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PROVIDENCE SOLAR CENTER
Madison County, Tennessee

DRAFT
ENVIRONMENTAL ASSESSMENT

Prepared for:
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Symbols, Acronyms, and Abbreviations

AADT	Annual Average Daily Traffic
AC	alternate current
APE	Area of Potential Effects
BMP	best management practice
BZA	Board of Zoning Appeals
CEQ	Council on Environmental Quality
CFR	Code of Federal Register
CO	Carbon monoxide
CRA	Cultural Resource Analysts
dBA	A-weighted decibel
dbh	diameter at breast height
DC	direct current
DNL	day-night sound level
EA	Environmental Assessment
EO	Executive Order
F-A-R	Forestry-Agriculture-Recreation
FPPA	Farmland Protection Policy Act
GHG	greenhouse gas
I-40	Interstate 40
IRP	Integrated Resource Plan
kV	kilovolts
Lmax	maximum noise level
$\mu g/m^3$	micrograms per cubic meter
MW	megawatt
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NO_2	nitrogen dioxide
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
PM_{10}	Particulate matter having a diameter of less than or equal to 10 microns
$PM_{2.5}$	Particulate matter having a diameter of less than or equal to 2.5 microns
PPA	power purchase agreement
ppb	parts per billion
ppm	parts per million
PSC	Providence Solar Center, LLC
PV	photovoltaic
ROW	right-of-way
RSO	Renewable Standard Offer
SHPO	State Historic Preservation Office
SO_2	sulfur dioxide
STEMC	Southwest Tennessee Electric Membership Corporation
SWPPP	Stormwater Pollution Prevention Plan
TDEC	Tennessee Department of Environmental Conservation
TVA	Tennessee Valley Authority
TVARAM	Tennessee Valley Authority Rapid Assessment Method
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish And Wildlife Service

CHAPTER 1 – INTRODUCTION

The Tennessee Valley Authority (TVA) proposes to execute a power purchase agreement (PPA) with Providence Solar Center (PSC), LLC, a subsidiary of Silicon Ranch Corporation, for electricity generated by PSC's proposed 20-megawatt (MW) solar photovoltaic (PV) facility between Providence Road and Bond Cemetery Road near the unincorporated community of Denmark, Tennessee (Figure 1-1). The proposed solar farm would occupy approximately 118 acres of a 288-acre tract that PSC will lease for a 20-year period with 5-year extension options from the property owner. The proposed solar PV facility (Proposed Action) would be connected via a 0.5-mile 12.47-kilovolt (kV) overhead power line to the nearby Morris Substation, which is owned by Southwest Tennessee Electric Membership Corporation (STEMC).

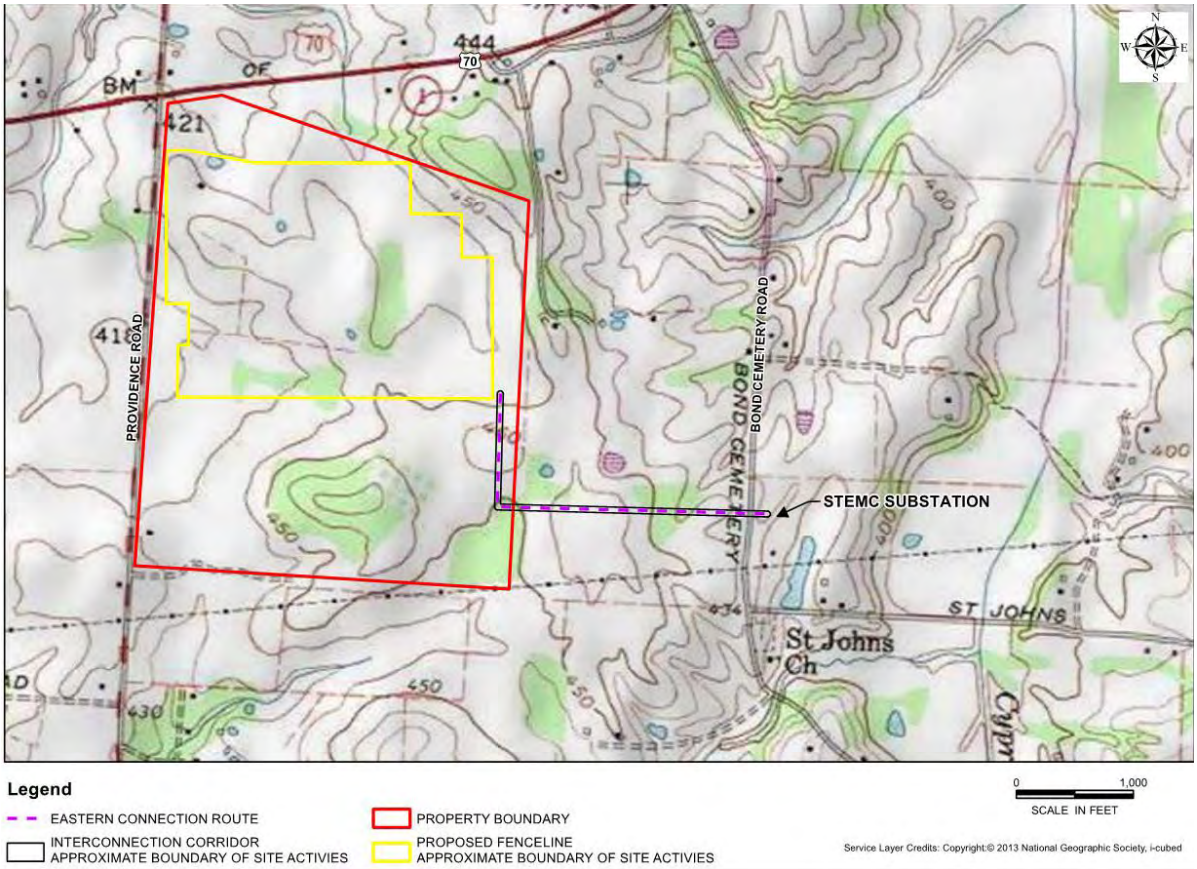


Figure 1-1. Location of the proposed solar facility.

1.1 Purpose and Need for Action

In its 2011 Integrated Resource Plan (IRP; TVA 2011) TVA established the goal of increasing its renewable energy generating capacity by 1,500 to 2,500 MW by 2020. TVA established the Renewable Standard Offer (RSO) program as one of the means of meeting this goal. Under the RSO program, TVA purchases energy at established terms and conditions (the "standard offer") from operators of qualifying renewable energy-generating facilities. Qualifying facilities must be new, located within the TVA service area, and must generate electricity from specific technologies or fuels. Solar PV generation is one of the

qualifying technologies. PSC has met the qualifications for the RSO program, and TVA must decide whether to execute the PPA.

TVA's 2015 IRP (TVA 2015) recommends the continued expansion of renewable energy-generating capacity, including the addition of between 175 and 800 MW of solar capacity by 2023. The proposed action would help meet this need for additional solar capacity.

1.2 Scoping and Public Involvement

The National Environmental Policy Act (NEPA) requires all federal agencies to consider the impact of their proposed actions on the environment in accordance with regulations implementing NEPA promulgated by the Council on Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] Parts 1500 to 1508) and TVA procedures for implementing NEPA.

This Environmental Assessment (EA) has been prepared to assess the potential environmental impacts of the Proposed Action, which is described as TVA entering into the PPA with PSC and the associated construction and operation of the proposed solar energy system by PSC.

Under the RSO, TVA's obligation to purchase renewable power is contingent upon the satisfactory conclusion of the environmental review and TVA's determination that the action will be "Environmentally Acceptable." In order to determine acceptability, the TVA must take into account applicable federal laws and regulations and conclude that no significant direct, indirect, or cumulative impacts on the human environment would result from the location, operation, and/or maintenance of the proposed generating facility and that the facility would be consistent with the all applicable federal, state, and local laws and regulations.

Through the process of internal scoping and a review of applicable laws and regulations, TVA has identified the following resource areas for analysis in the EA due to the potential for impacts:

- Land Use and Zoning
- Socioeconomics
- Environmental Justice
- Visual Resources
- Cultural Resources
- Air Quality and Greenhouse Gas Emissions
- Noise
- Utilities
- Waste Management
- Transportation
- Geology and Soils
- Surface Water
- Wetlands
- Vegetation
- Wildlife
- Threatened and Endangered Species

TVA also considered potential effects related to groundwater, public and occupational health and safety, recreation, natural areas, and floodplains. However, TVA found these potential effects to be absent or minor and to not require further evaluation.

This draft EA is being issued for public review and comment. TVA will carefully review any comments received on this draft EA and address them, as appropriate, in the final EA.

1.3 Necessary Permits or Licenses

As discussed in Section 2.1.2, the current design proposed by PSC for the solar energy system would not involve discharges to surface waters and would not be situated in wetlands or involve work in streams. Therefore, the construction of the solar energy system would not require an Aquatic Resource Alteration Permit/Section 401 Water Quality Certification or a United State Army Corps of Engineers (USACE) Section 404 Permit. The proposed solar energy system would require a National Pollutant Discharge Elimination System (NPDES) Construction Stormwater Permit, as more than one acre of the project site would be disturbed by construction activities such as clearing, grubbing, or grading of the upland project areas. In January 2014, PSC was granted conditional approval from the Madison County Zoning Board to construct the solar energy system. PSC will have to file a design plan and building permit with Madison County for approval prior to the start of construction activities. The solar energy system would be designed in accordance with all applicable requirements in the National Electric Code.

CHAPTER 2 – ALTERNATIVES

This chapter explains the rationale for selecting the alternatives to be evaluated, describes each alternative, provides a comparison of the potential environmental impact of those alternatives, and identifies the preferred alternative.

2.1 Description of Alternatives

This EA evaluates two alternatives: the No Action Alternative and the Proposed Action Alternative.

2.1.1 Alternative A – The No Action Alternative

The No Action Alternative provides for a baseline of conditions against which the impacts of the Proposed Action Alternative can be measured. Under this alternative, TVA would not purchase the power generated by the project under the RSO PPA with PSC. In the absence of the PPA, PSC would not construct and operate the proposed solar facility, and STEMC would not make the upgrades to its electrical system necessary to transmit the power generated by the facility. TVA would rely on other sources of generation described in the 2015 IRP (TVA 2015) to ensure an adequate energy supply and to meet its goals for increased renewable and low-greenhouse gas (GHG)-emitting power generation.

Environmental conditions in the project area would remain unchanged in the immediate future.

2.1.2 Alternative B, Option 1 – Proposed Action

Under the Proposed Action, TVA would enter into a PPA with PSC through the RSO program to purchase the electricity generated from the proposed solar energy system for a 20-year period. In addition, TVA's action includes granting access to the existing TVA transmission line easement as it would be crossed by the interconnection line from the PSC facility to the TVA grid. PSC would construct, operate, and maintain a 20-MW direct current (DC) PV solar power generation facility on an approximate 288-acre privately owned tract located near the unincorporated community of Denmark in western Madison County, Tennessee. The proposed solar array and associated improvements (e.g., access roads, fence) would occupy approximately 118 acres (Figure 2-1). In addition, a laydown area within the fenced area would be required within an upland area with little to no environmental constraints (e.g., presence of wetlands or streams) within the site boundaries.

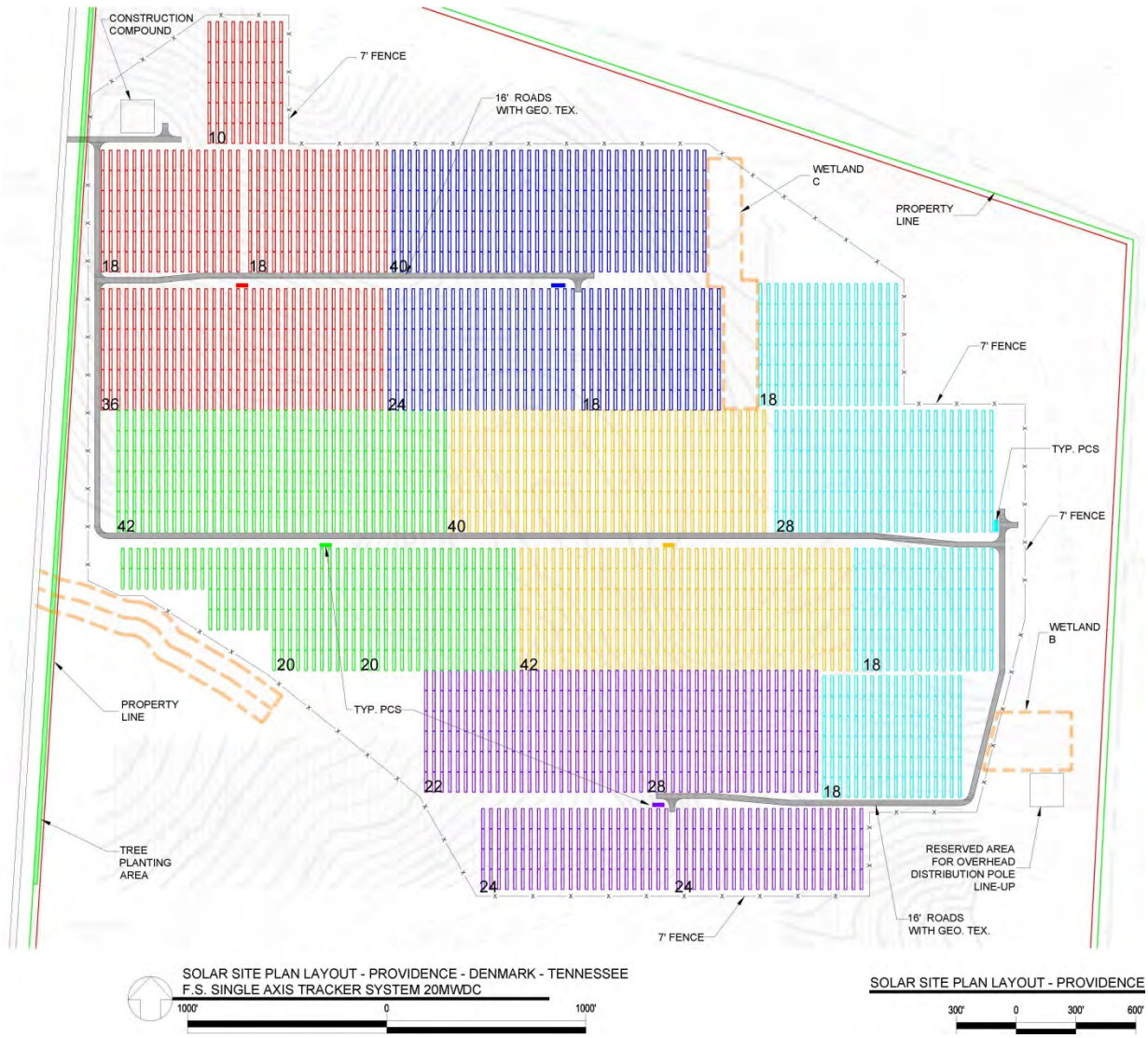


Figure 2-1. Providence Solar Center conceptual site plan.

The solar energy system would be composed of multi-acre, single-axis tracker, ground-mounted PV solar arrays. Unlike a fixed-tilt racking system in which the solar panels are set at one fixed angle, the single-axis tracker would pivot the panels to track the sun's positional shifts and collect solar energy more efficiently than traditional fixed-tilt racking systems. Solar panels would be secured within an array using prefabricated mounting kits, with the top of the solar panels reaching a maximum height of 8 feet above grade surface, depending on position of the sun and weather conditions. Each array would be secured using a series of posts, racks, and other hardware. The posts would be installed into the ground to a typical depth of up to 8 feet, depending on local soil and wind conditions. These support structures are typically piles or metal posts that would be driven into the ground by either specialized pile drivers or drilled augers depending on future geotechnical analyses. No night lighting or security lighting would be installed; however, lights would be located within each inverter station cabinet for use when opened for inspection at night. Figure 2-2 shows a typical array of single-axis tracker panels.

Figure 2-2. Photovoltaic array – single-axis tracker example.

Construction of the proposed solar facility involves minimal grading, minimal clearing of vegetation and trimming tree limbs, driving posts, assembling the racking to the posts, and attaching the solar panels to the racking. Trenches (typically 24 to 36 inches deep) would be dug for DC wiring connecting the arrays to six inverters. All trenches would be backfilled to grade. Each inverter, along with a transformer, would be mounted on a concrete equipment pad. Alternating current (AC) wiring installed in trenches would connect the transformers to a pad-mounted combiner box. A 12.47-kV overhead interconnection line consisting of three conductors (wires) would run from the combiner box to the interconnection point at the STEMC-owned Morris Substation. Within the substation area, the interconnection line would be routed into a manually operated disconnect and recloser prior to connecting into the STEMC distribution grid.

Standard practice is to work with the slope of the land and minimize grading work to the maximum extent possible. Any required grading would likely be limited to a maximum of 160 acres. The areas proposed for grading are identified below:

- Maximum of 118 acres within the fence line of the solar energy system (including laydown areas, roadways, concrete pads, and other elements)
- Additional 42 acres of land in the northern portion of the project area to complement grading for the development and help with sheet water flow.

Grading would be performed with portable earth-moving equipment and would result in a slope consistent with that of the existing grades. No soils would be disposed of off site from the grading activities, and any soil imported would likely be limited to clean sand that would be used for foundations and/or trenching.

The project area is currently being farmed. This area would be mowed or harvested as needed during construction and then would be naturally revegetated with grass or other low-growing vegetation, as only minimal vegetation clearing is proposed for this action. No trees would be cleared nor wetlands or streams graded during the construction of the solar facility. PSC would construct a gravel access road from Providence Road into the project site and complete additional gravel roadways as shown on Figure 2-1. A 7-foot-high security fence, topped with three strands of barbed wire and equipped with a gate, would be installed surrounding the solar array system. As part of the zoning approval for the proposed solar power generation facility, PSC will plant a buffer of Leyland cypress evergreen trees along the western boundary of the project site outside the security fence. PSC would be responsible for maintaining the tree buffer, which would need to grow to a minimum of 12 feet tall (see Section 3.1 for more information).

There would be no major physical disturbance during the operation of the proposed solar facility. Routine maintenance, such as fence repair, vegetation management (e.g., mowing), and other periodic routine solar array operation and maintenance activities, would also periodically occur within the project site. Tree maintenance may be required in order to maintain solar performance in accordance with contractual obligations. Following completion of construction activities, the remaining 170 acres of the project site that is outside of the proposed perimeter fence would continue to be managed by the existing property owner as agricultural land.

It is anticipated that the following types of equipment would be used during construction activities:

- Backhoe(s)
- Flatbed semi-truck(s)
- Semi-truck(s)
- Forklift(s)
- Bobcats and/or specialized tractors with extender or drill with auger or pile driver for installation of array support posts
- Concrete truck.

An interconnection route has been identified to connect the proposed solar energy system to TVA's grid via an interconnection point within the Morris Substation east of the project area. STEMC would perform minor upgrades to the substation necessary to handle the additional electric load, and these upgrades would be contained within the gravel areas of the substation. The 0.5-mile overhead interconnection line, consisting of three conductors (wires), would be strung overhead on newly constructed poles approximately 30 feet tall and spaced at intervals of 150 feet in order to deliver the generated power from the solar energy system to the interconnection point. The overhead interconnection line would leave the project site from the southeast corner, cross into the adjacent eastern private property, run along the field edges and southern boundary of this property, and enter the substation property from the south. About 2,200 feet of the interconnection line would be off of the PSC property. PSC would lease a 60-foot-wide right-of-way (ROW) occupying approximately 3 acres for this segment of the line. Most of this proposed ROW is cropland. No tree clearing in the ROW is proposed, but some tree trimming and removal of other tall vegetation may be necessary. Once the line is constructed, tall vegetation would be periodically cleared from the ROW per industry standards. Woody debris from such

maintenance activities will be recycled or reused on site. TVA would also need to grant access to allow PSC to cross TVA's existing transmission easement. Figure 2-3 shows the approximate route from the project site to the substation.

Figure 2-3. Route of the proposed interconnection line to the Morris Substation.

2.1.3 Alternatives Considered but Eliminated From Further Discussion

Siting requirements for a 20-MW solar energy generating facility include a contiguous area of at least 100 acres that is relatively level, proximity to an existing transmission line and/or substation capable of receiving the energy generated by the facility, and an adequate solar resource (i.e., adequate sunshine). Additional siting criteria include one or few landowners, a properly zoned site, and adjacent landowners that are receptive to the proposed development. To date, PSC and its other financial stakeholders in the TVA RSO program has concurrently vetted three other sites in the surrounding region of western Tennessee. This site has been selected and prioritized over the other three sites based on proximity to a substation that can accept the modeled electric load from the proposed solar PV facility, the willingness of the private landowner to enter into a lease agreement with PSC, and the acceptance of the proposed facility by surrounding property owners and the authorities having local jurisdiction.

Another option for development of the project site was to arrange the solar array into a compact square-shaped layout located in the southern portion of the project site. This design was originally conceived and eliminated by PSC following review of the results of the Critical Environmental Impacts Analysis, conducted by Ecology and Environment, Inc. in 2013. Unlike the 2013 conceptual design, the current solar energy system design avoids known environmental constraints that have been identified and field-delineated. Therefore, the original conceptual square-shaped layout has been eliminated from further discussion.

A second option (Option 2) for an overhead interconnection line was considered (Figure 2-4). Under this option, the overhead line would leave the site to the north and run up to J. Bond Lane. It would then turn east and run along J. Bond Lane, before turning south and running along Bond Cemetery Road to the interconnection with the Morris Substation. This

interconnection line would be approximately 2.0 miles long and would be installed within the existing STEMC ROW. The existing line is located within road ROWs and goes through residential areas (approximately 17 landowners). This option was eliminated from further consideration by STEMC due to complexities associated with installing a new interconnection line within the existing ROW.

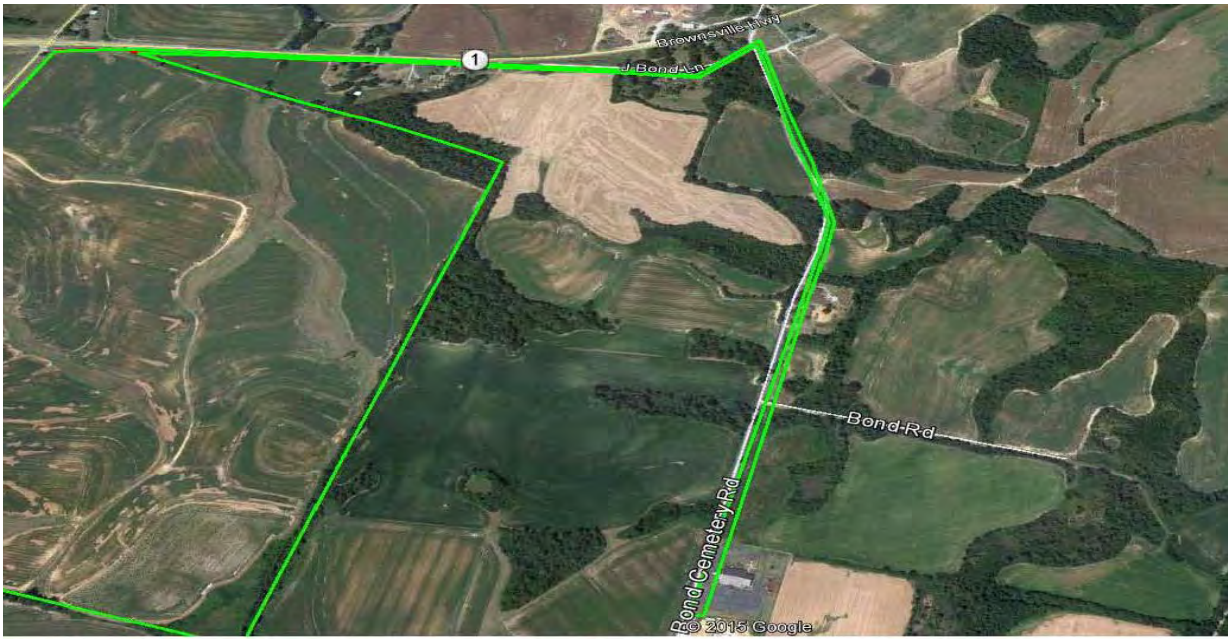


Figure 2-4. Route of the Option 2 northern interconnection line to Morris Substation.

A third interconnection line (Option 3) was also considered. Option 3 would utilize an underground interconnection line leaving the southeast corner of the project site and continuing in a straight path across the adjacent (to the east) property to the eastern property boundary, where it would resurface aboveground heading due north along the eastern property boundary and enter the substation property from the south. However, this option was eliminated from further discussion due to the adjacent private landowner and PSC not being able to agree on future access to the subsurface line.

2.2 Comparison of Alternatives

The summary and comparison of impacts by alternative for each resource area evaluated is provided in Table 2-1.

Table 2-1. Summary and Comparison of Alternatives by Resource Area.

Resource Area	Impacts From No Action Alternative	Impacts From Proposed Action Alternative
Land Use and Zoning	No impacts anticipated	Minor direct, indirect, and cumulative adverse impacts. Land use of the site would change from agricultural to light industrial, with the surrounding area usage not changing. A relatively small portion of a large area land use category would be lost to a new use type.
Socioeconomics	No impacts anticipated	Minor beneficial direct, indirect, and cumulative impacts during construction and operation and maintenance activities by creation of local jobs, an increase in local tax base from an increase in assessed property value, and potential for expansion of future solar energy systems into the region.
Environmental Justice	No impacts anticipated	No direct or indirect impacts anticipated for either the solar PV system or the interconnection.
Visual Resources	No impacts anticipated	Minor direct, indirect, and cumulative adverse impacts. The security fence and solar energy generating system would be visible from points adjacent to the north, west, and south of the site. The new interconnection line would be north of woodlands and only visible from farmland located to the north and from the adjacent Bond Cemetery Road to the east.
Cultural Resources	No impacts anticipated	No direct, indirect, or cumulative impacts are anticipated for either solar PV system or the interconnection.
Air Quality & Greenhouse Gas Emissions	No impacts anticipated	Negligible temporary direct impacts would occur during construction activities. The project could reduce the amount of combustion necessary in the area for power production, resulting in a minor beneficial impact to air quality, and assist in the reduction of GHG emissions on behalf of TVA.
Noise	No impacts anticipated	Negligible temporary direct impacts would occur during construction activities for either solar the PV system or the interconnection. No direct, indirect, or cumulative impacts are anticipated during system operations.
Utilities	No impacts anticipated	Beneficial direct, indirect, and cumulative impacts to electrical supply in the area due to additional renewable energy resource supply and potential for expansion of future solar energy systems into the region.
Waste Management	No impacts anticipated	Minor direct, indirect, and cumulative adverse impacts anticipated for the solar PV system or the interconnection. Construction waste generated during construction activities would be directed to local landfills. Impacts during system operation would be negligible through implementation of a

Resource Area	Impacts From No Action Alternative	Impacts From Proposed Action Alternative
		recycling program.
Transportation	No impacts anticipated	Minor direct and indirect temporary adverse impacts associated with construction activities for the solar PV system or the interconnection. No cumulative impacts.
Geology and Soils	No impacts anticipated	No direct, indirect, or cumulative geologic impacts anticipated for either the solar PV system or the interconnection. Minor impacts to prime farmland.
Surface Water	No impacts anticipated	No direct or indirect impacts are anticipated for either the solar PV system or the interconnection.
Wetlands	No impacts anticipated	No direct or indirect impacts are anticipated for either the solar PV system or the interconnection.
Vegetation	No impacts anticipated	Minor direct and indirect temporary adverse impacts associated with construction activities for the solar PV system or the interconnection. Long-term impacts associated with the operation of the facility due to vegetation change from row crops to permanent grass and herb cover.
Wildlife	No impacts anticipated	Minor direct and indirect temporary adverse impacts associated with construction activities for the solar PV system or the interconnection.
Threatened & Endangered Species	No impacts anticipated	No direct or indirect impacts are anticipated for either the solar PV system or the interconnection.

2.3 The Preferred Alternative

TVA's preferred alternative is the Proposed Action Alternative, which would fulfill the purpose and need for this project. This alternative entails the purchase of power by TVA through a PPA with PSC, resulting in the associated construction, operation, and maintenance by PSC of a 20-MW DC PV solar power generation facility located on the 118-acre portion of an existing 288-acre tract of farmland, and an 0.5-mile-long interconnection line located on 3 acres of existing farmland. This solar energy system has been designed to avoid the majority of environmental constraints identified and delineated during the assessment, and to have the least environmental impact possible while helping achieve TVA's renewable energy goals and meet future energy demands.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes the nature, extent, and importance of environmental resources in their existing setting on the project site. It provides a baseline for the assessment of potential effects of the alternatives described in Chapter 2. The scope of environmental consequences evaluated in this EA for the Proposed Action focuses on impacts related to the construction and operation of the proposed solar energy system at the project site. This information is summarized in Section 2.2 and in Table 2-1.

The CEQ defines a cumulative impact as the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually insignificant but collectively significant actions taking place over a period of time (40 CFR 1508.7). The cumulative impacts analysis recognizes the effects of the proposed alternatives on the various resources. It also recognizes the effects of other past, present, and reasonably foreseeable future actions, and it describes the additive or cumulative effects that might result. Although some cumulative effects, however minimal, could be identified for virtually any resource or condition, the effects described in this document are believed to be the most pertinent and most representative of those associated with the proposed action. The cumulative impacts associated with the proposed action are described in the individual resource sections in Chapter 3.

According to the Federal Emergency Management Agency Flood Insurance Rate Map, the project area and proposed interconnect route are designated as Zone X (unshaded), meaning they are located outside the 100- and 500-year floodplains, and there is a minimal risk of flooding. Therefore, there would be no direct, indirect, or cumulative floodplain impacts under the Proposed Action Alternative, and the Proposed Action would comply with Executive Order 11988 – Floodplain Management. The elements of the Proposed Action Alternative are not located within 5 miles of areas designated as a natural area, open space, park, or wildlife management area or refuge.

3.1 Land Use and Zoning

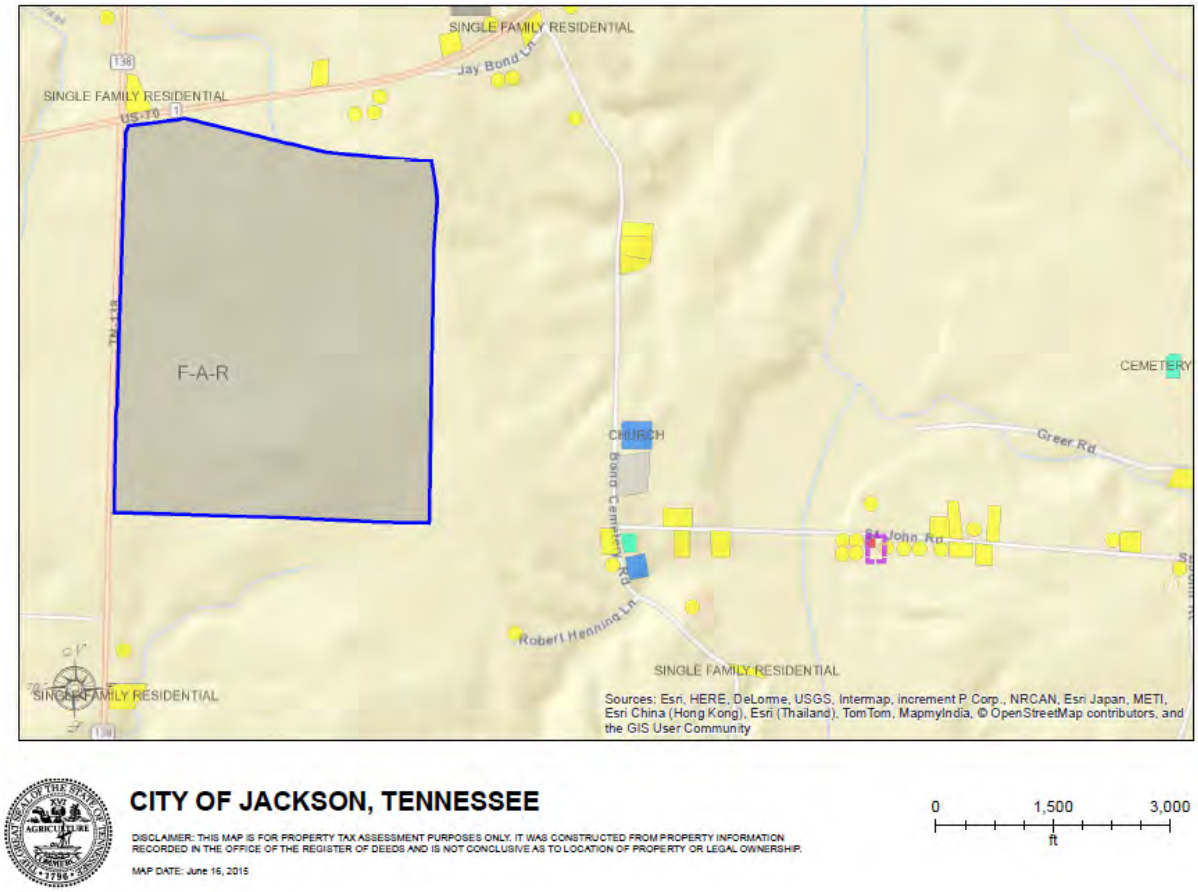
This section provides an overview and details of the existing land use at and surrounding the project site, as well as the potential impacts on land use that would be associated with the alternatives.

3.1.1 Affected Environment

The term “land use” can be characterized as the way in which land has been developed and used in the agricultural, residential, and industrial landscapes. Denmark, Tennessee is an unincorporated community located in Madison County, which has developed a county-wide zoning ordinance in order to control the direction of development and to keep similar land uses together. The project site is agricultural land with two intermittent streams and a few small forested areas, mostly on its perimeter.

The project site is located in the Forestry-Agriculture-Recreational (F-A-R) Zoning District, which allows public and semi-public uses subject to approval by the Madison County Board of Zoning Appeals (BZA). The F-A-R Zoning District provides for agricultural uses and maintenance as permanent open land. The District also allows for residential development

of the lowest density, designed to work without public water or sanitary sewer. Uses permitted upon appeal to the BZA include mobile home parks, trailer parks, and customary accessory buildings for such uses (which meet certain regulatory requirements); churches, schools, and other suitable public and semi-public uses; customary buildings for such uses; home occupations; greenhouses; nurseries; commercial riding stables; kennels; private landing strips for fixed-wing single-engine aircraft; rustic restaurants; daycare centers; homes for the aged; commercial mobile communication services; accessory dwelling units; wineries; bed and breakfasts; bar-b-que pits; and distilleries (Jackson, 2014). Land use in the area surrounding the project site is similar to the existing use at the project site. According to the City of Jackson online Property Search Application (Figure 3-1), while the majority of the surrounding zoning designations fall within the F-A-R District, existing land uses vary, and include scattered single-family residential (generally north and east of the project site), light industrial (northeast of the project site), a church and a cemetery (east of the project site), and public utilities (STEMC-owned substation, located east of the project site).



Note 1: The blue outline is that of the 288-acre project site area. Per the City of Jackson website, the yellow highlights are single-family residential, the grey highlight is public utility, the dark blue highlights are churches, the light blue are cemeteries, the red are retail, and the purple dashed line indicates a commercial zoning district that does not include F-A-R.

Figure 3-1. Existing land use and zoning.

3.1.2 Environmental Consequences

3.1.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the proposed solar energy system would not be constructed. Therefore, no project-related impacts to land use would occur. Existing land use would be expected to remain under current farmland usage. Existing land use in the surrounding areas would be expected to remain a mix of agricultural farmland, residential land, and unused land.

3.1.2.2 Alternative B – Proposed Action Alternative

Minor direct, indirect, and cumulative land use impacts would be expected with the Proposed Action Alternative. Under the Proposed Action Alternative, land use at the project site would change from an agricultural to light industrial with the installation of the solar energy system. However, adjacent and surrounding land uses would remain the same and would generally be unaffected by the change in land use at the project site.

In late 2013, PCS applied to the Madison County BZA for approval to construct and operate the solar facility. On January 22, 2014, the BZA approved PSC's request with the condition that PSC must plant a buffer of evergreen trees along the frontage of Providence Road (Highway 138, the western site boundary; see Figure 3-2) that would eventually grow to a minimum height of 12 feet. PSC will comply with this condition and maintain the evergreen tree buffer for the life of the solar facility.

There are no known large developments, including other solar facilities, proposed in the surrounding area. The construction and operation of the proposed solar facility is unlikely to result in changes in land uses in the surrounding area; therefore, any cumulative impacts on land use would be minimal.

3.2 Socioeconomics

3.2.1 Affected Environment

The Proposed Action is located near the unincorporated community of Denmark in western Madison County, approximately 75 miles northeast of Memphis, Tennessee. Madison County is identified as the area of impact with regard to socioeconomics.

3.2.1.1 Socioeconomic Environment

The population of Madison County, as reported by the United States Census in 2010, was 98,294, and the estimated 2014 Madison County population is 98,178 (U.S. Census Bureau 2015). Census tract 17, which contains the project site, has a population of approximately 1,511. According to the Madison County website, while once largely agricultural, Madison County's economy has become more diversified in the industrial and commercial markets. Two of the largest industrial plants in the county include Procter & Gamble and Stanley/Black and Decker. Madison County offers a wide variety of economic, cultural, and educational benefits and is home to several colleges.

The City of Jackson is the county seat of Madison County, and its labor draw includes Madison and the surrounding eight counties. Thirty percent of Madison County's workforce commutes from the surrounding counties. This number is higher in the manufacturing sector. The Jackson (Madison County) area civilian labor force in April 2015 was 136,310. Of that, the area employment was 127,380, with an unemployment rate of 6.6 percent (Jackson Chamber 2014). According to the State of Tennessee, Department of Employment Security, Research and Statistics and the U.S. Department of Labor Bureau of

Labor Statistics, in October 2015, the county labor force was 46,727, employment was 44,062, and the unemployment rate was 5.7 percent. From October 2014 to October 2015, the Madison County unemployment rate decreased 0.9 percent. By comparison, the unemployment rate for the State of Tennessee in October 2015 was 5.4 percent, which was a 0.9-percent decrease in unemployment from October 2014. These rates were not seasonally adjusted. The per capita annual income (2009-2013) in Madison County was $23,283, and the median household income for the same years $41,617. By comparison, in the State of Tennessee, the per capita annual income for 2009-2013 was $24,409, and the median household income was $44,298 (U.S. Department of Labor 2015).

3.2.2 Environmental Consequences

3.2.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not purchase the power from PSC. Therefore, the proposed solar energy system would not be constructed, and there would be no project-related impacts to socioeconomics.

3.2.2.2 Alternative B – Proposed Action Alternative

Under the Proposed Action Alternative, construction activities at the project site are anticipated to take approximately 6 months to complete. During that time, a crew of approximately 8 to 12 personnel would be employed, with approximately 12 personnel on site during peak construction. Personnel would include a mix of general laborers, electrical technicians, and journeyman-level electricians, a majority of whom would come from the local/regional workforce. Work is anticipated to be conducted 5 days per week for up to 6 months, with no weekend or holiday work. Short-term beneficial economic impacts are anticipated resulting from construction activities, including the purchase of some materials, equipment, and services locally, and a temporary increase in local employment and income. This increase would have positive impacts locally and regionally. Local vegetation management providers would be contracted to complete operation and maintenance activities during the lifecycle of the project, which would also result in beneficial economic impacts.

Tennessee offers a special ad valorem property tax assessment for certified green energy production facilities. Tennessee SB 1000 stipulated that the assessed property value of all certified green energy production facilities (as defined in Tenn. Code § 67-4-2007) may not exceed 12.5 percent of installed costs for solar. In addition, Tenn. Code Ann. Section 67-6-346 would allow for PSC to apply for a refund of taxes paid, or to apply for authority to make tax-exempt purchases of machinery and equipment used to produce solar electricity. Therefore, impacts to the local tax base would be slightly positive through a slight increase in assessed property value and associated taxes. There would be insignificant direct, indirect, or cumulative impacts associated with the operation of the proposed solar facility.

3.3 Environmental Justice

3.3.1 Affected Environment

Executive Order (EO) 12898 – Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations was issued in 1994 to focus federal attention on the environmental and human health effects of federal actions on minority and low-income populations, with the goal of achieving environmental protection for all communities. The EO directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations to the greatest extent practicable and permitted by

law. Although EO 12898 does not apply to TVA, TVA routinely considers environmental justice in its planning processes.

Minority individuals are those who are members of the following population groups: American Indian or Alaskan Native, Asian or Pacific Islander, Black (not of Hispanic origin), or Hispanic. Minority populations in an affected area should be identified where either the minority population of the affected area exceeds 50 percent, or the minority population percentage of an affected area is meaningfully larger than the minority population percentage in the general population of the surrounding region (CEQ 1997). According to the U.S. Census, the minority population of the State of Tennessee in 2013 was 24 percent and in Madison County (2013) was 42.1 percent. By comparison, Census Tract 17, which contains the proposed solar facility, had a minority population of 37.8 percent.

Low-income populations in an affected area should be identified with the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty (CEQ 1997). Poverty status is reported as the number of persons or families with income below a defined threshold level. Madison County's poverty rate for the years 2009-2013 was 20 percent, and the poverty rate for Census Tract 17 was 12.5 percent, which is lower than the State of Tennessee poverty rate for the same years (17.6 percent; U.S. Census Bureau 2015).

3.3.2 Environmental Consequences

3.3.2.1 Alternative A – No Action Alternative

Implementation of the No Action Alternative would not result in any project-related disproportionate adverse environmental or health impacts to low-income or minority populations.

3.3.2.2 Alternative B – Proposed Action Alternative

There would be no direct, indirect, or cumulative disproportionate impacts on minority or low-income populations associated with the Proposed Action Alternative. The local minority population is lower than the county but higher that the state percentages. The local poverty rate is lower than both the county and state percentages. The proposed facility would not be located adjacent to residential neighborhoods, schools, playgrounds, churches, or other such resources and/or receptors. The temporary increase in construction-related traffic would be negligible (see Section 3.10.2) and therefore, would not be expected to impact local populations in an adverse manner for an extended period of time. Implementation of the Proposed Action is anticipated to result in a slight overall net decrease in air quality pollutants and GHGs, and would not be expected to result in disproportionate adverse environmental or health effects on low-income or minority populations. The Proposed Action would not have the potential to substantially affect human health or the environment through the exclusion of persons, the denial of benefits, or the subjection of persons to discrimination or health and/or safety risks.

3.4 Visual Resources

Visual resources are the visual characteristics of a place, including both natural and man-made attributes. How an observer experiences a particular location can be determined by the visual resources at and surrounding that location. The following sections describe the aesthetic and visual characteristics of the project site and surrounding area.

3.4.1 Affected Environment

The 288-acre project site is agricultural land, located at the corner of Brownsville Highway/US 70 and Providence Road/Highway 138 near the unincorporated community of Denmark. Two gravel roads that connect to Highway 138 are located on site. The project site is bordered on the northeastern and eastern property boundaries by forested areas. The nearest residence from which the site is visible is located approximately 230 feet north of the project site, across Brownsville Highway. A church is located approximately 2,000 feet due east of the project site boundary, adjacent to the north to the STEMC substation. The proposed interconnection line would run along woodland bordered by farmland. Figure 3-2 shows the locations of subsequent photographs (Figures 3-3, 3-4, and 3-5) that illustrate the current conditions at the project site.

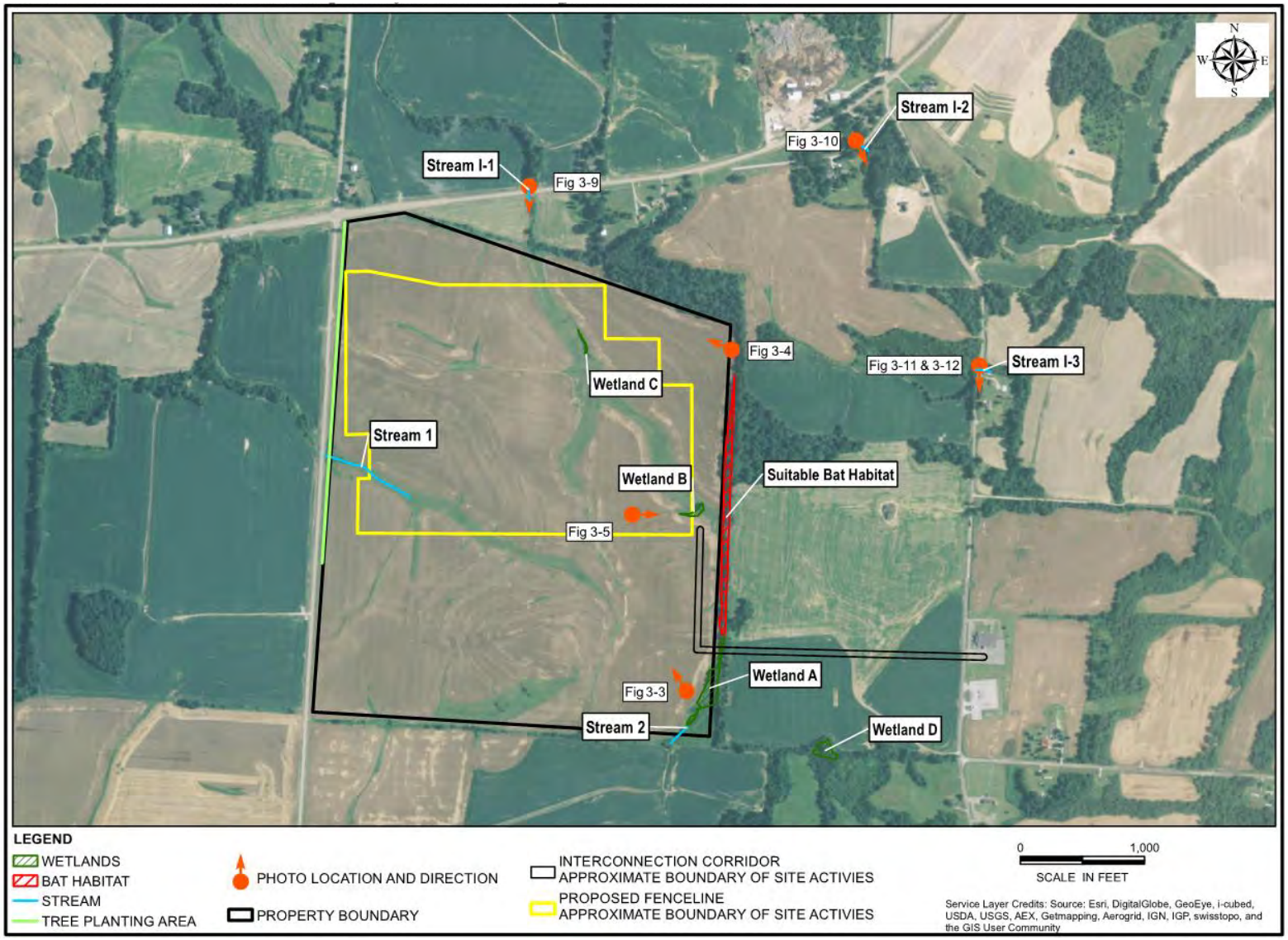


Figure 3-2. Locations of photographic documentation and project area environmental resources.

Figure 3-3. View of flat to gently rolling topography, facing northwest from the southeast corner of the site.

Figure 3-4. View of wooded area along the northeastern border of the site, facing northwest.

Figure 3-5. View of Wetland B in the east-central portion of the site, facing east.

3.4.2 Environmental Consequences

3.4.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not enter into a PPA with PSC, and the proposed solar energy system would not be constructed. Therefore, no project-related impacts to visual resources would result, as no change in the appearance of the project site or within the surrounding areas would occur as a result of project activities. Existing views would remain unchanged from the present setting of agricultural land and scattered residences. The landscape may, however, change over time depending on actions of the area landowners.

3.4.2.2 Alternative B – Proposed Action Alternative

Minor direct and indirect adverse effects would be expected with the Proposed Action Alternative. During the course of construction, visual changes at the project site would result from the presence of construction equipment and delivery equipment, as well as the presence of personnel and their vehicles. In addition, heavy machinery would be visible both on site and travelling to and from the site on existing roadways, changing the now agricultural landscape to one that contains man-made items and materials.

The viewshed would change with construction vehicles, equipment, and personnel present at the project site. Upon completion, the solar energy system would consist of approximately 66,000 solar PV panels on steel racking structures and associated electrical equipment on concrete pads. The racking system with panels would be approximately 8 feet high at its tallest point, and would rotate the modules from east to west over the course of the day to minimize the angle of incidence between the incoming sunlight and the panels. The entire project site would be surrounded by a 7-foot-tall security fence topped with barbed wire and a gate for security and safety purposes. The fence, PV panel arrays, and other electrical infrastructure would be visible from points adjacent to the north, south, and west of the site. As required by the Madison County zoning board, an evergreen tree buffer

with an eventual height of at least 12 feet would be planted along the western boundary (along Highway 138, see Figure 3-2). This vegetative screen would help reduce potential visual impacts experienced by the local community by blocking views of solar facility components located close to Highway 138. More distant components at higher elevations farther from the road may still be visible.

A tree line exists along the northeastern and eastern boundaries of the project site. This tree line would not be disturbed during the construction and maintenance of the solar facility and would block views of the solar facility and fencing the northeast and east, including most of the nearby residences. It would also block the view of the facility from part of the stretch of Brownsville Highway/US70 north of the site .

The facility interconnection line would be strung on new utility poles from the facility to the existing substation about 0.5 mile east of the facility. The interconnection line would be visible from surrounding farmland and Bond Cemetery Road. Given the presence of power lines and the substation along Bond Cemetery Road, the new interconnection line would result in minor additional visual impacts. Once the solar energy system components are installed and operational, the only other equipment present at the project site would be periodic and associated with maintenance and regular mowing.

Given the overall change from a gently rolling agricultural landscape to one that contains man-made items, impacts to visual resources would be minor. If more solar energy systems are developed throughout the region, the project site could result in a minor cumulative impact to visual resources. It is anticipated that the remaining area outside of the fenceline of the project site and access road will remain undeveloped, and farming practices are expected to continue as they exist currently.

3.5 Cultural Resources

Cultural resources include, but are not limited to, prehistoric and historic archaeological sites, historic structures, and historic sites at which important events occurred. Cultural resources are finite, non-renewable, and often fragile. They are frequently threatened by industrial, commercial, and residential development, as well as construction of roads and other infrastructure. Under Section 106 of the National Historic Preservation Act of 1966 (NHPA), TVA is required to consider ways to avoid or minimize effects from TVA undertakings on significant cultural resources. The NHPA addresses the preservation of “historic properties,” which are defined under the Act as any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP).

Two broad categories of cultural resources are archaeological resources and historic architecture. Some examples of archaeological resources are earthworks, weapons and projectiles, human remains, rock carvings, and remains of subsurface structures, such as domestic fire pits. Historic architecture consists of standing structures that are 50 years old or older. Consistent with Section 106 of the NHPA, such structures, as well as archaeological resources, must meet certain criteria to qualify for inclusion on the NRHP.

3.5.1 Affected Environment

In April–June and October 2015, Cultural Resource Analysts, Inc. (CRA) staff, on behalf of Arcadis, conducted Phase I archaeological and historic architecture surveys of the area of potential effects (APE) for the proposed solar facility (CRA 2015). The purpose of the surveys was to locate and identify archaeological and historic architectural resources

within the APE and to evaluate their eligibility for inclusion in the NRHP. Prior to conducting field surveys, CRA and Arcadis conducted a record and literature search through the Tennessee Division of Archaeology to determine the presence of known archaeological sites, and a search through the Tennessee Historical Commission and NRHP records to determine the presence of known architectural/historical resources within the APE.

3.5.1.1 Architectural Resources

Desktop and field analyses were completed by CRA regarding the Proposed Action's potential to affect historic properties. The purpose of the analyses was to identify previously recorded historic architectural resources within the APE, which was defined to include a 0.5-mile buffer surrounding the solar energy system. The review included an analysis of historical aerial imagery and topographic quadrangles, a review of the files maintained by the Tennessee Historical Commission, and a review of the NRHP and National Historic Landmark (NHL) databases maintained by the National Park Service (NPS). Information on known historic architectural resources occurring in or near the APE was examined, as well as previously completed cultural resources reports and historic documents pertinent to the APE. Upon confirming that there are no previously recorded historic architectural resources within the APE, a comparative review of modern and historical imagery and historical topographic quadrangle maps was undertaken to identify any historical architectural resources (50 years of age or older) located within the APE. Based on the above research, a total of 13 single or grouped structures were identified within the project area on the 1959 quadrangle map, ten of which were within the 0.5-mile APE (Figure 3-6). Each of these structures was visited, and lines of sight were documented. Construction dates for each of the identified architectural resources were determined using data in the Tennessee Property Viewer.

Nine of the ten architectural resources were constructed between 1920 and 1965, and reflect forms and property types common throughout rural western Tennessee that are undistinguished in character and construction. Based on the background research and architectural assessment, they do not have significance associations under NRHP Criteria A or B and lack significance to be considered eligible under Criterion C. Resource MD739 consists of St. John Baptist Church and an associated cemetery, identified as St. John Baptist Church #2 Cemetery. The church is an undistinguished mid-twentieth-century brick building lacking distinguishing architectural features and historical importance. Marked graves in the cemetery predominantly date between 1918 and the 1990s and lack distinctive design features; no persons of transcendent importance are represented and no association with historic events was identified by the background research. Therefore, based on this study, TVA has determined that the APE contains no aboveground historic properties listed or eligible for listing in the NRHP and is consulting with the Tennessee State Historic Preservation Office (SHPO) and federally recognized Indian tribes regarding this determination; concurrence is pending.

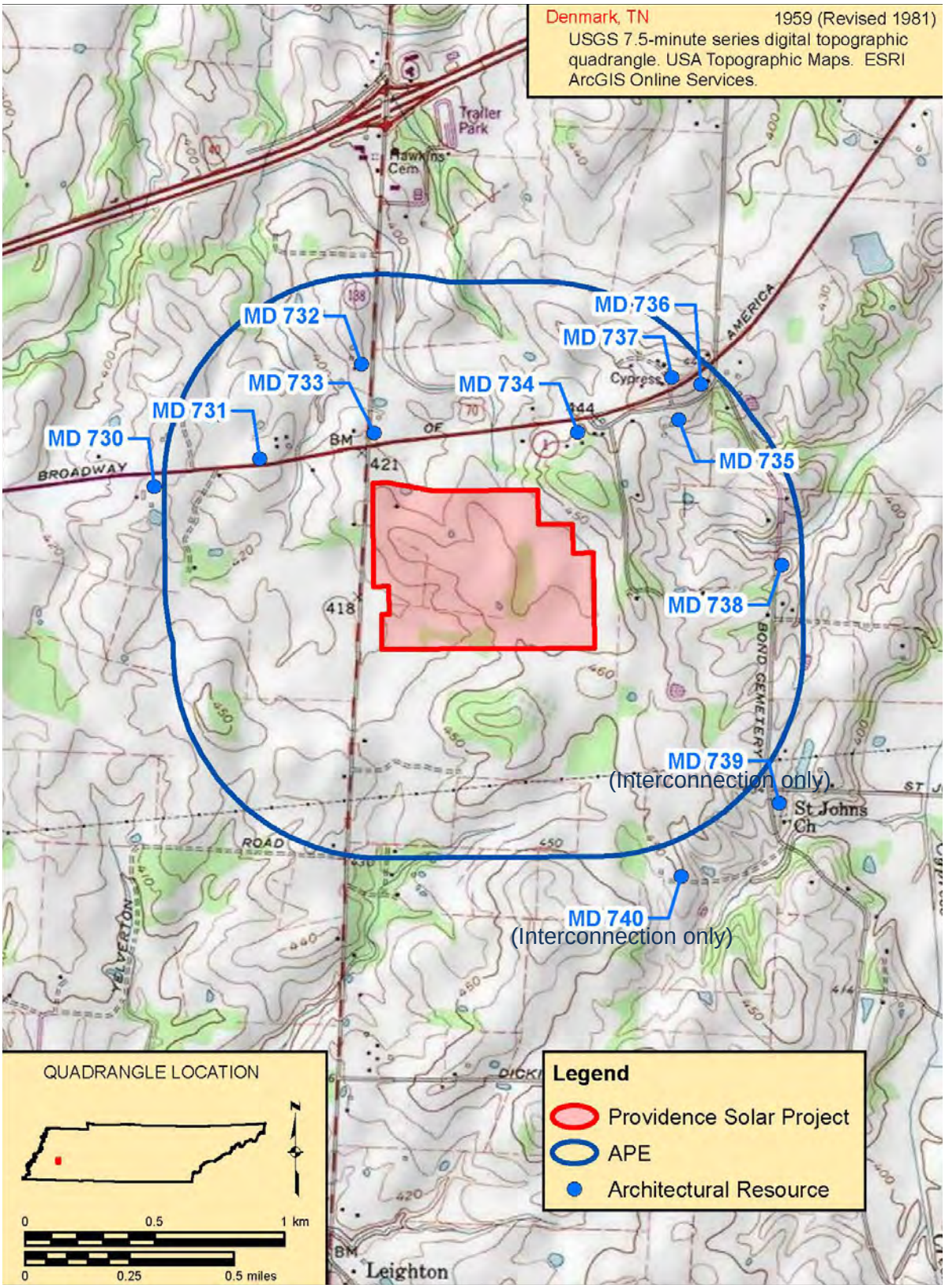


Figure 3-6. Architectural survey results.

3.5.1.2 Archaeological Resources

Four known archaeological sites were identified within a 1.0-mile radius of the project site. No known archaeological sites were located within the project area. The archaeological survey consisted of a pedestrian survey supplemented by screened shovel testing. As a result of the survey, one previously unrecorded site and four non-site localities were identified (Figure 3-7). Several scattered artifacts were recovered from the project site and are considered isolated finds. The findings associated with these sites (CRA 2015) are summarized as follows:

Site 40MD253 is located on a low rise in the northwestern corner of the project area. A structure is depicted at this location on the 1959 Denmark, Tennessee topographic quadrangle map. The site was initially identified through historic artifacts recovered from shovel tests. Several bare patches with more than 25 percent surface visibility were present within the site. These areas were surface collected. Additional historic materials (glass, ceramic, and metal artifacts) were recovered from the surface collection. Brick fragments (machine made) were also observed scattered across this area. In addition, a light density of prehistoric material was recovered from the surface collection. Soils at the site were shallow and eroded. No sub-plow zone materials were recovered, and no sub-plow zone deposits were identified. The site lacks the data to provide information important to the history or prehistory of the area. For the above reasons, 40MD253 is not considered eligible for inclusion on the NRHP.

Non-Site Locality 1 is represented by historic materials observed eroding out of a drainage gully. The gully extended out of the project area and into a modern dump. All of the materials are out of context. Due to the secondary context for the materials at this location, no site form was submitted to the Tennessee Division of Archaeology.

Non-Site Locality 2 is located on a rise in the southwestern corner of the project area. A structure is depicted at this location on the 1959 Denmark, Tennessee topographic quadrangle map. This area was initially shovel tested; however, no cultural materials were recovered from the shovel tests. A surface collection of the area produced 25 historic artifacts. Brick fragments (machine made) were also observed scattered across this same area. All artifacts recovered from Non-Site Locality 2 were collected as piece plots. A site form was submitted for this locality, but due to the lack of evidence for a pre-1933 occupation, the locality was not given a state site number.

Non-Site Locality 3 was identified through a surface collection in the south-central portion of the project area. Shovel tests in the area failed to produce artifacts. Several bare patches with more than 25 percent surface visibility were noted in this area. These bare patches were collected after a heavy rain. A light density of historic artifacts was recovered from the surface collection. No structures are depicted at this location on the 1959 Denmark, Tennessee topographic quadrangle map. A site form was submitted for this locality, but due to the lack of evidence for a pre-1933 occupation, the locality was not given a state site number.

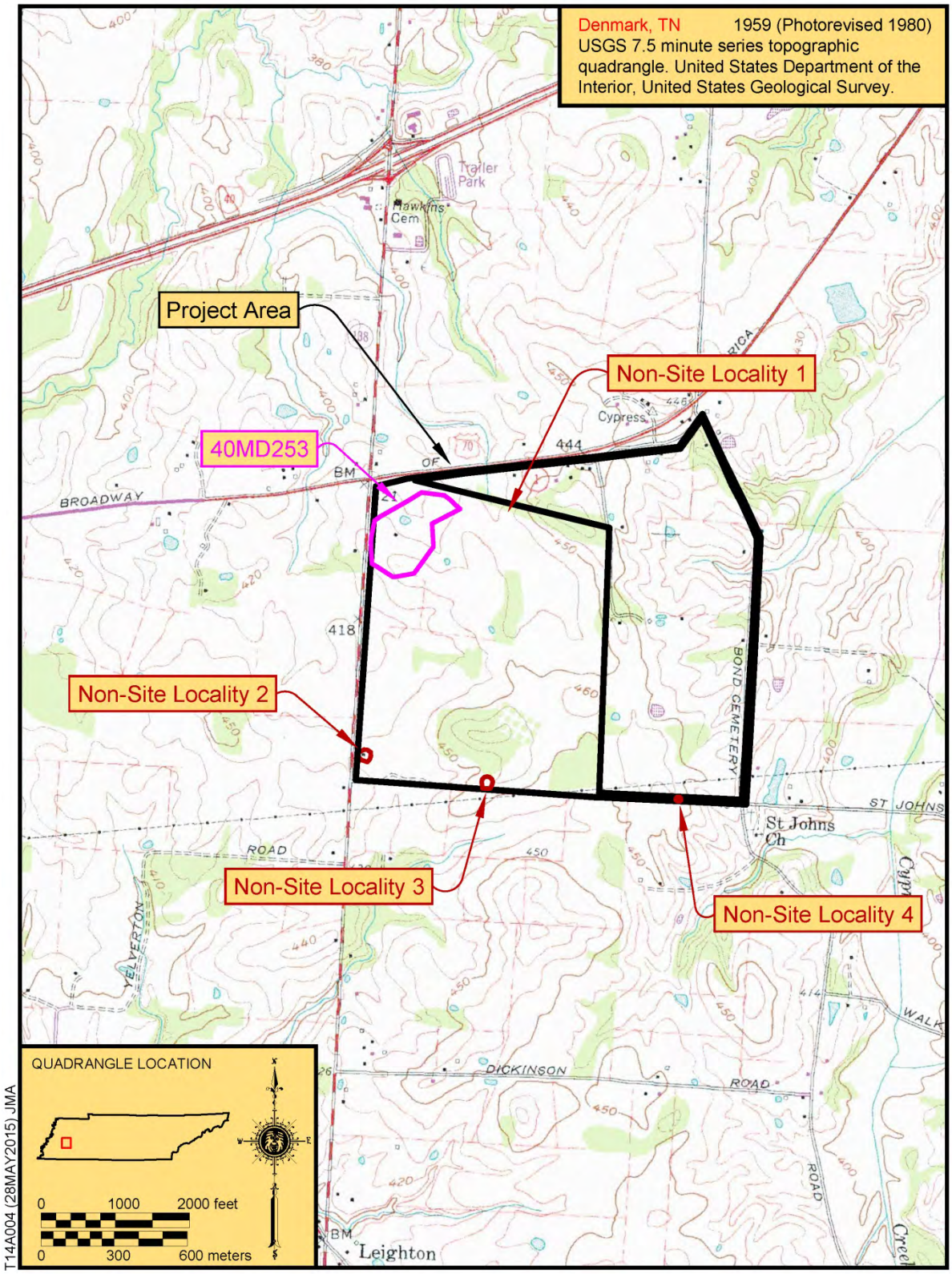


Figure 3-7. Archaeological survey results

Non-Site Locality 4 was identified during a surface collection south of the proposed interconnection route. A light density of historic materials was recovered during the surface collection of a sideslope. This area was situated in a corn field with more than 75 percent surface visibility at the time of the survey. No structures are depicted at this location on the 1959 Denmark, Tennessee topographic quadrangle map. Due to the location of the non-site, the light density of materials, and the lack of evidence for a structure at this location, no site form was submitted to the Tennessee Division of Archaeology.

Based on this Phase I archaeological survey, TVA finds that the project area contains no archaeological resources included or eligible for inclusion in the NRHP. TVA is consulting with the Tennessee SHPO and federally-recognized Indian tribes regarding this determination; concurrence is pending.

3.5.2 Environmental Consequences

3.5.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the proposed solar energy system would not be constructed; therefore, no project-related impacts to historic properties would occur.

3.5.2.2 Alternative B – Proposed Action Alternative

There would be no direct, indirect, or cumulative impacts to historic properties associated with the Proposed Action Alternative. Based on the architectural survey, the Phase I Archaeological Survey, and previous records searches, no archaeological sites or historic resources listed on or eligible for inclusion on the NRHP would be impacted by construction of the Proposed Action. TVA is consulting with the SHPO and with federally recognized Indian tribes on this determination.

3.6 Air Quality and Greenhouse Gas Emissions

3.6.1 Affected Environment

Air quality is a valuable environmental resource. Through its passage of the Clean Air Act, Congress mandated the protection and enhancement of our nation's air quality resources. National Ambient Air Quality Standards (NAAQS) for the following criteria pollutants have been set to protect the public health and welfare:

- Sulfur dioxide (SO_2)
- Ozone
- Nitrogen dioxide (NO_2)
- Particulate matter whose particles are less than or equal to 10 micrometers (PM_{10})
- Particulate matter whose particles are less than or equal to 2.5 micrometers ($PM_{2.5}$)
- Carbon monoxide (CO)
- Lead.

The primary NAAQS were promulgated to protect the public health, and the secondary NAAQS were promulgated to protect the public welfare from any known or anticipated adverse effects associated with the presence of pollutants in the ambient air. Areas in violation of the NAAQS are designated as nonattainment areas. New sources to be located in or near these areas may be subject to more stringent air permitting requirements. A listing of the NAAQS is presented in Table 3-1. National standards other than annual

standards are not to be exceeded more than once per year (except where noted). Based on available ambient air quality data, Madison County is currently in attainment for all other criteria pollutants (USEPA 2015a).

Table 3-1. National Ambient Air Quality Standards.

Pollutant	Primary and Secondary Standards	Averaging Time	Level	Form
CO	Primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Lead	Primary and secondary	Rolling 3 month average	0.15 µg/m^3 (1)	Not to be exceeded
NO_2	Primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	Primary and secondary	Annual	53 ppb (2)	Annual mean
Ozone	Primary and secondary	8-hour	0.070 ppm (3)	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years
$PM_{2.5}$	Primary	Annual	12 µg/m^3	Annual mean, averaged over 3 years
	Secondary	Annual	15 µg/m^3	Annual mean, averaged over 3 years
PM_{10}	Primary and secondary	24-hour	35 µg/m^3	98th Percentile, averaged over 3 years
	Primary and secondary	24-hour	150 µg/m^3	Not to be exceeded more than once per year on average over 3 years
SO_2	Primary	1-hour	75 ppb (4)	99th Percentile of 1hour daily maximum concentrations, averaged over 3 years
	Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year on average over 3 years

Source: USEPA 2015d
Abbreviations: ppb = parts per billion, ppm = parts per million, µg/m^3 = micrograms per cubic meter.
Notes:
(1) Final rule signed on October 15, 2008. The 1978 lead standard (1.5 µg/m^3 as a quarterly average) remains in effect until 1 year after an area is designated for the 2008 standard except that, in areas designated nonattainment for the 1978 standard, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.
(2) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.
(3) Final rule signed on March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, the United States Environmental Protection Agency (USEPA) revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected

number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed on June 2, 2010. The 1971 annual and 24-hour SO_2 standards were revoked in that same rulemaking. However, these standards remain in effect until 1 year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

GHGs are chemical compounds in the Earth's atmosphere that trap and convert sunlight into infrared heat. Gases exhibiting greenhouse properties come from both natural and man-made sources. The most common GHGs emitted from natural processes and human activities include carbon dioxide, methane, and nitrous oxide. The primary GHG emitted by human activities in the U.S. is carbon dioxide, representing more than 80 percent of total GHG emissions, which comes mostly from energy use (USEPA 2015b). Agricultural activities also contribute to GHG emissions. Various management practices (e.g., irrigation, tillage, fertilizer application) for agricultural soils can lead to production and emissions of nitrous oxide. Management of agricultural soils accounts for more than half of the agriculture sector emissions, which was 9 percent of the total U.S. GHG emissions in 2013 (USEPA 2015c).

3.6.2 Environmental Consequences

3.6.2.1 Alternative A – No Action Alternative

Selecting the No Action Alternative would not impact air quality at or surrounding the project site. There would be no short- or long-term emissions due to construction or operation of a solar energy system. Ambient air quality would remain unchanged from that which exists currently.

3.6.2.2 Alternative B – Proposed Action Alternative

Minor impacts to air quality associated with the Proposed Action Alternative would occur during the construction phase. Construction activities would result in emissions from construction equipment and vehicles, employee vehicles, and fugitive dust mobilization resulting from grading and vegetation clearing activities and on-site vehicle movement. Vehicles would emit particulate matter, nitrogen oxides, CO, volatile organic compounds, and SO_2 from the combustion of gasoline and diesel fuel. The impacts of these emissions would be negligible and would not adversely affect area air quality. Fugitive dust emissions would be primarily deposited at or in close proximity to the location of project activities and mostly within the project site. Best Management Practices (BMPs), including dust suppression using water from nearby non-potable sources, would be employed as necessary to mitigate for dust and other construction-related emissions that could impact localized air quality. Therefore, it is anticipated that air quality impacts associated with construction of the solar energy system would be negligible and limited in duration.

Minor increases in GHG emissions would result from construction activities. The impacts of these GHG emissions would be negligible in comparison to other regional sources of GHG emissions.

The operation of the solar energy system would result in a small increase in the capacity of non-emitting generating sources in TVA's energy resource portfolio and would generate power that otherwise would have been largely generated by the combustion of fossil fuels. Therefore, operation of the proposed solar energy system could result in a minor beneficial impact to air quality and reduced GHG emissions.

3.7 Noise

3.7.1 Affected Environment

Noise is defined as an unwanted sound that can induce hearing loss or interfere with ordinary daily activities, such as communication or sleep. People's reaction to noise varies according to the duration, type, and characteristics of the source; distance between the source and the listener; listener sensitivity; background noise level; and time of day. It is important to keep in mind the distinction between the physical characteristics used to quantify sound levels and the more qualitative or subjective aspects of the person, animal, or object on the receiving end; it is the adverse reaction to sound or the annoyance created by sound that is then defined as noise. Despite the more subjective reaction, however, noise can be measured; that is, sound sources having certain characteristics can reasonably be expected to induce harm or annoyance, and this can be quantified in a statistically meaningful manner. Level of annoyance depends on the intensity, frequency weighting (pitch), and duration of the sound. To quantify noise and describe its effects on the natural and human environment, a basic description of sound terminology is presented below.

As a sound wave moves through the atmosphere, a temporary increase in pressure occurs; it is the pressure change that is detected as sound. The magnitude of the pressure change is the loudness and the frequency of those temporary changes is the pitch. The healthy human ear detects pressure differences over a wide range of sensitivities. A handy method for comparing these vast pressure differences is to describe them in exponential rather than linear terms. This simplifies the units and more closely depicts the way humans actually perceive sound levels. The decibel (dB) is a logarithmic ratio of the increase in atmospheric pressure a sound event causes compared to a defined reference or baseline pressure.

Because the human ear responds differently to different sound frequencies, the perceived loudness increases far more rapidly than it does for mid-frequency sounds. The sound pressure level represented by a given decibel value is, therefore, typically adjusted to make it more relevant to sounds that the human ear hears especially well. For example, an "A-weighted" decibel (dB[A]) is derived by emphasizing mid-range frequencies to which the human ear responds especially well and de-emphasizing, or penalizing, frequencies lower than 1,000 Hertz and frequencies higher than 5,000 Hertz.

To account for the typically lower levels of background noise at night, community noise levels are typically described using the A-weighted day-night sound level (DNL). DNL is defined as the average sound energy in a 24-hour period with a 10 dB penalty added to the nighttime levels (10:00 p.m. to 7:00 a.m.). DNL is a useful descriptor for noise because it averages ongoing yet intermittent noise, and it measures total sound energy over a 24-hour period.

The Noise Control Act of 1972 directs federal agencies to comply with applicable federal, state, and local noise control regulations. Neither Madison County nor the unincorporated community of Denmark have noise control regulations. The nearest noise receptor to the site that may experience impacts is a residence located approximately 230 feet to the north of the project site boundary.

Given the site setting, typical noise levels would be associated with agricultural farm machinery operating within the site boundaries and automotive vehicles on the surrounding rural county roads and Brownsville Road/US 70. As noted in Table 3-2, truck traffic on the

county roads generate noise levels in the mid-70s dB(A) at a distance of 50 feet. The USEPA has estimated that farm tractors generate noise levels of 100 dB(A) at a distance of 50 feet. Therefore, the highest noise levels at the site are associated with the periodic operation of farm machinery.

3.7.2 Environmental Consequences

3.7.2.1 Alternative A – No Action Alternative

Selecting the No Action Alternative would not increase noise levels at or surrounding the project site. Noise levels would remain unchanged from that which exists currently, which includes usage of farm machinery such as farm tractors and harvesters.

3.7.2.2 Alternative B – Proposed Action Alternative

Construction activities would result in short-term increase in noise levels in the project area. This increase would occur between 7 am and 5 pm, 5 days per week during the construction period. Noise sources would include variable pitches and volumes from vehicles and equipment involved in site preparation activities and the installation of racking structures. Maximum noise levels for the types of construction equipment expected to be used range from 74 to 101 dB(A) at a distance of 50 feet (Table 3-2). With multiple pieces of equipment operating concurrently, noise levels would be relatively high during daytime periods at locations within several hundred feet of active construction sites. According to the USEPA, the zone of relatively high construction noise typically extends to distances of 400 to 800 feet from the site of major equipment operations (USEPA 1971).

Table 3-2. Maximum Noise Levels at 50 feet for Common Construction Equipment.

Equipment Type	Maximum Noise Level (L_{max}) at 50 Feet (dB[A], slow[1])
Flat Bed Truck	74
Concrete Truck	79
Compactor (ground)	83
Dozer	82
Dump Truck	76
Excavator	81
Generator	81
Pickup Truck	75
Grader	N/A
Vibratory Pile Driver	101
Warning Horn	83

Source: USDOT 2015

[1] Slow response as measured on the A scale of a sound level meter or time-weighted average.

The nearest residence to the project site boundaries is located approximately 230 feet to the north. Given the temporary nature of proposed construction activities, the limited amount of noise generated by heavy equipment, and the proposed setbacks from receptors, this impact would be negligible and limited in nature. In addition, limited truck and worker traffic might be audible on nearby transportation routes, having temporary minor

adverse effects; however, these effects would not be distinguishable from normal traffic activities.

Construction noise would dominate the soundscape for all on-site personnel. Construction personnel, particularly equipment operators, would use personal hearing protection to limit exposure and ensure compliance with federal health and safety regulations.

Following the completion of construction activities, the ambient sound environment would be expected to return to existing levels. There would be no noise from operating of the solar energy system, with the exception of periodic mowing of the site to maintain grassy areas. Mowing would occur infrequently and in short duration, and would produce noise similar to existing noises in the surrounding areas such as vehicle traffic, mowers, and farm equipment. The cabinets containing the electrical equipment (inverters and transformers) typically contain any equipment noise. There would be no long-term changes in the noise environment, and overall noise impacts would be insignificant.

3.8 Utilities

3.8.1 Affected Environment

Available power sources to the county residents within the project area are electricity and natural gas. No significant renewable energy sources are currently located in the project area. TVA is the source of electrical service to Madison County, which is then distributed by STEMC to the area in the vicinity of the project site. No gas, water, or wastewater utility services are available within 4 miles of the project site.

3.8.2 Environmental Consequences

3.8.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the proposed solar energy system would not be constructed; therefore, there would be no project-related impacts to utilities. The existing land use would be expected to remain the same, and the few utility services in the immediate project area would otherwise remain unchanged.

3.8.2.2 Alternative B – Proposed Action Alternative

There would be no adverse direct, indirect, or cumulative impacts to utilities associated with the Proposed Action Alternative. The Proposed Action would generate construction and demolition waste materials. In addition, the interconnection power line from the site to the STEMC-owned substation would be constructed as described in Section 2.1.2.1. The interconnection line would begin on the project site and traverse private property to the STEMC-owned substation, where it would be connected with the TVA grid. A separate electrical service line would not be required to power the solar tracker system motors or cabinet lighting. No adverse impacts are expected to result from the Proposed Action Alternative to existing utilities. This alternative would provide for additional capacity and additional renewable energy supply provided by TVA to its customers.

3.9 Waste Management

3.9.1 Affected Environment

This section describes waste (both non-hazardous and hazardous) materials and hazardous wastes associated with the project site and surrounding area. Republic Services currently operates the Jackson-Madison County Municipal Solid Waste Landfill, which is approximately 13 miles from the project site. This landfill receives solid waste under

Tennessee Department of Environment and Conservation Permit No. SNL570000239. Under the permit, this landfill can accept municipal wastes, construction and demolition materials, rock, wood wastes, yard trimmings, soil, asphalt, scrap metal, ash from wood combustion, and similar types of wastes.

A Phase I environmental site assessment of the project area was completed by Arcadis in July 2015. No contaminated areas or structures containing hazardous materials or petroleum products were identified on the project site. Two petroleum underground storage tank sites were initially identified as being adjacent to the west of the site; however, following a site reconnaissance and further research, it was determined that these two sites are actually located approximately 0.5 mile to the north of the site. Therefore, there are no documented environmentally impacted areas in or immediately adjacent to the project site.

3.9.2 Environmental Consequences

3.9.2.1 Alternative A – No Action Alternative

Selecting the No Action Alternative would not affect solid or hazardous waste conditions at or surrounding the project site. Potential for impact to hazardous waste would remain unchanged from that which currently exists, which includes usage of farm machinery for agricultural purposes.

3.9.2.2 Alternative B – Proposed Action Alternative

The Proposed Action Alternative would result in minor direct and indirect impacts and cumulative impacts. Waste associated with construction and operation of the proposed solar energy system would be handled and disposed of in accordance with local, state, and federal regulations. Construction activities would involve use of machinery (e.g., semi-trucks, field trucks, tractors) fueled by petroleum products. Construction contractors would be responsible for preventing spills by implementing proper storage and handling procedures. There are no environmentally impacted areas within the project site or surrounding area; therefore, construction activities would not exasperate potentially sensitive environmentally impacted areas.

The nearby Jackson-Madison County Municipal Solid Waste Landfill would accept construction waste (e.g., wooden crates, cardboard boxes, plastic packaging, excess electrical wiring). Waste associated with construction and operation of the proposed solar energy system would be disposed of in separate dumpsters for metals, wood, and general trash. Pickup would be (at minimum) once a week, and more often if necessary. The dumpsters would be in the on-site construction staging area, and construction crews will have 3-yard trash skips with them when working at remote areas of the site. The generation of waste would be temporary and would result in a minor impact to the landfill due to the disposal of the waste materials. Construction waste materials will be recycled to the extent practicable. Waste generation during operation would be minimal and would mainly result from the replacement of equipment. A decommissioning plan for the proposed solar facility would be developed by PSC in order to document the recycling plan of solar facility components and current exemptions from hazardous waste regulations applicable to recycling of such materials. The decommissioning plan would be implemented by PSC at the expiration of the PPA, contingent upon the execution of an amended or alternative PPA for the sale of power after the 20-year period.

3.10 Transportation

3.10.1 Affected Environment

Roadways and other transportation infrastructure serving the project site and surrounding area are described in this section. The main transportation near the project site is via roadways, while within the project site, there are unimproved gravel/dirt roads. Regional access is provided by Interstate 40 (I-40; Figure 1-1). An 0.8-mile section of the paved, two-lane Highway 138 (Providence Road) connects I-40 to the west side of the project site. U.S. Highway 70/State Route 1 (Brownsville Highway) runs east-west along the northern edge of the project site and intersects State Route 138 at the northwest corner of the site. Unimproved gravel/dirt roads enter the western portion of the project area from State Route 138.

The average annual daily traffic (AADT) is the average number of vehicles traveling along a roadway each day. The Tennessee Department of Transportation has also quantified the highest number of vehicles that travel within a 1-hour period along each roadway (referred to as 'One Way Peak Hour'). These data are summarized in the following table.

Table 3-3. Existing Average Annual Daily Traffic and One-Way Peak Hour on Nearby Roadways.

Roadway	Average Annual Daily Traffic - 2014	Number of Lanes	One Way Peak Hour
Interstate 40 - northeast of Exit 66 (Station 65)	32,161	4	1,077
U.S. Highway 70/State Route 1 west of SR 138 (Station 75)	2,082	2	111
State Route 138 - along western boundary of project site (Station 18)	840	2	55

Source: Tennessee Department of Transportation 2015

3.10.2 Environmental Consequences

3.10.2.1 Alternative A – No Action Alternative

Selecting the No Action Alternative would not affect transportation conditions at or surrounding the project site.

3.10.2.2 Alternative B – Proposed Action Alternative

Under the Proposed Action Alternative, minor short-term impacts would occur due to additional vehicles and day-labor traffic during construction. These effects would be primarily due to worker commutes and delivery of equipment and materials to and from the construction site. Eight to 12 crew members would be on site from approximately 7 am to 5 pm, 5 days a week, for approximately 4 to 5 months. A majority of these workers would likely come from the local or regional area, and others would come from outside the region. Workers would either drive their own vehicles or carpool to the project site, and parking would be available on site. Construction equipment and material delivery would require two to five semi-tractor trailer trucks visiting the project site per day for approximately 3 weeks of the construction activities. These larger vehicles would be easily accommodated by existing roadways.

At the peak of construction, there would be a maximum of about 25 to 30 additional vehicle trips per day on State Road 138, which is an approximate 4 percent and 55 percent increase to its AADT and one-way peak hour, respectively. Therefore, traffic would increase in the immediate area because of additional vehicles, which may cause minor traffic delays near the project site. These delays would likely occur at the beginning (7 am) and end (5 pm) of the workday. This increase would be temporary and would end with the construction phase. The existing transportation infrastructure would be sufficient to support the increase in vehicle traffic. Although the effects would be minor, contractors would route and schedule construction vehicles as part of an overall construction management plan, and would strategically locate staging areas in advance at the project site to minimize traffic impacts. All construction vehicles would be equipped with backing alarms, two-way radios, and slow moving vehicle signs when appropriate. Traffic during facility operation would be minimal and would consist of periodic visits to conduct facility inspections and maintenance. Overall, the Proposed Action Alternative would result in minor, temporary, direct and indirect impacts, but no cumulative impacts.

3.11 Geology and Soils

3.11.1 Affected Environment

The project site is located in the Gulf Coastal Plain Province within the Mississippi embayment of West Tennessee. This region extends in a wide belt from New Jersey to Texas along the coast of the United States. The rock formations of this region consist of sedimentary rocks from the Cenozoic, tertiary age consisting of sand, silt, clay, and gravel, which were deposited mostly in a marine environment. According to the U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS) Web Soil Survey and Soil Survey of Madison County, Tennessee dated 2014, the entire project area contains silt loam soils (Appendix A). Loam soils retain nutrients and water while allowing excess water to drain away, making them ideal for agricultural uses. Small portions of the site contain silt loam soils with steep slopes, which are prone to severe erosion.

Prime farmland, as defined by the USDA, “is land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). The soils are of the highest quality and can economically produce sustained high yields of crops when treated and managed according to acceptable farming methods.” Approximately 86 percent (247 acres) of the project area is designated as prime farmland or prime farmland if drained (USDA 2014). The soil types on the project area considered prime farmland are Calhoun and Henry silt loam (prime farmland if drained), Calloway silt loam, Collins silt loam, Grenada silt loam, Loring silt loam, Memphis silt loam, and Vicksburg silt loam. Figure 3-8 shows the locations of prime farmland soils on the project site.

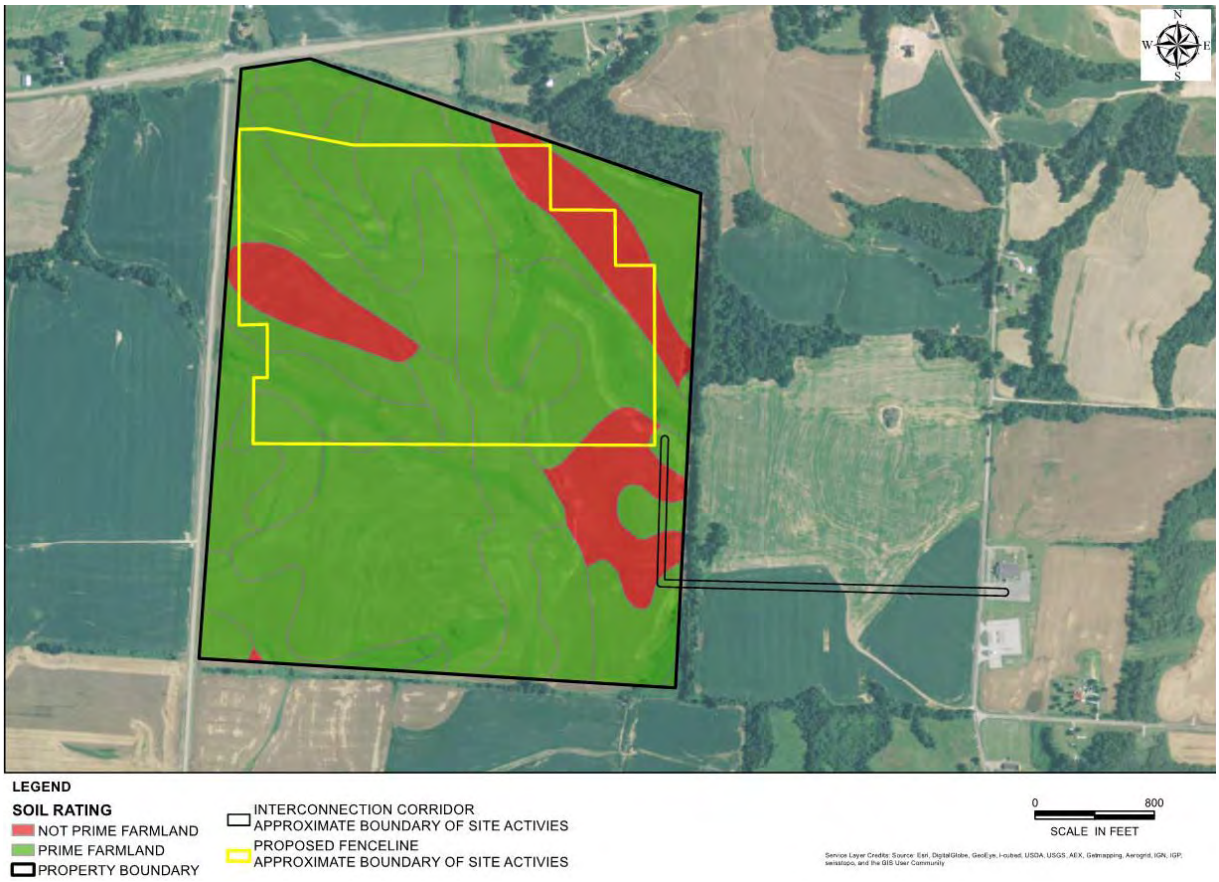


Figure 3-8. Prime farmland classification.

3.11.2 Environmental Consequences

3.11.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, existing resource trends would occur. Limited amounts of soil erosion would be expected to continue along the water features within the project site and in the farm fields in association with normal crop practices. Agricultural crop practices and associated soil conservation measures would also continue within the project site. Soil erosion rates and soil productivity would not be adversely or beneficially impacted under the No Action Alternative. No direct, indirect, or cumulative impacts to soil resources would occur under this alternative.

3.11.2.2 Alternative B – Proposed Action Alternative

The Proposed Action Alternative would result in minor, temporary, direct, and indirect soil impacts and a small cumulative impact due to loss of agricultural production. There would be minimal grading during the construction of the solar energy system. As a result, there would be a slight increase in erosion and sedimentation. The creation of new surfaces, in the form of the gravel access roads and impervious concrete equipment pads, would result in a slight increase in stormwater runoff and potential increase in soil erosion. The use of BMPs, such as sediment control measures (e.g., silt fencing) would minimize the potential impacts. As discussed in Section 1.3, an NPDES permit for discharges of stormwater associated with construction activities would likely be required. As a part of the NPDES application process, a Stormwater Pollution Prevention Plan (SWPPP) would be developed

to identify the necessary management practices that would be employed during construction to mitigate potential impacts.

The USDA NRCS uses a land evaluation and site assessment system to establish a farmland conversion impact rating score. This score is used as an indicator for the project stakeholders to consider alternative sites if the potential adverse impacts on the farmland exceed the recommended allowable level (USDA 2014). The construction and operation of the Proposed Action would potentially impact/convert prime farmland. There are approximately 184,166 acres of prime farmland in Madison County, which is approximately 51 percent of the total land area in the county. The conversion of the 118-acre area into the solar energy system represents 0.07 percent of the total available farmland in the county. In accordance with the Farmland Protection Policy Act (FPPA), Arcadis and TVA coordinated with the local office of the NRCS to determine the effects on prime or unique farmlands subject to the FPPA. On August 18, 2015, the USDA issued a letter indicating that no further assessment was required under the FPPA. This was based on the fact that, while agricultural production would cease on the project site, long-term impacts to prime farmlands and soil productivity on the site would be insignificant, and the site could be readily returned to agricultural production once the solar farm is dismantled. Based on the limited site disturbance and USDA findings, there would be insignificant direct and indirect effects on prime farmland under the Proposed Action Alternative.

3.12 Surface Water

3.12.1 Affected Environment

In April 2015, ARCADIS personnel identified two water features on the project site that are maintained by the property owner to assist with site drainage from the surrounding agricultural land (Figure 3-2). Stream 1 is an intermittent stream on the western side of the project site. The channelized stream flows west and exits the property via a culvert under Providence Road to a larger stream channel flowing through the neighboring farmland. Two ephemeral agricultural drainage swales converge upstream of the site and the intermittent stream branch. The intermittent stream is low quality and overgrown with goldenrod, blackberry shrubs, and other edge species along the steep stream channel embankments. Wetland A is the headwaters of perennial Stream 2, which flows south exiting the site along the southeast boundary into neighboring agricultural fields. Eventually, the stream flows south into Rice Branch, which flows southwest into Jeffers Creek. Jeffers Creek flows to the Hatchie River. The stream banks are overgrown with scrub-shrub and herbaceous vegetation (e.g., blackberry, Japanese honeysuckle, vines). The identified streams are not located within the footprint of the proposed facilities.

Stream I-1 (Figure 3-9) is a perennial stream located to the north of the project site and crosses under U.S. Highway 70/State Route 1 via a culvert. Stream I-1 is a tributary of Panther Creek and flows north to the main stem of Panther Creek and South Fork Forked Deer River. Stream I-2 (Figure 3-10) is an ephemeral stream located along J. Bond Lane, which flows south into Cypress Creek, a tributary to the South Fork Forked Deer River. The stream bed is covered in rip-rap with a narrow channel near the road, but the stream widens and meanders once inside the adjacent forested area. Stream I-3 is an ephemeral stream within the ROW of Bond Cemetery Lane and becomes intermittent once the tree line starts approximately 20 yards east of the roadway (Figures 3-11 and 3-12). Stream I-3 is a tributary of Cypress Creek. The stream is located adjacent to residential property, and the stream bed has been littered with residential trash (e.g., tires, chairs) and concrete.

Panther Creek and Jeffers Creek are both listed as impaired by the Tennessee Department of Environmental Conservation (TDEC 2014). Twenty-one miles of Panther Creek in Madison and Haywood Counties are listed as impaired because of *Escherichia coli* from a nearby package plant and pasture grazing. Approximately 11 miles of Jeffers Creek in Madison and Haywood Counties are listed as impaired because of physical substrate habitat alteration and loss of biological integrity due to siltation from crop production and channelization. Rice Branch and Cypress Creek are not listed as impaired by TDEC.

Stormwater drainage surrounding the project area is provided through a system of open drainage ditches and culverts. Stormwater in the northern portion of the project area travels through this system and eventually flows north into Panther Creek, and stormwater in the southern portion of the project area travels through this system, eventually flowing south into Rice Branch. The project area is currently used for agricultural purposes and is not subject to any individual NPDES permits.

Figure 3-9. Stream I-1, facing south.

Figure 3-10. Stream I-2, facing south.

Figure 3-11. Stream I-3, facing east.

Figure 3-12 Stream I-3 intermittent portion, facing west.

3.12.2 Environmental Consequences

3.12.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, existing resource trends would continue to occur. Limited amounts of soil erosion would be expected to continue along the water features within the project site. Soil erosion rates and soil productivity would not be adversely or beneficially impacted under the No Action Alternative. No project-related direct, indirect, or cumulative impacts to surface water resources would occur under this alternative.

3.12.2.2 Alternative B – Proposed Action Alternative

Much of the solar farm site would be graded during the construction of the solar energy system. As a result, there would be an increase in erosion and sedimentation. The creation of new impervious surface, in the form of the gravel access road and concrete equipment pads, would result in a negligible increase in stormwater runoff and potential increase in soil erosion. Solar panels would be spaced to minimize heavy sheeting of water from the panel surfaces. Sediment control measures (e.g., silt fencing) would minimize the potential impacts to the streams located outside of the development zones.

Existing resource trends in Panther Creek and Jeffers Creek would continue, and these surface water bodies are anticipated to remain impaired under the Proposed Action Alternative. After construction of the Proposed Action, the project area would be maintained with a permanent cover crop that would result in a small, long-term beneficial impact to surface water quality by reducing the runoff of sediment and agricultural chemicals from the former cropland.

As discussed in Section 1.3, an NPDES permit for discharges of stormwater associated with construction activities would likely be required. As a part of the NPDES application process, a SWPPP would be developed to identify the necessary management practices that would be employed during construction. With the proper implementation of BMPs and adherence to the required permits (e.g., NPDES permit), implementation of the Proposed

Action Alternative would result in minor, temporary, direct, and indirect adverse surface water impacts during construction. As mentioned above, there would be small, beneficial, long-term impacts to surface water during operation of the solar energy system. No cumulative impacts are anticipated

3.13 Wetlands

3.13.1 Affected Environment

Wetlands are those areas inundated by surface water or groundwater such that vegetation adapted to saturated soil conditions is prevalent. Examples include swamps, marshes, bogs, and wet meadows. Wetland fringe areas are also found along the edges of most watercourses and impounded waters (both natural and man-made). Wetland habitat provides valuable public benefits including flood/erosion control, water quality improvement, wildlife habitat, and recreation opportunities.

In April 2015, ARCADIS personnel conducted a wetland delineation survey on the project area. The wetland delineation was conducted in compliance with applicable Clean Water Act standards.

A TVA-developed modification of the Ohio Rapid Assessment Method (Mack 2001) specific to the TVA regions (Tennessee Valley Authority Rapid Assessment Method [TVARAM]) was used to categorize wetlands by their functions, sensitivity to disturbance, rarity, and ability to be replaced. The categorization was used to evaluate impacts and to determine the appropriate levels of mitigation, if necessary. TVARAM scores are used to classify wetlands into three categories. Category 1 wetlands are considered “limited quality waters.” They represent degraded aquatic resources having limited potential for restoration with such low functionality that lower standards for avoidance, minimization, and mitigation can be applied. Category 2 includes wetlands of moderate quality and wetlands that are degraded but which carry reasonable potential for restoration. Category 3 generally includes wetlands of very high quality or of regional/statewide concern, such as wetlands that provide habitat for threatened or endangered species. Avoidance and minimization are the preferred mitigation measures for Category 2 and 3 wetlands.

Three wetlands were delineated within the project area (Table 3-4, Figure 3-2). The National Wetland Inventory indicated the occurrence of an 0.3-acre pond in the northwestern portion of the project area, north of the proposed solar facility site. This pond was not present during the 2015 survey, and does not appear on recent aerial imagery.

Table 3-4 Wetlands within the Project Site.

Wetland Identifier	Type[1]	Wetland Acreage	TVARAM Category (score)
Wetland A	PSS1	0.92	Category 1
Wetland B	POW	0.14	Category 1
Wetland C	PSS1	0.03	Category 1
Total		**1.09**	

[1] Type Classifications (Cowardin et al. 1979): PSS1=Palustrine, scrub-shrub, broad-leaved deciduous; POW=Palustrine, open water/unknown bottom.

Wetland A is a 0.92-acre palustrine scrub-shrub wetland associated with the headwaters of Stream 2, which flows south off the project area as described in Section 3.12. This wetland is seasonally flooded and saturated and located between agricultural fields. Dominant vegetation in Wetland A includes scrub-shrub, black willow trees, *Carex* sedges, knotweed, and blackberry.

Wetland B (Figure 3-5) is a 0.14-acre isolated palustrine, open water, depression wetland bordered by a few black willow trees. The permanently flooded wetland is located to the east of the proposed construction limits. Dominant vegetation includes black willow trees and tall fescue. It is connected to a constructed drainage channel heading northwest from the wetland. The drainage channel is not within the proposed construction limits.

Wetland C is a 0.03-acre palustrine scrub-shrub wetland associated with an ephemeral stream which travels north off the project site and eventually connects to Panther Creek. However, the ephemeral stream has been altered by agricultural activities and resembles a drainage ditch. This seasonally flooded wetland is dominated by black willow with eastern cottonwood, American sycamore, and fescue.

As shown on Figure 3-2, Wetland D is a 0.38-acre forested wetland located on property adjacent to the project site. It was originally in the path of a former interconnection route, but is now currently not part of any project development element. It is associated with a depression and creates the headwaters of a stream located off site to the south and east. This stream eventually drains into Cypress Creek. Dominant vegetation within this wetland includes common persimmon, American elm, winged elm, Virginia creeper, goldenrod, Japanese honeysuckle, and poison ivy. This wetland is saturated throughout the year with low chroma soils.

3.13.2 Environmental Consequences

Wetlands are regulated under Section 404 of the Clean Water Act. In order to conduct specific activities in wetlands, authorization under a Section 404 permit from the USACE is required depending on the wetland's size and hydrologic connectivity to a navigable waterway. EO 11990 requires all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities. The EO also instructs federal agencies to avoid actions that promote development in wetlands unless there is no practicable alternative.

3.13.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not purchase power from the proposed solar facility, which would not be constructed or operated. The owner of the property would continue to use the site for agricultural production, and environmental conditions on the property would remain the same. Therefore, there would be no direct, indirect, or cumulative wetland impacts as a result of the implementation of the No Action Alternative.

3.13.2.2 Alternative B – Proposed Action Alternative

There would be no direct, indirect, or cumulative impacts associated with the Proposed Action Alternative. Consistent with EO 11990, the solar generation facility was designed to avoid the four delineated wetlands (see Figure 2-1). The interconnection line would be constructed outside of the delineated wetland areas. Erosion and sedimentation BMPs would be implemented during construction to minimize potential impacts to these wetlands.

3.14 Vegetation

3.14.1 Affected Environment

The project site is located within the Loess Plain sub-ecoregion of the Mississippi Valley Loess Plains ecoregion (USEPA 2012). This ecoregion stretches from near the Ohio River in western Kentucky to Louisiana. It consists primarily of irregular plains, with oak-hickory and oak-hickory-pine natural vegetation. The sub-ecoregion contains gently rolling, irregular plains. The region is dominated by agriculture, and most of the forest cover has been removed to create cropland.

According to aerial photography and site surveys, approximately 3 percent of the 288-acre project area is currently forested, mainly near the boundaries of the property and near wetland and small stream areas. The oak-dominated secondary successional forested areas include black oak, eastern red cedar, white oak, honey locust, winged elm, red maple, tulip poplar, American sycamore, sweet gum, and red oak. The understory within these forested areas has poison ivy as the dominant herbaceous species along with the same tree species in the canopy. The remaining area is grassland or active agricultural fields, dominated by grasses, weeds, and unharvested agricultural crops including tall fescue, soybean, ryegrass, and blackberry. No unique plant communities were observed during field surveys.

EO 13112 serves to prevent the introduction of invasive species and provides for their control to minimize the economic, ecological, and human health impacts that those species potentially cause. In this context, invasive species are non-native species that invade natural areas, displace native species, and degrade ecological communities or ecosystem processes (Miller et al. 2010). Much of the project site contains invasive species (e.g., Japanese honeysuckle and Chinese privet), which reflects the frequency and magnitude of disturbance present on site. Disturbances associated with activities, such as agriculture, can encourage invasion and establishment of weedy plants.

3.14.2 Environmental Consequences

3.14.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not purchase power from the proposed solar facility, which would not be constructed or operated. Changes to local plant communities resulting from natural ecological processes and human-related disturbance would continue to occur. Therefore, there would be no direct, indirect, or cumulative vegetation impacts as under the No Action Alternative.

3.14.2.2 Alternative B – Proposed Action Alternative

Adoption of the Proposed Action Alternative would not significantly affect the terrestrial ecology of the region. The Proposed Action would result in the mowing of tall vegetation, primarily grasses and herbs, and no forested areas would be cleared during the construction of the proposed solar energy system. Following construction, the cleared areas would be revegetated with grass, and the site would be maintained by mowing during the operation of the facility. This would result in the establishment of a mix of grass and herbaceous vegetation within most of the solar energy system footprint. The herbaceous communities currently found on the project site do not support native plant communities with conservation values. These agricultural habitats are common and well represented throughout the region. There would be long-term vegetation impacts from the change from row crops to permanent grass and herb cover. Implementation of the Proposed Action

Alternative would result in minor long-term direct impacts and no indirect or cumulative impacts.

3.15 Wildlife

3.15.1 Affected Environment

The wildlife in the oak-hickory ecosystem is highly diverse. The wildlife that would be found within and surrounding the project site are those adapted to disturbance and presence of human activity that is typically found in rural, agricultural areas. Examples of typical wildlife that could be found include American crow, Carolina chickadee, tufted titmouse, American goldfinch, red-bellied woodpecker, downy woodpecker, eastern meadowlark, red-winged blackbird, groundhog, eastern chipmunk, eastern gray squirrel, ring-necked snake, gray rat snake, five-line skink, copperhead snake, spring peeper, and upland chorus frog (Whitaker and Hamilton 1998, LeGrand 2005; Niemiller et al. 2013).

During the April 2015 field survey, ARCADIS biologists observed various wildlife species including northern cardinal, eastern cottontail, white-tailed deer, turkey vultures, mourning dove, chorus frog, red-winged blackbird, red-bellied woodpecker, black rat snake, garter snake, raccoon, fox, and a red-tailed hawk. No unique or rare wildlife habitat was observed within the project site.

3.15.2 Environmental Consequences

3.15.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not purchase power from the proposed solar facility, which likely would not be constructed or operated. Changes to local plant communities resulting from natural ecological processes and human-related disturbance would continue to occur. Therefore, there would be no direct, indirect, or cumulative wildlife species impacts under the No Action Alternative.

3.15.2.2 Alternative B – Proposed Action Alternative

Adoption of the Proposed Action Alternative would not significantly affect area wildlife populations. The Proposed Action would affect cleared agricultural fields, as no forested areas would be cleared during the construction of the Proposed Action. Wildlife species within the project site would be displaced during construction activities. These species would likely move to similar habitat that surrounds the project site. Following construction, the cleared areas would be revegetated with grass and maintained during the operation of the solar energy system. While this could potentially provide habitat for many wildlife species adapted to grassland habitats, the presence of the solar panels would likely limit the wildlife use of the site. Given the prevalence of early successional wildlife habitats in the area, impacts to wildlife populations would be minor, and no adverse indirect or cumulative impacts would occur.

3.16 Threatened and Endangered Species

The Endangered Species Act requires federal agencies to conserve species listed as endangered or threatened and to determine the effects of their proposed actions on listed species and their critical habitat. Endangered species are those determined to be in danger of extinction throughout all or a significant portion of their range. Threatened species are those determined to be likely to become endangered within the foreseeable future. Section 7 of the Endangered Species Act requires federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS) when their proposed actions may affect endangered or

threatened species or their critical habitats. TDEC and the Tennessee Wildlife Resources Agency also maintain lists of plants and animals protected within Tennessee.

3.16.1 Affected Environment

Federally listed species potentially occurring on the project site were determined through a search of the Initial Project Scoping feature of the USFWS Information, Planning, and Conservation System (USFWS 2015). State listed species were determined through a quadrangle search of the TDEC, Natural Heritage Inventory Program's Interactive Rare Species Database (TDEC 2015). These databases indicate that two federally listed species and one state-listed species could occur within the project site (Table 3-5). The USFWS has also determined that the threatened northern long-eared bat has the potential to occur throughout the State of Tennessee. Thus, a review of habitat suitability for this species is included in this assessment. No known maternity roosts or caves occupied by this bat have been recorded in Madison County, Tennessee.

Table 3-5 Federal and State Listed Species in the Vicinity of the Project Site.

Common Name	Scientific Name	Federal Status[1]	State Status (Rank[2])
Fish			
Piebald madtom	*Noturus gladiator*	-	NMGT (S3)
Mammals			
Indiana bat	*Myotis sodalis*	END	END (S1)
Northern long-eared bat	*Myotis septentionalis*	THR	NMGT (S4)
Plants			
Whorled sunflower	*Helianthus verticillatus*	END	END (S1)

[1]Status abbreviations: END=Endangered, NMGT=In need of management, THR=Threatened.
[2]State rank abbreviations: S1 - critically imperiled with five or fewer occurrences; S3=Rare or uncommon with 21 to 100 occurrences, S4=Apparently secure.

During winter, Indiana bats hibernate in caves and mines located in karst areas of the United States. In summer, it uses a variety of forest habitats for roosting, foraging, and raising young (USFWS 2014). Potential roost sites are located under the exfoliating bark, cracks, crevices, and/or hollow live trees or snags larger than 5 inches in diameter at breast height (dbh). Roost trees are typically within canopy gaps in a forest, in a fenceline, or along a wooded edge. Habitats in which maternity roosts occur include riparian zones, bottomland and floodplain habitats, wooded wetlands, and upland communities. Indiana bats typically forage in semi-open to closed (open understory) forested habitats, forest edges, and riparian areas.

Similar to the Indiana bat, the northern long-eared bat hibernates in caves and mines in the winter. During summer, the northern long-eared bat roosts singly or in colonies underneath bark, in cavities, or in crevices of both live and dead trees and/or snags typically 3 inches dbh or larger (USFWS 2014). Males and non-reproductive females may also roost in cooler places, like caves and mines. This bat selects roost trees based on their ability to retain bark or provide cavities or crevices. It has also been found, rarely, roosting in structures like barns and sheds. These bats emerge at dusk to forage in upland and lowland woodlots and

tree-lined corridors, feeding on insects (USFWS 2014). Suitable summer habitat consists of a wide variety of forested/wooded habitats and may also include some adjacent and interspersed non-forested habitats such as emergent wetlands and adjacent edges of agricultural fields. These wooded areas may be dense or loose aggregates of trees with variable amounts of canopy closure. Typical summer habitat is occupied from mid-May through mid-August each year (USFWS 2014).

In April 2015, ARCADIS conducted a Phase 1 Indiana bat and northern long-eared bat habitat assessment on the project site to determine the availability of suitable summer habitat for these listed species. Surveys were conducted in accordance with the 2015 Range-wide Indiana Bat Summer Survey Guidelines (USFWS 2015). The survey found potentially suitable habitat, including mature hardwood trees and snags, for both bats along the periphery of the project site, which included the northern, eastern, and southern property boundaries (see Figure 3-2). The southern project boundary contains a fence row of trees that are covered in vines, which provides low quality habitat for the bats. The eastern boundary of the project site contains 2 acres of forested habitat. All of the potentially suitable bat habitat is outside the proposed disturbance area.

The whorled sunflower occurs in moist, prairie-like openings in woodlands and along adjacent creeks. The plant grows in sandy clay soils which are alkaline, high in organic matter, and seasonally wet (USFWS 2011). The only known population in Madison County, Tennessee is located within a railroad ROW near Pinson, about 19 miles southeast of the project site. Subsequent surveys of Madison County have not located any other populations (USFWS 2011). No suitable habitat for this species occurs within the project site or the proposed interconnection route.

The piebald madtom occurs in large creeks and rivers in moderate-swift currents with clean sand or gravel substrates. No suitable habitat for this species occurs within the project site or the proposed interconnection route.

3.16.2 Environmental Consequences

3.16.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not purchase power from the proposed solar facility, which likely would not be constructed or operated. Environmental conditions on the property would remain the same. Therefore, there would be no direct, indirect, or cumulative impacts to threatened and endangered species.

3.16.2.2 Alternative B – Proposed Action Alternative

There would be no direct, indirect, or cumulative impacts associated with the Proposed Action Alternative. There is no suitable habitat for the whorled sunflower or piebald madtom within the project site. Habitat suitable for the Indiana bat and northern long-eared bat along the boundaries of the project site would not be affected.

3.17 Unavoidable Adverse Environmental Impacts

The Proposed Action could cause some unavoidable adverse environmental effects. Specifically, construction activities would increase noise and traffic as well as impact the aesthetics of the general area. The evergreen tree planting along SR-138, required by the Board of Zoning, would help reduce visual impacts. Construction activities would be limited to daytime hours, which would help minimize noise impacts during construction. Transportation impacts during construction would be minimized by development of an

overall construction management plan that would route and schedule construction vehicles as well as strategically locate staging areas in order to ensure that impacts are minor. With the application of appropriate and standard environmental safeguards such as those described above, these unavoidable adverse effects are expected to be minor.

3.18 Relationship of Short-Term Uses and Long-Term Productivity

Short-term uses are those that generally occur on a year-to-year basis. Examples are wildlife use of forage, timber management, recreation, and uses of water resources. Long-term productivity is the capability of the land to provide resources, both market and non-market, for future generations.

In this context, long-term impacts to site productivity would be those that last beyond the life of the project. The Proposed Action would affect short-term uses of the project site by converting it from agricultural production to solar power generation. The effects on long-term productivity would be minimal as agricultural production could be readily restored on all but a very small portion of the solar facility site following the decommissioning and removal of the solar facilities.

3.19 Irreversible and Irretrievable Commitments of Resources

An irreversible or irretrievable commitment of resources would occur when resources would be consumed, committed, or lost because of the project. The commitment of a resource would be considered irretrievable when the project would directly eliminate the resource, its productivity, or its utility for the life of the project and possibly beyond.

Construction and operation activities would result in an irretrievable and irreversible commitment of natural and physical resources. The implementation of the Proposed Action Alternative would involve irreversible commitment of fuel and resource labor required for the construction, maintenance, and operation of the solar energy system. It would also involve the commitment of prime farmland within the project area for the life of the solar energy system. Because removal of the solar arrays and associated on-site infrastructure could be accomplished rather easily, and the facility would not irreversibly alter the site, the project site could be returned to its original condition or used for other productive purposes once it is decommissioned. Most of the solar facility components could also be recycled after the facility is decommissioned.

CHAPTER 4 – LIST OF PREPARERS

Brian Maillet (ARCADIS)

Position:	Solar Program Manager
Education:	PMP, B.S., Environmental Science, Soil Engineering Minor
Experience:	19 years in NEPA Compliance, New and Traditional Energy Assessments, including generation, transmission, and legacy
Involvement:	Project Management

Charles P. Nicholson (TVA)

Position:	Senior NEPA Compliance Specialist
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Involvement:	NEPA Compliance

Hallie Hearnes (CRA)

Position:	Architectural Historian
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Experience:	5 years in architectural history and regulatory compliance
Involvement:	Architectural Analysis and Reporting

Andrew Bradbury (CRA)

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Tiffany Novak (ARCADIS)

Position:	Senior Environmental Scientist
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Involvement:	Project Management, NEPA Compliance, Document Preparation

Sara Moore (ARCADIS)

Position:	Staff Environmental Scientist
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Experience:	8 years in NEPA Compliance
Involvement:	Document Preparation, Biological resources

CHAPTER 5 – LITERATURE CITED

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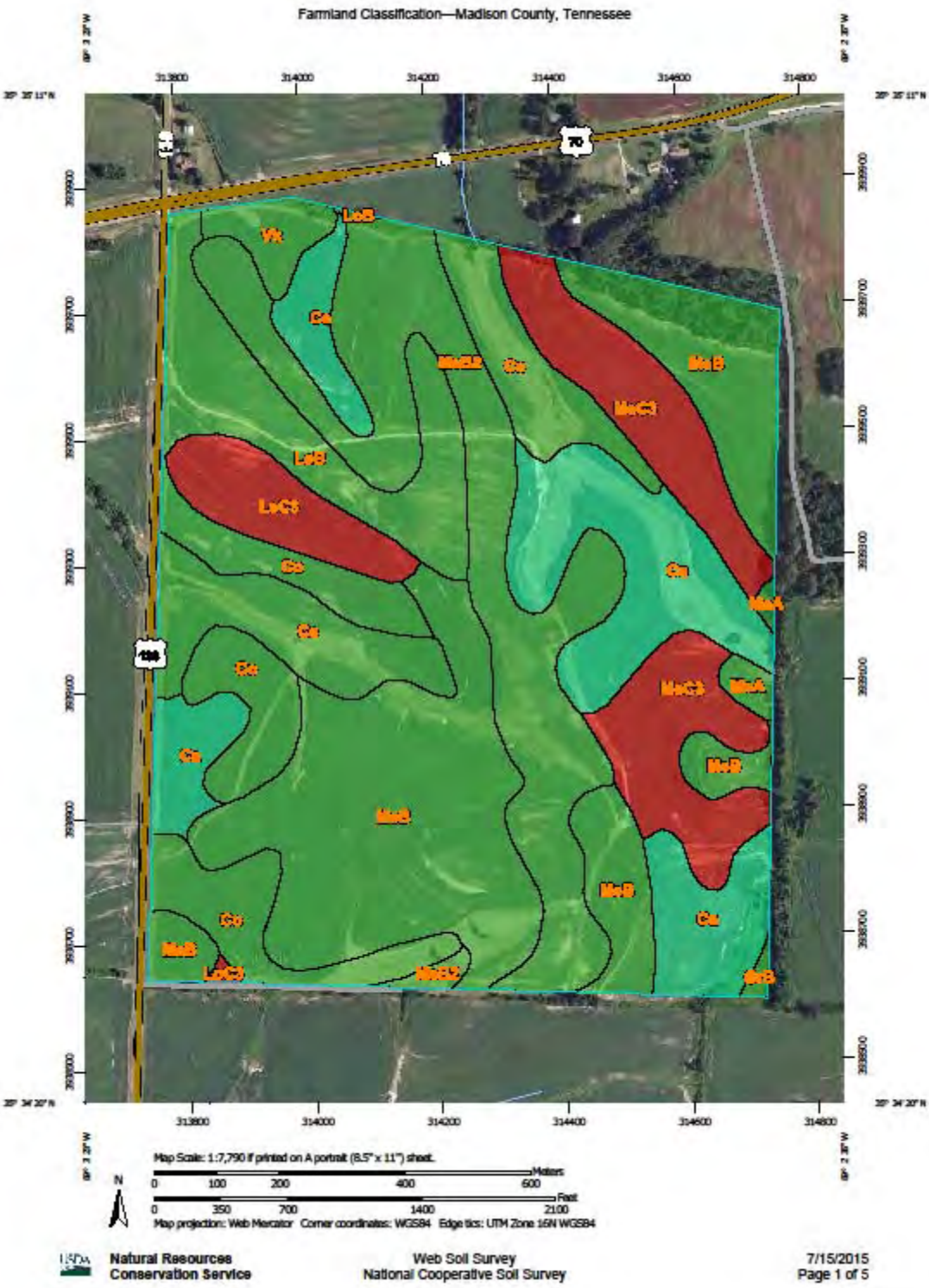
Appendix A – Soil Survey Map


Farmland Classification—Madison County, Tennessee
313800
314000
314200
314400
314600
314800
70
LeB
Vk
Ca
MaB2
Ga
MaB
MaC3
LeB
LeC3
Ga
Ga
Ga
Ga
Ga
MaA
MaC3
MaA
MaB
Ca
MaB
MaB
Ga
Ga
MaB
LeC3
MaB2
MaB
Map Scale: 1:7,790 if printed on A portrait (8.5" x 11") sheet.
Meters
0 100 200 400 600
Feet
0 350 700 1400 2100
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84
Natural Resources Conservation Service
Web Soil Survey
National Cooperative Soil Survey
7/15/2015
Page 1 of 5

Farmland Classification—Madison County, Tennessee

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Lines

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Soil Rating Points

- Not prime farmland
- All areas are prime farmland
- Prime farmland if drained
- Prime farmland if protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated
- Prime farmland if drained and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if irrigated and drained
- Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season
- Prime farmland if subsoiled, completely removing the root inhibiting soil layer
- Prime farmland if irrigated and the product of I (soil erodibility) x C (climate factor) does not exceed 60
- Prime farmland if irrigated and reclaimed of excess salts and sodium
- Farmland of statewide importance
- Farmland of local importance
- Farmland of unique importance
- Not rated or not available

Water Features

MAP INFORMATION

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Madison County, Tennessee
Survey Area Data: Version 9, Sep 24, 2014

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

Date(s) aerial images were photographed: Mar 12, 2011—Sep 30, 2011

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

Farmland Classification

Farmland Classification— Summary by Map Unit — Madison County, Tennessee (TN113)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
Ca	Calhoun and Henry silt loams	Prime farmland if drained	43.6	15.2%
Co	Calloway silt loam, 0 to 2 percent slopes	All areas are prime farmland	25.3	8.8%
Cs	Collins silt loam, 0 to 2 percent slopes, frequently flooded, brief duration	All areas are prime farmland	24.2	8.4%
GrB	Grenada silt loam, 2 to 5 percent slopes	All areas are prime farmland	0.5	0.2%
LeC3	Lexington silt loam, 5 to 8 percent slopes, severely eroded	Not prime farmland	10.4	3.6%
LoB	Loring silt loam, 2 to 5 percent slopes	All areas are prime farmland	21.5	7.5%
LoC3	Loring silt loam, 5 to 8 percent slopes, severely eroded	Not prime farmland	0.3	0.1%
MeA	Memphis silt loam, 0 to 2 percent slopes	All areas are prime farmland	1.9	0.7%
MeB	Memphis silt loam, 2 to 5 percent slopes	All areas are prime farmland	75.4	26.2%
MeB2	Memphis silt loam, 2 to 5 percent slopes, eroded, north	All areas are prime farmland	49.2	17.1%
MeC3	Memphis silt loam, 5 to 8 percent slopes, severely eroded, north	Not prime farmland	30.7	10.7%
Vk	Vicksburg silt loam	All areas are prime farmland	4.5	1.5%
Totals for Area of Interest			**287.5**	**100.0%**

Description

Farmland classification identifies map units as prime farmland, farmland of statewide importance, farmland of local importance, or unique farmland. It identifies the location and extent of the soils that are best suited to food, feed, fiber, forage, and oilseed crops. NRCS policy and procedures on prime and unique farmlands are published in the "Federal Register," Vol. 43, No. 21, January 31, 1978.

Rating Options

Aggregation Method: No Aggregation Necessary

Tie-break Rule: Lower

Appendix B – Correspondence

USDA

United States Department of Agriculture

Date: August 18, 2015

Brian Mailet
ARCADIS
114 Lovell Road, Suite 202
Knoxville, Tennessee 37934

Re: Proposed Providence Solar Center in Madison County, Tennessee

Mr. Mailet,

I have reviewed your request for a Farmland Protection Policy Act (FPPA) assessment on the above-mentioned project. Projects are subject to FPPA requirements if they may irreversibly convert farmland (directly or indirectly) to non-agricultural use and are completed by a Federal agency, or with assistance from a Federal agency.

Given the type of project (Solar Energy), and how the project is implemented, leads me to conclude that this project does not permanently convert farmland. Given that the project could be removed and normal farming practices resume on the site without much difficulty. As such, this projects appears to meet the exemption for the FPPA assessment. **Therefore, the FPPA assessment is not be required for this project.**

If the Federal agency assisting you with this project disagrees with my conclusion, let me know and I will contact our agency FPPA advisor and review the request again. If you have any additional questions, please contact me at (731) 668-0700.

Charles L. Davis
Resource Soil Scientist

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