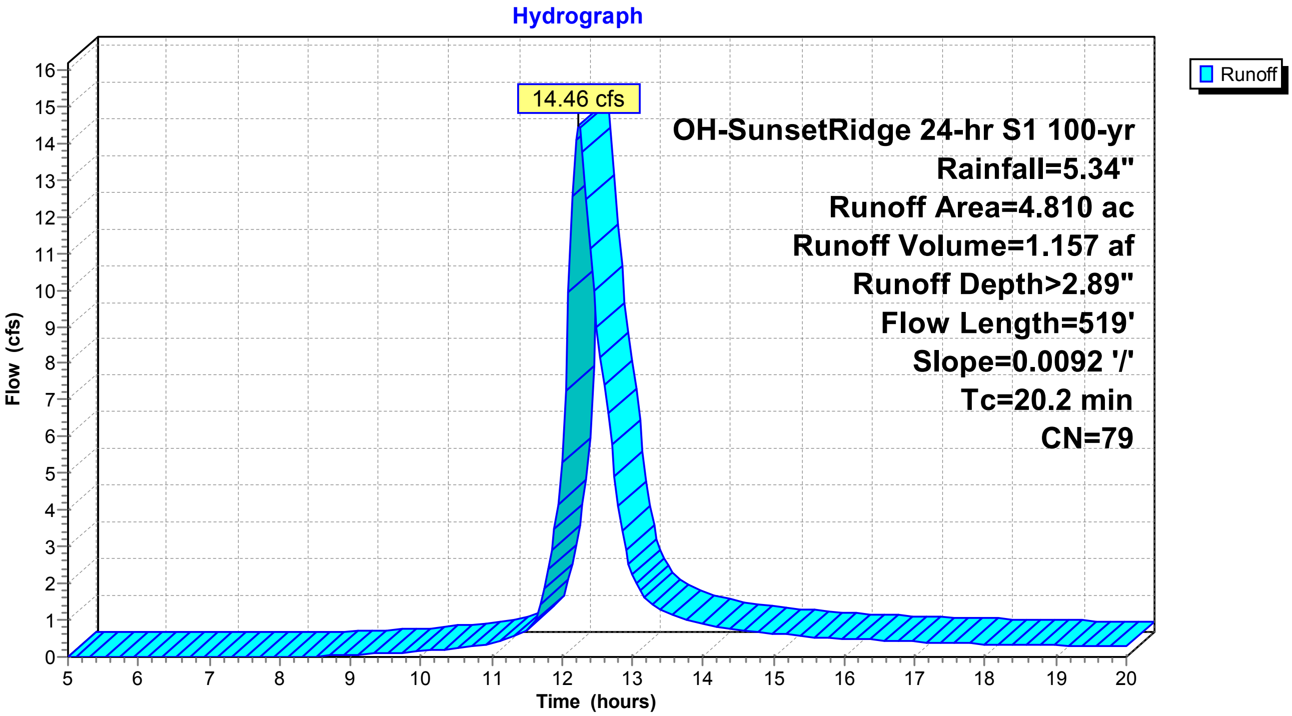
Runoff = 14.46 cfs @ 12.24 hrs, Volume= 1.157 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
4.520	78	Meadow, non-grazed, HSG D
0.290	96	Gravel surface, HSG D
4.810	79	Weighted Average
4.810		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.2	519	0.0092	0.43		**Lag/CN Method,**

Subcatchment 70S: DC-28



Summary for Subcatchment 71S: DC-29

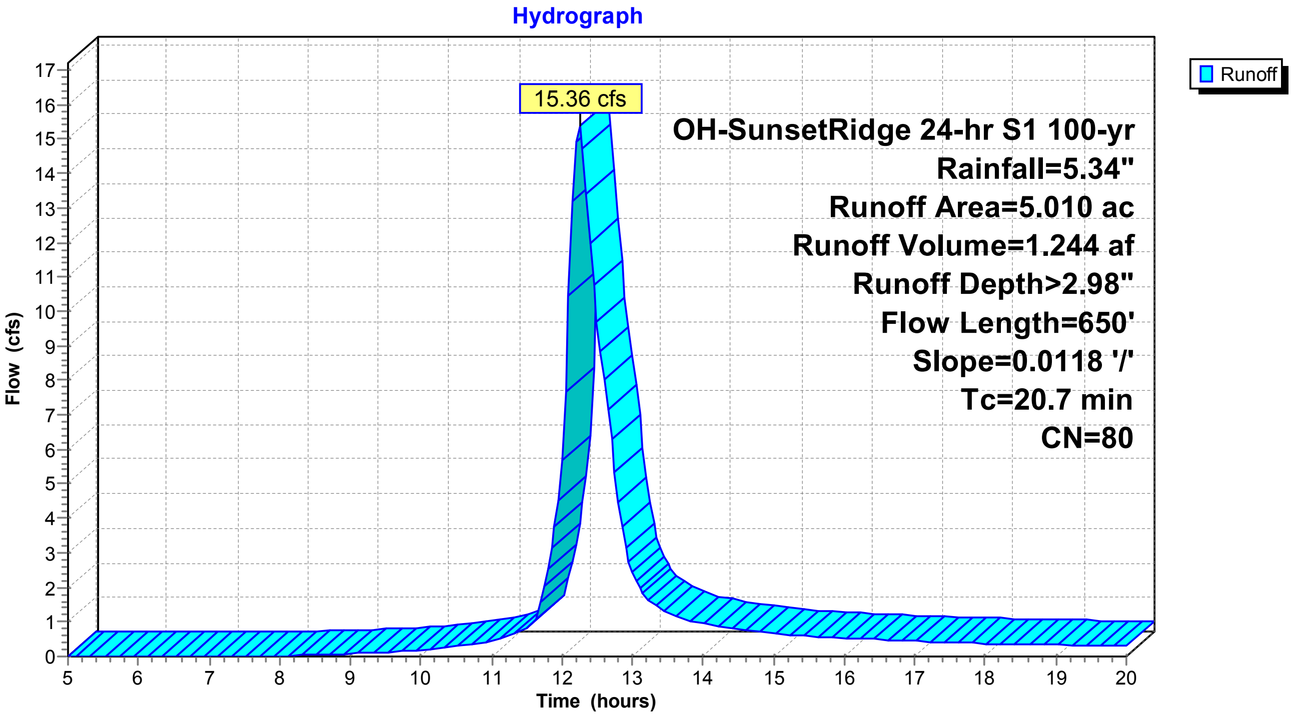
Runoff = 15.36 cfs @ 12.25 hrs, Volume= 1.244 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
4.320	78	Meadow, non-grazed, HSG D
0.690	96	Gravel surface, HSG D
5.010	80	Weighted Average
5.010		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.7	650	0.0118	0.52		**Lag/CN Method,**

Subcatchment 71S: DC-29



Summary for Subcatchment 72S: DC-30

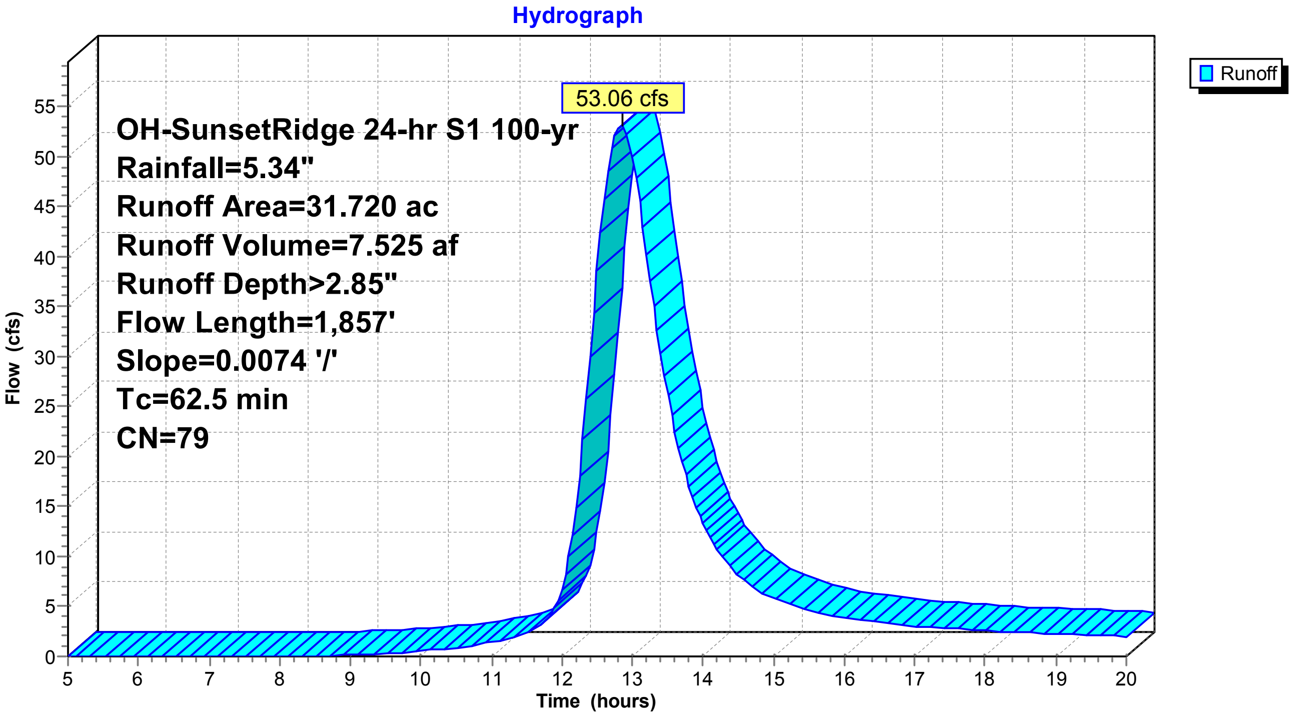
Runoff = 53.06 cfs @ 12.84 hrs, Volume= 7.525 af, Depth> 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
30.590	78	Meadow, non-grazed, HSG D
1.120	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
31.720	79	Weighted Average
31.710		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
62.5	1,857	0.0074	0.50		**Lag/CN Method,**

Subcatchment 72S: DC-30



Summary for Subcatchment 73S: DC-31

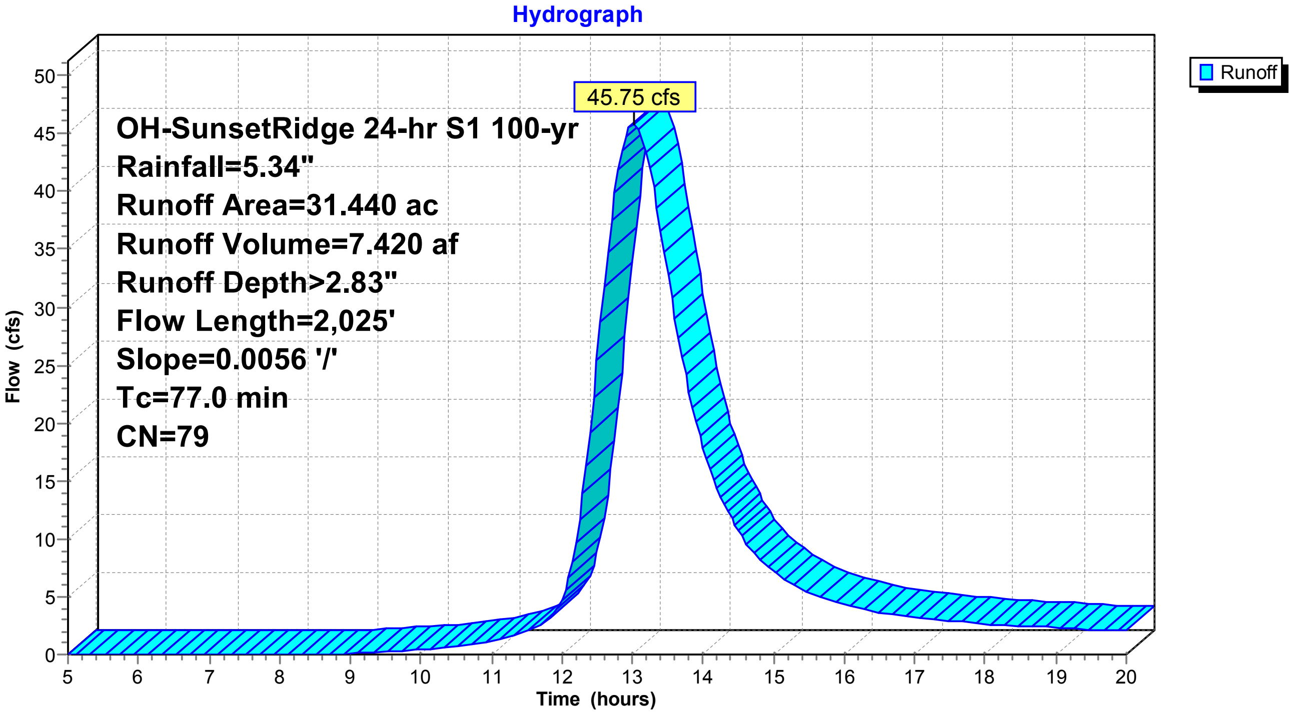
Runoff = 45.75 cfs @ 13.02 hrs, Volume= 7.420 af, Depth> 2.83"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
30.110	78	Meadow, non-grazed, HSG D
1.320	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
31.440	79	Weighted Average
31.430		99.97% Pervious Area
0.010		0.03% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.0	2,025	0.0056	0.44		**Lag/CN Method,**

Subcatchment 73S: DC-31



Summary for Subcatchment 74S: DC-32

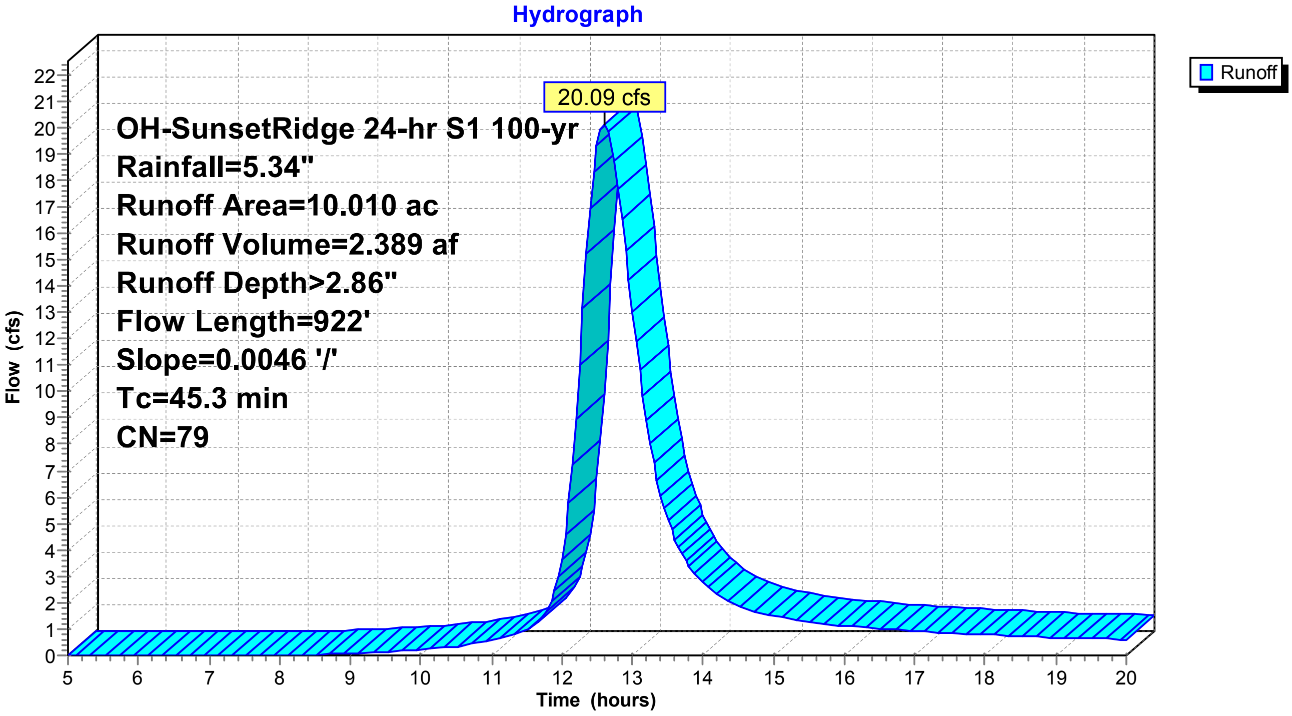
Runoff = 20.09 cfs @ 12.60 hrs, Volume= 2.389 af, Depth> 2.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
9.370	78	Meadow, non-grazed, HSG D
0.630	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
10.010	79	Weighted Average
10.000		99.90% Pervious Area
0.010		0.10% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
45.3	922	0.0046	0.34		**Lag/CN Method,**

Subcatchment 74S: DC-32



Summary for Subcatchment 75S: DC-33

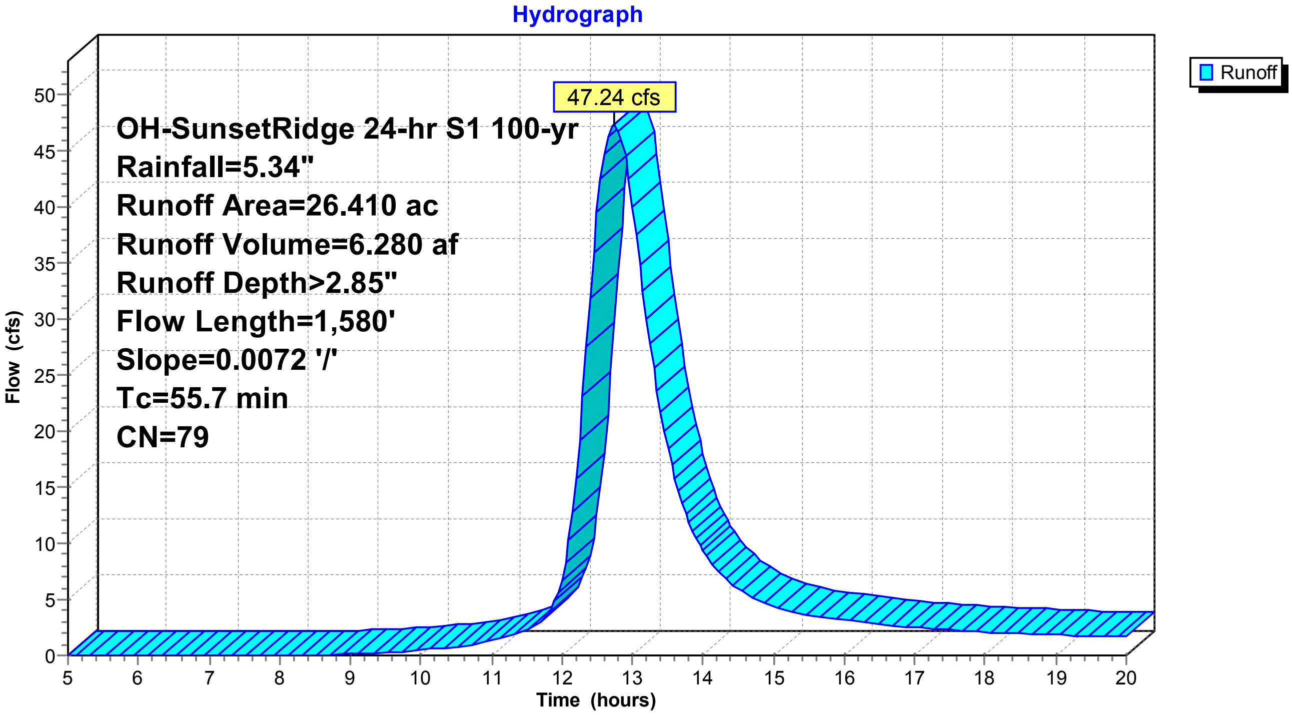
Runoff = 47.24 cfs @ 12.73 hrs, Volume= 6.280 af, Depth> 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
25.550	78	Meadow, non-grazed, HSG D
0.850	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
26.410	79	Weighted Average
26.400		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
55.7	1,580	0.0072	0.47		**Lag/CN Method,**

Subcatchment 75S: DC-33



Summary for Subcatchment 76S: DC-34

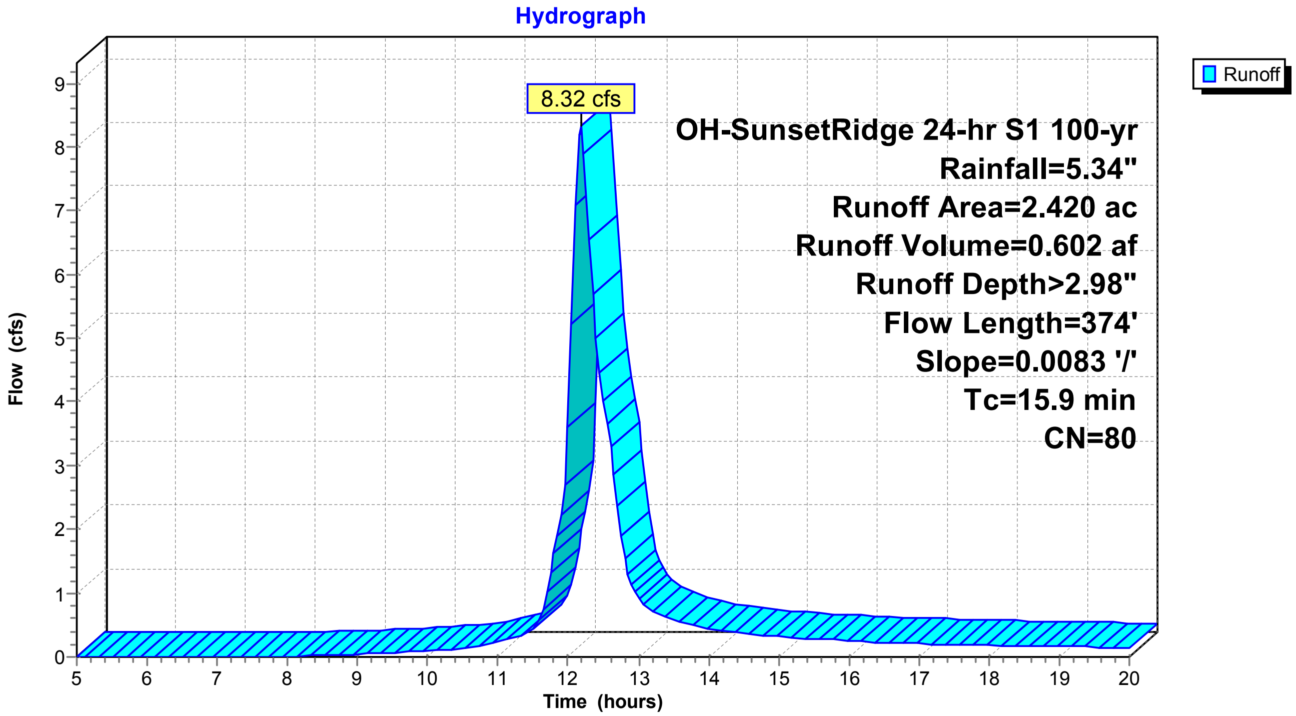
Runoff = 8.32 cfs @ 12.18 hrs, Volume= 0.602 af, Depth> 2.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
2.110	78	Meadow, non-grazed, HSG D
0.310	96	Gravel surface, HSG D
2.420	80	Weighted Average
2.420		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.9	374	0.0083	0.39		**Lag/CN Method,**

Subcatchment 76S: DC-34



Summary for Subcatchment 77S: DC-35

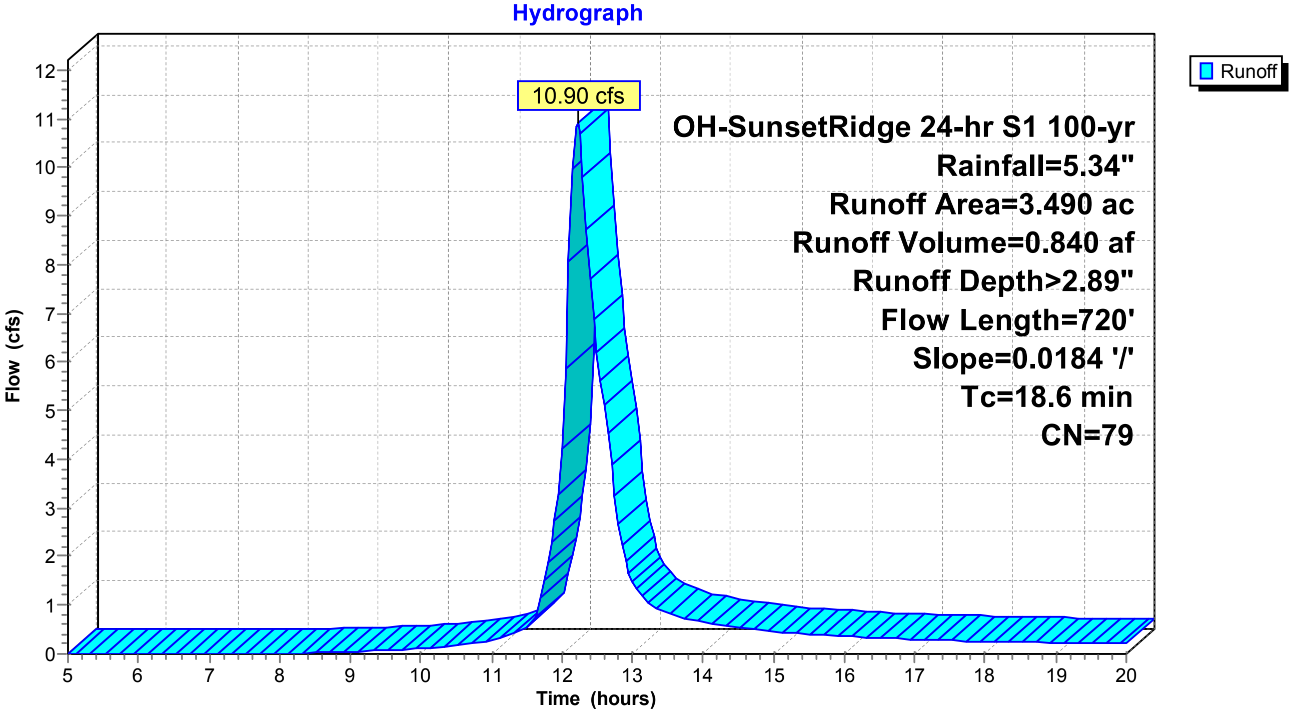
Runoff = 10.90 cfs @ 12.22 hrs, Volume= 0.840 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
3.260	78	Meadow, non-grazed, HSG D
0.230	96	Gravel surface, HSG D
3.490	79	Weighted Average
3.490		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
18.6	720	0.0184	0.65		**Lag/CN Method,**

Subcatchment 77S: DC-35



Summary for Subcatchment 78S: DC-36

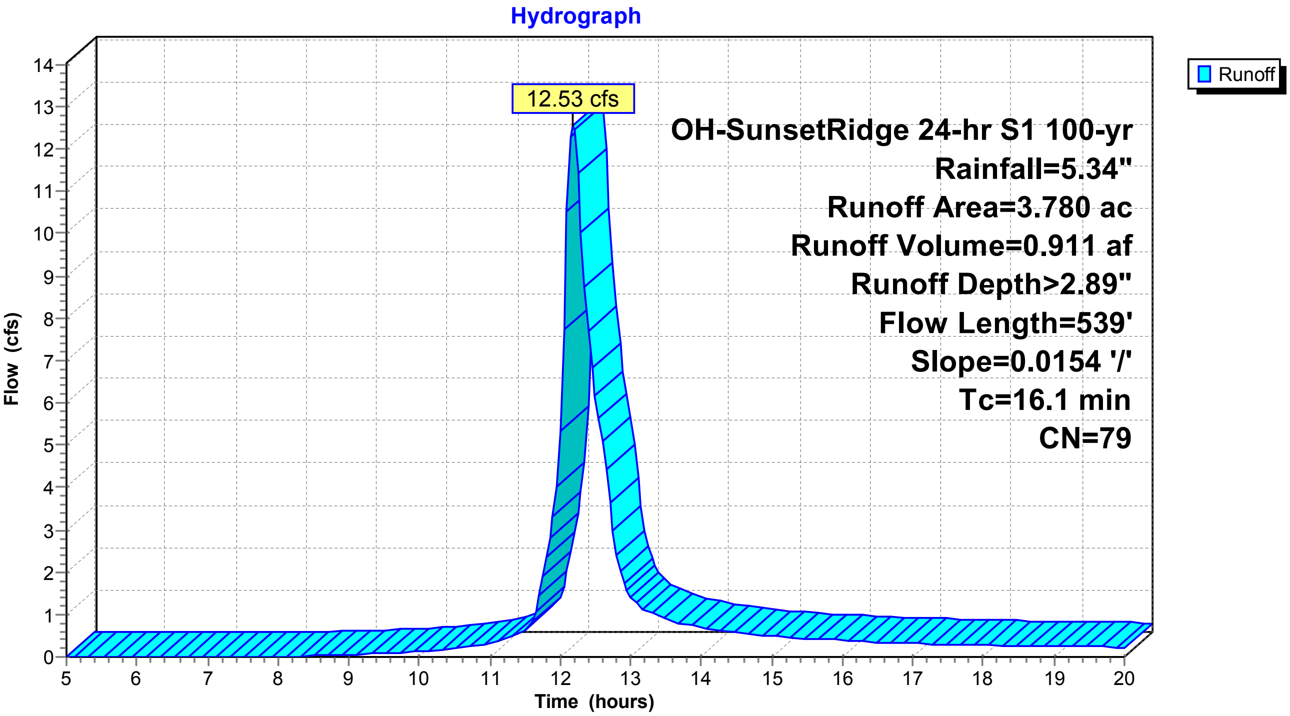
Runoff = 12.53 cfs @ 12.18 hrs, Volume= 0.911 af, Depth> 2.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
3.580	78	Meadow, non-grazed, HSG D
0.200	96	Gravel surface, HSG D
3.780	79	Weighted Average
3.780		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	539	0.0154	0.56		**Lag/CN Method,**

Subcatchment 78S: DC-36



Summary for Subcatchment 79S: DC-37

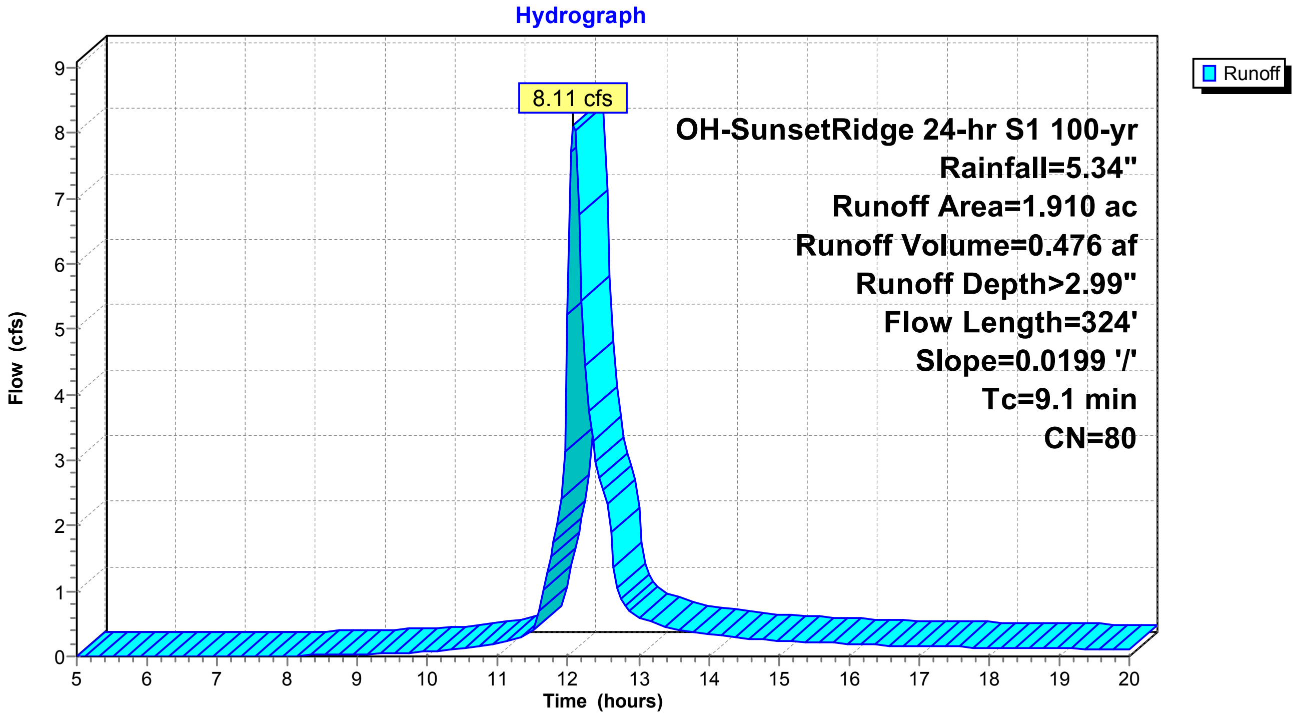
Runoff = 8.11 cfs @ 12.08 hrs, Volume= 0.476 af, Depth> 2.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
1.720	78	Meadow, non-grazed, HSG D
0.180	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
1.910	80	Weighted Average
1.900		99.48% Pervious Area
0.010		0.52% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.1	324	0.0199	0.59		**Lag/CN Method,**

Subcatchment 79S: DC-37



Summary for Subcatchment 80S: DC-38

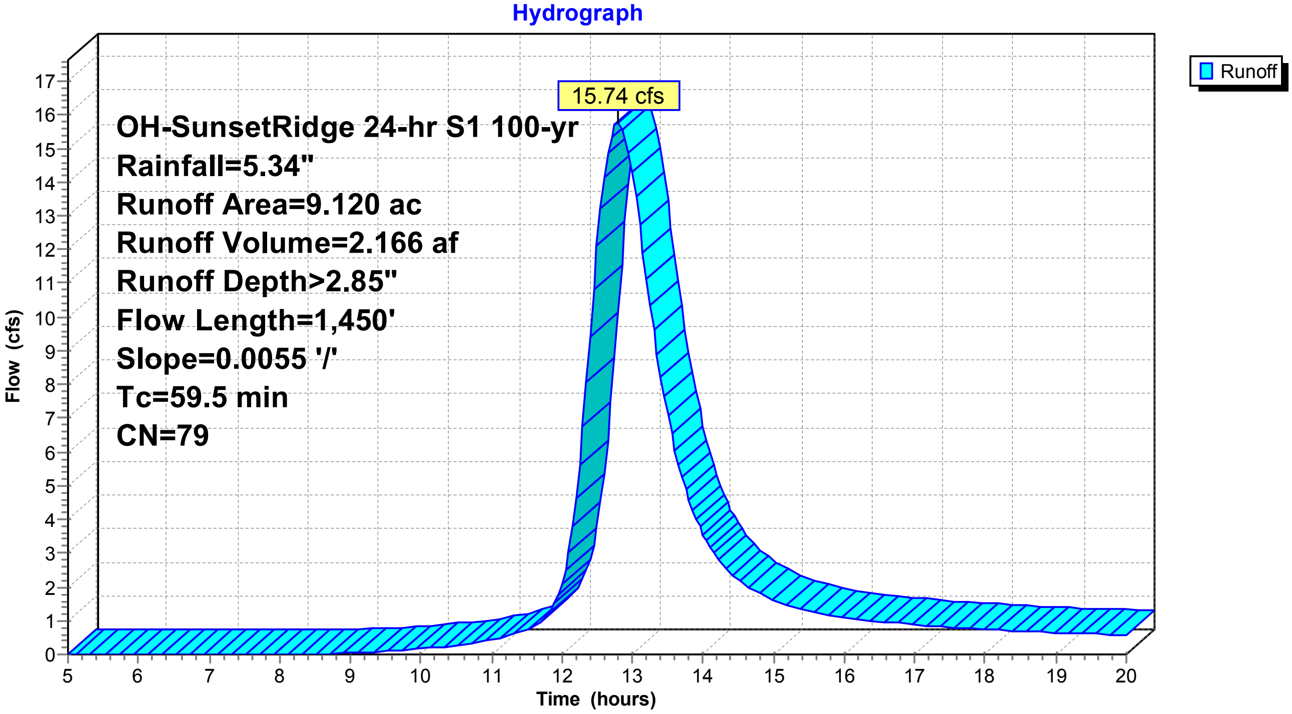
Runoff = 15.74 cfs @ 12.79 hrs, Volume= 2.166 af, Depth> 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
8.500	78	Meadow, non-grazed, HSG D
0.620	96	Gravel surface, HSG D
9.120	79	Weighted Average
9.120		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
59.5	1,450	0.0055	0.41		**Lag/CN Method,**

Subcatchment 80S: DC-38



Summary for Subcatchment 81S: DC-39

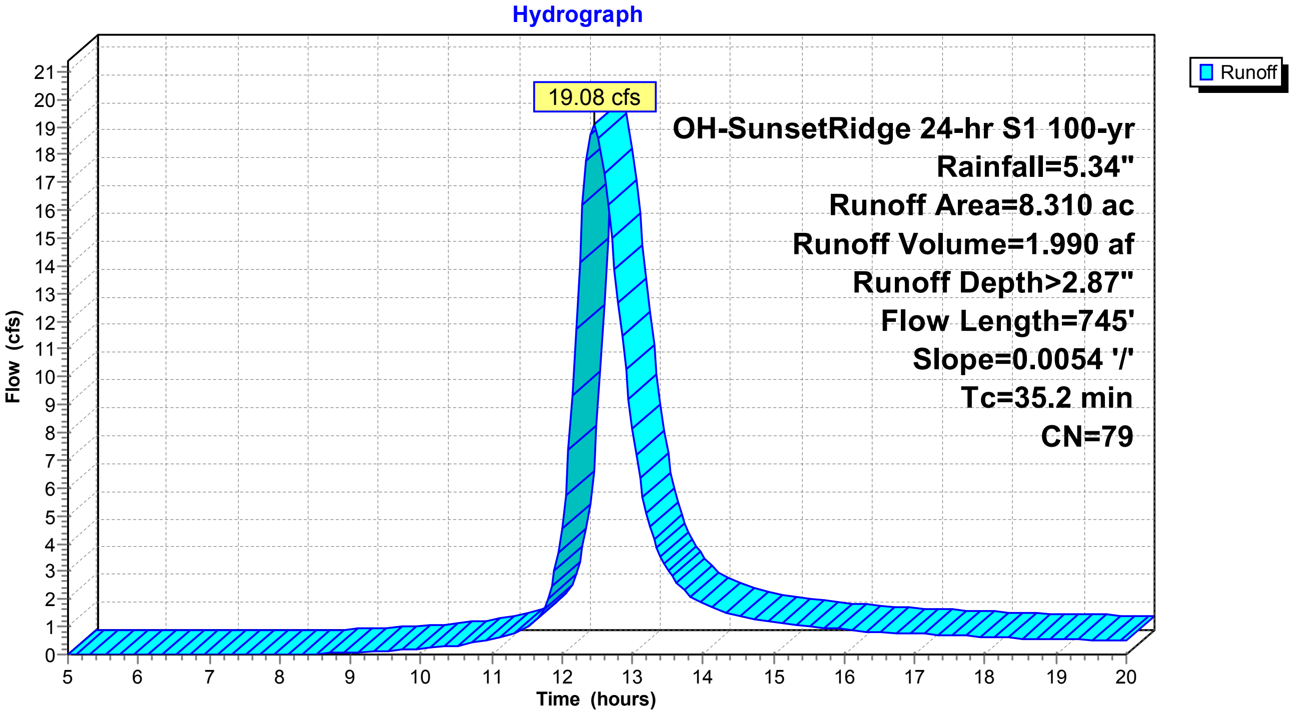
Runoff = 19.08 cfs @ 12.46 hrs, Volume= 1.990 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
7.740	78	Meadow, non-grazed, HSG D
0.560	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
8.310	79	Weighted Average
8.300		99.88% Pervious Area
0.010		0.12% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
35.2	745	0.0054	0.35		**Lag/CN Method,**

Subcatchment 81S: DC-39



Summary for Subcatchment 82S: DC-40

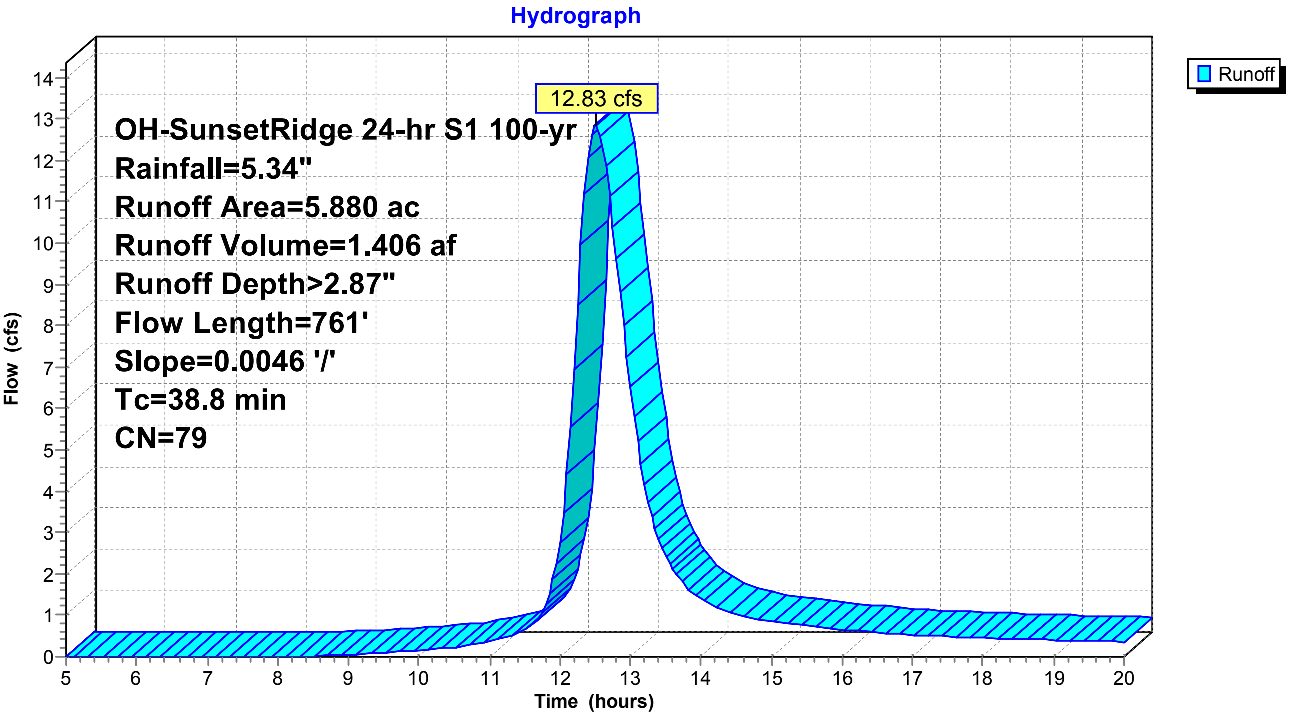
Runoff = 12.83 cfs @ 12.51 hrs, Volume= 1.406 af, Depth> 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
5.580	78	Meadow, non-grazed, HSG D
0.300	96	Gravel surface, HSG D
5.880	79	Weighted Average
5.880		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.8	761	0.0046	0.33		**Lag/CN Method,**

Subcatchment 82S: DC-40



Summary for Subcatchment 83S: DC-41

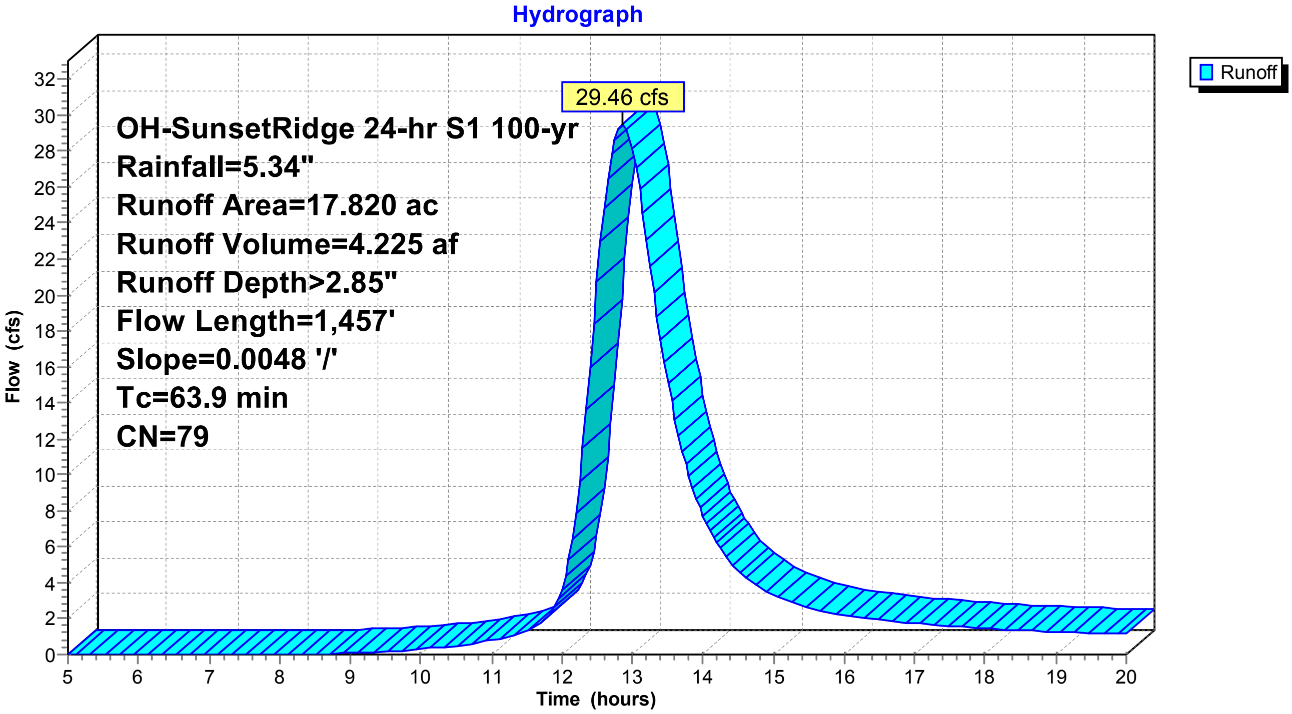
Runoff = 29.46 cfs @ 12.85 hrs, Volume= 4.225 af, Depth> 2.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
17.090	78	Meadow, non-grazed, HSG D
0.720	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
17.820	79	Weighted Average
17.810		99.94% Pervious Area
0.010		0.06% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
63.9	1,457	0.0048	0.38		**Lag/CN Method,**

Subcatchment 83S: DC-41



Summary for Subcatchment 84S: DC-42

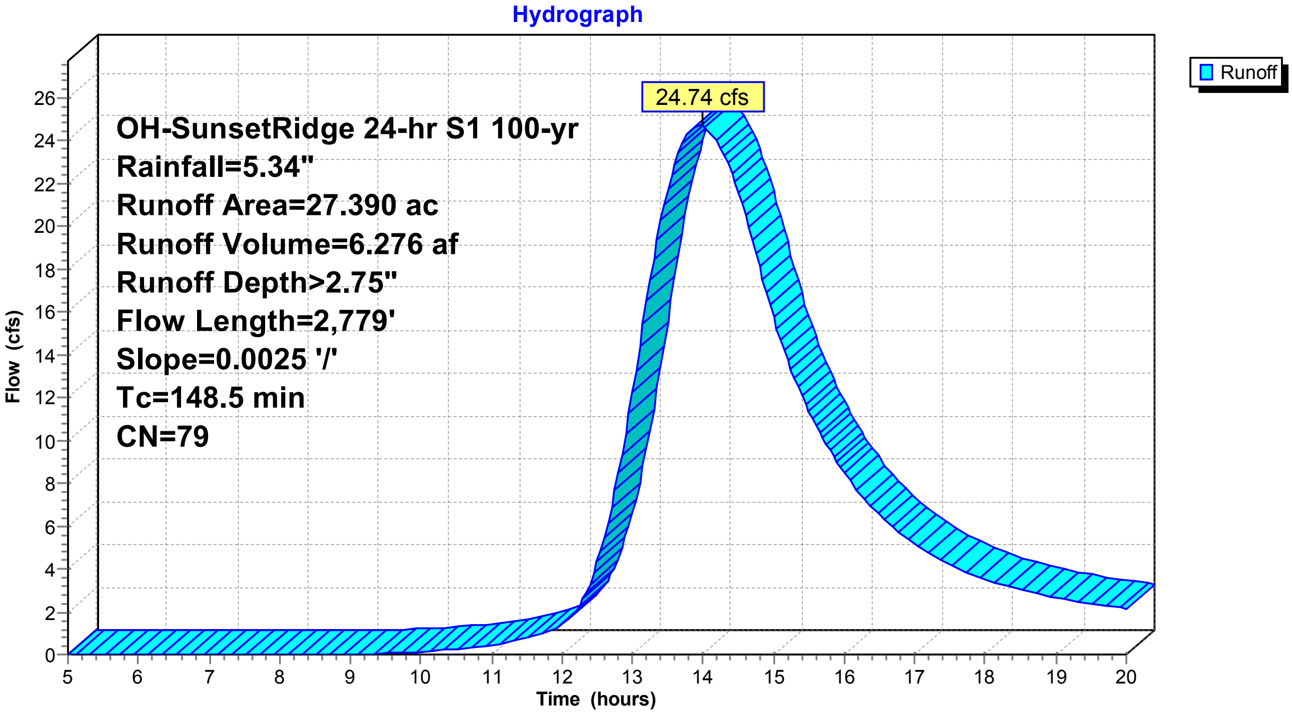
Runoff = 24.74 cfs @ 13.99 hrs, Volume= 6.276 af, Depth> 2.75"

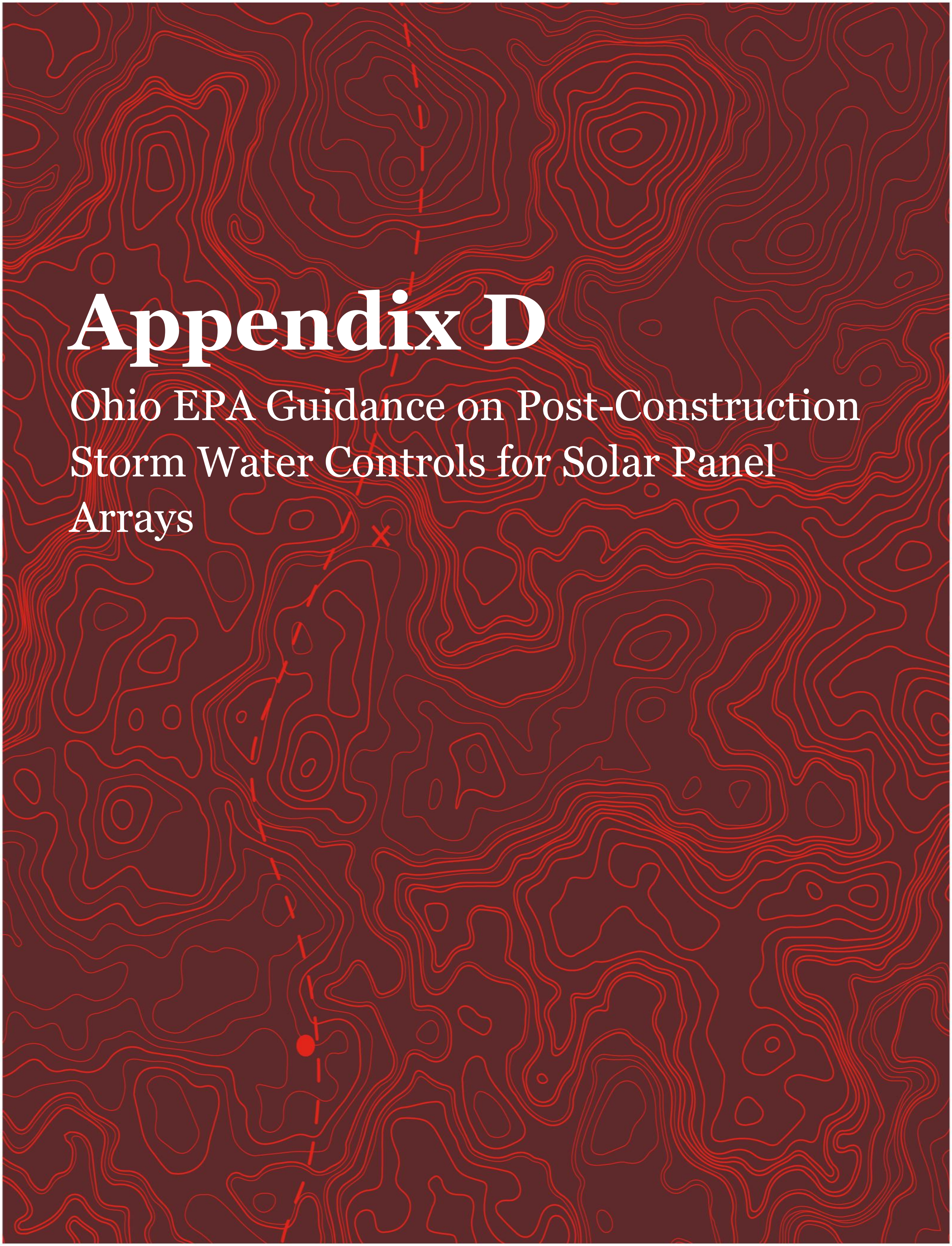
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
OH-SunsetRidge 24-hr S1 100-yr Rainfall=5.34"

Area (ac)	CN	Description
26.400	78	Meadow, non-grazed, HSG D
0.980	96	Gravel surface, HSG D
0.010	98	Unconnected pavement, HSG D
27.390	79	Weighted Average
27.380		99.96% Pervious Area
0.010		0.04% Impervious Area
0.010		100.00% Unconnected

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
148.5	2,779	0.0025	0.31		**Lag/CN Method,**

Subcatchment 84S: DC-42





Appendix D

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

Division of Surface Water
October 2019

NPDES Construction General Permit
#OHC00005

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.

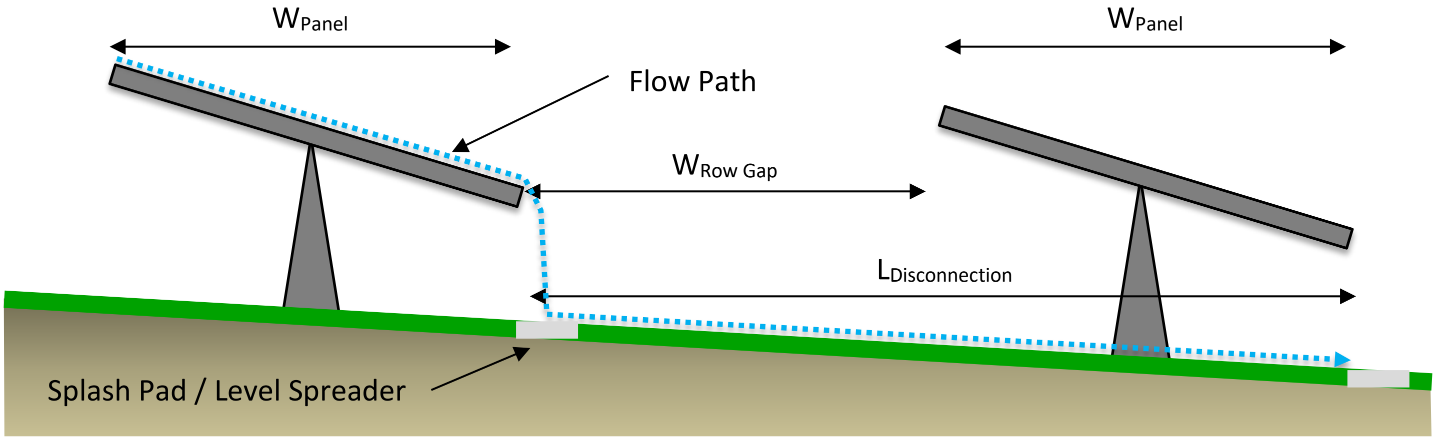


Figure 1: Schematic profile of solar panel array providing impervious area disconnection.

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.*

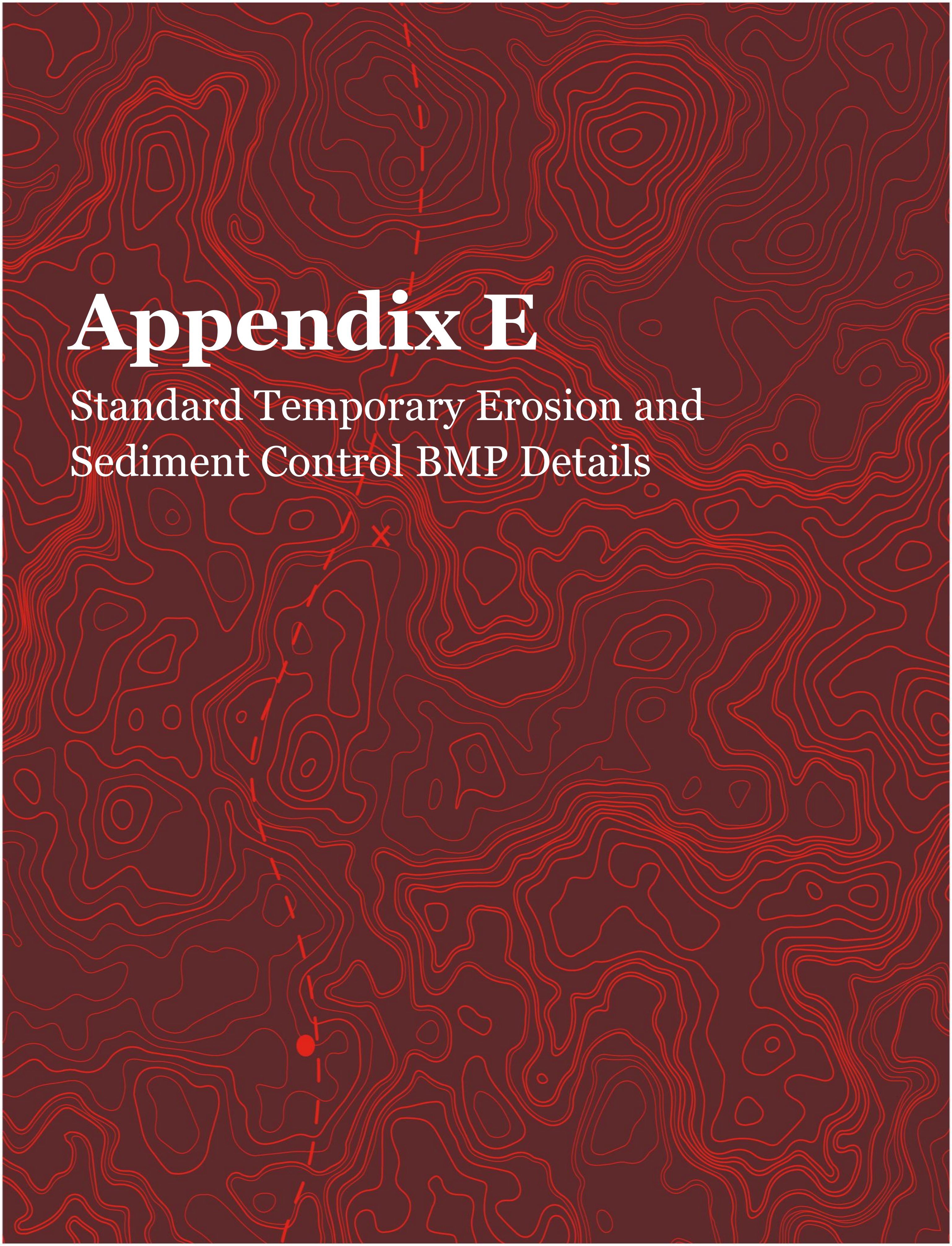
Ohio Department of Natural Resources. 2006 (with updates). *Rainwater and Land Development Manual*.

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.

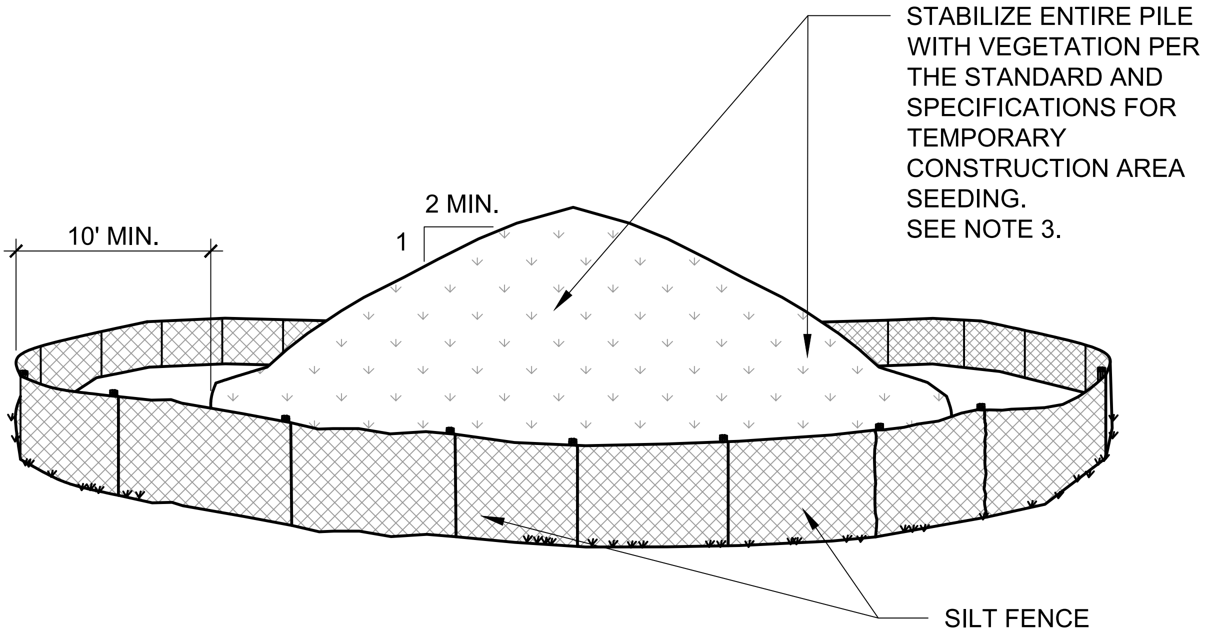
Contact

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



Appendix E

Standard Temporary Erosion and Sediment Control BMP Details

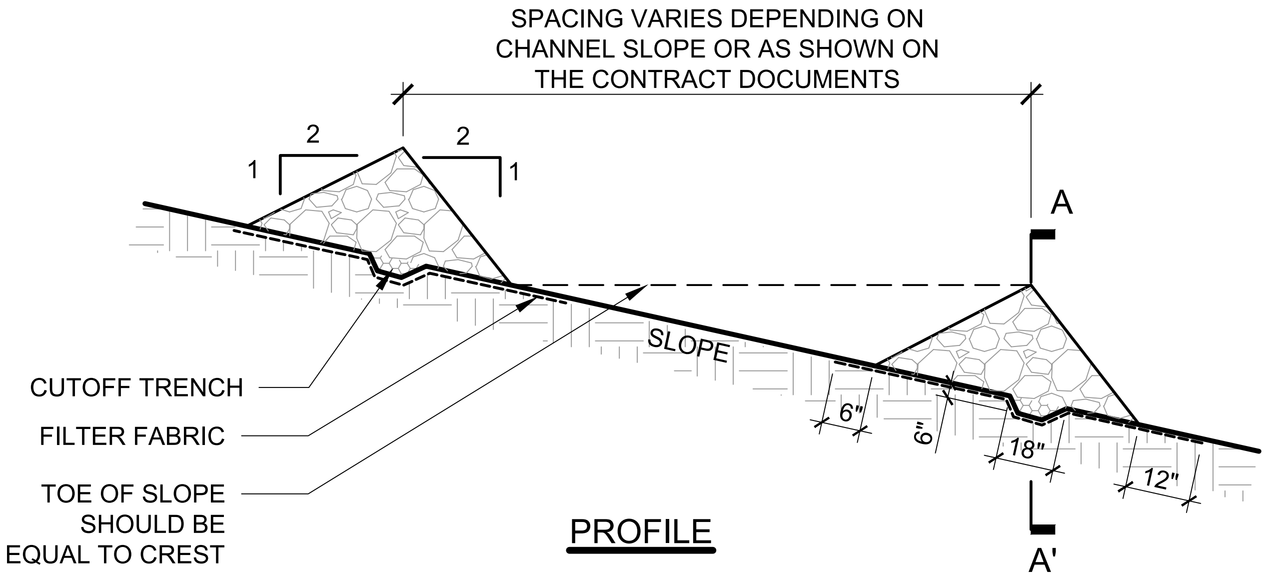


NOTES:

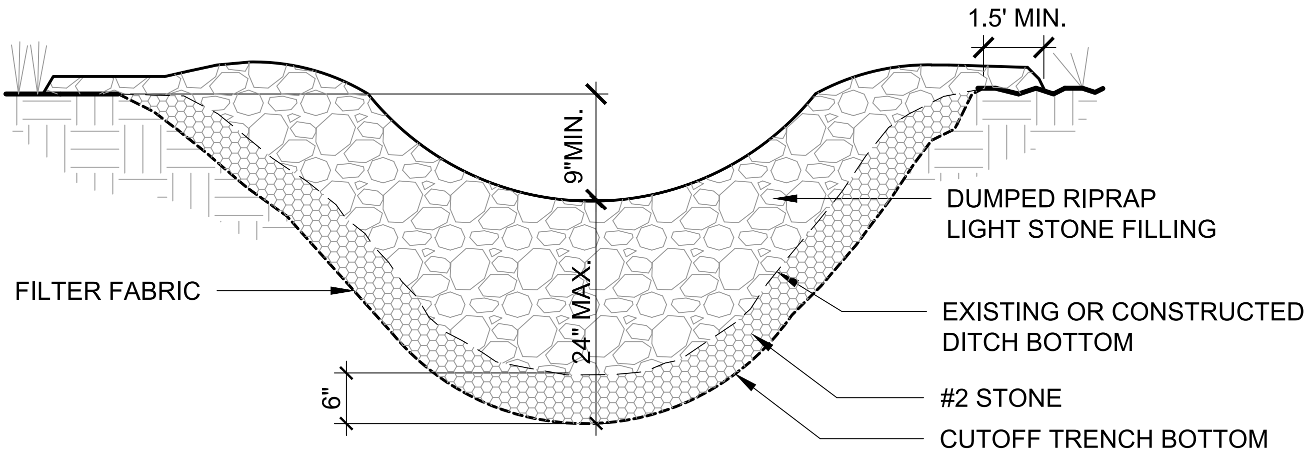
1. AREA CHOSEN FOR STOCKPILING OPERATIONS SHALL BE DRY, STABILIZED AND LOCATED AWAY FROM KNOWN WORK AREAS TO PREVENT RELOCATION.
2. MAXIMUM STOCKPILE HEIGHT SHALL BE 12 FEET.
3. EACH PILE SHALL BE SURROUNDED WITH SILT FENCING, INSTALLED PER SILT FENCE DETAIL, THEN STABILIZED IN ACCORDANCE WITH THE OHIO DEPARTMENT OF TRANSPORTATION STANDARD AND SPECIFICATIONS FOR TEMPORARY CONSTRUCTION AREA SEEDING WITHIN 7 DAYS OF COMPLETION.
4. A PERIMETER DIKE/SWALE SHALL BE LOCATED UP-SLOPE OF THE TOPSOIL STOCKPILE TO DIVERT STORMWATER AROUND THE STOCKPILE.

Environmental Design & Research,
Landscape Architecture, Engineering & Environmental Services, D.P.C.
217 Montgomery Street, Suite 1000
Syracuse, New York 13202
P. 315.471.0688

PROJECT TITLE: **EXAMPLE BMP**
DRAWING TITLE: **STABILIZED SOIL STOCKPILE**
DRAWN BY: **HP**
CHECKED BY: **TD**
EDR JOB NUMBER:
DRAWING NUMBER: 1.0
SCALE: **NTS**
DATE: **01/09/2020**



PROFILE



SECTION A-A'

NOTES:

1. STONE SHALL BE PLACED ON A FILTER FABRIC FOUNDATION TO THE LINES, GRADES AND LOCATIONS SHOWN IN THE PLAN.
2. EXTEND THE STONE A MINIMUM OF 1.5 FEET BEYOND THE DITCH BANKS TO PREVENT STORMWATER FROM FLOWING AROUND THE CHECK DAM.
3. ENSURE THAT CHANNEL APPURTENANCES SUCH AS CULVERT ENTRANCES BELOW CHECK DAMS ARE NOT SUBJECT TO DAMAGE OR BLOCKAGE FROM DISPLACED STONE.
4. MAXIMUM DRAINAGE AREA 2 ACRES.

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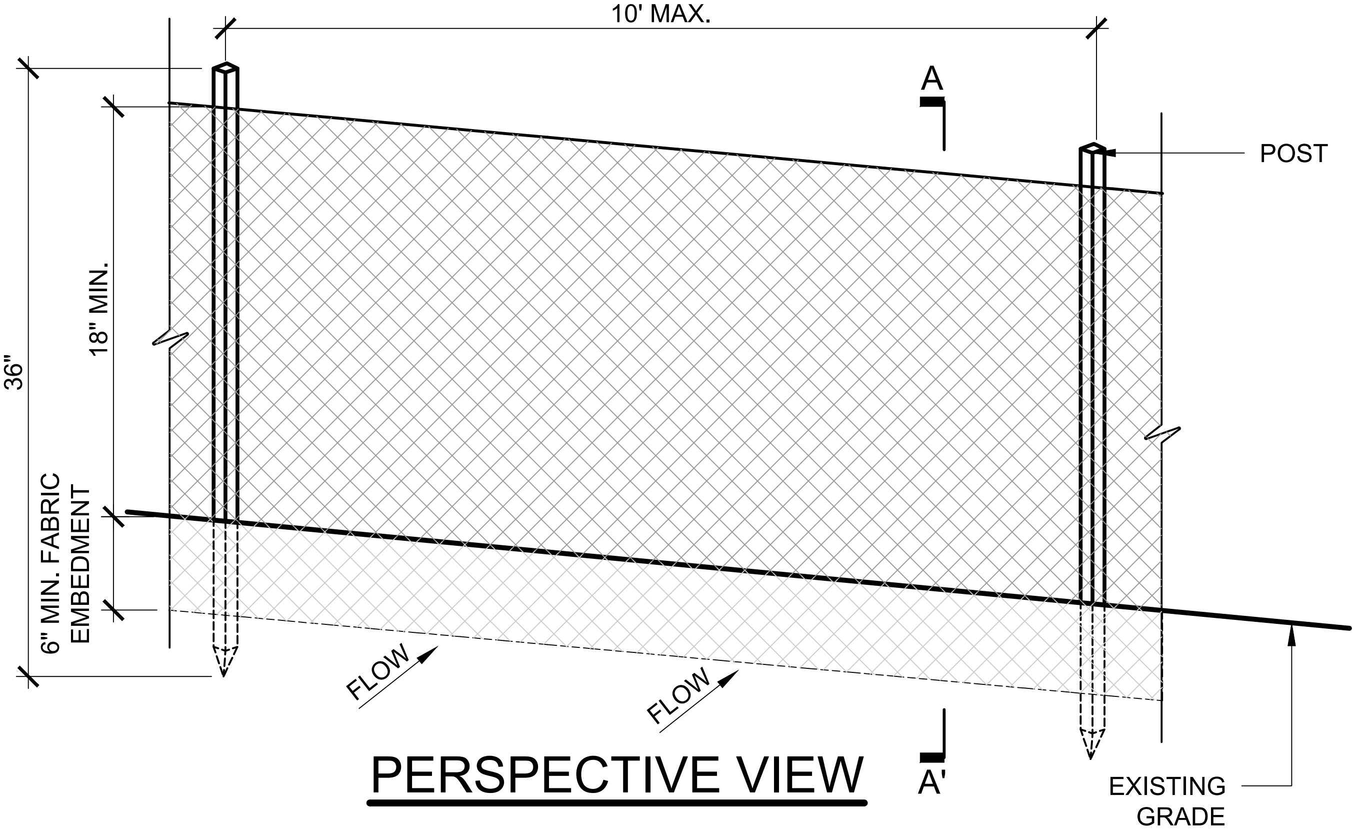
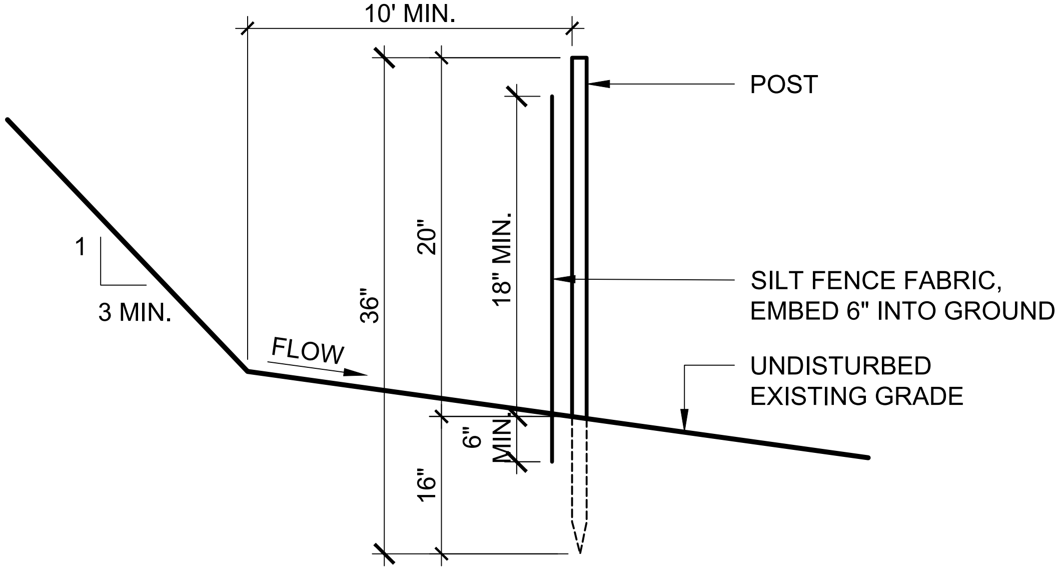
Syracuse, New York 13202
P. 315.471.0688

PROJECT TITLE: **EXAMPLE BMP**		**EDR** JOB NUMBER:	
DRAWING TITLE: **STONE CHECK DAM**		DRAWING NUMBER: 2.0	
DRAWN BY: **HP**	CHECKED BY: **TD**	SCALE: **NTS**	DATE: **01/09/2020**



PERSPECTIVE VIEW



SECTION A-A'

NOTES:

1. WHEN TWO SECTIONS OF SILT FENCE FABRIC ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY 6" AND FOLDED. FILTER CLOTH SHALL BE EITHER FILTER X, MIRAFI 100X, STABLINKA T140N, OR APPROVED EQUAL.
2. PREFABRICATED UNITS SHALL MEET THE MINIMUM REQUIREMENTS SHOWN.
3. MAINTENANCE SHALL BE PERFORMED IMMEDIATELY AND MATERIAL REMOVED WHEN "BULGES" DEVELOP IN THE SILT FENCE.

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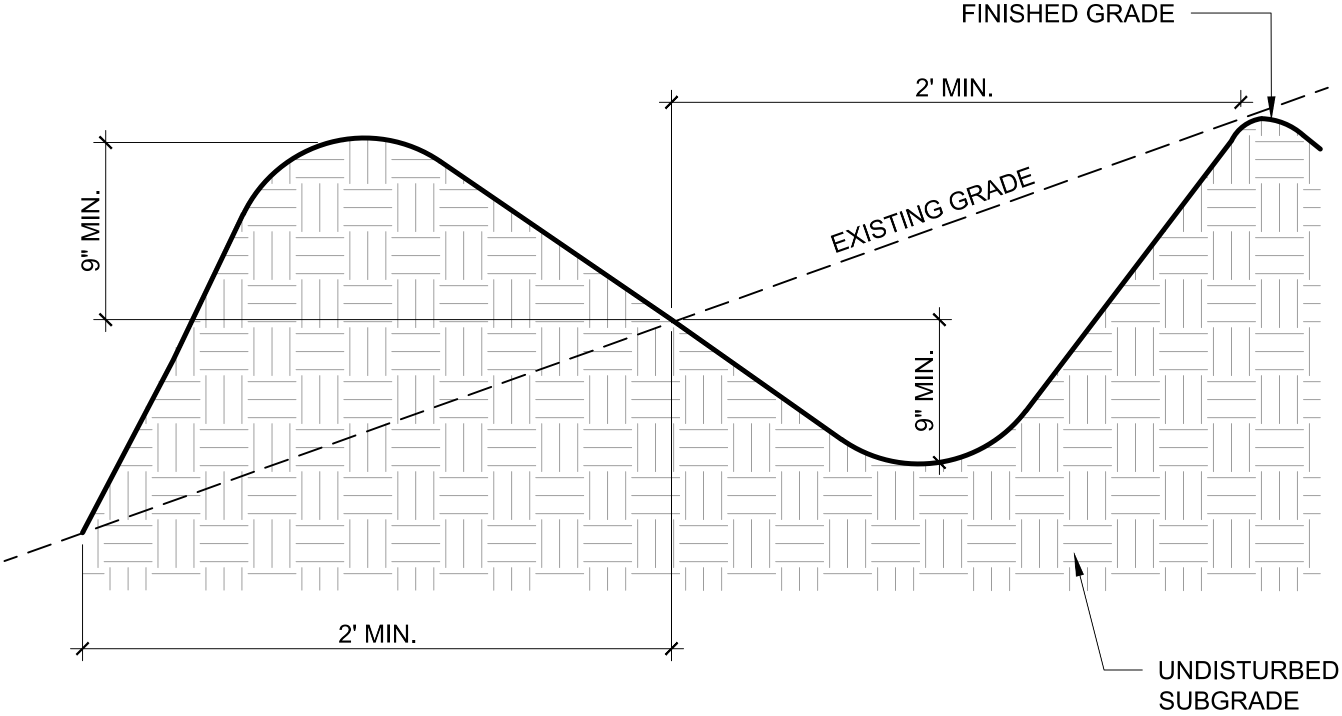
PROJECT TITLE: **EXAMPLE BMP**
DRAWING TITLE: **SILT FENCE**
DRAWN BY: **HP** CHECKED BY: **TD**

EDR JOB NUMBER:
DRAWING NUMBER: 3.0
SCALE: **NTS** DATE: **01/09/2020**



CROSS SECTION

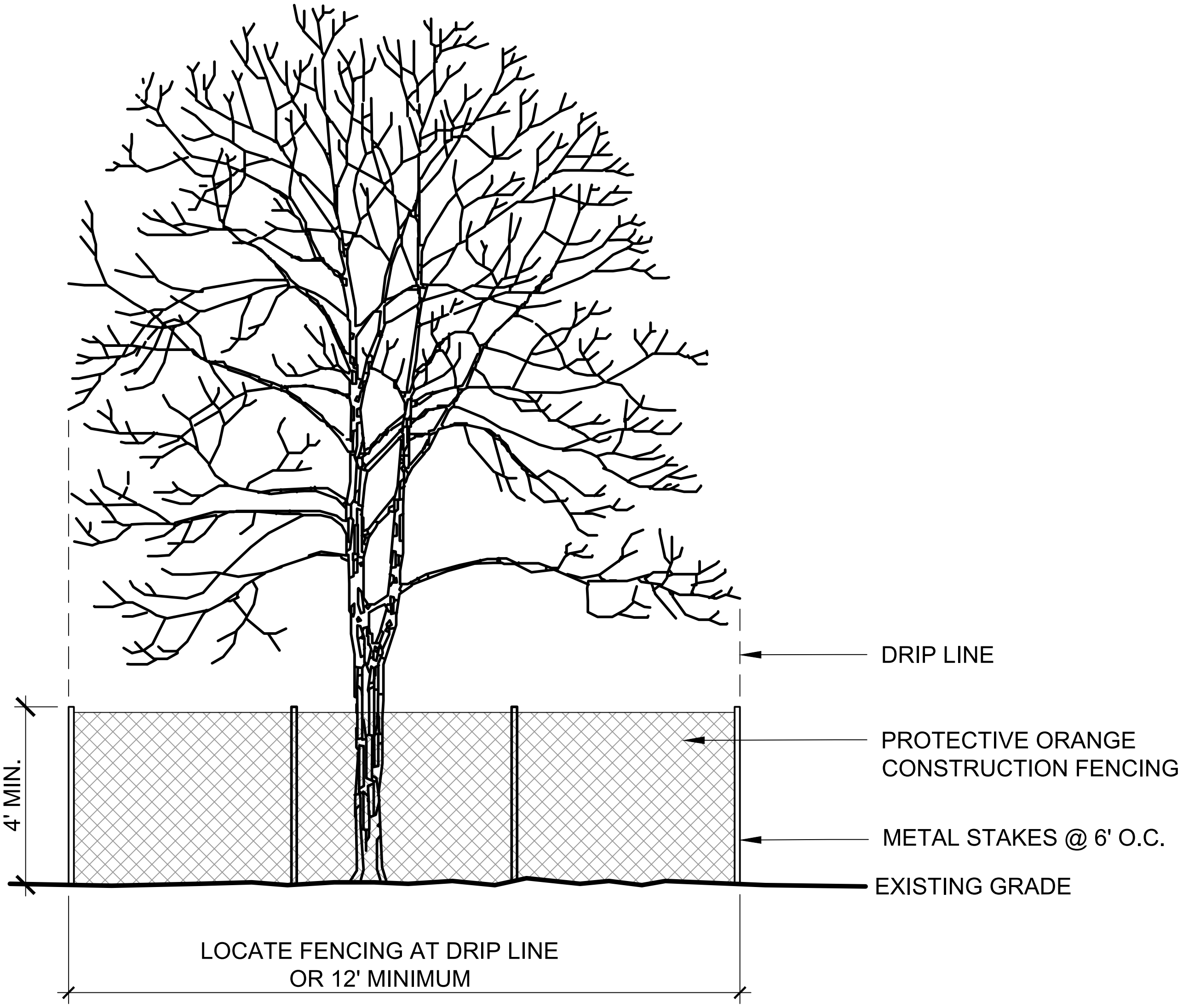
NOTES:

1. ALL PERIMETER DIKE/SWALE SHALL HAVE UNINTERRUPTED POSITIVE DOWNWARD SLOPE TO A STABILIZED OUTLET.
2. DIVERTED RUNOFF FROM DISTURBED AREAS SHALL BE CONVEYED TO AN APPROVED SEDIMENT TRAPPING DEVICE.
3. DIVERTED RUNOFF FROM AN UNDISTURBED AREA SHALL OUTLET INTO AN UNDISTURBED STABILIZED AREA AT A NON-EROSIVE VELOCITY.
4. THE SWALE SHALL BE EXCAVATED OR SHAPED TO LINE GRADE, AND CROSS SECTION AS REQUIRED TO MEET THE CRITERIA SPECIFIED IN THE STANDARD AND SPECIFICATIONS FOR PERIMETER DIKE/SWALE.
5. STABILIZATION OF THE AREA DISTURBED BY THE DIKE/SWALE SHALL BE INSTALLED IN ACCORDANCE WITH THE STANDARD AND SPECIFICATIONS FOR TEMPORARY CONSTRUCTION AREA SEEDING LOCATED ON PAGE 13 OF THE OHIO DEPARTMENT OF TRANSPORTATION HANDBOOK FOR SEDIMENT AND EROSION CONTROL.
6. PERIODIC INSPECTION AND REQUIRED MAINTENANCE MUST BE PROVIDED AFTER EACH RAIN EVENT AND/OR SWPPP INSPECTION.
7. MAX DRAINAGE AREA LIMIT: 2 ACRES.

Environmental Design & Research,
Landscape Architecture, Engineering & Environmental Services, D.P.C.
217 Montgomery Street, Suite 1000
Syracuse, New York 13202
P. 315.471.0688

PROJECT TITLE: **EXAMPLE BMP**
DRAWING TITLE: **PERIMETER DIKE OR SWALE**
DRAWN BY: **HP** CHECKED BY: **TD**

EDR JOB NUMBER:
DRAWING NUMBER: 4.0
SCALE: **NTS** DATE: **01/09/2020**



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Landscape Architecture, Engineering & Environmental Services, D.P.C.
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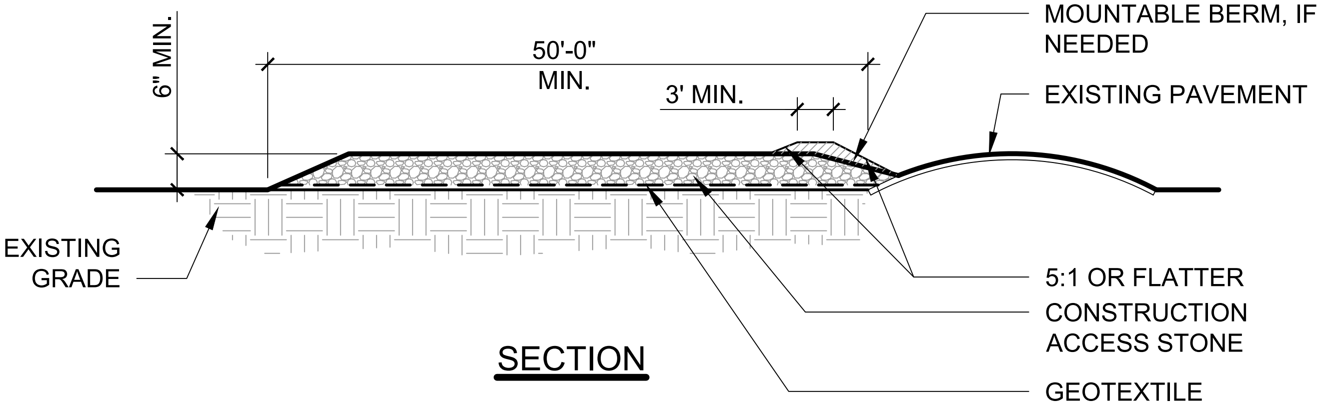
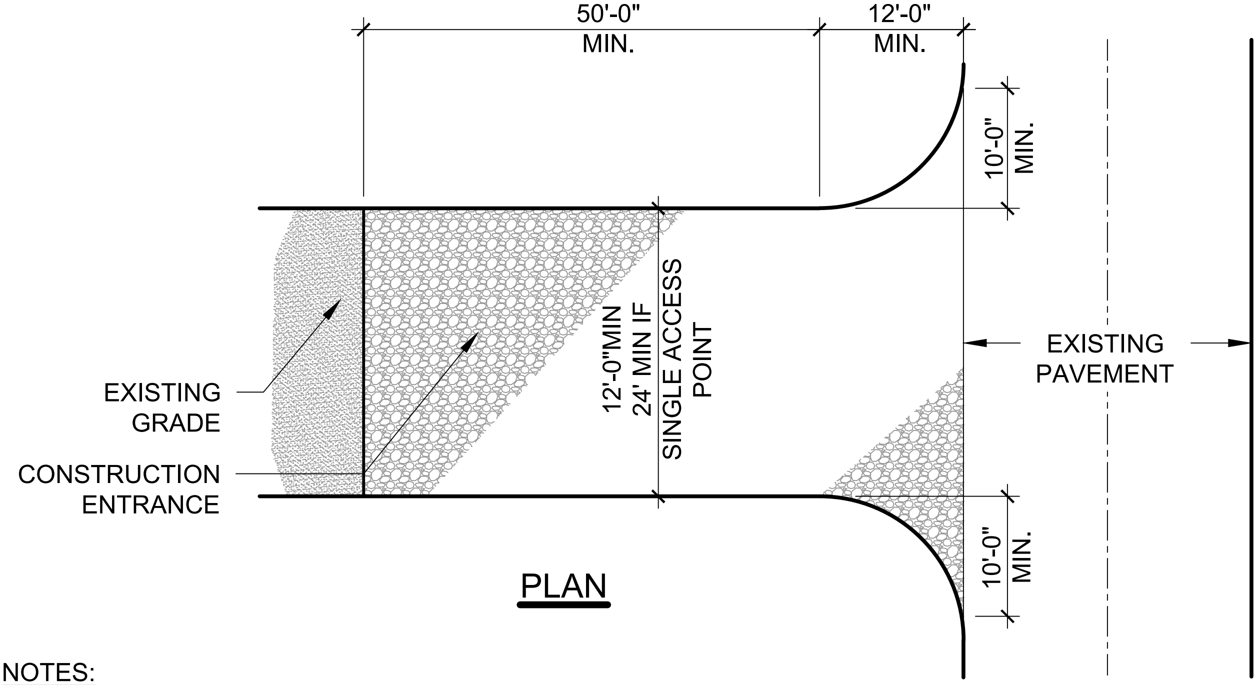
Syracuse, New York 13202
P. 315.471.0688

PROJECT TITLE: **EXAMPLE BMP**	
DRAWING TITLE: **VEGETATION PROTECTION**	
DRAWN BY: **HP**	CHECKED BY: **TD**

EDR JOB NUMBER:	
DRAWING NUMBER: 5.0	
SCALE: **NTS**	DATE: **01/09/2020**





NOTES:

1. CONSTRUCTION ACCESS STONE SIZE - MATRIX OF #4 AND #5 STONE, OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
2. GEOTEXTILE:
   - 2.A. MIRAFI 500X OR APPROVED EQUAL.
   - 2.B. SHALL BE PLACED UNDER THE ENTIRE STABILIZED CONSTRUCTION ENTRANCE PRIOR TO PLACING OF STONE.
3. SURFACE WATER - ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ACCESS SHALL BE PIPED ACROSS THE STABILIZED CONSTRUCTION ACCESS. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM SHALL BE USED.
4. MAINTENANCE - THE CONSTRUCTION ACCESS SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO THE PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHTS-OF-WAY MUST BE REMOVED IMMEDIATELY.
5. WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ACCESS ONTO PUBLIC RIGHTS-OF-WAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE..

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Syracuse, New York 13202
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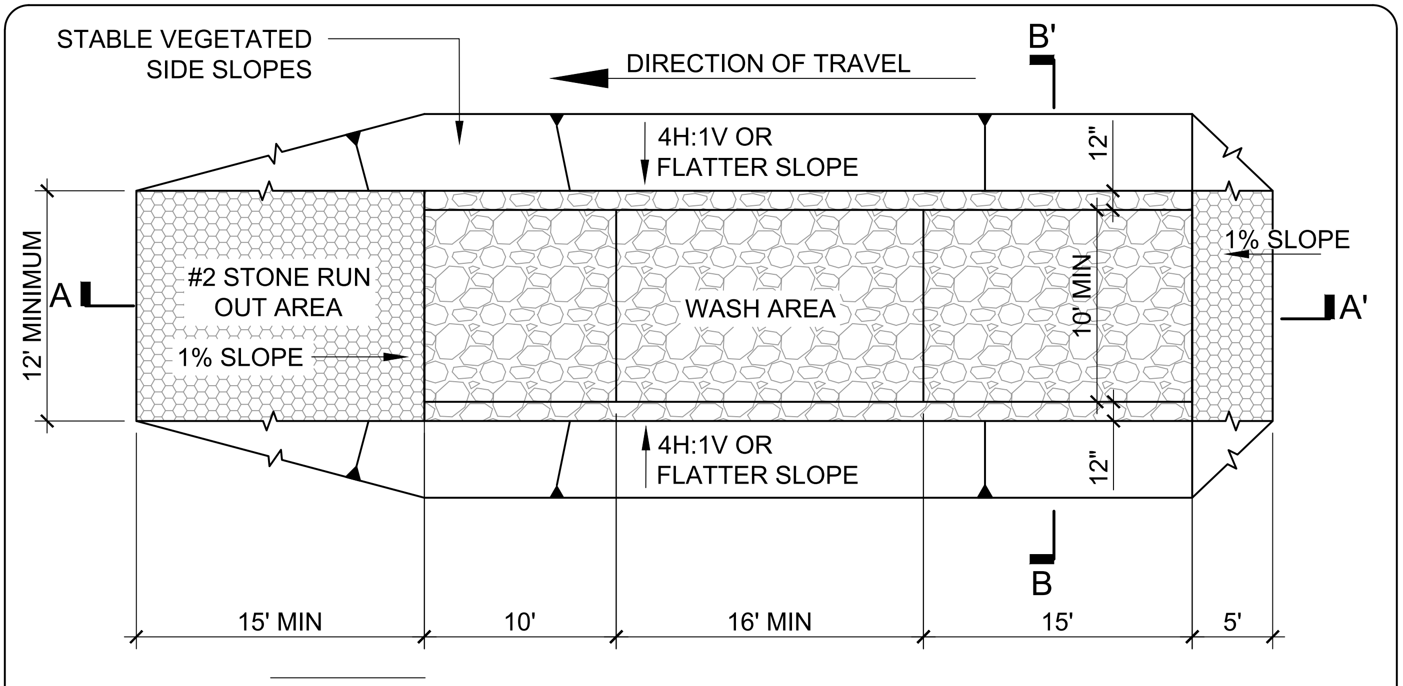
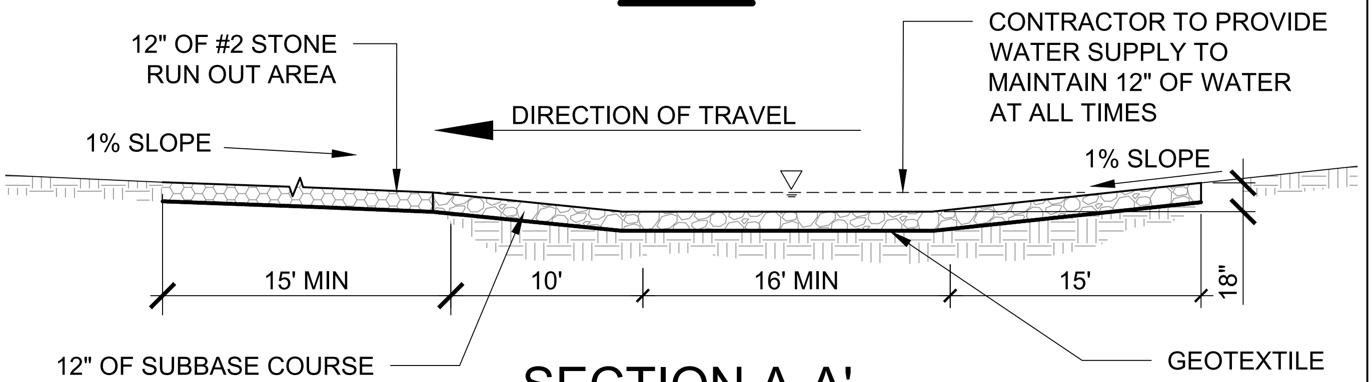
PROJECT TITLE: **EXAMPLE BMP**	
DRAWING TITLE: **STABILIZED CONSTRUCTION ACCESS**	
DRAWN BY: **HP**	CHECKED BY: **TD**

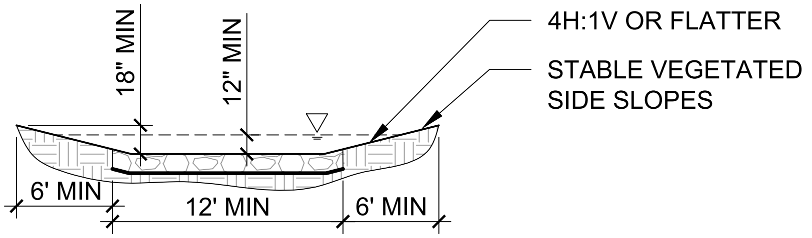
EDR JOB NUMBER:	
DRAWING NUMBER: 6.0	
SCALE: **NTS**	DATE: **01/09/2020**



PLAN



SECTION A-A'



SECTION B-B'

NOTES:

1. THE WHEEL WASH SHALL BE CONSTRUCTED AND STABILIZED (INCLUDING VEGETATION) PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.
2. CONTRACTOR SHALL REMOVE ACCUMULATED SEDIMENT FROM WHEEL WASH ON A DAILY BASIS. MORE FREQUENT REMOVAL MAY BE NECESSARY BASED ON USE AND SITE CONDITIONS.
3. WASH WATER SHALL BE DISCHARGED TO AN APPROVED SEDIMENT TRAP.

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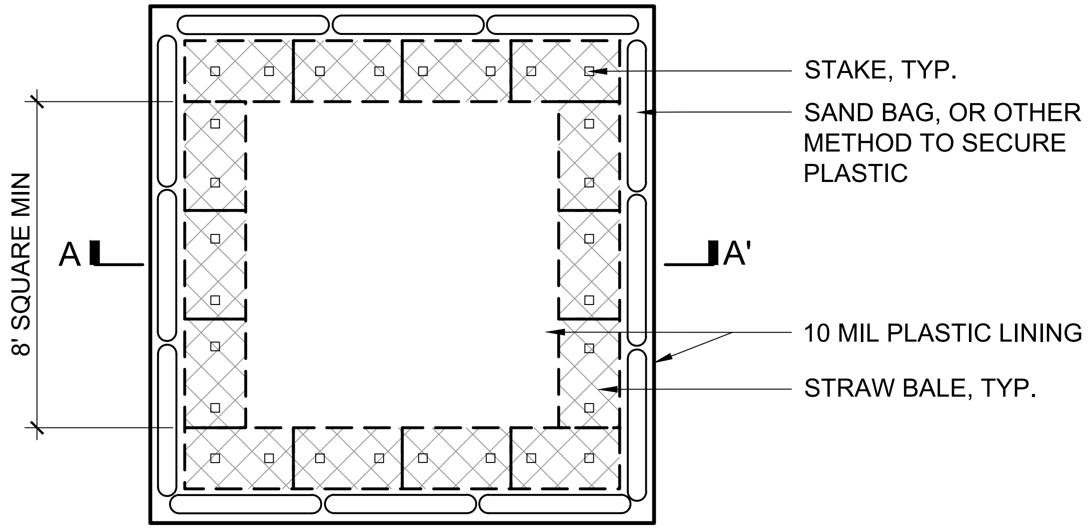
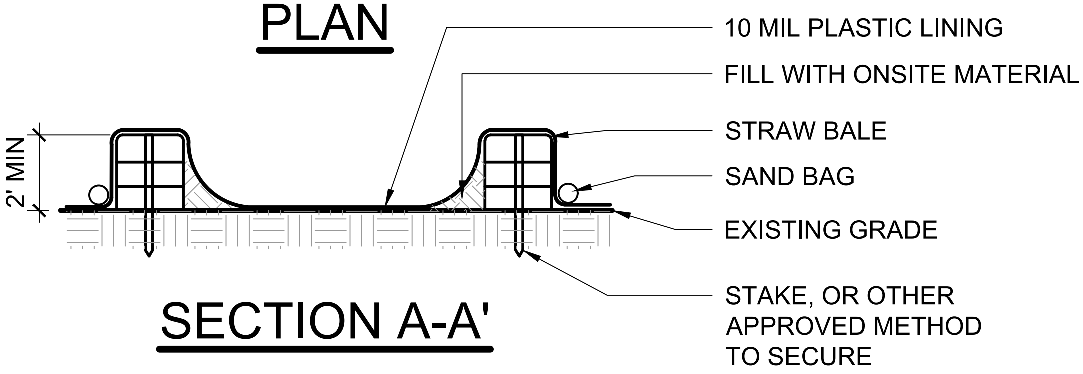
PROJECT TITLE: **EXAMPLE BMP**	
DRAWING TITLE: **WHEEL WASH**	
DRAWN BY: **HP**	CHECKED BY: **TD**

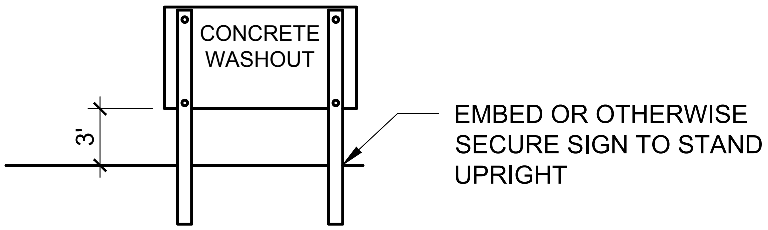
EDR JOB NUMBER:	
DRAWING NUMBER: 7.0	
SCALE: **NTS**	DATE: **01/09/2020**



PLAN



SECTION A-A'



CONCRETE WASHOUT SIGN

NOTES:

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SIZING, CONSTRUCTION, AND INTEGRITY OF THE WASHOUT. THE CAPACITY OF THE WASHOUT SHALL BE 60 GALLONS PER TRUCK TO BE CLEANED WITHIN THE EXPECTED MAINTENANCE FREQUENCY. ADDITIONAL CAPACITY SHALL BE PROVIDED TO ACCOMMODATE RAINFALL.
2. OTHER METHODS OF CONCRETE WASHOUT CONTAINMENT MAY BE UTILIZED IF APPROVED BY THE OWNER'S REPRESENTATIVE.
3. LOCATE WASHOUT AREA AT LEAST 100' FROM STORM DRAINS, OPEN DITCHES, OR WATER BODIES.
4. THE PLASTIC LINING SHALL BE MAINTAINED IN A WATER TIGHT CONDITION AND SHALL BE REPLACED AT EVERY CLEANING.
5. DO NOT ALLOW RUNOFF TO ENTER THIS AREA.
6. THE CONCRETE WASHOUT SIGN SHALL BE PLACED WITHIN 30 FEET OF THE TEMPORARY CONCRETE WASHOUT FACILITY.

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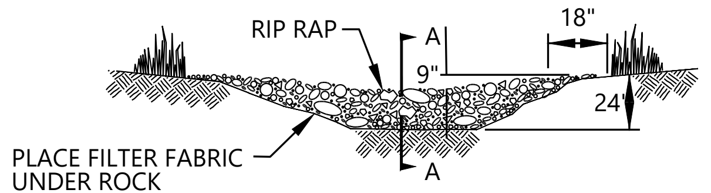
PROJECT TITLE: **EXAMPLE BMP**
DRAWING TITLE: **CONCRETE WASHOUT AREA**
DRAWN BY: **HP**
CHECKED BY: **TD**

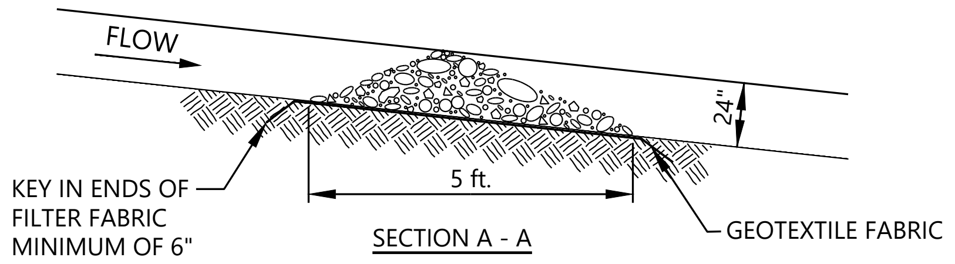
EDR JOB NUMBER:
DRAWING NUMBER: 8.0
SCALE: **NTS**
DATE: **01/09/2020**

ROCK CHECK SHALL BE USED WHERE NEEDED AS A FILTER MEDIA, OR WHERE EROSION CONTROL BLANKETS AND/OR FIBER ROLLS DO NOT PROVIDE ADEQUATE EROSION AND SEDIMENT CONTROL.



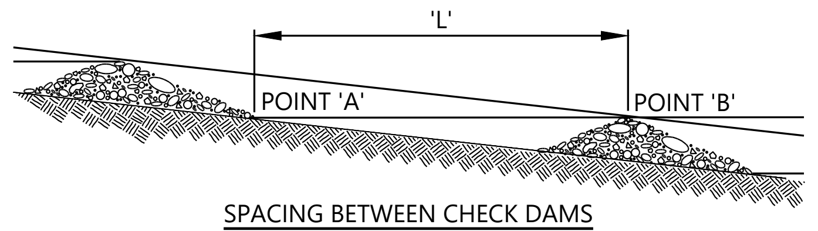
VIEW LOOKING UPSTREAM

KEY STONE INTO THE DITCH BANKS AND EXTEND IT BEYOND THE ABUTMENTS A MINIMUM OF 18" TO PREVENT OVER FLOW AROUND DAM.



SECTION A - A

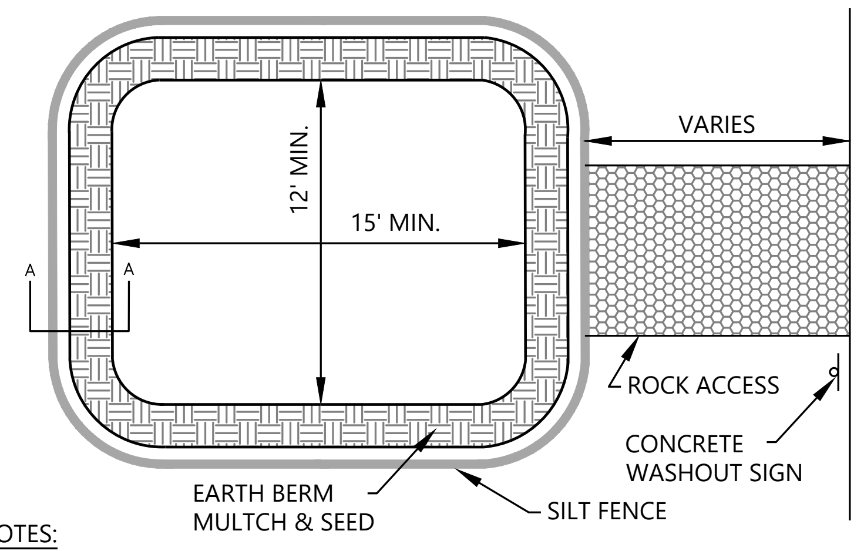
'L' = THE DISTANCE SUCH THAT POINTS 'A' AND 'B' ARE OF EQUAL ELEVATION.



SPACING BETWEEN CHECK DAMS

Westwood	TEMPORARY ROCK CHECK DAM	01

AN APPROVED ALTERNATE MAY BE USED
USE AS NEEDED



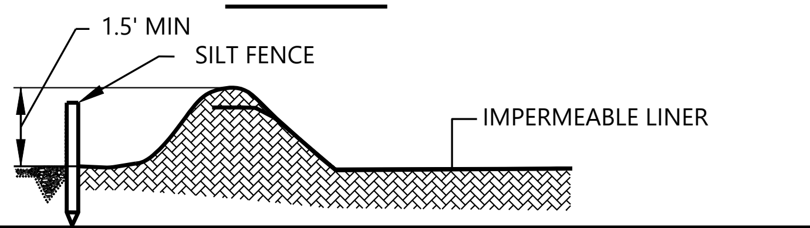
NOTES:
CONCRETE WASHOUT AREAS WILL HAVE AN IMPERMEABLE LINER TO PREVENT CONCRETE WASHOUT WATER FROM INFILTRATING/CONTACTING WITH SOIL.

IMPERMEABLE LINER INCLUDES 10 MIL POLYLINER OR COMPACTED CLAY LINER.

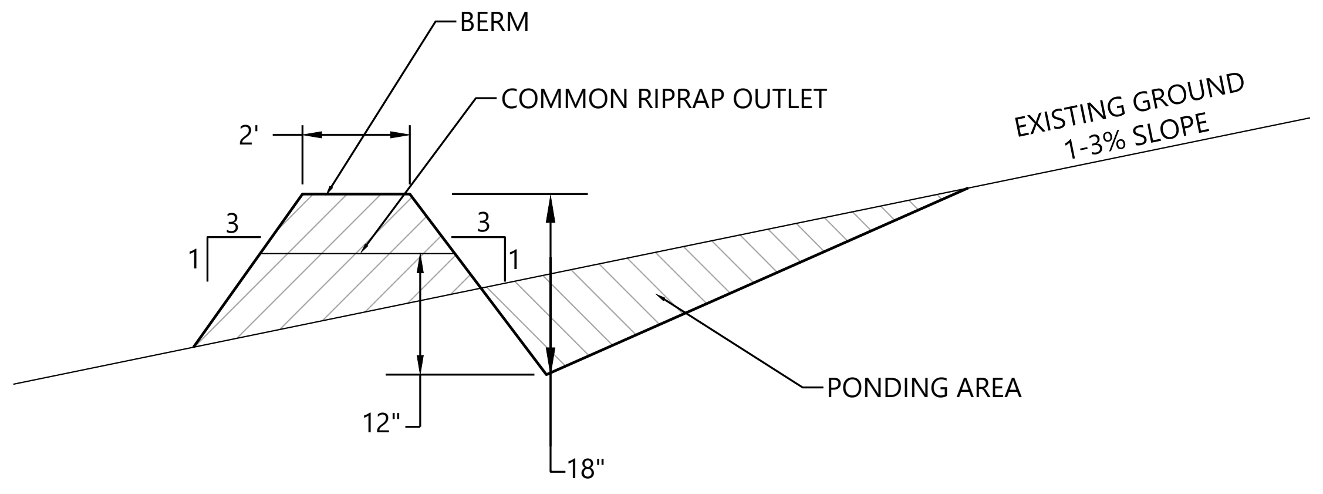
ALTERNATE WASHOUT SYSTEMS CAN BE USED IN LIEU OF WHAT IS SHOWN IN THIS DETAIL.

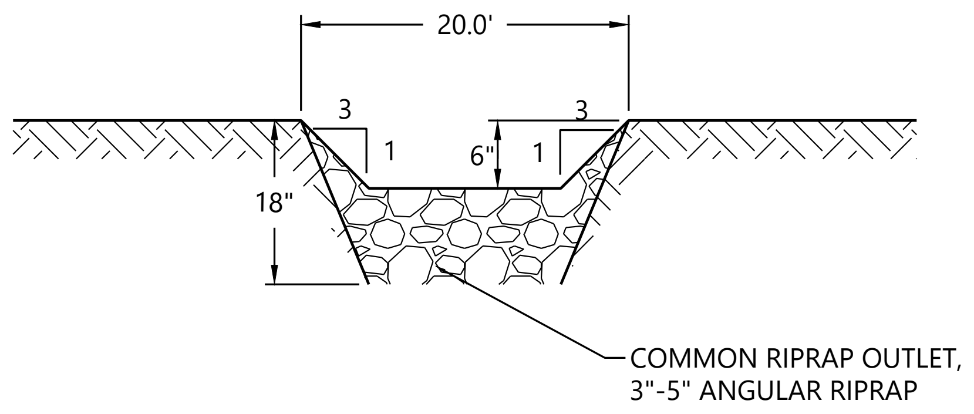
REMOVE CONCRETE WASHOUT AREAS AFTER CONSTRUCTION.

SECTION A-A



Westwood	CONCRETE WASHOUT AREA	02





NOTES:
1. CUT CREATED FROM PONDING SHALL BE USED AS FILL TO BUILD BERM
2. ROCK OUTLETS TO BE PLACED AT LOW AREAS PER FIELD CONDITIONS OR EVERY 500 FEET.
3. RIP RAP SHALL BE 3"-5" ANGULAR RIPRAP

Westwood	TOPSOIL SEDIMENT CONTROL BERM	03

APPENDIX F

DRAIN TILE MITIGATION PLAN

south branch solar

Drain Tile Mitigation Plan

South Branch Solar
Hancock County, Ohio

July 2021

Table of Contents

Attachments

A – Existing Drain Tile Aerial Identification Mapping
B – Typical Drain Tile Repair Construction Details

1. Introduction

South Branch Solar, LLC (South Branch) proposes to construct an up to 205 MWac solar generating facility, South Branch Solar (the “Project” or “Facility”) in Hancock County, Ohio. The Project will be located in Washington Township, immediately north of the Village of Arcadia. The Project site consists of approximately 1,000 acres of predominantly undeveloped farmland, with evidence of harvested crops and drain tiles to aid in drainage of the fields. South Branch has developed the following Drain Tile Mitigation Plan for the Project to cover the proper care and maintenance of drain tile systems to ensure continued productivity of the farmland.

2. Drain Tile Identification

South Branch has contracted with Boes Quality Drainage to support drain tile locating efforts on the Project. Drain tile locating services will consist of coordination with the county engineer, private landowner interviews, review of aerial imagery, and visual field observations to locate and GPS exact location of drain tile. Data on the existing drain tile system will be aggregated to create a comprehensive mapping of known and suspected drain tile systems. Landowner coordination and field investigations are ongoing during permitting efforts and the mapping will be updated upon receipt of additional information and prior to construction.

Attachment A provides existing mapping of the drain tile system based on the expertise of Boes Quality Drainage, desktop aerial photography, and consultation with landowners.

3. Drain Tile Avoidance

South Branch will implement the following drain tile avoidance measures prior to construction:

- Drain tile mains, as well as active lateral drain times located in low-lying areas, will be considered in the development of the final Project layout and avoided where practicable or relocated where not practicable.
- The drain tile dataset will be shown on the final construction plans or on a separate exhibit, as required.
- Identified drain tile mains will be flagged in the field to facilitate avoidance and provide protection from damage during construction.

4. Damaged Drain Tile Identification

Even under ideal circumstances, some drain tile damage during construction is unavoidable. The following techniques will be utilized to identify damaged drain tile during Project construction activities:

- For excavation associated with the installation of collection lines and foundation slabs, any broken tile system will likely be visible along the boundary of the excavated area.

- In the event drain tile is damaged during pile installation, the location will be assessed for the need for repair, as discussed in more detail in Section 5, Drain Tile Repair.

- It is possible that drain tile damage is not noted immediately upon the event, as damage may become evident over time. Evidence of damage may include unexpected flows of water out of the ground, ponding, wet spots, or the formation of localized voids in dry conditions. Construction crews will regularly monitor and assess the Project Area for any such conditions. Should conditions indicative of damaged tile be noted, the location will be assessed for the need for repair based on the specifications below in Section 5, Drain Tile Repair.

5. Drain Tile Repair

The following protocols will be implemented if broken drain tile is identified:

a) Unless otherwise agreed to by the landowner, underground drain tile mains that are within the footprint of the Facility, or extend beyond it, that are damaged from construction will be repaired by a qualified contractor promptly after discovery, or as weather and soil conditions allow.
  i) If it cannot be determined if a drain tile line extends onto neighboring parcels based on field assessment and/or mapping dataset, the line will be treated as a main line and be subject to repair, regardless of landowner agreements.

b) Prior to construction, low-lying areas, where ponding is most likely to occur in the event active lateral drain tiles are damaged, will be surveyed by a local expert familiar with the Project Area and abutting properties, using best practices familiar to the surrounding community.
  i) Locations of active lateral drain tile will be mapped using GPS and compared to Project design parameters.
  ii) The identified locations will be used to re-route drain tile or adjust Project design to avoid damage.
  iii) In instances where neither re-routing or design modification are feasible, surveyed locations will be used to guide repairs which will be undertaken promptly after discovery, or as weather and soil conditions allow.

c) All repairs will be completed by a qualified contractor, and will consist of the following:
  i) Drain tile lines that are subject to repair shall be repaired at a minimum to the standard details provided in Attachment B.
  ii) Any new drain tile lines will be of comparable quality to the original and will be installed to restore the underground drainage capacity found onsite prior to construction.
  iii) All subsurface drains subject to repair shall be repaired or replaced with materials of equal or higher quality and of equal or larger capacity inside diameter as those that were damaged or removed.
  iv) To the greatest extent practicable, the subsurface drain repair shall maintain the original alignment, grading, and water flow.

d) The locations of all subsurface drains that are damaged and/or repaired will be documented. The location will be recorded on Project mapping, a photo will be collected, and a description of the repair will be documented and available to the landowner at their request.

6. Complaint Resolution

South Branch is committed to addressing landowner concerns regarding drain tile repair and maintenance. Per the Complaint Resolution Plan developed for the Facility, landowners may file concerns:

- By phone, using the Project-specific phone number identified for use during the construction and operations and maintenance (O&M) phases. Once established, these phone numbers will be provided to local officials, posted on signage at the Project entrance, and reflected on the Project website.
- In person, by visiting the temporary construction office onsite during the construction phase, or the permanent O&M facility during normal business hours. Complaints can be filed with the construction manager or O&M staff.
- In writing, by filing a written complaint to the local construction office or O&M facility.
- Electronically, using a dedicated Project email account provided on the Project website (www.southbranchsolar.com), correspondence, and on signage.

South Branch will work to address landowner concerns related to drainage in a timely manner.

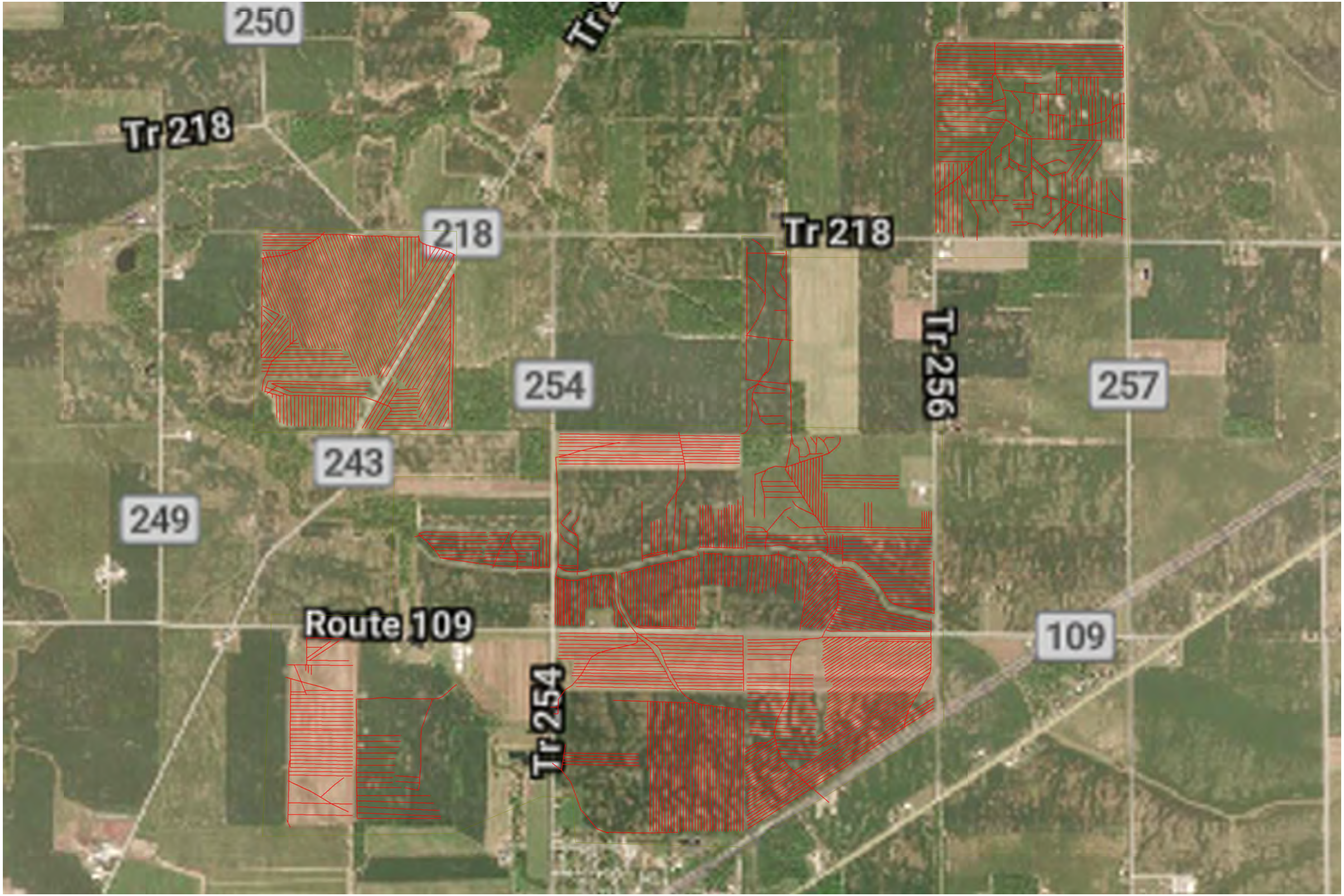
7. References

Ohio Department of Agriculture. Ohio Pipeline Standards and Construction Specifications. 2015. Accessed February 2021. https://agri.ohio.gov/wps/wcm/connect/gov/553ebd44-98e5-485c-a78d-49156289a388/PIPELINE+STANDARD+12-28-15new+letterhead.pdf?MOD=AJPERES&CONVERT_TO=url&CACHEID=ROOTWORKSPACE.Z18_M1HGGIK0N0JO00QO9DDDDM3000-553ebd44-98e5-485c-a78d-49156289a388-nbcL.gv

Tom Huddleston, Huddleston McBride Land Drainage. (2021). *Agricultural Drainage Considerations Including Modifications and Maintenance Recommendations for Ground Mounted Solar Projects Within Existing Agricultural Land Use Areas.*

Attachment A

Existing Drain Tile Aerial Identification Mapping



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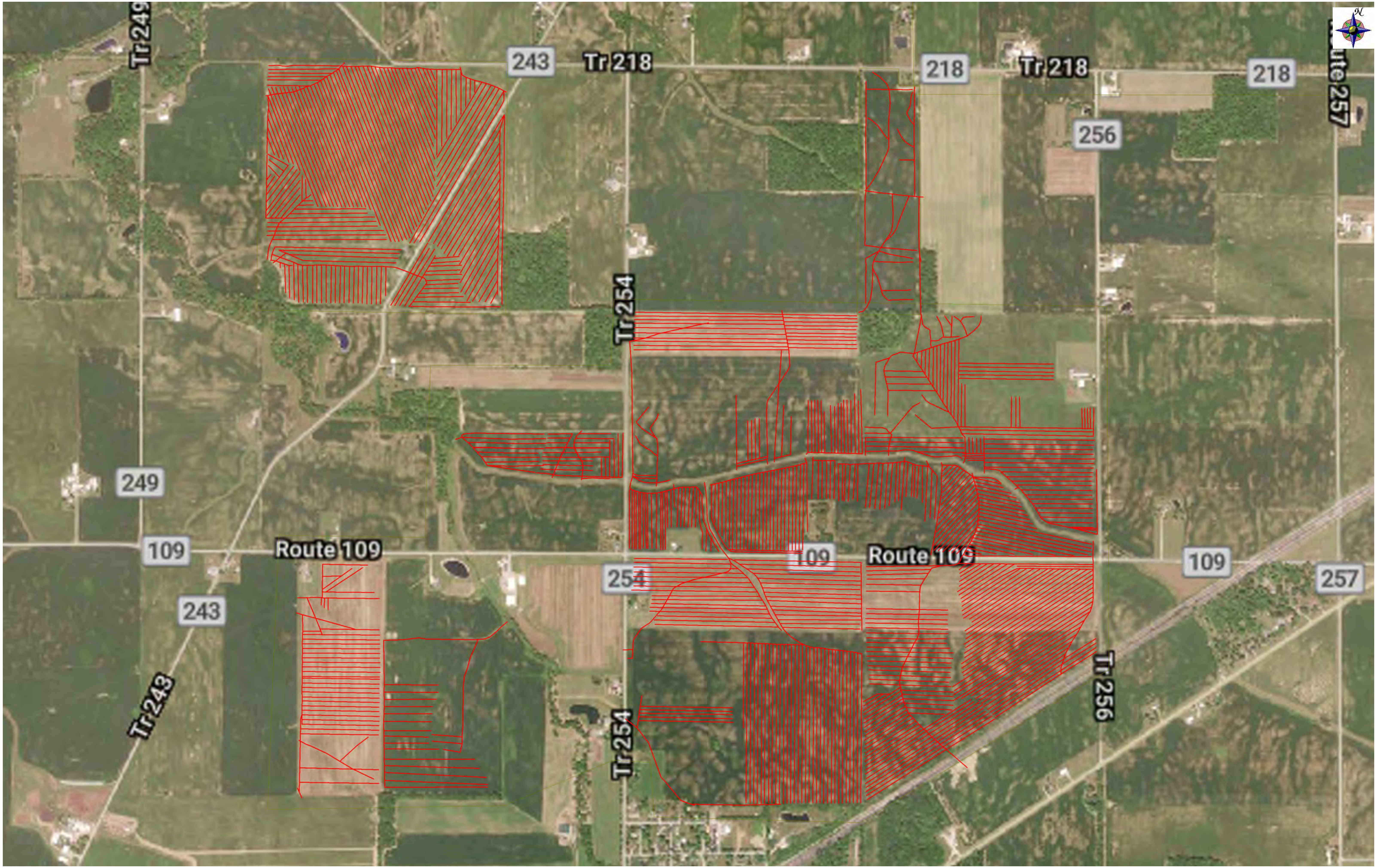
Tr 218
218
Tr 218
254
243
249
Tr 256
257
Route 109
109
Tr 254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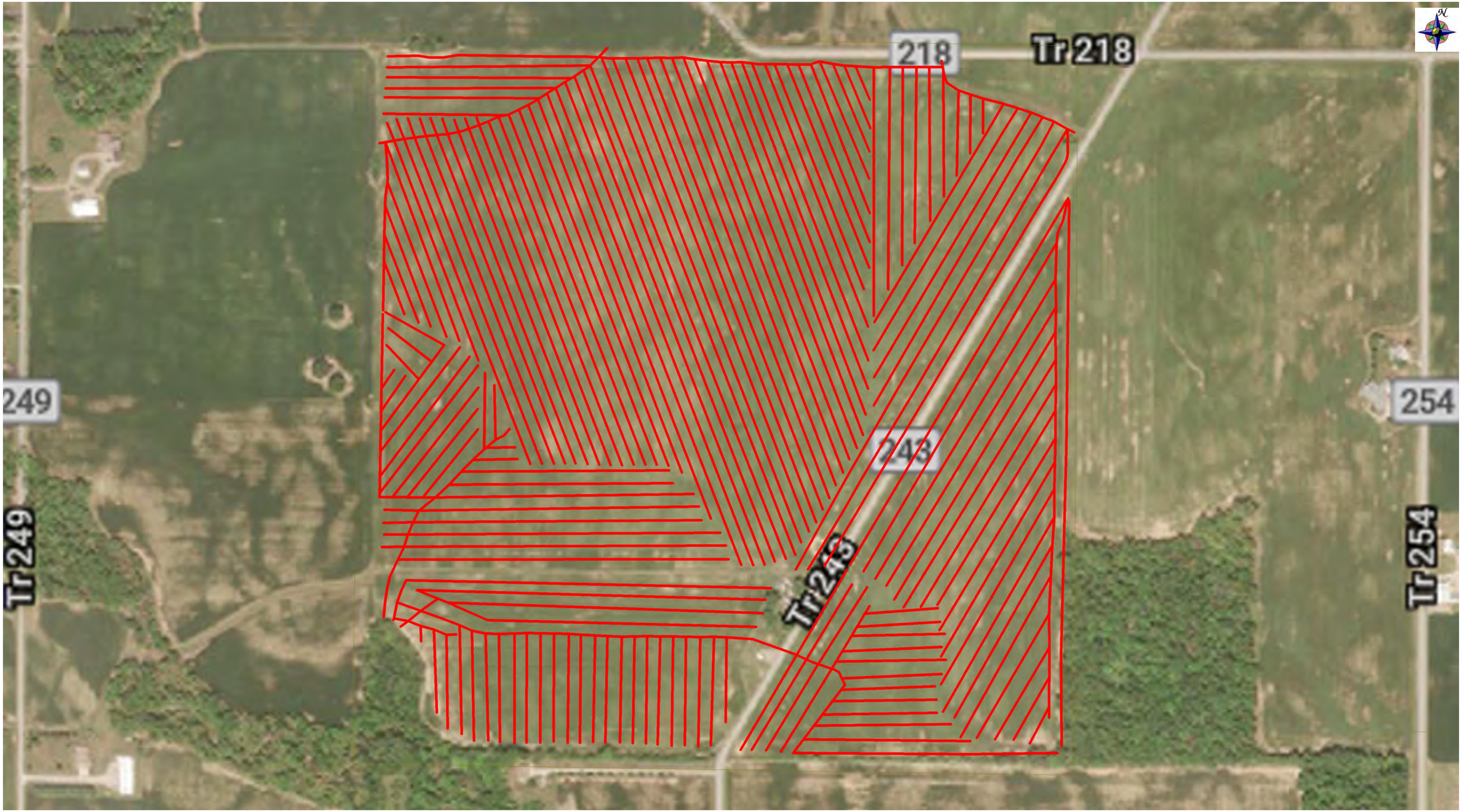
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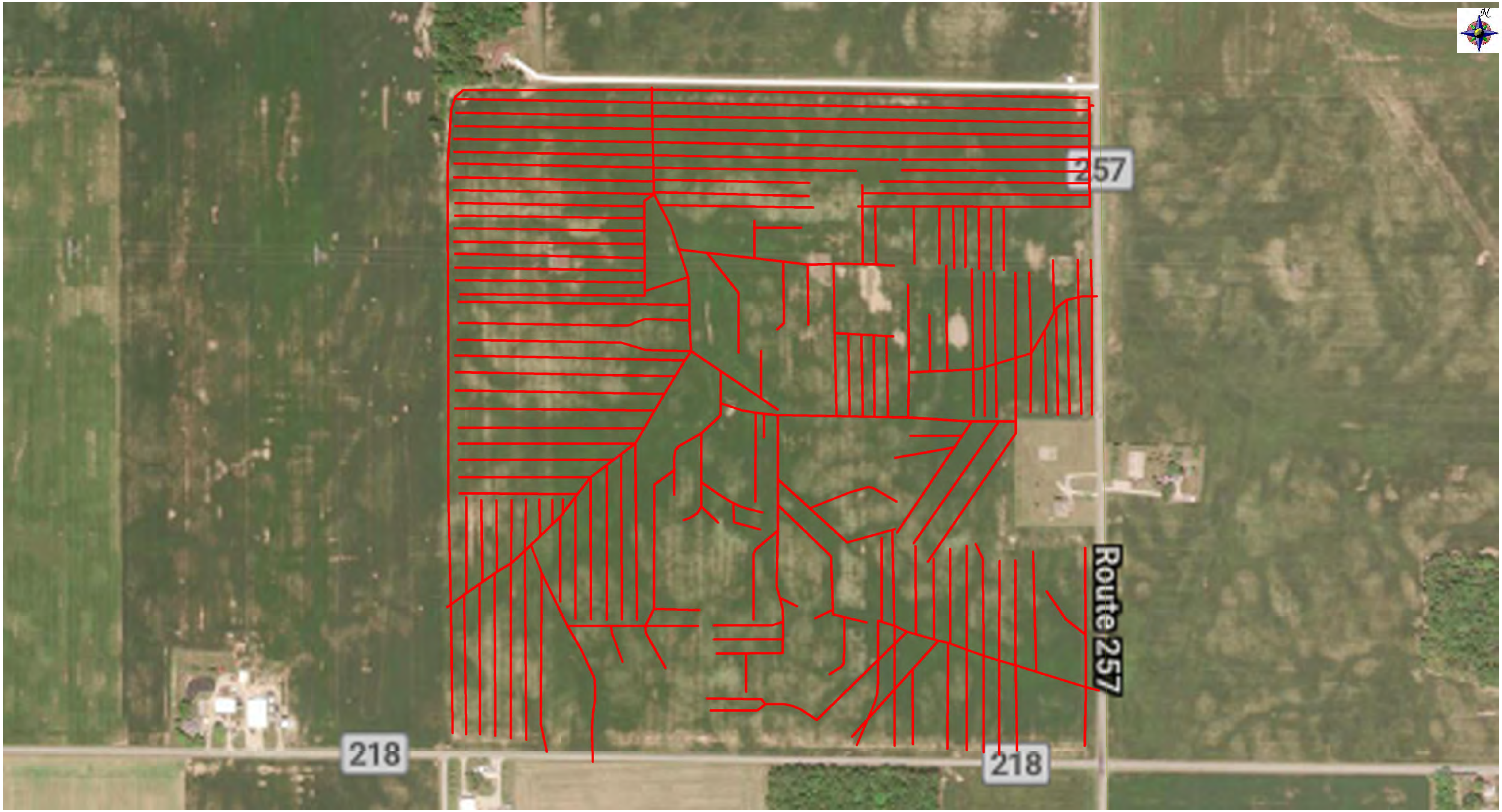
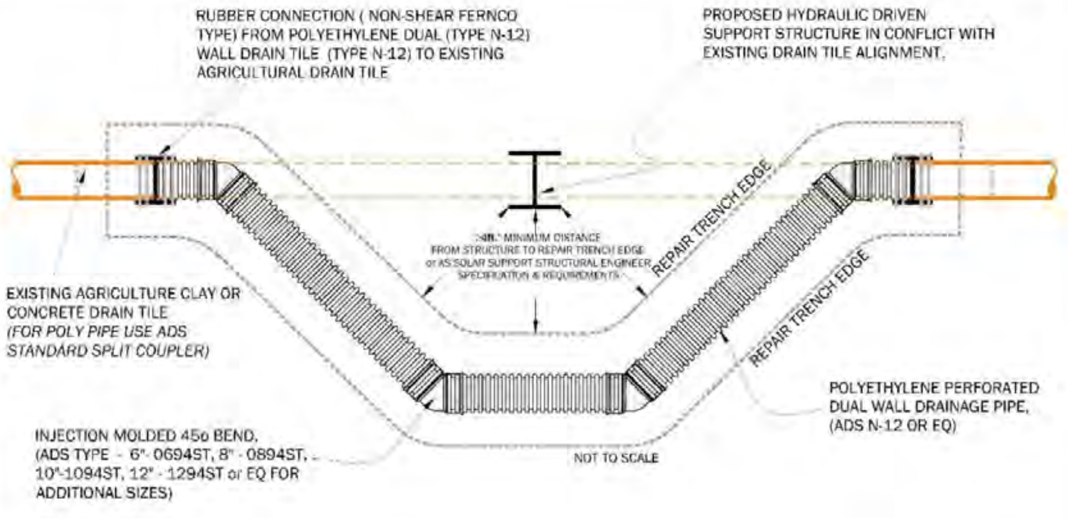

257
Route 257
218
218

Attachment B

Typical Drain Tile Repair Construction Details

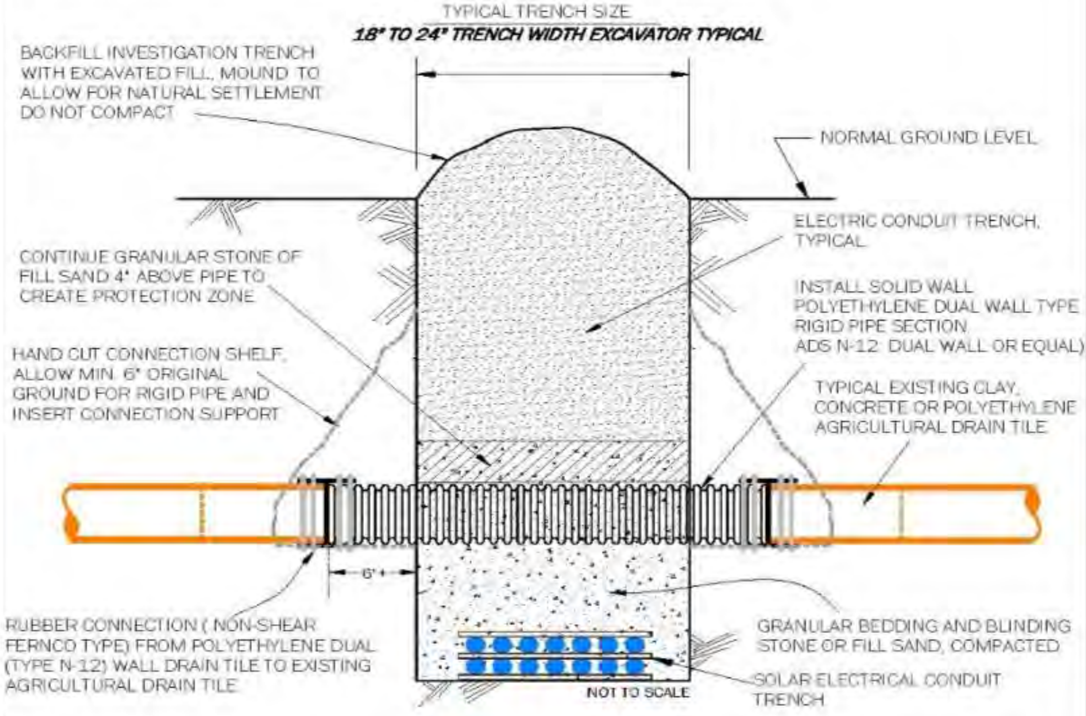


SAFETY NOTE: OPEN CUT TRENCHES SHALL BE SHEETED AND BRACED AS REQUIRED BY THE GOVERNING STATE AND FEDERAL LAWS AND MUNICIPAL ORDINANCES, AND AS MAY BE NECESSARY TO PROTECT LIFE. THE CONTRACTOR SHALL COMPLY WITH ALL STATE AND FEDERAL SAFETY REGULATIONS AS OUTLINED IN THE LATEST REVISIONS OF THE FEDERAL CONSTRUCTION SAFETY STANDARDS AND WITH APPLICABLE PROVISIONS AND REGULATIONS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

EXISTING DRAIN TILE BYPASS REROUTE

FOR COMMERCIAL SOLAR ENERGY PROJECTS
EXISTING DRAIN TILE REROUTE WHICH IS IN CONFLICT WITH FIXED IMPROVEMENT
INSTALLED AS MODIFICATION TO ORIGINAL ROUTE
HUDDLESTON - McBRIDE TYPICAL SECTION NO. 360D

TYPICAL CONSTRUCTION SECTION [360D].



SAFETY NOTE: OPEN CUT TRENCHES SHALL BE SHEETED AND BRACED AS REQUIRED BY THE GOVERNING STATE AND FEDERAL LAWS AND MUNICIPAL ORDINANCES, AND AS MAY BE NECESSARY TO PROTECT LIFE. THE CONTRACTOR SHALL COMPLY WITH ALL STATE AND FEDERAL SAFETY REGULATIONS AS OUTLINED IN THE LATEST REVISIONS OF THE FEDERAL CONSTRUCTION SAFETY STANDARDS AND WITH APPLICABLE PROVISIONS AND REGULATIONS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION.

EXISTING CLAY DRAIN TILE REPAIR SECTION AT ELECTRIC CONDUIT TRENCH

FOR COMMERCIAL SOLAR ENERGY PROJECTS
EXISTING AGRICULTURAL DRAIN TILE REPLACEMENT SECTION
TYPICAL REPAIR SECTION FOR DRAIN TILE REPAIR AT ELECTRIC CONDUIT TRENCH
HUDDLESTON DRAINAGE TYPICAL SECTION NO. 62A

TYPICAL CONSTRUCTION SECTION [62A].

APPENDIX G

PUBLIC INVOLVEMENT PROGRAM

south branch solar

Public Involvement Program

South Branch Solar
Hancock County, Ohio

July 2021

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Attachments

1. Introduction

South Branch Solar, LLC (South Branch) is proposing development of an up to 205-megawatt single-axis tracking, photovoltaic solar facility (the Project) on approximately 1,000 acres of privately-owned land in Washington Township, Hancock County, Ohio (the Project Area). South Branch has created an open dialogue with community members by being available via phone, email, and in-person visits. South Branch is committed to addressing community members' questions, complaints, and/or concerns during all phases of the Project and has developed this Public Involvement Program to assist in community engagement.

2. Public Information Meeting and Pre-Application Community Engagement

To ensure community involvement throughout the development of the Project, South Branch has been connecting and communicating with neighbors, various local government entities, and community organizations prior to commencing the Ohio Power Siting Board (OPSB) permitting process. Prior to submitting the application to the OPSB, Project representatives have met with and/or reached out to the following stakeholders:

- Washington Township Board of Trustees
- Washington Township Fire Department
- Arcadia Local School District Board of Education
- Arcadia Village Council
- Hancock County Chamber of Commerce
- Hancock County Commissioners
- Hancock County Economic Development Council
- Hancock County Hope House
- Hancock, Hardin, Seneca and Wyandot County Farm Bureau
- Hancock County Soil & Water Conservation District
- Hancock Wood Electric Cooperative
- International Brotherhood of Electrical Workers Local 8

South Branch held an in-person Public Information Meeting for South Branch Solar on June 24, 2021 to present Project details to the community. Project information materials provided at this meeting are included in Appendix A and were posted to the Project website, through which the public also has the ability to submit questions to the Project team.

Notices for these meetings were mailed to participating and adjacent landowners and public notices were published in *The Courier* in accordance with OAC 4906-3-03(B)(1). Meeting details were also posted on the Project website (www.southbranchsolar.com).

Landowners were able to request paper or digital copies of the presentation materials following the meeting, and South Branch provided a copy to the one request made. During the meeting, South Branch encouraged attendees to give input to assist in Project planning and development efforts. Questions were answered, and a Frequently Asked Questions summary section was posted to the Project website. A blank copy of the sign-in sheet and comment card are included in Appendix B.

As a result of the feedback from the Public Information Meeting and pre-application community engagement, South Branch incorporated a number of modifications to its Project design and plan. For example, South Branch significantly increased the distance of the Project from the Village of Arcadia in response to concerns pertaining to potential visual effect, which resulted in removing Project features from approximately 8.25 acres within the Project Area. Similarly, feedback regarding potential visual concerns from residents in the vicinity of the intersection of County Road 109 and Township Road 254 resulted in excluding Project features from another approximately 2.75-acre portion of the Project Area. South Branch is currently exploring opportunities to utilize such areas for the benefit of the community (e.g., development of a pollinator garden or similar use to enhance visual appearance). Concerns from neighbors about maintaining the rural character of the landscape of the community resulted in proposed enhanced vegetative screening as well. Community feedback also reinforced the importance of a careful approach to identification and maintenance of drain tiles and a thoughtful stormwater management strategy.

3. Hearings

Once the OPSB Application is filed, OPSB Staff will review and file a Report of Investigation. The OPSB will schedule two hearings: a public hearing where members of the community can testify and submit comments; and an adjudicatory hearing. South Branch will use these hearings as an opportunity to obtain additional feedback regarding the Project. South Branch and Project representatives will be available after the public hearing to address any questions and concerns from community members.

4. Complaint Resolution Plan

South Branch has developed a Complaint Resolution Plan to address public questions, concerns, and complaints prior to and during Project construction and operation. A copy of the Complaint Resolution Plan and pre-construction and pre-operation notification letters will be provided to community members in the Project area via mail as prescribed below. The Complaint Resolution Plan identifies the process for the public to file a complaint/question, as well as South Branch's protocol for response and processing protocol, including identifying:

- Points of contact for complaints, including a specialized expert for addressing drain tile issues promptly;
- Various ways contact information and Project status will be shared;
- Timing commitments for review, response, and resolution, including an acknowledgement and commitment to rapid turn-around regarding potential drain tile issues; and
- Logbook and mapping file commitments in order to evaluate and anticipate trends, track resolution progress, and provide regular reporting to the OPSB of complaint information.

The Complaint Resolution Plan has been included as a separate element of the OPSB Application.

5. Construction

At least seven days prior to construction, South Branch will send a notification letter via mail to: property owners and tenants within and adjacent to the Project Area, government officials, and emergency responders. The notice will include a construction timeline, contact information, and a copy of the Complaint Resolution Plan. As part of the Complaint Resolution Plan, South Branch will record all questions and complaints received and will respond in accordance with the procedures established in the Complaint Resolution Plan. South Branch will educate contractors on the Complaint Resolution Plan during Project planning and will discuss the Complaint Resolution Plan at the OPSB Pre-Construction Meeting.

6. Operation

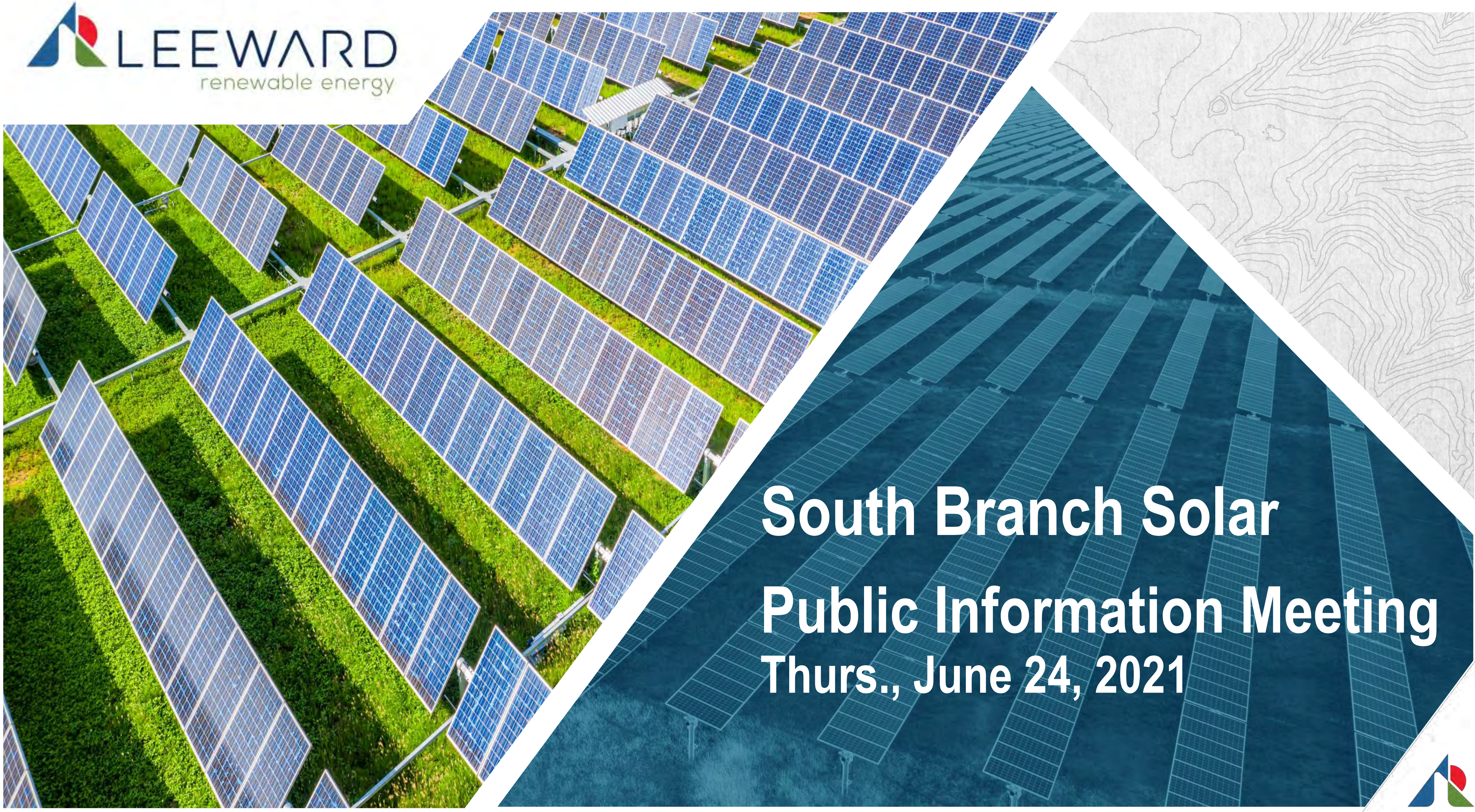
At least seven days prior to commencement of commercial operation, South Branch will send a notification letter via mail to: property owners and tenants property owners and tenants within and adjacent to the Project Area, government officials, and emergency responders. The notice will provide information about the start of operation and any remaining restoration activities. A copy of the Complaint Resolution Plan will be provided again, as updated for operational conditions and contacts. As part of the Complaint Resolution Plan, South Branch will record all questions and complaints received and will respond in accordance with the procedures established in the Complaint Resolution Plan. During Project operation it is expected that the operations and maintenance (O&M) office will house full-time employees, allowing South Branch to respond to any questions or complaints received in a timely manner.

7. Project Website

The Project website, www.southbranchsolar.com, provides an additional opportunity for residents to learn more about the Project and engage with Project representatives. The website contains information applicable to the OPSB public participation and permitting processes, the Public Information Meeting, and Project maps. South Branch's contact information is also provided, should the public have questions or concerns. Updates to contacts, including in association with complaints, will be maintained as they may change throughout the lifecycle of the Project.

ATTACHMENT A

PUBLIC INFORMATION BOARDS

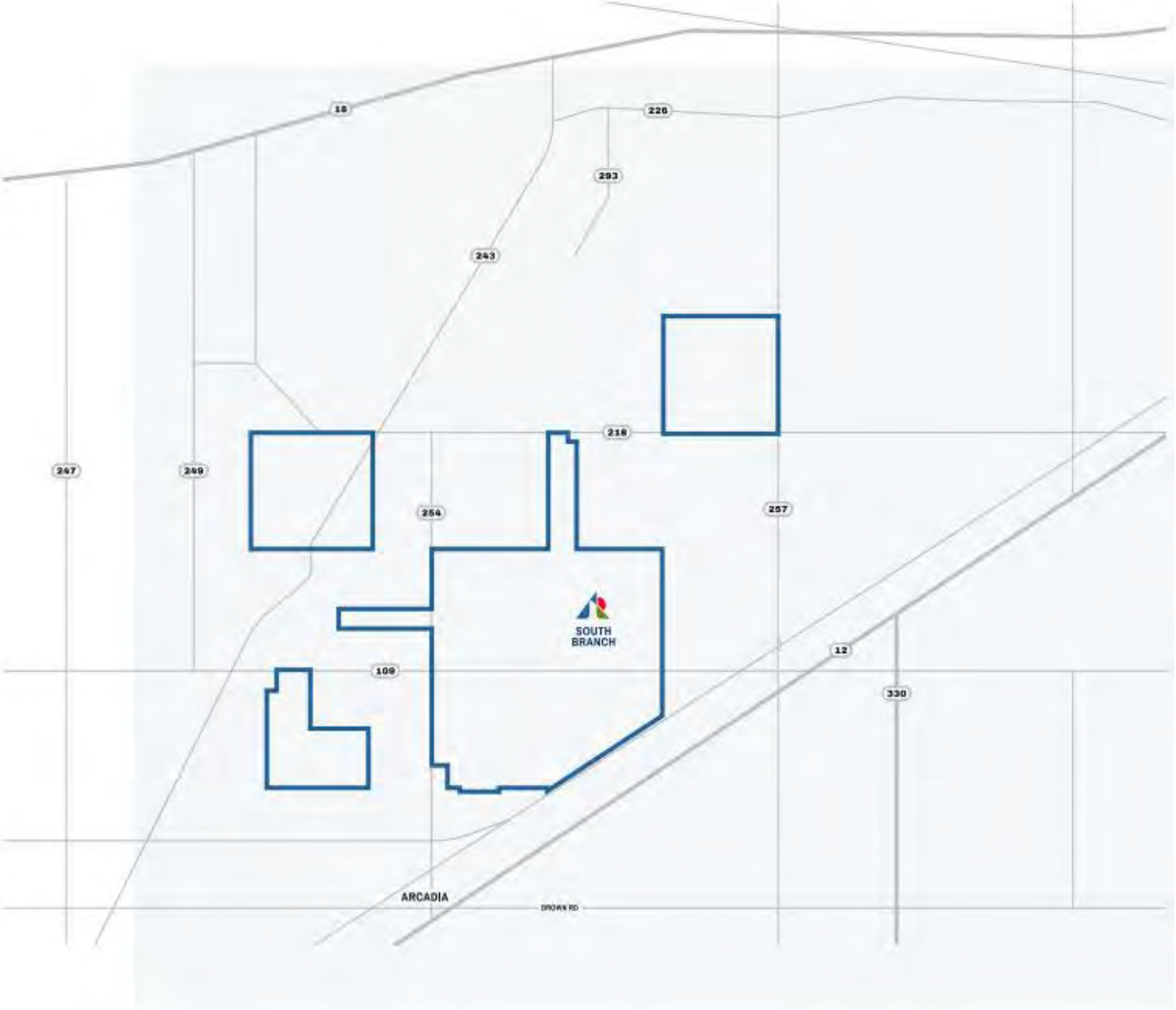


South Branch Solar

Public Information Meeting

Thurs., June 24, 2021

SOUTH BRANCH SOLAR



PROJECT FACTS

LEEWARD
renewable energy

OVERVIEW

Up to 205 megawatt (MW) alternating current (AC) solar project in the early stages of development. Electricity generated by the solar facility will be supplied to the PJM transmission system.

DESIGN

- Nearest residence 160 feet
- Visual screening with professional landscaping
- Native grasses and pollinators planted on site after construction.

LOCATION

Approximately 1,000 acres north of the Village of Arcadia in Hancock County, Ohio.

PERMITTING

- South Branch Solar will submit a permit application to the Ohio Power Siting Board (OPSB) in June 2021.
- An OPSB permit is required prior to a company constructing and operating a solar project in the state.
- As part of the OPSB permit review process, numerous studies and plans are required.

SCHEDULE

Planning	***Permitting***	***Construction***	***Operations***
2018-2020	*2021-2022*	*2023-2024*	*2024* →

WHO WE ARE – LEEWARD RENEWABLE ENERGY

- Leading developer, owner and operator of U.S. renewable generation projects.
- 22 renewable energy facilities across nine states including an approved solar project in Ohio.
- 2,000+ Megawatts (MW) of renewable energy capacity.
- 17 Gigawatts (GW) under development, spanning over 100 projects.
- Headquartered in Dallas, TX with regional offices in Chicago, IL, Houston, TX, and San Francisco, CA.
- Owner of South Branch Solar, LLC.
- Portfolio company of OMERS Infrastructure, one of Canada's largest pension plans.

FREQUENTLY ASKED QUESTIONS

PROJECT SITE SELECTION

- Suitable, flat acreage with minimal environmental and cultural sensitivities
- Near existing electrical infrastructure
- Strong regional demand for new, low-cost solar power

PROPERTY VALUES

- Solar is a low-intensity, passive use compared to many other "by-right" uses
- Project will not generate substantive noise, traffic or dust once operational
- Enhanced setbacks and professional landscaping will be used to mitigate visual impacts
- Well-developed solar projects will not have a negative impact on property values

PROJECT DECOMMISSIONING

- All improvements removed and property will be restored to its original condition
- Decommissioning bond will be posted prior to commercial operation
- 30+ years of native ground cover will rejuvenate soils

PROPERTY DRAINAGE

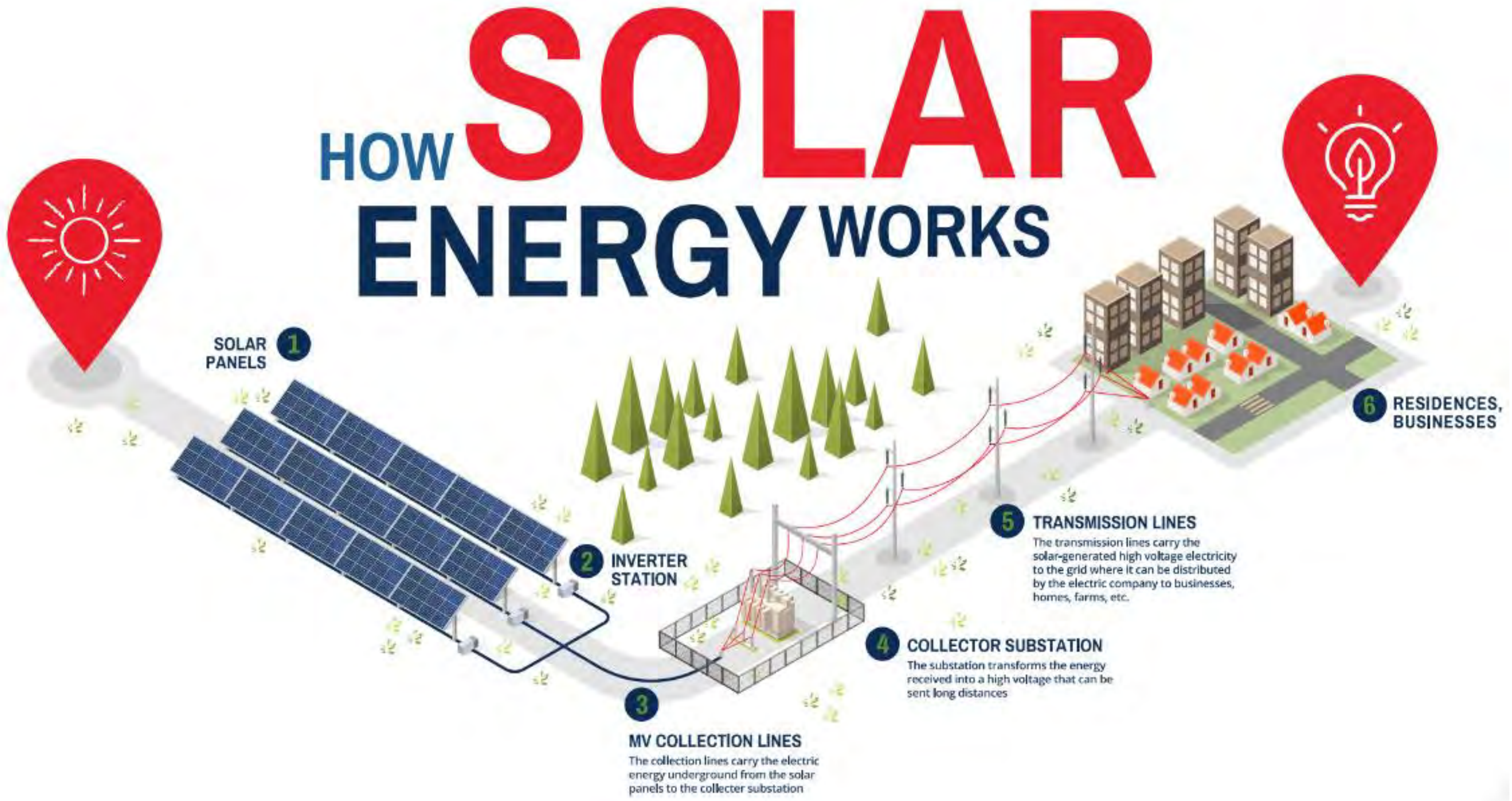
- Drainage will not be negatively impacted by the solar project
- Drain tile survey completed prior to final design and construction
- Damaged main tiles will be rerouted or repaired by local experts
- Native vegetation will benefit the property's drainage
- Proper drainage required for solar operations

NOISE & GLARE

- Negligible noise or glare beyond the project boundary
- Panels are designed to absorb light to generate electricity
- Landscape buffering further mitigates concerns

HOW IT WORKS

LEEWARD renewable energy



3 MV COLLECTION LINES
The collection lines carry the electric energy underground from the solar panels to the collecter substation

4 COLLECTOR SUBSTATION
The substation transforms the energy received into a high voltage that can be sent long distances

5 TRANSMISSION LINES
The transmission lines carry the solar-generated high voltage electricity to the grid where it can be distributed by the electric company to businesses, homes, farms, etc.

SOLAR DEVELOPMENT & PROJECT LIFECYCLE OVERVIEW

Site Selection
- Proximate capability
- Suitable access to electrical transmission system
- Electrical injection acreage – size, topography, etc.

Electrical Interconnection
- Multi-year study process resulting in an interconnection service agreement and ultimately backfeed of power to the grid

Feasibility Study → System Impact Study → Facility Study → Construction & Interconnection Service → Construction → Electrical Backfeed

Power Offtake
- Long-term Power Purchase Agreements (PPAs) with creditworthy counterparties (e.g. utilities, large industrial users, etc.)
- The PPA guarantees a revenue stream that enables the financing of the project

Permitting
- Certificate of Environmental Compatibility and Public Need (CECPN) and other discretionary actions
- Grading & building permits

Construction
- Approximately 9–18-month duration

Operations
- ~30-40+ years

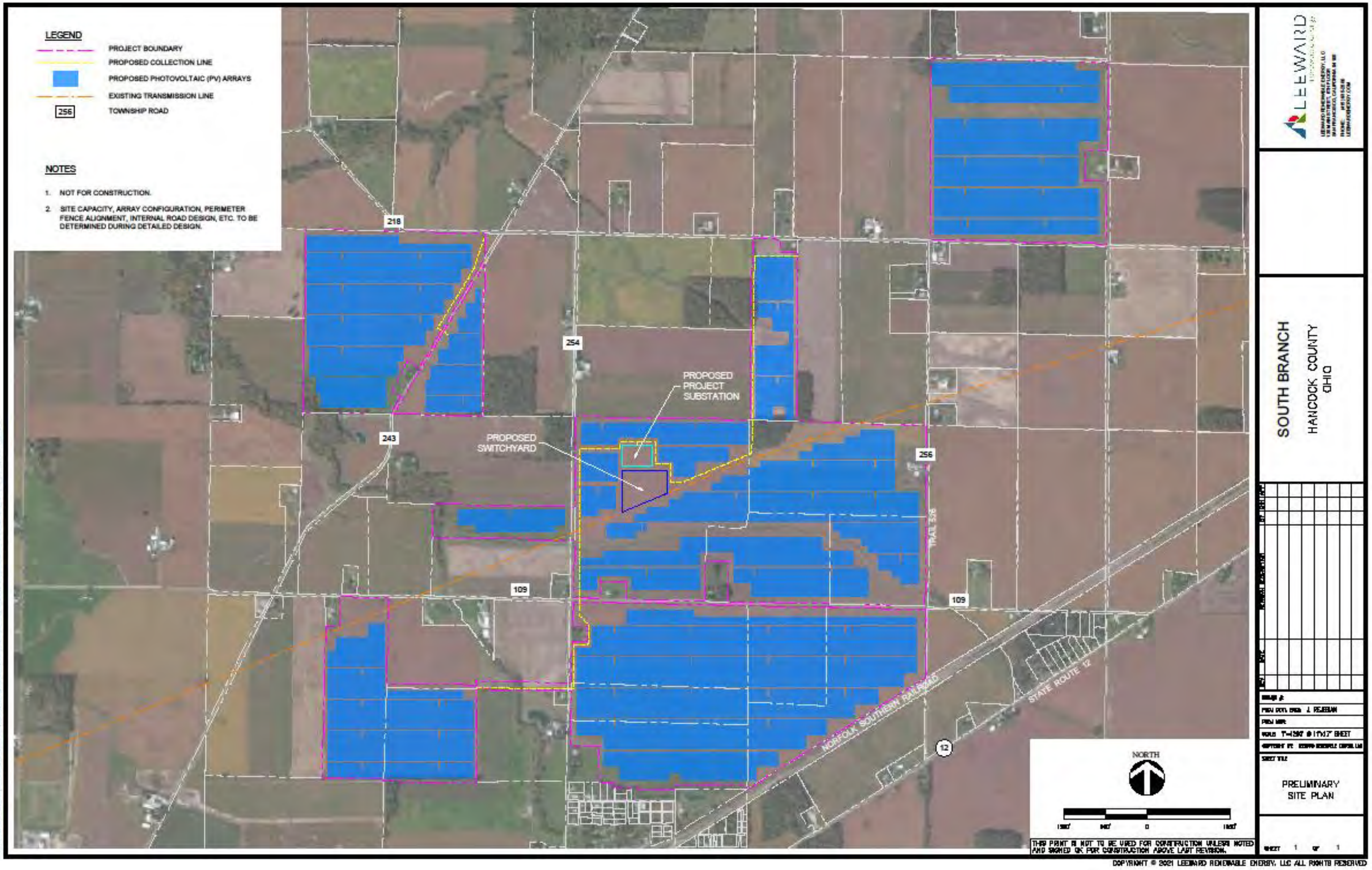
Decommissioning
- Restoration to pre-existing condition

PERMITTING STUDIES

The Ohio Power Siting Board application for South Branch Solar will include the following studies and plans:

- **Stormwater Management Strategy** – Commitment to pre-construction development of a comprehensive stormwater management plan.
- **Transportation Assessment** – Road-use planning to minimize large deliveries and adequate roadway network.
- **Geotechnical Investigation** – Preliminary analysis of subsurface conditions in the project area.
- **Acoustic Assessment** – Measurement of ambient acoustic conditions to support a project design with minimal noise outside facility boundaries.
- **Economic Impact Study** – Estimates economic costs and benefits resulting from project development.
- **Wetlands/Stream Delineations** – Formal delineations to support water resource avoidance and impact minimization.
- **Decommissioning Plan** – Roadmap for restoration following end of commercial operations.
- **Federal and State Threatened and Endangered Species Consultation** – Integrating protective measures, as appropriate, to avoid impact to listed species.
- **Visual Assessment and Simulations** – Assessment of representative views to plan landscaping and other viewshed mitigation strategies.
- **Cultural Resources Review** – Field studies to confirm no adverse impact to archaeological resources or historic structures in coordination with State Historical Preservation Office.
- **Agricultural Impacts** – Analysis of pollinator-friendly vegetation options and planning to minimize impacts to existing drainage tile systems.

PRELIMINARY SITE PLAN



NOTES

1. NOT FOR CONSTRUCTION.
2. SITE CAPACITY, ARRAY CONFIGURATION, PERIMETER FENCE ALIGNMENT, INTERNAL ROAD DESIGN, ETC. TO BE DETERMINED DURING DETAILED DESIGN.

THIS PRINT IS NOT TO BE USED FOR CONSTRUCTION UNLESS NOTED AND SIGNED OK FOR CONSTRUCTION ABOVE LAST REVISION.

PRELIMINARY SITE LAYOUT, SUBJECT TO CHANGE BASED ON DETAILED DESIGN

VISUAL SIMULATION

BEFORE - LOOKING NORTH FROM MONROE ST

VISUAL SIMULATION

AFTER– LOOKING NORTH FROM MONROE ST.

VISUAL SIMULATION

BEFORE - LOOKING SE FROM COUNTY RD. 109

VISUAL SIMULATION

AFTER - LOOKING SE FROM COUNTY RD. 109

ECONOMIC BENEFITS

ECONOMIC BENEFITS

Property Tax increase from $1.1M to $1.8M

Breakdown	**130MW**	**205MW**
▪ ARCADIA LSD	$622,109	$984,046
▪ HANCOCK COUNTY	$456,626	$722,286
▪ WASHINGTON TWP	$59,586	$94,252
▪ HANCOCK CO. PARK DISTRICT	$17,807	$28,168
▪ FINDLAY-HANCOCK CO PUBLIC LIBRARY	$10,272	$16,248
▪ ARCADIA CORP	$15,265	$31,292
TOTAL:	**$1,166,400**	**$1,845,000**

** Totals are estimates based on 2021 tax distribution*

LOCAL BENEFITS

JOB CREATION

- During construction, approximately:
  - 420 direct Ohio jobs anticipated.
  - 650 Ohio supply chain, hospitality, and other related jobs.
- On-going operational investment approximately:
  - 20 full-time jobs during the project's life throughout the state.

LOCAL IMPACTS

- Minimal impact on county services, such as schools, EMS, water, and other public services.
- No emissions generated and limited water use during operation.
- Natural vegetation throughout the project will benefit soil conditions.
- Equipment will be removed at the end of operation, and the land restored to its prior condition.

ATTACHMENT B

SIGN-IN SHEET & COMMENT CARDS

COMMUNITY MEETING SIGN-IN SHEET

South Branch Solar June 24, 2021

south branch solar

Name	Address	Email/Phone

South Branch Solar, LLC
c/o Leeward Energy
6688 North Central Expressway
Suite 500
Dallas, TX 75206
Attention: Rob Kalbouss

South Branch Solar Question/Feedback

Name:____

Phone:____

Email:____

Question or Comment:

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APPENDIX H

PJM STUDIES

PJM Studies

- AD1-070
    - Feasibility Study – January 2018
    - System Impact Study – December 2019

- AF2-375
    - Feasibility Study – July 2020
    - System Impact Study – February 2021

- AG1-076
    - Feasibility Study – January 2021

Generation Interconnection Feasibility Study Report

For

PJM Generation Interconnection Request Queue Position AD1-070

Fostoria Central 138kV

January 2018

Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

The Interconnection Customer (IC) proposes to install PJM Project #AD1-070, a 205.0 MW (36.0 MW Capacity) wind facility in Hancock County, Ohio (see Figure 2). The point of interconnection will be a direct connection AEP's Fostoria Central138kV substation (see Figure 1). The Secondary point of interconnection is to AEP's Fostoria Central – Melmore 138kV circuit (See figure 3).

The requested in backfeed date is July 1, 2020.

The requested in service date is September 30, 2020.

Attachment Facilities

Primary Point of Interconnection (Fostoria Central 138kV Substation)

To accommodate the interconnection at the Fostoria Central 138 kV substation, the installation of a new 138 kV circuit breaker will be required, associated protection and control equipment, SCADA, and 138 kV revenue metering.

Direct Connection to the Fostoria Central 138 kV Substation Work and Cost:

- Install one (1) new 138 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, SCADA, and 138 kV revenue metering will also be required.

- **Estimated Station Cost: $1,000,000**

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
138 kV Revenue Metering	$250,000
Upgrade line protection and controls at the Fostoria Central 138 kV substation.	$250,000
Total	**$500,000**

Table 1

Secondary Point of Interconnection (Fostoria Central – Melmore 138 kV)

To accommodate the interconnection on the Fostoria Central – Melmore 138 kV circuit, a new three (3) circuit breaker 138 kV switching station physically configured in a breaker and half bus arrangement but operated as a ring-bus will be constructed (see Figure 3). Installation of associated protection and control equipment, 138kV line risers, SCADA, and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Interconnection Customer Requirements

It is understood that the IC is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Fostoria Central 138 kV substation are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the “Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System” document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Option 1

Network Impacts

The Queue Project AD1-070 was evaluated as a 205.0 MW (Capacity 36.0 MW) injection at the Fostoria Central 138 kV substation in the AEP area. Project AD1-070 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-070 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2021 Case

Contingency Descriptions

The following contingencies resulted in overloads:

	Option 1
Contingency Name	**Description**
ATSI-P2-3-CEI-345-001	CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345 DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345 END
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
ATSI-P2-3-OEC-345-031	CONTINGENCY 'ATSI-P2-3-OEC-345-031' /* HAYES 345KV BRK B-3_6_ 12 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 239290 CKT 1 /* 02HAYES 345 02HAYES 138 END
ATSI-P7-1-CEI-345-001	CONTINGENCY 'ATSI-P7-1-CEI-345-001' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END

Option 1	
Contingency Name	**Description**
ATSI-P7-1-OEC-345-001	CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END

Table 2

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

AD1-070 Multiple Facility Contingency

#	Contingency		Affected Area	Facility Description	Bus		Cir.	PF	Loading		Rating		MW Con.	FG App.
	Type	Name			From	To			Initial	Final	Type	MVA		
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.49	98.98	ER	316	10.43	1
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.49	98.98	ER	316	10.43	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	87.39	88.29	ER	1243	24.49	2
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE 345 kV line	238569	239725	2	DC	91.9	92.76	ER	1646	31.13	3
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.52	99.02	ER	316	10.43	4
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.52	99.02	ER	316	10.43	
7	LFFB	ATSI-P2-3-OEC-345-031	FE - FE	X1-027A TAP-02BEAVER 345 kV line	907060	238569	1	DC	82.48	83.17	ER	1742	26.41	5

Table 3

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

AD1-070 Contribution to Previously Identified Overloads														
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.71	118.99	ER	500	14.13	6
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.71	118.99	ER	500	14.13	
3	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.41	112.69	ER	500	14.13	7
4	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.41	112.69	ER	500	14.13	

Table 4

Steady-State Voltage Requirements

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

LGEE Impacts to be determined during later study phases (as applicable).

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

OVEC Impacts to be determined during later study phases (as applicable).

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

None

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

AD1-070 Multiple Facility Contingency					
	Contingency		Affected Area	Facility Description	
#	Type	Name			
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	There is an existing PJM base line (b2897) project to reconductor the Avon-Admiral Q2 line 795Kcmil ACSR conductor to 795kcmil ACSS 45/7 strand with rating of 435MVA summer normal & 500MVA summer emergency. The base line projects are proposed to alleviate the thermal overload identified for the 2021 PJM Winter generation deliverability study. After the proposed PJM base line project has been completed the Admiral-Avon Q2 138kV line new rating would be 435MVA summer normal and 500MVA summer emergency, the limiting element would be the newly reconductor Admiral-Avon Q2 138kv transmission line, and the new expected Admiral-Avon Q2 138kV line overload would be from 62.56% to 66.93% of its 500MVA summer emergency rating, for the same contingency. See notes. Note 1: The line rating 316MVA summer emergency rating on the model is not correct. The Admiral-Avon Q2 138kV line actual rating is 273MVA summer normal and 332MVA summer emergency rating, higher than the model rating. The limiting element is a transmission line conductor 795Kcmil ACSR 36/1 strand. The line loading based on the actual line rating for the same contingency would be from 94.13% to 100.8% (DC power flow) of its emergency rating (332MVA). Note 2: (PJM b2897). The scheduled in-service date is 06/1/2021.
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	PJM identified a thermal overload on the Beaver-Carlisle 345Kv line for PJM Queue AC2-103 project. The PJM identified thermal overload was confirmed by FE. The limiting elements for the identified thermal overloads are GCY51 ZR3 relay at Beaver and relay thermal (RT) CEYB, impedance relay (ZR) GCY and relay thermal blinder (RT BDD) at Carlisle 345kV substation. ATSI proposed installing a new Dual SEL 345kV relay with UPLC at Beaver and Carlisle substation and adjusting the setting of the Carlisle 345/138kV transformer #1 over current differential relay (BDD). After the proposed projects have been completed, the new Beaver-Carlisle 345kV line rating would be 1228MVA summer normal and 1424MVA summer emergency rating, the new limiting element would be a wave-trap at Carlisle 345kV substation, and the expected line loading would be from 78.08% to 88.54% of its 1424MVA summer emergency rating for the same contingency. The estimated cost to upgrade the Beaver-Carlisle 345kv line relay is $504,700 (without tax).

AD1-070 Multiple Facility Contingency					
	Contingency				
#	Type	Name	Affected Area	Facility Description	
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE 345 kV line	PJM identified a thermal overload on the Beaver-Lake Ave 345Kv line for PJM Queue AC2-103 project. The identified thermal overload was confirmed by FE. The limiting elements for the identified overloads are the existing (2) 954Kcmil ACSR substation conductor (SCCIR) at Beaver 345kV substation and the Beaver-Lake Ave 345kV ckt 2 (2) 954Kcmil ACSR 45/7 strand conductor line drop. ATSI proposed to reconductor the existing (2) 954Kcmil ACSR substation conductor (SCCIR) at Beaver 345kV substation with (2) 954kcmil ACSS 48/7 strand conductor, 2156MVA summer normal & 2295MVA summer emergency rating and the Beaver-Lake Ave 345kV ckt 2 (2) 954Kcmil ACSR 45/7 strand conductor line drop at Beaver with (2) 954Kcmil 54/7 ACSS conductor, 2184MVA summer normal rating and 2326MVA summer emergency rating. After the proposed conductor work has been completed, the Beaver-Lake Ave 345kV ckt2 new line rating would be 1555MVA summer normal and 1892MVA summer emergency, the limiting element would be a substation conductor (SCCIR) 3500 SAC 127 conductor at Beaver substation and the new expected line overload would be from 81.73% to 92.17% of its 1892MVA summer emergency rating, for the same contingency. See note The estimated cost to reconductor the Beaver 345kV substation and line drop conductor on the Beaver-Lake Ave # 345kV line is $45,000 (without tax).
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	There is a proposed PJM base line project (b2897) to upgrade the Admiral-Lorain Q2 138kV line. The limiting elements on the Admiral-Lorain Q2 138kV line are a substation conductor SCCIR (line drop) 795Kcmil ACSR 26/7 strand and a transmission line conductor 795Kcmil ACSR 36/1 strand. The base line projects are proposed to alleviate the thermal overload identified for the 2021 PJM Winter generation deliverability study. The proposed PJM base line projects are to reconductor the existing 795Kcmil ACSR substation conductor (line drop) and 795Kcmil ACSR 26/7 strand transmission line conductor to 795kcmil ACSS with a rating of 435MVA summer normal & 500MVA summer emergency. In-service date Fall of 2020. After all the proposed PJM base line projects have been completed, the Lorain-Admiral Q2 138kV line expected overload would be from 62.58% to 66.95% of its 500MVA summer emergency rating, for the same contingency. Note 1: (PJM b2897). The scheduled in-service date is 06/1/2021.
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	
7	LFFB	ATSI-P2-3-OEC-345-031	FE - FE	X1-027A TAP-02BEAVER 345 kV line	PJM identified a thermal overload on the Beaver-Lake Ave 345Kv line for PJM Queue AC2-103 project. The identified thermal overload was confirmed by FE. The limiting elements for the identified overload are the Beaver substation conductor (SCCIR) 954Kcmil ACSR 45/7 strand (the limiting element). ATSI proposed to reconductor the exiting Beaver substation conductor (SCCIR) 954Kcmil ACSR 45/7 strand (limiting element) with bundle 954kcmil ACSS 48/7 strand conductor, 2184MVA summer normal & 2326MVA summer emergency rating. After the proposed reconductoring projects have been completed, the X1-027A-Beaver 345kV new line rating would be 1486MVA summer normal and 1878MVA summer emergency and the new limiting element would be the transmission line 954Kcmil ACSR 45/7 strand conductor, and the expected line loading would be from 78.1% to 92.29% of its 1878MVA summer emergency rating, for the same contingency. See note. The estimated cost to reconductor the Beaver substation conductor on Beaver-X1-027(Davis Bessie) 345kV line is $41,800 (without tax).

Previous System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, identified for earlier generation or transmission interconnection projects in the PJM Queue)

AD1-070 Contribution to Previously Identified Overloads					
#	**Contingency**		**Affected Area**	**Facility Description**	**Proposed Mitigation**
	Type	**Name**			
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	There is an existing proposed PJM base line upgrade project (b2896) to alleviate the overload. After the proposed PJM base line upgrade have been completed, the Black River-US Steel 138kV line rating would be 552MVA summer normal and 659MVA summer emergency. After all the proposed PJM base line projects have been completed, the Black River-Charleston (US Steel) 138kV line expected overload would be from 92.88% to 95.56% of its 659MVA summer emergency rating, for the same contingency. See note. The PJM base line projects are listed below: – PJM (b2896)-reconductor the Black River-Charleston 138kV line existing 795Kcmil ACSS conductor with bundle 795Kcmil ACSS conductor with a rating of 897MVA summer normal and 1031MVA summer emergency rating. The scheduled in-service date is 06/1/2021. – PJM (b2896)-upgrade the 2000A wave-traps at Black River and Charleston substation with 3000A wave-trap with rating of 733MVA summer normal and 831MVA summer emergency rating. The scheduled in-service date is 06/1/2021.
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	
3	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	There is an existing PJM base line upgrade project (b2896) to reduce the identified overload. After PJM base line b2896 have been completed, PJM identified additional thermal overload on the Charleston (US Steel)-Lorain Q2 138Kv line for PJM Queue AC2-103 project. The identified PJM Queue AC2-103 project thermal overload was confirmed by FE. ATSI proposed additional PJM Queue AC2-103 project mitigation to alleviate the remaining overload. After all proposed base line upgrade projects have been completed, the Charleston-Lorain Q2 138kV rating would be 548MVA summer normal and 688MVA summer emergency and the Charleston-Lorain Q2 138kV line expected overload would be 81.90% to 86.21% of its 688MVA summer emergency rating, for the same contingency. Existing PJM base line project: – PJM b2896 - reconductor the existing Charleston-Lorain Q2 138kV line 795Kcmil ACSS conductor to a bundle 795Kcmil ACSS conductor with a rating of 897MVA summer normal and 1031MVA summer emergency rating. The scheduled in-service date is 06/1/2021. – PJM b2896 - upgrade the 2000A wave-traps at Charleston and Lorain substation to 3000A wave-trap with a rating of 733MVA summer normal and 831MVA summer emergency rating. The scheduled in-service date is 06/1/2021. New Proposed mitigation: – Reconductor the existing Lorain substation (2) 795Kcmil ACSR conductor to (2) 795Kcmil ACSS 30/19 strand conductor with a rating of 796MVA summer normal and 848MVA summer emergency rating. The scheduled in-service date is 06/1/2021. The estimated cost to reconductor the existing Lorain 138kV substation conductor (SCCIR) on the Lorain - US Steel Q2 138kV line with (2) 795Kcmil ACSS 30/19 stand conductor is $86,500 (without tax).
4	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed Backfeed Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this Feasibility Study, the construction of the 205.0 MW (36.0 MW Capacity) wind generating facility (PJM Project #AD1-070) will require the following additional interconnection charges. This plan of service will interconnect the proposed wind generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the IC's generating facility.

Please note that several of the First Energy upgrades are relying on PJM Baseline projects that are not scheduled to be in service until June 2021 which affects the requested in service date.

Cost Breakdown for Point of Interconnection (Fostoria Central 138kV Substation)			
Type	**Company**	**Description**	**Est. Cost**
Attachment Cost	AEP	Install one (1) 138 kV Circuit Breaker at the Fostoria Central 138 kV Substation	$1,000,000
Non-Direct Connection Cost Estimate	AEP	Install 138 kV Revenue Metering	$250,000
	AEP	Upgrade line protection and controls at the Fostoria Central kV substation	$250,000
	FE	Upgrade the Beaver-Carlisle 345kv line relay	$504,700
	FE	Reconductor the Beaver 345kV substation and line drop conductor on the Beaver-Lake Ave # 345kV line	$45,000
	FE	Reconductor the Beaver substation conductor on Beaver-X1-027(Davis Bessie) 345kV line	$41,800
	FE	The estimated cost to reconductor the existing Lorain 138kV substation conductor (SCCIR) on the Lorain - US Steel Q2 138kV line with (2) 795Kcmil ACSS 30/19 stand conductor	$86,500
		Total Estimated Cost for Project AD1-070	**$2,178,000**

Table 5

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Option 2

Network Impacts

The Queue Project AD1-070 was evaluated as a 205.0 MW (Capacity 36.0 MW) injection tapping Fostoria to Melmore 138kV line in the AEP area. Project AD1-070 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-070 was studied with a commercial probability of 53%. Potential network impacts were as follows:

Base Case Used

Summer Peak Analysis – 2021 Case

Contingency Descriptions

The following contingencies resulted in overloads:

	Option 2
Contingency Name	**Description**
712_B3_05TIFFIN 138-1_WOMOAB	CONTINGENCY '712_B3_05TIFFIN 138-1_WOMOAB' OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243015 TO BUS 243130 CKT 1 / 243015 05GREENL 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243130 TO BUS 245637 CKT 1 / 243130 05TIFFIN 138 245637 05TIFFIN C 69.0 1 OPEN BRANCH FROM BUS 247481 TO BUS 245637 CKT 1 / 247481 05HOLME STSS69.0 245637 05TIFFIN C 69.0 1 OPEN BRANCH FROM BUS 245648 TO BUS 245637 CKT 1 / 245648 05MAULE RD 69.0 245637 05TIFFIN C 69.0 1 END
AEP_P7-1_#7731-A	CONTINGENCY 'AEP_P7-1_#7731-A' OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1 OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1 END
AEP_P7-1_#7732-A	CONTINGENCY 'AEP_P7-1_#7732-A' OPEN BRANCH FROM BUS 242953 TO BUS 243110 CKT 1 / 242953 05AIRCO8 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 242953 TO BUS 243137 CKT 1 / 242953 05AIRCO8 138 243137 05W.END 138 1 OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1

	Option 2
Contingency Name	Description
	END
ATSI-P2-3-CEI-345-001	CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345 DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345 END
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
ATSI-P7-1-CEI-345-001	CONTINGENCY 'ATSI-P7-1-CEI-345-001' /* AVON-BEAVER #1 AND #2 345KV LINE OUTAGES DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 1 /* 02AVON 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238551 TO BUS 239725 CKT 2 /* 02AVON 345 02LAKEAVE 345 END
ATSI-P7-1-OEC-345-001	CONTINGENCY 'ATSI-P7-1-OEC-345-001' /* BEAVER-LAKAVE 345 CK 1 & 2 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2 /* 02BEAVER 345 02LAKEAVE 345 END

Table 6

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

AD1-070 Multiple Facility Contingency - Option 2

	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.45	98.99	ER	316	10.78	1
2	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02AD Q-2-02AVON 138 kV line	238524	238552	1	DC	97.45	98.99	ER	316	10.78	
3	DCTL	ATSI-P7-1-OEC-345-001	FE - FE	02BEAVER-02CARLIL 345 kV line	238569	238607	1	DC	87.35	88.23	ER	1243	23.96	2
4	LFFB	ATSI-P2-3-OEC-345-023	FE - FE	02BEAVER-02LAKEAVE	238569	239725	2	DC	91.86	92.71	ER	1646	30.32	3

AD1-070 Multiple Facility Contingency - Option 2														
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
				345 kV line										
5	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.45	98.99	ER	316	10.78	4
6	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02LRN Q2-02AD Q-2 138 kV line	238915	238524	1	DC	97.45	98.99	ER	316	10.78	
7	DCTL	AEP_P7-1_#7731-A	AEP - FE	05HOWARD-02BRKSID 138 kV line	243024	238586	1	DC	83.8	99.45	ER	245	38.36	5
8	DCTL	AEP_P7-1_#7731-A	AEP - AEP	AC2-015 TAP-05HOWARD 138 kV line	932050	243024	1	DC	84.17	106.94	ER	167	38.03	6
9	DCTL	AEP_P7-1_#7732-A	AEP - AEP	AC2-015 TAP-05HOWARD 138 kV line	932050	243024	1	DC	81	102.25	ER	167	35.48	

Table 7

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

AD1-070 Contribution to Previously Identified Overloads - Option 2														
	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
10	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.67	118.99	ER	500	14.6	7
11	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02BLKRVR-02USSTEEL 138 kV line	239728	239734	1	DC	117.67	118.99	ER	500	14.6	
12	LFFB	ATSI-P2-3-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.37	112.69	ER	500	14.6	8
13	DCTL	ATSI-P7-1-CEI-345-001	FE - FE	02USSTEEL-02LRN Q2 138 kV line	239734	238915	1	DC	111.37	112.69	ER	500	14.6	

Table 8

Steady-State Voltage Requirements

None

Affected System Analysis & Mitigation

LGEE Impacts:

LGEE Impacts to be determined during later study phases (as applicable).

MISO Impacts:

MISO Impacts to be determined during later study phases (as applicable).

Duke, Progress & TVA Impacts:

Duke Carolina, Progress, & TVA Impacts to be determined during later study phases (as applicable).

OVEC Impacts:

OVEC Impacts to be determined during later study phases (as applicable).

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

AD1-070 Delivery of Energy Portion of Interconnection Request - Option 2

	Contingency		Affected	Facility	Bus				Loading		Rating		MW	FG
#	Type	Name	Area	Description	From	To	Cir.	PF	Initial	Final	Type	MVA	Con.	App.
1	Non	Non	AEP - FE	05HOWARD-02BRKSID 138 kV line	243024	238586	1	DC	103.93	108.44	NR	167	16.69	
2	Non	Non	AEP - AEP	AD1-070 TAP-05FOSTOR 138 kV line	934460	243006	1	DC	79.96	149.75	NR	167	116.55	
3	N-1	712_B3_05TIFFIN 138-1_WOMOAB	AEP - AEP	AD1-070 TAP-05FOSTOR 138 kV line	934460	243006	1	DC	83.54	137.37	ER	245	131.88	

Table 9

Figure 1: Primary Point of Interconnection (Fostoria Central 138kV Substation)

Single-Line Diagram

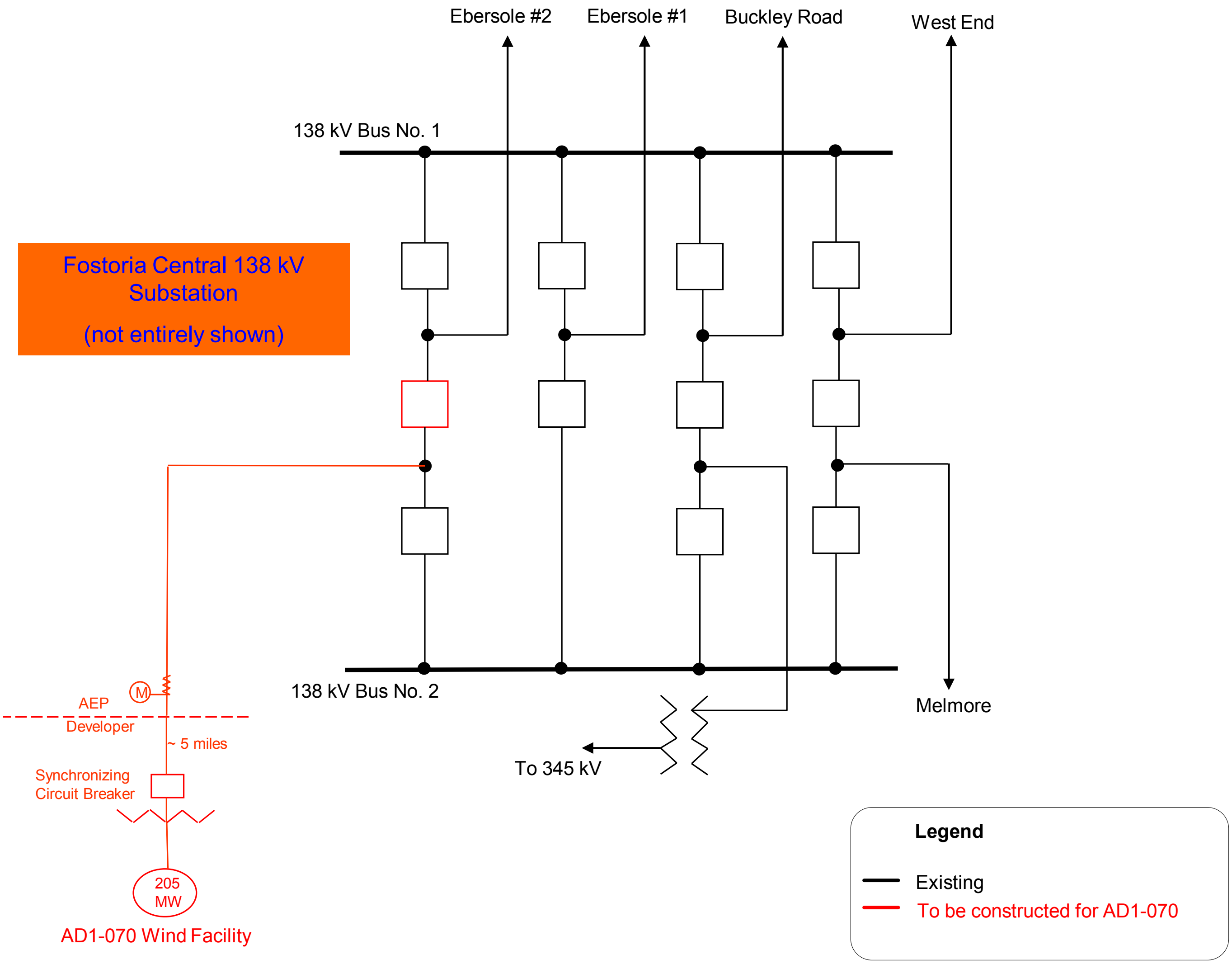


Figure 2: Primary Point of Interconnection (Fostoria Central 138 kV Substation)

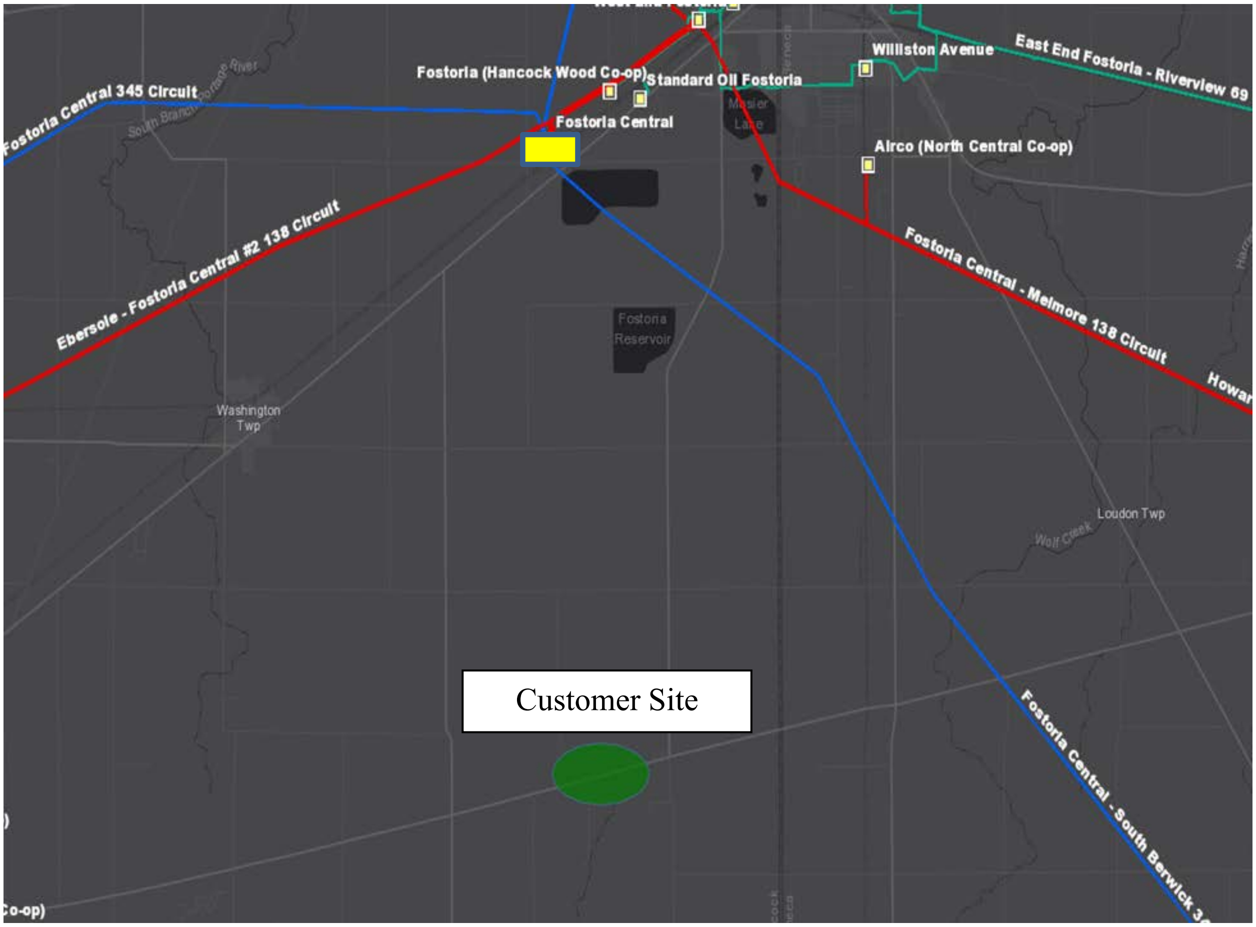


Figure 3: Secondary Point of Interconnection (Fostoria Central - Melmore 138kV)

Single-Line Diagram

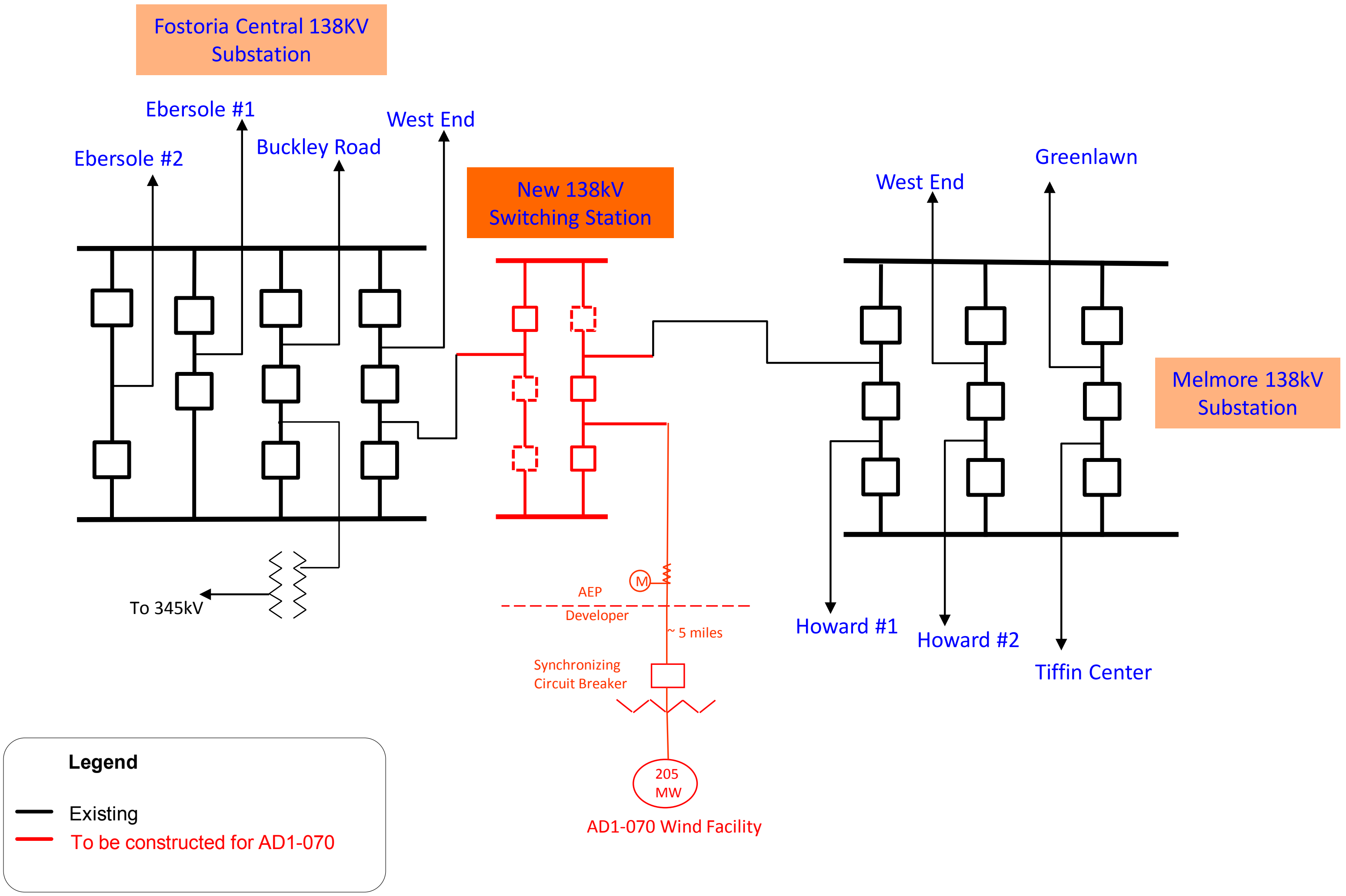


Figure 4: Secondary Point of Interconnection (Fostoria Central - Melmore 138kV)

Appendices - Option 1

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(FE - FE) The 02AD Q-2-02AVON 138 kV line (from bus 238524 to bus 238552 ckt 1) loads from 97.49% to 98.98% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.43 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O1*	*1.83*
934462	*AD1-070 E O1*	*8.6*
934761	*AD1-103 C O1*	*6.28*
934762	*AD1-103 E O1*	*42.02*
934891	*AD1-118*	*4.4*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*

901803	*W1-072A*	*2.52*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 2

(FE - FE) The 02BEAVER-02CARLIL 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 87.39% to 88.29% (**DC power flow**) of its emergency rating (1243 MVA) for the tower line contingency outage of 'ATSI-P7-1-OEC-345-001'. This project contributes approximately 24.49 MW to the thermal violation.

CONTINGENCY 'ATSI-P7-1-OEC-345-001'   /* BEAVER-LAKAVE 345 CK 1 & 2
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1   /* 02BEAVER 345 02LAKEAVE 345
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2   /* 02BEAVER 345 02LAKEAVE 345
  END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*22.36*
240968	*02BG2 GEN*	*1.12*
240969	*02BG4 G1*	*0.28*
240970	*02BG4 G2&3*	*0.56*
240971	*02BG4 G4&5*	*0.56*
240950	*02BG5*	*3.41*
240973	*02BG6 AMPO*	*4.97*
238670	*02DVBSG1*	*38.31*
238979	*02NAPMUN*	*5.32*
240975	*02PGE GEN*	*7.7*
239171	*02WLORG-2*	*6.1*
239172	*02WLORG-3*	*6.27*
239173	*02WLORG-4*	*6.26*
239174	*02WLORG-5*	*6.28*
932051	*AC2-015 C*	*4.94*
932052	*AC2-015 E*	*5.77*
932791	*AC2-103 C*	*11.37*
932792	*AC2-103 E*	*76.12*
934251	*AD1-052 C1*	*2.07*
934261	*AD1-052 C2*	*2.07*
934252	*AD1-052 E1*	*0.92*
934262	*AD1-052 E2*	*0.92*
934461	*AD1-070 C O1*	*4.3*
934462	*AD1-070 E O1*	*20.19*
934761	*AD1-103 C O1*	*19.12*
934762	*AD1-103 E O1*	*127.96*
934891	*AD1-118*	*11.43*
940241	*J419*	*8.29*
981121	*J444*	*19.57*
247551	*U4-028 C*	*1.49*

247940	*U4-028 E*	*9.94*
247552	*U4-029 C*	*1.49*
247941	*U4-029 E*	*9.94*
247567	*V2-006 C*	*1.77*
247961	*V2-006 E*	*11.85*
247548	*V4-010 C*	*3.21*
247947	*V4-010 E*	*21.47*
901803	*W1-072A*	*6.53*
907061	*X1-027A C1*	*0.94*
907064	*X1-027A C2*	*0.94*
907066	*X1-027A C3*	*0.94*
907068	*X1-027A C4*	*0.94*
907062	*X1-027A E1*	*31.98*
907065	*X1-027A E2*	*31.98*
907067	*X1-027A E3*	*31.98*
907069	*X1-027A E4*	*31.98*
931951	*AB1-107 1*	*43.8*
931961	*AB1-107 2*	*101.15*
925751	*AC1-051 C*	*0.7*
925752	*AC1-051 E*	*4.7*
926941	*AC1-181*	*0.58*

Appendix 3

(FE - FE) The 02BEAVER-02LAKEAVE 345 kV line (from bus 238569 to bus 239725 ckt 2) loads from 91.9% to 92.76% (**DC power flow**) of its emergency rating (1646 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-OEC-345-023'. This project contributes approximately 31.13 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-OEC-345-023'                    /* BEAVER 345KV BRK B-
121
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1          /* 02BEAVER
345 02LAKEAVE 345
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1          /* 02BEAVER
345 02CARLIL 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*33.94*
238564	*02BAYSG1*	*28.22*
240968	*02BG2 GEN*	*1.41*
240969	*02BG4 G1*	*0.35*
240970	*02BG4 G2&3*	*0.71*
240971	*02BG4 G4&5*	*0.71*
240950	*02BG5*	*4.31*
240973	*02BG6 AMPO*	*6.29*
239276	*02COLLW 11*	*-4.18*
239297	*02CPPW41*	*-5.13*
238670	*02DVBSG1*	*48.53*
238979	*02NAPMUN*	*6.76*
240975	*02PGE GEN*	*9.73*
239171	*02WLORG-2*	*7.75*
239172	*02WLORG-3*	*7.96*
239173	*02WLORG-4*	*7.94*
239174	*02WLORG-5*	*7.97*
932051	*AC2-015 C*	*6.25*
932052	*AC2-015 E*	*7.3*
932791	*AC2-103 C*	*14.43*
932792	*AC2-103 E*	*96.56*
934251	*AD1-052 C1*	*2.56*
934261	*AD1-052 C2*	*2.56*
934252	*AD1-052 E1*	*1.14*
934262	*AD1-052 E2*	*1.14*
934461	*AD1-070 C O1*	*5.47*
934462	*AD1-070 E O1*	*25.67*
934761	*AD1-103 C O1*	*24.26*
934762	*AD1-103 E O1*	*162.32*
934891	*AD1-118*	*14.5*

247551	*U4-028 C*	*1.87*
247940	*U4-028 E*	*12.52*
247552	*U4-029 C*	*1.87*
247941	*U4-029 E*	*12.52*
247567	*V2-006 C*	*2.29*
247961	*V2-006 E*	*15.29*
247548	*V4-010 C*	*4.02*
247947	*V4-010 E*	*26.91*
901803	*W1-072A*	*8.29*
907061	*X1-027A C1*	*1.19*
907064	*X1-027A C2*	*1.19*
907066	*X1-027A C3*	*1.19*
907068	*X1-027A C4*	*1.19*
907062	*X1-027A E1*	*40.57*
907065	*X1-027A E2*	*40.57*
907067	*X1-027A E3*	*40.57*
907069	*X1-027A E4*	*40.57*
918401	*AA1-056*	*1.95*
931951	*AB1-107 1*	*55.28*
931961	*AB1-107 2*	*128.22*
925751	*AC1-051 C*	*0.89*
925752	*AC1-051 E*	*5.95*
926941	*AC1-181*	*0.74*

Appendix 4

(FE - FE) The 02LRN Q2-02AD Q-2 138 kV line (from bus 238915 to bus 238524 ckt 1) loads from 97.52% to 99.02% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.43 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O1*	*1.83*
934462	*AD1-070 E O1*	*8.6*
934761	*AD1-103 C O1*	*6.28*
934762	*AD1-103 E O1*	*42.02*
934891	*AD1-118*	*4.4*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*

901803	*W1-072A*	*2.52*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 5

(FE - FE) The X1-027A TAP-02BEAVER 345 kV line (from bus 907060 to bus 238569 ckt 1) loads from 82.48% to 83.17% (**DC power flow**) of its emergency rating (1742 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-OEC-345-031'. This project contributes approximately 26.41 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-OEC-345-031'                    /* HAYES 345KV BRK B-
3_6_ 12
  DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1         /* 02HAYES
345 02DAV-BE 345
  DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1         /* 02HAYES
345 02BEAVER 345
  DISCONNECT BRANCH FROM BUS 239289 TO BUS 239290 CKT 1         /* 02HAYES
345 02HAYES 138
  END
```

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*33.44*
238564	*02BAYSG1*	*25.03*
240968	*02BG2 GEN*	*1.25*
240969	*02BG4 G1*	*0.31*
240970	*02BG4 G2&3*	*0.62*
240971	*02BG4 G4&5*	*0.62*
240950	*02BG5*	*3.83*
240973	*02BG6 AMPO*	*5.56*
239276	*02COLLW 11*	*-3.19*
239297	*02CPPW41*	*-3.91*
238670	*02DVBSG1*	*51.66*
238885	*02LEMOG1*	*6.33*
238886	*02LEMOG2*	*6.33*
238887	*02LEMOG3*	*6.33*
238888	*02LEMOG4*	*6.33*
238979	*02NAPMUN*	*6.24*
240975	*02PGE GEN*	*8.62*
932791	*AC2-103 C*	*20.36*
932792	*AC2-103 E*	*136.25*
934461	*AD1-070 C O1*	*4.64*
934462	*AD1-070 E O1*	*21.77*
934761	*AD1-103 C O1*	*34.22*
934762	*AD1-103 E O1*	*229.04*
934891	*AD1-118*	*14.1*
247567	*V2-006 C*	*2.07*
247961	*V2-006 E*	*13.88*
901803	*W1-072A*	*8.06*
907061	*X1-027A C1*	*1.68*

907064	*X1-027A C2*	*1.68*
907066	*X1-027A C3*	*1.68*
907068	*X1-027A C4*	*1.68*
907062	*X1-027A E1*	*57.24*
907065	*X1-027A E2*	*57.24*
907067	*X1-027A E3*	*57.24*
907069	*X1-027A E4*	*57.24*
918401	*AA1-056*	*1.93*
931951	*AB1-107 1*	*49.16*
931961	*AB1-107 2*	*126.33*
926941	*AC1-181*	*0.68*

Appendix 6

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 117.71% to 118.99% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.13 MW to the thermal violation.

CONTINGENCY 'ATSI-P2-3-CEI-345-001' /* BREAKER FAILURE ON S145 BREAKER AT AVON 345KV
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1 /* 02LAKEAVE 345 02AVON 345
DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2 /* 02LAKEAVE 345 02AVON 345
END

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O1*	*2.48*
934462	*AD1-070 E O1*	*11.65*
934761	*AD1-103 C O1*	*8.52*
934762	*AD1-103 E O1*	*57.*
934891	*AD1-118*	*5.97*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*

247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

Appendix 7

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 111.41% to 112.69% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.13 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O1*	*2.48*
934462	*AD1-070 E O1*	*11.65*
934761	*AD1-103 C O1*	*8.52*
934762	*AD1-103 E O1*	*57.*
934891	*AD1-118*	*5.97*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*

247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

Appendices – Option 2

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. Although this information is not used "as is" for cost allocation purposes, it can be used to gage other generators impact.

It should be noted the generator contributions presented in the appendices sections are full contributions, whereas in the body of the report, those contributions take into consideration the commercial probability of each project.

Appendix 1

(FE - FE) The 02AD Q-2-02AVON 138 kV line (from bus 238524 to bus 238552 ckt 1) loads from 97.45% to 98.99% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.78 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O2*	*1.89*
934462	*AD1-070 E O2*	*8.89*
934761	*AD1-103 C O2*	*6.33*
934762	*AD1-103 E O2*	*42.39*
934891	*AD1-118*	*4.4*
LTF	*CARR*	*0.9*
LTF	*CBM-S1*	*3.88*
LTF	*CBM-S2*	*1.64*
LTF	*CBM-W1*	*31.44*
LTF	*CBM-W2*	*27.29*
LTF	*CIN*	*4.37*

LTF	*CPLE*	*0.29*
LTF	*G-007*	*1.12*
LTF	*IPL*	*2.81*
LTF	*LGEE*	*0.8*
LTF	*MEC*	*8.63*
LTF	*MECS*	*16.34*
LTF	*O-066*	*3.81*
LTF	*RENSSELAER*	*0.7*
LTF	*ROSETON*	*5.06*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*
901803	*W1-072A*	*2.52*
LTF	*WEC*	*1.39*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
LTF	*Y3-032*	*13.61*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 2

(FE - FE) The 02BEAVER-02CARLIL 345 kV line (from bus 238569 to bus 238607 ckt 1) loads from 87.35% to 88.23% (**DC power flow**) of its emergency rating (1243 MVA) for the tower line contingency outage of 'ATSI-P7-1-OEC-345-001'. This project contributes approximately 23.96 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P7-1-OEC-345-001'                    /* BEAVER-LAKAVE 345
CK 1 & 2
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1           /* 02BEAVER
345 02LAKEAVE 345
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 2           /* 02BEAVER
345 02LAKEAVE 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*22.36*
240968	*02BG2 GEN*	*1.12*
240969	*02BG4 G1*	*0.28*
240970	*02BG4 G2&3*	*0.56*
240971	*02BG4 G4&5*	*0.56*
240950	*02BG5*	*3.41*
240973	*02BG6 AMPO*	*4.97*
238670	*02DVBSG1*	*38.31*
238979	*02NAPMUN*	*5.32*
240975	*02PGE GEN*	*7.7*
239171	*02WLORG-2*	*6.1*
239172	*02WLORG-3*	*6.27*
239173	*02WLORG-4*	*6.26*
239174	*02WLORG-5*	*6.28*
932051	*AC2-015 C*	*4.94*
932052	*AC2-015 E*	*5.77*
932791	*AC2-103 C*	*11.37*
932792	*AC2-103 E*	*76.11*
934251	*AD1-052 C1*	*2.07*
934261	*AD1-052 C2*	*2.07*
934252	*AD1-052 E1*	*0.92*
934262	*AD1-052 E2*	*0.92*
934461	*AD1-070 C O2*	*4.21*
934462	*AD1-070 E O2*	*19.75*
LTF	*AD1-092*	*4.68*
LTF	*AD1-093*	*8.03*
LTF	*AD1-094*	*1.53*
934761	*AD1-103 C O2*	*18.07*
934762	*AD1-103 E O2*	*120.91*
934891	*AD1-118*	*11.43*

LTF	*CARR*	*1.36*
LTF	*CBM-S1*	*7.56*
LTF	*CBM-S2*	*2.4*
LTF	*CBM-W1*	*73.96*
LTF	*CBM-W2*	*55.9*
LTF	*CIN*	*9.16*
LTF	*CPLE*	*0.34*
LTF	*G-007*	*2.55*
LTF	*IPL*	*5.9*
940241	*J419*	*8.29*
981121	*J444*	*19.57*
LTF	*LGEE*	*1.6*
LTF	*MEC*	*18.54*
LTF	*MECS*	*41.25*
LTF	*O-066*	*8.62*
LTF	*RENSSELAER*	*1.07*
LTF	*ROSETON*	*7.74*
247551	*U4-028 C*	*1.49*
247940	*U4-028 E*	*9.94*
247552	*U4-029 C*	*1.49*
247941	*U4-029 E*	*9.94*
247567	*V2-006 C*	*1.77*
247961	*V2-006 E*	*11.85*
247548	*V4-010 C*	*3.21*
247947	*V4-010 E*	*21.47*
901803	*W1-072A*	*6.53*
LTF	*WEC*	*3.05*
907061	*X1-027A C1*	*0.94*
907064	*X1-027A C2*	*0.94*
907066	*X1-027A C3*	*0.94*
907068	*X1-027A C4*	*0.94*
907062	*X1-027A E1*	*31.98*
907065	*X1-027A E2*	*31.98*
907067	*X1-027A E3*	*31.98*
907069	*X1-027A E4*	*31.98*
LTF	*Y3-032*	*34.89*
LTF	*Z1-043*	*11.71*
931951	*AB1-107 1*	*43.8*
931961	*AB1-107 2*	*101.14*
LTF	*AB2-013*	*6.69*
925751	*AC1-051 C*	*0.7*
925752	*AC1-051 E*	*4.7*
926941	*AC1-181*	*0.58*

Appendix 3

(FE - FE) The 02BEAVER-02LAKEAVE 345 kV line (from bus 238569 to bus 239725 ckt 2) loads from 91.86% to 92.71% (**DC power flow**) of its emergency rating (1646 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-OEC-345-023'. This project contributes approximately 30.32 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-OEC-345-023'                    /* BEAVER 345KV BRK B-
121
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1          /* 02BEAVER
345 02LAKEAVE 345
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1          /* 02BEAVER
345 02CARLIL 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
241902	*02_Y1-069 GE*	*33.94*
238564	*02BAYSG1*	*28.22*
240968	*02BG2 GEN*	*1.41*
240969	*02BG4 G1*	*0.35*
240970	*02BG4 G2&3*	*0.71*
240971	*02BG4 G4&5*	*0.71*
240950	*02BG5*	*4.31*
240973	*02BG6 AMPO*	*6.29*
239276	*02COLLW 11*	*-4.18*
239297	*02CPPW41*	*-5.13*
238670	*02DVBSG1*	*48.52*
238979	*02NAPMUN*	*6.75*
240975	*02PGE GEN*	*9.73*
239171	*02WLORG-2*	*7.75*
239172	*02WLORG-3*	*7.96*
239173	*02WLORG-4*	*7.94*
239174	*02WLORG-5*	*7.97*
932051	*AC2-015 C*	*6.25*
932052	*AC2-015 E*	*7.3*
932791	*AC2-103 C*	*14.43*
932792	*AC2-103 E*	*96.56*
934251	*AD1-052 C1*	*2.56*
934261	*AD1-052 C2*	*2.56*
934252	*AD1-052 E1*	*1.14*
934262	*AD1-052 E2*	*1.14*
934461	*AD1-070 C O2*	*5.32*
934462	*AD1-070 E O2*	*25.*
LTF	*AD1-092*	*6.31*
LTF	*AD1-093*	*10.84*
LTF	*AD1-094*	*2.07*

934761	*AD1-103 C O2*	*22.81*
934762	*AD1-103 E O2*	*152.63*
934891	*AD1-118*	*14.5*
LTF	*CARR*	*2.21*
LTF	*CBM-S1*	*10.75*
LTF	*CBM-S2*	*3.99*
LTF	*CBM-W1*	*97.12*
LTF	*CBM-W2*	*77.65*
LTF	*CIN*	*12.56*
LTF	*CPLE*	*0.65*
LTF	*G-007*	*3.32*
LTF	*IPL*	*8.09*
LTF	*LGEE*	*2.24*
LTF	*MEC*	*25.21*
LTF	*MECS*	*52.8*
LTF	*O-066*	*11.27*
LTF	*RENSSELAER*	*1.73*
LTF	*ROSETON*	*12.51*
247551	*U4-028 C*	*1.87*
247940	*U4-028 E*	*12.52*
247552	*U4-029 C*	*1.87*
247941	*U4-029 E*	*12.52*
247567	*V2-006 C*	*2.29*
247961	*V2-006 E*	*15.29*
247548	*V4-010 C*	*4.02*
247947	*V4-010 E*	*26.91*
901803	*W1-072A*	*8.29*
LTF	*WEC*	*4.1*
907061	*X1-027A C1*	*1.19*
907064	*X1-027A C2*	*1.19*
907066	*X1-027A C3*	*1.19*
907068	*X1-027A C4*	*1.19*
907062	*X1-027A E1*	*40.57*
907065	*X1-027A E2*	*40.57*
907067	*X1-027A E3*	*40.57*
907069	*X1-027A E4*	*40.57*
LTF	*Y3-032*	*44.43*
LTF	*Z1-043*	*15.79*
918401	*AA1-056*	*1.95*
931951	*AB1-107 1*	*55.28*
931961	*AB1-107 2*	*128.22*
LTF	*AB2-013*	*9.03*
925751	*AC1-051 C*	*0.89*
925752	*AC1-051 E*	*5.95*
926941	*AC1-181*	*0.74*

Appendix 4

(FE - FE) The 02LRN Q2-02AD Q-2 138 kV line (from bus 238915 to bus 238524 ckt 1) loads from 97.45% to 98.99% (**DC power flow**) of its emergency rating (316 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 10.78 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*8.97*
238572	*02BEAVGB*	*1.6*
240968	*02BG2 GEN*	*0.45*
240969	*02BG4 G1*	*0.11*
240970	*02BG4 G2&3*	*0.23*
240971	*02BG4 G4&5*	*0.23*
240950	*02BG5*	*1.38*
240973	*02BG6 AMPO*	*2.01*
239276	*02COLLW 11*	*-2.18*
239297	*02CPPW41*	*-2.81*
238979	*02NAPMUN*	*2.12*
240975	*02PGE GEN*	*3.11*
239175	*02WLORG-6*	*2.53*
932791	*AC2-103 C*	*3.73*
932792	*AC2-103 E*	*24.99*
934251	*AD1-052 C1*	*0.99*
934261	*AD1-052 C2*	*0.99*
934252	*AD1-052 E1*	*0.44*
934262	*AD1-052 E2*	*0.44*
934461	*AD1-070 C O2*	*1.89*
934462	*AD1-070 E O2*	*8.89*
934761	*AD1-103 C O2*	*6.33*
934762	*AD1-103 E O2*	*42.39*
934891	*AD1-118*	*4.4*
LTF	*CARR*	*0.9*
LTF	*CBM-S1*	*3.88*
LTF	*CBM-S2*	*1.64*
LTF	*CBM-W1*	*31.44*
LTF	*CBM-W2*	*27.29*
LTF	*CIN*	*4.37*

LTF	*CPLE*	*0.29*
LTF	*G-007*	*1.12*
LTF	*IPL*	*2.81*
LTF	*LGEE*	*0.8*
LTF	*MEC*	*8.63*
LTF	*MECS*	*16.34*
LTF	*O-066*	*3.81*
LTF	*RENSSELAER*	*0.7*
LTF	*ROSETON*	*5.06*
247551	*U4-028 C*	*0.71*
247940	*U4-028 E*	*4.72*
247552	*U4-029 C*	*0.71*
247941	*U4-029 E*	*4.72*
247548	*V4-010 C*	*1.52*
247947	*V4-010 E*	*10.19*
901803	*W1-072A*	*2.52*
LTF	*WEC*	*1.39*
907062	*X1-027A E1*	*10.5*
907065	*X1-027A E2*	*10.5*
907067	*X1-027A E3*	*10.5*
907069	*X1-027A E4*	*10.5*
LTF	*Y3-032*	*13.61*
931951	*AB1-107 1*	*17.55*
931961	*AB1-107 2*	*38.52*

Appendix 5

(AEP - FE) The 05HOWARD-02BRKSID 138 kV line (from bus 243024 to bus 238586 ckt 1) loads from 83.8% to 99.45% (**DC power flow**) of its emergency rating (245 MVA) for the tower line contingency outage of 'AEP_P7-1_#7731-A'. This project contributes approximately 38.36 MW to the thermal violation.

```
CONTINGENCY 'AEP_P7-1_#7731-A'
  OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1                / 243006
05FOSTOR 138 934460 AD1-070 TAP 138 1
  OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1                / 243039
05MELMOR 138 243110 05STIFFI 138 1
  END
```

Bus Number	Bus Name	Full Contribution
932051	AC2-015 C	14.23
932052	AC2-015 E	16.6
934461	AD1-070 C O2	6.74
934462	AD1-070 E O2	31.63
934791	AD1-106 C O2	1.51
934792	AD1-106 E O2	2.47
LTF	CARR	0.14
LTF	CBM-S1	0.97
LTF	CBM-S2	0.39
LTF	CBM-W1	6.38
LTF	CBM-W2	6.61
LTF	CIN	1.08
LTF	CPLE	0.07
LTF	G-007	0.28
LTF	IPL	0.7
LTF	LGEE	0.21
LTF	MEC	2.02
LTF	MECS	2.85
LTF	O-066	0.93
LTF	RENSSELAER	0.11
LTF	ROSETON	0.82
247926	U1-059 E	2.36
247542	U4-001 C	8.26
247934	U4-001 E	55.28
247551	U4-028 C	2.43
247940	U4-028 E	16.28
247552	U4-029 C	2.43
247941	U4-029 E	16.28
247548	V4-010 C	3.93
247947	V4-010 E	26.28
247942	W1-056 E	0.87

LTF	*WEC*	*0.32*
925751	*AC1-051 C*	*2.*
925752	*AC1-051 E*	*13.38*

Appendix 6

(AEP - AEP) The AC2-015 TAP-05HOWARD 138 kV line (from bus 932050 to bus 243024 ckt 1) loads from 84.17% to 106.94% (**DC power flow**) of its emergency rating (167 MVA) for the tower line contingency outage of 'AEP_P7-1_#7731-A'. This project contributes approximately 38.03 MW to the thermal violation.

CONTINGENCY 'AEP_P7-1_#7731-A'
  OPEN BRANCH FROM BUS 243006 TO BUS 934460 CKT 1 / 243006 05FOSTOR 138 934460 AD1-070 TAP 138 1
  OPEN BRANCH FROM BUS 243039 TO BUS 243110 CKT 1 / 243039 05MELMOR 138 243110 05STIFFI 138 1
  END

Bus Number	*Bus Name*	*Full Contribution*
932051	*AC2-015 C*	*30.03*
932052	*AC2-015 E*	*35.04*
934461	*AD1-070 C O2*	*6.68*
934462	*AD1-070 E O2*	*31.35*
LTF	*CALDERWOOD*	*0.02*
LTF	*CARR*	*< 0.01*
LTF	*CATAWBA*	*0.02*
LTF	*CBM-W1*	*4.07*
LTF	*CBM-W2*	*0.84*
LTF	*CELEVELAND*	*0.06*
LTF	*CHEOAH*	*0.02*
LTF	*CHILHOWEE*	*< 0.01*
LTF	*CIN*	*0.17*
LTF	*CLIFTY*	*0.46*
LTF	*G-007*	*0.08*
LTF	*HAMLET*	*0.08*
LTF	*IPL*	*0.11*
LTF	*LGEE*	*< 0.01*
LTF	*MEC*	*0.54*
LTF	*MECS*	*3.07*
LTF	*MORGAN*	*< 0.01*
LTF	*O-066*	*0.25*
LTF	*RENSSELAER*	*< 0.01*
LTF	*ROSETON*	*0.03*
LTF	*ROWAN*	*0.05*
LTF	*SANTEETLA*	*< 0.01*
LTF	*TVA*	*< 0.01*
247551	*U4-028 C*	*2.41*
247940	*U4-028 E*	*16.14*
247552	*U4-029 C*	*2.41*
247941	*U4-029 E*	*16.14*

LTF	*UNIONPOWER*	*0.02*
247548	*V4-010 C*	*3.91*
247947	*V4-010 E*	*26.19*
LTF	*WEC*	*0.11*
925751	*AC1-051 C*	*0.64*
925752	*AC1-051 E*	*4.3*

Appendix 7

(FE - FE) The 02BLKRVR-02USSTEEL 138 kV line (from bus 239728 to bus 239734 ckt 1) loads from 117.67% to 118.99% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.6 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O2*	*2.56*
934462	*AD1-070 E O2*	*12.04*
934761	*AD1-103 C O2*	*8.6*
934762	*AD1-103 E O2*	*57.55*
934891	*AD1-118*	*5.97*
LTF	*CARR*	*1.22*
LTF	*CBM-S1*	*5.16*
LTF	*CBM-S2*	*2.13*
LTF	*CBM-W1*	*42.36*

LTF	*CBM-W2*	*36.42*
LTF	*CIN*	*5.84*
LTF	*CPLE*	*0.37*
LTF	*G-007*	*1.55*
LTF	*IPL*	*3.76*
LTF	*LGEE*	*1.07*
LTF	*MEC*	*11.55*
LTF	*MECS*	*22.11*
LTF	*O-066*	*5.27*
LTF	*RENSSELAER*	*0.95*
LTF	*ROSETON*	*6.88*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*
247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
LTF	*WEC*	*1.86*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
LTF	*Y3-032*	*18.43*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

Appendix 8

(FE - FE) The 02USSTEEL-02LRN Q2 138 kV line (from bus 239734 to bus 238915 ckt 1) loads from 111.37% to 112.69% (**DC power flow**) of its emergency rating (500 MVA) for the line fault with failed breaker contingency outage of 'ATSI-P2-3-CEI-345-001'. This project contributes approximately 14.6 MW to the thermal violation.

```
CONTINGENCY 'ATSI-P2-3-CEI-345-001'                    /* BREAKER FAILURE ON
S145 BREAKER AT AVON 345KV
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 1          /*
02LAKEAVE 345 02AVON 345
  DISCONNECT BRANCH FROM BUS 239725 TO BUS 238551 CKT 2          /*
02LAKEAVE 345 02AVON 345
  END
```

Bus Number	*Bus Name*	*Full Contribution*
238564	*02BAYSG1*	*12.16*
238572	*02BEAVGB*	*2.15*
240968	*02BG2 GEN*	*0.61*
240969	*02BG4 G1*	*0.15*
240970	*02BG4 G2&3*	*0.31*
240971	*02BG4 G4&5*	*0.31*
240950	*02BG5*	*1.87*
240973	*02BG6 AMPO*	*2.72*
239276	*02COLLW 11*	*-2.84*
239297	*02CPPW41*	*-3.58*
238979	*02NAPMUN*	*2.87*
240975	*02PGE GEN*	*4.21*
239175	*02WLORG-6*	*3.41*
932051	*AC2-015 C*	*3.48*
932052	*AC2-015 E*	*4.06*
932791	*AC2-103 C*	*5.07*
932792	*AC2-103 E*	*33.91*
934251	*AD1-052 C1*	*1.35*
934261	*AD1-052 C2*	*1.35*
934252	*AD1-052 E1*	*0.6*
934262	*AD1-052 E2*	*0.6*
934461	*AD1-070 C O2*	*2.56*
934462	*AD1-070 E O2*	*12.04*
934761	*AD1-103 C O2*	*8.6*
934762	*AD1-103 E O2*	*57.55*
934891	*AD1-118*	*5.97*
LTF	*CARR*	*1.22*
LTF	*CBM-S1*	*5.16*
LTF	*CBM-S2*	*2.13*
LTF	*CBM-W1*	*42.36*

LTF	*CBM-W2*	*36.42*
LTF	*CIN*	*5.84*
LTF	*CPLE*	*0.37*
LTF	*G-007*	*1.55*
LTF	*IPL*	*3.76*
LTF	*LGEE*	*1.07*
LTF	*MEC*	*11.55*
LTF	*MECS*	*22.11*
LTF	*O-066*	*5.27*
LTF	*RENSSELAER*	*0.95*
LTF	*ROSETON*	*6.88*
247542	*U4-001 C*	*1.52*
247934	*U4-001 E*	*10.14*
247551	*U4-028 C*	*0.96*
247940	*U4-028 E*	*6.4*
247552	*U4-029 C*	*0.96*
247941	*U4-029 E*	*6.4*
247567	*V2-006 C*	*1.01*
247961	*V2-006 E*	*6.74*
247548	*V4-010 C*	*2.07*
247947	*V4-010 E*	*13.83*
901803	*W1-072A*	*3.41*
LTF	*WEC*	*1.86*
907062	*X1-027A E1*	*14.25*
907065	*X1-027A E2*	*14.25*
907067	*X1-027A E3*	*14.25*
907069	*X1-027A E4*	*14.25*
LTF	*Y3-032*	*18.43*
915952	*Y3-092 FTWR*	*31.39*
915953	*Y3-092 NFTWR*	*31.39*
931951	*AB1-107 1*	*23.8*
931961	*AB1-107 2*	*52.22*
923821	*AB2-019*	*1.76*
925751	*AC1-051 C*	*0.5*
925752	*AC1-051 E*	*3.32*
926941	*AC1-181*	*0.32*

Generation Interconnection System Impact Study Report

For

PJM Generation Interconnection Request Queue Position AD1-070

Fostoria Central 138kV

December 2019

Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement.

The System Impact Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

General

Air Energy TCI Inc. (Air Energy) proposes to install PJM Project #AD1-070, a 205.0 MW (36.0 MW Capacity) wind facility in Hancock County, Ohio (see Figure 2). The point of interconnection will be a direct connection to AEP's Fostoria Central138kV substation (see Figure 1).

The requested in backfeed date is July 1, 2020.

The requested in service date is September 30, 2020.

Attachment Facilities

Primary Point of Interconnection (Fostoria Central 138kV Substation)

To accommodate the interconnection at the Fostoria Central 138 kV substation, the installation of a new 138 kV circuit breaker will be required, associated protection and control equipment, SCADA, and 138 kV revenue metering.

Direct Connection to the Fostoria Central 138 kV Substation Work and Cost:

- Install one (1) new 138 kV circuit breaker (see Figure 1). Installation of associated protection and control equipment, SCADA, and 138 kV revenue metering will also be required.

- **Estimated Station Cost: $1,000,000**

Non-Direct Connection Cost Estimate

The total preliminary cost estimate for Non-Direct Connection work is given in the following table below:

For AEP building Non-Direct Connection cost estimates:

Description	Estimated Cost
138 kV Revenue Metering	$250,000
Upgrade line protection and controls at the Fostoria Central 138 kV substation.	$250,000
Total	**$500,000**

Table 1

Interconnection Customer Requirements

It is understood that Air Energy is responsible for all costs associated with this interconnection. The costs above are reimbursable to AEP. The cost of Air Energy's generating plant and the costs for the line connecting the generating plant to the Fostoria Central 138 kV substation are not included in this report; these are assumed to be Air Energy's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for American Electric Power to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

Requirement from the PJM Open Access Transmission Tariff:

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

Revenue Metering and SCADA Requirements

PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Sections 24.1 and 24.2.

AEP Requirements

The Interconnection Customer will be required to comply with all AEP Revenue Metering Requirements for Generation Interconnection Customers. The Revenue Metering Requirements may be found within the "Requirements for Connection of New Facilities or Changes to Existing Facilities Connected to the AEP Transmission System" document located at the following link:

http://www.pjm.com/~/media/planning/plan-standards/private-aep/aep-interconnection-requirements.ashx

Network Impacts

The Queue Project AD1-070 was evaluated as a 205.0 MW (Capacity 36.0 MW) injection into the Fostoria Central 138 kV substation in the AEP area. Project AD1-070 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AD1-070 was studied with a commercial probability of 100%. Potential network impacts were as follows:

Summer Peak Analysis - 2021

Generator Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

1. (FE - FE) The 02LAKVEW-02GRNFLD 138 kV line (from bus 238874 to bus 238768 ckt 1) loads from 98.15% to 101.00% (AC power flow) of its emergency rating (316 MVA) for the tower line contingency outage of 'ADD202'. This project contributes approximately 10.62 MW to the thermal violation.

```
CONTINGENCY 'ADD202'
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1          /* 02DAVIS
BESSE 345 02HAYES 345
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 907060 CKT 1          /* 02DAVIS
BESSE 345 X1-027A TAP 345
  END
```

Please refer to Appendix 4 for a table containing the generators having contribution to this flowgate.

2. (FE - FE) The 02OTTAWA-02LAKVEW 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 98.89% to 101.26% (AC power flow) of its emergency rating (375 MVA) for the tower line contingency outage of 'ADD202'. This project contributes approximately 10.62 MW to the thermal violation.

```
CONTINGENCY 'ADD202'
```

```
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1           /* 02DAVIS
BESSE 345 02HAYES 345
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 907060 CKT 1           /* 02DAVIS
BESSE 345 X1-027A TAP 345
  END
```

Please refer to Appendix 5 for a table containing the generators having contribution to this flowgate.

Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

Steady-State Voltage Requirements

(Results of the steady-state voltage studies should be inserted here)

None

Short Circuit

(Summary of impacted circuit breakers)

New circuit breakers found to be over-duty:

None

Affected System Analysis & Mitigation

LGEE Impacts:

None

MISO Impacts:

No impact in the preliminary study but MISO will be performing a retool. Study results will be addressed in the Facilities Study.

Duke, Progress & TVA Impacts:

None

OVEC Impacts:

None

Delivery of Energy Portion of Interconnection Request

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.
Only the most severely overloaded conditions are listed. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed, which will study all overload conditions associated with the overloaded element(s) identified.

None

Light Load Analysis

No problems identified

Stability and Reactive Power Requirement

(Results of the dynamic studies should be inserted here)

No problems identified

New System Reinforcements

(Upgrades required to mitigate reliability criteria violations, i.e. Network Impacts, initially caused by the addition of this project generation)

1. To resolve the Lakeview – Greenfield 138 kV line overload:

   There is a planned 2023 baseline upgrade B3034 - Lakeview-Greenfield 138 kV Reconductor and Substation Upgrades.
   The new expected circuit SE rating would be 385 MVA/SE with baseline upgrade B3034.

   AD1-070 can wait for the baseline upgrade to be in-service or request advancement of the baseline upgrade to their study year of summer 2021 and pay an advancement cost if the advancement is feasible per FE. Per FE, at this time (October 2019) the B3034 baseline upgrade can be advanced to 6/1/2021 at no advancement cost.

2. To resolve the Ottawa - Lakeview 138 kV line overload:

There is a planned 2023 baseline upgrade B3033 - Ottawa-Lakeview 138 kV Reconductor and Substation Upgrades.
The new expected circuit SE rating would be 516 MVA/SE with baseline upgrade B3033.

AD1-070 can wait for the baseline upgrade to be in-service or request advancement of the baseline upgrade to their study year of summer 2021 and pay an advancement cost if the advancement is feasible per FE. Per FE, the B3033 baseline upgrade cannot be advanced to 6/1/2021.

Contribution to Previously Identified System Reinforcements

(Overloads initially caused by prior Queue positions with additional contribution to overloading by this project. This project may have a % allocation cost responsibility which will be calculated and reported for the Impact Study)
(Summary form of Cost allocation for transmission lines and transformers will be inserted here if any)

None

Schedule

It is anticipated that the time between receipt of executed agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would be between 24 to 36 months after signing an interconnection agreement.

Note: The time provided between anticipated normal completion of System Impact, Facilities Studies, subsequent execution of ISA and ICSA documents, and the proposed Backfeed Date is shorter than usual and may be difficult to achieve.

Conclusion

Based upon the results of this System Impact Study, the construction of the 205.0 MW (36.0 MW Capacity) wind generating facility of Air Energy (PJM Project #AD1-070) will require the following additional interconnection charges. This plan of service will interconnect the proposed wind generating facility in a manner that will provide operational reliability and flexibility to both the AEP system and the Air Energy generating facility.

Please note that several of the First Energy upgrades are relying on PJM Baseline projects that are not scheduled to be in service until June 2021 which affects the requested in service date.

Cost Breakdown for Point of Interconnection (Fostoria Central 138kV Substation)			
Attachment Cost	AEP	Install one (1) 138 kV Circuit Breaker at the Fostoria Central 138 kV Substation	$1,000,000
Non-Direct Connection Cost Estimate	AEP	Install 138 kV Revenue Metering	$250,000
	AEP	Upgrade line protection and controls at the Fostoria Central kV substation	$250,000
		Total Estimated Cost for Project AD1-070	**$1,500,000**

Table 2

The estimates are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements.

Figure 1: Point of Interconnection (Fostoria Central 138kV Substation)

Single-Line Diagram

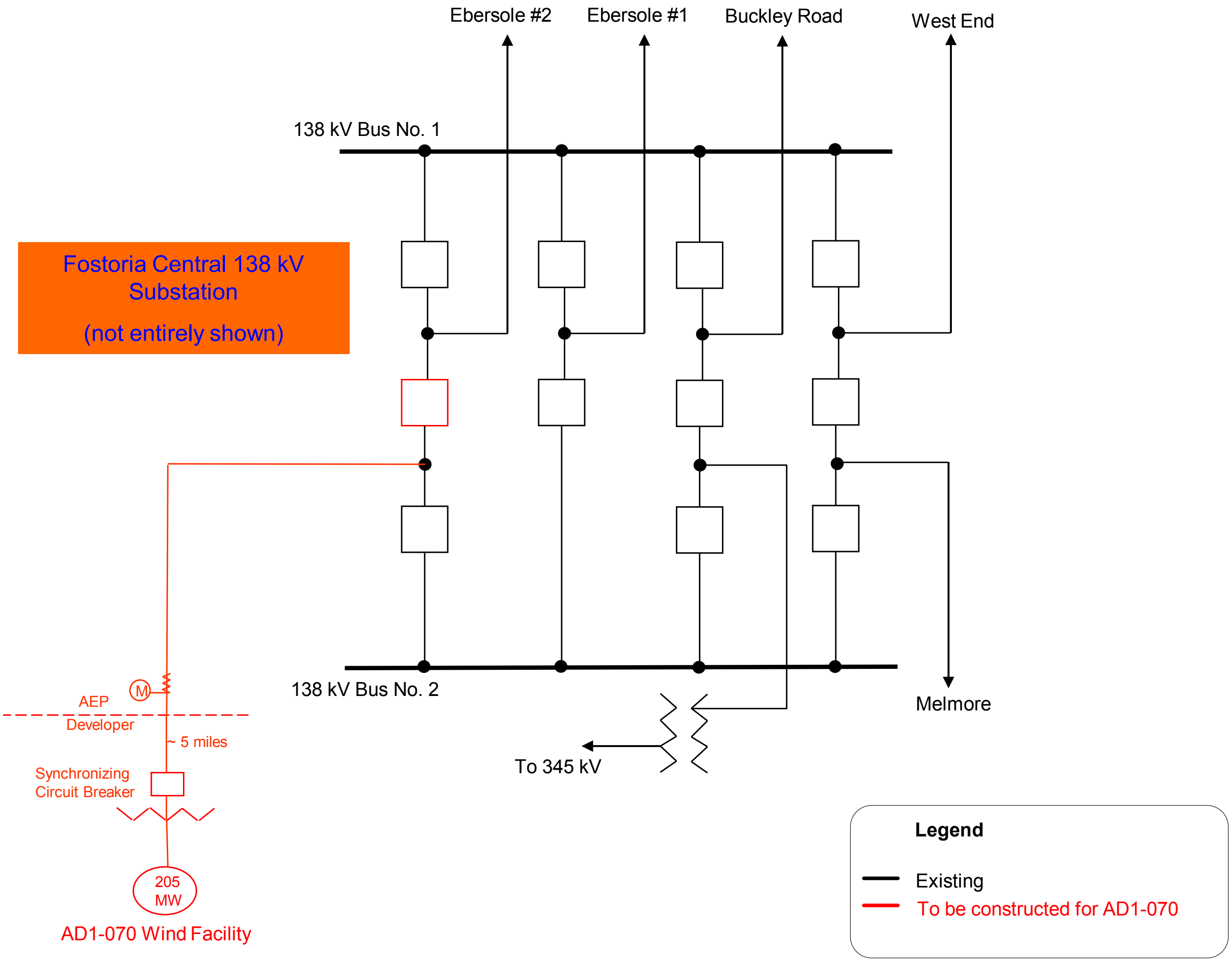
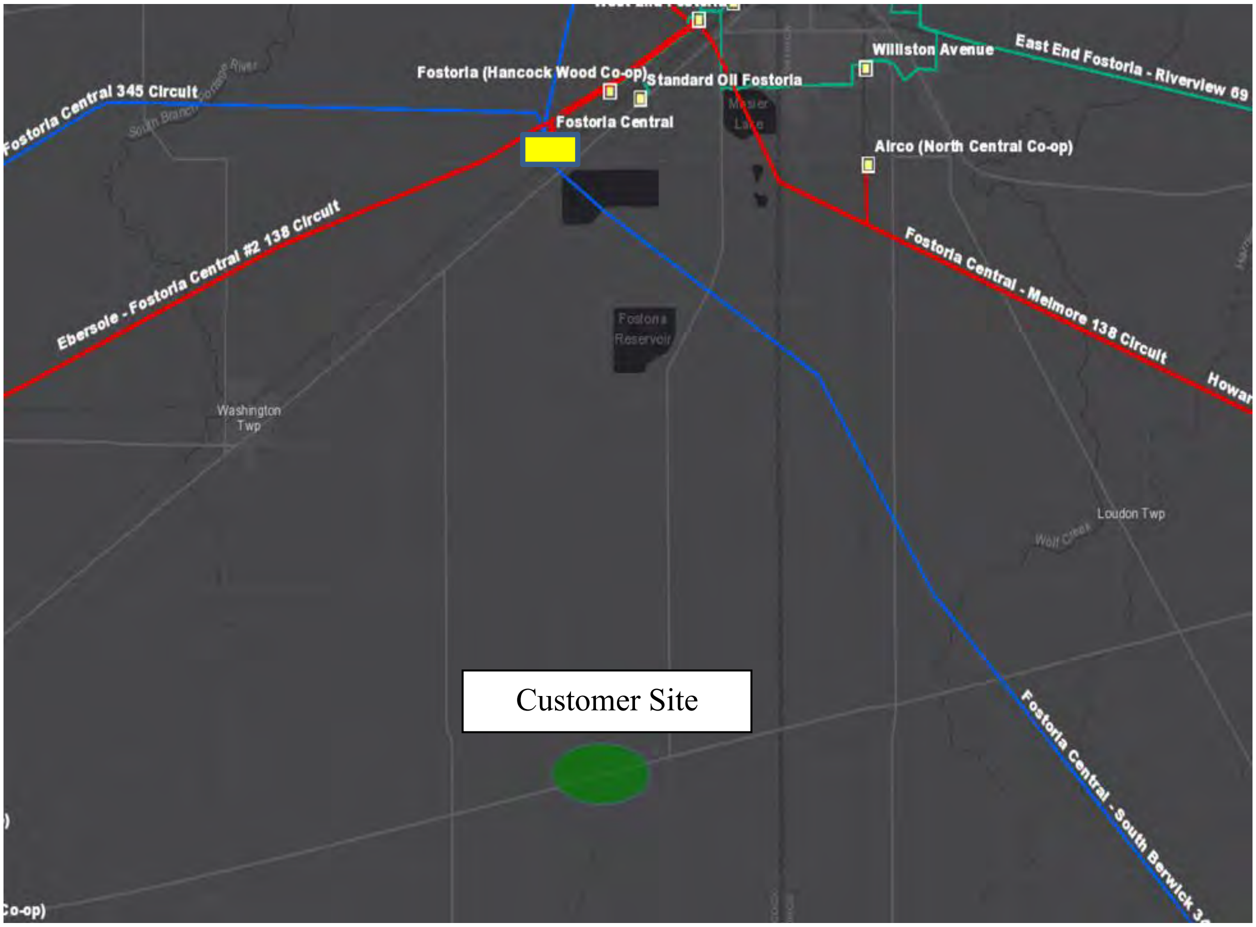


Figure 2: Point of Interconnection (Fostoria Central 138 kV Substation)



Appendices

The following appendices contain additional information about each flowgate presented in the body of the report. For each appendix, a description of the flowgate and its contingency was included for convenience. However, the intent of the appendix section is to provide more information on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the Appendices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the Appendices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators.

It should be noted the project/generator MW contributions presented in the body of the report and appendices sections are full contributions, whereas the loading percentages reported in the body of the report, take into consideration the commercial probability of each project as well as the ramping impact of "Adder" contributions.

Appendix 4

(FE - FE) The 02LAKVEW-02GRNFLD 138 kV line (from bus 238874 to bus 238768 ckt 1) loads from 98.15% to 101.00% (AC power flow) of its emergency rating (316 MVA) for the tower line contingency outage of 'ADD202'. This project contributes approximately 10.62 MW to the thermal violation.

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BESSE 345 02HAYES 345
  DISCONNECT BRANCH FROM BUS 238654 TO BUS 907060 CKT 1          /* 02DAVIS
BESSE 345 X1-027A TAP 345
  END
```

Bus Number	Bus Name	Full Contribution
238564	02BAYSG1	12.54
238601	02FRMENG 1	3.78
238602	02FRMENG 2	3.78
238603	02FRMENG 3	6.83
238979	02NAPMUN	2.36
934251	AD1-052 C1	0.54
934261	AD1-052 C2	0.54
934461	AD1-070 C O1	1.87
934462	AD1-070 E O1	8.76
934891	AD1-118	4.37
LTF	CARR	0.6
LTF	CBM-S1	3.34
LTF	CBM-S2	1.25
LTF	CBM-W1	30.53
LTF	CBM-W2	24.14
LTF	CIN	3.91
LTF	CPLE	0.21
LTF	G-007	0.95
LTF	IPL	2.52
938021	J793	38.14
LTF	LGEE	0.69
LTF	MEC	7.88
LTF	MECS	16.76
LTF	O-066	3.22
LTF	RENSSELAER	0.47
LTF	ROSETON	3.41
247551	U4-028 C	0.73
247940	U4-028 E	4.88

247552	U4-029 C	0.73
247941	U4-029 E	4.88
247548	V4-010 C	1.7
247947	V4-010 E	11.38
LTF	WEC	1.28
931951	AB1-107 1	24.31
931961	AB1-107 2	39.89
926941	AC1-181	0.25

Appendix 5

(FE - FE) The 02OTTAWA-02LAKVEW 138 kV line (from bus 239030 to bus 238874 ckt 1) loads from 98.89% to 101.26% (AC power flow) of its emergency rating (375 MVA) for the tower line contingency outage of 'ADD202'. This project contributes approximately 10.62 MW to the thermal violation.

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Bus Number	Bus Name	Full Contribution
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LTF	CBM-W2	24.14
LTF	CIN	3.91
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LTF	G-007	0.95
LTF	IPL	2.52
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247552	U4-029 C	0.73
247941	U4-029 E	4.88
247548	V4-010 C	1.7
247947	V4-010 E	11.38
LTF	WEC	1.28
931951	AB1-107 1	24.31
931961	AB1-107 2	39.89
926941	AC1-181	0.25

Generation Interconnection

Feasibility Study Report

for

Queue Project AF2-375

FOSTORIA CENTRAL 138 KV

77.76 MW Capacity / 129.6 MW Energy

July 2020

Table of Contents

1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

2 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Hancock County, Ohio. The installed facilities will have a total capability of 129.6 MW with 77.76 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF2-375**
Project Name	FOSTORIA CENTRAL 138 KV
State	Ohio
County	Hancock
Transmission Owner	AEP
MFO	129.6
MWE	129.6
MWC	77.76
Fuel	Solar
Basecase Study Year	2023

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AF2-375 will interconnect with the AEP transmission system via a direct connection to Fostoria Central 138 kV substation.

To accommodate the interconnection on the Fostoria Central 138 kV substation, the substation will have to be expanded requiring the installation of one (1) 138 kV circuit breaker (see Attachment 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Installation of the generator lead first span exiting the POI station, including the first structure outside the AEP fence, will also be included in AEP's scope. In the case where the generator lead is a single span, the structure in the customer station will be the customer's responsibility.

5 Cost Summary

The AF2-375 project will be responsible for the following costs:

Description	**Total Cost**
Total Physical Interconnection Costs	$1,464,000
Total System Network Upgrade Costs	$276,654,420
Total Costs	**$278,118,420**

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an onsite review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 88-129. If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the tables below:

6.1 Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	**Total Cost**
138 kV Revenue Metering	$388,000
Generator lead first span exiting the POI station, including the first structure outside the fence	$400,000
Total Attachment Facility Costs	$788,000

6.2 Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	**Total Cost**
Expand the Fostoria Central 138 kV substation: Install one (1) additional 138 kV breaker. Installation of associated protection and control equipment, 138 kV line risers and SCADA will also be required.	$631,000
Total Direct Connection Facility Costs	$631,000

6.3 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	**Total Cost**
Review protection and control settings at the Fostoria Central 138 kV station	$45,000
Total Non-Direct Connection Facility Costs	$45,000

7 Incremental Capacity Transfer Rights (ICTRs)

None

8 Schedule

It is anticipated that the time between receipt of executed Agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would generally be between 24 to 36 months after signing Agreement execution.

9 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

10 Revenue Metering and SCADA Requirements

10.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

10.2 Meteorological Data Reporting Requirements

Solar generation facilities shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit)
- Irradiance (Watts/meter^2)
- Ambient air temperature (Fahrenheit) – (Accepted, not required)
- Wind speed (meters/second) – (Accepted, not required)
- Wind direction (decimal degrees from true north) – (Accepted, not required)

10.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

11 Summer Peak - Load Flow Analysis – Primary POI

The Queue Project AF2-375 was evaluated as a 129.6 MW (Capacity 77.8 MW) injection at the Fostoria Central 138 kV substation in the AEP area. Project AF2-375 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-375 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

11.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

11.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918572	238654	02DAV-BE	345.0	ATSI	239289	02HAYES	345.0	ATSI	1	ATSI-P2-3-OEC-345-026	breaker	1878.0	99.99	100.35	DC	14.52
95515923	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P7-1_#10926	tower	245.0	99.44	100.88	DC	7.83

11.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918543	238569	02BEAVER	345.0	ATSI	239725	02LAKEAVE	345.0	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1878.0	103.85	104.33	DC	19.66
100801300	238874	02LAKVEW	138.0	ATSI	238768	02GRNFLD	138.0	ATSI	1	ATSI-P7-1-TE-345-027A	tower	316.0	120.14	121.08	DC	6.57
100801307	239030	02OTTAWA	138.0	ATSI	238874	02LAKVEW	138.0	ATSI	1	ATSI-P7-1-TE-345-027A	tower	380.0	116.72	117.5	DC	6.57
95515853	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	121.01	122.6	DC	23.38
95947779	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	146.55	148.67	DC	7.85
95947617	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P2-2_#7118_05HOWARD 138_1-B	bus	251.0	139.69	141.88	DC	12.18
95947618	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1	bus	251.0	128.72	130.45	DC	9.66
95947793	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P4_#10134_05HOWARD 138_B	breaker	251.0	139.69	141.88	DC	12.18
95947794	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P4_#10133_05HOWARD 138_H	breaker	251.0	139.73	141.92	DC	12.18
95947795	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#1176_05FREMNT C 69.0_L	breaker	251.0	129.44	131.17	DC	9.66
95947796	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#2200_05FREMNT C 69.0_E	breaker	251.0	128.72	130.45	DC	9.66
95515017	243009	05FRMNT	138.0	AEP	239154	02W.FREM	138.0	ATSI	1	AEP_P2-2_#7118_05HOWARD 138_1-B	bus	361.0	103.91	108.01	DC	14.81
95515235	243009	05FRMNT	138.0	AEP	239154	02W.FREM	138.0	ATSI	1	AEP_P4_#10133_05HOWARD 138_H	breaker	361.0	103.91	108.01	DC	14.81
95515236	243009	05FRMNT	138.0	AEP	239154	02W.FREM	138.0	ATSI	1	AEP_P4_#10134_05HOWARD 138_B	breaker	361.0	103.91	108.01	DC	14.81

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515023	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P2-2_#7725_05FREMCT 138_1	bus	245.0	102.3	103.53	DC	6.71
95515261	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7725_05FREMCT 138_M	breaker	245.0	102.3	103.53	DC	6.71
95515262	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7728_05FREMCT 138_C	breaker	245.0	100.55	101.82	DC	6.92
95515922	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P7-1_#10927	tower	245.0	101.6	103.04	DC	7.83
95947592	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P2-2_#9521_05CHATFL 138_2	bus	167.0	154.19	156.3	DC	7.8
95947769	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	164.75	166.65	DC	7.03
95947770	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#10729_05CHATFL 138_E	breaker	167.0	154.78	156.93	DC	7.98
95947771	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#9521_05CHATFL 138_F	breaker	167.0	154.19	156.3	DC	7.8
95947751	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	177.94	180.06	DC	7.85

11.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515506	242935	05E LIMA	345.0	AEP	242945	05SW LIM	345.0	AEP	1	AEP_P1-2_#11144-B	operation	971.0	109.16	110.65	DC	14.45
95515463	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	115.71	117.67	DC	19.97
95515464	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	AEP_P1-3_#5063_05SBERWI 345_1-B	operation	1318.0	112.93	114.84	DC	25.18
95948032	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	137.46	139.52	DC	7.65
95948121	243006	05FOSTOR	138.0	AEP	247172	05EBERSO	138.0	AEP	1	AEP_P1-2_#7761-A	operation	245.0	108.52	117.59	DC	22.22
95948172	243006	05FOSTOR	138.0	AEP	939160	AE1-146 TAP	138.0	AEP	2	AEP_P1-2_#7757	operation	245.0	96.38	105.1	DC	21.36
95947989	243039	05MELMOR	138.0	AEP	242984	05CHATFL	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	173.29	175.54	DC	8.35
95948018	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7709	operation	167.0	154.08	156.18	DC	7.77
95948001	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	170.63	172.69	DC	7.65

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95948074	939160	AE1-146 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	2	AEP_P1-2_#7757	operation	245.0	116.29	125.01	DC	21.36
95515486	945620	AF1-227 TAP	345.0	AEP	242939	05MARYSV	345.0	AEP	1	Base Case	operation	897.0	111.07	111.7	DC	12.5

11.5 System Reinforcements - Summer Peak Load Flow - Primary POI

ID	Idx	Facility	Upgrade Description	Cost
95515235,95515236,95515017	9	05FRMNT 138.0 kV - 02W.FREM 138.0 kV Ckt 1	AEP **AEPO0026b (450)** : Replace 1200 A Switch at Fremont **Project Type** : FAC **Cost** : $200,000 **Time Estimate** : 12-18 Months ATSI **TE-002B (803)** : Re-conductor the 0.8 miles of transmission line between West Fremont-Fremont 138 kV line. Existing transmission line conductor size 954 ACSR should be replaced with 954 ACSS. AEP would need to replace their section of limiting conductor and provide estimates for their replacement. **Project Type** : Facility **Cost** : $1,950,000 **Time Estimate** : 18.0 Months	$2,150,000
95947617,95947794,95947618,95947796,95947793,95947795	8	05FREMCT 138.0 kV - 05FRMNT 138.0 kV Ckt 1	AEP **AEPO0020a (422)** : Reconfigure Fremont Center 69kV yard into 8 breaker ring for $12,000,000.This upgrade will be tested during the System Impact studies. If not adequate, additional mitigation may be required including : 1) Rebuild 7 miles of single circuit line (ACSR ~ 795 ~ 45/7 ~ TERN conductor) between Fremont and Fremont Center with 1590 ACSR. [$10,500,000] 2) Replace 1200A switch at Fremont [$200,000] 3) Replace two Sub Cond 1590 AAC 61 Str at Fremont [$200,000] **Project Type** : Con **Cost** : $12,000,000 **Time Estimate** : 24-36 Months **AEPO0020b (423)** : Rebuild 7 miles of single circuit line (ACSR ~ 795 ~ 45/7 ~ TERN conductor) between Fremont and Fremont Center with 1590 ACSR. **Project Type** : FAC **Cost** : $10,500,000 **Time Estimate** : 24-36 Months **AEPO0020e (426)** : A sag study will be required on the 4.0 miles of ACSR ~ 795 ~ 45/7 ~ TERN - Conductor Section 1 to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be around $20,000 (no remediation required, just sag study) and $6 million (complete line re-conductor/rebuild). New rating after sag study: S/N: 251 S/E: 335 MVA. Time Estimate: a) Sag Study: 6-12 months. b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. **Project Type** : FAC **Cost** : $20,000 **Time Estimate** : Sag Study : 6 - 12 Months	$22,500,020

ID	Idx	Facility	Upgrade Description	Cost
95947592,95947769,95947770,95947771	10	05MELMOR 138.0 kV - 05HOWARD 138.0 kV Ckt 1	**AEP** **AEPO0023b (435)** : Rebuild 27 mile double circuit line between Melmore and Howard with 1033 ACSR (Replacing ACSR ~ 397.5 ~ 30/7 ~ LARK). **Project Type** : FAC **Cost** : $81,000,000 **Time Estimate** : 24-36 Months **AEPO0023c (436)** : Replace two sub Cond 300 MCM CU 37 Str at Howard **Project Type** : FAC **Cost** : $200,000 **Time Estimate** : 12-18 Months **AEPO0023d (437)** : Replace Bus 0.75" CU Tubular at Howard **Project Type** : FAC **Cost** : $100,000 **Time Estimate** : 12-18 Months **AEPO0023e (438)** : Replace five Sub cond 795 AAC 37 Str at Howard **Project Type** : FAC **Cost** : $500,000 **Time Estimate** : 12-18 Months	$81,800,000
98918543	3	02BEAVER 345.0 kV - 02LAKEAVE 345.0 kV Ckt 2	**ATSI** **N6186** : Reconductor Beaver - LakeAve 345kV #2 line with dual 954Kcmil ACSS **Project Type** : FAC **Cost** : $5,921,900 **Time Estimate** : 12 Months	$ 5,921,900
95515922,95515023,95515262,95515261,95515923	2	05HOWARD 138.0 kV - 02ASHLAND 138.0 kV Ckt 1	**AEP** **AEPO0029a (467)** : 1) 8 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK - Conductor Section 1 will need to be rebuilt/reconductored. Estimated cost: $12 million. **Project Type** : FAC **Cost** : $12,000,000 **Time Estimate** : 24-36 Months **AEPO0029b (468)** : 2) Replace five Sub cond 795 AAC 37 Str at Howard. Estimated cost: $100,000. **Project Type** : FAC **Cost** : $500,000 **Time Estimate** : 12- 18 Months	$12,500,000
100801307	5	02OTTAWA 138.0 kV - 02LAKVEW 138.0 kV Ckt 1	**ATSI** **b3033 (734)** : Ottawa-Lakeview 138 kV Re-conductor and Substation Upgrades **Project Type** : FAC **Cost** : $20,000,000 **Time Estimate** : Projected in-service date: 12/01/2023 Months	$20,000,000

ID	Idx	Facility	Upgrade Description	Cost
95515853	6	**05FOSTOR 345.0 kV - 05E LIMA 345.0 kV Ckt 1**	**AEP** **AEPO0030a (469) : Replace five sub Cond 2156 ACSR 84/19 Std at E Lima** **Project Type : FAC** **Cost : $500,000** **Time Estimate : 12- 18 Months** **AEPO0030b (470) : Sag study is required on 4 mile single circuit line between Fremont Center and Fremont with 954 ACSR. The cost is expected to be around $20,000.The Rating after the sag study S/N: 1409MVA, S/E: 1887MVA. Rebuild/Re-conductor, cost : $ 8 million** **Project Type : FAC** **Cost : $20,000** **Time Estimate : Sag Study : 6 - 12 Months** **AEPO0030c (471) : Replace sub Cond 2870 MCM ACSR at E Lima** **Project Type : FAC** **Cost : $100,000** **Time Estimate : 12- 18 Months**	$620,000
95947779	7	**05CHATFL 138.0 kV - AC2-015 TAP 138.0 kV Ckt 1**	**AEP** **AEPO0021c (429) : Replace 600A switch at Chatfield** **Project Type : FAC** **Cost : $200,000** **Time Estimate : 12-18 Months** **AEPO0044b (525) : Rebuild/Re-conductor 4.5miles of ACSR ~ 397.5 ~ 30/7 ~ LARK - Conductor Section 1 to mitigate the overload.** **Project Type : FAC** **Cost : $6,750,000** **Time Estimate : 24-36 Months**	$6,950,000

ID	Idx	Facility	Upgrade Description	Cost
95947751	11	**AC2-015 TAP 138.0 kV - 05HOWARD 138.0 kV Ckt 1**	**AEP** **AEPO0027a (455) : Relocate Fostoria Central- Melmore or the Howard-Melmore #1 line into a new breaker string at Melmore. This upgrade will be tested during the System Impact studies. If not adequate, additional mitigation may be required including:** **Project Type : CON** **Cost : $4,000,000** **Time Estimate : 24-36 Months** **AEPO0027b (456) : Rebuild 11.5 mile double circuit line between AC2-015 TAP and Howard** **with 1590 ACSR (replacing ACSR ~ 397.5 ~ 30/7 ~ LARK conductor)** **Project Type : FAC** **Cost : $34,500,000** **Time Estimate : 24-36 Months** **AEPO0027c (457) : Replace sub Cond 300 MCM CU 37 Str at Howard** **Project Type : FAC** **Cost : $100,000** **Time Estimate : 12-18 Months** **AEPO0027d (458) : Upgrade CT Thermal Limit 749 Amps & Relay Thermal Limit 749 Amps at Howard** **Project Type : FAC** **Cost : $50,000** **Time Estimate : 12-18 Months** **AEPO0027e (459) : Replace Sub cond 397.5 ACSR 26/7 at Howard** **Project Type :** **Cost : $100,000** **Time Estimate : 12-18 Months** **AEPO0027f (460) : Upgrade Relay Compliance Trip Limit 975 Amps at Howard** **Project Type : FAC** **Cost : $25,000** **Time Estimate : 12-18 Months** **AEPO0027g (461) : Replace five Sub cond 795 AAC 37 Str at Howard** **Project Type : FAC** **Cost : $500,000** **Time Estimate : 12-18 Months**	$39,275,000
98918572	1	**02DAV-BE 345.0 kV - 02HAYES 345.0 kV Ckt 1**	**ATSI** **TE-008B : Reconductor the existing 30.3 miles of the Davis Besse-Hayes 345 kV line with 954 ACSS 45/7 bundled (2 conductors per phase). Reconductor the substation conductor and line drops at Davis Besse 345 kV and at Hayes 345 kV with 1590 ACSS bundled (2 conductors per phase).** **Project Type : FAC** **Cost : $61,357,500** **Time Estimate : 36 Months**	$61,357,500

ID	Idx	Facility	Upgrade Description	Cost
100801300	4	**02LAKVEW 138.0 kV - 02GRNFLD 138.0 kV Ckt 1**	**ATSI** **OEC-011-B (770) : Re-conductor roughly 13.1 miles of the Greenfield-Lakeview 138 kV Line (currently bundled 336 ACSR) with 795 ACSS conductor. Replace two 1200A line switches with 2000A line switches. Upgrade 500 CU substation conductor at Greenfield to exceed line ratings of 795 ACSS. Upgrade RT for B-242 to exceed line ratings of 795 ACSS.** **Project Type : Facility** **Cost : $23,580,000** **Time Estimate : 24.0 Months**	$23,580,000
			TOTAL COST	**$276,654,420**

11.6 Flow Gate Details - Primary POI

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

11.6.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918572	238654	02DAV-BE	ATSI	239289	02HAYES	ATSI	1	ATSI-P2-3-OEC-345-026	breaker	1878.0	99.99	100.35	DC	14.52

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	4.5595	50/50	4.5595
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**34.8835**	**50/50**	**34.8835**
238885	02LEMOG1	5.5921	50/50	5.5921
238886	02LEMOG2	5.5921	50/50	5.5921
238887	02LEMOG3	5.5921	50/50	5.5921
238888	02LEMOG4	5.5921	50/50	5.5921
238979	02NAPMUN	5.2342	Adder	6.16
239276	02COLLW 11	-2.3427	Adder	-2.76
239293	02BS-PKR	0.3980	50/50	0.3980
239297	02CPPW41	-2.6392	Adder	-3.1
241902	Y1-069 GE	31.3699	50/50	31.3699
244357	05GRANGER EL	0.2809	Adder	0.33
915952	Y3-092 NFTWR	81.0900	Merchant Transmission	81.0900
923821	AB2-019 FTWR	2.2705	Merchant Transmission	2.2705
931951	AB1-107 1	46.1063	50/50	46.1063
931961	AB1-107 2	127.5179	50/50	127.5179
932791	AC2-103 C	11.8933	50/50	11.8933
932792	AC2-103 E	79.6074	50/50	79.6074
934461	AD1-070 C O1	3.4278	Adder	4.03
934462	AD1-070 E O1	16.0917	Adder	18.93
934761	AD1-103 C O1	19.9970	50/50	19.9970
934762	AD1-103 E O1	133.8260	50/50	133.8260
934891	AD1-118	14.1834	50/50	14.1834
936601	AD2-075	10.5268	Adder	12.38
938911	AE1-119	111.4410	50/50	111.4410
939161	AE1-146 C O1	7.3931	Adder	8.7
939162	AE1-146 E O1	3.4525	Adder	4.06
940841	AE2-072 C	8.3515	Adder	9.83
940842	AE2-072 E	5.5677	Adder	6.55
941781	AE2-181 C	3.9649	Adder	4.66
941782	AE2-181 E	2.6433	Adder	3.11
942661	AE2-282 C O1	6.0573	Adder	7.13
942662	AE2-282 E O1	3.1873	Adder	3.75
943951	AF1-063 C O1	1.7603	Adder	2.07
943952	AF1-063 E O1	0.9759	Adder	1.15
943961	AF1-064 C O1	4.7085	Adder	5.54
943962	AF1-064 E O1	2.3401	Adder	2.75
944551	AF1-120 C	3.6703	Adder	4.32
944552	AF1-120 E	1.8489	Adder	2.18
945401	AF1-205 C O1	3.3952	Adder	3.99
945402	AF1-205 E O1	2.2634	Adder	2.66

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
945411	AF1-206 C O1	16.4749	Adder	19.38
945412	AF1-206 E O1	10.9832	Adder	12.92
945641	AF1-229 C	7.2045	Adder	8.48
945642	AF1-229 E	4.8030	Adder	5.65
950351	J466	2.4510	PJM External (MISO)	2.4510
950942	J325 E	0.3362	PJM External (MISO)	0.3362
952312	J646 E	0.1451	PJM External (MISO)	0.1451
952401	J752 C	1.2500	PJM External (MISO)	1.2500
952402	J752 E	6.7630	PJM External (MISO)	6.7630
952971	J793	119.5617	PJM External (MISO)	119.5617
953271	J701 C	0.6089	PJM External (MISO)	0.6089
953272	J701 E	3.2944	PJM External (MISO)	3.2944
953321	J799	19.1438	PJM External (MISO)	19.1438
953781	J833	10.1480	PJM External (MISO)	10.1480
953811	J839	8.8070	PJM External (MISO)	8.8070
954111	J875	13.0980	PJM External (MISO)	13.0980
955181	J996	7.7312	PJM External (MISO)	7.7312
955781	J1062	17.2095	PJM External (MISO)	17.2095
956161	J1103	1.5932	PJM External (MISO)	1.5932
956751	J1173	7.1888	PJM External (MISO)	7.1888
958321	AF2-126 C	2.9961	Adder	6.65
958322	AF2-126 E	1.4868	Adder	3.3
958331	AF2-127 C	1.2036	Adder	2.67
958332	AF2-127 E	0.6332	Adder	1.41
959181	AF2-209 C O1	3.6651	Adder	8.14
959182	AF2-209 E O1	1.7135	Adder	3.8
960301	AF2-321 C	6.0663	Adder	13.47
960302	AF2-321 E	4.0442	Adder	8.98
960841	AF2-375 C O1	3.9242	Adder	8.71
960842	AF2-375 E O1	2.6161	Adder	5.81
960951	AF2-386 C O1	0.4444	Adder	0.99
960952	AF2-386 E O1	0.6137	Adder	1.36
WEC	WEC	1.6717	Confirmed LTF	1.6717
LGEE	LGEE	2.0424	Confirmed LTF	2.0424
CPLE	CPLE	0.4035	Confirmed LTF	0.4035
CBM-W2	CBM-W2	29.6806	Confirmed LTF	29.6806
NY	NY	1.8653	Confirmed LTF	1.8653
CBM-W1	CBM-W1	100.5053	Confirmed LTF	100.5053
TVA	TVA	3.8346	Confirmed LTF	3.8346
O-066	O-066	19.1251	Confirmed LTF	19.1251
CBM-S2	CBM-S2	6.2886	Confirmed LTF	6.2886
CBM-S1	CBM-S1	24.6654	Confirmed LTF	24.6654
G-007	G-007	2.9370	Confirmed LTF	2.9370
MADISON	MADISON	2.1289	Confirmed LTF	2.1289
MEC	MEC	7.4047	Confirmed LTF	7.4047

11.6.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515922	243024	05HOWARD	AEP	241111	02ASHLAND	ATSI	1	AEP_P7-1_#10927	tower	245.0	101.6	103.04	DC	7.83

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.5212	50/50	3.5212
247551	**U4-028 C (Suspended)**	**2.1054**	**50/50**	**2.1054**
247552	**U4-029 C (Suspended)**	**2.1054**	**50/50**	**2.1054**
247926	U1-059 E	2.1405	Adder	2.52
247940	**U4-028 E (Suspended)**	**14.0897**	**50/50**	**14.0897**
247941	**U4-029 E (Suspended)**	**14.0897**	**50/50**	**14.0897**
247942	W1-056 E	0.7873	Adder	0.93
247947	V4-010 E	23.5648	50/50	23.5648
925751	AC1-051 C	2.2454	50/50	2.2454
925752	AC1-051 E	15.0268	50/50	15.0268
932051	AC2-015 C	15.5397	50/50	15.5397
932052	AC2-015 E	18.4126	50/50	18.4126
934461	AD1-070 C O1	1.8495	Adder	2.18
934462	AD1-070 E O1	8.6822	Adder	10.21
937021	AD2-136 C O1	7.5793	50/50	7.5793
937022	AD2-136 E O1	50.7227	50/50	50.7227
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.5791**	**50/50**	**3.5791**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**23.9524**	**50/50**	**23.9524**
939161	AE1-146 C O1	3.6733	Adder	4.32
939162	AE1-146 E O1	1.7154	Adder	2.02
941741	AE2-174 C	4.7197	50/50	4.7197
941742	AE2-174 E	22.0954	50/50	22.0954
960841	AF2-375 C O1	2.1173	Adder	4.7
960842	AF2-375 E O1	1.4115	Adder	3.13
WEC	WEC	0.1824	Confirmed LTF	0.1824
LGEE	LGEE	0.2094	Confirmed LTF	0.2094
CPLE	CPLE	0.0126	Confirmed LTF	0.0126
CBM-W2	CBM-W2	3.0712	Confirmed LTF	3.0712
NY	NY	0.1781	Confirmed LTF	0.1781
CBM-W1	CBM-W1	10.2832	Confirmed LTF	10.2832
TVA	TVA	0.3710	Confirmed LTF	0.3710
O-066	O-066	2.0294	Confirmed LTF	2.0294
CBM-S2	CBM-S2	0.4104	Confirmed LTF	0.4104
CBM-S1	CBM-S1	2.4112	Confirmed LTF	2.4112
G-007	G-007	0.3130	Confirmed LTF	0.3130
MADISON	MADISON	0.2540	Confirmed LTF	0.2540
MEC	MEC	0.7945	Confirmed LTF	0.7945

11.6.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918543	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1878.0	103.85	104.33	DC	19.66

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	5.5203	50/50	5.5203
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**30.9385**	**50/50**	**30.9385**
238979	02NAPMUN	5.8692	Adder	6.9
239171	02WLORG-2	6.2588	50/50	6.2588
239172	02WLORG-3	6.3656	50/50	6.3656
239173	02WLORG-4	6.3656	50/50	6.3656
239174	02WLORG-5	6.3984	50/50	6.3984
239276	02COLLW 11	-3.2825	Adder	-3.86
239293	02BS-PKR	0.4819	50/50	0.4819
239297	02CPPW41	-3.7140	Adder	-4.37
241902	Y1-069 GE	31.6089	50/50	31.6089
244357	05GRANGER EL	0.3699	Adder	0.44
247548	V4-010 C	3.4613	Adder	4.07
247551	**U4-028 C (Suspended)**	**1.6148**	**Adder**	**1.9**
247552	**U4-029 C (Suspended)**	**1.6148**	**Adder**	**1.9**
247940	**U4-028 E (Suspended)**	**10.8071**	**Adder**	**12.71**
247941	**U4-029 E (Suspended)**	**10.8071**	**Adder**	**12.71**
247947	V4-010 E	23.1641	Adder	27.25
915952	Y3-092 NFTWR	111.1700	Merchant Transmission	111.1700
923821	AB2-019 FTWR	3.1128	Merchant Transmission	3.1128
925751	AC1-051 C	0.7882	Adder	0.93
925752	AC1-051 E	5.2747	Adder	6.21
931951	AB1-107 1	47.2190	Adder	55.55
931961	AB1-107 2	128.4895	50/50	128.4895
932051	AC2-015 C	5.4739	Adder	6.44
932052	AC2-015 E	6.4859	Adder	7.63
932791	AC2-103 C	14.3954	50/50	14.3954
932792	AC2-103 E	96.3550	50/50	96.3550
934252	AD1-052 E1	0.9741	Adder	1.15
934262	AD1-052 E2	0.9741	Adder	1.15
934461	AD1-070 C O1	4.6417	Adder	5.46
934462	AD1-070 E O1	21.7903	Adder	25.64
934761	AD1-103 C O1	24.2039	50/50	24.2039
934762	AD1-103 E O1	161.9799	50/50	161.9799
934891	AD1-118	12.3849	Adder	14.57
937021	AD2-136 C O1	5.8134	Adder	6.84
937022	AD2-136 E O1	38.9054	Adder	45.77
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**2.7452**	**Adder**	**3.23**

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**18.3720**	**Adder**	**21.61**
938911	AE1-119	97.3101	Adder	114.48
939161	AE1-146 C O1	9.8399	Adder	11.58
939162	AE1-146 E O1	4.5952	Adder	5.41
940841	AE2-072 C	9.6069	Adder	11.3
940842	AE2-072 E	6.4046	Adder	7.53
941741	AE2-174 C	4.6395	Adder	5.46
941742	AE2-174 E	21.7197	Adder	25.55
941761	AE2-176 C	15.7920	50/50	15.7920
941762	AE2-176 E	10.5280	50/50	10.5280
941781	AE2-181 C	4.4280	Adder	5.21
941782	AE2-181 E	2.9520	Adder	3.47
942661	AE2-282 C O1	6.7521	Adder	7.94
942662	AE2-282 E O1	3.5530	Adder	4.18
943951	AF1-063 C O1	1.9881	Adder	2.34
943952	AF1-063 E O1	1.1022	Adder	1.3
943961	AF1-064 C O1	5.5224	Adder	6.5
943962	AF1-064 E O1	2.7447	Adder	3.23
944551	AF1-120 C	4.0913	Adder	4.81
944552	AF1-120 E	2.0610	Adder	2.42
945401	AF1-205 C O1	3.8070	Adder	4.48
945402	AF1-205 E O1	2.5380	Adder	2.99
945411	AF1-206 C O1	18.3646	Adder	21.61
945412	AF1-206 E O1	12.2431	Adder	14.4
945641	AF1-229 C	8.4376	Adder	9.93
945642	AF1-229 E	5.6251	Adder	6.62
955781	J1062	17.1690	PJM External (MISO)	17.1690
957031	AF2-004 1	3.9284	50/50	3.9284
957041	AF2-004 2	3.9284	50/50	3.9284
957051	AF2-004 3	3.9284	50/50	3.9284
957061	AF2-004 4	3.9284	50/50	3.9284
957111	AF2-005	0.7134	Adder	1.58
958321	AF2-126 C	3.5140	Adder	7.8
958322	AF2-126 E	1.7439	Adder	3.87
958331	AF2-127 C	1.3594	Adder	3.02
958332	AF2-127 E	0.7152	Adder	1.59
960301	AF2-321 C	6.7971	Adder	15.09
960302	AF2-321 E	4.5314	Adder	10.06
960841	AF2-375 C O1	5.3138	Adder	11.8
960842	AF2-375 E O1	3.5426	Adder	7.86
960951	AF2-386 C O1	0.4969	Adder	1.1
960952	AF2-386 E O1	0.6862	Adder	1.52
WEC	WEC	1.8906	Confirmed LTF	1.8906
LGEE	LGEE	2.4109	Confirmed LTF	2.4109
CPLE	CPLE	0.5213	Confirmed LTF	0.5213
CBM-W2	CBM-W2	34.3816	Confirmed LTF	34.3816
NY	NY	2.3160	Confirmed LTF	2.3160
CBM-W1	CBM-W1	109.0372	Confirmed LTF	109.0372
TVA	TVA	4.5164	Confirmed LTF	4.5164
O-066	O-066	23.0832	Confirmed LTF	23.0832
CBM-S2	CBM-S2	7.7914	Confirmed LTF	7.7914
CBM-S1	CBM-S1	29.0702	Confirmed LTF	29.0702

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
G-007	G-007	3.5433	Confirmed LTF	3.5433
MADISON	MADISON	1.9616	Confirmed LTF	1.9616
MEC	MEC	8.4344	Confirmed LTF	8.4344

11.6.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100801300	238874	02LAKVEW	ATSI	238768	02GRNFLD	ATSI	1	ATSI-P7-1-TE-345-027A	tower	316.0	120.14	121.08	DC	6.57

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238979	02NAPMUN	2.0137	Adder	2.37
247548	V4-010 C	1.4173	Adder	1.67
247551	**U4-028 C (Suspended)**	**0.6058**	**Adder**	**0.71**
247552	**U4-029 C (Suspended)**	**0.6058**	**Adder**	**0.71**
247940	**U4-028 E (Suspended)**	**4.0539**	**Adder**	**4.77**
247941	**U4-029 E (Suspended)**	**4.0539**	**Adder**	**4.77**
247947	V4-010 E	9.4848	Adder	11.16
931951	AB1-107 1	20.4819	Adder	24.1
931961	AB1-107 2	33.3903	Adder	39.28
934252	AD1-052 E1	0.4965	Adder	0.58
934262	AD1-052 E2	0.4965	Adder	0.58
934461	AD1-070 C O1	1.5523	Adder	1.83
934462	AD1-070 E O1	7.2874	Adder	8.57
934891	AD1-118	3.6503	Adder	4.29
937021	AD2-136 C O1	2.1807	Adder	2.57
937022	AD2-136 E O1	14.5942	Adder	17.17
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**1.0298**	**Adder**	**1.21**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**6.8917**	**Adder**	**8.11**
938911	AE1-119	28.6811	Adder	33.74
941741	AE2-174 C	1.8997	Adder	2.23
941742	AE2-174 E	8.8934	Adder	10.46
941781	AE2-181 C	1.5261	Adder	1.8
941782	AE2-181 E	1.0174	Adder	1.2
942661	AE2-282 C O1	2.3452	Adder	2.76
942662	AE2-282 E O1	1.2341	Adder	1.45
943961	AF1-064 C O1	1.9970	Adder	2.35
943962	AF1-064 E O1	0.9925	Adder	1.17
944551	AF1-120 C	1.4210	Adder	1.67
944552	AF1-120 E	0.7159	Adder	0.84
945401	AF1-205 C O1	1.3062	Adder	1.54
945402	AF1-205 E O1	0.8708	Adder	1.02
945411	AF1-206 C O1	6.3786	Adder	7.5
945412	AF1-206 E O1	4.2524	Adder	5.0
958321	AF2-126 C	1.2707	Adder	2.82
958322	AF2-126 E	0.6306	Adder	1.4
960301	AF2-321 C	2.3259	Adder	5.16
960302	AF2-321 E	1.5506	Adder	3.44
960841	AF2-375 C O1	1.7771	Adder	3.94
960842	AF2-375 E O1	1.1847	Adder	2.63

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
960951	AF2-386 C O1	0.1705	Adder	0.38
960952	AF2-386 E O1	0.2354	Adder	0.52
WEC	WEC	0.5683	Confirmed LTF	0.5683
LGEE	LGEE	0.7057	Confirmed LTF	0.7057
CPLE	CPLE	0.1449	Confirmed LTF	0.1449
CBM-W2	CBM-W2	10.1802	Confirmed LTF	10.1802
NY	NY	0.6371	Confirmed LTF	0.6371
CBM-W1	CBM-W1	33.3392	Confirmed LTF	33.3392
TVA	TVA	1.3230	Confirmed LTF	1.3230
O-066	O-066	6.5184	Confirmed LTF	6.5184
CBM-S2	CBM-S2	2.2137	Confirmed LTF	2.2137
CBM-S1	CBM-S1	8.5115	Confirmed LTF	8.5115
G-007	G-007	1.0015	Confirmed LTF	1.0015
MADISON	MADISON	0.6733	Confirmed LTF	0.6733
MEC	MEC	2.5249	Confirmed LTF	2.5249

11.6.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
100801307	239030	02OTTAWA	ATSI	238874	02LAKVEW	ATSI	1	ATSI-P7-1-TE-345-027A	tower	380.0	116.72	117.5	DC	6.57

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238979	02NAPMUN	2.0137	Adder	2.37
247548	V4-010 C	1.4173	Adder	1.67
247551	**U4-028 C (Suspended)**	**0.6058**	**Adder**	**0.71**
247552	**U4-029 C (Suspended)**	**0.6058**	**Adder**	**0.71**
247940	**U4-028 E (Suspended)**	**4.0539**	**Adder**	**4.77**
247941	**U4-029 E (Suspended)**	**4.0539**	**Adder**	**4.77**
247947	V4-010 E	9.4848	Adder	11.16
931951	AB1-107 1	20.4819	Adder	24.1
931961	AB1-107 2	33.3903	Adder	39.28
934252	AD1-052 E1	0.4965	Adder	0.58
934262	AD1-052 E2	0.4965	Adder	0.58
934461	AD1-070 C O1	1.5523	Adder	1.83
934462	AD1-070 E O1	7.2874	Adder	8.57
934891	AD1-118	3.6503	Adder	4.29
937021	AD2-136 C O1	2.1807	Adder	2.57
937022	AD2-136 E O1	14.5942	Adder	17.17
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**1.0298**	**Adder**	**1.21**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**6.8917**	**Adder**	**8.11**
938911	AE1-119	28.6811	Adder	33.74
941741	AE2-174 C	1.8997	Adder	2.23
941742	AE2-174 E	8.8934	Adder	10.46
941781	AE2-181 C	1.5261	Adder	1.8
941782	AE2-181 E	1.0174	Adder	1.2
942661	AE2-282 C O1	2.3452	Adder	2.76
942662	AE2-282 E O1	1.2341	Adder	1.45
943961	AF1-064 C O1	1.9970	Adder	2.35
943962	AF1-064 E O1	0.9925	Adder	1.17
944551	AF1-120 C	1.4210	Adder	1.67
944552	AF1-120 E	0.7159	Adder	0.84
945401	AF1-205 C O1	1.3062	Adder	1.54
945402	AF1-205 E O1	0.8708	Adder	1.02
945411	AF1-206 C O1	6.3786	Adder	7.5
945412	AF1-206 E O1	4.2524	Adder	5.0
958321	AF2-126 C	1.2707	Adder	2.82
958322	AF2-126 E	0.6306	Adder	1.4
960301	AF2-321 C	2.3259	Adder	5.16
960302	AF2-321 E	1.5506	Adder	3.44
960841	AF2-375 C O1	1.7771	Adder	3.94
960842	AF2-375 E O1	1.1847	Adder	2.63

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
960951	AF2-386 C O1	0.1705	Adder	0.38
960952	AF2-386 E O1	0.2354	Adder	0.52
WEC	WEC	0.5683	Confirmed LTF	0.5683
LGEE	LGEE	0.7057	Confirmed LTF	0.7057
CPLE	CPLE	0.1449	Confirmed LTF	0.1449
CBM-W2	CBM-W2	10.1802	Confirmed LTF	10.1802
NY	NY	0.6371	Confirmed LTF	0.6371
CBM-W1	CBM-W1	33.3392	Confirmed LTF	33.3392
TVA	TVA	1.3230	Confirmed LTF	1.3230
O-066	O-066	6.5184	Confirmed LTF	6.5184
CBM-S2	CBM-S2	2.2137	Confirmed LTF	2.2137
CBM-S1	CBM-S1	8.5115	Confirmed LTF	8.5115
G-007	G-007	1.0015	Confirmed LTF	1.0015
MADISON	MADISON	0.6733	Confirmed LTF	0.6733
MEC	MEC	2.5249	Confirmed LTF	2.5249

11.6.6 Index 6

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515853	242936	05FOSTOR	AEP	242935	05E LIMA	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	121.01	122.6	DC	23.38

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	5.3099	50/50	5.3099
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**23.5116**	**50/50**	**23.5116**
238885	02LEMOG1	6.0712	50/50	6.0712
238886	02LEMOG2	6.0712	50/50	6.0712
238887	02LEMOG3	6.0712	50/50	6.0712
238888	02LEMOG4	6.0712	50/50	6.0712
238979	02NAPMUN	5.2701	Adder	6.2
239293	02BS-PKR	0.4635	50/50	0.4635
241902	Y1-069 GE	31.4894	50/50	31.4894
244357	05GRANGER EL	0.2415	Adder	0.28
247548	V4-010 C	3.4604	Adder	4.07
247549	V3-028 C	-1.0591	Adder	-1.25
247551	**U4-028 C (Suspended)**	**1.6727**	**Adder**	**1.97**
247552	**U4-029 C (Suspended)**	**1.6727**	**Adder**	**1.97**
247940	**U4-028 E (Suspended)**	**11.1946**	**Adder**	**13.17**
247941	**U4-029 E (Suspended)**	**11.1946**	**Adder**	**13.17**
247947	V4-010 E	23.1582	Adder	27.24
924791	AB2-131 C OP	3.1953	Adder	3.76
924792	AB2-131 E OP	5.2133	Adder	6.13
925131	AB2-170 C O1	-6.8838	Adder	-8.1
925751	AC1-051 C	0.7660	Adder	0.9
925752	AC1-051 E	5.1261	Adder	6.03
927181	AC1-212 C	-0.1288	Adder	-0.15
927183	AC1-212 BAT	1.5872	Merchant Transmission	1.5872
931951	AB1-107 1	53.4304	50/50	53.4304
931961	AB1-107 2	128.0037	50/50	128.0037
932051	AC2-015 C	5.3943	Adder	6.35
932052	AC2-015 E	6.3915	Adder	7.52
932791	AC2-103 C	8.0135	50/50	8.0135
932792	AC2-103 E	53.6379	50/50	53.6379
933721	AC2-195 C O1	2.9502	Adder	3.47
933722	AC2-195 E O1	1.7986	Adder	2.12
934252	AD1-052 E1	0.8498	Adder	1.0
934262	AD1-052 E2	0.8498	Adder	1.0
934461	AD1-070 C O1	6.4937	50/50	6.4937
934462	AD1-070 E O1	30.4842	50/50	30.4842
934761	AD1-103 C O1	13.4736	50/50	13.4736
934762	AD1-103 E O1	90.1693	50/50	90.1693
934891	AD1-118	15.3986	50/50	15.3986
936722	AD2-091 BAT	8.1970	Merchant Transmission	8.1970

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
936752	AD2-096 BAT	2.8820	Merchant Transmission	2.8820
937021	AD2-136 C O1	6.0219	Adder	7.08
937022	AD2-136 E O1	40.3004	Adder	47.41
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**2.8437**	**Adder**	**3.35**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**19.0307**	**Adder**	**22.39**
938911	AE1-119	120.9890	50/50	120.9890
939161	AE1-146 C O1	8.4124	Adder	9.9
939162	AE1-146 E O1	3.9285	Adder	4.62
941741	AE2-174 C	4.6383	Adder	5.46
941742	AE2-174 E	21.7141	Adder	25.55
941761	AE2-176 C	9.7926	Adder	11.52
941762	AE2-176 E	6.5284	Adder	7.68
941781	AE2-181 C	3.6390	Adder	4.28
941782	AE2-181 E	2.4260	Adder	2.85
942042	AE2-216 BAT	9.0167	Merchant Transmission	9.0167
942661	AE2-282 C O1	5.7547	Adder	6.77
942662	AE2-282 E O1	3.0281	Adder	3.56
943011	AE2-324	0.9644	Adder	1.13
943961	AF1-064 C O1	6.1503	50/50	6.1503
943962	AF1-064 E O1	3.0567	50/50	3.0567
944551	AF1-120 C	3.4869	Adder	4.1
944552	AF1-120 E	1.7566	Adder	2.07
944571	AF1-122 C O1	1.7764	Adder	2.09
944572	AF1-122 E O1	2.4532	Adder	2.89
945401	AF1-205 C O1	3.4184	Adder	4.02
945402	AF1-205 E O1	2.2790	Adder	2.68
945411	AF1-206 C O1	15.6518	Adder	18.41
945412	AF1-206 E O1	10.4345	Adder	12.28
945623	AF1-227 BAT	9.1580	Merchant Transmission	9.1580
945641	AF1-229 C	17.1274	50/50	17.1274
945642	AF1-229 E	11.4182	50/50	11.4182
946203	AF1-285 BAT	2.9556	Merchant Transmission	2.9556
950311	G934 C	2.0763	PJM External (MISO)	2.0763
950312	G934 E	8.3052	PJM External (MISO)	8.3052
950351	J466	3.3606	PJM External (MISO)	3.3606
950791	J201 C	0.4014	PJM External (MISO)	0.4014
950792	J201 E	1.6056	PJM External (MISO)	1.6056
950871	J246 C	0.1060	PJM External (MISO)	0.1060
950872	J246 E	0.4238	PJM External (MISO)	0.4238
950942	J325 E	0.4626	PJM External (MISO)	0.4626
951531	J533 C	3.0272	PJM External (MISO)	3.0272
951532	J533 E	12.1088	PJM External (MISO)	12.1088
951571	J538 C	3.0615	PJM External (MISO)	3.0615
951572	J538 E	12.2460	PJM External (MISO)	12.2460
951941	J602 C	2.9787	PJM External (MISO)	2.9787
951942	J602 E	16.1153	PJM External (MISO)	16.1153
952201	J589 C	2.5107	PJM External (MISO)	2.5107
952202	J589 E	13.5833	PJM External (MISO)	13.5833
952312	J646 E	0.2014	PJM External (MISO)	0.2014
952401	J752 C	1.7094	PJM External (MISO)	1.7094
952402	J752 E	9.2486	PJM External (MISO)	9.2486

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
952611	J717 C	2.8035	PJM External (MISO)	2.8035
952612	J717 E	15.1675	PJM External (MISO)	15.1675
952761	J728 C	2.6072	PJM External (MISO)	2.6072
952762	J728 E	14.1244	PJM External (MISO)	14.1244
952881	J758	12.4160	PJM External (MISO)	12.4160
952971	J793	166.0035	PJM External (MISO)	166.0035
953071	J794 C	0.1653	PJM External (MISO)	0.1653
953072	J794 E	0.8941	PJM External (MISO)	0.8941
953271	J701 C	0.8320	PJM External (MISO)	0.8320
953272	J701 E	4.5016	PJM External (MISO)	4.5016
953291	J796	22.3489	PJM External (MISO)	22.3489
953321	J799	27.3218	PJM External (MISO)	27.3218
953361	J806	11.5237	PJM External (MISO)	11.5237
953771	J832	7.6630	PJM External (MISO)	7.6630
953781	J833	14.5530	PJM External (MISO)	14.5530
953811	J839	12.1900	PJM External (MISO)	12.1900
953941	J857	8.7178	PJM External (MISO)	8.7178
954111	J875	18.6060	PJM External (MISO)	18.6060
955071	J984 C	2.1594	PJM External (MISO)	2.1594
955072	J984 E	11.6826	PJM External (MISO)	11.6826
955121	J989	8.5008	PJM External (MISO)	8.5008
955181	J996	11.2720	PJM External (MISO)	11.2720
955261	J1005	18.7160	PJM External (MISO)	18.7160
955591	J1043 C	0.8500	PJM External (MISO)	0.8500
955592	J1043 E	15.0614	PJM External (MISO)	15.0614
955781	J1062	25.3650	PJM External (MISO)	25.3650
956011	J1088	14.0370	PJM External (MISO)	14.0370
956021	J1089	16.0820	PJM External (MISO)	16.0820
956031	J1090	8.9046	PJM External (MISO)	8.9046
956161	J1103	2.1770	PJM External (MISO)	2.1770
956741	J1172	5.1105	PJM External (MISO)	5.1105
956751	J1173	10.2680	PJM External (MISO)	10.2680
956801	J1178	5.8208	PJM External (MISO)	5.8208
957111	AF2-005	0.2221	Adder	0.49
958321	AF2-126 C	7.3840	50/50	7.3840
958322	AF2-126 E	3.6644	50/50	3.6644
958591	AF2-150 C O1	1.8664	Adder	4.14
958592	AF2-150 E O1	2.5773	Adder	5.72
960301	AF2-321 C	5.1526	Adder	11.44
960302	AF2-321 E	3.4350	Adder	7.62
960841	AF2-375 C O1	14.0263	50/50	14.0263
960842	AF2-375 E O1	9.3509	50/50	9.3509
960853	AF2-376 BAT	1.7381	Merchant Transmission	1.7381
960863	AF2-377 BAT	1.6782	Merchant Transmission	1.6782
960951	AF2-386 C O1	0.3996	Adder	0.89
960952	AF2-386 E O1	0.5518	Adder	1.22
NEWTON	NEWTON	1.5881	Confirmed LTF	1.5881
FARMERCITY	FARMERCITY	0.0669	Confirmed LTF	0.0669
G-007A	G-007A	0.4004	Confirmed LTF	0.4004
VFT	VFT	1.1094	Confirmed LTF	1.1094
CALDERWOOD	CALDERWOOD	0.6685	Confirmed LTF	0.6685
CBM-W1	CBM-W1	39.8193	Confirmed LTF	39.8193

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
PRAIRIE	PRAIRIE	3.5542	Confirmed LTF	3.5542
CHEOAH	CHEOAH	0.6687	Confirmed LTF	0.6687
EDWARDS	EDWARDS	0.3675	Confirmed LTF	0.3675
TILTON	TILTON	0.9047	Confirmed LTF	0.9047
MADISON	MADISON	3.5986	Confirmed LTF	3.5986
GIBSON	GIBSON	1.0030	Confirmed LTF	1.0030
BLUEG	BLUEG	3.5171	Confirmed LTF	3.5171
TRIMBLE	TRIMBLE	1.1347	Confirmed LTF	1.1347
CATAWBA	CATAWBA	0.3808	Confirmed LTF	0.3808

11.6.7 Index 7

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947779	242984	05CHATFL	AEP	932050	AC2-015 TAP	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	146.55	148.67	DC	7.85

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.7060	50/50	3.7060
247551	**U4-028 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247552	**U4-029 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247940	**U4-028 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247941	**U4-029 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247947	V4-010 E	24.8020	50/50	24.8020
925751	AC1-051 C	2.3830	50/50	2.3830
925752	AC1-051 E	15.9476	50/50	15.9476
934252	AD1-052 E1	0.2602	Adder	0.31
934262	AD1-052 E2	0.2602	Adder	0.31
934461	AD1-070 C O1	1.8541	Adder	2.18
934462	AD1-070 E O1	8.7038	Adder	10.24
937021	AD2-136 C O1	7.9218	50/50	7.9218
937022	AD2-136 E O1	53.0154	50/50	53.0154
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.7409**	**50/50**	**3.7409**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**25.0350**	**50/50**	**25.0350**
939161	AE1-146 C O1	3.6010	Adder	4.24
939162	AE1-146 E O1	1.6816	Adder	1.98
941741	AE2-174 C	4.9675	50/50	4.9675
941742	AE2-174 E	23.2554	50/50	23.2554
960841	AF2-375 C O1	2.1225	Adder	4.71
960842	AF2-375 E O1	1.4150	Adder	3.14
WEC	WEC	0.1263	Confirmed LTF	0.1263
LGEE	LGEE	0.0930	Confirmed LTF	0.0930
CBM-W2	CBM-W2	1.6871	Confirmed LTF	1.6871
NY	NY	0.1073	Confirmed LTF	0.1073
CBM-W1	CBM-W1	8.8070	Confirmed LTF	8.8070
TVA	TVA	0.1540	Confirmed LTF	0.1540
O-066	O-066	1.3306	Confirmed LTF	1.3306
CBM-S1	CBM-S1	1.0224	Confirmed LTF	1.0224
G-007	G-007	0.2059	Confirmed LTF	0.2059
MADISON	MADISON	0.3851	Confirmed LTF	0.3851
MEC	MEC	0.5180	Confirmed LTF	0.5180
CATAWBA	CATAWBA	0.0101	Confirmed LTF	0.0101

11.6.8 Index 8

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947794	243008	05FREMCT	AEP	243009	05FRMNT	AEP	1	AEP_P4_#10133_05HOWARD 138_H	breaker	251.0	139.73	141.92	DC	12.18

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	0.1985	Adder	0.23
247548	V4-010 C	10.1278	50/50	10.1278
247551	**U4-028 C (Suspended)**	**4.0352**	**50/50**	**4.0352**
247552	**U4-029 C (Suspended)**	**4.0352**	**50/50**	**4.0352**
247926	U1-059 E	1.8732	Adder	2.2
247940	**U4-028 E (Suspended)**	**27.0048**	**50/50**	**27.0048**
247941	**U4-029 E (Suspended)**	**27.0048**	**50/50**	**27.0048**
247942	W1-056 E	0.6890	Adder	0.81
247947	V4-010 E	67.7782	50/50	67.7782
925751	AC1-051 C	2.0239	50/50	2.0239
925752	AC1-051 E	13.5443	50/50	13.5443
932051	AC2-015 C	16.1528	50/50	16.1528
932052	AC2-015 E	19.1391	50/50	19.1391
934252	AD1-052 E1	-0.6535	Adder	-0.77
934262	AD1-052 E2	-0.6535	Adder	-0.77
934461	AD1-070 C O1	2.8770	Adder	3.38
934462	AD1-070 E O1	13.5060	Adder	15.89
937021	AD2-136 C O1	14.5267	50/50	14.5267
937022	AD2-136 E O1	97.2173	50/50	97.2173
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**6.8598**	**50/50**	**6.8598**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**45.9082**	**50/50**	**45.9082**
939161	AE1-146 C O1	5.6006	Adder	6.59
939162	AE1-146 E O1	2.6155	Adder	3.08
941741	AE2-174 C	13.5751	50/50	13.5751
941742	AE2-174 E	63.5518	50/50	63.5518
960841	AF2-375 C O1	3.2936	Adder	7.31
960842	AF2-375 E O1	2.1957	Adder	4.87
WEC	WEC	0.1118	Confirmed LTF	0.1118
LGEE	LGEE	0.2316	Confirmed LTF	0.2316
CPLE	CPLE	0.1217	Confirmed LTF	0.1217
CBM-W2	CBM-W2	2.8092	Confirmed LTF	2.8092
NY	NY	0.0824	Confirmed LTF	0.0824
CBM-W1	CBM-W1	1.5763	Confirmed LTF	1.5763
TVA	TVA	0.4382	Confirmed LTF	0.4382
O-066	O-066	0.6787	Confirmed LTF	0.6787
CBM-S2	CBM-S2	1.2600	Confirmed LTF	1.2600
CBM-S1	CBM-S1	2.8116	Confirmed LTF	2.8116
G-007	G-007	0.1040	Confirmed LTF	0.1040
MEC	MEC	0.5561	Confirmed LTF	0.5561

11.6.9 Index 9

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515236	243009	05FRMNT	AEP	239154	02W.FREM	ATSI	1	AEP_P4_#10134_05HOWARD 138_B	breaker	361.0	103.91	108.01	DC	14.81

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	0.2413	Adder	0.28
247548	V4-010 C	12.0247	50/50	12.0247
247551	**U4-028 C (Suspended)**	**4.8123**	**50/50**	**4.8123**
247552	**U4-029 C (Suspended)**	**4.8123**	**50/50**	**4.8123**
247926	U1-059 E	2.3087	Adder	2.72
247940	**U4-028 E (Suspended)**	**32.2057**	**50/50**	**32.2057**
247941	**U4-029 E (Suspended)**	**32.2057**	**50/50**	**32.2057**
247942	W1-056 E	0.8492	Adder	1.0
247947	V4-010 E	80.4733	50/50	80.4733
925751	AC1-051 C	2.4338	50/50	2.4338
925752	AC1-051 E	16.2880	50/50	16.2880
932051	AC2-015 C	19.3080	50/50	19.3080
932052	AC2-015 E	22.8775	50/50	22.8775
934252	AD1-052 E1	-0.8029	Adder	-0.94
934262	AD1-052 E2	-0.8029	Adder	-0.94
934461	AD1-070 C O1	4.1126	50/50	4.1126
934462	AD1-070 E O1	19.3066	50/50	19.3066
937021	AD2-136 C O1	17.3244	50/50	17.3244
937022	AD2-136 E O1	115.9404	50/50	115.9404
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**8.1810**	**50/50**	**8.1810**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**54.7496**	**50/50**	**54.7496**
939161	AE1-146 C O1	6.8063	Adder	8.01
939162	AE1-146 E O1	3.1785	Adder	3.74
941741	AE2-174 C	16.1178	50/50	16.1178
941742	AE2-174 E	75.4552	50/50	75.4552
960841	AF2-375 C O1	8.8833	50/50	8.8833
960842	AF2-375 E O1	5.9222	50/50	5.9222
WEC	WEC	0.1367	Confirmed LTF	0.1367
LGEE	LGEE	0.2835	Confirmed LTF	0.2835
CPLE	CPLE	0.1488	Confirmed LTF	0.1488
CBM-W2	CBM-W2	3.4398	Confirmed LTF	3.4398
NY	NY	0.1006	Confirmed LTF	0.1006
CBM-W1	CBM-W1	1.9140	Confirmed LTF	1.9140
TVA	TVA	0.5362	Confirmed LTF	0.5362
O-066	O-066	0.8400	Confirmed LTF	0.8400
CBM-S2	CBM-S2	1.5433	Confirmed LTF	1.5433
CBM-S1	CBM-S1	3.4421	Confirmed LTF	3.4421
G-007	G-007	0.1279	Confirmed LTF	0.1279
MEC	MEC	0.6801	Confirmed LTF	0.6801

11.6.10 Index 10

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947769	243039	05MELMOR	AEP	243024	05HOWARD	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	164.75	166.65	DC	7.03

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.9970	50/50	3.9970
247551	**U4-028 C (Suspended)**	**2.5848**	**50/50**	**2.5848**
247552	**U4-029 C (Suspended)**	**2.5848**	**50/50**	**2.5848**
247940	**U4-028 E (Suspended)**	**17.2982**	**50/50**	**17.2982**
247941	**U4-029 E (Suspended)**	**17.2982**	**50/50**	**17.2982**
247947	V4-010 E	26.7490	50/50	26.7490
934252	AD1-052 E1	0.2726	Adder	0.32
934262	AD1-052 E2	0.2726	Adder	0.32
934461	AD1-070 C O1	1.6604	Adder	1.95
934462	AD1-070 E O1	7.7944	Adder	9.17
937021	AD2-136 C O1	9.3052	50/50	9.3052
937022	AD2-136 E O1	62.2736	50/50	62.2736
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**4.3941**	**50/50**	**4.3941**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**29.4070**	**50/50**	**29.4070**
941741	AE2-174 C	5.3575	50/50	5.3575
941742	AE2-174 E	25.0810	50/50	25.0810
960841	AF2-375 C O1	1.9008	Adder	4.22
960842	AF2-375 E O1	1.2672	Adder	2.81
WEC	WEC	0.0973	Confirmed LTF	0.0973
LGEE	LGEE	0.0411	Confirmed LTF	0.0411
CALDERWOOD	CALDERWOOD	0.0075	Confirmed LTF	0.0075
CBM-W2	CBM-W2	1.0319	Confirmed LTF	1.0319
NY	NY	0.0758	Confirmed LTF	0.0758
CBM-W1	CBM-W1	7.7937	Confirmed LTF	7.7937
TVA	TVA	0.0560	Confirmed LTF	0.0560
O-066	O-066	1.0147	Confirmed LTF	1.0147
CHEOAH	CHEOAH	0.0085	Confirmed LTF	0.0085
CBM-S1	CBM-S1	0.3919	Confirmed LTF	0.3919
G-007	G-007	0.1570	Confirmed LTF	0.1570
MADISON	MADISON	0.4254	Confirmed LTF	0.4254
MEC	MEC	0.3798	Confirmed LTF	0.3798
CATAWBA	CATAWBA	0.0248	Confirmed LTF	0.0248

11.6.11 Index 11

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947751	932050	AC2-015 TAP	AEP	243024	05HOWARD	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	177.94	180.06	DC	7.85

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.7060	50/50	3.7060
247551	**U4-028 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247552	**U4-029 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247940	**U4-028 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247941	**U4-029 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247947	V4-010 E	24.8020	50/50	24.8020
925751	AC1-051 C	2.3830	50/50	2.3830
925752	AC1-051 E	15.9476	50/50	15.9476
932051	AC2-015 C	23.9931	50/50	23.9931
932052	AC2-015 E	28.4288	50/50	28.4288
934252	AD1-052 E1	0.2602	Adder	0.31
934262	AD1-052 E2	0.2602	Adder	0.31
934461	AD1-070 C O1	1.8541	Adder	2.18
934462	AD1-070 E O1	8.7038	Adder	10.24
937021	AD2-136 C O1	7.9218	50/50	7.9218
937022	AD2-136 E O1	53.0154	50/50	53.0154
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.7409**	**50/50**	**3.7409**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**25.0350**	**50/50**	**25.0350**
939161	AE1-146 C O1	3.6010	Adder	4.24
939162	AE1-146 E O1	1.6816	Adder	1.98
941741	AE2-174 C	4.9675	50/50	4.9675
941742	AE2-174 E	23.2554	50/50	23.2554
960841	AF2-375 C O1	2.1225	Adder	4.71
960842	AF2-375 E O1	1.4150	Adder	3.14
WEC	WEC	0.1263	Confirmed LTF	0.1263
LGEE	LGEE	0.0930	Confirmed LTF	0.0930
CBM-W2	CBM-W2	1.6871	Confirmed LTF	1.6871
NY	NY	0.1073	Confirmed LTF	0.1073
CBM-W1	CBM-W1	8.8070	Confirmed LTF	8.8070
TVA	TVA	0.1540	Confirmed LTF	0.1540
O-066	O-066	1.3306	Confirmed LTF	1.3306
CBM-S1	CBM-S1	1.0224	Confirmed LTF	1.0224
G-007	G-007	0.2059	Confirmed LTF	0.2059
MADISON	MADISON	0.3851	Confirmed LTF	0.3851
MEC	MEC	0.5180	Confirmed LTF	0.5180
CATAWBA	CATAWBA	0.0101	Confirmed LTF	0.0101

11.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AB1-107	Bayshore-GM Powertrain 138 kV & Lallendorf 345kV	Engineering and Procurement
AB2-019	Erie West 345kV	Engineering and Procurement
AB2-131	Galion-Roberts South 138kV	Active
AB2-170	East Lima-Marysville 345kV	Under Construction
AC1-051	Willard-S. Greenwich 69kV	Active
AC1-212	Minster 69kV	Engineering and Procurement
AC2-015	Chatfield-Howard 138kV	Active
AC2-103	Beaver-Davis Besse 345 kV I	Active
AC2-195	Galion-Roberts South 138kV	Active
AD1-052	Freemont Energy Center	Under Construction
AD1-070	Fostoria Central 138 kV	Active
AD1-103	Beaver-Davis Besse 345 kV II	Active
AD1-118	Lemoyne	Active
AD2-075	Segreto 345kV	Active
AD2-091	Hardin Tap 345kV	Active
AD2-096	Marysville 345kV	Active
AD2-136	Melmore Tap 138kV	Active
AD2-191	Melmore 138kV	Withdrawn
AE1-119	Lemoyne 345 kV	Active
AE1-146	Ebersole #2-Fostoria Central 138 kV	Active
AE2-072	East Leipsic-Richland 138 kV	Active
AE2-174	Seneca 138 kV	Active
AE2-176	Groton 138 kV Solar	Active
AE2-181	Snyder 69kV	Active
AE2-216	Hardin Switch 345 kV	Active
AE2-282	East Fayette 138 kV	Active
AE2-324	Galion-Roberts South II 138 kV	Active
AF1-063	Lockwood Road 138 kV	Active
AF1-064	Weston 69 kV	Active
AF1-120	East Fayette 2 138 kV	Active
AF1-122	Cardington 138 kV	Active
AF1-205	Napolean Muni 138 kV	Active
AF1-206	Fayette-Lyons 138 kV	Active
AF1-227	Marysville-East Lima 345 kV	Active
AF1-229	Galion-South Berwick 345 kV	Active
AF1-285	Gunn Road 345 kV	Active
AF2-004	Beaver 345 kV	Active
AF2-005	Beaver 138 kV	Active
AF2-126	Weston 69 kV II	Active
AF2-127	Lockwood Road 138 kV	Active

Queue Number	Project Name	Status
AF2-150	Galion 138 kV	Active
AF2-209	South Hicksville 138 kV	Active
AF2-321	Stryker-Ridgeville 138 kV	Active
AF2-375	Fostoria Central 138 kV	Active
AF2-376	Timber Switch 138 kV	Active
AF2-377	Logtown 138 kV	Active
AF2-386	Bryan 69 kV	Active
U1-059	Ada-Dunkirk 69kV	In Service
U4-028	Fostoria Central-Greenlawn-Howard 138kV	Suspended
U4-029	Fostoria Central-Greenlawn-Howard 138kV	Suspended
V3-028	East Lima-Marysville 345kV	Under Construction
V4-010	Tiffin Center 138kV	Engineering and Procurement
W1-056	Ada-Dunkirk 69kV	In Service
Y1-069	Bay Shore-Fostoria Central 345kV & Bayshore-Monroe 345kV	In Service
Y3-092	Erie West 345kV	Engineering and Procurement
J1005	MISO	MISO
J1043	MISO	MISO
J1062	MISO	MISO
J1088	MISO	MISO
J1089	MISO	MISO
J1090	MISO	MISO
J1103	MISO	MISO
J1172	MISO	MISO
J1173	MISO	MISO
J1178	MISO	MISO
J201	MISO	MISO
J246	MISO	MISO
J325	MISO	MISO
J466	MISO	MISO
J533	MISO	MISO
J538	MISO	MISO
J589	MISO	MISO
J602	MISO	MISO
J646	MISO	MISO
J701	MISO	MISO
J717	MISO	MISO
J728	MISO	MISO
J752	MISO	MISO
J758	MISO	MISO
J793	MISO	MISO
J794	MISO	MISO
J796	MISO	MISO
J799	MISO	MISO
J806	MISO	MISO
J832	MISO	MISO
J833	MISO	MISO
J839	MISO	MISO
J857	MISO	MISO
J875	MISO	MISO
J984	MISO	MISO
J989	MISO	MISO
J996	MISO	MISO

11.8 Contingency Descriptions - Primary POI

Contingency Name	Contingency Definition
AEP_P1-2_#7105	CONTINGENCY 'AEP_P1-2_#7105' OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 END
AEP_SUBT_P4_#2200_05FREMNT C 69.0_E	CONTINGENCY 'AEP_SUBT_P4_#2200_05FREMNT C 69.0_E' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 END
AEP_P1-2_#7761-A	CONTINGENCY 'AEP_P1-2_#7761-A' OPEN BRANCH FROM BUS 247172 TO BUS 939160 CKT 2 / 247172 05EBERSO 138 939160 AE1-146 TAP 138 2 END
ATSI-P7-1-TE-345-029A	CONTINGENCY 'ATSI-P7-1-TE-345-029A' /* X1-027A - BEAVER & BEAVER - HAYES 345 DISCONNECT BRANCH FROM BUS 907060 TO BUS 238569 CKT 1 /* X1-027A_AT12 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 END

Contingency Name	Contingency Definition
AEP_SUBT_P4_#1208_05HOWARD 69.0_U	CONTINGENCY 'AEP_SUBT_P4_#1208_05HOWARD 69.0_U' OPEN BRANCH FROM BUS 245666 TO BUS 243024 CKT 1 / 245666 05HOWRD1EQ 999 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 245666 TO BUS 245663 CKT 1 / 245666 05HOWRD1EQ 999 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 245659 TO BUS 245663 CKT 1 / 245659 05E BUCYRU 69.0 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245678 CKT 1 / 245663 05HOWARD 69.0 245678 05NGALIOSS 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245679 CKT 1 / 245663 05HOWARD 69.0 245679 05WILLARD 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245657 CKT 1 / 245663 05HOWARD 69.0 245657 05WSHELBY 69.0 1 REMOVE SWSHUNT FROM BUS 245663 / 245663 05HOWARD 69.0 END

Contingency Name	Contingency Definition
AEP_P7-1_#10927	CONTINGENCY 'AEP_P7-1_#10927' OPEN BRANCH FROM BUS 242950 TO BUS 242955 CKT 1 / 242950 05ACADEM 138 242955 05APPVLY 138 1 OPEN BRANCH FROM BUS 242950 TO BUS 246941 CKT 1 / 242950 05ACADEM 138 246941 05MILL2Z 138 1 OPEN BRANCH FROM BUS 242955 TO BUS 243061 CKT 1 / 242955 05APPVLY 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247302 TO BUS 242962 CKT Z1 / 247302 05BLDBG8 138 242962 05BLDBGZ 138 Z1 OPEN BRANCH FROM BUS 242962 TO BUS 247278 CKT 1 / 242962 05BLDBGZ 138 247278 05MILL1Z 138 1 OPEN BRANCH FROM BUS 242962 TO BUS 243070 CKT 1 / 242962 05BLDBGZ 138 243070 05OHIOCT 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247278 TO BUS 243044 CKT Z1 / 247278 05MILL1Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 247278 TO BUS 243050 CKT 1 / 247278 05MILL1Z 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 246941 TO BUS 243044 CKT Z1 / 246941 05MILL2Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 246941 TO BUS 243160 CKT 1 / 246941 05MILL2Z 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243050 TO BUS 245567 CKT 1 / 243050 05NBELVL 138 245567 05NBELLVIL 69.0 1 OPEN BRANCH FROM BUS 243160 TO BUS 245425 CKT 1 / 243160 05WTRNWY 138 245425 05W TRINWY 12.0 1 END

Contingency Name	Contingency Definition
AEP_P4_#10133_05HOWARD 138_H	CONTINGENCY 'AEP_P4_#10133_05HOWARD 138_H' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243050 TO BUS 245567 CKT 1 / 243050 05NBELVL 138 245567 05NBELLVIL 69.0 1 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_P1-3_#5063_05SBERWI 345_1-B	CONTINGENCY 'AEP_P1-3_#5063_05SBERWI 345_1-B' OPEN BRANCH FROM BUS 242917 TO BUS 242942 CKT 1 / 242917 05SBERW EQ 999 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242917 TO BUS 243180 CKT 1 / 242917 05SBERW EQ 999 243180 05SBERWICK 69.0 1 OPEN BRANCH FROM BUS 242917 TO BUS 243199 CKT 1 / 242917 05SBERW EQ 999 243199 05SBERW1-L 12.0 1 OPEN BRANCH FROM BUS 945640 TO BUS 242942 CKT 1 / 945640 AF1-229 TAP 345 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242936 TO BUS 242942 CKT 1 / 242936 05FOSTOR 345 242942 05SBERWI 345 1 END
AEP_P4_#10729_05CHATFL 138_E	CONTINGENCY 'AEP_P4_#10729_05CHATFL 138_E' OPEN BRANCH FROM BUS 242984 TO BUS 932050 CKT 1 / 242984 05CHATFL 138 932050 AC2-015 TAP 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 1 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END
ATSI-P7-1-TE-345-027A	CONTINGENCY 'ATSI-P7-1-TE-345-027A' /* DB - X1-027A & DB - HAYES 345 DISCONNECT BRANCH FROM BUS 238654 TO BUS 907060 CKT 1 /* 02DAV-BE 345 X1-027A_AT12 345 DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345 02HAYES 345 END

Contingency Name	Contingency Definition
AEP_P4_#7112_05MELMOR 138_C	CONTINGENCY 'AEP_P4_#7112_05MELMOR 138_C' OPEN BRANCH FROM BUS 242953 TO BUS 243110 CKT 1 / 242953 05AIRCO8 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 242953 TO BUS 243137 CKT 1 / 242953 05AIRCO8 138 243137 05W.END
AEP_P4_#9521_05CHATFL 138_F	CONTINGENCY 'AEP_P4_#9521_05CHATFL 138_F' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END
AEP_P2-2_#7118_05HOWARD 138_1-B	CONTINGENCY 'AEP_P2-2_#7118_05HOWARD 138_1-B' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END

Contingency Name	Contingency Definition
AEP_P7-1_#10926	CONTINGENCY 'AEP_P7-1_#10926' OPEN BRANCH FROM BUS 242950 TO BUS 242955 CKT 1 / 242950 05ACADEM 138 242955 05APPVLY 138 1 OPEN BRANCH FROM BUS 242950 TO BUS 246941 CKT 1 / 242950 05ACADEM 138 246941 05MILL2Z 138 1 OPEN BRANCH FROM BUS 242955 TO BUS 243061 CKT 1 / 242955 05APPVLY 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247302 TO BUS 242962 CKT Z1 / 247302 05BLDBG8 138 242962 05BLDBGZ 138 Z1 OPEN BRANCH FROM BUS 242962 TO BUS 247278 CKT 1 / 242962 05BLDBGZ 138 247278 05MILL1Z 138 1 OPEN BRANCH FROM BUS 242962 TO BUS 243070 CKT 1 / 242962 05BLDBGZ 138 243070 05OHIOCT 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247278 TO BUS 243044 CKT Z1 / 247278 05MILL1Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 247278 TO BUS 243050 CKT 1 / 247278 05MILL1Z 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 246941 TO BUS 243044 CKT Z1 / 246941 05MILL2Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 246941 TO BUS 243160 CKT 1 / 246941 05MILL2Z 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243160 TO BUS 245425 CKT 1 / 243160 05WTRNWY 138 245425 05W TRINWY 12.0 1 END
AEP_P1-2_#7757	CONTINGENCY 'AEP_P1-2_#7757' OPEN BRANCH FROM BUS 247172 TO BUS 243006 CKT 1 / 247172 05EBERSO 138 243006 05FOSTOR 138 1 END

Contingency Name	Contingency Definition
AEP_P4_#7728_05FREMCT 138_C	CONTINGENCY 'AEP_P4_#7728_05FREMCT 138_C' OPEN BRANCH FROM BUS 245616 TO BUS 243009 CKT 1 / 245616 05FREMNTEQ 999 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 245616 TO BUS 245617 CKT 1 / 245616 05FREMNTEQ 999 245617 05FREMONT 69.0 1 OPEN BRANCH FROM BUS 245616 TO BUS 245618 CKT 1 / 245616 05FREMNTEQ 999 245618 05FREMONT- 12.0 1 OPEN BRANCH FROM BUS 239154 TO BUS 243009 CKT 1 / 239154 02W.FREM 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END
AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1	CONTINGENCY 'AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 END
AEP_P2-2_#7725_05FREMCT 138_1	CONTINGENCY 'AEP_P2-2_#7725_05FREMCT 138_1' OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END
Base Case	

Contingency Name	Contingency Definition
AEP_P1-2_#11144-B	CONTINGENCY 'AEP_P1-2_#11144-B' OPEN BRANCH FROM BUS 945620 TO BUS 242939 CKT 1 / 945620 AF1-227 TAP 345 242939 05MARYSV 345 1 END
AEP_P4_#10134_05HOWARD 138_B	CONTINGENCY 'AEP_P4_#10134_05HOWARD 138_B' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_SUBT_P4_#1176_05FREMNT C 69.0_L	CONTINGENCY 'AEP_SUBT_P4_#1176_05FREMNT C 69.0_L' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245641 TO BUS 245614 CKT 1 / 245641 05BIRCHARDSS69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 OPEN BRANCH FROM BUS 245623 TO BUS 245625 CKT 1 / 245623 05HOLRAN 69.0 245625 05MAPLE GR 69.0 1 OPEN BRANCH FROM BUS 245625 TO BUS 245628 CKT 1 / 245625 05MAPLE GR 69.0 245628 05RIVERVIE 69.0 1 REMOVE SWSHUNT FROM BUS 245614 / 245614 05FREMNT C 69.0 END
AEP_P2-2_#9521_05CHATFL 138_2	CONTINGENCY 'AEP_P2-2_#9521_05CHATFL 138_2' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END

Contingency Name	Contingency Definition
AEP_P1-2_#7709	CONTINGENCY 'AEP_P1-2_#7709' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 END
AEP_P4_#7725_05FREMCT 138_M	CONTINGENCY 'AEP_P4_#7725_05FREMCT 138_M' OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END
ATSI-P2-3-OEC-345-026	CONTINGENCY 'ATSI-P2-3-OEC-345-026' /* BEAVER 345KV BRK B-182 DISCONNECT BRANCH FROM BUS 238569 TO BUS 907060 CKT 1 /* 02BEAVER 345 X1-027A TAP 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239171 CKT 1 /* 02BEAVER 345 02WLORG-2 14 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239172 CKT 1 /* 02BEAVER 345 02WLORG-3 14 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239173 CKT 1 /* 02BEAVER 345 02WLORG-4 14 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239174 CKT 1 /* 02BEAVER 345 02WLORG-5 14 REMOVE MACHINE 2 FROM BUS 239171 /* 02WLORG-2 14 REMOVE MACHINE 3 FROM BUS 239172 /* 02WLORG-3 14 REMOVE MACHINE 4 FROM BUS 239173 /* 02WLORG-4 14 REMOVE MACHINE 5 FROM BUS 239174 /* 02WLORG-5 14 DISCONNECT BUS 239171 /* 02WLORG-2 14 DISCONNECT BUS 239172 /* 02WLORG-3 14 DISCONNECT BUS 239173 /* 02WLORG-4 14 DISCONNECT BUS 239174 /* 02WLORG-5 14 END
ATSI-P2-3-OEC-345-023	CONTINGENCY 'ATSI-P2-3-OEC-345-023' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END

12 Light Load Analysis

Light Load Studies (As applicable)

Not Applicable.

13 Short Circuit Analysis

The following Breakers are overdutied:

To be determined during later study phases.

14 Stability and Reactive Power Assessment

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined during later study phases.

15 Affected Systems

15.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

15.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

15.3 MISO

MISO Impacts to be determined during later study phases (as applicable).

15.4 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

15 Secondary Point of Interconnection

AF2-375 will interconnect with the AEP transmission system at a new 138 kV switching station cut into the Ebersole – Fostoria Central 138 kV circuit #1.

To accommodate the interconnection on the AEP-owned Fostoria – Ebersole 138 kV circuit #1, a new three (3) circuit breaker 138 kV switching station physically configured as a ring-bus will be constructed (see Attachment 2). Installation of associated protection and control equipment, 138 kV line risers, SCADA, and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

Installation of the generator lead first span exiting the POI station, including the first structure outside the AEP fence, will also be included in AEP's scope. In the case where the generator lead is a single span, the structure in the customer station will be the customer's responsibility.

16 Summer Peak – Load Flow Analysis – Secondary POI

The Queue Project AF2-375 was evaluated as a 129.6 MW (Capacity 77.8 MW) injection tapping the Ebersole to Fostoria Central 138 kV line in the AEP area. Project AF2-375 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-375 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

16.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

16.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918572	238654	02DAV-BE	345.0	ATSI	239289	02HAYES	345.0	ATSI	1	ATSI-P2-3-OEC-345-026	breaker	1878.0	99.99	100.34	DC	14.21
95515923	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P7-1_#10926	tower	245.0	99.44	100.8	DC	7.42

16.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918543	238569	02BEAVER	345.0	ATSI	239725	02LAKEAVE	345.0	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1878.0	103.85	104.31	DC	19.1
95515853	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	121.14	121.8	DC	20.13
95947779	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	146.55	148.54	DC	7.37
95947617	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P2-2_#7118_05HOWARD 138_1-B	bus	251.0	139.69	141.74	DC	11.45
95947618	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1	bus	251.0	128.72	130.35	DC	9.06
95947793	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P4_#10134_05HOWARD 138_B	breaker	251.0	139.69	141.74	DC	11.45
95947794	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P4_#10133_05HOWARD 138_H	breaker	251.0	139.73	141.78	DC	11.45
95947795	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#1176_05FREMNT C 69.0_L	breaker	251.0	129.44	131.06	DC	9.06
95947796	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#2200_05FREMNT C 69.0_E	breaker	251.0	128.72	130.35	DC	9.06
95515017	243009	05FRMNT	138.0	AEP	239154	02W.FREM	138.0	ATSI	1	AEP_P2-2_#7118_05HOWARD 138_1-B	bus	361.0	103.91	107.76	DC	13.91
95515235	243009	05FRMNT	138.0	AEP	239154	02W.FREM	138.0	ATSI	1	AEP_P4_#10133_05HOWARD 138_H	breaker	361.0	103.91	107.76	DC	13.91
95515236	243009	05FRMNT	138.0	AEP	239154	02W.FREM	138.0	ATSI	1	AEP_P4_#10134_05HOWARD 138_B	breaker	361.0	103.91	107.76	DC	13.91
95515262	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P4_#7728_05FREMCT 138_C	breaker	245.0	100.64	101.85	DC	6.56

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515922	243024	05HOWARD	138.0	AEP	241111	02ASHLAND	138.0	ATSI	1	AEP_P7-1_#10927	tower	245.0	101.6	102.96	DC	7.42
95947592	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P2-2_#9521_05CHATFL 138_2	bus	167.0	154.19	156.16	DC	7.31
95947769	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	164.75	166.53	DC	6.59
95947770	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#10729_05CHATFL 138_E	breaker	167.0	154.78	156.79	DC	7.48
95947771	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#9521_05CHATFL 138_F	breaker	167.0	154.19	156.16	DC	7.31
95947751	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	177.94	179.93	DC	7.37

16.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515506	242935	05E LIMA	345.0	AEP	242945	05SW LIM	345.0	AEP	1	AEP_P1-2_#11144-B	operation	971.0	108.87	110.38	DC	14.71
95515463	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	115.71	116.46	DC	16.82
95515464	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	AEP_P1-3_#5063_05SBERWI 345_1-B	operation	1318.0	112.93	113.69	DC	21.83
95948032	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	137.46	139.39	DC	7.17
145165063	243006	05FOSTOR	138.0	AEP	939160	AE1-146 TAP	138.0	AEP	2	AEP_P1-2_#7757-A	operation	245.0	96.34	105.06	DC	21.36
95947989	243039	05MELMOR	138.0	AEP	242984	05CHATFL	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	173.29	175.4	DC	7.82
95948018	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7709	operation	167.0	154.08	156.05	DC	7.28
95948001	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	170.63	172.56	DC	7.17
145164919	939160	AE1-146 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	2	AEP_P1-2_#7757-A	operation	245.0	116.25	124.97	DC	21.36
95515486	945620	AF1-227 TAP	345.0	AEP	242939	05MARYSV	345.0	AEP	1	Base Case	operation	897.0	111.07	112.54	DC	13.18
145164941	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	AEP_P1-2_#7761-A	operation	245.0	108.48	122.39	DC	34.07
145164943	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	Base Case	operation	167.0	85.13	109.38	DC	40.5

16.5 Flow Gate Details - Secondary POI

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

16.5.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918572	238654	02DAV-BE	ATSI	239289	02HAYES	ATSI	1	ATSI-P2-3-OEC-345-026	breaker	1878.0	99.99	100.34	DC	14.21

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	4.5595	50/50	4.5595
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**34.8835**	**50/50**	**34.8835**
238885	02LEMOG1	5.5921	50/50	5.5921
238886	02LEMOG2	5.5921	50/50	5.5921
238887	02LEMOG3	5.5921	50/50	5.5921
238888	02LEMOG4	5.5921	50/50	5.5921
238979	02NAPMUN	5.2342	Adder	6.16
239276	02COLLW 11	-2.3427	Adder	-2.76
239293	02BS-PKR	0.3980	50/50	0.3980
239297	02CPPW41	-2.6392	Adder	-3.1
241902	Y1-069 GE	31.3699	50/50	31.3699
244357	05GRANGER EL	0.2809	Adder	0.33
915952	Y3-092 NFTWR	81.0900	Merchant Transmission	81.0900
923821	AB2-019 FTWR	2.2705	Merchant Transmission	2.2705
931951	AB1-107 1	46.1063	50/50	46.1063
931961	AB1-107 2	127.5179	50/50	127.5179
932791	AC2-103 C	11.8933	50/50	11.8933
932792	AC2-103 E	79.6074	50/50	79.6074
934461	AD1-070 C O1	3.4278	Adder	4.03
934462	AD1-070 E O1	16.0917	Adder	18.93
934761	AD1-103 C O1	19.9970	50/50	19.9970
934762	AD1-103 E O1	133.8260	50/50	133.8260
934891	AD1-118	14.1834	50/50	14.1834
936601	AD2-075	10.5268	Adder	12.38
938911	AE1-119	111.4410	50/50	111.4410
939161	AE1-146 C O1	7.3931	Adder	8.7
939162	AE1-146 E O1	3.4525	Adder	4.06
940841	AE2-072 C	8.3515	Adder	9.83
940842	AE2-072 E	5.5677	Adder	6.55
941781	AE2-181 C	3.9649	Adder	4.66
941782	AE2-181 E	2.6433	Adder	3.11
942661	AE2-282 C O1	6.0573	Adder	7.13
942662	AE2-282 E O1	3.1873	Adder	3.75
943951	AF1-063 C O1	1.7603	Adder	2.07
943952	AF1-063 E O1	0.9759	Adder	1.15
943961	AF1-064 C O1	4.7085	Adder	5.54
943962	AF1-064 E O1	2.3401	Adder	2.75
944551	AF1-120 C	3.6703	Adder	4.32
944552	AF1-120 E	1.8489	Adder	2.18
945401	AF1-205 C O1	3.3952	Adder	3.99
945402	AF1-205 E O1	2.2634	Adder	2.66

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
945411	AF1-206 C O1	16.4749	Adder	19.38
945412	AF1-206 E O1	10.9832	Adder	12.92
945641	AF1-229 C	7.2045	Adder	8.48
945642	AF1-229 E	4.8030	Adder	5.65
950351	J466	2.4510	PJM External (MISO)	2.4510
950942	J325 E	0.3362	PJM External (MISO)	0.3362
952312	J646 E	0.1451	PJM External (MISO)	0.1451
952401	J752 C	1.2500	PJM External (MISO)	1.2500
952402	J752 E	6.7630	PJM External (MISO)	6.7630
952971	J793	119.5617	PJM External (MISO)	119.5617
953271	J701 C	0.6089	PJM External (MISO)	0.6089
953272	J701 E	3.2944	PJM External (MISO)	3.2944
953321	J799	19.1438	PJM External (MISO)	19.1438
953781	J833	10.1480	PJM External (MISO)	10.1480
953811	J839	8.8070	PJM External (MISO)	8.8070
954111	J875	13.0980	PJM External (MISO)	13.0980
955181	J996	7.7312	PJM External (MISO)	7.7312
955781	J1062	17.2095	PJM External (MISO)	17.2095
956161	J1103	1.5932	PJM External (MISO)	1.5932
956751	J1173	7.1888	PJM External (MISO)	7.1888
958321	AF2-126 C	2.9961	Adder	6.65
958322	AF2-126 E	1.4868	Adder	3.3
958331	AF2-127 C	1.2036	Adder	2.67
958332	AF2-127 E	0.6332	Adder	1.41
959181	AF2-209 C O2	3.6192	Adder	8.03
959182	AF2-209 E O2	1.6920	Adder	3.76
960301	AF2-321 C	6.0663	Adder	13.47
960302	AF2-321 E	4.0442	Adder	8.98
960841	AF2-375 C O2	3.8401	Adder	8.52
960842	AF2-375 E O2	2.5601	Adder	5.68
960951	AF2-386 C O2	0.4452	Adder	0.99
960952	AF2-386 E O2	0.6147	Adder	1.36
WEC	WEC	1.6717	Confirmed LTF	1.6717
LGEE	LGEE	2.0424	Confirmed LTF	2.0424
CPLE	CPLE	0.4035	Confirmed LTF	0.4035
CBM-W2	CBM-W2	29.6806	Confirmed LTF	29.6806
NY	NY	1.8653	Confirmed LTF	1.8653
CBM-W1	CBM-W1	100.5053	Confirmed LTF	100.5053
TVA	TVA	3.8346	Confirmed LTF	3.8346
O-066	O-066	19.1251	Confirmed LTF	19.1251
CBM-S2	CBM-S2	6.2886	Confirmed LTF	6.2886
CBM-S1	CBM-S1	24.6654	Confirmed LTF	24.6654
G-007	G-007	2.9370	Confirmed LTF	2.9370
MADISON	MADISON	2.1289	Confirmed LTF	2.1289
MEC	MEC	7.4047	Confirmed LTF	7.4047

16.5.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515922	243024	05HOWARD	AEP	241111	02ASHLAND	ATSI	1	AEP_P7-1_#10927	tower	245.0	101.6	102.96	DC	7.42

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.5212	50/50	3.5212
247551	**U4-028 C (Suspended)**	**2.1054**	**50/50**	**2.1054**
247552	**U4-029 C (Suspended)**	**2.1054**	**50/50**	**2.1054**
247926	U1-059 E	2.1405	Adder	2.52
247940	**U4-028 E (Suspended)**	**14.0897**	**50/50**	**14.0897**
247941	**U4-029 E (Suspended)**	**14.0897**	**50/50**	**14.0897**
247942	W1-056 E	0.7873	Adder	0.93
247947	V4-010 E	23.5648	50/50	23.5648
925751	AC1-051 C	2.2454	50/50	2.2454
925752	AC1-051 E	15.0268	50/50	15.0268
932051	AC2-015 C	15.5397	50/50	15.5397
932052	AC2-015 E	18.4126	50/50	18.4126
934461	AD1-070 C O1	1.8495	Adder	2.18
934462	AD1-070 E O1	8.6822	Adder	10.21
937021	AD2-136 C O1	7.5793	50/50	7.5793
937022	AD2-136 E O1	50.7227	50/50	50.7227
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.5791**	**50/50**	**3.5791**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**23.9524**	**50/50**	**23.9524**
939161	AE1-146 C O1	3.6733	Adder	4.32
939162	AE1-146 E O1	1.7154	Adder	2.02
941741	AE2-174 C	4.7197	50/50	4.7197
941742	AE2-174 E	22.0954	50/50	22.0954
960841	AF2-375 C O2	2.0048	Adder	4.45
960842	AF2-375 E O2	1.3365	Adder	2.97
WEC	WEC	0.1824	Confirmed LTF	0.1824
LGEE	LGEE	0.2094	Confirmed LTF	0.2094
CPLE	CPLE	0.0126	Confirmed LTF	0.0126
CBM-W2	CBM-W2	3.0712	Confirmed LTF	3.0712
NY	NY	0.1781	Confirmed LTF	0.1781
CBM-W1	CBM-W1	10.2832	Confirmed LTF	10.2832
TVA	TVA	0.3710	Confirmed LTF	0.3710
O-066	O-066	2.0294	Confirmed LTF	2.0294
CBM-S2	CBM-S2	0.4104	Confirmed LTF	0.4104
CBM-S1	CBM-S1	2.4112	Confirmed LTF	2.4112
G-007	G-007	0.3130	Confirmed LTF	0.3130
MADISON	MADISON	0.2540	Confirmed LTF	0.2540
MEC	MEC	0.7945	Confirmed LTF	0.7945

16.5.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
98918543	238569	02BEAVER	ATSI	239725	02LAKEAVE	ATSI	2	ATSI-P2-3-OEC-345-023	breaker	1878.0	103.85	104.31	DC	19.1

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	5.5203	50/50	5.5203
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**30.9385**	**50/50**	**30.9385**
238979	02NAPMUN	5.8692	Adder	6.9
239171	02WLORG-2	6.2588	50/50	6.2588
239172	02WLORG-3	6.3656	50/50	6.3656
239173	02WLORG-4	6.3656	50/50	6.3656
239174	02WLORG-5	6.3984	50/50	6.3984
239276	02COLLW 11	-3.2825	Adder	-3.86
239293	02BS-PKR	0.4819	50/50	0.4819
239297	02CPPW41	-3.7140	Adder	-4.37
241902	Y1-069 GE	31.6089	50/50	31.6089
244357	05GRANGER EL	0.3699	Adder	0.44
247548	V4-010 C	3.4613	Adder	4.07
247551	**U4-028 C (Suspended)**	**1.6148**	**Adder**	**1.9**
247552	**U4-029 C (Suspended)**	**1.6148**	**Adder**	**1.9**
247940	**U4-028 E (Suspended)**	**10.8071**	**Adder**	**12.71**
247941	**U4-029 E (Suspended)**	**10.8071**	**Adder**	**12.71**
247947	V4-010 E	23.1641	Adder	27.25
915952	Y3-092 NFTWR	111.1700	Merchant Transmission	111.1700
923821	AB2-019 FTWR	3.1128	Merchant Transmission	3.1128
925751	AC1-051 C	0.7882	Adder	0.93
925752	AC1-051 E	5.2747	Adder	6.21
931951	AB1-107 1	47.2190	Adder	55.55
931961	AB1-107 2	128.4895	50/50	128.4895
932051	AC2-015 C	5.4739	Adder	6.44
932052	AC2-015 E	6.4859	Adder	7.63
932791	AC2-103 C	14.3954	50/50	14.3954
932792	AC2-103 E	96.3550	50/50	96.3550
934252	AD1-052 E1	0.9741	Adder	1.15
934262	AD1-052 E2	0.9741	Adder	1.15
934461	AD1-070 C O1	4.6417	Adder	5.46
934462	AD1-070 E O1	21.7903	Adder	25.64
934761	AD1-103 C O1	24.2039	50/50	24.2039
934762	AD1-103 E O1	161.9799	50/50	161.9799
934891	AD1-118	12.3849	Adder	14.57
937021	AD2-136 C O1	5.8134	Adder	6.84
937022	AD2-136 E O1	38.9054	Adder	45.77
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**2.7452**	**Adder**	**3.23**

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
937382	AD2-191 E (Withdrawn : 06/03/2020)	18.3720	Adder	21.61
938911	AE1-119	97.3101	Adder	114.48
939161	AE1-146 C O1	9.8399	Adder	11.58
939162	AE1-146 E O1	4.5952	Adder	5.41
940841	AE2-072 C	9.6069	Adder	11.3
940842	AE2-072 E	6.4046	Adder	7.53
941741	AE2-174 C	4.6395	Adder	5.46
941742	AE2-174 E	21.7197	Adder	25.55
941761	AE2-176 C	15.7920	50/50	15.7920
941762	AE2-176 E	10.5280	50/50	10.5280
941781	AE2-181 C	4.4280	Adder	5.21
941782	AE2-181 E	2.9520	Adder	3.47
942661	AE2-282 C O1	6.7521	Adder	7.94
942662	AE2-282 E O1	3.5530	Adder	4.18
943951	AF1-063 C O1	1.9881	Adder	2.34
943952	AF1-063 E O1	1.1022	Adder	1.3
943961	AF1-064 C O1	5.5224	Adder	6.5
943962	AF1-064 E O1	2.7447	Adder	3.23
944551	AF1-120 C	4.0913	Adder	4.81
944552	AF1-120 E	2.0610	Adder	2.42
945401	AF1-205 C O1	3.8070	Adder	4.48
945402	AF1-205 E O1	2.5380	Adder	2.99
945411	AF1-206 C O1	18.3646	Adder	21.61
945412	AF1-206 E O1	12.2431	Adder	14.4
945641	AF1-229 C	8.4376	Adder	9.93
945642	AF1-229 E	5.6251	Adder	6.62
955781	J1062	17.1690	PJM External (MISO)	17.1690
957031	AF2-004 1	3.9284	50/50	3.9284
957041	AF2-004 2	3.9284	50/50	3.9284
957051	AF2-004 3	3.9284	50/50	3.9284
957061	AF2-004 4	3.9284	50/50	3.9284
957111	AF2-005	0.7134	Adder	1.58
958321	AF2-126 C	3.5140	Adder	7.8
958322	AF2-126 E	1.7439	Adder	3.87
958331	AF2-127 C	1.3594	Adder	3.02
958332	AF2-127 E	0.7152	Adder	1.59
960301	AF2-321 C	6.7971	Adder	15.09
960302	AF2-321 E	4.5314	Adder	10.06
960841	AF2-375 C O2	5.1636	Adder	11.46
960842	AF2-375 E O2	3.4424	Adder	7.64
960951	AF2-386 C O2	0.4977	Adder	1.1
960952	AF2-386 E O2	0.6873	Adder	1.53
WEC	WEC	1.8906	Confirmed LTF	1.8906
LGEE	LGEE	2.4109	Confirmed LTF	2.4109
CPLE	CPLE	0.5213	Confirmed LTF	0.5213
CBM-W2	CBM-W2	34.3816	Confirmed LTF	34.3816
NY	NY	2.3160	Confirmed LTF	2.3160
CBM-W1	CBM-W1	109.0372	Confirmed LTF	109.0372
TVA	TVA	4.5164	Confirmed LTF	4.5164
O-066	O-066	23.0832	Confirmed LTF	23.0832
CBM-S2	CBM-S2	7.7914	Confirmed LTF	7.7914
CBM-S1	CBM-S1	29.0702	Confirmed LTF	29.0702

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
G-007	G-007	3.5433	Confirmed LTF	3.5433
MADISON	MADISON	1.9616	Confirmed LTF	1.9616
MEC	MEC	8.4344	Confirmed LTF	8.4344

16.5.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515853	242936	05FOSTOR	AEP	242935	05E LIMA	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	121.14	121.8	DC	20.13

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	5.3099	50/50	5.3099
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**23.5116**	**50/50**	**23.5116**
238885	02LEMOG1	6.0712	50/50	6.0712
238886	02LEMOG2	6.0712	50/50	6.0712
238887	02LEMOG3	6.0712	50/50	6.0712
238888	02LEMOG4	6.0712	50/50	6.0712
238979	02NAPMUN	5.2701	Adder	6.2
239293	02BS-PKR	0.4635	50/50	0.4635
241902	Y1-069 GE	31.4894	50/50	31.4894
244357	05GRANGER EL	0.2415	Adder	0.28
247548	V4-010 C	3.4604	Adder	4.07
247549	V3-028 C	-1.0591	Adder	-1.25
247551	**U4-028 C (Suspended)**	**1.6727**	**Adder**	**1.97**
247552	**U4-029 C (Suspended)**	**1.6727**	**Adder**	**1.97**
247940	**U4-028 E (Suspended)**	**11.1946**	**Adder**	**13.17**
247941	**U4-029 E (Suspended)**	**11.1946**	**Adder**	**13.17**
247947	V4-010 E	23.1582	Adder	27.24
924791	AB2-131 C OP	3.1953	Adder	3.76
924792	AB2-131 E OP	5.2133	Adder	6.13
925131	AB2-170 C O1	-6.8838	Adder	-8.1
925751	AC1-051 C	0.7660	Adder	0.9
925752	AC1-051 E	5.1261	Adder	6.03
927181	AC1-212 C	-0.1288	Adder	-0.15
927183	AC1-212 BAT	1.5872	Merchant Transmission	1.5872
931951	AB1-107 1	53.4304	50/50	53.4304
931961	AB1-107 2	128.0037	50/50	128.0037
932051	AC2-015 C	5.3943	Adder	6.35
932052	AC2-015 E	6.3915	Adder	7.52
932791	AC2-103 C	8.0135	50/50	8.0135
932792	AC2-103 E	53.6379	50/50	53.6379
933721	AC2-195 C O1	2.9502	Adder	3.47
933722	AC2-195 E O1	1.7986	Adder	2.12
934252	AD1-052 E1	0.8498	Adder	1.0
934262	AD1-052 E2	0.8498	Adder	1.0
934461	AD1-070 C O1	6.4937	50/50	6.4937
934462	AD1-070 E O1	30.4842	50/50	30.4842
934761	AD1-103 C O1	13.4736	50/50	13.4736
934762	AD1-103 E O1	90.1693	50/50	90.1693
934891	AD1-118	15.3986	50/50	15.3986
936722	AD2-091 BAT	8.1970	Merchant Transmission	8.1970

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
936752	AD2-096 BAT	2.8820	Merchant Transmission	2.8820
937021	AD2-136 C O1	6.0219	Adder	7.08
937022	AD2-136 E O1	40.3004	Adder	47.41
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**2.8437**	**Adder**	**3.35**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**19.0307**	**Adder**	**22.39**
938911	AE1-119	120.9890	50/50	120.9890
939161	AE1-146 C O1	8.4124	Adder	9.9
939162	AE1-146 E O1	3.9285	Adder	4.62
941741	AE2-174 C	4.6383	Adder	5.46
941742	AE2-174 E	21.7141	Adder	25.55
941761	AE2-176 C	9.7926	Adder	11.52
941762	AE2-176 E	6.5284	Adder	7.68
941781	AE2-181 C	3.6390	Adder	4.28
941782	AE2-181 E	2.4260	Adder	2.85
942042	AE2-216 BAT	9.0167	Merchant Transmission	9.0167
942661	AE2-282 C O1	5.7547	Adder	6.77
942662	AE2-282 E O1	3.0281	Adder	3.56
943011	AE2-324	0.9644	Adder	1.13
943961	AF1-064 C O1	6.1503	50/50	6.1503
943962	AF1-064 E O1	3.0567	50/50	3.0567
944551	AF1-120 C	3.4869	Adder	4.1
944552	AF1-120 E	1.7566	Adder	2.07
944571	AF1-122 C O1	1.7764	Adder	2.09
944572	AF1-122 E O1	2.4532	Adder	2.89
945401	AF1-205 C O1	3.4184	Adder	4.02
945402	AF1-205 E O1	2.2790	Adder	2.68
945411	AF1-206 C O1	15.6518	Adder	18.41
945412	AF1-206 E O1	10.4345	Adder	12.28
945623	AF1-227 BAT	9.1580	Merchant Transmission	9.1580
945641	AF1-229 C	17.1274	50/50	17.1274
945642	AF1-229 E	11.4182	50/50	11.4182
946203	AF1-285 BAT	2.9556	Merchant Transmission	2.9556
950311	G934 C	2.0763	PJM External (MISO)	2.0763
950312	G934 E	8.3052	PJM External (MISO)	8.3052
950351	J466	3.3606	PJM External (MISO)	3.3606
950791	J201 C	0.4014	PJM External (MISO)	0.4014
950792	J201 E	1.6056	PJM External (MISO)	1.6056
950871	J246 C	0.1060	PJM External (MISO)	0.1060
950872	J246 E	0.4238	PJM External (MISO)	0.4238
950942	J325 E	0.4626	PJM External (MISO)	0.4626
951531	J533 C	3.0272	PJM External (MISO)	3.0272
951532	J533 E	12.1088	PJM External (MISO)	12.1088
951571	J538 C	3.0615	PJM External (MISO)	3.0615
951572	J538 E	12.2460	PJM External (MISO)	12.2460
951941	J602 C	2.9787	PJM External (MISO)	2.9787
951942	J602 E	16.1153	PJM External (MISO)	16.1153
952201	J589 C	2.5107	PJM External (MISO)	2.5107
952202	J589 E	13.5833	PJM External (MISO)	13.5833
952312	J646 E	0.2014	PJM External (MISO)	0.2014
952401	J752 C	1.7094	PJM External (MISO)	1.7094
952402	J752 E	9.2486	PJM External (MISO)	9.2486

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
952611	J717 C	2.8035	PJM External (MISO)	2.8035
952612	J717 E	15.1675	PJM External (MISO)	15.1675
952761	J728 C	2.6072	PJM External (MISO)	2.6072
952762	J728 E	14.1244	PJM External (MISO)	14.1244
952881	J758	12.4160	PJM External (MISO)	12.4160
952971	J793	166.0035	PJM External (MISO)	166.0035
953071	J794 C	0.1653	PJM External (MISO)	0.1653
953072	J794 E	0.8941	PJM External (MISO)	0.8941
953271	J701 C	0.8320	PJM External (MISO)	0.8320
953272	J701 E	4.5016	PJM External (MISO)	4.5016
953291	J796	22.3489	PJM External (MISO)	22.3489
953321	J799	27.3218	PJM External (MISO)	27.3218
953361	J806	11.5237	PJM External (MISO)	11.5237
953771	J832	7.6630	PJM External (MISO)	7.6630
953781	J833	14.5530	PJM External (MISO)	14.5530
953811	J839	12.1900	PJM External (MISO)	12.1900
953941	J857	8.7178	PJM External (MISO)	8.7178
954111	J875	18.6060	PJM External (MISO)	18.6060
955071	J984 C	2.1594	PJM External (MISO)	2.1594
955072	J984 E	11.6826	PJM External (MISO)	11.6826
955121	J989	8.5008	PJM External (MISO)	8.5008
955181	J996	11.2720	PJM External (MISO)	11.2720
955261	J1005	18.7160	PJM External (MISO)	18.7160
955591	J1043 C	1.0693	PJM External (MISO)	1.0693
955592	J1043 E	18.9483	PJM External (MISO)	18.9483
955781	J1062	25.3650	PJM External (MISO)	25.3650
956011	J1088	14.0370	PJM External (MISO)	14.0370
956021	J1089	16.0820	PJM External (MISO)	16.0820
956031	J1090	8.9046	PJM External (MISO)	8.9046
956161	J1103	2.1770	PJM External (MISO)	2.1770
956741	J1172	5.1105	PJM External (MISO)	5.1105
956751	J1173	10.2680	PJM External (MISO)	10.2680
956801	J1178	5.8208	PJM External (MISO)	5.8208
957111	AF2-005	0.2221	Adder	0.49
958321	AF2-126 C	7.3840	50/50	7.3840
958322	AF2-126 E	3.6644	50/50	3.6644
958591	AF2-150 C O2	1.8092	Adder	4.02
958592	AF2-150 E O2	2.4985	Adder	5.55
960301	AF2-321 C	5.1526	Adder	11.44
960302	AF2-321 E	3.4350	Adder	7.62
960841	AF2-375 C O2	5.4410	Adder	12.08
960842	AF2-375 E O2	3.6273	Adder	8.05
960853	AF2-376 BAT	1.7381	Merchant Transmission	1.7381
960863	AF2-377 BAT	1.6782	Merchant Transmission	1.6782
960951	AF2-386 C O2	0.4013	Adder	0.89
960952	AF2-386 E O2	0.5542	Adder	1.23
NEWTON	NEWTON	1.5881	Confirmed LTF	1.5881
FARMERCITY	FARMERCITY	0.0669	Confirmed LTF	0.0669
G-007A	G-007A	0.4004	Confirmed LTF	0.4004
VFT	VFT	1.1094	Confirmed LTF	1.1094
CALDERWOOD	CALDERWOOD	0.6685	Confirmed LTF	0.6685
CBM-W1	CBM-W1	39.8193	Confirmed LTF	39.8193

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
PRAIRIE	PRAIRIE	3.5542	Confirmed LTF	3.5542
CHEOAH	CHEOAH	0.6687	Confirmed LTF	0.6687
EDWARDS	EDWARDS	0.3675	Confirmed LTF	0.3675
TILTON	TILTON	0.9047	Confirmed LTF	0.9047
MADISON	MADISON	3.5986	Confirmed LTF	3.5986
GIBSON	GIBSON	1.0030	Confirmed LTF	1.0030
BLUEG	BLUEG	3.5171	Confirmed LTF	3.5171
TRIMBLE	TRIMBLE	1.1347	Confirmed LTF	1.1347
CATAWBA	CATAWBA	0.3808	Confirmed LTF	0.3808

16.5.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947779	242984	05CHATFL	AEP	932050	AC2-015 TAP	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	146.55	148.54	DC	7.37

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.7060	50/50	3.7060
247551	**U4-028 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247552	**U4-029 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247940	**U4-028 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247941	**U4-029 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247947	V4-010 E	24.8020	50/50	24.8020
925751	AC1-051 C	2.3830	50/50	2.3830
925752	AC1-051 E	15.9476	50/50	15.9476
934252	AD1-052 E1	0.2602	Adder	0.31
934262	AD1-052 E2	0.2602	Adder	0.31
934461	AD1-070 C O1	1.8541	Adder	2.18
934462	AD1-070 E O1	8.7038	Adder	10.24
937021	AD2-136 C O1	7.9218	50/50	7.9218
937022	AD2-136 E O1	53.0154	50/50	53.0154
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.7409**	**50/50**	**3.7409**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**25.0350**	**50/50**	**25.0350**
939161	AE1-146 C O1	3.6010	Adder	4.24
939162	AE1-146 E O1	1.6816	Adder	1.98
941741	AE2-174 C	4.9675	50/50	4.9675
941742	AE2-174 E	23.2554	50/50	23.2554
960841	AF2-375 C O2	1.9926	Adder	4.42
960842	AF2-375 E O2	1.3284	Adder	2.95
WEC	WEC	0.1263	Confirmed LTF	0.1263
LGEE	LGEE	0.0930	Confirmed LTF	0.0930
CBM-W2	CBM-W2	1.6871	Confirmed LTF	1.6871
NY	NY	0.1073	Confirmed LTF	0.1073
CBM-W1	CBM-W1	8.8070	Confirmed LTF	8.8070
TVA	TVA	0.1540	Confirmed LTF	0.1540
O-066	O-066	1.3306	Confirmed LTF	1.3306
CBM-S1	CBM-S1	1.0224	Confirmed LTF	1.0224
G-007	G-007	0.2059	Confirmed LTF	0.2059
MADISON	MADISON	0.3851	Confirmed LTF	0.3851
MEC	MEC	0.5180	Confirmed LTF	0.5180
CATAWBA	CATAWBA	0.0101	Confirmed LTF	0.0101

16.5.6 Index 6

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947794	243008	05FREMCT	AEP	243009	05FRMNT	AEP	1	AEP_P4_#10133_05HOWARD 138_H	breaker	251.0	139.73	141.78	DC	11.45

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	0.1985	Adder	0.23
247548	V4-010 C	10.1278	50/50	10.1278
247551	**U4-028 C (Suspended)**	**4.0352**	**50/50**	**4.0352**
247552	**U4-029 C (Suspended)**	**4.0352**	**50/50**	**4.0352**
247926	U1-059 E	1.8732	Adder	2.2
247940	**U4-028 E (Suspended)**	**27.0048**	**50/50**	**27.0048**
247941	**U4-029 E (Suspended)**	**27.0048**	**50/50**	**27.0048**
247942	W1-056 E	0.6890	Adder	0.81
247947	V4-010 E	67.7782	50/50	67.7782
925751	AC1-051 C	2.0239	50/50	2.0239
925752	AC1-051 E	13.5443	50/50	13.5443
932051	AC2-015 C	16.1528	50/50	16.1528
932052	AC2-015 E	19.1391	50/50	19.1391
934252	AD1-052 E1	-0.6535	Adder	-0.77
934262	AD1-052 E2	-0.6535	Adder	-0.77
934461	AD1-070 C O1	2.8770	Adder	3.38
934462	AD1-070 E O1	13.5060	Adder	15.89
937021	AD2-136 C O1	14.5267	50/50	14.5267
937022	AD2-136 E O1	97.2173	50/50	97.2173
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**6.8598**	**50/50**	**6.8598**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**45.9082**	**50/50**	**45.9082**
939161	AE1-146 C O1	5.6006	Adder	6.59
939162	AE1-146 E O1	2.6155	Adder	3.08
941741	AE2-174 C	13.5751	50/50	13.5751
941742	AE2-174 E	63.5518	50/50	63.5518
960841	AF2-375 C O2	3.0943	Adder	6.87
960842	AF2-375 E O2	2.0629	Adder	4.58
WEC	WEC	0.1118	Confirmed LTF	0.1118
LGEE	LGEE	0.2316	Confirmed LTF	0.2316
CPLE	CPLE	0.1217	Confirmed LTF	0.1217
CBM-W2	CBM-W2	2.8092	Confirmed LTF	2.8092
NY	NY	0.0824	Confirmed LTF	0.0824
CBM-W1	CBM-W1	1.5763	Confirmed LTF	1.5763
TVA	TVA	0.4382	Confirmed LTF	0.4382
O-066	O-066	0.6787	Confirmed LTF	0.6787
CBM-S2	CBM-S2	1.2600	Confirmed LTF	1.2600
CBM-S1	CBM-S1	2.8116	Confirmed LTF	2.8116
G-007	G-007	0.1040	Confirmed LTF	0.1040
MEC	MEC	0.5561	Confirmed LTF	0.5561

16.5.7 Index 7

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515236	243009	05FRMNT	AEP	239154	02W.FREM	ATSI	1	AEP_P4_#10134_05HOWARD 138_B	breaker	361.0	103.91	107.76	DC	13.91

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	0.2413	Adder	0.28
247548	V4-010 C	12.0247	50/50	12.0247
247551	**U4-028 C (Suspended)**	**4.8123**	**50/50**	**4.8123**
247552	**U4-029 C (Suspended)**	**4.8123**	**50/50**	**4.8123**
247926	U1-059 E	2.3087	Adder	2.72
247940	**U4-028 E (Suspended)**	**32.2057**	**50/50**	**32.2057**
247941	**U4-029 E (Suspended)**	**32.2057**	**50/50**	**32.2057**
247942	W1-056 E	0.8492	Adder	1.0
247947	V4-010 E	80.4733	50/50	80.4733
925751	AC1-051 C	2.4338	50/50	2.4338
925752	AC1-051 E	16.2880	50/50	16.2880
932051	AC2-015 C	19.3080	50/50	19.3080
932052	AC2-015 E	22.8775	50/50	22.8775
934252	AD1-052 E1	-0.8029	Adder	-0.94
934262	AD1-052 E2	-0.8029	Adder	-0.94
934461	AD1-070 C O1	4.1126	50/50	4.1126
934462	AD1-070 E O1	19.3066	50/50	19.3066
937021	AD2-136 C O1	17.3244	50/50	17.3244
937022	AD2-136 E O1	115.9404	50/50	115.9404
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**8.1810**	**50/50**	**8.1810**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**54.7496**	**50/50**	**54.7496**
939161	AE1-146 C O1	6.8063	Adder	8.01
939162	AE1-146 E O1	3.1785	Adder	3.74
941741	AE2-174 C	16.1178	50/50	16.1178
941742	AE2-174 E	75.4552	50/50	75.4552
960841	AF2-375 C O2	8.3468	50/50	8.3468
960842	AF2-375 E O2	5.5645	50/50	5.5645
WEC	WEC	0.1367	Confirmed LTF	0.1367
LGEE	LGEE	0.2835	Confirmed LTF	0.2835
CPLE	CPLE	0.1488	Confirmed LTF	0.1488
CBM-W2	CBM-W2	3.4398	Confirmed LTF	3.4398
NY	NY	0.1006	Confirmed LTF	0.1006
CBM-W1	CBM-W1	1.9140	Confirmed LTF	1.9140
TVA	TVA	0.5362	Confirmed LTF	0.5362
O-066	O-066	0.8400	Confirmed LTF	0.8400
CBM-S2	CBM-S2	1.5433	Confirmed LTF	1.5433
CBM-S1	CBM-S1	3.4421	Confirmed LTF	3.4421
G-007	G-007	0.1279	Confirmed LTF	0.1279
MEC	MEC	0.6801	Confirmed LTF	0.6801

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ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947769	243039	05MELMOR	AEP	243024	05HOWARD	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	164.75	166.53	DC	6.59

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.9970	50/50	3.9970
247551	**U4-028 C (Suspended)**	**2.5848**	**50/50**	**2.5848**
247552	**U4-029 C (Suspended)**	**2.5848**	**50/50**	**2.5848**
247940	**U4-028 E (Suspended)**	**17.2982**	**50/50**	**17.2982**
247941	**U4-029 E (Suspended)**	**17.2982**	**50/50**	**17.2982**
247947	V4-010 E	26.7490	50/50	26.7490
934252	AD1-052 E1	0.2726	Adder	0.32
934262	AD1-052 E2	0.2726	Adder	0.32
934461	AD1-070 C O1	1.6604	Adder	1.95
934462	AD1-070 E O1	7.7944	Adder	9.17
937021	AD2-136 C O1	9.3052	50/50	9.3052
937022	AD2-136 E O1	62.2736	50/50	62.2736
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**4.3941**	**50/50**	**4.3941**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**29.4070**	**50/50**	**29.4070**
941741	AE2-174 C	5.3575	50/50	5.3575
941742	AE2-174 E	25.0810	50/50	25.0810
960841	AF2-375 C O2	1.7803	Adder	3.95
960842	AF2-375 E O2	1.1868	Adder	2.63
WEC	WEC	0.0973	Confirmed LTF	0.0973
LGEE	LGEE	0.0411	Confirmed LTF	0.0411
CALDERWOOD	CALDERWOOD	0.0075	Confirmed LTF	0.0075
CBM-W2	CBM-W2	1.0319	Confirmed LTF	1.0319
NY	NY	0.0758	Confirmed LTF	0.0758
CBM-W1	CBM-W1	7.7937	Confirmed LTF	7.7937
TVA	TVA	0.0560	Confirmed LTF	0.0560
O-066	O-066	1.0147	Confirmed LTF	1.0147
CHEOAH	CHEOAH	0.0085	Confirmed LTF	0.0085
CBM-S1	CBM-S1	0.3919	Confirmed LTF	0.3919
G-007	G-007	0.1570	Confirmed LTF	0.1570
MADISON	MADISON	0.4254	Confirmed LTF	0.4254
MEC	MEC	0.3798	Confirmed LTF	0.3798
CATAWBA	CATAWBA	0.0248	Confirmed LTF	0.0248

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ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947751	932050	AC2-015 TAP	AEP	243024	05HOWARD	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	177.94	179.93	DC	7.37

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.7060	50/50	3.7060
247551	**U4-028 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247552	**U4-029 C (Suspended)**	**2.2005**	**50/50**	**2.2005**
247940	**U4-028 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247941	**U4-029 E (Suspended)**	**14.7265**	**50/50**	**14.7265**
247947	V4-010 E	24.8020	50/50	24.8020
925751	AC1-051 C	2.3830	50/50	2.3830
925752	AC1-051 E	15.9476	50/50	15.9476
932051	AC2-015 C	23.9931	50/50	23.9931
932052	AC2-015 E	28.4288	50/50	28.4288
934252	AD1-052 E1	0.2602	Adder	0.31
934262	AD1-052 E2	0.2602	Adder	0.31
934461	AD1-070 C O1	1.8541	Adder	2.18
934462	AD1-070 E O1	8.7038	Adder	10.24
937021	AD2-136 C O1	7.9218	50/50	7.9218
937022	AD2-136 E O1	53.0154	50/50	53.0154
937381	**AD2-191 C (Withdrawn : 06/03/2020)**	**3.7409**	**50/50**	**3.7409**
937382	**AD2-191 E (Withdrawn : 06/03/2020)**	**25.0350**	**50/50**	**25.0350**
939161	AE1-146 C O1	3.6010	Adder	4.24
939162	AE1-146 E O1	1.6816	Adder	1.98
941741	AE2-174 C	4.9675	50/50	4.9675
941742	AE2-174 E	23.2554	50/50	23.2554
960841	AF2-375 C O2	1.9926	Adder	4.42
960842	AF2-375 E O2	1.3284	Adder	2.95
WEC	WEC	0.1263	Confirmed LTF	0.1263
LGEE	LGEE	0.0930	Confirmed LTF	0.0930
CBM-W2	CBM-W2	1.6871	Confirmed LTF	1.6871
NY	NY	0.1073	Confirmed LTF	0.1073
CBM-W1	CBM-W1	8.8070	Confirmed LTF	8.8070
TVA	TVA	0.1540	Confirmed LTF	0.1540
O-066	O-066	1.3306	Confirmed LTF	1.3306
CBM-S1	CBM-S1	1.0224	Confirmed LTF	1.0224
G-007	G-007	0.2059	Confirmed LTF	0.2059
MADISON	MADISON	0.3851	Confirmed LTF	0.3851
MEC	MEC	0.5180	Confirmed LTF	0.5180
CATAWBA	CATAWBA	0.0101	Confirmed LTF	0.0101

16.6 Contingency Descriptions - Secondary POI

Contingency Name	Contingency Definition
AEP_P1-2_#7105	CONTINGENCY 'AEP_P1-2_#7105' OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 END
AEP_SUBT_P4_#2200_05FREMNT C 69.0_E	CONTINGENCY 'AEP_SUBT_P4_#2200_05FREMNT C 69.0_E' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 END
AEP_P1-2_#7761-A	CONTINGENCY 'AEP_P1-2_#7761-A' OPEN BRANCH FROM BUS 247172 TO BUS 939160 CKT 2 / 247172 05EBERSO 138 939160 AE1-146 TAP 138 2 END
ATSI-P7-1-TE-345-029A	CONTINGENCY 'ATSI-P7-1-TE-345-029A' /* X1-027A - BEAVER & BEAVER - HAYES 345 DISCONNECT BRANCH FROM BUS 907060 TO BUS 238569 CKT 1 /* X1-027A_AT12 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 END

Contingency Name	Contingency Definition
AEP_P7-1_#10927	CONTINGENCY 'AEP_P7-1_#10927' OPEN BRANCH FROM BUS 242950 TO BUS 242955 CKT 1 / 242950 05ACADEM 138 242955 05APPVLY 138 1 OPEN BRANCH FROM BUS 242950 TO BUS 246941 CKT 1 / 242950 05ACADEM 138 246941 05MILL2Z 138 1 OPEN BRANCH FROM BUS 242955 TO BUS 243061 CKT 1 / 242955 05APPVLY 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247302 TO BUS 242962 CKT Z1 / 247302 05BLDBG8 138 242962 05BLDBGZ 138 Z1 OPEN BRANCH FROM BUS 242962 TO BUS 247278 CKT 1 / 242962 05BLDBGZ 138 247278 05MILL1Z 138 1 OPEN BRANCH FROM BUS 242962 TO BUS 243070 CKT 1 / 242962 05BLDBGZ 138 243070 05OHIOCT 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247278 TO BUS 243044 CKT Z1 / 247278 05MILL1Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 247278 TO BUS 243050 CKT 1 / 247278 05MILL1Z 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 246941 TO BUS 243044 CKT Z1 / 246941 05MILL2Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 246941 TO BUS 243160 CKT 1 / 246941 05MILL2Z 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243050 TO BUS 245567 CKT 1 / 243050 05NBELVL 138 245567 05NBELLVIL 69.0 1 OPEN BRANCH FROM BUS 243160 TO BUS 245425 CKT 1 / 243160 05WTRNWY 138 245425 05W TRINWY 12.0 1 END

Contingency Name	Contingency Definition
AEP_SUBT_P4_#1208_05HOWARD 69.0_U	CONTINGENCY 'AEP_SUBT_P4_#1208_05HOWARD 69.0_U' OPEN BRANCH FROM BUS 245666 TO BUS 243024 CKT 1 / 245666 05HOWRD1EQ 999 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 245666 TO BUS 245663 CKT 1 / 245666 05HOWRD1EQ 999 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 245659 TO BUS 245663 CKT 1 / 245659 05E BUCYRU 69.0 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245678 CKT 1 / 245663 05HOWARD 69.0 245678 05NGALIOSS 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245679 CKT 1 / 245663 05HOWARD 69.0 245679 05WILLARD 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245657 CKT 1 / 245663 05HOWARD 69.0 245657 05WSHELBY 69.0 1 REMOVE SWSHUNT FROM BUS 245663 / 245663 05HOWARD 69.0 END
AEP_P1-3_#5063_05SBERWI 345_1-B	CONTINGENCY 'AEP_P1-3_#5063_05SBERWI 345_1-B' OPEN BRANCH FROM BUS 242917 TO BUS 242942 CKT 1 / 242917 05SBERW EQ 999 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242917 TO BUS 243180 CKT 1 / 242917 05SBERW EQ 999 243180 05SBERWICK 69.0 1 OPEN BRANCH FROM BUS 242917 TO BUS 243199 CKT 1 / 242917 05SBERW EQ 999 243199 05SBERW1-L 12.0 1 OPEN BRANCH FROM BUS 945640 TO BUS 242942 CKT 1 / 945640 AF1-229 TAP 345 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242936 TO BUS 242942 CKT 1 / 242936 05FOSTOR 345 242942 05SBERWI 345 1 END

Contingency Name	Contingency Definition
AEP_P4_#10133_05HOWARD 138_H	CONTINGENCY 'AEP_P4_#10133_05HOWARD 138_H' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243050 TO BUS 245567 CKT 1 / 243050 05NBELVL 138 245567 05NBELLVIL 69.0 1 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_P4_#10729_05CHATFL 138_E	CONTINGENCY 'AEP_P4_#10729_05CHATFL 138_E' OPEN BRANCH FROM BUS 242984 TO BUS 932050 CKT 1 / 242984 05CHATFL 138 932050 AC2-015 TAP 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 1 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END
AEP_P4_#7112_05MELMOR 138_C	CONTINGENCY 'AEP_P4_#7112_05MELMOR 138_C' OPEN BRANCH FROM BUS 242953 TO BUS 243110 CKT 1 / 242953 05AIRCO8 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 242953 TO BUS 243137 CKT 1 / 242953 05AIRCO8 138 243137 05W.END
AEP_P4_#9521_05CHATFL 138_F	CONTINGENCY 'AEP_P4_#9521_05CHATFL 138_F' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END

Contingency Name	Contingency Definition
AEP_P2-2_#7118_05HOWARD 138_1-B	CONTINGENCY 'AEP_P2-2_#7118_05HOWARD 138_1-B' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_P7-1_#10926	CONTINGENCY 'AEP_P7-1_#10926' OPEN BRANCH FROM BUS 242950 TO BUS 242955 CKT 1 / 242950 05ACADEM 138 242955 05APPVLY 138 1 OPEN BRANCH FROM BUS 242950 TO BUS 246941 CKT 1 / 242950 05ACADEM 138 246941 05MILL2Z 138 1 OPEN BRANCH FROM BUS 242955 TO BUS 243061 CKT 1 / 242955 05APPVLY 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247302 TO BUS 242962 CKT Z1 / 247302 05BLDBG8 138 242962 05BLDBGZ 138 Z1 OPEN BRANCH FROM BUS 242962 TO BUS 247278 CKT 1 / 242962 05BLDBGZ 138 247278 05MILL1Z 138 1 OPEN BRANCH FROM BUS 242962 TO BUS 243070 CKT 1 / 242962 05BLDBGZ 138 243070 05OHIOCT 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 247278 TO BUS 243044 CKT Z1 / 247278 05MILL1Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 247278 TO BUS 243050 CKT 1 / 247278 05MILL1Z 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 246941 TO BUS 243044 CKT Z1 / 246941 05MILL2Z 138 243044 05MILLWO 138 Z1 OPEN BRANCH FROM BUS 246941 TO BUS 243160 CKT 1 / 246941 05MILL2Z 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243070 TO BUS 243160 CKT 1 / 243070 05OHIOCT 138 243160 05WTRNWY 138 1 OPEN BRANCH FROM BUS 243160 TO BUS 245425 CKT 1 / 243160 05WTRNWY 138 245425 05W TRINWY 12.0 1 END

Contingency Name	Contingency Definition
AEP_P4_#7728_05FREMCT 138_C	CONTINGENCY 'AEP_P4_#7728_05FREMCT 138_C' OPEN BRANCH FROM BUS 245616 TO BUS 243009 CKT 1 / 245616 05FREMNTEQ 999 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 245616 TO BUS 245617 CKT 1 / 245616 05FREMNTEQ 999 245617 05FREMONT 69.0 1 OPEN BRANCH FROM BUS 245616 TO BUS 245618 CKT 1 / 245616 05FREMNTEQ 999 245618 05FREMONT- 12.0 1 OPEN BRANCH FROM BUS 239154 TO BUS 243009 CKT 1 / 239154 02W.FREM 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243009 CKT 1 / 243008 05FREMCT 138 243009 05FRMNT 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 1 / 243008 05FREMCT 138 243130 05TIFFIN 138 1 OPEN BRANCH FROM BUS 243008 TO BUS 243130 CKT 2 / 243008 05FREMCT 138 243130 05TIFFIN 138 2 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 REMOVE SWSHUNT FROM BUS 243008 / 243008 05FREMCT 138 END
AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1	CONTINGENCY 'AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 END
Base Case	
AEP_P1-2_#11144-B	CONTINGENCY 'AEP_P1-2_#11144-B' OPEN BRANCH FROM BUS 945620 TO BUS 242939 CKT 1 / 945620 AF1-227 TAP 345 242939 05MARYSV 345 1 END
AEP_P1-2_#7757-A	CONTINGENCY 'AEP_P1-2_#7757-A' OPEN BRANCH FROM BUS 247172 TO BUS 960840 CKT 1 / 247172 05EBERSO 138 960840 AF2-375 TAP 138 1 END

Contingency Name	Contingency Definition
AEP_P4_#10134_05HOWARD 138_B	CONTINGENCY 'AEP_P4_#10134_05HOWARD 138_B' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_SUBT_P4_#1176_05FREMNT C 69.0_L	CONTINGENCY 'AEP_SUBT_P4_#1176_05FREMNT C 69.0_L' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245641 TO BUS 245614 CKT 1 / 245641 05BIRCHARDSS69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 OPEN BRANCH FROM BUS 245623 TO BUS 245625 CKT 1 / 245623 05HOLRAN 69.0 245625 05MAPLE GR 69.0 1 OPEN BRANCH FROM BUS 245625 TO BUS 245628 CKT 1 / 245625 05MAPLE GR 69.0 245628 05RIVERVIE 69.0 1 REMOVE SWSHUNT FROM BUS 245614 / 245614 05FREMNT C 69.0 END
AEP_P2-2_#9521_05CHATFL 138_2	CONTINGENCY 'AEP_P2-2_#9521_05CHATFL 138_2' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END
AEP_P1-2_#7709	CONTINGENCY 'AEP_P1-2_#7709' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 END

Contingency Name | **Contingency Definition**

ATSI-P2-3-OEC-345-026

```
CONTINGENCY 'ATSI-P2-3-OEC-345-026'                    /* BEAVER 345KV BRK B-182
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 907060 CKT 1        /* 02BEAVER 345 X1-027A TAP 345
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239171 CKT 1        /* 02BEAVER 345 02WLORG-2 14
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239172 CKT 1        /* 02BEAVER 345 02WLORG-3 14
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239173 CKT 1        /* 02BEAVER 345 02WLORG-4 14
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239174 CKT 1        /* 02BEAVER 345 02WLORG-5 14
  REMOVE MACHINE 2 FROM BUS 239171                       /* 02WLORG-2 14
  REMOVE MACHINE 3 FROM BUS 239172                       /* 02WLORG-3 14
  REMOVE MACHINE 4 FROM BUS 239173                       /* 02WLORG-4 14
  REMOVE MACHINE 5 FROM BUS 239174                       /* 02WLORG-5 14
  DISCONNECT BUS 239171                            /* 02WLORG-2 14
  DISCONNECT BUS 239172                            /* 02WLORG-3 14
  DISCONNECT BUS 239173                            /* 02WLORG-4 14
  DISCONNECT BUS 239174                            /* 02WLORG-5 14
END
```

ATSI-P2-3-OEC-345-023

```
CONTINGENCY 'ATSI-P2-3-OEC-345-023'                    /* BEAVER 345KV BRK B-121
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1        /* 02BEAVER 345 02LAKEAVE 345
  DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1        /* 02BEAVER 345 02CARLIL 345
END
```

17 Light Load Analysis

Light Load Studies (As applicable)

Not Applicable.

18 Short Circuit Analysis

The following Breakers are overdutied:

To be determined during later study phases.

19 Stability and Reactive Power Assessment

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined during later study phases.

20 Affected Systems

20.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

20.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

20.3 MISO

MISO Impacts to be determined during later study phases (as applicable).

20.4 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

Generation Interconnection

System Impact Study Report

for

Queue Project AF2-375

EBERSOLE-FOSTORIA CENTRAL 138 KV

77.76 MW Capacity / 129.6 MW Energy

February 2021

Table of Contents

1 Introduction

This System Impact Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 205, as well as the System Impact Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

2 Preface

The intent of the System Impact Study is to determine a plan, with approximate cost and construction time estimates, to connect the subject generation interconnection project to the PJM network at a location specified by the Interconnection Customer. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system. All facilities required for interconnection of a generation interconnection project must be designed to meet the technical specifications (on PJM web site) for the appropriate transmission owner.

In some instances an Interconnection Customer may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection or merchant transmission upgrade, may also contribute to the need for the same network reinforcement. The possibility of sharing the reinforcement costs with other projects may be identified in the Feasibility Study, but the actual allocation will be deferred until the System Impact Study is performed.

The System Impact Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

3 General

The Interconnection Customer (IC), has proposed a Solar generating facility located in Hancock County, Ohio. The installed facilities will have a total capability of 129.6 MW with 77.76 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this project is December 31, 2022. This study does not imply a TO commitment to this in-service date.

Queue Number	**AF2-375**
Project Name	EBERSOLE-FOSTORIA CENTRAL 138 KV
State	Ohio
County	Hancock
Transmission Owner	AEP
MFO	129.6
MWE	129.6
MWC	77.76
Fuel	Solar
Basecase Study Year	2023

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AF2-375 will interconnect with the AEP transmission system via a new station cut into the Ebersole - Fostoria Central 138 kV circuit.

To accommodate the interconnection on the Ebersole - Fostoria Central 138 kV circuit, a new three (3) 138 kV station configured and operated as a ring-bus will be constructed (see Attachment 1). Installation of associated protection and control equipment, 138 kV line risers, SCADA, jumpers, switches and 138 kV revenue metering will also be required. AEP reserves the right to specify the final acceptable configuration considering design practices, future expansion, and compliance requirements.

AEP will extend one span of 138 kV transmission line for the generation-leads going to the AF2-375 site. Unless this span extends directly from within the AEP station at the POI to the IC collector station structure, AEP will build and own the first transmission line structure outside of the proposed station fence to which the AEP and AF2-375 transmission line conductors will attach.

5 Cost Summary

The AF2-375 project will be responsible for the following costs:

Description	**Total Cost**
Total Physical Interconnection Costs	$9,688,000
Allocation towards System Network Upgrade Costs*	$0
Total Costs	**$9,688,000**

*As your project progresses through the study process and other projects modify their request or withdraw, then your cost allocation could change.

The estimates provided in this report are preliminary in nature, as they were determined without the benefit of detailed engineering studies. Final estimates will require an on-site review and coordination to determine final construction requirements. In addition, Stability analysis will be completed during the Facilities Study stage. It is possible that a need for additional upgrades could be identified by these studies.

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Note 1: PJM Open Access Transmission Tariff (OATT) section 217.3A outline cost allocation rules. The rules are further clarified in PJM Manual 14A Attachment B. The allocation of costs for a network upgrade will start with the first Queue project to cause the need for the upgrade. Later queue projects will receive cost allocation contingent on their contribution to the violation and are allocated to the queues that have not closed less than 5 years following the execution of the first Interconnection Service Agreement which identifies the need for this upgrade.

Note 2: For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

6.1 Attachment Facilities

The total preliminary cost estimate for the Attachment work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
138 kV Revenue Metering	$388,000
Generator lead first span exiting the POI station, including the first structure outside the fence	$400,000
Total Attachment Facility Costs	**$788,000**

6.2 Direct Connection Cost Estimate

The total preliminary cost estimate for the Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Construct a new three (3) circuit breaker 138 kV switching station physically configured and operated as a ring-bus. Installation of associated protection and control equipment, 138 kV line risers, jumpers, switches, and SCADA will also be required.	$8,040,000
Total Direct Connection Facility Costs	**$8,040,000**

6.3 Non-Direct Connection Cost Estimate

The total preliminary cost estimate for the Non-Direct Connection work is given in the table below. These costs do not include CIAC Tax Gross-up.

Description	Total Cost
Review protection and control settings at the Ebersole 138 kV station	$45,000
Review protection and control settings at the Fostoria Central 138 kV station	$45,000
Ebersole – Fostoria Central 138 kV Transmission Line Cut In	$770,000
Total Non-Direct Connection Facility Costs	**$860,000**

7 Schedule

It is anticipated that the time between receipt of executed Agreements and Commercial Operation may range from 12 to 18 months if no line work is required. If line work is required, construction time would generally be between 24 to 36 months after Agreement execution.

8 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

9 Revenue Metering and SCADA Requirements

9.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

9.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

9.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

10 Summer Peak Analysis

The Queue Project AF2-375 was evaluated as a 129.6 MW (Capacity 77.8 MW) injection into a tap of the Ebersole to Fostoria Central 138 kV line in the AEP area. Project AF2-375 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AF2-375 was studied with a commercial probability of 100.0 %. Potential network impacts were as follows:

10.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

10.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

10.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515853	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	114.37	115.67	AC	20.11
95947779	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	123.06	126.81	AC	7.38
95947617	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P2-2_#7118_05HOWARD 138_1-B	bus	251.0	114.98	118.86	AC	11.46
95947618	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1	bus	251.0	109.99	113.06	AC	9.07
95947793	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P4_#10134_05HOWARD 138_B	breaker	251.0	114.98	118.86	AC	11.46
95947794	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_P4_#10133_05HOWARD 138_H	breaker	251.0	114.99	118.87	AC	11.46
95947795	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#1176_05FREMNT C 69.0_L	breaker	251.0	110.69	113.76	AC	9.07
95947796	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#2200_05FREMNT C 69.0_E	breaker	251.0	109.99	113.06	AC	9.07
117438004	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	AEP_SUBT_P4_#1178_05FREMNT C 69.0_J	breaker	251.0	107.69	110.76	AC	9.07
95947592	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P2-2_#9521_05CHATFL 138_2	bus	167.0	128.72	132.45	AC	7.32
95947769	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	136.42	139.78	AC	6.59
95947770	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#10729_05CHATFL 138_E	breaker	167.0	129.2	133.01	AC	7.48
95947771	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P4_#9521_05CHATFL 138_F	breaker	167.0	128.72	132.45	AC	7.32
95947751	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	152.86	156.62	AC	7.38

10.4 Steady-State Voltage Requirements

None

10.5 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515506	242935	05E LIMA	345.0	AEP	242945	05SW LIM	345.0	AEP	1	AEP_P1-2_#11144-B	operation	971.0	101.88	103.39	AC	14.72
95515463	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	111.23	112.61	AC	16.77
95515464	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	AEP_P1-3_#5063_05SBERWI 345_1-B	operation	1318.0	107.22	108.62	AC	21.78
95948032	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	113.92	117.57	AC	7.17
145165063	243006	05FOSTOR	138.0	AEP	939160	AE1-146 TAP	138.0	AEP	2	AEP_P1-2_#7757-A	operation	245.0	92.56	100.61	AC	21.35
95947989	243039	05MELMOR	138.0	AEP	242984	05CHATFL	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	145.65	149.64	AC	7.82
95948018	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7709	operation	167.0	128.65	132.36	AC	7.28
95948001	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7105	operation	167.0	145.86	149.51	AC	7.17
145164919	939160	AE1-146 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	2	AEP_P1-2_#7757-A	operation	245.0	111.46	119.54	AC	21.35
95515486	945620	AF1-227 TAP	345.0	AEP	242939	05MARYSV	345.0	AEP	1	Base Case	operation	897.0	98.73	100.19	AC	13.2
145164941	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	AEP_P1-2_#7761-A	operation	245.0	103.84	116.82	AC	34.06
145164943	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	Base Case	operation	167.0	81.33	104.69	AC	40.49

10.6 System Reinforcements

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-375	Upgrade Number
95947617,95947794,95947618,95947796,95947793,117438004,95947795	3	**05FREMCT 138.0 kV - 05FRMNT 138.0 kV Ckt 1**	A sag study will be required on the 4.0 miles of ACSR ~ 795 ~ 45/7 ~ TERN - Conductor Section 1 to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be around $20,000 (no remediation required, just sag study) and $6 million (complete line reconductor/rebuild). New rating after sag study: S/N:251 S/E: 335 MVA. Time Estimate: a) Sag Study: 6-12 months. b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. This upgrade is presently driven by a prior queue cycle.	$20 K	$0	N6297.1
95515853	1	**05FOSTOR 345.0 kV - 05E LIMA 345.0 kV Ckt 1**	Replace five sub Cond 2156 ACSR 84/19 Std at E Lima. $500K. Time Estimate 12-18 months. New expected SE rating 1409 MVA. PJM Network Upgrade N6538.1 Sag study is required on the line. The cost is expected to be around $20,000. The SE rating after the sag study is expected to be 1539 MVA. Rebuild/Reconductor, cost: $ 8 million. Time Estimate 6-12 months for sag study. PJM Network Upgrade N6538.2 These upgrades are presently driven by a prior queue cycle.	$500 K $20 K	$0	N6538.1 N6538.2
95947779	2	**05CHATFL 138.0 kV - AC2-015 TAP 138.0 kV Ckt 1**	A sag study will be required on the 4.5 miles of ACSR ~ 397.5 ~ 30/7 ~ LARK – Conductor Section 1 to mitigate the overload. Depending on the sag study results, the cost for this upgrade is expected to be between $20,000 (no remediation required, just sag study) and $6.75 million (complete line reconductor/rebuild). New rating after sag study: S/N:167 S/E: 245. Time Estimate: a) Sag Study: 6-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. PJM Network Upgrade N6295. This upgrade is presently driven by a prior queue cycle.	$20 K	$0	N6295

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-375	Upgrade Number
95947592,95947769,95947770, 95947771	4	**05MELMOR 138.0 kV - 05HOWARD 138.0 kV Ckt 1**	Perform a Sag Study will be required on the 27 miles of Conductor Section 1, ACSR ~ 397.5 ~ 30/7 ~ LARK. Depending on the sag study results, cost for this upgrade is expected to be between $108,000 (no remediations required just sag study) new ratings after sag study: S/N: 167 S/E: 245 and $40.5 million (complete line rebuild/Reconductor). Time Estimate: a) Sag Study: 16-12 months b) Rebuild: The standard time required for construction differs from state to state. An approximate construction time would be 24 to 36 months after signing an interconnection agreement. PJM Network Upgrade N6298.1. This upgrade is presently driven by a prior queue cycle.	$108 K	$0	N6298.1

ID	Idx	Facility	Upgrade Description	Cost	Cost Allocated to AF2-375	Upgrade Number
95947751	5	**AC2-015 TAP 138.0 kV - 05HOWARD 138.0 kV Ckt 1**	A Sag Study will be required on the (11.1) -mile section of ACSR~397.5~30/7~LARK Conductor section 1 line to mitigate the overload. New Ratings after the sag study S/N : 167 MVA S/E: 173 MVA. Depending on the sag study results, cost for this upgrade is expected to be between $44,400 (no remediations required just sag study) and $34.5 million (complete double line reconductor/rebuild required with 1590 ACSR). PJM Network Upgrade N6296. Howard Line risers Sub cond 300 MCM CU 37 Str need to be replaced, Estimated cost: $100k. 12-18 months time estimate. New SE rating expected to be 179 MVA. PJM Network Upgrade N6296.4. Upgrade CT Thermal Limit 749 Amps & Relay Thermal Limit 749 Amps at Howard. An engineering study will need to be conducted to determine if the thermal limits settings can be adjusted to mitigate the overload, Estimated Cost $25,000. New relay packages will be required if the settings cannot be adjusted, Estimated Cost: $600,000. 12-18 months time estimate. New SE rating expected to be 180 MVA. PJM Network Upgrade N6296.1. Replace Sub cond 397.5 ACSR 26/7 at Howard, estimated cost: $100k. 12-18 months time estimate. New SE rating expected to be 233 MVA. PJM Network Upgrade N6296.2. Upgrade Relay Compliance Trip Limit 975 Amps at Howard. Estimated cost: $25k. 12-18 months time estimate. New SE rating expected to be 255 MVA. PJM Network Upgrade N6296.5. Replace five Sub cond 795 AAC 37 Str at Howard. Estimated cost: $500k. 12-18 months time estimate. New SE rating is 330 MVA. . PJM Network Upgrade N6296.6. These upgrades are presently driven by a prior queue cycle.	$44.4 K $100 K $25 K $100 K $25 K $500 K	$0	N6296 N6296.4 N6296.1 N6296.2 N6296.5 N6296.6
			Total Cost	**$1,462,400**	**$0**	

Note : For customers with System Reinforcements listed: If your present cost allocation to a System Reinforcement indicates $0, then please be aware that as changes to the interconnection process occur, such as prior queued projects withdrawing from the queue, reducing in size, etc, the cost responsibilities can change and a cost allocation may be assigned to your project. In addition, although your present cost allocation to a System Reinforcement is presently $0, your project may need this system reinforcement completed to be deliverable to the PJM system. If your project comes into service prior to completion of the system reinforcement, an interim deliverability study for your project will be required.

10.7 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

10.7.1 Index 1

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95515853	242936	05FOSTOR	AEP	242935	05E LIMA	AEP	1	ATSI-P7-1-TE-345-029A	tower	1318.0	114.37	115.67	AC	20.11

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
238564	02BAYSG1	5.1683	50/50	5.1683
238670	**02DVBSG1 (Deactivation : 31/05/2020)**	**22.6082**	**50/50**	**22.6082**
238885	02LEMOG1	5.9101	50/50	5.9101
238886	02LEMOG2	5.9101	50/50	5.9101
238887	02LEMOG3	5.9101	50/50	5.9101
238888	02LEMOG4	5.9101	50/50	5.9101
238979	02NAPMUN	5.2647	Adder	6.19
239293	02BS-PKR	0.4512	50/50	0.4512
241902	Y1-069 GE	30.6534	50/50	30.6534
244357	05GRANGER EL	0.2411	Adder	0.28
247548	V4-010 C	3.4564	Adder	4.07
247549	V3-028 C	-1.0601	Adder	-1.25
247551	**U4-028 C (Suspended)**	**1.6708**	**Adder**	**1.97**
247552	**U4-029 C (Suspended)**	**1.6708**	**Adder**	**1.97**
247940	**U4-028 E (Suspended)**	**11.1812**	**Adder**	**13.15**
247941	**U4-029 E (Suspended)**	**11.1812**	**Adder**	**13.15**
247947	V4-010 E	23.1316	Adder	27.21
925751	AC1-051 C	0.7648	Adder	0.9
925752	AC1-051 E	5.1181	Adder	6.02
927181	AC1-212 C	-0.1291	Adder	-0.15
927183	AC1-212 BAT	1.5902	Merchant Transmission	1.5902
931951	**AB1-107 1 (Suspended)**	**53.3850**	**50/50**	**53.3850**
931961	**AB1-107 2 (Suspended)**	**127.9089**	**50/50**	**127.9089**
932051	AC2-015 C	5.3861	Adder	6.34
932052	AC2-015 E	6.3818	Adder	7.51
932791	AC2-103 C	8.0073	50/50	8.0073
932792	AC2-103 E	53.5964	50/50	53.5964
933721	AC2-195 C O1	2.9412	Adder	3.46
933722	AC2-195 E O1	1.7931	Adder	2.11
934252	AD1-052 E1	0.8489	Adder	1.0
934262	AD1-052 E2	0.8489	Adder	1.0
934461	AD1-070 C O1	6.4876	50/50	6.4876
934462	AD1-070 E O1	30.4555	50/50	30.4555
934761	AD1-103 C O1	13.4632	50/50	13.4632
934762	AD1-103 E O1	90.0996	50/50	90.0996
934891	AD1-118	15.3874	50/50	15.3874
936722	AD2-091 BAT	8.2050	Merchant Transmission	8.2050
936752	AD2-096 BAT	2.8900	Merchant Transmission	2.8900
937021	AD2-136 C O1	6.0147	Adder	7.08
937022	AD2-136 E O1	40.2525	Adder	47.36

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
938911	AE1-119	120.9010	50/50	120.9010
939161	AE1-146 C O1	8.4006	Adder	9.88
939162	AE1-146 E O1	3.9230	Adder	4.62
941741	AE2-174 C	4.6330	Adder	5.45
941742	AE2-174 E	21.6892	Adder	25.52
941761	AE2-176 C	9.7805	Adder	11.51
941762	AE2-176 E	6.5204	Adder	7.67
941781	AE2-181 C	3.6350	Adder	4.28
941782	AE2-181 E	2.4234	Adder	2.85
942042	AE2-216 BAT	9.0255	Merchant Transmission	9.0255
942661	AE2-282 C O1	5.7484	Adder	6.76
942662	AE2-282 E O1	3.0248	Adder	3.56
943011	AE2-324	0.9614	Adder	1.13
943961	AF1-064 C O1	6.1446	50/50	6.1446
943962	AF1-064 E O1	3.0539	50/50	3.0539
944551	AF1-120 C	3.4831	Adder	4.1
944552	AF1-120 E	1.7546	Adder	2.06
944571	AF1-122 C O1	1.7725	Adder	2.09
944572	AF1-122 E O1	2.4478	Adder	2.88
945401	AF1-205 C O1	3.4150	Adder	4.02
945402	AF1-205 E O1	2.2766	Adder	2.68
945411	AF1-206 C O1	15.6345	Adder	18.39
945412	AF1-206 E O1	10.4230	Adder	12.26
945641	AF1-229 C	17.1151	50/50	17.1151
945642	AF1-229 E	11.4101	50/50	11.4101
946203	AF1-285 BAT	2.9590	Merchant Transmission	2.9590
950311	G934 C	2.0763	PJM External (MISO)	2.0763
950312	G934 E	8.3052	PJM External (MISO)	8.3052
950351	J466	3.3603	PJM External (MISO)	3.3603
950791	J201 C	0.4014	PJM External (MISO)	0.4014
950792	J201 E	1.6056	PJM External (MISO)	1.6056
950871	J246 C	0.1059	PJM External (MISO)	0.1059
950872	J246 E	0.4238	PJM External (MISO)	0.4238
950942	J325 E	0.4626	PJM External (MISO)	0.4626
951531	J533 C	3.0268	PJM External (MISO)	3.0268
951532	J533 E	12.1072	PJM External (MISO)	12.1072
951571	J538 C	3.0615	PJM External (MISO)	3.0615
951572	J538 E	12.2460	PJM External (MISO)	12.2460
952201	J589 C	2.5104	PJM External (MISO)	2.5104
952202	J589 E	13.5816	PJM External (MISO)	13.5816
952312	J646 E	0.2014	PJM External (MISO)	0.2014
952401	J752 C	1.7093	PJM External (MISO)	1.7093
952402	J752 E	9.2477	PJM External (MISO)	9.2477
952611	J717 C	2.8032	PJM External (MISO)	2.8032
952612	J717 E	15.1658	PJM External (MISO)	15.1658
952761	J728 C	2.6069	PJM External (MISO)	2.6069
952762	J728 E	14.1228	PJM External (MISO)	14.1228
952881	J758	12.4140	PJM External (MISO)	12.4140
952971	J793	165.9903	PJM External (MISO)	165.9903
953071	J794 C	0.1653	PJM External (MISO)	0.1653
953072	J794 E	0.8941	PJM External (MISO)	0.8941
953271	J701 C	0.8320	PJM External (MISO)	0.8320

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
953272	J701 E	4.5012	PJM External (MISO)	4.5012
953291	J796	22.3489	PJM External (MISO)	22.3489
953321	J799	27.3199	PJM External (MISO)	27.3199
953361	J806	11.5222	PJM External (MISO)	11.5222
953771	J832	7.6620	PJM External (MISO)	7.6620
953781	J833	14.5520	PJM External (MISO)	14.5520
953941	J857	8.7165	PJM External (MISO)	8.7165
954111	J875	18.6060	PJM External (MISO)	18.6060
955071	J984 C	2.1594	PJM External (MISO)	2.1594
955072	J984 E	11.6826	PJM External (MISO)	11.6826
955181	J996	11.2712	PJM External (MISO)	11.2712
955591	J1043 C	1.1530	PJM External (MISO)	1.1530
955592	J1043 E	20.4312	PJM External (MISO)	20.4312
955781	J1062	25.3635	PJM External (MISO)	25.3635
956011	J1088	14.0355	PJM External (MISO)	14.0355
956021	J1089	16.0803	PJM External (MISO)	16.0803
956031	J1090	8.9037	PJM External (MISO)	8.9037
956741	J1172	5.1100	PJM External (MISO)	5.1100
956801	J1178	5.8201	PJM External (MISO)	5.8201
957111	AF2-005	0.4172	Adder	0.49
958321	AF2-126 C	6.2550	50/50	6.2550
958322	AF2-126 E	3.1275	50/50	3.1275
958591	AF2-150 C	3.5158	Adder	4.14
958592	AF2-150 E	4.8551	Adder	5.71
960301	AF2-321 C	9.7090	Adder	11.42
960302	AF2-321 E	6.4727	Adder	7.61
960841	AF2-375 C	10.2555	Adder	12.07
960842	AF2-375 E	6.8370	Adder	8.04
960853	AF2-376 BAT	3.2875	Merchant Transmission	3.2875
960863	AF2-377 BAT	3.1745	Merchant Transmission	3.1745
NEWTON	NEWTON	1.6042	Confirmed LTF	1.6042
BLUEG	BLUEG	3.5432	Confirmed LTF	3.5432
G-007A	G-007A	0.4339	Confirmed LTF	0.4339
VFT	VFT	1.2062	Confirmed LTF	1.2062
PRAIRIE	PRAIRIE	3.5930	Confirmed LTF	3.5930
COFFEEN	COFFEEN	0.2741	Confirmed LTF	0.2741
CHEOAH	CHEOAH	0.6752	Confirmed LTF	0.6752
EDWARDS	EDWARDS	0.3727	Confirmed LTF	0.3727
TILTON	TILTON	0.9141	Confirmed LTF	0.9141
MADISON	MADISON	3.5986	Confirmed LTF	3.5986
GIBSON	GIBSON	1.0112	Confirmed LTF	1.0112
CALDERWOOD	CALDERWOOD	0.6754	Confirmed LTF	0.6754
FARMERCITY	FARMERCITY	0.0678	Confirmed LTF	0.0678
TRIMBLE	TRIMBLE	1.1431	Confirmed LTF	1.1431
CATAWBA	CATAWBA	0.3853	Confirmed LTF	0.3853
CBM-W1	CBM-W1	39.6192	Confirmed LTF	39.6192

10.7.2 Index 2

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947779	242984	05CHATFL	AEP	932050	AC2-015 TAP	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	123.06	126.81	AC	7.38

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.7071	50/50	3.7071
247551	**U4-028 C (Suspended)**	**2.2012**	**50/50**	**2.2012**
247552	**U4-029 C (Suspended)**	**2.2012**	**50/50**	**2.2012**
247940	**U4-028 E (Suspended)**	**14.7308**	**50/50**	**14.7308**
247941	**U4-029 E (Suspended)**	**14.7308**	**50/50**	**14.7308**
247947	V4-010 E	24.8089	50/50	24.8089
925751	AC1-051 C	2.3834	50/50	2.3834
925752	AC1-051 E	15.9502	50/50	15.9502
934252	AD1-052 E1	0.2604	Adder	0.31
934262	AD1-052 E2	0.2604	Adder	0.31
934461	AD1-070 C O1	1.8556	Adder	2.18
934462	AD1-070 E O1	8.7109	Adder	10.25
937021	AD2-136 C O1	7.9242	50/50	7.9242
937022	AD2-136 E O1	53.0310	50/50	53.0310
939161	AE1-146 C O1	3.6037	Adder	4.24
939162	AE1-146 E O1	1.6829	Adder	1.98
941741	AE2-174 C	4.9689	50/50	4.9689
941742	AE2-174 E	23.2619	50/50	23.2619
960841	AF2-375 C	3.7622	Adder	4.43
960842	AF2-375 E	2.5081	Adder	2.95
LGEE	LGEE	0.0953	Confirmed LTF	0.0953
CBM-W2	CBM-W2	1.7117	Confirmed LTF	1.7117
NY	NY	0.1040	Confirmed LTF	0.1040
TVA	TVA	0.1596	Confirmed LTF	0.1596
WEC	WEC	0.1276	Confirmed LTF	0.1276
O-066	O-066	1.2970	Confirmed LTF	1.2970
CBM-S1	CBM-S1	1.0565	Confirmed LTF	1.0565
G-007	G-007	0.1997	Confirmed LTF	0.1997
MADISON	MADISON	0.3851	Confirmed LTF	0.3851
MEC	MEC	0.5228	Confirmed LTF	0.5228
CATAWBA	CATAWBA	0.0088	Confirmed LTF	0.0088
CBM-W1	CBM-W1	8.8571	Confirmed LTF	8.8571

10.7.3 Index 3

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947794	243008	05FREMCT	AEP	243009	05FRMNT	AEP	1	AEP_P4_#10133_05HOWARD 138_H	breaker	251.0	114.99	118.87	AC	11.46

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
244357	05GRANGER EL	0.1987	Adder	0.23
247548	V4-010 C	10.1296	50/50	10.1296
247551	**U4-028 C (Suspended)**	**4.0361**	**50/50**	**4.0361**
247552	**U4-029 C (Suspended)**	**4.0361**	**50/50**	**4.0361**
247926	U1-059 E	1.8757	Adder	2.21
247940	**U4-028 E (Suspended)**	**27.0109**	**50/50**	**27.0109**
247941	**U4-029 E (Suspended)**	**27.0109**	**50/50**	**27.0109**
247942	W1-056 E	0.6899	Adder	0.81
247947	V4-010 E	67.7904	50/50	67.7904
925751	AC1-051 C	2.0243	50/50	2.0243
925752	AC1-051 E	13.5475	50/50	13.5475
932051	AC2-015 C	16.1560	50/50	16.1560
932052	AC2-015 E	19.1429	50/50	19.1429
934252	AD1-052 E1	-0.6531	Adder	-0.77
934262	AD1-052 E2	-0.6531	Adder	-0.77
934461	AD1-070 C O1	2.8788	Adder	3.39
934462	AD1-070 E O1	13.5146	Adder	15.9
937021	AD2-136 C O1	14.5300	50/50	14.5300
937022	AD2-136 E O1	97.2392	50/50	97.2392
939161	AE1-146 C O1	5.6048	Adder	6.59
939162	AE1-146 E O1	2.6174	Adder	3.08
941741	AE2-174 C	13.5776	50/50	13.5776
941742	AE2-174 E	63.5632	50/50	63.5632
960841	AF2-375 C	5.8429	Adder	6.87
960842	AF2-375 E	3.8953	Adder	4.58
LGEE	LGEE	0.2345	Confirmed LTF	0.2345
CPLE	CPLE	0.1244	Confirmed LTF	0.1244
CBM-W2	CBM-W2	2.8583	Confirmed LTF	2.8583
NY	NY	0.0824	Confirmed LTF	0.0824
TVA	TVA	0.4452	Confirmed LTF	0.4452
WEC	WEC	0.1134	Confirmed LTF	0.1134
O-066	O-066	0.7123	Confirmed LTF	0.7123
CBM-S2	CBM-S2	1.2889	Confirmed LTF	1.2889
CBM-S1	CBM-S1	2.8542	Confirmed LTF	2.8542
G-007	G-007	0.1071	Confirmed LTF	0.1071
MEC	MEC	0.5641	Confirmed LTF	0.5641
CBM-W1	CBM-W1	1.6513	Confirmed LTF	1.6513

10.7.4 Index 4

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947769	243039	05MELMOR	AEP	243024	05HOWARD	AEP	1	AEP_P4_#7112_05MELMOR 138_C	breaker	167.0	136.42	139.78	AC	6.59

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.9975	50/50	3.9975
247551	**U4-028 C (Suspended)**	**2.5852**	**50/50**	**2.5852**
247552	**U4-029 C (Suspended)**	**2.5852**	**50/50**	**2.5852**
247940	**U4-028 E (Suspended)**	**17.3008**	**50/50**	**17.3008**
247941	**U4-029 E (Suspended)**	**17.3008**	**50/50**	**17.3008**
247947	V4-010 E	26.7525	50/50	26.7525
934252	AD1-052 E1	0.2728	Adder	0.32
934262	AD1-052 E2	0.2728	Adder	0.32
934461	AD1-070 C O1	1.6610	Adder	1.95
934462	AD1-070 E O1	7.7973	Adder	9.17
937021	AD2-136 C O1	9.3066	50/50	9.3066
937022	AD2-136 E O1	62.2830	50/50	62.2830
941741	AE2-174 C	5.3582	50/50	5.3582
941742	AE2-174 E	25.0843	50/50	25.0843
960841	AF2-375 C	3.3603	Adder	3.95
960842	AF2-375 E	2.2402	Adder	2.64
LGEE	LGEE	0.0422	Confirmed LTF	0.0422
CBM-W2	CBM-W2	1.0565	Confirmed LTF	1.0565
NY	NY	0.0730	Confirmed LTF	0.0730
TVA	TVA	0.0602	Confirmed LTF	0.0602
WEC	WEC	0.0983	Confirmed LTF	0.0983
O-066	O-066	0.9744	Confirmed LTF	0.9744
CHEOAH	CHEOAH	0.0065	Confirmed LTF	0.0065
CBM-S1	CBM-S1	0.4175	Confirmed LTF	0.4175
G-007	G-007	0.1508	Confirmed LTF	0.1508
MADISON	MADISON	0.4254	Confirmed LTF	0.4254
MEC	MEC	0.3845	Confirmed LTF	0.3845
CALDERWOOD	CALDERWOOD	0.0060	Confirmed LTF	0.0060
CATAWBA	CATAWBA	0.0238	Confirmed LTF	0.0238
CBM-W1	CBM-W1	7.8313	Confirmed LTF	7.8313

10.7.5 Index 5

ID	FROM BUS#	FROM BUS	FROM BUS AREA	TO BUS#	TO BUS	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
95947751	932050	AC2-015 TAP	AEP	243024	05HOWARD	AEP	1	AEP_SUBT_P4_#1208_05HOWARD 69.0_U	breaker	167.0	152.86	156.62	AC	7.38

Bus #	Bus	Gendeliv MW Impact	Type	Full MW Impact
247548	V4-010 C	3.7071	50/50	3.7071
247551	**U4-028 C (Suspended)**	**2.2012**	**50/50**	**2.2012**
247552	**U4-029 C (Suspended)**	**2.2012**	**50/50**	**2.2012**
247940	**U4-028 E (Suspended)**	**14.7308**	**50/50**	**14.7308**
247941	**U4-029 E (Suspended)**	**14.7308**	**50/50**	**14.7308**
247947	V4-010 E	24.8089	50/50	24.8089
925751	AC1-051 C	2.3834	50/50	2.3834
925752	AC1-051 E	15.9502	50/50	15.9502
932051	AC2-015 C	23.9952	50/50	23.9952
932052	AC2-015 E	28.4313	50/50	28.4313
934252	AD1-052 E1	0.2604	Adder	0.31
934262	AD1-052 E2	0.2604	Adder	0.31
934461	AD1-070 C O1	1.8556	Adder	2.18
934462	AD1-070 E O1	8.7109	Adder	10.25
937021	AD2-136 C O1	7.9242	50/50	7.9242
937022	AD2-136 E O1	53.0310	50/50	53.0310
939161	AE1-146 C O1	3.6037	Adder	4.24
939162	AE1-146 E O1	1.6829	Adder	1.98
941741	AE2-174 C	4.9689	50/50	4.9689
941742	AE2-174 E	23.2619	50/50	23.2619
960841	AF2-375 C	3.7622	Adder	4.43
960842	AF2-375 E	2.5081	Adder	2.95
LGEE	LGEE	0.0953	Confirmed LTF	0.0953
CBM-W2	CBM-W2	1.7117	Confirmed LTF	1.7117
NY	NY	0.1040	Confirmed LTF	0.1040
TVA	TVA	0.1596	Confirmed LTF	0.1596
WEC	WEC	0.1276	Confirmed LTF	0.1276
O-066	O-066	1.2970	Confirmed LTF	1.2970
CBM-S1	CBM-S1	1.0565	Confirmed LTF	1.0565
G-007	G-007	0.1997	Confirmed LTF	0.1997
MADISON	MADISON	0.3851	Confirmed LTF	0.3851
MEC	MEC	0.5228	Confirmed LTF	0.5228
CATAWBA	CATAWBA	0.0088	Confirmed LTF	0.0088
CBM-W1	CBM-W1	8.8571	Confirmed LTF	8.8571

10.8 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AB1-107	Bayshore-GM Powertrain 138 kV & Lallendorf 345kV	Suspended
AC1-051	Willard-S. Greenwich 69kV	Active
AC1-212	Minster 69kV	Engineering and Procurement
AC2-015	Chatfield-Howard 138kV	Active
AC2-103	Beaver-Davis Besse 345 kV I	Engineering and Procurement
AC2-195	Galion-Roberts South 138kV	Active
AD1-052	Freemont Energy Center	Under Construction
AD1-070	Fostoria Central 138 kV	Active
AD1-103	Beaver-Davis Besse 345 kV II	Active
AD1-118	Lemoyne	Active
AD2-091	Hardin Tap 345kV	Active
AD2-096	Marysville 345kV	Active
AD2-136	Melmore Tap 138kV	Active
AE1-119	Lemoyne 345 kV	Active
AE1-146	Ebersole #2-Fostoria Central 138 kV	Active
AE2-174	Seneca 138 kV	Active
AE2-176	Groton 138 kV Solar	Active
AE2-181	Snyder 69kV	Active
AE2-216	Hardin Switch 345 kV	Active
AE2-282	East Fayette 138 kV	Active
AE2-324	Galion-Roberts South II 138 kV	Active
AF1-064	Weston 69 kV	Active
AF1-120	East Fayette 2 138 kV	Active
AF1-122	Cardington 138 kV	Active
AF1-205	Napolean Muni 138 kV	Active
AF1-206	Fayette-Lyons 138 kV	Active
AF1-229	Galion-South Berwick 345 kV	Active
AF1-285	Gunn Road 345 kV	Active
AF2-005	Beaver 138 kV	Active
AF2-126	Weston 69 kV II	Active
AF2-150	Galion 138 kV	Active
AF2-321	Stryker-Ridgeville 138 kV	Active
AF2-375	Fostoria Central 138 kV	Active
AF2-376	Timber Switch 138 kV	Active
AF2-377	Logtown 138 kV	Active
U1-059	Ada-Dunkirk 69kV	In Service
U4-028	Fostoria Central-Greenlawn-Howard 138kV	Suspended
U4-029	Fostoria Central-Greenlawn-Howard 138kV	Suspended

Queue Number	Project Name	Status
V3-028	East Lima-Marysville 345kV	Partially in Service - Under Construction
V4-010	Tiffin Center 138kV	Engineering and Procurement
W1-056	Ada-Dunkirk 69kV	In Service
Y1-069	Bay Shore-Fostoria Central 345kV & Bayshore-Monroe 345kV	In Service
J1043	MISO	MISO
J1062	MISO	MISO
J1088	MISO	MISO
J1089	MISO	MISO
J1090	MISO	MISO
J1172	MISO	MISO
J1178	MISO	MISO
J201	MISO	MISO
J246	MISO	MISO
J325	MISO	MISO
J466	MISO	MISO
J533	MISO	MISO
J538	MISO	MISO
J589	MISO	MISO
J646	MISO	MISO
J701	MISO	MISO
J717	MISO	MISO
J728	MISO	MISO
J752	MISO	MISO
J758	MISO	MISO
J793	MISO	MISO
J794	MISO	MISO
J796	MISO	MISO
J799	MISO	MISO
J806	MISO	MISO
J832	MISO	MISO
J833	MISO	MISO
J857	MISO	MISO
J875	MISO	MISO
J984	MISO	MISO
J996	MISO	MISO

10.9 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P4_#10134_05HOWARD 138_B	CONTINGENCY 'AEP_P4_#10134_05HOWARD 138_B' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_SUBT_P4_#1176_05FREMNT C 69.0_L	CONTINGENCY 'AEP_SUBT_P4_#1176_05FREMNT C 69.0_L' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245641 TO BUS 245614 CKT 1 / 245641 05BIRCHARDSS69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 OPEN BRANCH FROM BUS 245623 TO BUS 245625 CKT 1 / 245623 05HOLRAN 69.0 245625 05MAPLE GR 69.0 1 OPEN BRANCH FROM BUS 245625 TO BUS 245628 CKT 1 / 245625 05MAPLE GR 69.0 245628 05RIVERVIE 69.0 1 REMOVE SWSHUNT FROM BUS 245614 / 245614 05FREMNT C 69.0 END
AEP_P2-2_#9521_05CHATFL 138_2	CONTINGENCY 'AEP_P2-2_#9521_05CHATFL 138_2' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END

Contingency Name	Contingency Definition
AEP_P4_#9521_05CHATFL 138_F	CONTINGENCY 'AEP_P4_#9521_05CHATFL 138_F' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END
AEP_SUBT_P4_#1178_05FREMNT C 69.0_J	CONTINGENCY 'AEP_SUBT_P4_#1178_05FREMNT C 69.0_J' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 247860 TO BUS 245649 CKT 1 / 247860 05BATTERY SS69.0 245649 05BLOOM RD 69.0 1 OPEN BRANCH FROM BUS 247860 TO BUS 245627 CKT 1 / 247860 05BATTERY SS69.0 245627 05N FREMON 69.0 1 OPEN BRANCH FROM BUS 245649 TO BUS 245611 CKT 1 / 245649 05BLOOM RD 69.0 245611 05E FREMON 69.0 1 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 OPEN BRANCH FROM BUS 245617 TO BUS 245627 CKT 1 / 245617 05FREMONT 69.0 245627 05N FREMON 69.0 1 END
AEP_P1-2_#7105	CONTINGENCY 'AEP_P1-2_#7105' OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 END
AEP_P4_#7112_05MELMOR 138_C	CONTINGENCY 'AEP_P4_#7112_05MELMOR 138_C' OPEN BRANCH FROM BUS 242953 TO BUS 243110 CKT 1 / 242953 05AIRCO8 138 243110 05STIFFI 138 1 OPEN BRANCH FROM BUS 242953 TO BUS 243137 CKT 1 / 242953 05AIRCO8 138 243137 05W.END

Contingency Name	Contingency Definition
AEP_P2-2_#7118_05HOWARD 138_1-B	CONTINGENCY 'AEP_P2-2_#7118_05HOWARD 138_1-B' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_P1-2_#7761-A	CONTINGENCY 'AEP_P1-2_#7761-A' OPEN BRANCH FROM BUS 247172 TO BUS 939160 CKT 2 / 247172 05EBERSO 138 939160 AE1-146 TAP 138 2 END
AEP_SUBT_P4_#2200_05FREMNT C 69.0_E	CONTINGENCY 'AEP_SUBT_P4_#2200_05FREMNT C 69.0_E' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 END

Contingency Name	Contingency Definition
AEP_SUBT_P4_#1208_05HOWARD 69.0_U	CONTINGENCY 'AEP_SUBT_P4_#1208_05HOWARD 69.0_U' OPEN BRANCH FROM BUS 245666 TO BUS 243024 CKT 1 / 245666 05HOWRD1EQ 999 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 245666 TO BUS 245663 CKT 1 / 245666 05HOWRD1EQ 999 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 245659 TO BUS 245663 CKT 1 / 245659 05E BUCYRU 69.0 245663 05HOWARD 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245678 CKT 1 / 245663 05HOWARD 69.0 245678 05NGALIOSS 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245679 CKT 1 / 245663 05HOWARD 69.0 245679 05WILLARD 69.0 1 OPEN BRANCH FROM BUS 245663 TO BUS 245657 CKT 1 / 245663 05HOWARD 69.0 245657 05WSHELBY 69.0 1 REMOVE SWSHUNT FROM BUS 245663 / 245663 05HOWARD 69.0 END
AEP_P1-3_#5063_05SBERWI 345_1-B	CONTINGENCY 'AEP_P1-3_#5063_05SBERWI 345_1-B' OPEN BRANCH FROM BUS 242917 TO BUS 242942 CKT 1 / 242917 05SBERW EQ 999 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242917 TO BUS 243180 CKT 1 / 242917 05SBERW EQ 999 243180 05SBERWICK 69.0 1 OPEN BRANCH FROM BUS 242917 TO BUS 243199 CKT 1 / 242917 05SBERW EQ 999 243199 05SBERW1-L 12.0 1 OPEN BRANCH FROM BUS 945640 TO BUS 242942 CKT 1 / 945640 AF1-229 TAP 345 242942 05SBERWI 345 1 OPEN BRANCH FROM BUS 242936 TO BUS 242942 CKT 1 / 242936 05FOSTOR 345 242942 05SBERWI 345 1 END
AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1	CONTINGENCY 'AEP_SUBT_P2-2_#1175_05FREMNT C 69.0_1' OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 1 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 243008 TO BUS 245614 CKT 3 / 243008 05FREMCT 138 245614 05FREMNT C 69.0 3 OPEN BRANCH FROM BUS 245645 TO BUS 245614 CKT 1 / 245645 05CLYDE 69.0 245614 05FREMNT C 69.0 1 OPEN BRANCH FROM BUS 245611 TO BUS 245614 CKT 2 / 245611 05E FREMON 69.0 245614 05FREMNT C 69.0 2 OPEN BRANCH FROM BUS 245614 TO BUS 245623 CKT 1 / 245614 05FREMNT C 69.0 245623 05HOLRAN 69.0 1 END

Contingency Name	Contingency Definition
AEP_P4_#10133_05HOWARD 138_H	CONTINGENCY 'AEP_P4_#10133_05HOWARD 138_H' OPEN BRANCH FROM BUS 241111 TO BUS 243024 CKT 1 / 241111 02ASHLAND 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243050 CKT 1 / 243024 05HOWARD 138 243050 05NBELVL 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243061 CKT 1 / 243024 05HOWARD 138 243061 05NLEXTN 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243101 CKT 1 / 243024 05HOWARD 138 243101 05SHELNS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243117 CKT 1 / 243024 05HOWARD 138 243117 05SULFRS 138 1 OPEN BRANCH FROM BUS 243024 TO BUS 243100 CKT 1 / 243024 05HOWARD 138 243100 05SHELGH 138 1 OPEN BRANCH FROM BUS 243050 TO BUS 245567 CKT 1 / 243050 05NBELVL 138 245567 05NBELLVIL 69.0 1 REMOVE SWSHUNT FROM BUS 243024 / 243024 05HOWARD 138 END
AEP_P4_#10729_05CHATFL 138_E	CONTINGENCY 'AEP_P4_#10729_05CHATFL 138_E' OPEN BRANCH FROM BUS 242984 TO BUS 932050 CKT 1 / 242984 05CHATFL 138 932050 AC2-015 TAP 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 1 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 2 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 2 END
Base Case	
AEP_P1-2_#11144-B	CONTINGENCY 'AEP_P1-2_#11144-B' OPEN BRANCH FROM BUS 945620 TO BUS 242939 CKT 1 / 945620 AF1-227 TAP 345 242939 05MARYSV 345 1 END
AEP_P1-2_#7757-A	CONTINGENCY 'AEP_P1-2_#7757-A' OPEN BRANCH FROM BUS 247172 TO BUS 960840 CKT 1 / 247172 05EBERSO 138 960840 AF2-375 138 1 END
AEP_P1-2_#7709	CONTINGENCY 'AEP_P1-2_#7709' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 END

Contingency Name	Contingency Definition
ATSI-P7-1-TE-345-029A	CONTINGENCY 'ATSI-P7-1-TE-345-029A' /* X1-027A - BEAVER & BEAVER - HAYES 345 DISCONNECT BRANCH FROM BUS 907060 TO BUS 238569 CKT 1 /* X1-027A_AT12 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238569 CKT 1 /* 02HAYES 345 02BEAVER 345 END

11 Light Load Analysis

Not applicable

12 Short Circuit Analysis

The following Breakers are overdutied:

None.

13 Stability and Reactive Power

(Summary of the VAR requirements based upon the results of the dynamic studies)

To be determined in the Facilities Study Phase.

14 Affected Systems

14.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

14.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

14.3 MISO

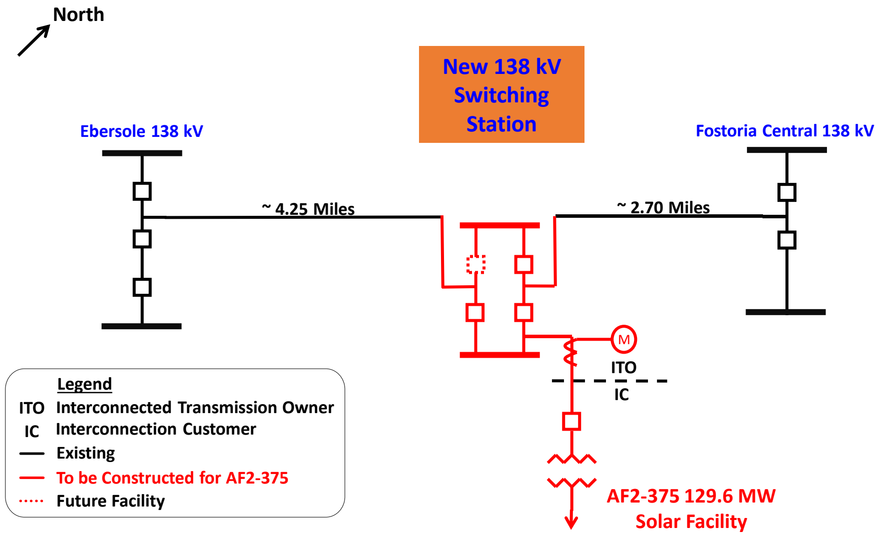
MISO Impacts to be determined during later study phases (as applicable).

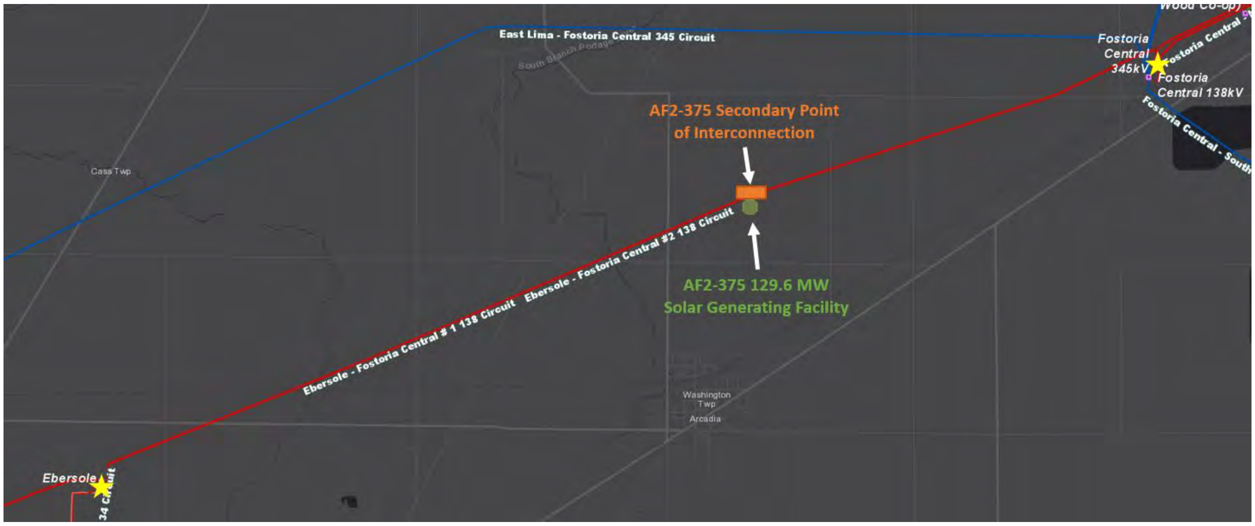
14.4 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

15 Attachment 1: One Line Diagram and Project Site Location

**AF2-375 Point of Interconnection Fostoria Central – Ebersole Circuit #1 138 kV
Single-line Diagram (remote stations not completely shown)**




East Lima - Fostoria Central 345 Circuit
South Branch Portage
Wood Co-op)
Fostoria Central 345kV
Fostoria Central
Fostoria Central 138kV
Fostoria Central - South
AF2-375 Secondary Point of Interconnection
Cass Twp
Ebersole - Fostoria Central #2 138 Circuit
AF2-375 129.6 MW Solar Generating Facility
Ebersole - Fostoria Central # 1 138 Circuit
Washington Twp
Arcadia
Ebersole
34 Circuit

Generation Interconnection

Feasibility Study Report

for

Queue Project AG1-076

FOSTORIA CENTRAL 138 KV

46 MW Capacity / 0 MW Energy

January 2021

Table of Contents

1 Introduction

This Feasibility Study has been prepared in accordance with the PJM Open Access Transmission Tariff, 36.2, as well as the Feasibility Study Agreement between the Interconnection Customer (IC), and PJM Interconnection, LLC (PJM), Transmission Provider (TP). The Interconnected Transmission Owner (ITO) is AEP.

2 Preface

The intent of the feasibility study is to determine a plan, with ballpark cost and construction time estimates, to connect the subject generation to the PJM network at a location specified by the Interconnection Customer. The Interconnection Customer may request the interconnection of generation as a capacity resource or as an energy-only resource. As a requirement for interconnection, the Interconnection Customer may be responsible for the cost of constructing: (1) Direct Connections, which are new facilities and/or facilities upgrades needed to connect the generator to the PJM network, and (2) Network Upgrades, which are facility additions, or upgrades to existing facilities, that are needed to maintain the reliability of the PJM system.

In some instances a generator interconnection may not be responsible for 100% of the identified network upgrade cost because other transmission network uses, e.g. another generation interconnection, may also contribute to the need for the same network reinforcement. Cost allocation rules for network upgrades can be found in PJM Manual 14A, Attachment B. The possibility of sharing the reinforcement costs with other projects may be identified in the feasibility study, but the actual allocation will be deferred until the impact study is performed.

The Interconnection Customer seeking to interconnect a wind or solar generation facility shall maintain meteorological data facilities as well as provide that meteorological data which is required per Schedule H to the Interconnection Service Agreement and Section 8 of Manual 14D.

An Interconnection Customer with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

The Feasibility Study estimates do not include the feasibility, cost, or time required to obtain property rights and permits for construction of the required facilities. The project developer is responsible for the right of way, real estate, and construction permit issues. For properties currently owned by Transmission Owners, the costs may be included in the study.

3 General

The Interconnection Customer (IC) has proposed an uprate to a planned Solar generating facility located in Hancock, Ohio. This project is an increase to the Interconnection Customer's AD1-070 project, which will share the same point of interconnection. The AG1-076 queue position is a 0 MW uprate (46 MW Capacity uprate) to the previous project. The total installed facilities will have a capability of 205 MW with 82 MW of this output being recognized by PJM as Capacity. The proposed in-service date for this uprate project is December 29, 2023. This study does not imply a TO commitment to this in-service date.

Queue Number	**AG1-076**
Project Name	FOSTORIA CENTRAL 138 KV
State	Ohio
County	Hancock
Transmission Owner	AEP
MFO	205
MWE	0
MWC	46
Fuel	Solar
Basecase Study Year	2024

Any new service customers who can feasibly be commercially operable prior to June 1st of the basecase study year are required to request interim deliverability analysis.

4 Point of Interconnection

AG1-076 will interconnect with the AEP transmission system as an uprate to AD1-070 at the Fostoria Central 138 kV substation.

5 Cost Summary

The AG1-076 project will be responsible for the following costs:

Description	**Total Cost**
Total Physical Interconnection Costs	$0
Total System Network Upgrade Costs	$0
Total Costs	$0

This cost excludes a Federal Income Tax Gross Up charges. This tax may or may not be charged based on whether this project meets the eligibility requirements of IRS Notice 2016-36, 2016-25 I.R.B. (6/20/2016). If at a future date it is determined that the Federal Income Tax Gross charge is required, the Transmission Owner shall be reimbursed by the Interconnection Customer for such taxes.

Cost allocations for any System Upgrades will be provided in the System Impact Study Report.

Note: These cost estimates assume that no relaying upgrades are required to accommodate this project. During later study phases, AEP/PJM may determine that relaying upgrades may be required depending on final project schedules for the existing project.

6 Transmission Owner Scope of Work

The total physical interconnection costs is given in the table below:

Description	Total Cost
Total Physical Interconnection Costs	$0

7 Interconnection Customer Requirements

It is understood that the Interconnection Customer (IC) is responsible for all costs associated with this interconnection. The costs above are reimbursable to the Transmission Owner. The cost of the IC's generating plant and the costs for the line connecting the generating plant to the Point of Interconnection are not included in this report; these are assumed to be the IC's responsibility.

The Generation Interconnection Agreement does not in or by itself establish a requirement for the Transmission Owner to provide power for consumption at the developer's facilities. A separate agreement may be reached with the local utility that provides service in the area to ensure that infrastructure is in place to meet this demand and proper metering equipment is installed. It is the responsibility of the developer to contact the local service provider to determine if a local service agreement is required.

1. An Interconnection Customer entering the New Services Queue on or after October 1, 2012 with a proposed new Customer Facility that has a Maximum Facility Output equal to or greater than 100 MW shall install and maintain, at its expense, phasor measurement units (PMUs). See Section 8.5.3 of Appendix 2 to the Interconnection Service Agreement as well as section 4.3 of PJM Manual 14D for additional information.

2. The Interconnection Customer may be required to install and/or pay for metering as necessary to properly track real time output of the facility as well as installing metering which shall be used for billing purposes. See Section 8 of Appendix 2 to the Interconnection Service Agreement as well as Section 4 of PJM Manual 14D for additional information.

8 Revenue Metering and SCADA Requirements

8.1 PJM Requirements

The Interconnection Customer will be required to install equipment necessary to provide Revenue Metering (KWH, KVARH) and real time data (KW, KVAR) for IC's generating Resource. See PJM Manuals M-01 and M-14D, and PJM Tariff Section 8 of Attachment O.

8.2 Meteorological Data Reporting Requirements

The solar generation facility shall provide the Transmission Provider with site-specific meteorological data including:

- Back Panel temperature (Fahrenheit) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Irradiance (Watts/meter2) - (Required for plants with Maximum Facility Output of 3 MW or higher)
- Ambient air temperature (Fahrenheit) - (Accepted, not required)
- Wind speed (meters/second) - (Accepted, not required)
- Wind direction (decimal degrees from true north) - (Accepted, not required)

8.3 Interconnected Transmission Owner Requirements

The IC will be required to comply with all Interconnected Transmission Owner's revenue metering requirements for generation interconnection customers located at the following link:

http://www.pjm.com/planning/design-engineering/to-tech-standards/

9 Summer Peak - Load Flow Analysis

The Queue Project AG1-076 was evaluated as a 0.0 MW (Capacity 46.0 MW) injection tapping the Fostoria Central 138 kV line in the AEP area. Project AG1-076 was evaluated for compliance with applicable reliability planning criteria (PJM, NERC, NERC Regional Reliability Councils, and Transmission Owners). Project AG1-076 was studied with a commercial probability of 53.0 %. Potential network impacts were as follows:

9.1 Generation Deliverability

(Single or N-1 contingencies for the Capacity portion only of the interconnection)

None

9.2 Multiple Facility Contingency

(Double Circuit Tower Line, Fault with a Stuck Breaker, and Bus Fault contingencies for the full energy output)

None

9.3 Contribution to Previously Identified Overloads

(This project contributes to the following contingency overloads, i.e. "Network Impacts", identified for earlier generation or transmission interconnection projects in the PJM Queue)

None

9.4 Potential Congestion due to Local Energy Deliverability

PJM also studied the delivery of the energy portion of this interconnection request. Any problems identified below are likely to result in operational restrictions to the project under study. The developer can proceed with network upgrades to eliminate the operational restriction at their discretion by submitting a Merchant Transmission Interconnection request.

Note: Only the most severely overloaded conditions are listed below. There is no guarantee of full delivery of energy for this project by fixing only the conditions listed in this section. With a Transmission Interconnection Request, a subsequent analysis will be performed which shall study all overload conditions associated with the overloaded element(s) identified.

ID	FROM BUS#	FROM BUS	kV	FROM BUS AREA	TO BUS#	TO BUS	kV	TO BUS AREA	CKT ID	CONT NAME	Type	Rating MVA	PRE PROJECT LOADING %	POST PROJECT LOADING %	AC|DC	MW IMPACT
168087783	242935	05E LIMA	345.0	AEP	242945	05SW LIM	345.0	AEP	1	AEP_P2-1_242939 05MARYSV 345 945620 AF1-227 TAP 345 1-A	operation	971.0	112.79	115.12	DC	22.58
168087900	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	Base Case	operation	1025.0	107.1	108.49	DC	31.41
168087901	242936	05FOSTOR	345.0	AEP	242935	05E LIMA	345.0	AEP	1	AEP_P1-2_#2749_554-A	operation	1318.0	105.91	107.31	DC	40.61
168087788	242984	05CHATFL	138.0	AEP	932050	AC2-015 TAP	138.0	AEP	1	AEP_P1-2_#7105_8900707	operation	167.0	129.03	132.24	DC	11.89
168087762	243006	05FOSTOR	138.0	AEP	939160	AE1-146 TAP	138.0	AEP	2	AEP_P1-2_#7757_11500705-B	operation	204.0	121.52	138.19	DC	34.01
168087862	243006	05FOSTOR	138.0	AEP	960840	AF2-375 TAP	138.0	AEP	1	AEP_P1-2_#7761_20858-B	operation	245.0	104.57	119.01	DC	35.39
168087835	243008	05FREMCT	138.0	AEP	243009	05FRMNT	138.0	AEP	1	PJM_PLANT FREMONT	operation	251.0	116.76	119.18	DC	13.48

168087685	243039	05MELMOR	138.0	AEP	242984	05CHATFL	138.0	AEP	1	AEP_P1-2_#7105_8900707	operation	167.0	165.71	169.19	DC	12.92
168087727	243039	05MELMOR	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#15237	operation	167.0	151.06	154.48	DC	12.65
168087993	247172	05EBERSO	138.0	AEP	243059	05NFINDL	138.0	AEP	1	Base Case	operation	167.0	89.64	102.32	DC	21.19
164232810	907200	AD1-103 TAP	345.0	ATSI	238569	02BEAVER	345.0	ATSI	1	ATSI-P1-2-OEC-345-810	operation	1742.0	101.14	101.75	DC	23.77
169551488	932050	AC2-015 TAP	138.0	AEP	243024	05HOWARD	138.0	AEP	1	AEP_P1-2_#7105_8900707	operation	167.0	162.29	165.5	DC	11.89
169551539	939160	AE1-146 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	2	AEP_P1-2_#7757_11500705-B	operation	204.0	145.54	162.21	DC	34.01
169551541	939160	AE1-146 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	2	Base Case	operation	150.0	102.38	107.87	DC	18.28
169857652	945620	AF1-227 TAP	345.0	AEP	242939	05MARYSV	345.0	AEP	1	Base Case	operation	897.0	108.19	109.18	DC	19.59
169857716	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	AEP_P1-2_#7761_20858-B	operation	245.0	118.47	132.92	DC	35.39
169857718	960840	AF2-375 TAP	138.0	AEP	247172	05EBERSO	138.0	AEP	1	Base Case	operation	167.0	105.96	118.79	DC	21.42

9.5 System Reinforcements

None

9.6 Flow Gate Details

The following indices contain additional information about each facility presented in the body of the report. For each index, a description of the flowgate and its contingency was included for convenience. The intent of the indices is to provide more details on which projects/generators have contributions to the flowgate in question. All New Service Queue Requests, through the end of the Queue under study, that are contributors to a flowgate will be listed in the indices. Please note that there may be contributors that are subsequently queued after the queue under study that are not listed in the indices. Although this information is not used "as is" for cost allocation purposes, it can be used to gage the impact of other projects/generators. It should be noted the project/generator MW contributions presented in the body of the report are Full MW Impact contributions which are also noted in the indices column named "Full MW Impact", whereas the loading percentages reported in the body of the report, take into consideration the PJM Generator Deliverability Test rules such as commercial probability of each project as well as the ramping impact of "Adder" contributions. The MW Impact found and used in the analysis is shown in the indices column named "Gendeliv MW Impact".

9.7 Queue Dependencies

The Queue Projects below are listed in one or more indices for the overloads identified in your report. These projects contribute to the loading of the overloaded facilities identified in your report. The percent overload of a facility and cost allocation you may have towards a particular reinforcement could vary depending on the action of these earlier projects. The status of each project at the time of the analysis is presented in the table. This list may change as earlier projects withdraw or modify their requests.

Queue Number	Project Name	Status
AB1-107	Bayshore-GM Powertrain 138 kV & Lallendorf 345kV	Suspended
AC1-051	Willard-S. Greenwich 69kV	Withdrawn
AC2-015	Chatfield-Howard 138kV	Active
AC2-103	Beaver-Davis Besse 345 kV I	Engineering and Procurement
AD1-070	Fostoria Central 138 kV	Active
AD1-103	Beaver-Davis Besse 345 kV II	Active
AD1-118	Lemoyne	Active
AD2-136	Melmore Tap 138kV	Active
AE1-119	Lemoyne 345 kV	Active
AE1-146	Ebersole #2-Fostoria Central 138 kV	Active
AE2-072	East Leipsic-Richland 138 kV	Active
AE2-174	Seneca 138 kV	Active
AE2-176	Groton 138 kV Solar	Active
AE2-181	Snyder 69kV	Active
AE2-282	East Fayette 138 kV	Active
AF1-063	Lockwood Road 138 kV	Active
AF1-064	Weston 69 kV	Active
AF1-120	East Fayette 2 138 kV	Active
AF1-205	Napolean Muni 138 kV	Active
AF1-206	East Fayette 138 kV	Active
AF1-229	Galion-South Berwick 345 kV	Active
AF2-004	Beaver 345 kV	Active
AF2-005	Beaver 138 kV	Active
AF2-126	Weston 69 kV II	Active
AF2-127	Lockwood Road 138 kV	Active
AF2-321	Stryker-Ridgeville 138 kV	Active
AF2-375	Ebersole-Fostoria 138 kV	Active
AG1-056	Stryker-Ridgeville 138 kV	Active
AG1-076	Fostoria Central 138 kV	Active
AG1-199	Allen Junction 345 kV	Active
AG1-319	Northside 138 kV	Active
AG1-358	Howard-Melmore 138 kV	Active
AG1-425	Groton 138 kV	Active
AG1-500	Beaver 345 kV	Active
AG1-501	Beaver 138 kV	Active
U4-028	Fostoria Central-Greenlawn-Howard 138kV	Suspended
U4-029	Fostoria Central-Greenlawn-Howard 138kV	Suspended
V4-010	Tiffin Center 138kV	Engineering and Procurement

Y1-069	Bay Shore-Fostoria Central 345kV & Bayshore-Monroe 345kV	In Service

9.8 Contingency Descriptions

Contingency Name	Contingency Definition
AEP_P1-2_#7105_8900707	CONTINGENCY 'AEP_P1-2_#7105_8900707' OPEN BRANCH FROM BUS 243024 TO BUS 243039 CKT 1 / 243024 05HOWARD 138 243039 05MELMOR 138 1 END
AEP_P1-2_#7757_11500705-B	CONTINGENCY 'AEP_P1-2_#7757_11500705-B' OPEN BRANCH FROM BUS 960840 TO BUS 247172 CKT 1 / 960840 AF2-375 TAP 138 247172 05EBERSO 138 1 END
ATSI-P1-2-OEC-345-810	CONTINGENCY 'ATSI-P1-2-OEC-345-810' /* LINE 02HAYES TO 02DAV-BE 345 CK 1 DISCONNECT BRANCH FROM BUS 239289 TO BUS 238654 CKT 1 /* 02HAYES 345 02DAV-BE 345 END
AEP_P1-2_#7761_20858-B	CONTINGENCY 'AEP_P1-2_#7761_20858-B' OPEN BRANCH FROM BUS 939160 TO BUS 247172 CKT 2 / 939160 AE1-146 TAP 138 247172 05EBERSO 138 2 END
AEP_P2-1_242939 05MARYSV 345 945620 AF1-227 TAP 345 1-A	CONTINGENCY 'AEP_P2-1_242939 05MARYSV 345 945620 AF1-227 TAP 345 1-A' OPEN BRANCH FROM BUS 242939 TO BUS 945620 CKT 1 END
PJM_PLANT FREMONT	CONTINGENCY 'PJM_PLANT FREMONT' REMOVE MACHINE 1 FROM BUS 238601 REMOVE MACHINE 2 FROM BUS 238602 REMOVE MACHINE 3 FROM BUS 238603 END
AEP_P1-2_#15237	CONTINGENCY 'AEP_P1-2_#15237' OPEN BRANCH FROM BUS 242984 TO BUS 243039 CKT 1 / 242984 05CHATFL 138 243039 05MELMOR 138 1 OPEN BRANCH FROM BUS 242984 TO BUS 245656 CKT 1 / 242984 05CHATFL 138 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 245655 TO BUS 245656 CKT 1 / 245655 05CARROTHR 69.0 245656 05CHATFIEL 69.0 1 OPEN BRANCH FROM BUS 245656 TO BUS 247380 CKT 1 / 245656 05CHATFIEL 69.0 247380 05NEW WASHSS69.0 1 OPEN BRANCH FROM BUS 242984 TO BUS 932050 CKT 1 / 242984 05CHATFL 138 932050 AC2-015 TAP 138 1 OPEN BRANCH FROM BUS 932050 TO BUS 243024 CKT 1 / 932050 AC2-015 TAP 138 243024 05HOWARD 138 1 END

ATSI-P7-1-OEC-345-004_NON	CONTINGENCY 'ATSI-P7-1-OEC-345-004_NON' /* DB - BAVER & DB - HAYES 345 DISCONNECT BRANCH FROM BUS 238654 TO BUS 907200 CKT 1 /* 02DAV-BE 345 AD1-103 345 DISCONNECT BRANCH FROM BUS 907200 TO BUS 238569 CKT 1 /* AD1-103 345 02BEAVER 345 DISCONNECT BRANCH FROM BUS 238654 TO BUS 239289 CKT 1 /* 02DAV-BE 345 02HAYES 345 END
ATSI-P2-3-OEC-345-002	CONTINGENCY 'ATSI-P2-3-OEC-345-002' /* BEAVER 345KV BRK B-121 DISCONNECT BRANCH FROM BUS 238569 TO BUS 239725 CKT 1 /* 02BEAVER 345 02LAKEAVE 345 DISCONNECT BRANCH FROM BUS 238569 TO BUS 238607 CKT 1 /* 02BEAVER 345 02CARLIL 345 END
Base Case	
AEP_P1-2_#2749_554-A	CONTINGENCY 'AEP_P1-2_#2749_554-A' OPEN BRANCH FROM BUS 238745 TO BUS 945640 CKT 1 / 238745 02GALION 345 945640 AF1-229 TAP 345 1 END

10 Short Circuit Analysis

The following Breakers are overdutied

None

11 Affected Systems

11.1 TVA

TVA Impacts to be determined during later study phases (as applicable).

11.2 Duke Energy Progress

Duke Energy Progress Impacts to be determined during later study phases (as applicable).

11.3 MISO

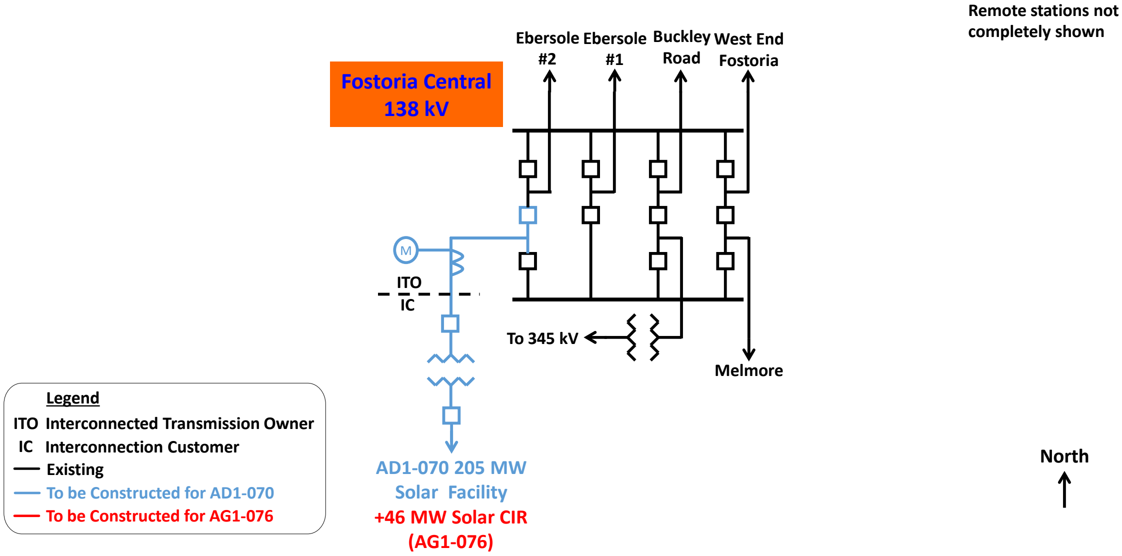
MISO Impacts to be determined during later study phases (as applicable).

11.4 LG&E

LG&E Impacts to be determined during later study phases (as applicable).

12 Attachment 1: One Line Diagram and Project Site Location

AG1-076 Point of Interconnection Fostoria Central 138 kV Circuit Single-line Diagram




Bloom Twp
West Longley
Sunoco Pipeline (Customer Owned)
Amsden
Bendix (Fostoria)
Buckley Road
Arbor Street
North End Fostoria
town
Bloomdale
MENELL MINING (CUST. OWN)
East End Fostoria
Fostoria (Hancock Wood Co-op)
West End Fostoria
Williston Avenue
Bascom Central
Cass Twp
Fostoria Central 345kV
Airco (North Central Co-op)
Ebersole - Fostoria Central #2 138 Circuit
Washington Twp
Ebersole
AD1-070 and AG1-076 Point of Interconnection
Howard
Loudon Twp
Northeast Findlay
Fostoria Central - South Berwick 345 Circuit
Landmark (Hancock Wood Co-op)
ers
stwood
Marion (Hancock Wood Co-op)
New R
AG1-076 46 MW CIR Uprate
Biglick Twp
dlay
UST.)
FINDLAY RESERVOIR#2

APPENDIX I

ECONOMIC IMPACT STUDY

Economic Impacts of the South Branch Solar Project

Gilbert Michaud, David Jenkins, Michael J. Zimmer

June 2021

Prepared by

OHIO UNIVERSITY
VOINOVICH SCHOOL
OF LEADERSHIP AND PUBLIC AFFAIRS

About the Voinovich School

Ohio University's Voinovich School of Leadership and Public Affairs develops public-private partnerships for regional, state, and national collective impact in the areas of economic development and entrepreneurship, energy and the environment, public service, and social innovation. The School is a leader in addressing rural and state issues of national importance. By blending real-world problem solving and government, nonprofit sector, and industry partnerships with education, students are offered unique learning opportunities as they advance and prepare for careers serving the public interest. For additional information, visit www.ohio.edu/voinovich-school.

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Table of Contents

Figures and Tables

Abbreviations

AC — Alternating Current
EIA — Economic Impact Analysis
FTE — Full-Time Equivalents
GDP — Gross Domestic Product
GW — Gigawatt
IMPLAN — IMpact Analysis for PLANning (economic modeling software)
IO — Input-Output
JEDI — Jobs and Economic Development Impact
kW — Kilowatt
MW — Megawatt
NREL — National Renewable Energy Laboratory
O&M — Operation and Maintenance
OPSB — Ohio Power Siting Board
ORC — Ohio Revised Code
PV — Photovoltaic
SB — Senate Bill
U.S. — United States

Executive Summary

This study represents a multi-phase economic impact analysis for the proposed **South Branch Solar project**, as conducted by Ohio University's Voinovich School of Leadership and Public Affairs. In 2021, our research team[1] learned that South Branch Solar, LLC (South Branch Solar) had an interest in developing its South Branch Solar project (the Project) in Hancock County, Ohio, at a total installed capacity of up to **205 megawatts (MW-AC)**. In order to support the developer's application to the Ohio Power Siting Board (OPSB) for the Project, as well as related outreach efforts, our team conducted this economic impact analysis.

Key findings from our research indicated that, at 205 MW-AC, the Project would bring considerable economic impacts to Ohio, including **1,072 total construction phase jobs** (over the course of 12–18 months), and an **annual 21 operations and maintenance (O&M) phase jobs** (over the course of roughly 30–40 years), assuming 80% Ohio-based labor, and 30% Ohio-based materials. We also found that for every 1 job directly supported in the construction of the Project, an additional 1.54 jobs are supported in the state, with that same figure being 1.33 additional jobs in the O&M phase. Overall, we note that these figures represent conservative economic impact estimates, as increasing the percentage of Ohio-based labor and materials would further increase the positive economic impact.

The Project would bring **$179 million of total economic impacts in the construction phase** to Ohio, under the analyzed scenario. We next calculated the Project's **annual O&M phase impact at $7.1 million** in our estimate. Finally, we determined that Hancock County would receive between **$1.435 and $1.845 million in annual tax revenues** from South Branch Solar through the Payment in Lieu of Taxes (PILOT) agreement, depending on the service payment required by any potential resolution passed by the Board of County Commissioners, much of which would go to local school districts.

Suggested citation: Michaud, G., Jenkins, D., & Zimmer, M. J. (2021). *Economic Impacts of the South Branch Solar Project*. Ohio University's Voinovich School of Leadership and Public Affairs.

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[1] See biographies in the Appendix.

1. Introduction to the Study

Changes in consumer preferences, continued cost declines, and policy incentives have spurred the acceleration of the utility-scale solar energy industry in the United States (U.S.) in recent years.[2] The State of Ohio, in particular, has one operational utility-scale solar facility (Hardin I, in Hardin County, at 150 megawatts (MW)) at the time of this writing, and 12 additional projects, ranging from 65 to 300 MW, that have been approved by the Ohio Power Siting Board (OPSB) since the beginning of 2018.[3] At least 25 additional projects, sized 50 MW or larger, are categorized as pending cases via the OPSB, and, in total (between both approved and pending), represent nearly 4,500 MW (or 4.5 gigawatts (GW)) of generation capacity potentially coming on-line in the state.[4] This represents a noticeable increase in Ohio's solar energy capacity, which, until recently, has largely been smaller-scale distributed solar (i.e., small rooftop or ground-mounted arrays on homes and small businesses).[5]

South Branch Solar is interested in constructing an up to 205 MW-AC solar energy project in Hancock County, Ohio[6], known as the South Branch Solar project (the Project), in the coming years, and would like to better comprehend the economic impacts that it would bring to the region and state. These economic data will provide South Branch Solar and other parties with quantitative metrics to utilize in the OPSB regulatory and approval process, marketing and outreach, and related efforts. Overall, investigating these impacts of the Project helps to provide a clearer understanding of its economic potential, especially as Ohio continues to look for ways to enhance sustainable and diversification efforts for the economy.

The following sections of this report detail our methods for analyzing these economic impacts and the results of our calculations. In particular, our results focus on the direct, indirect, and induced economic impacts during both the construction and operation and maintenance (O&M) phases of the Project, and we conclude with synthesizing implications of this potential Project for the State of Ohio.

2. South Branch Solar Economic Impact Analysis

2.1. Overview

Economic impact analysis (EIA) is a frequently used research approach to better understand the effect of an event or industry, such as the exogenous shock from the new construction of a large solar energy project, to local and state economies. Such analyses fundamentally use input-output (IO) methods to re-create inter-industry linkages and calculate the impact on an economy. In this report, we calculated the economic impacts from the projected build-out of the up to 205 MW-AC Project in Hancock County, Ohio. These impacts were calculated using traditional EIA methods, with data provided by South Branch Solar, including Project size, location, and payroll parameters.

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[2] Solar Energy Industries Association. (2021). *Solar industry research data*. Retrieved from https://www.seia.org/solar-industry-research-data.

[3] Ohio Power Siting Board. (2020). *Solar farm map and statistics*. Retrieved from https://puco.ohio.gov/wps/portal/gov/puco/utilities/electricity/service-area-map/solarfarmmapandstatistics.

[4] Ibid. The total figure, as of May 28, 2021, is 4,451.90 MW, or almost 4.5 GW. The OPSB, originally known as the Ohio Power Siting Commission, was created in 1972. The authority of the Board is outlined in Ohio Revised Code (ORC) Chapter 4906.

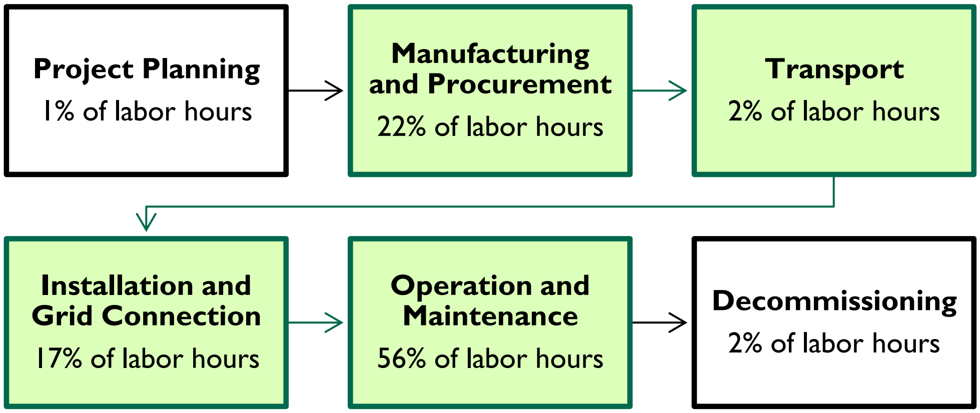
[5] Solar Energy Industries Association. (2020). *Ohio solar*. Retrieved from https://www.seia.org/state-solar-policy/ohio-solar.

[6] See: https://www.co.hancock.oh.us/.

To conduct this analysis, the research team used the National Renewable Energy Laboratory's (NREL) Jobs and Economic Development Impact (JEDI) tool, which is well known and regarded for estimating the economic impacts of different types of power generation facilities. Here, we used JEDI to estimate the projected effects of an exogenous increase in demand that would result from new economic activity in a region (i.e., the Project), in terms of employment, labor income, value added (i.e., increase in the study area's gross domestic product, or GDP), and total output (i.e., the total economic impact to the region/state). The research team used NREL's solar photovoltaic (PV) system cost benchmark data and other cost/modeling inputs specific to Ohio, as described in Section 2.2. Ultimately, our analysis provides an estimate of the overall economic impacts by project phase (i.e., construction, and then O&M).

Below, Figure 1 first illustrates the traditional development process for a utility-scale solar energy project. The focus of our analysis is the economic impact of the manufacturing, construction, and O&M phases of the Project, which (according to the figure) includes the manufacturing and procurement, transport, installation and grid connection, and O&M phase, of the Project (as highlighted in green). The economic impacts modeled in this study do *not* cover the planning and decommissioning phases of the Project (which is only about 3% of the total labor hours).

Figure 1. Utility-Scale Solar Project Development Process



Note. Figure adapted from the International Renewable Energy Agency (IRENA).[7]

Modeling the economic impacts of the Project requires us to examine three discernible types of effects. An exogenous increase in economic activity in any given geographic area creates a ripple effect in the economy of that area. In this case, the proposed 205 MW-AC Project in Hancock County is going to require several manufacturing, construction, and O&M jobs. These jobs, and their associated compensation and output, are what we refer to as the ***direct effect***. Beyond this initial effect, there will also be an increase in the demand for intermediate goods needed in the manufacturing, construction, and maintenance of this Project, which is what we call the ***indirect effect***. Finally, the additional income of workers within the construction and manufacturing industries is going to lead to added economic activity in terms of buying goods and services (e.g., at grocery stores, local restaurants, etc.), which, in turn, creates new economic activity in a region. In essence, individuals' spending will induce more spending. We call this last wave of impacts the ***induced effect***. The total economic impact of the Project is the sum of direct, indirect, and induced effects, as displayed in Figure 2.

---

[7] International Renewable Energy Agency (IRENA). (2017). *Renewable energy benefits: Leveraging local capacity for solar PV*. Retrieved from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/Jun/IRENA_Leveraging_for_Solar_PV_2017.pdf.

Figure 2. The Total Economic Impact of Utility-Scale Solar

Note. Figure developed by authors.

Beyond the direct, indirect, and induced effects, Table 1 offers a list of additional economic impact analysis terminology that is used in this report.

Table 1. Economic Impact Analysis Variables and Definitions

Variable	Definition
Employment	Employment refers to an industry-specific mix of full-time, part-time, and seasonal jobs. Expressed as full-time equivalents (FTE).
Labor Income	Labor income refers to all forms of employment income, including employee compensation (i.e., wages, salaries, and benefits) and proprietor income.
Value Added	Value added is the difference between an industry's total output and the cost of its intermediate inputs; it is a measure of the contribution to gross domestic product (GDP).
Output	Output is the value of production by industry in a calendar year. It can also be described as annual revenues plus net inventory change. It is often referred to as "total economic impact."
Multipliers	Multipliers describe how, for a given change in a particular industry, a resulting change will occur in the overall economy. For instance, employment multipliers describe the total jobs generated as a result of 1 job in the target industry.

2.2. Methods and Inputs

The NREL JEDI models are tools that allow researchers to calculate the economic impacts of constructing and operating power generation facilities.[8] NREL has developed JEDI models specific to various generation assets, including, but not limited to, biofuels, coal, hydro, natural gas plants, and wind energy. For this study, we utilized the solar PV JEDI model as the central tool to estimate the economic impacts of the Project.

Because the solar PV JEDI model is no longer regularly updated by NREL, we updated the model to include 2019 multipliers from IMpact Analysis for PLANning (IMPLAN), as well as 2020 NREL benchmark costs, representing the most recent data available for each. The model default values for project costs in JEDI were specifically updated from cost inputs from the NREL report entitled, "U.S. Solar Photovoltaic System and Energy Storage Cost Benchmark: Q1 2020." We assume that the Project will employ one-axis tracker technology.

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[8] National Renewable Energy Laboratory. (2021). *JEDI: Jobs & economic development impact models*. Retrieved from https://www.nrel.gov/analysis/jedi/.

The aforementioned NREL report includes cost benchmarks by category (e.g., module, inverter, etc.) for 5 MW, 10 MW, 50 MW, and 100 MW project sizes. We ran a series of non-linear regressions of costs on project size to determine the different inputs for the higher MW sized Project (i.e., South Branch), acknowledging the condition of economies of scale for mounting, electrical, installation, permitting, and business overhead. However, the differences across project sizes were negligible, and, thus, we opted to use the NREL 100 MW cost inputs for our calculations, despite the Project's up to 205 MW capacity. Below, Table 2 presents the researcher-updated cost inputs used in this study.

Table 2. JEDI Model Cost Inputs

Installation Costs (per watt)	205 MW-AC
Materials & Equipment	
Mounting	$0.12
Modules	$0.41
Electrical	$0.07
Inverter	$0.05
Labor	
Installation	$0.11
Other Costs	
Permitting	$0.0002
Other Costs	$0.12
Business Overhead	$0.13
Total	**$1.01**

Once we updated the cost defaults in our JEDI model, we proceeded to calculate the economic impacts by Project phase. We used payroll parameter estimates provided by the South Branch Solar. JEDI further requires assumptions on what products are locally manufactured, as well as what percentage of materials and labor are purchased locally. In this study, we assume 80% of the labor is from Ohio,[9] and 30% of the materials are from Ohio,[10] for both construction and O&M phases. We also assume that "other costs" (i.e., architectural, office services, and permitting costs) are spent locally at the rate of 80%. To model the O&M impacts of the Project, we use the NREL $14 per kilowatt (kW) per year estimate for O&M expenses, where 60% of that estimate goes towards labor and 40% towards material and equipment.

2.3. Economic Impacts by Project Phase

For the expenses and local spending as a result of the construction and O&M of the Project, we assume that 80% of the labor originates in Ohio, given that the property tax exemption only applies to projects where 80% of employees during the construction phase are Ohio-domiciled.[11] Table 3 presents the one-time, construction phase economic impacts of the Project. As shown, this Project would support 1,072 total construction phase jobs in Ohio and generate a one-time total economic impact to Ohio of over $179 million.

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[9] A requirement to enter Ohio's Payment in Lieu of Taxes (PILOT) agreement.

[10] A common assumption employed in prior studies, both through calculations of available market-based materials in Ohio, as well as developer estimates. For example, see: Michaud, G., Khalaf, C., Zimmer, M., & Jenkins, D. (2020). *Measuring the economic impacts of utility-scale solar in Ohio*. Retrieved from https://www.ohio.edu/voinovich-school/news-resources/reports-publications/utility-scale-solar.

[11] See: Bricker & Eckler. (2011). *Ohio General Assembly reforms renewable and advanced energy tax policy*. Retrieved from http://www.bricker.com/documents/publications/2223.pdf.

Table 3. Construction Phase Economic Impacts to Ohio of the South Branch Solar Project

	Employment	Labor Income	Value Added	Total Economic Impact
Direct Effect	422	$31,261,900	$34,532,200	$38,564,700
Indirect Effect	397	$27,446,200	$47,321,900	$98,553,500
Induced Effect	253	$14,004,300	$24,412,400	$41,937,900
Total Effect	**1,072**	**$72,712,400**	**$106,266,500**	**$179,056,100**
Multiplier	**2.54**	**2.33**	**3.08**	**4.64**

Note. Values may not perfectly sum due to rounding.

Next, Table 4 presents the *annual* O&M phase economic impacts of the Project. Each year, the Project will support 21 total jobs in Ohio and generate a total economic impact of over $7 million. Because these are annual values, the figures can be multiplied by the assumed life of the solar energy system (often 30–40 years) to determine the comprehensive impacts during the Project's operational life.[12]

Table 4. O&M Phase Economic Impacts to Ohio of the South Branch Solar Project

	Employment	Labor Income	Value Added	Total Economic Impact
Direct Effect	9	$1,279,400	$2,109,400	$4,457,900
Indirect Effect	7	$521,300	$859,500	$1,816,400
Induced Effect	5	$277,100	$483,200	$830,000
Total Effect	**21**	**$2,077,900**	**$3,452,100**	**$7,104,300**
Multiplier	**2.33**	**1.62**	**1.64**	**1.59**

Note. Values may not perfectly sum due to rounding.

Compared to other power generation assets, solar energy facilities have relatively lower O&M requirements. Regular maintenance such as inverter servicing, ground-keeping, module cleaning, or site security is relatively easy, and can be performed by the owner or local contractors. The monitoring of facility performance can be achieved remotely by the original equipment manufacturer or another asset manager.[13] We want to reiterate that facility decommissioning is *not* analyzed in this study, but it is likely additive and will increase the economic benefits of the Project, meaning that our calculations represent conservative estimates.

---

[12] Put another way, at an assumed 40-year lifespan of the Project, the comprehensive O&M-related economic impacts of the Project would sum to over $284 million.

[13] International Finance Corporation. (2015). *Utility-scale solar photovoltaic power plants*. Retrieved from https://www.ifc.org/wps/wcm/connect/f05d3e00498e0841bb6fbbe54d141794/IFC+olar+eport_Web+08pdf?MOD=AJPERES.

3. Tax Impacts

Ohio's exemption on tangible personal property and real property of certain qualified energy projects was enacted with the passing of Ohio Senate Bill (SB) 232 in 2010.[14] This provision exempts qualified energy projects, as certified by the Director of Development Services, using renewable energy resources (such as solar PV) from taxation. To qualify for the exemption, the owner or lessee must submit an application to the OPSB by December 31, 2022, and the construction of the energy facility must begin before January 1, 2023.[15] For a qualified energy project with a nameplate capacity of 20 MW or greater, a Board of County Commissioners (the Board) of an Ohio county (in the case of the Project, Hancock County), if the county has not been declared an alternative energy zone, has to approve the application to exempt the property located in that county from taxation. The tangible personal property of the qualified energy project is exempt from taxation for all ensuing tax years if the property was placed into service before January 1, 2024. The Board may then require a service payment to be made in addition to the $7,000 per MW of nameplate capacity service payment required in lieu of property taxes. The sum of the service payments shall not exceed $9,000 per MW of nameplate capacity located in the county.[16] The Board shall specify the time and manner in which the payment(s) required by the resolution shall be paid to the county treasurer. The director certifies an energy project after the Board of County Commissioners of the county in which the project is located has adopted a resolution approving the application.

Given the above, the up to 205 MW-AC Project will result in annual tax revenues paid to Hancock County between $1.435 and $1.845 million, depending on the service payment required by any potential resolution passed by the Board.[17] Taken together, this tax revenue will benefit local schools, health systems, senior citizens, and many other aspects in the communities of Hancock County, Ohio. Traditionally, in Ohio, most of these dollars go to school districts, as, statewide, roughly two-thirds of paid property taxes collected by counties are distributed to schools.[18] As such, out of the tax revenues gained from the Project, we anticipate that between $957,000 and $1.23 million would go to public school districts in Hancock County (calculated as two-thirds of the lower and upper limits for the PILOT).

4. Conclusions

This study's aim was to better comprehend the key economic impacts for the proposed up to 205 MW-AC South Branch Solar project in Hancock County, Ohio. Across our modeling and research tasks, we found a multitude of positive economic benefits that the Project would bring, such as the projected $1.435 million to $1.845 million of annual tax revenues to Hancock County. Our economic impact modeling shows that the Project would support 1,072 construction jobs in the state, and 21 O&M jobs. We also calculated $179 million of

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[14] Ohio Revised Code. (2019). *5727.75 Exemption on tangible personal property and real property of certain qualified energy projects*. Retrieved from http://codes.ohio.gov/orc/5727.75.

[15] Ibid.

[16] Ibid.

[17] Our analysis assumes that South Branch Solar will enter into the PILOT agreement, which will abate real property and tangible personal property taxes and replace them with the payments as depicted above. We use the projected installed capacity of 205 MW-AC, and multiply by $7,000/MW as our lower bound, and $9,000/MW as our upper bound.

[18] County Commissioners Association of Ohio. (2014). *Chapter 14: Local property taxes*. Retrieved from http://www.ccao.org/wp-content/uploads/HBKCHAP014%2010-2-14.pdf.

one-time construction phase economic impacts to the state, and an annual $7.1 million O&M phase impact, with the potential to reach $366 million and $8.9 million, respectively, if all labor and materials were from Ohio.

Broadly, the continued build-out of utility-scale solar in Ohio is continuing to promote economic growth, diversification, durable job creation, new economic clusters, and stable income generation across the state. Moreover, advancing a clean energy economy in Ohio may help attract additional businesses to the state. The state's growing solar industry is an increasingly important factor in corporate location or expansion decisions, procurement planning, foreign investment, and particularly for facilities like research laboratories, data centers, server farms, warehouse and logistics, government and community facilities, and our military. Finally, these large solar energy facilities may be a strategy to replace historical generation from coal and nuclear that have reached the end of their useful lives.

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Appendix: Research Team Biographies

Gilbert Michaud, Assistant Professor of Practice, Ohio University (Principal Investigator)

Gilbert Michaud, Ph.D. is an Assistant Professor of Practice at the Voinovich School of Leadership and Public Affairs at Ohio University. His applied research portfolio focuses on renewable energy policy, electric utilities, state politics, and economic and workforce development. Dr. Michaud also serves as a Faculty Affiliate at the Gerald R. Ford School of Public Policy at the University of Michigan, and as a Senior Research Fellow at Global Law Initiatives for Sustainable Development (gLAWcal).

Previously, Michaud served as principal investigator on an American Electric Power (AEP) grant project to evaluate the economic impacts of solar energy deployment in Ohio. Other funded research activities have included economic impact studies for utility-scale solar developers, an Ohio energy job trends report, and many other projects funded by the U.S. Department of Energy, U.S. Small Business Administration, and U.S. Economic Development Administration. For his applied research portfolio, Dr. Michaud was awarded a faculty sustainability research award from Ohio University's Office of Sustainability, as well as a Midwest Energy News 40 Under 40 award, both in 2018. In 2019, he won the "Best Article of the Year" award from the Association of Energy Engineers (AEE) for his paper: "Non-Utility Photovoltaic Deployment: Evaluation of U.S. State-Level Policy Drivers." In 2020, he was given the annual "Leadership in Sustainability Award" by the Mid-Ohio Regional Planning Commission (MORPC).

Michaud has published numerous academic articles in journals such as the *International Journal of Energy Research*, *Journal of Environmental Planning and Management*, *The Electricity Journal*, *Renewable Energy Focus*, and *Regional Science Policy & Practice*, among many other scholarly venues. He is author or co-author of roughly 80 technical, white paper reports and commentary articles, including ones for Solar United Neighbors, the Virginia Department of Environmental Quality, and Appalachian Partnership, Inc., and has been quoted in several national news media outlets, including NPR, Forbes, and Bloomberg Law. He serves as an advisory board member for both Solar United Neighbors of Ohio and Virginia, as well as the national policy chair for the American Solar Energy Society. Dr. Michaud has also served as a guest editor for a special issue of *Solar Energy* journal focused on solar policy and economics for climate action.

Prior to his academic career, Dr. Michaud worked as an economics content author for Sapling Learning, Inc., as well as the lead researcher for the Energy & Power segment of U.S. Business Executive Journal. He holds a Ph.D. in Public Policy & Administration from the L. Douglas Wilder School of Government and Public Affairs at Virginia Commonwealth University (VCU), as well as a certificate in Data Analytics from Cornell University.

David Jenkins, Research Associate, Ohio University

David Jenkins is a Research Associate at the Voinovich School of Leadership and Public Affairs at Ohio University. In this role, he focuses on energy policy and economic development studies, largely related to renewable energy, climate, and sustainability. Previously, he conducted research on public health data and program evaluation, as well as ecological and environmental modeling and research for The U.S. Army Corps of Engineers. He holds a bachelor's degree in Applied Mathematics from the University of Akron, and a master's degree in Ecology and Evolutionary Biology from Ohio University.

Michael Zimmer, Executive-in-Residence, Ohio University

Michael Zimmer, J.D. works with the Voinovich School of Leadership and Public Affairs at Ohio University on a wide range of energy and water issues. A longtime attorney based in Washington, D.C., he is a national expert on energy policy, corporate sustainability, clean tech transactions, and finance. Zimmer has been at the forefront of public policy changes since serving as Vice President and Assistant General Counsel of the American Gas Association to the National Energy Plan and advanced natural gas technologies and liquefied natural gas in the late 1970s. He led the American Bar Association's (ABA) Renewables and Distributed Energy Committee from 2008 to 2010, and led the ABA Energy and Environmental Markets and Finance Committee from 2010 to 2012. Zimmer has been educated at Providence College and University of Baltimore School of Law, and has attended courses at Brown University and the Northwestern Kellogg School of Business.

APPENDIX J

COMPLAINT RESOLUTION PLAN

south branch solar

Complaint Resolution Plan

South Branch Solar
Hancock County, Ohio

July 2021

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1. Introduction

South Branch Solar, LLC (South Branch) is proposing to construct an up to 205-megawatt solar energy generating facility known as the South Branch Solar project (the Project) on approximately 1,000 acres in Washington Township, Hancock County, Ohio (the Project Area). South Branch plans to develop, own, and operate the Project for its useable life. As such, South Branch intends to be a good neighbor in the local community. South Branch will keep the community informed of Project updates and will address comments, concerns or questions from the local public during all phases of the Project. This Complaint Resolution Plan establishes a process for community engagement and receiving, investigating, and addressing complaints.

2. Community Engagement

Throughout the development process, South Branch has interacted with multiple landowners, including those within and neighboring the Project Area, as well as local officials and community organizations.

As part of the Ohio Power Siting Board (OPSB) permitting process, a public hearing will be held to obtain on-the-record comments regarding the Project. South Branch held a public information meeting on June 24, 2021, to provide Project-specific information and answer questions from the community.

To keep the public informed about the Project, South Branch has developed a Project website (www.southbranchsolar.com). The website provides Project-specific information, including contact information, frequently asked questions and an outline of the OPSB permitting process, including information about opportunities for public involvement. The Project website will be continuously updated and will act as an up-to-date public source of information for all interested parties. A copy of this Complaint Resolution Plan will be posted to the website.

In addition, South Branch will name a construction manager and/or community liaison for the Project who will serve as a central point of contact for issues management during construction. That person will work with the construction team and construction contractor to promptly address and keep a log of all community-related issues. Visible signage listing the Project-specific phone number and email address for this contact person will be posted at the construction entrance to the Project site.

In addition, the Project contact person will identify a specific local expert to address matters related to drain tiles in order to provide a focused and rapid evaluation of potential issues and efficiently develop a response plan.

3. Complaint Resolution

The complaint resolution process, outlined below, can be used to address public questions, concerns or complaints during all phases of the Project.

3.1 COMPLAINT FILING PROCESS

There are several ways in which an individual can file a complaint, including:

- By phone, using the Project-specific phone number identified for use during the construction and operations and maintenance (O&M) phases. Once established, these phone numbers will be provided to local officials, posted on signage at the Project entrance, and reflected on the Project website.
- In person, by visiting the temporary construction office onsite during the construction phase, or the permanent O&M facility during normal business hours. Complaints can be filed with the construction manager or O&M staff.
- In writing, by filing a written complaint to the local construction office or O&M facility.
- Electronically, using a dedicated Project email account provided on the Project website, correspondence, and on signage.

In order to accurately and thoroughly address a complaint, the following information should be provided with the complaint:

- Name of complainant;
- Date the complaint was filed;
- Contact information of the complainant; and
- Detailed information about the complaint including, if possible, the location, date, and time the issue occurred, and any other details that may help identify and evaluate the issue.

3.2 COMPLAINT REVIEW PROCESS

In coordination with the complainant, South Branch will work to address complaints effectively and efficiently such that both parties are satisfied. Upon receipt of a complaint, South Branch staff will evaluate whether the complaint relates to a particularly urgent issue, such as a claim that drain tiles are affected. All complaints received will be logged and, depending upon the nature of the complaint, one of two procedures will be followed, as outlined below. The complaint logbook will include any available pertinent information on the complaint, including the complainant's name, the date the complaint was received, the nature of the complaint, actions/resolutions taken to address the complaint, and the date that the matter was resolved. South Branch will provide a copy of the logbook entries to OPSB Staff on a quarterly basis throughout Project construction and the first 5 years of operation.

3.2.1 Drain Tile Complaints

Drain tile complaints will be logged and the specific location (to the extent able to be identified) will be noted on Project mapping. As each related issue is investigated, locations will be refined and maintained on mapping, along with other related information, in order to track concerns, identify potential properties along the path of flow in order in order to monitor, and anticipate future issues, as appropriate. Drain tile complaints will be directed to the Project's designated local expert for such issues, and action will be taken promptly to assess root causes and undertake to remedy them as quickly as possible. Action may include field investigation and/or other actions to determine the extent to which the Project may have contributed to a particular issue and to identify appropriate actions to address related issues. This rapid response approach acknowledges that addressing drainage concerns quickly can identify whether actions are necessary in order to avoid the potential for broader impacts or issues.

Following the initial response, a plan that includes an appropriate timeline will be developed to address the complaint, as appropriate.

3.2.2 Other Complaints

Other complaints will also be logged. The need for incorporation into Project mapping will depend upon the nature of the complaint. South Branch will follow up on all other received complaints within two business days, excluding holidays. If a complaint is received during the construction phase, the construction manager or community liaison will be responsible for initiating review. If a complaint is filed during the operations phase, O&M staff or the community liaison will be responsible for initiating review. The first step to addressing a complaint is determining whether there was violation of federal, state, local laws or permit conditions. South Branch also will determine whether outside resources are necessary for proper response.

South Branch is committed to resolving complaints within 30 days of receipt, unless extenuating circumstances require a longer time, or it is determined that the complaint is unresolvable. If complaint resolution lasts longer than 30 days, South Branch will communicate with the complainant, providing an explanation for the extended time and a timeline for addressing the complaint.

4. Notifications

At least seven days prior to the start of Project construction, and at least seven days prior to the start of Project operation, South Branch will provide a notice of the upcoming activities to property owners and tenants within and adjacent to the Project Area, government officials, and emergency responders. The notices will be sent via mail and will provide information about the Project, including contact information, and a copy of the final Complaint Resolution Plan. The pre-construction notice will include a timeframe for Project construction and a planned schedule for post-construction restoration activities. The pre-operation notice will contain a timeframe for the start of Project operation.

APPENDIX K

TRANSPORTATION MANAGEMENT PLAN

south branch solar

Transportation Management Plan

South Branch Solar
Hancock County, Ohio

July 2021

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Figure

Tables

Attachment

1. Introduction

South Branch Solar, LLC (South Branch) is planning development of South Branch Solar, an up to 205-megawatt utility-scale solar electric generating facility (the Project). The Project will include solar panel arrays along with associated infrastructure such as access roads, fencing, underground and aboveground electric collector lines, inverters, substations, an operations and maintenance (O&M) building, five weather stations, and temporary laydown yards for use during construction. The Project is proposed in Hancock County within approximately 1,000 acres of property (the Project Area) as shown in Figure 1.

Access to the Project Area will be use state, county, and township roads, as well as new on-site private gravel access roads. This evaluation identifies the public routes that could be used for delivery of equipment and travel of workers to the Project Area during the construction period. During operation, only minimal traffic is expected to be generated by the Project.

South Branch is and will continue to coordinate with the Hancock County Engineer to plan construction routes and develop a Road Use Maintenance Agreement (RUMA) prior to Project construction. Details regarding specific routes and deliveries, as well as the status of road conditions and other uses (e.g., school bus routes and timing) will be considered to reduce potential impact on the surrounding community to the greatest extent possible.

2. Methodology

For the purposes of this evaluation, it is assumed that Interstate, four-lane state highways, and two-lane state highways are sufficient to accommodate the construction traffic associated with the Project with respect to load capacity, geometry, and condition; therefore, specific evaluations were not undertaken.

For the county and township roads, a desktop study was undertaken to identify potential travel corridors and to assess their characteristics. A preliminary site reconnaissance was also undertaken to ground truth conditions, particularly with regards to road condition, potential vertical clearance, weight restriction, and geometry issues. A pavement index survey was not completed, and videos were not taken. A detailed roadway capacity analysis was not completed for this study. As design progresses, it is assumed that additional details will be the subject of a Road Use Management Agreement (RUMA) entered into between South Branch and applicable jurisdictions.

3. Transportation Management Plan

Project construction is anticipated to occur over a period of approximately 16 months. Over this period, work will be phased across the Project Area, with deliveries occurring as various activities are required and/or completed.

3.1 VEHICLE TYPES AND CHARACTERISTICS

The size and types of vehicles needed to deliver construction equipment, construction materials, and Project components include flatbed or tractor-trailer equipment delivery vehicles (AASHTO WB-50) and multi-axle dump trucks. Construction equipment such as excavators, bulldozers, and wheel tractor-scrapers will be transported to the Project Area on fixed-bed or tractor-semi-trailer low-boy vehicles. Most vehicles will be below the maximum allowable size and weight. Some limited components, such as switchgear or transformers for substation or switchyard construction may require the use of overweight/oversized vehicles.

In addition, typical automobiles and pickup trucks will be used to transport construction workers and for incidental truck trips.

To deliver the construction equipment, materials, and construction workers during the construction of the Project, the routes selected for use will experience increased vehicle traffic. While exact needs will not be known until final design and contractor selection, similarly sized solar energy facilities have reflected estimated daily construction traffic on the order of 4,000 to 8,000 vehicles. Traffic will be reviewed with the County Engineer prior to construction, as appropriate measures are incorporated into construction to minimize effect on local roadways and the community.

The highest traffic volume will occur during peak construction periods, when the rack foundation posts, racking, and module assembly are taking place in parallel. Oversize and overweight loads are only expected for certain substation and switchyard components.

3.2 SURROUNDING ROADWAY NETWORK

The Project is surrounded by a strong transportation network that includes Interstate 75 (I-75) to the west; State Route (SR) 613 to the north, which extends from I-75 to Fostoria; SR 330 to the east; and SR 12 that extends through the southern portion of the Project Area. While it is possible for the construction equipment, concrete, aggregate, supplies, and general construction traffic to approach the Project Area from multiple directions, it is expected that the concentrated traffic will travel these main roads. From these roads, local roads (state, county, and township) will be used to access the Project Area. The following roads were identified with the potential for use for construction access or other Project-related support:

- SR 12 (Fremont Street)
- County Route (CR) 109
- CR 216
- Township Road (TR) 218
- TR 226/CR 226
- TR 243
- TR 254
- TR 256
- TR 257
- CR 257

Table 1 provides a summary of roadway characteristics for the identified state, county, and township roads. The Ohio Department of Transportation (ODOT) Traffic Monitoring Management System (TMMS) was reviewed to determine if existing data on traffic volumes (Annual Average Daily Traffic, or AADT) for the routes considered was available; it is provided in Table 1, where available.

Road conditions were based on observations made during a field reconnaissance on April 9, 2021, and use the following metrics:

- Excellent = recently paved;
- Good = pavement appears stable with minor cracking;
- Fair = pavement appears stable but may have a higher amount of cracking, especially at the pavement edge, and potholes may be present; and
- Poor = pavement is severely distressed with excessive cracks, potholes, rutting, and deterioration.

Photographs of each road, as indicated in Table 1, are provided in Attachment A. Table 2 provides information on bridges noted for the assessed roads in the Project's immediate vicinity, as provided on *https://bridgereports.com/oh/hancock/exhibit*.

Table 1 – Road Characteristics

Road	From	To	Photo(s)	General Pavement Condition[1]	Surface Type[1]	Speed Limit	Concern	Traffic Count[2]
State Route 12	CR 254	CR 257	22, 24 & 25	Good to fair	Asphalt	Varies from 25 to 55 mph	None	7,330
Country Route 109	CR 243	CR 257	5, 6, 7, 19 & 20	Good to fair	Asphalt	No signs	None	893
County Route 216	SR 12	CR 257	23 & 26	Fair to poor	Asphalt	Varies from 25 to 55 mph	None	768
Township Road 218	CR 250	CR 257	1, 2, 3 & 4	Good	Asphalt	No signs	None	148
Township Road 226 (turns to CR 226 after CR 257)	CR 243	CR 257	15 & 16	Fair	Asphalt	No signs	None	No Data
Township Road 243	CR 216	CR 226	6, 13, 14 & 15	Good to fair	Asphalt	No signs; 35 mph for curves recommended	None	363
Township Road 254	CR 216	CR 218	8, 9, 10, 11 & 12	Good to fair	Asphalt	No signs to 25 mph near school	None	295
Township Road 256	CR 109	CR218	20 & 21	Good to fair	Asphalt	No signs	Very narrow	No Data
Township Route 257	CR216	SR12	17 & 18	Good to fair	Asphalt	No signs	None	699
County Route 257	SR12	CR 226						

[1] Based on observations made on April 9, 2021.

[2] Source: https://gis.dot.state.oh.us/tims/Map/ActiveTransportation.

Table 2 – Bridge Information

Bridge	Year Built	Total Length/ Road Width Between Curbs (feet)	Design Load	Average Daily Traffic (% Trucks)	Latest Inspection Date	Criteria Noted During Inspection				
						Condition	Deck	Super-Structure	Sub-Structure	Sufficiency Rating
SR Fremont Street over Branch of Portage River	1986	25.9/36.1	MS 18+Mod/ HS 20+Mod	8,436* (7)	3/2018	Good	Very Good	Very Good	Good	92.2
Gibson Street Arcadia over Joseph Boley	1930	30.8/16.4	Posted for load	50* (2)	8/2018	Fair	Good	Good	Satisfactory	45.8
North Street Arcadia over Joseph Boley	1954; 2010	24.9/21.0	MS 18+Mod/ HS 20+Mod	315* (8)	7/2018	Good	Excellent	Excellent	Excellent	80.0
CR 109 over Joseph Boley Ditch	2010	44.6/27.9	Not specified	876** (4)	7/2018	Good	Excellent	Excellent	Excellent	91.2
TR 243 over Joseph Boley Ditch	2002	35.1/27.9	MS 18+Mod/ HS 20+Mod	356** (7)	7/2018	Good	Excellent	Excellent	Excellent	97.0
TR 218 over South Branch Portage River	2001	29.9/24.0	MS 18+Mod/ HS 20+Mod	146** (10)	8/2018	Good	Excellent	Very Good	Excellent	91.5
TR 243 over Joseph Boley Ditch	1973	50.5/25.9	None provided	373** (8)	7/2018	Good	Very Good	Very Good	Very Good	87.9
TRC 243 over Joseph Boley Ditch	1973	46.9/27.9	MS 18+Mod/ HS 20+Mod	373** (8)	7/2018	Fair	Very Good	Very Good	Satisfactory	89.0

*2015 data. **2017 data.

3.3 ANTICIPATED TRAFFIC IMPACTS

A final delivery plan has not yet been finalized, but it is likely that local roads (county and township) surrounding and traversing the Project Area will be used during construction. For most deliveries, vehicles will be below the maximum allowable size and weight and no delays to local traffic should be experienced. Occasionally, when delivery vehicles are traveling on narrow roadways or when there is an oversized vehicle, traffic control will be used to manage local traffic; however, the delays to local traffic should be minimal due to the relatively low traffic volume in the Project Area. Because this is an agricultural area, heavier use by nearby farmers during planting and harvesting are expected to occur; South Branch will work with local landowners and farmers to the extent practicable to coordinate deliveries and road closures with agricultural activities. In response to feedback from the community, all construction traffic pertaining to vehicles with a gross vehicle weight exceeding 8,500 pounds will not be permitted to enter the municipal limits of the Village of Arcadia. Prior to construction, a RUMA will be developed that will incorporate details of a Traffic Control Plan that will describe the procedures that will be used to manage traffic during construction.

Given the current road conditions and the temporary and intermittent nature of construction traffic, no material adverse impact to public roads from Project construction is expected. Given that there will be little to no traffic during Project operation, the focus of the RUMA and transportation management planning will be on construction only. In the event that public roads or other infrastructure are damaged due to construction traffic (which is not anticipated at this time), the road or infrastructure would be repaired to pre-construction condition.

New service roads on private property will facilitate access within the Project Area. The roads will be approximately 20 feet wide and have aggregate as cover, adequate to support the size and weight of construction, maintenance, and rescue vehicles.

3.4 TRAFFIC CONTROL MEASURES

South Branch is committed to implementing construction safely and in a manner that minimizes impact on surrounding roads and the community. Although details will be developed as a part of the Project's RUMA, anticipated measures will include the following:

- Development of a Traffic Safety Map that refines and identifies routes and intersections to be used during construction, and locations where construction traffic will be restricted, as reflected in the RUMA;
- Inspection of existing road conditions prior initiation of construction;
- Use of clear signs to direct construction deliveries in the use of appropriate routes and entrances;
- Coordination with local officials and local farmers prior to major deliveries to select the optimum timing;
- Use of devices such as safety cones and flaggers with high-visibility vests to provide traffic control, as warranted; and
- Careful communication of traffic delivery and traffic safety commitments to workers and visitors.

4. Permits and Agreements

Prior to construction, the construction contractor will obtain all necessary permits from ODOT and the Hancock County Engineer. As previously noted, South Branch will work with the Hancock County Engineer to develop and implement a RUMA for construction activities. This agreement would include procedures for road repairs, temporary road closures, lane closures, road access restrictions, and traffic control. For driveway access off county and township roads, required permits will be obtained from the Hancock County Engineer.

Road crossings by underground or overhead electrical collection lines, and extending electrical lines within existing road rights-of-way, are also expected to require a permit from the Hancock County Engineer.

Additionally, Special Hauling Permits are required when loads exceed maximum dimensions or weights. Table 3 summarizes the characteristics of vehicles without Special Hauling Permit requirements for State of Ohio highways.

Table 3 – Dimensional Criteria for Vehicles Not Requiring Special Hauling Permits

Vehicle Characteristic	State Highway Limit
Width of vehicle, inclusive of load	8.5 feet
Height of vehicle, inclusive of load	13.5 feet
Length of vehicle, inclusive of load and bumpers	85 feet
Total weight of vehicle with 3 or more axles	80,000 pounds

For Project construction, most vehicles will be below current maximum dimensions and weights. Therefore, Special Hauling Permits are only anticipated for a few vehicles that may exceed these criteria, such as those delivering switchgear or transformers.

FIGURE

GIS FILE PATH: C:\Users\dverrier\OneDrive - haleyaldrich.com\Desktop\Local\Sunset_solar\GIS\Maps\2021_05_OPSB\0135392_001_0002_02_PROJECT_LOCATION_AERIAL.mxd - USER: dverrier - LAST SAVED: 5/19/2021 1:17:41 PM

LEGEND

- ROAD
- PROJECT AREA
- CITY OR TOWN BOUNDARY

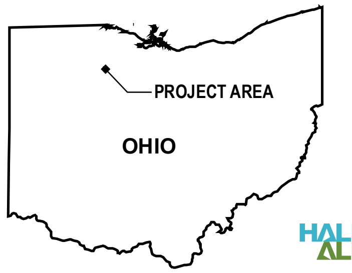
NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
3. CITY AND TOWN BOUNDARIES DATA SOURCE: OHIO ENVIRONMENTAL MANAGEMENT AGENCY (OEMA)
4. AERIAL IMAGERY SOURCE: ESRI

N

0 2,000 4,000

SCALE IN FEET

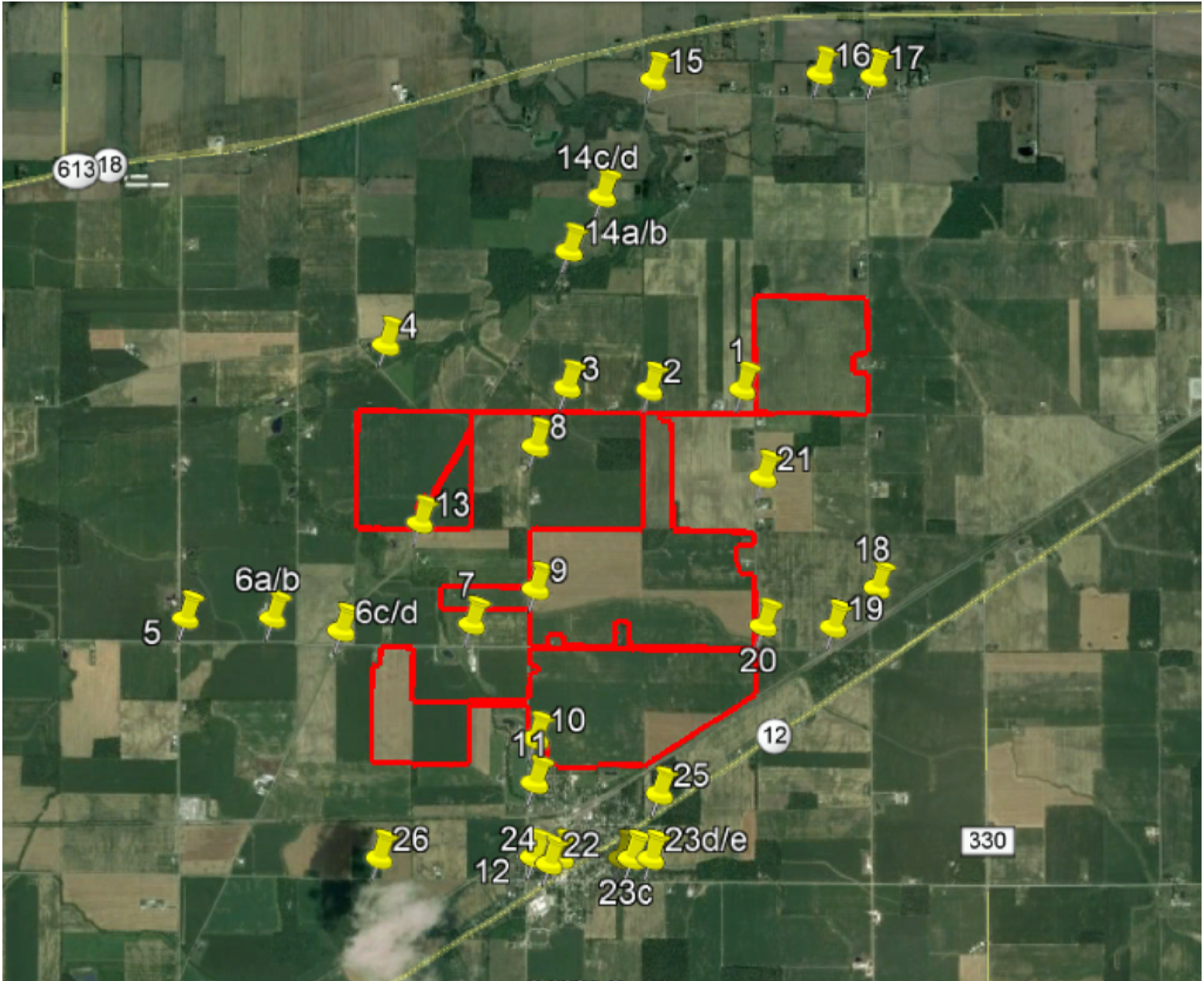


HALEY ALDRICH

Figure 1
Project Location

South Branch Solar
Hancock County, Ohio

ATTACHMENT A


15
16
17
613
18
14c/d
14a/b
4
1
3
2
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21
13
18
9
6a/b
7
6c/d
19
5
20
10
11
12
25
26
24
22
23d/e
12
23c
330

Photo 1a: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 1b: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 2a: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 2b: CR218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 3a: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 3b: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 4a: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 4b: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 4c: CR 218
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 5a:CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 5b: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 6a: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 6b:CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 6c: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 6d: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 7a: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 7b: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 8a: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 8b: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 9a: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 9b: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 10a: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 10b: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 11a: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 11b: CR 254
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 12a: CR 254/CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 12b: CR 254/CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 12c: CR 254/CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 12d: CR 254/CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 13a: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 13b: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 14a: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 14b: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 14c: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 14d: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 14e: CR 243
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 15a: CR 243/CR 226
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 15b: CR 243/226
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 15c: CR 243/226
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 15d: CR 243/226
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 16a: CR 226
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 16b: CR 226
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 17a: CR 257
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 17b: CR 257
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 18a: CR 257
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 18b: CR 257
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 19a: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 19b: CR 109
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 20a: CR 109/CR 256
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 20b: CR 109/CR 256
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 20c: CR 109/CR 256
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 21a: CR 256
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 21b: CR 256
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 22a: SR 12
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 22b: SR 12
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 23a: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 23b: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 23c: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 23d: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 23e: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 24a: SR 12
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 24b: SR 12
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 25a: SR 12
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 25b: SR 12
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 26a: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

Photo 26b: CR 216
(Photo Credit: K. Lindenschmidt, 4/9/2021)

APPENDIX L

DECOMMISSIONING PLAN

DECOMMISSIONING PLAN

SOUTH BRANCH SOLAR
WASHINGTON TOWNSHIP
HANCOCK COUNTY, OH

Prepared for:

South Branch Solar, LLC

6688 N Central Expressway Suite 500

Dallas, TX 75206 Contact:

Rob Kalbouss

Prepared By:

Kimley»Horn

Kimley-Horn & Associates, Inc.

2400 Corporate Exchange Dr. Suite 120

Columbus, OH 43231

Contact: Derik Leary, P.E.

Prepared on: July 19, 2021

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Appendices

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1.0 INTRODUCTION

Background

South Branch Solar, LLC (Project Company) is developing the South Branch Solar Project (Project) on approximately 1000 acres of leased land. The Project will be located in Washington Township, Hancock County, Ohio. The project will have several access points. The central project area will be accessed along the east and west sides of Township Rd. 254 and 243. The northeastern project area will be accessed at two points along Township Rd. 257, approximately 0.5 and 0.3 miles north of the intersection of Township Rd. 254 and Township Rd. 218. The southeastern project site can be accessed along Township Rd. 109, approximately 0.3 miles east of the intersection of Township Rd. 243 and Township Rd. 109. The geographical coordinates are 41°8'13.64"N, 83°31'20.89"W and the Solar Project is anticipated to remain operational for 35-40 years. Refer to **Appendix A: C.101 Overall Site Plan** for general location and project layout.

The Project is planned to occupy approximately 1000-acres of agricultural land for the solar field. The site is bound to the east and west by agricultural fields, to the south by residential properties and agricultural fields, and to the north by woodland and agricultural fields. Site topography is moderately sloped and slopes from the southeast to the northwest with drainage towards the South Branch of the Portage River. The Federal Emergency Management Agency (FEMA) has designated the project areas as Zone X, outside the 0.2% chance annual flood plain.

This Decommissioning Plan (Plan) is developed in compliance with Ohio Power Siting Board and industry standards.

This Plan covers the following elements of the Solar Photovoltaic (PV) portion of the development:

- Removal off-site for disposal of all Project Components as defined, including any underground structures to at least 3 feet below-grade;
- Revegetation, restoration and road repair activities;
- Decommissioning escrow account.

If the Project ceases to perform its intended function for more than twelve (12) months, the Project will be completely removed within twelve (12) months, and the site restored in accordance with this Decommissioning Plan and Ohio Power Siting Board rules and regulations.

2.0 PROJECT COMPONENTS

The Project Components that are subject to decommissioning include the Solar PV equipment summarized below. The decommissioning activities associated with these components are discussed in Section 3.0 of this Plan.

PV Equipment

The Project will use Solar Photovoltaic (PV) modules mounted on single axis trackers installed on steel pile foundations.

Internal Power Collection System

The PV-generated DC power will be collected from each of the multiple rows of PV modules through one or more combiner boxes and conveyed to inverters. The inverters will convert the DC power to AC power. A project substation will be constructed to covert the electricity voltage, as necessary. The project will be interconnected into the existing Overhead Power Lines running northeast through the site between Township Rd. 254 and Township Rd. 256.

Inverters, transformers, and PV combining switchgear will be mounted on concrete or pile foundations.

Earthwork

It is anticipated the site will require minimal grading for the Project. Site grading and drainage will be conducted in accordance with Final Engineering plans approved by Washington Township, Hancock County, and the Ohio Power Siting Board.

Roads

Access to the Project areas will be via Township Rd. 109, Township Rd. 243, and Township Rd. 257. The site access roads will be constructed in accordance with Hancock County requirements. The on-site access roads will be compacted dirt or gravel in accordance with the Final Geotechnical Report.

Fencing

The Project site will be fenced with an approximately seven-foot-high fence for security purposes. Entry gates will be provided at the site access points on Township Rd. 109, Township Rd. 243, and Township Rd. 257.

3.0 PROJECT DECOMMISSIONING AND RECYLCING

Decommissioning includes removal of above-ground and below-ground structures relating to the Solar PV portion of the Project. Only minor grading is anticipated during construction; and therefore, will require limited to no grading following decommissioning. Temporary erosion and sedimentation control Best Management Practices will be implemented during the decommissioning phase of the Project.

Decommissioning Preparation

The first step in the decommissioning process will be to assess existing site conditions and prepare the site for demolition. Onsite storage area(s) will be established, for collection and temporary storage of demolition debris, pending final transportation and disposal and/or recycling according to the procedures listed below.

Permits and Approvals Required for Decommissioning

It is anticipated that an NPDES Permit from the Ohio Environmental Protection Agency Division of Surface Water (DSW) will be required. The site is not anticipated to impact waters of the United States or Threatened or Endangered species; thus, no federal approvals are expected. Appropriate applications for permits will be submitted and approved prior to decommissioning activities, including any permits required through the Soil and Water Conservation District, Washington Township, and/or Hancock County.

PV Equipment Removal and Recycling

During decommissioning, Project components owned by the Project Company that are no longer needed will be removed from the site and recycled or disposed of at an appropriately licensed disposal facility. Above ground portions of the PV module supports will be removed. Below ground portions of the PV module supports will be removed entirely where practical. Those supports that are more firmly anchored may be cut off to a safe depth of at least three (3) feet below grade (except for parcel 510000130930 which shall be to a depth of four (4) feet) or to the depth of bedrock, and the remaining support may be left in place. This depth will avoid impact of underground equipment on future farming or other construction activities. The demolition debris and removed equipment may be cut or dismantled into pieces that can be safely lifted or carried with the onsite equipment being used. The debris and equipment will be processed for transportation and delivery to an appropriately licensed disposal facility or recycling center. Modules will be disposed of or recycled in accordance with local, state, and federal regulations.

Internal Power Collection System

The combiner boxes, cables, inverters, and transformers will be dismantled. The concrete foundations will be broken up, removed and recycled. If ground-screw or steel foundations are used, they will be removed and recycled. The underground cable and conduit will be removed where less than three (3) feet below grade (except for parcel 510000130930 which shall be to a depth of four (4) feet). Overhead conductors will be removed from the poles, and the poles and pole foundations will be removed. Aluminum from the conductors will be recycled or removed from the site to an appropriately licensed disposal facility. All components of the project substation including, but not limited to, foundations, buildings, machinery, equipment, cabling, and connections to transmission lines will be removed.

Roads

Unless requested in writing by the landowner, gravel from on-site access roads will be removed and recycled. Once the gravel is removed, the soil below the gravel along compacted dirt access roads will be scarified a depth of 18-inches and blended, as noted in the Site Restoration section below.

Fencing

Unless requested in writing by the landowner, project site perimeter fence will be removed at the end of the decommissioning project. Since the Project site is not currently fenced, this includes removal of all posts, footings, fencing material, gates, etc. to return the site to pre-Project condition.

Landscaping

Unless requested in writing by the landowner to be removed, all vegetative landscaping and screening installed as part of the Project will be left in place. Landscape areas in which landscaping is removed will be restored as noted in the Site Restoration section below.

Site Restoration

Once removal of all Project equipment and landscaping is complete, all areas of the Project site that were traversed by vehicles and construction and/or decommission equipment that exhibit compaction and rutting, will be restored by the Project Company. All prior agricultural land will be ripped at least 18 inches deep or to the extent practicable and all pasture will be ripped at least 12 inches deep or to the extent practicable. The existence of drain tile lines or underground utilities may necessitate less ripping depth. Once this is complete, seed will be distributed for the establishment of vegetative land cover.

4.0 FUTURE LAND USE

The Project site is currently agricultural land. All solar panels will be removed from the property and the land will be restored so that it can be returned to agricultural use at the end of the Project life cycle. This Decommissioning Plan is consistent with Ohio Power Siting Board (OPSB) requirements to return the land to its pre-Project conditions, suitable for agricultural use.

5.0 PROJECT DECOMMISSION COSTS AND FINANCIAL ASSURANCE

This Decommissioning Plan will be updated prior to Construction and will consider salvage value of the Solar PV components of the Project. All solar components will be repurposed, salvaged, recycled, or hauled offsite for disposal. Solar components that are anticipated to have resale or salvage value that may be used to offset the cost of decommissioning include solar modules, racking system, steel piles, inverters, and transformers. Materials that have no value at the time of decommissioning will be recycled when possible or hauled offsite to a licensed solid waste disposal facility. A Project decommissioning cost estimate was created based on the South Branch Ridge Solar – Overall Site Plan included in **Appendix A.** See Table 1 below for a current decommissioning cost estimate, including salvage value. Industry standard prices in 2021 for removal costs were determined using RS Means cost data. Removal costs includes materials, contractor installation/demolition, mobilization and demobilization, overhead and profit, and performance bonding.

In the event that the Total Decommission Cost (decommission costs minus salvage value) is a net positive number, the Project Company will post decommissioning funds in the form of a surety bond, letter of credit, guaranty, including affiliate guaranty or other financial assurance consistent with the Final Decommissioning Cost Estimate. This Decommissioning Plan and financial assurance will be reviewed every 5 years to assess the value of the financial assurance versus the Total Decommission Cost.

TABLE 1
SOUTH BRANCH SOLAR DECOMMISSIONING COST ESTIMATE[1]

NO.	ITEMS	QUANTITY	UNITS	PRICE	COST
1	Mobilization	1	LS	$436,858	$436,858
2	SWPPP, Erosion Control Measures	1	LS	$593,000	$593,000
3	Seeding	871	AC	$208	$181,168
4	Ripping 12"-18" topsoil/scarifying access road and rough grading existing soil	871	AC	$99	$86,229
5	Remove and Recycle Chainlink Fence, 7' High	93,668	LF	$4.34	$406,520
6	Disconnection and Demolition of Switchyard/Substation Equipment	3	EA	$66,754	$200,262
7	Removal and Recycle AC Cables	127,512	LF	$0.19	$24,228
8	Remove and Recycle DC Cables	1,054,065	LF	$0.18	$189,732
9	Backfill AC and DC trenches	218,454	LF	$0.18	$39,322
10	Remove and Recycle Inverters	60	EA	$242	$14,520
11	Removed and Recycle Photovoltaic Modules	500,688	EA	$9.00	$4,506,192
12	Remove and Recycle Piles (10'W6x7 piles @ 25' OC assumed)	42,657	EA	$13	$554,541
13	Remove and Recycle Support Assemblies	6,925	EA	$204	$1,412,700
14	Contaminated Soils Testing	1	LS	$2,000	$2,000
15	Reclamation Monitoring and Maintenance	1	LS	$5,000	$5,000
16	Transportation[2]	1	LS	$521,738	$521,738
	SUB-TOTAL OF DECOMMISSION COSTS				**$9,174,010**
17	Remove and Recycle Chainlink Fence, 12' High[3]	93,668	LF	$0.19	$17,797
18	Remove and Recycle Switchyard/Substation Equipment[4]	3	EA	$13,351	$40,053
19	Removal and Recycle AC Cables[3]	127,512	LF	$0.08	$10,201
20	Remove and Recycle DC Cables[3]	1,054,065	LF	$0.08	$84,325
21	Removed and Recycle Photovoltaic Modules[5]	500,688	EA	$4.96	$2,483,413
22	Remove and Recycle Piles[3] (10'W6x7 piles @ 25' OC assumed)	42,657	EA	$3.70	$157,831
23	Remove and Recycle Support Assemblies[3]	6,925	EA	$16.17	$111,978
	SUB-TOTAL OF SALVAGE VALUES				**$2,905,598**
TOTAL (DECOMMISSION COSTS – SALVAGE VALUE)					**$6,268,412**

[1] *This Engineer's Opinion of Probable Construction Cost is based upon the Overall Site Plan prepared Westwood Professional Services, Inc. dated 07/14/2021. The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs. These quantities and costs are subject to change pending Final Engineering and should be updated as necessary.*

[2] *This assumes that approximately 753 trips of a 40,000 lb. capacity demolition roll-off truck will travel 100 miles round trip to a recycling and disposal facility.*

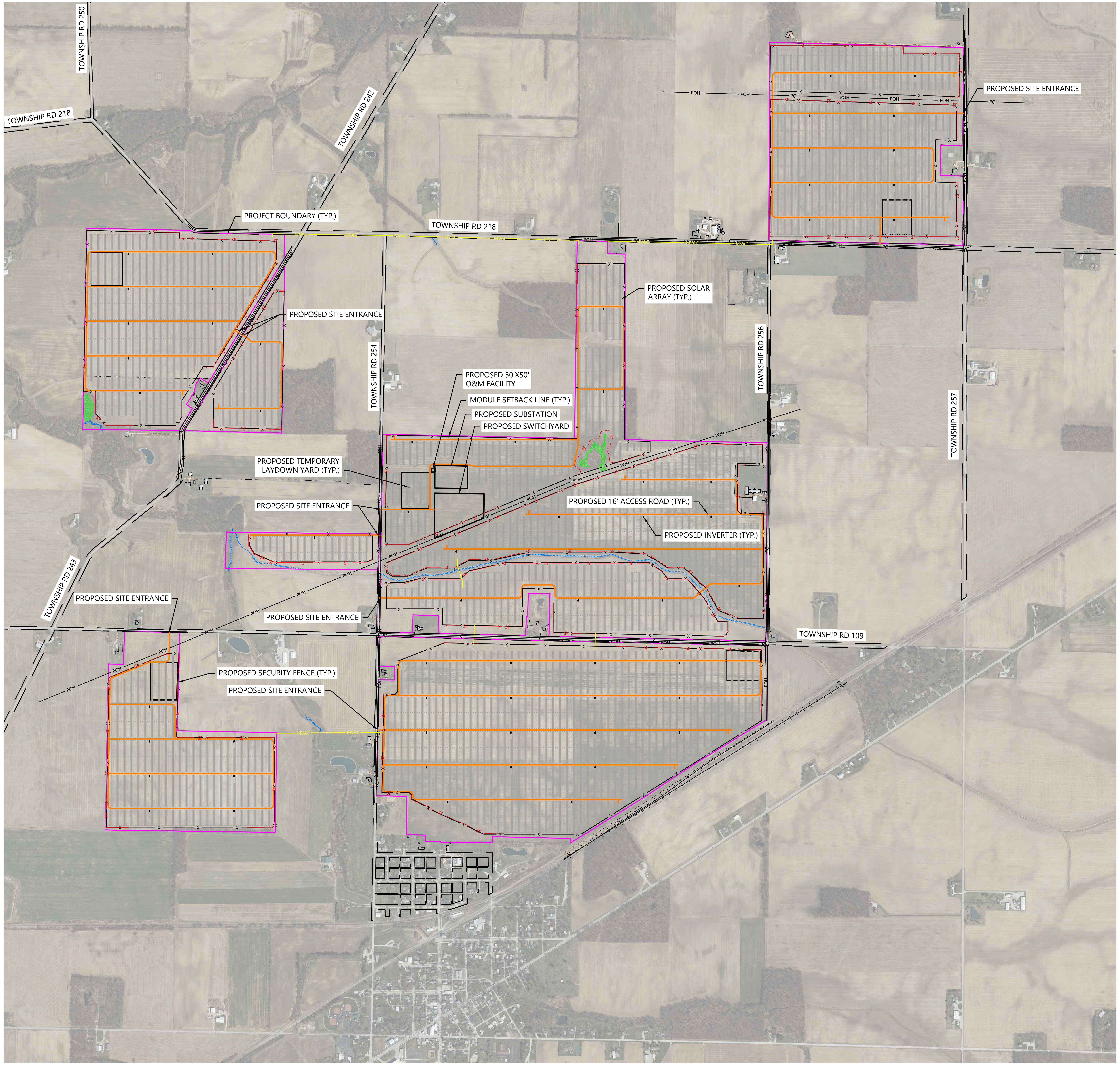
[3] *This Salvage Value Estimate is based off 2021 RS means raw material scrap prices. Material salvage values were based off of current US salvage exchange rates. Material salvage values was determined using the most prevalent salvageable metal in each component: Copper Wire @$0.08/LF (AC and DC Cables) and Steel @ $0.19/LF of fence, @ $3.70/pile, and @ $16.17/assembly.*

[4] *Switchyard/Substation Equipment material salvage value was determined to be 20% of removal costs from past projects of similar size and scope.*

[5] *Photovoltaic Module material salvage rate is based on straight-line depreciation of modules (-0.5%/year). For PV Module Removal/Recycle labor and equipment costs are computed at present values, while salvage value is computed at 35-year depreciated values.*

APPENDIX A

South Branch Solar – C.101 Overall Site Plan



LEGEND:

	PROJECT BOUNDARY
	SECTION LINES
	RIGHT-OF-WAY LINES
	EASEMENT LINES
	EX. TREELINE
	EX. PAVED ROAD
	EX. GRAVEL ROAD
	EX. DRIVEWAY
	EX. RAILROAD
X	EX. FENCE LINE
POH	EX. OVERHEAD POWER
	PROPOSED SOLAR ARRAY
	PROPOSED ACCESS ROAD
X	PROPOSED SECURITY FENCE
SF	PROPOSED SILT FENCE
▭	PROPOSED ELECTRICAL EQUIPMENT
MVAC	PROPOSED COLLECTION
	PROPOSED LAYDOWN YARD
▭	PROPOSED SUBSTATION/SWITCHYARD
▩	PROPOSED O&M FACILITY
🟩	DELINEATED WETLANDS
🟦	DELINEATED STREAMS

SYSTEM SPECIFICATIONS	
SYSTEM SIZE - MWDC	270.37
SYSTEM SIZE - MWAC	205
DC/AC (AT INVERTER)	1.32
MODULE MODEL	LONGI LR5 72HBD-540M
MODULE RATING (W)	540
MODULE QUANTITY	500,688
STRINGS (27 MODULES PER STRING)	18,544
INVERTER QUANTITY	60

Westwood

Phone (952) 937-5150
Fax (952) 937-5822
Toll Free (888) 937-5150
12701 Whitewater Drive, Suite #300
Minnetonka, MN 55343
westwoodps.com

Westwood Professional Services, Inc.

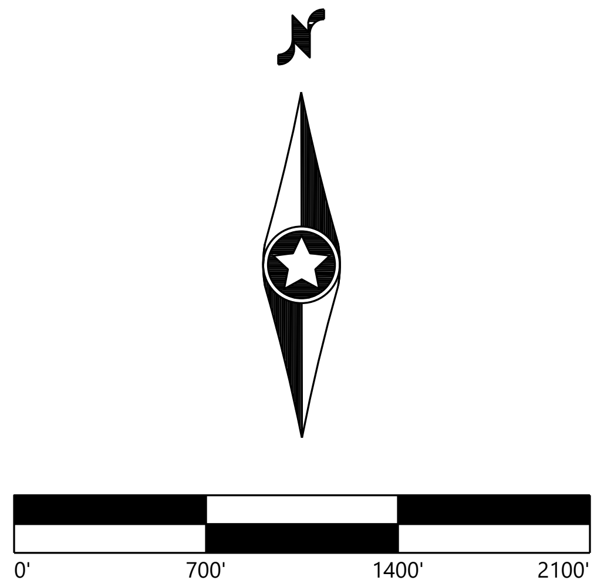
PREPARED FOR:

LEEWARD
renewable energy

6688 N CENTRAL EXPRESSWAY, SUITE 500
DALLAS, TX 75206

REVISIONS:

#	DATE	COMMENT



South Branch Solar

Hancock County, OH

Overall Site Plan

NOT FOR CONSTRUCTION

DATE: 07/14/2021

SHEET: C.101

N:\0031696.00_CAD_Civil\0031696-OA-01.dwg 7/14/2021 3:51 PM Zachary Sinn

APPENDIX M

HORIZONTAL DIRECTIONAL DRILL CONTINGENCY PLAN

south branch solar

Horizontal Directional Drilling Contingency Plan

South Branch Solar
Hancock County, Ohio

July 2021

Table of Contents

Introduction

South Branch Solar, LLC (South Branch) is proposing an up to 205-megawatt solar energy facility, South Branch Solar (the Project) on approximately 1,000 acres within Washington Township, Hancock County, Ohio (the Project Area). Although the majority of the Project Area is upland and will not require stream crossings, some limited areas exist where underground electrical interconnections may use a trenchless excavation method known as horizontal directional drilling (HDD). HDD is a steerable utility installation system commonly used to install cable and pipelines beneath roads, rivers, wetlands, and other obstacles. HDD is a safe, efficient, cost-effective method and utilizes a watery mud-slurry, drilling fluid mixture throughout the operation in order to reduce friction and stabilize the drilled hole. The drilling fluid mixture typically consists primarily of water, with limited amounts of bentonite clay, a natural, non-toxic substance.

During the HDD process there is potential for drilling fluids to be inadvertently released to the surface (sometimes referred to as “frac-out” or “release”). Frac-out is most likely to occur near the bore entry and exit points, however, the entire bore hole will be monitored for instances of seepage or inadvertent release during construction.

The following operational procedures and outlined responsibilities will be established for the prevention, containment, and remediation of any frac-outs that may occur in connection with the potential use of HDD as part of the Project. It is expected that, while in-field roles will be associated with members of the construction contractor’s team, South Branch will provide oversight for the implementation of these measures.

Procedures and Responsibilities

Any potential HDD operations will be carefully monitored and carried out by an experienced contractor. A Site Supervisor will be designated to oversee any potential HDD activities, and to lead the implementation of this frac-out management plan.

In addition, South Branch will have an environmental specialist on-site during construction activities that may affect sensitive areas, including during the implementation of HDD activities. The specialist will be familiar with water quality protection issues and potential threatened or endangered species of plants and animals that may be encountered. The environmental specialist will have authority to direct the Site Supervisor to implement measures in the event necessary for environmental protection.

Monitoring of HDD activity will include inspection of the entry and exit points as well as along the drill path, continuous examination of drilling pressures and return flows, and necessary documentation of drilling status and conditions.

The Site Supervisor will be responsible for ensuring that all relevant employees are trained properly for conducting standard HDD activity and responding to potential inadvertent release. The Site Supervisor will be responsible for confirming availability and managing the necessary equipment on-site during which time HDD frac-out may occur and utilizing such equipment safely and effectively. In the event of any inadvertent frac-out from HDD activities, the Site Supervisor will be responsible for reporting such occurrences to the required and appropriate agencies.

Equipment

If HDD is utilized in Project construction, certain equipment will be made available in order to carry out such work safely and in preparation of any inadvertent release occurrences. Such equipment may include spill response kits and spill containment materials, hay bales, silt fences, sandbags, portable pumps, plastic sheeting, and a vacuum truck.

Inadvertent Release Containment & Control

If inadvertent release of drilling fluid is detected as a result of HDD activities taking place on-site, the contractor will take immediate action to identify the release and ensure appropriate response is taken, in consultation with the environmental specialist. The release will be promptly assessed by the contractor, in coordination with the environmental specialist and communication with the South Branch, to determine whether the release may potentially reach adjacent waterbodies, wetlands or other nearby sensitive areas.

If inadvertent release occurs in upland areas immediate actions will be taken to contain the release, utilizing hay bales, silt fences, and sandbags. Once contained the released fluid will be collected using appropriate equipment and either recycled or disposed of in an approved location.

If an inadvertent release occurs in a wetland or other waterbody, whether of inside or outside of the Project Area, immediate actions will be taken to contain the release and prevent migration. If public health and safety are threatened by an inadvertent release, all drilling operations will halt immediately until the threat is eliminated.

All disturbed areas associated with the Project will be stabilized and restored per the specifications outlined in the Project Stormwater Pollution Prevention Plan.

Reporting

If an inadvertent release occurs within a wetland, waterbody, or other sensitive resource area, the contractor and/or Site Supervisor will immediately notify South Branch. Regulatory agencies will be notified as required by applicable laws and regulations and will include:

- Date and time of inadvertent release;
- Location of the release;
- Type and approximate quantity of the release;
- How the release occurred, and HDD activity being performed at the time;
- Description of potentially sensitive areas in relation to release location; and
- Description of methods to contain and remediate the release location, as applicable.

For minor releases not requiring regulatory reporting, HDD may continue if full containment is achieved as described above. For releases requiring external reporting and communication, HDD activities shall not restart without prior approval from the Site Supervisor and the environmental specialist.

APPENDIX N

NOISE EVALUATION

ACENTECH

33 Moulton Street
Cambridge MA 02138
617 499 8000
acentech.com

July 20, 2021

Lynn Gresock
Haley & Aldrich, Inc.
3 Bedford Farms Drive | Suite 301
Bedford, New Hampshire 03110
Email: LGresock@haleyaldrich.com

Subject **South Branch Solar Project Noise Evaluation**
Hancock County, Ohio
Acentech Project No. 634331

Dear Lynn:

Under contract to Haley & Aldrich, Inc. (Haley & Aldrich), Acentech Incorporated (Acentech) has conducted a noise evaluation for South Branch Solar (the Project), a new solar facility proposed on approximately 1,000 acres in Washington Township, Hancock County, Ohio (the Project Area). We developed an acoustic model to calculate the expected operational sound levels of each of the noise producing equipment at nearby community receivers. The equipment includes transformers, inverters, and solar panel tracker motors. We have also provided a narrative discussion on construction noise.

EXECUTIVE SUMMARY

Based on the Ohio Power Siting Board (OPSB) guidelines, which generally require that operational energy facility impacts be 5 decibels (dB) or less over measured ambient on an average continuous equivalent sound level (L_{Aeq}) basis at non-participating receptors, we completed a noise evaluation for the Project. All Project impacts are well below the accepted OPSB standard.

We predicted the noise in the community from Project equipment, including inverters, transformers, and tracker motors. Project-only operational nighttime sound levels range from 23 dBA to 37 dBA at the receivers closest to the Project Area, resulting in no increase in sound level over the ambient conditions. Predicted Project-only operational daytime sound levels range from 36 dBA to 47 dBA; we did not predict an increase in sound levels over the ambient greater than 1 dB. The predicted daytime sound levels were conservative because they assumed that all the tracker motors would operate at the same time and continuously. Nighttime sound levels were conservative because they assume inverters and transformers will be active.

Receivers further from the Project Area, for example, further south within the Village of Arcadia will have even less influence by the Project and, thus, lower operational noise exposures. For reference, 30 to 40 dBA is typical of interior sound levels, such as in a bedroom, while 50 dBA is typical of outdoor ambient conditions half a mile from a major highway (e.g., 1,000 cars/hour, with vehicles at a speed of 60 miles per hour [mph]).

The construction noise estimates were based on typical construction equipment and distances from construction activities to residential receivers. These predictions range from 59 dBA to 94 dBA. For a number of reasons, the predicted construction sound levels are conservative, representing a “worst case scenario” for noise emission. Actual noise exposure will vary depending on the schedule of construction and the location of the equipment.

GLOSSARY OF TERMS

dB – decibel, unweighted sound level. Note that this can be used to refer to relative increases in sound level as well as overall sound level.

dBA – A-weighted sound level. Note that this only refers to overall sound level, never relative increases in sound level.

L_{A10} – the A-weighted sound pressure level (dBA) exceeded 10% of the measurement interval.

L_{A50} – the A-weighted sound pressure level (dBA) exceeded 50% of the measurement interval.

L_{A90} – the A-weighted sound pressure level (dBA) exceeded 90% of the measurement interval.

L_{Aeq} – the A-weighted average continuous equivalent sound pressure level (dBA). Often referred to as L_{eq}.

L_{dn} – day-night average sound level, defined as the 24-hour A-weighted equivalent sound level (dBA), with a 10-dB penalty applied to nighttime levels.

L_p – Sound Pressure Level, dB relative to 20 micro-Pascals.

L_w – Sound Power Level, dB relative to 1 pico-watt.

PROJECT NOISE GUIDELINES

OPSB

No noise rules or regulations exist at the state level in Ohio, but the Project falls under the purview of the OPSB. The OPSB generally requires that operational energy facility impacts be 5 dB or less over measured ambient on an L_{Aeq} basis at non-participating receptors.

Other Local Ordinances

The Project Area is located in Washington Township and immediately north of the Village of Arcadia. We are not aware of any quantitative noise regulations within these jurisdictions, but the OPSB rules will supersede all local regulations.

BACKGROUND NOISE SURVEY

The ambient noise determination completed for the Project used standard methods based on good acoustical engineering principles and generally followed ANSI/ASA S1.13-2020. With the help of a local representative of Haley & Aldrich, Acentech performed unattended noise measurements from April 9 to April 19, 2021 using two Rion NL-52 sound level meters (SLMs). The SLMs met the requirements of ANSI/ASA S1.4-2014/Part 1 for a Class 1 sound level meter. The equipment is calibrated annually as well as field calibrated immediately prior to use.

We were not able to observe on-site weather conditions for the duration of the measurements. Historical meteorological data from a nearby MET tower (Weather Station ID: KOHVANDA8, via Weather Underground) indicates average daily temperatures ranged from 45 to 55 degrees F, and there was some measurable precipitation between April 9 and 11, 2021.

The two locations of our SLMs are shown in Figure 1 below. We obtained data in 1-hr intervals, including L_{Aeq} and other statistical metrics (e.g., L_{A10}, L_{A50}, L_{A90}).

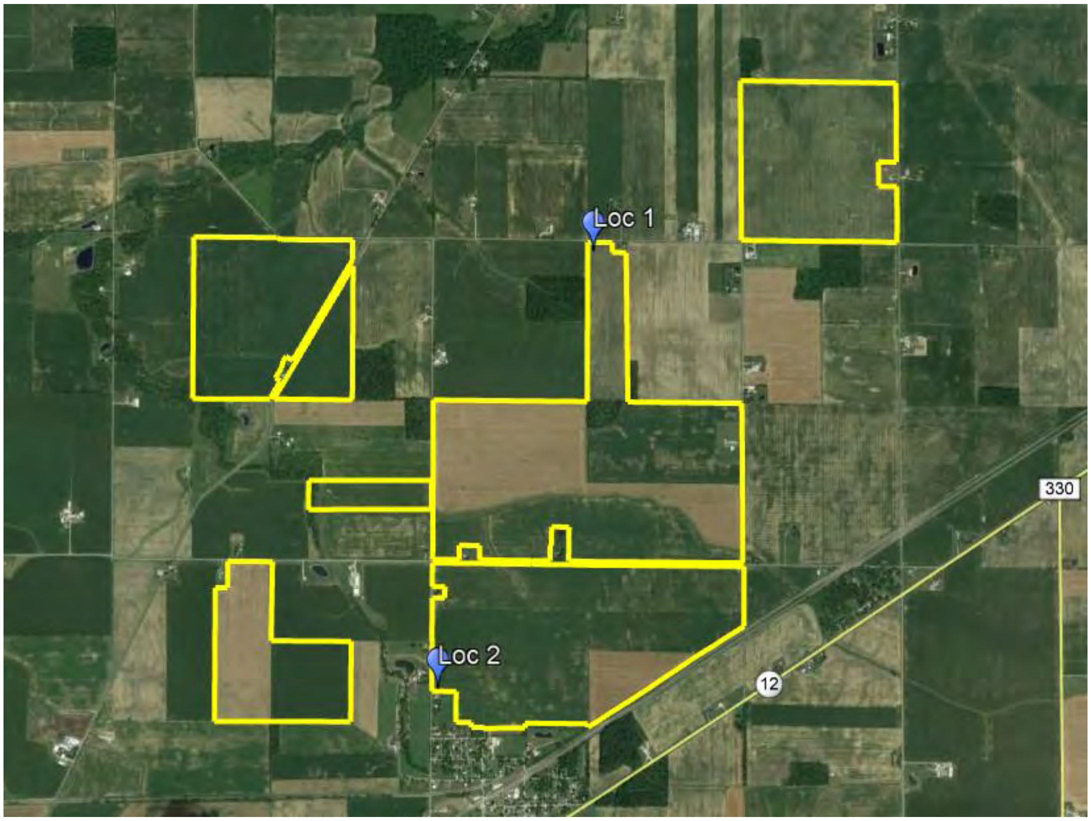


Figure 1: Measurement locations

Figures 2 and 3, attached, present time histories of environmental sound levels measured at the two monitoring locations. These plots include the following acoustic descriptors:

- $L_{\text{Aeq, 1-hr}}$ – the equivalent sound level, which includes both steady background sounds (e.g., distant traffic) plus short-term intrusive sounds (e.g. local car passerby).
- $L_{\text{A10, 1-hr}}$ – the sound level exceeded 10% of the measurement interval, in this case 6 minutes of each hour. Typical of brief transient sound events.
- $L_{\text{A50, 1-hr}}$ – the sound level exceeded 50% of the measurement interval, in this case 30 minutes of each hour. The median sound level.
- $L_{\text{A90, 1-hr}}$ – the sound level exceeded 90% of the measurement interval, in this case 54 minutes of each hour. Typical of continuous sounds, and often similar to the minimum sound level.

Table 1 below summarizes the average sound metrics measured at each location based on time of day. L_{Aeq} was calculated from $L_{\text{Aeq, 1-hr}}$ for the entire daytime and nighttime periods, respectively. Statistics (L_{A10}, L_{A50}, L_{A90}) presented are the average of the 1-hr statistics measured during the daytime and nighttime period, respectively. The day-night average sound level (L_{dn}) is defined as the 24-hour A-weighted equivalent sound level, with a 10-dB penalty applied to nighttime levels.

Table 1: Summary of average measured ambient sound levels

Location	Day (7 am – 10 pm)				Night (10 pm – 7 am)				Day/Night
	L_{Aeq}	L_{A10}	L_{A50}	L_{A90}	L_{Aeq}	L_{A10}	L_{A50}	L_{A90}	L_{dn}
Loc. 1	50	50	41	35	46	44	33	28	54
Loc. 2	52	50	42	37	51	45	36	32	57

Noise Goals

When added to the existing ambient sound levels, the *Project-only* sound levels that correspond with a 5 dB increase above ambient (L_{Aeq}) at each monitoring location are summarized below in Table 2 (e.g., 50 dBA ambient plus 54 dBA *Project-only* sound contribution results in a 55 dBA combined sound level).

Table 2: Project-Only Sound Levels corresponding with a 5 dB increase over ambient L_{Aeq}

Location	Project-Only Sound Level Guideline (dBA)	
	Daytime (7 am – 10 pm)	Nighttime (10 pm – 7 am)
1	54	50
2	56	55

OPERATIONAL NOISE EVALUATION

Acentech developed an acoustic model of the proposed Project and surrounding neighborhood. The acoustic model was developed using Cadna/A software to estimate the contributions of various noise sources to the community sound levels. Cadna/A complies with international standard ISO 9613-2 "Attenuation of sound during propagation outdoors -- Part 2: General method of calculation."

The noise producing equipment at the proposed Project includes:

- Inverters with integrated MV transformers (quantity: 60). Basis of design is Sungrow SG3150-MW, with a MV transformer rated at 3150 kVA with an output voltage of 34.5 kV.
- Substation transformers (quantity: 1). 120 MVA 138 kV. No model number is available at this time as they are custom units to be designed. We have modeled sound levels based on a similar unit, which provided sound pressure level at 1 m; we added 3 dB to these sound levels to account for measurement uncertainty. We have assumed the spectra of the unit based on prior project experience.
- Tracker motors (quantity: ~5,000). Basis of design is NEXTracker Horizon Single Axis Tracker motor. Sound pressure levels provided at 0.3 m at full load test conditions. We have assumed the spectra of the unit based on prior project experience.

The site plan used in this modeling is enclosed. Table 3 provides the input sound power level (L_w) we have assumed for the equipment.

Table 3: Equipment Octave Band Sound Power Level

Equipment	**Octave Band Center Frequency (Hz)**									**Overall Sound Power (dBA)**
	31.5	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**	
	Sound Power Level (dB re 1 pico-watt)									
Inverter with integrated MV Transformer	83	76	81	74	70	69	70	77	68	80
Substation Transformer	127	120	111	99	94	84	78	73	68	99
Tracker Motor	94	81	75	71	70	67	62	58	56	72

Nighttime Operation

For nighttime operation, we understand that normally the inverters and tracker motors will be inactive, but the transformers will likely be energized and producing noise. For this Project, the distribution transformers are integrated into the inverters, so we have assumed that the equipment within the inverters (i.e., the transformer) will run at night and we assumed that to have the associated sound level as noted in Table 3.

RESULTS

We calculated noise levels at 26 existing non-participating residences (NP1 through NP26) and two participating residences (P1, P2) in the area surrounding the Project, shown in Figures 4A and 4B. Calculated noise levels at other residences further from the project are shown in the sound contours, described below. We calculated the sound level at these locations with receiver heights of 1.5 meters. We compared modeled noise levels to the noise guidance summarized above.

Sound Levels at Non-Participating Residences

Table 4, enclosed, presents the estimated daytime and nighttime sound levels for the Project, the combined future sound level (Project plus ambient), and the predicted increase over ambient at the nearby residences. The ambient is defined as the ambient L_{Aeq}, as shown above in Table 1. For reference, 30-40 dBA is typical of interior sound levels in a bedroom, and 50 dBA is typical of ambient conditions half a mile from a major highway (e.g., 1000 cars/hour, vehicle speed of 60 mph).

We have predicted that Project sound sources will not increase daytime sound levels at non-participating residences within 250 ft by more than 1 dB above ambient. These results are also conservative because they assume the tracker motors will all be operating at the same time and continuously, when in reality they will not all operate at the same time and typically run for 5-10 seconds every 1-2 minutes.

We do not predict any increase over ambient sound levels for nighttime.

Both daytime and nighttime sound levels are well below the accepted OPSB standard.

Sound Contours

Figure 5 shows Project-only daytime sound contours for the rest of the Project area, calculated at a height of 1.5 meters, from 25 dBA to 50 dBA in 5-dB increments. Figure 6 shows Project-only nighttime sound contours.

Receivers further from the project area, further south within the Village of Arcadia, will have even smaller project operational noise exposures. Locations beyond the 25 dBA contour are not anticipated to have significant Project noise impacts.

CONSTRUCTION NOISE EVALUATION

Our evaluation of construction noise emissions to the surrounding community is based on documentation provided by Haley & Aldrich describing the construction phases for a similar solar facility. The phases described below may take place concurrently at different areas throughout the Project Area, and thus will affect different residential receivers at different times.

- Phase 1: Grading and other site preparation
- Phase 2: Installation of array foundations (assumed by pile driving)
- Phase 3: Solar panel assembly
- Phase 4: Inverter pad and substation construction
- Phase 5: Array commissioning, waste removal, site clean-up

We based our analysis on our own understanding of typical equipment associated with these activities. Expected equipment includes graders, backhoes, pile drivers, dump trucks, cranes and various delivery trucks. We have identified sound levels associated with this equipment based on USEPA guidance[1] and other relevant references, including Ohio solar farm OPSB submittals. Table 6 below presents the typical equipment and sound levels used in our assessment for each phase. All values are sound pressure levels at

---

[1] Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances, EPA (1971).

50 ft. For our analysis, we have assumed that near any given non-participating receiver, only one of each piece of equipment listed will be operating simultaneously at that particular location.

Table 6: Equipment sound levels

Phase	Equipment Maximum Sound Pressure Level at 50 ft (dBA)	Combined Maximum Sound Pressure Level of Expected Equipment at 50 ft (dBA)
1	Grader (85 dBA), Backhoe (83 dBA), Dump Truck (85 dBA)	89
2	Pile Driver (100 dBA), Backhoe (83 dBA), Dump Truck (85 dBA)	100
3	Backhoe (83 dBA), Crane (83 dBA), Dump Truck (85 dBA)	89
4	Concrete Truck (85 dBA), Backhoe (83 dBA), Crane (83 dBA)	89
5	Garbage Truck (85 dBA), Dump Truck (85 dBA), Backhoe (83 dBA)	85

We also note that not all phases and their respective activities will be carried out at the same distances from receivers. Grading, for instance, will be performed throughout selected areas of the entire Project Area, including at property boundaries as close as 30 ft from non-participating residences. Grading is expected to be minimal. In contrast, the closest inverter pad to a non-participating residence is 450 ft and the closest solar panel is approximately 180 ft from a non-participating residence. These varying distances are reflected in Table 7, which shows predicted noise levels for each phase at four distances.

For a number of reasons, the predicted sound levels in Table 7 are conservative, representing a “worst case scenario” for noise emission. First, the relatively high emission of the grading phase is due to the proximity of this activity to the property line. In practice, the noise levels will only be this high at receivers very close to the property line and only for a period of a few hours or less. For example, Phase 2 activities include pile driving, which control the combined maximum sound pressure level reported below, but pile driving will not occur for 100% of the time during Phase 2. All of our sound level predictions are also conservative in that they do not take into account ground absorption, atmospheric attenuation, or natural barriers. Furthermore, the combined sound levels assume that multiple pieces of equipment associated with a particular phase will be operating at the same time and in close proximity.

Table 7: Construction Estimated Sound Levels by Phase

Phase	Combined Maximum Sound Pressure Level of Expected Equipment at 50 ft (dBA)	Predicted Maximum Sound Level (dBA)			
		Receiver at 30 ft	Receiver at 180 ft	Receiver at 450 ft	Receiver at 1500 ft
1	89	94	78	70	59
2	100	-	89	81	71
3	89	-	78	70	59
4	89	-	-	70	59
5	85	-	74	66	55

* * * * *

Please contact me at 617-499-8027 or aodom@acentech.com with any questions or comments.

Sincerely,

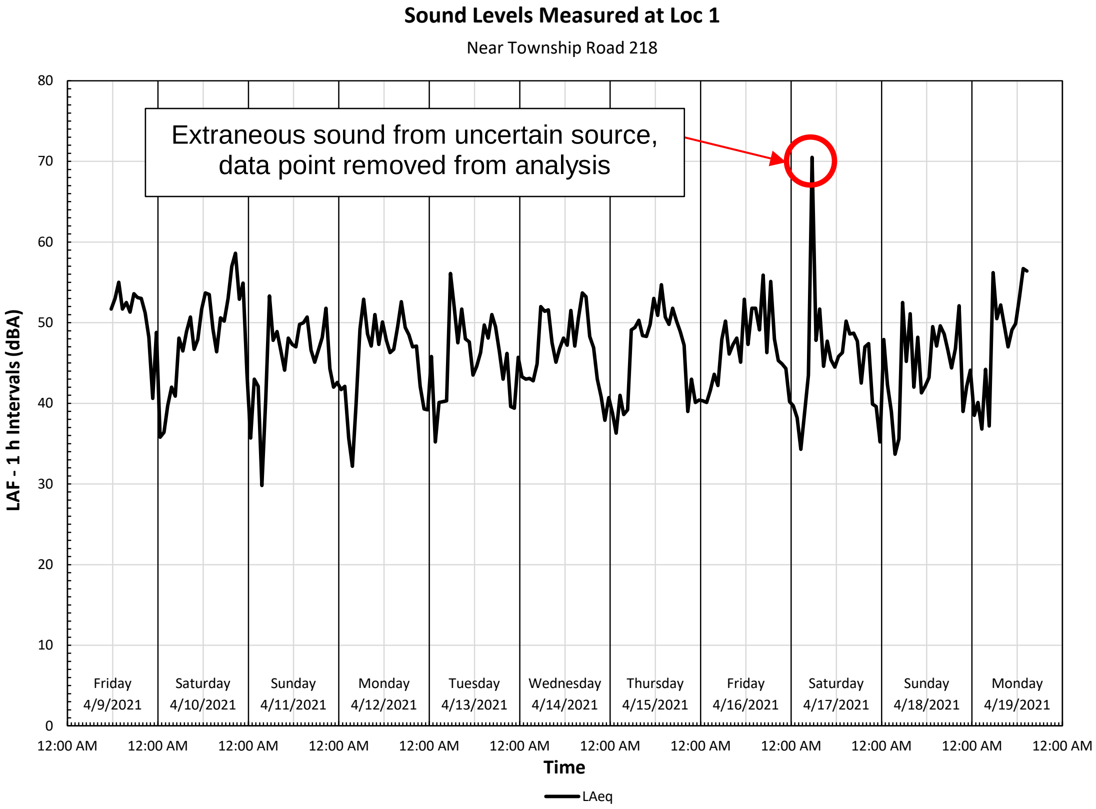
ACENTECH INCORPORATED

Alex Odom
Consultant

Cc: Michael Bahtiarian, Josh Brophy (Acentech)
Jacqueline Bruce (Haley & Aldrich)

Encl: Figures 2-6
Table 4
Appendix A: Site Plan

FIGURE 2: Sound Levels Measured at Location 1



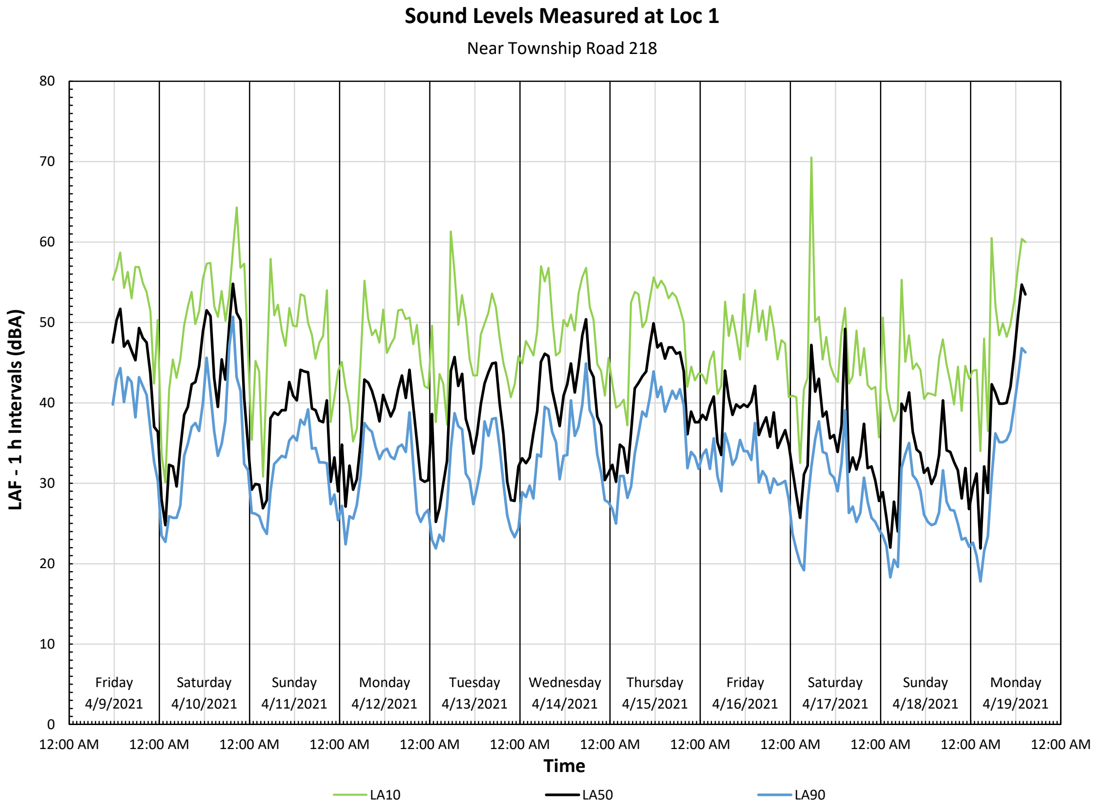
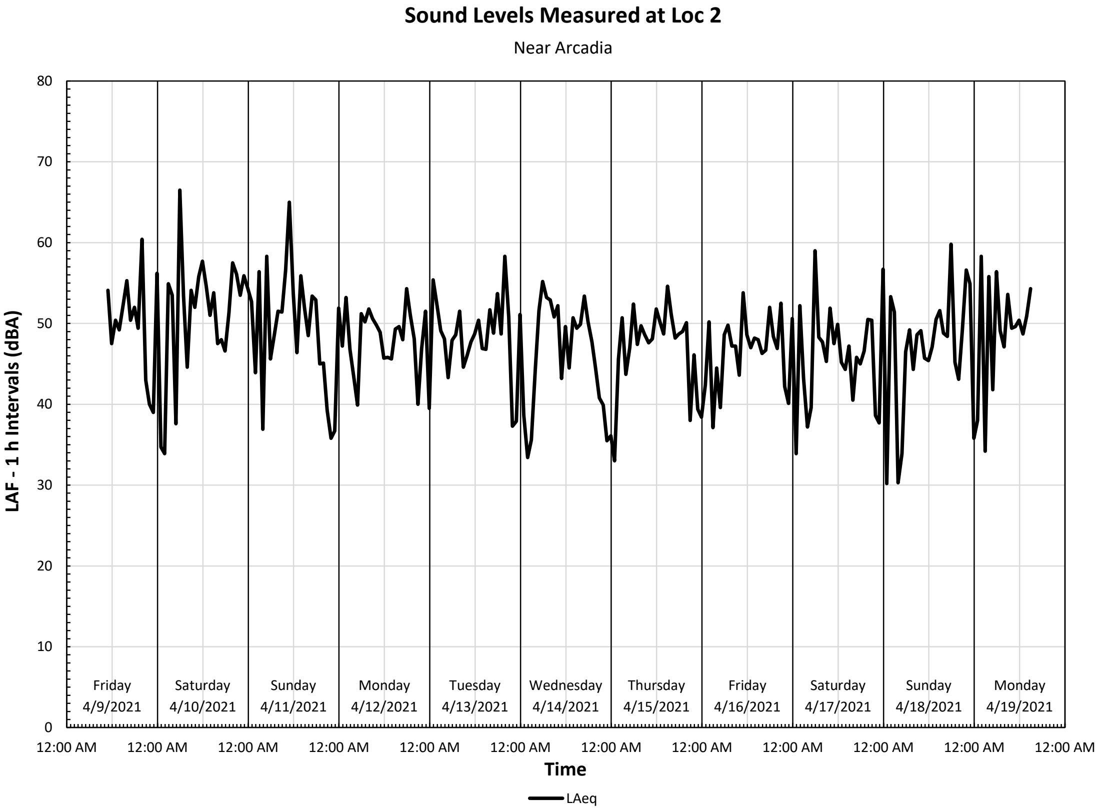


FIGURE 3: Sound Levels Measured at Location 2



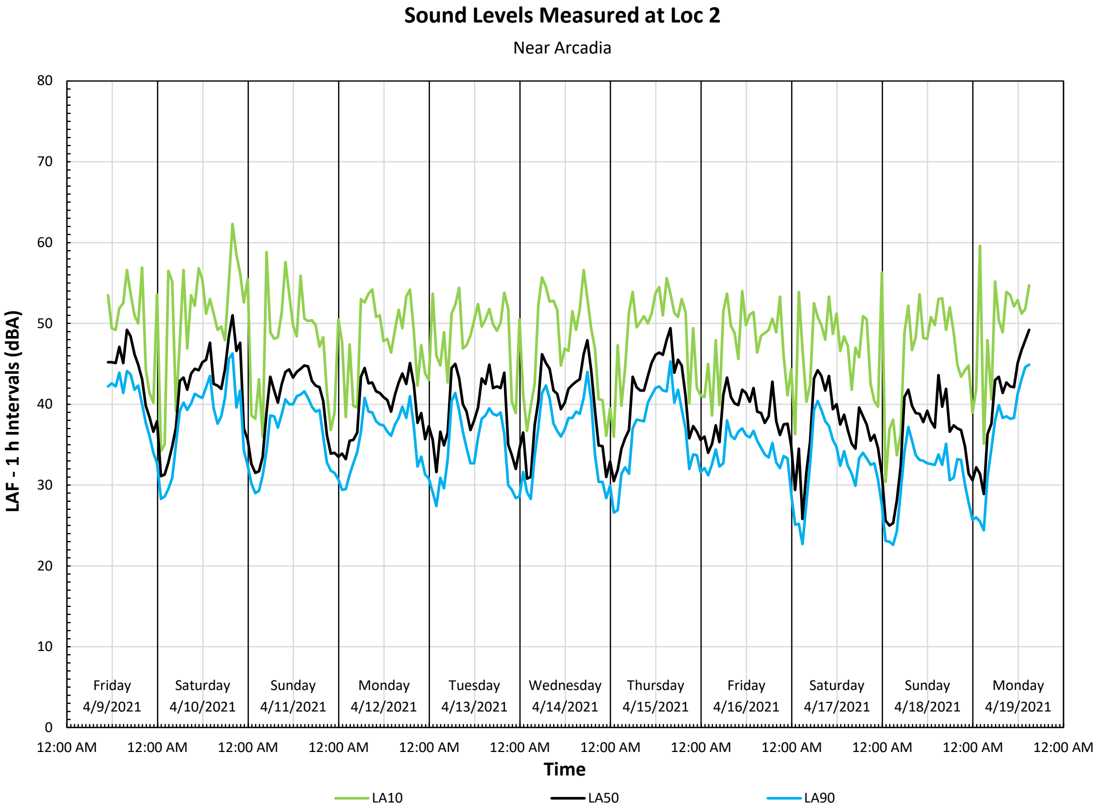


FIGURE 4A: Modeled residential receivers (North half of project)

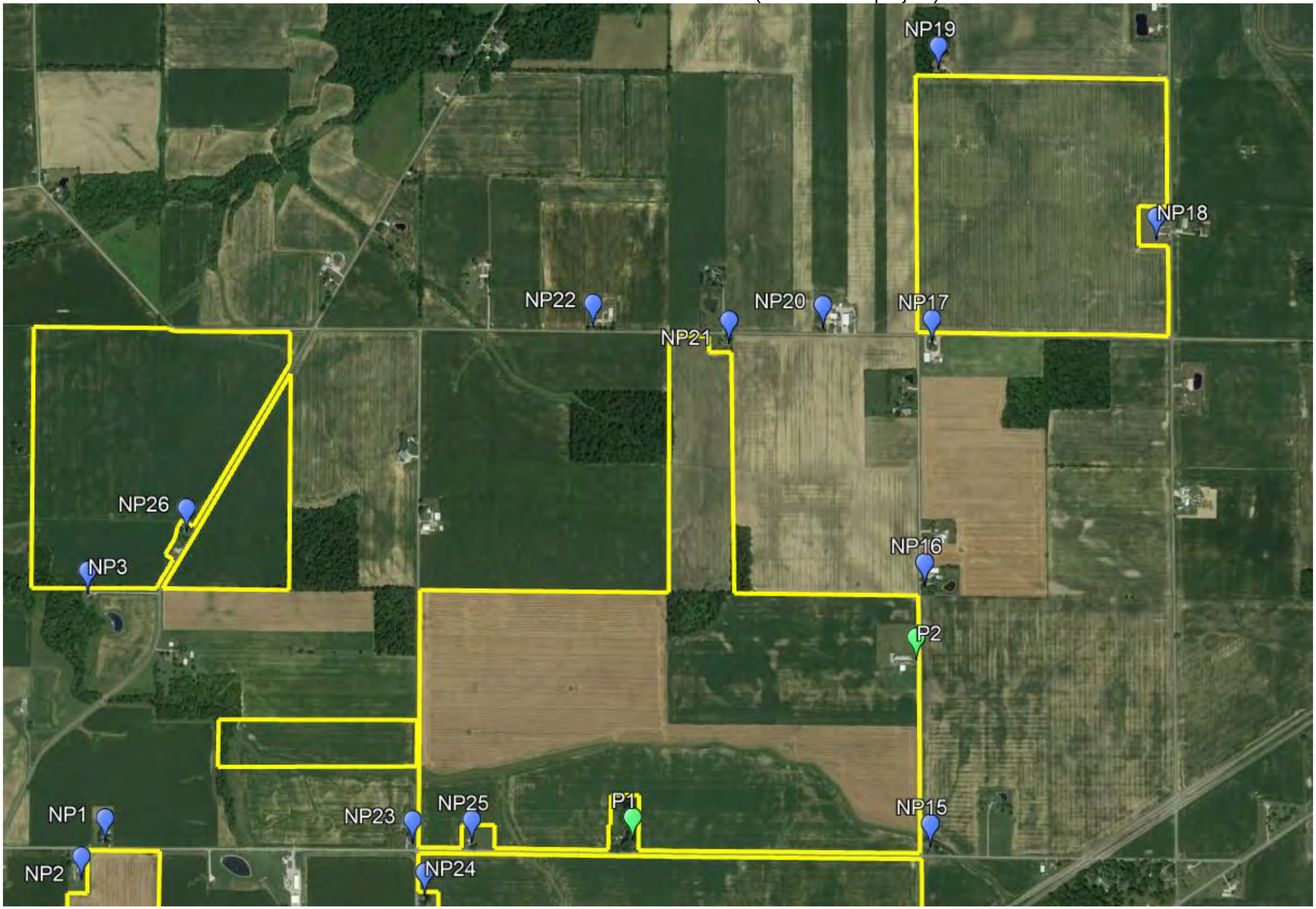


FIGURE 4B: Modeled residential receivers (South half of project)

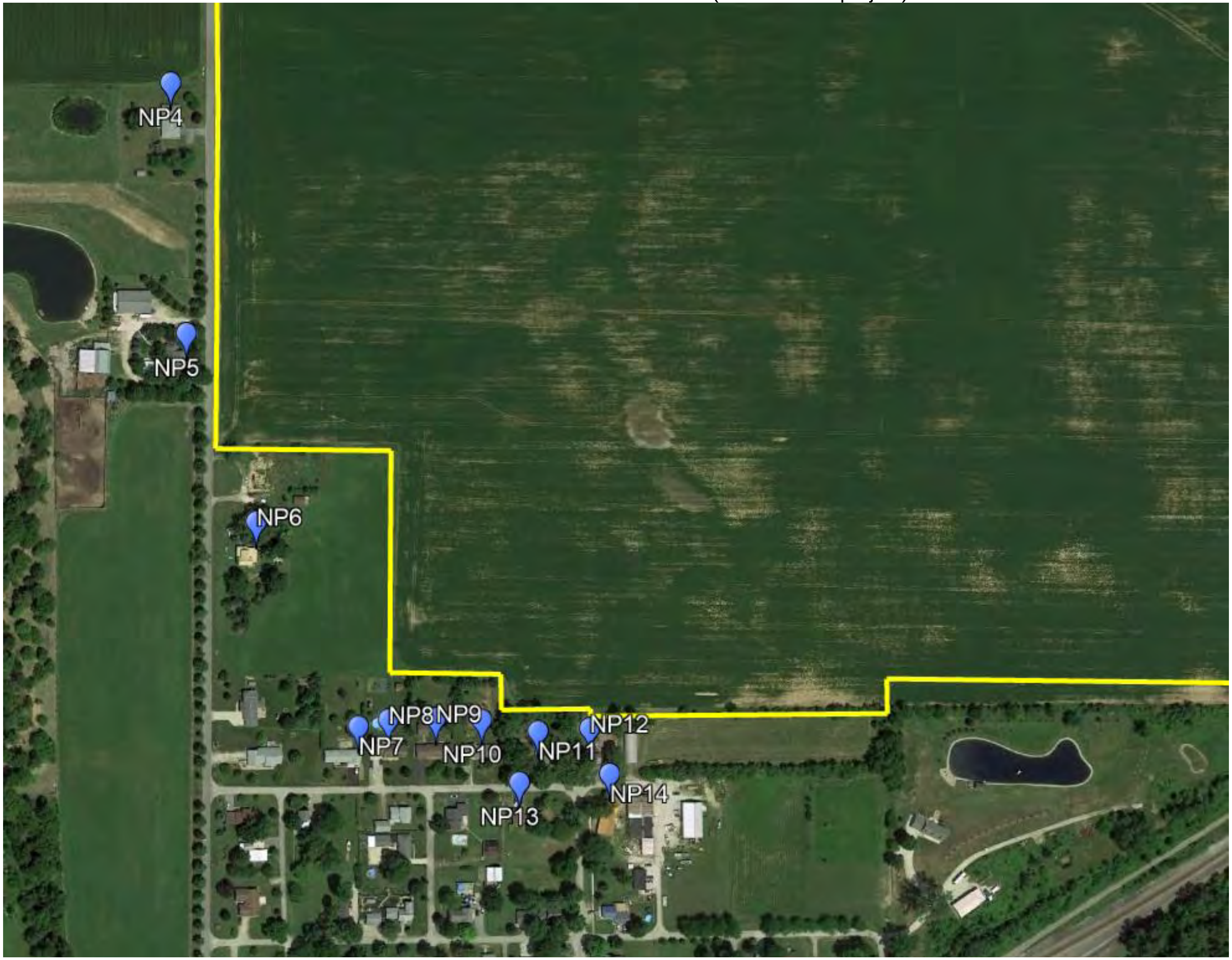


Table 4: Modeling Results

Receiver	Ambient (dBA)		Calculated Project Only Sound Level (dBA)		Combined Future Sound Level (dBA)		Expected Increase over Ambient (dB)	
	Day	Night	Day	Night	Day	Night	Day	Night
P1	52	51	47	36	53	51	1	0
P2	50	46	41	30	51	46	1	0
NP1	52	51	37	29	52	51	0	0
NP2	52	51	38	28	52	51	0	0
NP3	50	46	42	30	51	46	1	0
NP4	52	51	42	32	52	51	0	0
NP5	52	51	41	31	52	51	0	0
NP6	52	51	40	30	52	51	0	0
NP7	52	51	39	29	52	51	0	0
NP8	52	51	39	29	52	51	0	0
NP9	52	51	40	29	52	51	0	0
NP10	52	51	40	29	52	51	0	0
NP11	52	51	40	29	52	51	0	0
NP12	52	51	41	29	52	51	0	0
NP13	52	51	39	29	52	51	0	0
NP14	52	51	40	29	52	51	0	0
NP15	52	51	41	29	52	51	0	0
NP16	50	46	39	29	50	46	0	0
NP17	50	46	41	29	51	46	1	0
NP18	50	46	43	26	51	46	1	0
NP19	50	46	42	23	51	46	1	0
NP20	50	46	36	29	50	46	0	0
NP21	50	46	41	31	51	46	1	0
NP22	50	46	36	31	50	46	0	0
NP23	52	51	42	35	52	51	0	0
NP24	52	51	44	35	53	51	1	0
NP25	52	51	46	37	53	51	1	0
NP26	52	51	45	33	53	51	1	0

FIGURE 5: Project-Only Daytime Sound Contours (dBA)

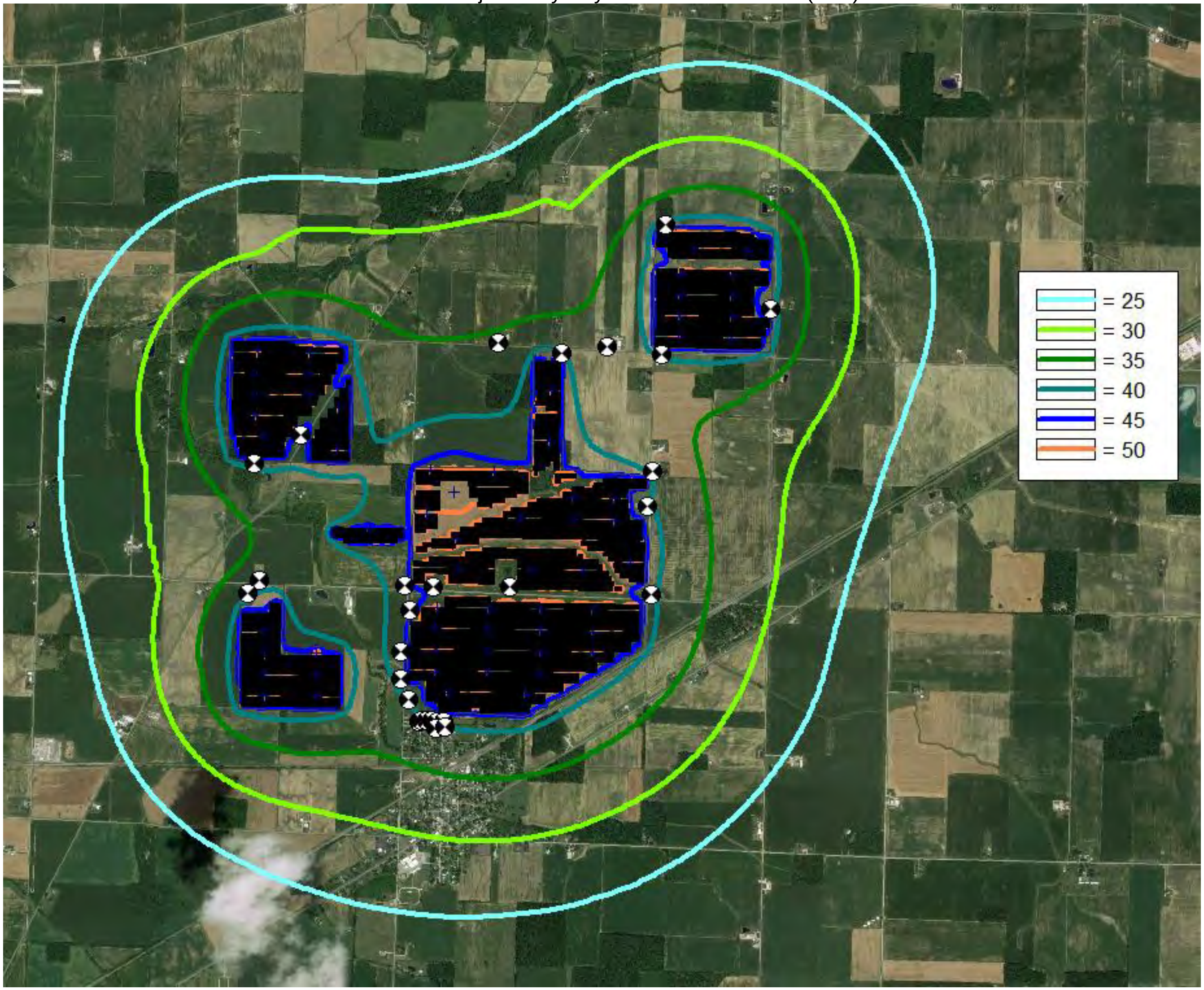
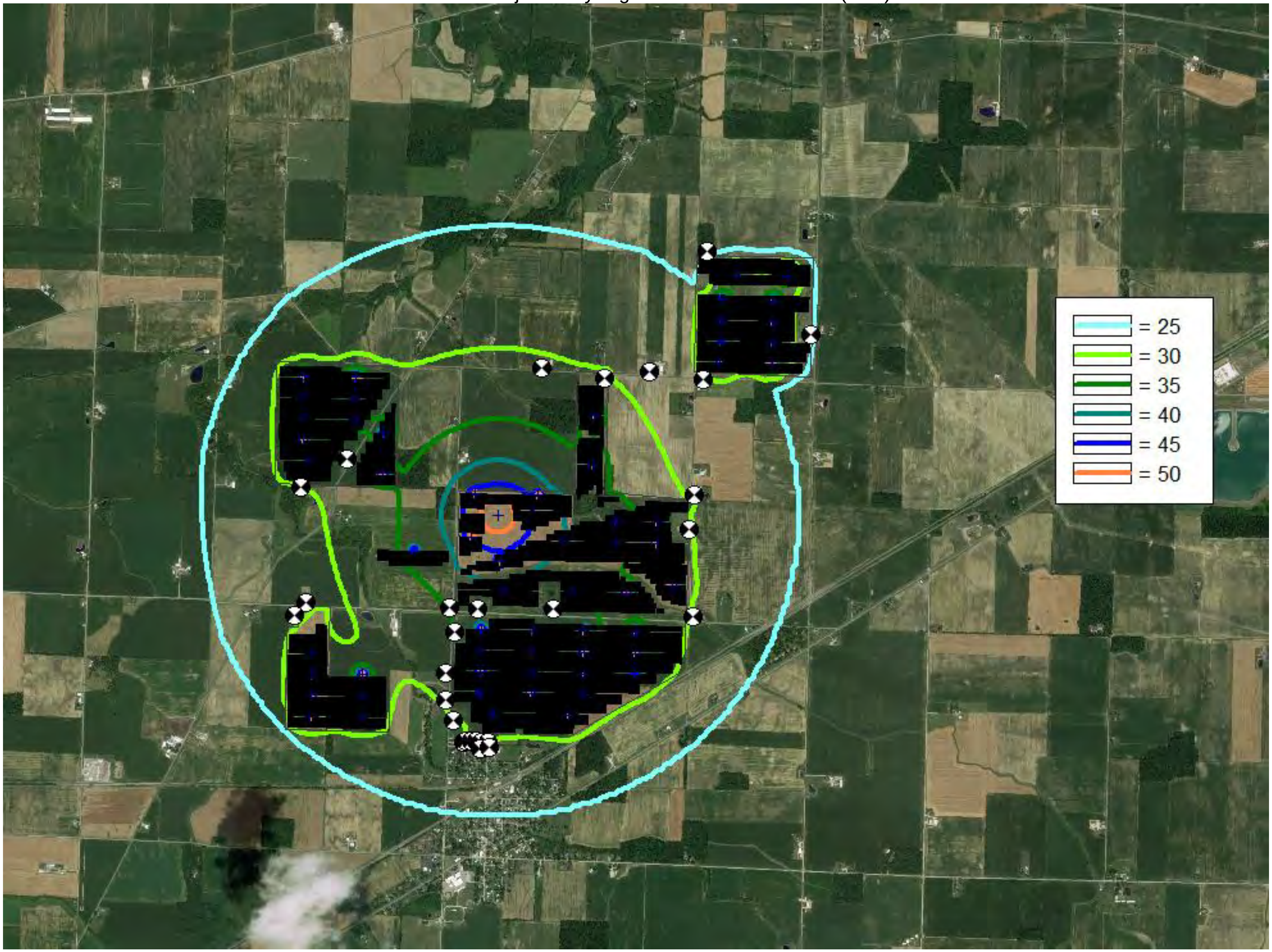
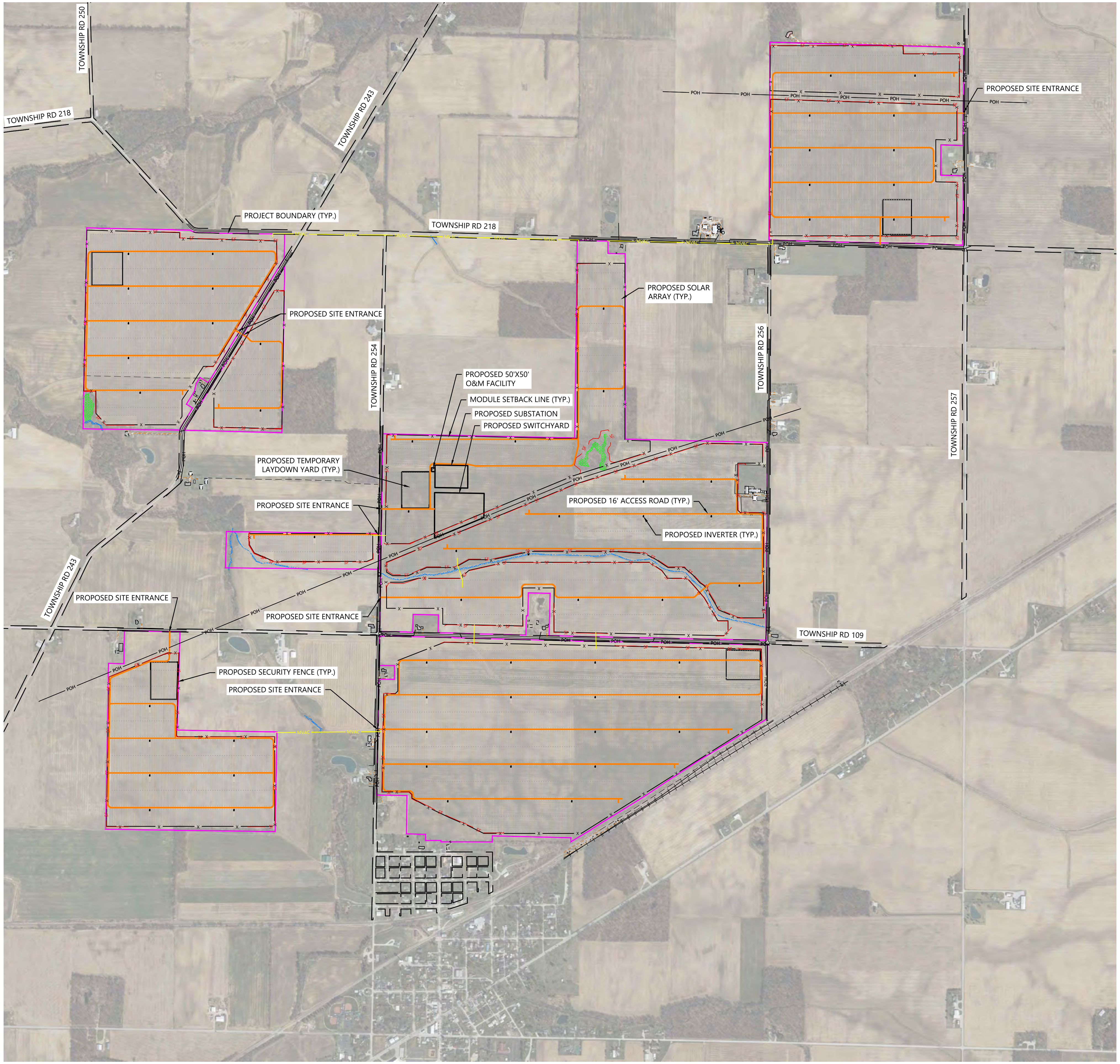


FIGURE 6: Project-Only Nighttime Sound Contours (dBA)



Appendix A – Site Plan



LEGEND:

━	PROJECT BOUNDARY
— — —	SECTION LINES
— — —	RIGHT-OF-WAY LINES
- - - -	EASEMENT LINES
◡◡◡	EX. TREELINE
═	EX. PAVED ROAD
= = =	EX. GRAVEL ROAD
= = =	EX. DRIVEWAY
┼┼┼	EX. RAILROAD
— x —	EX. FENCE LINE
— POH —	EX. OVERHEAD POWER
▯▯▯▯▯	PROPOSED SOLAR ARRAY
━	PROPOSED ACCESS ROAD
— x —	PROPOSED SECURITY FENCE
— SF —	PROPOSED SILT FENCE
▭	PROPOSED ELECTRICAL EQUIPMENT
— MVAC —	PROPOSED COLLECTION
▨	PROPOSED LAYDOWN YARD
▭	PROPOSED SUBSTATION/SWITCHYARD
▩	PROPOSED O&M FACILITY
🟩	DELINEATED WETLANDS
🟦	DELINEATED STREAMS

SYSTEM SPECIFICATIONS	
SYSTEM SIZE - MWDC	270.37
SYSTEM SIZE - MWAC	205
DC/AC (AT INVERTER)	1.32
MODULE MODEL	LONGI LR5 72HBD-540M
MODULE RATING (W)	540
MODULE QUANTITY	500,688
STRINGS (27 MODULES PER STRING)	18,544
INVERTER QUANTITY	60

Westwood

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renewable energy
6688 N CENTRAL EXPRESSWAY, SUITE 500
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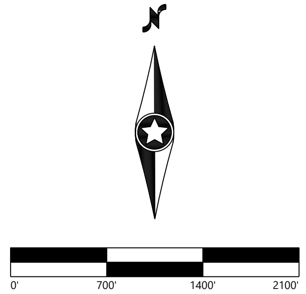
REVISIONS:

#	DATE	COMMENT



South Branch Solar

Hancock County, OH

Overall Site Plan

NOT FOR CONSTRUCTION

DATE: 07/14/2021

SHEET: C.101

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APPENDIX O

WETLAND AND STREAM DELINEATION REPORT

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WETLAND AND STREAM DELINEATION REPORT
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

Prepared for:
South Branch Solar, LLC

Prepared by:
Haley & Aldrich, Inc.

File No. 0135392-002
July 2021

HALEY & ALDRICH, INC.
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SIGNATURE PAGE FOR

WETLAND AND STREAM DELINEATION REPORT
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

PREPARED FOR
SOUTH BRANCH SOLAR, LLC

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Lynn Gresock

Lynn Gresock
Principal Consultant
Haley & Aldrich, Inc.

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Appendix B – Wetland Determination Data and Stream Inventory Data Forms

List of Tables (embedded in report text)

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1. Introduction

This Wetland and Stream Delineation Report summarizes the results of field work performed by Haley & Aldrich, Inc. (Haley & Aldrich) in April 2021 to locate and identify wetlands and streams to support South Branch Solar (the Project), a photovoltaic solar facility proposed in Washington Township, Hancock County, Ohio (Figure 1).

Approximately 1,019 acres of land (the Study Area) was included in the field delineation effort conducted on behalf of South Branch Solar, LLC. The Study Area is located immediately north of the Village of Arcadia, approximately 3 miles southwest of the City of Fostoria, and 6 miles northeast of the City of Findlay. Most of the Study Area is actively farmed, primarily in row crops (e.g., soybeans and corn). Small areas of forest and an active cow pasture are also present. In addition to several roadways, there are existing electric transmission and distribution lines that cross the Study Area.

A total of two wetlands and five stream segments (three of which are associated with South Branch Portage River, one is an unnamed perennial stream, and the remaining is an intermittent stream) were delineated during the field investigations. Of these waterbodies, Haley & Aldrich's analysis suggests one wetland appears to be isolated and is likely to be considered jurisdictional by the Ohio Environmental Protection Agency (Ohio EPA). Another was observed to have hydrological connections to other Waters of the United States and would likely be considered jurisdictional by the U.S. Army Corps of Engineers (USACE). The delineated intermittent and perennial streams identified in the analysis are also likely to be considered jurisdictional by the USACE.

2. Regulatory Authorities

2.1 WATERS OF THE UNITED STATES

The Study Area is located within the USACE Buffalo District. As defined by the USACE, Waters of the United States include lakes, ponds, streams (intermittent and perennial), and wetlands, which are regulated under Sections 401 and 404 of the Clean Water Act. Federal jurisdictional wetlands are defined as "those that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions."

The USACE also regulates navigable waters under Section 10 of the Rivers and Harbor Act (33 United States Code [U.S.C.] 401 et seq.), which requires a permit from the USACE to construct any structure in or over any navigable water of the United States, as well as any proposed action that would alter or disturb (such as excavation/dredging or deposition of materials) these waters. If the proposed structure or activity affects the course, location, condition, or capacity of the navigable water, even if the proposed activity is outside the boundaries of the water body, a permit from the USACE is required.

2.2 OHIO WETLANDS AND STREAMS

The Ohio EPA Division of Surface Water regulates wetlands pursuant to Section 401 of the federal Clean Water Act. Section 401 of the Clean Water Act requires that state agencies evaluate projects that will result in the discharge of dredged or fill material into Waters of the United States to determine whether the discharge will violate the state's water quality standards. Section 401 Water Quality Certifications are issued for the discharge of dredge and fill materials to Waters of the State.

"Waters of the State" are those waters within the jurisdiction of the Ohio EPA. They are generally defined as surface and underground water bodies, which extend through or exist wholly within the state; these include, but are not limited to, streams and both isolated and non-isolated wetlands. Private ponds, or any pond, reservoir, or facility built for reduction of pollutants prior to discharge are not included in this definition.

In addition to Waters of the United States, the Ohio EPA also regulates and issues permits for isolated wetland and ephemeral stream impacts under Sections 6111.21 and 6111.03(J)(1) of the Ohio Revised Code (ORC). The state relies on the USACE jurisdictional authority regarding wetland and stream determinations and delineations including whether a wetland is isolated or non-isolated and whether a stream is ephemeral.

3. Methodology

Prior to initiating field investigations, Haley & Aldrich conducted a desktop review of publicly available data to evaluate the presence of mapped wetlands and streams within the Study Area. Data consulted included:

- United States Geological Survey (USGS) topographic quadrangle maps;
- United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps;
- Natural Resources Conservation Service (NRCS) Web Soil Survey;
- Federal Emergency Management Agency (FEMA) Flood Insurance maps;
- National Hydrography Dataset (NHD);
- Ohio Wetlands Inventory (OWI); and
- Recent aerial photography.

The wetland and stream delineation field survey was performed in accordance with criteria set forth in the *Corps of Engineers Wetland Delineation Manual* ([Environmental Laboratory, 1987] [Manual]) and the *2010 Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Midwest Region* ([Version 2.0] [USACE, 2010] [Supplement]). Data was collected from one or more sample plots in each delineated wetland (depending on the size of the delineated area) and was recorded on USACE Wetland Determination Data forms. The boundaries of wetlands were located with a Trimble TDC150 Global Positioning System (GPS) unit with reported sub-meter accuracy.

Hydrology was evaluated based on indicators that are divided into two categories: primary and secondary. The 1987 Manual and 2010 Supplement define hydrology as present when at least one primary indicator or two secondary indicators are identified. One primary indicator is sufficient to evaluate whether hydrology is present; however, if primary indicators are absent, two or more secondary indicators are required to evaluate hydrology. If other potential hydrology evidence was found (e.g., moss trim lines or microtopographic relief), it was subsequently documented on the Wetland Determination Data Form.

Hydrophytic vegetation was assessed by identifying plant species and their assigned wetland indicator rating of obligate, facultative wet, facultative, facultative upland, or upland, according to the *2018 National Wetland Plant List* (USACE, 2018). In both upland and wetland communities, vegetation was characterized using the areal dominance method, with a 30-foot-radius around the soil sample location for trees, a 15-foot-radius for saplings/shrubs, and a 5-foot-radius for herbaceous plants.

Hydric soil indicators were evaluated using soil characteristics, as defined in *Field Indicators of Hydric Soils in the United States (Version 8.0)* (NRCS, 2016). Evidence of hydric soil indicators were recorded based on the presence of color matrix, hue, and redoximorphic features, such as saturation, gleyed matrix, mottling, hydrogen sulfide odor, and/or organic/peat layers. Soil test pits were dug using a shovel to a depth of approximately 18 inches, or refusal due the presence of hard pan layer, rock, or hard fill material. Soil color was described using the Munsell Color book, and soil texture was determined using USDA hand-texture methods.

Wetlands were classified based on the Cowardin classification system (Cowardin, *et al.*, 1979). This system includes classifications for Palustrine Emergent (PEM), Palustrine Scrub-Shrub (PSS), and Palustrine Forested (PFO) wetlands. Within PEM wetlands, emergent plants make up at least 30 percent aerial coverage and are the tallest life form. Within PSS wetlands, woody plants less than 20 feet tall are the dominant vegetation. PFO wetlands are dominated by woody plants at least 20 feet tall.

Wetlands were also evaluated using the *Ohio Rapid Assessment Method (ORAM) for Wetlands v. 5.0* (Mack, 2001). The ORAM process focuses on an assessment of delineated wetlands, as opposed to the boundary of wetlands. The ORAM assessment utilizes scoring forms to determine the ecological and functional value of a particular wetland. The ORAM was developed to provide a relatively fast and easy method for determining the appropriate category of a wetland under the Wetland Anti-Degradation Rule, Ohio Administrative Code (OAC) Rule 3745-1-54. These regulations specify three wetland categories: Category 1, Category 2, and Category 3, which correspond to low-, medium-, and high-quality wetlands, respectively.

Additional surface waters, including stream channels and drainage ways, found during field work were investigated, and ordinary high-water marks were located with GPS. Delineated streams were characterized on the Stream Inventory Data Form, as well as the Primary Headwater Habitat Evaluation Form (Ohio EPA, 2012) and Qualitative Habitat Evaluation Index and Use Assessment Field Sheet, as necessary. Recorded stream data included average water width, average ordinary high-water mark width, bankfull width, stream depth, bank height and slope, meander, gradient, channel substrate types, and adjacent vegetative community characteristics. To the extent practicable, these surface waters were investigated to evaluate drainage patterns and potential connections to other Waters of the United States.

Streams were classified as either perennial, intermittent, or ephemeral. A perennial stream has flowing water year-round during a typical year. They are generally identified as solid blue lines on USGS topographic maps. An intermittent stream has flowing water during certain times of the year when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Intermittent streams are generally identified as dashed blue lines on USGS topographic maps. An ephemeral stream has flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral streams are not identified on USGS topographic maps. These desktop classifications were refined based on conditions observed during the field survey (e.g., flowing water unrelated to recent precipitation in an unmapped stream would be classified as intermittent).

4. Site Setting

4.1 PHYSIOGRAPHY AND SOILS

The Study Area is located in the Till Plains section of the larger Central Lowlands physiographic province. Topography with the Study Area is generally flat with areas of greater relief associated with stream channels. Elevation within the Study Area ranges from approximately 775 feet above mean sea level (amsl) in the western portion of the Study Area to approximately 800 feet amsl along the southern extent of the Study Area (USGS, 2021). A topographic map of the Study Area and surrounding region is provided as Figure 2.

Soil map units, drainage class, and hydric classification are listed in Table 1, in order of prevalence within the Study Area, and provided as Figure 2 (NRCS, 2021).

Table 1. Study Area Soils

Soil Map Unit Symbol	Soil Map Unit Name	Percentage of Study Area	Drainage Class	Hydric Classification[1]
PmA	Pewamo silty clay loam, 0 to 1 percent slopes	33.3	Very Poorly Drained	Hydric
GsB	Glynwood-Blount-Houcktown complex, 1 to 4 percent slopes	25.9	Moderately Well Drained – Somewhat Poorly Drained	Not Hydric
Blg1A1	Blount silt loam, ground moraine, 0 to 2 percent slopes	25.8	Somewhat Poorly Drained	Hydric
BpA	Blount-Houcktown complex, 0 to 3 percent slopes	6.9	Somewhat Poorly Drained – Moderately Well Drained	Not Hydric
AkA	Alvada loam, 0 to 1 percent slopes	2.9	Very Poorly Drained	Hydric
Blg2A1	Blount loam, ground moraine, 0 to 2 percent slopes	0.9	Somewhat Poorly Drained	Not Hydric
BrA	Blount-Jenera complex, 0 to 3 percent slopes	0.9	Somewhat Poorly Drained – Moderately Well Drained	Not Hydric
Gwg1B1	Glynwood silt loam, ground moraine, 2 to 6 percent slopes	0.7	Moderately Well Drained	Not Hydric
HrB	Houcktown-Glynwood-Jenera complex, 1 to 4 percent slopes	0.8	Moderately Well Drained	Not Hydric
SoA	Sloan silty clay loam, 0 to 1 percent slopes, occasionally flooded	0.5	Very Poorly Drained	Hydric
JeB	Jenera fine sandy loam, 2 to 6 percent slopes	0.6	Moderately Well Drained	Not Hydric
Blg1B1	Blount silt loam, ground moraine, 2 to 4 percent slopes	0.3	Somewhat Poorly Drained	Not Hydric
JeA	Jenera fine sandy loam, 0 to 2 percent slopes	0.3	Moderately Well Drained	Not Hydric
SmA	Shoals silt loam, 0 to 2 percent slopes, occasionally flooded	0.1	Somewhat Poorly Drained	Not Hydric
Gwg5C2	Glynwood clay loam, ground moraine, 6 to 12 percent slopes, eroded	0.1	Moderately Well Drained	Not Hydric

Note:

[1] Soils mapping source: USDA, NRCS Web Soil Survey (accessed 13 July 2021).

Descriptions of each soil series comprising at least five percent of the Study Area, in order of prevalence, are provided below. See Figure 2 for mapping of all soil map units located within the Study Area.

- **Pewamo Series:** Pewamo series soils consist of deep, dark-colored soils that are poorly drained. They are nearly level and located on the till plain. Pewamo series soils have a seasonal high-water table. The available moisture capacity is high, and permeability is moderately slow.
- **Glynwood Series**: Glynwood series soils consist of very deep, moderately well drained soils on ground moraines and end moraines. The depth to the top of an intermittent perched high-water table ranges from 1 to 2 feet between January and April in normal years. Permeability is slow to very slow. These soils are well suited to agricultural use.
- **Blount Series**: Blount series soils consist of very deep, somewhat poorly drained soils on wave-worked till plains, till plains, and near-shore zones (relict). Depth to the top of a perched seasonal high-water table ranges from 0.5 to 2 feet in normal years. Permeability is slow to very slow. These soils are well suited to agricultural use.

4.2 HYDROLOGY

The Study Area is located in the Cedar-Portage Watershed (USGS HUC 04100010). The major streams located in this watershed include the Portage River, Sugar Creek, Lacarpe Creek, Bayou Ditch, Berger Ditch, and Wolf Ditch. The Portage River flows northeast to Lake Erie.

The majority of surface hydrology within the Study Area is generated by precipitation and surface water sheet flow from adjacent areas at higher elevations. The Study Area has an average annual precipitation of 33.82 inches, as measured in nearby Findlay, Ohio (NCDC, 2021).

There are four NWI wetlands mapped within the Study Area: one freshwater forested wetland (NWI code: PFO1A) and three riverine wetlands (NWI codes: R2UBH and R4SBC). One of the riverine wetlands coincides with the South Branch Portage River, while the others follow unnamed streams.

The OWI indicates the potential presence of six, relatively small wetlands within the Study Area. These areas are classified as "Woods on Hydric Soil." State and federally mapped aquatic resources within the Study Area are summarized in Table 2 and depicted on Figure 3.

Table 2. State and Federally Mapped Wetlands and Streams within the Study Area

Code	Wetland Type	Status
PFO1A	Freshwater Forested Wetland	No official state or federal status
R2UBH	Riverine	No official state or federal status
R4SBC	Riverine	No official state or federal status
34 (6 occurrences)	Woods on Hydric Soil	No official state or federal status

5. Results

Field investigations to delineate wetlands and streams within the Study Area were completed by Haley & Aldrich wetland scientists between 19 to 23 April 2021. A total of two wetlands and five stream segments were identified. Delineated wetlands and streams are depicted on Figure 4 and are summarized in Tables 3 and 4, respectively.

5.1 DELINEATED WETLANDS

Wetland MMA is a 1.02-acre PFO wetland with two small PEM wetland areas (totaling 0.11-acre) that extends into the edge of the adjacent agricultural fields. The observed indicators of wetland hydrology in this wetland were Sparsely Vegetated Concave Surface (B8), Surface Soil Cracks (B6) in the PEM areas, and High-Water Table (A2) in the PFO portion. The dominant vegetation in the PFO portion included shagbark hickory (*Carya ovata*), green ash (*Fraxinus pennsylvanica*), and lakebank (*Carex lacustris*). The PEM portion was largely unvegetated. The observed hydric soil indicator was Depleted Matrix (F3).

Wetland MMB is a 0.84-acre PFO wetland that is located between a perennial stream and active agricultural land. The observed indicators of wetland hydrology included High-Water Table (A2), Sparsely Vegetated Concave Surface (B8), Water-Stained Leaves, Crayfish Burrows (C8), and Geomorphic Position (D2). The dominant vegetation included silver maple (*Acer saccharinum)*, red maple (*Acer rubrum*), slippery elm (*Ulmus rubra*), green ash, Pennsylvania smartweed (*Persicaria pensylvanica*), trout lily (*Erythronium americanum*), and poison ivy (*Toxicodendron radicans*). The observed hydric soil indicator was Depleted Matrix (F3).

Table 3 contains the complete inventory of wetlands delineated in the Study Area. Representative photos of each wetland are included in Appendix A and completed Wetland Determination Data Forms are provided in Appendix B. Wetland community type was classified according to the Cowardin classification (Cowardin, *et al*., 1979).

Table 3. Delineated Wetlands

Wetland ID	Wetland Community[1]	Delineated Area[2] (acres)	ORAM Category	Presumed Jurisdiction[3]
Wetland MMA	PFO	1.02	2	Ohio EPA
	PEM	0.11	2	Ohio EPA
Wetland MMB	PFO	0.84	2	USACE

Notes:

[1] Wetland classifications are based on the Cowardin classification system.

[2] Area of delineated wetlands presented on Figure 4 represent the entire wetland area identified during field investigations within the Study Area and may include small areas outside of the actual Study Area limits.

[3] If necessary, final federal and state jurisdiction can only be confirmed through consultation with USACE and Ohio EPA staff.

5.2 DELINEATED STREAMS

Stream MM1 (South Branch Portage River) is a perennial stream that flows north through a small, wooded area in the western portion of the Study Area. The average ordinary high-water mark width was approximately 9 feet and the stream had a silt, sand, cobble, gravel, and cobble substrate. The water was clear and approximately 8 inches deep at the time of observation. Small fish were observed in deeper holes within the stream.

Stream MM2 is a perennial stream that generally flows west through agricultural areas in the center of the Study Area. The average ordinary high-water mark width was approximately 8 feet, and the stream had a silt and sand substrate. The water was clear and approximately 8 inches deep at the time of observation. This stream has been channelized to accept water from drain tiles in the adjacent agricultural fields.

Stream MM3 (South Branch Portage River) is a perennial stream that flows northwest through largely agricultural land in the southwest portion of the Study Area. The average ordinary high-water mark width was approximately 12 feet, and the stream had a silt, sand, and cobble substrate. The water was clear and approximately 6 inches deep at the time of observation.

Stream MM4 (South Branch Portage River) is a perennial stream that flows northwest through a forested area in the western portion of the Study Area. The average ordinary high-water mark width was approximately 21 feet, and the stream had a silt, sand, gravel, and cobble substrate. The water was clear and approximately 4 inches deep at the time of observation.

Stream MM5 is an intermittent stream that flows northwest through an agricultural area in the northern portion of the Study Area into a culvert under Township Road 218. The average ordinary high-water mark width was approximately 6 feet, and the stream had a silt, sand, gravel, and cobble substrate. The water was clear and approximately 5 inches deep at the time of observation. This stream has been channelized to accept water from drain tiles in the adjacent agricultural fields.

Table 4 below contains a summary of streams delineated within the Study Area. Representative photos of each stream are included in Appendix A, and completed Stream Data Inventory Forms are provided in Appendix B.

Table 4. Delineated Streams

Stream ID	Stream Type[1]	Delineated Length (feet)[2]	Delineated Width (feet)[3]	Delineated Depth (inches)[3]	HHEI Score	Presumed Jurisdiction[4]
Stream MM1[5]	Perennial	570	9	8	71	USACE
Stream MM2	Perennial	6,740	8	8	79	USACE
Stream MM3[5]	Perennial	330	12	6	74	USACE
Stream MM4[5]	Perennial	310	21	4	85	USACE
Stream MM5	Intermittent	140	6	5	69	USACE

Notes:

[1] A perennial stream has flowing water year-round during a typical year. Perennial streams are generally identified as solid blue lines on USGS topographic maps. An intermittent stream has flowing water during certain times of the year when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Intermittent streams are generally identified as dashed blue lines on USGS topographic maps. An ephemeral drain has flowing water only during and for a short duration after precipitation events in a typical year. Ephemeral drains are not identified on USGS Topographic maps.

[2] Length of delineated wetlands presented on Figure 4 represent the entire stream length identified during field investigations and may include small areas outside of the actual Study Area limits.

[3] Stream characteristics are an average of conditions observed during the field survey.

[4] If necessary, jurisdiction will be confirmed through agency consultation.

[5] South Branch Portage River.

6. Conclusions

A total of two wetlands and five stream segments (three of which are associated with the South Branch Portage River, one is an unnamed perennial stream, and the remaining is an intermittent stream) were delineated during the field investigations conducted by Haley & Aldrich in April 2021. Haley & Aldrich's analysis suggests Wetland MMA appears to be isolated, and as such, is likely to be considered jurisdictional by the Ohio EPA. Wetland MMB was observed to have hydrological connections to other Waters of the United States (South Branch Portage River) and would likely be considered jurisdictional by the USACE. The delineated intermittent and perennial streams are also likely to be considered jurisdictional by the USACE. If necessary, it is recommended that a final determination of jurisdictional status be made through consultation with the USACE and Ohio EPA.

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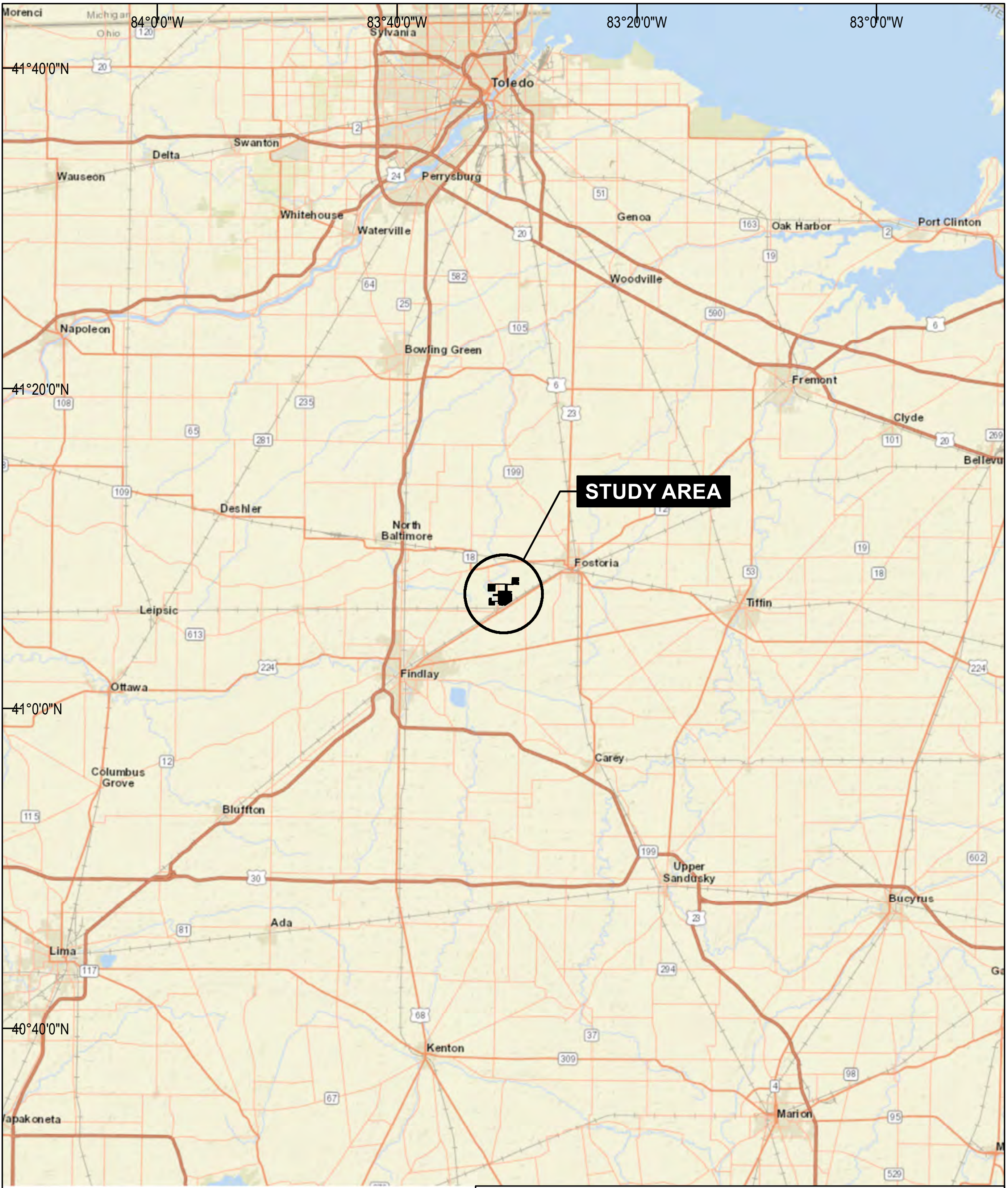
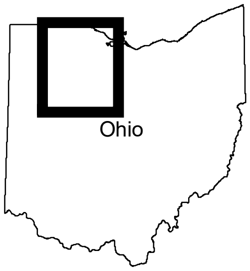
\\haleyaldrich.com\share\CF\Projects\135392\Wetlands\Report\Final Report\2021_0713_HAI_South_Branch_Solar_Wetland Report_F.docx

FIGURES





0 5 10

SCALE IN MILES

MAP SOURCE: ESRI

SITE COORDINATES: 41°07'32"N, 83°30'25"W

HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

STUDY AREA OVERVIEW

APPROXIMATE SCALE: 1 IN = 10 MI
JULY 2021

FIGURE 1

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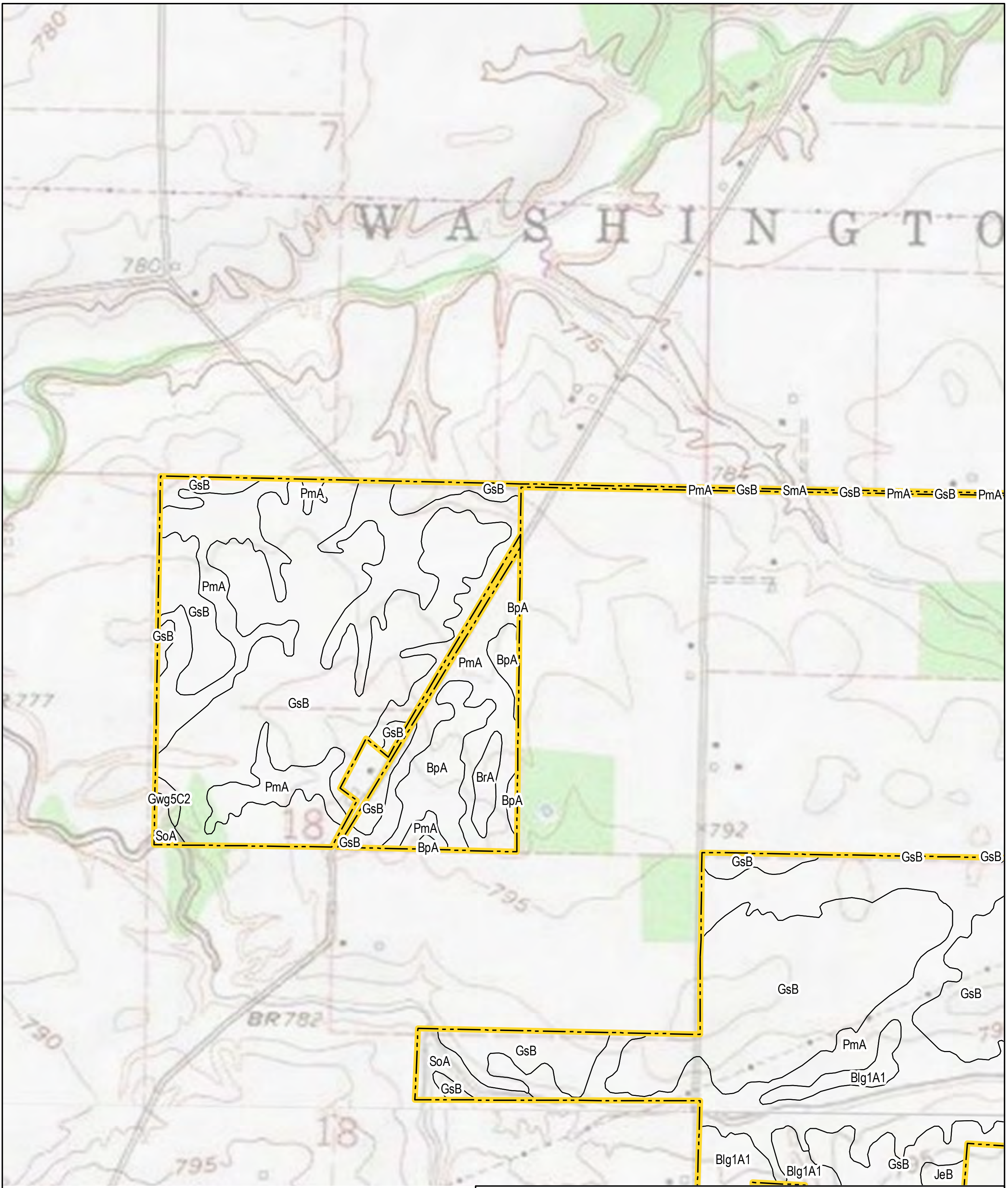
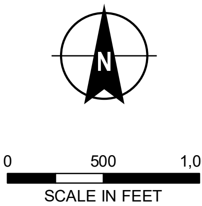


LEGEND

☐	SOIL MAP UNIT
▭	STUDY AREA

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI



HALEY ALDRICH

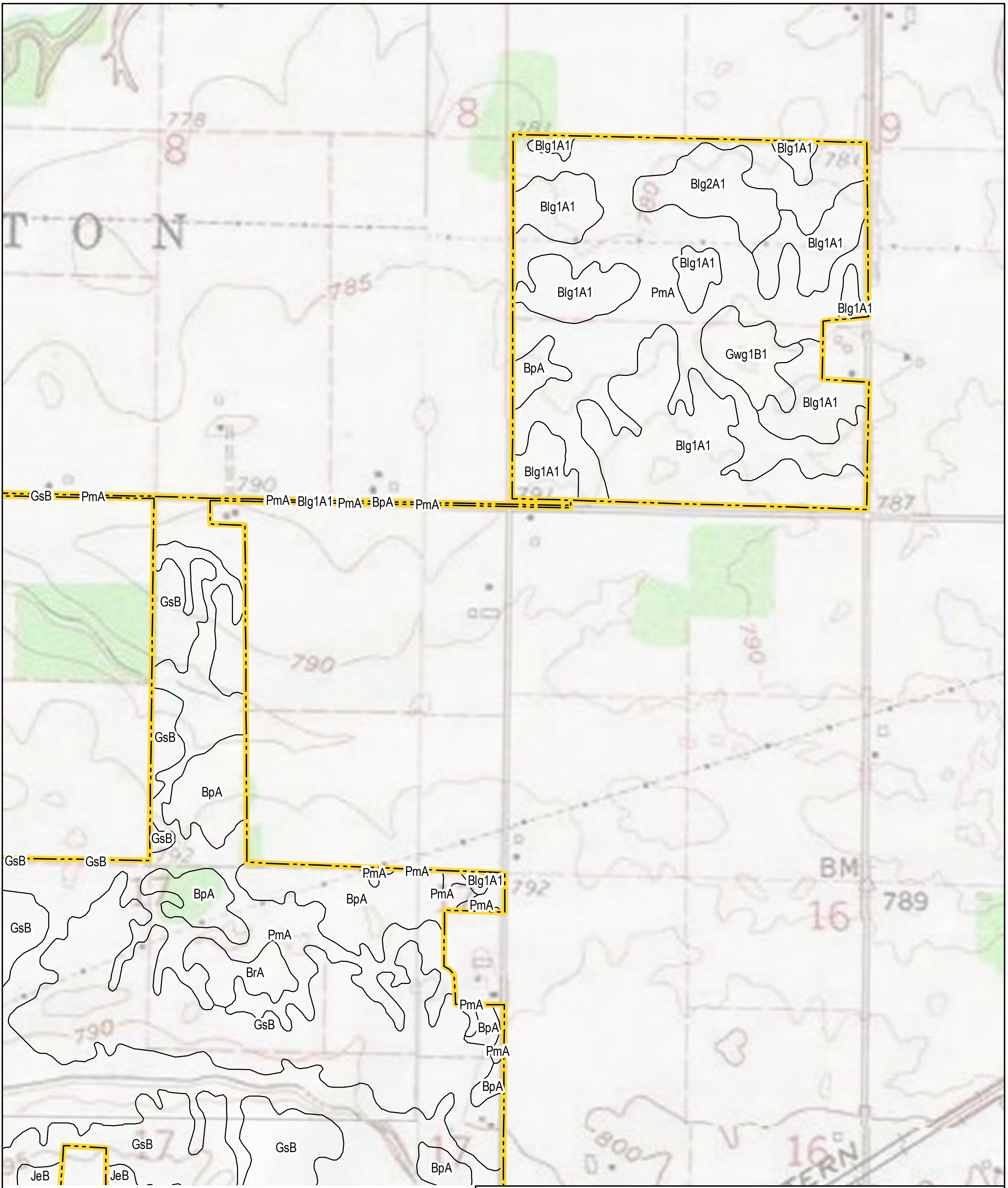
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHY AND SOILS

SCALE: AS SHOWN
JULY 2021

SHEET 1 OF 4
FIGURE 2

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0002_TOPOGRAPHY_AND_SOILS_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 10:18:21 AM



LEGEND

☐ SOIL MAP UNIT

☐ STUDY AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

N

0 500 1,000

SCALE IN FEET

HALEY ALDRICH

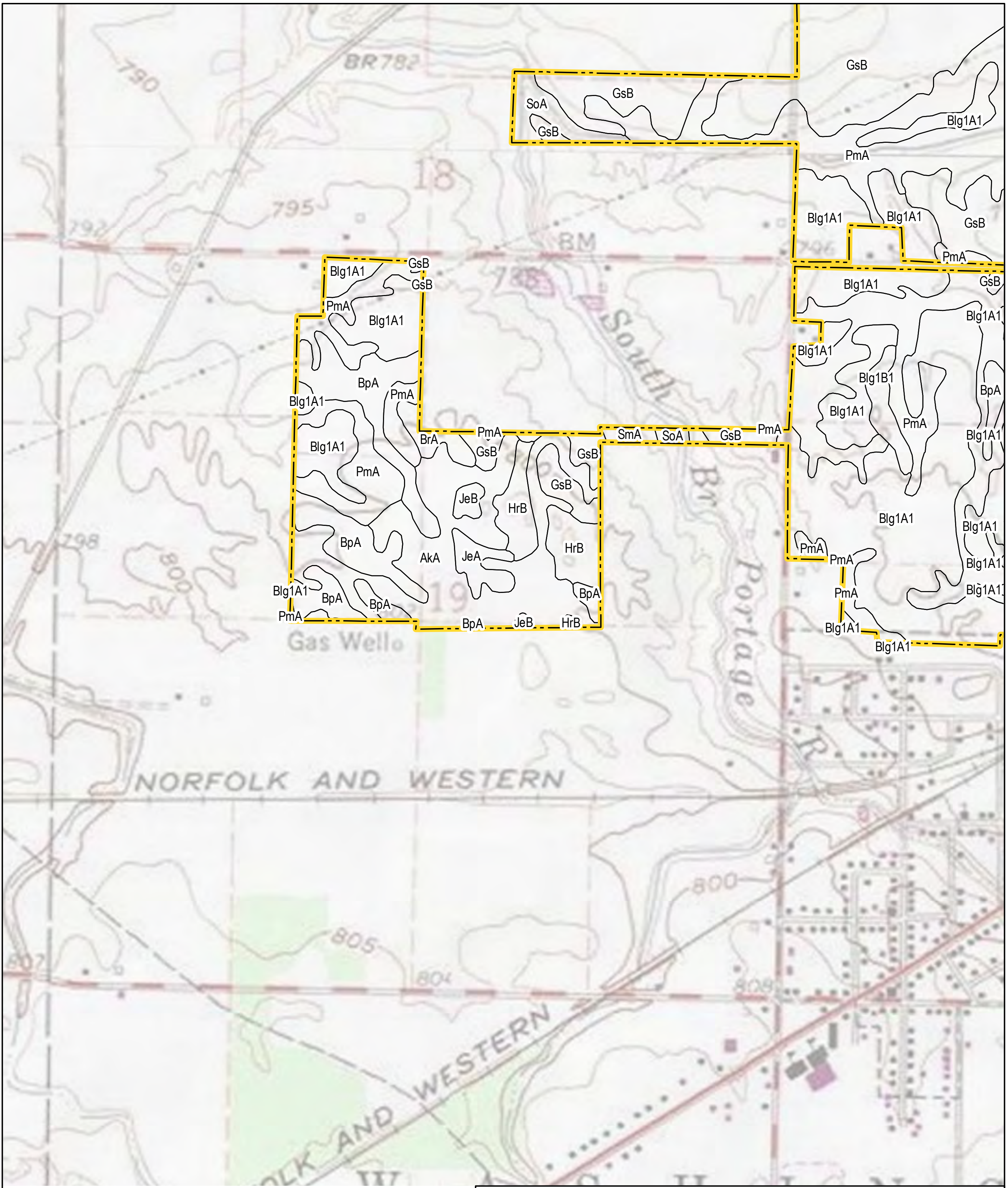
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHY AND SOILS

SCALE: AS SHOWN
JULY 2021

SHEET 2 OF 4
FIGURE 2

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0002_TOPOGRAPHY_AND_SOILS_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 10:18:21 AM



LEGEND

☐ SOIL MAP UNIT

▭ STUDY AREA

N

0 500 1,000

SCALE IN FEET

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

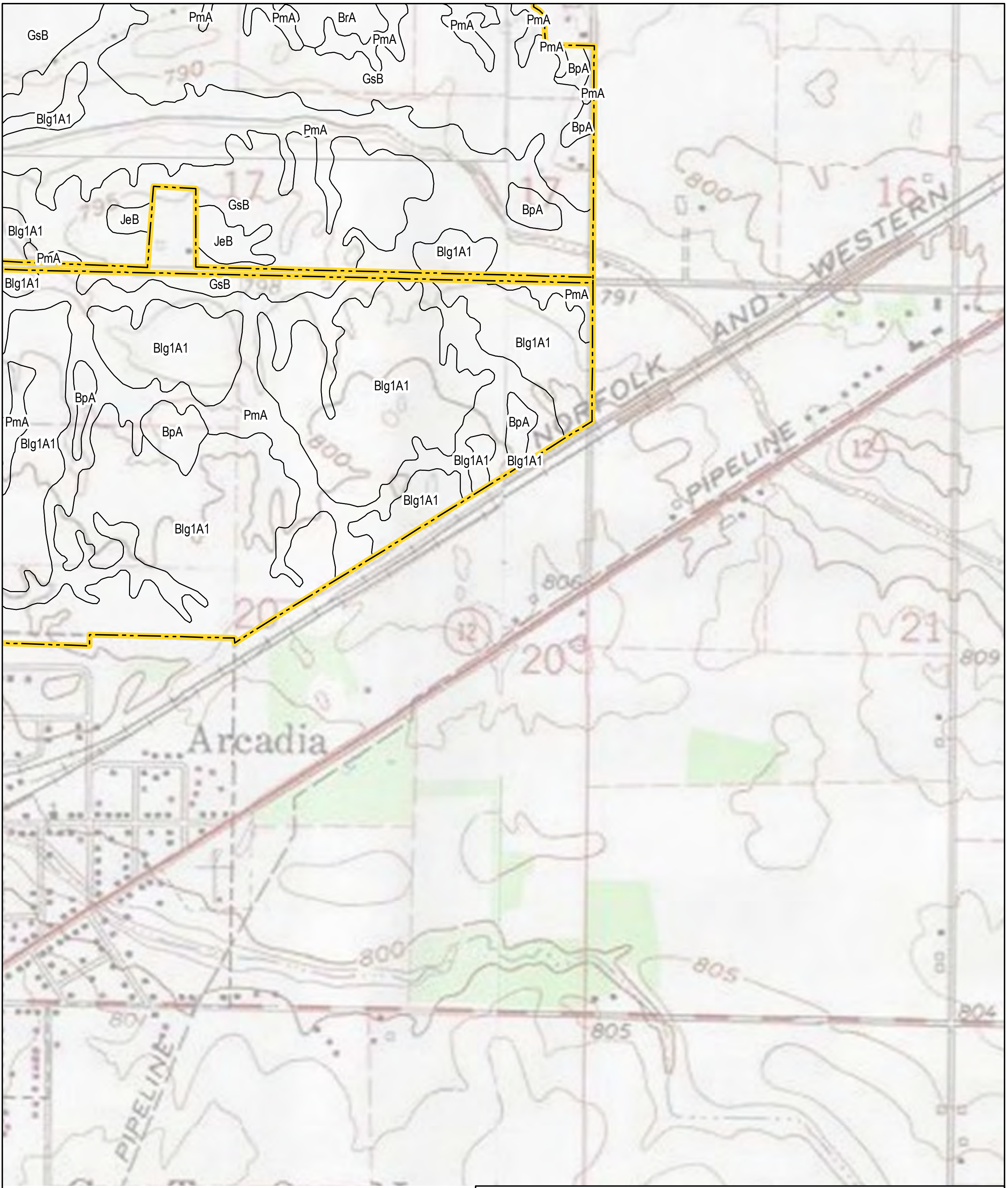
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHY AND SOILS

SCALE: AS SHOWN
JULY 2021

SHEET 3 OF 4
FIGURE 2

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0002_TOPOGRAPHY_AND_SOILS_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 10:18:21 AM



LEGEND

☐ SOIL MAP UNIT

▭ STUDY AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

N

0 500 1,000

SCALE IN FEET

HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHY AND SOILS

SCALE: AS SHOWN
JULY 2021

SHEET 4 OF 4
FIGURE 2

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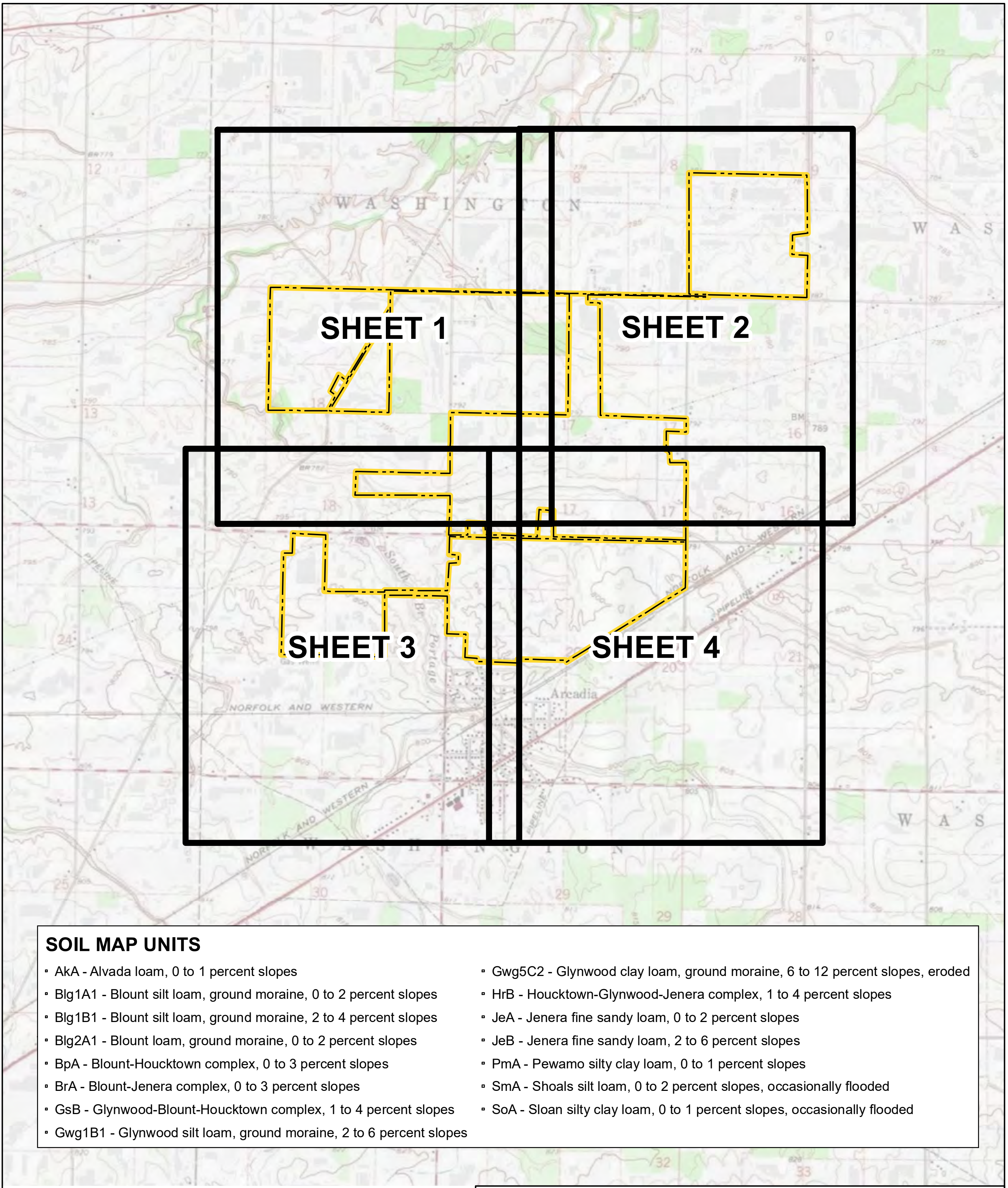


SOIL MAP UNITS

- AkA - Alvada loam, 0 to 1 percent slopes
- Blg1A1 - Blount silt loam, ground moraine, 0 to 2 percent slopes
- Blg1B1 - Blount silt loam, ground moraine, 2 to 4 percent slopes
- Blg2A1 - Blount loam, ground moraine, 0 to 2 percent slopes
- BpA - Blount-Houcktown complex, 0 to 3 percent slopes
- BrA - Blount-Jenera complex, 0 to 3 percent slopes
- GsB - Glynwood-Blount-Houcktown complex, 1 to 4 percent slopes
- Gwg1B1 - Glynwood silt loam, ground moraine, 2 to 6 percent slopes
- Gwg5C2 - Glynwood clay loam, ground moraine, 6 to 12 percent slopes, eroded
- HrB - Houcktown-Glynwood-Jenera complex, 1 to 4 percent slopes
- JeA - Jenera fine sandy loam, 0 to 2 percent slopes
- JeB - Jenera fine sandy loam, 2 to 6 percent slopes
- PmA - Pewamo silty clay loam, 0 to 1 percent slopes
- SmA - Shoals silt loam, 0 to 2 percent slopes, occasionally flooded
- SoA - Sloan silty clay loam, 0 to 1 percent slopes, occasionally flooded

LEGEND

▭ STUDY AREA

N

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

0 2,000 4,000
Feet

HALEY ALDRICH

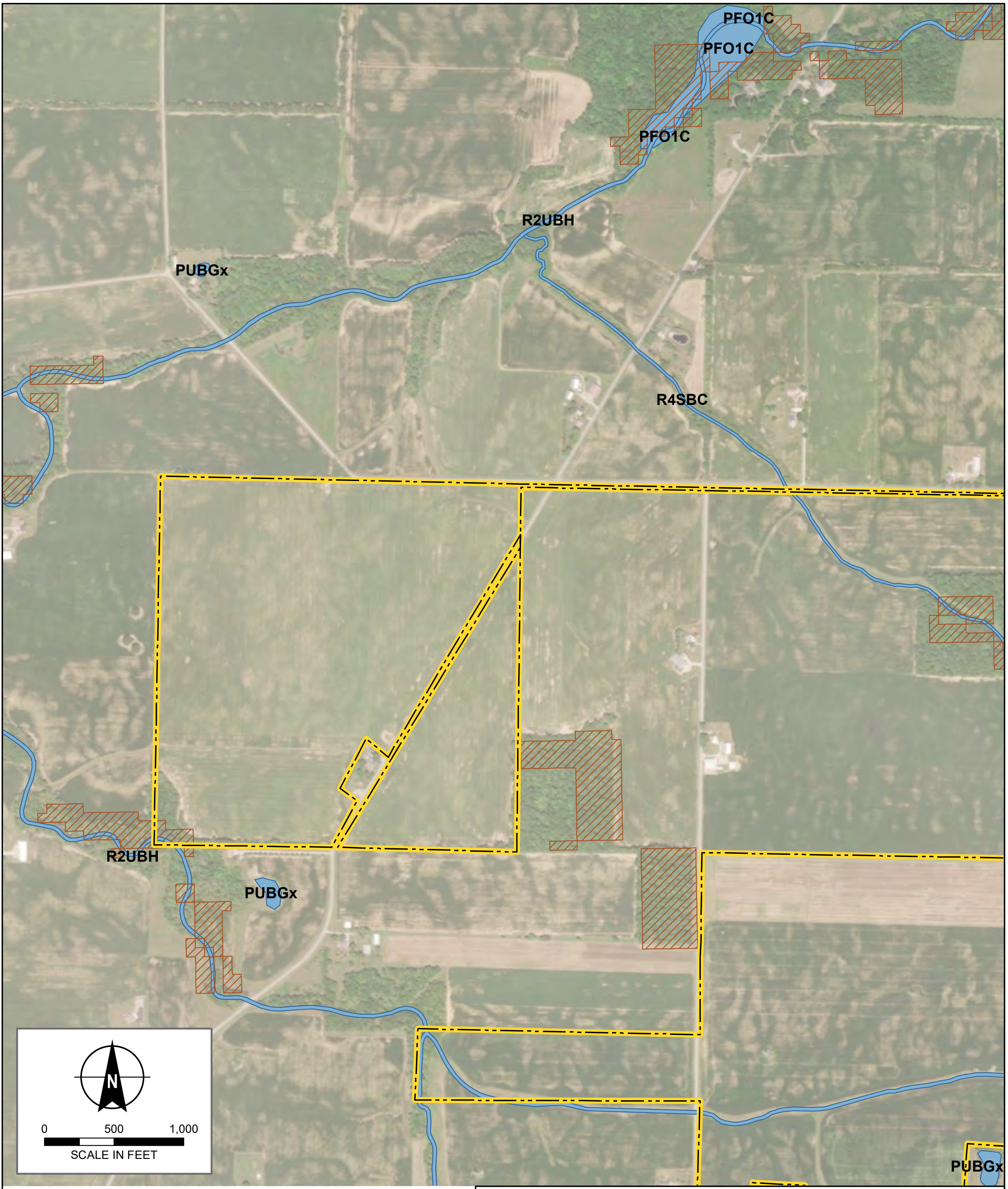
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHY AND SOILS

SCALE: AS SHOWN
JULY 2021

INDEX SHEET
FIGURE 2

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0002_TOPOGRAPHY_AND_SOILS_INDEX_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:17:42 AM



OHIO WETLAND INVENTORY

- 🟦 OPEN WATER
- ▨ WOODS ON HYDRIC SOIL
- ▨ SHALLOW MARSH
- ▨ SHRUB/SCRUB WETLAND
- ▨ WET MEADOW
- ▨ FARMED WETLAND

- 🟦 NWI WETLAND
- ☐ STUDY AREA

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

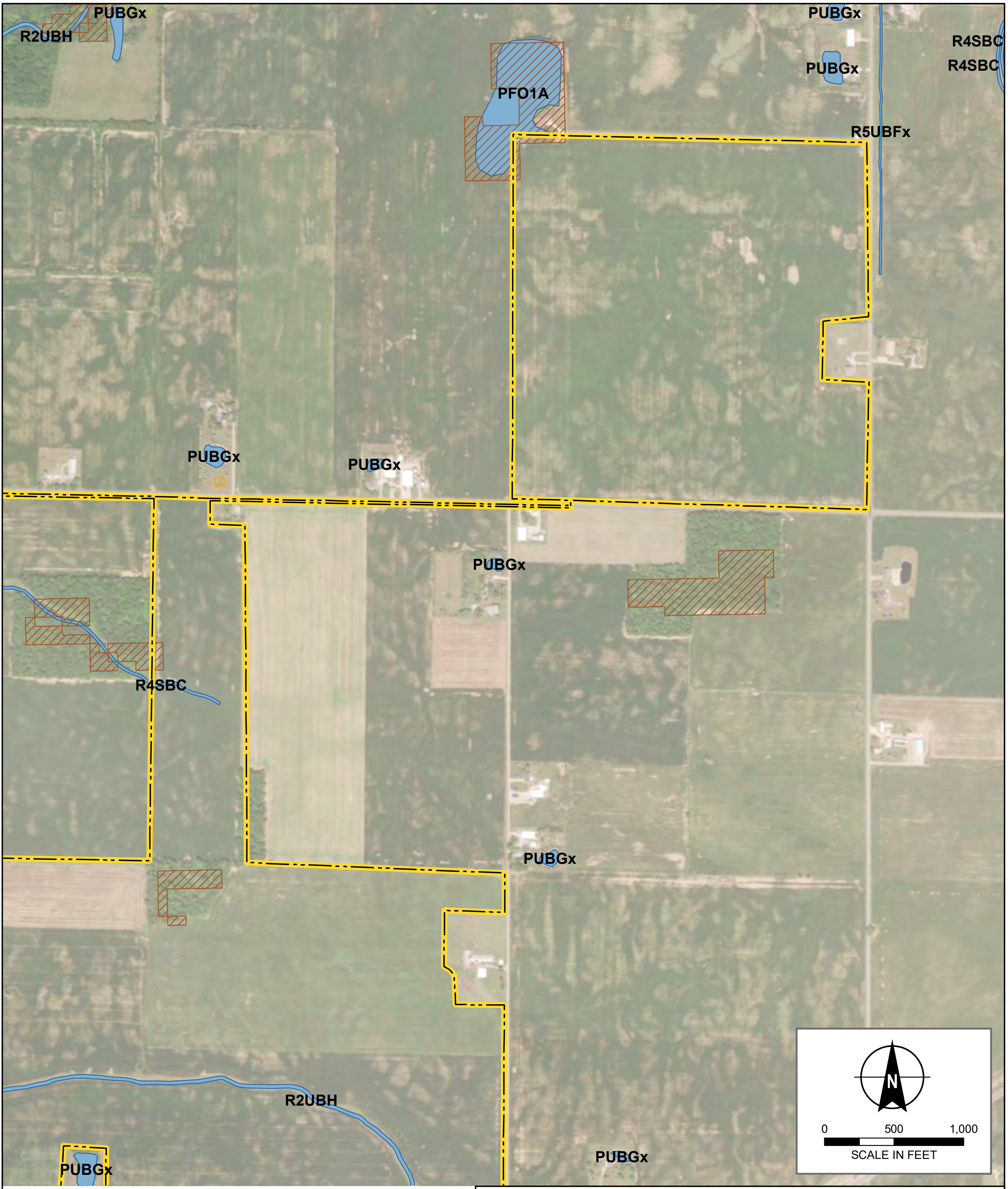
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

FEDERAL AND STATE MAPPED AQUATIC RESOURCES

SCALE: AS SHOWN
JULY 2021

SHEET 1 OF 4
FIGURE 3

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0003_MAPPED AQUATIC RESOURCES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:19:22 AM



OHIO WETLAND INVENTORY

- 🟦 OPEN WATER
- ▨ WOODS ON HYDRIC SOIL
- ▨ SHALLOW MARSH
- ▨ SHRUB/SCRUB WETLAND
- ▨ WET MEADOW
- ▨ FARMED WETLAND
- 🟦 NWI WETLAND
- ▭ STUDY AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

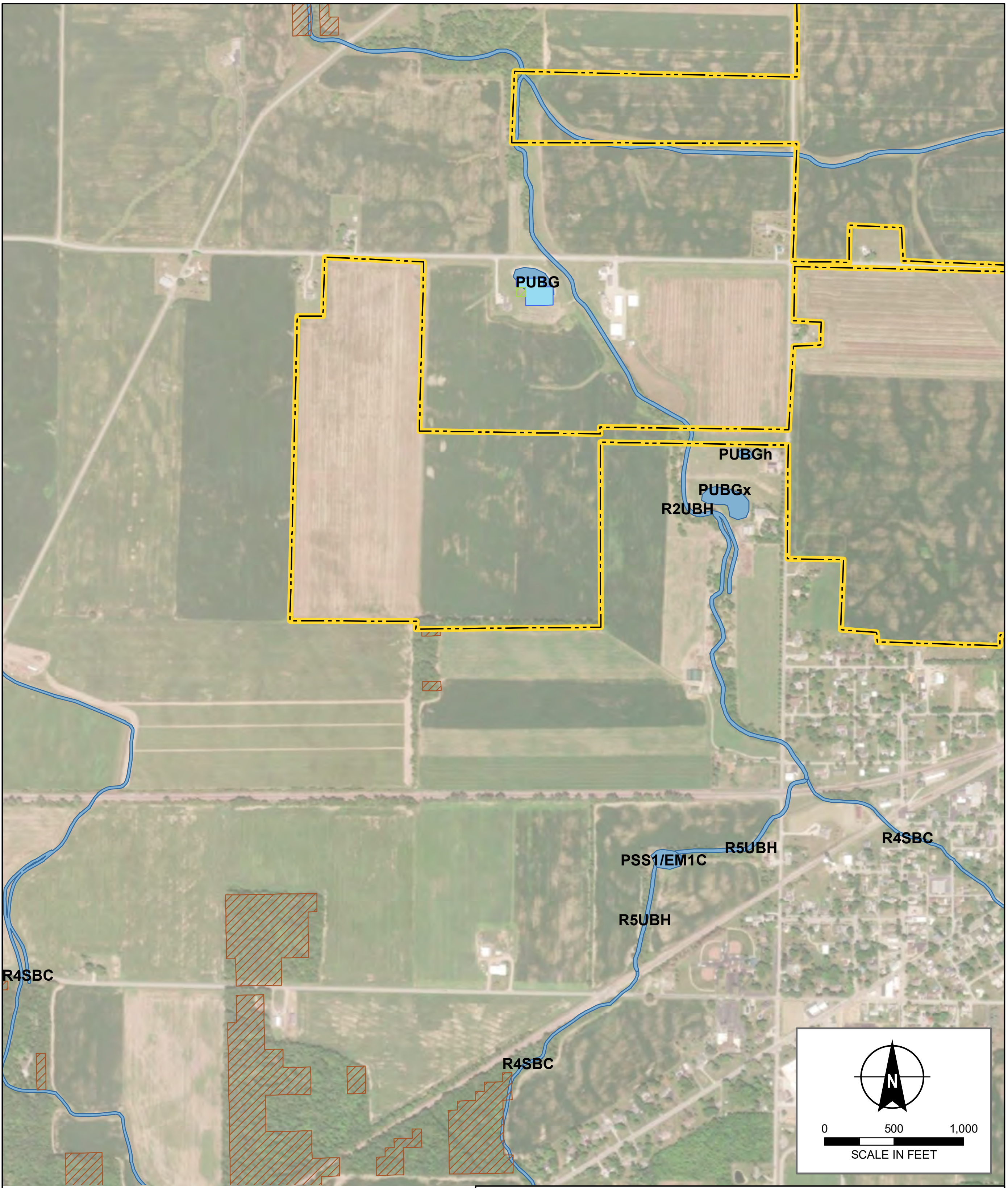
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

FEDERAL AND STATE
MAPPED AQUATIC RESOURCES

SCALE: AS SHOWN
JULY 2021

SHEET 2 OF 4
FIGURE 3

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0003_MAPPED AQUATIC RESOURCES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:19:22 AM



OHIO WETLAND INVENTORY

- ▆ OPEN WATER
- ▨ WOODS ON HYDRIC SOIL
- ▨ SHALLOW MARSH
- ▨ SHRUB/SCRUB WETLAND
- ▨ WET MEADOW
- ▨ FARMED WETLAND

- ▆ NWI WETLAND
- ▭ STUDY AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

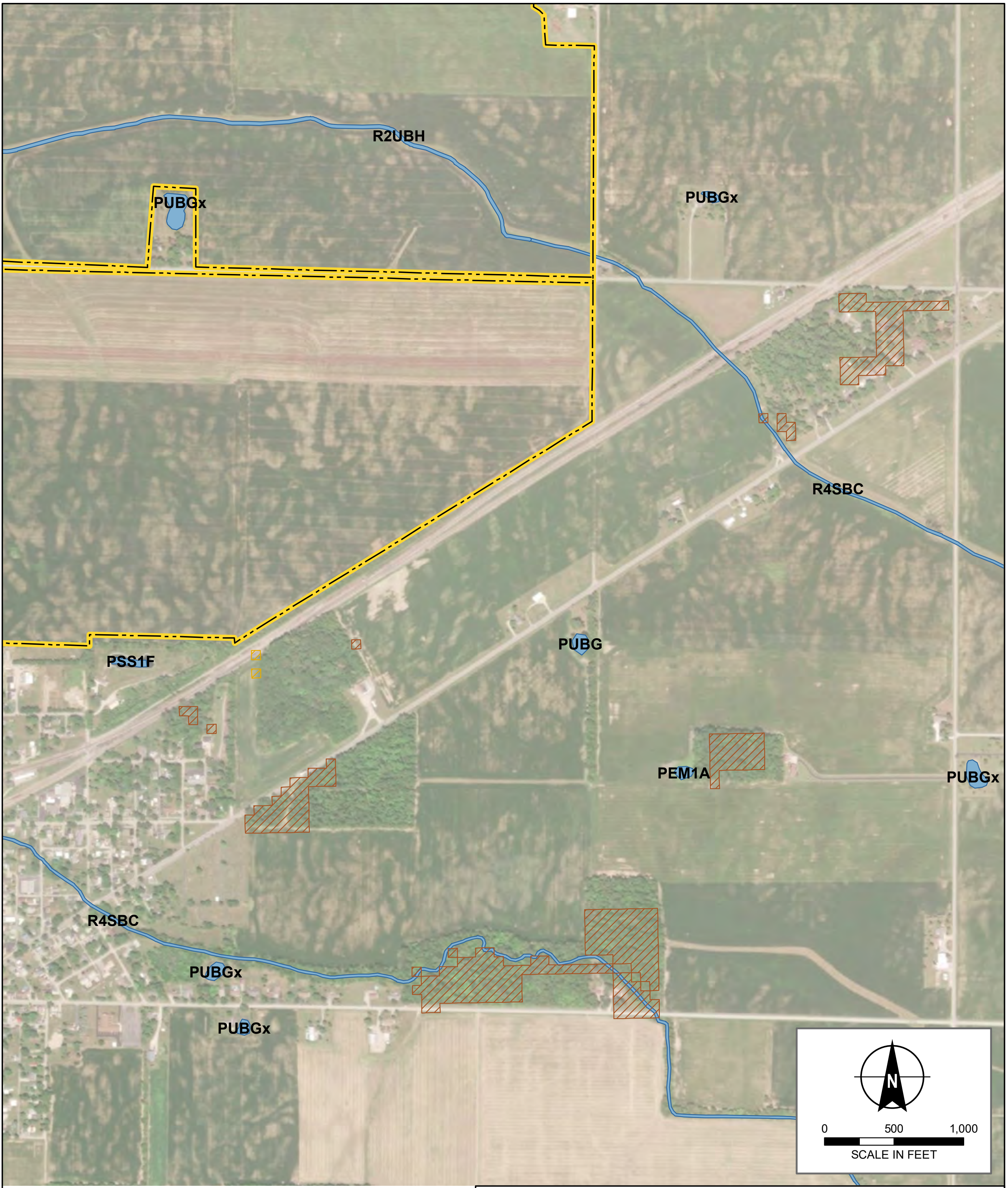
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

FEDERAL AND STATE MAPPED AQUATIC RESOURCES

SCALE: AS SHOWN
JULY 2021

SHEET 3 OF 4
FIGURE 3

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0003_MAPPED AQUATIC RESOURCES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:19:22 AM



OHIO WETLAND INVENTORY

- ▨ OPEN WATER
- ▨ WOODS ON HYDRIC SOIL
- ▨ SHALLOW MARSH
- ▨ SHRUB/SCRUB WETLAND
- ▨ WET MEADOW
- ▨ FARMED WETLAND

- ▨ NWI WETLAND
- ▭ STUDY AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

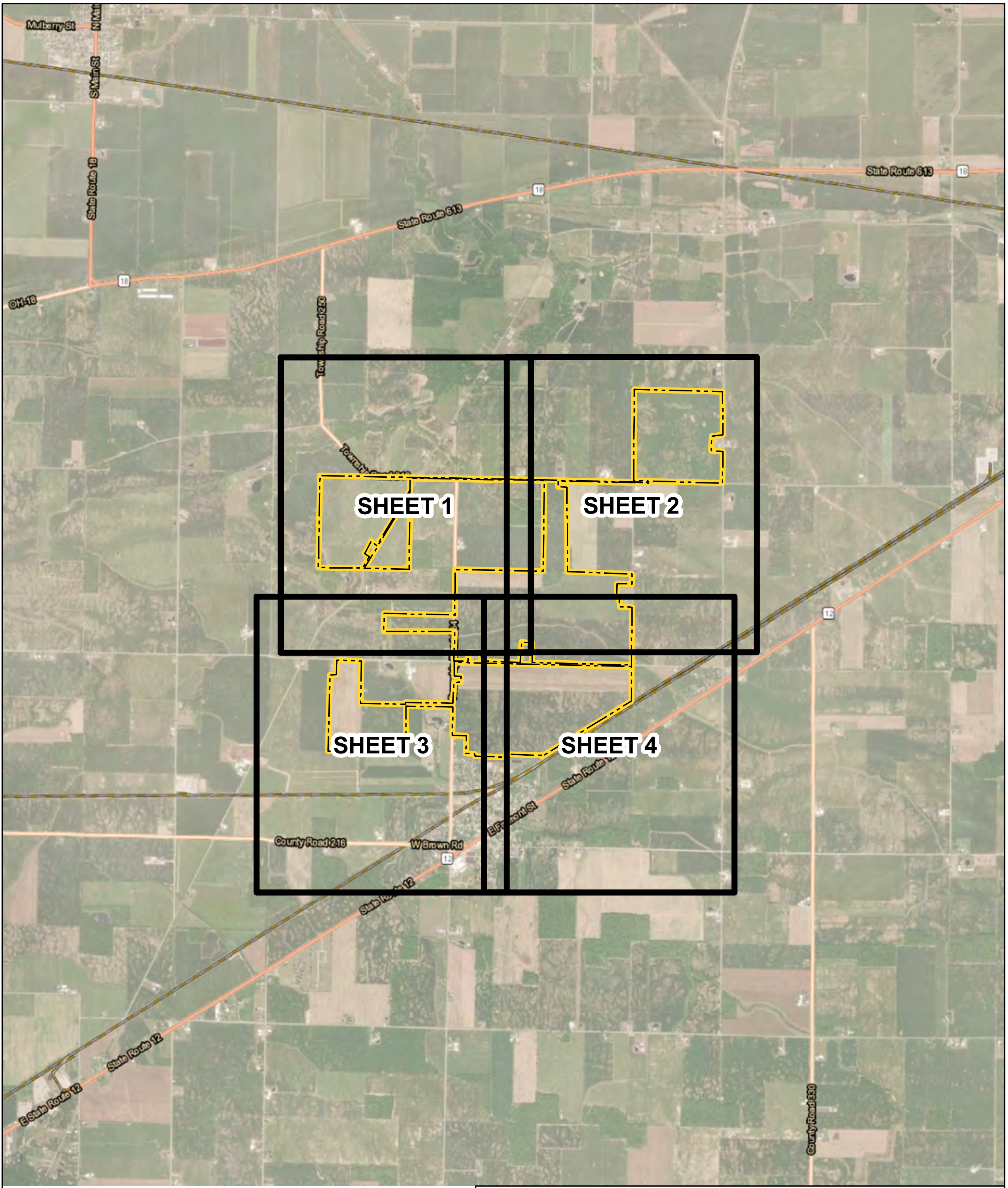
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

FEDERAL AND STATE MAPPED AQUATIC RESOURCES

SCALE: AS SHOWN
JULY 2021

SHEET 4 OF 4
FIGURE 3

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0003_MAPPED AQUATIC RESOURCES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:19:22 AM



LEGEND

▭ STUDY AREA

0 0.5 1
Miles

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

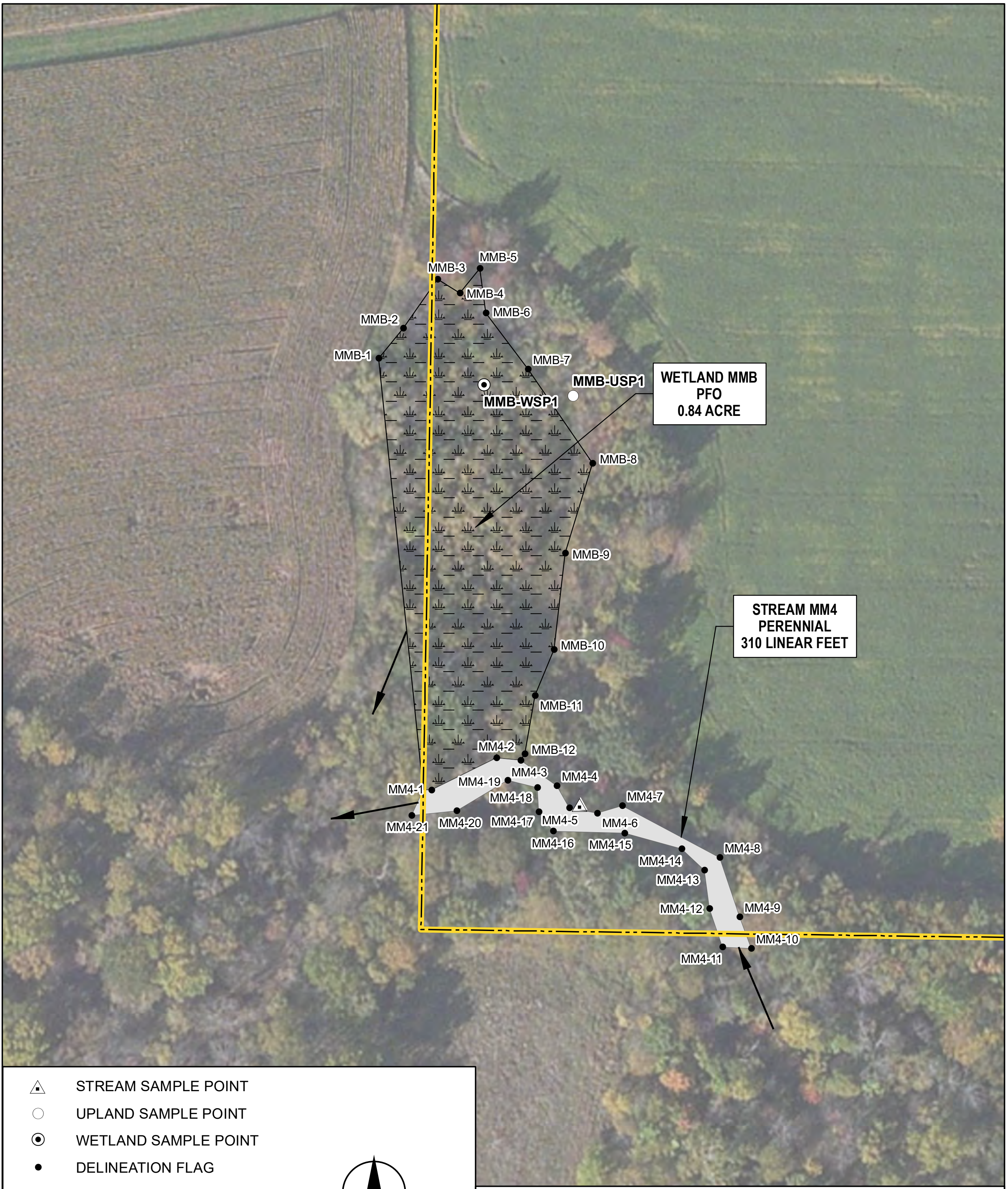
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

FEDERAL AND STATE
MAPPED AQUATIC RESOURCES

SCALE: AS SHOWN
JULY 2021

INDEX SHEET
FIGURE 3

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0003_MAPPED AQUATIC RESOURCES_INDEX_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 10:24:32 AM



△ STREAM SAMPLE POINT

○ UPLAND SAMPLE POINT

⊙ WETLAND SAMPLE POINT

● DELINEATION FLAG

▬ CULVERT

→ FEATURE CONTINUES

▨ DELINEATED STREAM

▨ DELINEATED WETLAND

▭ STUDY AREA

N

0 50 100
Feet

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DELINEATED WETLAND TYPES ARE BASED ON COWARDIN CLASSIFICATION.
3. BASE MAP SOURCE: ESRI

HALEY ALDRICH

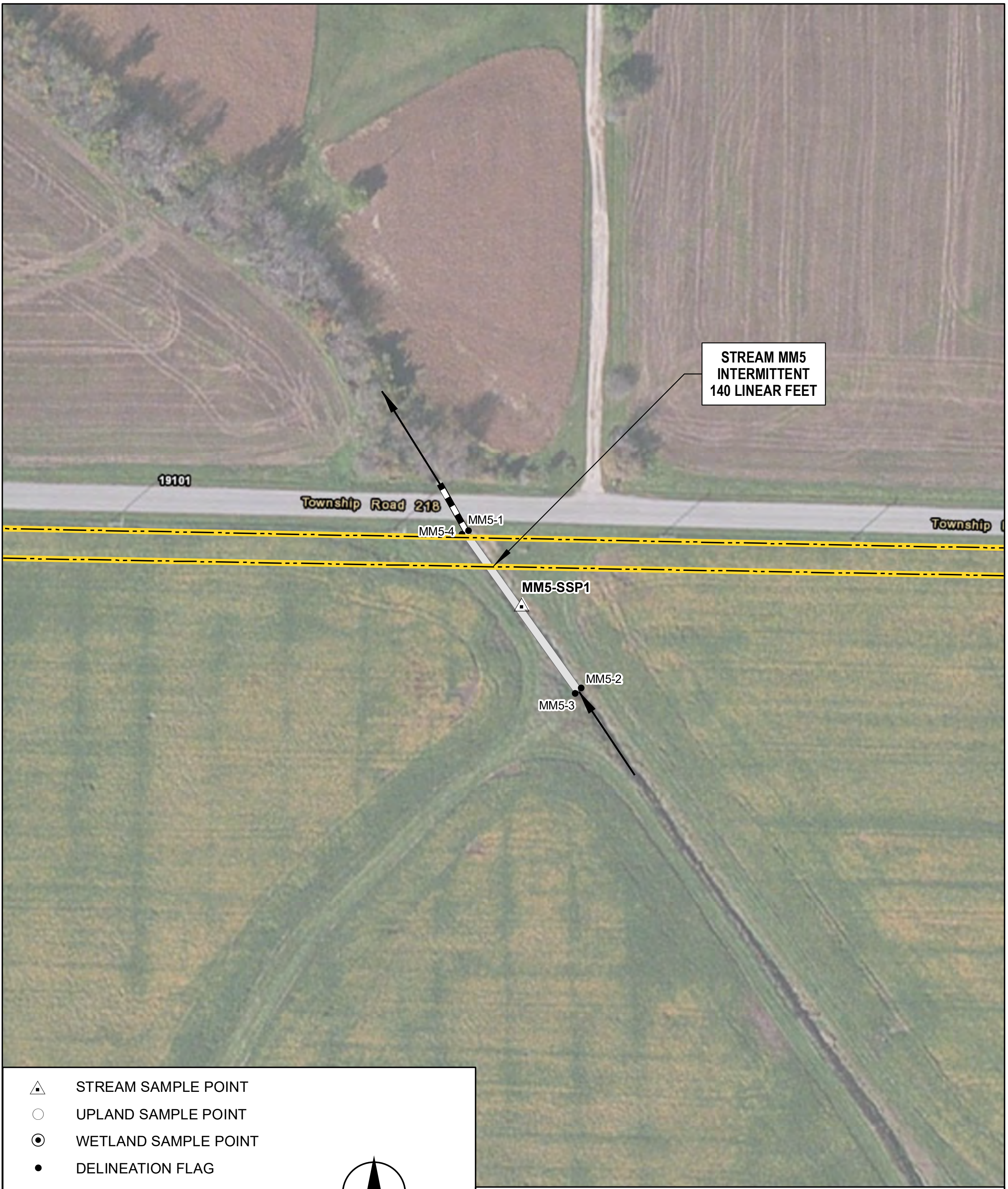
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 1 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM



STREAM MM5
INTERMITTENT
140 LINEAR FEET

- △ STREAM SAMPLE POINT
- ○ UPLAND SAMPLE POINT
- ⦿ WETLAND SAMPLE POINT
- • DELINEATION FLAG
- CULVERT
- → FEATURE CONTINUES
- DELINEATED STREAM
- DELINEATED WETLAND
- STUDY AREA

N

0 50 100
Feet

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. DELINEATED WETLAND TYPES ARE BASED ON COWARDIN CLASSIFICATION.
3. BASE MAP SOURCE: ESRI

HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS
AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 2 OF 14

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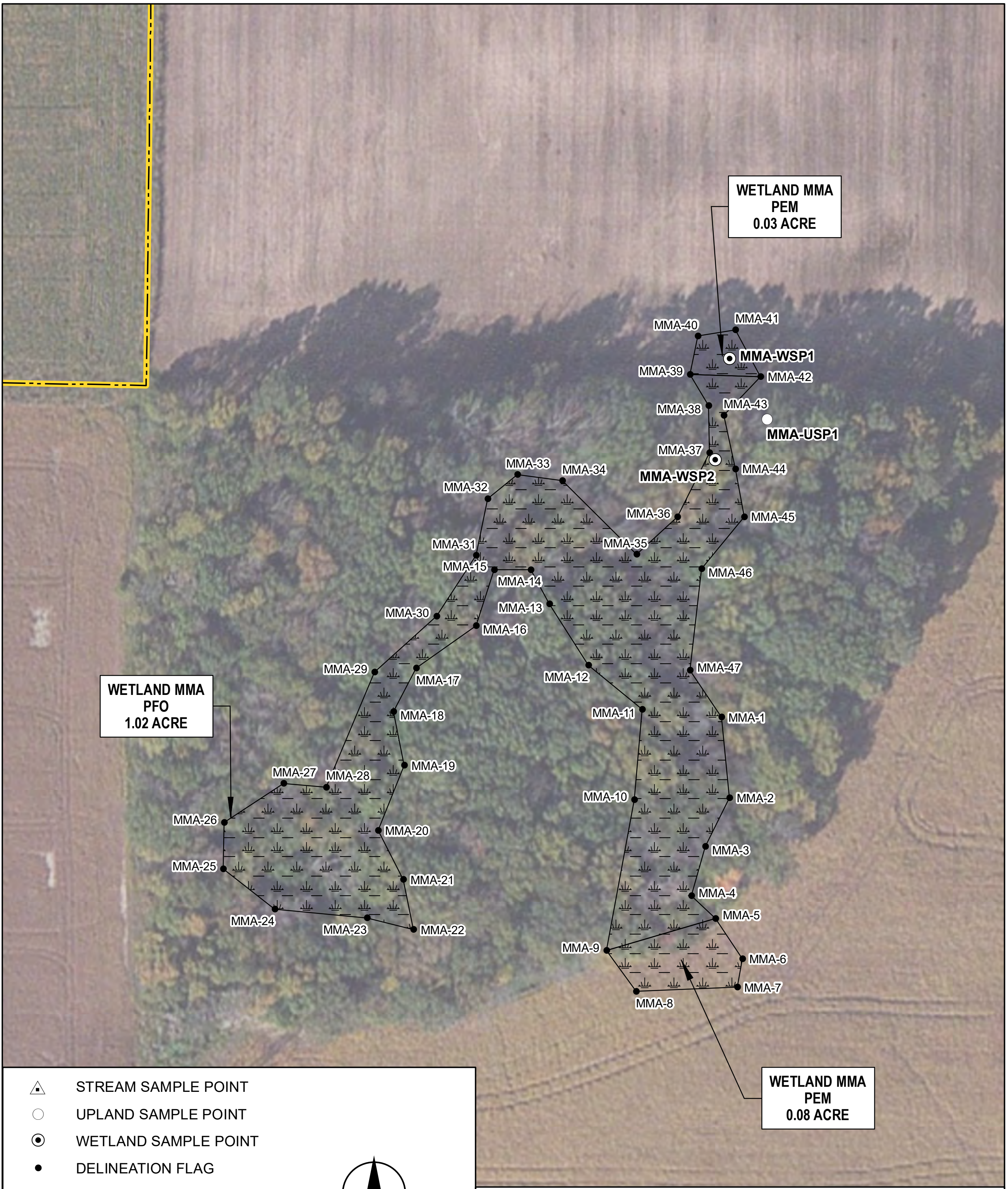

△ STREAM SAMPLE POINT

○ UPLAND SAMPLE POINT

⊙ WETLAND SAMPLE POINT

● DELINEATION FLAG

CULVERT

FEATURE CONTINUES

▨ DELINEATED STREAM

▨ DELINEATED WETLAND

▭ STUDY AREA

N

0 50 100
Feet

NOTES
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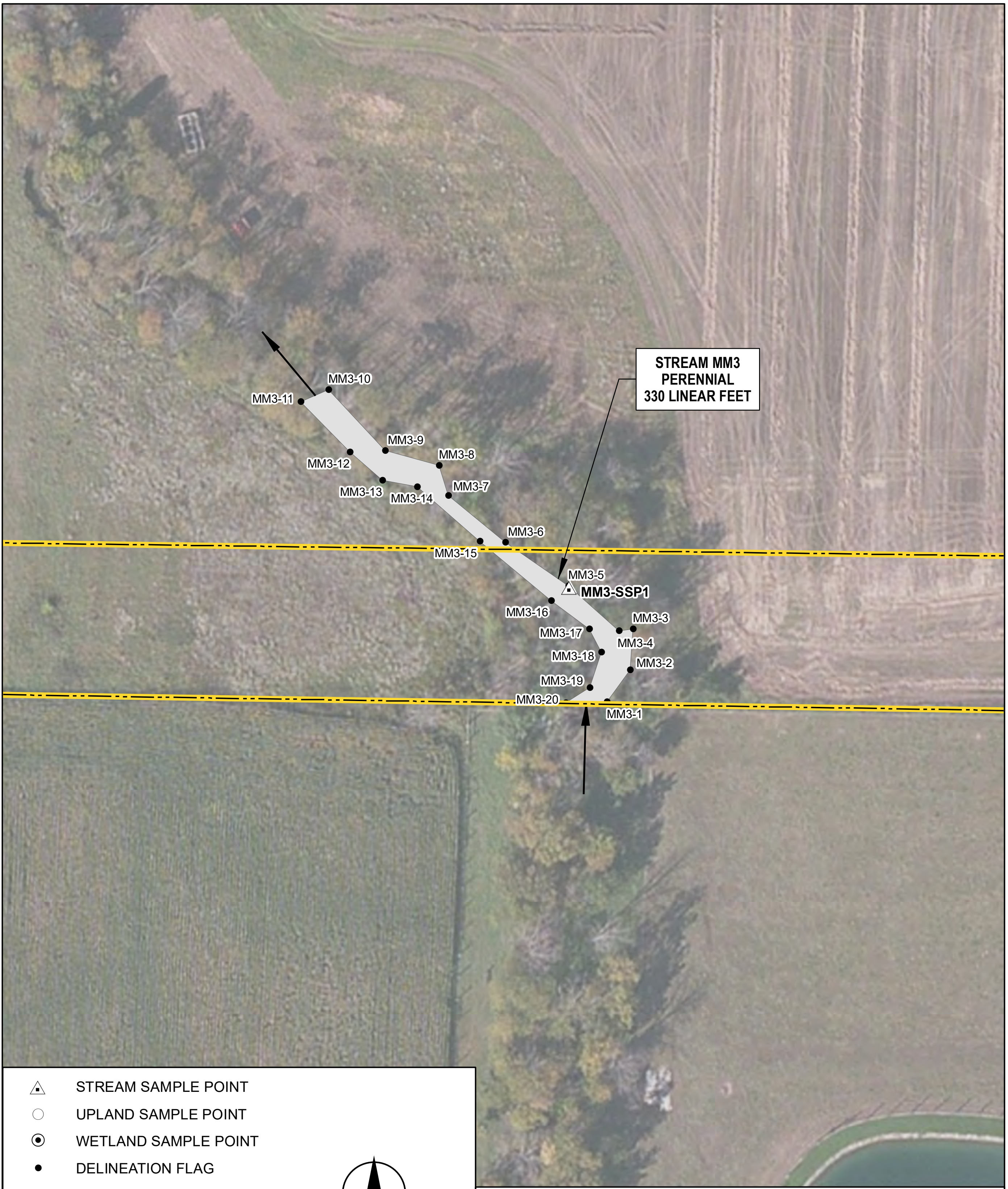
HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 3 OF 14



NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 4 OF 14

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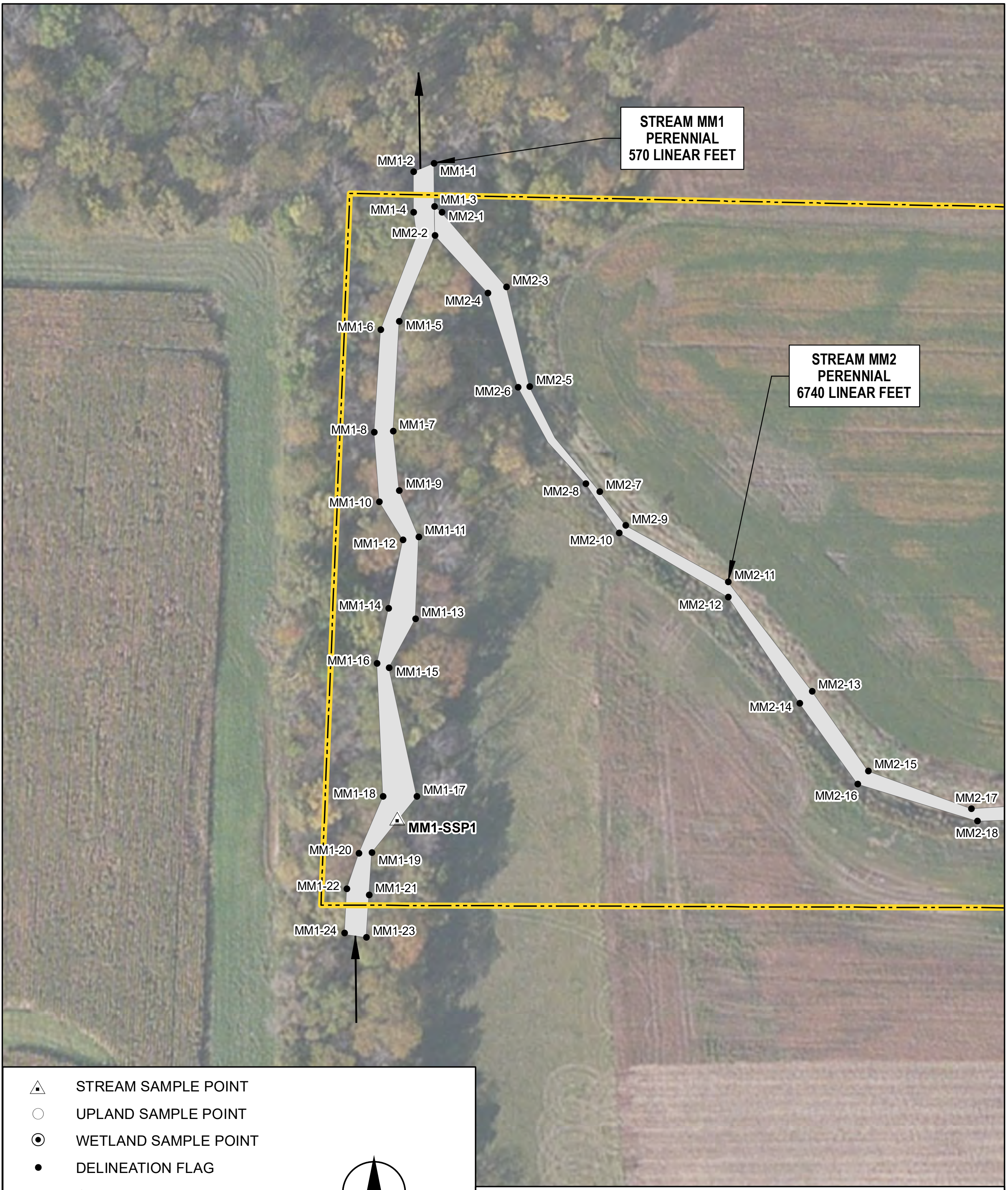

△ STREAM SAMPLE POINT
○ UPLAND SAMPLE POINT
◉ WETLAND SAMPLE POINT
● DELINEATION FLAG
CULVERT
→ FEATURE CONTINUES
DELINEATED STREAM
DELINEATED WETLAND
STUDY AREA

NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS
AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 5 OF 14

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NOTES
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3. BASE MAP SOURCE: ESRI

HALEY ALDRICH

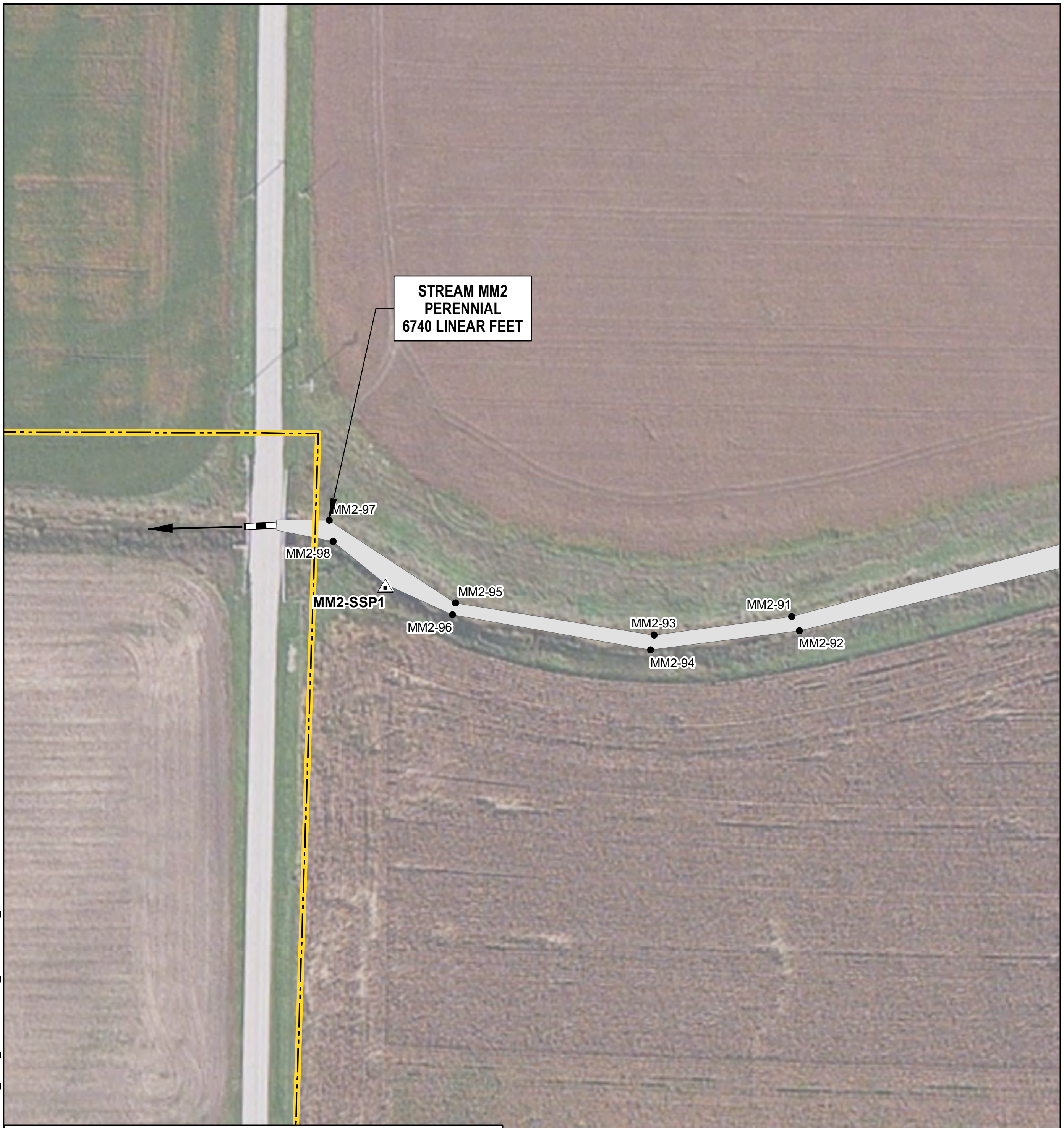
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS
AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 6 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM



△	STREAM SAMPLE POINT
○	UPLAND SAMPLE POINT
⦿	WETLAND SAMPLE POINT
●	DELINEATION FLAG
▬ ▬	CULVERT
→	FEATURE CONTINUES
▨	DELINEATED STREAM
☐	DELINEATED WETLAND
☐	STUDY AREA

N

0 50 100
Feet

NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 7 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM

△ STREAM SAMPLE POINT

○ UPLAND SAMPLE POINT

⦿ WETLAND SAMPLE POINT

● DELINEATION FLAG

CULVERT

→ FEATURE CONTINUES

▭ DELINEATED STREAM

DELINEATED WETLAND

STUDY AREA

N

0 50 100
Feet

NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 8 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM

△ STREAM SAMPLE POINT
○ UPLAND SAMPLE POINT
◉ WETLAND SAMPLE POINT
● DELINEATION FLAG
▬ CULVERT
→ FEATURE CONTINUES
▭ DELINEATED STREAM
▭ DELINEATED WETLAND
▭ STUDY AREA

N

0 50 100
Feet

NOTES
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3. BASE MAP SOURCE: ESRI

HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS
AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 9 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM

△ STREAM SAMPLE POINT

○ UPLAND SAMPLE POINT

⦿ WETLAND SAMPLE POINT

● DELINEATION FLAG

▬ CULVERT

→ FEATURE CONTINUES

▭ DELINEATED STREAM

▭ DELINEATED WETLAND

▭ STUDY AREA

NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 10 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM

- △ STREAM SAMPLE POINT
- ○ UPLAND SAMPLE POINT
- ⦿ WETLAND SAMPLE POINT
- ● DELINEATION FLAG
- ▬ CULVERT
- → FEATURE CONTINUES
- ▭ DELINEATED STREAM
- ▭ DELINEATED WETLAND
- ▭ STUDY AREA

NOTES

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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS
AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 11 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM

⚠	STREAM SAMPLE POINT
○	UPLAND SAMPLE POINT
⊙	WETLAND SAMPLE POINT
●	DELINEATION FLAG
▬ ▬	CULVERT
→	FEATURE CONTINUES
▨	DELINEATED STREAM
☐	DELINEATED WETLAND
☐	STUDY AREA

NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 12 OF 14

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- △ STREAM SAMPLE POINT
- ○ UPLAND SAMPLE POINT
- ◉ WETLAND SAMPLE POINT
- ● DELINEATION FLAG
- CULVERT
- → FEATURE CONTINUES
- ▨ DELINEATED STREAM
- DELINEATED WETLAND
- STUDY AREA

N

0 50 100
Feet

NOTES
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 13 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM

- △ STREAM SAMPLE POINT
- ○ UPLAND SAMPLE POINT
- ◉ WETLAND SAMPLE POINT
- • DELINEATION FLAG
- CULVERT
- → FEATURE CONTINUES
- ▨ DELINEATED STREAM
- DELINEATED WETLAND
- STUDY AREA

NOTES
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HALEY ALDRICH

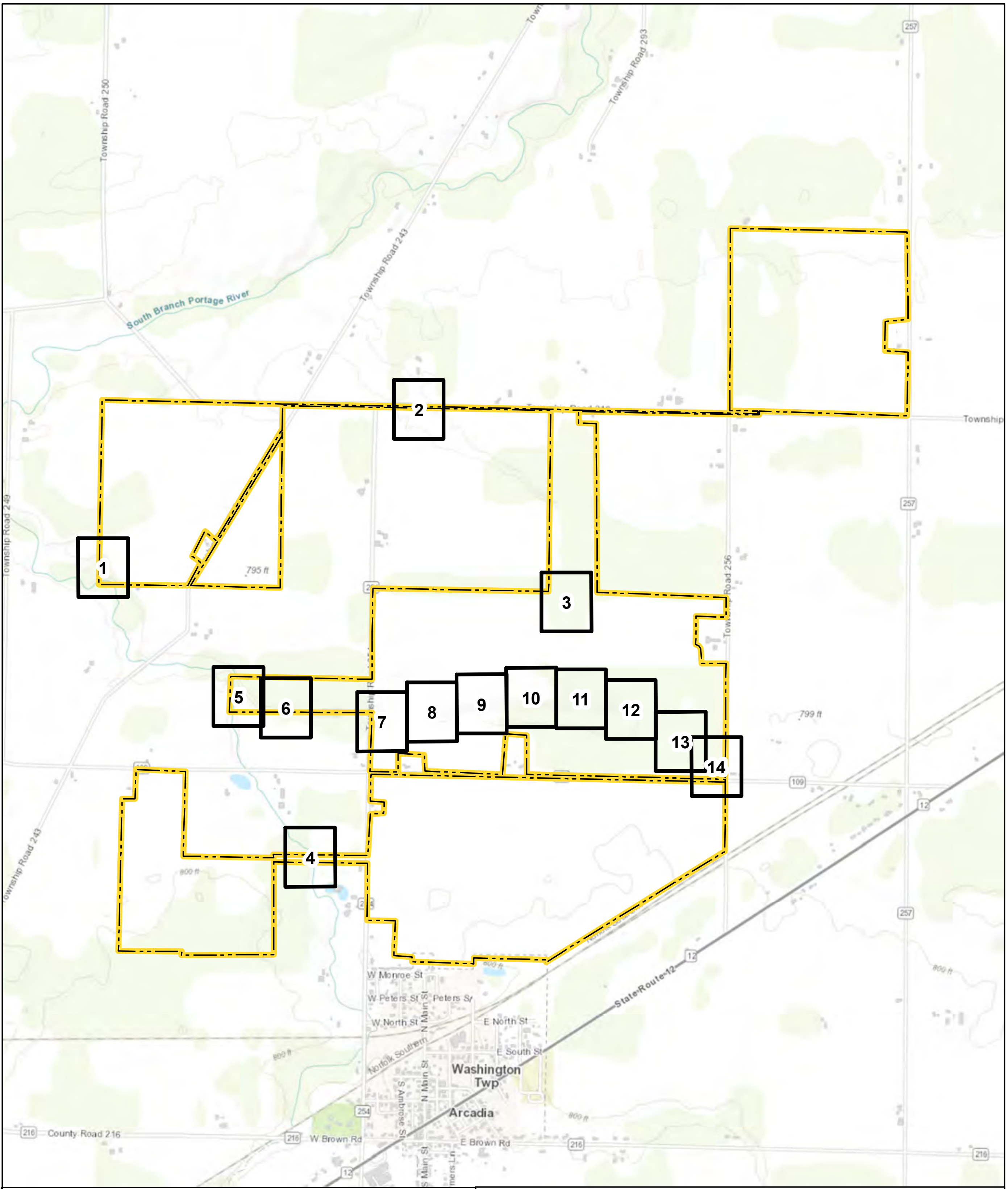
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
SHEET 14 OF 14

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 11:05:03 AM



☐ INDEX SHEET

☐ STUDY AREA

0 0.25 0.5
Miles

NOTES
1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
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HALEY ALDRICH

SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

DELINEATED WETLANDS
AND STREAMS

SCALE: AS SHOWN
JULY 2021

FIGURE 4
INDEX SHEET

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\135392_0004_DELINEATED_FEATURES_INDEX_D2.mxd — USER: mmartin — LAST SAVED: 7/13/2021 10:27:27 AM

APPENDIX A

Photo Log

Photo 1: View looking west within Wetland MMA (PFO) near flag MMA-48.

Photo 2: View looking north within Wetland MMA (PEM) near sample point MMA-42.

Photo 3: View looking southwest within Wetland MMB (PFO) near sample point MMB-WSP1.

Photo 4: View looking south at Stream MM1 (Perennial) near sample point MM1-3.

Photo 5: View looking southeast at Stream MM2 (Perennial) near flag MM2-2.

Photo 6: View looking south at Stream MM3 (Perennial) near flag MM3-4.

Photo 7: View looking southeast at Stream MM4 (Perennial) near flag MM4-3.

Photo 8: View looking southeast at Stream MM5 near sample point MM5-SSP1.

APPENDIX B

Wetland Determination Data and Stream Inventory Data Forms

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: South Branch Solar City/County: Hancock County Sampling Date: 4-20-21
Applicant/Owner: Leeward State: OH Sampling Point: MMA-WSP1
Investigator(s): M. Martin, K. Lindenschmidt Section, Township, Range: Washington
Landform (hillside, terrace, etc.): depression Local relief (concave, convex, none): concave
Slope (%): 0 Lat: 41.130177 Long: -83.505469 Datum: WGS84
Soil Map Unit Name: PmA-Pewamo silty clay loam, 0 to 1 percent slopes NWI classification: PEM
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)
Are Vegetation x , Soil ___ , or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___
Are Vegetation ___ , Soil ___ , or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No X	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X	No ___	
Wetland Hydrology Present?	Yes X	No ___	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30ft rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Sapling/Shrub Stratum (Plot size: 15 ft rad.)			
1.			
2.			
3.			
4.			
5.			
	=Total Cover		
Herb Stratum (Plot size: 5ft rad.)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	=Total Cover		
Woody Vine Stratum (Plot size: 15ft rad.)			
1.			
2.			
	=Total Cover		

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ___ (A)
Total Number of Dominant Species Across All Strata: ___ (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: ___ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species		x 1 =
FACW species		x 2 =
FAC species		x 3 =
FACU species		x 4 =
UPL species		x 5 =
Column Totals:	(A)	(B)

Prevalence Index = B/A = ___

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ___ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)
Sample point located in the edge of active agricultural field. Unvegetated at time of site visit.

SOIL

Sampling Point: MMA-WSP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-8	10YR 3/2	100					Loamy/Clayey	
8-18	2.5Y 4/1	90	10YR 4/6	10	C	PL	Loamy/Clayey	Prominent redox concentrations

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

[2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10)
X Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 5 cm Mucky Peat or Peat (S3)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
X Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ Coast Prairie Redox (A16)
___ Iron-Manganese Masses (F12)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** X **No** ___

Remarks:

This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
x Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ True Aquatic Plants (B14)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Gauge or Well Data (D9)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

x Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No x Depth (inches): ___
Water Table Present? Yes ___ No x Depth (inches): ___
Saturation Present? Yes ___ No x Depth (inches): ___
(includes capillary fringe)

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: Sunset Ridge Solar　City/County: Hancock County　Sampling Date: 4-20-21
Applicant/Owner: Leeward　State: OH　Sampling Point: MMA-WSP2
Investigator(s): M. Martin, K. Lindenschmidt　Section, Township, Range: Washington
Landform (hillside, terrace, etc.): depression　Local relief (concave, convex, none): concave
Slope (%): 0　Lat: 41.129978　Long: -83.505504　Datum: WGS84
Soil Map Unit Name: PmA-Pewamo silty clay loam, 0 to 1 percent slopes　NWI classification: PFO
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are "Normal Circumstances" present? Yes x No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No x	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X	No ___	
Wetland Hydrology Present?	Yes X	No ___	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30ft rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Carya laciniosa*	20	Yes	FACW
2.			
3.			
4.			
5.			
	20	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft rad.)			
1. *Fraxinus pennsylvanica*	40	Yes	FACW
2.			
3.			
4.			
5.			
	40	=Total Cover	
Herb Stratum (Plot size: 5ft rad.)			
1. *Rubus occidentalis*	20	Yes	UPL
2. *Carex lacustris*	80	Yes	OBL
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	100	=Total Cover	
Woody Vine Stratum (Plot size: 15ft rad.)			
1.			
2.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	3	(A)
Total Number of Dominant Species Across All Strata:	4	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	75.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	80	x 1 = 80
FACW species	60	x 2 = 120
FAC species	0	x 3 = 0
FACU species	0	x 4 = 0
UPL species	20	x 5 = 100
Column Totals:	160 (A)	300 (B)

Prevalence Index = B/A = 1.88

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** x

Remarks: (Include photo numbers here or on a separate sheet.)
Evidence of past logging (old stumps, downed timber).

SOIL

Sampling Point: MMA-WSP2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-18	10YR 4/1	85	10YR 3/6	15	C	M	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.
[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5)
- ___ 2 cm Muck (A10)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ 5 cm Mucky Peat or Peat (S3)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Dark Surface (S7)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- X Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ? Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

- ? Coast Prairie Redox (A16)
- ___ Iron-Manganese Masses (F12)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ___

Depth (inches): ___

Hydric Soil Present? **Yes** X **No** ___

Remarks:
This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

- ___ Surface Water (A1)
- X High Water Table (A2)
- X Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- X Water-Stained Leaves (B9)
- ___ Aquatic Fauna (B13)
- ___ True Aquatic Plants (B14)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres on Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Gauge or Well Data (D9)
- ___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ___ Surface Soil Cracks (B6)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No X Depth (inches): ___
Water Table Present? Yes X No ___ Depth (inches): 6
Saturation Present? (includes capillary fringe) Yes X No ___ Depth (inches): 0

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: South Branch Solar City/County: Hancock County Sampling Date: 4-20-21

Applicant/Owner: Leeward State: OH Sampling Point: MMA-USP1

Investigator(s): M. Martin, K. Lindenschmidt Section, Township, Range: Washington

Landform (hillside, terrace, etc.): terrace Local relief (concave, convex, none): convex

Slope (%): 1 Lat: 41.130060 Long: -83.505370 Datum: WGS84

Soil Map Unit Name: PmA-Pewamo silty clay loam, 0 to 1 percent slopes NWI classification: NA

Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)

Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are “Normal Circumstances” present? Yes x No ___

Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ___ No X

Hydric Soil Present? Yes ___ No X

Wetland Hydrology Present? Yes ___ No X

Is the Sampled Area within a Wetland? Yes ___ No X

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30ft rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Carya laciniosa*	40	Yes	FACW
2. *Quercus rubra*	15	Yes	FACU
3. *Ulmus rubra*	10	No	FAC
4.			
5.			
	65	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft rad.)			
1. *Cornus racemosa*	40	Yes	FAC
2. *Ulmus rubra*	10	No	FAC
3. *Rosa multiflora*	15	Yes	FACU
4. *Ostrya virginiana*	5	No	FACU
5.			
	70	=Total Cover	
Herb Stratum (Plot size: 5ft rad.)			
1. *Galium aparine*	10	Yes	FACU
2. *Phlox subulata*	10	Yes	UPL
3. *Rubus occidentalis*	20	Yes	UPL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	40	=Total Cover	
Woody Vine Stratum (Plot size: 15ft rad.)			
1.			
2.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 28.6% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	40	x 2 =	80
FAC species	60	x 3 =	180
FACU species	45	x 4 =	180
UPL species	30	x 5 =	150
Column Totals:	175 (A)		590 (B)

Prevalence Index = B/A = 3.37

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation

___ 2 - Dominance Test is >50%

___ 3 - Prevalence Index is ≤3.0[1]

___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: MMA-USP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-14	7.5YR 3/1	100					Loamy/Clayey	
14-20	7.5YR 4/1	85	7.5YR 5/8	15	C	M	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5)
☐ 2 cm Muck (A10)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 5 cm Mucky Peat or Peat (S3)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Dark Surface (S7)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

☐ Coast Prairie Redox (A16)
☐ Iron-Manganese Masses (F12)
☐ Red Parent Material (F21)
☐ Very Shallow Dark Surface (F22)
☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ______ **No** X

Remarks:

This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☐ Water Marks (B1)
☐ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☐ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Sparsely Vegetated Concave Surface (B8)
☐ Water-Stained Leaves (B9)
☐ Aquatic Fauna (B13)
☐ True Aquatic Plants (B14)
☐ Hydrogen Sulfide Odor (C1)
☐ Oxidized Rhizospheres on Living Roots (C3)
☐ Presence of Reduced Iron (C4)
☐ Recent Iron Reduction in Tilled Soils (C6)
☐ Thin Muck Surface (C7)
☐ Gauge or Well Data (D9)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☐ Drainage Patterns (B10)
☐ Dry-Season Water Table (C2)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Stunted or Stressed Plants (D1)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ______	No x	Depth (inches): ______
Water Table Present?	Yes ______	No x	Depth (inches): ______
Saturation Present? (includes capillary fringe)	Yes ______	No x	Depth (inches): ______

Wetland Hydrology Present? **Yes** ______ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: South Branch Solar City/County: Hancock County Sampling Date: 4/21/21
Applicant/Owner: Leeward State: OH Sampling Point: MMB-WSP1
Investigator(s): M. Martin, K. Lindenschmidt Section, Township, Range: Washington
Landform (hillside, terrace, etc.): depression Local relief (concave, convex, none): concave
Slope (%): 3 Lat: 41.131257 Long: -83.530296 Datum: WGS84
Soil Map Unit Name: Gwg5C2 - Glynwood clay loam, ground moraine, 6-12 percent slopes, eroded NWI classification: PFO
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ___ (If no, explain in Remarks.)
Are Vegetation ___, Soil ___, or Hydrology ___ significantly disturbed? Are “Normal Circumstances” present? Yes x No ___
Are Vegetation ___, Soil ___, or Hydrology ___ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes X	No ___	**Is the Sampled Area within a Wetland?** **Yes** X **No** ___
Hydric Soil Present?	Yes X	No ___	
Wetland Hydrology Present?	Yes X	No ___	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30ft rad.)			
1. *Fraxinus pennsylvanica*	60	Yes	FACW
2. *Acer negundo*	10	No	FAC
3. *Ulmus rubra*	5	No	FAC
4.			
5.			
	75	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft rad.)			
1. *Ulmus rubra*	15	Yes	FAC
2. *Acer negundo*	10	Yes	FAC
3. *Fraxinus pennsylvanica*	10	Yes	FACW
4. *Cornus amomum*	5	No	FACW
5.			
	40	=Total Cover	
Herb Stratum (Plot size: 5ft rad.)			
1. *Lysimachia nummularia*	50	Yes	FACW
2. *Persicaria pensylvanica*	10	No	FACW
3. *Mentha arvensis*	20	Yes	FACW
4. *Barbarea vulgaris*	5	No	FAC
5.			
6.			
7.			
8.			
9.			
10.			
	85	=Total Cover	
Woody Vine Stratum (Plot size: 15ft rad.)			
1.			
2.			
		=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 6 (A)
Total Number of Dominant Species Across All Strata: 6 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	155	x 2 =	310
FAC species	45	x 3 =	135
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	200 (A)		445 (B)

Prevalence Index = B/A = 2.23

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
X 2 - Dominance Test is >50%
X 3 - Prevalence Index is ≤3.0[1]
___ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** X **No** ___

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: MMB-WSP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
0-4	10YR 3/2	100					Loamy/Clayey	
4-14	10YR 3/2	95	7.5YR 5/6	5	C	PL	Loamy/Clayey	Prominent redox concentrations
14-20	10YR 4/2	70	7.5YR 5/6	30	C	M	Loamy/Clayey	Prominent redox concentrations

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

[2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 5 cm Mucky Peat or Peat (S3)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
X Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
? Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

? Coast Prairie Redox (A16)
___ Iron-Manganese Masses (F12)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______
Depth (inches): ______

Hydric Soil Present? **Yes** X **No** ___

Remarks:
This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

X Surface Water (A1)
X High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
X Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ True Aquatic Plants (B14)
___ Hydrogen Sulfide Odor (C1)
X Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Gauge or Well Data (D9)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
X Geomorphic Position (D2)
X FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes X No ___ Depth (inches): 1
Water Table Present? Yes X No ___ Depth (inches): 0
Saturation Present? Yes X No ___ Depth (inches): 0
(includes capillary fringe)

Wetland Hydrology Present? **Yes** X **No** ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Midwest Region

Project/Site: South Branch Solar   City/County: Hancock County   Sampling Date: 4/21/21
Applicant/Owner: Leeward   State: OH   Sampling Point: MMB-USP1
Investigator(s): M. Martin, K. Lindenschmidt   Section, Township, Range: Washington
Landform (hillside, terrace, etc.): SLOPE   Local relief (concave, convex, none): CONVEX
Slope (%): 6   Lat: 41.131239   Long: -83.530064   Datum: WGS84
Soil Map Unit Name: Gwg5C2 - Glynwood clay loam, ground moraine, 6-12 percent slopes, eroded   NWI classification: NA
Are climatic / hydrologic conditions on the site typical for this time of year? Yes x No ____ (If no, explain in Remarks.)
Are Vegetation ____, Soil ____, or Hydrology ____ significantly disturbed? Are "Normal Circumstances" present? Yes x No ____
Are Vegetation ____, Soil ____, or Hydrology ____ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No X	**Is the Sampled Area within a Wetland?** **Yes** ____ **No** X
Hydric Soil Present?	Yes ____	No X	
Wetland Hydrology Present?	Yes ____	No X	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: 30ft rad.)	Absolute % Cover	Dominant Species?	Indicator Status
1. *Gleditsia triacanthos*	30	Yes	FACU
2. *Ulmus rubra*	20	Yes	FAC
3. *Prunus serotina*	10	No	FACU
4.			
5.			
	60	=Total Cover	
Sapling/Shrub Stratum (Plot size: 15 ft rad.)			
1. *Ulmus rubra*	20	Yes	FAC
2. *Ostrya virginiana*	10	Yes	FACU
3. *Lonicera maackii*	10	Yes	UPL
4.			
5.			
	40	=Total Cover	
Herb Stratum (Plot size: 5ft rad.)			
1. *Rubus flagellaris*	20	Yes	FACU
2. *Barbarea vulgaris*	20	Yes	FAC
3. *Erythronium americanum*	10	Yes	UPL
4.			
5.			
6.			
7.			
8.			
9.			
10.			
	50	=Total Cover	
Woody Vine Stratum (Plot size: 15ft rad.)			
1. *Vitis vulpina*	5	Yes	FAC
2. *Toxicodendron radicans*	5	Yes	FAC
	10	=Total Cover	

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 5 (A)
Total Number of Dominant Species Across All Strata: 10 (B)
Percent of Dominant Species That Are OBL, FACW, or FAC: 50.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	70	x 3 =	210
FACU species	70	x 4 =	280
UPL species	20	x 5 =	100
Column Totals:	160 (A)		590 (B)

Prevalence Index = B/A = 3.69

Hydrophytic Vegetation Indicators:

____ 1 - Rapid Test for Hydrophytic Vegetation
____ 2 - Dominance Test is >50%
____ 3 - Prevalence Index is ≤3.0[1]
____ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
____ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ____ **No** X

Remarks: (Include photo numbers here or on a separate sheet.)

SOIL

Sampling Point: MMB-USP1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth	Matrix		Redox Features					
(inches)	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]	Texture	Remarks
0-6	10YR 3/2	100					Loamy/Clayey	
6-20	7.5YR 4/4	90	7.5YR 5/3	10	C	M	Loamy/Clayey	Faint redox concentrations

[1] Type: C=Concentration, D=Depletion, RM=Reduced Matrix, MS=Masked Sand Grains.

[2] Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

___ Histosol (A1)
___ Histic Epipedon (A2)
___ Black Histic (A3)
___ Hydrogen Sulfide (A4)
___ Stratified Layers (A5)
___ 2 cm Muck (A10)
___ Depleted Below Dark Surface (A11)
___ Thick Dark Surface (A12)
___ Sandy Mucky Mineral (S1)
___ 5 cm Mucky Peat or Peat (S3)
___ Sandy Gleyed Matrix (S4)
___ Sandy Redox (S5)
___ Stripped Matrix (S6)
___ Dark Surface (S7)
___ Loamy Mucky Mineral (F1)
___ Loamy Gleyed Matrix (F2)
___ Depleted Matrix (F3)
___ Redox Dark Surface (F6)
___ Depleted Dark Surface (F7)
___ Redox Depressions (F8)

Indicators for Problematic Hydric Soils[3]:

___ Coast Prairie Redox (A16)
___ Iron-Manganese Masses (F12)
___ Red Parent Material (F21)
___ Very Shallow Dark Surface (F22)
___ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type: ______

Depth (inches): ______

Hydric Soil Present? **Yes** ___ **No** X

Remarks:
This data form is revised from Midwest Regional Supplement Version 2.0 to include the NRCS Field Indicators of Hydric Soils, Version 7.0, 2015 Errata. (http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_051293.docx)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one is required; check all that apply)

___ Surface Water (A1)
___ High Water Table (A2)
___ Saturation (A3)
___ Water Marks (B1)
___ Sediment Deposits (B2)
___ Drift Deposits (B3)
___ Algal Mat or Crust (B4)
___ Iron Deposits (B5)
___ Inundation Visible on Aerial Imagery (B7)
___ Sparsely Vegetated Concave Surface (B8)
___ Water-Stained Leaves (B9)
___ Aquatic Fauna (B13)
___ True Aquatic Plants (B14)
___ Hydrogen Sulfide Odor (C1)
___ Oxidized Rhizospheres on Living Roots (C3)
___ Presence of Reduced Iron (C4)
___ Recent Iron Reduction in Tilled Soils (C6)
___ Thin Muck Surface (C7)
___ Gauge or Well Data (D9)
___ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

___ Surface Soil Cracks (B6)
___ Drainage Patterns (B10)
___ Dry-Season Water Table (C2)
___ Crayfish Burrows (C8)
___ Saturation Visible on Aerial Imagery (C9)
___ Stunted or Stressed Plants (D1)
___ Geomorphic Position (D2)
___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No X	Depth (inches): ___
Water Table Present?	Yes ___	No X	Depth (inches): ___
Saturation Present? (includes capillary fringe)	Yes ___	No X	Depth (inches): ___

Wetland Hydrology Present? **Yes** ___ **No** X

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Background Information

Name: Michael Martin

Date: 4-20-21

Affiliation: Haley & Aldrich Inc

Address: 200 Town Centre Drive, Rochester, NY 14623

Phone Number: 585-321-4265

e-mail address: mmartin@haleyaldrich.com

Name of Wetland: MMA

Vegetation Communit(ies): PFO, PEM

HGM Class(es): Depression

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See delineation report map.

Lat/Long or UTM Coordinate 41.129978N, -83.505504

USGS Quad Name Bloomdale

County Hancock

Township Washington

Section and Subsection

Hydrologic Unit Code 04100010

Site Visit 4-20-21

National Wetland Inventory Map

Ohio Wetland Inventory Map Woods on Hydric Soil (Fig 3-Wetland Delineation Rpt)

Soil Survey Hancock County Soil Survey

Delineation report/map Figure 4 of Wetland Delineation Rpt

Name of Wetland: MMA	
Wetland Size (acres, hectares): 1.13 acres	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Wetland Delineation Report Figure 4

Comments, Narrative Discussion, Justification of Category Changes:

Wetland has pockets of standing water in PFO portion Area was logged in the past and slash/equipment rutting is present, PEM portions are small areas in the edge of adjacent ag fields

Final score : 44	**Category:** 2

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	/	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	/	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	/	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	/	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	/	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	/	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

MMA

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	[✓ NO] Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	[✓ NO] Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	[✓ NO] Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	[✓ NO] Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	[✓ NO] Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	[✓ NO] Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	[✓ NO] Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	[✓ NO] Go to Question 8b

MMA

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	[✓ NO] Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	[✓ NO] Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	[✓ NO] Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	[✓ NO] Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	0ak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

Site: MMA	Rater(s): M. Martin	Date: 4-20-21

2	2
max 6 pts.	subtotal

Metric 1. Wetland Area (size).

Select one size class and assign score.
- ☐ >50 acres (>20.2ha) (6 pts)
- ☐ 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- ☐ 10 to <25 acres (4 to <10.1ha) (4 pts)
- ☐ 3 to <10 acres (1.2 to <4ha) (3 pts)
- ☑ 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- ☐ 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- ☐ <0.1 acres (0.04ha) (0 pts)

5	7
max 14 pts.	subtotal

Metric 2. Upland buffers and surrounding land use.

2a. Calculate average buffer width. Select only one and assign score. Do not double check.
- ☐ WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- ☑ MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- ☐ NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- ☐ VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.
- ☐ VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- ☐ LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- ☐ MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- ☑ HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

18	25
max 30 pts.	subtotal

Metric 3. Hydrology.

3a. Sources of Water. Score all that apply.
- ☐ High pH groundwater (5)
- ☐ Other groundwater (3)
- ☐ Precipitation (1)
- ☑ Seasonal/Intermittent surface water (3)
- ☐ Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.
- ☐ 100 year floodplain (1)
- ☐ Between stream/lake and other human use (1)
- ☐ Part of wetland/upland (e.g. forest), complex (1)
- ☐ Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.
- ☐ >0.7 (27.6in) (3)
- ☐ 0.4 to 0.7m (15.7 to 27.6in) (2)
- ☑ <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.
- ☐ Semi- to permanently inundated/saturated (4)
- ☐ Regularly inundated/saturated (3)
- ☑ Seasonally inundated (2)
- ☐ Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.
- ☑ None or none apparent (12)
- ☐ Recovered (7)
- ☐ Recovering (3)
- ☐ Recent or no recovery (1)

Check all disturbances observed
- ☐ ditch
- ☐ tile
- ☐ dike
- ☐ weir
- ☐ stormwater input
- ☐ point source (nonstormwater)
- ☐ filling/grading
- ☐ road bed/RR track
- ☐ dredging
- ☐ other________________

8	33
max 20 pts.	subtotal

Metric 4. Habitat Alteration and Development.

4a. Substrate disturbance. Score one or double check and average.
- ☐ None or none apparent (4)
- ☐ Recovered (3)
- ☑ Recovering (2)
- ☐ Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.
- ☐ Excellent (7)
- ☐ Very good (6)
- ☐ Good (5)
- ☐ Moderately good (4)
- ☑ Fair (3)
- ☐ Poor to fair (2)
- ☐ Poor (1)

4c. Habitat alteration. Score one or double check and average.
- ☐ None or none apparent (9)
- ☐ Recovered (6)
- ☑ Recovering (3)
- ☐ Recent or no recovery (1)

Check all disturbances observed
- ☐ mowing
- ☐ grazing
- ☐ clearcutting
- ☑ selective cutting
- ☐ woody debris removal
- ☐ toxic pollutants
- ☐ shrub/sapling removal
- ☐ herbaceous/aquatic bed removal
- ☐ sedimentation
- ☐ dredging
- ☐ farming
- ☐ nutrient enrichment

33
subtotal this page

ORAM v. 5.0 Field Form Quantitative Rating

Site: MMA	**Rater(s):** M. Martin	**Date:** 4-20-21

33
subtotal first page

0 | 33
max 10 pts. | subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- ☐ Bog (10)
- ☐ Fen (10)
- ☐ Old growth forest (10)
- ☐ Mature forested wetland (5)
- ☐ Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- ☐ Lake Erie coastal/tributary wetland-restricted hydrology (5)
- ☐ Lake Plain Sand Prairies (Oak Openings) (10)
- ☐ Relict Wet Prairies (10)
- ☐ Known occurrence state/federal threatened or endangered species (10)
- ☐ Significant migratory songbird/water fowl habitat or usage (10)
- ☐ Category 1 Wetland. See Question 1 Qualitative Rating (-10)

11 | 44
max 20 pts. | subtotal

Metric 6. Plant communities, interspersion, microtopography.

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- ☐ Aquatic bed
- 0 Emergent
- ☐ Shrub
- 2 Forest
- ☐ Mudflats
- ☐ Open water
- ☐ Other_______________

6b. horizontal (plan view) Interspersion.
Select only one.

- ☐ High (5)
- ☐ Moderately high(4)
- ☑ Moderate (3)
- ☐ Moderately low (2)
- ☐ Low (1)
- ☐ None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- ☐ Extensive >75% cover (-5)
- ☐ Moderate 25-75% cover (-3)
- ☐ Sparse 5-25% cover (-1)
- ☑ Nearly absent <5% cover (0)
- ☐ Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- ☐ Vegetated hummucks/tussucks
- 2 Coarse woody debris >15cm (6in)
- 2 Standing dead >25cm (10in) dbh
- 2 Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

44

End of Quantitative Rating. Complete Categorization Worksheets.

ORAM Summary Worksheet

MMA

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES [✓ NO]	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES [✓ NO]	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES [✓ NO]	If yes, Category 3.
	Question 4. Significant bird habitat	YES [✓ NO]	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES [✓ NO]	If yes, Category 1.
	Question 6. Bogs	YES [✓ NO]	If yes, Category 3.
	Question 7. Fens	YES [✓ NO]	If yes, Category 3.
	Question 8a. Old Growth Forest	YES [✓ NO]	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES [✓ NO]	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES [✓ NO]	If yes, Category 3
	Question 11. Relict Wet Prairies	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	▨
	Metric 2. Buffers and surrounding land use	5	▨
	Metric 3. Hydrology	18	▨
	Metric 4. Habitat	8	▨
	Metric 5. Special Wetland Communities	0	▨
	Metric 6. Plant communities, interspersion, microtopography	11	▨
	TOTAL SCORE	44	Category based on score breakpoints 2

Complete Wetland Categorization Worksheet.

Wetland Categorization Worksheet

MMA

Choices	**Circle one**		**Evaluation of Categorization Result of ORAM**
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	[✓ NO]	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	[✓ NO]	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	[✓ NO]	Is quantitative rating score *greater* than the Category 2 scoring threshold *(including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	[✓ YES] Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	[✓ NO]	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	[✓ NO] Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	**Category 1**	[✓ **Category 2**]	**Category 3**

End of Ohio Rapid Assessment Method for Wetlands.

Background Information

Name: Michael Martin

Date: 4-21-21

Affiliation: Haley + Aldrich Inc

Address: 200 Town Centre Drive, Rochester, NY 14623

Phone Number: 585-321-4265

e-mail address: mmartin@haleyaldrich.com

Name of Wetland: MMB

Vegetation Communit(ies): PFO

HGM Class(es): Riverine

Location of Wetland: include map, address, north arrow, landmarks, distances, roads, etc.

See delineation report map.

Lat/Long or UTM Coordinate 41,131257; -83,530296	
USGS Quad Name Bloomdale	
County Hancock	
Township Washington	
Section and Subsection	
Hydrologic Unit Code 04100010	
Site Visit 4-21-21	
National Wetland Inventory Map No	
Ohio Wetland Inventory Map No	
Soil Survey Hancock County Soil Survey	
Delineation report/map Figure 4 of Wetland Delineation Rpt	

Name of Wetland: MMB	
Wetland Size (acres, hectares): 1.09 acres	

Sketch: Include north arrow, relationship with other surface waters, vegetation zones, etc.

See Wetland Delineation Report Figure 4.

Comments, Narrative Discussion, Justification of Category Changes:

Wetland adjacent to South Branch Portage River. Receives water from drain tiles in adjacent agricultural fields.

Final score : 46	**Category:** 2

Scoring Boundary Worksheet

INSTRUCTIONS. The initial step in completing the ORAM is to identify the "scoring boundaries" of the wetland being rated. In many instances this determination will be relatively easy and the scoring boundaries will coincide with the "jurisdictional boundaries." For example, the scoring boundary of an isolated cattail marsh located in the middle of a farm field will likely be the same as that wetland's jurisdictional boundaries. In other instances, however, the scoring boundary will not be as easily determined. Wetlands that are small or isolated from other surface waters often form large contiguous areas or heterogeneous complexes of wetland and upland. In separating wetlands for scoring purposes, the hydrologic regime of the wetland is the main criterion that should be used. Boundaries between contiguous or connected wetlands should be established where the volume, flow, or velocity of water moving through the wetland changes significantly. *Areas with a high degree of hydrologic interaction should be scored as a single wetland.* In determining a wetland's scoring boundaries, use the guidelines in the ORAM Manual Section 5.0. In certain instances, it may be difficult to establish the scoring boundary for the wetland being rated. These problem situations include wetlands that form a patchwork on the landscape, wetlands divided by artificial boundaries like property fences, roads, or railroad embankments, wetlands that are contiguous with streams, lakes, or rivers, and estuarine or coastal wetlands. These situations are discussed below, however, it is recommended that Rater contact Ohio EPA, Division of Surface Water, 401/Wetlands Section if there are additional questions or a need for further clarification of the appropriate scoring boundaries of a particular wetland.

#	Steps in properly establishing scoring boundaries	done?	not applicable
Step 1	Identify the wetland area of interest. This may be the site of a proposed impact, a reference site, conservation site, etc.	✓	
Step 2	Identify the locations where there is physical evidence that hydrology changes rapidly. Such evidence includes both natural and human-induced changes including, constrictions caused by berms or dikes, points where the water velocity changes rapidly at rapids or falls, points where significant inflows occur at the confluence of rivers, or other factors that may restrict hydrologic interaction between the wetlands or parts of a single wetland.	✓	
Step 3	Delineate the boundary of the wetland to be rated such that all areas of interest that are contiguous to and within the areas where the hydrology does not change significantly, i.e. areas that have a high degree of hydrologic interaction are included within the scoring boundary.	✓	
Step 4	Determine if artificial boundaries, such as property lines, state lines, roads, railroad embankments, etc., are present. These should not be used to establish scoring boundaries unless they coincide with areas where the hydrologic regime changes.	✓	
Step 5	In all instances, the Rater may enlarge the minimum scoring boundaries discussed here to score together wetlands that could be scored separately.	✓	
Step 6	Consult ORAM Manual Section 5.0 for how to establish scoring boundaries for wetlands that form a patchwork on the landscape, divided by artificial boundaries, contiguous to streams, lakes or rivers, or for dual classifications.	✓	

End of Scoring Boundary Determination. Begin Narrative Rating on next page.

Narrative Rating

INSTRUCTIONS. Answer each of the following questions. Questions 1, 2, 3 and 4 should be answered based on information obtained from the site visit or the literature *and* by submitting a Data Services Request to the Ohio Department of Natural Resources, Division of Natural Areas and Preserves, Natural Heritage Data Services, 1889 Fountain Square Court, Building F-1, Columbus, Ohio 43224, 614-265-6453 (phone), 614-265-3096 (fax), http://www.dnr.state.oh.us/dnap . The remaining questions are designed to be answered primarily by the results of the site visit. Refer to the User's Manual for descriptions of these wetland types. Note: "Critical habitat" is legally defined in the Endangered Species Act and is the geographic area containing physical or biological features essential to the conservation of a listed species or as an area that may require special management considerations or protection. The Rater should contact the Region 3 Headquarters or the Columbus Ecological Services Office for updates as to whether critical habitat has been designated for other federally listed threatened or endangered species. "Documented" means the wetland is listed in the appropriate State of Ohio database.

MMB

#	Question	Circle one	
1	**Critical Habitat.** Is the wetland in a township, section, or subsection of a United States Geological Survey 7.5 minute Quadrangle that has been designated by the U.S. Fish and Wildlife Service as "critical habitat" for any threatened or endangered plant or animal species? Note: as of January 1, 2001, of the federally listed endangered or threatened species which can be found in Ohio, the Indiana Bat has had critical habitat designated (50 CFR 17.95(a)) and the piping plover has had critical habitat proposed (65 FR 41812 July 6, 2000).	YES Wetland should be evaluated for possible Category 3 status Go to Question 2	[✓ NO] Go to Question 2
2	**Threatened or Endangered Species.** Is the wetland known to contain an individual of, or documented occurrences of federal or state-listed threatened or endangered plant or animal species?	YES Wetland is a Category 3 wetland. Go to Question 3	[✓ NO] Go to Question 3
3	**Documented High Quality Wetland.** Is the wetland on record in Natural Heritage Database as a high quality wetland?	YES Wetland is a Category 3 wetland Go to Question 4	[✓ NO] Go to Question 4
4	**Significant Breeding or Concentration Area.** Does the wetland contain documented regionally significant breeding or nonbreeding waterfowl, neotropical songbird, or shorebird concentration areas?	YES Wetland is a Category 3 wetland Go to Question 5	[✓ NO] Go to Question 5
5	**Category 1 Wetlands.** Is the wetland less than 0.5 hectares (1 acre) in size and **hydrologically isolated** and either 1) comprised of vegetation that is dominated (greater than eighty per cent areal cover) by *Phalaris arundinacea, Lythrum salicaria,* or *Phragmites australis*, or 2) an acidic pond created or excavated on mined lands that has little or no vegetation?	YES Wetland is a Category 1 wetland Go to Question 6	[✓ NO] Go to Question 6
6	**Bogs.** Is the wetland a peat-accumulating wetland that 1) has no significant inflows or outflows, 2) supports acidophilic mosses, particularly *Sphagnum* spp., 3) the acidophilic mosses have >30% cover, 4) at least one species from Table 1 is present, and 5) the cover of invasive species (see Table 1) is <25%?	YES Wetland is a Category 3 wetland Go to Question 7	[✓ NO] Go to Question 7
7	**Fens.** Is the wetland a carbon accumulating (peat, muck) wetland that is saturated during most of the year, primarily by a discharge of free flowing, mineral rich, ground water with a circumneutral ph (5.5-9.0) and with one or more plant species listed in Table 1 and the cover of invasive species listed in Table 1 is <25%?	YES Wetland is a Category 3 wetland Go to Question 8a	[✓ NO] Go to Question 8a
8a	**"Old Growth Forest."** Is the wetland a forested wetland and is the forest characterized by, but not limited to, the following characteristics: overstory canopy trees of great age (exceeding at least 50% of a projected maximum attainable age for a species); little or no evidence of human-caused understory disturbance during the past 80 to 100 years; an all-aged structure and multilayered canopies; aggregations of canopy trees interspersed with canopy gaps; and significant numbers of standing dead snags and downed logs?	YES Wetland is a Category 3 wetland. Go to Question 8b	[✓ NO] Go to Question 8b

MMB

8b	**Mature forested wetlands.** Is the wetland a forested wetland with 50% or more of the cover of upper forest canopy consisting of deciduous trees with large diameters at breast height (dbh), generally diameters greater than 45cm (17.7in) dbh?	YES Wetland should be evaluated for possible Category 3 status. Go to Question 9a	[✓ NO] Go to Question 9a
9a	**Lake Erie coastal and tributary wetlands.** Is the wetland located at an elevation less than 575 feet on the USGS map, adjacent to this elevation, or along a tributary to Lake Erie that is accessible to fish?	YES Go to Question 9b	[✓ NO] Go to Question 10
9b	Does the wetland's hydrology result from measures designed to prevent erosion and the loss of aquatic plants, i.e. the wetland is partially hydrologically restricted from Lake Erie due to lakeward or landward dikes or other hydrological controls?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 9c
9c	Are Lake Erie water levels the wetland's primary hydrological influence, i.e. the wetland is hydrologically unrestricted (no lakeward or upland border alterations), or the wetland can be characterized as an "estuarine" wetland with lake and river influenced hydrology. These include sandbar deposition wetlands, estuarine wetlands, river mouth wetlands, or those dominated by submersed aquatic vegetation.	YES Go to Question 9d	NO Go to Question 10
9d	Does the wetland have a predominance of native species within its vegetation communities, although non-native or disturbance tolerant native species can also be present?	YES Wetland is a Category 3 wetland Go to Question 10	NO Go to Question 9e
9e	Does the wetland have a predominance of non-native or disturbance tolerant native plant species within its vegetation communities?	YES Wetland should be evaluated for possible Category 3 status Go to Question 10	NO Go to Question 10
10	**Lake Plain Sand Prairies (Oak Openings)** Is the wetland located in Lucas, Fulton, Henry, or Wood Counties and can the wetland be characterized by the following description: the wetland has a sandy substrate with interspersed organic matter, a water table often within several inches of the surface, and often with a dominance of the gramineous vegetation listed in Table 1 (woody species may also be present). The Ohio Department of Natural Resources Division of Natural Areas and Preserves can provide assistance in confirming this type of wetland and its quality.	YES Wetland is a Category 3 wetland. Go to Question 11	[✓ NO] Go to Question 11
11	**Relict Wet Prairies.** Is the wetland a relict wet prairie community dominated by some or all of the species in Table 1. Extensive prairies were formerly located in the Darby Plains (Madison and Union Counties), Sandusky Plains (Wyandot, Crawford, and Marion Counties), northwest Ohio (e.g. Erie, Huron, Lucas, Wood Counties), and portions of western Ohio Counties (e.g. Darke, Mercer, Miami, Montgomery, Van Wert etc.).	YES Wetland should be evaluated for possible Category 3 status Complete Quantitative Rating	[✓ NO] Complete Quantitative Rating

Table 1. Characteristic plant species.

invasive/exotic spp	fen species	bog species	Oak Opening species	wet prairie species
Lythrum salicaria	*Zygadenus elegans var. glaucus*	*Calla palustris*	*Carex cryptolepis*	*Calamagrostis canadensis*
Myriophyllum spicatum	*Cacalia plantaginea*	*Carex atlantica var. capillacea*	*Carex lasiocarpa*	*Calamogrostis stricta*
Najas minor	*Carex flava*	*Carex echinata*	*Carex stricta*	*Carex atherodes*
Phalaris arundinacea	*Carex sterilis*	*Carex oligosperma*	*Cladium mariscoides*	*Carex buxbaumii*
Phragmites australis	*Carex stricta*	*Carex trisperma*	*Calamagrostis stricta*	*Carex pellita*
Potamogeton crispus	*Deschampsia caespitosa*	*Chamaedaphne calyculata*	*Calamagrostis canadensis*	*Carex sartwellii*
Ranunculus ficaria	*Eleocharis rostellata*	*Decodon verticillatus*	*Quercus palustris*	*Gentiana andrewsii*
Rhamnus frangula	*Eriophorum viridicarinatum*	*Eriophorum virginicum*		*Helianthus grosseserratus*
Typha angustifolia	*Gentianopsis spp.*	*Larix laricina*		*Liatris spicata*
Typha xglauca	*Lobelia kalmii*	*Nemopanthus mucronatus*		*Lysimachia quadriflora*
	Parnassia glauca	*Schechzeria palustris*		*Lythrum alatum*
	Potentilla fruticosa	*Sphagnum spp.*		*Pycnanthemum virginianum*
	Rhamnus alnifolia	*Vaccinium macrocarpon*		*Silphium terebinthinaceum*
	Rhynchospora capillacea	*Vaccinium corymbosum*		*Sorghastrum nutans*
	Salix candida	*Vaccinium oxycoccos*		*Spartina pectinata*
	Salix myricoides	*Woodwardia virginica*		*Solidago riddellii*
	Salix serissima	*Xyris difformis*		
	Solidago ohioensis			
	Tofieldia glutinosa			
	Triglochin maritimum			
	Triglochin palustre			

End of Narrative Rating. Begin Quantitative Rating on next page.

ORAM v. 5.0 Field Form Quantitative Rating

Site: MMB	**Rater(s):** M. Martin	**Date:** 4-22-21

2	2
max 6 pts.	subtotal

Metric 1. Wetland Area (size).

Select one size class and assign score.
- ☐ >50 acres (>20.2ha) (6 pts)
- ☐ 25 to <50 acres (10.1 to <20.2ha) (5 pts)
- ☐ 10 to <25 acres (4 to <10.1ha) (4 pts)
- ☐ 3 to <10 acres (1.2 to <4ha) (3 pts)
- ☑ 0.3 to <3 acres (0.12 to <1.2ha) (2pts)
- ☐ 0.1 to <0.3 acres (0.04 to <0.12ha) (1 pt)
- ☐ <0.1 acres (0.04ha) (0 pts)

1	3
max 14 pts.	subtotal

Metric 2. Upland buffers and surrounding land use.

2a. Calculate average buffer width. Select only one and assign score. Do not double check.
- ☐ WIDE. Buffers average 50m (164ft) or more around wetland perimeter (7)
- ☐ MEDIUM. Buffers average 25m to <50m (82 to <164ft) around wetland perimeter (4)
- ☑ NARROW. Buffers average 10m to <25m (32ft to <82ft) around wetland perimeter (1)
- ☐ VERY NARROW. Buffers average <10m (<32ft) around wetland perimeter (0)

2b. Intensity of surrounding land use. Select one or double check and average.
- ☐ VERY LOW. 2nd growth or older forest, prairie, savannah, wildlife area, etc. (7)
- ☐ LOW. Old field (>10 years), shrub land, young second growth forest. (5)
- ☐ MODERATELY HIGH. Residential, fenced pasture, park, conservation tillage, new fallow field. (3)
- ☐ HIGH. Urban, industrial, open pasture, row cropping, mining, construction. (1)

24	27
max 30 pts.	subtotal

Metric 3. Hydrology.

3a. Sources of Water. Score all that apply.
- ☐ High pH groundwater (5)
- ☑ Other groundwater (3)
- ☑ Precipitation (1)
- ☑ Seasonal/Intermittent surface water (3)
- ☐ Perennial surface water (lake or stream) (5)

3b. Connectivity. Score all that apply.
- ☑ 100 year floodplain (1)
- ☐ Between stream/lake and other human use (1)
- ☐ Part of wetland/upland (e.g. forest), complex (1)
- ☑ Part of riparian or upland corridor (1)

3c. Maximum water depth. Select only one and assign score.
- ☐ >0.7 (27.6in) (3)
- ☐ 0.4 to 0.7m (15.7 to 27.6in) (2)
- ☑ <0.4m (<15.7in) (1)

3d. Duration inundation/saturation. Score one or dbl check.
- ☐ Semi- to permanently inundated/saturated (4)
- ☑ Regularly inundated/saturated (3)
- ☐ Seasonally inundated (2)
- ☐ Seasonally saturated in upper 30cm (12in) (1)

3e. Modifications to natural hydrologic regime. Score one or double check and average.
- ☑ None or none apparent (12)
- ☐ Recovered (7)
- ☐ Recovering (3)
- ☐ Recent or no recovery (1)

Check all disturbances observed
- ☐ ditch
- ☐ tile
- ☐ dike
- ☐ weir
- ☐ stormwater input
- ☐ point source (nonstormwater)
- ☐ filling/grading
- ☐ road bed/RR track
- ☐ dredging
- ☐ other__________________

11	38
max 20 pts.	subtotal

Metric 4. Habitat Alteration and Development.

4a. Substrate disturbance. Score one or double check and average.
- ☑ None or none apparent (4)
- ☐ Recovered (3)
- ☐ Recovering (2)
- ☐ Recent or no recovery (1)

4b. Habitat development. Select only one and assign score.
- ☐ Excellent (7)
- ☐ Very good (6)
- ☐ Good (5)
- ☑ Moderately good (4)
- ☐ Fair (3)
- ☐ Poor to fair (2)
- ☐ Poor (1)

4c. Habitat alteration. Score one or double check and average.
- ☐ None or none apparent (9)
- ☐ Recovered (6)
- ☑ Recovering (3)
- ☐ Recent or no recovery (1)

Check all disturbances observed
- ☐ mowing
- ☐ grazing
- ☐ clearcutting
- ☑ selective cutting
- ☐ woody debris removal
- ☐ toxic pollutants
- ☐ shrub/sapling removal
- ☐ herbaceous/aquatic bed removal
- ☐ sedimentation
- ☐ dredging
- ☐ farming
- ☐ nutrient enrichment

38
subtotal this page

last revised 1 February 2001 jjm

Site: MMB	Rater(s): M. Martin	Date: 4-22-21

38
subtotal first page

0	38
max 10 pts.	subtotal

Metric 5. Special Wetlands.

Check all that apply and score as indicated.

- ☐ Bog (10)
- ☐ Fen (10)
- ☐ Old growth forest (10)
- ☐ Mature forested wetland (5)
- ☐ Lake Erie coastal/tributary wetland-unrestricted hydrology (10)
- ☐ Lake Erie coastal/tributary wetland-restricted hydrology (5)
- ☐ Lake Plain Sand Prairies (Oak Openings) (10)
- ☐ Relict Wet Prairies (10)
- ☐ Known occurrence state/federal threatened or endangered species (10)
- ☐ Significant migratory songbird/water fowl habitat or usage (10)
- ☐ Category 1 Wetland. See Question 1 Qualitative Rating (-10)

8	46
max 20 pts.	subtotal

Metric 6. Plant communities, interspersion, microtopography.

6a. Wetland Vegetation Communities.
Score all present using 0 to 3 scale.

- ☐ Aquatic bed
- ☐ Emergent
- ☐ Shrub
- 2 Forest
- ☐ Mudflats
- ☐ Open water
- ☐ Other________________

6b. horizontal (plan view) Interspersion.
Select only one.

- ☐ High (5)
- ☑ Moderately high(4)
- ☐ Moderate (3)
- ☐ Moderately low (2)
- ☐ Low (1)
- ☐ None (0)

6c. Coverage of invasive plants. Refer to Table 1 ORAM long form for list. Add or deduct points for coverage

- ☐ Extensive >75% cover (-5)
- ☐ Moderate 25-75% cover (-3)
- ☐ Sparse 5-25% cover (-1)
- ☑ Nearly absent <5% cover (0)
- ☐ Absent (1)

6d. Microtopography.
Score all present using 0 to 3 scale.

- ☐ Vegetated hummucks/tussucks
- 1 Coarse woody debris >15cm (6in)
- 1 Standing dead >25cm (10in) dbh
- ☐ Amphibian breeding pools

Vegetation Community Cover Scale

0	Absent or comprises <0.1ha (0.2471 acres) contiguous area
1	Present and either comprises small part of wetland's vegetation and is of moderate quality, or comprises a significant part but is of low quality
2	Present and either comprises significant part of wetland's vegetation and is of moderate quality or comprises a small part and is of high quality
3	Present and comprises significant part, or more, of wetland's vegetation and is of high quality

Narrative Description of Vegetation Quality

low	Low spp diversity and/or predominance of nonnative or disturbance tolerant native species
mod	Native spp are dominant component of the vegetation, although nonnative and/or disturbance tolerant native spp can also be present, and species diversity moderate to moderately high, but generally w/o presence of rare threatened or endangered spp
high	A predominance of native species, with nonnative spp and/or disturbance tolerant native spp absent or virtually absent, and high spp diversity and often, but not always, the presence of rare, threatened, or endangered spp

Mudflat and Open Water Class Quality

0	Absent <0.1ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 to <4ha (2.47 to 9.88 acres)
3	High 4ha (9.88 acres) or more

Microtopography Cover Scale

0	Absent
1	Present very small amounts or if more common of marginal quality
2	Present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of highest quality

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End of Quantitative Rating. Complete Categorization Worksheets.

ORAM Summary Worksheet

MMB

		circle answer or insert score	Result
Narrative Rating	Question 1 Critical Habitat	YES [✓ NO]	If yes, Category 3.
	Question 2. Threatened or Endangered Species	YES [✓ NO]	If yes, Category 3.
	Question 3. High Quality Natural Wetland	YES [✓ NO]	If yes, Category 3.
	Question 4. Significant bird habitat	YES [✓ NO]	If yes, Category 3.
	Question 5. Category 1 Wetlands	YES [✓ NO]	If yes, Category 1.
	Question 6. Bogs	YES [✓ NO]	If yes, Category 3.
	Question 7. Fens	YES [✓ NO]	If yes, Category 3.
	Question 8a. Old Growth Forest	YES [✓ NO]	If yes, Category 3.
	Question 8b. Mature Forested Wetland	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9b. Lake Erie Wetlands - Restricted	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 9d. Lake Erie Wetlands – Unrestricted with native plants	YES [✓ NO]	If yes, Category 3
	Question 9e. Lake Erie Wetlands - Unrestricted with invasive plants	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
	Question 10. Oak Openings	YES [✓ NO]	If yes, Category 3
	Question 11. Relict Wet Prairies	YES [✓ NO]	If yes, evaluate for Category 3; may also be 1 or 2.
Quantitative Rating	Metric 1. Size	2	
	Metric 2. Buffers and surrounding land use	1	
	Metric 3. Hydrology	24	
	Metric 4. Habitat	11	
	Metric 5. Special Wetland Communities	0	
	Metric 6. Plant communities, interspersion, microtopography	8	
	TOTAL SCORE	46	Category based on score breakpoints 2

Complete Wetland Categorization Worksheet.

Wetland Categorization Worksheet

WMMB

Choices	Circle one		Evaluation of Categorization Result of ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 2, 3, 4, 6, 7, 8a, 9d, 10	YES Wetland is categorized as a Category 3 wetland	[✓ NO]	Is quantitative rating score *less* than the Category 2 scoring threshold (*excluding* gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been over-categorized by the ORAM
Did you answer "Yes" to any of the following questions: Narrative Rating Nos. 1, 8b, 9b, 9e, 11	YES Wetland should be evaluated for possible Category 3 status	[✓ NO]	Evaluate the wetland using the 1) narrative criteria in OAC Rule 3745-1-54(C) and 2) the quantitative rating score. If the wetland is determined to be a Category 3 wetland using either of these, it should be categorized as a Category 3 wetland. Detailed biological and/or functional assessments may also be used to determine the wetland's category.
Did you answer "Yes" to Narrative Rating No. 5	YES Wetland is categorized as a Category 1 wetland	[✓ NO]	Is quantitative rating score *greater* than the Category 2 scoring threshold (*including* any gray zone)? If yes, reevaluate the category of the wetland using the narrative criteria in OAC Rule 3745-1-54(C) and biological and/or functional assessments to determine if the wetland has been under-categorized by the ORAM
Does the quantitative score fall within the scoring range of a Category 1, 2, or 3 wetland?	[✓ YES] Wetland is assigned to the appropriate category based on the scoring range	NO	If the score of the wetland is located within the scoring range for a particular category, the wetland should be assigned to that category. In all instances however, the narrative criteria described in OAC Rule 3745-1-54(C) can be used to clarify or change a categorization based on a quantitative score.
Does the quantitative score fall with the *"gray zone"* for Category 1 or 2 or Category 2 or 3 wetlands?	YES Wetland is assigned to the higher of the two categories or assigned to a category based on detailed assessments and the narrative criteria	[✓ NO]	Rater has the option of assigning the wetland to the higher of the two categories or to assign a category based on the results of a nonrapid wetland assessment method, e.g. functional assessment, biological assessment, etc, and a consideration of the narrative criteria in OAC rule 3745-1-54(C).
Does the wetland otherwise exhibit *moderate OR superior* hydrologic OR habitat, OR recreational functions AND the wetland was *not* categorized as a Category 2 wetland (in the case of moderate functions) or a Category 3 wetland (in the case of superior functions) by this method?	YES Wetland was undercategorized by this method. A written justification for recategorization should be provided on Background Information Form	[✓ NO] Wetland is assigned to category as determined by the ORAM.	A wetland may be undercategorized using this method, but still exhibit one or more superior functions, e.g. a wetland's biotic communities may be degraded by human activities, but the wetland may still exhibit superior hydrologic functions because of its type, landscape position, size, local or regional significance, etc. In this circumstance, the narrative criteria in OAC Rule 3745-1-54(C)(2) and (3) are controlling, and the under-categorization should be corrected. A written justification with supporting reasons or information for this determination should be provided.

Final Category

Choose one	Category 1	Category 2	Category 3
		✓	

End of Ohio Rapid Assessment Method for Wetlands.

STREAM INVENTORY DATA FORM

PROJECT INFORMATION

PROJECT NAME: South Branch Solar

DATE: 4-20-21

PROJECT NUMBER: 135392

COUNTY/STATE: Hancock/OH

OBSERVER NAME: M. Martin

WEATHER: Cloudy, 40°

STREAM INFORMATION

H&A STREAM ID: MM1

NEAREST FLAG #: MM1-17

WATER WIDTH: 8'

STREAM NAME: S. Branch Portage River

STREAM WIDTH: 9'

FLOW TYPE: ☒ PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL

BANKFULL WIDTH: 12'

PERCEPTIBLE FLOW: ☒ YES ☐ NO

FLOW DIRECTION: N

PROBED STREAM DEPTH: 8''

OBSERVED WATER QUALITY: clear

CHANNEL SUBSTRATE: silt, cobble, sand, gravel

AQUATIC HABITAT ☒ OVERHANGING ☒ COBBLE RIFFLES ☐ MUD BAR ☐ TREES/SHRUBS ☐ SAND BAR ☒ SAND/GRAVEL BEACH BAR ☐ AQUATIC VEGETATION ☒ DEEP HOLES ☐ OTHER:

WILDLIFE OBSERVED ☐ WATERFOWL ☐ TURTLES ☐ INVERTEBRATES ☒ FISH ☐ FROGS ☐ SALAMANDERS ☐ OTHER:

OBSERVED USE ☐ DRINKING ☐ SWIMMING ☒ DRAINAGE ☐ IRRIGATION ☐ FISHING ☐ BOATING ☐ OTHER:

LEFT BANK HEIGHT: 2'

RIGHT BANK HEIGHT: 5'

BANK SUBSTRATE: silt loam

LEFT BANK SLOPE: 50%

RIGHT BANK SLOPE: 40%

EROSION POTENTIAL: high

MEANDER: moderate

GRADIENT: moderate

% CANOPY CLOSURE: 25

ADJACENT COMMUNITY TYPES: narrow tree buffer/agriculture

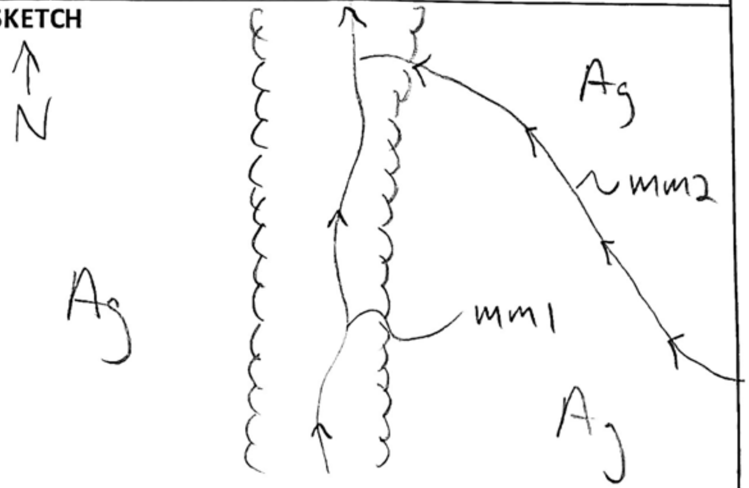
DOMINANT TREES: hackberry

DOMINANT SHRUBS: honeysuckle

DOMINANT HERBACEOUS: reed canary

NOTES

SKETCH



Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 4

SITE NAME/LOCATION South Branch Solar

SITE NUMBER MM1 RIVER BASIN CEDAR-PORTAGE DRAINAGE AREA (mi²) 7.35

LENGTH OF STREAM REACH (ft) 200 LAT. 41.12538 LONG. -83.52337 RIVER CODE ____ RIVER MILE ____

DATE 04/20/21 SCORER Martin COMMENTS ____

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☑ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

HHEI Metric Points

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐ ☐	BLDR SLABS [16 pts]	0%	☐ ☐	SILT [3 pt]	25%
☐ ☐	BOULDER (>256 mm) [16 pts]	0%	☐ ☐	LEAF PACK/WOODY DEBRIS [3 pts]	0%
☐ ☐	BEDROCK [16 pt]	0%	☐ ☐	FINE DETRITUS [3 pts]	0%
☐ ☐	COBBLE (65-256 mm) [12 pts]	5%	☐ ☐	CLAY or HARDPAN [0 pt]	0%
☐ ☐	GRAVEL (2-64 mm) [9 pts]	50%	☐ ☐	MUCK [0 pts]	0%
☐ ☐	SAND (<2 mm) [6 pts]	20%	☐ ☐	ARTIFICIAL [3 pts]	0%

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5.00% (A)

Substrate Percentage Check 100% (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 0

TOTAL NUMBER OF SUBSTRATE TYPES: 4

Substrate Max = 40: 4 A + B

2. Maximum Pool Depth *(Measure the maximum pool depth within the 61 meter (200 ft)* evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐ > 30 centimeters [20 pts]
☐ > 22.5 - 30 cm [30 pts]
☐ > 10 - 22.5 cm [25 pts]
☐ > 5 cm - 10 cm [15 pts]
☐ < 5 cm [5 pts]
☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS ____ **MAXIMUM POOL DEPTH (centimeters):** 30

Pool Depth Max = 30: 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐ > 4.0 meters (> 13') [30 pts]
☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐ ≤ 1.0 m (<=3' 3") [5 pts]

COMMENTS ____ **AVERAGE BANKFULL WIDTH (meters):** 4.00

Bankfull Width Max=30: 0

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

RIPARIAN WIDTH

L R	(Per Bank)
☐ ☐	Wide >10m
☐ ☐	Moderate 5-10m
☐ ☐	Narrow <5m
☐ ☐	None

FLOODPLAIN QUALITY

L R	(Most Predominant per Bank)	L R	
☐ ☐	Mature Forest, Wetland	☐ ☐	Conservation Tillage
☐ ☐	Immature Forest, Shrub or Old Field	☐ ☐	Urban or Industrial
☐ ☐	Residential, Park, New Field	☐ ☐	Open Pasture, Row Crop
☐ ☐	Fenced Pasture	☐ ☐	Mining or Construction

COMMENTS ____

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☑ Stream Flowing
☐ Subsurface flow with isolated pools (Interstitial)
☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Dry channel, no water (Ephemeral)

COMMENTS ____

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None
☐ 0.5
☐ 1.0
☐ 1.5
☐ 2.0
☐ 2.5
☐ 3.0
☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☐ No QHEI Score ______ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☐ WWH Name: ______ Distance from Evaluated Stream ______
☐ CWH Name: ______ Distance from Evaluated Stream ______
☐ EWH Name: ______ Distance from Evaluated Stream ______

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: **Bloomdale** NRCS Soil Map Page: ______ NRCS Soil Map Stream Order ______

County: **Hancock** Township / City: **Washington**

MISCELLANEOUS

Base Flow Conditions? (Y/N): **Y** Date of last precipitation: ______ Quantity: **0.00**

Photograph Information: **See Wetland Delineation Report photolog**

Elevated Turbidity? (Y/N): **N** Canopy (% open): **75%**

Were samples collected for water chemistry? (Y/N): **N** (Note lab sample no. or id. and attach results) Lab Number: ______

Field Measures: Temp (°C) ______ Dissolved Oxygen (mg/l) ______ pH (S.U.) ______ Conductivity (µmhos/cm) ______

Is the sampling reach representative of the stream (Y/N) **Y** If not, please explain: ______

Additional comments/description of pollution impacts: ______

BIOTIC EVALUATION

Performed? (Y/N): **N** (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

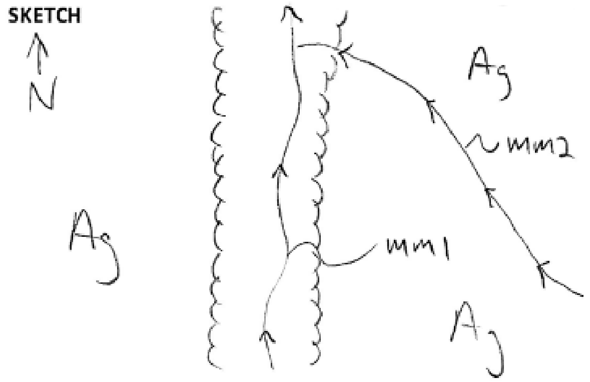
Fish Observed? (Y/N) **Y** Voucher? (Y/N) **N** Salamanders Observed? (Y/N) **N** Voucher? (Y/N) **N**
Frogs or Tadpoles Observed? (Y/N) **N** Voucher? (Y/N) **N** Aquatic Macroinvertebrates Observed? (Y/N) **N** Voucher? (Y/N) **N**

Comments Regarding Biology: ______

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW ➔



Save as pdf

Reset Form

STREAM INVENTORY DATA FORM

PROJECT INFORMATION

PROJECT NAME: South Branch Solar	DATE: 4-20-21
PROJECT NUMBER: 135392	COUNTY/STATE: Hancock/Ohio
OBSERVER NAME: M. Martin	WEATHER: 40°, Cloudy

STREAM INFORMATION

H&A STREAM ID: MM2	NEAREST FLAG #: MM2-96	WATER WIDTH: 8'
STREAM NAME: unnamed		STREAM WIDTH: 8'
FLOW TYPE: ☐ PERENNIAL ☑ INTERMITTENT ☐ EPHEMERAL		BANKFULL WIDTH: 25'
PERCEPTIBLE FLOW: ☑ YES ☐ NO	FLOW DIRECTION: W	PROBED STREAM DEPTH: 8"
OBSERVED WATER QUALITY: Clear		CHANNEL SUBSTRATE: silt, sand

AQUATIC HABITAT ☐ OVERHANGING ☐ COBBLE RIFFLES ☐ MUD BAR ☐ TREES/SHRUBS ☐ SAND BAR ☐ SAND/GRAVEL BEACH BAR ☑ AQUATIC VEGETATION ☑ DEEP HOLES ☐ OTHER:

WILDLIFE OBSERVED ☐ WATERFOWL ☐ TURTLES ☐ INVERTEBRATES ☑ FISH ☑ FROGS ☐ SALAMANDERS ☐ OTHER:

OBSERVED USE ☐ DRINKING ☐ SWIMMING ☑ DRAINAGE ☐ IRRIGATION ☐ FISHING ☐ BOATING ☐ OTHER:

LEFT BANK HEIGHT: 8'	RIGHT BANK HEIGHT: 8'	BANK SUBSTRATE: silt loam
LEFT BANK SLOPE: 40%	RIGHT BANK SLOPE: 50%	EROSION POTENTIAL: low
MEANDER: moderate	GRADIENT: moderate	% CANOPY CLOSURE: 0

ADJACENT COMMUNITY TYPES: ag

DOMINANT TREES: –

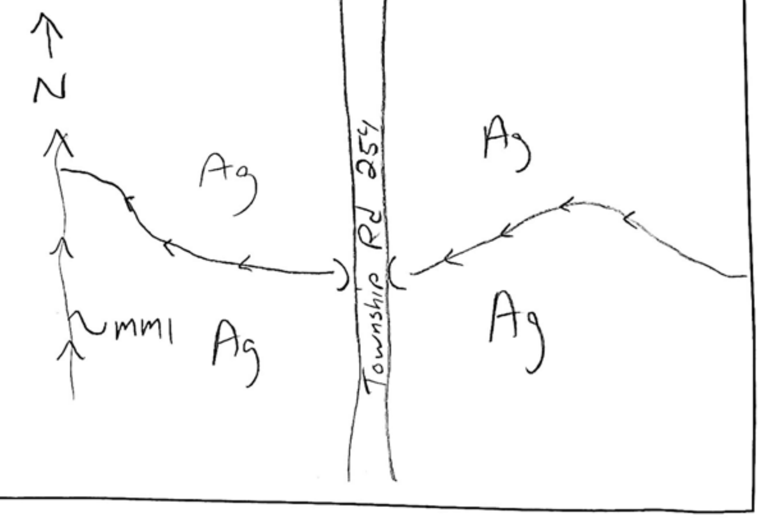
DOMINANT SHRUBS: –

DOMINANT HERBACEOUS: reed canary grass, winter wheat

NOTES

Receives water from adjacent drain tiles.

SKETCH



OhioEPA

Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 4

SITE NAME/LOCATION SOUTH BRANCH SOLAR

SITE NUMBER MM2 RIVER BASIN CEDAR-PORTAGE DRAINAGE AREA (mi^2) 4.04

LENGTH OF STREAM REACH (ft) 200 LAT. 41.12497 LONG. -83.51596 RIVER CODE RIVER MILE

DATE 04/20/21 SCORER MARTIN COMMENTS

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☐ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐☐	BLDR SLABS [16 pts]	0%	☐☐	SILT [3 pt]	10%
☐☐	BOULDER (>256 mm) [16 pts]	0%	☐☐	LEAF PACK/WOODY DEBRIS [3 pts]	0%
☐☐	BEDROCK [16 pt]	0%	☐☐	FINE DETRITUS [3 pts]	0%
☐☐	COBBLE (65-256 mm) [12 pts]	10%	☐☐	CLAY or HARDPAN [0 pt]	0%
☐☐	GRAVEL (2-64 mm) [9 pts]	20%	☐☐	MUCK [0 pts]	0%
☐☐	SAND (<2 mm) [6 pts]	60%	☐☐	ARTIFICIAL [3 pts]	0%

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5.00% (A)

Substrate Percentage Check 100% (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 0

TOTAL NUMBER OF SUBSTRATE TYPES: 4

HHEI Metric Points

Substrate Max = 40: 4 (A + B)

2. Maximum Pool Depth *(Measure the maximum pool depth within the 61 meter (200 ft)* evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐	> 30 centimeters [20 pts]	☐	> 5 cm - 10 cm [15 pts]
☐	> 22.5 - 30 cm [30 pts]	☐	< 5 cm [5 pts]
☐	> 10 - 22.5 cm [25 pts]	☐	NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS **MAXIMUM POOL DEPTH (centimeters):** 25

Pool Depth Max = 30: 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☑	> 4.0 meters (> 13') [30 pts]	☐	> 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐	> 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]	☐	≤ 1.0 m (<=3' 3") [5 pts]
☐	> 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]		

COMMENTS **AVERAGE BANKFULL WIDTH (meters):** 8.00

Bankfull Width Max=30: 0

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

L R	RIPARIAN WIDTH (Per Bank)	L R	FLOODPLAIN QUALITY (Most Predominant per Bank)	L R	
☐☐	Wide >10m	☐☐	Mature Forest, Wetland	☐☐	Conservation Tillage
☐☐	Moderate 5-10m	☐☐	Immature Forest, Shrub or Old Field	☐☐	Urban or Industrial
☐☐	Narrow <5m	☐☐	Residential, Park, New Field	☐☐	Open Pasture, Row Crop
☐☐	None	☐☐	Fenced Pasture	☐☐	Mining or Construction

COMMENTS

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☑ Stream Flowing
☐ Subsurface flow with isolated pools (Interstitial)
☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Dry channel, no water (Ephemeral)

COMMENTS

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None ☐ 0.5 ☐ 1.0 ☐ 1.5 ☐ 2.0 ☐ 2.5 ☐ 3.0 ☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☐ No QHEI Score ______ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☐ WWH Name: ______ Distance from Evaluated Stream ______

☐ CWH Name: ______ Distance from Evaluated Stream ______

☐ EWH Name: ______ Distance from Evaluated Stream ______

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE <u>ENTIRE</u> WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: **ARCADIA** NRCS Soil Map Page: ______ NRCS Soil Map Stream Order ______

County: **HANCOCK** Township / City: **WASHINGTON**

MISCELLANEOUS

Base Flow Conditions? (Y/N): **Y** Date of last precipitation: ______ Quantity: **0.00**

Photograph Information: **See wetland delineation report photolog**

Elevated Turbidity? (Y/N): **N** Canopy (% open): **100%**

Were samples collected for water chemistry? (Y/N): **N** (Note lab sample no. or id. and attach results) Lab Number: ______

Field Measures: Temp (°C) ______ Dissolved Oxygen (mg/l) ______ pH (S.U.) ______ Conductivity (µmhos/cm) ______

Is the sampling reach representative of the stream (Y/N) **Y** If not, please explain: ______

Additional comments/description of pollution impacts: ______

BIOTIC EVALUATION

Performed? (Y/N): **N** (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) **N** Voucher? (Y/N) **N** Salamanders Observed? (Y/N) **N** Voucher? (Y/N) **N**

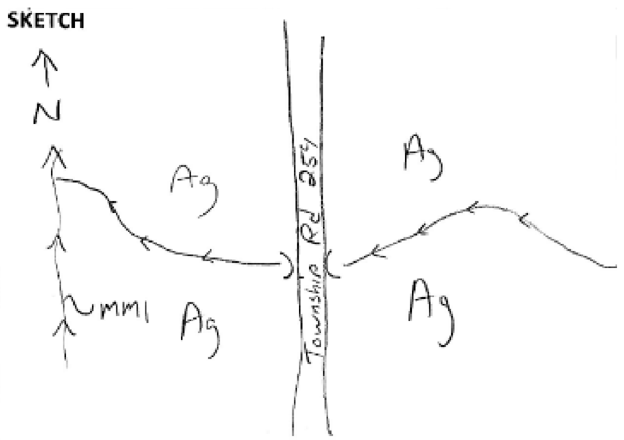
Frogs or Tadpoles Observed? (Y/N) **N** Voucher? (Y/N) **N** Aquatic Macroinvertebrates Observed? (Y/N) **N** Voucher? (Y/N) **N**

Comments Regarding Biology: ______

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This <u>must</u> be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW ➔



Save as pdf

Reset Form

STREAM INVENTORY DATA FORM

PROJECT INFORMATION

PROJECT NAME: South Branch Solar

DATE: 4-21-21

PROJECT NUMBER: 135392

COUNTY/STATE: Hancock / OH

OBSERVER NAME: M. Martin

WEATHER: Sunny, 35°

STREAM INFORMATION

STREAM ID: MM3

WATER WIDTH: 10'

STREAM NAME: S. Branch Portage River

STREAM WIDTH: 12'

FLOW TYPE: ☑ PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL

BANKFULL WIDTH: 16'

PERCEPTIBLE FLOW: ☑ YES ☐ NO

PROBED STREAM DEPTH: 6"

DIRECTION OF FLOW: N NE E SE S SW W [✓ NW]

CHANNEL SUBSTRATE: silt, sand, cobble, gravel

PERCEPTIBLE FLOW: ☑ YES ☐ NO

OBSERVED WATER QUALITY: clear

AQUATIC HABITAT ☑ OVERHANGING ☐ COBBLE RIFFLES ☐ MUD BAR ☐ TREES/SHRUBS ☐ SAND BAR ☑ SAND/GRAVEL BEACH BAR ☑ AQUATIC VEGETATION ☑ DEEP HOLES ☐ OTHER:

WILDLIFE OBSERVED ☐ WATERFOWL ☐ TURTLES ☐ INVERTABRATES ☐ FISH ☐ FROGS ☐ SALAMANDERS ☐ OTHER:

OBSERVED USE ☐ DRINKING ☐ SWIMMING ☑ DRAINAGE ☐ IRRIGATION ☐ FISHING ☐ BOATING OTHER:

LEFT BANK HEIGHT: 5'

RIGHT BANK HEIGHT: 3'

BANK SUBSTRATE: silt loam

LEFT BANK SLOPE: 80%

RIGHT BANK SLOPE: 40%

EROSION POTENTIAL: high

MEANDER: moderate

GRADIENT: moderate

% CANOPY CLOSURE: 5%

ADJACENT COMMUNITY TYPES: Ag + narrow vegetated buffer

DOMINANT TREES: honey locust, black cherry

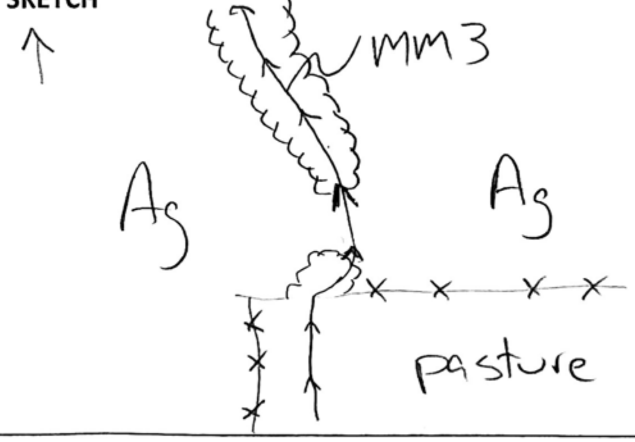
DOMINANT SHRUBS: raspberry, boxelder

DOMINANT HERBACEOUS: Asters, dandelion, grasses

NOTES

Flows through bison pasture south of Study Area.

SKETCH



Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 4

SITE NAME/LOCATION SOUTH BRANCH SOLAR

SITE NUMBER MM3 RIVER BASIN CEDAR-PORTAGE DRAINAGE AREA (mi²) 7.17

LENGTH OF STREAM REACH (ft) 200 LAT. 41.11954 LONG. -83.51908 RIVER CODE RIVER MILE

DATE 04/21/21 SCORER MARTIN COMMENTS

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☐ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐ ☐	BLDR SLABS [16 pts]	0%	☐ ☐	SILT [3 pt]	30%
☐ ☐	BOULDER (>256 mm) [16 pts]	0%	☐ ☐	LEAF PACK/WOODY DEBRIS [3 pts]	0%
☐ ☐	BEDROCK [16 pt]	0%	☐ ☐	FINE DETRITUS [3 pts]	0%
☐ ☐	COBBLE (65-256 mm) [12 pts]	40%	☐ ☐	CLAY or HARDPAN [0 pt]	0%
☐ ☐	GRAVEL (2-64 mm) [9 pts]	20%	☐ ☐	MUCK [0 pts]	0%
☐ ☐	SAND (<2 mm) [6 pts]	10%	☐ ☐	ARTIFICIAL [3 pts]	0%

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5.00% (A)

Substrate Percentage Check 100% (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 0

TOTAL NUMBER OF SUBSTRATE TYPES: 4

HHEI Metric Points

Substrate Max = 40: 4

A + B

2. Maximum Pool Depth *(Measure the maximum pool depth within the 61 meter (200 ft)* evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐ > 30 centimeters [20 pts]
☐ > 22.5 - 30 cm [30 pts]
☐ > 10 - 22.5 cm [25 pts]
☐ > 5 cm - 10 cm [15 pts]
☐ < 5 cm [5 pts]
☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS

MAXIMUM POOL DEPTH (centimeters): 15

Pool Depth Max = 30: 0

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☑ > 4.0 meters (> 13') [30 pts]
☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐ ≤ 1.0 m (<=3' 3") [5 pts]

COMMENTS

AVERAGE BANKFULL WIDTH (meters): 5.00

Bankfull Width Max=30: 0

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

L R	RIPARIAN WIDTH (Per Bank)	L R	FLOODPLAIN QUALITY (Most Predominant per Bank)	L R	
☐ ☐	Wide >10m	☐ ☐	Mature Forest, Wetland	☐ ☐	Conservation Tillage
☐ ☐	Moderate 5-10m	☐ ☐	Immature Forest, Shrub or Old Field	☐ ☐	Urban or Industrial
☐ ☐	Narrow <5m	☐ ☐	Residential, Park, New Field	☐ ☐	Open Pasture, Row Crop
☐ ☐	None	☐ ☐	Fenced Pasture	☐ ☐	Mining or Construction

COMMENTS

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☑ Stream Flowing
☐ Subsurface flow with isolated pools (Interstitial)
☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Dry channel, no water (Ephemeral)

COMMENTS

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None
☐ 0.5
☐ 1.0
☐ 1.5
☐ 2.0
☐ 2.5
☐ 3.0
☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☐ No QHEI Score ______ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☐ WWH Name: ______ Distance from Evaluated Stream ______

☐ CWH Name: ______ Distance from Evaluated Stream ______

☐ EWH Name: ______ Distance from Evaluated Stream ______

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: **ARCADIA** NRCS Soil Map Page: ______ NRCS Soil Map Stream Order ______

County: **HANCOCK** Township / City: **WASHINGTON**

MISCELLANEOUS

Base Flow Conditions? (Y/N): **Y** Date of last precipitation: ______ Quantity: **0.00**

Photograph Information: **See wetland delineation report photolog**

Elevated Turbidity? (Y/N): **N** Canopy (% open): **95%**

Were samples collected for water chemistry? (Y/N): **N** (Note lab sample no. or id. and attach results) Lab Number: ______

Field Measures: Temp (°C) ______ Dissolved Oxygen (mg/l) ______ pH (S.U.) ______ Conductivity (µmhos/cm) ______

Is the sampling reach representative of the stream (Y/N) **Y** If not, please explain: ______

Additional comments/description of pollution impacts: ______

BIOTIC EVALUATION

Performed? (Y/N): **N** (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) **Y** Voucher? (Y/N) **N** Salamanders Observed? (Y/N) **N** Voucher? (Y/N) **N**

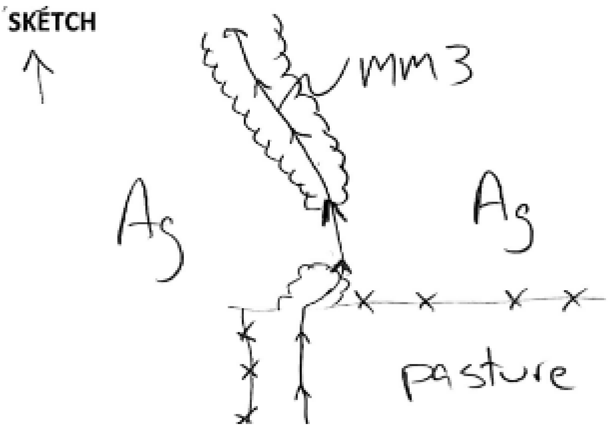
Frogs or Tadpoles Observed? (Y/N) **N** Voucher? (Y/N) **N** Aquatic Macroinvertebrates Observed? (Y/N) **N** Voucher? (Y/N) **N**

Comments Regarding Biology: ______

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW ➜



Save as pdf

Reset Form

STREAM INVENTORY DATA FORM

PROJECT INFORMATION

PROJECT NAME: South Branch Solar	DATE: 4-21-21
PROJECT NUMBER: 135392	COUNTY/STATE: Hancock/OH
OBSERVER NAME: M. Martin	WEATHER: Sunny, 38°

STREAM INFORMATION

H&A STREAM ID: MM4	NEAREST FLAG #: MM4-2	WATER WIDTH: 20'
STREAM NAME: S. Branch Portage River		STREAM WIDTH: 21'
FLOW TYPE: ☒ PERENNIAL ☐ INTERMITTENT ☐ EPHEMERAL		BANKFULL WIDTH: 23'
PERCEPTIBLE FLOW: ☒ YES ☐ NO	FLOW DIRECTION: SE	PROBED STREAM DEPTH: 4''
OBSERVED WATER QUALITY: Clear		CHANNEL SUBSTRATE: cobbles silt gravel sand

AQUATIC HABITAT ☒ OVERHANGING ☒ COBBLE RIFFLES ☐ MUD BAR ☒ TREES/SHRUBS ☐ SAND BAR ☒ SAND/GRAVEL BEACH BAR ☐ AQUATIC VEGETATION ☒ DEEP HOLES ☐ OTHER:

WILDLIFE OBSERVED ☐ WATERFOWL ☐ TURTLES ☐ INVERTEBRATES ☐ FISH ☐ FROGS ☐ SALAMANDERS ☐ OTHER:

OBSERVED USE ☐ DRINKING ☐ SWIMMING ☒ DRAINAGE ☐ IRRIGATION ☐ FISHING ☐ BOATING ☐ OTHER:

LEFT BANK HEIGHT: 3'-7'	RIGHT BANK HEIGHT: 2'-15'	BANK SUBSTRATE: silt loam
LEFT BANK SLOPE: 60	RIGHT BANK SLOPE: 70	EROSION POTENTIAL: yes/high
MEANDER: mod/high	GRADIENT: Flat	% CANOPY CLOSURE: 30

ADJACENT COMMUNITY TYPES: Narrow wood area agriculture

DOMINANT TREES: box elder, green ash, sycamore

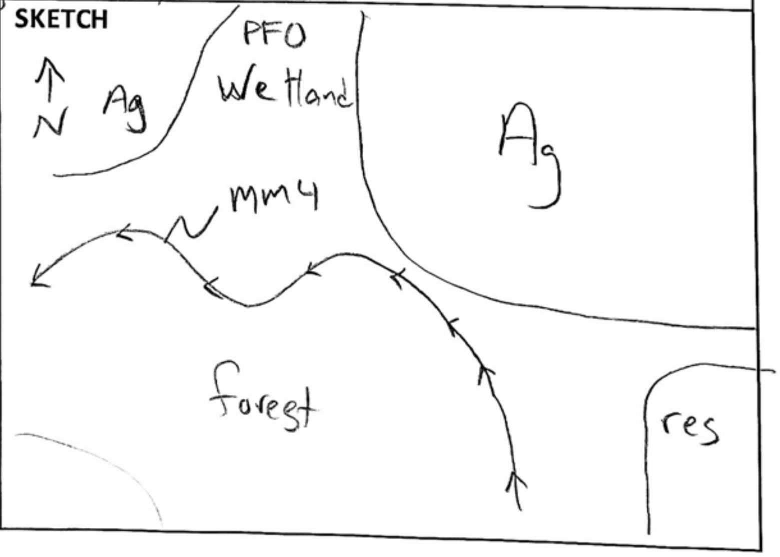
DOMINANT SHRUBS: boxelder

DOMINANT HERBACEOUS: sedges, creeping jenny

NOTES

Adjacent wetland receives water from drain tiles in adjacent ag. fields.

SKETCH



OhioEPA

Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 4

SITE NAME/LOCATION SOUTH BRANCH SOLAR

SITE NUMBER MM4 RIVER BASIN CEDAR-PORTAGE DRAINAGE AREA (mi^2) 12.10

LENGTH OF STREAM REACH (ft) 200 LAT. 41.13043 LONG. -83.53003 RIVER CODE ______ RIVER MILE ______

DATE 04/21/21 SCORER MARTIN COMMENTS ______

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☑ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. **SUBSTRATE (Estimate percent of every type of substrate present.** Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐ ☐	BLDR SLABS [16 pts]	0%	☐ ☐	SILT [3 pt]	20%
☐ ☐	BOULDER (>256 mm) [16 pts]	0%	☐ ☐	LEAF PACK/WOODY DEBRIS [3 pts]	0%
☐ ☐	BEDROCK [16 pt]	0%	☐ ☐	FINE DETRITUS [3 pts]	0%
☐ ☐	COBBLE (65-256 mm) [12 pts]	25%	☐ ☐	CLAY or HARDPAN [0 pt]	0%
☐ ☐	GRAVEL (2-64 mm) [9 pts]	35%	☐ ☐	MUCK [0 pts]	0%
☐ ☐	SAND (<2 mm) [6 pts]	20%	☐ ☐	ARTIFICIAL [3 pts]	0%

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 5.00%

Substrate Percentage Check 100%

(A) SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 0

(B) TOTAL NUMBER OF SUBSTRATE TYPES: 4

HHEI Metric Points

Substrate Max = 40: 4

A + B

2. **Maximum Pool Depth *(Measure the maximum pool depth within the 61 meter (200 ft)* evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes)** (Check *ONLY* one box):

☐ > 30 centimeters [20 pts]
☐ > 22.5 - 30 cm [30 pts]
☐ > 10 - 22.5 cm [25 pts]
☐ > 5 cm - 10 cm [15 pts]
☐ < 5 cm [5 pts]
☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS ______ **MAXIMUM POOL DEPTH (centimeters):** 20

Pool Depth Max = 30: 0

3. **BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):**

☑ > 4.0 meters (> 13') [30 pts]
☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐ ≤ 1.0 m (<=3' 3") [5 pts]

COMMENTS ______ **AVERAGE BANKFULL WIDTH (meters):** 7.00

Bankfull Width Max=30: 0

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

L R	RIPARIAN WIDTH (Per Bank)	L R	FLOODPLAIN QUALITY (Most Predominant per Bank)	L R	
☑ ☑	Wide >10m	☐ ☐	Mature Forest, Wetland	☐ ☐	Conservation Tillage
☐ ☐	Moderate 5-10m	☐ ☐	Immature Forest, Shrub or Old Field	☐ ☐	Urban or Industrial
☐ ☐	Narrow <5m	☐ ☐	Residential, Park, New Field	☐ ☐	Open Pasture, Row Crop
☐ ☐	None	☐ ☐	Fenced Pasture	☐ ☐	Mining or Construction

COMMENTS ______

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☑ Stream Flowing
☐ Subsurface flow with isolated pools (Interstitial)
☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Dry channel, no water (Ephemeral)

COMMENTS ______

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☐ None
☐ 0.5
☐ 1.0
☐ 1.5
☐ 2.0
☐ 2.5
☐ 3.0
☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☐ No QHEI Score ______ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☐ WWH Name: ______ Distance from Evaluated Stream ______

☐ CWH Name: ______ Distance from Evaluated Stream ______

☐ EWH Name: ______ Distance from Evaluated Stream ______

MAPPING: ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION

USGS Quadrangle Name: **BLOOMDALE** NRCS Soil Map Page: ______ NRCS Soil Map Stream Order ______

County: **HANCOCK** Township / City: **WASHINGTON**

MISCELLANEOUS

Base Flow Conditions? (Y/N): **Y** Date of last precipitation: ______ Quantity: **0.00**

Photograph Information: **See wetland delineation report photolog**

Elevated Turbidity? (Y/N): **N** Canopy (% open): **70%**

Were samples collected for water chemistry? (Y/N): **N** (Note lab sample no. or id. and attach results) Lab Number: ______

Field Measures: Temp (°C) ______ Dissolved Oxygen (mg/l) ______ pH (S.U.) ______ Conductivity (µmhos/cm) ______

Is the sampling reach representative of the stream (Y/N) **Y** If not, please explain: ______

Additional comments/description of pollution impacts: ______

BIOTIC EVALUATION

Performed? (Y/N): **N** (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

Fish Observed? (Y/N) **Y** Voucher? (Y/N) **N** Salamanders Observed? (Y/N) **N** Voucher? (Y/N) **N**

Frogs or Tadpoles Observed? (Y/N) **N** Voucher? (Y/N) **N** Aquatic Macroinvertebrates Observed? (Y/N) **N** Voucher? (Y/N) **N**

Comments Regarding Biology: ______

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW ➜

Save as pdf

Reset Form

STREAM INVENTORY DATA FORM

PROJECT INFORMATION

PROJECT NAME: South Branch Solar	DATE: 4-22-21
PROJECT NUMBER: 135392	COUNTY/STATE: Hancock / OH
OBSERVER NAME: M. Martin	WEATHER: Sunny, 45°

STREAM INFORMATION

STREAM ID: MM5	WATER WIDTH: 6'
STREAM NAME: unnamed	STREAM WIDTH: 6'
FLOW TYPE: ☐ PERENNIAL ☑ INTERMITTENT ☐ EPHEMERAL	BANKFULL WIDTH: 12'
PERCEPTIBLE FLOW: ☑ YES ☐ NO	PROBED STREAM DEPTH: 6"
DIRECTION OF FLOW: N NE E SE S SW W [✓ NW]	CHANNEL SUBSTRATE: silt, sand, gravel, cobble
PERCEPTIBLE FLOW: ☑ YES ☐ NO	OBSERVED WATER QUALITY: clear

AQUATIC HABITAT ☑ OVERHANGING ☐ COBBLE RIFFLES ☐ MUD BAR ☐ TREES/SHRUBS ☐ SAND BAR ☐ SAND/GRAVEL BEACH BAR ☐ AQUATIC VEGETATION ☐ DEEP HOLES ☐ OTHER:

WILDLIFE OBSERVED ☐ WATERFOWL ☐ TURTLES ☐ INVERTABRATES ☐ FISH ☐ FROGS ☐ SALAMANDERS ☐ OTHER:

OBSERVED USE ☐ DRINKING ☐ SWIMMING ☑ DRAINAGE ☐ IRRIGATION ☐ FISHING ☐ BOATING OTHER:

LEFT BANK HEIGHT: 4'	RIGHT BANK HEIGHT: 4'	BANK SUBSTRATE: silt loam
LEFT BANK SLOPE: 30%	RIGHT BANK SLOPE: 30%	EROSION POTENTIAL: low
MEANDER: none	GRADIENT: moderate	% CANOPY CLOSURE: 0

ADJACENT COMMUNITY TYPES: Agriculture

DOMINANT TREES: —

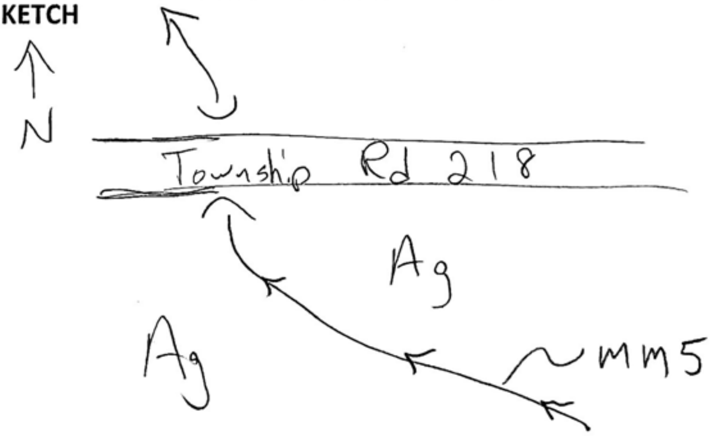
DOMINANT SHRUBS: —

DOMINANT HERBACEOUS: grasses, crops

NOTES

Receives water from drain tiles in adjacent ag. fields

SKETCH



Primary Headwater Habitat Evaluation Form

HHEI Score (sum of metrics 1, 2, 3) : 69

SITE NAME/LOCATION SOUTH BRANCH SOLAR

SITE NUMBER MM5 RIVER BASIN CEDAR-PORTAGE DRAINAGE AREA (mi^2) 0.77

LENGTH OF STREAM REACH (ft) 140 LAT. 41.13722 LONG. -83.51382 RIVER CODE ______ RIVER MILE ______

DATE 04/22/21 SCORER MARTIN COMMENTS ______

NOTE: Complete All Items On This Form - Refer to "Field Evaluation Manual for Ohio's PHWH Streams" for Instructions

STREAM CHANNEL MODIFICATIONS: ☐ NONE / NATURAL CHANNEL ☐ RECOVERED ☐ RECOVERING ☐ RECENT OR NO RECOVERY

1. SUBSTRATE (Estimate percent of every type of substrate present. Check *ONLY* two predominant substrate *TYPE* boxes (Max of 32). Add total number of significant substrate types found (Max of 8). Final metric score is sum of boxes A & B.

TYPE		PERCENT	TYPE		PERCENT
☐ ☐	BLDR SLABS [16 pts]	0%	☐ ☐	SILT [3 pt]	15%
☐ ☐	BOULDER (>256 mm) [16 pts]	0%	☐ ☐	LEAF PACK/WOODY DEBRIS [3 pts]	0%
☐ ☐	BEDROCK [16 pt]	0%	☐ ☐	FINE DETRITUS [3 pts]	0%
☐ ☐	COBBLE (65-256 mm) [12 pts]	10%	☐ ☐	CLAY or HARDPAN [0 pt]	0%
☐ ☐	GRAVEL (2-64 mm) [9 pts]	35%	☐ ☐	MUCK [0 pts]	0%
☐ ☐	SAND (<2 mm) [6 pts]	40%	☐ ☐	ARTIFICIAL [3 pts]	0%

Total of Percentages of Bldr Slabs, Boulder, Cobble, Bedrock 10.00% (A)

Substrate Percentage Check 100% (B)

SCORE OF TWO MOST PREDOMINATE SUBSTRATE TYPES: 15

TOTAL NUMBER OF SUBSTRATE TYPES: 4

HHEI Metric Points

Substrate Max = 40: 19 (A + B)

2. Maximum Pool Depth *(Measure the maximum pool depth within the 61 meter (200 ft)* evaluation reach at the time of evaluation. Avoid plunge pools from road culverts or storm water pipes) (Check *ONLY* one box):

☐ > 30 centimeters [20 pts]
☐ > 22.5 - 30 cm [30 pts]
☐ > 10 - 22.5 cm [25 pts]
☐ > 5 cm - 10 cm [15 pts]
☐ < 5 cm [5 pts]
☐ NO WATER OR MOIST CHANNEL [0 pts]

COMMENTS ______ **MAXIMUM POOL DEPTH (centimeters):** 15

Pool Depth Max = 30: 25

3. BANK FULL WIDTH (Measured as the average of 3-4 measurements) (Check *ONLY* one box):

☐ > 4.0 meters (> 13') [30 pts]
☐ > 3.0 m - 4.0 m (> 9' 7" - 13') [25 pts]
☐ > 1.5 m - 3.0 m (> 9' 7" - 4' 8") [20 pts]
☐ > 1.0 m - 1.5 m (> 3' 3" - 4' 8") [15 pts]
☐ ≤ 1.0 m (<=3' 3") [5 pts]

COMMENTS ______ **AVERAGE BANKFULL WIDTH (meters):** 3.75

Bankfull Width Max=30: 25

This information must also be completed

RIPARIAN ZONE AND FLOODPLAIN QUALITY ☆NOTE: River Left (L) and Right (R) as looking downstream☆

L R	RIPARIAN WIDTH (Per Bank)	L R	FLOODPLAIN QUALITY (Most Predominant per Bank)	L R	
☐ ☐	Wide >10m	☐ ☐	Mature Forest, Wetland	☐ ☐	Conservation Tillage
☐ ☐	Moderate 5-10m	☐ ☐	Immature Forest, Shrub or Old Field	☐ ☐	Urban or Industrial
☐ ☐	Narrow <5m	☐ ☐	Residential, Park, New Field	☐ ☐	Open Pasture, Row Crop
☐ ☐	None	☐ ☐	Fenced Pasture	☐ ☐	Mining or Construction

COMMENTS ______

FLOW REGIME *(At Time of Evaluation)* (Check *ONLY* one box):

☑ Stream Flowing
☐ Subsurface flow with isolated pools (Interstitial)
☐ Moist Channel, isolated pools, no flow (Intermittent)
☐ Dry channel, no water (Ephemeral)

COMMENTS ______

SINUOSITY (Number of bends per 61 m (200 ft) of channel) (Check *ONLY* one box):

☑ None
☐ 0.5
☐ 1.0
☐ 1.5
☐ 2.0
☐ 2.5
☐ 3.0
☐ >3

STREAM GRADIENT ESTIMATE

☐ Flat (0.5 ft/100 ft) ☐ Flat to Moderate ☐ Moderate (2 ft/100 ft) ☐ Moderate to Severe ☐ Severe (10 ft/100 ft)

ADDITIONAL STREAM INFORMATION (This Information Must Also be Completed):

QHEI PERFORMED? - ☐ Yes ☐ No QHEI Score ______ (If Yes, Attach Completed QHEI Form)

DOWNSTREAM DESIGNATED USE(S)

☐ WWH Name: ______ Distance from Evaluated Stream ______
☐ CWH Name: ______ Distance from Evaluated Stream ______
☐ EWH Name: ______ Distance from Evaluated Stream ______

MAPPING: **ATTACH COPIES OF MAPS, INCLUDING THE ENTIRE WATERSHED AREA. CLEARLY MARK THE SITE LOCATION**

USGS Quadrangle Name: **BLOOMDALE** NRCS Soil Map Page: ______ NRCS Soil Map Stream Order ______

County: **HANCOCK** Township / City: **WASHINGTON**

MISCELLANEOUS

Base Flow Conditions? (Y/N): **Y** Date of last precipitation: ______ Quantity: **0.00**

Photograph Information: **See wetland delineation report photolog**

Elevated Turbidity? (Y/N): **N** Canopy (% open): **100%**

Were samples collected for water chemistry? (Y/N): **N** (Note lab sample no. or id. and attach results) Lab Number: ______

Field Measures: Temp (°C) ______ Dissolved Oxygen (mg/l) ______ pH (S.U.) ______ Conductivity (µmhos/cm) ______

Is the sampling reach representative of the stream (Y/N) **Y** If not, please explain: ______

Additional comments/description of pollution impacts: ______

BIOTIC EVALUATION

Performed? (Y/N): **N** (If Yes, Record all observations. Voucher collections optional. NOTE: all voucher samples must be labeled with the site ID number. Include appropriate field data sheets from the Primary Headwater Habitat Assessment Manual)

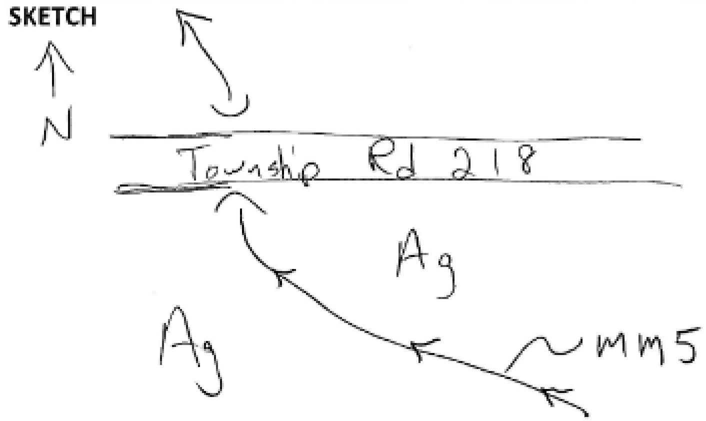
Fish Observed? (Y/N) **N** Voucher? (Y/N) **N** Salamanders Observed? (Y/N) **N** Voucher? (Y/N) **N**
Frogs or Tadpoles Observed? (Y/N) **N** Voucher? (Y/N) **N** Aquatic Macroinvertebrates Observed? (Y/N) **N** Voucher? (Y/N) **N**

Comments Regarding Biology: ______

DRAWING AND NARRATIVE DESCRIPTION OF STREAM REACH (This must be completed):

Include important landmarks and other features of interest for site evaluation and a narrative description of the stream's location

FLOW ➜



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Reset Form

APPENDIX P

SPECIES CONSULTATION

Species Consultation

- United States Fish and Wildlife Service
    - Consultation Letter – February 2021
    - Agency Response – March 2021
    - Additional Consultation – July 2021
    - Agency Response – July 2021

- Ohio Department of Natural Resources
    - Consultation Letter – February 2021
    - Agency Response – May 2021
    - Additional Consultation – July 2021

HALEY
ALDRICH

HALEY & ALDRICH, INC.
200 Town Centre Drive
Suite 2
Rochester, NY 14623
585.359.9000

25 February 2021
File No. 135392-002

United States Fish and Wildlife Service
Ohio Field Office
4625 Morse Road, Suite 104
Columbus, Ohio 43230-8355

Subject: Request for Species Review - Sunset Ridge Solar

To Whom it May Concern:

Haley & Aldrich, Inc. is requesting information from the United States Fish and Wildlife Service regarding the potential presence of threatened or endangered species on or near the proposed location of a solar energy facility known as Sunset Ridge Solar (the Project). A generalized Area of Interest (AOI) for the Project is shown on Figures 1 and 2. The Project will require an application before the Ohio Power Siting Board; it is not yet known whether impacts to wetlands would require a state or federal permit.

The AOI is located entirely within Hancock County, Ohio, and is generally bounded to the south and east by Township Road 261, just over two miles southwest of Fostoria. To the southwest, the southernmost portion of the AOI is located on the outskirts of Arcadia. The AOI is generally bounded to the west by Township Road 249. A GoogleEarth file is provided with this request; the center of the AOI is approximately 41° 8’ 0.68”N, 83° 29 ’51.33”W.

The AOI consists primarily of agricultural land interspersed with small areas of trees. Although no layout is yet available, the goal will be to limit the need for tree clearing.

We would appreciate it if you could review your files and provide any available information to indicate whether additional studies are required to determine the potential for protected species impacts.

If you have any questions or require additional information, please do not hesitate to contact me (585-321-4218; jgbruce@haleyaldrich.com). Thank you in advance for your assistance.

Sincerely yours,
HALEY & ALDRICH, INC.

Jacqueline G Bruce
Jacqueline G. Bruce
Project Manager

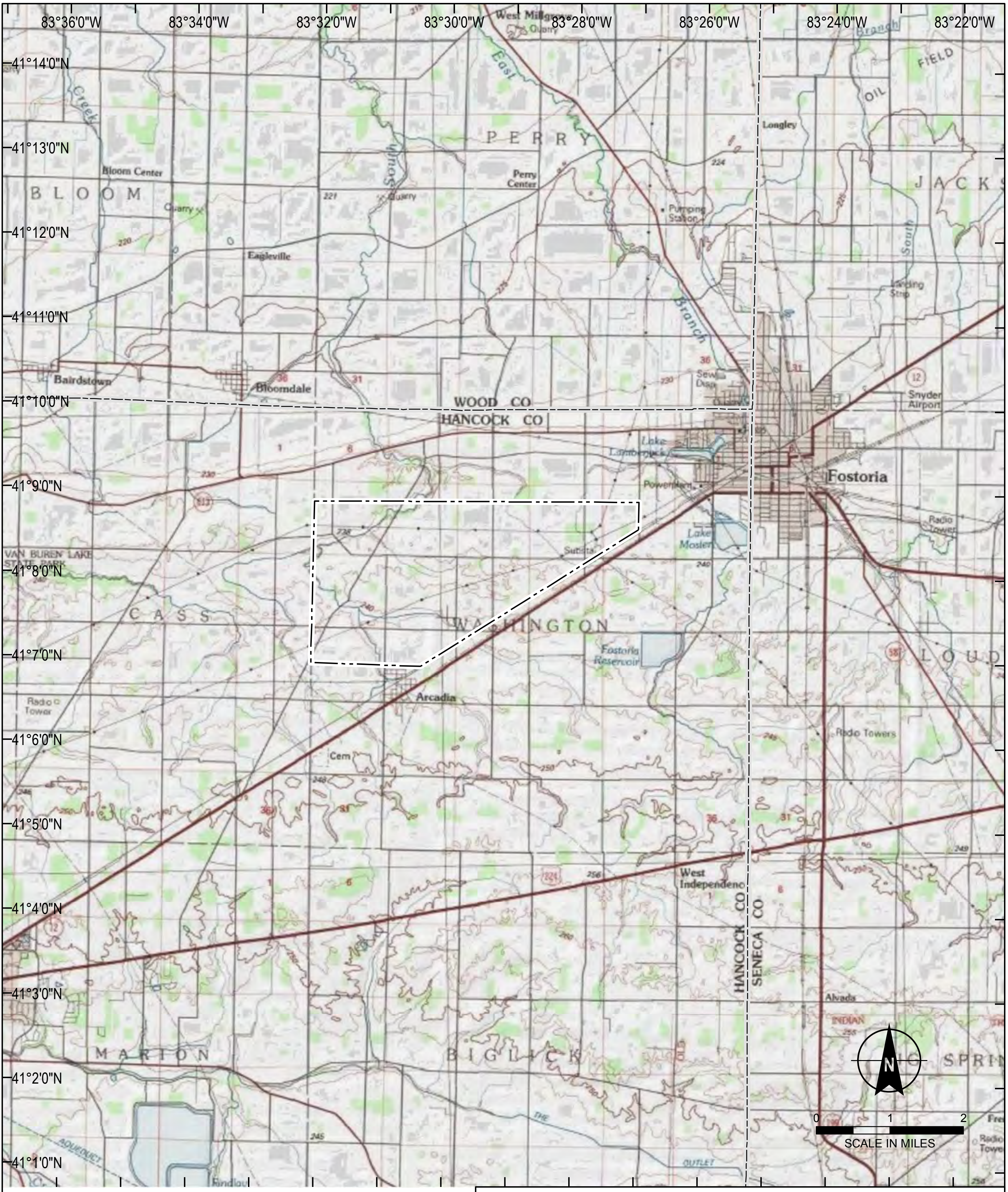
Lynn Gresock
Lynn Gresock
Principal Consultant

Attachments: Figures 1 and 2 and GoogleEarth file– Area of Interest

cc: Leeward Renewable Energy Development, LLC, Attn: Robert Kalbouss

\\haleyaldrich.com\share\CF\Projects\135392\T&E Species\2021_0225_Sunset Ridge_USFWS Request for Review.docx

GIS FILE PATH: C:\Users\dverrier\OneDrive - haleyaldrich.com\Desktop\Local\Sunset_solar\GIS\Maps\2021_02\0135392_001_0001_TOPOGRAPHIC_MAP.mxd — USER: dverrier — LAST SAVED: 2/18/2021 11:14:19 AM



LEGEND

- ▭ AREA OF INTEREST (AOI)
- ▭ COUNTY BOUNDARY

NOTES

1. COUNTY BOUNDARY SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
2. BASE MAP SOURCE: USGS

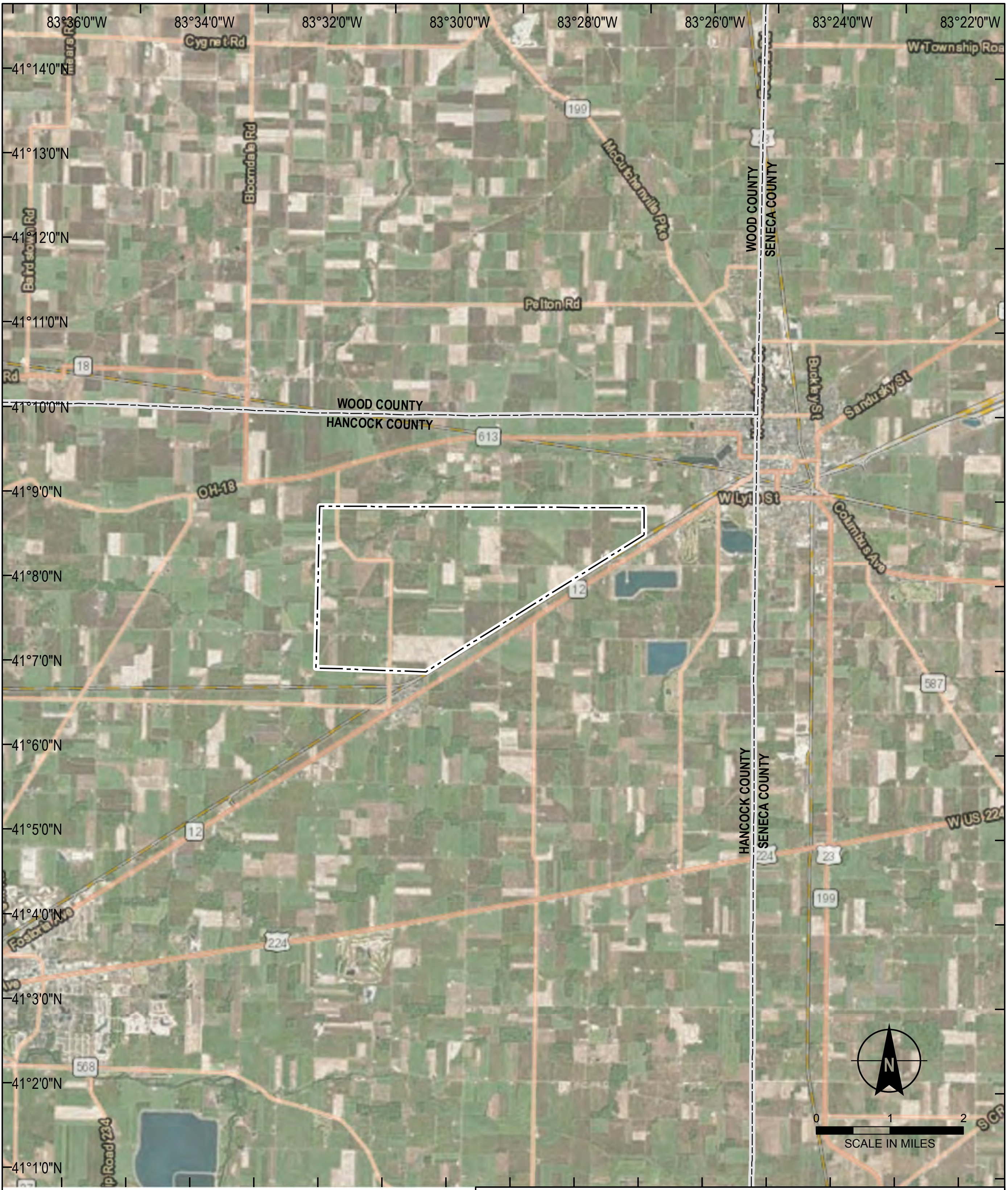
HALEY ALDRICH

SUNSET RIDGE SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHIC MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2021

FIGURE 1



LEGEND

AREA OF INTEREST (AOI)

COUNTY BOUNDARY

NOTES

1. COUNTY BOUNDARY SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

SUNSET RIDGE SOLAR
HANCOCK COUNTY, OHIO

AERIAL MAP

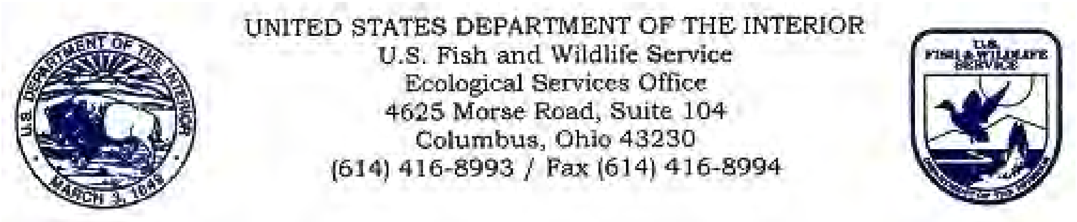
APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2021

FIGURE 2

GIS FILE PATH: C:\Users\dverrier\OneDrive - haleyaldrich.com\Desktop\Local\Sunset_solar\GIS\Maps\2021_02\0135392_001_0002_AERIAL_MAP.mxd — USER: dverrier — LAST SAVED: 2/18/2021 11:14:37 AM

From: Ohio, FW3
To: Bruce, Jacqueline; Gresock, Lynn; Rob Kalbouss
Cc: nathan.reardon@dnr.state.oh.us; Parsons, Kate
Subject: Haley & Aldrich, Sunset Ridge Solar Project, Hancock County, Ohio
Date: Tuesday, March 2, 2021 12:06:30 PM
Attachments: pastedImagebase640.png
pastedImagebase641.png

CAUTION: External Email



UNITED STATES DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service
Ecological Services Office
4625 Morse Road, Suite 104
Columbus, Ohio 43230
(614) 416-8993 / Fax (614) 416-8994

TAILS# 03E15000-2021-TA-0887

Dear Ms. Bruce,

The U.S Fish and Wildlife Service (Service) has received your recent correspondence requesting information about the subject proposal. We offer the following comments and recommendations to assist you in minimizing and avoiding adverse impacts to threatened and endangered species pursuant to the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq), as amended (ESA).

Federally Threatened and Endangered Species: The endangered Indiana bat (*Myotis sodalis*) and threatened northern long-eared bat (*Myotis septentrionalis*) occur throughout the State of Ohio. The Indiana bat and northern long-eared bat may be found wherever suitable habitat occurs unless a presence/absence survey has been performed to document absence. Suitable summer habitat for Indiana bats and northern long-eared bats consists of a wide variety of forested/wooded habitats where they roost, forage, and breed that may also include adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields, woodlots, fallow fields, and pastures. Roost trees for both species include live and standing dead trees ≥3 inches diameter at breast height (dbh) that have any exfoliating bark, cracks, crevices, hollows and/or cavities. These roost trees may be located in forested habitats as well as linear features such as fencerows, riparian forests, and other wooded corridors. Individual trees may be considered suitable habitat when they exhibit the characteristics of a potential roost tree and are located within 1,000 feet of other forested/wooded habitat. Northern long-eared bats have also been observed roosting in human-made structures, such as buildings, barns, bridges, and bat houses; therefore, these structures should also be considered potential summer habitat. In the winter, Indiana bats and northern long-eared bats hibernate in caves, rock crevices and abandoned mines.

We recommend minimizing tree clearing to the maximum extent possible and avoiding clearing of any woodlots and we appreciate your commitment to preserving forested areas where possible and to clearing unavoidable trees only between October 1 and March 31. However, at this time we are unable to fully assess the potential impact of the project on federally listed bats. *Therefore, we recommend additional coordination with this office regarding project siting in order for us to provide project-specific conservation recommendations for federally listed bats.*

Section 7 Coordination: If there is a federal nexus for the project (e.g., federal funding provided, federal permits required to construct), then no tree clearing should occur on any portion of the project area until consultation under section 7 of the ESA, between the Service and the federal action agency, is completed. We recommend the federal action agency submit a determination of effects to this office, relative to the Indiana bat and northern long-eared bat, for our review and concurrence. This letter provides technical assistance only and does not serve as a completed section 7 consultation document.

Stream and Wetland Avoidance: Over 90% of the wetlands in Ohio have been drained, filled, or modified by human activities, thus is it important to conserve the functions and values of the remaining wetlands in Ohio (https://epa.ohio.gov/portals/47/facts/ohio_wetlands.pdf). We recommend avoiding and minimizing project impacts to all wetland habitats (e.g., forests, streams, vernal pools) to the maximum extent possible in order to benefit water quality and fish and wildlife habitat. Additionally, natural buffers around streams and wetlands should be preserved to enhance beneficial functions. If streams or wetlands will be impacted, the U.S. Army Corps of Engineers should be contacted to determine whether a Clean Water Act section 404 permit is required. Best management practices should be used to minimize erosion, especially on slopes. Disturbed areas should be mulched and revegetated with native plant species. In addition, prevention of non-native, invasive plant establishment is critical in maintaining high quality habitats.

Due to the project type, size, and location, we do not anticipate adverse effects to any other federally endangered, threatened, or proposed species, or proposed or designated critical habitat. Should the project design change, or additional information on listed or proposed species or their critical habitat become available, or if new information reveals effects of the action that were not previously considered, coordination with the Service should be initiated to assess any potential impacts.

Thank you for your efforts to conserve listed species and sensitive habitats in Ohio. We recommend coordinating with the Ohio Department of Natural Resources due to the potential for the proposed project to affect state listed species and/or state lands. Contact Mike Pettegrew, Acting Environmental Services Administrator, at (614) 265-6387 or at mike.pettegrew@dnr.state.oh.us.

If you have questions, or if we can be of further assistance in this matter, please contact our office at (614) 416-8993 or ohio@fws.gov.

Sincerely,

Patrice Ashfield
Field Office Supervisor

cc: Nathan Reardon, ODNR-DOW
Kate Parsons, ODNR-DOW

HALEY ALDRICH

HALEY & ALDRICH, INC.
3 Bedford Farms Drive
Bedford, NH 03110
603.625.5353

July 15, 2021

Patrice Ashfield, Field Office Supervisor
United States Fish and Wildlife Service
Ecological Services Office
4625 Morse Road, Suite 104
Columbus, OH 43230

Subject: South Branch Solar (formerly Sunset Ridge Solar), TAILS# 03E15000-2021-TA-0887

Dear Ms. Ashfield:

Thank you for your correspondence of March 2, 2021 identifying that no federal species other than the Indiana bat and northern long-eared bat, which occur throughout the State of Ohio, are expected to occur within the vicinity of the South Branch Solar project (formerly known as Sunset Ridge Solar) in Washington Township, Hancock County, Ohio. The correspondence recommends minimizing tree clearing and committing to clearing unavoidable trees (≥3 inches diameter at breast height) only between October 1 and March 31. Additional coordination is recommended to fully assess the potential impact of the South Branch Solar project on federally listed bats.

The South Branch Solar property is generally open active agricultural fields, and the proposed layout has minimized the need for tree clearing. Figure 1 shows the areas where limited tree clearing will be necessary in order to accommodate the layout and function of the South Branch Solar project. A total of approximately 4 acres of tree clearing is proposed. Clearing will be restricted to occur only between October 1 and March 31.

With this additional information, we request that you confirm whether these measures will be sufficiently protective of the federally listed species for which potential exists to occur in the area. Please let me know if any additional information would be helpful to support your review. Thank you.

Sincerely yours,
HALEY & ALDRICH, INC.
Lynn Gresock
Lynn Gresock
Principal Consultant

\\haleyaldrich.com\share\CF\Projects\135392\T&E Species\USFWS\South Branch Solar_USFWS Follow-Up_7-15-21.docx

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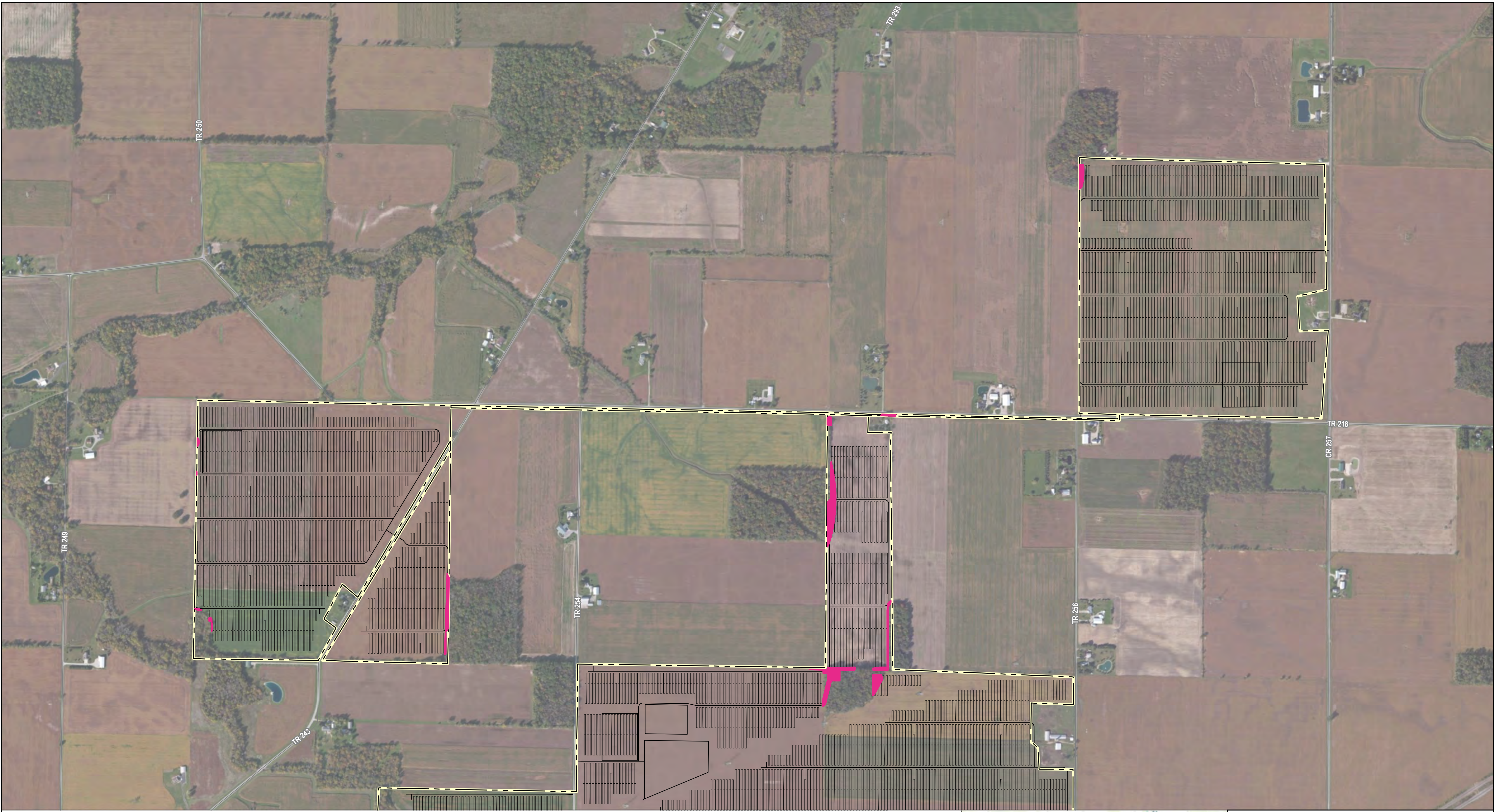


LEGEND

—	ROAD
—	PROJECT LAYOUT COMPONENT
🟥	TREE CLEARING AREA
▭	PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
3. AERIAL IMAGERY SOURCE: ESRI

N

0 970 1,940
SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

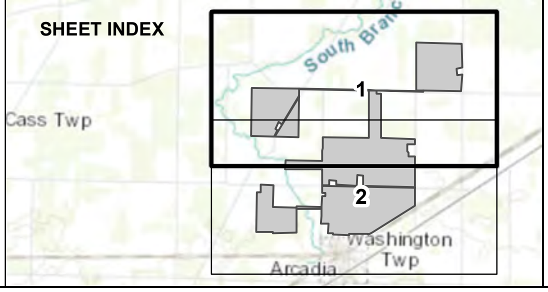
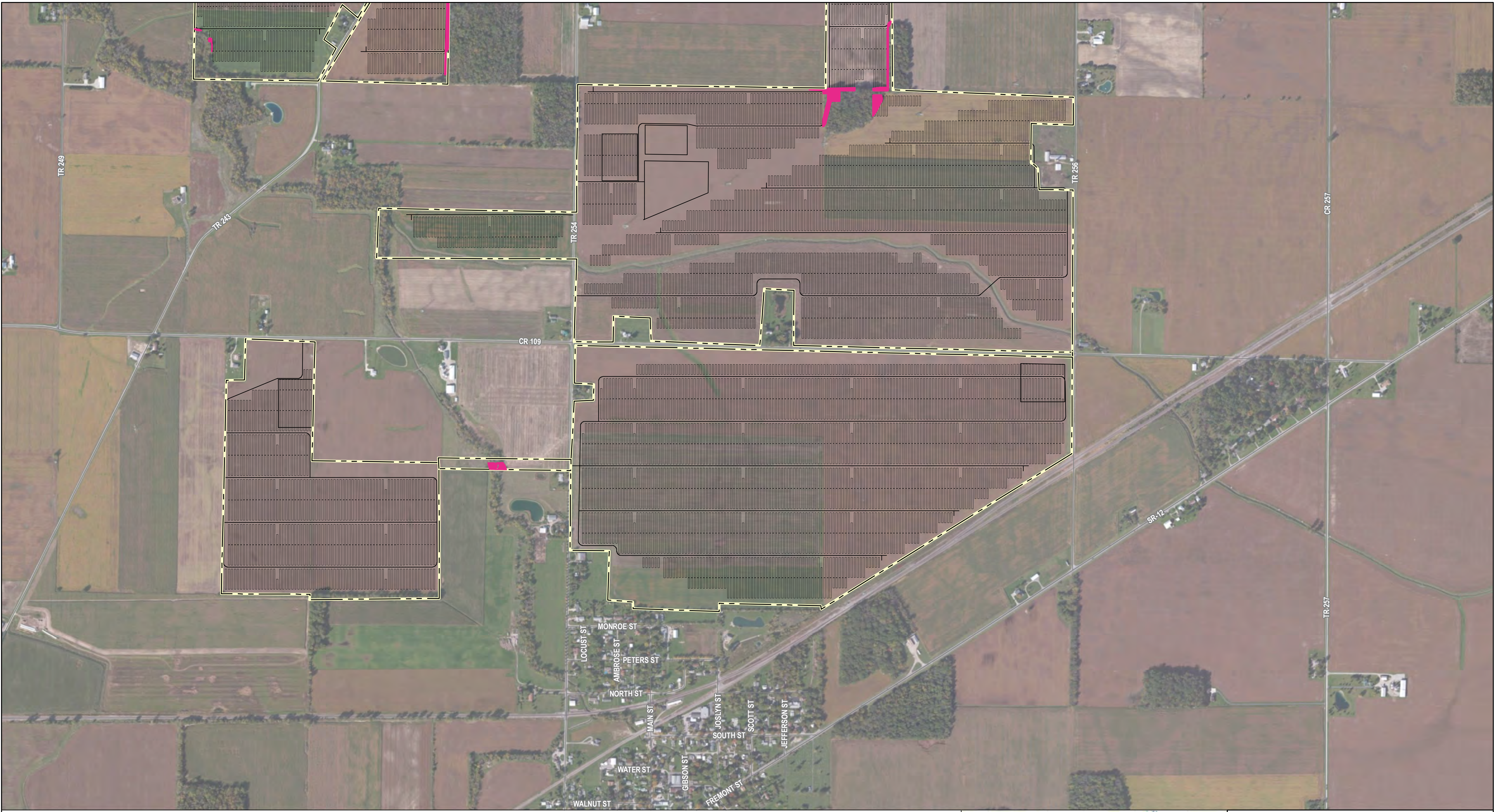


Figure 1: Tree Clearing Areas

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

—	ROAD
—	PROJECT LAYOUT COMPONENT
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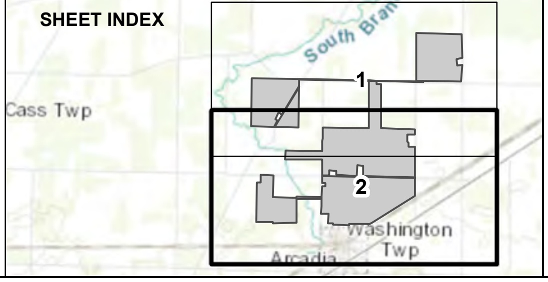

Figure 1: Tree Clearing Areas

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio

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From: Seymour, Megan
To: Gresock, Lynn
Subject: Re: [EXTERNAL] South Branch Solar (formerly Sunset Ridge) Consultation Follow-Up, TAILS # 03E15000-2021-TA-0887
Date: Friday, July 16, 2021 4:14:44 PM

CAUTION: External Email

Lynn,

Thank you for the additional information. We appreciate your commitment to clear trees during the season when listed bats would not be using this habitat. If there is a federal nexus for the project (e.g., federal funding provided, federal permits required to construct), then no tree clearing should occur on any portion of the project area until consultation under section 7 of the ESA, between the Service and the federal action agency, is completed. We recommend the federal action agency submit a determination of effects to this office, relative to the Indiana bat and northern long-eared bat, for our review and concurrence. If there is no Federal nexus, then no additional coordination is necessary.

Best,
Megan

Megan Seymour
Wildlife Biologist
U.S. Fish and Wildlife Service
Ohio Ecological Services Field Office
4625 Morse Rd., Suite 104
Columbus, OH 43230
614-416-8993 ext. 116 (office)
614-542-7502 (cell)

From: Ohio, FW3 <ohio@fws.gov>
Sent: Thursday, July 15, 2021 11:22 AM
To: Seymour, Megan <megan_seymour@fws.gov>
Subject: Fw: [EXTERNAL] South Branch Solar (formerly Sunset Ridge) Consultation Follow-Up, TAILS # 03E15000-2021-TA-0887

Lynn has sent confirmation of tree clearing
Thanks

From: Gresock, Lynn <LGresock@haleyaldrich.com>
Sent: Thursday, July 15, 2021 10:29 AM
To: Ohio, FW3 <ohio@fws.gov>
Subject: [EXTERNAL] South Branch Solar (formerly Sunset Ridge) Consultation Follow-Up, TAILS #

03E15000-2021-TA-0887

Thank you in advance for your review of the additional project information reflected in the attached.

Lynn Gresock
Principal Consultant

Haley & Aldrich, Inc.
3 Bedford Farms Drive|Suite 301
Bedford, New Hampshire 03110

T: (603) 391.3325
C: (978) 302.7833

www.haleyaldrich.com

HALEY & ALDRICH, INC.
200 Town Centre Drive
Suite 2
Rochester, NY 14623
585.359.9000

25 February 2021
File No. 135392-002

Ohio Department of Natural Resources
2045 Morse Road, Building E-2
Columbus, Ohio 43229-6693

Attention: Sarah Tebbe, Environmental Specialist

Subject: Request for Species Review - Sunset Ridge Solar

Dear Ms. Tebbe:

Haley & Aldrich, Inc. is requesting information from the Ohio Department of Natural Resources regarding the potential presence of threatened or endangered species on or near the proposed location of a solar energy facility known as Sunset Ridge Solar (the Project). A generalized Area of Interest (AOI) for the Project is shown on Figures 1 and 2. The Project will require an application before the Ohio Power Siting Board; it is not yet known whether impacts to wetlands would require a state or federal permit.

The AOI is located entirely within Hancock County, Ohio, and is generally bounded to the south and east by Township Road 261, just over two miles southwest of Fostoria. To the southwest, the southernmost portion of the AOI is located on the outskirts of Arcadia. The AOI is generally bounded to the west by Township Road 249. A GoogleEarth file is provided with this request; the center of the AOI is approximately 41° 8' 0.68"N, 83° 29 '51.33"W.

The AOI consists primarily of agricultural land interspersed with small areas of trees. Although no layout is yet available, the goal will be to limit the need for tree clearing.

We would appreciate if you could review your files and provide any available information to indicate whether additional studies are required to determine the potential for protected species impacts.

If you have any questions or require additional information, please do not hesitate to contact me (585-321-4218; jgbruce@haleyaldrich.com). Thank you in advance for your assistance.

Sincerely yours,
HALEY & ALDRICH, INC.

Jacqueline G. Bruce

Jacqueline G. Bruce
Project Manager

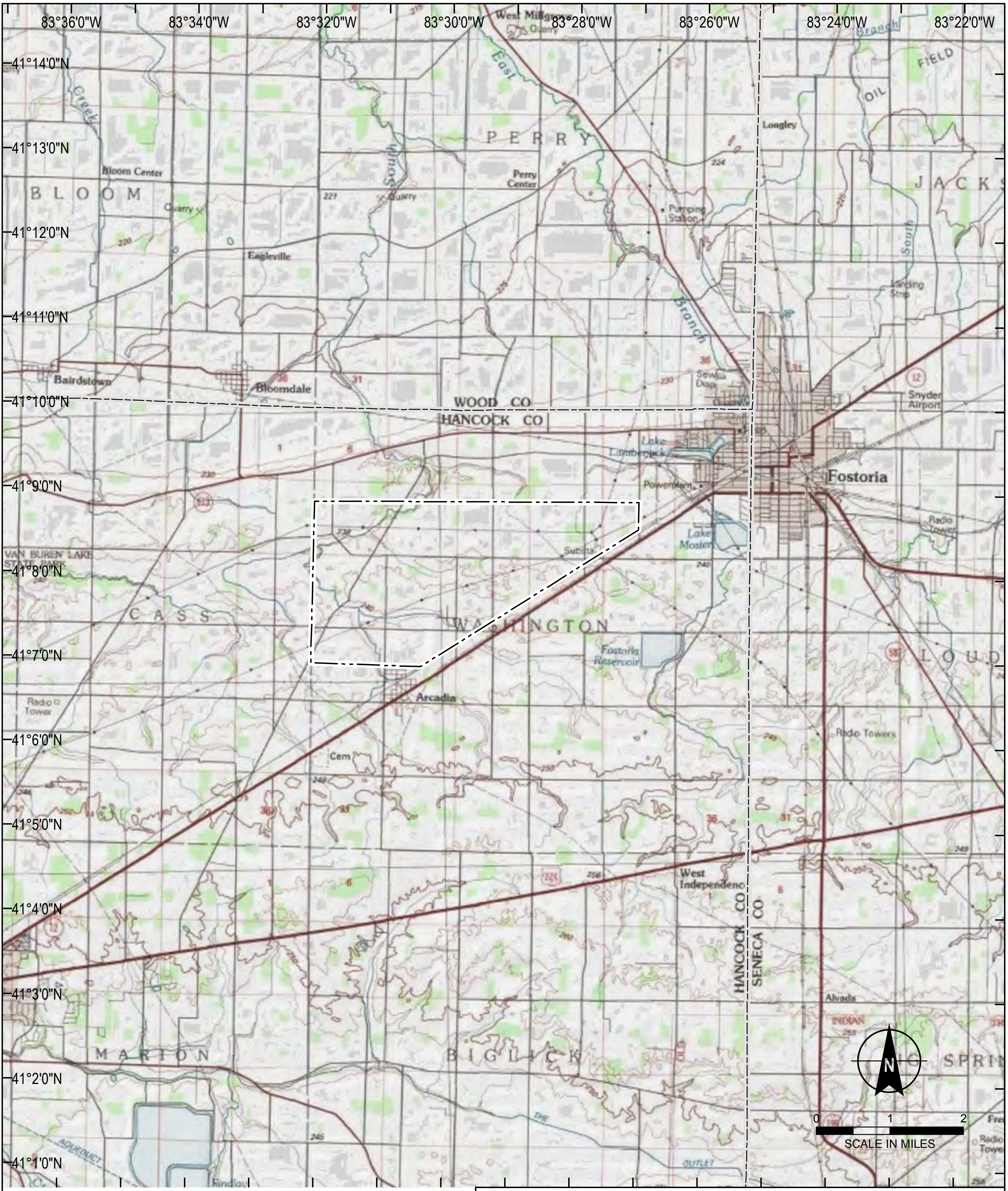
Lynn Gresock

Lynn Gresock
Principal Consultant

Attachments: Figures 1 and 2 and Google Earth file – Area of Interest

cc: Leeward Renewable Energy Development, LLC, Attn: Robert Kalbouss

\\haleyaldrich.com\share\CF\Projects\135392\T&E Species\2021_0225_Sunset Ridge_ODNR Request for Review.docx



LEGEND

AREA OF INTEREST (AOI)

COUNTY BOUNDARY

NOTES

1. COUNTY BOUNDARY SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
2. BASE MAP SOURCE: USGS

HALEY ALDRICH

SUNSET RIDGE SOLAR
HANCOCK COUNTY, OHIO

TOPOGRAPHIC MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2021

FIGURE 1

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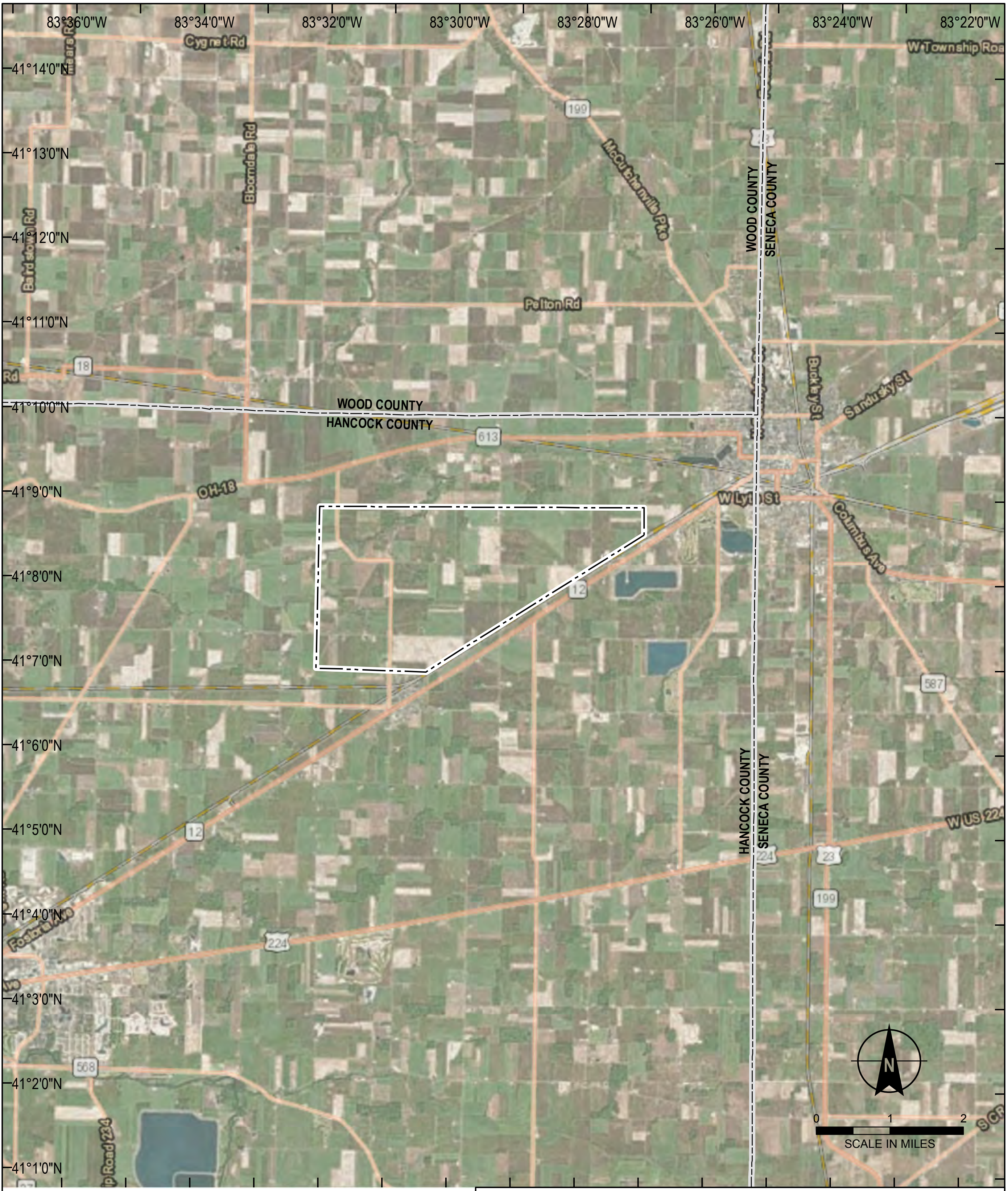


LEGEND

AREA OF INTEREST (AOI)

COUNTY BOUNDARY

NOTES

1. COUNTY BOUNDARY SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
2. BASE MAP SOURCE: ESRI

HALEY ALDRICH

SUNSET RIDGE SOLAR
HANCOCK COUNTY, OHIO

AERIAL MAP

APPROXIMATE SCALE: 1 IN = 2000 FT
FEBRUARY 2021

FIGURE 2

GIS FILE PATH: C:\Users\dverrier\OneDrive - haleyaldrich.com\Desktop\Local\Sunset_solar\GIS\Maps\2021_02\0135392_001_0002_AERIAL_MAP.mxd — USER: dverrier — LAST SAVED: 2/18/2021 11:14:37 AM

Ohio Department of Natural Resources

MIKE DeWINE, GOVERNOR
MARY MERTZ, DIRECTOR

Office of Real Estate
John Kessler, Chief
2045 Morse Road – Bldg. E-2
Columbus, OH 43229
Phone: (614) 265-6621
Fax: (614) 267-4764

May 7, 2021

Jackie Bruce
Haley & Aldrich, Inc.
200 Town Centre Drive, Suite 2
Rochester, New York 14623

Re: 21-0249; Sunset Ridge Solar, Hancock County

Project: The proposed project involves the construction of a solar energy facility.

Location: The proposed project is located in Washington Township, Hancock County, Ohio.

The Ohio Department of Natural Resources (ODNR) has completed a review of the above referenced project. These comments were generated by an inter-disciplinary review within the Department. These comments have been prepared under the authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), the National Environmental Policy Act, the Coastal Zone Management Act, Ohio Revised Code and other applicable laws and regulations. These comments are also based on ODNR's experience as the state natural resource management agency and do not supersede or replace the regulatory authority of any local, state or federal agency nor relieve the applicant of the obligation to comply with any local, state or federal laws or regulations.

Natural Heritage Database: The Natural Heritage Database has no records at or within a one-mile radius of the project area.

A review of the Ohio Natural Heritage Database indicates there are no other records of state endangered or threatened plants or animals within the project area. There are also no records of state potentially threatened plants, special interest or species of concern animals, or any federally listed species. In addition, we are unaware of any unique ecological sites, geologic features, animal assemblages, scenic rivers, state wildlife areas, state nature preserves, state or national parks, state or national forests, national wildlife refuges, or other protected natural areas within the project area. The review was performed on the project area you specified in your request as well as an additional one-mile radius. Records searched date from 1980.

Please note that Ohio has not been completely surveyed and we rely on receiving information from many sources. Therefore, a lack of records for any particular area is not a statement that rare species or unique features are absent from that area. Although all types of plant communities have been surveyed, we only maintain records on the highest quality areas.

Fish and Wildlife: The Division of Wildlife (DOW) has the following comments.

The DOW recommends that impacts to streams, wetlands and other water resources be avoided and minimized to the fullest extent possible, and that best management practices be utilized to minimize erosion and sedimentation.

The Division of Wildlife is working closely with our partners at Ohio Pollinator Habitat Initiative (OPHI) to create and enhance pollinator habitat at solar power installations. The OPHI Solar Pollinator Program Advisory Team has developed the Ohio Solar Site Pollinator Habitat Planning and Assessment Form and is available for your use. The form can be found at the following: http://nebula.wsimg.com/7cf0240c398d5819e3e6ff011f0ba456?AccessKeyId=570E4FC7FCD2ED2F0C1A&disposition=0&alloworigin=1. We recommend that the areas between and around the solar panels be planted with legumes and wildflowers (i.e. forbs) that are beneficial to pollinators and other wildlife and reduce use of non-native grass and gravel. The recommended legumes and forbs listed below are low-growing so as not to cast shadows on the solar panels and would only require one to two mowings a year for maintenance, which should minimize maintenance costs. For other areas of the installation where vegetation does not have to be low-growing, alternative pollinator mixes are available with a more diverse array of flowering plants. This perennial vegetation will provide beneficial foraging habitat to songbirds and pollinators while reducing storm water runoff, standing water, and erosion. Please contact the Ohio Pollinator Habitat Initiative http://www.ophi.info/, and specifically Mike Retterer mretterer@pheasantsforever.org for further information on solar power facility pollinator plantings.

Recommended low-growing grasses and forbs may include:

Little Bluestem	*Schizachyrium scoparium*
Sideoats Grama	*Bouteloua curtipendula*
Alfalfa	*Medicago spp.*
Alsike Clover	*Trifolium hybridum*
Brown-eyed Susan	*Rudbeckia triloba*
Butterfly Milkweed	*Asclepias tuberosa*
Lanceleaf Coreopsis	*Coreopsis lanceolata*
Partridge Pea	*Chamaecrista fasciculata*
Timothy	*Phleum pratense*
Orchardgrass	*Dactylis glomerata*
Crimson Clover	*Trifolium incarnatum*
Ladino or White Clover	*Trifolium repens*

The entire state of Ohio is within the range of the Indiana bat (*Myotis sodalis*), a state endangered and federally endangered species, the northern long-eared bat (*Myotis septentrionalis*), a state endangered and federally threatened species, the little brown bat (*Myotis lucifugus*), a state endangered species, and the tricolored bat (*Perimyotis subflavus*), a state endangered species. During the spring and summer (April 1 through September 30), these species of bats predominately roost in trees behind loose, exfoliating bark, in crevices and cavities, or in the leaves. However, these species are also dependent on the forest structure surrounding roost trees. If trees are present within the project area, and trees must be cut, the DOW recommends cutting only occur from October 1 through March 31, conserving trees with loose, shaggy bark and/or crevices, holes, or cavities, as well as trees with DBH ≥ 20 if possible. If trees are present within the project area, and trees must be cut during the summer months, the DOW recommends a mist net survey or acoustic survey be conducted from June 1 through August 15, prior to any cutting.

Mist net and acoustic surveys should be conducted in accordance with the most recent version of the "*OHIO DIVISION OF WILDLIFE GUIDANCE FOR BAT SURVEYS AND TREE CLEARING*". https://ohiodnr.gov/static/documents/wildlife/wildlife-management/Bat+Survey+Guidelines.pdf

If state listed bats are documented, DOW recommends cutting only occur from October 1 through March 31, however, limited summer tree cutting may be acceptable after consultation with DOW (contact Sarah Stankavich, sarah.stankavich@dnr.state.oh.us).

The DOW also recommends that a desktop habitat assessment, followed by a field assessment if needed, is conducted to determine if there are potential hibernaculum(a) present within the project area. Information about how to conduct habitat assessments can be found in the current USFWS "*Range-wide Indiana Bat Survey Guidelines*." If a habitat assessment finds that potential hibernacula are present within 0.25 miles of the project area, please send this information to Sarah Stankavich, sarah.stankavich@dnr.state.oh.us for project recommendations. If a potential or known hibernaculum is found, the DOW recommends a 0.25-mile tree cutting and subsurface disturbance buffer around the hibernaculum entrance, however, limited summer or winter tree cutting may be acceptable after consultation with DOW. If no tree cutting or subsurface impacts to a hibernaculum are proposed, this project is not likely to impact these species.

The project is within the range of the following listed mussel species:

Federally Endangered
clubshell (*Pleurobema clava*)
rayed bean (*Villosa fabalis*)

State Endangered
purple lilliput (*Toxolasma lividum*)

State Threatened
pondhorn (*Uniomerus tetralasmus*)
black sandshell (*Ligumia recta*)

This project must not have an impact on freshwater native mussels at the project site. This applies to both listed and non-listed species. Per the Ohio Mussel Survey Protocol (2020), all Group 2, 3, and 4 streams (Appendix A) require a mussel survey. Per the Ohio Mussel Survey Protocol, Group 1 streams (Appendix A) and unlisted streams with a watershed of 5 square miles or larger above the point of impact should be assessed using the Reconnaissance Survey for Unionid Mussels (Appendix B) to determine if mussels are present. Mussel surveys may be recommended for these streams as well. This is further explained within the Ohio Mussel Survey Protocol. Therefore, if in-water work is planned in any stream that meets any of the above criteria, the DOW recommends the applicant provide information to indicate no mussel impacts will occur. If this is not possible, the DOW recommends a professional malacologist conduct a mussel survey in the project area. If mussels that cannot be avoided are found in the project area, as a last resort, the DOW recommends a professional malacologist collect and relocate the mussels to suitable and similar habitat upstream of the project site. Mussel surveys and any subsequent mussel relocation should be done in accordance with the Ohio Mussel Survey Protocol. The Ohio Mussel Survey Protocol (2020) can be found at:
http://wildlife.ohiodnr.gov/portals/wildlife/pdfs/licenses%20&%20permits/OH%20Mussel%20Survey%20Protocol.pdf

The project is within the range of the western banded killifish (*Fundulus diaphanus menona*), a state endangered fish. The DOW recommends no in-water work in perennial streams from March 15 through June 30 to reduce impacts to indigenous aquatic species and their habitat. If no in-water work is proposed in a perennial stream, this project is not likely to impact this or other aquatic species.

The project is within the range of the Kirtland's snake (*Clonophis kirtlandii*), a state threatened species. This secretive species prefers wet meadows and other wetlands. Due to the location, the type of habitat within the project area, and the type of work proposed, this project is not likely to impact this species.

The project is within the range of the black-crowned night-heron *(Nycticorax nycticorax*), a state-threatened bird. Night-herons are so named because they are nocturnal, conducting most of their foraging in the evening hours or at night, and roost in trees near wetlands and waterbodies during the day. Night herons are migratory and are typically found in Ohio from April 1 through December 1 but can be found in more urbanized areas with reliable food sources year-round. Black-crowned night-herons primarily forage in wetlands and other shallow aquatic habitats, and roost in trees nearby. These night-herons nest in small trees, saplings, shrubs, or sometimes on the ground, near bodies of water and wetlands. If this type of habitat will be impacted, construction should be avoided in this habitat during the species' nesting period of May 1 through July 31. If this type of habitat will not be impacted, this project is not likely to impact this species.

The project is within the range of the least bittern (*Ixobrychus exilis*), a state threatened bird. This secretive marsh species prefers dense emergent wetlands with thick stands of cattails, sedges, sawgrass or other semiaquatic vegetation interspersed with woody vegetation and open water. If this type of habitat will be impacted, construction should be avoided in this habitat during the species' nesting period of May 1 through July 31. If this type of habitat will not be impacted, this project is not likely to impact this species.

The project is within the range of the northern harrier (*Circus hudsonis*), a state endangered bird. This is a common migrant and winter species. Nesters are much rarer, although they occasionally breed in large marshes and grasslands. Harriers often nest in loose colonies. The female builds a nest out of sticks on the ground, often on top of a mound. Harriers hunt over grasslands. If this type of habitat will be impacted, construction should be avoided in this habitat during the species' nesting period of April 15 through July 31. If this habitat will not be impacted, this project is not likely to impact this species.

Due to the potential of impacts to federally listed species, as well as to state listed species, we recommend that this project be coordinated with the U.S. Fish & Wildlife Service.

Geological Survey: The Division of Geological Survey has the following comment.

Physiographic Region

The proposed project area is in Washington Township, Hancock County. This area is in the Fostoria Lake-Plain Shoals physiographic region. This region is characterized by low relief hillocks and shallow closed depressions of the Defiance Moraine that has been lightly eroded by Lake Maumee. Sandy areas are common (Ohio Department of Natural Resources, Division of Geological Survey, 1998).

Surficial/Glacial Geology

The project area lies within the glaciated margin of the state and includes several Wisconsinan-age glacial features. The majority of the project area is covered by the lake-planed moraine within the Lake Maumee Basin. Thin sand deposits overlie some of the lake-planed moraine and represent minor, overlying thin beach or dune deposits. The far southwestern portion of project area is covered by the hummocky till of the Defiance Moraine (Pavey et al, 1999). Glacial drift throughout most of the study area is between 17 and 66 feet thick. Drift is thinnest along stream valleys and thickest beneath the moraine in the southern portion of the study area (Powers and Swinford, 2004).

Bedrock Geology

The uppermost bedrock unit in the project area is the Silurian-age Greenfield Dolomite. This unit is characterized by olive gray to yellowish brown dolomite. There is an absence of shale laminae compared to overlying units. It may contain sedimentary breccia zones. The Greenfield dolomite is found only in the far south-eastern portion of the project area. Underlying the Greenfield Dolomite is the Lockport Dolomite. This unit is Silurian-age and consists of bluish gray to gray dolomite with minor interbedding of limestone, chert and shale. Fossils and planar to irregular bedding are common. This unit makes up a majority of the project area. It should be noted that bedrock is not exposed at the surface within the boundaries of the project area due to significant glacial drift (Slucher et al, 2006).

Oil, Gas and Mining

ODNR has record of 76 oil and gas wells within one mile of the proposed project area. Most of these wells are listed as historical production wells. These wells are part of the Findlay Consolidated Oil and Gas Field. Wells in this area produce out of the Trenton Formation (Ohio Department of Natural Resources, Division of Oil and Gas, Ohio Oil and Gas Wells Locator).

ODNR does not have record of any mining operations within the project area. The nearest mine is the active Gerken Materials, Inc. limestone quarry located 6.3 miles to the north of the project area (Ohio Department of Natural Resources, Division of Mineral Resources, Mines of Ohio).

Seismic Activity

Several small earthquakes have historically been recorded near the site. The three events closest to the site are listed in the chart below (Ohio Department of Natural Resources, Division of Geological Survey, Ohio Earthquake Epicenters):

Date	Magnitude	Distance to Site Boundary	County	Township
February 25, 2010	2.9	2.3 miles	Seneca	Loudon
June 4, 1990	2.3	2.5 miles	Hancock	Washington
September 29, 1974	3.0	4.3 miles	Wood	Perry

Karst

Karst features usually form in areas that are covered by thin or no glacial drift and the bedrock is limestone or dolomite. There are no sinkholes within the bounds of the project area. A significant thickness of glacial drift limits the formation of sinkholes. However, the underlying Lockport and Greenfield Dolomite are composed of carbonate bedrock which can be prone to the development of karst features. The nearest verified sink hole to the project area is 7.6 miles to the northeast. (Ohio Department of Natural Resources, Division of Geological Survey, Ohio Karst).

Soils

According to the USDA Web Soil Survey, the project area consists primarily of soils derived from glacial till and loess. Pewamo, Glynwood and Blount are the most common soil series found within the boundaries of the project area. Together these soils cover over 93% of the project area and have a clay loam soil texture (USDA Web Soil Survey).

There is a moderate risk of shrink-swell potential in these soils. Slope is variable, with slope exceeding a 6% grade. Steepest slopes are along stream valleys (Robbins et al., 2006 and USDA Web Soil Survey).

Groundwater

Groundwater resources are plentiful throughout the project area. Wells developed in bedrock are likely to yield 25 to 100 gallons per minute. Limestone and dolomite aquifers provide substantial groundwater yields throughout the project area (Schmidt, 1981 and Ohio Department of Natural Resources, Division of Water, Bedrock Aquifer Map, 2000). Wells developed in glacial material are likely to yield up to 25 gallons per minute. The lowest unconsolidated aquifer yields are on the wave planed till plain in the northern portion of the project area. Higher yields are found within the Defiance Moraine. Higher groundwater yields typically reflect larger diameter, properly developed and screened wells (Ohio Department of Natural Resources, Division of Water, Statewide Unconsolidated Aquifer Map, 2000).

ODNR has record of 203 water wells drilled within one mile of the project area. These wells range in depth from 50 to 214 feet deep, with an average depth of 87 feet. The most common aquifer listed is limestone. Of the 203 water wells 192 of the wells are completed in limestone bedrock. Two wells are completed in shale bedrock. The remaining wells are completed in sand and gravel or clay and rock. A sustainable yield of 5 to 100 gallons per minute is expected from wells drilled in this area based on well log records. The average sustainable yield from these records within one mile was 25 gallons per minute. This is based on records from 37 wells within one mile of the project area that contain sustainable yield data (Ohio Department of Natural Resources, Division of Geological Survey, Ohio Water Wells).

Water Resources: The Division of Water Resources has the following comment.

The local floodplain administrator should be contacted concerning the possible need for any floodplain permits or approvals for this project. Your local floodplain administrator contact information can be found at the website below.

http://water.ohiodnr.gov/portals/soilwater/pdf/floodplain/Floodplain%20Manager%20Community%20Contact%20List_8_16.pdf

ODNR appreciates the opportunity to provide these comments. Please contact Sarah Tebbe, Environmental Specialist, at Sarah.Tebbe@dnr.ohio.gov if you have questions about these comments or need additional information.

Mike Pettegrew
Environmental Services Administrator (Acting)

References

Ohio Department of Natural Resources, Division of Geological Survey, *Ohio Earthquake Epicenters,* online interactive map, https://gis.ohiodnr.gov/MapViewer/?config=earthquakes

Ohio Department of Natural Resources, Division of Geological Survey, *Ohio Karst,* online interactive map, https://gis.ohiodnr.gov/website/dgs/karst_interactivemap/

Ohio Department of Natural Resources, Division of Geological Survey, (1998). *Physiographic Regions of Ohio.* Ohio Department of Natural Resources, Ohio Department of Natural Resources, Division of Geological Survey, map with text, 2 p., scale 1:2,100,000.

Ohio Department of Natural Resources, Division of Geological Survey, (In progress). *Statewide Surficial Geology Map.* GIS coverage.

Ohio Department of Natural Resources, Division of Water, *Ohio Water Wells,* online interactive map, https://gis.ohiodnr.gov/MapViewer/?config=waterwells.

Ohio Department of Natural Resources, Division of Water, (2000). *Statewide Bedrock Aquifer Map*, GIS coverage.

Ohio Department of Natural Resources, Division of Water, (2000). *Statewide Unconsolidated Aquifer Map*, GIS coverage.

Slucher, E., Swinford, E., Larsen, G., Schumacher, G., Shrake, D., Rice, C., Caudill, M., Rea, R. and Powers, D. (2006). *Bedrock Geologic Map of Ohio,* Ohio Department of Natural Resources, Division of Geological Survey, map, scale 1:500,000.

USDA Web Soil Survey, (Last modified 2019). *Web Soil Survey Interactive Map,* United States Department of Agriculture, National Resources Conservation Service, online interactive map, https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx.

Schmidt, J. (1991). *Groundwater Resources Map of Greene County*, Ohio Department of Natural Resources, Division of Geological Survey, map.

HALEY & ALDRICH, INC.
3 Bedford Farms Drive
Bedford, NH 03110
603.625.5353

July 15, 2021

Nathan Reardon
Ohio Department of Natural Resources
2045 Morse Road
Columbus, OH 43229

Subject: South Branch Solar (formerly Sunset Ridge Solar), 21-0249

Dear Mr. Reardon:

On May 7, 2021, we received correspondence from the Ohio Department of Natural Resources (ODNR) Office of Real Estate reviewing a range of information associated with the proposed location of the South Branch Solar project (the Project) (formerly Sunset Ridge Solar). In this letter, we are providing additional information with regard to issues specifically identified by the ODNR Division of Wildlife in order to clarify the need for special protective measures in association with the various identified species with the potential to occur in the area.

In addition to specific species, the Division of Wildlife recommended minimizing wetland and stream impacts and implementing best management practices to minimize erosion and sedimentation, as well as incorporating pollinator species into the vegetation of the solar facility. As can be seen on Figure 1, very few wetland and stream resources are located within the Project site. The layout has prioritized avoidance of wetlands and streams; at this time, one stream crossing is proposed for access and no wetland impacts are anticipated. Best management practices, in accordance with ODNR's stormwater management guidance, will be implemented during construction to minimize erosion and sedimentation. Pollinator species will be among those used for vegetation of the Project site.

The following species were identified with the potential to occur within the Project area:

- State-listed bats: Indiana bat, northern long-eared bat, little brown bat, and tricolored bat (all of which have the potential to occur throughout the state);
- State and federally listed mussels: clubshell, rayed bean, purple lilliput, pondhorn, and black sandshell (which have the potential to be located in streams of a certain size);
- The western banded killifish, which can be present in certain perennial streams;
- The black-crowned night-heron, which forages in wetlands and other shallow aquatic habitats;
- The least bittern, which also prefers dense emergent wetlands with thick stands of cattails, sedges, sawgrass, or other semi-aquatic vegetation interspersed with woody vegetation and open water; and
- The northern harrier, a migrant species that hunts and nests in grasslands.

Although the Kirtland's snake was noted, the correspondence concluded that the Project is not likely to impact this species due to the location, the type of habitat present, and the type of work proposed.

Information regarding the Project's potential to impact each of the species bulleted above is provided below.

State-Listed Bats

The ODNR correspondence requested that a desktop habitat assessment be conducted in accordance with the United States Fish and Wildlife Service's (USFWS) *Range-wide Indiana Bat Survey Guidelines* (most recently issued in March 2020), followed by a field assessment as needed, to determine if there are potential hibernaculum present within the Project area (as a 0.25-mile buffer is typically beneficial around such areas).

We are currently unaware of any known or potential hibernacula within 0.25-mile of the Project site. As outlined in the USFWS guidance, the first step was consultation with that agency. The USFWS maintains information regarding hibernacula locations in Ohio; however, this information is not publicly available (https://www.fws.gov/midwest/endangered/mammals/nleb/nhisites.html). We have initiated coordination with the USFWS and in their response (dated March 2, 2021) they did not indicate the presence of a known hibernacula within 0.25-mile of the Project site (as would be expected if one were present).

We have also completed additional desktop evaluations to review the potential for hibernacula in the vicinity of the Project, including a review of aerial photography and topographic mapping within 3 miles of the Project footprint. We have reviewed ODNR mapping of known mine openings and the nearest mapped mine opening is located approximately 4.5 miles northwest of the Project site near Bairdstown, Ohio (https://gis.ohiodnr.gov/MapViewer/?config=OhioMines). We also reviewed ODNR's Karst Interactive Map for field verified or suspected karst locations in the vicinity. The nearest field-verified or suspected karst point is located approximately 9 miles south-southeast of the Project site near Vanlue, Ohio (https://gis.ohiodnr.gov/website/dgs/karst_interactivemap/). In the ODNR letter of May 7, 2021, the Ohio Division of Geological Survey indicated the nearest sinkhole was located 7.6 miles northeast of the Project site. No significant forests or caves are known to exist within 3 miles of the Project footprint. No previous species survey reports were readily available for review within the area, nor did desktop habitat review indicate additional research would identify materially different results.

During field investigations associated with wetland and stream delineations as well as habitat observations, no cave openings were observed. As a result, it appears unlikely that any hibernacula are present within 0.25-mile of the Project site and further field surveys for hibernacula do not appear warranted.

The Project property is generally open active agricultural fields, and the proposed layout has minimized the need for tree clearing. Figure 1 shows the areas where limited tree clearing will be necessary in order to accommodate the layout and function of the Project. A total of approximately 4 acres of tree clearing is proposed. Clearing of trees ≥3 inches diameter at breast height will be restricted to occur only between October 1 and March 31.

State and Federally Listed Mussels

Streams within the Project site consist of several segments of the South Branch Portage River, one additional perennial unnamed stream, and an intermittent stream. The intermittent stream is not anticipated to be suitable for mussel habitat. The United States Geological Survey (USGS) indicates that the unnamed stream transitions from perennial to intermittent within the Project site. Both the segments of the South Branch Portage River (top right) and the unnamed perennial stream (bottom right) have been channelized and degraded in association with the surrounding agricultural use (i.e., row crops). Neither perennial stream is listed in Appendix A of the Ohio Mussel Survey Protocol.

According to StreamStats (results attached) the South Branch Portage River in the vicinity of the Project site has a drainage area of approximately 7.17 square miles, while the drainage area for the unnamed stream ranges from 3.88 in the western portion of the Project site to 3.21 in the eastern portion of the Project site. A road crossing and potential collector line crossings are proposed through the perennial unnamed stream; however, based on the criteria provided by ODNR, it is our understanding that no mussel surveys would be required for in-water work proposed within the perennial unnamed stream.

Although the South Branch Portage River does have a calculated watershed greater than 5 square miles, its degraded nature may not result in suitable mussel habitat. It is expected that a below-ground collector line will be installed across this segment of the South Branch Portage River. As long as this installation does not involve in-water work, it is our understanding that a mussel survey would not be required. If in-water work were proposed, the need for a mussel survey would potentially need to be considered.

Western Banded Killifish

As noted above, the portions of the South Branch Portage River and the unnamed perennial stream that extend through the Project site have been substantially degraded by agricultural practices (including channelization, removal of canopy, siltation, and agricultural runoff). Western banded killifish prefer low-gradient streams with clear water, abundant aquatic vegetation, and substrates of sand, marl, or organic debris free of silt. Furthermore, the stream is a very small perennial stream (as shown in the photograph to the right). As a result, we do not anticipate impacts to the western banded killifish.

Black-Crowned Night-Heron

Wetlands and waterbodies delineated on-site are relatively small (as can be seen on Figure 1) and appear unlikely to provide adequate nesting habitat for this species. The minor amounts of tree clearing proposed for Project construction will occur in narrow strips along the edges of active agricultural fields. As a result, we do not anticipate any impacts to nesting black-crowned night-herons.

Least Bittern

As noted in ODNR's May 7, 2021 response, this species prefers dense emergent wetlands with thick stands of cattails, sedges, sawgrass or other semiaquatic vegetation interspersed with woody vegetation and open water. No such habitat is present within the Project site (as can be seen on Figure 1) and the largely agricultural land use is not suitable for this species. As a result, we do not anticipate any impacts to least bitterns.

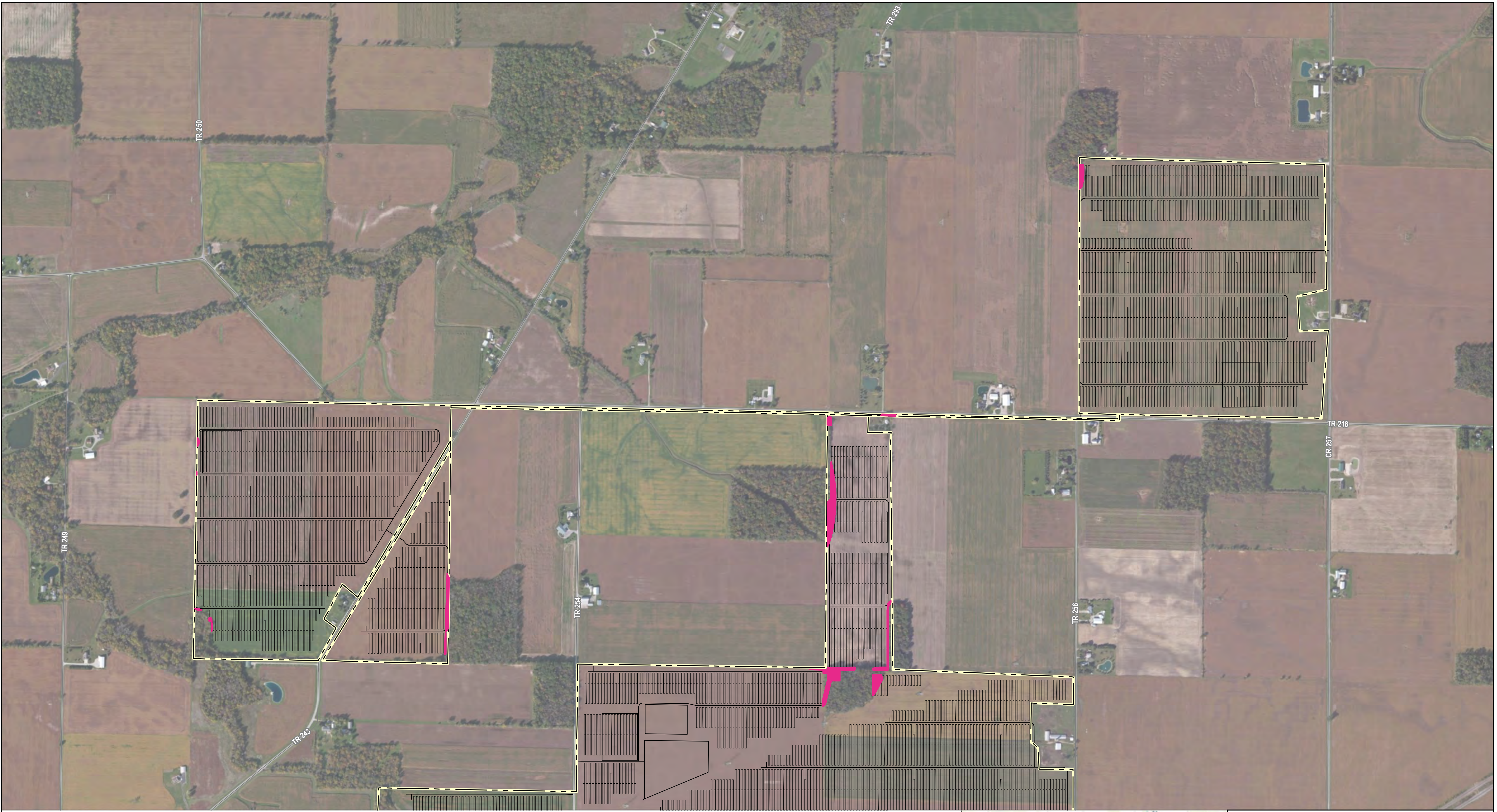
Northern Harrier

As noted in ODNR's May 7, 2021 response, this species is a common migrant and winter species but rare nester in the region, preferring to nest in large marshes and grasslands. On-site investigations indicate no large marshes or grasslands/pastures are present within the Project site. As a result, we do not anticipate any impacts to nesting northern harriers.

With this additional information, we request that you confirm whether you are in agreement that only the summer-roosting bats require seasonal clearing restrictions for species protection and that, if in-water work was to occur for the South Branch Portage River, a mussel survey would potentially need to be considered. Please let me know if any additional information would be helpful to support your review. Thank you.

Sincerely yours,
HALEY & ALDRICH, INC.
Lynn Gresock
Lynn Gresock
Principal Consultant

\\haleyaldrich.com\share\CF\Projects\135392\T&E Species\ODNR\South Branch Solar_ODNR Follow-Up_7-15-21.docx



LEGEND

── ROAD

── PROJECT LAYOUT COMPONENT

🟥 TREE CLEARING AREA

▭ PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
3. AERIAL IMAGERY SOURCE: ESRI

N

0 970 1,940

SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

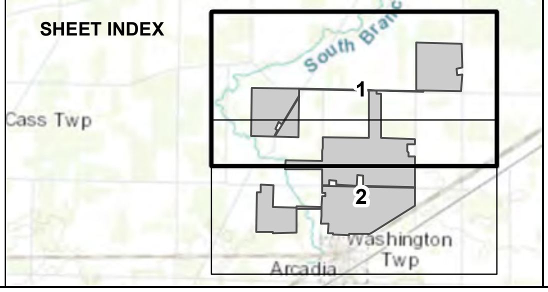


Figure 1: Tree Clearing Areas

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio

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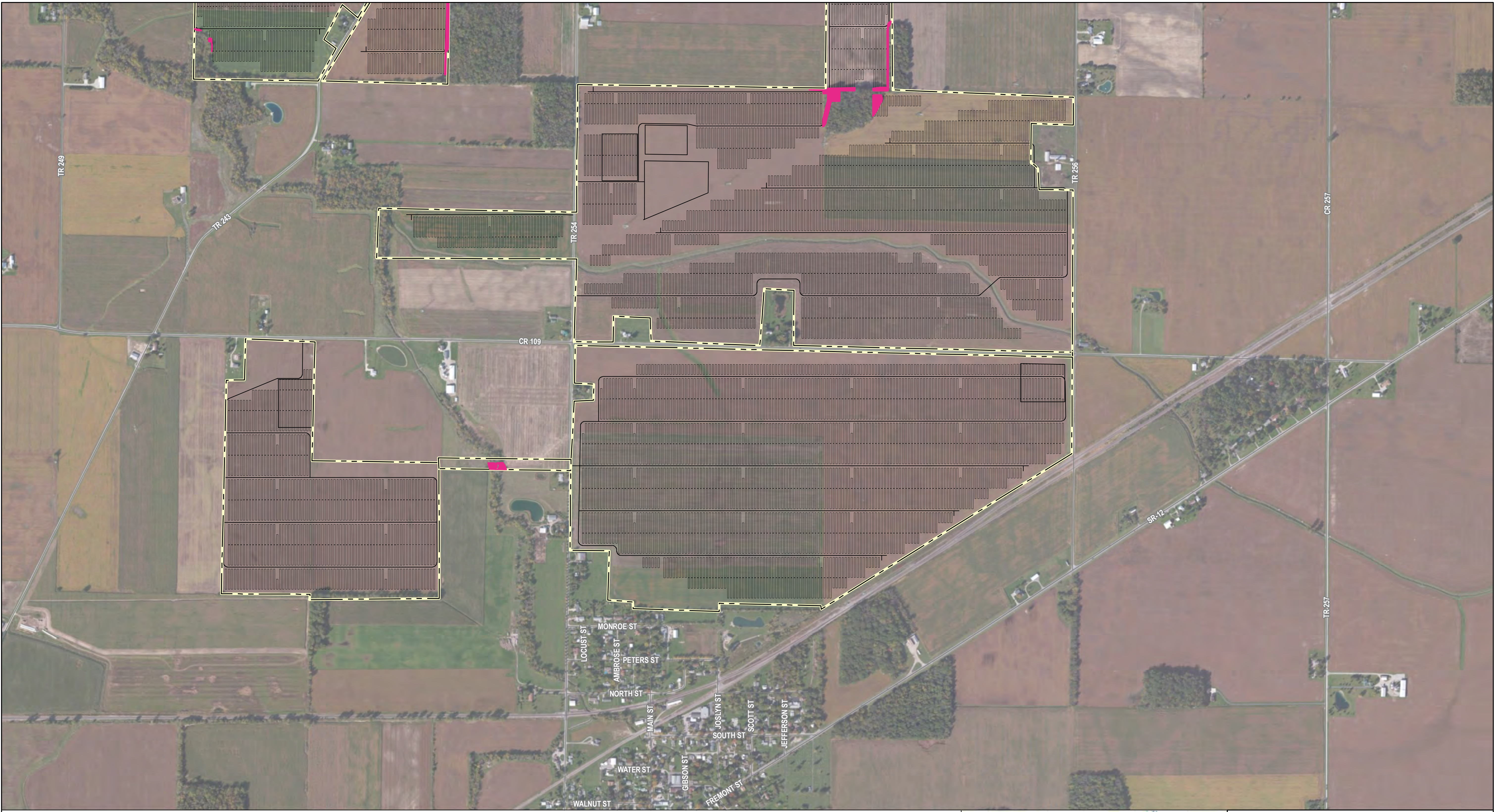

LEGEND

- ─ ROAD
- ─ PROJECT LAYOUT COMPONENT
- 🟥 TREE CLEARING AREA
- ▭ PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
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0 970 1,940

SCALE IN FEET

HALEY ALDRICH

SHEET INDEX

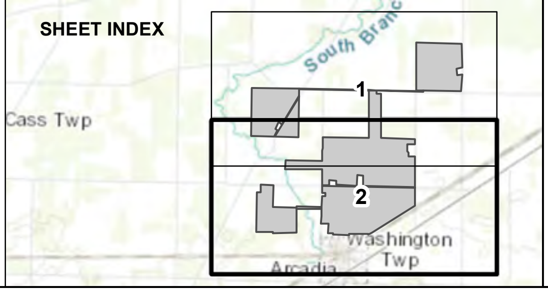

Figure 1: Tree Clearing Areas

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio

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StreamStats Report

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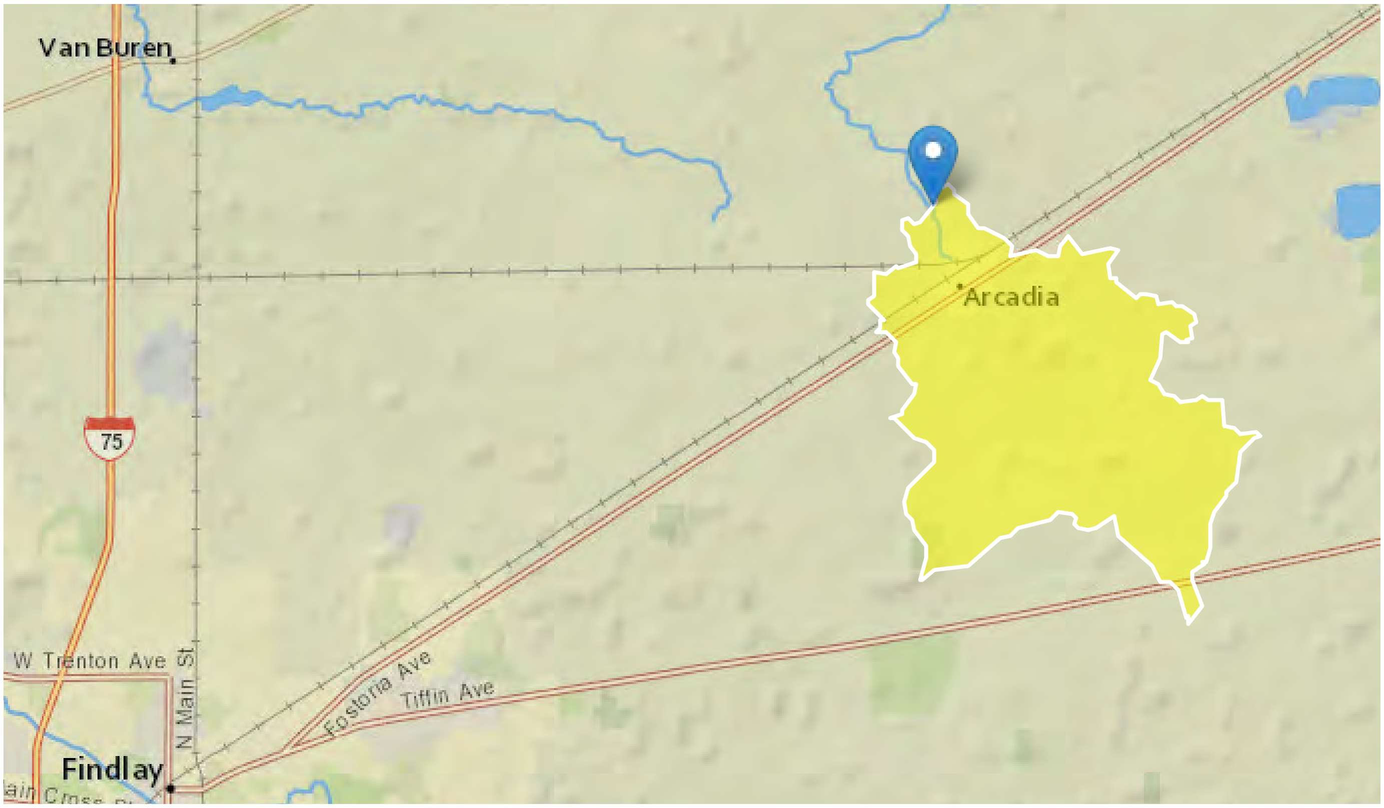

South Branch Portage River (H&A ID MM3)

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	7.17	square miles

Application Version: 4.6.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

StreamStats Report

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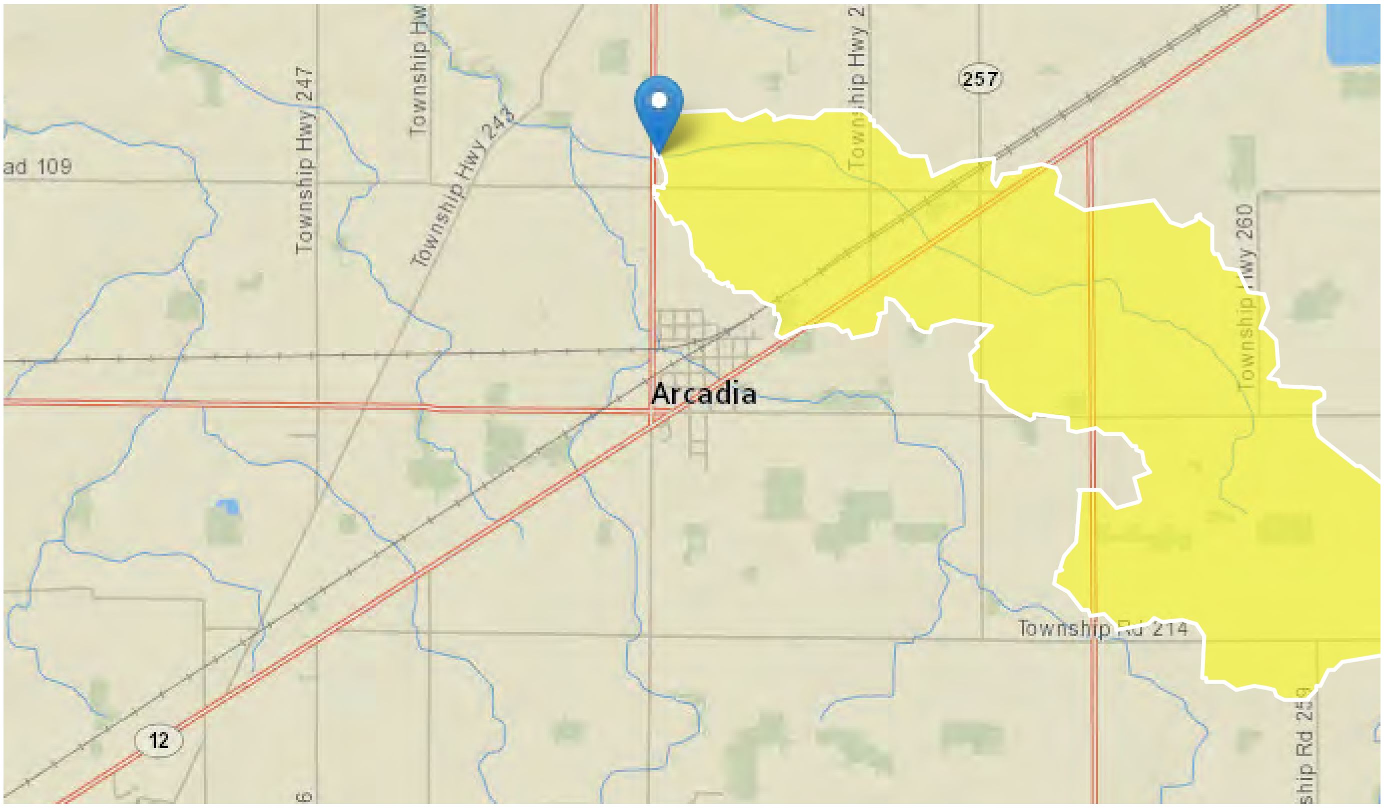

Unnamed stream - western crossing (H&A ID MM2)

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.88	square miles

Application Version: 4.6.0
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

StreamStats Report

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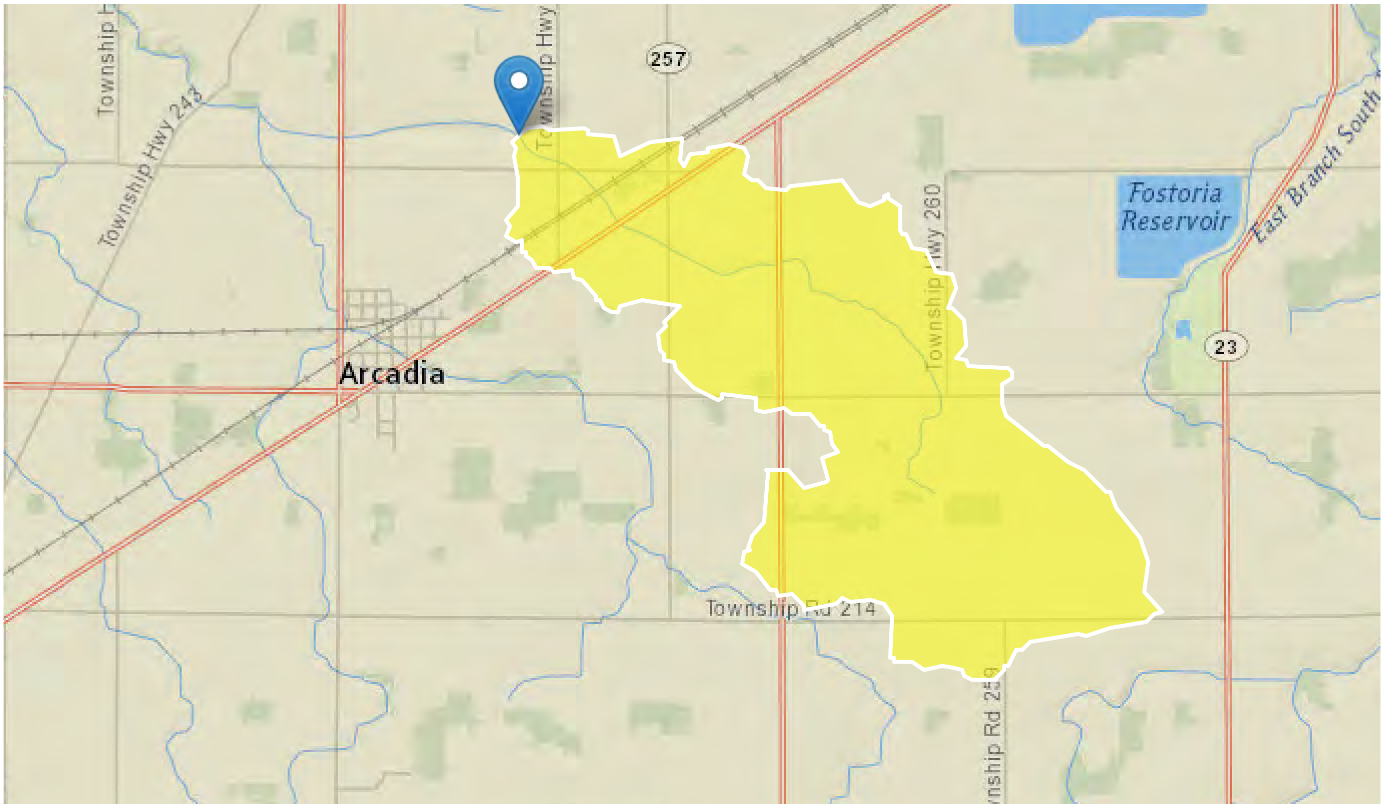

South Branch Solar proposed road crossing.

Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	3.21	square miles

Application Version: 4.5.3
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

APPENDIX Q

CULTURAL RESOURCE CONSULTATION

OHIO
HISTORY
CONNECTION

In reply refer to:
2021-HAN-51637

June 21, 2021

Lynn Gresock
Haley & Aldrich, Inc.
3 Bedford Farms Drive, Suite 301
Bedford, New Hampshire 03110
Email: lgresock@haleyaldrich.com

RE: Review-Phase I Archaeological Survey, South Branch Solar Project, Washington Township, Hancock County, Ohio

Dear Ms. Gresock:

This letter is in response to the correspondence received on May 24, 2021 regarding the proposed South Branch Solar Project that is being permitted by the Ohio Power Siting Board (OPSB). We appreciate the opportunity to comment on this project. The comments of the Ohio State Historic Preservation Office (SHPO) are made pursuant to Section 149.53 of the Ohio Revised Code requesting cooperation among state agencies in the preservation of historic properties, Ohio Administrative Code Chapters 4906-4-08 (D). The comments of the Ohio SHPO are also submitted in accordance with the provisions of Section 106 of the National Historic Preservation Act of 1966, as amended (54 U.S.C. 306108 [36 CFR 800]).

The proposed undertaking involves the construction of a solar energy facility and its' related infrastructure within a proposed 1,000-acre parcel, which is defined as the direct Area of Potential Effect (APE). The following review and comments pertain only to the *Phase I Archaeological Investigations for the Approximately 404.7 ha (1,000 ac) South Branch Solar Project in Washington Township, Hancock County, Ohio* by Weller & Associates, Inc. (Weller 2021). The architectural component will be submitted in a stand-alone report, and therefore the review will be under a separate cover.

The archaeological survey involved a literature review, surface collection, and visual inspection of the entire APE, as defined above. The literature review revealed no previously documented archaeological sites within or immediately adjacent to the APE. Furthermore, it was determined that the APE had not been subjected to any previous cultural resource studies prior to this survey.

The archaeological field work involved surface collection and visual inspection which resulted in the identification of 21 previously undocumented archaeological sites, 33HK944-33HK964. Sites 33HK945-33HK953, 33HK955-33HK957, and 33HK963 are documented as prehistoric isolated finds represented by a variety of artifact types, including lithic debitage and projectile points. The remaining eight (8) sites, 33HK944, 33HK954, 33HK958-33HK962, and 33HK964 are documented as historic-era scatters represented by less than 30 artifacts per site. Based on the available data, the SHPO concurs with Weller that these sites are not considered eligible for inclusion to the National Register of Historic Places (NRHP) under Criterion D. Therefore, as proposed, there will be no effect on significant archaeological resources within the APE. No further archaeological investigations are warranted for the 1,000-acre APE unless the scope of work changes or new/additional archaeological remains are discovered during the course of construction. In such a situation, this office should be contacted. If you have any questions concerning this review, please contact me via email at sbiehl@ohiohistory.org. Thank you for your cooperation.

Sincerely,

Stephen M. Biehl

Stephen M. Biehl, Project Reviews Coordinator (archaeology)
Resource Protection and Review
State Historic Preservation Office

cc: Ryan J. Weller, Weller & Associates, Inc.

RPR Serial No. 1088740

"Please be advised that this is a Section 106 decision. This review decision may not extend to other SHPO programs."

Phase I Archaeological Investigations for the approximately 404.7 ha (1,000 ac) South Branch Solar Project in Washington Township, Hancock County, Ohio

Ryan J. Weller

May 24, 2021

1395 West Fifth Ave.
Columbus, OH 43212
Phone: 614.485.9435
Fax: 614.485.9439
www.wellercrm.com

Phase I Archaeological Investigations for the approximately 404.7 ha (1,000 ac) South Branch Solar Project in Washington Township, Hancock County, Ohio

By

Ryan J. Weller

Submitted By:

Ryan J. Weller, P.I.
Weller & Associates, Inc.
1395 West Fifth Ave.
Columbus, OH 43212
Phone: 614.485.9435 Fax: 614.485.9439

Prepared For:

Haley & Aldrich, Inc.
3 Bedford Farms Drive
Bedford, NH 03110

Lead Agency:

Ohio Power Siting Board (OPSB)

Ryan J. Weller, P.I.

May 24, 2021

W-2914

Abstract

Phase I Archaeological Investigations for the approximately 404.7 ha (1,000 ac) South Branch Solar Project (the Project) in Washington Township, Hancock County, Ohio. Weller completed the work for submission to the lead state agency, the Ohio Power Siting Board (OPSB), and will be submitted to the Ohio History Connection (OHC), which serves as the Ohio State Historic Preservation Office (SHPO), for review. These investigations were conducted within agricultural field situations and in areas where construction-related activity for the Project is planned (the Project Area). These investigations involved surface collection methods of archaeological sampling and visual inspection. These investigations identified 21 previously unrecorded archaeological sites (33HK0944 through 33HK0964).

The Project is for the development and use of the involved tracts/parcels for a solar farm. These will be installed or constructed within what were agricultural fields at the time of these investigations. The Project Area is located in an upland, rural, and largely agricultural setting that is about midway between the cities of Findlay and Fostoria; it is to the north and east of the Village of Arcadia. The Project Area and its surrounding setting are consistent with farmland and sparsely populated conditions. The terrain is not very diverse till plain conditions that include gently undulating to nearly level conditions. There are no riparian situations or floodplains involved in this area.

A literature review conducted prior to the field investigations determined that there have been very few resources recorded within the study area for this Project. There have not been any archaeological sites identified in the area and only a single architectural resource is recorded. There are no recorded significant resources (i.e., National Register of Historic Places or Determination of Eligibility) in the study area. There have not been any professional surveys completed within the project or its study area.

These investigations identified 21 previously unrecorded archaeological sites (33HK0944 through 33HK0964); however, site 33HK0960 is located outside of the current Project Area. None of these sites are considered to be significant cultural resources and they are not regarded as landmarks. A finding similar to ‘no historic properties affected’ as outlined by 36 CFR § 800.4 and 36 CFR § 800.5 is considered appropriate. No further archaeological work is deemed necessary for the Project.

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Introduction

In April 2021, Weller & Associates, Inc. (Weller) completed Phase I Archaeological Investigations for the approximately 404.7 ha (1,000 ac) South Branch Solar Project (the Project), a photovoltaic solar facility proposed in Washington Township, Hancock County, Ohio (Project Area; Figures 1-3). This survey was conducted using methods and strategies that are in accordance with the National Register of Historic Places (NRHP) pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 [36 CFR 800]). This report summarizes the results of the fieldwork and literature review. The report format and design are consistent with that established in *Archaeology Guidelines* (Ohio Historic Preservation Office [OHPO] 1994).

The Project will be installed or constructed within the Project Area what were agricultural fields at the time of these investigations.

The field investigations for this Project were completed in April 2021 and was conducted based on field conditions and as landowner permissions were granted. Justin Fryer, Chris Goodrich, Josh Engle, Nikki DeWitt, Cullen Dunajski, Ashley Shaw, Daniel DuBoe, and Seth Cooper completed the field investigations. An assessment of the potential effect from the Project on historic structures in the surrounding area will be completed by Weller but contained in a separate report.

Environmental Setting

Climate

Hancock County, like all of Ohio, has a continental climate with hot and humid summers and cold winters. About 36 inches of precipitation falls annually. The wettest time of year is during the growing season, from April to September (United States Department of Agriculture, Soil Conservation Service [USDA, SCS] 2020).

Physiography, Relief, and Drainage

Central Hancock County is located within the Central Ohio Clayey Till Plain region of Ohio (Brockman 1998). The relief in this region is often gently rolling to flat with noticeable relief along drainages as they are entrenched. The Project Area is located on a rolling and elevated moraine considered the Defiance Moraine; typically, the relief is more rolling or undulating than the surrounding setting; however, the Project Area is moderately flat. The Project Area is drained by the South Branch Portage River and relative unnamed tributaries, all of which flow into the Portage River and empty into Lake Erie.

Geology

Underlying the glacial till in Hancock County is Silurian-aged bedrock (Brockman 1998; USDA, SCS 1973). This includes limestone and dolomitic materials that occasionally produce cherty deposits.

Soils

The majority of the Project Area is located within the Blount-Pewamo Association with a narrow sleeve of Sloan-Eel-Shoals Association along the lone drainage. These soils are formed from glacial till in upland situations. There are 15 soil series types present within the Project Area (Table 1; USDA, SCS 2021). These are mostly indicative of till plain conditions. Most of these soils are indicative of slight rises with low relief. Pewamo series soils account for about a third of the Project Area and are found in low areas that are imperfectly drained and considered less likely to contain cultural materials.

Table 1. Soil Types Identified in the Project Area.

Soil Name	Slope %	% in Project	Landform Type
Alvada loam	0-1	2.5	Slight rises in uplands
Blount silt loam	0-2	30.0	Slight rises on till plains
Blount loam	0-2	.8	Slight rises on till plains
Blount silt loam	2-4	.2	Slight rises on till plains
Blount-Houcktown complex	0-3	6.3	Slight rises on till plains
Blount-Jenera complex	0-3	.8	Slight rises on till plains
Glynwood-Blount-Houcktown complex	1-4	23.6	Rises on till plains
Glynwood silt loam	2-6	.6	Rises on till plains
Glynwood clay loam	6-12	.1	Slopes of rises in till plains
Houcktown-Glynwood-Jenera complex	1-4	.7	Rises on till plains
Jenera fine sandy loam	0-2	.2	Slight rises on till plains
Jenera fine sandy loam	2-6	.7	Slight rises on till plains
Pewamo silty clay loam	0-1	32.9	Low, depressions in till plains
Shoals silt loam	0-2	.1	Low areas near streams
Sloan silty clay loam	0-1	.5	Low areas near streams

Flora

In the past, there was great floral diversity in Ohio and this is important in understanding past cultures land use. This diversity is relative to the soils and the terrain that generally includes the till plain, lake plain, terminal glacial margins, and unglaciated plateau (Forsyth 1970). Three major glacial advances, including the Kansan, Illinoisan, and Wisconsinan, have affected the landscape of Ohio. The effects of the Wisconsin glaciation are most pronounced and have affected more than half of the state (Pavey et al. 1999).

The least diverse part of Ohio extends in a belt from the northeast below the lake-affected areas through most of western Ohio (Gordon 1966). These areas are part of the late Wisconsin ground moraine and lateral end moraines. It is positioned between the lake plains region and the terminal glacial moraines. This area included broad forested areas of beech maple forests interspersed with mixed oak forests in elevated terrain or where relief is greater (Forsyth 1970; Gordon 1966). Prairie environments, such as those in Wyandot and Marion County areas, would contain islands of forests but were mostly expansive open terrain dominated by grasses.

The northwestern Ohio terrain is nearly flat because of ancient glacial lakes and glaciation, which affected the flora. However, the vegetation was more diverse than the till plain to the south and east because of the variety of factors that contributed to its terrain. Forests within the Black Swamp were generally comprised of elm/ash stands; however, dissected areas along drainages and drier, elevated areas from beach deposits would contain mixed forests of oak and hickory (Gordon 1966, 1969). There was little upland floral diversity in the lake plains (Black Swamp region) except for the occasional patches of oak and hickory. Floral variety was most evident in narrow sleeves along larger stream valleys where there is relief.

The most biological diversity in Ohio is contained within the Allegheny Plateau, which encompasses the southeastern two-thirds of the state (Sheaffer and Rose 1998). Because this area is higher and has drier conditions, it is dominated by mixed oak forests. Some locations within the central part of this area contain beech and mixed mesophytic forests. There are large patches of oak and sugar maple forests to the south of the terminal moraine from Richland to Mahoning County (Gordon 1966).

Generally, beech forests are the most common variety through Ohio and could be found in all regions. Oak and hickory forests dominated the southeastern Ohio terrain and were found with patchy frequency across most of northern Ohio. Areas that were formerly open prairies and grasslands are in glacial areas but are still patchy. These are in the west central part of the state. Oak and sugar maple forests occur predominantly along the glacial terminal moraine. Elm-ash swamp forests are prevalent in glaciated areas including the northern and western parts of Ohio (Gordon 1966; Pavey et al. 1999).

Hancock County, including the Project Area, is generally within what is considered to be a beech forest area with an east-west sleeve of elm-ash swampland nearby (Gordon 1966).

Fauna

The upland forest zone offered a diversity of mammals to the prehistoric diet. This food source consisted of white-tailed deer, black bear, Eastern cottontail rabbit, opossum, a variety of squirrels, as well as other less economically important mammals. Several avian species were a part of the upland prehistoric diet as well (i.e., wild turkey, quail, ruffed grouse, passenger pigeon, etc.). The lowland zone offered significant species as well. Raccoon, beaver, and muskrat were a few of the mammals, while wood duck and wild goose were the economically important birds. Fishes and shellfish were also an integral part of the prehistoric diet. Ohio muskellunge, yellow perch, white crappie, long nose gar, channel catfish, pike, and sturgeon were several of the fish, whereas, the Ohio naiad mollusc, butterfly’s shell, long solid, common bullhead, knob rockshell, and cod shell were the major varieties of shellfish. Reptiles and amphibians, such as several varieties of snakes, frogs, and turtles, were also part of the prehistoric diet (Trautman 1981; Lafferty 1979; Mahr 1949).

Cultural Setting

The first inhabitants of Ohio were probably unable to enter this land until the ice sheets of the Wisconsin glacier melted around 16,000 B.P. Paleoindian sites are considered rare due to the age of the sites and the effects of land altering activities such as erosion. Such sites were mostly used temporarily and thus lack the accumulation of human occupational deposits that would have been created by frequent visitation. Paleoindian artifact assemblages are characteristic of transient hunter-gatherer foraging activity and subsistence patterns. In Ohio, major Paleoindian sites have been documented along large river systems and near flint outcrops in the Unglaciated Plateau (Cunningham 1973). Otherwise, Paleoindian sites in the glaciated portions of Ohio are encountered infrequently and are usually represented by isolated finds or open-air scatters.

The Paleoindian period is characterized by tool kits and gear utilized in hunting Late Pleistocene megafauna and other herding animals including, but not limited to, short-faced bear, barren ground caribou, flat-headed peccary, bison, mastodon, giant beaver (Bamforth 1988; Brose 1994; McDonald 1994). Groups have been depicted as being mobile and nomadic (Tankersley 1989); artifacts include projectile points, multi-purpose unifacial tools, burins, gravers, and spokeshaves (Tankersley 1994). The most diagnostic artifacts associated with this period are fluted points that exhibit a groove or channel positioned at the base to facilitate hafting. The projectiles dating from the late Paleoindian period generally lack this trait; however, the lance form of the blade is retained and is often distinctive from the following Early Archaic period (Justice 1987).

The Archaic period has been broken down into three sub-categories, including the Early, Middle, and Late Archaic. During the Early Archaic period (ca. 10,000-8000 B.P.), the environment was becoming increasingly arid as indicated by the canopy (Shane 1987). This period of dryness allowed for the exploitation of areas that were previously inaccessible or undesirable. The Early Archaic period does not diverge greatly from the Paleoindian regarding the type of settlement. Societies still appear to be largely mobile with reliance on herding animals (Fitting 1963). For these reasons, Early Archaic artifacts can be encountered in nearly all settings throughout Ohio. Tool diversity increased at this time including hafted knives that are often re-sharpened by the process of beveling the utilized blade edge and intense basal grinding (Justice 1987). There is a basic transition from lance-shaped points to those with blades that are triangular. Notching becomes a common hafting trait. Another characteristic trait occurring almost exclusively in the Early and Middle Archaic periods is basal bifurcation and large blade serrations. Tool forms begin to vary more and may be a reflection of differential resource exploitation. Finished tools from this period can include bifacial knives, points, drills/perforators, utilized flakes, and scrapers.

The Middle Archaic period (8000-6000 B.P.) is poorly known or understood in archaeological contexts within Ohio. Some (e.g., Justice 1987) regard small bifurcate points as being indicative of this period. Ground stone artifacts become more prevalent at this time. Other hafted bifaces exhibit large side notches with squared bases, but this same trait can extend back to the Paleoindian period. The climate at this time is much like that of the modern era. Middle Archaic period subsistence tended to be associated with small patch foraging that involved a consistent need for mobility with a shift towards stream valleys (Stafford 1994). Sites encountered from this time period throughout most of Ohio tend to be lithic scatters or isolated finds. The initial appearance of regional traits may be apparent at this time.

The Late Archaic period in Ohio (ca 6000-3000 B.P.) diverges from the previous periods in many ways. Preferred locations within a regional setting appear to have been repeatedly occupied. The more intensive and repeated occupations often resulted in the creation of greater social and material culture complexity. The environment during this period was warmer and drier. Most elevated landforms in northeastern Ohio have yielded Archaic artifacts (Prufer and Long 1986: 7), and the same can be stated for the remainder of Ohio.

Various artifacts are diagnostic of the Late Archaic period. Often, burial goods provide evidence that there was some long-distance movement of materials, while lithic materials used in utilitarian assemblages are often from a local chert outcrop. There is increased variation in projectile point styles that may reflect regionalism. Slate was often used in the production of ornamental artifacts. Ground and polished stone artifacts reached a high level of development. This is evident in such artifacts as grooved axes, celts, bannerstones, and other slate artifacts.

It is during the Terminal Archaic period (ca 3500-2500 B.P.) that extensive and deep burials are encountered. Cultural regionalism within Ohio is evident in the presence of Crab Orchard (southwest), Glacial Kame (northern), and Meadowood (central to Northeastern). Along the Ohio River, intensive occupations have been placed within the Riverton phase. Pottery makes its first appearance during the Terminal Late Archaic.

The Early Woodland period (ca 3000-2100 B.P.) in Ohio is often associated with the Adena culture and the early mound builders (Dragoo 1976). Early and comparably simple geometric earthworks first appear with mounds more spread across the landscape. Pottery at this time is thick and tempered with grit, grog or limestone; however, it becomes noticeably thinner towards the end of the period. There is increased emphasis on gathered plant resources, including maygrass, chenopodium, sunflower, and squash. Habitation sites have been documented that include structural evidence. Houses that were constructed during this period were circular, having a diameter of up to 18.3 m (Webb and Baby 1963) and often with paired posts (Cramer 1989). Artifacts dating from this period include leaf-shaped blades with parallel to lobate hafting elements, drilled slate pieces, ground stone, thick pottery, and increased use of copper. Early Woodland artifacts can be recovered from every region of Ohio.

In northwest and north-central Ohio, there are not very many mounds or village sites that indicate an Early Woodland occupation. Artifacts from these areas often are reflective of seasonal hunting excursions. Adena-like bifaces and tools are commonly found in river and stream valleys that drain into Lake Erie as well as in the uplands. It is assumed that Early Woodland inhabitants used these areas for little more than a transient hunting-collecting subsistence. One of the best-known Early Woodland sites is the Leimbach site. This site is located where the Huron River empties into Lake Erie (Shane 1975). Early Woodland ceramics and lugged vessels have been recovered from this site. Evidence of Early Woodland activity, such as ceramics, has been encountered infrequently at locations across north-central and northwestern Ohio.

The Middle Woodland period (ca 2200-1600 B.P.) is often considered to be equivalent with the Hopewell culture. The largest earthworks in Ohio date from this period. There is dramatic increase in the appearance of exotic materials that appear most often in association with earthworks and burials. Artifacts representative of this period include thinner, grit-tempered pottery, dart-sized projectile points (Lowe Flared, Steuben, Snyders, and Chesser) [Justice 1987], exotic materials (mica, obsidian, and marine shell, etc.). The points are often thin, bifacially beveled, and have flat cross sections. There seems to have been a marked increase in the population as well as increased levels of social organization. Middle Woodland sites seem to reflect a seasonal exploitation of the environment. There is a notable increase in the amount of Eastern Agricultural Complex plant cultigens, including chenopodium, knotweed, sumpweed, and little barley. This seasonal exploitation may have followed a scheduled resource extraction year in which the populations moved camp several times per year, stopping at known resource extraction loci. Middle Woodland land use appears to center on the regions surrounding earthworks (Dancey 1992; Pacheco 1996); however, there is evidence of repeated occupation away from earthworks (Weller 2005). Household structures during this period varied, with many of them being squares with rounded corners (Weller 2005). Exotic goods are often attributed to funerary activities associated with mounds and earthworks. Utilitarian items are more frequently encountered outside of funerary/ritual contexts. The artifact most diagnostic of this period is the bladelet, a prismatic and thin razor-like tool, and bladelet cores. Middle Woodland remains are more commonly recovered from central Ohio south and lacking from most areas in the northern and southeastern part of the state.

Little information is known about the Middle Woodland period of western and northwestern Ohio. This may be due to a poor representation of artifacts from this period or because the area is not directly associated with the Hopewell culture. The loosely associated patterns of earthworks to habitation sites that have been identified in central and southern Ohio areas are not present in this region. Sites associated with this period have been identified along the south and western shores of Lake Erie, but they are not common (Stothers et al. 1979; Stothers 1986).

The Late Woodland period (ca A.D. 400-900) is distinct from the previous periods in several ways. There appears to be a population increase and a more noticeable aggregation of groups into formative villages. The villages are often positioned along large streams, on terraces, and were likely seasonally occupied (Cowan 1987). This increased sedentism was due in part to a greater reliance on horticultural garden plots, much more so than in the preceding Middle Woodland period. The early Late Woodland groups were growing a wide variety of crop plants that are collectively referred to as the Eastern Agricultural Complex. These crops included maygrass, sunflower, and domesticated forms of goosefoot and sumpweed. This starch and protein diet was supplemented with wild plants and animals. Circa A.D. 800 to 1000, populations adopted maize agriculture, and around this same time, shell-tempered ceramics appear. Other technological innovations and changes during this time period included the bow and arrow and changes in ceramic vessel forms.

Evidence suggests that the Late Woodland occupations in northern Ohio developed from the Western Basin Middle Woodland tradition. The Late Woodland period in northern Ohio is best defined by ceramic traditions. Western Basin Late Woodland sites have been identified in most of the river valleys in northwestern Ohio such as the Maumee, Auglaize, and the Sandusky Rivers. Radiocarbon dating establishes this Late Woodland occupation at the first century B.C. to A.D. 500 (Pratt and Bush 1981). The Western Basin tradition consists of three primary phases, which include the Riviere au Vase, the Younge (Fitting 1965), and the Springwells phase. Influence from the Cole complex may extend into the area from the south, but this remains theoretical and not well researched.

The Late Prehistoric period in northwest and northern Ohio is often associated with an intensification of the use of plant resources, the presence of large villages, and a steady population increase. Permanent villages were associated with a heavy dependence on farming. These villages were often located on the meander belt zones of river valleys (Stothers et al. 1984: 6). Subsistence of these farming communities relied upon maize, beans, and squash as the major cultigens. Villages were often strategically located on bluff tops. There is a change in social structure to a chiefdom-based society. The Late Prehistoric period in northwest Ohio has been segregated into the Sandusky tradition and smaller phases based largely on age and ceramic assemblage traits.

The Sandusky tradition has been broken up into four phases. These phases are identified (in chronological order) as Eiden, Wolf, Fort Meigs, and Indian Hills. These are often associated with a style of ceramic referred to as Mixter Tool Impressed, Mixter Dentate, Mixter Cordmarked, and Parker Festooned. The Eiden and Wolf phases show a dependence upon fishing, and villages are usually associated with large cemeteries (Schneider 2000; Shane 1967).

The Fort Meigs and Indian Hills phases occur late in the Late Prehistoric period. The Fort Meigs phase may be related to the Wolf phase in that the pottery is similar. Fort Meigs phase occupations are identified by specific rim and neck motifs that are applied to their pottery. The Indian Hills phase is associated with shell-tempered pottery. Some villages show evidence of defensive features such as stockade lines, ditches, or earthen walls (Pratt and Bush 1981: 155). There is little evidence to support inter-village relationships, such as trade; this lack may have been due to competition for localized resources.

Protohistoric to Settlement

By the mid-1600s, French explorers traveled through the Ohio country as trappers, traders, and missionaries. They kept journals about their encounters and details of their travels. These journals are often the only resource historians have regarding the early occupants of seventeenth century Ohio. The earliest village encountered by the explorers in 1652 was a Tionontati village located along the banks of Lake Erie and the Maumee River. Around 1670, it is known that three Shawnee villages were located along the confluence of the Ohio River and. the Little Miami River. Because of the Iroquois Wars, which continued from 1641-1701, explorers did not spend much time in the Ohio region, and little else is known about the natives of Ohio during the 1600s. Although the Native American tribes of Ohio may have been affected by the outcome of the Iroquois Wars, no battles occurred in Ohio (Tanner 1987).

French explorers traveled extensively through the Ohio region from 1720-1761. During these expeditions, the locations of many Native American villages were documented. In 1751, a Delaware village known as Maguck existed near present-day Chillicothe. In 1758, a Shawnee town known as 'Lower Shawnee 2' existed at the same location. The French also documented the locations of trading posts and forts, which were typically established along the banks of Lake Erie or the Ohio River (Tanner 1987).

While the French were establishing a claim to the Ohio country, many Native Americans were also entering new areas of the region. The Shawnee were being forced out of Pennsylvania because of English settlement along the eastern coast. The Shawnee created a new headquarters at Shawnee Town, which was located at the mouth of the Scioto River. This headquarters served as a way to pull together many of the tribes which had been dispersed because of the Iroquois Wars (Tanner 1987).

Warfare was bound to break out as the British also began to stake claims in the Ohio region by the mid-1700s. The French and Indian War (1754-1760) affected many Ohio Native Americans; however, no battles were recorded in Ohio (Tanner 1987). Although the French and Indian War ended in 1760, the Native Americans continued to fight against the British explorers. In 1764, Colonel Henry Bouquet led a British troop from Fort Pitt, Pennsylvania to near Zanesville, Ohio.

In 1763, the Seven Years' War fought between France and Britain, also known as the French and Indian War ended with The Treaty of Paris. In this Peace of Paris, the French ceded their claims in the entire Ohio region to the British. When the American Revolution ended with the Second Treaty of Paris in 1783, the Americans gained the entire Ohio region from the British; however, they designated Ohio as Indian Territory. Native Americans were not to move south of the Ohio River, yet Americans were encouraged to head west into the newly acquired land to occupy and govern it (Tanner 1987).

By 1783, Native Americans had established fairly distinct boundaries throughout Ohio. The Shawnee tribes generally occupied southwest Ohio, while the Delaware tribes stayed in the eastern half of the state. Wyandot tribes were located in north-central Ohio, and Ottawa tribes were restricted to northeast Ohio. There was also a small band of Mingo tribes in eastern Ohio along the Ohio River, and there was a band of Mississauga tribes in northeastern Ohio along Lake Erie. The Shawnee people had several villages within Ross County along the Scioto River (Tanner 1987). Although warfare between tribes continued, it was not as intense as it had been in previous years. Conflicts were contained because boundaries and provisions had been created by earlier treaties.

In 1795, the Treaty of Greenville was signed as a result of the American forces defeat of the Native American forces at the Battle of Fallen Timbers. This allocated the northern portion of Ohio to the Native Americans, while the southern portion was opened for Euro-American settlement. Although most of the battles which led up to this treaty did not occur in Ohio, the outcome resulted in dramatic fluctuations in the Ohio region. The Greenville Treaty line was established, confining all Ohio Native Americans to northern Ohio, west of the Tuscarawas River (Tanner 1987).

Ohio Native Americans were again involved with the Americans and the British in the War of 1812. Unlike the previous wars, many battles were fought in the Ohio country during the War of 1812. By 1815, peace treaties began to be established between the Americans, British, and Native Americans. The Native Americans lost more and more of their territory in Ohio. By 1830, the Shawnee, Ottawa, Wyandot, and Seneca were the only tribes remaining in Ohio. These tribes were contained on reservations in northwest Ohio. By the middle 1800s, the last of the Ohio Native Americans signed treaties and were removed from the Ohio region.

Hancock County History

Hancock County was originally part of the Northwestern Territory ceded by Virginia to the United States Government and was organized in 1828. Its namesake is John Hancock, signer of the Declaration of Independence and person of political significance during the Revolutionary War. The county is located in northwestern Ohio and includes relatively diverse terrain. The Defiance Moraine is the dominant landform, which bisects the county from east to west through the center. The southern part of the county is Till Plain while the northern part is in the Lake Plain (Brockman 1998). The Blanchard River and its tributaries drain the majority of the southern part. This drainage runs along the Defiance Moraine and is the source of occasional inundations. The northern part of the county is drained by streams that flow to Lake Erie, including Middle Branch Portage River.

Early inhabitants of the county were generally focused along the drainages and particularly the Blanchard River. Immigrants to the county were primarily arriving to till the soil. Initially, settlement was at Fort Findlay, a War of 1812 stockade. Native American groups were also occupying the area at this time, including those from the

Wyandot Tribe and Ottawa further down river. Shawnee were known to the area as well. One of the first inhabitants of the county and the region was that of Jean Jacques Blanchard who immigrated to the area in 1769. He was a Frenchman that originated from New Orleans and settled along the river of his namesake after marrying a Native American woman (Beardsley 1881; Brown 1886; Spaythe 1903).

Some of the early activity in the county was during the War of 1812. It was in that year that General Hull's campaign passed through the county leaving a path referred to as "Hull's Trail." Hull ordered the construction of Fort Findlay and it was located on the Blanchard River. It was constructed and named for Colonel James Findlay. This would become the site of the first Euro-American occupant of the county by a soldier named Thorp or Tharp who resided in Fort Findlay in the War of 1812 and remained there after its evacuation (Beardsley 1881). The first family to settle was the Benjamin Cox family.

The influx of settlers to the county happened just after the War of 1812 and continued into the 1820s. These settlers inhabited the area around Findlay and the river and were primarily focused on agriculture. Log cabins would often have double functions as taverns or for trades such as blacksmith or ferrier. Grist and sawmills soon followed to serve the growing agricultural community.

The transportation of good and travel routes in the county was originally via pirogues that navigated the Blanchard to the Auglaize and eventually to the Maumee. Cross country trade was usually made by travel to Sandusky City to access markets such as New York. The early road systems were tethered to the various ridges and elevations in the county, which served as natural corridors. The growth of the county was furthered by the construction of various railroads starting in 1839 with the Bellefontaine & Perrysburg. Numerous other railroads would spring up and continue to be constructed to about 1900. Many of these were local lines but were significant in the economic development and prosperity of the county. The connection to the eastern market economies for the sale and transport of the agricultural products is typically what the smaller communities relied upon. Still, the communities of Findlay and Bluffton tended to be the center of attention and activity. Findlay, being centrally located was an easy choice for the county seat (Beardsley 1881; Brown 1886; Spaythe 1903).

The exploitation of mineral resources in the county happened amidst the Industrial Revolution. It was in the 1880s that oil and gas were discovered, and it has been valuable to the local economy ever since. The arrival of Marathon Oil brought jobs and wealth to Findlay thus spurring the development of the Findlay Country Club Golf Course. Agriculture also remains a vital component of the county's economy. There has been an increase in the development of industrial and business economy throughout the central part of the county and extending to Bluffton due to the accessibility to Interstate 75 (I-75). This is particularly pronounced around Findlay, Bluffton, and increasingly more to the north. According to the most recent census, the county has more than 74,000 inhabitants (Ohio History Central 2021).

Washington Township History

Washington Township, named after President George Washington, organized in 1832. Washington Township is located in the northeast corner of Hancock north of Big Lick Township, east of Cass Township, south of Wood County, and west of Seneca County. The Portage River, the east and middle branch of the Portage River, and several unnamed tributaries flow through the township. Lake Lamberjack, Veterans Memorial Reservoir, Fostoria Reservoir, and Mosier Lake are in the northeast corner of the township. Highways 613, 18, and 12 run through the township. The Norfolk & Western and the Baltimore and Ohio Railroads run through the township. The township is mostly hilly woodland and farmland (Beardsley 1881).

John Gersuch, of Wayne County, Ohio, made the first land purchase in Washington Township in December 1830 and moved to the township in April 1831. Land purchases in 1831 included James Connelly, John Norris, Richard Cole, and Thomas Kelley. The first schoolhouse in the township was built in about 1833 with Isaac Wiseman as the teacher on James Wiseman's farm. By the 1880s the township had nine schools. The Lake Erie & Western Railroad that ran northeast to southwest and the Continental Road, later the New York, Chicago, & St. Louis Rail Way that ran east and west in the township crossed at Arcadia. By the 1880s the township had a population of over 2,000. Methodists built the first church in 1832. Other churches in the township included Evangelical Lutheran, Presbyterian, German Reformed, German Baptist, and United Brethren (Beardsley 1881).

John Gorsuch platted Risdon, named for Daniel Risdon, in 1832. The town post office was established in 1837 with Alvin Coles as postmaster. The town merged with Rome in Seneca County to form Fostoria, named for Charles W. Foster, in 1855. Most of Fostoria sits in Seneca County. The town was the home of College of the United Brethren. (Beardsley 1881; Brown 1886).

David Peters and Ambrose Peters platted Arcadia in July 1855. where soon the Lake Erie & Western Railroad and the New York, Chicago, & St. Louis Rail Way would cross. The Lake and Western Railroad came to the area 1859 and then the New York, Chicago, and St. Louis Railroad crossed the town in 1881. The Toledo, Fostoria, & Findlay Electric Line ran from Findlay to Fostoria paralleling the Lake Erie & Western. David Peters opened the first store. In about 1859, Samuel Blackford built a steam-powered grist mill in the town. In 1859, Arcadia incorporated and gained a post office with A.W. Fredrick as postmaster. Industry in the town included handle factories, a broom factory, a pump factory, a saw and planing mill, a concrete factory, and more. By the 1880s the village had a population of about 500. Churches in the town included Methodist, Presbyterian, and Lutheran. Societies in the town included an Odd Fellows, Knights of Pythias, Rathburn Sisters, Maccabes, Lions, and Modern Woodsmen lodges. (Beardsley 1881; Brown 1886).

Research Design

The purpose of a Phase I archaeological survey is to locate and identify cultural resources that could be affected by the Project. The Project Area is located in a very homogeneous setting regarding its relief and soils. These investigations are directed to answer or address the following questions:

1) Did the literature review reveal anything that suggests the Project Area had been previously surveyed, and what is the relationship of previously recorded properties to the Project Area?
2) Are cultural resources likely to be identified in the Project Area?

Archaeological Field Methods

The survey conducted for the Project may include several different survey sampling strategies. These are detailed in the following text.

Shovel test unit excavation. Shovel test units were placed at 15-m intervals. Shovel test units measure 50 cm on a side and are excavated to 10 cm below the topsoil/subsoil interface. Individual shovel test units were documented regarding their depth, content, and color (i.e., Munsell). Wherever sites are encountered, Munsell color readings are taken per shovel test unit. All of the undisturbed soil matrices from shovel test units are screened using 0.6 cm hardware mesh. When sites are encountered, additional shovel test units will be excavated at 7.5-m intervals extending on grid and in the two cardinal directions within the corridor from the positive locations.

Shovel probes. These are excavated in locations where disturbance is not obvious at the surface. They are initiated as shovel test units and are excavated to about 20 cm at a minimum before they are abandoned due to severe disturbance. If the soil is not disturbed, the shovel probe becomes a shovel test unit.

Surface Collection. Agricultural fields that were investigated were in soybean stubble, corn stubble, winter wheat, tilled, or daikon. The bare ground surface visibility in these fields ranged from 50 to 90 percent. Pedestrian transects were spaced at between 7.5- to 10-m intervals and reduced, as appropriate, when cultural materials were identified. This method benefitted from the weathering, season, and immaturity of the wheat. Artifacts and sites were plotted using GPS as they were identified.

Visual inspection. Locations where cultural resources were not expected, such as disturbed/wet areas, stream crossings, and ditches, were walked over and visually inspected. This method was used to verify the likelihood of the absence of any cultural resources being located in these areas. This method was also utilized to document the general terrain and the surrounding area and verify the lack of any topography.

The application of the resulting field survey methods was documented in field notes, field maps, and Project maps.

Prehistoric Artifact Analysis

An artifact inventory was accomplished upon completion of the fieldwork. This involved identifying the functional attributes of individual artifacts, as well as the artifact cluster(s) or site assemblage collectively. The prehistoric artifact types and material were identified during the inventory process. The lithic artifact categories are modeled after Flenniken and Garrison (1975) and include the following:

> *Fire-cracked rock*. This is granite, igneous or sedimentary rock types that are fragmented due to cultural thermal activity (i.e., hearths, earth ovens, etc.). These exhibit angular fracturing aberrant to those caused by glacial activity. Sometimes they exhibit burning with blackness or redness, but not always. Their presence at a site indicates that thermal features were once present at or near that location. Their identification on the surface of a farm field indicates that a feature may have been truncated or fully incorporated into the plowzone or that a midden has been encountered with the plow.
>
> *Biface*. A biface is defined as an artifact that has been culturally modified on two faces (ventral and dorsal). Complete and fragmentary preforms, manufacturing rejects, projectiles or knives are included in this category.
>
> *Uniface*. A uniface only has evidence of use-wear on one side of the artifact. Unifacial artifacts include utilized flakes, end and side scrapers, and bladelets. However, bladelets are unifacial artifacts, typically categorized as blades or lamellar flakes, and are diagnostic of the Middle Woodland period.
>
> *Core*. A core represents the initial stage of chert procurement and reduction. A core has evidence of flake removal or checking present to delineate that the object has been culturally modified. Cores can be recovered from bedded outcrops or gathered from alluvial and glacial deposits.
>
> *Primary Decortication Flakes*. This flake type represents the initial reduction of a core. Generally, these flakes have a natural patina or cortex over most of the dorsal side and are void of other flake scars. Artifact assemblages with chert resources obtained from bedded resources usually do not have decortication flakes of any kind because there is no patina/cortex formation.
>
> *Secondary Decortication Flakes*. These flakes occur as a by-product of patina/cortex removal of a core. They are differentiated from the previous flake type by a lesser amount of cortex evident on the dorsal side and at least one or

part of one previous flake scar. These flakes have steep flake platform angles (greater than 75 degrees).

Primary Thinning Flakes. This flake type represents a transitional mode of chert reduction. The intent of this reduction activity is to reduce a core to a crude biface. Flakes have a steep platform angle (i.e., greater than 65 degrees) and lack cortex. However, occasional small remnants of cortex are prevalent at this point, especially on the striking platform.

Blocky Irregular. These are chunks and amorphous chert fragments that are produced during core reduction. These frequently occur during the creation of a striking platform or by accident. They represent a transitional core reduction stage similar to that of primary thinning.

Secondary Thinning Flakes. These flake types represent a reduction mode that is a direct result of the previous reduction activities (i.e., primary thinning). Soft, antler billet percussion and pressure flaking are used for this mode of reduction. At this point, the chert artifact being reduced or thinned is a biface rather than a core. The striking platform for this flake type is commonly represented by the edge of the biface. The platform angle is typically acute but can range from 30° to 65°. Previously removed flake scars are common on the dorsal side.

Broken Flakes. This flake type is common. Flakes for this investigation are considered broken when diagnostic attributes (e.g., flake scarring or platform) are absent from the artifact. Therefore, a flake that is broken in half and retains the platform is considered complete because the function can be ascertained regardless of its obvious fragmentary nature.

Sharpening flake. This type of debitage is produced during the creation of a finished edge or rejuvenation of an existing tool edge. It is created by pressure flaking rather than percussion. These flakes are typically small and have evidence of grinding and platform preparation near their striking platform. This flaking often produces small concoidal ripples in the chert centering on the striking platform.

Shatter or Angular Shatter. These artifacts most frequently occur during percussion flake reduction of cores. These artifacts lack striking platforms, are thin, narrow, and triangular. They cannot be definitively associated with a specific functional category of chert reduction due to their ubiquity.

Identification of the material type of individual artifacts is based on several attributes, including color, inclusions, and luster. Several resources were used to aid in the inventory of the material types, including Converse (1994), DeRegnaucourt and Georgiady (1998), and Stout and Schoenlaub (1945).

Historic Period Artifact Analysis

The artifacts recovered during these investigations will be inventoried and analyzed. The inventory will be specific to type and age if the artifact is temporally diagnostic. The functional inventory of the site will be similar to that of South (1977) where artifacts are segregated into categories such as kitchen, arms, architecture, and etcetera. South's theoretical approach also emphasizes the development and interpretation of artifact patterns found at sites. This method can be used to understand depositional patterning on the intra- and inter-site level. Ball (1984) modified this approach, making it applicable for use in the Ohio Valley.

Artifacts recovered from the subsurface testing will be inventoried and the results analyzed to identify differential patterning of functionally specific artifact groups within areas of high and low artifact density. The specific historic period temporal affiliation of the artifacts will be determined by relative dating. The identification of historic artifacts for purposes of determining age is guided by ceramic/artifact analyses or source books by Carskadden et al. (1985); Cushion (1980); Dalrymple (1989); Deiss (1981); Esary (1982); Ewins (1997); Greer (1981); Hughes and Lester (1981); Hume (1991); Lang (1995); Majewski and O'Brien (1987); Mansberger (1981); McConnell (1992); McCorvie (1987); Miller (1987); Newman (1970); Ramsay (1976); Sonderman (1979); Spargo (1926); Sprague (2002); Stelle (2001); Sunbury (1979); Sussman (1977); Visser (1997); and Zimler (1987).

Curation

A letter regarding the disposition of the cultural materials identified and collected during the field investigations for the Project was sent to participating landowners. At the time of this report, return letter(s) from the landowner(s) outlining the disposition of these materials had not been received. Notes and maps affiliated with this Project will be maintained by Weller.

Literature Review

The literature review study area is defined as the polygon that encompasses the overall limits of disturbance for a project and includes all recorded cultural resources that are within 1.6 km (1.0 mi) of the footprint of the planned development/construction activity. In conducting the literature review, the following resources were consulted at OHPO and the State Library of Ohio:

1) *An Archeological Atlas of Ohio* (Mills 1914);
2) OHPO United States Geological Survey (USGS) 7.5' series topographic maps;
3) Ohio Archaeological Inventory (OAI) files;
4) Ohio Historic Inventory (OHI) files;
5) National Register of Historic Places (NRHP) files;
6) OHPO consensus Determinations of Eligibility (DOE) files;

7) OHPO CRM/contract archaeology files; and
8) County atlases, histories, historic USGS 15'series topographic map(s), and current USGS 7.5' series topographic map(s).

A review of the *Atlas* (Mills 1914) was conducted and there are no relative resources indicated within the 1-mile Study Area.

There are no archaeological sites recorded within the Project Area or the 1-mile Study Area (Figures 2 and 3).

A review of the OHI files was conducted. The Ray German House (HAN0042105), which is located at 304 East Brown Road in Arcadia, is the only recorded resource within the 1-mile study area. This is a Bungalow style residence, located just south and west of the Project Area, which is circa 1920 (Figures 2 and 3).

A review of the NRHP files and OHPO consensus DOE files was conducted. There have not been any significant cultural resources identified within the Project Area or 1-mile study area.

A review of the CRM/contract files was conducted and there have not been any such surveys completed within the Project Area or the 1-mile study area.

Cartographic/atlas resources were reviewed for the Project Area to verify the locations of any buildings or structures that might be involved in this Project. Review of a late nineteenth century atlas (Figure 4) indicates that there are three structures within the Project Area. One of the buildings, associated with the Heistand parcel, is in the eastern part of his property. Buildings are noted on the J. Hosler, and N. Emerine properties (Hardesty 1875). Review of the USGS *1903 Findlay and 1901 Fostoria, Ohio 15 Minute Series (Topographic)* maps were reviewed (Figure 5). This resource indicated that there are likely some residences/buildings within the Project Area. Some of the locations where buildings are noted are actually cutouts from the Project. Still, it appears that there are about three buildings in or very near the Project Area from the early part of the twentieth century.

There are two cemeteries that are indicated within the 1-mile study area (Figures 2 and 3) - the Arcadia and Wells Cemeteries. Neither of these resources are located within or immediately adjacent to the Project Area.

Evaluation of Research Questions 1 and 2

There were two questions presented in the research design that will be addressed at this point. These are:

1) Did the literature review reveal anything that suggests the Project Area had been previously surveyed?

2) Are cultural resources likely to be identified during these investigations?

There were very few recorded cultural resources within the Project Area or the 1-mile Study Area. There were no archaeological sites recorded and only one architectural resource; no significant sites were noted. The Project Area is located in an upland till plain area that is just south of a noteworthy beach ridge. A tributary of the Portage River cuts through the Project Area. Areas along this drainage and near the area where the beach ridge is bisected by the stream would be expected to have increased/repeated prehistoric period activity. The Project Area is less diverse and has topographic conditions that are nearly level to very gently undulating. A high percentage (about 33%) of the overall area contains Pewamo series soils, which are poorly drained and prone to flooding. These are not regarded as being desirable locations for habitation or historic period activity/buildings. Inspection of cartographic maps and atlases suggest that it is likely that historic period former or extant residential archaeological deposits would be identified during these investigations.

Based on the results of the literature review, terrain, proximity to drainages/streams, and the upland nature of the overall setting, it is not expected that any dense prehistoric period deposits would be identified. Prehistoric activity in this type of setting would be expected to be reflective of logistical, short-termed to transient foraging behavior. This would dictate sites with few artifacts and a high amount of tool forms versus manufacturing debris.

Archaeological Fieldwork Results

The field investigations for this Project were completed in April 2021 (Figures 6-37). The work was conducted during suitable weather conditions, which occasionally required delays in the work to avoid over-saturated or snow-covered situations. Generally, surface collection methods of investigation are conducted whenever possible; for this Project, surface collection methods accounted for the entire Project Area. The survey was conducted in several agricultural fields, which are not completely contiguous. These investigations resulted in the identification of 21 previously unrecorded archaeological sites, 33HK0944 through 33HK0964; however, site 33HK0960 is located outside of the current Project Area.

The field investigation for this Project involved several agricultural fields located north, northwest, and northeast of the Village of Arcadia. Collectively, these areas are all contained in somewhat generic upland till plain conditions and are without any major drainages or valleys intercepting them. The South Branch Portage River does cross through the Project Area. The landscape through the Project Area is nearly flat to having slight elevations or rises; there are no steep slopes. The setting is consistent with lowly populated farming conditions. The survey was conducted in parts of Sections 17, 18, 19, and 20 of Washington Township.

Surface collection methods of archaeological sampling were conducted throughout the Project Area. Weller's field investigations were benefited by the time of year, early spring, when previously harvested fields are afforded an opportunity to weather. Another benefit is that any associated winter wheat fields were still immature and surface visibility was suitable for surface collection. This also occurs prior to the spring planting season, so the damage to crops is essentially negated. The surface collection conditions within the Project Area involved soybean stubble fields, corn stubble fields, winter wheat fields, and tilled field conditions (Figures 6-20). All of these situations offered at least 50 percent bare ground surface visibility. Pedestrian transects were spaced at approximately 10-m intervals throughout these areas. However, once any cultural materials were identified, the transect intervals were reduced to 2-m intervals to identify additional and diagnostic materials. All 21 sites identified during these field investigations resulted from pedestrian surface collection survey.

The 21 identified archaeological sites include historic and prehistoric period deposits and each site is treated somewhat differently based upon identification and collection strategies. The sites were all plotted with GPS to get accurate locational data. Individual prehistoric period artifacts are plotted, accordingly. Historic period site locations have the perimeter of the scatter plotted. Artifacts that are contained within a defined polygon are collected strategically with a focus of diagnostic materials and materials that may indicate a habitation versus discard or trash disposal. The following is a description of the sites that were identified during the field investigations for the Project.

Archaeological Site Descriptions

Weller identified 21 previously unrecorded archaeological sites (33HK0944 through 33HK0964), which include prehistoric and historic period components. There were no artifacts identified from 33HK0964. The following sections describe the artifacts (Table 2), sites, context, the materials identified/collected, and evaluates them regarding their individual site significance.

Table 2. Artifact Inventory for Sites 33HK0944 through 33HK0963.

Site	Bag	Artifact	Material	Count
33HK0944	1	Plain Whiteware		1
		Whiteware		1
		Clear Bottle Glass		3
		Blue Green Canning Jar Glass		1
		Flint Colored Glass		1
		Apothecary Bottle Frag		1
33HK0945	2	Primary Thinning Flake	Glacial	1
33HK0946	3	Primary Thinning Flake	Columbus Delaware	1
33HK0947	4	Brewerton Corner Notched	Pipe Creek	1
33HK0948	5	Stanly Stemmed	Pipe Creek	1
33HK0949	6	Big Sandy	Upper Mercer	1
33HK0950	7	Ledbetter Stemmed	Cedarville-Gulph	1
33HK0951	8	Utilized Flake	Upper Mercer	1

Table 2. Artifact Inventory for Sites 33HK0944 through 33HK0963.				
Site	**Bag**	**Artifact**	**Material**	**Count**
33HK0952	9	Hafted Distal Biface Frag	Pipe Creek	1
33HK0953	10	Kirk Serrated	Columbus-Delaware	1
33HK0954	11	Plain Whiteware		1
		Porcelain		2
		BOYD'S Canning Jar Seal		1
		Brown Bottle Glass		1
		Clear Bottle Glass		2
		Blue Green Bottle Glass		3
		Melted Glass		1
33HK0955	12	Utilized Flake	Upper Mercer	1
33HK0956	13	Graham Cave Side Notched-like	Glacial	1
33HK0957	14	Primary Thinning Flake	Upper Mercer	1
33HK0958	15	Stoneware		1
		Porcelain		1
		Porcelain		1
		Plain Whiteware		1
		Clear Bottle Glass		1
		Depression Glass		1
		Molded Glass		2
		Pane Glass		1
33HK0959	16	Stoneware		5
		Brick Fragment		1
		Plain Whiteware		3
		Opaque Glass		1
		Canning Jar Porcelain Seal		3
		Blue Green Bottle Glass		4
		Amethyst Bottle Glass		3
		Amethyst Bottle Top		1
33HK0960	17	Blue Edge Whiteware		1
		Transfer Print		1
		Plain Whiteware		4
		Stoneware		2
		Molded Opaque Glass		1
		Canning Jar Seal		1
		Ceramic Bottle Top Cork		1
		Flint Cork Bottle Top		1
		Amethyst Bottle Top		1
		Blue Green Bottle Glass		6
		Clear Bottle Glass		1

Table 2. Artifact Inventory for Sites 33HK0944 through 33HK0963.				
Site	**Bag**	**Artifact**	**Material**	**Count**
		Amethyst Bottle Glass		2
		Melted Glass		1
		Carbon Battery Rod		1
		Cut Animal Bone		1
		Partial Harmonica Plate		1
33HK0961	18	Plain Whiteware		1
		Green Slipware		1
		Stoneware		2
		Drainage Tile Fragment		1
		Opaque Glass		2
		Canning Jar Seal		2
		Green Depression Glass		1
		Cobalt Glass		4
		Green Bottle Glass		2
		Blue Green Bottle Glass		2
		Clear Bottle Glass		5
		Clear Bottle Glass Screw Top		3
33HK0962	19	Stoneware		2
		Opaque Glass		1
		Clear Bottle Glass		1
		Amethyst Bottle Glass		2
		Green Bottle Glass		1
		Clear Bottle Glass Tops		2
		Amethyst Bottle Top		1
33HK0963	20	Secondary Thinning Flake	Upper Mercer	1

33HK0944

This is a historic period artifact scatter that was identified during surface collection of a tilled field (Figure 15). The bare ground surface visibility within the field ranged from 70 to 90 percent. This site is located in the Northeast Quarter of Section 20 of Washington Township, immediately south of the CR 109 right-of-way. This area is drained by an unnamed tributary of South Branch Portage River and is part of the Portage River Watershed. The dimensions of this site are 23 m north-south by 28 m east-west; the site size is considered to be 439 sq m.

Atlas and cartographic resources were consulted to add context to the site. This area was owned by J. Heistand in the late nineteenth century, but there are no houses indicated. There are no buildings indicated in the area according to modern topographic maps or those that date from the early twentieth century.

There were eight historic period artifacts identified from this site (Figure 40; Table 2). These appear to be indicative of the late nineteenth to early twentieth century. However, many of these artifacts are temporally generic and have manufacturing dates that span multiple historic periods. An apothecary bottle fragment that was identified from the site is indicative of the late nineteenth century (Newman 1970). The entire assemblage is indicative of kitchen-related materials and is interpreted as being reflective of a secondary/trash deposition.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; U.S. Department of the Interior, National Park Service [USDI, NPS] 1997:44-45) and the ability to yield further and important information regarding the history of area/region. The site appears to be a secondary deposition or trash deposit within a tilled field. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0945

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 16). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 80 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Northwest Quarter of Section 20 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by the South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, this site is considered to be 1 sq m in size.

The artifact that was identified from this site is a flake of Glacial chert (Table 2). This is functionally indicative of core reduction activity. This is not considered to be temporally diagnostic.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0946

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 19). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 80 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Northwest Quarter of Section 20 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is a flake of Columbus-Delaware chert (Table 2). This is functionally indicative of core reduction activity. This is not considered to be temporally diagnostic.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0947

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 15). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 70 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Southeast Quarter of Section 17 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is the majority of a Brewerton Corner Notched point (Figure 39; Table 2). This finished tool was manufactured from Pipe Creek chert. The blade edges are convex and refined with a plano-biconvex cross-section. The notches are shallow and form slight barbs at the shoulders. The base is fragmented but is slightly expanding. The size and characteristics suggest it formerly functioned as a projectile point. Brewerton points date from the Late Archaic Laurentian Tradition from about 3000-1700 BC (Justice 1987:115).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0948

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 15). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 70 percent. Pedestrian transects were reduced to 2 m intervals to verify the isolation of this artifact. The site is located in the

Southeast Quarter of Section 17 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River. This is part of the Portage River watershed and flows northerly to Lake Erie As an isolated find, the site is considered to be 1 sq m in size.

A nearly complete Stanly Stemmed point was identified from this site (Figure 39; Table 2). This was manufactured from striped Pipe Creek chert. The blade edges are nearly straight and evidence reworking. The blade is plano-biconvex. The stem and base, including the bifurcation, are heavily ground. Based on the edge treatment, this artifact appears to have functioned as a projectile point. Stanly Stemmed points date from the Early Archaic period from about 5800-5500 BC (Justice 1987:97).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0949

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 15). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 70 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Southeast Quarter of Section 17 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

This site is represented by the proximal majority of a Big Sandy point (Figure 39; Table 2). This tool was manufactured from Upper Mercer chert. The blade edges are irregular and slightly convex, they also evidence fine and/or worn serrations. The cross-section is plano-biconvex. The side notches are shallow and form slight barbs at the shoulders. The expanding base is not ground. Based on the edge wear traits, this likely functioned as a hafted knife. Big Sandy points date from the Early Archaic period from about 8000-6000 BC (Justice 1987:61).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0950

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 15). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 70 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Southeast Quarter of Section 17 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is the proximal portion of a Ledbetter Stemmed point (Figure 39; Table 2). This was manufactured from Cedarville-Guelph chert. The blade edges are straight and retouched. The blade cross-section is plano-biconvex. The shoulders are slight. The stem and the slightly expanding base are not ground. Based on the size, symmetry, and edge treatment, this artifact was likely used as a projectile point. This Ledbetter Stemmed points date from the Late Archaic period from about 2500-1000 BC (Justice 1987:150).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0951

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 12). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 70 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Southwest Quarter of Section 17 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is a utilized flake of Upper Mercer chert (Table 2). This type of unifacial artifact is most commonly attributed to use as an expedient cutting tool. These are not regarded as being temporally diagnostic.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0952

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 12). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 80 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Southeast Quarter of Section 18 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

This site is represented by the distal portion of a hafted biface that was manufactured from gray Pipe Creek chert (Table 2). This tool was fractured just below the shoulders. The blade is straight and finely serrated. The cross-section is plano-biconvex. One of the blade edges has been beveled. This artifact may have been used as a projectile point or a knife in the past. It is not regarded as being temporally diagnostic as it is too fragmented.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0953

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 12). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 80 percent. Pedestrian transects were reduced to 2 m intervals to verify the isolation of this artifact. The site is located in the Southeast Quarter of Section 18 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

This site is represented by the proximal portion of a Kirk Serrated point (Figure 39; Table 2). This was manufactured from Columbus-Delaware chert. The blade is slightly rhomboid in cross-section and is slightly beveled. One blade edge is heavily serrated and the other is straight but without serrations. The shoulders are prominent and at 90-degree angles. There is a fracture in the central part of the base. However, there is grinding evident in the shoulders, along the stem, and to the base. This artifact would have formerly functioned as a knife based on its size and differing edge treatment/use. Kirk points date from the Early Archaic period from about 7500-6900 BC (Justice 1987:71).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0954

This is a historic period artifact scatter that was identified during surface collection of a soybean stubble field (Figure 18). The bare ground surface visibility at the time of survey ranged from 70 to 90 percent. The artifacts were identified from an upland area that is in the Northwest Quarter of Section 19, Washington Township. This is north of CR 218 and west of CR 257. This is in an upland till plain area, slight rise that is drained by South Branch Portage River, which is part of the Portage River watershed and empties into Lake Erie. The dimensions of the site are 12 m north-south by 13 m east-west; the site is considered to be 114 sq m in size.

Atlas and cartographic maps were reviewed to establish previous ownership and context. In the late nineteenth century, this was on the M. Snyder property and there are no buildings indicated in that area at this time (Hardest 1875). There were no buildings indicated in this area according to early twentieth century and modern topographic maps.

There were 11 historic period artifacts identified from this site (Figure 41; Table 2). These are all affiliated with kitchen-related materials and many are too generic or temporally homogenous to be assigned a specific historic period component. Bottle and jar glass are the majority of the artifacts and these appear to date from the early to middle part of the twentieth century. A portion of a BOYD's canning jar seal from the site indicates it post-dates 1871 manufacture (Whitten 2021). The blue-green bottle glass is indicative of a canning jar. The materials appear to date from the late nineteenth to early twentieth centuries. All of the artifacts that were identified from this site are associated with kitchen-related items; this may be regarded as a secondary trash disposal site (Ball 1984).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0955

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 18). At the time of survey, the bare ground surface visibility in the field ranged from 70 to 90 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the

Northwest Quarter of Section 19 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is a utilized flake of Upper Mercer chert (Table 2). This type of unifacial artifact is most commonly attributed to use as an expedient cutting tool. These are not regarded as being temporally diagnostic.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0956

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 8). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 80 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Northeast Quarter of Section 17 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

A nearly complete Graham Cave Side Notched-like point was identified from this site (Figure 39; Table 2). This was manufactured from Glacial chert. The blade has a cross-section that is slightly rhomboid, which reflects the slight beveling near the tip. One blade edge is straight, the other is convex with serrations on both sides. The side notches are broad, but relatively shallow and form slight shoulders. There is some fracturing at the base, but it is clearly concave with at least one slightly protruding ear. This artifact would have been used as a hafted knife. Graham Cave Side Notched points date from the Early Archaic period from 8000-5500 BC (Justice 1987:64).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0957

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 13). At the time of survey, the bare ground surface visibility in the field ranged from 60 to 70 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Southeast Quarter of Section 17 of Washington Township. The site was identified from a nearly area that is in till plain conditions. This site is drained by an unnamed tributary of South Branch Portage River and it is immediately south of this stream. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is a flake of Upper Mercer chert (Table 2). This is functionally indicative of core reduction activity. This is not regarded as being temporally diagnostic.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0958

This is a historic period artifact scatter that was identified during surface collection of a soybean stubble field (Figure 6). The bare ground surface visibility at the time of survey ranged from 60 to 80 percent. The artifacts were identified from an upland area that is in the Southeast Quarter of Section 8, Washington Township. This is north of CR 218 and west of CR 257. This is in an upland till plain area that is drained by South Branch Portage River, which is part of the Portage River watershed and empties into Lake Erie. The dimensions of the site are 22 m north-south by 31 m east-west, the site is considered to be 543 sq m in size.

Atlas and cartographic maps were reviewed to establish previous ownership and context. In the late nineteenth century, this was on the H. Myers property and there are no buildings indicated at this time (Hardest 1875). There were no buildings indicated in this area according to early twentieth century and modern topographic maps.

There were nine historic period artifacts identified from this site (Figure 42; Table 2). These are mostly affiliated with kitchen-related materials and many are too generic or temporally homogenous to be assigned a specific historic period component. The lone artifact that is not associated with kitchen-related materials is a pane glass fragment, which is architectural hardware. The presence of stoneware, porcelain, and whiteware (along with the other artifacts) are not aberrant with early to middle twentieth century manufacture. A light green shard of Depression glass was identified that dates from the middle twentieth century (Newman 1970). The blue-green bottle glass is indicative of a canning jar. The materials appear to date from the late nineteenth to early twentieth centuries. All of the artifacts that were identified from this site are associated with kitchen-related items; this may be regarded as a secondary trash disposal site (Ball 1984).

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0959

This is a historic period artifact scatter that was identified during surface collection of a soybean stubble field (Figure 6). The bare ground surface visibility at the time of survey ranged from 60 to 80 percent. The artifacts were identified from an upland area that is in the Southeast Quarter of Section 8, Washington Township. This is north of CR 218 and west of CR 257. This is in an upland till plain nearly level area that is drained by South Branch Portage River, which is part of the Portage River watershed and empties into Lake Erie. The dimensions of the site are 47 m north-south by 45 m east-west, the site is considered to be 1,421 sq m in size.

Atlas and cartographic maps were reviewed to establish previous ownership and context. In the late nineteenth century, this was on the H. Myers property and there are no buildings indicated at this time (Hardest 1875). There were no buildings indicated in this area according to early twentieth century and modern topographic maps.

There were 18 artifacts identified from this site (Figure 43; Table 2). These are all consistent with kitchen-related artifacts which suggests this is indicative of a secondary/trash disposal area. There is one artifact, a machine-made brick fragment, that is indicative of architectural hardware. The assemblage appears to date from around 1900 as the bottle glass fragments have seams (i.e., post-1865) and machined cork tops (Newman 1970). The presence of stoneware and whiteware are temporally homogeneous.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0960

This site was encountered within a now abandoned portion of the Project Area. It is a historic period artifact scatter that was identified during surface collection of a tilled field exhibiting 80 to 100 percent visibility and winter wheat exhibiting 60 to 80 percent visibility. The site is located in the Southeast Quarter of Section 20 of Washington Township and is east of Arcadia. The site is located on a slight upland rise that is drained by the South Branch Portage River. This is part of the Portage River watershed and empties into Lake Erie. The dimensions of the site are 110 m north-south by 112 m east-west, the site is considered to be 7,238 sq m in size.

Atlas and cartographic maps were consulted to assist in determining context. The H. Ebersole residence is indicated at this location dating from the late nineteenth century (Hardesty 1875; Figure 38). Review of the early twentieth century topographic map indicates that there was a house in the vicinity. There are no buildings indicated according to modern topographic mapping.

There were 26 artifacts identified from this site (Figure 44; Table 2) and the majority are affiliated with kitchen-related materials. There was one sherd of blue edge whiteware and a transfer print sherd identified, which have a manufacture date that is pre-1865 (Majewski and O'Brien 1987; Miller 1980). Other artifacts that likely date from the nineteenth century include bottle tops that would have been corked, but these have apparent seams which indicate post-1865 manufacture (Newman 1970).

An artifact indicative of the food category would be the cut animal bone that was identified. This is from a large bone and is likely swine or bovine. Indicative of the energy category is part of a carbon battery rod. There was one artifact that is considered as a personal item, a metal harmonica plate fragment. This has rectangular holes that facilitate the sound and a fastening hole. These likely date from the late nineteenth to early twentieth century (Figure 44).

There was one artifact that was recovered that is indicative of architectural hardware, a brick fragment. This appeared to be manufactured rather than locally made, which would date it to the latter part of the nineteenth century (Greer 1980). Other brick fragments were noted at the site but not collected as they offer little intrinsic value beyond their recognition and type.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0961

This is a historic period artifact scatter that was identified during surface collection of a corn stubble field (Figure 11). The bare ground surface visibility at the time of survey ranged from 60 to 80 percent. The artifacts were identified from an upland area that is in the Northwest Quarter of Section 18, Washington Township. This site was identified from a nearly flat to low-lying upland landform that is drained by South Branch Portage River; this is part of the Portage River watershed and drains to Lake Erie. The dimensions of the site are 20 m north-south by 52 m east-west, the site is considered to be 682 sq m in size.

Atlas and cartographic maps were reviewed to establish previous ownership and context. In the late nineteenth century, this was on the J. Hosler property and there are no buildings indicated at this time in that area (Hardest 1875). There were no buildings indicated in this area according to early twentieth century and modern topographic maps.

There were 26 artifacts identified from this site (Figure 45; Table 2). There is a drainage tile fragment recovered that is indicative of how poorly drained this area is. The remainder of the assemblage is entirely affiliated with Kitchen-related artifacts; which is considered to be indicative of secondary/trash disposal (Ball 1984). Such as deposit is typically only as old as the most recently manufactured artifact(s) that are within it, especially from plowed contexts. The identification of cobalt glass, opaque glass, screw-top bottle fragments, and Depression glass all are consistent with a middle twentieth century deposit (Ramsay 1969; Newman 1970). The remainder of the assemblage can date from the nineteenth to twentieth century.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0962

This is a historic period artifact scatter that was identified during surface collection of a soybean stubble field (Figure 18). The bare ground surface visibility at the time of survey that was 80 percent. The artifacts were identified from an upland area that is in the Northeast Quarter of Section 19, Washington Township. This is to the south of CR 109 and is northwest of the Community of Arcadia. The dimensions of the site are 21 m north-south by 15 m east-west, the site is considered to be 203 sq m in size.

Atlas and cartographic maps were reviewed to establish previous ownership and context. In the late nineteenth century, this was on the A. Peters property and there are no buildings indicated at this time in that area (Hardest 1875). There were no buildings indicated in this area according to early twentieth century and modern topographic maps.

There were 10 artifacts identified from this site (Figure 46; Table 2). These are all indicative of kitchen-related artifacts and it is likely that these are affiliated with a secondary, trash deposit (Ball 1984). The bottle tops that were identified have seams and machined tops. The identification of opaque or milk glass is generally indicative of an early to middle twentieth century manufacture. The materials appear to be affiliated with the early to middle twentieth century.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0963

This site is an isolated prehistoric period artifact that was identified during surface collection of a soybean stubble field (Figure 18). At the time of survey, the bare ground surface visibility in the field that was 80 percent. Pedestrian transects were reduced to 2-m intervals to verify the isolation of this artifact. The site is located in the Northwest Quarter of Section 19 of Washington Township. The site was identified from a slight upland rise in till plain conditions. This site is drained by the South Branch Portage River. This is part of the Portage River watershed and flows northerly to Lake Erie. As an isolated find, the site is considered to be 1 sq m in size.

The artifact that was identified from this site is a flake of Upper Mercer chert (Table 2). This is functionally indicative of bifacial reduction activity. This is not considered to be temporally diagnostic.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; U.S. Department of the Interior, National Park Service [USDI, NPS] 1997:44-45) and the ability to yield further and important information regarding the prehistory of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

33HK0964

This site is a historic period scatter that was identified during surface collection of a tilled field (Figure 15). The bare ground surface visibility within the field ranged from 70 to 90 percent. This site is located in the Northwest Quarter of Section 20 of Washington Township. This is to the east of CR 254 and is south of CR 109. This area is drained by an unnamed tributary of South Branch Portage River and is part of the Portage River watershed. This eventually empties into Lake Erie. The dimensions of the site are 13 m north-south by 38 m east-west, the site size is considered to be273 sq m.

There were no artifacts collected from this site as they consisted only of fragmented bricks and glass. These were not collected as they would offer little information beyond their locational data. There are no buildings indicated in this area according to the reviewed atlas and cartographic map data. This site appears to be affiliated with a secondary trash disposal possibly affiliated with a former building that was situated elsewhere.

This site was evaluated for its eligibility for the NRHP. This site lacks integrity (Little et al. 2000:39-43; USDI, NPS 1997:44-45) and the ability to yield further and important information regarding the history of the area and region. It also has a functionally and numerically limited artifact assemblage. This site is not considered to be eligible for inclusion into the NRHP, and further work at this site is not deemed necessary.

Fieldwork Summary

These field investigations resulted in the identification of 21 previously unrecorded archaeological sites, 33HK0944 through 33HK0964 (Figure 47; Table 2), including 13 prehistoric period components and eight historic period deposits. For the most part, the historic period deposits align with former residential locations or are indicative of dubiously related field trash or secondary deposition. Such sites are somewhat common in poorly drained upland areas.

There were 13 prehistoric period sites identified during these field investigations (33HK0945-953, 955-957, and 963). All of these sites are considered to be isolated finds. The collective assemblage includes four artifacts that are flakes/debitage and nine that are tool forms; that is, 69 percent of the prehistoric period artifacts are tools. This is very telling regarding the former prehistoric period land use in the surveyed areas. Low amount of artifacts/site, high functionality, and a high ratio of tools versus flakes have all been characteristics that are consistent with logistical foraging strategies. These are inherently indicative of short-termed to transient hunting-foraging behavior (Binford 1980). These results are consistent with what would be expected from this setting and was anticipated prior to these investigations.

The prehistoric temporal period represented and the chert materials were recognized. There were six artifacts that are regarded as being temporally diagnostic. There were four Early Archaic and two Late Archaic period artifacts identified from this project area. Interestingly, there were no Woodland period artifacts identified and this may have broader implications regarding Woodland period land use and settlement. Also, nearly half of all the prehistoric period artifacts identified are temporally diagnostic, that is a very high ratio relative to manufacturing debris and any assemblage where all of the prehistoric artifacts are collected.

There is diversity to the types of chert materials that were identified during survey of this area. There were 13 artifacts and all are of some type of chert. Pipe Creek chert outcrops in north-central Ohio and it would be presumed to be the most common chert type encountered, its probably about 18.6 km (30 mi) from where it outcrops. This is the most reliable known chert source in the area; however, other cherts like Onondaga or Glacial types can be gathered from float sources. There were five different chert types identified during these investigations including: Columbus-Delaware (n=2), Cedarville-Guelph (n=1), Upper Mercer (n=5), Pipe Creek (n=3), and Glacial (n=2). The majority of the chert is of Upper Mercer, which is a good quality chert that is derived from the Coshocton County region in Ohio that is to the southeast of the project area about 150 km. The second most common chert type is that of the local variety, Pipe Creek. The percentages and types of materials identified during these investigations are not aberrant to expectations. However, since this is a small sample, it can change noticeably with the addition of more sites/materials data.

The methodology for field investigations sufficiently identified the types of prehistoric activity that was common in this area. Weller was limited in their survey to the Project Area, specifically those areas in upland conditions that do not have very diverse or dynamic topographic or relief. There is a small, named stream that bisects the Project Area; however, this is not a natural easement that is bordered by the Project Area. It would be expected that evidence for more intensive and/or repeated prehistoric period land use would be located on elevations lining this drainage. Additionally, the Project Area is located about 1.5 miles south of a long, pronounced linear beach ridge formation. This extension landform is sandy, relatively dry, elevated, and is the boundary definition between till plain conditions and the Lake Plain. This is another terrain feature where prehistoric period material is considered to be more likely. The Project Area is contained in comparably generic upland conditions where intensive, repeated, and habitation types of materials would be expected. The survey results exemplify this supposition.

APE Definition and NRHP Determination

The Area of Potential Effect (APE) is a term that must be applied on an individual project basis. The nature of the project or undertaking is considered in determining the APE. This may include areas that are off the property or outside of the actual project's boundaries to account for possible visual impacts. When construction is limited to underground activity, the APE may be contained within the footprint of the project area. The archaeological APE for this Project includes the proposed footprint of the Project and a limited area surrounding it (the Project Area). Plans for the Project Area include the construction and operation of a photovoltaic solar facility and related components.

There were 21 previously unrecorded archaeological sites identified, 33HK0944-964 (Figure 47). Though 33HK0960 is outside of the current Project, it was still evaluated. None of these sites are considered to be significant and they would not be regarded as being eligible for the NRHP; they are not landmarks. There are no significant archaeological resources within the Project Area.

Recommendations

In April 2021, Weller & Associates, Inc. (Weller) completed Phase I Archaeological Investigations for the approximately 404.7 ha (1,000 ac) South Branch Solar Project (the Project), a photovoltaic solar facility proposed in Washington Township, Hancock County, Ohio. These investigations involved intensive surface collection and visual inspection through various agricultural field situations that account for the Project Area. These investigations identified 21 previously unrecorded archaeological sites (33HK0944 through 33HK0964) with 33HK0960 being outside of the Project Area. None of these sites are considered to be significant and they are not regarded as landmarks. No further archaeological work is considered to be necessary for the Project.

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Figures

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Figure 1. Political map of Ohio showing the approximate location of the Project Area.

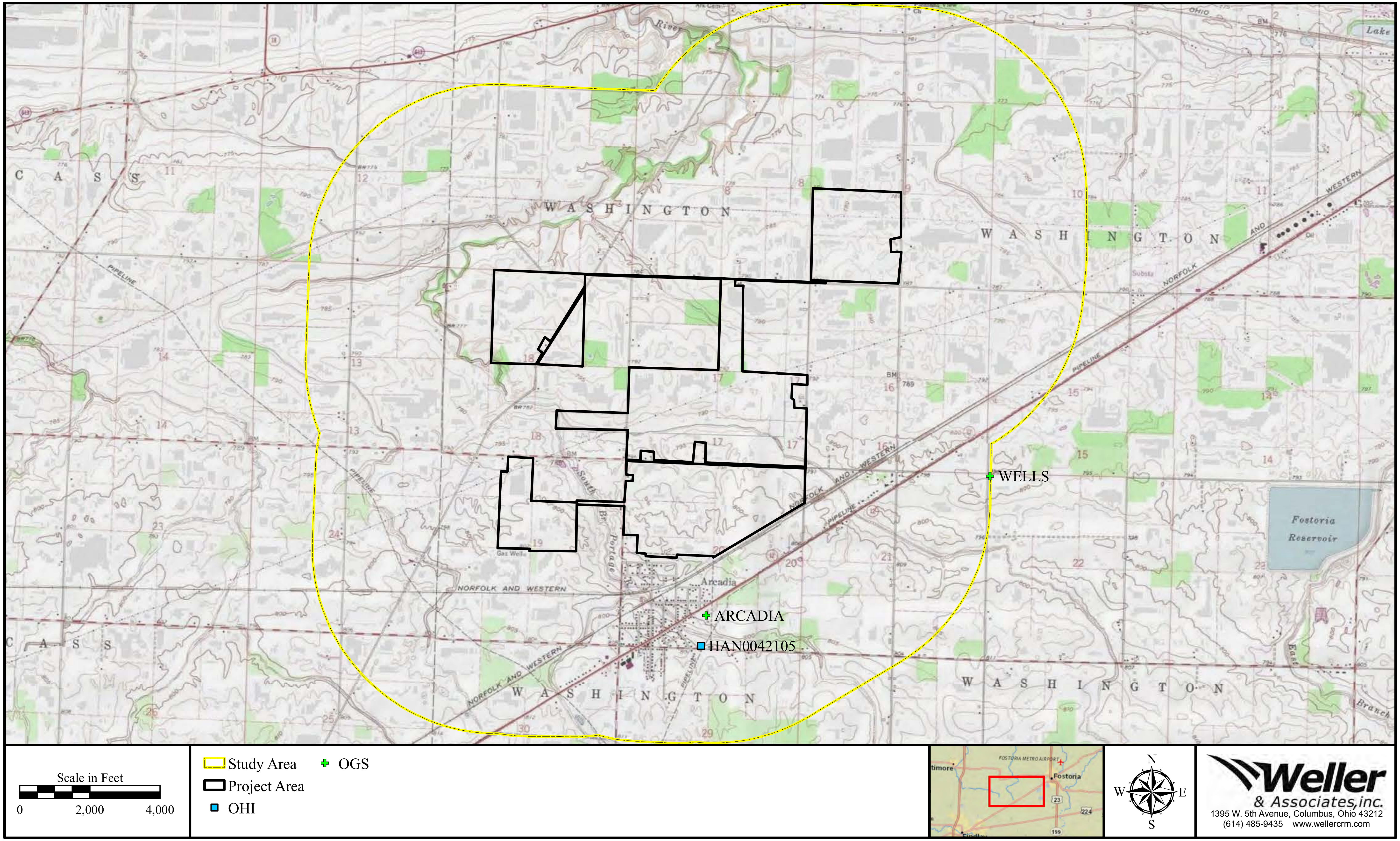


Figure 2. Portions of the USGS *1988 Bloomdale, 1977 Fostoria, 1977 Arcadia, and 1988 Alvada, Ohio 7.5 Minute Series (Topographic)* map indicating the location of the Project Area and recorded resources in the 1-mile Study Area.

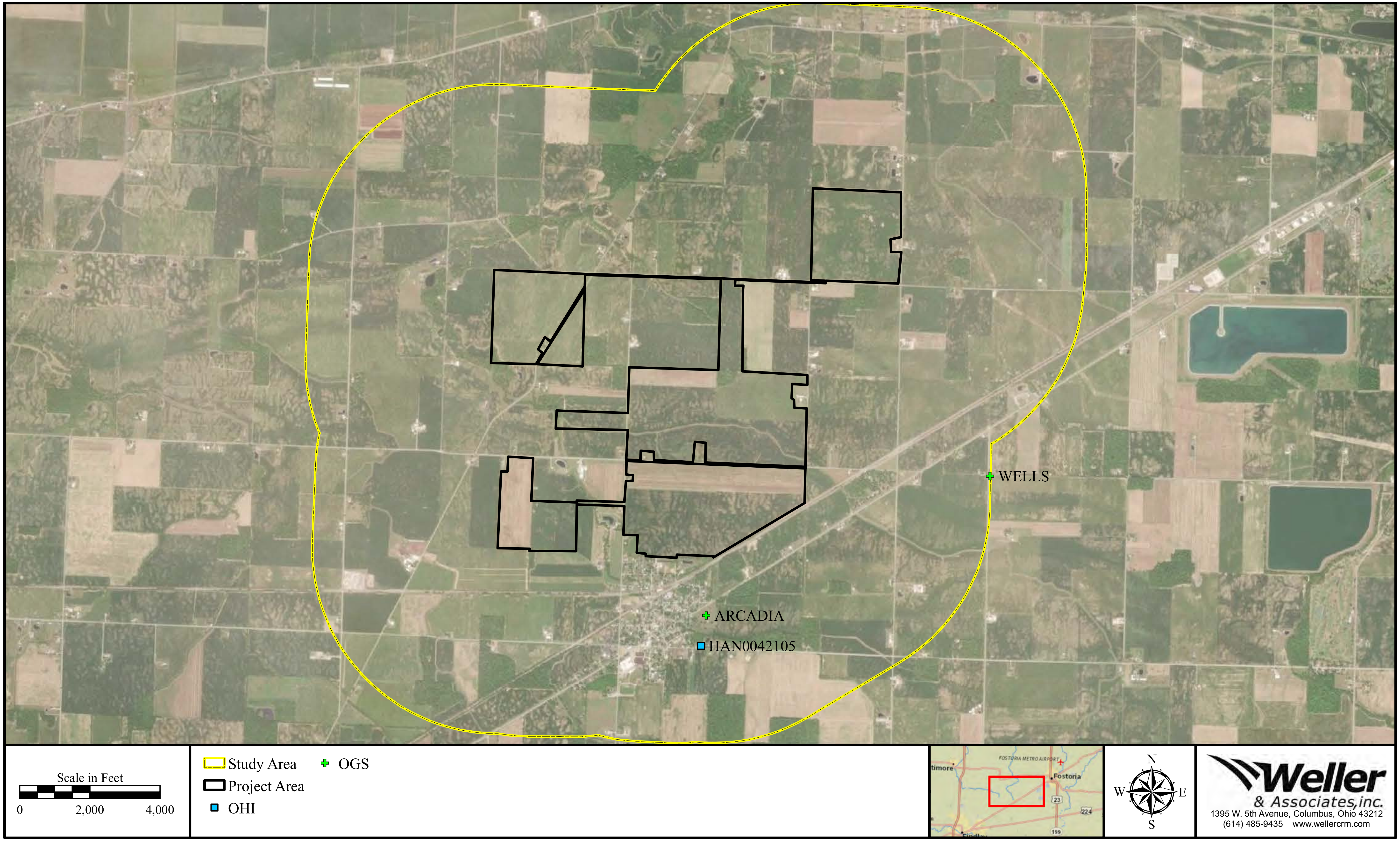


Figure 3. Aerial map indicating the location of the Project Area and recorded resources within the 1-mile Study Area.

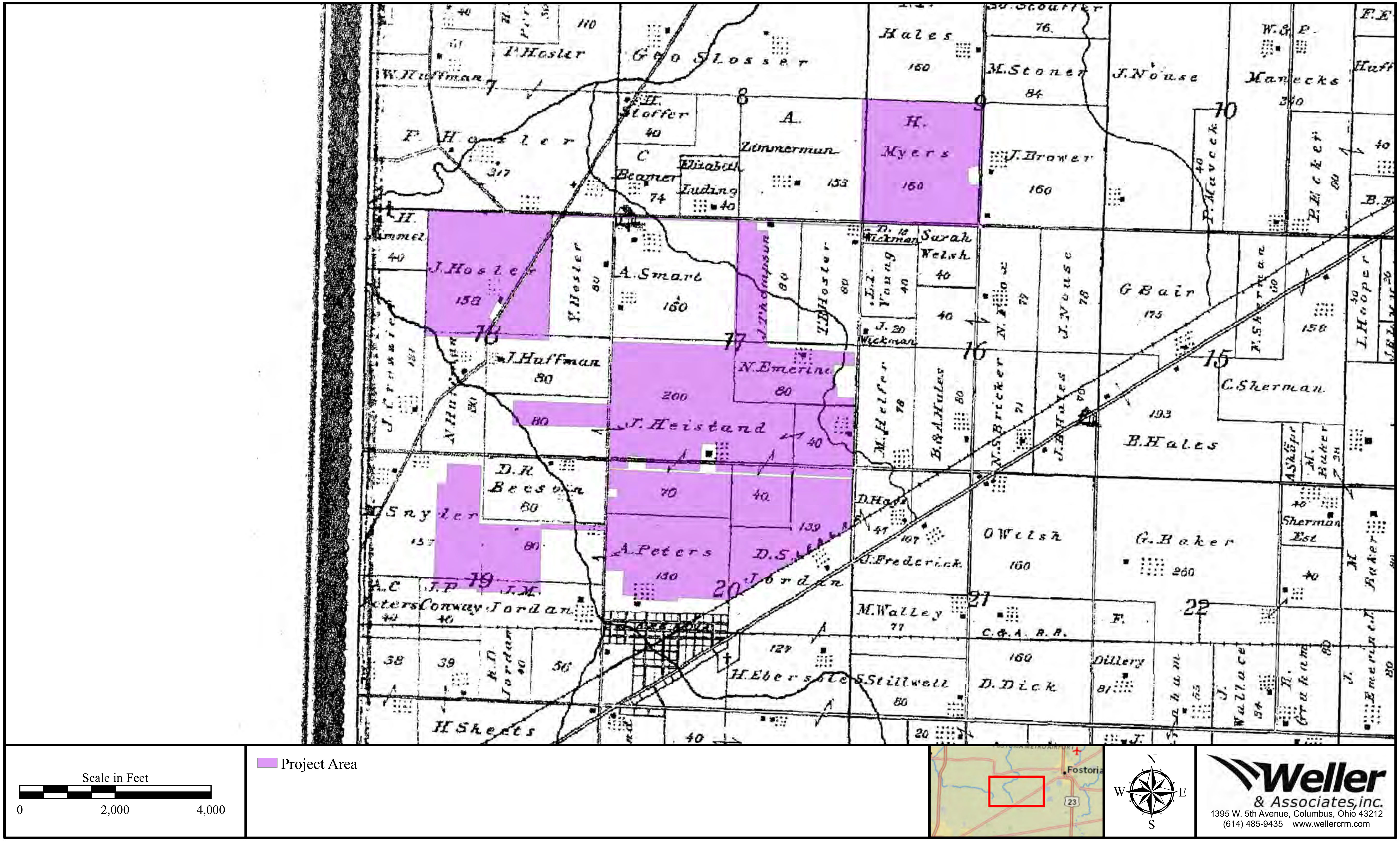


Figure 4. Portion of the *Illustrated Historcal Atlas of Hancock County, Ohio* (Hardesty 1875) indicating the approximate location of the Project Area.

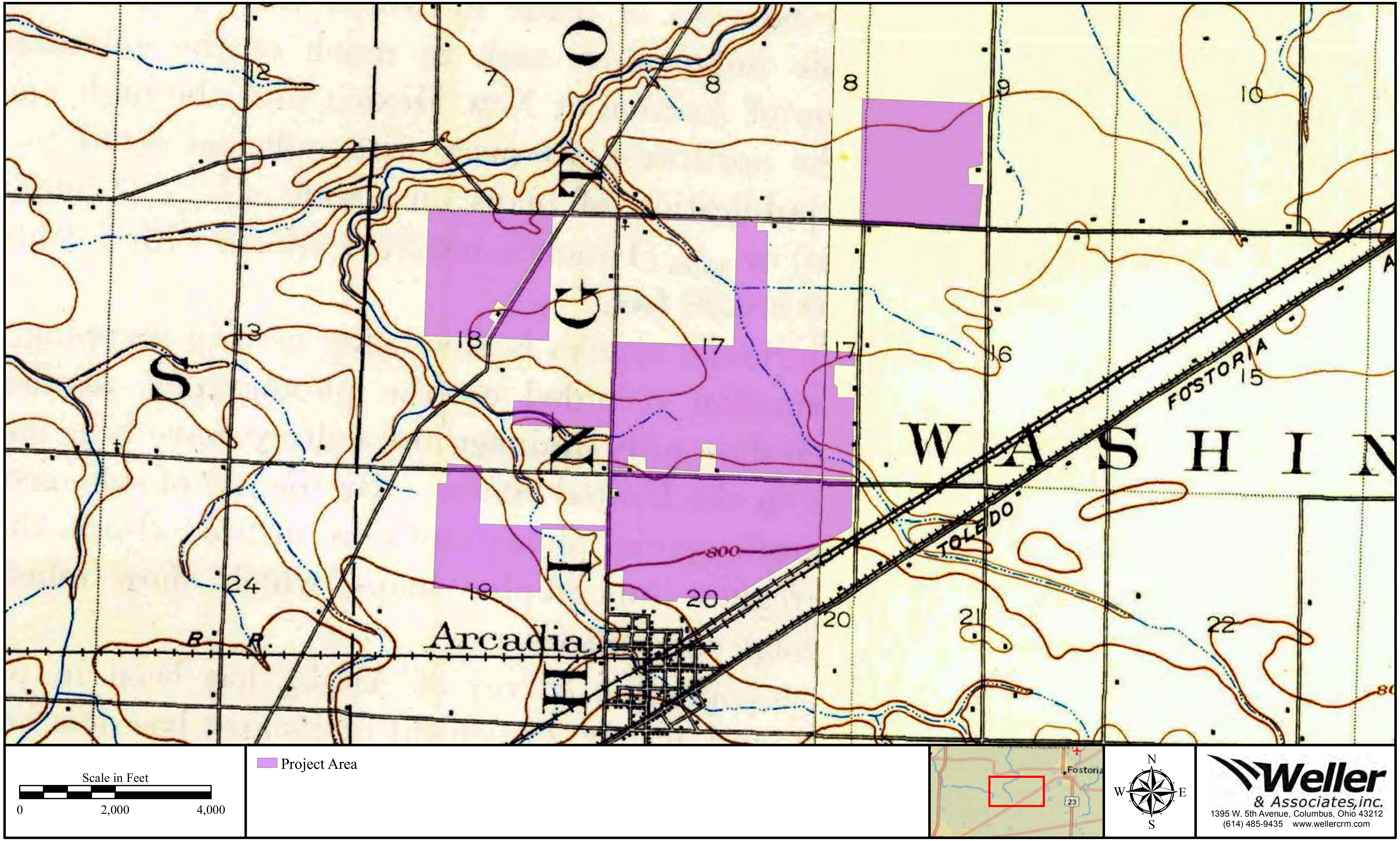


Figure 5. Portions of the USGS *1903 Findlay and 1901 Fostoria, Ohio 15 Minute Series (Topographic)* maps indicating the approximate location of the Project Area.

Figure 6. Fieldwork results and photo orientation map.

Figure 7. Fieldwork results and photo orientation map.

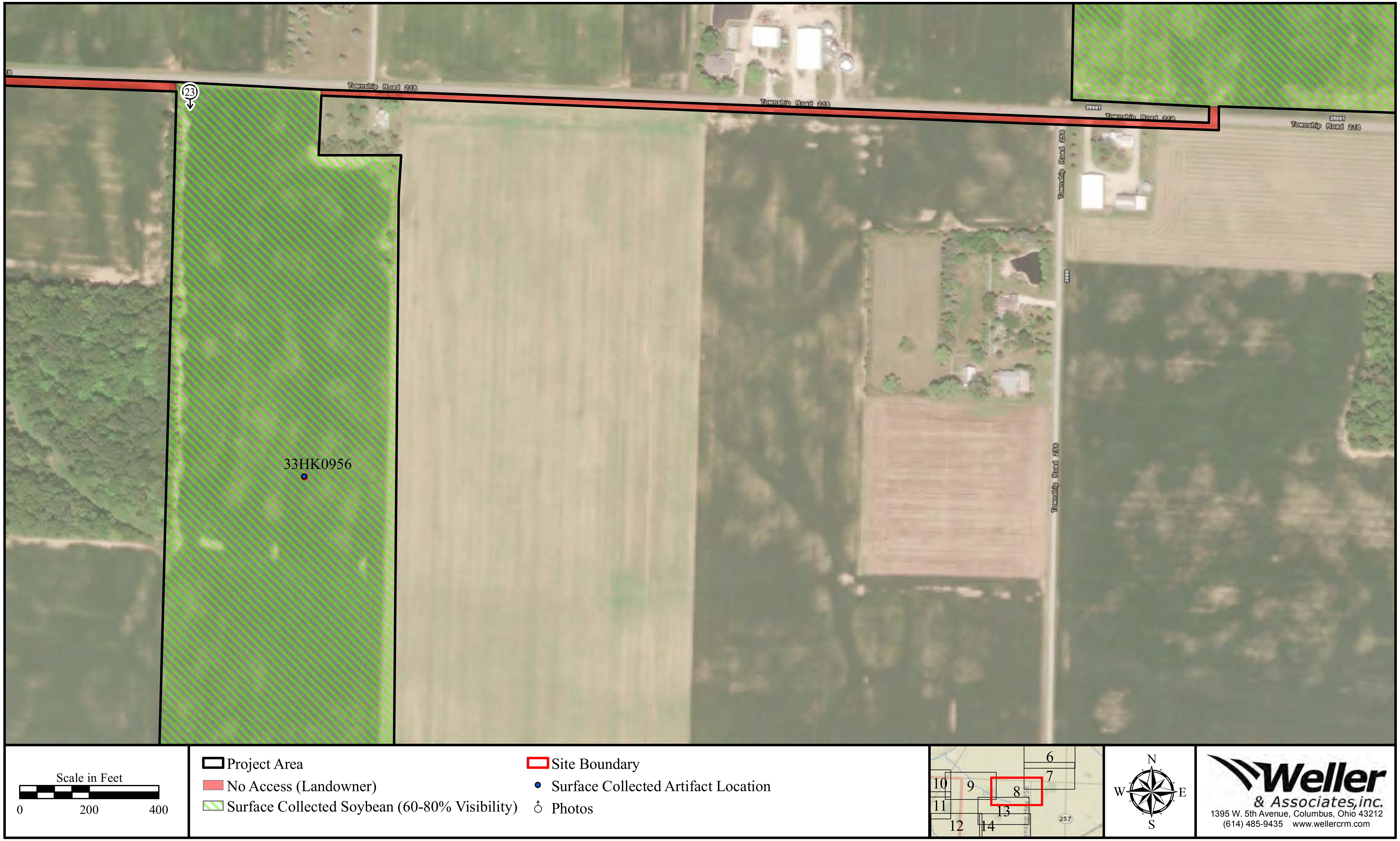


Figure 8. Fieldwork results and photo orientation map.

Figure 9. Fieldwork results and photo orientation map.

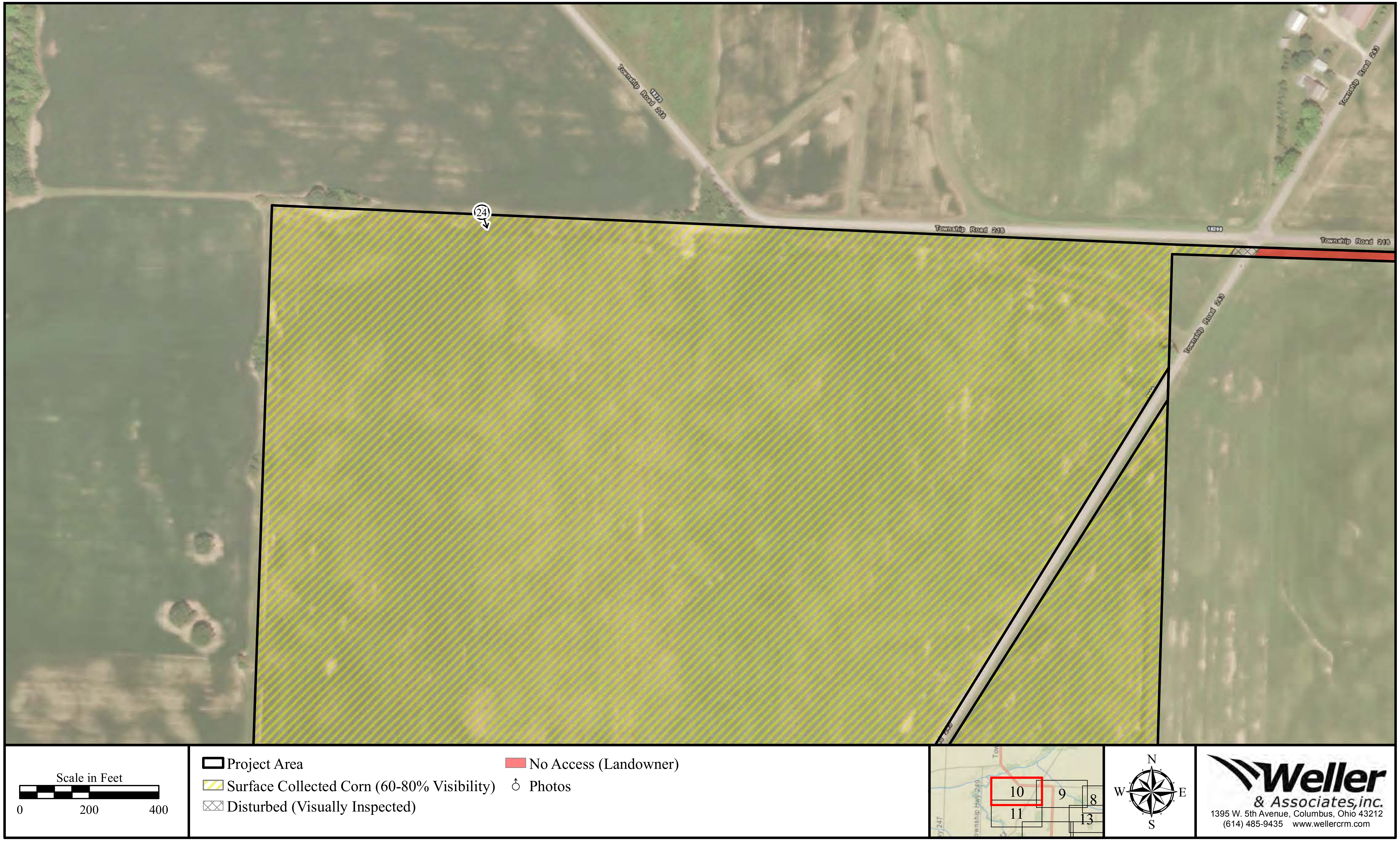


Figure 10. Fieldwork results and photo orientation map.

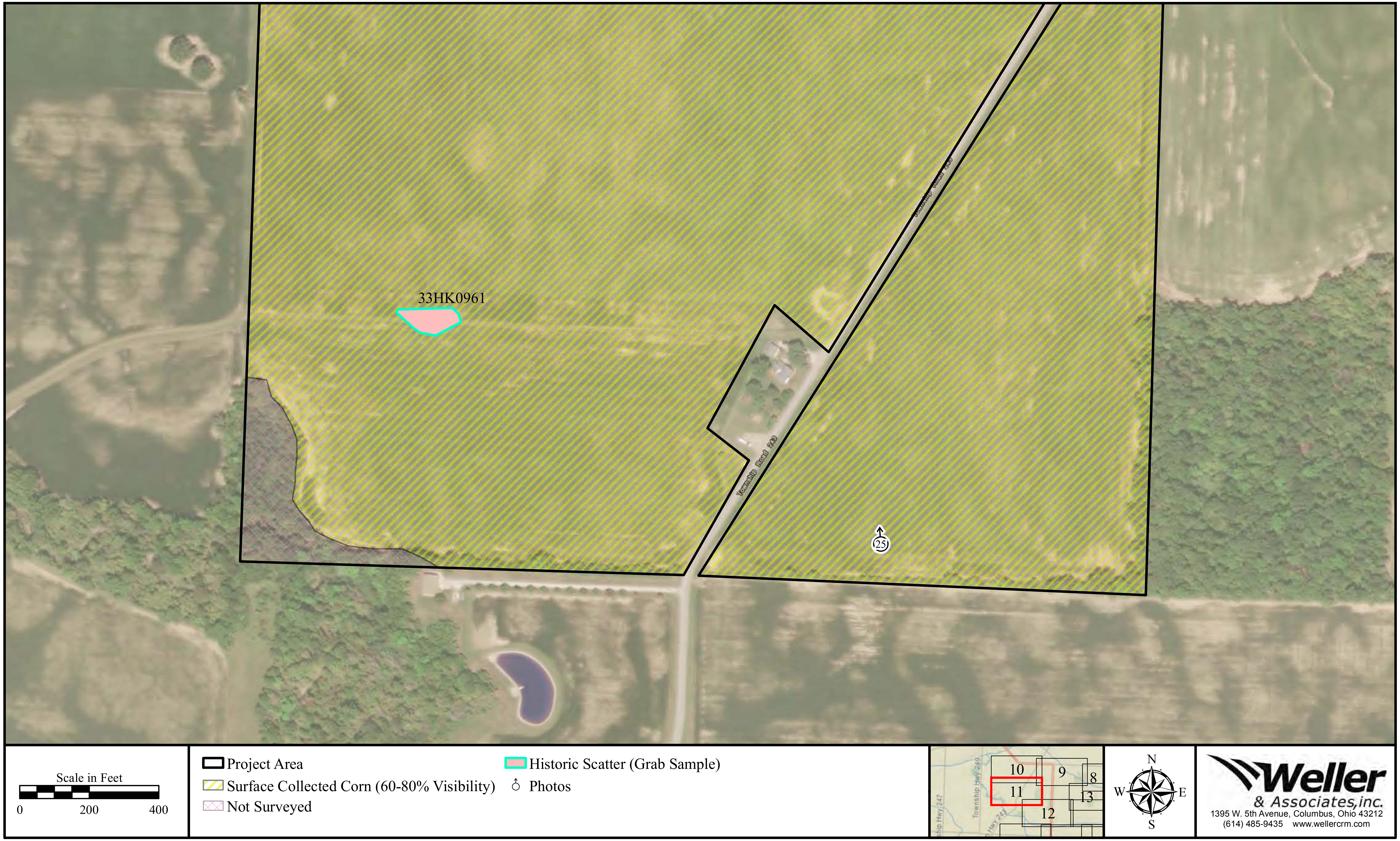


Figure 11. Fieldwork results and photo orientation map.

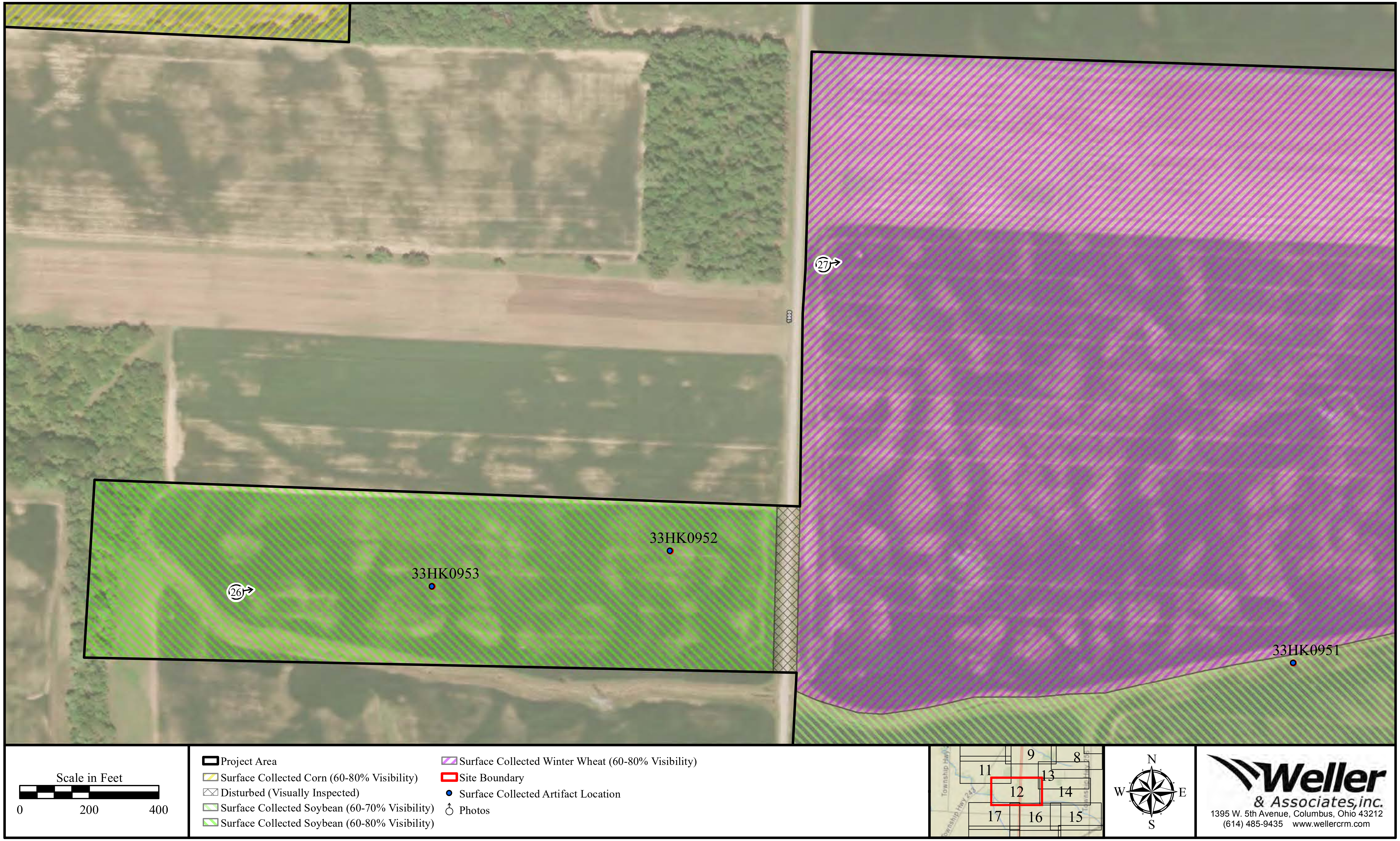


Figure 12. Fieldwork results and photo orientation map.

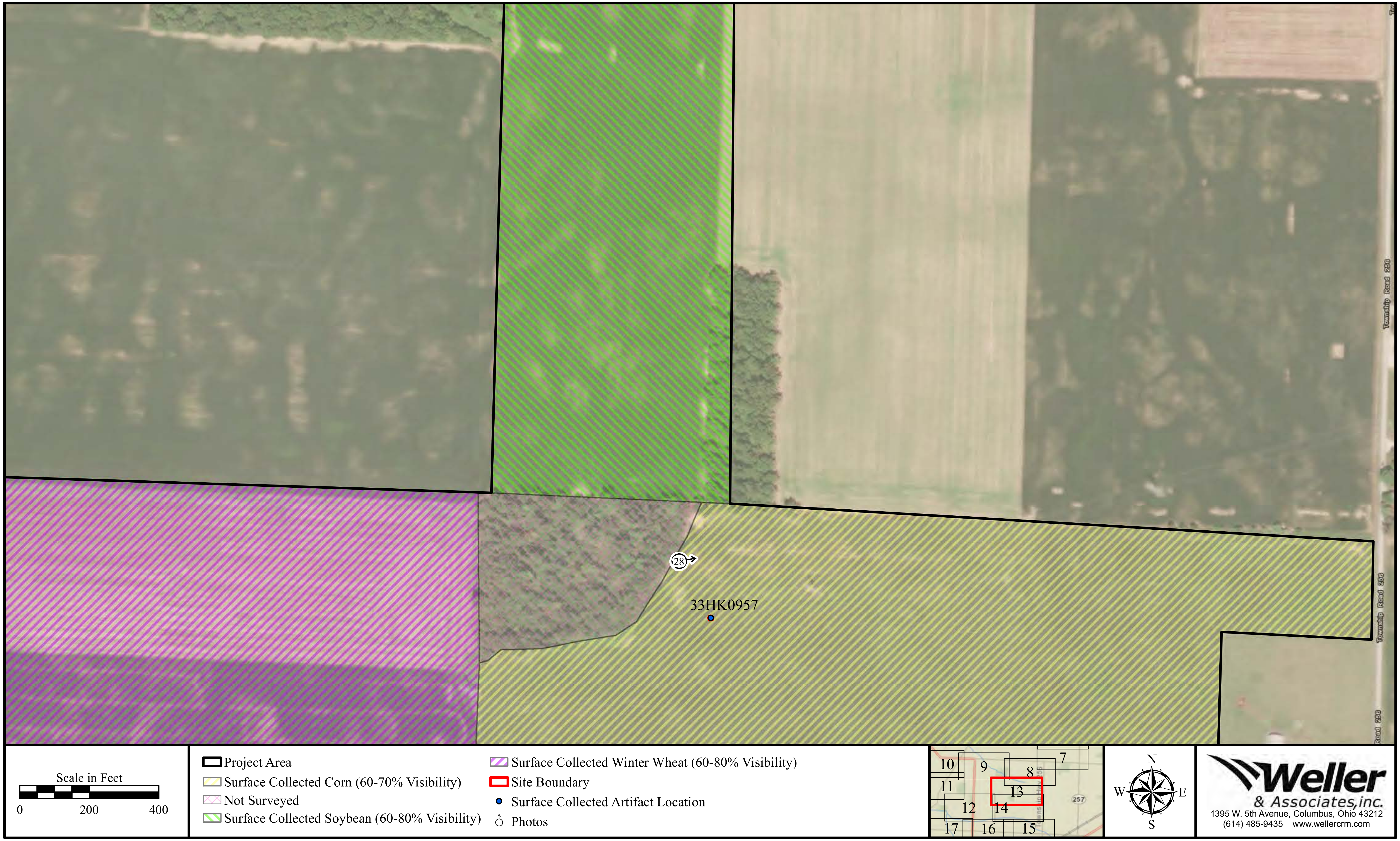


Figure 13. Fieldwork results and photo orientation map.

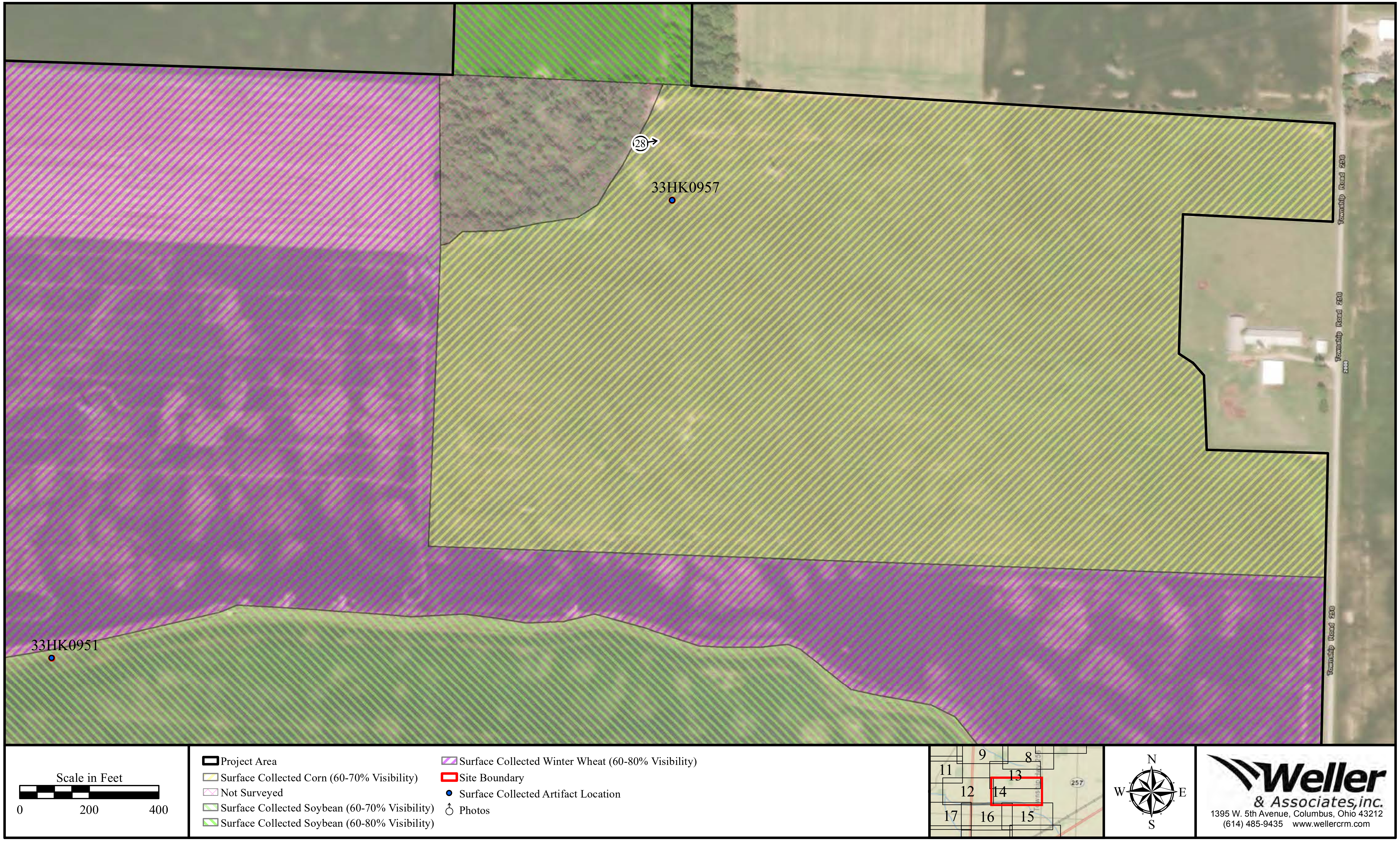


Figure 14. Fieldwork results and photo orientation map.

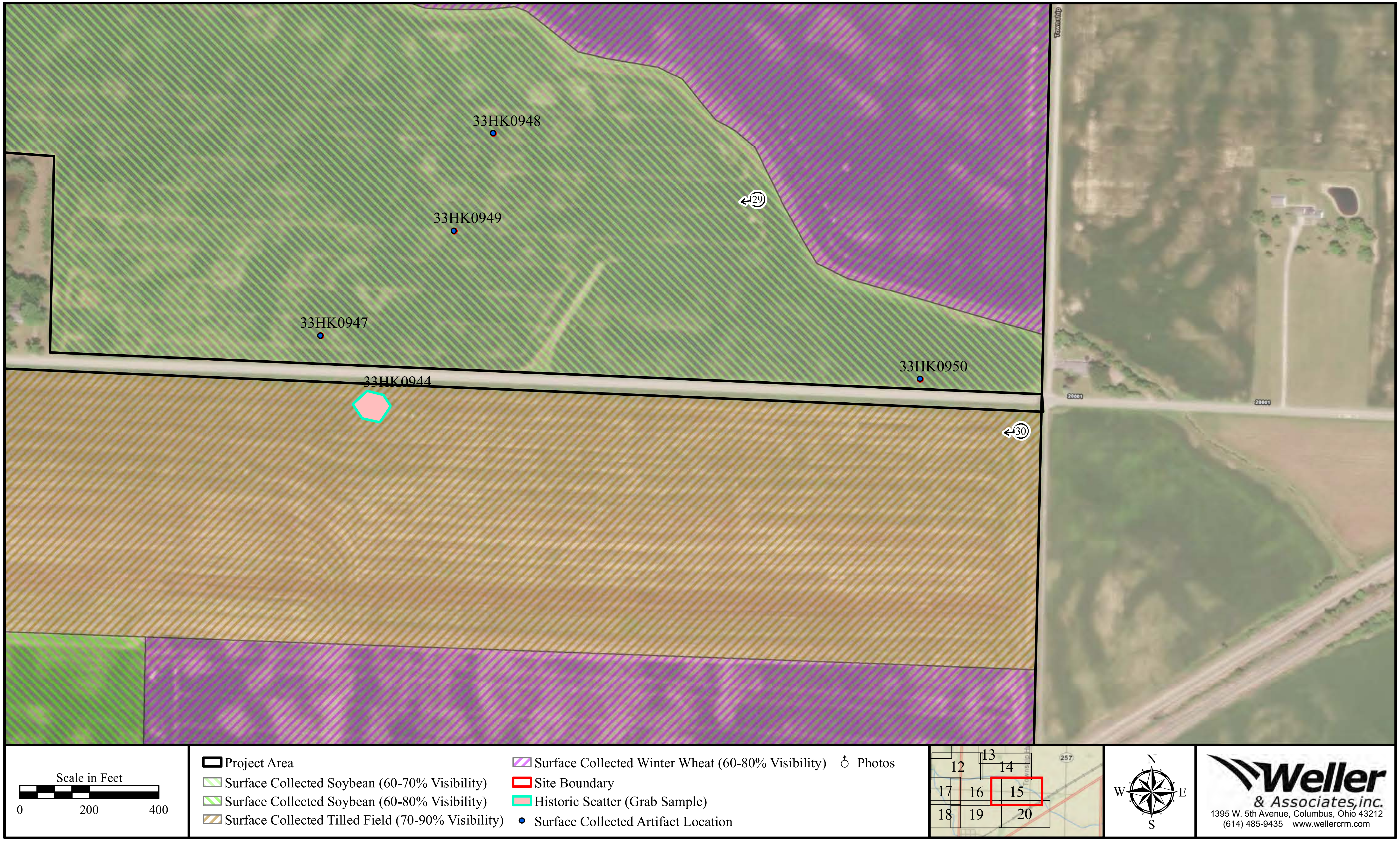


Figure 15. Fieldwork results and photo orientation map.

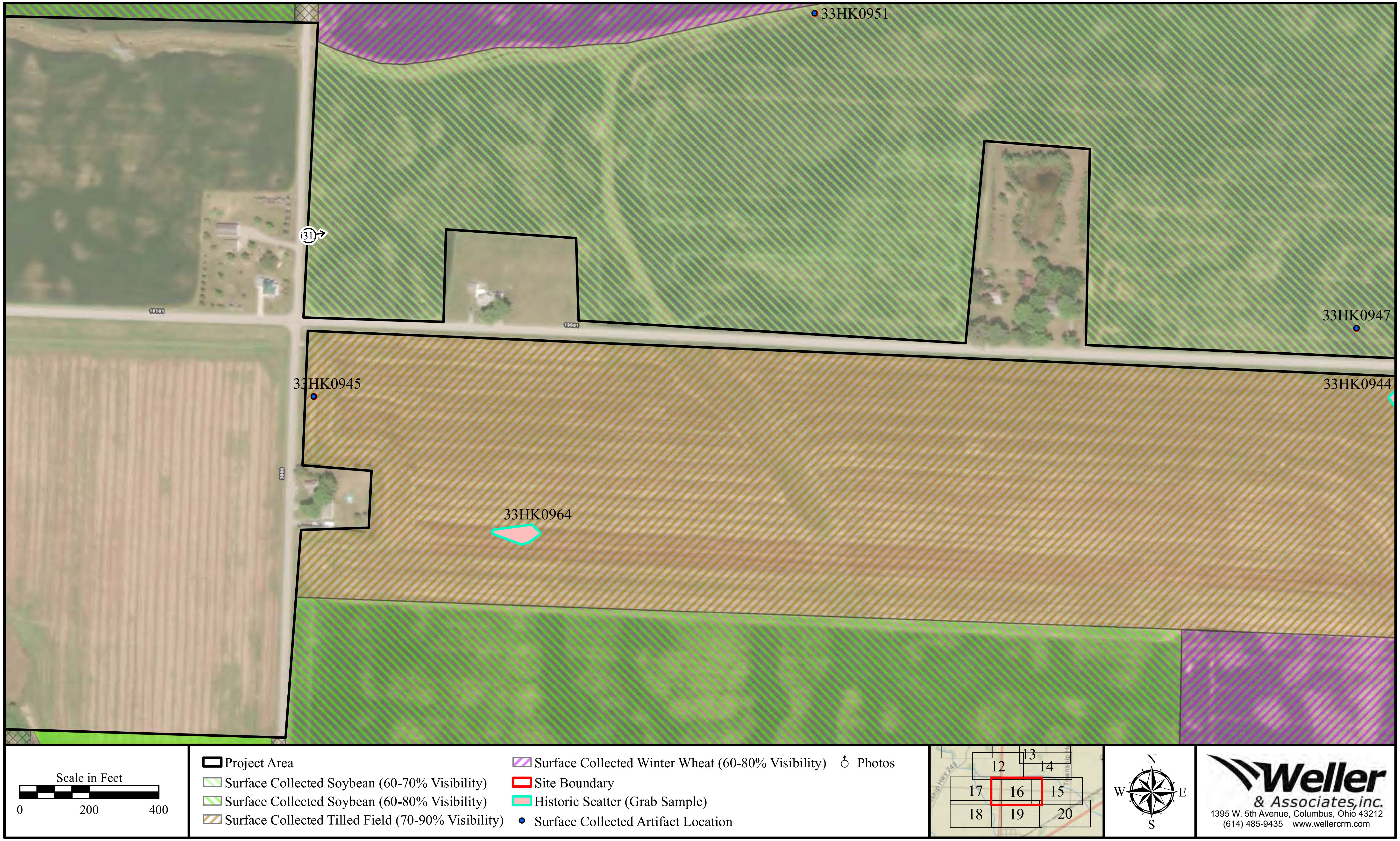


Figure 16. Fieldwork results and photo orientation map.

Figure 17. Fieldwork results and photo orientation map.

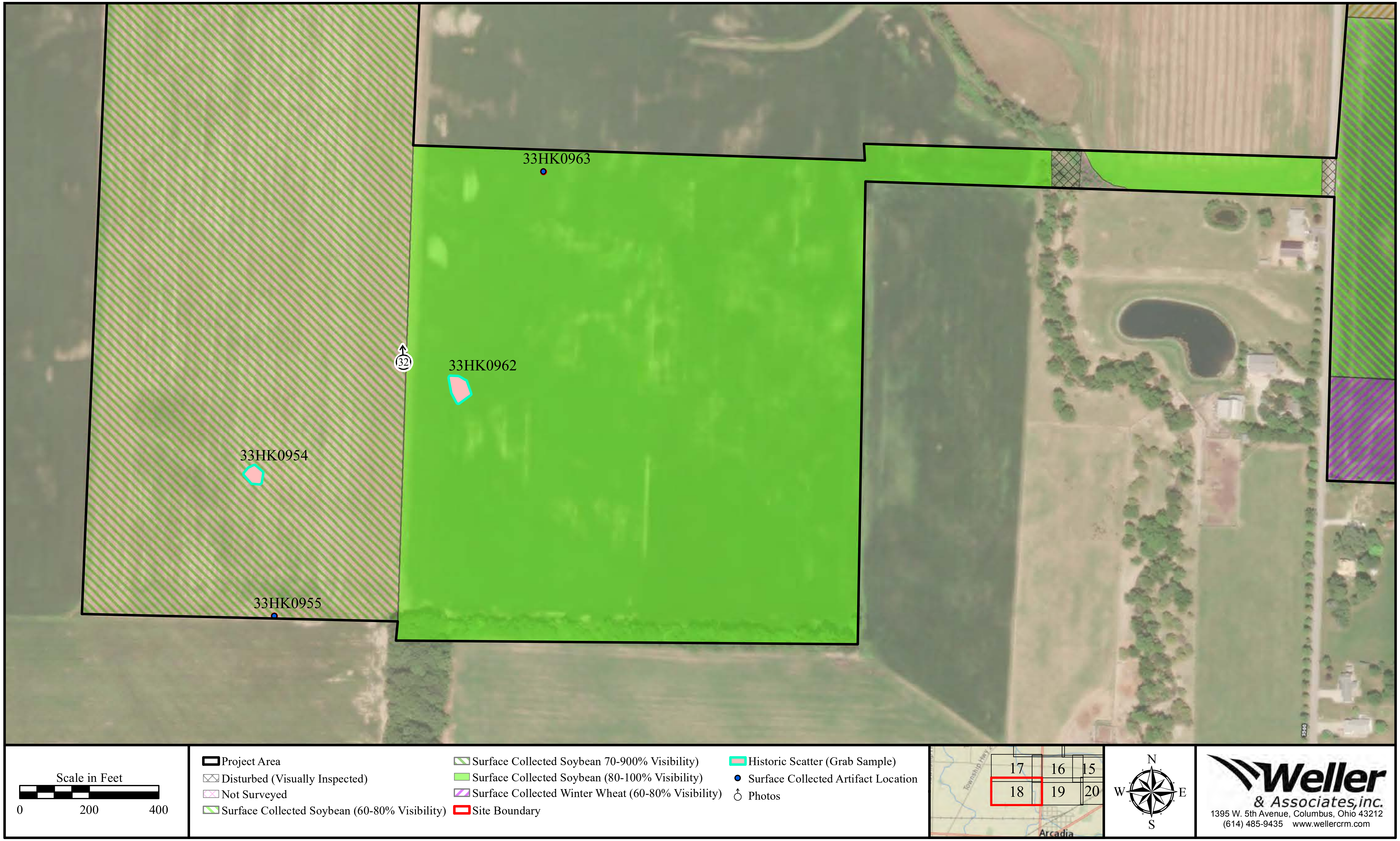


Figure 18. Fieldwork results and photo orientation map.

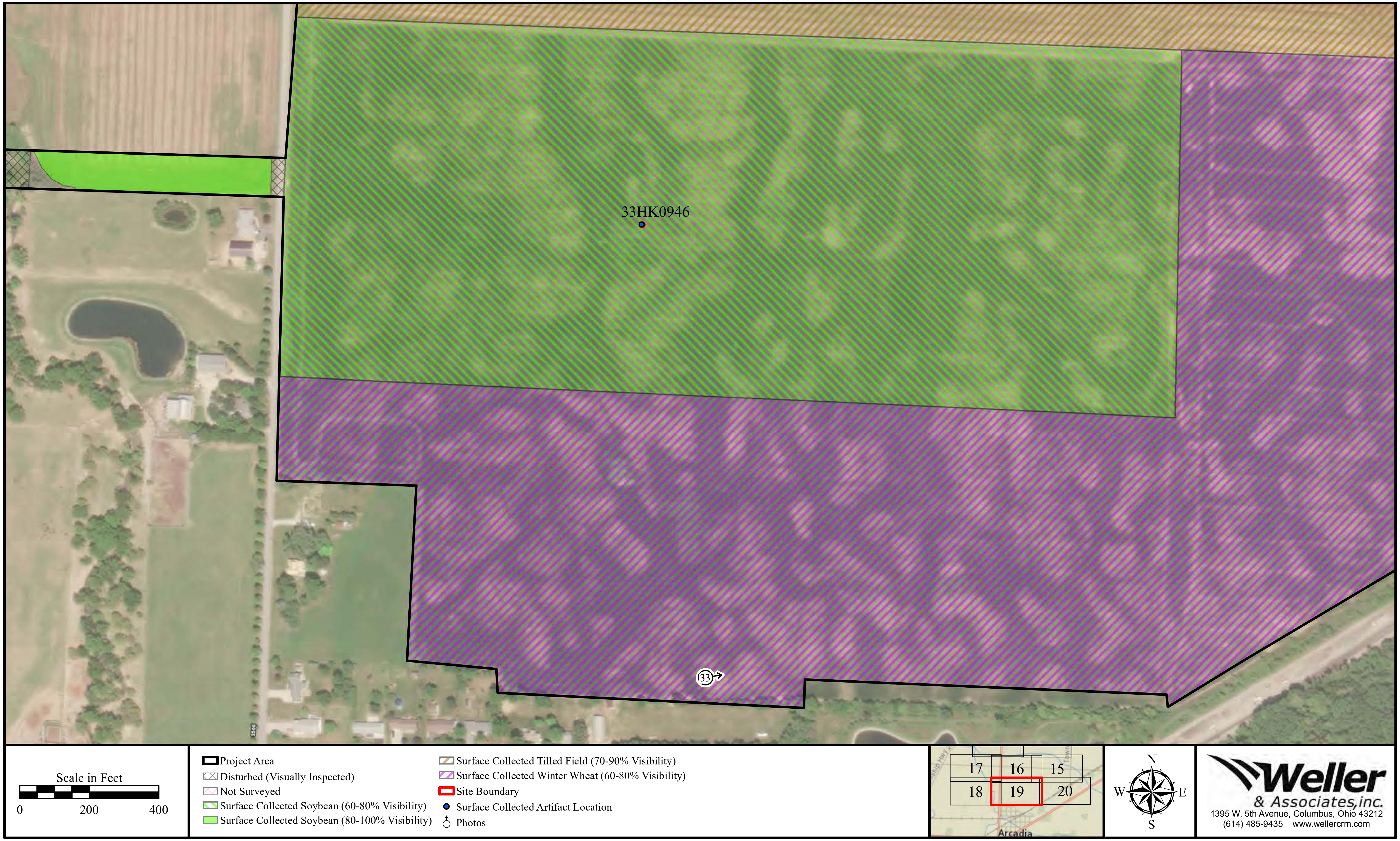


Figure 19. Fieldwork results and photo orientation map.

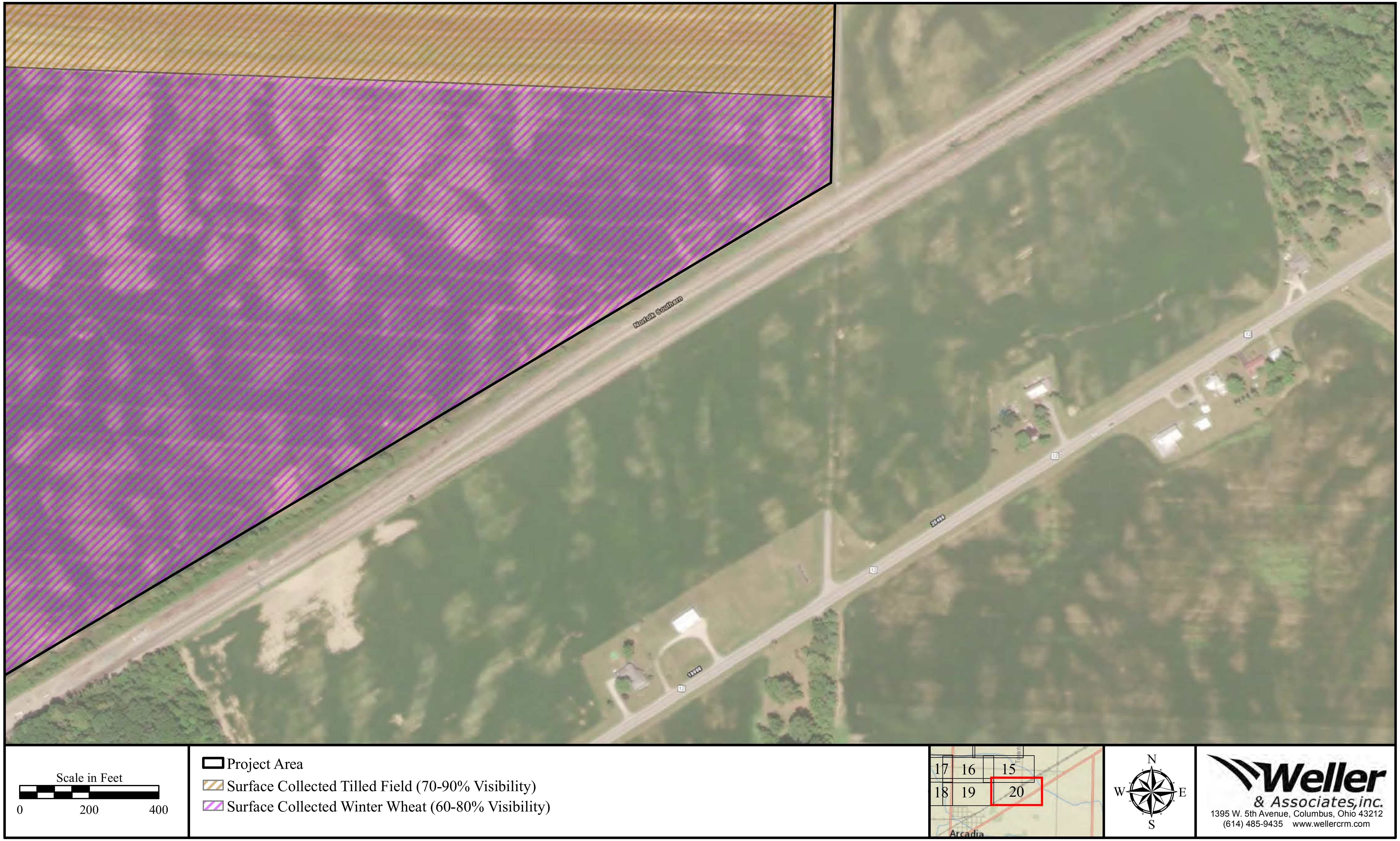


Figure 20. Fieldwork results and photo orientation map.

Figure 21. Surface collected soybean field containing 33HK0958 and 959.

Figure 22. Surface collected soybean field in the northeastern aspect of the Project Area.

Figure 23. Surface collected soybean field containing 33HK0956.

Figure 24. Surface collected corn stubble field containing 33HK0961.

Figure 25. Surface collected corn stubble field in the western aspect of the Project Area.

Figure 26. Surface collected soybean field containing site 33HK0952 and 953.

Figure 27. Surface collected winter wheat in the central portion of the Project Area.

Figure 28. Surface collected corn stubble field containing 33HK0957.

Figure 29. Surface collected soybean field containing sites 33HK0947-950.

Figure 30. Surface collected tilled field containing 33HK0944, 945, and 964.

Figure 31. Surface collected soybean field in the central portion of the Project Area.

Figure 32. Surface collected soybean fields containing sites 33HK0954, 955, 962, and 963.

Figure 33. Surface collected winter wheat in the central portion of the Project Area.

Figure 34. Visibility typical throughout the surface collected winter wheat in the Project Area.

Figure 35. Visibility typical throughout the surface collected soybean stubble in the Project Area.

Figure 36. Visibility typical throughout the surface collected corn stubble in the Project Area.

Figure 37. Visibility typical throughout the surface collected tilled field in the Project Area.

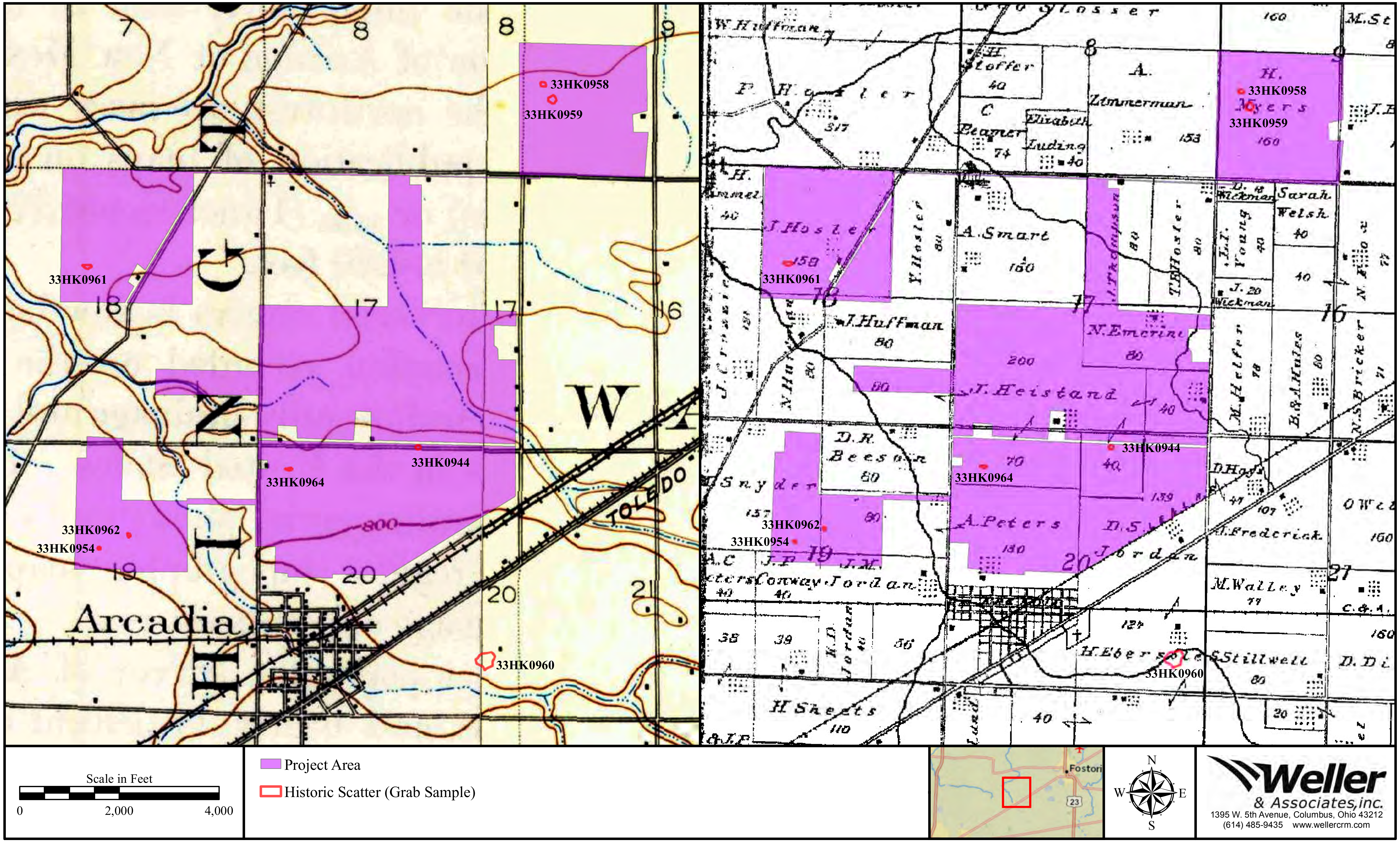


Figure xx. Portions of the USGS *1903 Findlay, and 1901 Fostoria, Ohio 15 Minute Series (Topographic)* maps (left) and *Illustrated Historical Atlas of Hancock County, Ohio* (Hardesty 1875; right) indicating the approximate location of the Project Area and location of historic scatters.

HK0947

Brewerton Corner Notched

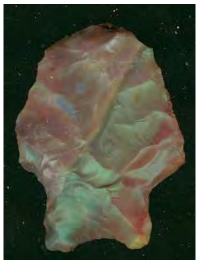
Length: na
Width: na
Stem Length: na
Neck Width: 13.7mm
Thickness: 5.0mm
Material: Pipe Creek

HK0953

Kirk Serrated

Length: na
Width: 31.5mm
Stem Length: 12.7mm
Neck Width: 19.3mm
Thickness: 8.4mm
Material: Columbus Delaware

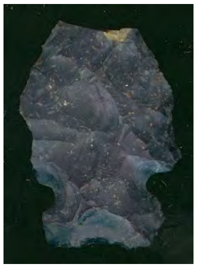
HK0948



Stanley Stemmed

Length: na
Width: 22.0mm
Stem Length: 11.0mm
Neck Width: 14.2mm
Thickness: 5.5mm
Material: Pipe Creek

HK0949



Big Sandy

Length: na
Width: na
Stem Length: 7.7mm
Neck Width: 16.1mm
Thickness: 5.5mm
Material: Upper Mercer

HK0950

Ledbetter Stemmed

Length: na
Width: 32.6mm
Stem Length: 14mm
Neck Width: 19.1mm
Thickness: 10.0mm
Material: Cedarville - Gulph

HK0956

Graham Cave Side Notched

Length: 50.7mm
Width: 27.1mm
Stem Length: 11.5mm
Neck Width: 18.6mm
Thickness: 8.9mm
Material: Glacial

Scale

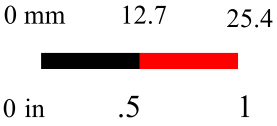


Figure 39. Some of the prehistoric artifacts from the Project Area.

HK0944

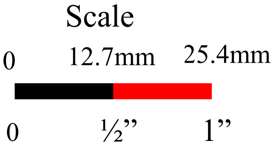


Figure 40. Some of the artifacts from Site HK0944.

HK0954

Scale

0 12.7mm 25.4mm

0 ½” 1”

Figure 41. Some of the artifacts from Site HK0954.

HK0958

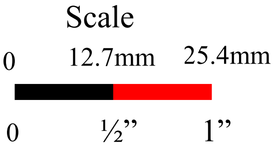


Figure 42. Some of the artifacts from Site HK0958.

HK0959

Scale

0 12.7mm 25.4mm

0 ½” 1”

Figure 43. Some of the artifacts from Site HK0959.

HK0960

Scale

0 12.7mm 25.4mm

0 ½” 1”

Figure 44. Some of the artifacts from Site HK0960.

HK0961

Scale

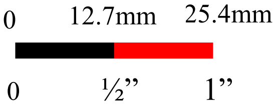
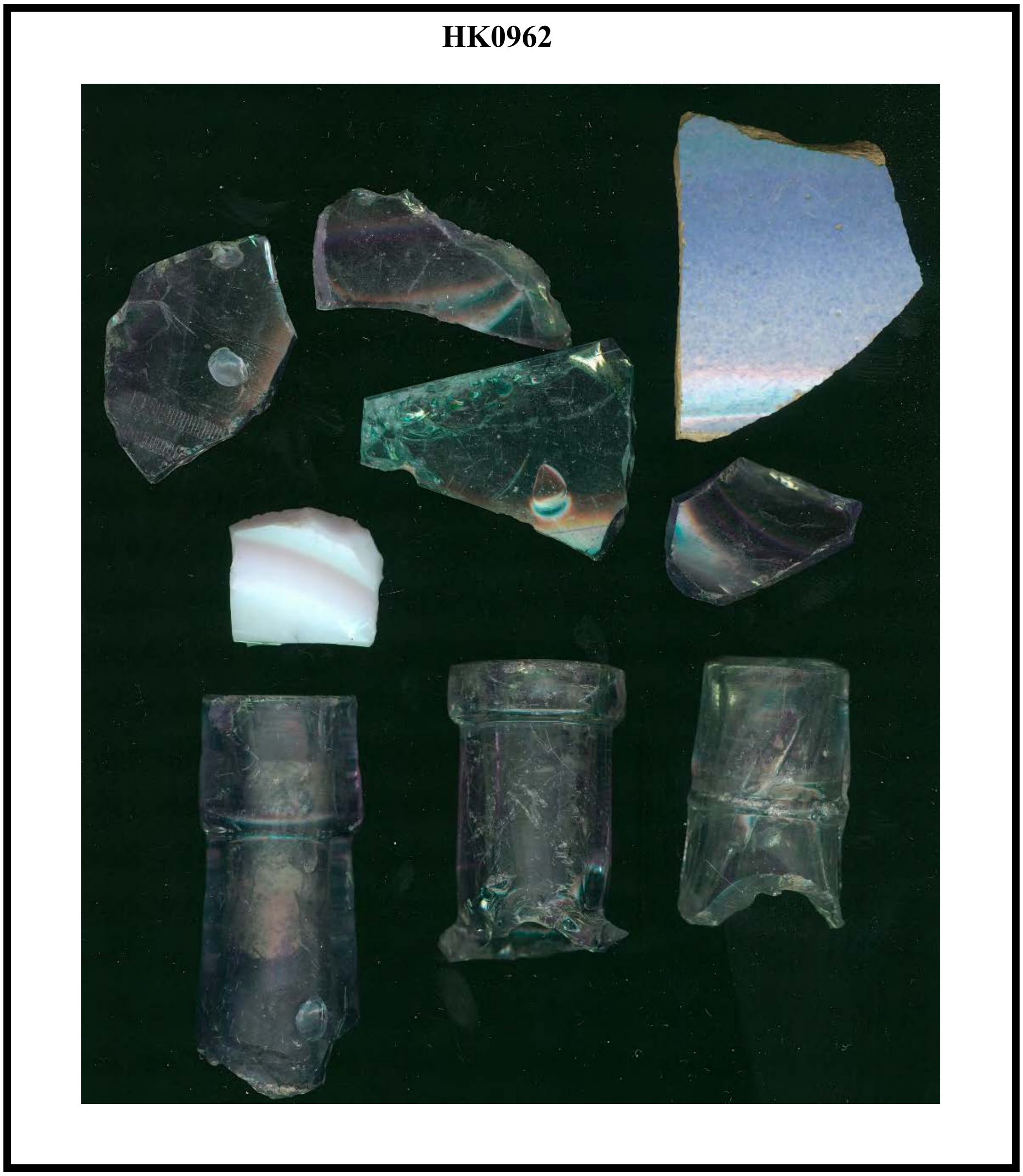


Figure 45. Some of the artifacts from Site HK0961.



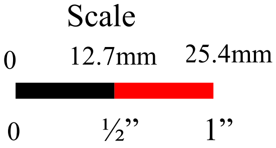


Figure 46. Some of the artifacts from Site HK0962.

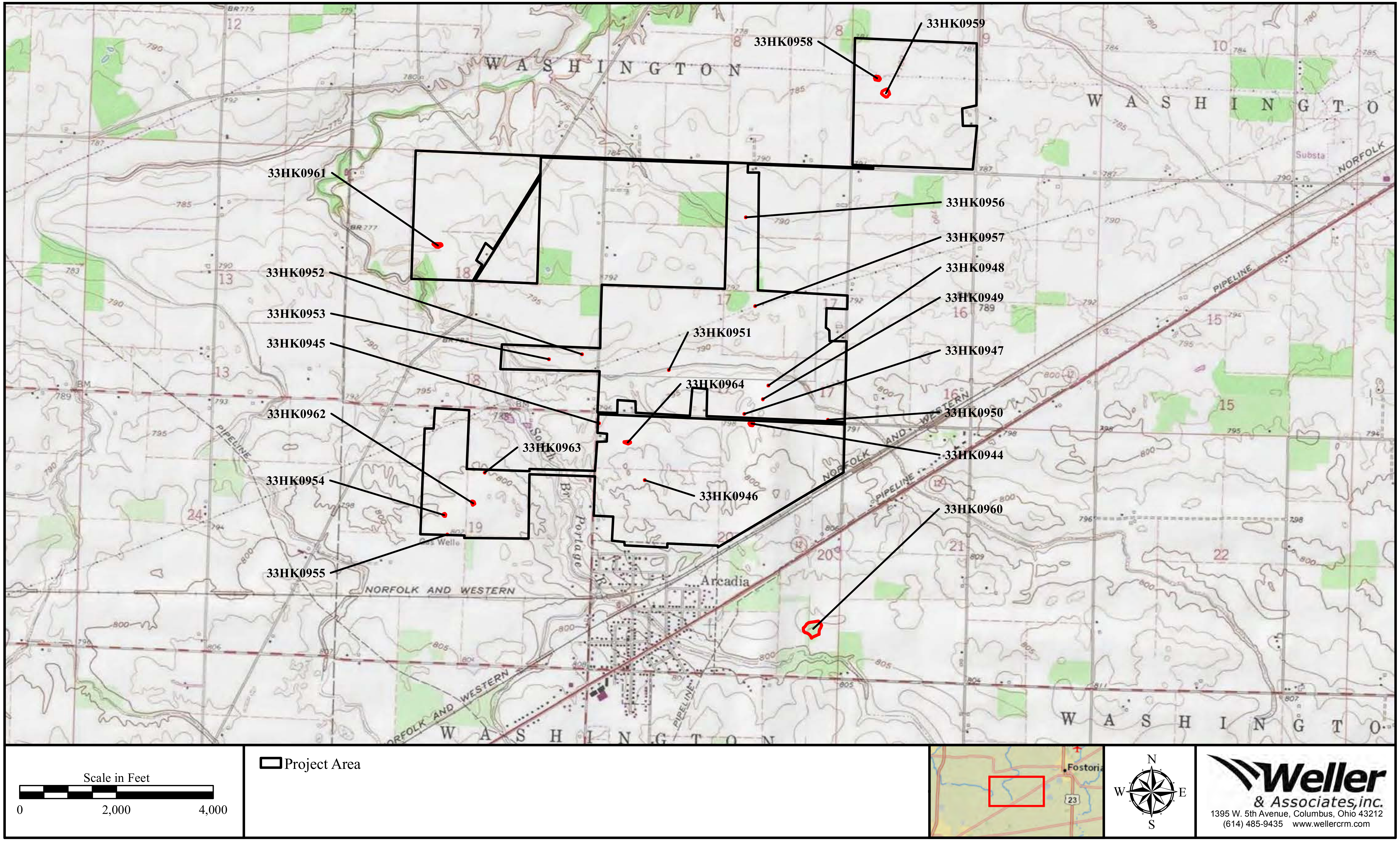


Figure 47. Portion of the USGS *1988 Bloomdale, 1977 Fostoria, 1977 Arcadia, and 1988 Alvada, Ohio 7.5 Minute Series (Topographic)* maps indicating the location of the Project Area and cultural site locations.

APPENDIX R

VISUAL IMPACT ASSESSMENT

www.haleyaldrich.com

VISUAL IMPACT ASSESSMENT FOR
SOUTH BRANCH SOLAR
HANCOCK COUNTY, OHIO

by
Haley & Aldrich, Inc.

for
South Branch Solar, LLC

File No. 0135392-002
July 2021

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List of Acronyms and Abbreviations

3D	three-dimensional
AC	alternating current
amsl	above mean sea level
the Applicant	South Branch Solar, LLC
DC	direct current
DSM	digital surface model
gen-tie	generation tie
kV	kilovolt
MW	megawatt
NLCD	National Land Cover Database
NRHP	National Register of Historic Places
O&M	Operations and Maintenance
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
OSIP	Ohio Statewide Imagery Program
the Project	South Branch Solar
the Project Area	an approximately 1,000-acre area within Hancock County, Ohio within which South Branch Solar is proposed
PV	photovoltaic
SHPO	State Historic Preservation Office
the Study Area	the area within a 5-mile radius of the Project Area
USDOT	U.S. Department of Transportation
VIA	Visual Impact Assessment
VSA	Visual Study Area

1. Introduction

This Visual Impact Assessment (VIA) has been prepared to evaluate the potential visual effects of South Branch Solar, an up to 205-megawatt (MW) solar photovoltaic (PV) facility (the Project) proposed by South Branch Solar, LLC (the Applicant). Landmarks and potential visibility within a 5-mile radius have been considered; however, given the low profile of Project-related features and character of the surrounding area, a considerably smaller area was found to have the potential for visual effect.

The Project is proposed to be located within an approximately 1,000-acre area (the Project Area) in Washington Township, Hancock County, Ohio (see Figure 1). The following sections reflect the requirements of Ohio Administrative Code (OAC) 4906-4-08(D)(4), as modified in accordance with the Project's waiver request to evaluate a 5-mile Visual Study Area (VSA), as well as established VIA methodologies, that have been prepared by and under the direction of professionals with experience in completing such assessments.

The following sections address:

- The visual components and characteristics of the Project;
- The character and visual quality of the VSA;
- An inventory and evaluation of visually sensitive resources within the VSA;
- An evaluation of the potential visibility of the Project within the VSA;
- Presentation of visual simulations from select locations within the VSA;
- An assessment of the potential visual impacts anticipated to be associated with the Project; and
- A discussion of measures proposed to minimize the potential visual impacts of the Project.

2. Visual Characteristics of South Branch Solar

2.1 DESCRIPTION OF THE PROJECT AREA

The Project Area encompasses approximately 1,000 acres of land predominantly in active agricultural use. As shown on Figure 1, agricultural areas with scattered woodlots and fencerow vegetation surround the majority of the Project Area. Two high-voltage electric transmission corridors traverse the Project Area.

The Project Area is located in Washington Township in Hancock County, Ohio. Several residences are located in the vicinity of the Project Area, with considerably higher residential density located on the opposite side of active rail lines to the southwest in the Village of Arcadia; the City of Fostoria (3 miles to the northeast); and the City of Findlay (5 miles to the southwest).

Active rail lines generally bound the Project Area to the southeast. The Village of Arcadia, with its associated neighborhood roads, bounds the Project Area to the south. Township Road 218 generally bounds the Project Area to the north, with only one Project parcel located north of this road. Township Road 243 generally bounds the Project Area to the west, with only one Project parcel located west of this road. Township Road 256 generally bounds the Project Area to the east, with only one Project parcel located east of the road. Several other local roads cross the Project Area, connecting the larger transportation corridors.

There are 29 residences within 250 feet of the Project Area, reflecting approximately 13 residences per square mile, as is typical for the area, with the nearest located over 160 feet from the solar array. Landscaping and woodlots on abutting properties provide a significant degree of existing visual screening.

The Project Area has moderate relief, with an approximate high elevation of 805 feet above mean sea level (amsl) in the southeastern portion, and a low elevation of 780 feet amsl in the western portion. Most of the Project Area is flat, with the most topographic variation along the riparian corridors within which the South Brand Portage River and its tributaries flow. Within 5 miles of the Project Area, terrain is similar, with minimal variance in grades except in locations immediately proximate to water features, such as the South Branch Portage River.

2.2 VISUAL CHARACTERISTICS OF SOUTH BRANCH SOLAR

The Project is a solar-powered electric generating facility that will provide renewable energy to the bulk power transmission system to support the needs of electric utilities and their customers. The Project will consist of up to approximately 500,000 PV solar panels within the Project Area; the layout evaluated in this VIA is shown on Figure 2. The panels will be ground-mounted on metal racking supported by piles that are driven into the ground and will be configurated in long rows or “arrays.” The arrays will be grouped in clusters throughout the Project Area, with each contiguous area enclosed by fencing and gated for security and public safety. The selected fencing is anticipated to be 7-foot-tall woven wire, rather than chain link topped with barbed wire, to maintain consistency with the agricultural character of the surrounding area.

The arrays will generally follow the existing topography of the Project Area, with only minimal grading proposed. The PV arrays proposed for the Project will include a single axis “tracking” style racking system. Using this system, the arrays will be oriented in a roughly north-south direction and equipped to rotate the panels from east to west to maintain an approximately 90-degree angle with the direction of sunlight. Tracking arrays will face east at sunrise, rotate throughout the day, and end up facing west at sunset. At their maximum tilted height, the panels are expected to be no more than 15 feet tall.

The arrays will be connected to inverters, which will convert the direct current (DC) electricity generated by the solar panels to alternating current (AC), and then to a series of predominantly belowground interconnecting electric cables (collector lines) that will deliver the energy to a new Project Substation and Utility Switchyard, located in the eastern central portion of the Project layout, east of Township Road 254 and adjacent to the existing approximately 100-foot-tall, 138-kilovolt (kV) overhead electric transmission line that extends through the Project Area. Equipment within the substation and switchyard is anticipated to average 50 feet, with the tallest component (the lightning mast) at a height of 70 feet.

As noted, most of the collector lines are anticipated to be belowground. One segment, located along Township Road 218, may be aboveground, sharing structures with existing electrical lines that currently extend within the road right-of-way. Because all collector lines will either be belowground or sharing structures where existing overhead features currently exist, these have not been a focus of the VIA. The voltage will be increased (stepped up) from 34.5-kV to 138-kV to allow for the generation tie (gen-tie) between the Project and the existing, adjacent aboveground 138-kV electric transmission line.

Other aboveground components of the Project include: five meteorological stations, which will each occupy no more than 400 square feet and be no taller than 15 feet; an operations and maintenance building (approximately 15 feet tall), proposed adjacent to the Project Substation; small inverter pads, interspersed with the arrays, upon which the integrated inverters/transformers (each less than 10 feet tall) will be constructed; and gravel roads that will provide access to the Project Area during construction and operation. The preliminary layout of the Project is provided as Figure 2.

3. Visual Assessment Methodology

OAC 4906-04-08(D) requires that potential visual impacts from a proposed generating facility be evaluated for recreational, scenic, and historic resources within a 10-mile radius. However, the Applicant has requested a waiver from the 10-mile radius requirement based on the generally low profile of the Project, and the results of the visibility assessment for a 5-mile radius are presented herein.

A preliminary viewshed analysis was conducted using United States Geological Survey three-dimensional (3D) Elevation Program 1/3 arc-second digital elevation models as a preliminary tool to consider the potential visual effect of the Project. The use of this conservative tool is expected to considerably overstate the potential for visibility. An initial screening using “bare earth” topographic information is provided as Figure 3 and reflects the relatively flat terrain within 5 miles of the Project Area. However, considerable vegetation and other features exist that would screen or block line-of-sight views toward the Project.

Figure 4 refines the area of potential visibility by adding information derived from the Ohio Statewide Imagery Program’s (OSIP) 2007 light detection and ranging (LiDAR) data for Hancock, Seneca, and Wood counties. As can be seen in Figure 4, the incorporation of the available LiDAR data for the areas surrounding the Project Area indicates a reduced potential for visibility of the Project. To the south, existing structures and vegetation in the Village of Arcadia will limit the potential for views of the Project. To the north, views are limited due to the heavily treed lands located along the South Branch Portage River. Figure 4 shows the potential for views of the Project may be slightly more expansive to the east and west, with only limited views indicated as possible beyond 3 miles from the Project Area.

None of these results take into consideration the influence of distance and atmospheric conditions on apparent visibility, nor the manner in which structures, vegetation, and other features have the potential to block line-of-sight from a given location beyond what is indicated in the National Land Cover Database (NLCD) vegetation data.

In terms of apparent visibility, well-established distance zones have been defined, including agency protocols published by the U.S. Forest Service, Bureau of Land Management and U.S. Department of Transportation (USDOT), as a guide for identifying distances from which landscape detail can be perceived by a viewer. Using appropriate adjustments associated with Ohio’s landscape types, the following distance zones have been defined for use in this VIA:

- Near-Foreground Views: 0 to 0.5-mile. At this distance, a viewer is able to perceive details of an object with clarity. Surface textures, small features, and the full intensity and value of color can be seen on foreground objects.

- Foreground Views: 0.5 to 1.5 miles. At this distance, elements in the landscape tend to retain visual prominence, but detailed textures become less distinct. Larger scale landscape elements remain as a series of recognizable and distinguishable landscape patterns, colors, and textures.

- Middle-Ground Views: 1.5 to 4.0 miles. The middle-ground is usually the predominant distance at which landscapes are seen. At these distances, a viewer can perceive individual structures and trees, but not in great detail. This is the zone where the parts of the landscape start to join together; individual hills become a range, individual trees merge into a forest, and buildings appear as simple geometric forms. Colors will be distinguishable but subdued by a bluish cast and softer tones than those in the foreground. Contrast in texture between landscape elements will also be reduced.

- Background Views: Over 4.0 miles. The background defines the broader regional landscape within which a view occurs. Within this distance zone, the landscape is simplified; only broad landforms are discernable, and atmospheric conditions often render the landscape an overall bluish color. Texture has generally disappeared, and color has flattened, but large patterns of vegetation are discernable. Silhouettes of one land mass set against another and/or the skyline are often the dominant visual characteristics in the background. The background contributes to scenic quality by providing a softened backdrop for foreground and middle-ground features, an attractive vista, or a distant focal point.

Although actual views are truncated to much shorter distances, based upon the results of the 5-mile screening models and these distance zones, evaluating the full 5-mile radius allows for assessment within each of the distance zones and consideration of the potential for sensitive viewers to see the Project. The 5-mile VSA encompasses an area of approximately 118 square miles and includes the Village of Arcadia and parts of the Cities of Fostoria and Findlay.

Additional information will be presented within the 5-mile VSA to provide the following:

- An inventory of potentially visually sensitive resources, along with information regarding anticipated potential for visibility;
- An evaluation of general landscape character (land use types and anticipated viewers within the VSA);
- An assessment of anticipated visual impacts, including ground-truthing to verify anticipated visual assumptions;
- Representative photographic simulations;
- Consideration for the potential for glare; and
- Information regarding planned mitigation measures, including details regarding planned landscaping.

It should be noted that a Phase I Architectural History Survey has been conducted in coordination with the Ohio State Historic Preservation Office (SHPO). Although no indication of potential impact to such resources has been identified, the Applicant will work with the SHPO to confirm that understanding.

4. Inventory of Visually Sensitive Resources

Visually sensitive resources within the VSA were identified per the requirements of OAC 4906-04-08(D). Figure 6 shows the location, within the 5-mile VSA, of the following:

- Formally adopted land and water recreation areas;
- Recreational trails;
- Scenic rivers;
- Scenic routes or byways; and
- Registered landmarks of historic, religion, archaeological, scenic, natural, or other cultural significance (those districts, sites, buildings, structures, and objects that are recognized by, registered with, or identified as eligible for registration by the national registry of natural landmarks, the state historical preservation office or Ohio Department of Natural Resources (ODNR).

File review was conducted using resources available from the Ohio SHPO Online Mapping System. The database included review of the Ohio Archaeological Inventory, the Ohio History Inventory, National Register of Historic Places (NRHP) files, the Historic Bridge Inventory, previous cultural resource surveys, and information on cemeteries maintained by the Ohio Genealogical Society. Recreational areas were identified based on resources provided by the U.S. Fish and Wildlife Service, ODNR, United States Forest Service, National Park Service, Bureau of Land Management, and local municipalities, including the Village of Arcadia and the Cities of Fostoria and Findlay. The resources that occur within the VSA are addressed below, along with a discussion of the potential for viewshed impact to the resource category. Resources within the VSA are shown assigned to respective visibility distance zone categories.

4.1 PUBLIC LANDS AND RECREATIONAL AREAS AND TRAILS

As shown in Table 1, there are 18 recreational areas and trails that were identified within the 5-mile VSA of the Project. Of these, the conservative screening modeling indicated that three resources would have the potential for view of the Project. Each of these three resources (the Fostoria Reservoir, the Veterans Memorial Reservoir, and the Veterans Memorial Park) are located within the middle-ground distance zone of the VSA (1.5 to 4.0 miles). Ground-truthing was conducted to indicate whether visibility was likely. For all three features, intervening topography, vegetation, and structures were observed that prevented views of the existing overhead transmission lines that extend across the Project Area. Therefore, based on distance and existing features (predominantly wooded vegetation, as well as intervening structures), the Project is not expected to alter the existing visual landscape of these resources.

Table 1. Public Lands and Recreational Areas and Trails within the VSA

ID[1]	Resource	Type	Distance Zone	Visibility[2]
1	Arcadia Community Center	Recreational Area	Near-Foreground	No
2	Aeraland Recreational Area	Recreational Area	Foreground	No
3	City Park	Recreational Area	Middle-Ground	No
4	Daugherty Lake	Recreational Area	Middle-Ground	No
5	Fostoria City Park	Recreational Area	Middle-Ground	No
6	Fostoria Country Club	Recreational Area	Middle-Ground	No

ID[1]	Resource	Type	Distance Zone	Visibility[2]
7	Fostoria Reservoir	Recreational Area	Middle-Ground	Possible
8	Fostoria Reservoir Park	Recreational Area	Middle-Ground	No
9	Gray Park	Recreational Area	Middle-Ground	No
10	Lakeland Golf Course	Recreational Area	Middle-Ground	No
11	Lumberjack Lake	Recreational Area	Middle-Ground	No
12	Meadowlark Park	Recreational Area	Middle-Ground	No
13	Mosier Lake	Recreational Area	Middle-Ground	No
14	Mottram Lake	Recreational Area	Middle-Ground	No
15	Portage Park	Recreational Area	Middle-Ground	No
16	Red Hawk Run Golf Course	Recreational Area	Middle-Ground	No
17	Veterans Memorial Reservoir	Recreational Area	Middle-Ground	Possible
18	Veterans Memorial Reservoir Park	Recreational Area	Middle-Ground	Possible

[1] As shown on Figure 6.
[2] Model results based on both topographic and vegetative screening.

4.2 DESIGNATED SCENIC RESOURCES

As shown on Figure 6, there are no designated scenic resources within the 5-mile VSA for the Project.

4.3 PROPERTIES OF HISTORIC SIGNIFICANCE

As shown in Table 2, there are eight known properties of historic significance within the 5-mile VSA for the Project. The conservative screening model indicates that the Project will not be visible from any of these resources. Note that each of these resources is located within the more densely settled areas of Arcadia and Fostoria, where existing structures and vegetation block the potential for line-of-sight to the Project.

Table 2. Properties of Historic Significance within the VSA

ID[1]	Resource	Type	Distance Zone	Visibility[2]
19	Washington Township Cemetery	Cemetery	Near-Foreground	No
20	Knollcrest Cemetery	Cemetery	Foreground	No
21	Fountain Cemetery	Cemetery	Middle-Ground	No
22	St. Wendelin Cemetery	Cemetery	Middle-Ground	No
23	Fostoria Downtown Historic District	NRHP Site	Middle-Ground	No
24	Fostoria Mausoleum	NRHP Site	Middle-Ground	No
25	Dana, Marcus, House	NRHP Site	Middle-Ground	No
26	Cory, Ambrose, House – “Tanglewood”	NRHP Site	Background	No

[1] As shown on Figure 6.
[2] Model results based on both topographic and vegetative screening.

4.4 HIGH-USE PUBLIC AREAS

As shown in Table 3, there are 27 high-use public areas within the 5-mile VSA for the Project. However, the conservative screening model indicates that the Project would not have the potential to be visible from any of these identified areas. Each of these resources are located within the more densely settled areas within the VSA, the Village of Arcadia and portions of the cities of Fostoria and Findlay. Intervening structures and vegetation block the potential for line-of-sight to the Project.

Table 3. High Use Public Areas within the VSA

ID[1]	Resource	Type	Distance Zone	Visibility[2]
27	Arcadia School	School	Foreground	No
28	Diebleys Airport	Air Navigation	Middle-Ground	No
29	Encounter Church	Place of Worship	Middle-Ground	No
30	Enon Valley Presbyterian Church	Place of Worship	Middle-Ground	No
31	First Christian Church	Place of Worship	Middle-Ground	No
32	Fostoria High School	School	Middle-Ground	No
33	Fostoria Intermediate School	School	Middle-Ground	No
34	Kaubisch Public Library	Library	Middle-Ground	No
35	Living Hope Foursquare Church	Place of Worship	Middle-Ground	No
36	Open Door Family Worship Center	Place of Worship	Middle-Ground	No
37	Revival Center	Place of Worship	Middle-Ground	No
38	Saint Wendelin Catholic Church	Place of Worship	Middle-Ground	No
39	Saint Wendelin Catholic School	School	Middle-Ground	No
40	Salem United Methodist Church	Place of Worship	Middle-Ground	No
41	Trinity Episcopal Church	Place of Worship	Middle-Ground	No
42	Wesley United Methodist Church	Place of Worship	Middle-Ground	No
43	Bethel Baptist Church	Place of Worship	Background	No
44	Christ Community Church	Place of Worship	Background	No
45	First Church of the Nazarene	Place of Worship	Background	No
46	Higher Ground Ministries	Place of Worship	Background	No
47	Parkview Christian Church	Place of Worship	Background	No
48	Riley Elementary School	School	Background	No
49	St. Catherine's Manor of Fostoria	Place of Worship	Background	No
50	StoneBridge Church of God	Place of Worship	Background	No
51	Trinity United Brethren Church	Place of Worship	Background	No
52	Rutter	Air Navigation	Middle-Ground	No
53	Arcadia United Methodist Church	Place of Worship	Middle-Ground	No

[1] As shown on Figure 6.

[2] Model results based on both topographic and vegetative screening.

5. Landscape and Viewer Characteristics

5.1 TOPOGRAPHIC RELIEF AND VEGETATION

The eastern portion of the VSA is largely composed of relatively flat area with only significant relief changes along stream corridors. These streams generally drain north and west to the South Branch Portage River. The western portion of the VSA shows more prominent relief than the eastern portion. The soils in the west are generally gently sloping to steep. The South Branch Portage River and several tributaries flow generally northwest through the VSA. This river is deeply entrenched, and downcutting has produced limestone gorges and deeply cut tributaries. Elevations in the VSA range from approximately 705 feet amsl along the South Branch Portage River, north of the Project Area, to approximately 910 feet amsl southeast of the Project Area, near the edge of the VSA.

Forested areas in proximity to the Project Area tend to be reflected by scattered woodlots amongst active agricultural areas, as well as roadside vegetation. Within the broader VSA, densely forested areas occur along riparian areas such as the South Branch Portage River. Pasture and cropland comprise a significant percentage of the vegetation within the VSA.

5.2 LANDSCAPE CHARACTER

The landscape character within a given VSA can provide a useful framework for the assessment of a facility's potential visual effects. Landscape types within the Project's VSA were categorized based on the similarity of various features, including landform, vegetation, water, and/or land cover patterns, in accordance with established visual resource assessment methodologies (Smardon et al., 1988; USDA Forest Service, 1995; USDOT Federal Highway Administration, 1981; and USDI Bureau of Land Management, 1980). The USGS NLCD was used to help define the character and location of various landscape types within the VSA (see Figure 7). The landscape types defined within the VSA are presented in Table 4. As can be seen, the most significant landscape type is reflective of the agricultural nature of the area and comprises pasture and cropland. Forested area, as noted above, is characteristic of certain areas within the VSA, with density of forested areas in each given location varying as shown on Figure 7. However, the Village of Arcadia and the cities of Fostoria and Findlay present distinctly different landscape character from the more generalized surrounding area due to their more densely settled nature.

Table 4. Landscape Types Within the Visual Study Area

Landscape Type	Total Area of Landscape Type within the VSA (acres)	% of Landscape Type within the VSA
Pasture and Cropland	61,520	81.6
Forest	4,030	5.3
Developed	8,740	11.6
Wetland	300	0.4
Open Water	517	0.7
Grassland	162	0.2
Scrub/Shrub	112	0.2
TOTAL	75,381	100.0

Because visibility is influenced considerably by distance, an evaluation of each landscape type has also been assessed to determine where it falls within each distance zone within the VSA, as summarized in Table 5.

Table 5. Distance Zones by Landscape Type

Landscape Type	Landscape Type by Distance Zone			
	Near-Foreground (0 – 0.5-mile)	Foreground (0.5 – 1.5 miles)	Middle-Ground (1.5 – 4.0 miles)	Background (4.0 – 5.0 miles)
TOTAL	4,716	8,851	39,376	22,437
Pasture and Cropland	4,138 (87.7%)	7,691 (86.9%)	32,959 (83.7%)	16,732 (74.5%)
Forest	171 (3.6%)	581 (6.6%)	1,692 (4.3%)	1,586 (7.1%)
Developed	390 (8.3%)	524 (5.9%)	4,038 (10.2%)	3,788 (16.8%)
Wetland	4.6 (0.1%)	37.9 (0.4%)	139 (0.4%)	119 (0.5%)
Open Water	2.9 (0.1%)	3.5 (0%)	469 (1.2%)	41.4 (0.2%)
Grassland	8.2 (0.2%)	7.6 (0.1%)	62.5 (0.2%)	83.6 (0.4%)
Scrub/Shrub	1.8 (0%)	6.4 (0.1%)	16.8 (0%)	87.2 (0.4%)

As can be seen, the near-foreground is dominated by the pasture and cropland landscape type as well as other low-vegetation communities, with smaller areas of forest interspersed throughout. However, within these areas also extend existing overhead electric transmission lines and an active rail line, as well as scattered residences and farming structures. Portions of the Village of Arcadia (which is separated from the Project Area by the active rail line) are within the near-foreground, where more densely populated areas reflect the majority of the developed landscape type; roads extending through the area also contribute to the developed area.

The foreground includes the balance of the Village of Arcadia, and otherwise continues with similar landscape characteristics. Once reaching the middle-ground, at distances between 1.5 and 4 miles from the Project Area, portions of Fostoria and some other smaller developed areas are incorporated into the landscape character. At the background distance, another significant portion of Fostoria is incorporated, and the fringes of Findlay can be seen, again with some smaller developed areas.

5.3 LANDSCAPE SIMILARITY ZONES

Within the VSA, consideration was given to landscape similarity, as determined through an evaluation of topography, vegetation, water, land use, and anticipated user activities. The VSA was determined to encompass six landscape similarity zones, as described below.

- Rural Residential/Agricultural – This category reflects the most prevalent landscape type within the VSA, as can be seen on Figure 7. Within these areas, where vegetation or structures block the line-of-sight, visibility would be obstructed; however, where limited vegetation exists, the relatively flat terrain results in the potential for views. Many of the residential properties within the VSA are vegetated by fencerows or other plantings. As distance increases, the potential visibility would be expected to become considerably less pronounced.

- Settlements – Within the VSA there are several areas of denser residential settlement, such as Arcadia, Findlay, and Fostoria, as can be seen on Figure 7. Viewers located within the settlement, where existing structures would obstruct external views, would not have the potential to see the Project, while possible views could exist along the nearer edges of the settlements. It is not expected the Project would be visible from either Findley or Fostoria, due to distance and intervening elements that would block the potential for line-of-sight.

- Recreational Areas – This category encompasses the scattered recreational areas within the VSA, as detailed in Section 4 and shown on Figure 6, including the state-designated resources, public parks, and private recreational facilities. Note that none of the identified resources are expected to have views of the Project.

- Transportation Corridors – This category encompasses the various roadways (state, county, and township) that extend within the VSA (shown as developed corridors on Figure 7). While the majority of the roadways most proximate to the Project Area are local roads, several county and other more heavily traveled roadways exist. This category also includes railroad transportation infrastructure. Notably, an active rail line extends between the Project Area and the Village of Arcadia.

- Open Water – The South Branch Portage River and several local reservoirs are the most significant open water bodies within the VSA (as shown on Figure 7) and are not expected to have views of the Project. Other smaller streams and features located throughout the VSA may offer recreational activities but tend to be surrounded by denser areas of vegetation.

- Utility Corridors – In addition to local distribution lines and the 138-kV electric transmission line into which the Project will interconnect, a 345-kV electric transmission line also extends across the Project Area in a west-east orientation, as shown on Figure 2. These provide existing visual elements within the immediate landscape within and surrounding the Project Area.

5.4 VIEWER GROUP

Possible viewer groups within the VSA were identified. These groups were determined based on the frequency and duration of exposure to views of the Project, the viewer's position in the landscape, and the viewer's activity and presumed sensitivity to changes in the visual landscape. Viewer groups identified are described below.

- Local Residents: Local residents have views that are likely to be stationary. They have knowledge of the local landscape and are sensitive to alterations to particular views that are important to them. Residences are scattered throughout the area immediately surrounding the Project Area in most directions, with denser settlements located to the south, in the Village of Arcadia, and farther from the Project.

- Through Travelers: These individuals are traveling through the area on roadways. These viewers, because they are driving, are typically focused on the road and immediate surroundings and would experience only transitory views of their surroundings. Consequently, their views of the surrounding landscape will generally be peripheral and relatively brief in duration.

- Tourists and Recreational Users: These individuals include recreational users visiting from out of the local area, as well as residents engaged in seasonal recreational activities. Due to the limited view potential from designated recreational areas, this category is not anticipated to be significant for the Project.

6. Visual Impact Assessment

6.1 PV ARRAY AND O&M BUILDING VIEWSHED ANALYSIS

The viewshed analysis provided in this study was conducted to incorporate the screening effects of topography, vegetation, and structures (as shown in Figure 4). A viewshed analysis discussion based on topography alone (as reflected in Figure 3) is not provided because the results of such an analysis do not accurately represent conditions within the VSA.

Viewshed maps were prepared using a digital surface model (DSM) derived from the Ohio Statewide Imagery Program's (OSIP) 2007 LiDAR data for Hancock, Seneca, and Wood counties; a 200-foot by 200-foot point grid representing the proposed PV panel locations; a PV panel and operations and maintenance (O&M) building height of 15 feet; an observer height of 6 feet; and ESRI ArcGIS® software with the Spatial Analyst extension. Because the O&M building is in a discrete location, while the arrays are located throughout the Project Area, the focus of this analysis is on the solar arrays.

The DSM used for the viewshed was created from the LiDAR data, which includes the elevations of buildings, trees, and any other objects in the landscape that are detected by laser light pulses during the data collection process (the average point spacing in the LiDAR point cloud obtained from OSIP is approximately 7 feet). Because LiDAR data for narrow, vertical landscape features such as overhead utility lines and roadside hedgerows can be interpreted by the software as solid objects and introduce artificial screening into the viewshed analysis, such features were filtered out of the LiDAR point cloud when creating the DSM. Vegetation apparent within the LiDAR data inside the Project fence lines was also filtered out of the LiDAR data to reflect the bare-earth elevation in these locations. The resulting DSM was then used as an input surface for the viewshed analysis. Because such features have been removed, the resulting viewshed is expected to overstate the potential for visibility.

Once the viewshed analysis was completed, PV panel visibility was eliminated in areas where line-of-sight would be blocked for the viewer because the DSM elevation exceeded the bare-earth elevation by 6 feet or more. Changes to the modeled visibility in these areas is required for two reasons: 1) in locations where trees or structures are present in the DSM, the initial viewshed reflects visibility from the vantage point of a person standing on the tree top or building roof, which is not the intent of this analysis; and 2) to reflect the fact that ground-level vantage points within buildings or areas of vegetation exceeding 6 feet in height will generally be screened from views of the Project.

Because it accounts for the screening provided by structures and many of the trees located in the surroundings, the DSM viewshed analysis is a reasonable representation of Project visibility. However, it should be noted that certain characteristics of the Project and VSA are not modeled and may further restrict visibility (e.g., the vegetation removed from the model, color, distance from viewer, and atmospheric/weather conditions). As a result, there may be some areas where visibility indicated by the viewshed does not necessarily equate to actual Project visibility.

Based on the viewshed analysis, potential visibility of the proposed solar panels within the VSA is illustrated in Figure 4 and summarized in Table 6. The model indicates that views of the Project will be screened from approximately 88 percent of the VSA by intervening topography and vegetation; actual visibility is expected to be even less due to additional vegetation and other site-specific factors.

Table 6. Panel Viewshed Analysis Results Summary

Analysis	VSA	Modeled Visibility by Distance Zone			
		Near-Foreground (0 – 0.5-mile)	Foreground (0.5 – 1.5 miles)	Middle-Ground (1.5 – 4.0 miles)	Background (4.0 – 5.0 miles)
Total Area	75,381	4,716	8,852	39,376	22,437
Viewshed Visibility	9,281 (12.3%)	3,732 (79.1%)	3,278 (37.0%)	2,244 (5.7%)	27.6 (0.1%)
Note: All values are approximate and provided in acres.					

PV panel visibility is concentrated within the near-foreground distance zone, with 79 percent of the area within 0.5-mile from the Project Area indicated as having potential views of some portion of the Project. View potential from areas beyond the near-foreground and into the foreground distance zone (0.5 to 1.5 miles) is considerably reduced, with only 37 percent of the foreground distance zone indicated as having the potential for views of the PV panels, and middle-ground and background viewing potential is significantly less.

Ground-truthing (as discussed in Section 6.2) indicates that no areas beyond the foreground distance, and only limited areas within that distance, were currently observed to have views of the approximately 140-foot and approximately 100-foot existing overhead transmission lines that extend through the Project Area. The Project (with a maximum panel height of 15 feet) is also not expected to be visible except in relative proximity.

Potential PV panel visibility within the various Landscape Types, as predicted by the viewshed analysis, is summarized in Table 7.

Table 7. Landscape Types Viewshed Analysis Results Summary

Analysis	VSA	Landscape Type			
		Pasture/Cropland/ Grassland/Scrub-Shrub	Forest	Developed	Wetland/Open Water
Total Area	75,381	61,794	4,029	8,740	818
Viewshed Visibility	9,281 (12.3%)	8,701 (14.1%)	5.6 (0.1%)	487 (5.6%)	87 (10.6%)
Modeled Viewshed Visibility – Near Foreground (0 – 0.5-mile)	4,716	3,518	3.4	209	1
Modeled Viewshed Visibility – Foreground (0.5 – 1.5 miles)	8,851	3,104	1.5	172	0.2
Modeled Visibility – Middle-Ground (1.5 – 4.0 miles)	39,376	2,051	0.7	106	86
Modeled Visibility – Background (4.0 – 5.0 miles)	22,437	28	0	0.1	0
Note: All values are approximate and provided in acres.					

The Pasture/Cropland/Grassland/Scrub-Shrub Landscape Type, which makes up 82 percent of the VSA, has the greatest potential for visibility (14 percent) of the proposed solar arrays. As noted above, ground-truthing via field reconnaissance indicates that areas more distant than the foreground are extremely unlikely to have views of the Project, and that views even at that distance will be limited.

The viewshed map (Figure 4) also illustrates how potential views of the Project would become more limited to smaller portions of the proposed PV panel arrays as distance increases from the Project in certain directions.

6.2 PROJECT SUBSTATION AND UTILITY SWITCHYARD VIEWSHED ANALYSIS

A DSM viewshed analysis was also conducted for aboveground electrical components, consisting of the Project Substation and Utility Switchyard. This viewshed analysis was based on the conservative assumption that related components will be 50 feet tall. While lightning masts associated with each will be approximately 70 feet tall, they will be individual, slender elements that are similar in height to the existing 138-kV overhead transmission lines. Other elements of the Project Substation and Utility Switchyard are expected to generally be at lower elevations than 50 feet; however, they were conservatively assigned an average of this height to reflect the potential variability of structures within the fence lines.

Potential modeled visibility of the Project Substation and Utility Switchyard is illustrated in Figure 8 and summarized in Table 8. As indicated by this analysis, these Project components will be screened from approximately 93 percent of the VSA by intervening landforms, vegetation, and structures.

Table 8. Project Substation and Utility Switchyard Viewshed Analysis Results Summary

Analysis	VSA	Modeled Visibility by Distance Zone			
		Near-Foreground (0 – 0.5-mile)	Foreground (0.5 – 1.5 miles)	Middle-Ground (1.5 – 4.0 miles)	Background (4.0 – 5.0 miles)
Total Area	75,381	4,716	8,852	39,376	22,437
Viewshed Visibility	5,357 (7.1%)	2,328 (49.4%)	1,598 (18.1%)	1,386 (3.5%)	45 (0.2%)
Note: All values are approximate and provided in acres.					

Potential modeled visibility of the Project Substation and Utility Switchyard within the various Landscape Types, as predicted by the viewshed analysis, is summarized in Table 9.

Table 9. Landscape Types Viewshed Analysis Results Summary

Analysis	VSA	Landscape Type			
		Pasture/Cropland/ Grassland/Scrub-Shrub	Forest	Developed	Wetland/Open Water
Total Area	75,381	61,794	4,029	8,740	818
Viewshed Visibility	5,357 (7.1%)	5,000 (8.1%)	2 (0.0%)	273 (3.1%)	82 (10.0%)
Modeled Viewshed Visibility – Near Foreground (0 – 0.5-mile)	2,328	2,201	1	125	1
Modeled Viewshed Visibility – Foreground (0.5 – 1.5 miles)	1,598	1,504	0	94	0

Analysis	VSA	Landscape Type			
		Pasture/Cropland/ Grassland/Scrub-Shrub	Forest	Developed	Wetland/Open Water
Modeled Visibility – Middle-Ground (1.5 – 4.0 miles)	1,386	1,251	1	53	81
Modeled Visibility – Background (4.0 – 5.0 miles)	45	44	0	1	0
Note: All values are approximate and provided in acres.					

The model results indicate the potential for visibility within the Project Area, and for limited areas within the foreground view, with modeled visibility were even further limited as distances radiate out from the Project Area. The model indicates the potential for views where line-of-sight is reflected by the presence of open fields; the Village of Arcadia, for example, would not be expected to have views of these features both due to distance and the effect of intervening structures.

As noted above, ground-truthing (as discussed in Section 6.2) indicates that no areas beyond the foreground distance, and only limited areas within that distance, were currently observed to have views of the approximately 140-foot-tall and approximately 100-foot-tall existing overhead transmission lines that extend through the Project Area. For this reason, these features are also not expected to be visible. Note that non-participating residences surrounding the Project Area are at least 1,200 feet from the Project Substation and Utility Switchyard. That distance and their location within the interior of the Project layout are expected to limit visibility of these structures. Although the Project Substation and Utility Switchyard may be visible from some location in close proximity to the Project, they will be viewed against the backdrop of the existing, taller, overhead transmission infrastructure that extends across the Project site; therefore, they will not result in a meaningful change in visual character.

6.3 FIELD VERIFICATION

Haley & Aldrich conducted field verification to consider potential visibility of the Project as suggested by the viewshed analysis. During the various site visits, staff members drove public roads and visited public vantage points within the VSA and obtained photographs from 43 individual viewpoints; field photographs have been supplemented with GoogleEarth street view photographs. Those viewpoints and associated photographs are shown in Attachment A. The existing overhead 345-kV and 138-kV electrical corridors that traverse the Project Area (approximately 140 and 100 feet tall, respectively) were used as one point of reference to gauge the potential for visibility.

Field review confirmed that the Project will be a considerably less visible than suggested by the viewshed analysis due to existing vegetative screening such as residential landscaping and woodlots (even during winter leaf-off conditions), and the effects of distance. In addition, during the growing season, visibility of the Project from residences and roadways may also be limited by crop growth (particularly for taller crops such as corn) where foreground agricultural fields exist. The combination of relatively low panel height, existing vegetation, gentle variations in topography, the addition of proposed landscaping, and the atmospheric effects of distance will limit visibility of the Project from the majority of the VSA.

6.4 VIEWS FROM VISUALLY SENSITIVE AREAS

As discussed in Section 4, detailed consideration was given to public lands, recreational areas and trails, designated scenic resources, resources of historic significance, and high-use public areas within the VSA. From most of these resources, distance and existing screening by vegetation, topography, or intervening structures is expected to screen the Project from view. Where visibility may be possible, the viewing context and distance would be unlikely to materially change the character of the landscape from visually sensitive resources; therefore, no impact is anticipated. Although the Fostoria Reservoir, the Veterans Memorial Reservoir, and the Veterans Memorial Park were indicated as having the potential for views of the Project, ground-truthing indicated that this is unlikely.

7. Representative Visual Simulations

Visual simulations from four representative locations were produced to illustrate the appearance of the Project and to evaluate its potential visual impact on the existing landscape and viewers within the VSA. An overview of the locations selected for visual simulations is provided in Attachment B.

7.1 VISUAL SIMULATION METHODOLOGY

Visual simulations of the proposed Project were developed by constructing a 3D computer model of the proposed PV arrays and full Project layout based on specifications, dimensions, and locations provided by the Applicant. Next, the camera specifications used to take the selected photographs in the field were replicated in the 3D model. This is done by positioning the 3D camera in the same real-world coordinate system as the Project model using GPS coordinates collected at each photo location. The camera is then aligned, and the camera's target position (view direction) adjusted until the modeled 3D elements align exactly with the elements in the photograph. Once this step is complete, the Project is included in the photograph at the correct location, perspective, and scale. At this point, the appropriate sun angle is simulated based on the specific date, time, and location (latitude and longitude) at which the photograph was taken. This information allows the program to realistically illustrate highlights, shading, and shadows for all Project components shown in the view. All PV panel simulations include single-axis tracker arrays with the panels oriented perpendicular to the sun, on an east-west axis, on north-south aligned arrays. Details of the Project components are rendered using Photoshop to indicate their visual characteristics within the view context. Landscape features were then added to reflect the identified mitigation strategy.

7.2 VISUAL SIMULATION RESULTS

The visual simulations are provided in Attachment B, with a discussion of the potential visual effects associated with the Project are summarized below. An inset image is provided for each to depict the location of the photographer relative to the evaluated Project layout. For each viewpoint, the existing view is depicted, followed by a view representing conditions with the Project in place, showing a 3D simulation of the Project. Where landscaping is proposed (a landscaped photograph, showing the 3D simulation of the Project and any proposed landscaping is also provided). As discussed in Section 9, landscaping is proposed in certain areas that will soften and screen potential views of Project elements still further.

7.2.1 Viewpoint 1 – Monroe Street

7.2.1.1 Existing Conditions

This view is taken from Monroe Street, just east of its intersection with Ambrose Street, looking north toward the Project Area. This view represents potential views from the northernmost portion of the Village of Arcadia, which lies south of the Project Area.

The existing foreground review reflects lawns associated with single family residences located along Monroe Street. Utility poles and wires, as well as trees of varying ages and sizes can be seen within the mown portion of the lawn areas. The location of the Project Area relative to the residential properties is demarcated clearly by the taller herbaceous plantings on the agricultural fields further north. Existing views include an expanse of those fields, with other residential and farm structures, overhead electric distribution and transmission lines, and forested areas visible in the distance.

There are several locations throughout the Project Area where Project features will be set back similar distances from nearby roads and/or other viewers. This location was selected as a relatively heavily traveled roadway that offers this perspective on potential Project visibility.

7.2.1.2 Proposed Project

With the simulated Project in place, the foreground does not change. Although the Project Area is located immediately along the area of taller herbaceous vegetation, the Project layout has incorporated an approximately 160-foot buffer from the closest residence and has eliminated the potential for panels in much of this area.

The panels are shown tilted at their maximum tilt, which would only happen at certain times of the day; the panels would be at a lesser tilt angle throughout the rest of the day. The arrays are surrounded by 7-foot-tall agricultural-style security fencing, which is designed to match the existing character of the area, with wooden posts and woven wire fencing. As can be seen, the panels are visible behind the residences located on the north side of Monroe Street at a distance of approximately 550 feet.

7.2.1.3 Landscaped Simulation

In response to feedback from nearby residents, the Applicant plans to install robust landscaping along the outside of the security fence. This simulation incorporates the proposed Level 3 Landscape Buffer, which is a mixture of deciduous and evergreen vegetation, with varying heights and textures. Although views of the panels are not completely obstructed, the integration of a diversity of species is intended to soften and screen views of the panels. Low-growing grasses and pollinator-friendly vegetation are also incorporated in the landscape plan to provide additional color and enhance the habitat within the Project Area. Grasses are expected to be maintained within the intervening fields, which will also contribute to softening and screening of Project views.

7.2.2 Viewpoint 2 – Township Road 109

7.2.2.1 Existing Conditions

This view is taken from Township Road 109, at a location that is central to the Project Area, looking to where the Project would be located to the southeast. County Route 109 is one of only two locations where panels are proposed on both sides of a road; Township Road 243 is the other. Since there are several residences proximate to this location, it was selected as representative of this type of view. This represents a location where panels will be set back by approximately 300 feet from the viewer to reflect the manner in which views of the Project will be influenced by distance. Viewers from this location would include travelers driving along County Route 109, as well as residents with potential views. The photograph is taken approximately 250 feet northwest from the location of the closest array.

The existing foreground and midground of the view are of agricultural fields, with roadside grasses and relatively open fields with no growth visible in this leaf-off picture. During the growing season, especially if corn were to be planted, the crop growth would likely block line-of-sight to the south. In the background, trees are visible across much of the view, with several residential and farming structures also present, as well the Village of Arcadia water tower.

7.2.2.2 Proposed Project

With the simulated Project in place, the foreground does not change. Although the Project Area is located immediately across County Road 109, the Project layout has incorporated an approximately 160-foot buffer from the closest residence and has eliminated the potential for panels in the foreground.

The panels are shown tilted at their maximum tilt, which would only happen at certain times of the day; the panels would be at a lesser tilt angle throughout the rest of the day. The arrays are surrounded by 7-foot-tall agricultural-style security fencing, which is designed to match the existing character of the area, with wooden posts and woven wire fencing. As can be seen, the panels are visible behind the residences located on the north side of Monroe Street at a distance of approximately 550 feet.

7.2.2.3 Landscaped Simulation

In response to feedback from nearby residents, the Applicant plans to install robust landscaping along the outside of the security fence. This simulation incorporates the proposed Level 3 Landscape Buffer, which is a mixture of deciduous and evergreen vegetation, with varying heights and textures. Although views of the panels are not completely obstructed, the integration of a diversity of species is intended to soften and screen views of the panels. Low-growing grasses and pollinator-friendly vegetation are also incorporated in the landscape plan to provide additional color and enhance the habitat within the Project Area. Grasses are expected to be maintained within the intervening fields, which will also contribute to softening and screening of Project views.

7.2.3 Viewpoint 3 – Township Road 249

7.2.3.1 Existing Conditions

Throughout the Project Area, most views will be set back similar distances from nearby roads and/or other viewers. This location was selected as it lies near several residences located along Township Road 249, approximately 2,000 feet west of the Project Area. This view illustrates how quickly the profile of the Project will dissipate with distance.

The existing near-foreground of the view is of open agricultural fields, with corn stubble visible in this leaf-off picture. Several mature trees are located in the middle-ground, beyond which the Project will be located. In the background, agricultural fields and structures are visible across much of the view, with several visible residential and forested areas. The existing 138-kV overhead electric transmission line structures can be seen in the background of this view, traversing the area amongst the open agricultural fields and the treed areas. With mature crops planted in the fields in the foreground, the Project will be further obscured from view.

7.2.3.2 *Proposed Project*

With the simulated Project in place, the foreground and middle-ground of the image does not change. As is the case in this photograph, more direct views of the Project will be possible during the winter season. During the growing season, crop growth would soften and likely obscure Project views to the south. With even low crop growth, the distantly viewed panels are expected to be obscured. This foreground agricultural field is not a part of the Project Area and is expected to continue its current agricultural use.

The panels are shown tilted toward the viewer at their maximum tilt, which would happen only at certain times of the day; a lesser tilt would occur at other times of the day, reducing the visual height of the panels. Details of the fencing surrounding the panels are difficult to discern; however, the panels are visible in the distance as a low horizontal feature set behind the existing mature trees.

The tops of the trees are visible beyond the panels and the existing 138-kV overhead transmission lines are still visible, although other shorter structures in the distance are obscured.

7.2.3.3 *Landscaped Simulation*

Landscaping is not planned for locations such as this, where the panels are set back a considerable distance, no residences are in immediate proximity, and existing agricultural fields are expected to effectively screen potential views of the Project. Low-growing grasses and pollinator-friendly vegetation are incorporated along the outer edge of the security fence to provide additional color and enhance the habitat within the Project Area. Grasses are also expected to be maintained within the intervening fields, which will also contribute to softening and screening of Project views.

7.2.4 Viewpoint 4 – Township Road 256

7.2.4.1 *Existing Conditions*

This location was selected as it lies near several residences located along Township Road 218 and is representative of views from roadways that traverse the Project Area. There are several locations throughout the Project Area where Project features will be set back similar distances from nearby roads and/or other viewers.

The existing foreground has electric distribution infrastructure, with corn stubble visible in the middle-ground and background in this leaf-off picture. In the background, agricultural fields and structures are visible across much of the view, with several visible residential and forested areas. The existing 345-kV overhead electric transmission lines can be seen in the background of this view, traversing the area amongst the agricultural fields.

7.2.4.2 *Proposed Project*

With the simulated Project in place, the panels are visible in the foreground of the image, set back approximately 140 feet from the viewer.

The panels are shown at their maximum tilt, which would happen only at certain times of the day; a lesser tilt angle would occur at other times of the day, reducing the visual height of the panels. Details of the fencing surrounding the array area are visible in front of the panels. The existing 345-kV overhead transmission lines are still visible in the background, towering over the 15-foot-tall panels.

7.2.4.3 Landscaped Simulation

The Applicant plans to install robust landscaping along the outside of the security fence. This simulation incorporates the proposed Level 3 Landscape Buffer, which is a mixture of deciduous and evergreen vegetation, with varying heights and textures. Although views of the panels are not completely obstructed, the integration of a diversity of species is intended to soften and screen views of the panels. Low-growing grasses and pollinator-friendly vegetation are also incorporated in the landscape plan to provide additional color and enhance the habitat within the Project Area. Grasses are expected to be maintained within the intervening fields, which will also contribute to softening and screening of Project views.

7.3 SUMMARY

In summary, the visual simulations illustrate that visibility of the solar array quickly dissipates with distance and proposed landscaping will soften and screen much of the Project from view.

In limited locations where panels are directly adjacent to roads and residences, the fence and panels may be visible. However, the effect of that visibility on scenic quality or existing landscape character will be very particular to the individual viewing experience. None of the visually sensitive resources identified in Section 4 are expected to have unmitigated, direct views of the Project; therefore, potential visual impacts from the Project will primarily be on nearby non-participating residences and local roads that extend through and immediately around the Project Area. Proposed landscaping to reduce visual effects is not shown on these simulations and is discussed further in Section 9.

The aboveground electrical facilities are consolidated in a location where existing, taller electrical infrastructure, such as the approximately 100-foot-tall 138-kV transmission line, is currently present. Although their higher profile could enhance their visibility, their discrete location limits the viewers who would experience a material change. The effect of that change is limited by being co-located with the existing 138-kV overhead transmission line, which is approximately 100 feet tall.

8. Potential for Glare

At times, glare has been raised as a potential concern for PV solar facility installations. Glare is defined as a continuous source of bright light and is a common phenomenon in our everyday lives. Both the sun and artificial light sources can cause glare either directly (such as from a sunset when driving westbound) or indirectly (such as from the sun's reflections off a lake or glass window). Potential concerns associated with glare may include:

- Safety impacts, such as the potential to disorient motorists when driving or pilots when taking off or landing; or
- Annoyance impacts, such as distraction, after-image in the viewer's vision, or temporary avoidance of a view due to the presence of reflected light.

PV panels, such as those proposed for the Project, are designed to absorb as much sunlight as possible and, in most conditions, reflect very little light. In fact, the PV panels being contemplated include anti-reflective coatings to further maximize energy absorption. Modern PV modules reflect as little as two percent of incoming sunlight, about the same as water and less than soil or even wood shingles (Sandia 2014).

PV facilities with panels mounted on single-axis trackers (such as the Project) rotate to follow the course of the sun to optimize the incident angle of sunlight on their surface. In addition to this optimization producing more energy, this design has the added benefit of generally minimizing glare, which is much more likely to occur at less optimal incident angles.

In considering the potential for glare effects associated with the Project, the extent to which panels will be visible due to such factors as topography or vegetation was considered; the types of potential viewers potentially subject to consideration of such effects was also identified. Details are provided in Attachment C. No glare impacts were modeled in association with the Project.

9. Planned Mitigation and Minimization

No visual impacts are anticipated for any of the designated scenic resources evaluated within 5 miles of the Project Area, although some nearby residences will have views of portions of the Project. To offset visual impacts for local viewers from individual non-participating residences and travelers along local roadways, landscaping will be implemented in locations as shown in the Landscape and Lighting Plan (Attachment D).

The use of fencing compatible with the agricultural character of the surrounding area and the implementation of a landscaping plan will provide for softening of the horizontal lines to lessen potential impacts associated with near-foreground views. The Landscape and Lighting Plan, provided as Attachment D, outlines the methods to be employed by the Applicant to blend the Project into the existing landscape. The Landscape Plan indicates locations where added screening is currently proposed in the form of landscape plantings, and detail regarding the anticipated vegetative screening scenarios. Note that these specific locations may be adjusted based on final design refinements, coordination with landowners regarding preference, and/or other factors.

10. Conclusions

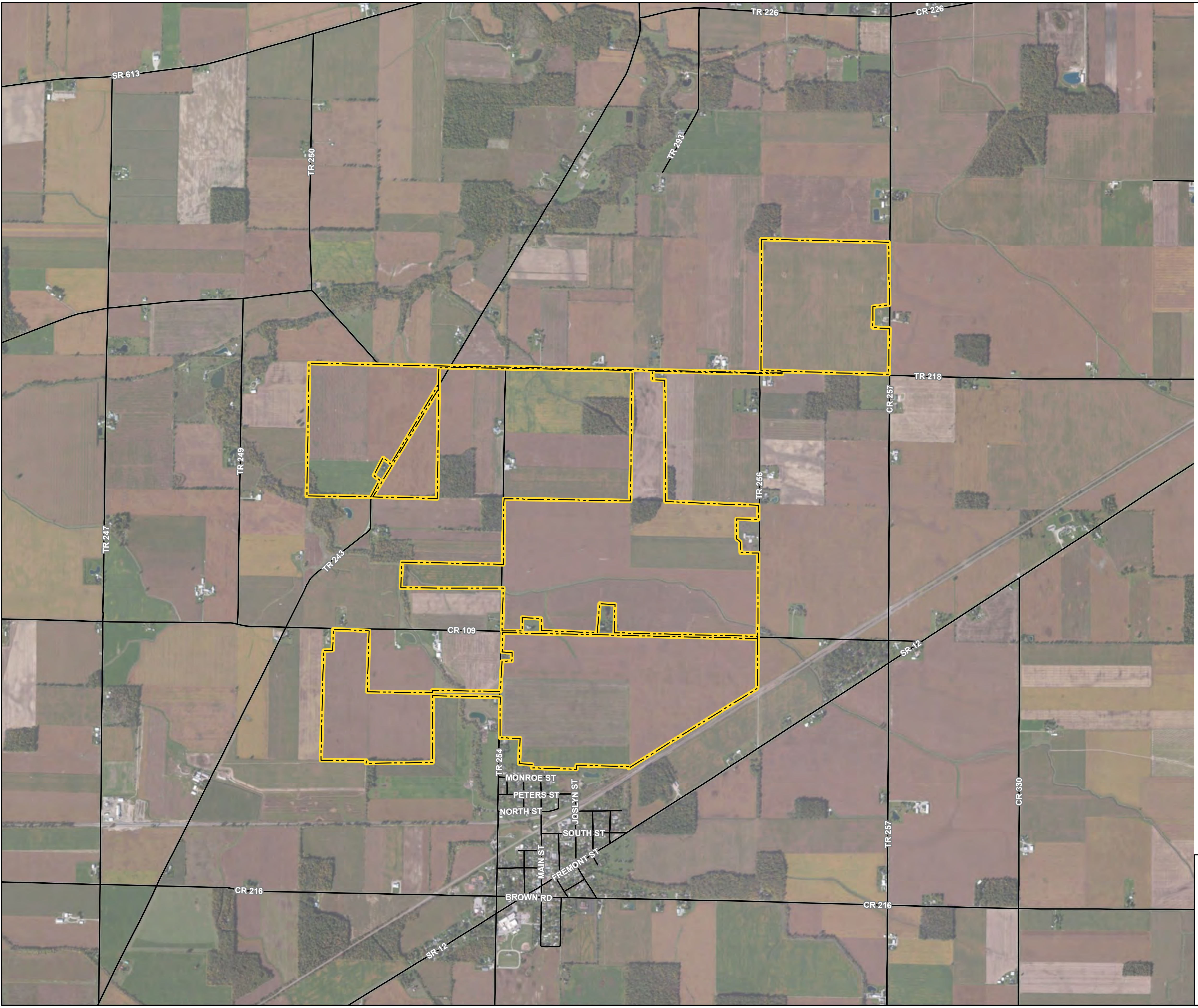
Based upon the analyses described above, the Project is not expected to be visible from any of the identified visually sensitive viewing resources. Visibility of significant portions of the Project is concentrated within the Project Area itself and the open fields located immediately adjacent to the Project. PV panel visibility is higher within the near-foreground distance zone (up to 0.5-mile) and diminishes significantly at the foreground and middle-ground distances. Although modeling indicates that potential visibility could extend between the foreground distance, ground-truthing, as documented in Attachment A, indicated this potential for visibility is overstated. Beyond 0.5-mile, screening provided by existing vegetation and wooded stream corridors, in combination with the low height of the solar panels, will significantly limit Project visibility.

The aboveground electrical components associated with the Project are taller but more compact and are located immediately proximate to other electrical structures of a similar height, such as the approximately 100-foot-tall 138kV transmission line. Although the substation features may be visible from some locations, the impacts of the visibility are expected to be diminished due to the narrow profile of the tallest elements and the neutral color of components, as they blend with the background vegetation and sky.

As illustrated in the visual simulations, the Project will result in varying levels of visual impact when viewed from adjacent roads and residences. This impact may be mitigated by the presence of seasonal crops in actively farmed fields; however, during the rest of the year, the Project will introduce areas of low-lying structures that will alter the existing agricultural character of the landscape. However, as demonstrated in the simulations, this visibility and potential visual impact diminishes rapidly as the Project is viewed from greater distances and landscaping is proposed to further mitigate potential views from sensitive receptors. It is anticipated that impacts will be limited to areas directly adjacent to the Project.

As discussed in Section 9 and Attachment D, the use of landscaping in certain locations (to be revised based upon final design, drain tile locations, and landowner considerations) along certain perimeters of the Project fence line is expected to mitigate the visual impact of the Project when viewed at near-foreground distances. The plantings will serve to break up the horizontal lines created by the array and fence line and help the Project blend with the existing landscape, providing aesthetic as well as ecological benefits.

FIGURES



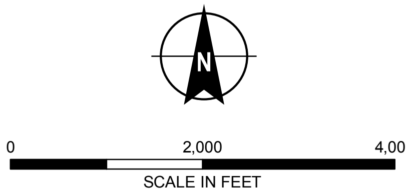
LEGEND

— ROAD

▭ PROJECT AREA

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. ROADS DATA SOURCE: OHIO LOCATION BASED RESPONSE SYSTEM (LBRS)
3. AERIAL IMAGERY SOURCE: ESRI



HALEY ALDRICH

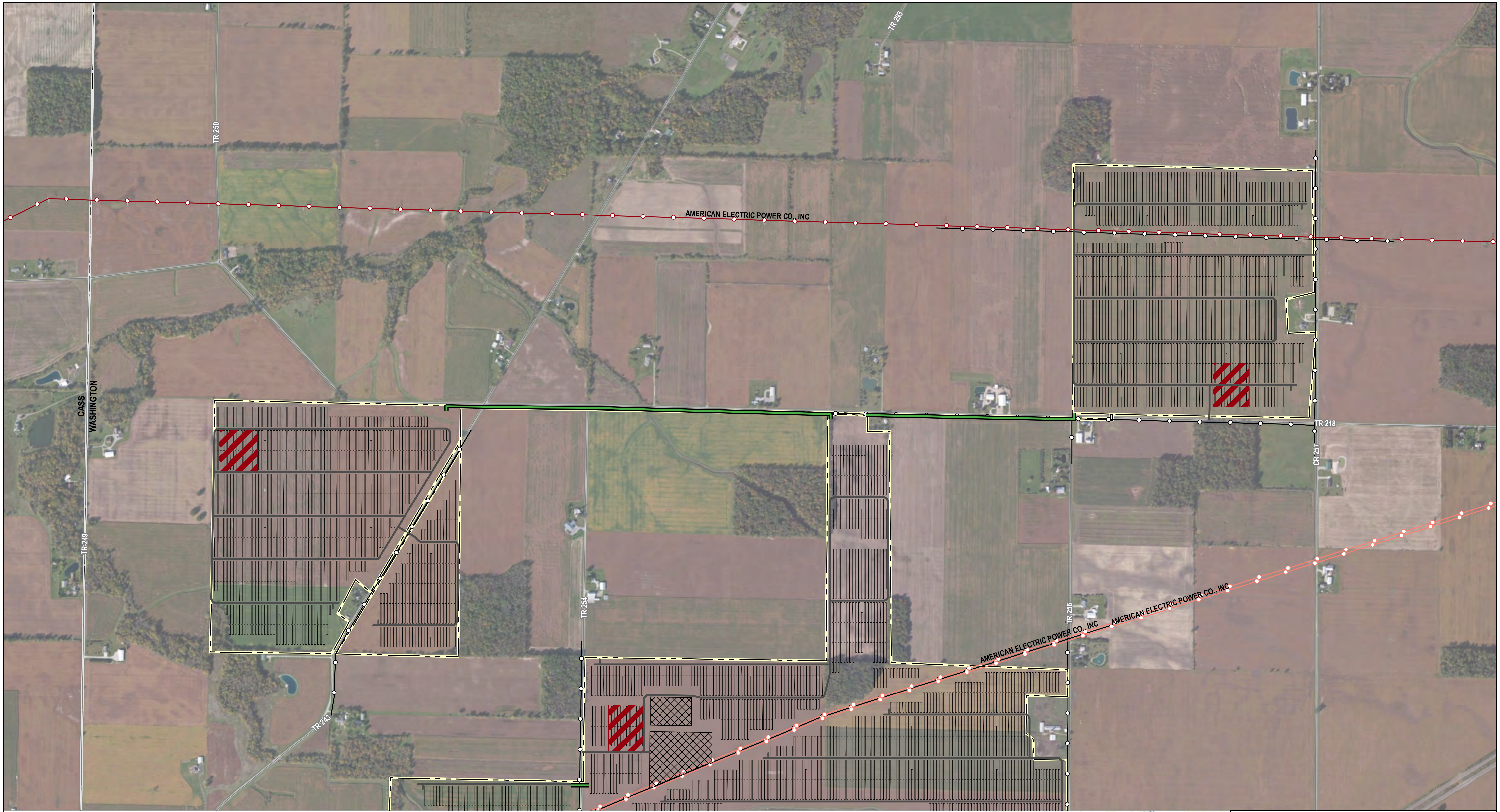
SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

PROJECT AREA

JULY 2021

FIGURE 1

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\VIA\135392_0001_PROJECT AREA.mxd — USER: mmartin — LAST SAVED: 7/15/2021 1:42:14 PM



LEGEND

🟩	POTENTIAL COLLECTION LINE
▬	POTENTIAL GRAVEL ROAD
—○—	138 kV TRANSMISSION LINE
—○—	345kV TRANSMISSION LINE
—○—	TRANSMISSION LINE, UNKNOWN VOLTAGE
—	ROAD
☐	POTENTIAL SOLARY ARRAY
▨	LAYDOWN AREA
⊠	SUBSTATION
☐	PROJECT AREA
☐	TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. kV = KILOVOLTS
3. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD) AND CLIENT
4. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
6. AERIAL IMAGERY SOURCE: ESRI

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SCALE IN FEET

SHEET INDEX

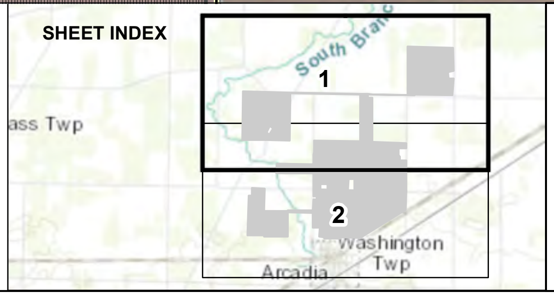
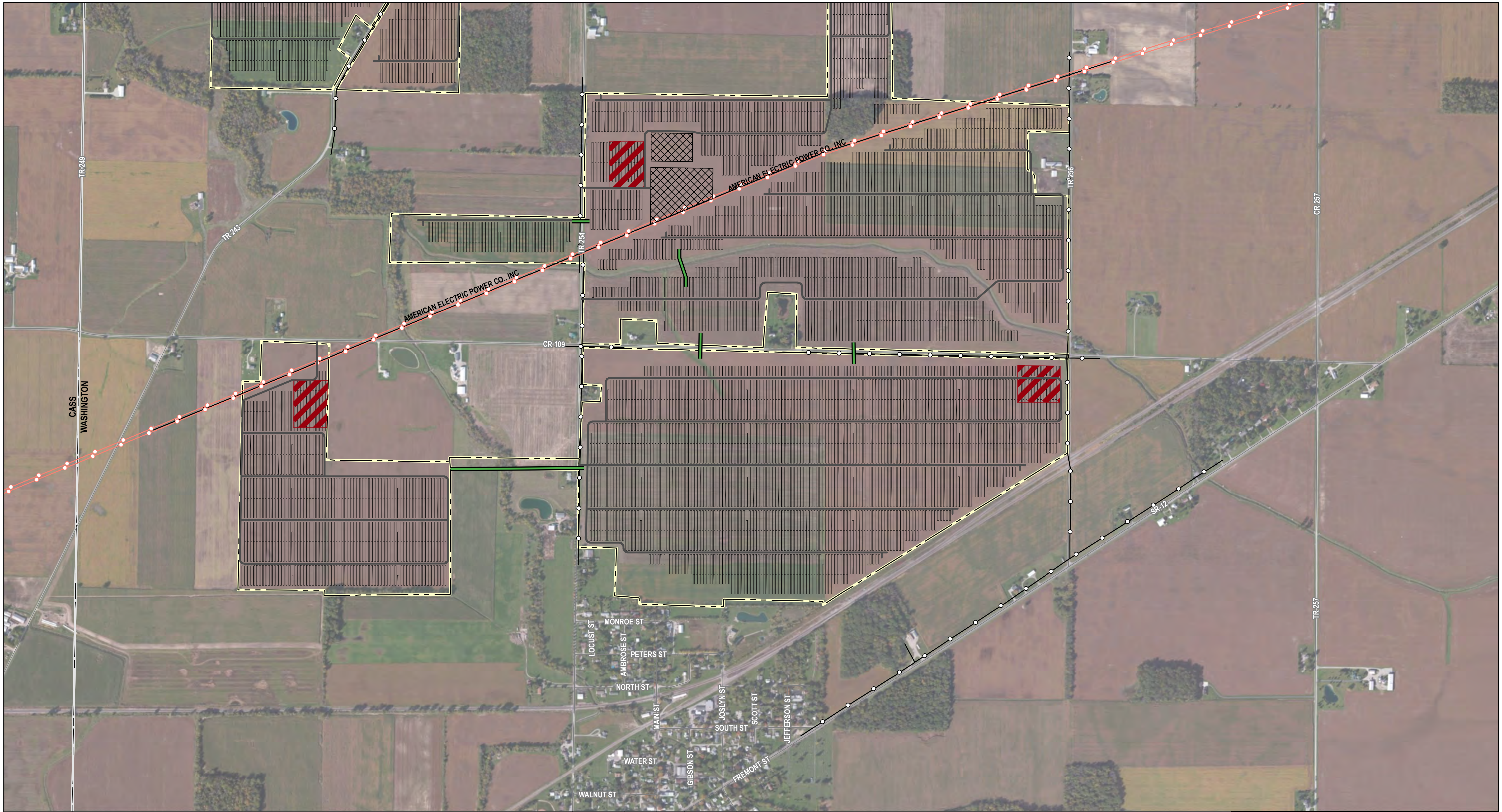


Figure 2 Preliminary Project Layout

Sheet 1 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

- ▬ POTENTIAL COLLECTION LINE
- ▬ POTENTIAL GRAVEL ROAD
- —○— 138 kV TRANSMISSION LINE
- —○— 345kV TRANSMISSION LINE
- —○— TRANSMISSION LINE, UNKNOWN VOLTAGE
- — ROAD
- ☐ POTENTIAL SOLARY ARRAY
- ▨ LAYDOWN AREA
- ▦ SUBSTATION
- ☐ PROJECT AREA
- ☐ TOWNSHIP BOUNDARY

NOTES

1. ALL LOCATIONS AND DIMENSIONS ARE APPROXIMATE.
2. kV = KILOVOLTS
3. ELECTRIC TRANSMISSION LINES DATA SOURCE: DEPARTMENT OF HOMELAND SECURITY (DHS) HOMELAND INFRASTRUCTURE FOUNDATION-LEVEL DATA (HIFLD) AND CLIENT
4. ROADS DATA SOURCE: OHIO DEPARTMENT OF TRANSPORTATION (ODOT)
5. TOWNSHIP BOUNDARIES DATA SOURCE: OHIO EMERGENCY MANAGEMENT AGENCY (OEMA)
6. AERIAL IMAGERY SOURCE: ESRI

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SCALE IN FEET

SHEET INDEX

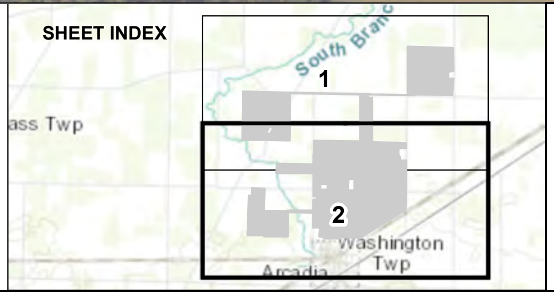
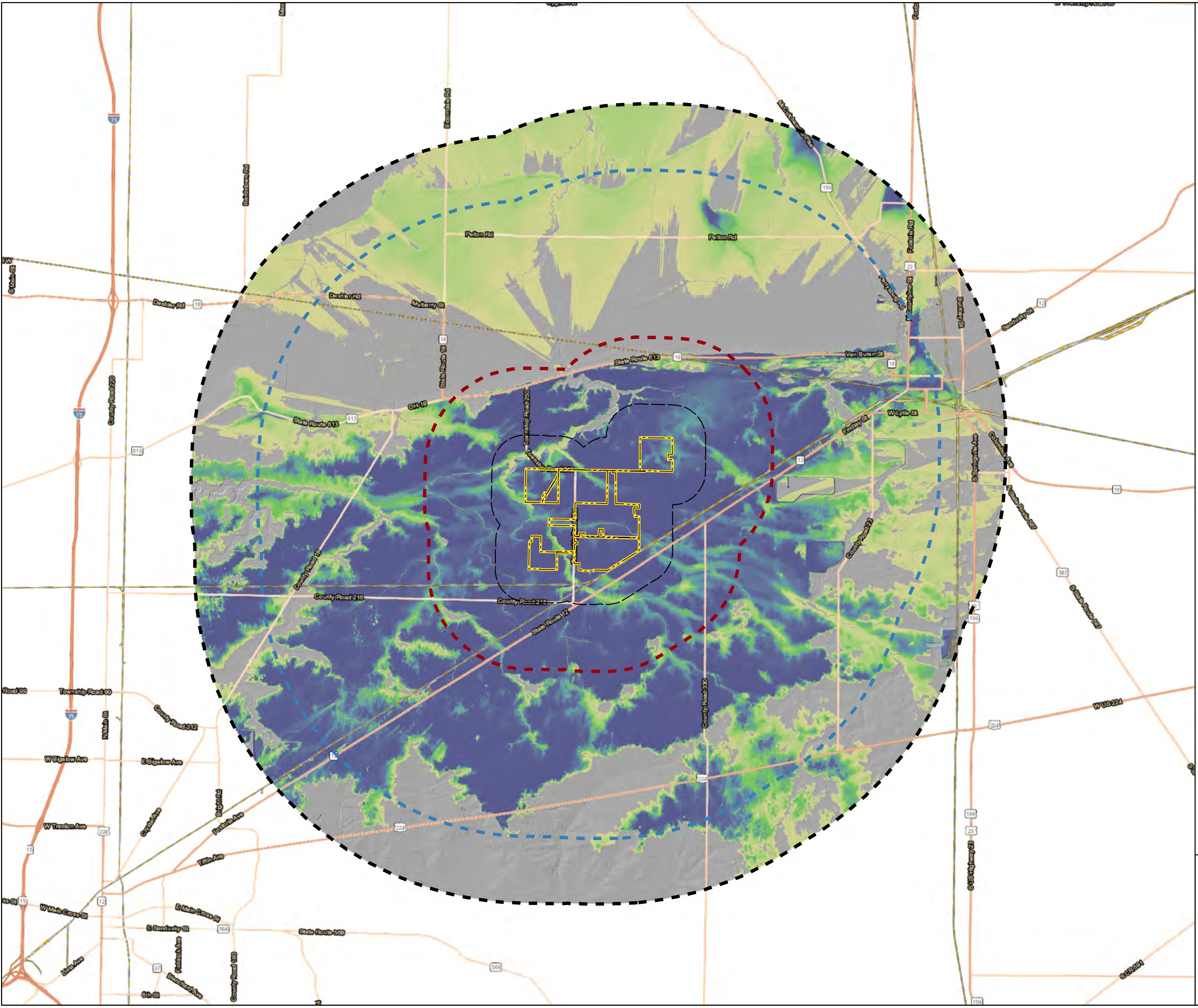


Figure 2 Preliminary Project Layout

Sheet 2 of 2

South Branch Solar
Hancock County, Ohio



LEGEND

▭ PROJECT AREA

▭ 0.5-MILE BUFFER

▭ 1.5-MILE BUFFER

▭ 4-MILE BUFFER

▭ 5-MILE BUFFER

PANEL VISIBILITY

MORE PANELS POTENTIALLY VISIBLE

FEWER PANELS POTENTIALLY VISIBLE

NOTES

1. VIEWSHED ANALYSIS BASED ON OHIO GEOGRAPHICALLY REFERENCED INFORMATION PROGRAM (OGRIP) LIDAR DATA USING BARE EARTH ELEVATIONS ONLY. OBSERVER HEIGHT WAS ASSUMED TO BE 6 FEET AND PANEL HEIGHT WAS ASSUMED TO BE 15 FEET.

2: BASEMAP: ESRI WORLD TRANSPORTATION AND OGRIP LIDAR HILLSHADE.

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0 1 2

Miles

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HANCOCK COUNTY, OHIO

PANEL VIEWSHED ANALYSIS: BARE EARTH

JULY 2021

FIGURE 3

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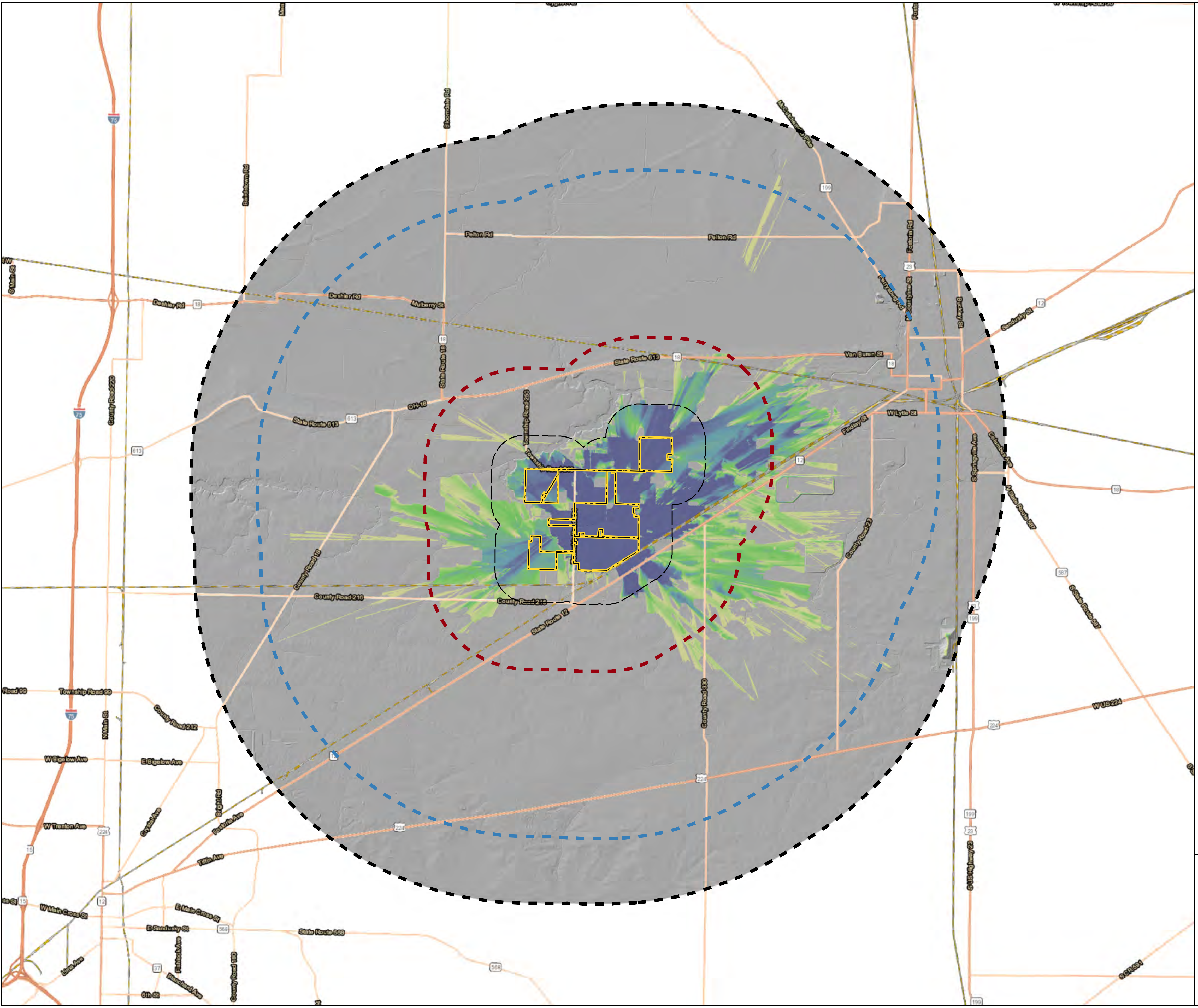

LEGEND

- 🟨 PROJECT AREA
- ⬚ 0.5-MILE BUFFER
- 🟥 1.5-MILE BUFFER
- 🟦 4-MILE BUFFER
- ⬛ 5-MILE BUFFER

PANEL VISIBILITY

- MORE PANELS POTENTIALLY VISIBLE
- FEWER PANELS POTENTIALLY VISIBLE

NOTES

1. VIEWSHED ANALYSIS BASED ON OHIO GEOGRAPHICALLY REFERENCED INFORMATION PROGRAM (OGRIP) LIDAR DATA AND ACCOUNTS FOR THE SCREENING EFFECTS OF VEGETATION, BUILDINGS AND OTHER STRUCURES. OBSERVER HEIGHT WAS ASSUMED TO BE 6 FEET AND PANEL HEIGHT WAS ASSUMED TO BE 15 FEET.

2: BASEMAP: ESRI WORLD TRANSPORTATION AND OGRIP LIDAR HILLSHADE.

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Miles

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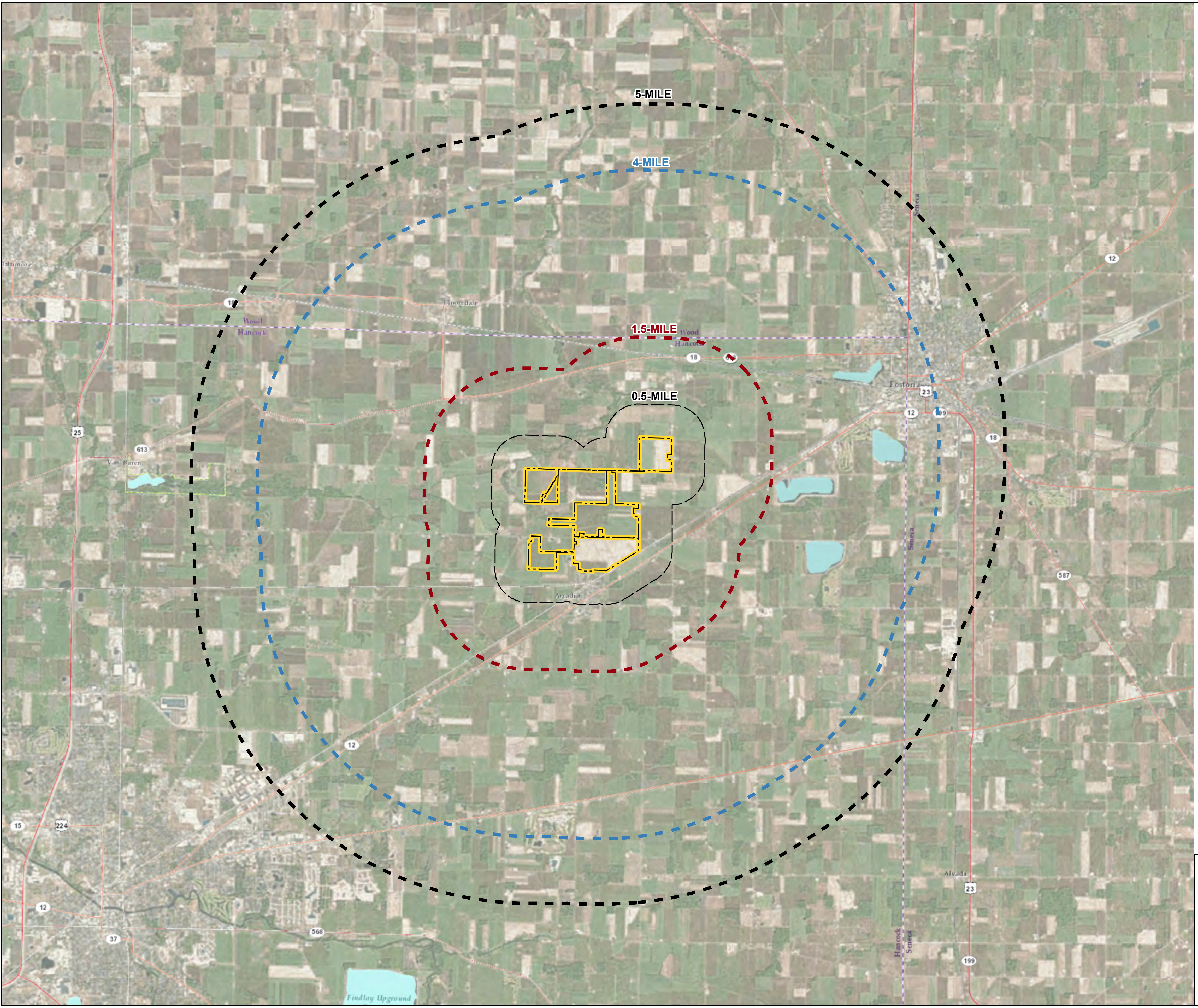
HANCOCK COUNTY, OHIO

PANEL VIEWSHED ANALYSIS:
VEGETATED

JULY 2021

FIGURE 4

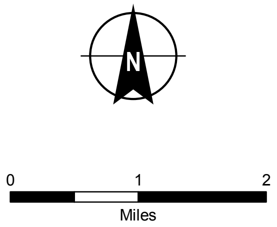


LEGEND

- ⬚ 0.5-MILE BUFFER
- ⬚ 1.5-MILE BUFFER
- ⬚ 4-MILE BUFFER
- ⬚ 5-MILE BUFFER
- ⬚ PROJECT AREA

NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI REFERENCE LAYER.



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HANCOCK COUNTY, OHIO

VISUAL STUDY AREA

JULY 2021

FIGURE 5

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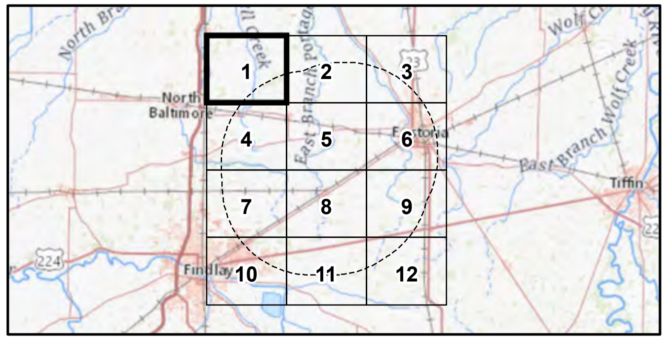
LEGEND

- ● AIR NAVIGATION FACILITY
- ● CEMETERY
- ● SCENIC RESOURCE
- ● LIBRARY
- ● PLACE OF WORSHIP
- ● RECREATIONAL AREA
- ● SCHOOL
- ▭ 0.5-MILE BUFFER
- ▭ 1.5-MILE BUFFER
- ▭ 4-MILE BUFFER
- ▭ 5-MILE BUFFER
- ▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 1 OF 12

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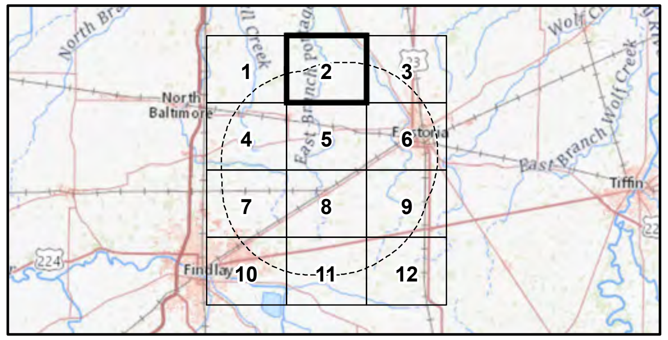
LEGEND

● AIR NAVIGATION FACILITY
● CEMETERY
● SCENIC RESOURCE
● LIBRARY
● PLACE OF WORSHIP
● RECREATIONAL AREA
● SCHOOL
0.5-MILE BUFFER
1.5-MILE BUFFER
4-MILE BUFFER
5-MILE BUFFER
PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 2 OF 12

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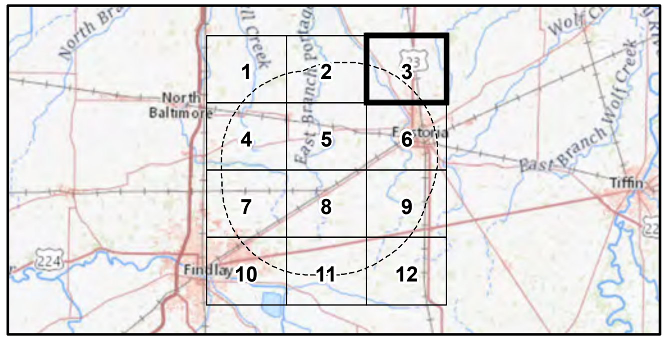
LEGEND

●	AIR NAVIGATION FACILITY
●	CEMETERY
●	SCENIC RESOURCE
●	LIBRARY
●	PLACE OF WORSHIP
●	RECREATIONAL AREA
●	SCHOOL
▭	0.5-MILE BUFFER
▭	1.5-MILE BUFFER
▭	4-MILE BUFFER
▭	5-MILE BUFFER
▭	PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 3 OF 12

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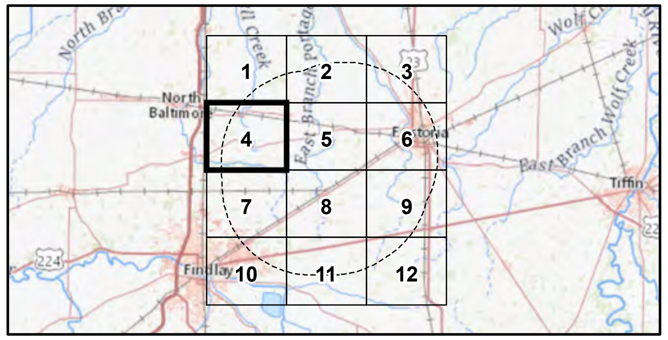
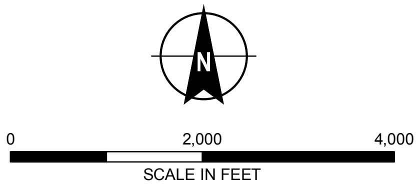
LEGEND

- ● AIR NAVIGATION FACILITY
- ● CEMETERY
- ● SCENIC RESOURCE
- ● LIBRARY
- ● PLACE OF WORSHIP
- ● RECREATIONAL AREA
- ● SCHOOL
- ⬚ 0.5-MILE BUFFER
- ⬚ 1.5-MILE BUFFER
- ⬚ 4-MILE BUFFER
- ⬚ 5-MILE BUFFER
- ⬚ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION



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HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 4 OF 12

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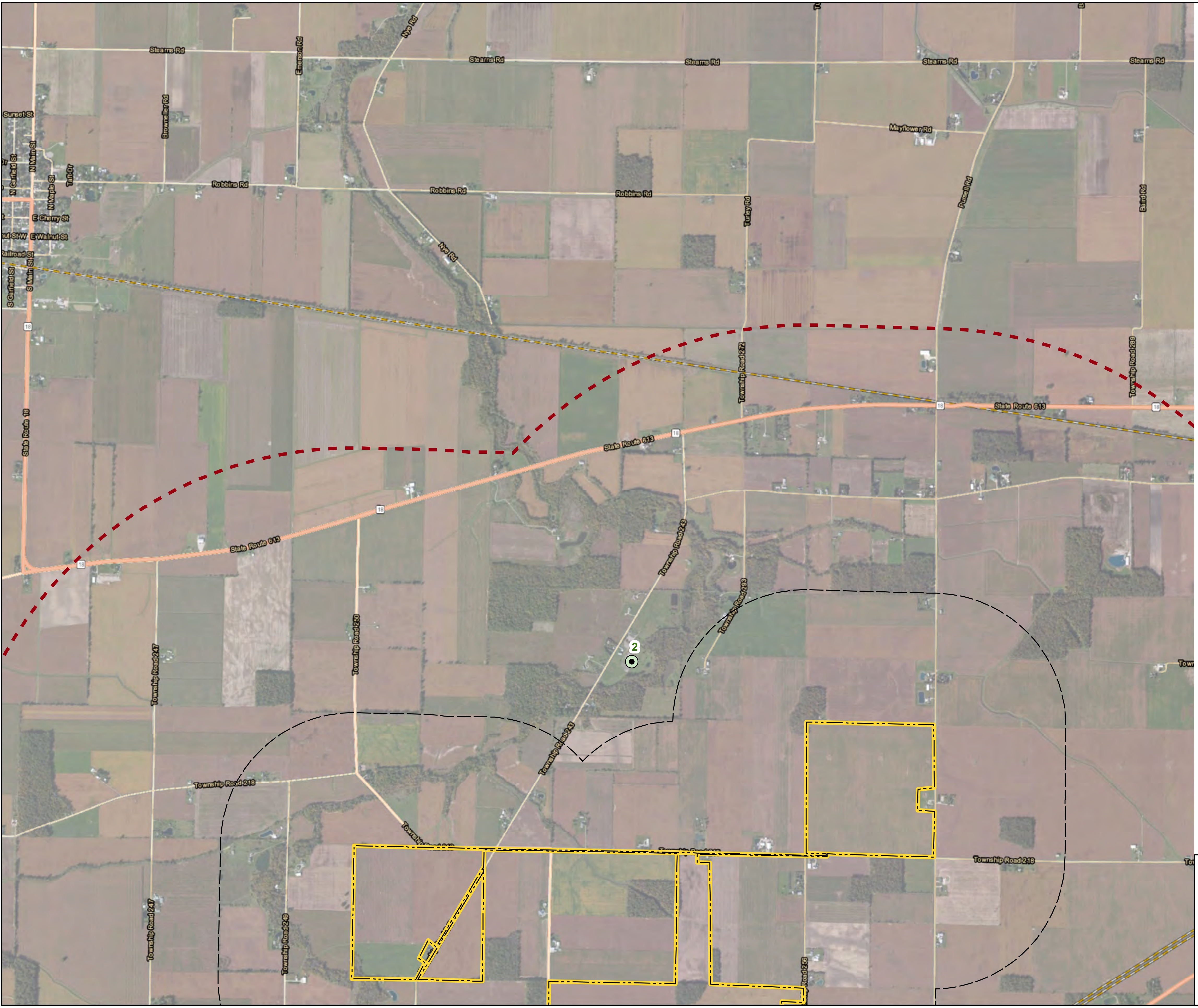

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LEGEND

- ● AIR NAVIGATION FACILITY
- ● CEMETERY
- ● SCENIC RESOURCE
- ● LIBRARY
- ● PLACE OF WORSHIP
- ● RECREATIONAL AREA
- ● SCHOOL
- ▭ 0.5-MILE BUFFER
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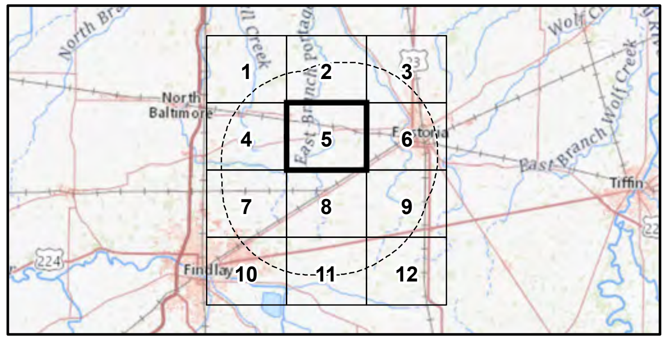
- ▭ 4-MILE BUFFER
- ▭ 5-MILE BUFFER
- ▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 5 OF 12

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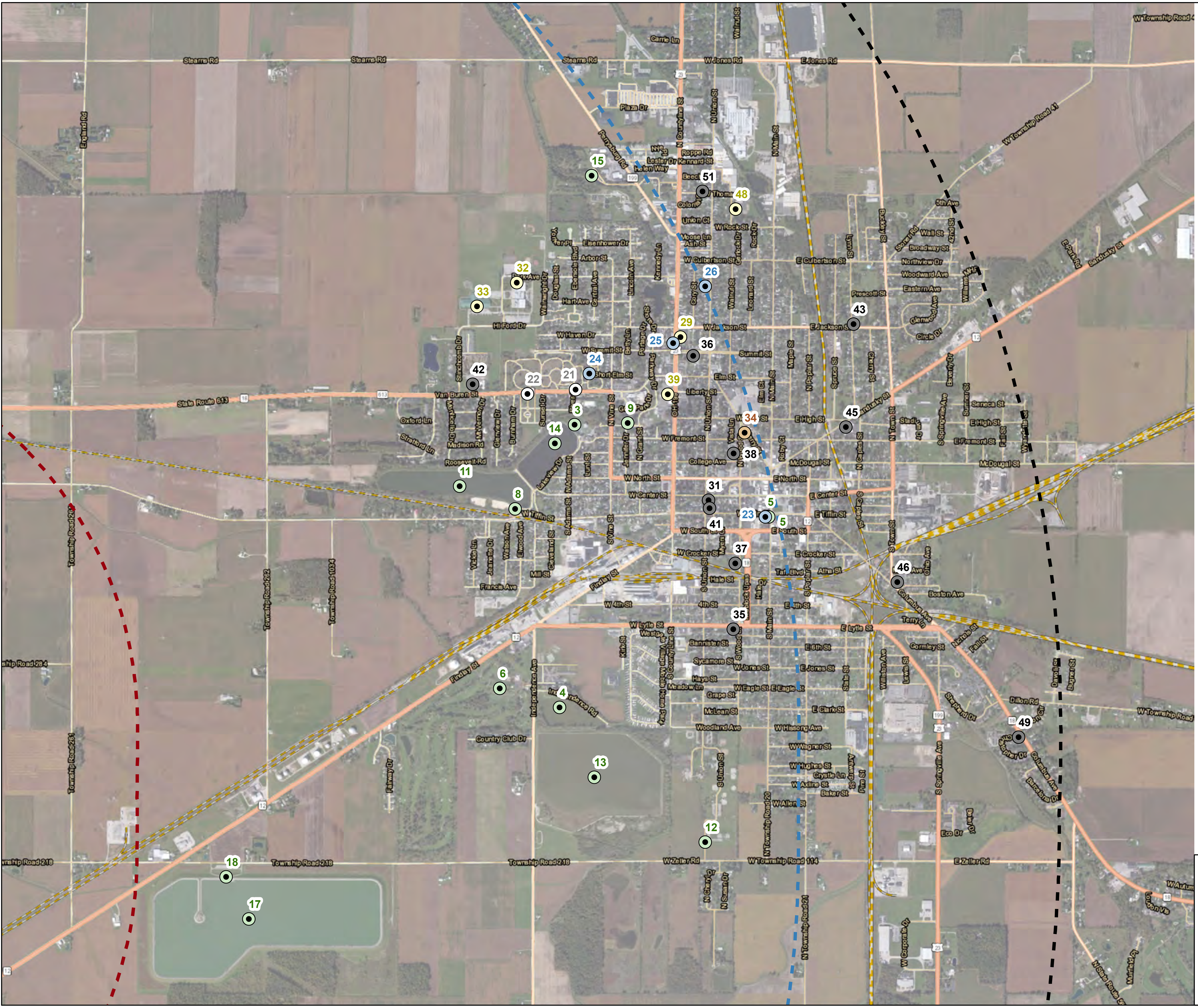

LEGEND

- ⊙ AIR NAVIGATION FACILITY
- ⊙ CEMETERY
- ⊙ SCENIC RESOURCE
- ⊙ LIBRARY
- ● PLACE OF WORSHIP
- ⊙ RECREATIONAL AREA
- ⊙ SCHOOL
- ▭ 0.5-MILE BUFFER
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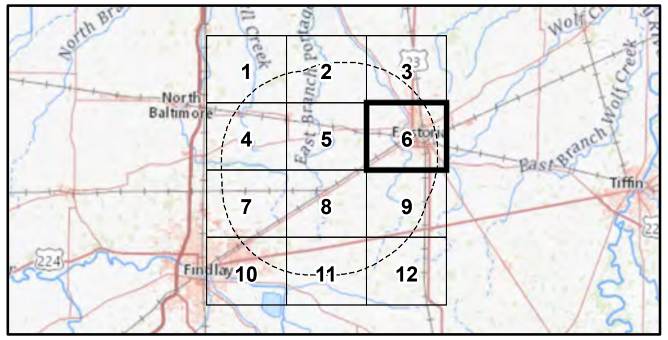
- ▭ 4-MILE BUFFER
- ▭ 5-MILE BUFFER
- ▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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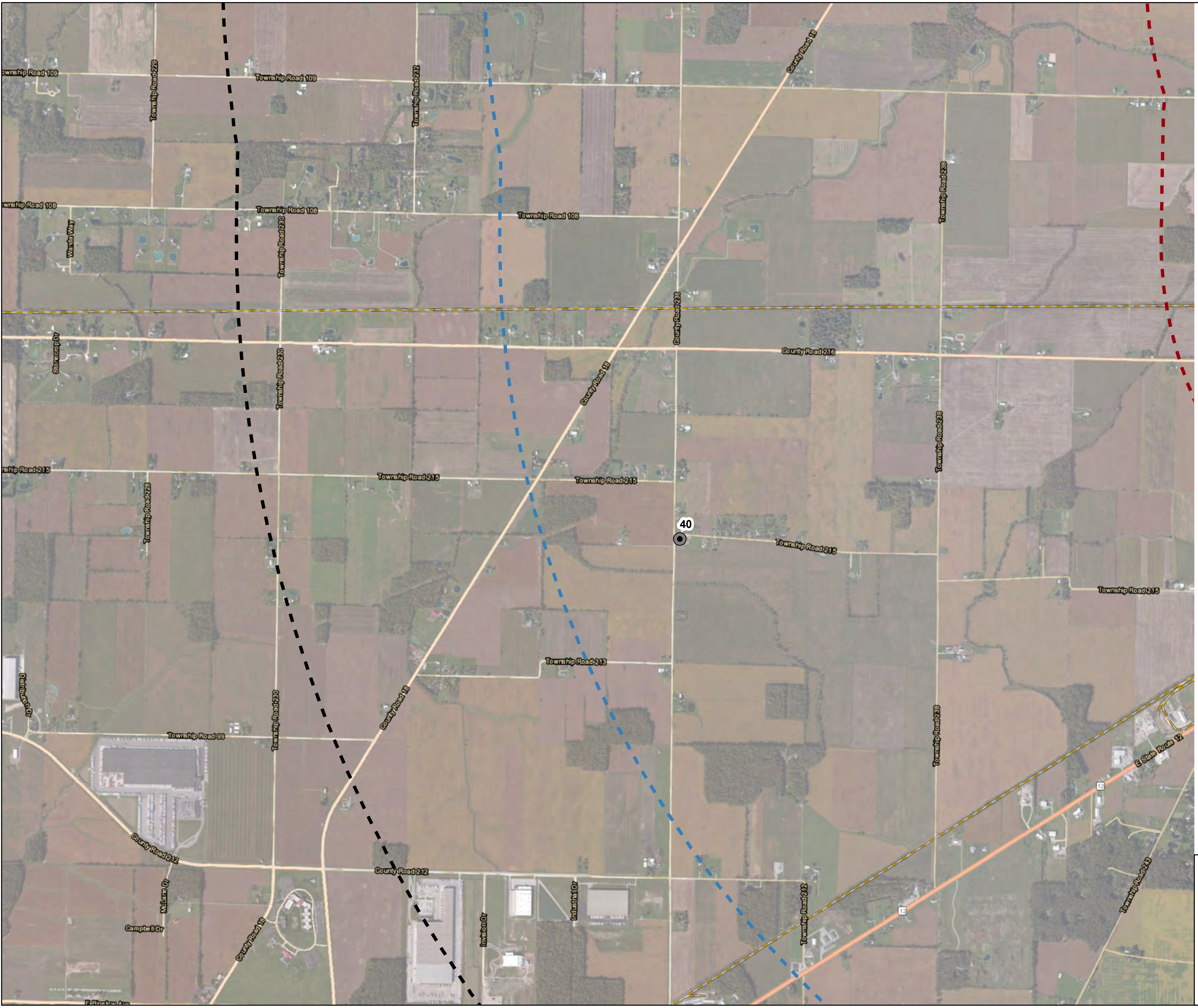
SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

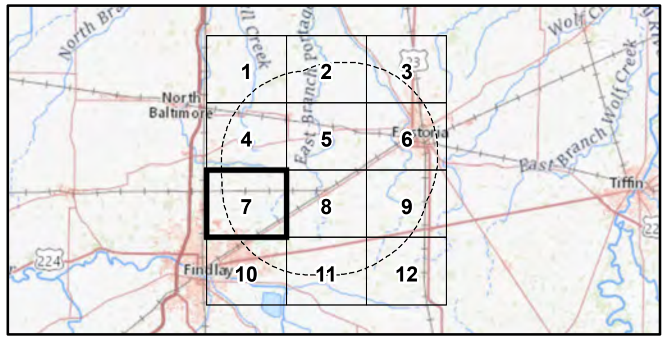
JULY 2021

FIGURE 6
SHEET 6 OF 12



LEGEND

● AIR NAVIGATION FACILITY
● CEMETERY
● SCENIC RESOURCE
● LIBRARY
● PLACE OF WORSHIP
● RECREATIONAL AREA
● SCHOOL
▭ 0.5-MILE BUFFER
▭ 1.5-MILE BUFFER
▭ 4-MILE BUFFER
▭ 5-MILE BUFFER
▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 7 OF 12

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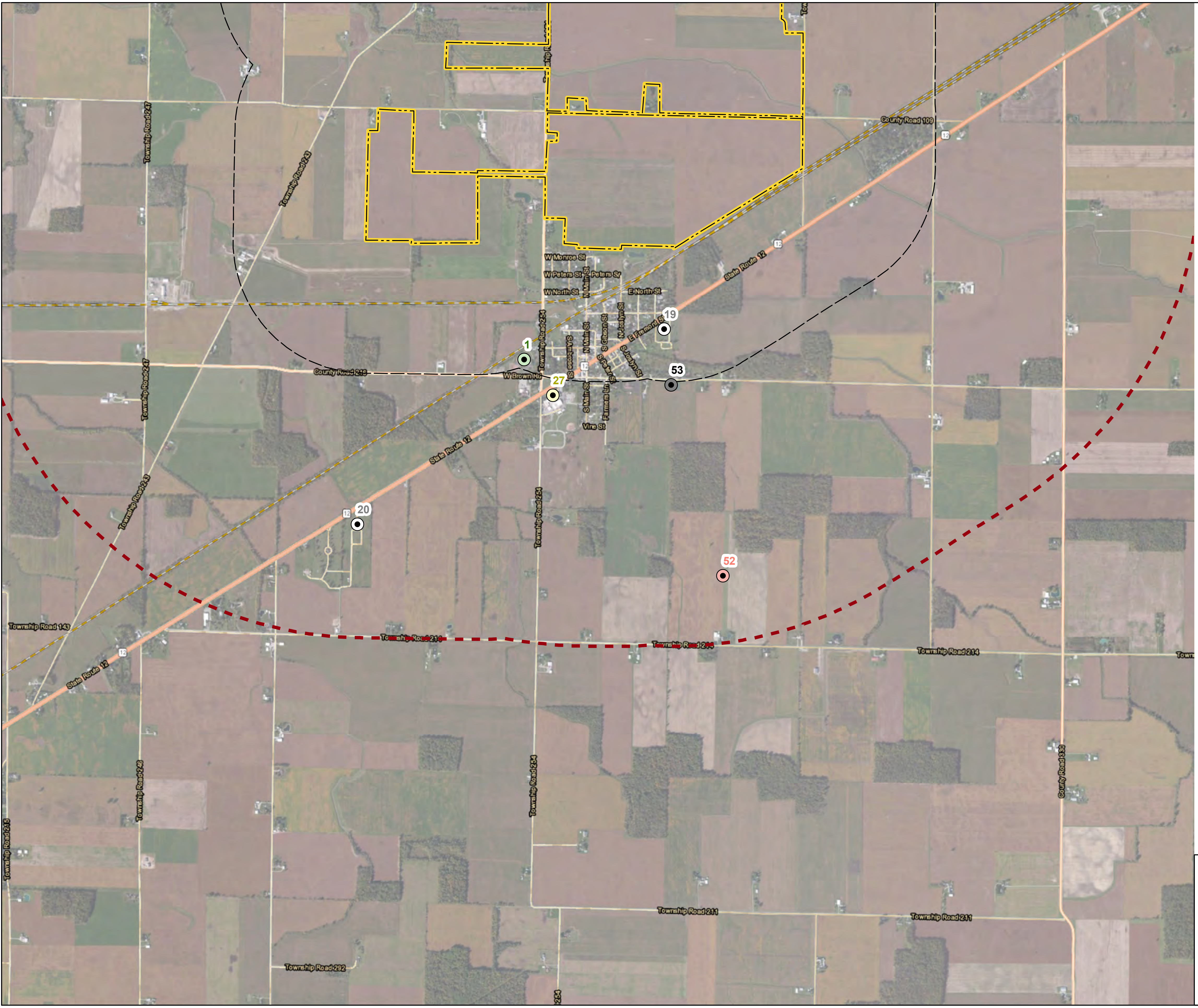
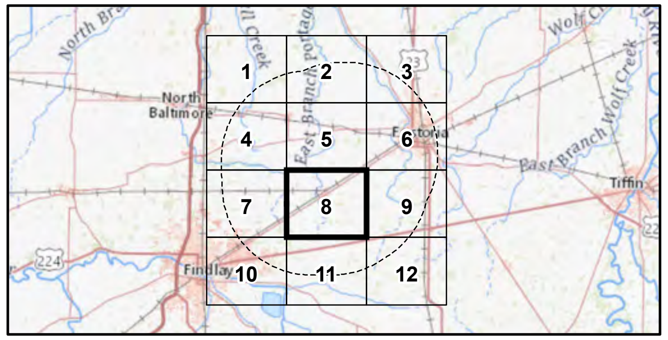


LEGEND

- ● AIR NAVIGATION FACILITY
- ● CEMETERY
- ● SCENIC RESOURCE
- ● LIBRARY
- ● PLACE OF WORSHIP
- ● RECREATIONAL AREA
- ● SCHOOL
- ▭ 0.5-MILE BUFFER
- ▭ 1.5-MILE BUFFER
- ▭ 4-MILE BUFFER
- ▭ 5-MILE BUFFER
- ▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

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SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 8 OF 12

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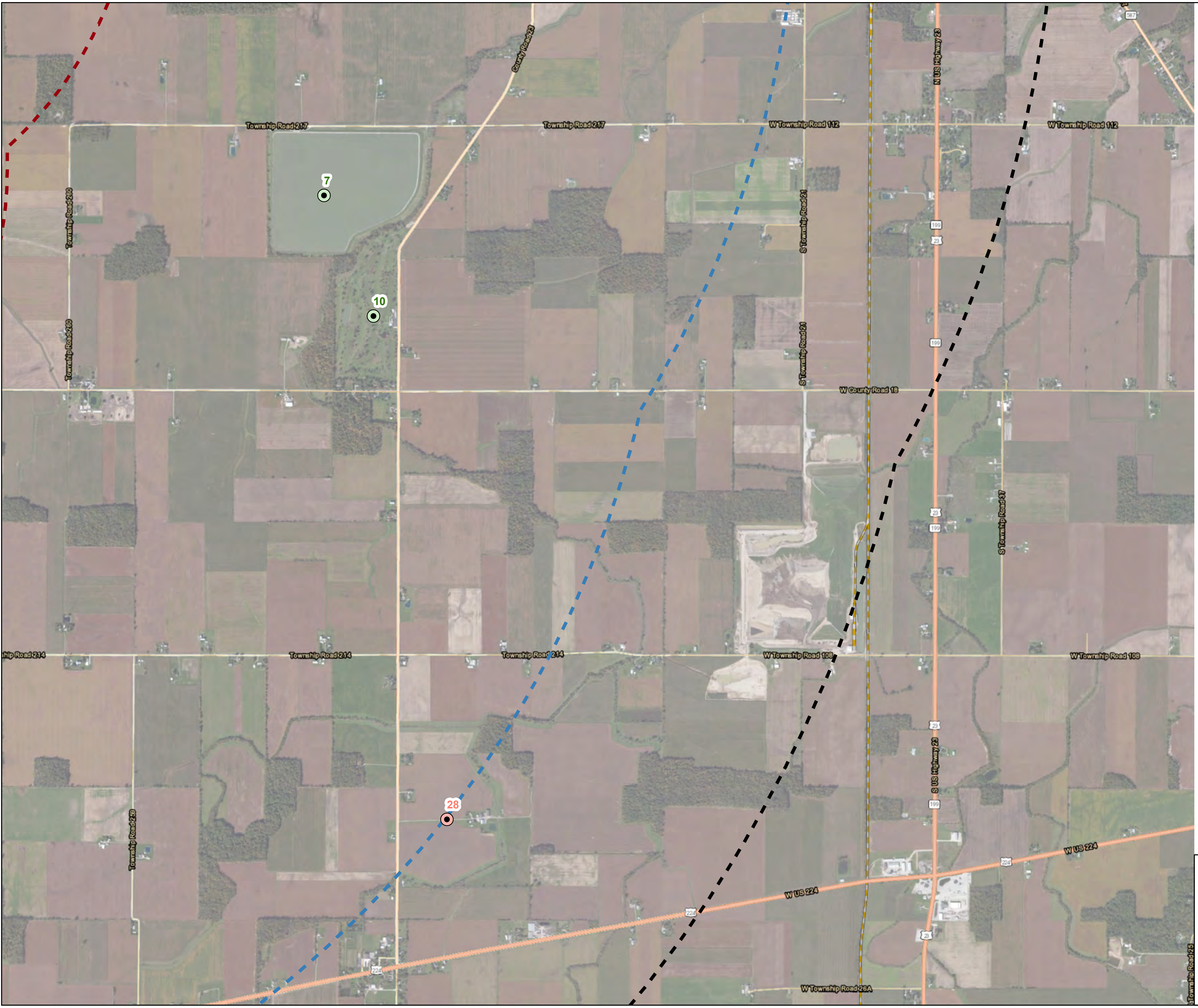
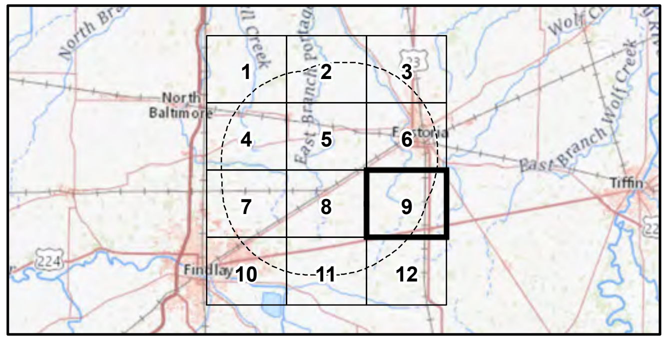


LEGEND

● AIR NAVIGATION FACILITY
● CEMETERY
● SCENIC RESOURCE
● LIBRARY
● PLACE OF WORSHIP
● RECREATIONAL AREA
● SCHOOL
▭ 0.5-MILE BUFFER
▭ 1.5-MILE BUFFER
▭ 4-MILE BUFFER
▭ 5-MILE BUFFER
▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

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SCALE IN FEET

HALEY ALDRICH

SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 9 OF 12

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\VIA\135392_0006_VISUALLY SENSITIVE RESOURCES.mxd — USER: mmartin — LAST SAVED: 7/9/2021 12:04:17 AM

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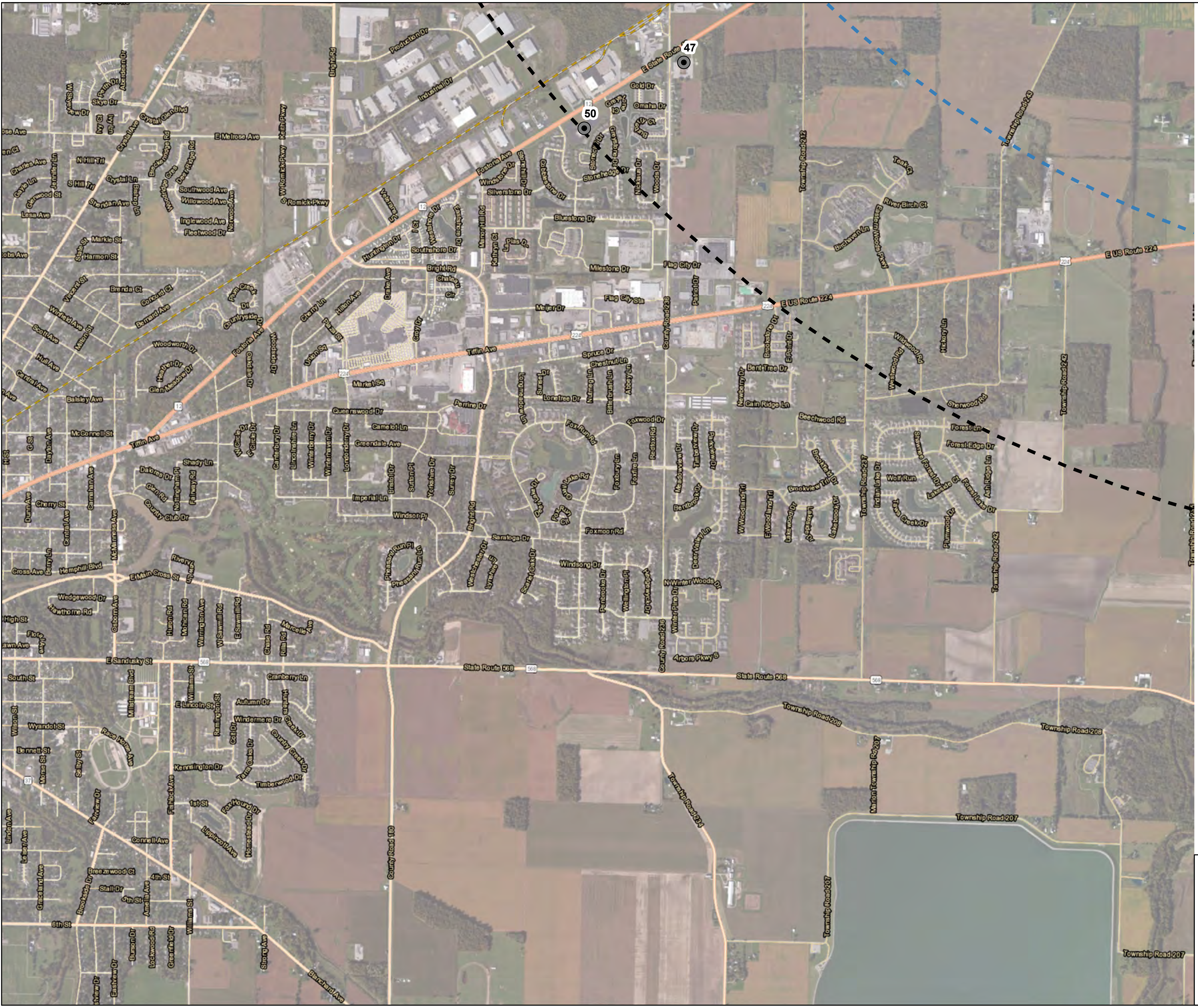


LEGEND

● AIR NAVIGATION FACILITY

● CEMETERY

● SCENIC RESOURCE

● LIBRARY

● PLACE OF WORSHIP

● RECREATIONAL AREA

● SCHOOL

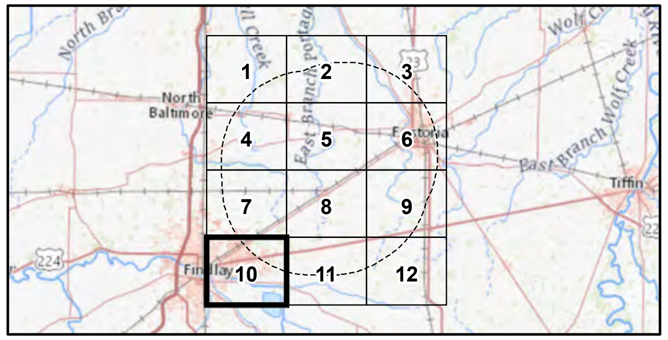
▭ 0.5-MILE BUFFER

▭ 1.5-MILE BUFFER

▭ 4-MILE BUFFER

▭ 5-MILE BUFFER

▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

N

0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

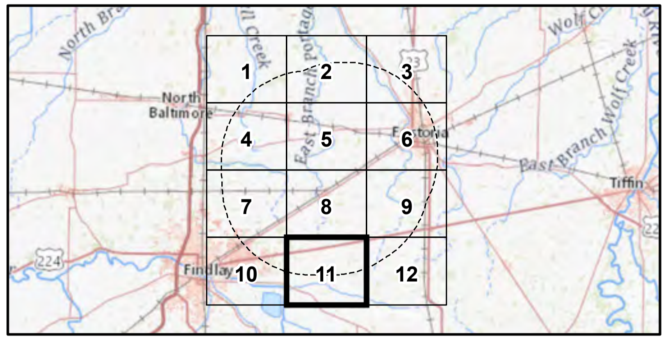
VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 10 OF 12

LEGEND

- ● AIR NAVIGATION FACILITY
- ● CEMETERY
- ● SCENIC RESOURCE
- ● LIBRARY
- ● PLACE OF WORSHIP
- ● RECREATIONAL AREA
- ● SCHOOL
- ▭ 0.5-MILE BUFFER
- ▭ 1.5-MILE BUFFER
- ▭ 4-MILE BUFFER
- ▭ 5-MILE BUFFER
- ▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

N

0 2,000 4,000
SCALE IN FEET

HALEY ALDRICH

SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 11 OF 12

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\VIA\135392_0006_VISUALLY SENSITIVE RESOURCES.mxd — USER: mmartin — LAST SAVED: 7/9/2021 12:04:17 AM

LEGEND

● AIR NAVIGATION FACILITY

● CEMETERY

● SCENIC RESOURCE

● LIBRARY

● PLACE OF WORSHIP

● RECREATIONAL AREA

● SCHOOL

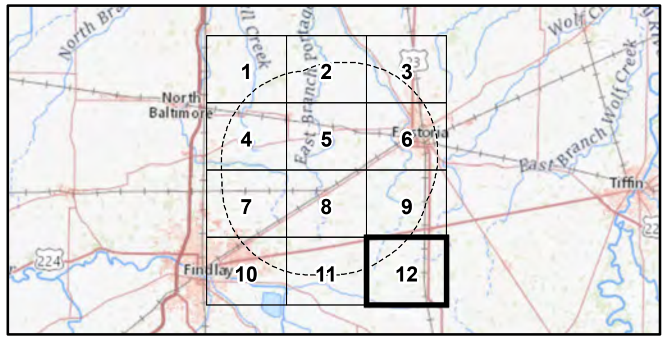
▭ 0.5-MILE BUFFER

▭ 1.5-MILE BUFFER

▭ 4-MILE BUFFER

▭ 5-MILE BUFFER

▭ PROJECT AREA



NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION

N

0 2,000 4,000

SCALE IN FEET

HALEY ALDRICH

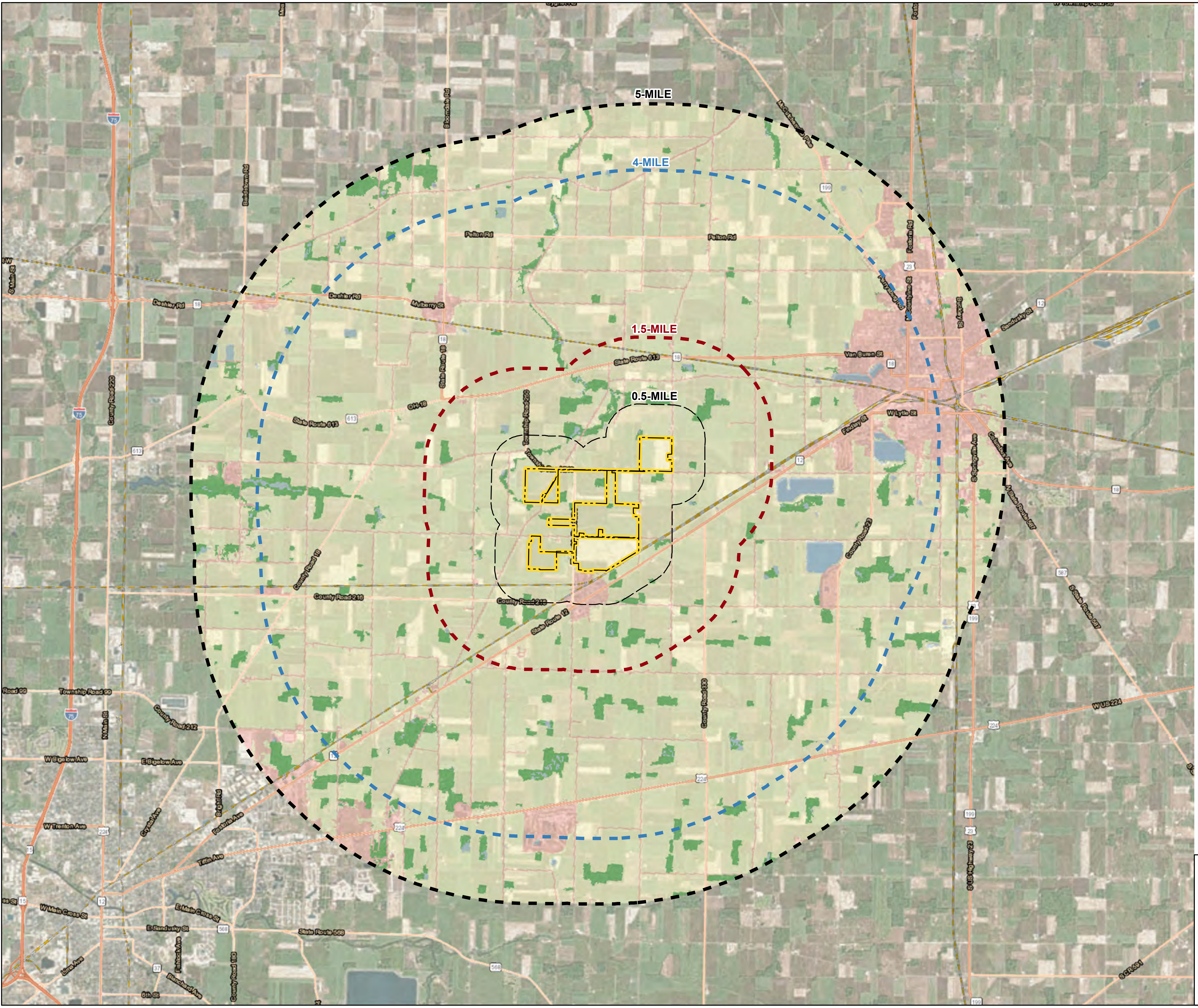
SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

VISUALLY SENSITIVE RESOURCES

JULY 2021

FIGURE 6
SHEET 12 OF 12

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\VIA\135392_0006_VISUALLY SENSITIVE RESOURCES.mxd — USER: mmartin — LAST SAVED: 7/9/2021 12:04:17 AM



LEGEND

🟦	WETLAND/OPEN WATER
🟥	DEVELOPED
🟩	FOREST
🟨	PASTURE/CROPLAND/GRASSLAND/SCRUB-SHRUB/BARREN
▭	0.5-MILE BUFFER
▭	1.5-MILE BUFFER
▭	4-MILE BUFFER
▭	5-MILE BUFFER
▭	PROJECT AREA

NOTES

1. BASEMAP: CLARITY WORLD IMAGERY AND ESRI WORLD TRANSPORTATION.

N

0 1 2
Miles

HALEY ALDRICH

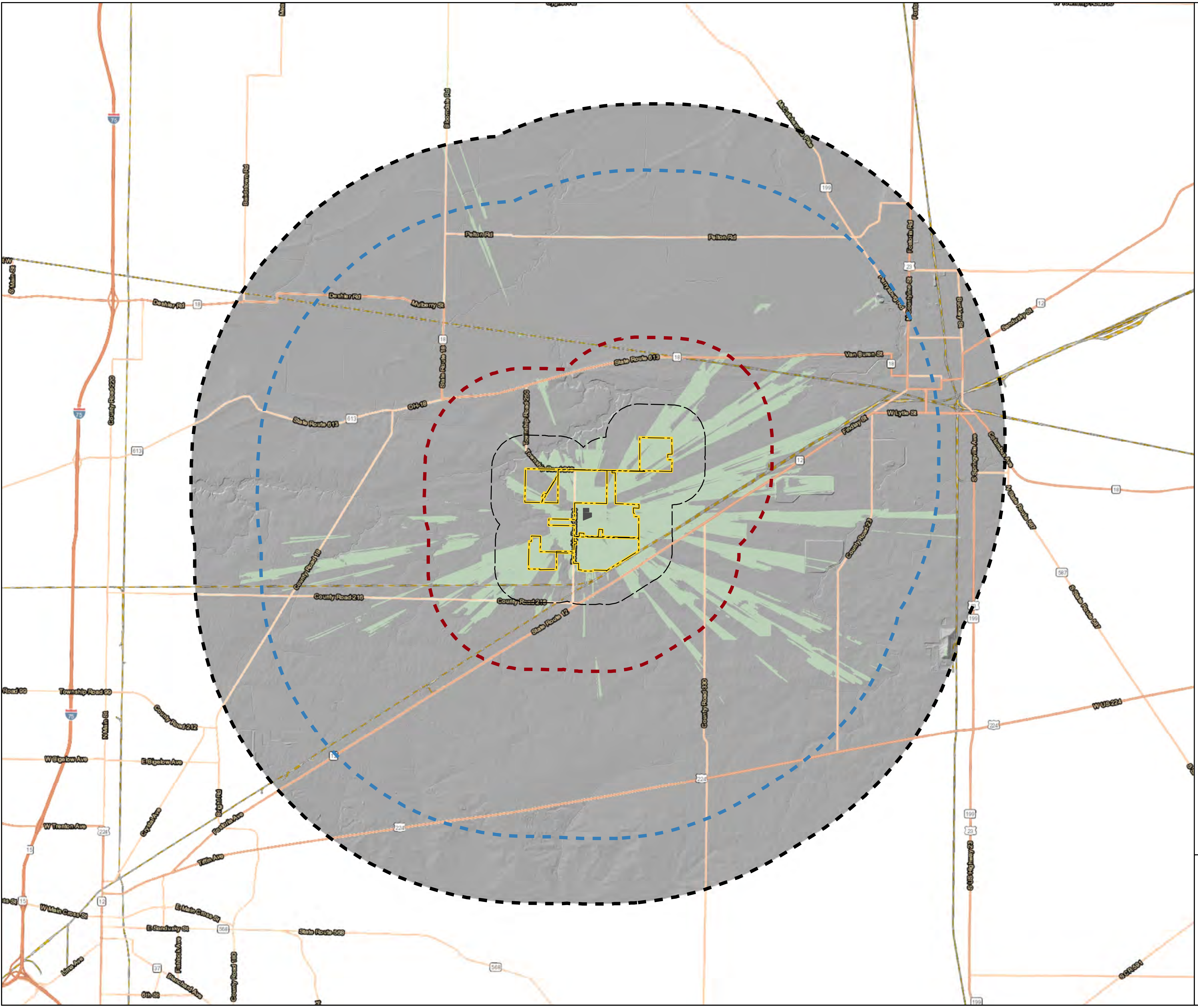
SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

LANDSCAPE CHARACTER

JULY 2021

FIGURE 7

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\VIA\135392_0007_LANDSCAPE CHARACTER.mxd — USER: mmartin — LAST SAVED: 7/15/2021 2:09:58 PM



LEGEND

- 🟩 POTENTIALLY VISIBLE
- ■ SUBSTATION
- PROJECT AREA
- 0.5-MILE BUFFER
- 1.5-MILE BUFFER
- 4-MILE BUFFER
- 5-MILE BUFFER

NOTES

1. VIEWSHED ANALYSIS BASED ON OHIO GEOGRAPHICALLY REFERENCED INFORMATION PROGRAM (OGRIP) LIDAR DATA AND ACCOUNTS FOR THE SCREENING EFFECTS OF VEGETATION, BUILDINGS AND OTHER STRUCURES. OBSERVER HEIGHT WAS ASSUMED TO BE 6 FEET AND SUBSTATION HEIGHT WAS ASSUMED TO BE 50 FEET.

2: BASEMAP: ESRI WORLD TRANSPORTATION AND OGRIP LIDAR HILLSHADE.

N

0 1 2
Miles

HALEY ALDRICH

SOUTH BRANCH SOLAR PROJECT
HANCOCK COUNTY, OHIO

PROJECT SUBSTATION AND UTILITY SWITCHYARD VIEWSHED ANALYSIS

JULY 2021

FIGURE 8

GIS FILE PATH: C:\Users\mmartin\Desktop\South_Branch\GIS\Maps\VIA\135392_000X_VIEWSHED ANALYSIS_SUBSTATION.mxd — USER: mmartin — LAST SAVED: 7/15/2021 6:22:02 PM

ATTACHMENT A
PHOTOGRAPH LOG

PHOTO LOG
SOUTH BRANCH SOLAR
APRIL 2021

Photo 1. Route 12, looking northwest

Photo 2. Intersection of Jefferson and E South, looking east

Photo 3. Township Road 243 (South), looking notheast

Photo 4. Township Road 109 (West), looking southwest

Photo 5. Township Road 218 (West), looking southeast

Photo 6. Township Road 254 (North), looking south

Photo 7. Township Road 218 (East), looking northwest

Photo 8. Township Road 257 (Central), looking west

Photo 9. Township Road 109 (Central), looking north

Photo 10. Township Road 109 (East), looking southwest

Photo 11. Township Road 257 (South), looking northwest

Photo 12. Township Road 216 (East), looking south

Photo 13. Township 254 (South), looking east

Photo 14. Township Road 216 (West), looking north

Photo 15. Township Road 243 (Central), looking east

Photo 16. Township Road 249, looking east

Photo 17. Township Road 243 (North), looking northeast

Photo 18. Township Road 256, looking northeast

Photo 19. Township 257 (North), looking southwest

Photo 20. Fostoria Central 138kV Substation, looking west

Photo 21. Township Road 293, looking southeast

Photo 22. Washington Township Cemetery, looking east

Photo 23. Arcadia Community Center, looking north-northwest

Photo 24. Aerland Recreation Area, looking southeast

Photo 25. Veterans Memorial Reservoir Park, looking west-northwest

Photo 26. Fostoria Reservoir Park, looking southwest

Photo 27. City Park, looking southwest

Photo 28. Gray Park, looking southwest

Photo 29. Meadowland Park, looking southwest

Photo 30. Fostoria Country Club, looking west-southwest

Photo 31. Knollcrest Cemetery, looking northeast

Photo 32. Portage Park, looking southwest

Photo 33. Van Buren State Park, looking southeast

Photo 34. Bechtel Cemetery, looking southeast

Photo 35. Allen Township Youth Sports Plex, looking southeast

Photo 36. Lakeland Golf Course, looking west

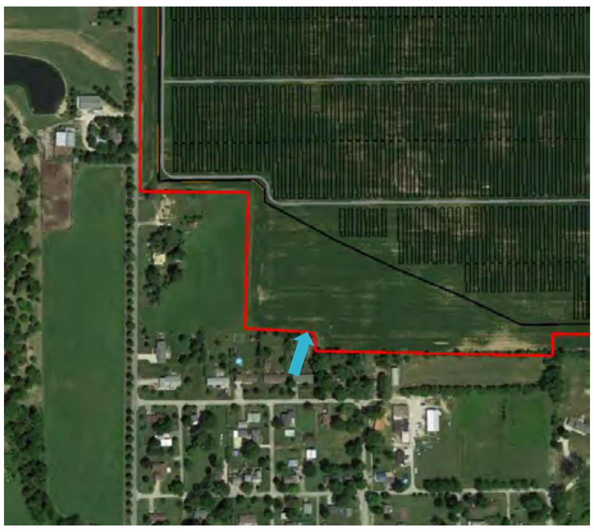
Photo 37. Arcadia School, looking northwest

ATTACHMENT B
VISUAL SIMULATIONS

Before

After

After with Landscaping



PLANIT
www.planitstudios.com

Visual Simulations - Viewpoint 1: Monroe Street

South Branch Solar
Hancock County, Ohio

Before

After

After with Landscaping

PLANIT
www.planitstudios.com

Visual Simulations - Viewpoint 2: Township Road 109

South Branch Solar
Hancock County, Ohio

Before

After

After with Landscaping

(no landscaping proposed)

PLANIT
www.planitstudios.com

Visual Simulations - Viewpoint 3: Township Road 249

South Branch Solar
Hancock County, Ohio

Before

After

After with Landscaping

PLANIT
www.planitstudios.com

Visual Simulations -
Viewpoint 4: County Road 218

South Branch Solar
Hancock County, Ohio

ATTACHMENT C
SOLAR GLARE ANALYSIS

HALEY & ALDRICH, INC.
200 Town Centre Drive
Suite 2
Rochester, NY 14623
585.359.9000

MEMORANDUM

19 July 2021
File No. 0135392-002

TO: South Branch Solar, LLC

FROM: Haley & Aldrich, Inc.

SUBJECT: South Branch Solar: Solar Glare Analysis

On behalf of South Branch Solar, LLC (South Branch), Haley & Aldrich, Inc. (Haley & Aldrich) conducted a solar glare analysis of the South Branch Solar project (the Project) using the Solar Glare Hazard Analysis Tool (SGHAT) available through ForgeSolar.

PROJECT SUMMARY

Haley & Aldrich understands that the Project is an up to 205-megawatt solar photovoltaic facility proposed on approximately 1,000 acres in Washington Township, Hancock County, Ohio (the Project Area). The Project will encompass approximately 500,000 solar photovoltaic (PV) panels with a height of no more than 15 feet at maximum tilt. Panels will be grouped in arrays with 7-foot-tall agricultural style security fencing around each area. The proposed PV panels are single-axis trackers that will be laid in a north-south orientation and track the sun east to west throughout the course of the day. As PV panels are designed to absorb sunlight to generate electricity, the potential for glare is anticipated to be minimal; in addition, South Branch proposes to install panels coated with anti-reflective coating to further minimize the potential for glare. However, the analysis reflected in this memorandum conservatively assumes that an anti-reflective coating is not used.

The SGHAT analysis showed no indication that glare will result from the Project for traffic on nearby modeled roads or at modeled receptor locations. Details on the methodology and results obtained are provided below.

SOLAR GLARE

Glare is defined as a continuous source of bright light and is a common phenomenon in our everyday lives. Both the sun and artificial light sources can cause glare either directly (such as from a sunset when driving westbound) or indirectly (such as from the sun's reflections off a lake or mirror). Potential concerns associated with glare may include:

- Safety impacts, such as the potential to disorient motorists when driving or pilots when taking off or landing; or

- Annoyance impacts, such as distraction, after-image in the viewer's vision, or temporary avoidance of a view due to the presence of reflected light.

PV panels, such as those proposed for the Project, are designed to absorb as much sunlight as possible and, in most conditions, reflect very little light. Modern PV modules reflect as little as two percent of incoming sunlight, about the same as water and less than soil or even wood shingles.[1] Many PV panels include anti-reflective coatings to maximize energy absorption; South Branch plans to use panels with such coatings.

PV solar facilities with panels mounted on single-axis trackers, such as those planned for the Project, rotate throughout the day, following the course of the sun to optimize the capture of sunlight on their surface. In addition to producing more energy, this design has the added benefit of minimizing glare, as high tilt angles would only occur at certain times of the day.

In considering the potential for glare associated with the Project, the extent to which panels will be visible due to such factors as topography or vegetation was considered. However, the analysis did not incorporate existing or proposed landscaping, in order to provide a conservative assessment of the solar glare potential.

SOLAR GLARE ANALYSIS

Using the SGHAT model, Haley & Aldrich completed an analysis to identify the potential for solar glare to result from the Project. The attached figure shows the locations from which the potential for solar glare from the Project was analyzed.

Residential Considerations

Several nearby representative residential locations were selected for assessment (identified as Observation Points OP 1 through OP 7). Most of the Project Area is composed of agricultural fields, with only scattered rural residences in the immediate surroundings and more dense residential development to the south in the Village of Arcadia. Distance and existing intervening vegetation are expected to minimize the potential for glare, although the effect of vegetation is not included in this analysis.

---

[1] Solar Energy Industries Association (SEIA). Photovoltaics. https://www.seia.org/initiatives/photovoltaics.

Airport Considerations

No public airports are proximate to the Project Area; the closest is over 1 mile from the Project Area. Notices of Construction were filed for the Project with the Federal Aviation Administration on 12 July 2021; Determinations of No Hazard to Air Navigation are anticipated. As such, no further analysis regarding the potential for glare from the Project to nearby airports was conducted.

Roadway Considerations

Glare has the potential to temporarily obstruct vision, which can be of particular concern in locations with higher speed limits or curving road geometry. As such, the potential for glare should be evaluated to identify the potential for such issues. Roads within and around the Project Area are listed below, along with other information applicable to the potential for glare concerns. Note that no roads within the Project Area are posted for high speeds, and that roadway geometry does not reflect sharp curves. Because the tracking system is oriented in a north-south direction and the panels will angle to face east in the early morning, moving towards a flatter position midday, and tilting west to capture the evening sun in the afternoon, roads that are positioned directly in an east-west direction relative to panels would be expected to have the greatest potential to experience some reflections. This, however, would only occur during certain limited times of day or seasons of the year and would quickly change as the sun position also changes.

Local roadways have been reviewed to assess their anticipated potential for experiencing glare. These roadway segments were then analyzed using the ForgeSolar SGHAT. Details are provided in the following sections.

Route Receptor 1: Township Road 257

This approximately 24-foot-wide Washington Township asphalt road lies in a north-south orientation and generally forms the eastern boundary of the northeastern portion of the Project Area. At its closest point, panels would be located on the western side of the road, at a distance of approximately 100 feet. Landscaping, proposed along portions of the roadway, and setback is expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 2: Township Road 218 (East)

This approximately 20-foot-wide Washington Township road lies in an east-west orientation and bisects the Project Area. Several Project components, including collector lines, are proposed proximate to this roadway. At their closest point, panels would be located north of the roadway, at a distance of approximately 100 feet. Landscaping, proposed along portions of the roadway, and setback are expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 3: Township Road 218 (West)

This approximately 20-foot-wide Washington Township road lies in an east-west orientation, generally forming the northern boundary of the Project Area, before turning 45 degrees northwest to join with Township Road 250 and turning back to an east-west orientation. Panels are proposed on the south side of the road, set back a minimum of 130 feet. Setback and panel orientation are expected to minimize the potential for glare.

Route Receptor 4: Township Road 249

This approximately 11-foot-wide Washington Township road lies between Township Road 218 and County Road 109 in a north-south orientation and generally forms the western boundary of the Project Area. At their closest point, panels are proposed approximately 0.25-mile east of the road. Distance is expected to minimize the potential for glare.

Route Receptor 5: Township Road 254 (North)

This approximately 20-foot-wide Washington Township road bisects the Project Area, lying in a north-south orientation between Township Road 218 and County Road 109, with solar arrays proposed on both sides. A collector line crossing is proposed, connecting arrays on the west to the substation on the east. At their closest point, panels are proposed approximately 80 feet from the road. Setback and panel orientation are expected to minimize the potential for glare.

Route Receptor 6: County Road 109 (West)

This approximately 22-foot-wide Hancock County road lies in the middle of the Project Area, in an east-west orientation. At its closest point, west of Township Road 254, panels are proposed approximately 300 feet south of the road, on the south side of the existing transmission line right-of-way (ROW). Landscaping, proposed along the south side of the existing transmission line ROW, is expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 7: Township Road 254 (South)

This approximately 20-foot-wide Washington Township road bisects the Project Area, lying in a north-south orientation between County Road 109 and Township Road 216, with solar arrays proposed on both sides. A collector line crossing is proposed, connecting arrays on the west to the substation on the east. At their closest point, panels are proposed approximately 80 feet from the road. Landscaping, proposed on the western side of the road, along with panel setback and orientation are expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 8: County Road 109 (East)

This approximately 22-foot-wide Hancock County road lies in the middle of the Project Area in an east-west orientation. Underground collection lines will cross this road, connecting arrays on the south and north sides of the road. At its closest point, panels are proposed to be located approximately 100 feet off the road. Landscaping, proposed on both sides of the road between Township Road 254 and 256, is expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 9: Township Road 256

This approximately 12-foot-wide Washington Township asphalt road extends for approximately 1.0 mile in a north-south orientation along the eastern edge of the Project Area. Panels are proposed on the west side. Landscaping, proposed along portions of the roadway, is expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 10: Township Road 243

This approximately 22-foot-wide Washington Township road bisects the northwestern portion of the Project Area, with panels lying on both the east and west side of the road, just south of Township Road 218. Landscaping, proposed to be added along both sides of the road, is expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 11: Township Road 216

This approximately 24-foot-wide Washington Township road is located south and west of the Project Area, lying in a generally east-west orientation extending through the Village of Arcadia. The closest Project components are proposed approximately 0.5-mile from this road. Distance is expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

Route Receptor 12: State Route 12

This approximately 30-foot-wide State route is located southeast of the Project Area and lies in a generally northeast-southwest orientation for this stretch. At its closest point, Project components are proposed 0.2-mile to the northwest, with two intervening active railroad tracks. Distance and existing vegetation and structures are expected to minimize the potential for glare, although the effect of vegetation is not incorporated in this analysis.

Route Receptor 13: Monroe Street, Gibson Street, Peters Street, Joslyn Street, E North Street, and East Street

These local roadways lie within the Village of Arcadia and are part of the northernmost neighborhood in that community. Monroe Street is an approximately 17-foot-wide local road that lies in an east-west orientation, with properties on the north side of Monroe Street abutting the Project Area. Monroe Street extends east from Township Road 254 for approximately 0.2-mile before turning 90 degrees south and becoming Gibson Street, an approximately 16-foot-wide local road that ends on Peters Street. Peter Street extends east off Township Road 254 for approximately 0.3-mile before turning 90 degrees south and becoming Joslyn Street, which crosses the two active railroad lines. E North Street extends east off Joslyn Street for 0.2-mile before turning 90 degrees north and becoming East Street.

Landscaping is proposed north of Monroe Street, along the southern edge of the southernmost array area. The proposed landscaping and existing vegetation and structures are expected to minimize the potential for glare, although the effect of landscaping is not incorporated in this analysis.

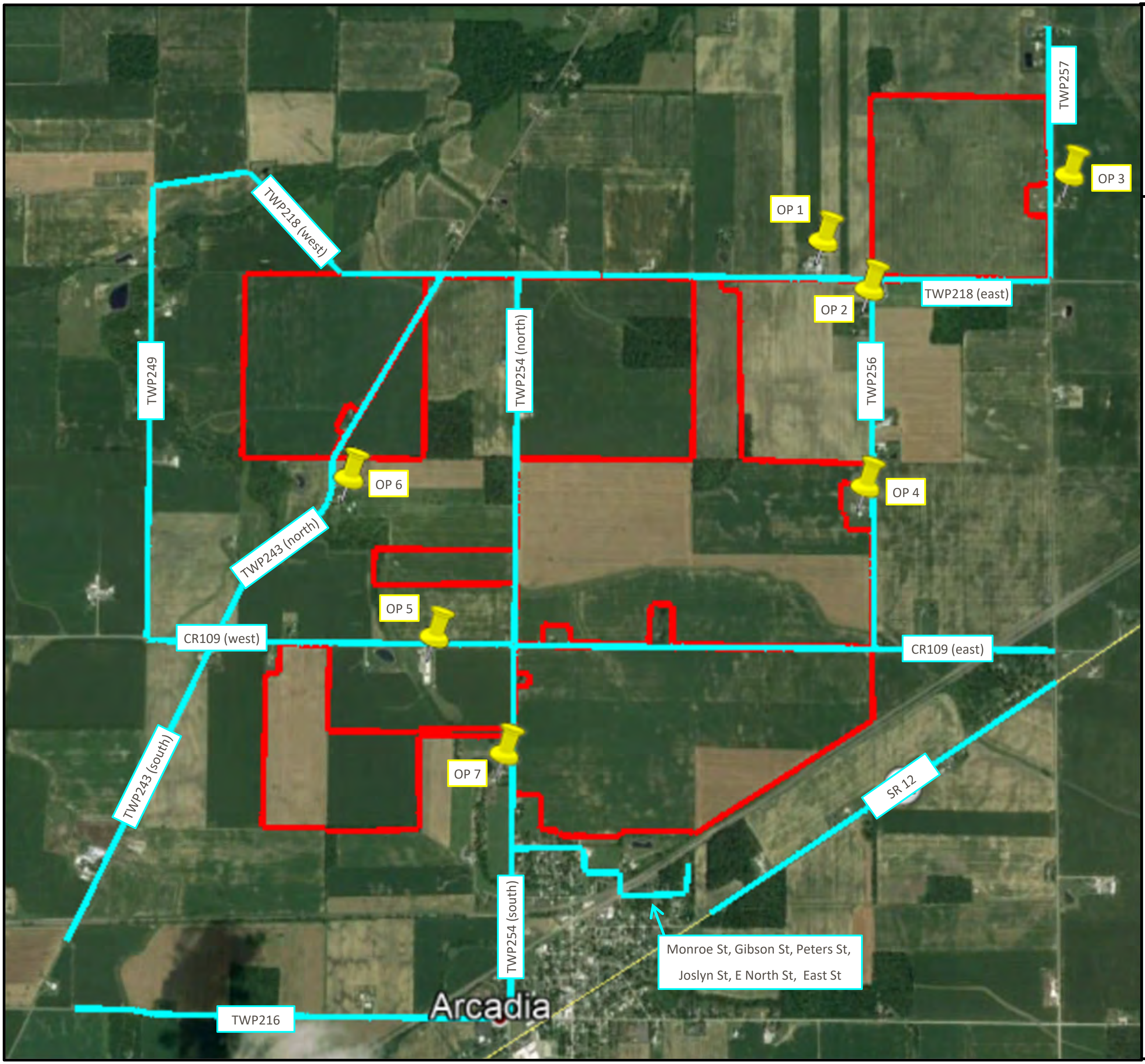
SOLAR GLARE MODELING RESULTS

The SGHAT was used to assess the 7 observation points and the 13 roadway segments outlined above to identify the Project’s potential to cause glare; as noted, no landscaping or vegetation was incorporated into the analysis. Although use of an anti-reflective coating is expected, the model was run conservatively assuming this coating was not applied to model maximum potential impacts. Impacts were evaluated for potential viewers along the roads at an estimated viewing height of 5 feet. The SGHAT output is attached.

Even with the conservative assumptions employed in this analysis, the SGHAT analysis showed no indication that glare will result from the Project for traffic on nearby modeled roads or at modeled receptor locations.

\\haleyaldrich.com\share\CF\Projects\135392\Visual\Glare\Final\Solar Glare Analysis - South Branch Solar_7-19-21.docx

Solar Glare Analysis Locations



LEGEND

- ▬ Project Area Route
- ▬ Receptors
- 📌 Observation Points

South Branch Solar - Washington Township, OH

Preliminary Layout

Created June 28, 2021
Updated July 19, 2021
Time-step 1 minute
Timezone offset UTC-5
Site ID 55896.9979

Project type Advanced
Project status: active
Category 100 MW to 1 GW

Misc. Analysis Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodologies:

- Observation point: **Version 2**
- 2-Mile Flight Path: **Version 2**
- Route: **Version 2**

Summary of Results No glare predicted!

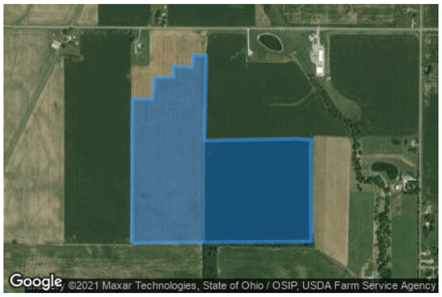
PV Name	Tilt deg	Orientation deg	"Green" Glare min	"Yellow" Glare min	Energy Produced kWh
PV array 1	SA tracking	SA tracking	0	0	-
PV array 10	SA tracking	SA tracking	0	0	-
PV array 2	SA tracking	SA tracking	0	0	-
PV array 3	SA tracking	SA tracking	0	0	-
PV array 4	SA tracking	SA tracking	0	0	-
PV array 5	SA tracking	SA tracking	0	0	-
PV array 6	SA tracking	SA tracking	0	0	-
PV array 7	SA tracking	SA tracking	0	0	-
PV array 8	SA tracking	SA tracking	0	0	-
PV array 9	SA tracking	SA tracking	0	0	-

Component Data

PV Array(s)

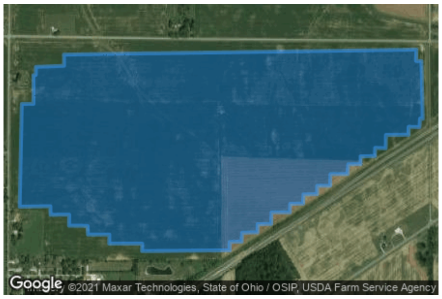
Total PV footprint area: 774.8 acres

Name: PV array 1
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 78.7 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.120591	-83.529104	794.68	7.17	801.85
2	41.120574	-83.528203	794.75	7.17	801.92
3	41.121302	-83.528117	794.05	7.17	801.22
4	41.121318	-83.527259	796.27	7.17	803.45
5	41.121690	-83.527302	795.21	7.17	802.38
6	41.121641	-83.526444	796.72	7.17	803.89
7	41.122062	-83.526401	794.36	7.17	801.53
8	41.122045	-83.525821	795.12	7.17	802.29
9	41.119184	-83.525907	800.22	7.17	807.39
10	41.119249	-83.521852	792.25	7.17	799.42
11	41.119217	-83.521165	791.30	7.17	798.47
12	41.118909	-83.521187	793.65	7.17	800.82
13	41.115789	-83.521165	801.69	7.17	808.86
14	41.115757	-83.529126	797.92	7.17	805.09

Name: PV array 10
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 212.5 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.121898	-83.515106	792.46	7.17	799.63
2	41.121632	-83.515108	793.52	7.17	800.69
3	41.121624	-83.515212	793.69	7.17	800.86
4	41.120668	-83.515208	792.71	7.17	799.88
5	41.120664	-83.515733	792.26	7.17	799.43
6	41.117239	-83.515827	794.88	7.17	802.05
7	41.117257	-83.514465	797.61	7.17	804.78
8	41.116968	-83.514454	797.56	7.17	804.73
9	41.116974	-83.513628	800.20	7.17	807.37
10	41.116607	-83.513633	799.90	7.17	807.07
11	41.116598	-83.512807	800.01	7.17	807.18
12	41.116308	-83.512796	799.12	7.17	806.29
13	41.116309	-83.511843	799.61	7.17	806.78
14	41.116006	-83.511855	800.05	7.17	807.22
15	41.116006	-83.510385	801.39	7.17	808.56
16	41.115758	-83.510393	801.34	7.17	808.51
17	41.115784	-83.506499	805.55	7.17	812.72
18	41.116065	-83.506493	804.86	7.17	812.03
19	41.116074	-83.505966	805.69	7.17	812.87
20	41.116370	-83.505952	803.56	7.17	810.73
21	41.116382	-83.505265	803.00	7.17	810.17
22	41.116655	-83.505262	802.11	7.17	809.28
23	41.116664	-83.504656	801.01	7.17	808.18
24	41.117052	-83.504645	800.22	7.17	807.39
25	41.117049	-83.503832	800.71	7.17	807.88
26	41.117334	-83.503816	800.74	7.17	807.91
27	41.117344	-83.503237	799.98	7.17	807.15
28	41.117649	-83.503228	800.51	7.17	807.68
29	41.117656	-83.502622	802.57	7.17	809.74
30	41.117938	-83.502612	801.60	7.17	808.77
31	41.117934	-83.502038	803.31	7.17	810.48
32	41.118326	-83.502025	803.23	7.17	810.40
33	41.118326	-83.501271	801.05	7.17	808.22
34	41.118653	-83.501239	800.39	7.17	807.56
35	41.118657	-83.500683	800.46	7.17	807.63
36	41.118916	-83.500682	800.17	7.17	807.34
37	41.118926	-83.500050	797.75	7.17	804.92
38	41.119200	-83.500044	797.92	7.17	805.09
39	41.119185	-83.499570	798.12	7.17	805.29
40	41.119630	-83.499562	797.37	7.17	804.54
41	41.119631	-83.498565	797.15	7.17	804.32
42	41.119902	-83.498556	797.20	7.17	804.37
43	41.119889	-83.498075	798.74	7.17	805.91
44	41.120178	-83.498045	798.76	7.17	805.93
45	41.120167	-83.497929	798.94	7.17	806.11
46	41.122093	-83.497988	791.45	7.17	798.62
47	41.122097	-83.498227	791.37	7.17	798.54
48	41.122474	-83.498213	790.40	7.17	797.57
49	41.122351	-83.509940	792.63	7.17	799.80
50	41.122353	-83.510044	792.34	7.17	799.51
51	41.122309	-83.513858	791.68	7.17	798.85
52	41.121935	-83.513856	791.00	7.17	798.17

Name: PV array 2
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 11.4 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad

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Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.126476	-83.522067	784.85	7.17	792.02
2	41.125886	-83.522067	782.20	7.17	789.37
3	41.125886	-83.521445	784.15	7.17	791.32
4	41.125514	-83.521445	783.64	7.17	790.81
5	41.125555	-83.516789	784.99	7.17	792.16
6	41.125829	-83.516789	786.80	7.17	793.97
7	41.125837	-83.516542	787.64	7.17	794.81
8	41.126500	-83.516531	792.22	7.17	799.39

Name: PV array 3
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 21.4 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad

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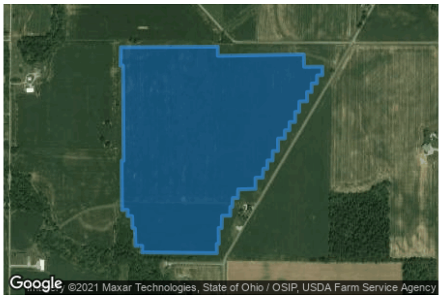
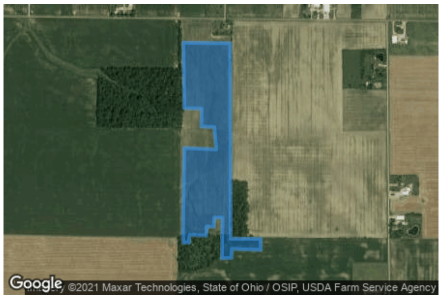
Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.130286	-83.523958	793.94	7.17	801.11
2	41.131951	-83.523969	793.41	7.17	800.58
3	41.131951	-83.523636	793.59	7.17	800.76
4	41.132214	-83.523620	792.45	7.17	799.62
5	41.132212	-83.523457	791.83	7.17	799.00
6	41.132561	-83.523465	790.67	7.17	797.84
7	41.132555	-83.523221	790.34	7.17	797.51
8	41.132837	-83.523219	789.24	7.17	796.41
9	41.132838	-83.522999	789.45	7.17	796.62
10	41.133132	-83.522998	788.19	7.17	795.36
11	41.133129	-83.522786	788.90	7.17	796.07
12	41.133383	-83.522783	787.82	7.17	794.99
13	41.133379	-83.522467	787.47	7.17	794.64
14	41.133779	-83.522461	785.98	7.17	793.15
15	41.133782	-83.522228	785.71	7.17	792.88
16	41.134087	-83.522237	785.16	7.17	792.33
17	41.134082	-83.521906	784.91	7.17	792.08
18	41.134372	-83.521905	784.20	7.17	791.38
19	41.134372	-83.521741	784.88	7.17	792.05
20	41.134711	-83.521732	783.83	7.17	791.00
21	41.134711	-83.521493	783.71	7.17	790.89
22	41.134977	-83.521492	783.12	7.17	790.29
23	41.134989	-83.521246	783.16	7.17	790.33
24	41.135247	-83.521245	782.91	7.17	790.08
25	41.135252	-83.521048	783.11	7.17	790.28
26	41.133387	-83.521033	788.53	7.17	795.70
27	41.133382	-83.521146	787.98	7.17	795.16
28	41.130258	-83.521115	794.29	7.17	801.46

Name: PV array 4
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 99.2 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



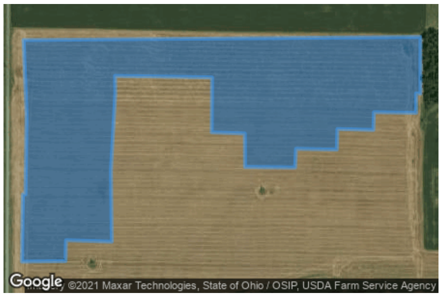
Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.130456	-83.529445	790.35	7.17	797.52
2	41.130430	-83.526122	793.49	7.17	800.66
3	41.130741	-83.526131	792.95	7.17	800.12
4	41.130741	-83.526035	793.09	7.17	800.26
5	41.131271	-83.526047	791.18	7.17	798.35
6	41.131266	-83.525910	791.67	7.17	798.84
7	41.131677	-83.525897	790.86	7.17	798.03
8	41.131683	-83.525527	792.55	7.17	799.72
9	41.131971	-83.525527	793.20	7.17	800.37
10	41.131975	-83.525438	793.74	7.17	800.91
11	41.132268	-83.525417	794.72	7.17	801.89
12	41.132268	-83.525191	794.92	7.17	802.09
13	41.132556	-83.525177	794.07	7.17	801.24
14	41.132574	-83.524407	792.53	7.17	799.70
15	41.132943	-83.524411	791.43	7.17	798.60
16	41.132945	-83.524086	790.56	7.17	797.73
17	41.133242	-83.524060	789.65	7.17	796.82
18	41.133244	-83.523884	789.05	7.17	796.22
19	41.133519	-83.523874	789.70	7.17	796.87
20	41.133517	-83.523649	787.78	7.17	794.95
21	41.133834	-83.523638	788.81	7.17	795.98
22	41.133835	-83.523406	788.09	7.17	795.26
23	41.134248	-83.523408	788.19	7.17	795.36
24	41.134256	-83.523102	787.32	7.17	794.49
25	41.134526	-83.523101	786.68	7.17	793.85
26	41.134526	-83.522902	786.46	7.17	793.63
27	41.134798	-83.522895	785.84	7.17	793.01
28	41.134800	-83.522651	785.37	7.17	792.54
29	41.135139	-83.522647	784.39	7.17	791.56
30	41.135138	-83.522470	784.05	7.17	791.22
31	41.135483	-83.522461	783.74	7.17	790.91
32	41.135493	-83.522115	783.18	7.17	790.35
33	41.135801	-83.522120	783.38	7.17	790.55
34	41.135800	-83.521919	783.35	7.17	790.52
35	41.136083	-83.521915	783.83	7.17	791.00
36	41.136091	-83.521680	783.00	7.17	790.17
37	41.136352	-83.521673	782.65	7.17	789.82
38	41.136367	-83.521438	782.33	7.17	789.50
39	41.136647	-83.521446	781.09	7.17	788.26
40	41.136641	-83.522249	781.50	7.17	788.67
41	41.137057	-83.522262	779.27	7.17	786.44
42	41.137008	-83.526082	781.60	7.17	788.77
43	41.137313	-83.526085	781.42	7.17	788.59
44	41.137297	-83.530390	785.20	7.17	792.37
45	41.136686	-83.530411	782.58	7.17	789.75
46	41.136681	-83.530290	782.47	7.17	789.64
47	41.133511	-83.530267	786.31	7.17	793.48
48	41.133513	-83.530353	786.38	7.17	793.55
49	41.132693	-83.530345	786.10	7.17	793.27
50	41.131873	-83.530337	784.08	7.17	791.25
51	41.131871	-83.530085	784.42	7.17	791.59
52	41.131672	-83.530090	785.41	7.17	792.59
53	41.131665	-83.529887	785.64	7.17	792.82
54	41.131269	-83.529875	787.31	7.17	794.48
55	41.131263	-83.529767	787.92	7.17	795.09
56	41.130677	-83.529738	790.26	7.17	797.43
57	41.130677	-83.529438	790.73	7.17	797.90

Name: PV array 5
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 28.4 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



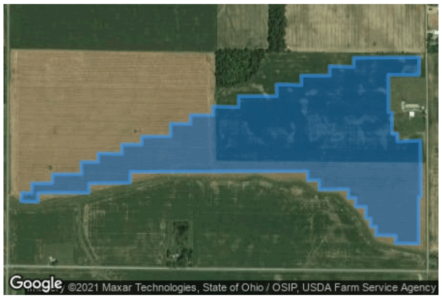
Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.136542	-83.506800	787.61	7.17	794.78
2	41.136525	-83.504718	791.01	7.17	798.18
3	41.130012	-83.504697	789.21	7.17	796.39
4	41.130005	-83.503359	791.71	7.17	798.88
5	41.129635	-83.503361	791.40	7.17	798.57
6	41.129669	-83.504643	789.16	7.17	796.33
7	41.129366	-83.504665	790.27	7.17	797.44
8	41.129358	-83.505094	790.11	7.17	797.28
9	41.130707	-83.505062	789.70	7.17	796.87
10	41.130707	-83.505416	789.14	7.17	796.31
11	41.130405	-83.505447	789.06	7.17	796.23
12	41.130410	-83.505767	788.44	7.17	795.62
13	41.130113	-83.505775	788.83	7.17	796.00
14	41.130131	-83.506525	788.20	7.17	795.37
15	41.129873	-83.506545	789.69	7.17	796.86
16	41.129875	-83.506794	790.50	7.17	797.67
17	41.130142	-83.506821	788.15	7.17	795.32
18	41.133035	-83.506757	784.32	7.17	791.49
19	41.132986	-83.505341	782.96	7.17	790.13
20	41.133730	-83.505427	783.02	7.17	790.19
21	41.133746	-83.506006	782.05	7.17	789.22
22	41.134344	-83.505984	785.24	7.17	792.41
23	41.134360	-83.506757	783.51	7.17	790.68

Name: PV array 6
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 37.1 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.129996	-83.507082	789.16	7.17	796.33
2	41.129944	-83.515893	790.42	7.17	797.59
3	41.128708	-83.515828	790.39	7.17	797.56
4	41.127356	-83.515852	795.52	7.17	802.69
5	41.127354	-83.515909	795.44	7.17	802.61
6	41.126226	-83.515928	790.11	7.17	797.28
7	41.126236	-83.514962	788.39	7.17	795.56
8	41.126586	-83.514952	791.06	7.17	798.23
9	41.126562	-83.513935	791.04	7.17	798.21
10	41.127750	-83.513954	794.10	7.17	801.27
11	41.127988	-83.513938	793.37	7.17	800.54
12	41.129038	-83.513857	789.74	7.17	796.91
13	41.129344	-83.513863	789.73	7.17	796.90
14	41.129317	-83.511709	789.62	7.17	796.79
15	41.128396	-83.511717	792.02	7.17	799.19
16	41.128376	-83.510982	792.71	7.17	799.88
17	41.127814	-83.510977	793.00	7.17	800.17
18	41.127806	-83.509866	791.82	7.17	798.99
19	41.128119	-83.509846	792.03	7.17	799.20
20	41.128105	-83.508941	792.52	7.17	799.69
21	41.128453	-83.508926	791.35	7.17	798.52
22	41.128437	-83.508128	791.18	7.17	798.35
23	41.128733	-83.508115	790.35	7.17	797.52
24	41.128723	-83.507179	789.66	7.17	796.83
25	41.129049	-83.507181	790.06	7.17	797.23
26	41.129047	-83.507082	790.13	7.17	797.30

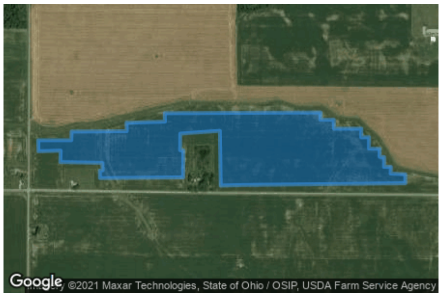
Name: PV array 7
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 95.5 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.125683	-83.514283	787.09	7.17	794.26
2	41.125680	-83.515188	786.59	7.17	793.76
3	41.125357	-83.515197	785.24	7.17	792.41
4	41.125370	-83.515641	785.60	7.17	792.77
5	41.125075	-83.515676	785.21	7.17	792.38
6	41.125060	-83.514920	785.37	7.17	792.54
7	41.125358	-83.514930	785.30	7.17	792.48
8	41.125368	-83.514389	785.92	7.17	793.09
9	41.125359	-83.512664	786.42	7.17	793.59
10	41.125675	-83.512664	787.49	7.17	794.66
11	41.125697	-83.510832	786.52	7.17	793.69
12	41.126063	-83.510816	787.46	7.17	794.63
13	41.126085	-83.502952	789.06	7.17	796.23
14	41.125778	-83.502954	788.39	7.17	795.56
15	41.125786	-83.502434	788.08	7.17	795.25
16	41.125469	-83.502439	789.03	7.17	796.20
17	41.125477	-83.501146	788.96	7.17	796.13
18	41.125192	-83.501144	789.28	7.17	796.45
19	41.125186	-83.500819	789.17	7.17	796.34
20	41.124904	-83.500825	789.74	7.17	796.91
21	41.124899	-83.500361	789.74	7.17	796.91
22	41.124521	-83.500375	789.68	7.17	796.85
23	41.124501	-83.500138	789.77	7.17	796.94
24	41.124236	-83.500154	789.98	7.17	797.15
25	41.124238	-83.499913	790.63	7.17	797.80
26	41.123953	-83.499921	790.36	7.17	797.53
27	41.123935	-83.499041	790.73	7.17	797.90
28	41.123682	-83.499052	790.68	7.17	797.85
29	41.123666	-83.498019	789.16	7.17	796.33
30	41.125236	-83.498024	795.91	7.17	803.08
31	41.125235	-83.497921	796.16	7.17	803.33
32	41.127109	-83.497947	794.24	7.17	801.41
33	41.127079	-83.498962	794.39	7.17	801.56
34	41.127341	-83.498973	794.71	7.17	801.88
35	41.127337	-83.499207	794.12	7.17	801.29
36	41.128032	-83.499207	793.94	7.17	801.11
37	41.128059	-83.499359	794.05	7.17	801.22
38	41.129290	-83.499364	791.09	7.17	798.26
39	41.129287	-83.498022	790.20	7.17	797.37
40	41.129883	-83.497998	789.61	7.17	796.78
41	41.129867	-83.500905	791.61	7.17	798.78
42	41.129560	-83.500916	792.31	7.17	799.48
43	41.129588	-83.501975	793.16	7.17	800.33
44	41.129273	-83.501969	793.39	7.17	800.56
45	41.129271	-83.503241	790.37	7.17	797.54
46	41.128952	-83.503230	789.83	7.17	797.00
47	41.128976	-83.503882	790.62	7.17	797.80
48	41.128978	-83.504340	789.65	7.17	796.82
49	41.128588	-83.504330	789.66	7.17	796.83
50	41.128586	-83.506025	789.71	7.17	796.88
51	41.128220	-83.506017	790.98	7.17	798.15
52	41.128247	-83.507165	791.84	7.17	799.01
53	41.127950	-83.507154	793.21	7.17	800.38
54	41.127958	-83.508149	793.02	7.17	800.19
55	41.127661	-83.508149	794.13	7.17	801.31
56	41.127669	-83.509037	793.61	7.17	800.78
57	41.127245	-83.509034	793.45	7.17	800.62
58	41.127239	-83.510314	792.06	7.17	799.23
59	41.126976	-83.510319	791.15	7.17	798.32
60	41.126980	-83.511196	790.41	7.17	797.58
61	41.126663	-83.511193	790.08	7.17	797.25

62	41.126679	-83.512250	789.85	7.17	797.02
63	41.126388	-83.512261	788.76	7.17	795.93
64	41.126394	-83.513001	788.54	7.17	795.71
65	41.125978	-83.512990	787.89	7.17	795.06
66	41.125981	-83.514274	788.13	7.17	795.30

Name: PV array 8
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 59.0 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad



Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.124226	-83.515850	788.19	7.17	795.36
2	41.124246	-83.514863	787.22	7.17	794.39
3	41.123862	-83.514879	789.46	7.17	796.63
4	41.123834	-83.513007	787.68	7.17	794.85
5	41.123586	-83.513001	788.43	7.17	795.60
6	41.123578	-83.513122	788.97	7.17	796.14
7	41.123323	-83.513117	789.92	7.17	797.09
8	41.123349	-83.509423	796.97	7.17	804.14
9	41.124254	-83.509420	795.44	7.17	802.61
10	41.124258	-83.509559	794.30	7.17	801.47
11	41.124818	-83.509552	791.34	7.17	798.51
12	41.124911	-83.507795	791.29	7.17	798.46
13	41.123076	-83.507757	797.81	7.17	804.98
14	41.123087	-83.507084	798.26	7.17	805.43
15	41.123093	-83.506848	797.81	7.17	804.98
16	41.123153	-83.499561	789.77	7.17	796.94
17	41.123453	-83.499562	789.34	7.17	796.51
18	41.123477	-83.500214	790.51	7.17	797.68
19	41.123698	-83.500201	789.69	7.17	796.86
20	41.123697	-83.500504	789.65	7.17	796.83
21	41.124030	-83.500501	789.81	7.17	796.98
22	41.124037	-83.500705	789.57	7.17	796.74
23	41.124303	-83.500701	789.74	7.17	796.91
24	41.124317	-83.501175	789.33	7.17	796.50
25	41.124698	-83.501174	789.51	7.17	796.68
26	41.124692	-83.501519	789.28	7.17	796.45
27	41.124984	-83.501511	789.46	7.17	796.63
28	41.124986	-83.502731	789.21	7.17	796.38
29	41.125283	-83.502735	790.00	7.17	797.17
30	41.125280	-83.503335	788.35	7.17	795.52
31	41.125527	-83.503321	788.45	7.17	795.62
32	41.125503	-83.510244	786.98	7.17	794.16
33	41.125220	-83.510233	787.49	7.17	794.66
34	41.125182	-83.511939	786.10	7.17	793.27
35	41.124900	-83.511928	786.70	7.17	793.88
36	41.124889	-83.514380	785.51	7.17	792.68
37	41.124594	-83.514391	785.88	7.17	793.05
38	41.124594	-83.515860	786.10	7.17	793.27

Name: PV array 9
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0 deg
Tracking axis tilt: 0.0 deg
Tracking axis panel offset: 0.0 deg
Maximum tracking angle: 50.0 deg
Resting angle: 60.0 deg
Footprint area: 131.6 acres
Rated power: -
Panel material: Smooth glass without AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 6.55 mrad

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.144339	-83.497746	780.29	7.17	787.46
2	41.137503	-83.497639	788.98	7.17	796.15
3	41.137584	-83.489571	786.36	7.17	793.53
4	41.138190	-83.489528	785.04	7.17	792.21
5	41.138218	-83.489120	784.78	7.17	791.95
6	41.138766	-83.489110	785.83	7.17	793.00
7	41.138780	-83.488799	785.32	7.17	792.49
8	41.139451	-83.488809	787.38	7.17	794.55
9	41.139475	-83.489925	789.37	7.17	796.54
10	41.140727	-83.489931	782.79	7.17	789.96
11	41.140731	-83.489815	782.80	7.17	789.97
12	41.141430	-83.489807	781.67	7.17	788.84
13	41.141414	-83.489357	781.94	7.17	789.11
14	41.141091	-83.489335	782.16	7.17	789.33
15	41.141107	-83.488820	783.85	7.17	791.02
16	41.144177	-83.488842	779.51	7.17	786.68
17	41.144177	-83.491524	779.80	7.17	786.97
18	41.144379	-83.491534	779.56	7.17	786.74

Route Receptor(s)

Name: Route 1
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	41.147021	-83.488190	778.95	5.00	783.95
2	41.137099	-83.488276	786.97	5.00	791.97

Name: Route 10
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	41.122812	-83.531835	795.03	5.00	800.03
2	41.111270	-83.539474	803.65	5.00	808.65

Name: Route 11
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	41.108618	-83.538058	803.78	5.00	808.78
2	41.108424	-83.517158	805.11	5.00	810.11

Name: Route 12
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	41.112466	-83.505829	803.49	5.00	808.49
2	41.121195	-83.488362	793.24	5.00	798.24

Name: Route 13
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.115113	-83.516026	801.67	5.00	806.67
2	41.114919	-83.512379	798.55	5.00	803.55
3	41.114143	-83.512379	799.08	5.00	804.08
4	41.113917	-83.510877	799.92	5.00	804.92
5	41.112882	-83.510619	801.96	5.00	806.96
6	41.113012	-83.507186	800.86	5.00	805.86
7	41.114272	-83.507229	801.47	5.00	806.47

Name: Route 14
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.137148	-83.520220	783.43	5.00	788.43
2	41.130263	-83.525756	794.51	5.00	799.51
3	41.128469	-83.525799	789.12	5.00	794.12
4	41.125640	-83.530047	786.59	5.00	791.59
5	41.123345	-83.531700	794.91	5.00	799.91

Name: Route 2
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.137099	-83.488705	786.89	5.00	791.89
2	41.137293	-83.511408	783.92	5.00	788.92

Name: Route 3
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.137293	-83.512266	783.27	5.00	788.27
2	41.137455	-83.525441	780.42	5.00	785.42
3	41.141333	-83.530162	777.69	5.00	782.69
4	41.140978	-83.535140	781.91	5.00	786.91

Name: Route 4
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.140590	-83.535226	774.20	5.00	779.20
2	41.125915	-83.535311	789.55	5.00	794.55

Name: Route 5
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.137099	-83.516042	783.82	5.00	788.82
2	41.123006	-83.516214	793.59	5.00	798.59

Name: Route 6
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.123103	-83.535311	791.30	5.00	796.30
2	41.122715	-83.516257	795.72	5.00	800.72

Name: Route 7
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.122391	-83.516171	794.93	5.00	799.93
2	41.108068	-83.516386	805.80	5.00	810.80

Name: Route 8
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.122682	-83.515957	794.77	5.00	799.77
2	41.122585	-83.488276	798.30	5.00	803.30

Name: Route 9
Route type Two-way
View angle: 50.0 deg

Vertex	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total elevation ft
1	41.122876	-83.497503	789.50	5.00	794.50
2	41.137035	-83.497632	790.98	5.00	795.98

Discrete Observation Receptors

Number	Latitude deg	Longitude deg	Ground elevation ft	Height above ground ft	Total Elevation ft
OP 1	41.137774	-83.500577	788.18	5.00	793.18
OP 2	41.135867	-83.498174	793.13	5.00	798.13
OP 3	41.140392	-83.487702	785.00	5.00	790.00
OP 4	41.128109	-83.498388	794.97	5.00	799.97
OP 5	41.122226	-83.520747	795.61	5.00	800.61
OP 6	41.128433	-83.525253	789.83	5.00	794.83
OP 7	41.117667	-83.517099	797.07	5.00	802.07

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt deg	Orientation deg	"Green" Glare min	"Yellow" Glare min	Energy Produced kWh	Data File
PV array 1	SA tracking	SA tracking	0	0	-	-
PV array 10	SA tracking	SA tracking	0	0	-	-
PV array 2	SA tracking	SA tracking	0	0	-	-
PV array 3	SA tracking	SA tracking	0	0	-	-
PV array 4	SA tracking	SA tracking	0	0	-	-
PV array 5	SA tracking	SA tracking	0	0	-	-
PV array 6	SA tracking	SA tracking	0	0	-	-
PV array 7	SA tracking	SA tracking	0	0	-	-
PV array 8	SA tracking	SA tracking	0	0	-	-
PV array 9	SA tracking	SA tracking	0	0	-	-

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 10 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 2 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 3 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 4 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 5 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 6 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 7 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 8 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

PV array 9 no glare found

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	0
OP: OP 3	0	0
OP: OP 4	0	0
OP: OP 5	0	0
OP: OP 6	0	0
OP: OP 7	0	0
Route: Route 1	0	0
Route: Route 10	0	0
Route: Route 11	0	0
Route: Route 12	0	0
Route: Route 13	0	0
Route: Route 14	0	0
Route: Route 2	0	0
Route: Route 3	0	0
Route: Route 4	0	0
Route: Route 5	0	0
Route: Route 6	0	0
Route: Route 7	0	0
Route: Route 8	0	0
Route: Route 9	0	0

No glare found

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for larg PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
- The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, nc discrete, spectrum.
- Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
- Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.

ATTACHMENT D
LANDSCAPING AND LIGHTING PLAN

south branch solar

Landscape and Lighting Plan

South Branch Solar
Hancock County, Ohio

July 2021

Table of Contents

1. Introduction

South Branch Solar, LLC (South Branch or Applicant) is proposing to construct an up to 205-megawatt solar energy generating facility (the Project) on approximately 1,000 acres in Hancock County, Ohio (the Project Area). South Branch has developed this conceptual plan of potential landscape and lighting to be used in specific locations within the Project Area.

In general, the need for lighting will be limited to the minimum necessary in order for security and/or task lighting in the event of the need for nighttime maintenance.

2. Landscaping Plan Design Methodology

The conceptual planting modules identified for the landscaping plan are designed to utilize native plant material intended to complement the existing vegetation within and adjacent to the Project Area. In most instances, the recommended planting modules are not intended to provide complete screening of the Project; rather, the plantings are intended to provide intermittent screening and soften the view while providing ecological benefits through the creation of foraging and habitat areas for local wildlife. The landscape mitigation outlined in this plan represents a preliminary concept with the main goal of minimizing and reducing the potential visual impacts to resources adjacent to the Project Area.

Another key component to developing a successful mitigation plan is to retain existing plant material wherever possible. Not only does this provide immediate screening for Project components but also has the added benefit of allowing new vegetation to blend more seamlessly with existing vegetation, increasing the likelihood for successful integration of the Project. Without the retention of existing plant material, Project components and even new vegetation would have a much stronger visual contrast, producing a less integrated result. Wherever feasible, retention of plant material, particularly near sensitive areas such as property lines and along public roads, will help to preserve and/or enhance the character of the surrounding context. In this instance, the majority of the Project Area consists of open agricultural fields, so the ability to retain existing mature trees is limited, but will be prioritized where possible. Of the approximately 15 acres of wooded vegetation on the site, it is expected that approximately 11 acres will remain.

The landscape mitigation is designed with the intent of softening the horizontal edges often introduced by solar arrays. Depending on the location and distance of potential viewing locations adjacent to the Project, varying plant types and densities are proposed within the Project Area in order to provide an appropriate level of mitigation. For example, a residence with views focused directly into the Project Area where arrays are located may receive a denser planting module than a local road where only fleeting views of the Project may be available. As such, this plan considers three preliminary planting modules which vary in density and plant material. The modules were developed in consideration of the existing landscape character, likelihood of successful establishment based on regionally appropriate species, and options to allow for a meaningful reduction in visual contrast associated with the Project to the greatest extent possible. The module options have been developed not only to assimilate the Project into its surroundings but to also provide ecological benefits.

Key aspects of design methodology; plant material selection and maintenance; specific locations where screening is currently proposed; and details regarding specific planting modules are provided in the following sections.

2.1 PLANT MATERIAL SELECTION AND MAINTENANCE

2.1.1 Visual Screening

Selecting an appropriate visual barrier is dependent on the context of the surroundings, which includes actively soliciting feedback from nearby residents. While an opaque fence may be well suited to an urban setting, it would not fit in a rural landscape. Vegetative buffers, on the other hand, have precedent in agricultural landscapes and would not appear out of place in most instances. The use of vegetation mimics typical farm field hedgerow borders while obscuring/screening the contrast of the horizontal elements of the Project.

2.1.2 Native Plant Materials

Selecting plant materials native to a specific site or region provides the opportunity for the greatest success. Species that are best suited for their site-specific climate will require minimal maintenance to achieve their maximum size and form and will have the greatest likelihood of survival. Planting native species allows the Project to become integrated into surrounding vegetation, while providing habitat, food, and shelter for other native species of insects, birds, and wildlife.

Using seed mixes of various native grasses is an effective method to introduce biodiversity to a site in a way that compliments the existing landscape. Creating habitat for insects, birds, butterflies, and bees provides an ecological benefit to the surrounding monoculture of agricultural crops. These plantings provide cover, food, breeding and feeding grounds for a variety of species. In addition to the ecological benefits, these areas help to soften the views of solar facilities during the growing season while maintaining open views and vistas that extend beyond the Project. Herbaceous plantings also help stabilize soils and filter runoff. Native grasses can provide visual interest both while in bloom and when left to stand over winter.

2.1.3 Existing Vegetative Setting

Existing vegetation mainly consists of agricultural crops within and adjacent to the Project Area. However, these expansive agricultural fields often are bounded by thin hedgerows; areas of wood lots and stream channels lined with a vegetative buffer are limited but do occur within the Project Area. Roadside trees are also located in places throughout the Project Area. Where appropriate, existing vegetation will inform the general plant material selection for the proposed mitigation plan. This strategy largely relies on the theory that the success of existing native species in the area serves as an indicator that conditions may be suitable for newly installed plants of the same or similar species.

2.2 PLANTING MODULES

Three distinct planting modules have been developed for use within the Project Area. A drawing of the three landscape buffer types is provided in plan and cross-section, and each is described below. Representative species reflected in each are noted in Table 1; all are Ohio native species or commonly grown in Ohio. Note that the illustration represents the condition of approximately 10 years of growth. The projected vegetation growth rates reflected for the various species in Table 1 are estimates and do not constitute any guarantee of plant establishment and success in a given area. Factors such as soil condition, precipitation rate, climate exposure, incorrect installation, establishment rate, vandalism, disease and pest infestation, maintenance of overgrowth, and vegetation competition play a key role in the health and projected growth of an individual specimen or species. Figure 1 illustrates the intended locations for each particular landscape type. Note that these are preliminary locations that will be revised based upon final engineering details, drain tile investigations, and other local considerations.

Table 1. Plant List

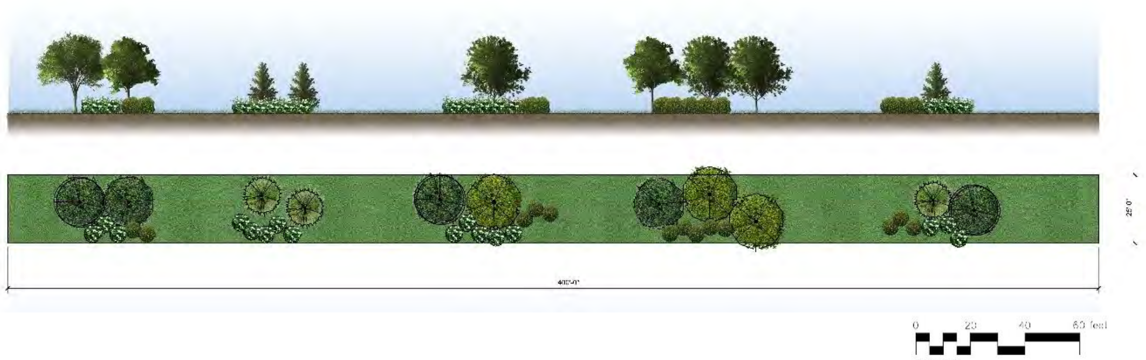
Name	Height			Landscape Buffer 1	Landscape Buffer 2	Landscape Buffer 3
	Installation	5-Year	Mature			
Pollinator Seed Mix (species vary)	Seed	1 – 3”	1 – 3”	✓	✓	✓
Balsam Fir (*Abies balsamea*)	4’	7’	50 – 70’		✓	✓
Ohio Buckeye (*Aesculus glabra*)	5 – 6’	13 – 14’	20 – 40’		✓	
Black Chokeberry (*Aronia melanocarpa*)	4’	4 – 8’	4 – 8’			✓
Hackberry (*Celtis occidentalis*)	6 – 8’	12 – 14’	40’	✓	✓	✓
Buttonbush (*Cephalanthus occidentalis*)	3 – 4’	6 – 7’	5 – 12’	✓	✓	✓
Eastern Redbud (*Cercis canadensis*)	5 – 6’	11 – 12’	20 – 30’		✓	
Grey Dogwood (*Cornus racemosa*)	4 – 5’	7 – 8’	10 – 15’			✓
Common Winterberry (*Ilex verticillata*)	3 – 4’	3 – 7’	3 – 12’	✓	✓	✓
Eastern Red Cedar (*Juniperus virginiana*)	4’	14’	30 – 40’			✓
Common Ninebark (*Physocarpus opulifolius*)	4’	6 – 8’	8 – 10’		✓	✓
Pin Oak (*Quercus palustris*)	6 – 8’	14 – 16’	50 – 70’	✓		✓
American Hop Hornbeam (*Ostrya virginiana*)	5 – 6’	11 – 12’	25 – 30’		✓	✓
White Pine (*Pinus strobus*)	4’	17’	50 – 80’	✓	✓	✓
American Elm (*Ulmus americana*)	6 – 8’	10 – 12’	40 – 50’	✓	✓	✓
Nannyberry (*Viburnum lentago*)	3 – 4’	6 – 8’	14 – 16’	✓	✓	✓

2.2.1 All Landscape Buffers: Pollinator Habitat

In each of the Landscape Modules, grasses and pollinator seed mixes will have the potential to be used in the vegetation plan. This is intended to soften the edges of agricultural fields or low visibility areas with use of a pollinator seed mix, or to enhance a landscaped area. The seed mix will provide seasonal color and texture interest as well as ecological benefits that did not previously exist within the Project Area. A variety of potential seed mixes will be specified based on the expected soil composition in different locations within the Project Area to increase survivability and successful regeneration.

2.2.2 Landscape Buffer 1: Vertical Softening

Landscape Buffer 1, shown below, is intended for use in areas with the potential for frequent viewers but without prolonged viewer duration. As shown on Figure 1, Landscape Buffer 1 has been selected for use along roadways where panels are relatively proximate to local roadways, but specific dwellings are not adjacent. Consisting of shrubs and trees of varying scale and form spaced to create visual interest, Landscape Buffer 1 has the ability to visually break up the horizontal line resulting from the solar array, and to provide partial screening and greater integration with the surrounding landscape. The lower profile of the majority of the selected species allows for partial Project screening while maintaining long views and open sky over the top of the Project's features. The resulting variety of colors and heights spaced along the array fenceline would not fully obscure visibility but would provide a natural screening to the viewed Project.

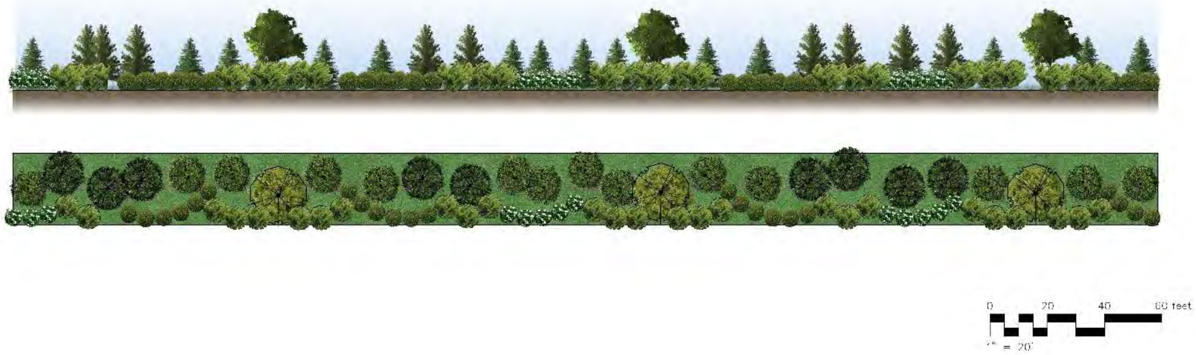


2.2.3 Landscape Buffer 2: Moderate Screening

Landscape Buffer 2, shown below, is intended to be used when stationary viewers are more proximate to Project features. As shown on Figure 1, its use is intended for locations where viewer may have the potential to see Project features, but where the layout buffer results in a reduced visual effect. Landscape Buffer 2 reflects an almost continuous stretch of plantings, consisting of tall deciduous and evergreen species as well as lower-growing shrubs. Species with varying coloration and size were selected for visual interest. Landscape Buffer 2, while a considerably greater level of screening than Landscape Buffer 1, is still intended to soften views toward the Project while allowing for longer-range line-of-sight.

2.2.4 Landscape Buffer 3: High Level of Screening

Landscape Buffer 3, shown below, is intended for use when stationary adjacent uses could be affected by a direct view of the Project. This buffer type results in a fairly continuous screen, and as noted on Figure 1, is intended for locations such as the closest residential areas in the Village of Arcadia and other residences with the potential for direct views with limited distance buffering. The intent is not to create a 100 percent opaque screen, but to provide a dynamic buffer that allows light to pass through and some depth of massing. Taller vegetation is intended to be interspersed with lower growing species to create visual interest and a more natural look to the vegetated area.



3. Lighting Plan

Lighting for the Project will be designed to have minimal impact on the surrounding community while providing for safe operations. Area lighting will meet the standards of applicable engineering and other codes and standards.

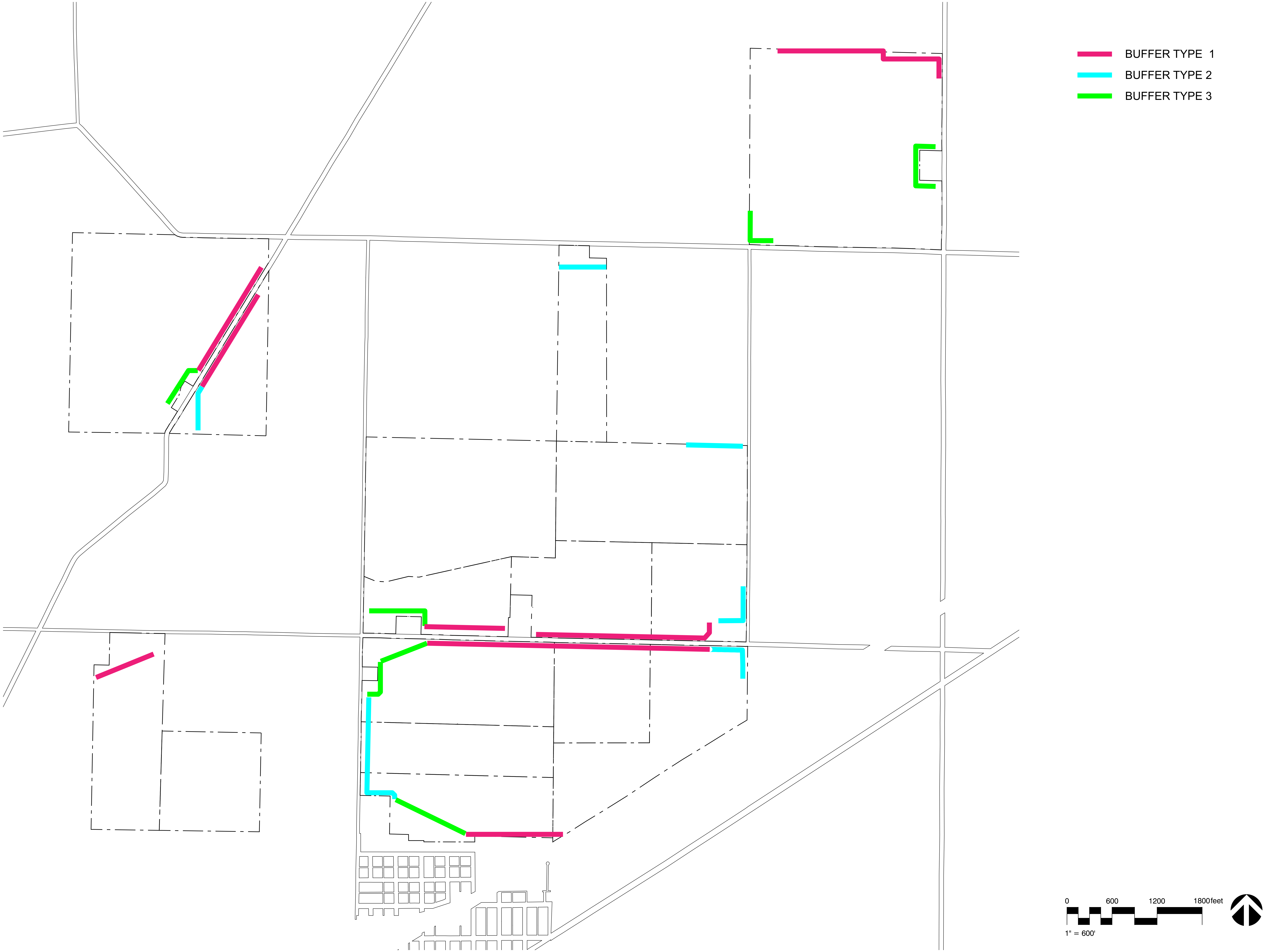
During construction no lighting is proposed within laydown areas, although it could be added as needed, should safety or vandalism issues be identified. Lighting during construction is anticipated to be minimal and will be restricted to construction hours (7:00 am to 7:00 pm). To the extent practicable, lighting will be oriented toward the interior of the Project, away from roadways and adjacent residences.

Downlit security lighting will be used at Project entrances, the Project Substation, the Utility Switchyard, the O&M Building, and at inverters. All fixtures will be oriented toward the Project and, to the extent appropriate for the purpose, be directed downward. Motion sensing lights can be used at entrances and the O&M building, while inverter lighting can be task lighting that would be manually turned on only in the event nighttime maintenance was required. It is expected that the electrical substation and utility switchyard associated with the Project will require lighting to remain on for security purposes; full cutoff optics will be used to reduce unwanted fugitive light.

4. Conclusion

Mitigation of visual impacts is an important component of the development of a solar facility. The proposed landscaping serves to reduce or minimize the potential visual impacts associated with the Project to the extent practicable. The three landscape buffers demonstrate potential mitigation options that could be incorporated into the Project. In addition to the visual mitigation provided, prioritizing the selection of native species further enhances ecological benefits through habitat creation and increased biodiversity. It is anticipated that the proposed landscaping will be effective in achieving the goals outlined in this plan. However, circumstances such as appropriate planting medium, the presence of utilities, availability of species at the time of procurement, and continued input from the key stakeholders (such as the County Soil and Water Conservation District and adjacent landowners for whom the screening is targeted) may result in alterations or substitutions to the proposed materials.

Lighting will also carefully balance the need for safety and task support with minimizing community visual effect. By limiting the lighting to the essential locations, and using sensor and manual task lighting to the extent possible, the community is not expected to be affected by the Project’s lighting.



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PROJECT NO.
021-054

DRAWN BY
S.P.H.

CHECKED BY
K.A.A.

NOT FOR CONSTRUCTION

SCREENING PLAN

Figure 1