Appendix B – Project Technical Reports

B-1. Wetland Delineation Report

B-2. Noise and Vibration Study

B-3. Air Quality Calculations

Appendix B-1 – Wetland Delineation Report

WETLAND DELINEATION REPORT
AGILE ENERGY
TURNING POINT SOLAR PROJECT
BROOKFIELD TOWNSHIP,
NOBLE COUNTY, OHIO

June 16, 2011

Prepared for:

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I. INTRODUCTION

A. Study Area Description

The Study Area is located on an approximately 788 acre property located east of State Route 83 south of the Town of Cumberland in Brookfield Township, Noble County, Ohio (Figure 1). Although undeveloped, several gas wells are located throughout the Study Area. The Study Area consists of pasture currently and recently utilized by livestock for grazing. URS conducted a wetlands and water resources delineation at the Study Area in February and March 2011.

Based on historical records, the Study Area was undeveloped from at least 1911 through approximately 1960. Portions of the Study Area were used for strip mining operations from the 1960s through the late 1980s, when the strip mine was reclaimed. Since the early 1990s, the Study Area has been used for recreational use and as grazing land for livestock.

B. Study Objectives

This wetland delineation report documents the findings of a detailed field investigation to identify and delineate wetlands and other waters of the U.S. within the Study Area. This delineation was conducted to alert planners to the location and significance of wetlands and other water resources so that avoidance and minimization could be implemented in the design of potential projects at the Study Area.

II. METHODS

A. Wetland Identification and Delineation

Wetlands within the Study Area were identified and their boundaries determined using the procedures outlined in the *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region* (*Interim Regional Supplement*) (U.S. Army Engineer Research and Development Center, 2010). Initially, potential wetlands were identified by examining topographic (Figure 1), soils (Figure 2), and National Wetlands Inventory (Figure 3) maps.

Wetland delineation field investigations were conducted in February and March 2011 using methods described in the *Interim Regional Supplement.* Following these methods, plant communities were characterized as to their soils, signs of hydrology, and dominant vegetation. Areas that exhibit hydric soils, wetland hydrology, and a dominance of hydrophytic vegetation were considered to be a wetland.

Soils were examined using a 1-inch diameter soil borer to extract cores. These cores were examined for hydric soil characteristics just below the A-horizon, usually between 8 and 18 inches below the ground surface. One of the more important field indicators examined is the hue, value, and chroma of the matrix (e.g., 10YR 6/1) and mottles (e.g., 10YR 5/6) of moist soils as determined by using the *Munsell Soil Color Chart* (Kollmorgen Instrument Corporation, 1994). Generally, mottled soils with a matrix chroma of two or less, or unmottled soils with a matrix chroma of one or less are considered to exhibit hydric soil characteristics (U.S. Army Engineer Research and Development Center, 2010). Mottled soils with a matrix chroma greater than two and unmottled soils with a matrix chroma greater than one are considered to exhibit non-hydric characteristics.

The hydrology criterion in the *Interim Regional Supplement* requires that an area exhibit one primary indicator of wetland hydrology or at least two secondary indicators of wetland hydrology. Primary indicators include standing water or saturated soils, water marks on trees, drift lines, water-stained leaves, and oxidized root zones surrounding living roots. Secondary wetland hydrology indicators include drainage patterns, microtopographic relief, presence of crayfish burrows, and sparsely vegetated concave surfaces. Additional secondary signs of hydrology include visible saturation on aerial photography and a positive FAC-neutral test (see below) (U.S. Army Engineer Research and Development Center, 2010).

Dominant vegetation for each community was determined by estimating dominant species in the tree, sapling, shrub, herb, and woody vine strata. Dominant species were determined by using the 50/20 dominance rule for each stratum. This was accomplished by determining the estimated percent areal cover for each species and the relative percent areal cover was calculated for each species by dividing each species percent cover by the total percent cover for all species and multiplying by 100. The species were then arranged in descending order of relative percent cover. A running total was kept by adding the relative cover of each species starting with the species with the highest relative cover until the total cover equaled 50. All species that were included in this calculation were regarded as dominant. Species of equal cover value that contributed to meeting the sum of 50 were also considered dominant. Additionally, other species that solely accounted for 20%

or more of the relative percent cover were also considered dominant species. The indicator status of each dominant species was then determined. An indicator status of obligate wetland (OBL), facultative wetland (FACW), facultative (FAC), facultative upland (FACU) and/or upland (UPL) has been assigned to each plant species on the *National List of Plant Species that Occur in Wetlands: Region 1* (Reed, 1988). An area has hydrophytic vegetation when, under normal circumstances, more than 50 percent of the composition of the dominant species from all strata is OBL, FACW, and/or FAC species.

In addition, a FAC-neutral test was calculated for each data set as a means of determining the presence of wetland hydrology. This test considers all FAC species as neutral for wetland determination and compares the number of dominant species wetter than FAC (*i.e.*, OBL, FACW) against the number of dominant species drier than FAC (*i.e.*, FACU, UPL). A positive FAC-neutral test results when dominant species wetter than FAC are more prevalent than dominant species drier than FAC. A positive FAC-neutral test is a secondary indicator of wetland hydrology.

To the extent possible, the hydrophytic vegetation decision should be based on the plant community that is normally present during the wet portion of the growing season in a normal rainfall year (U.S. Army Engineer Research and Development Center, 2010). Vegetation sampling for a wetland determination can be challenging when some plants are covered by snow or die back due to freezing temperatures or other factors. The growing season has begun on a site in a given year when two or more different non-evergreen vascular plant species growing in the wetland or surrounding areas exhibit one of the following: the emergence of herbaceous plants from the ground, the appearance of new growth from vegetative crowns, coleoptile/cotyledon emergence from seed, bud burst on woody plants (i.e., some green foliage is visible between spreading bud scales), the emergence or elongation of leaves of woody plants, or the emergence or opening of flowers (U.S. Army Engineer Research and Development Center, 2010). The wetland delineation field work at the Study Area was conducted prior to the occurrence of these events and therefore, outside the growing season.

Plots, and consequently communities, that met the three criteria of hydric soils, wetland hydrology, and hydrophytic vegetation were considered wetlands. Wetland boundaries were mapped where one or more of these criteria gave way to upland characteristics. Samples were also taken in nearby apparent upland areas to confirm that one or more of the criteria were not met in these locations.

The derived wetland boundaries were surveyed through the use of a Global Positioning System (GPS) receiver capable of sub-meter accuracy. The delineated wetlands were identified by letter and correspond to the wetlands illustrated on the wetland and stream location map (*e.g.,* Wetland A, Wetland B, etc). The wetland boundaries were recorded as polygons and the wetland areas were calculated using the shapefile properties utility in ArcMap.

B. Ohio Rapid Assessment Method

Delineated wetlands within the Study Area were categorized using the Ohio Rapid Assessment Method (ORAM, Version 5.0) (Mack, 2001). The scoring sheets (field forms) for individual wetlands were completed and were the basis for the provisional wetland categorizations. The ORAM was performed using detailed field evaluations.

C. Other waters of the U.S.

The Study Area was screened for the presence of areas that meet the criteria for "other waters of the U.S." These areas consist of ephemeral, intermittent, and perennial streams, as well as open water habitats such as ponds. Site drainage was determined by secondary source information and in the field using current regulatory guidance. Drainage channels that exhibited "bed and bank" and an ordinary high water mark in the channel were identified and delineated as jurisdictional streams. Drainage channels that did not exhibit an ordinary high water mark were regarded as drainageways.

Streams identified during the delineation were evaluated using the methods outlined in *Biological Criteria for the Protection of Aquatic Life* (Ohio Environmental Protection Agency, 1987). Data collection for all potential stream crossings included completion of either the Ohio EPA Qualitative Habitat Evaluation Index (QHEI) or the Headwater Habitat Evaluation Index (HHEI) form, depending on the size of the stream's drainage area. Following Ohio EPA guidance, any stream with a drainage area of greater than one square mile, or which has pools with maximum depths over 15.75 inches (40cm) was evaluated using the QHEI. The HHEI was used on streams with a drainage area of less than one square mile. Streams that exhibited a major change in morphology were scored at multiple representative locations. Please refer to **Appendix 3** for completed HHEI forms.

The derived stream courses were surveyed through the use of a Global Positioning System (GPS) receiver capable of sub-meter accuracy. The delineated streams are identified by a number or letter and correspond to the streams on the wetland and stream location map (*e.g.,* Stream 1, Stream 2, etc). The stream extents were recorded as polylines and the stream lengths were calculated using the shapefile properties utility in ArcMap.

D. Federal Jurisdiction of Wetlands

The Clean Water Act (U.S. Congress, 1972, amended 1977) makes it unlawful to discharge dredged or fill materials into "navigable waters" without a permit (33 U.S.C. S1311(a)). "Navigable waters" are defined as "the waters of the United States, including the territorial seas." The U.S. Army Corps of Engineers (Corps), which issues permits for discharge of dredged material or fill into navigable waters, interprets "waters of the United States" to include not only traditionally navigable waters, but tributaries of such waters and wetlands "adjacent" to such waters and tributaries. "Adjacent" is defined as wetlands "bordering, contiguous [to] or neighboring" waters of the United States even when they are "separated from [such] waters…by man-made dikes…and the like." Originally, the Corps maintained jurisdiction of wetlands isolated from waters of the U.S. by means of the "Migratory Bird Rule." The Migratory Bird Rule stated that wetlands are a key resource for waterfowl, which continuously migrate between states. The waterfowl being a vital resource, impacts to wetlands were considered to affect interstate trade and thus be under the purview of federal regulation. A U.S. Supreme Court ruling [Solid Waste Authority of Northern Cook County (SWANCC) v. The United States Army Corps of Engineers, 2001] ruled that migratory waterfowl were not sufficient cause alone to subject isolated wetlands to regulations pursuant to Section 404 of the Clean Water Act. Subsequently, a bill was signed into law by Governor Taft (Ohio House Bill 231) giving the Ohio EPA authority to regulate and permit impacts to isolated wetlands. Therefore, in an attempt to establish the level of jurisdictional authority, the hydrology of each wetland within the Study Area was evaluated to define whether or not individual wetlands should be considered adjacent or isolated.

In June of 2006, the United States Supreme Court has ruled on a case (Rapanos *et ux*. v. United States) challenging the Corps jurisdiction over several wetlands that drain via man-made ditches into navigable waters. In a split decision, the case was returned to the U.S. 6^{th} Circuit Court of Appeals. The opinion of note on this case was written by Justice Kennedy, who did not agree completely with either the three judge plurality or the three judge dissent. He concluded that a water or wetland is subject to regulations pursuant to Section 404 of the Clean Water Act if it possesses a "significant nexus" to waters that are navigable or could reasonably be so made. He directed the Corps to better define "a significant nexus" to establish the framework for inquiry. The rationale for the Corps jurisdiction over wetlands under the Clean Water Act is that wetlands perform critical functions for physical and chemical integrity of waterways such as pollutant trapping, flood control and runoff storage. In contrast, when wetland impacts on navigable waters are insubstantial, jurisdiction cannot be awarded based on the Clean Water Act. Further guidance was issued by the Corps in early June of 2007.

III. SITE DESCRIPTION

A. Drainage and Topography

The majority of the Study Area drains to Rannells Creek. The southeastern portion of the Study Area drains to Dyes Fork and the eastern portion of the Study Area drains to Coal Run. The Study Area is located in the following three 8-digit watersheds: the Bacon Run (at mouth) watershed (HUC 05040005), the West Fork of Duck Creek at Dexter City watershed (HUC 05030201), and the Wakatomika Creek above Harrod Run watershed (HUC 05040004). HUC 05040005 and HUC 05040004 drain to the Muskingum River, a tributary to the Ohio River whereas HUC 05030201 drains directly to the Ohio River. Drainage of the Study Area is by means of overland flow, roadside ditches, and streams of various sizes. Additionally, portions of the Study Area drain to ponds located on-site.

According to the Cumberland, Ohio (1994) USGS 7.5 minute topographic quadrangles, the Study Area exhibits rolling topography with elevations ranging from approximately 900 feet above mean sea level (MSL) to approximately 1,100 feet above MSL. Several streams and several areas of open water are illustrated on-site and a large portion of the Study Area is labeled as a reclaimed strip mine.

B. Soils

According to the National Resources Conservation Service's (NRCS) Web Soil Survey, the Study Area is underlain by five unique soil units as illustrated on Figure 2. None of the soil units are listed as hydric on the National Hydric Soils List (NRCS, 2011).

Table 1. Study Area Soil Types, Drainage, and Hydric Status.

Soil Unit	Drainage Class	Hydric Status[1]
Lowell-Gilpin silt loams, 35 to 70 percent slopes (LuF)	well drained	Non-Hydric
Morristown silty clay loam, 0 to8 percent slopes (MoB)	well drained	Non-Hydric
Morristown silty clay loam, 8 to 15 percent slopes (MoC)	well drained	Non-Hydric
Morristown silty clay loam, 15 to 25 percent slopes (MoD)	well drained	Non-Hydric
Udorthents-Pits complex (Uc)	N/A	Non-Hydric

[1]Natural Resources Conservation Service, 2000, 2004

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IV. WETLAND AND WATER RESOURCES

A. General Wetlands Results

According to the USFWS National Wetland Inventory online wetland mapper, several wetlands are located throughout the Study Area. The NWI data that covers the vicinity of the Study Area is included as Figure 3. One wetland designated as PEMYx/POWYx (palustrine, emergent/open water, saturated/semi-permanent/seasonal, excavated) is illustrated in the southeast portion of the Study Area. The remaining wetlands are designated as POWZx (palustrine, open water, intermittently exposed/permanent, excavated).

B. Delineated Wetlands

URS conducted a wetlands and water resources delineation at the Study Area in February and March 2011. As a result, 108 wetlands were delineated within the boundaries of the Study Area shown in Figures 1 and 2. An additional 31 wetlands were delineated in the vicinity of a transmission line corridor shown in Figure 4. Most of the delineated wetlands are located either wholly or partially within areas that are actively or recently used by grazing cattle. All wetlands that were delineated within the boundaries of the Study Area are generally described below in terms of location, jurisdictional status and quality as dictated by the ORAM v5.0. Many of the direct hydrologic connections were discerned after conducting the field investigation, by examining mapping provided in the Soil Survey as well as available aerial photography. Any wetlands preliminarily deemed isolated and/or not subject to regulations pursuant to Section 404 of the Clean water Act are described as such below. The covertype descriptions identify the dominant species in each habitat type by common name with the scientific name following in parentheses. Individual data forms included as **Appendix 1** provide the field support and additional details regarding the wetland/upland boundary determination. The ORAM forms completed for each individual wetland delineated within the Study Area are included as **Appendix 2**. QHEI and HHEI forms for each individual stream located within the Study Area are included as **Appendix 3**. Photographic documentation of each area delineated is included in Section IX.

The locations and extents of the delineated wetlands and streams are presented in Figures 4. Each delineated wetland is identified by letter (e.g., Wetland A, Wetland B, etc.) and each stream was given a numeric designation (e.g., Stream 1, Stream 2, etc.). The reader may refer to these figures and the wetland delineation data forms (**Appendix 1**) for detailed delineation data. A table showing the preliminary jurisdictional status, preliminary ORAM score, and on-site acreage is included as **Appendix 4**.

<u>Delineated Wetlands</u>

Of the 108 wetlands delineated within the main Study Area, 89 were preliminarily deemed as isolated and do not possess a significant nexus to a relatively permanent waterway (i.e. and perennial stream) or traditionally navigable waterway (e.g., the Ohio River). Of the 31 wetlands delineated within the transmission line corridor, 9 were deemed as isolated. These wetlands are solely under the jurisdiction of the Ohio EPA and are subject to Ohio Isolated Wetlands Laws. The remaining 19 wetlands of the main Study Area and 22 wetlands of the transmission line corridor are continuous with streams that drain off-site. Based on an examination of available imagery (i.e., USGS topographic maps, aerial photography, etc.) these streams eventually drain to the Ohio River. These wetlands were deemed as "waters of the U.S." and are subject to regulations pursuant to Section 404/401 of the Clean Water Act. However, the U.S. Army Corps of Engineers makes the final determination as to the jurisdiction of a wetland, stream, or other water.

Isolated Wetlands

Eighty eight of the 89 isolated wetlands located within the main Study Area are shallow depressions that were inundated during the field investigation. Dominant vegetation of these 88 wetlands included either soft rush (Juncus effusus), strawcolored flatsedge (Cyperus strigosus), woolgrass (Scirpus cyperinus), or reed canary grass (Phalaris arundinacea). Although some other emergent vegetation was present for some of the isolated wetlands located in the grazing portions of the Study Area, at least one of these three species was dominant in each of these wetlands. Based on the ORAM scores for these 88 wetlands, all are categorized as "Category One" which is typically indicative of low quality wetlands. Each of these wetlands has undergone considerable substrate disturbance, habitat alteration, and modifications to the natural hydrologic regime due to recent grazing and historic strip mining activities. These 89 wetlands total approximately 6.35 acres.

One of the 89 isolated wetlands located within this portion of the Study Area is associated with the edge of a pond (Pond 4). Dominant vegetation of this wetland (Wetland A) included eastern cottonwood (Populus deltoides) and sandbar willow (Salix interior) in addition to strawcolored flatsedge. Based on the ORAM score, Wetland A was categorized as scoring within the "Category One or Category Two Gray Zone". This wetland has also undergone considerable disturbance due to recent grazing and historic strip mining activities. However, Wetland A exhibits horizontal interspersion due to multiple cover types such as an herbaceous layer, a shrub layer, and open water which accounts for the slightly higher ORAM score when compared to the other 88 isolated wetlands. Wetland A is approximately 1.36 acres which does not account for the 0.19-acre of open water.

Waters of the U.S.

One perennial stream, twelve intermittent streams, and eight ephemeral streams are located within the boundaries of the main Study Area. A table showing the stream type and preliminary HHEI or QHEI score for the main Study Area is included in Table 2 and a table showing the stream type for the transmission line corridor is included in Table 2a. Nineteen wetlands are hydrologically continuous with these streams. Nine of the nineteen wetlands associated with streams (Wetland K', Wetland L, Wetland M, Wetland N, Wetland Q, Wetland AL, Wetland CR, Wetland CS, and Wetland CT) are linear and are along the floodplain of each respective stream. Dominant vegetation of these wetlands includes either, soft rush, strawcolored flatsedge, woolgrass, or reed canary grass. These wetlands are located entirely within the Study Area with the exception of Wetland CR which extends off-site. These wetlands total 0.889-acre on-site. Eight of the nineteen wetlands associated with streams (Wetland O, Wetland P, Wetland AN, Wetland AO, Wetland AP, Wetland AV, Wetland AW, and Wetland DQ) are non- linear depressions hydrologically continuous with the floodplain of each respective stream.

Dominant vegetation of these wetlands includes either narrow-leaf cattail (Typha angustifolia), soft rush, strawcolored flatsedge, woolgrass, or reed canary grass. These wetlands are located entirely within the Study Area with the exception of Wetland DQ which extends off-site. These wetlands total 0.29-acre on-site. Lastly, two of the nineteen wetlands hydrologically continuous with streams (Wetland AK and Wetland CC) are associated with ponds (designated as Pond 1 and Pond 2, respectively) that discharge into streams. Dominant vegetation of both Wetland AK and Wetland CC are sandbar willow and reed canary grass. Wetland AK and Wetland AC total 5.038 acres which does not account for the 8.43 acres of open water associated with these wetlands. In addition to the streams located on-site, 14.65 acres of area within the Study Area would be considered “waters of the U.S.” which includes 6.22 acres of wetlands and 8.43 acres of open water.

Based on the ORAM scores for these nineteen wetlands, all but Wetland AK and Wetland DQ are categorized as “Category One” which is typically indicative of low quality wetlands. Each of these wetlands has undergone considerable substrate disturbance, habitat alteration, and modifications to the natural hydrologic regime due to recent grazing and historic strip mining activities. Wetland AK was categorized as scoring within the “Category One or Category Two Gray Zone”. Wetland DQ was categorized as a “Modified Category Two” wetland. These wetlands have also undergone considerable disturbance due to recent grazing and historic strip mining activities, although Wetland AK exhibits some horizontal interspersion due to multiple cover types such as an herbaceous layer, a shrub layer, and open water and Wetland DQ is part of a larger wetland complex located mostly offsite that exhibited multiple covertypes and various hydrologic regimes thus accounting for the higher ORAM scores.

Table 2: Summary of Streams Identified at Study Area

Stream ID	Stream Type	HHEI Score	Impacted Stream (linear feet)	Preliminary Primary Headwater Habitat Classification
Stream 1	Intermittent	44	0	Modified Class II Primary Headwater Habitat
Stream 2	Ephemeral	21	0	Modified Class I Primary Headwater Habitat
Stream 3	Intermittent	36	0	Modified Class II Primary Headwater Habitat
Stream 4	Intermittent	55	-	Modified Class II Primary Headwater Habitat
Stream 5	Intermittent	47	797 of 969	Modified Class II Primary Headwater Habitat
Stream 6	Intermittent	62	0	Modified Class II Primary Headwater Habitat
Stream 7	Intermittent	49	0	Modified Class II Primary Headwater Habitat
Stream 8	Intermittent	54	0	Modified Class II Primary Headwater Habitat
Stream 8.1	Ephemeral	29	0	Modified Class I Primary Headwater Habitat
Stream 9	Intermittent	50	0	Modified Class II Primary Headwater Habitat
Stream 10	Ephemeral	25	0	Modified Class I Primary Headwater Habitat
Stream 11	Ephemeral	39	0	Modified Class II Primary Headwater Habitat
Stream 12	Intermittent	51	0	Modified Class II Primary Headwater Habitat
Stream 13	Ephemeral	39	0	Modified Class II Primary Headwater Habitat
Stream 14'	Ephemeral	18	313 of 581	Modified Class I Primary Headwater Habitat
Stream 14	Perennial	44	0	Modified Class II Primary Headwater Habitat

Stream ID	Stream Type	HHEI Score	Impacted Stream (linear feet)	Preliminary Primary Headwater Habitat Classification
Stream 16	Intermittent	56	0	Modified Class II Primary Headwater Habitat
Stream 100	Intermittent	54	212 of 2275	Modified Class II Primary Headwater Habitat
Stream 101	Ephemeral	36	448 of 615	Modified Class II Primary Headwater Habitat
Stream 102	Ephemeral	25	166 of 166	Modified Class I Primary Headwater Habitat
Stream 103	Intermittent	64	0	Modified Class II Primary Headwater Habitat

Table 2a: Summary of Streams Identified in Transmission Line Corridor

Stream ID	Stream Type	QHEI or HHEI Score	Impacted Stream (linear feet)
Stream 23	Perennial		505 of 2362
Stream 24	Perennial		270 of 270
Stream 54	Perennial		247 of 2682
Stream 64	Intermittent		15 of 249
Stream 66	Intermittent		220 of 220
Stream 82	Intermittent		235 of 605
Stream 83	Intermittent		48 of 83
Stream 84	Perennial		284 of 1513
Stream 85	Intermittent		475 of 475
Stream 86	Intermittent		69 of 470

Other Features

One additional pond designated as Pond 3 is not associated with any wetlands. Pond 3 is located in the southeastern portion of the Study Area and is approximately 2.40 acres. Pond 3 did not appear to exhibit any outflows during the field investigation and is therefore, likely isolated. A table showing a summary of the ponds located within the Study Area is included in Table 2.

Table 3: Summary of Ponds Identified at Study Area

Pond ID	Size (acres)	Jurisdictional Status	Impacted Pond (acres)
Pond 1	6.68	Water of the U.S.	0
Pond 2	1.75	Water of the U.S.	0
Pond 3	2.40	Isolated	0
Pond 4	0.19	Isolated	0
Pond 5	8.23	Isolated	0
Pond 6	0.11	Isolated	0.06
Pond 7	0.05	Isolated	0.01

Pond ID	Size (acres)	Jurisdictional Status	Impacted Pond (acres)
Pond 8	0.02	Isolated	0
Pond 9	0.03	Isolated	0
Pond 10	1.71	Isolated	0
Pond 11	0.74	Water of the U.S.	0
Pond 12	1.00	Water of the U.S.	0
Pond 13	0.59	Water of the U.S.	0
Pond 14	12.93	Isolated	0
Pond 15	1.31	Water of the U.S.	0

Fifteen linear depressions are located throughout the portion of the Study Area that are lined with rip/rap, lack sinuousity and do not correspond to drainage features depicted on the USGS topographic map. These areas are likely a result of strip mining reclamation activities and were considered non-jurisdictional drainageways.

V. SUMMARY

- URS Corporation conducted a wetland and water resources delineation field investigation at the Study Area in February and March 2011.

- This investigation identified a total of 108 wetlands, 21 streams, and 15 ponds within the 788-acre main Study Area, located mostly within fields actively used for grazing by livestock. It identified a total of 31 wetlands, 10 streams, and no additional ponds within a transmission line corridor.

- Of 139 wetlands delineated within the Study Area, 98 wetlands would not likely be subject to regulations pursuant to Section 404 of the Clean water Act, but would be regulated under Ohio's Isolated Wetland Laws.

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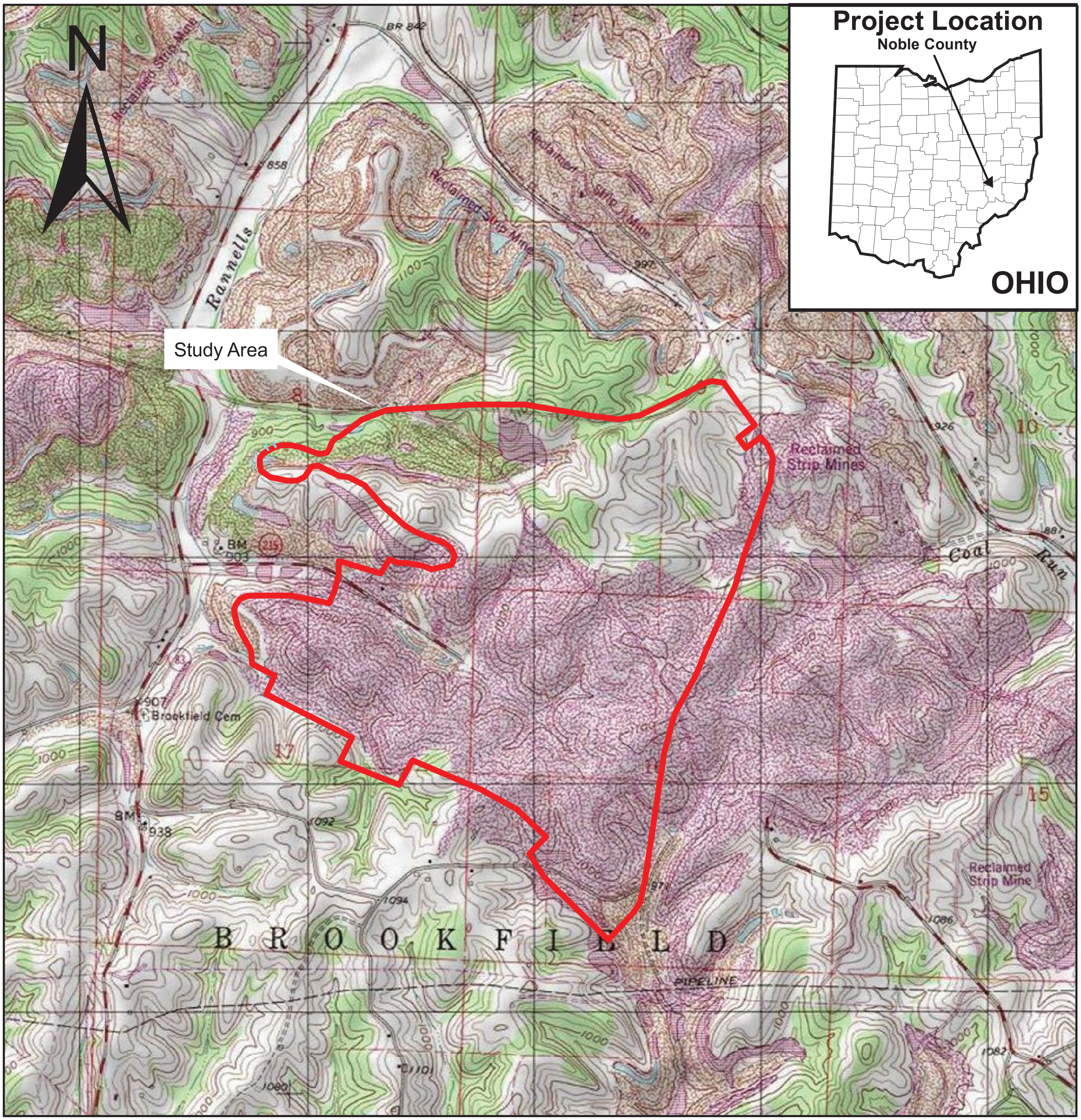
VII FIGURES



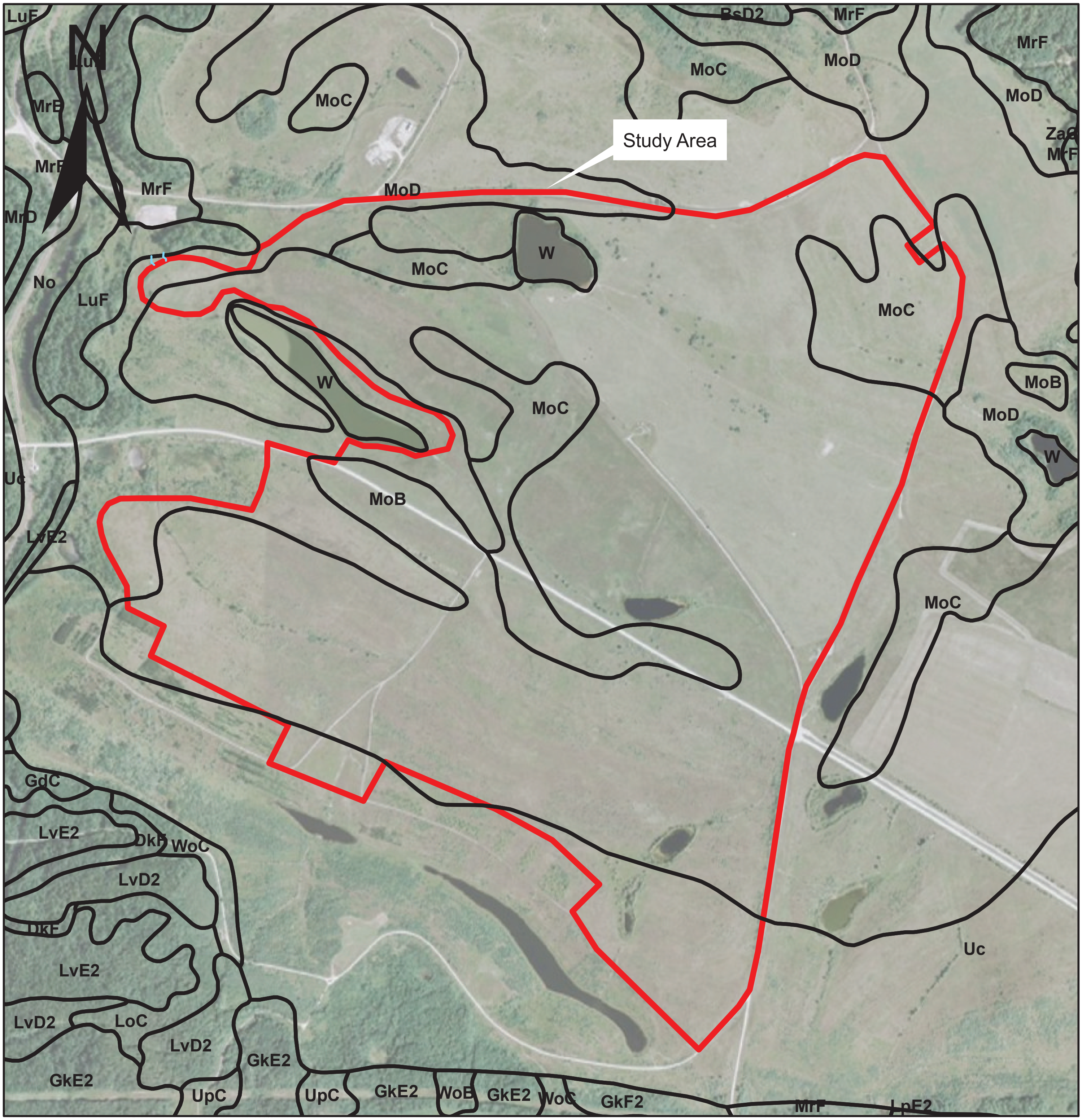
0 1,500 3,000 6,000 Feet

Basemap: Cumberland, OH 1994 USGS
7.5' Topographic Quadrangle

Agile Energy, Turning Point Solar Project, Brookfield Township, Noble County, Ohio

Figure 1 - Site Location Map

URS



0 625 1,250 2,500 Feet

Basemap: NRCS Web Soil Survey
http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure 2 - Soil Survey

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U.S. Fish and Wildlife Service

National Wetlands Inventory

May 17, 2011

Wetlands

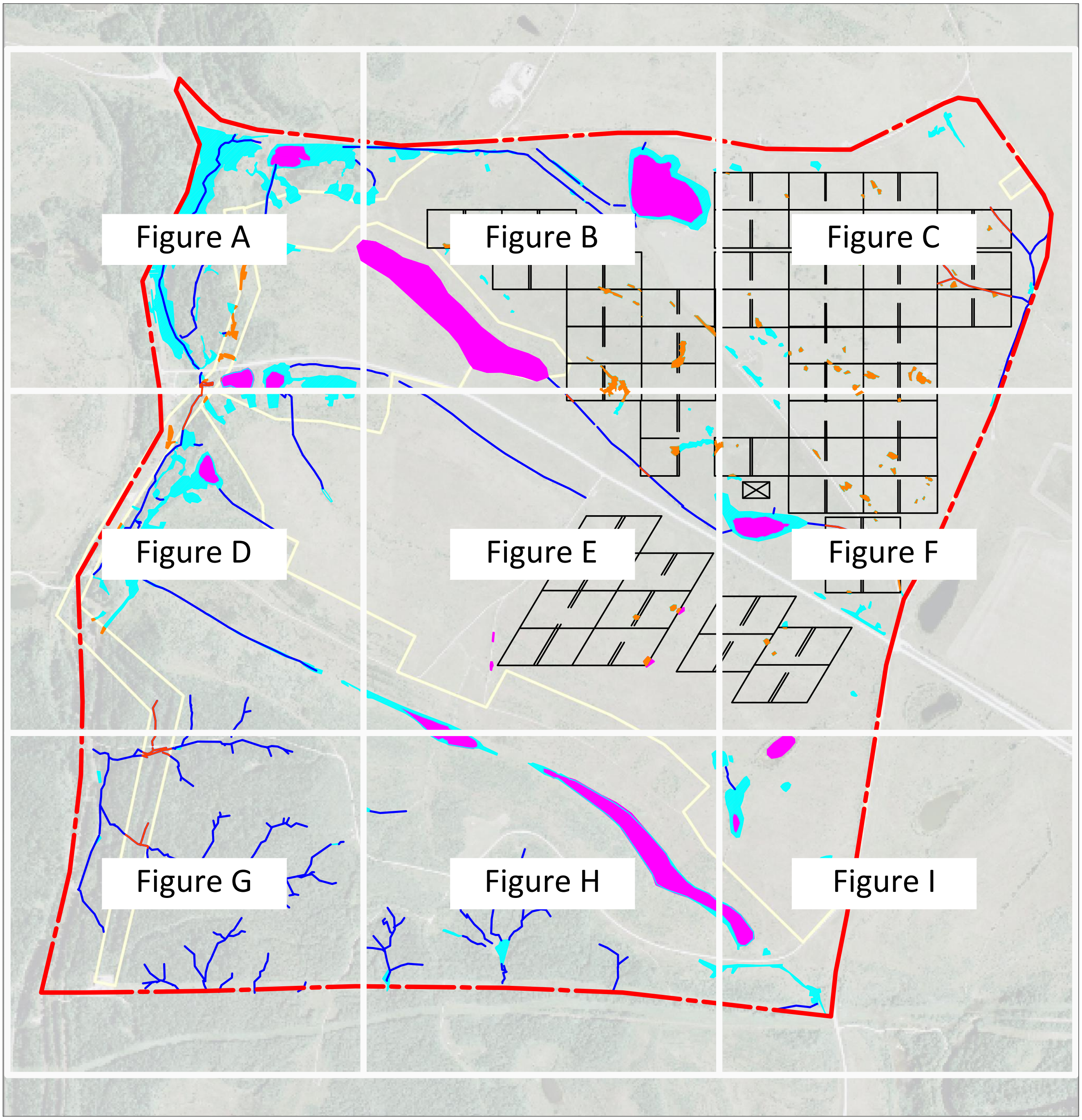
- Freshwater Emergent
- Freshwater Forested/Shrub
- Estuarine and Marine Deepwater
- Estuarine and Marine
- Freshwater Pond
- Lake
- Riverine
- Other

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

User Remarks:

Figure 3 - NWI Map

Figure 4



LEGEND

- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

N

0 375 750 1,500 3,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure - Wetland and Water Impact Map

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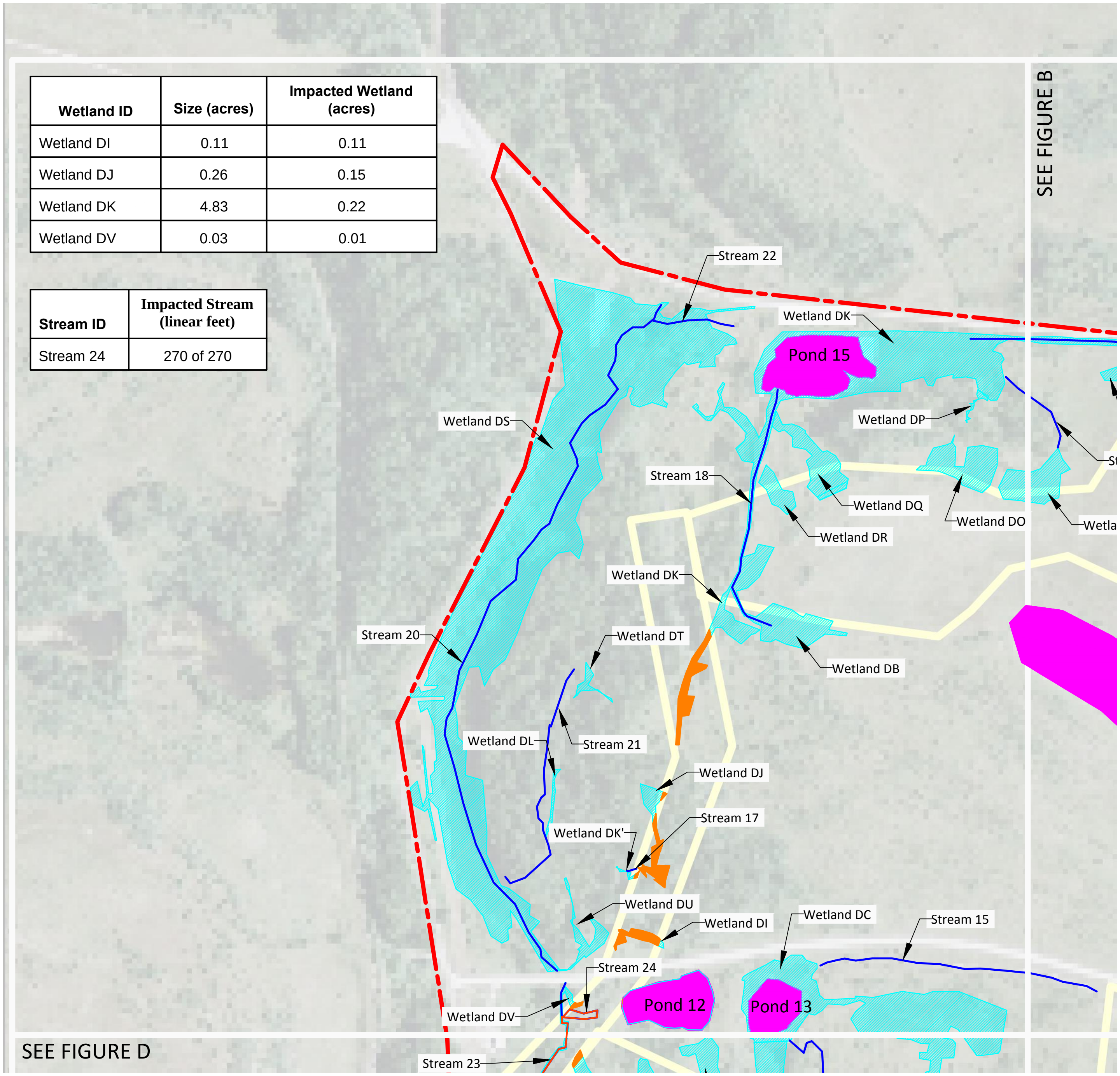
Wetland ID	Size (acres)	Impacted Wetland (acres)
Wetland DI	0.11	0.11
Wetland DJ	0.26	0.15
Wetland DK	4.83	0.22
Wetland DV	0.03	0.01

Stream ID	Impacted Stream (linear feet)
Stream 24	270 of 270



LEGEND

- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

N

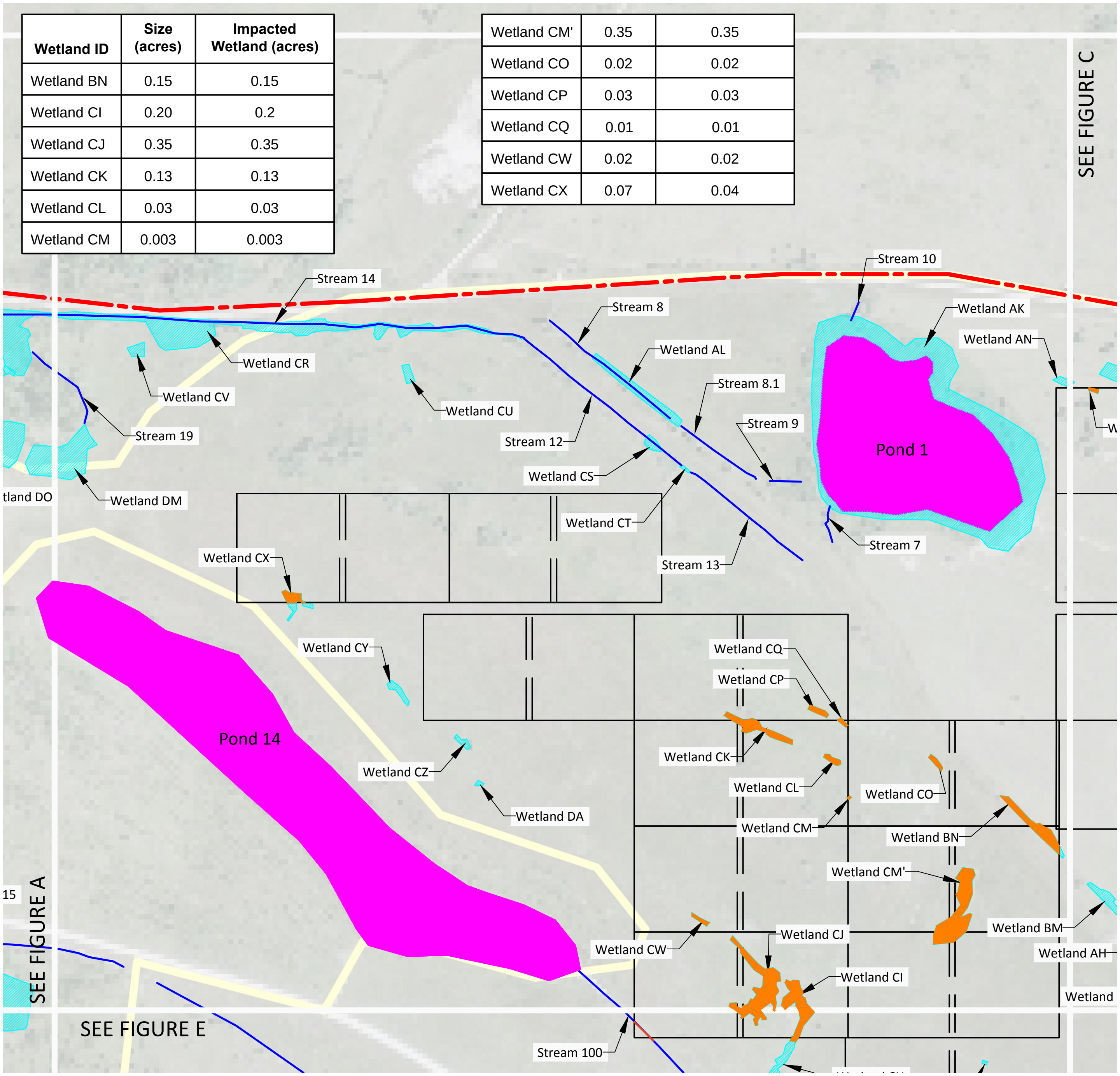
0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure A - Wetland and Water Impact Map

Wetland ID	Size (acres)	Impacted Wetland (acres)
Wetland BN	0.15	0.15
Wetland CI	0.20	0.2
Wetland CJ	0.35	0.35
Wetland CK	0.13	0.13
Wetland CL	0.03	0.03
Wetland CM	0.003	0.003

Wetland CM'	0.35	0.35
Wetland CO	0.02	0.02
Wetland CP	0.03	0.03
Wetland CQ	0.01	0.01
Wetland CW	0.02	0.02
Wetland CX	0.07	0.04



LEGEND

- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

N

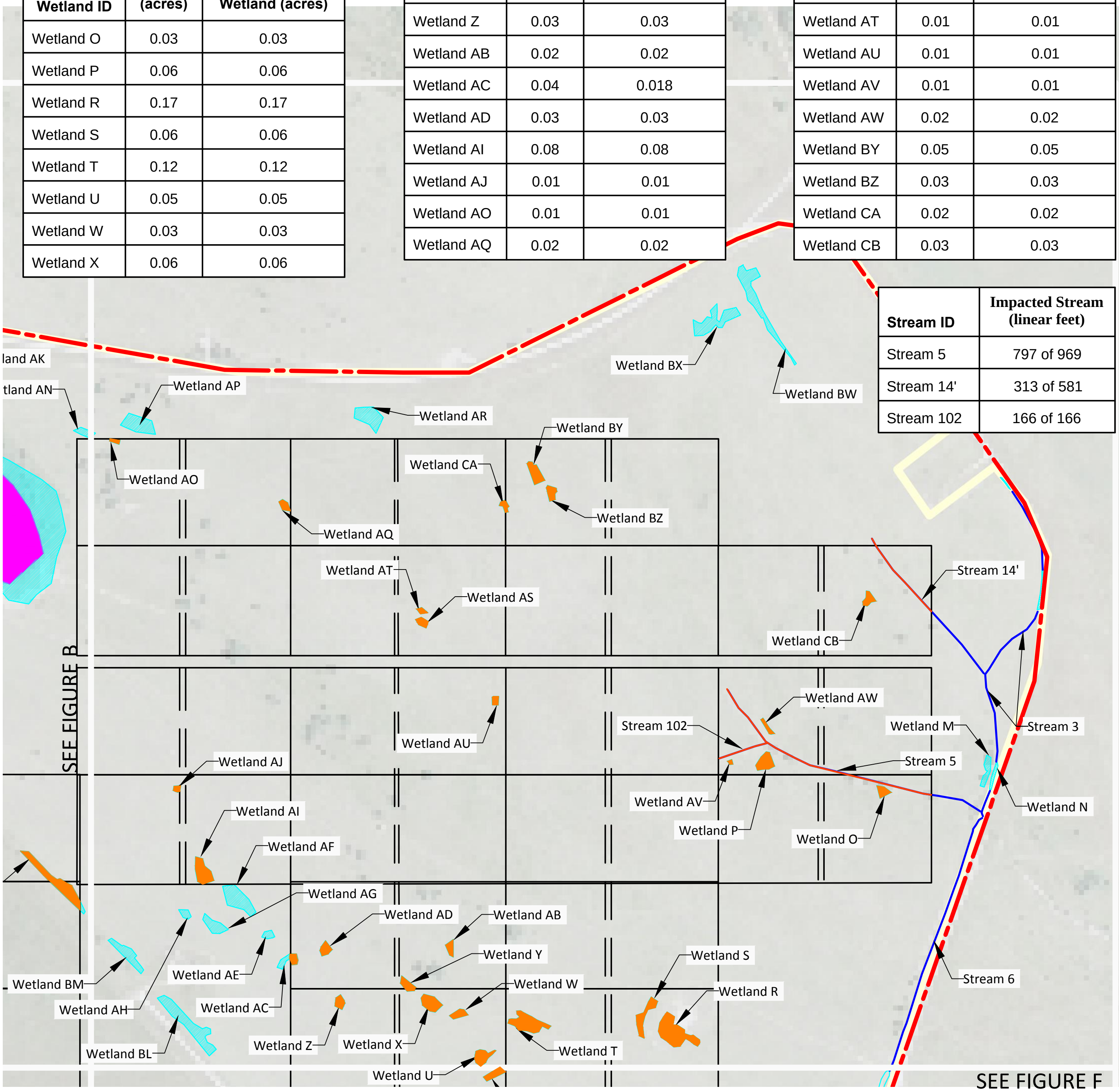
0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure B - Wetland and Water Impact Map

Wetland ID	Size (acres)	Impacted Wetland (acres)
Wetland O	0.03	0.03
Wetland P	0.06	0.06
Wetland R	0.17	0.17
Wetland S	0.06	0.06
Wetland T	0.12	0.12
Wetland U	0.05	0.05
Wetland W	0.03	0.03
Wetland X	0.06	0.06
Wetland Y	0.03	0.03
Wetland Z	0.03	0.03
Wetland AB	0.02	0.02
Wetland AC	0.04	0.018
Wetland AD	0.03	0.03
Wetland AI	0.08	0.08
Wetland AJ	0.01	0.01
Wetland AO	0.01	0.01
Wetland AQ	0.02	0.02
Wetland AS	0.02	0.02
Wetland AT	0.01	0.01
Wetland AU	0.01	0.01
Wetland AV	0.01	0.01
Wetland AW	0.02	0.02
Wetland BY	0.05	0.05
Wetland BZ	0.03	0.03
Wetland CA	0.02	0.02
Wetland CB	0.03	0.03

Stream ID	Impacted Stream (linear feet)
Stream 5	797 of 969
Stream 14'	313 of 581
Stream 102	166 of 166



LEGEND

- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

N

0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure C - Wetland and Water Impact Map

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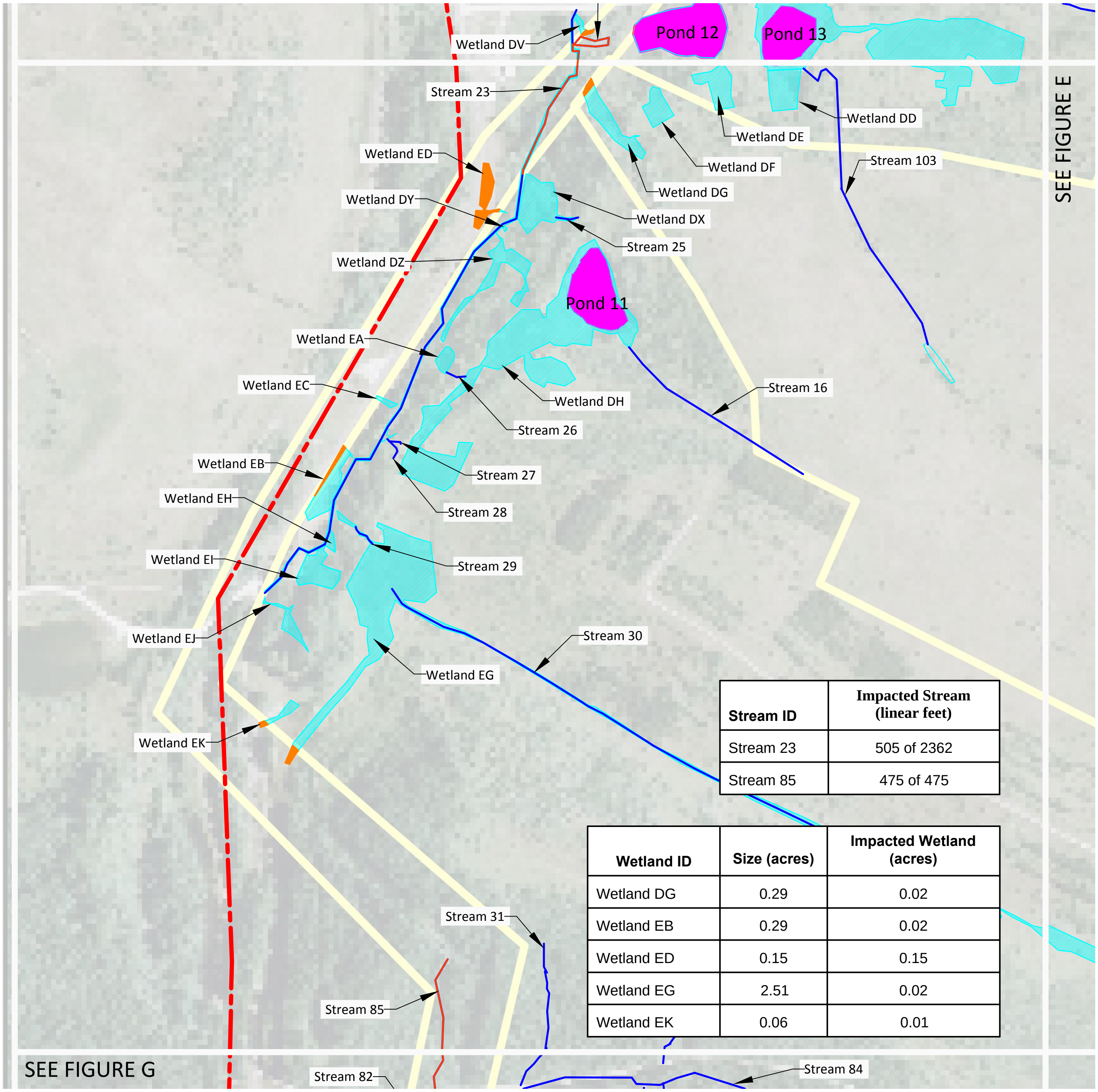


Stream ID	Impacted Stream (linear feet)
Stream 23	505 of 2362
Stream 85	475 of 475

Wetland ID	Size (acres)	Impacted Wetland (acres)
Wetland DG	0.29	0.02
Wetland EB	0.29	0.02
Wetland ED	0.15	0.15
Wetland EG	2.51	0.02
Wetland EK	0.06	0.01

LEGEND

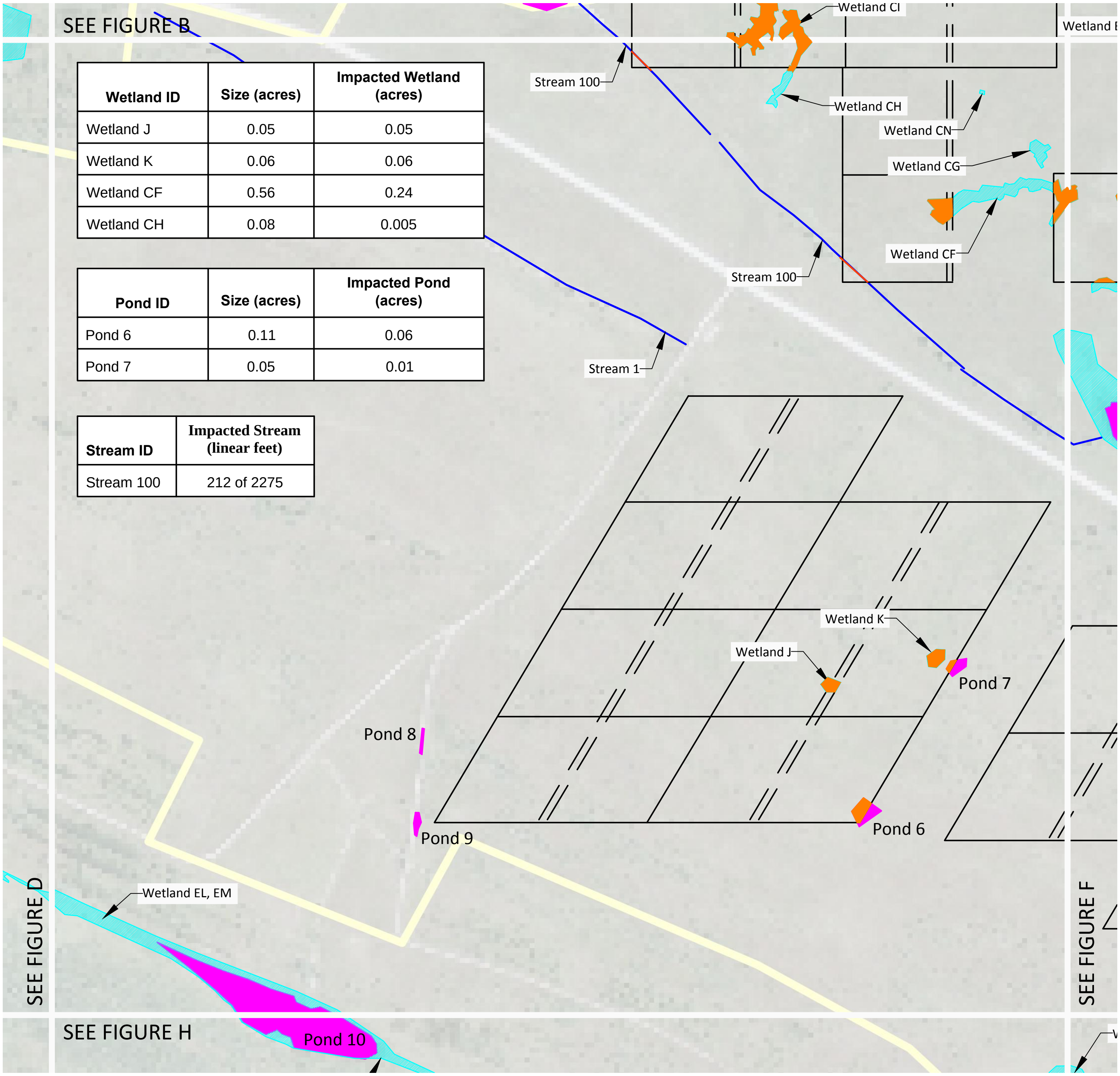
- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

N

0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure D - Wetland and Water Impact Map



Wetland ID	Size (acres)	Impacted Wetland (acres)
Wetland J	0.05	0.05
Wetland K	0.06	0.06
Wetland CF	0.56	0.24
Wetland CH	0.08	0.005

Pond ID	Size (acres)	Impacted Pond (acres)
Pond 6	0.11	0.06
Pond 7	0.05	0.01

Stream ID	Impacted Stream (linear feet)
Stream 100	212 of 2275

LEGEND

- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

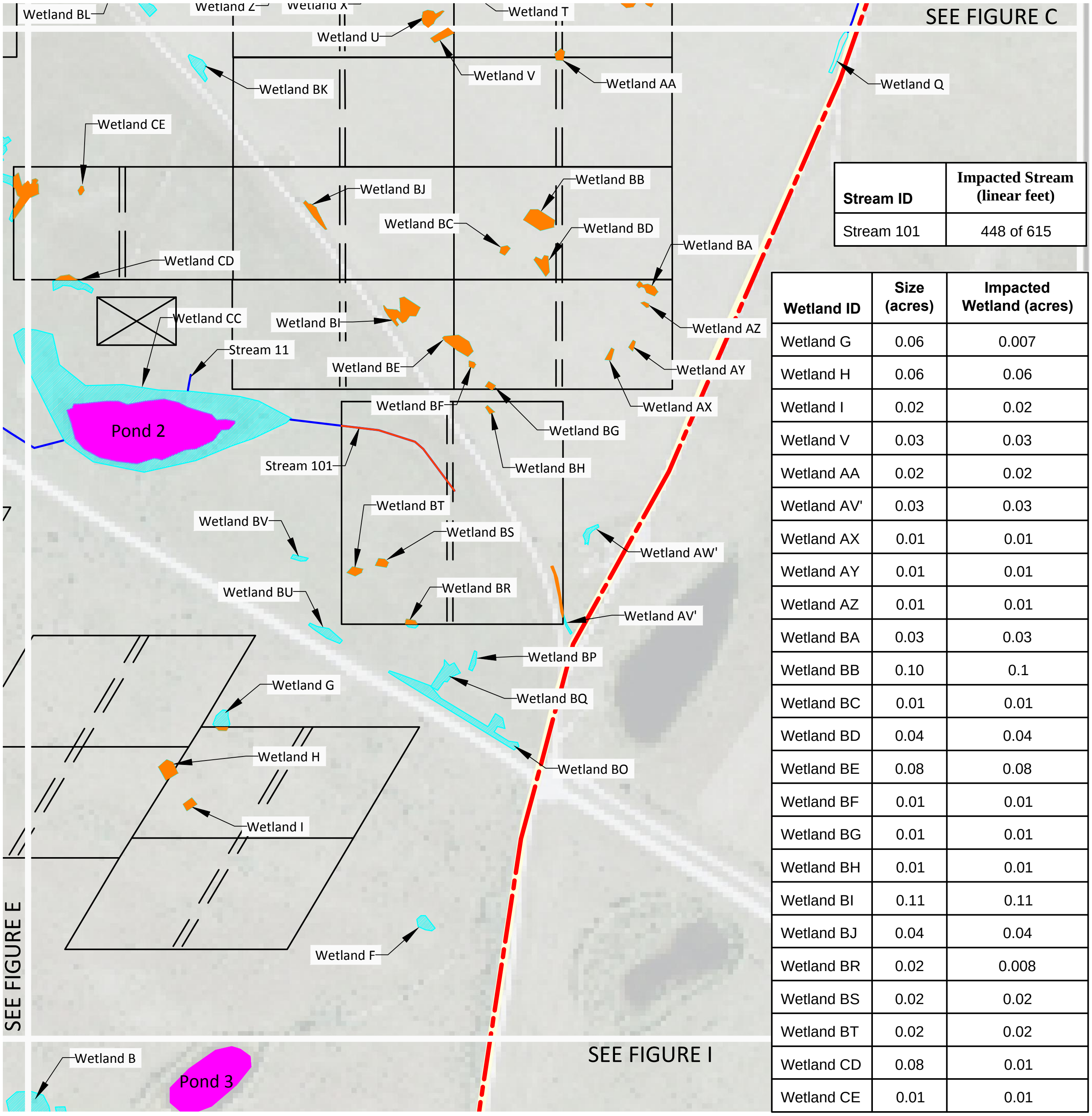
N

0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

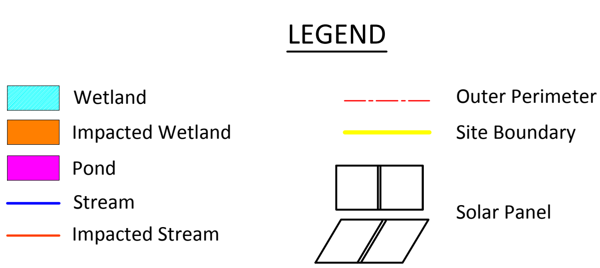
Figure E - Wetland and Water Impact Map

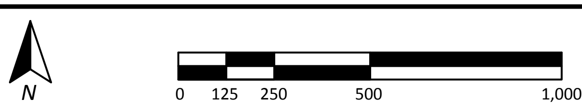
B-1 page B-1-26



Stream ID	Impacted Stream (linear feet)
Stream 101	448 of 615

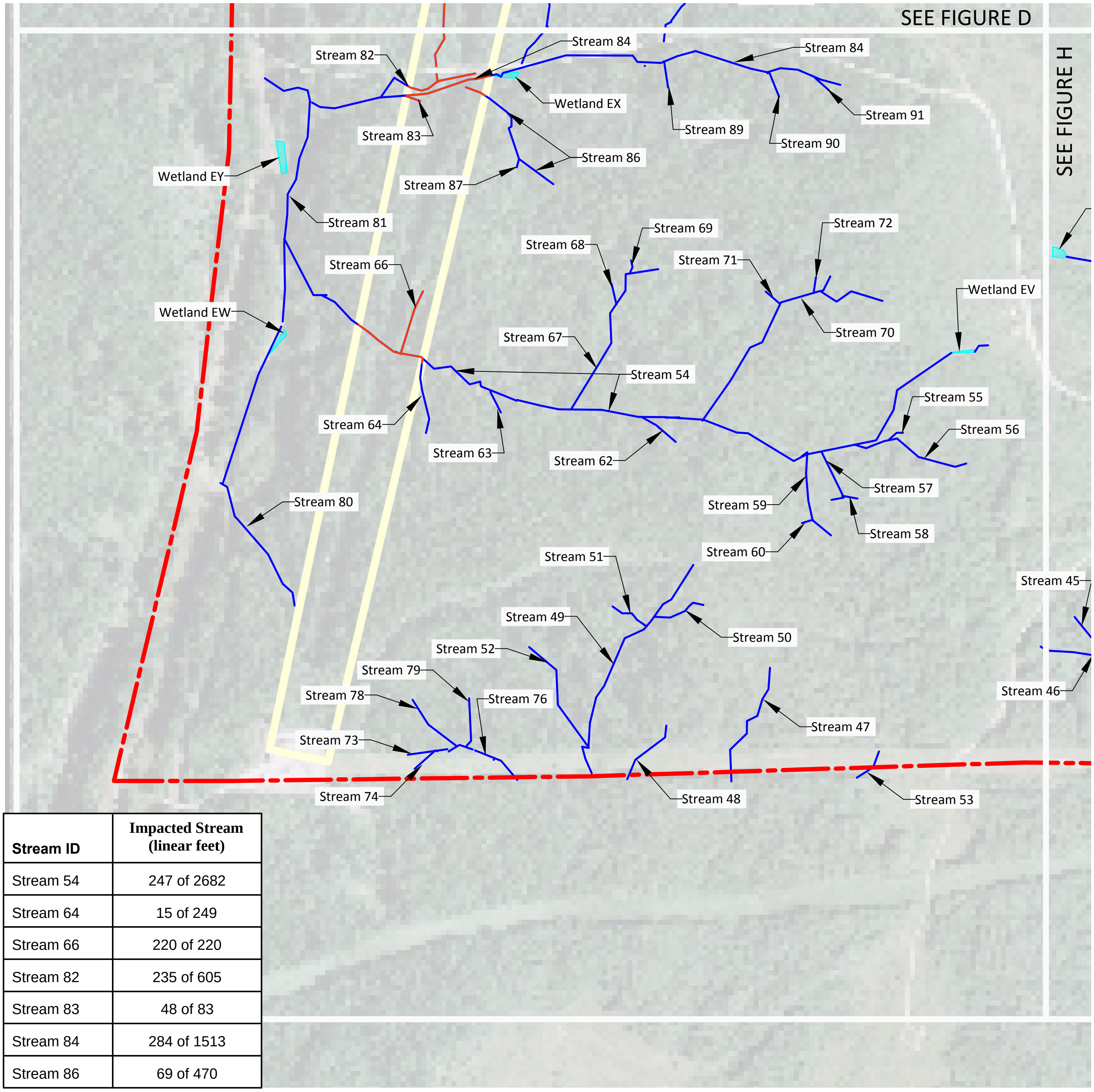
Wetland ID	Size (acres)	Impacted Wetland (acres)
Wetland G	0.06	0.007
Wetland H	0.06	0.06
Wetland I	0.02	0.02
Wetland V	0.03	0.03
Wetland AA	0.02	0.02
Wetland AV'	0.03	0.03
Wetland AX	0.01	0.01
Wetland AY	0.01	0.01
Wetland AZ	0.01	0.01
Wetland BA	0.03	0.03
Wetland BB	0.10	0.1
Wetland BC	0.01	0.01
Wetland BD	0.04	0.04
Wetland BE	0.08	0.08
Wetland BF	0.01	0.01
Wetland BG	0.01	0.01
Wetland BH	0.01	0.01
Wetland BI	0.11	0.11
Wetland BJ	0.04	0.04
Wetland BR	0.02	0.008
Wetland BS	0.02	0.02
Wetland BT	0.02	0.02
Wetland CD	0.08	0.01
Wetland CE	0.01	0.01





Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure F - Wetland and Water Impact Map



Stream ID	Impacted Stream (linear feet)
Stream 54	247 of 2682
Stream 64	15 of 249
Stream 66	220 of 220
Stream 82	235 of 605
Stream 83	48 of 83
Stream 84	284 of 1513
Stream 86	69 of 470

LEGEND

- Wetland
- Impacted Wetland
- Pond
- Stream
- Impacted Stream
- Outer Perimeter
- Site Boundary
- Solar Panel

N

0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure G - Wetland and Water Impact Map

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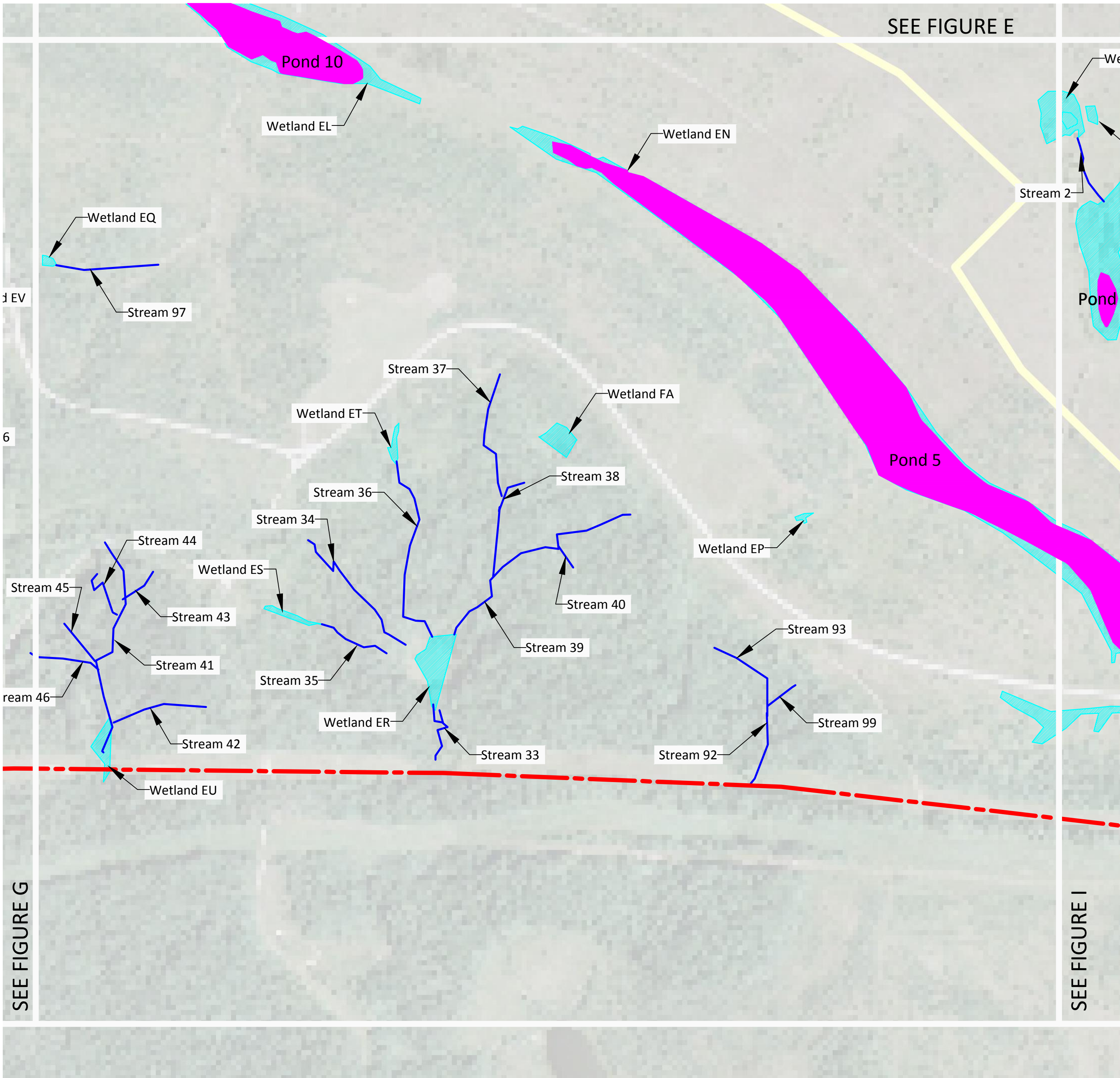
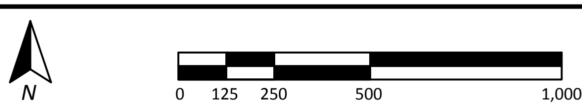


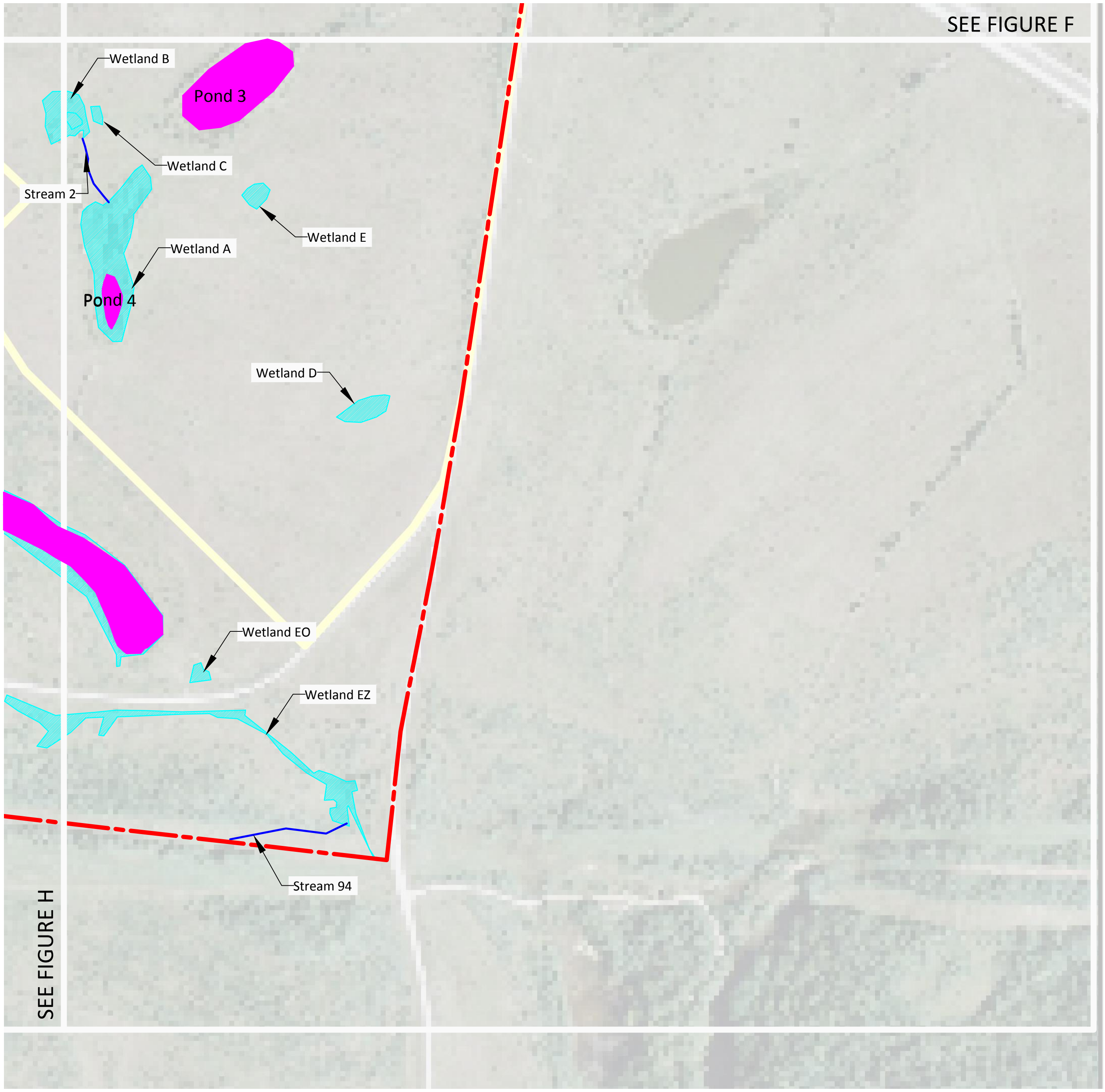
LEGEND

Wetland
Impacted Wetland
Pond
Stream
Impacted Stream
Outer Perimeter
Site Boundary
Solar Panel



Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure H - Wetland and Water Impact Map



LEGEND

Wetland
Impacted Wetland
Pond
Stream
Impacted Stream
Outer Perimeter
Site Boundary
Solar Panel

N

0 125 250 500 1,000

Agile Energy, Turning Point Solar Project,
Brookfield Township, Noble County, Ohio

Figure I - Wetland and Water Impact Map

B-1 page B-1-30

VIII PHOTOGRAPHS

URS

PHOTOGRAPHIC LOG

Client Name:	Project and Location:	Project No.
Agile Energy, Inc.	Turning Point Solar, Brookfield Twp., Noble County, Ohio	3814246

Photo No. 1 **Date:** 3/11

Description:

Typical dry drainage swale

Photo No. 2 **Date:** 3/11

Description:

Typical small wetland

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PHOTOGRAPHIC LOG

Client Name: Agile Energy, Inc.	Project and Location: Turning Point Solar, Brookfield Twp., Noble County, Ohio	Project No. 3814246

Photo No. 3 **Date:** 3/11

Description:

Typical small wetland

Photo No. 4 **Date:** 3/11

Description:

Typical small wetland

Client Name:	Project and Location:	Project No.
Agile Energy, Inc.	Turning Point Solar, Brookfield Twp., Noble County, Ohio	3814246

Photo No. 5 **Date:** 3/11

Description:

Typical small wetland

Photo No. 6 **Date:** 3/11

Description:

Typical small stream

Client Name:	Project and Location:	Project No.
Agile Energy, Inc.	Turning Point Solar, Brookfield Twp., Noble County, Ohio	3814246

Photo No. 7 **Date:** 3/11

Description:

Typical small stream

Photo No. 8 **Date:** 3/11

Description:

Large wetland along Rannells Creek

PHOTOGRAPHIC LOG		
Client Name: Agile Energy, Inc.	**Project and Location:** Turning Point Solar, Brookfield Twp., Noble County, Ohio	**Project No.** 3814246

Photo No. 9 **Date:** 3/11

Description:

Typical pond

Photo No. 10 **Date:** 3/11

Description:

Typical pond

IX DATA APPENDICES

APPENDIX 1
WETLAND DELINEATION FORMS

APPENDIX 2
ORAM FORMS

APPENDIX 3
STREAM ASSESSMENT FORMS

APPENDIX 4
WETLAND SUMMARY TABLE

Summary Table of Wetlands Delineated at 788-acre Property Located East of State Route 83 South of the Town of Cumberland in Brookfield Township, Noble County, Ohio

Wetland ID	Size (acres)	Preliminary ORAM score	Provisional Wetland Category	Preliminary Jurisdictional Status	Covertype	Impacted Wetland (acres)
A	1.36	30	One or Two Gray Zone	Isolated	Scrub/Shrub - Open Water	0
B	0.44	18	One	Isolated	Emergent	0
C	0.04	15	One	Isolated	Emergent	0
D	0.22	13	One	Isolated	Emergent	0
E	0.11	13	One	Isolated	Emergent	0
F	0.04	12	One	Isolated	Emergent	0
G	0.06	15	One	Isolated	Emergent	0.007
H	0.06	15	One	Isolated	Emergent	0.06
I	0.02	12	One	Isolated	Emergent	0.02
J	0.05	12	One	Isolated	Emergent	0.05
K	0.06	12	One	Isolated	Emergent	0.06
K'	0.00	16	One	Water of the U.S.	Emergent	0
L	0.03	16	One	Water of the U.S.	Emergent	0
M	0.04	16	One	Water of the U.S.	Emergent	0
N	0.02	16	One	Water of the U.S.	Emergent	0
O	0.03	16	One	Water of the U.S.	Emergent	0.03
P	0.06	18	One	Water of the U.S.	Emergent	0.06
Q	0.04	16	One	Water of the U.S.	Emergent	0
R	0.17	16	One	Isolated	Emergent	0.17
S	0.06	14	One	Isolated	Emergent	0.06
T	0.12	16	One	Isolated	Emergent	0.12
U	0.05	14	One	Isolated	Emergent	0.05
V	0.03	14	One	Isolated	Emergent	0.03
W	0.03	14	One	Isolated	Emergent	0.03
X	0.06	14	One	Isolated	Emergent	0.06
Y	0.03	14	One	Isolated	Emergent	0.03
Z	0.03	14	One	Isolated	Emergent	0.03
AA	0.02	12	One	Isolated	Emergent	0.02
AB	0.02	12	One	Isolated	Emergent	0.02
AC	0.04	12	One	Isolated	Emergent	0.018
AD	0.03	12	One	Isolated	Emergent	0.03
AE	0.02	12	One	Isolated	Emergent	0
AF	0.13	13	One	Isolated	Emergent	0
AG	0.06	12	One	Isolated	Emergent	0
AH	0.02	12	One	Isolated	Emergent	0
AI	0.08	12	One	Isolated	Emergent	0.08
AJ	0.01	12	One	Isolated	Emergent	0.01
AK	2.75	30	One or Two Gray Zone	Water of the U.S.	Scrub/Shrub - Open Water	0
AL	0.23	25	One	Water of the U.S.	Emergent	0
AN	0.03	18	One	Water of the U.S.	Emergent	0
AO	0.01	18	One	Water of the U.S.	Emergent	0.01
AP	0.11	20	One	Water of the U.S.	Emergent	0
AQ	0.02	14	One	Isolated	Emergent	0.02

Wetland ID	Size (acres)	Preliminary ORAM score	Provisional Wetland Category	Preliminary Jurisdictional Status	Covertype	Impacted Wetland (acres)
AR	0.11	16	One	Isolated	Emergent	0
AS	0.02	14	One	Isolated	Emergent	0.02
AT	0.01	14	One	Isolated	Emergent	0.01
AU	0.01	14	One	Isolated	Emergent	0.01
AV	0.01	16	One	Water of the U.S.	Emergent	0.01
AV'	0.03	16	One	Isolated	Emergent	0.03
AW	0.02	16	One	Water of the U.S.	Emergent	0.02
AW'	0.03	16	One	Isolated	Emergent	0
AX	0.01	12	One	Isolated	Emergent	0.01
AY	0.01	12	One	Isolated	Emergent	0.01
AZ	0.01	12	One	Isolated	Emergent	0.01
BA	0.03	12	One	Isolated	Emergent	0.03
BB	0.10	12	One	Isolated	Emergent	0.10
BC	0.01	12	One	Isolated	Emergent	0.01
BD	0.04	12	One	Isolated	Emergent	0.04
BE	0.08	15	One	Isolated	Emergent	0.08
BF	0.01	12	One	Isolated	Emergent	0.01
BG	0.01	12	One	Isolated	Emergent	0.01
BH	0.01	12	One	Isolated	Emergent	0.01
BI	0.11	13	One	Isolated	Emergent	0.11
BJ	0.04	14	One	Isolated	Emergent	0.04
BK	0.05	12	One	Isolated	Emergent	0
BL	0.19	13	One	Isolated	Emergent	0
BM	0.08	12	One	Isolated	Emergent	0
BN	0.15	15	One	Isolated	Emergent	0.15
BO	0.26	13	One	Isolated	Emergent	0
BP	0.02	12	One	Isolated	Emergent	0
BQ	0.08	12	One	Isolated	Emergent	0
BR	0.02	12	One	Isolated	Emergent	0.008
BS	0.02	12	One	Isolated	Emergent	0.02
BT	0.02	12	One	Isolated	Emergent	0.02
BU	0.05	12	One	Isolated	Emergent	0
BV	0.02	12	One	Isolated	Emergent	0
BW	0.18	13	One	Isolated	Emergent	0
BX	0.15	13	One	Isolated	Emergent	0
BY	0.05	12	One	Isolated	Emergent	0.05
BZ	0.03	12	One	Isolated	Emergent	0.03
CA	0.02	12	One	Isolated	Emergent	0.02
CB	0.03	14	One	Isolated	Emergent	0.03
CC	2.29	28	One	Water of the U.S.	Scrub/Shrub -	0
CD	0.08	14	One	Isolated	Emergent	0.01
CE	0.01	12	One	Isolated	Emergent	0.01
CF	0.56	14	One	Isolated	Emergent	0.24
CG	0.08	12	One	Isolated	Emergent	0
CH	0.08	12	One	Isolated	Emergent	0.005
CI	0.20	13	One	Isolated	Emergent	0.20
CJ	0.35	14	One	Isolated	Emergent	0.35

Wetland ID	Size (acres)	Preliminary ORAM score	Provisional Wetland Category	Preliminary Jurisdictional Status	Covertype	Impacted Wetland (acres)
CK	0.13	13	One	Isolated	Emergent	0.13
CL	0.03	14	One	Isolated	Emergent	0.03
CM	0.003	10	One	Isolated	Emergent	0.003
CM'	0.35	16	One	Isolated	Emergent	0.35
CN	0.004	14	One	Isolated	Emergent	0
CO	0.02	12	One	Isolated	Emergent	0.02
CP	0.03	14	One	Isolated	Emergent	0.03
CQ	0.01	14	One	Isolated	Emergent	0.01
CR	0.47	25	One	Water of the U.S.	Emergent	0
CS	0.04	19	One	Water of the U.S.	Emergent	0
CT	0.01	19	One	Water of the U.S.	Emergent	0
CU	0.04	11	One	Isolated	Emergent	0
CW	0.02	18	One	Isolated	Emergent	0.02
CX	0.07	18	One	Isolated	Emergent	0.04
CY	0.04	16	One	Isolated	Emergent	0
CZ	0.02	18	One	Isolated	Emergent	0
DA	0.01	13	One	Isolated	Emergent	0
DQ	0.04	38.5	Modified Two	Water of the U.S.	Emergent	0

Wetlands CR and DQ extend off-site. Figure represents on-site acreage.

Wetland Impact	Area (acres)
One or Two Gray Zone	.00
One	3.42
Modified Two	.00
Total	**3.42**
Preliminary Waters of the U.S.	0.13
Preliminary Isolated	3.29
Total	**3.42**

Delineated Wetlands for Transmission Line Corridor at 788-acre Property Located East of State Route 83 South of the Town of Cumberland in Brookfield Township, Noble County, Ohio

Wetland ID	Size (acres)	Preliminary ORAM score	Provisional Wetland Category	Preliminary Jurisdictional Status	Covertype	Impacted Wetland (acres)
DB	0.59	27.5	One	Water of the U.S.	Emergent	0
DF	0.17	21	One	Isolated	Emergent	0
DG	0.29	23	One	Isolated	Emergent	0.02
DH	3.12	33	One or Two Gray Zone	Water of the U.S.	Emergent - Open Water	0
DI	0.11	17.5	One	Isolated	Emergent	0.11
DJ	0.26	29.5	One	Isolated	Scrub-shrub	0.15
DK	4.83	38.5	Modified Two	Water of the U.S.	Emergent	0.22
DK'	0.01	25.5	One	Isolated	Emergent	0
DL	0.05	29.5	One	Water of the U.S.	Emergent	0
DM	0.54	16	One	Water of the U.S.	Emergent	0
DO	0.56	16	One	Water of the U.S.	Emergent	0
DP	0.02	38.5	Modified Two	Water of the U.S.	Emergent	0
DQ	0.52	38.5	Modified Two	Water of the U.S.	Emergent	0
DR	0.20	38.5	Modified Two	Water of the U.S.	Emergent	0
DS	11.71	35.5	Modified Two	Water of the U.S.	Emergent	0
DT	0.06	25	One	Water of the U.S.	Emergent	0
DU	0.17	22	One	Water of the U.S.	Emergent	0
DV	0.03	22	One	Isolated	Emergent	0.01
DX	0.41	36	Modified Two	Water of the U.S.	Scrub-shrub	0
DY	0.00	28	One	Isolated	Emergent	0
DZ	0.31	37	Modified Two	Water of the U.S.	Emergent	0
EA	0.08	25	One	Water of the U.S.	Emergent	0
EB	0.29	24	One	Water of the U.S.	Emergent	0.02
EC	0.02	18	One	Water of the U.S.	Emergent	0
ED	0.15	19	One	Water of the U.S.	Emergent	0.15
EF	0.01	26	One	Isolated	Emergent	0
EG	2.51	30	One or Two Gray Zone	Water of the U.S.	Emergent	0.02
EH	0.03	25	One	Isolated	Emergent	0
EI	0.25	28	One	Water of the U.S.	Emergent	0
EJ	0.09	25	One	Water of the U.S.	Emergent	0
EK	0.06	13	One	Water of the U.S.	Emergent	0.01

Wetland Impact	Area (acres)
One or Two Gray Zone	0.02
One	0.47
Modified Two	0.22
Total	**0.71**
Preliminary Waters of the U.S.	0.42
Preliminary Isolated	0.29
Total	**0.71**

Appendix B-2 – Noise and Vibration Study

R E P O R T

NOISE AND VIBRATION STUDY
TURNING POINT SOLAR PROJECT

Prepared for

Agile Energy

URS Project No. 13814681

Mark Storm, INCE Bd. Cert.
Senior Project Engineer – Acoustics & Noise Control

September 6, 2011

URS

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La Jolla, CA 92037
858.812.9292 Fax: 858.812.9293

TABLE OF CONTENTS

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Tables

Figures

Appendices

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ANSI	American National Standards Institute
A-wgt.	A-weighted
Caltrans	California Department of Transportation
CFR	Code of Federal Regulations
CR	County Road
dB	decibels
dBA	A-weighted sound level
D	distance
D_{ref}	reference distance
° F	degree Fahrenheit
EPA	U.S. Environmental Protection Agency
EPRI	Electric Power Research Institute
ft	feet
FHWA	Federal Highway Administration
Hz	Hertz
ID	identification
in/sec	inches per second
ISO	International Organization for Standardization
kHz	kilohertz
km	kilometer
kV	kilovolt
L_{10}	A-weighted sound level exceeded 10 percent of the measurement period
L_{50}	A-weighted sound level exceeded 50 percent of the measurement period
L_{90}	A-weighted sound level exceeded 90 percent of the measurement period
L_{dn} or DNL	Day-Night Average Sound Level
L_{eq}	equivalent sound level
L_{max}	maximum noise level
L_{min}	minimum noise level
LORS	Laws, Ordinances, Regulations, and Standards
LT	long-term
m	meters
μPa	microPascal
MW	megawatt
mph	miles per hour
O & M	Operations and Management
OBCF	octave band center frequency
OH	Ohio
PPVequip	peak particle velocity (from the equipment, at some distance)
PPVref	peak particle velocity (reference level at some distance)
Project	Turning Point Solar Project
PV	Photo-voltaic
PWL or L_w	sound power level
RCNM	Roadway Construction Noise Model
SLM	Sound Level Meter
SPL or L_p	sound pressure level
ST	short-term
Temp.	temperature
U.S.	United States
USC	United States Code
USDOT	United States Department of Transportation

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SECTION 1 INTRODUCTION

This report presents a detailed noise and vibration assessment conducted for the proposed Turning Point Solar Project (Project). The Project is a proposed electricity generation facility using photovoltaic (PV) panel arrays mounted on fixed solar tracking equipment. The Project would be built on reclaimed coal strip mine land owned by Columbus Southern Power Company and Ohio Power Company, collectively American Electric Power Ohio at a site located in Noble County, Ohio, about eight miles northwest of Caldwell, Ohio.When complete, the Turning Point facility would be the largest PV array east of the Mississippi River.

1.1 NOISE FUNDAMENTALS

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that is typically associated with human activity and that interferes with or disrupts normal activities. Although prolonged exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to environmental noise is annoyance. The response of individuals to similar noise events is diverse and influenced by the type of noise; the perceived importance of the noise, and its appropriateness in the setting; the time of day and the type of activity during which the noise occurs; and the sensitivity of the individual.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the human ear. Sound is generally characterized by several variables, including frequency and intensity. Frequency describes the pitch of the sound and is measured in Hertz (Hz), while intensity describes the sound's loudness and is measured in decibels (dB). Decibels are measured using a logarithmic scale. A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above approximately 110 dB begin to be felt inside the human ear as discomfort and eventually pain at 120 dB and higher levels. The minimum change in the sound level of individual events that an average human ear can detect is about 1 to 2 dB. A 3 to 5 dB change is readily perceived. A change in sound level of about 10 dB is usually perceived by the average person as a doubling (or if -10 dB, halving) of the sound's loudness.

Due to the logarithmic nature of the decibel unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically; however, some simple rules are useful in dealing with sound levels. For instance, if a sound's energy is doubled, the sound level increases by 3 dB, regardless of the initial sound level. By way of example: 60 dB + 60 dB = 63 dB, and 80 dB + 80 dB = 83 dB.

Sound level is usually expressed by reference to a known standard. This report refers to sound pressure level (SPL, or L_p) and sound power level (PWL, or Lw). In expressing sound pressure on a logarithmic scale, the sound pressure is compared to a reference value of 20 micropascals (µPa). SPL depends not only on the power of the source, but also on the distance from the source and on the acoustical characteristics of the space surrounding the source. PWL, on the other hand, is independent of these environmental factors. To help distinguish the two descriptors, one may use a lighting analogy: the

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wattage of a light bulb when turned on inside a large room will be a constant 100 watts, but the brightness or intensity of the light changes with receiver distance and other parameters (e.g, are the room walls painted white, which is reflective, or an absorptive black color?).

Hertz (Hz) is a measure of how many times each second the crest of a sound pressure wave passes a fixed point. For example, when a drummer beats a drum, the skin of the drum vibrates a number of times per second. When the drum skin vibrates 100 times per second it generates a sound pressure wave that is oscillating at 100 Hz, and this pressure oscillation is perceived by the ear/brain as a tonal pitch of 100 Hz. Sound frequencies between 20 and 20,000 Hz are within the range of sensitivity of the best human ear.

Sound from a tuning fork contains a single frequency (a pure tone), but most sounds one hears in the environment do not consist of a single frequency and instead are composed of a broad band of frequencies differing in sound level. The method commonly used to quantify environmental sounds consists of evaluating all frequencies of a sound according to a weighting system that reflects the typical frequency-dependent sensitivity of average healthy human hearing. This is called "A-weighting," and the decibel level measured is called the A-weighted sound level (dBA). In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA "curve" of decibel adjustment per octave band center frequency (OBCF) to a "flat" or unweighted SPL.

Although sound level value may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a mixture of noise from distant sources that creates a relatively steady background noise in which no particular source is identifiable. A single descriptor called the equivalent sound level (L_{eq}) may be used to describe sound that is changing in level. L_{eq} is the energy-mean dBA during a measured time interval. It is the "equivalent" constant sound level that would have to be produced by a given source to equal the acoustic energy contained in the fluctuating sound level measured. In addition to the energy-average level, it is often desirable to know the acoustic range of the noise source being measured. This is accomplished through the maximum L_{eq} (L_{max}) and minimum L_{eq} (L_{min}) indicators that represent the root-mean-square maximum and minimum noise levels measured during the monitoring interval. The L_{min} value obtained for a particular monitoring location is often called the acoustic floor for that location.

To describe the time-varying character of environmental noise, the statistical noise descriptors L_{10}, L_{50}, and L_{90} are commonly used. They are the noise levels exceeded 10 percent, 50 percent, and 90 percent of the measured time interval. Sound levels associated with the L_{10} typically describe transient or short-term events. Half of the sounds during the measurement interval are softer than L_{50} and half are louder, so it is often called the "median" sound level. Levels associated with L_{90} often describe background noise conditions and/or continuous, steady-state sound sources.

Finally, a sound measure known as the Day-Night Average Noise Level (L_{dn}) is defined as the A-weighted average sound level for a 24-hour day with a 10-dB penalty added to nighttime sound levels (10:00 p.m. to 7:00 a.m.) in order to compensate for increased sensitivity to noise during usually quieter nighttime hours..

Sound levels of typical noise sources and environments are provided in Table 1 to provide the reader a frame of reference.

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Table 1
Sound Pressure Levels of Typical Noise Sources and Noise Environments

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Jet Fly-over at 1000 ft (300m)	110-100	Rock Band
Gas Lawn Mower at 3 ft (1 m)	100-90	
Diesel Truck at 50 ft (15m), at 50 mph (80km/hr)	90-80	Food Blender at 3 ft (1 m)
Commercial Area, Gas Lawn Mower at 100 ft (30m)	70	Vacuum Cleaner at 10 ft (3 m)
Heavy Traffic at 300 ft (90 m)	60	Normal Speech at 3 ft (1 m)
Quiet Urban Daytime	50-40	Large Business Office
Quiet Urban/Suburban Nighttime	40-30	Theater, Large Conference Room (Background)
Quiet Rural Nighttime	30-20	Library, Bedroom at Night, Concert Hall (Background)
	20-10	Broadcast/Recording Studio
Lowest Threshold of Human Hearing	0	

Source: Caltrans, 2009.

1.2 VIBRATION FUNDAMENTALS

Unlike the case for gases and liquids, there are several types of wave motion in solids including compression, shear, and torsion and bending. The solid medium can be excited by forces, moments or pressure fields. This leads to the terminology “airborne” (pressure fields) or “structure-borne/ground-borne” (forces and moments) vibration.

Ground-borne vibration propagates from the source through the ground to adjacent buildings by surface waves. Vibration may be comprised of a single pulse, a series of pulses, or a continuous oscillatory motion. The frequency of a vibrating object describes how rapidly it is oscillating, measured in Hz. Most environmental vibrations consist of a composite, or “spectrum” of many frequencies, and generally are classified as broadband or random vibrations. The normal frequency range of most ground-borne vibration, which can be felt, generally starts from a low frequency of less than 1 Hz to a high of about 200 Hz. Vibration information for this report has been described in terms of the peak particle velocity (PPV) measured in inches per second (in/sec).

Vibration energy dissipates as it travels through the ground, causing the vibration amplitude to decrease with distance away from the source. High-frequency vibrations reduce much more rapidly than do low frequencies, so that in the far-field zone distant from a source, the low frequencies tend to dominate. Soil properties also affect the propagation of vibration. When ground-borne vibration interacts with a building,

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there is usually a ground-to-foundation coupling loss; but the vibration also can be amplified by the structural resonances of the walls and floors. Vibration in buildings is typically perceived as rattling of windows, shaking of loose items, or the motion of building surfaces. The vibration of building surfaces also can be radiated as sound and heard as a low-frequency rumbling noise, known as ground-borne noise.

Ground-borne vibration is generally limited to areas within a few hundred feet of certain types of industrial operations and construction/demolition activities such as pile driving. Road vehicles rarely create enough ground-borne vibration amplitude to be perceptible to humans unless the receiver is in immediate proximity to the source or the road surface is poorly maintained and has potholes or bumps. If traffic, typically heavy trucks, does induce perceptible building vibration, it is most likely an effect of low-frequency airborne noise or ground characteristics.

Building structural components also can be excited by high levels of low-frequency airborne noise (typically less than 100 Hz). The many structural components of a building, excited by low-frequency noise, can be coupled together to create complex vibrating systems. The low-frequency vibration of the structural components can cause smaller items such as ornaments, pictures, and shelves to rattle, which can cause annoyance to building occupants.

Human sensitivity to vibration varies by frequency and by receiver. Generally, people are more sensitive to low-frequency vibration. Human annoyance also is related to the number and duration of events; the more events or the greater the duration, the more annoying it becomes.

Construction and demolition activities can produce varying degrees of ground vibration, depending on the equipment and methods employed. Ground vibrations from these activities very rarely reach levels high enough to cause damage to structures, although special consideration must be made in cases where fragile historical buildings are near the project site. Activities that typically generate the highest levels of vibration are blasting and impact pile driving - neither of which may be expected to occur as part of the construction activities associated with the project.

Experience with ground-borne vibration suggests that vibration propagation is more efficient in stiff clay soils, and shallow rock seems to concentrate the vibration energy close to the surface and can result in ground-borne vibration problems at large distances from the source. Factors such as layering of the soil and depth to water table can have substantive effects on the propagation of ground-borne vibration. Table 2 presents PPV levels at a distance of 25 feet from measured data of various types of construction and demolition equipment (FTA, 2006). Although the table gives one level for each piece of equipment, it should be noted that there is a considerable variation in reported ground-vibration levels from construction/demolition activities. The data provides a reasonable estimate for a wide range of soil conditions.

Table 2
Vibration Source Levels for Construction/Demolition Equipment

Equipment		PPV at 25 Feet (inch per second)
Pile driver (impact)	Upper Range	1.518
	Typical	0.644
Pile driver (vibratory)	Upper Range	0.734
	Typical	0.170
Vibratory roller		0.210
Large bulldozer		0.089
Loaded trucks		0.076
Jackhammer		0.035
Small bulldozer		0.003

Source: Federal Transit Administration, 2006.

Vibration from construction or demolition can be evaluated for potential impacts at sensitive receivers. Typical activities evaluated for potential building damage due to construction or demolition vibration include demolition, pile driving, and drilling, or excavation in proximity to structures. The ground-borne vibration can also be evaluated for perception to reduce or eliminate annoyance or its likelihood. Vibration propagates according to the following expression, based on point sources with normal propagation conditions:

$$PPV_{equip} = PPV_{ref}\left(\frac{D_{ref}}{D}\right)^{1.5}$$

where: PPV_{equip} = the peak particle velocity in in/sec of the equipment adjusted for distance
PPV_{ref} = the reference vibration level in in/sec at D_{ref}
D_{ref} = the reference distance (25 feet if using data from Table 2)
D = the distance from the equipment to the receiver

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SECTION 2 AFFECTED ENVIRONMENT

This section describes the existing noise environment in the vicinity of the Project site. Potential noise effects associated with the proposed Project are assessed in a subsequent section. Representative noise-sensitive receivers that may be affected are identified, as well as the Laws, Ordinances, Regulations, and Standards (LORS) that either regulate or provide guidance for noise levels at those receivers.

2.1 PROJECT AREA

The Project is surrounded by lands that could reasonably be characterized as rural, with a mixture of wooded and pastoral areas. Nearby roadways include Belle Valley Road (OH 340) to the east, Renrock Road (OH 83) to the west, and Hedge Road (Township Highway 2) to the south, with Chapel Drive (County Highway 20) running east-west and roughly bisecting the project area. Nearest residential receivers along OH 340 to the northeast of the project are few in number and appear to be as close as approximately 0.8 miles (1,350 meters) from the Project boundary.

2.2 AMBIENT SOUND ENVIRONMENT

2.2.1 Estimation of Outdoor Ambient Sound Pressure Levels

Based on guidance from the U.S. Department of Transportation (DoT) Federal Transit Administration (FTA), and assuming the afore-stated roadways could be classified as examples of "other roadways" and generally represent the dominant sources of noise in the vicinity of the project, ambient sound levels might be expected to range from 50 to 70 dBA L_{eq} during the day and 40 to 60 dBA Leq at night, depending on the location of the listener (FTA, 2006). Alternately, based on population density of 35 persons per square mile, the same FTA reference suggests that ambient sound would be approximately 35 dBA L_{eq} during the day and 25 dBA L_{eq} at night. Since these represent only coarse estimates of anticipated existing ambient sound in the vicinity of the project, a field survey was performed to measure actual pre-project outdoor sound levels at representative locations that would more accurately characterize the affected environment with respect to noise. Expected natural noise sources would include wind through vegetation (e.g., rustling leaves), birdsong, dog barks and the like. Non-traffic man-made noise sources might include HVAC (e.g., air conditioning or "heat pump" units) and other equipment at or near the residential receivers.

2.2.2 Field Survey of Ambient Sound Pressure Levels

While Section 2.2.1 describes two FTA guidance-based methods to approximate outdoor ambient sound level ranges for the Project area and its surrounding vicinity, this section describes a methodology used to actually measure and document the outdoor sound levels that can more defensibly serve as a representative baseline characterization of the pre-Project ambient sound environment prior to predictive Project noise analysis and impact assessment.

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2.2.2.1 Noise-sensitive Receivers

The representative noise-sensitive receivers identified in the project vicinity include residential properties along OH 340, and are depicted on Figure 1. The closest of these to the Project appears to be an occupied residence at 11780 Belle Valley Road.

2.2.2.2 Sound Level Measurements

In order to determine ambient sound levels at the representative noise-sensitive receivers and other Project vicinity locations, two long-term (LT) measurements and six short-term (ST) measurements were conducted using laboratory-calibrated American National Standards Institute (ANSI) Type 1 sound level meters (SLM). ST measurements are, for purposes of this study, 15-25 munites in duration. LT measurements have continuous durations of 24 sequential hours. Each LT SLM was placed in a weatherproof environmental case, with an external microphone (connected via cable to the SLM within the case) positioned approximately five feet above the ground. Each ST SLM, with its directly-attached microphone, was placed on a tripod approximately five feet above the ground. Each SLM was equipped with a field-appropriate 3.5" diameter microphone windscreen and set for slow time-response and A-weighting. Each SLM was field-calibrated before and after each measurement period with an acoustic field calibrator. All sound level measurements were conducted in accordance with applicable portions of International Organization for Standardization (ISO) 1996a, b, and c standards.

Weather conditions during the survey period were generally warm with cloudy skies but no precipitation. The air temperature ranged from 64 degrees Fahrenheit (°F) in the moring to 83°F during the day, with 50-80 percent relative humidity. When observed and measured with a hand-held anemometer, winds were steady during the daytime hours and ranged from 2 to 6 miles per hour (mph) average speed. Observed weather conditions during the measurement periods were considered seasonally appropriate and thus representative of the area.

Tables 3 and 4 present summaries of the LT and ST SPL measurements, respectively. Field Noise Measurement Data Forms containing detailed information for each of the measurement locations are included in Appendix A. Appendix B also contains detailed noise metrics and statistical information for each sequential one hour portion of each LT measurement. Appendix C contains photos taken during the survey. The measurement locations are described as follows:

- **LT1** – The meter was placed approximately 1,800' northwest of the intersection of CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road). The SLM was located in the northeast quadrant of the project site, near a metal security gate along an existing dirt service road. The dominant noise source was vehicular traffic on CR-83 (Renrock Road). Other noise sources include landscaping activities and vocalizing birds.
- **LT2** – The meter was placed at the residence located at 11780 Belle Valley Road in the town of Cumberland. The SLM was placed approximately 65' northwest of a barn and approximately 200' from CR-340 (Belle Valley Road). The dominant noise source was vehicular traffic on CR-340 (Belle Valley Road). Other noise sources include landscaping activities, rustling leaves,

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roosters, dogs barking and vocalizing birds. Note that this site is the closest noise-sensitive receiver to the Project.

Table 3
Summary of Long Term Measurements (dBA)

Site ID	Start Time	L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}	L_{dn}	L_{day}	L_{night}
LT1	17:15	61	99	47	59	58	56	64	62	56
LT2	18:00	53	78	37	54	48	46	58	54	51

Notes:
Measurement period was August 22-23, 2011.Measurement duration was 24 sequential hours.
LT = Long Term, L_{dn} = Day-Night Average Noise Level, L_{day} = Daytime (0700-2200) Average Noise Level, L_{night} = Nighttime (2200-0700) Average Noise Level
Values presented are for the entire 24-hour measurement period. See Appendix B for further details.

- **ST1** – The meter was placed approximately 1,200' northeast of the intersection of CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road). The SLM was located in the northeast quadrant of the project site, near a proposed entrance along an existing dirt service road. The dominant noise sources include landscaping activities and vocalizing birds.
- **ST2** – The meter was placed approximately 1,500' off of CR-20 (Chapel Drive) and approximately 3,700' west of the intersection of CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road). The SLM was located along an existing dirt service road in the southwest quadrant of the project site. The dominant noise source was vehicular traffic on CR-83 (Renrock Road). Other noise sources include landscaping activities and vocalizing birds.
- **ST3** – The meter was placed at Brookfield Cemetery, which is located along CR-83 (Renrock Road). The SLM was located approximately 85' east of CR-83 and 20' from the parking lot fence line. The cemetery is elevated above the roadway surface. The dominant noise source was vehicular traffic on CR-83 (Renrock Road). Other noise sources include rustling leaves, flowing water in a stream, and vocalizing birds.
- **ST4** – The meter was placed along an existing dirt service road that borders the northern edge of the project site. The site was located approximately 0.5 miles north of the intersection of CR-83 (Renrock Road) and CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road). The SLM was located in the northwest quadrant of the project site, near a metal security gate. The site was elevated significantly higher than the roadway surface of CR-83. The dominant noise source was vehicular traffic on CR-83 (Renrock Road). Other noise sources include rustling leaves and vocalizing birds.
- **ST5** – The meter was placed at the residence located at 11906 Belle Valley Road in the town of Cumberland. The SLM was placed approximately 20' south of the southwest corner of the residence. This site was elevated higher than the road surface of CR-340 (Belle Valley Road). The dominant noise source was vehicular traffic on CR-340. Other noise sources include landscaping activities, dogs barking and vocalizing birds.

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- **ST6** – The meter was placed at the residence located at 11780 Belle Valley Road in the town of Cumberland. This address was also the location of LT2. The SLM was placed approximately 15' west of the corner of the residence, and approximately 100' from CR-340 (Belle Valley Road). The dominant noise source was vehicular traffic on CR-340 (Belle Valley Road). Other noise sources include landscaping activities, roosters, and vocalizing birds.

Table 4
Summary of Short-Term Measurements (dBA)

Site ID	Start Time	End Time	L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
ST1	8:10	8:25	53	55	50	54	53	52
ST2	8:45	9:00	58	60	57	59	59	58
ST3	9:55	10:10	51	56	47	52	50	49
ST4	10:40	10:55	59	63	56	60	59	58
ST5	11:40	12:05	52	71	43	51	46	45
ST6	12:10	12:25	57	77	47	59	50	49

Notes:
Measurement date was August 23, 2011. ST = Short Term

The long and short-term sound level measurements appear to be consistent with the lower end of the 50 to 70 dBA range as estimated with the proximity to roadway technique per FTA guidance.

2.3 LAWS, ORDINANCES, REGULATIONS AND STANDARDS

2.3.1 Federal

There are no federal LORS that directly affect this Project with respect to noise. However, there are guidelines at the federal level that direct the consideration of a broad range of noise and vibration issues as listed below:

- National Environmental Policy Act (42 United States Code [USC] 4321, et seq.) (Public Law-91-190) (40 Code of Federal Regulations [CFR] § 1506.5)
- Noise Control Act of 1972 (42 USC 4910)
- U.S. Department of Housing and Urban Development Noise Guidelines 24 CFR § 51 subpart B

The U.S. Environmental Protection Agency (EPA) has not promulgated standards or regulations for environmental noise generated by power plants; however, the EPA has published a guideline that specifically addresses issues of community noise (EPA 1974). This guideline, commonly referred to as the "levels document," contains goals for noise levels affecting residential land use of L_{dn} <55 dBA for exterior levels and L_{dn} <45 dBA for interior levels. The U.S. Department of Housing and Urban Development Noise Guidebook Chapter 2 (24 CFR Section 51.101(a)(8)) also recommends that exterior

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areas of frequent human use follow the EPA guideline of 55 dBA L_{dn}. However, the same Section 51.101(a)(8) indicates that a noise level of up to 65 dBA L_{dn} could be considered acceptable.

Occupational exposure to noise is regulated by Title 29, CFR, Part 1910.95. Protection against the effects of noise exposure shall be provided when the sound levels exceed an average of 90 dBA for an 8-hour period. When employees are subjected to sound exceeding this limit, feasible administrative or engineering controls shall be utilized. If such controls fail to reduce sound levels within 90 dBA, personal protective equipment shall be provided and used to reduce sound levels within the limits. The employer shall administer a continuing, effective hearing conservation program whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level of 85 dBA (measured via slow response). For purposes of the hearing conservation program, employee noise exposures shall be computed in accordance with 29 CFR 1910.95 Appendix A (noise exposure computation) without regard to any attenuation provided by the use of personal protective equipment.

2.3.2 State

The Ohio Power Siting Board requires a Certificate of Environmental Compatibility and Public Need for a major utility facility (OPSB, 2011), which is defined as:

- An electric generating plant of 50 MW or more, or
- An electric transmission line of 125 kV or more

Since this project is designed for 49MW of electricity generation and 69kV of transmission, a Certificate of Environmental Compatibility and Public Need does not appear to be required for this proposed Project. However, this report has considered 4906-13-07 (A) (3) of the Ohio Administrative Code as guidance with respect to noise analysis scope and discussion. For convenience, this guidance is summarized as follows:

- Describe the construction noise levels expected at the nearest property boundary. The description shall address dynamiting activities, operation of earth-moving equipment, driving of piles, erection of structures, truck traffic, and installation of equipment.
- Describe the operational noise levels expected at the nearest property boundary. The description shall address: generating equipment, processing equipment, associated road traffic.
- Indicate the location of any noise-sensitive areas within one mile of the proposed facility.

Describe equipment and procedures to mitigate the effects of noise emissions from the proposed facility during construction and operation.

2.3.3 Local

No local noise ordinance was discovered that would apply to this Project.

SECTION 3 FINDINGS

To estimate potential noise and vibration effects from the proposed Project, this report compares predictions of Project construction and facility operation noise and vibration with known and potentially applicable LORS as described in Section 2.3. For informational purposes, predicted operation noise levels are also compared with results from the field survey of existing ambient sound as presented in Section 2.2.2.

3.1 CONSTRUCTION NOISE

3.1.1 Methodology

Since the anticipated 12-month project construction schedule is known, the average aggregate daytime construction noise level (over an eight-hour shift) at the closest residential receiver (LT2, which is approximately 1,350 meter away from the project boundary) can be estimated for each month using the following assumptions:

- As reflected in the anticipated schedule, some construction activities will be concurrent. But for purposes of this analysis, and because the exact locations of these activities is either unknown at this time or could vary during the course of construction, all noise will be treated as originating from an "acoustic center" co-located with the geographic center of the project area—roughly, the position of the O&M Building intended to be located just north of Hedge Road, which is approximately 1.5 miles (2.4 km) from the nearest residential receiver (LT2).
- Reference noise level (SPL, L_{max}, at 1m) from each piece of construction equipment is either estimated from known engine power or consistent with data from the Federal Highway Administration (FHWA) *Roadway Construction Noise Model* (RCNM) User's Guide (FHWA, 2006).
- Although ground effects and terrain-based sound attenuation are conservatively neglected for this analysis, acoustical absorption from atmospheric conditions is included at a rate of about 1 dBA per thousand feet. This is in addition to geometric divergence, which offers attenuation at a general rate of 6 dBA per doubling of distance between the source of noise and a listener.

Table 5 includes a construction equipment list with associated utilization factors, operational hours per day, horse power, and L_{max} at 1 meter in dBA. The amount of construction equipment during the scheduled 12-months is presented in Appendix D.

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Table 5
Construction Equipment Type and Utilization

Construction Equipment Type	Utilization Factor (%)	Operational Hours per day	Horse Power	L_{max} at 1 Meter (dBA)
Personnel Vehicles	1%	1	350	115
Pickup Truck - 1/2 ton	40%	8	350	115
Pickup Truck - 3/4 ton	40%	8	350	115
Pickup Truck - 1 ton	40%	8	350	115
Water Truck	20%	8	350	115
Tractor w/ mower	40%	8	N/A	108
Motor grader	40%	8	200	113
Dozer	40%	8	400	116
Pan Scraper	40%	8	300	114
Compactor	20%	8	300	114
Front end loader	40%	6	200	113
Backhoe w/ loader	40%	6	100	110
Dump truck	40%	6	350	115
Trencher	40%	4	100	110
All-terrain forklift	20%	4	100	110
Semi delivery truck & trailer	40%	4	350	115
Concrete delivery truck	40%	4	350	115
Power line truck	40%	6	350	115
Construction labor (e.g., miscellaneous tools)	1%	8	N/A	109

Notes:
Construction equipment list, Operational Hours per day, and Horse Power were provided by the Client.
Utilization Factor (%) was obtained from Roadway Construction Noise Manual User's Gudie, FHWA, 2006.
L_{max} at 1 meter (dBA) was calculated based on Horse Power except for Tractor w/ mower and Construction labor. L_{max} at 1 meter for those two equipment pieces were obtained from Roadway Construction Noise Manual User's Gudie, FHWA, 2006.
N/A = Not Available.

3.1.2 Predicted Results

Using the afore-described methodology, L_{eq} at LT2 is expected to range from about 49 to 51 dBA over the course of project construction. As presented in Table 3, the daytime noise level at LT2 was 54 dBA, the nighttime noise level was 51 dBA, and L_{dn} value was 58 dBA, which is already higher than the EPA recommended outdoor limit guidance of 55 dBA L_{dn}. If the construction activity occurs eight hours a day and produces an average of 51 dBA, then the daytime L_{eq} might increase by 2 dBA (due to logarithmic

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addition of construction noise and the existing ambient sound) to 56 dBA. The L_{dn} at LT2 would therefore rise by 1 dBA to 59 dBA.

When surface grading, PV structure installation, or other construction may—for shorter periods of time—occur at the Project boundary closest to the nearest residential receiver (LT2), the L_{eq} range associated with construction noise may rise to 57-59 dBA. This higher range assumes the same roster and schedule of equipment from Table 5 and with quantities of equipment detailed by month as shown in Appendix D. Thus, the primary reason for the higher noise range is that the "acoustic center" for this scenario is closer to LT2: 1 km instead of 2.4 km distant. If this construction activity at the nearest Project boundary to LT2 generates 59 dBA for eight hours a day, the L_{dn} value would rise by 2 dBA to 60 dBA , which would only be 2 dBA higher than the ambient Ldn presented in Table 3.

While higher than the aforementioned 55 dBA L_{dn} outdoor limit guidance, the 60 dBA L_{dn} would be reduced by the sound insulating properties of the structure of the nearest residence, which (with windows closed) might be expected to provide 20-25 dBA of attenuation and thereby result in interior noise levels of 35-40 dBA L_{dn} that are below the EPA interior limit guidance of 45 dBA L_{dn}. If windows of the residential structure are open, the expected noise reduction would be considerably less and might not allow the intrustion of exterior noise to be less than 45 dBA L_{dn}.

Although impulsive or short-duration intermittent Project construction noises may occasionally be perceptible at LT2, in summary the energy-average exterior L_{dn} would increase 2 dBA while the energy-average interior L_{dn} would remain less than 45 dBA (again, assuming with closed windows). Therefore, and in addition to its temporary nature (i.e., once Project construction is completed, sources of construction activity noise are eliminated), construction noise is not considered to have a significant effect on LT2 or other noise-sensitive receivers.

3.1.3 Effects on Wildlife

Potential effects on wildlife species in the project vicinity would depend on their current level of habituation to man-made noise sources such as traffic noise and the presence and proximity of pre-project operating equipment (e.g., existing transmission lines) or human activity. The likelihood of effect, if any, would rise with decreasing distance to the project while it is under construction.

3.1.4 Construction Traffic

The estimated construction noise level range of 49 to 51 dBA L_{eq} expected at LT2 already includes consideration for construction worker passenger vehicles arriving and departing the project site. Traffic from these vehicles and construction-related deliveries would also increase noise levels in proximity to the roads/routes on which they travel, but the increase would only be 3 dBA for every doubling of traffic relative to existing volumes (assuming the proportions of vehicle types and their speeds are unchanged) on the potentially affected roadways. Effects, if any, would also be temporary and terminate upon completion of project construction.

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3.1.5 Construction Vibration

Given the distances between the nearest residential receivers and the Project, ground vibration levels from Project construction would be expected to attenuate to insignificant levels.

3.2 OPERATIONAL NOISE

3.2.1 Cadna/A Prediction Methodology and Results

The Cadna/A® Noise Prediction Model (Version 4.1.137) was used to estimate the Project-generated daytime operation sound level at noise-sensitive receivers. The Project configuration (e.g., proposed interveners) was imported into Cadna/A® from available Project CAD files. The Project is assumed to operate continuously during the day, with uninterrupted insolation.

The Project involves fixed-tilt arrays of PV electricity generating panels that, by design, do not have actuators that might otherwise generate intermittent noise when operating to re-position panels for tracking the sun's path through the sky. Also, the PV panels will only require washing once per year. Hence, for purposes of this analysis, typical daytime operational noise sources are likely limited to the following:

- Transformer/inverter equipment per 1MWAC array (80.8 dBA Sound Power Level each, based on test data of an Advanced Energy Solaron 500K, as provided by the manufacturer);
- Substation transformer (83.4 dBA Sound Power Level, based on transformer noise estimation from Beranek & Ver, 1996); and,
- Building HVAC from the occupied Control and O&M buildings (90.1 dBA Sound Power Level).

Figure 1 depicts predicted iso-dBA contours (i.e., like contours on a topographical map showing locations having the same elevation, these show locations having the same sound pressure level) from Project operation. Note that this aggregate Project-only operation noise, up to about 30 dBA, generally stays within the Project boundary. For purposes of image clarity, SPL contours less than 30 dBA are not shown on Figure 1. Ambient sound level is not depicted in Figure 1.

The closest noise-senstivie receiver is LT2, which is expected to experience less than 20 dBA of Project operation noise. Since the measured ambient L_{dn} at LT2 is 58 dBA, the Project operation noise is not expected to cause an increase; therefore, due to the lack of ambient sound increase and its expected contribution to the ambient being far less than 55 dBA L_{dn}, Project operation noise should not create a significant environmental effect..

At night, the project would not be operating due to lack of adequate insolation. Nighttime operations would thus likely be limited to some reduced activity at the O&M and Control Buildings, such as security or maintenance, and therefore result in project nighttime operation noise levels that are less than those during the daytime and would also be considered insignificant in effect.

B-2 page B-2-18

3.2.2 Effects on Wildlife

Potential effects on wildlife species in the project vicinity would depend on their current level of habituation to man-made noise sources such as traffic noise and the presence and proximity of pre-project operating equipment (e.g., existing transmission lines) or human activity. The likelihood of effect, if any, would rise with decreasing distance to the project and its operating noise sources.

3.2.3 Power Transmission

Noise sources associated with power transmission include occasional breaker operation in the substation, corona noise, and very low magnetostriction hum from the conductors. Breaker noise is considered impulsive in nature, lasting a very short duration and may occur only a few times per year. Corona noise is characterized as a buzz or hum, and is usually worse when the conductors are wet, such as in rain or fog.

The Electric Power Research Institute (EPRI) has conducted noise tests and studies and has published reference material on transmission line noise. Consistent with acoustic textbook discussion of propagation of noise from a line source, EPRI states that noise produced by a conductor decreases at a rate of three dB per doubling of distance from the source. The EPRI Transmission Line Reference Book indicates that the audible noise from a typical 525 kV line with two conductors per phase would likely be less than 40 dBA at a distance of 40 feet from the outside conductor at ground level. If only one conductor per phase is used, the noise level will be less. Consistent with the project description, the levels are expected to be less than described above because the transmission line used in the project is 69 kV (i.e., far less than 525 kV).

The new power transmission equipment for the project is therefore predicted to have no audible sound contribution to the nearest residential receivers, and is likewise expected to result in less than a significant effect.

3.2.4 Operation Traffic

The increase in traffic on existing roadways due to vehicles from project employees (i.e., those responsible for monitoring and maintaining operation on site) is expected to be very minor, and thus result in a less than significant effect.

3.2.5 Operational Vibration

Given the distances between the nearest residential receivers and the project, ground vibration levels from project operation would be expected to attenuate to insignificant levels.

3.3 CUMULATIVE EFFECTS

The project is not expected to result in significant cumulative effects related to noise during construction or operation. Hence, as no significant effects are anticipated from project construction or operational noise generation with respect to applicable LORS; neither are any significant cumulative effects expected.

B-2 page B-2-19

Construction noise is temporary and will conclude on completion of project construction. Although operation of the project will add some noise to the ambient sound environment, the magnitude is not considered significant and dissipates with increasing distance from the project boundary.

3.4 MITIGATION

As construction noise effects are temporary and the increase in ambient L_{dn} is only expected to rise by 2 dBA, the need for mitigation measures is not anticipated. However, consistent with industry expectations of responsible construction activity, the following practices are recommended:

- Construction equipment and vehicles will be equipped with factory-approved and properly maintained standard noise control equipment (e.g., engine exhaust mufflers, air intake filter/silencers, etc.) to minimize the effects of project construction on local noise levels.

SECTION 4 LIMITATIONS

The findings, opinions, and recommendations presented herein are based in part upon field measurements and observations of what are believed to be typical and representative conditions of normal activity in the vicinity of the proposed Project facilities and URS' understanding of normal proposed Project facility operating conditions, as presented in this report. The sound measurements and analyses were conducted using the professional standard of care as practiced in the industry and are, as appropriate, representative of the activity being measured as influenced by environmental conditions existing during the measurement period. Because of the variability of factors not within the control of the investigators, no warranty can be made that the exact sound, vibration, or activity levels would be obtained by subsequent field measurements. However, for similar climatic and seasonal conditions, intensity of community activity, and similar facility operations, the sound and vibration levels measured would be very similar to those reported or predicted, as applicable, herein.

SECTION 5 REFERENCES

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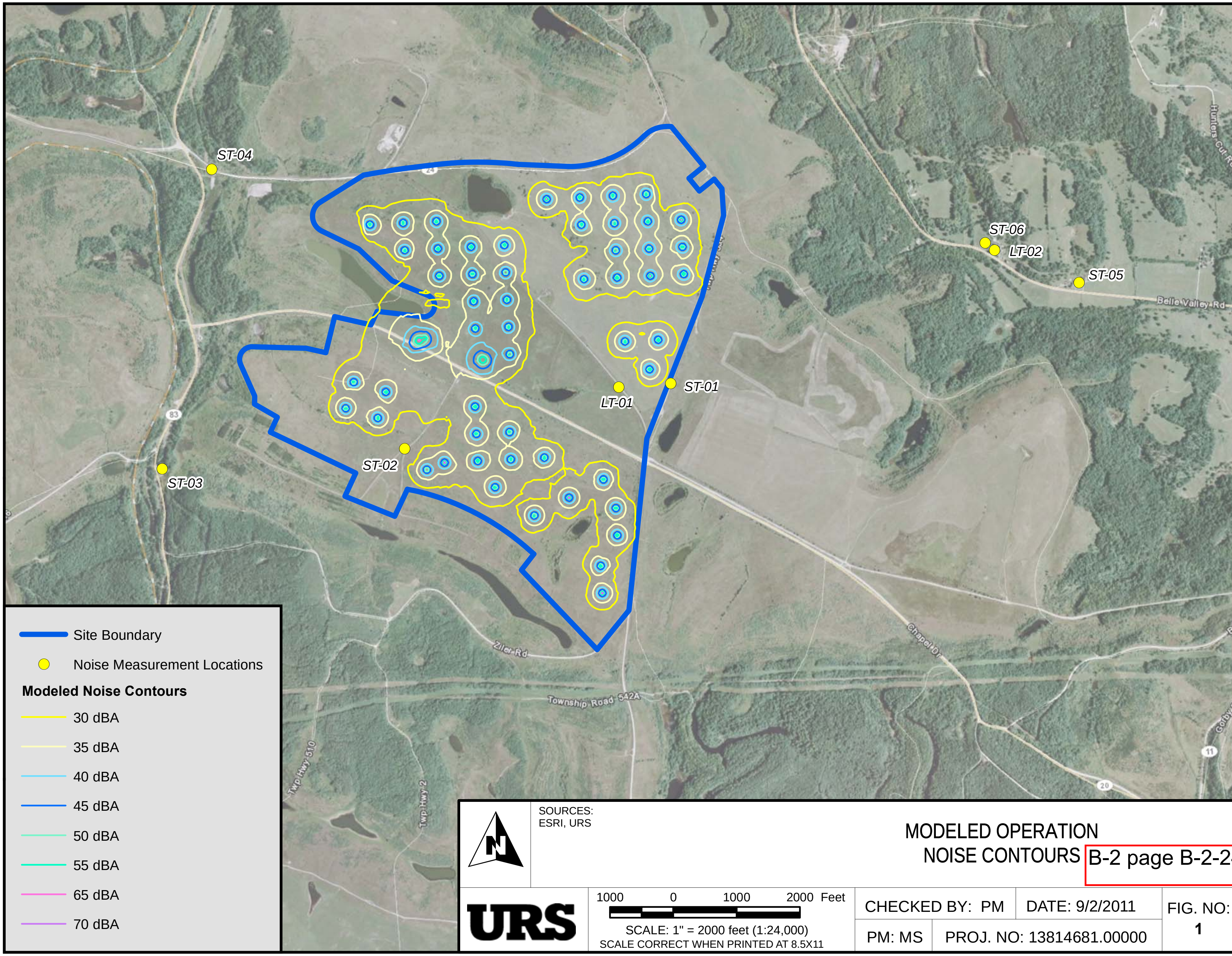
B-2 page B-2-22

B-2 page B-2-23

Path: J:\13814681 Turning Point Ohio\014 WORK IN PROGRESS\noise\upload to secure 4 Susumu\Noble_County_GIS.mxd, paul_moreno, 9/2/2011, 11:36:16 AM



B-2 page B-2-24

B-2 page B-2-25

URS Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT Project #: ______ Date: 8/22/11 Page 1 of 1
Monitoring Location: MIDDLE OF PROJECT SITE Analyst: JDD

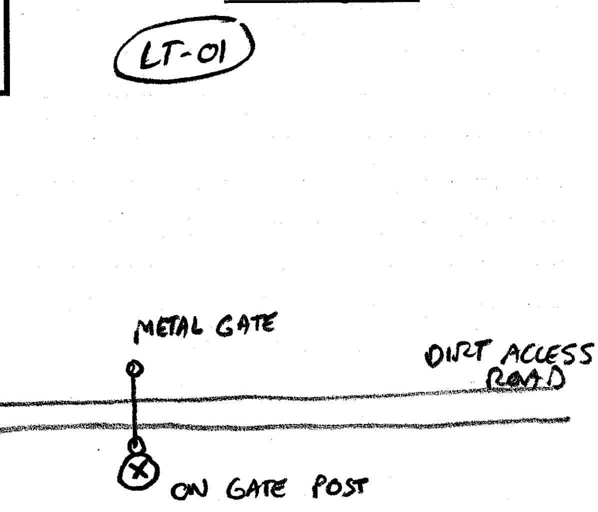
Sound Level Meter	Field Calibration	Weather Data
Model #: 820	Model #: CAL 200	Model #: K3500
Serial #: 1652	Serial #: 5789	Serial #: 1703474
Weighting: (A) / C / Flat	Calibration Level (dBA): 94 / (114)	Wind: (Steady)/Gusty/Calm
Response: (Slow) / Fast / Impl	Pre-Test 114.0 dBA	Precipitation: Yes (explain) / (No)
Windscreen: (Yes) / No (explain)	Post-Test ____ dBA	Avg Wind Speed/Direction: 3-6 MPH E
Topo: Flat / (Hilly)	GPS Coordinates (at SLM location)[#]	Temp (°F): 82.7 RH (%): 49.6
Terrain: Hard/(Soft)/Mixed/Snow	N39°48'32.2" W081°38'54.0"	Bar Psr (Hg): ____ Cloud Cover (%): 50%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
8/22	17:05								
									8/23 08:31 VERIFY RUNNING
8/23	17:46								

Roadway Name/Dir		
Speed (post/obs)*		
Number of Lanes		
Width (pave/row)		
1- or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass

Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? (Yes)/No 9

Additional Notes/Comments:

B-2 page B-2-26

Other Noise Sources: distant: aircraft/roadway traffic/trains/(landscaping)/rustling leaves/children playing/dogs barking/(birds vocalizing)/Insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT Project #: ______ Date: 8/22/11 Page 1 of 1
Monitoring Location: 11780 BELL VALLEY ROAD CUMBERLAND Analyst: SDD

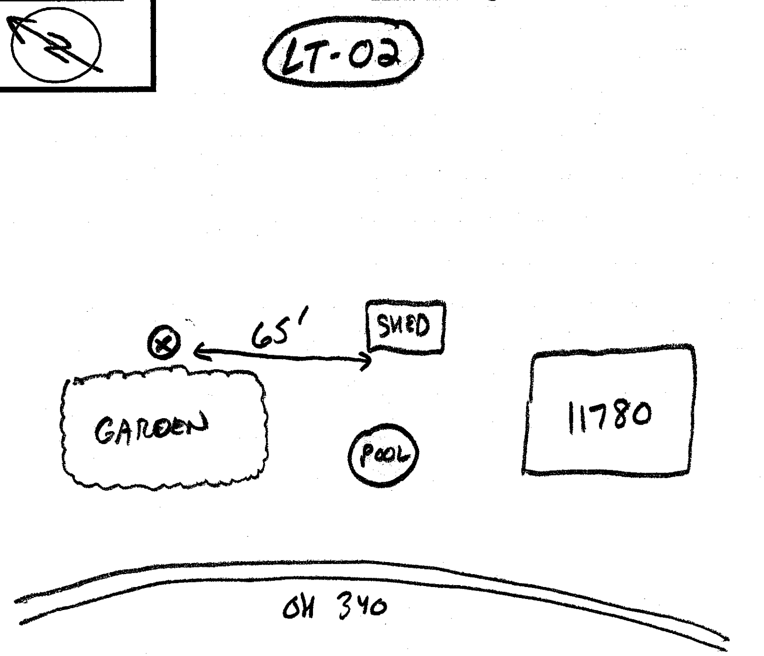
Sound Level Meter		Field Calibration		Weather Data	
Model #:	820	Model #:	CAL 200	Model #:	K3500
Serial #:	1651	Serial #:	5789	Serial #:	1703474
Weighting (A) / C / Flat		Calibration Level (dBA): 94 / (114)		Wind: (Steady)/Gusty/Calm	
Response (Slow) / Fast / Impl		Pre-Test	114.0 dBA	Precipitation: Yes (explain) / (No)	
Windscreen : (Yes) / No (explain)		Post-Test	dBA	Avg Wind Speed/Direction:	3-6 MPH E
Topo: Flat / (Hilly)		GPS Coordinates (at SLM location)#		Temp (°F): 82.9	RH (%): 49.6
Terrain: Hard/(Soft)/Mixed/Snow		N 39° 48' 51.2" W081° 37' 38.4"		Bar Psr (Hg):	Cloud Cover (%): 50%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
8/22	17:45								
									8/23 07:27 VERIFY RUNNING
									8/23 12:18 VERIFY RUNNING
8/23	18:03								

Roadway Name/Dir	BELL VALLEY (OH 340)	
Speed (post/obs)*	OBS 55MPH	
Number of Lanes	2	
Width (pave/row)	24'	
1- or 2- way	2	
Grade	FLAT	
Bus Stops	N/A	
Stoplights	N/A	
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass

Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? (Yes)/No 9

Additional Notes/Comments:

B-2 page B-2-27

ROOSTERS

Other Noise Sources: distant: aircraft/roadway traffic/trains/(landscaping)/(rustling leaves)/children playing/(dogs barking)/(birds vocalizing)/insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT   Project #: ______   Date: 8/23/11   Page 1 of 1

Monitoring Location: NEAR SITE ENTRANCE   Analyst: JDD

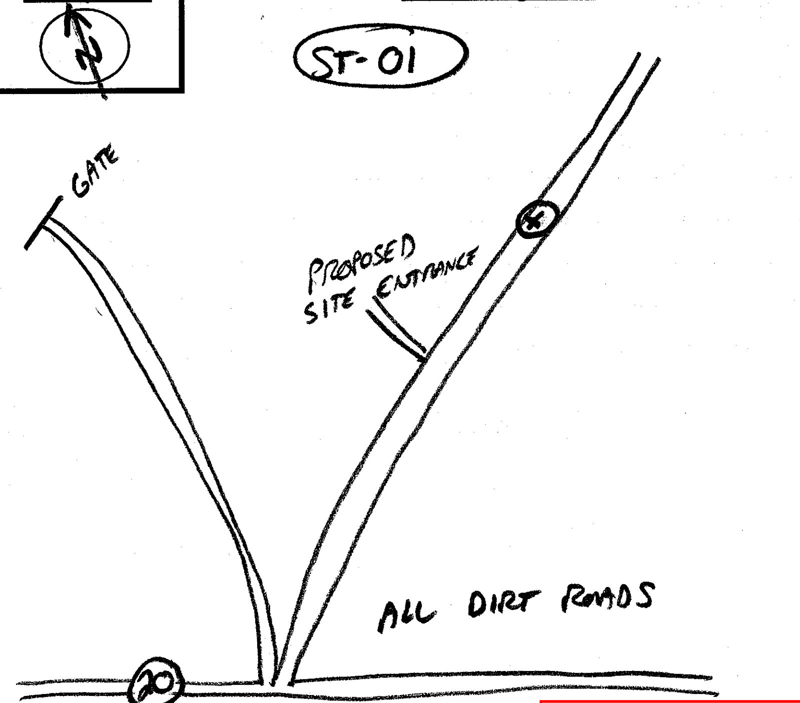
Sound Level Meter		Field Calibration		Weather Data	
Model #:	820	Model #:	CAL 200	Model #:	K3500
Serial #:	1414	Serial #:	5789	Serial #:	1703474
Weighting: (A) / C / Flat		Calibration Level (dBA): 94 / (114)		Wind: Steady/Gusty/(Calm)	
Response: (Slow) / Fast / Impl		Pre-Test	114.0 dBA	Precipitation: Yes (explain) (No)	
Windscreen: (Yes) / No (explain)		Post-Test	dBA	Avg Wind Speed/Direction:	N/A
Topo: Flat / (Hilly)		GPS Coordinates (at SLM location)#		Temp (°F): 64.0°	RH (%): 72.2
Terrain: Hard / (Soft) / Mixed / Snow		N39° 48' 32.3" W081° 38' 43.5"		Bar Psr (Hg): 978.6	Cloud Cover (%): 20%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
2	08:10	08:15	52.5	50.9	53.6	53.3	52.5	51.7	
3	08:15	08:20	52.9	50.4	54.1	53.8	53.2	51.5	
4	08:20	08:25	53.9	52.5	54.9	54.8	54.0	53.1	

Roadway Name/Dir		
Speed (post/obs)*		
Number of Lanes		
Width (pave/row)		
1- or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass

Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? (Yes) / No 7

Additional Notes/Comments:

B-2 page B-2-28

Other Noise Sources: distant: aircraft/roadway traffic/trains/(landscaping)/rustling leaves/children playing/dogs barking/(birds vocalizing)/Insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT Project #: ______ Date: 8/23/11 Page 1 of 1

Monitoring Location: SOUTHWEST SIDE OF PROJECT SITE Analyst: JDD

Sound Level Meter

Model #: 820

Serial #: 1414

Weighting: **A** / C / Flat

Response: **Slow** / Fast / Impl

Windscreen: **Yes** / No (explain)

Field Calibration

Model #: CAL 200

Serial #: 5789

Calibration Level (dBA): 94 / **114**

Pre-Test 114.0 dBA

Post-Test ______ dBA

Weather Data

Model #: K3500

Serial #: 1703474

Wind: **Steady** / Gusty / Calm

Precipitation: Yes (explain) / **No**

Avg Wind Speed/Direction: 3 MPH N

Topo: Flat / **Hilly**

Terrain: Hard / **Soft** / Mixed / Snow

GPS Coordinates (at SLM location)#: N39° 48' 24.6" W081° 39' 37.9"

Temp (°F): 65.6 RH (%): ______

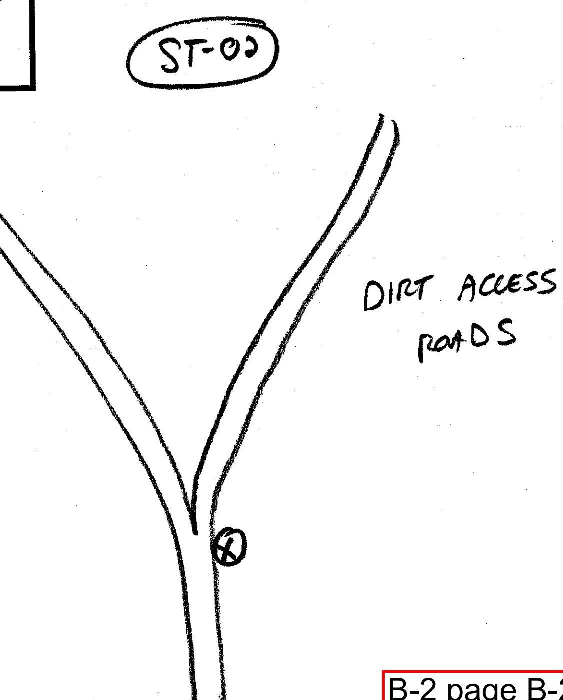
Bar Psr (Hg): 980.8 Cloud Cover (%): 30%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
7	08:45	08:50	58.1	57.5	59.6	58.9	58.3	57.5	
8	08:50	08:55	58.3	57.1	59.0	58.9	58.4	57.7	
9	08:55	09:00	58.9	58.2	59.8	59.7	58.8	58.2	

Roadway Name/Dir		
Speed (post/obs)*		
Number of Lanes		
Width (pave/row)		
1- or 2- way		
Grade		
Bus Stops		
Stoplights		
Motorcycles		
Automobiles		
Medium Trucks		
Heavy Trucks		
Buses		
Count duration		

compass

Site Diagram:



\# - note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? **Yes** / No 8

Additional Notes/Comments:

B-2 page B-2-29

Other Noise Sources: distant: aircraft/**roadway traffic**/trains/landscaping/**rustling leaves**/children playing/dogs barking/**birds vocalizing**/Insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

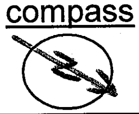
Project Name: OHIO TURNING POINT Project #: ____ Date: 8/23/11 Page 1 of 1
Monitoring Location: BROOKFIELD CEMETERY Analyst: SDD

Sound Level Meter	Field Calibration	Weather Data
Model #: 820	Model #: CAL 200	Model #: K3500
Serial #: 1414	Serial #: 5789	Serial #: 1703474
Weighting: (A) / C / Flat	Calibration Level (dBA): 94 / (114)	Wind: Steady/Gusty/(Calm)
Response: (Slow) / Fast / Impl	Pre-Test 114.0 dBA	Precipitation: Yes (explain) / (No)
Windscreen: (Yes) / No (explain)	Post-Test ____ dBA	Avg Wind Speed/Direction: 2MPH NW
Topo: Flat / (Hilly)	GPS Coordinates (at SLM location)#: N39°48'23.7" W081°40'27.0"	Temp (°F): 70.4 RH (%): 80.2
Terrain: Hard/(Soft)/Mixed/Snow		Bar Psr (Hg): 984.2 Cloud Cover (%): 20%

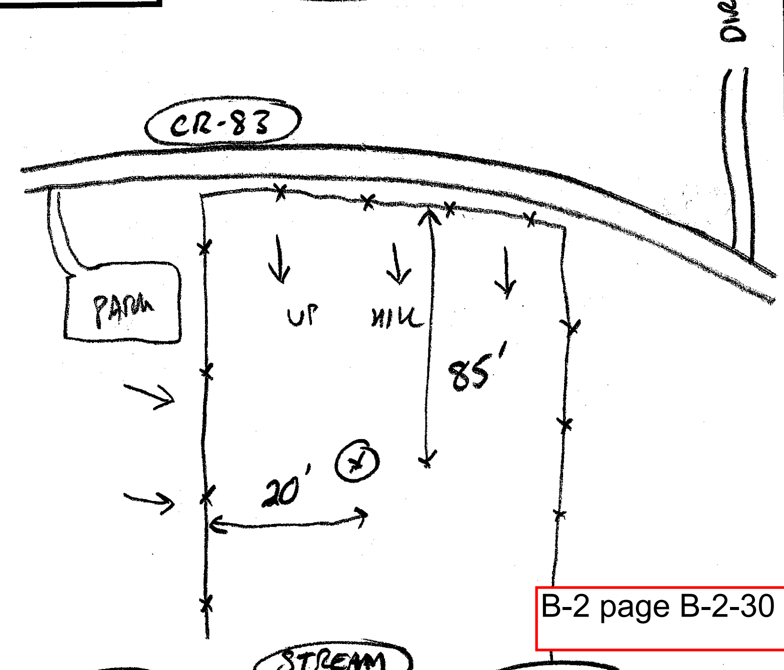
ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
12	09:55	10:00	49.1	46.8	51.1	50.7	48.9	47.3	
13	10:00	10:05	51.1	48.9	55.6	51.9	50.8	50.0	
14	10:05	10:10	51.6	48.7	55.4	53.5	51.3	49.3	

Roadway Name/Dir	RENROCK RD (CR-83)	
Speed (post/obs)*	OBS 45MPH	
Number of Lanes	2	
Width (pave/row)	24'	
1- or 2- way	2	
Grade	FLAT	
Bus Stops	N/A	
Stoplights	N/A	
Motorcycles	0	
Automobiles	0	
Medium Trucks	0	
Heavy Trucks	0	
Buses	0	
Count duration	15 MIN	

compass



Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? (Yes) / No 7

Additional Notes/Comments:

B-2 page B-2-30

Other Noise Sources: distant: aircraft/roadway traffic/trains/landscaping/(rustling leaves)/children playing/dogs barking/(birds vocalizing)/insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice

FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT	Project #:	Date: 8/23/11	Page 1 of 1
Monitoring Location: NORTHWEST CORNER OF PROJECT SITE		Analyst: SDD	

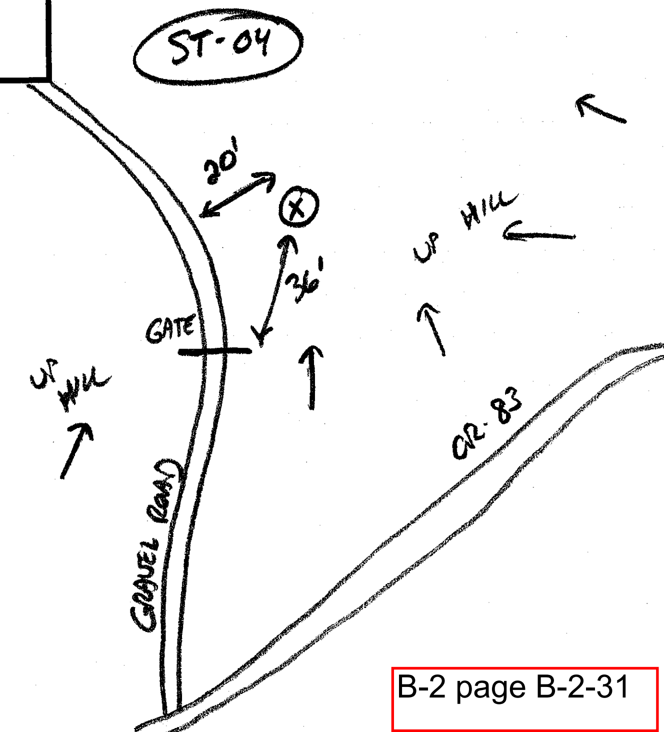
Sound Level Meter		Field Calibration		Weather Data	
Model #:	820	Model #:	CAL 200	Model #:	K3500
Serial #:	1414	Serial #:	5789	Serial #:	1703474
Weighting:	(A) / C / Flat	Calibration Level (dBA):	94 / (114)	Wind:	(Steady) / Gusty / Calm
Response:	(Slow) / Fast / Impl	Pre-Test	114.0 dBA	Precipitation:	Yes (explain) / (No)
Windscreen:	(Yes) / No (explain)	Post-Test	dBA	Avg Wind Speed/Direction:	3MPH NW
Topo:	Flat / (Hilly)	GPS Coordinates (at SLM location)#		Temp (°F): 78.4	RH (%): 64.0
Terrain:	Hard / (Soft) / Mixed / Snow	N39° 49' 09.9" W081° 40' 13.4"		Bar Psr (Hg): 985.0	Cloud Cover (%): 10%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
17	10:40	10:45	58.0	55.9	59.8	58.9	58.1	57.0	
18	10:45	10:50	59.4	58.4	61.2	59.9	59.3	58.4	
19	10:50	10:55	59.0	56.8	63.2	59.8	59.1	58.1	

Roadway Name/Dir	RENROCK RD (CR-83)	
Speed (post/obs)*	OBS 45MPH	
Number of Lanes	2	
Width (pave/row)	24'	
1- or 2- way	2	
Grade	FLAT	
Bus Stops	N/A	
Stoplights	N/A	
Motorcycles	0	
Automobiles	4	
Medium Trucks	0	
Heavy Trucks	1	
Buses	0	
Count duration	15 MIN	

compass

Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? (Yes) / No 8

Additional Notes/Comments:

B-2 page B-2-31

Other Noise Sources: distant: aircraft/roadway traffic/trains/landscaping/(rustling leaves)/children playing/dogs barking/(birds vocalizing)/insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT Project #: ______ Date: 8/23/11 Page 1 of 1
Monitoring Location: 11906 BELL VALLEY ROAD CUMBERLAND Analyst: JDD

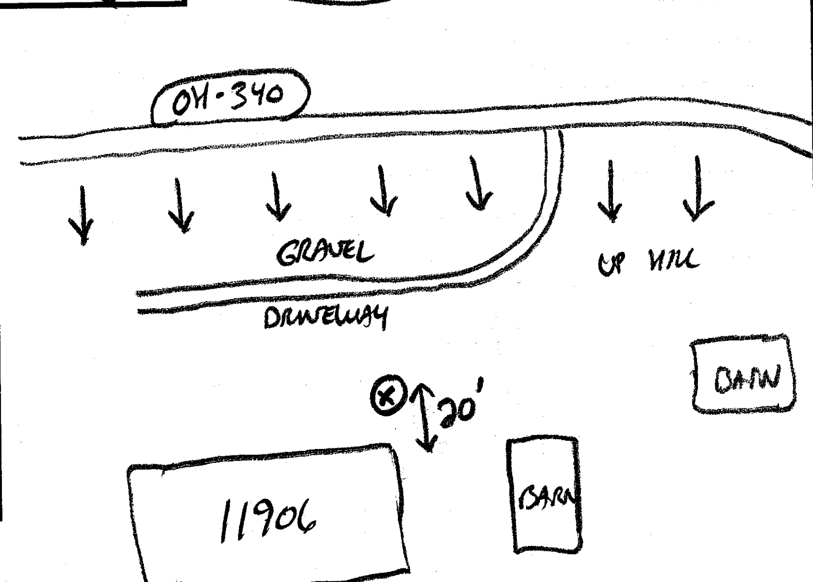
Sound Level Meter		Field Calibration		Weather Data	
Model #:	820	Model #:	CAL 200	Model #:	K3500
Serial #:	1414	Serial #:	5789	Serial #:	1703474
Weighting: **(A)** / C / Flat		Calibration Level (dBA): 94 / **(114)**		Wind: Steady/Gusty/**(Calm)**	
Response: **(Slow)** / Fast / Impl		Pre-Test	114.0 dBA	Precipitation: Yes (explain) / **(No)**	
Windscreen: **(Yes)** / No (explain)		Post-Test	dBA	Avg Wind Speed/Direction:	3 MPH E
Topo: Flat / **(Hilly)**		GPS Coordinates (at SLM location)#		Temp (°F): 77.0	RH (%): 61.2
Terrain: Hard / **(Soft)** / Mixed/Snow		N39° 48' 44.7" W081° 47' 18.1"		Bar Psr (Hg): 985.1	Cloud Cover (%): 10%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
22	11:30	11:35	50.5	43.4	67.9	49.6	46.8	45.4	
23	11:35	11:40	56.1	44.8	70.7	57.9	47.4	45.9	
24	11:40	11:45	48.0	43.7	62.6	48.9	46.2	44.2	
25	11:45	11:50	45.7	43.5	56.8	46.5	44.7	43.8	
26	11:50	11:55	50.5	43.9	66.5	52.8	45.2	44.2	

Roadway Name/Dir	BELL VALLEY (OH-340)	
Speed (post/obs)*	OBS 55MPH	
Number of Lanes	2	
Width (pave/row)	24'	
1- or 2- way	2	
Grade	FLAT	
Bus Stops	N/A	
Stoplights	N/A	
Motorcycles	0	
Automobiles	13	
Medium Trucks	1	
Heavy Trucks	5	
Buses	0	
Count duration	15MIN	

compass

Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

Photos Taken? **(Yes)** / No 8

Additional Notes/Comments:

B-2 page B-2-32

Other Noise Sources: distant: aircraft/roadway traffic/trains/**(landscaping)**/rustling leaves/children playing/**(dogs barking)**/**(birds vocalizing)**/insects

Additional Notes and Sketches on Reverse

URS Acoustics and Noise Control Practice
FIELD NOISE MEASUREMENT DATA FORM

Project Name: OHIO TURNING POINT Project #: ______ Date: 8/23/11 Page 1 of 1
Monitoring Location: 11780 BELL VALLEY ROAD CUMBERLAND Analyst: SDD

Sound Level Meter
Model #: 820
Serial #: 1414
Weighting: (A) / C / Flat
Response: (Slow) / Fast / Impl
Windscreen: (Yes) / No (explain)

Field Calibration
Model #: CAL 200
Serial #: 5789
Calibration Level (dBA): 94 / (114)
Pre-Test 114.0 dBA
Post-Test dBA

Weather Data
Model #: K3500
Serial #: 1703474
Wind: Steady/Gusty/(Calm)
Precipitation: Yes (explain) / (No)
Avg Wind Speed/Direction: 3 MPH E

Topo: Flat / (Hilly)
Terrain: Hard/(Soft)/Mixed/Snow

GPS Coordinates (at SLM location)#: N39°48' 50.0" W081°37'36.6"

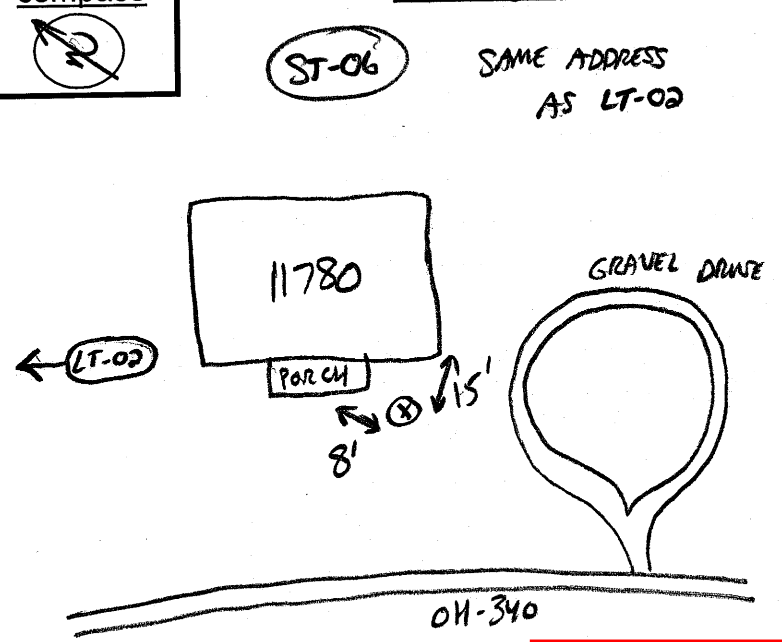
Temp (°F): 78.0 RH (%): 61.2
Bar Psr (Hg): 985.1 Cloud Cover (%): 10%

ID	Start Time	Stop Time	L_{eq}	L_{min}	L_{max}	L_{10}	L_{50}	L_{90}	Notes/Events
29	12:10	12:15	56.2	47.1	66.9	59.2	51.5	50.0	
30	12:15	12:20	58.7	47.4	77.0	59.3	50.3	48.2	
31	12:20	12:25	57.0	47.1	72.6	59.0	49.3	47.6	

Roadway Name/Dir	BELL VALLEY (OH-340)	
Speed (post/obs)*	OBS 55MPH	
Number of Lanes	2	
Width (pave/row)	24'	
1- or 2- way	2	
Grade	FLAT	
Bus Stops	N/A	
Stoplights	N/A	
Motorcycles	0	
Automobiles	13	
Medium Trucks	0	
Heavy Trucks	1	
Buses	0	
Count duration	15 MIN	

compass

Site Diagram:



- note coordinate system * - Speed estimated by Radar / Driving / Observation

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Photos Taken? (Yes)/No 6

Additional Notes/Comments:

ROOSTERS/ CHICKENS

Other Noise Sources: distant: aircraft/roadway traffic/trains/(landscaping)/rustling leaves/children playing/dogs barking/(birds vocalizing)/insects

Additional Notes and Sketches on Reverse

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Table B1
LT1 Hourly L_{eq} Noise Levels (dBA)

Start Time	L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
17:15	60	65	54	61	59	58
18:15	59	65	56	61	59	58
19:15	58	61	55	59	58	57
20:15	59	71	53	60	58	56
21:15	60	67	55	62	60	58
22:15	58	60	56	59	58	57
23:15	58	59	53	58	58	56
0:15	58	61	55	59	58	57
1:15	57	68	53	58	57	55
2:15	56	67	52	57	55	54
3:15	53	56	50	54	53	52
4:15	54	66	50	55	53	52
5:15	52	64	48	54	52	51
6:15	52	57	47	53	52	50
7:15	54	59	48	55	54	53
8:15	59	70	55	60	59	58
9:15	61	68	60	62	61	61
10:15	64	68	60	65	63	61
11:15	71	99	58	64	63	60
12:15	60	62	57	61	60	59
13:15	59	63	55	60	59	57
14:15	58	60	53	59	58	57
15:15	59	62	55	60	59	57
16:15	53	65	57	62	60	59

NOTES:
Continuous noise monitoring at this location took place from 8-22-11 to 8-23-11.

Figure B1: LT1 Hourly L_{eq} Noise Levels (Graphic View)

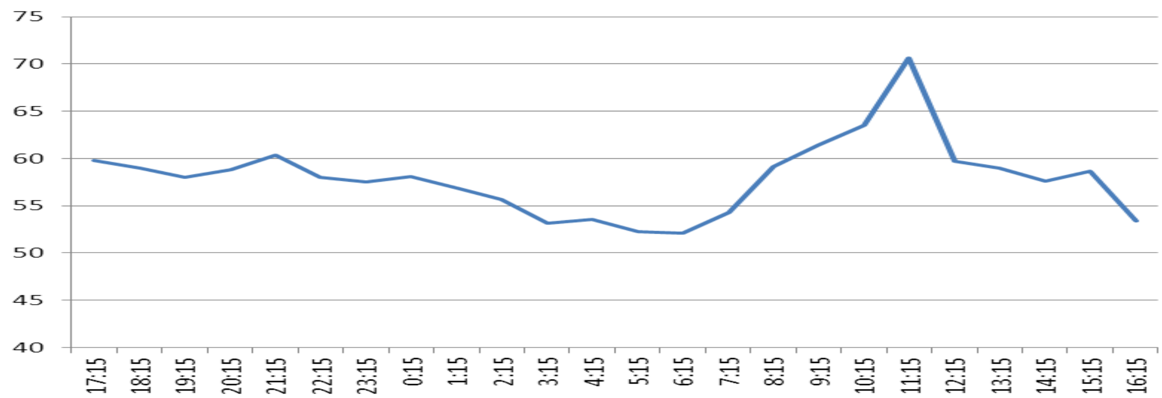

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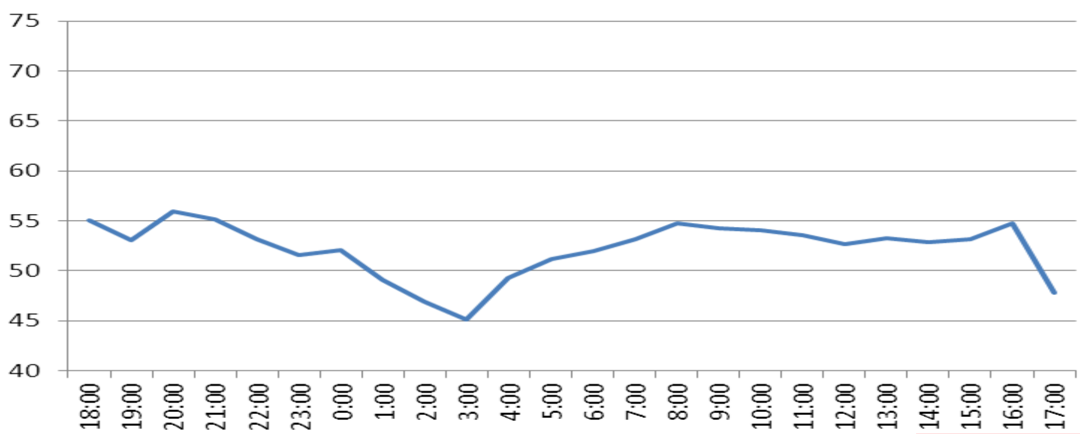
Table B2
LT2 Hourly L_{eq} Noise Levels (dBA)

Start Time	L_{eq}	L_{max}	L_{min}	L_{10}	L_{50}	L_{90}
18:00	55	73	46	58	52	51
19:00	53	70	44	55	50	49
20:00	56	74	44	58	53	51
21:00	55	68	51	57	53	52
22:00	53	62	50	54	52	52
23:00	52	65	49	52	51	50
0:00	52	67	48	53	50	49
1:00	49	68	47	49	48	47
2:00	47	62	45	47	47	46
3:00	45	62	43	45	44	43
4:00	49	69	42	48	43	43
5:00	51	70	42	55	43	42
6:00	52	69	37	56	42	40
7:00	53	70	37	57	43	38
8:00	55	72	38	58	45	41
9:00	54	72	44	57	48	45
10:00	54	71	44	57	49	47
11:00	54	72	44	55	47	46
12:00	53	75	43	54	47	45
13:00	53	72	42	55	47	45
14:00	53	73	42	56	45	44
15:00	53	72	42	56	48	45
16:00	55	78	43	57	47	45
17:00	48	71	43	57	46	45

NOTES:
Continuous noise monitoring at this location took place from 8-22-11 to 8-23-11.

Figure B2: LT2 Hourly L_{eq} Noise Levels (Graphic View)



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	**Photograph 1** **Date:** 08/22/11 **Location Tag:** LT1 **View Direction:** West **Comments:** Placed approximately 1800' northwest of the intersection of CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road).
	**Photograph 2** **Date:** 08/22/11 **Location Tag:** LT1 **View Direction:** Northwest **Comments:** The SLM was located in the northeast quadrant of the project site, near a metal security gate along an existing dirt service road.

	**Photograph 3** **Date:** 08/22/11 **Location Tag:** LT2 **View Direction:** Southeast **Comments:** Residence located at 11780 Belle Valley Road in the town of Cumberland.
	**Photograph 4** **Date:** 08/22/11 **Location Tag:** LT2 **View Direction:** West **Comments:** The SLM was placed approximately 65' northwest of a barn and approximately 200' from CR-340 (Belle Valley Road).

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	**Photograph 5** **Date:** 08/23/11 **Location Tag:** ST1 **View Direction:** North **Comments:** Placed approximately 1200’ northeast of the intersection of CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road).
	**Photograph 6** **Date:** 08/23/11 **Location Tag:** ST1 **View Direction:** Northeast **Comments:** The SLM was located in the northeast quadrant of the project site, near a proposed entrance along an existing dirt service road.

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	**Photograph 7** **Date:** 08/23/11 **Location Tag:** ST2 **View Direction:** Southwest **Comments:** Placed approximately 1500' off of CR-20 (Chapel Drive) and approximately 3700' west of the intersection of CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road).
	**Photograph 8** **Date:** 08/23/11 **Location Tag:** ST2 **View Direction:** Northeast **Comments:** The SLM was located along an existing dirt service road in the southwest quadrant of the project site.

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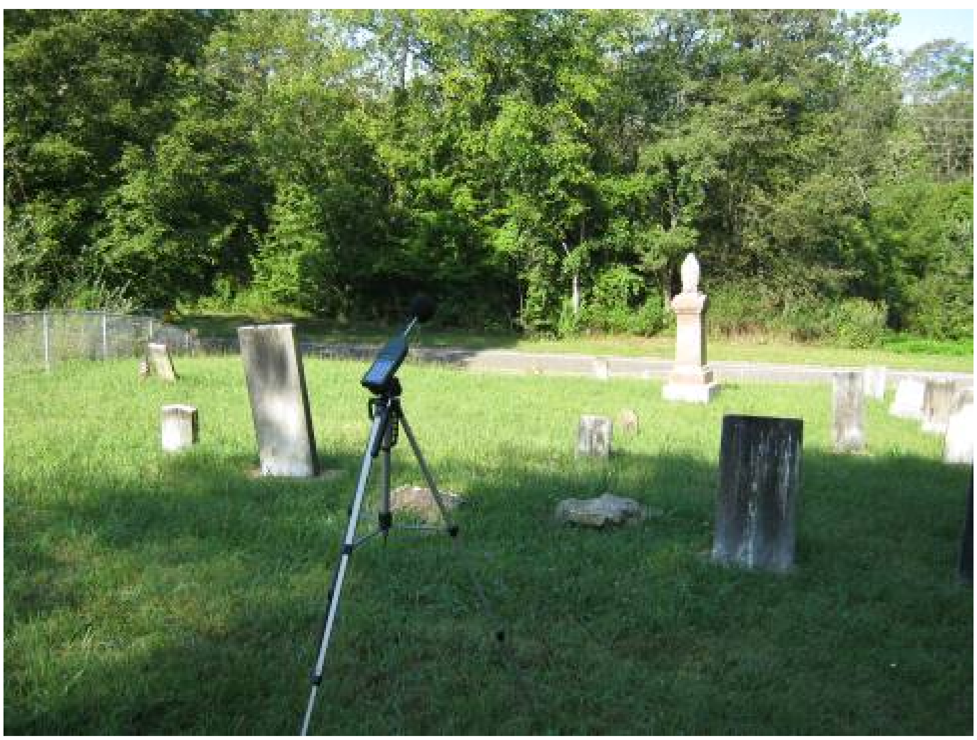
	**Photograph 9** **Date:** 08/23/11 **Location Tag:** ST3 **View Direction:** North **Comments:** Placed at Brookfield Cemetery, which is located along CR-83 (Renrock Road).
	**Photograph 10** **Date:** 08/23/11 **Location Tag:** ST3 **View Direction:** West **Comments:** The SLM was located approximately 85' east of CR-83 and 20' from the parking lot fence line. The cemetery is elevated above the roadway surface.

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	**Photograph 11** **Date:** 08/23/11 **Location Tag:** ST4 **View Direction:** North **Comments:** The site was located approximately 0.5 miles north of the intersection CR-83 (Renrock Road) and CR-20 (Chapel Drive) and Township Highway 47 (Ziler Road).
	**Photograph 12** **Date:** 08/23/11 **Location Tag:** ST4 **View Direction:** Southwest **Comments:** The SLM was located in the northwest quadrant of the project site, near a metal security gate. The site was elevated significantly higher than the roadway surface of CR-83.

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	**Photograph 13** **Date:** 08/23/11 **Location Tag:** ST5 **View Direction:** Southwest **Comments:** Placed at the residence located at 11906 Belle Valley Road in the town of Cumberland.
	**Photograph 14** **Date:** 08/23/11 **Location Tag:** ST5 **View Direction:** Northeast **Comments:** The SLM was placed approximately 20' south of the southwest corner of the residence. This site was elevated higher than the road surface of CR-340 (Belle Valley Road).

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Photograph 15
Date: 08/23/11

Location Tag:
ST6

View Direction:
Southeast

Comments:

Placed at the residence located at 11780 Belle Valley Road in the town of Cumberland. This address was also the location of **LT-02**.

Photograph 16
Date: 08/23/11

Location Tag:
ST6

View Direction:
Southwest

Comments:

The SLM was placed approximately 15’ west of the corner of the residence, and approximately 100’ from CR-340 (Belle Valley Road).

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Table D1
Construction Equipment Schedule

Construction Equipment	Months											
	1	2	3	4	5	6	7	8	9	10	11	12
Personnel Vehicles	20	40	60	80	80	80	80	80	80	80	80	60
Pickup Truck - 1/2 ton	4	4	4	6	6	8	8	8	8	8	8	6
Pickup Truck - 3/4 ton	2	2	3	4	4	4	4	4	4	4	4	3
Pickup Truck - 1 ton	1	1	3	4	4	4	4	4	4	4	4	3
Water Truck	2	2	2	2	2	1	1	1	1	1	1	1
Tractor w/ mower	1	0	0	0	0	0	0	0	0	0	0	0
Motor grader	1	1	1	1	1	1	1	1	1	1	1	1
Dozer	1	2	2	2	1	0	0	0	0	0	0	0
Pan Scraper	2	4	4	4	2	0	0	0	0	0	0	0
Compactor	1	2	2	2	1	0	0	0	0	0	0	0
Front end loader	1	2	2	2	1	0	0	0	0	0	0	0
Backhoe w/ loader	2	2	2	2	2	2	2	2	2	2	2	2
Dump truck	2	2	2	2	2	2	2	2	2	2	2	2
Trencher	1	2	3	4	4	4	4	4	4	3	2	1
All-terrain forklift	1	1	2	4	4	4	4	4	4	2	1	1
Semi delivery truck & trailer	1	1	2	3	3	3	3	3	3	2	2	1
Concrete delivery truck	1	2	3	4	4	4	4	4	4	3	2	2
Power line truck	2	2	2	2	2	2	2	0	0	0	0	0
Construction labor (e.g., miscellaneous tools)	30	60	80	100	100	100	100	100	100	100	100	80

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Appendix B-3 – Air Quality Calculations

Turning Point Solar Project - Construction Emission Calculations
Construction Schedule and Equipment/Labor List

Description	HP	Fuel	hr/day	Weight (ton)	Maximum on-site traveling distance per trip (mile/day/unit/trip)	Maximum off-site traveling distance per trip (mile/day/unit/trip)	Number of trip (single trip/day/unit)	Maximum total on-site traveling distance (mile/day/unit)	Maximum total off-site traveling distance (mile/day/unit)	Estimated onsite operating hour %	Construction Time (Months) May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	Number of Vehicles for entire period.
											1	2	3	4	5	6	7	8	9	10	11	12	
Personal Vehicles	250	G	1	2	0.50	30.00	2.00	1.00	60.00	6%	20	40	60	80	80	80	80	80	80	80	80	60	820
Pickup (1/2 ton)	350	G	8	3	0.50	30.00	4.00	2.00	120.00	6%	4	4	4	6	6	8	8	8	8	8	8	6	78
Pickup (3/4 ton)	350	D	8	4	0.50	30.00	4.00	2.00	120.00	6%	2	2	3	4	4	4	4	4	4	4	4	3	42
Pickup (1 ton)	350	D	8	5	0.50	30.00	4.00	2.00	120.00	6%	1	1	3	4	4	4	4	4	4	4	4	3	40
Water Truck	350	D	8	20	0.50	30.00	8.00	4.00	240.00	6%	2	2	2	2	2	1	1	1	1	1	1	1	17
Tractor with Mower	300	D	8	10	1.00	-	4.00	4.00	-	100%	1												1
Motor Grader	200	D	8	5	1.00	-	4.00	4.00	-	100%	1	1	1	1	1	1	1	1	1	1	1	1	12
Dozer	400	D	8	10	1.00	-	10.00	10.00	-	100%	1	2	2	2	1								8
Pan Scraper	300	D	8	10	1.00	-	4.00	4.00	-	100%	2	4	4	4	2								16
Compactor	300	D	8	10	1.00	-	4.00	4.00	-	100%	1	2	2	2	1								8
Front End Loader	200	D	6	5	1.00	-	10.00	10.00	-	100%	1	2	2	2	1								8
Backhoe with Loader	100	D	6	5	1.00	-	4.00	4.00	-	100%	2	2	2	2	2	2	2	2	2	2	2	2	24
Dump Truck	350	D	6	20	0.50	30.00	4.00	2.00	120.00	6%	2	2	2	2	2	2	2	2	2	2	2	2	24
Trencher	100	D	4	5	1.00	-	4.00	4.00	-	100%	1	2	3	4	4	4	4	4	4	3	2	1	36
All Terrain Forklift	100	D	4	5	1.00	-	10.00	10.00	-	100%	1	1	2	4	4	4	4	4	4	2	1	1	32
Semi Delivery Truck & Trailer	350	D	4	20	0.50	250.00	2.00	1.00	500.00	1%	1	1	2	3	3	3	3	3	3	2	2	1	27
Concrete Delivery Truck	350	D	4	20	0.50	30.00	4.00	2.00	120.00	6%	1	2	3	4	4	4	4	4	4	3	2	2	37
Power Line Truck	350	D	6	20	0.50	30.00	4.00	2.00	120.00	6%	2	2	2	2	2	2	2						14
Total											**46**	**72**	**99**	**128**	**123**	**119**	**119**	**117**	**117**	**112**	**109**	**83**	**1244**
Construction Labor			8								30	60	80	100	100	100	100	100	100	100	100	80	1050

NOTE:

1. Equipment count, size (hp), and hours per day based on information provided by Agile Energy,
2. Personal Vehicls are rated in 100hp to 350 hp, assumed the average is 250hp.
3. Assume Tractor with Mower is 300hp
4. Weight, travel distance (both onsite and offsite), and number of trips are from project description, data need responses, and assumptions
5. Assumed the average travel speeds are: 10 mph, onsite
   40 mph, offsite

Turning Point Solar Project - Construction Emission Calculations
Emission Factors

Table 2A. Emission Factors For Vehicle and Equipment Combustion Exhaust Emissions (onsite and offsite)

Equipment/Vehicle	HP	EF Source	EF Source Detail	Unit: lb/hr										
				Fugitive Dust PM10	Exhaust PM10	Total PM10	Fugitive Dust PM2.5	Exhaust PM2.5	Total PM2.5	CO	VOC	NOx	SOx	CO2
Personal Vehicles	250	Moves	Passenger Truck	0.00	0.00	0.00	0.00	0.00	0.00	0.76	0.04	0.08	0.00	43.51
Pickup (1/2 ton)	350	Moves	Light Commercial Truck	0.00	0.00	0.00	0.00	0.00	0.00	1.82	0.10	0.20	0.00	60.77
Pickup (3/4 ton)	350	Moves	Light Commercial Truck	0.00	0.02	0.03	0.00	0.02	0.02	0.22	0.06	0.40	0.00	82.87
Pickup (1 ton)	350	Moves	Light Commercial Truck	0.00	0.02	0.03	0.00	0.02	0.02	0.22	0.06	0.40	0.00	82.87
Water Truck	350	Moves	Single Unit Short-Haul Truck	0.00	0.02	0.03	0.00	0.02	0.02	0.21	0.04	0.46	0.00	110.34
Tractor with Mower	300	NonRoad	100hp, Tractors/Loaders/Backhoes	-	0.01	0.01	-	0.01	0.01	0.05	0.01	0.04	0.00	5.11
Motor Grader	200	NonRoad	175hp, Graders	-	0.03	0.03	-	0.03	0.03	0.11	0.02	0.27	0.00	46.60
Dozer	400	NonRoad	300hp, Crawler Tractor/Dozers	-	0.03	0.03	-	0.03	0.03	0.14	0.03	0.41	0.00	76.06
Pan Scraper	300	NonRoad	300hp, Scrapers	-	0.03	0.03	-	0.03	0.03	0.15	0.04	0.45	0.00	83.60
Compactor	300	NonRoad	300hp, Rollers	-	0.03	0.03	-	0.02	0.02	0.13	0.03	0.39	0.00	64.57
Front End Loader	200	NonRoad	175hp, Skid Steer Loaders	-	0.01	0.01	-	0.01	0.01	0.03	0.01	0.05	0.00	4.60
Backhoe with Loader	100	NonRoad	100hp, Tractors/Loaders/Backhoes	-	0.01	0.01	-	0.01	0.01	0.05	0.01	0.04	0.00	5.11
Dump Truck	350	Moves	Refuse Truck	0.01	0.06	0.06	0.00	0.05	0.05	0.31	0.06	1.28	0.00	202.92
Trencher	100	NonRoad	100hp, Trenchers	-	0.03	0.03	-	0.03	0.03	0.22	0.03	0.25	0.00	34.35
All Terrain Forklift	100	NonRoad	100hp, Rough Terrain Forklifts	-	0.03	0.03	-	0.03	0.03	0.21	0.02	0.23	0.00	33.45
Semi Delivery Truck & Trailer	350	Moves	Combination Long-haul Truck	0.00	0.06	0.06	0.00	0.06	0.06	0.29	0.06	1.47	0.00	277.49
Concrete Delivery Truck	350	Moves	Combination Long-haul Truck	0.00	0.06	0.06	0.00	0.06	0.06	0.29	0.06	1.47	0.00	277.49
Power Line Truck	350	Moves	Combination Long-haul Truck	0.00	0.06	0.06	0.00	0.06	0.06	0.29	0.06	1.47	0.00	277.49
Emergency Generator*	750	NonRoad	600hp, Generator Sets, using load fac	-	0.10	0.10	-	0.10	0.10	0.65	0.15	2.01	0.00	210.63
Riding Lawnmower	50	NonRoad	100hp, Front Mowers	-	0.01	0.01	-	0.01	0.01	0.08	0.02	0.14	0.00	16.38

Note:
1. The fugitive PM emissions here in this table are from brakewear and tirewear particulate

Table 2B. On-site Fugitive Dust Emissions

Emission Factor Equation:

(1) Travel on unpaved surfaces

$E = k * (s/12)^a * (W/3)^b * [(365 - P)/365]$ — Source: EPA AP-42 Section 13.2.2 Unpaved Roads Equations 1a and 2

E = size-specific emission factor (lb/VMT)

k, a, b = empirical constants

0.56 s = surface material silt content (%) — Construction sites - Scraper routes (smallest)

W = mean vehicle weight (tons)

139 P = Mean number of days per year with at least 0.01 inches of precipitation (from Cambridge, OH 1971-2000 NCDC Normals from MRCC)

constants — Industrial Roads

	PM_{10}	$PM_{2.5}$
k	1.5	0.15
a	0.9	0.9
b	0.45	0.45

(2) Bulldozing & grading

Source: EPA AP-42 Section 11.9

$E = p * 1 * s^{1.5} / M^{1.4}$

PM10 Emissions from bulldozing (lb/hr); Table 11.9-1 EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES (Overburden)

0.75 p = particle size multiplier for PM10

6.9 s = Silt content (%) (from Table 11.9-3 for bulldozers overburden)

7.9 M = Moisture content of surface material (%) (from Table 11.9-3 for bulldozers overburden)

0.75 lb/hr of PM10

$E = p * 5.7 * s^{1.2} / M^{1.3}$

PM2.5 Emissions from bulldozing (lb/hr); Table 11.9-1 EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES (Overburden)

0.105 p = particle size multiplier for PM2.5

6.9 s = Silt content (%) (from Table 11.9-3 for bulldozers overburden)

7.9 M = Moisture content of surface material (%) (from Table 11.9-3 for bulldozers overburden)

0.41 lb/hr of PM2.5

$E = p * 0.051 * S^{2.0}$

PM10 Emissions from grading (lb/VMT); Table 11.9-1 EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES (Overburden)

0.6 p = particle size multiplier for PM10

7.1 S = mean vehicle speed (mph) (from Table 11.9-3 for grader)

1.54 lb/VMT of PM10

$E = p * 0.040 * S^{2.5}$

PM2.5 Emissions from grading (lb/VMT); Table 11.9-1 EMISSION FACTOR EQUATIONS FOR UNCONTROLLED OPEN DUST SOURCES AT WESTERN SURFACE COAL MINES (Overburden)

0.031 p = particle size multiplier for PM2.5

7.1 S = mean vehicle speed (mph) (from Table 11.9-3 for grader)

0.17 lb/VMT of PM2.5

12 months of earth work

8 total construction hours per work day

21 construction days per month

(3) Dirt Piling or Material Handling

Source: PM10 Emissions from Material Handling (lb/ton) from EPA AP-42 Chapter 13.2.4 Eq. 1

$E = k * 0.0032 * (U/5)^{1.3} / (M/2)^{1.4}$ E = Emission factor (lb/ton material handled)

6.7 U = Mean Wind speed (mph) (Columbus International Airport, Columbus, OH; ASOS 1988-1992 data)

12 M = Moisture content of surface material (%) (from Table 13.2.4-1 for cover at municipal landfill)

constants

	PM_{10}	$PM_{2.5}$
k	0.35	0.053

0.00002 lb/ton of PM2.5

0.00013 lb/ton of PM10

21.00 construction days per month

6,235.63 density of soil (lb/yd3) (The range of surficial soil density (total unit weight) is from about sigma low 115 to sigma high 135 lb/cf. Use the highest as the most conservative value.)

50% soil and backfill moved by backhoe w/loader and trencher(cut out), backhoe w/loader (fill to dump truck or backfill onsite), and dump truck. (assumptions).

400.00 acre, disturbance area

17,424,068.00 square foot, disturbance area, assumption

1.00 feet depth of soils moved or disturbance (assumptions).

1,006,018.66 total tons of soil/backfill movement by the above equipment

12.00 months of earth work

3,992.14 total ton soil/backfill movement per day

(4) Cover Storage Pile during construction

E = 1.7 * G/1.5 * (365-H)/235 * I/15 * . Source: SCAQMD Table A9-9-E (source is readily available and representative)

PM10 Emission factor from wind erosion of storage piles per day per acre

9 G = Silt content (%) (from EPA AP-42 Table 13.2.4-1 for cover at municipal landfill)

139 H = number of days per year with at least 0.01 inches of precipitation (from assumptions)

15 I = Percentage of time that the unobstructed wind speed exceeds 12 mph at mean pile height (10 meter anemometer height)(Columbus International Airport, Columbus, OH; ASOS 1988-1992 data)

0.5 J = Fraction of TSP that is PM10 = 0.5

4.905 lb/acre/day

10 piles (assumptions)

0.1 Size of Pile (acre) (assumptions)

12 months total for piles present due to earth moving (assumptions).

2.45 lb/day PM10, total piles.

Equipment/Vehicle	(1) Travel on unpaved surfaces			(2) Bulldozing & grading			(3) Dirt Piling or Material Handling			(4) Cover Storage Pile			Total Onsite fugitive dust EF	
	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)	Mitigation Efficiency	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)	Mitigation Efficiency	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)	Mitigation Efficiency	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)	Mitigation Efficiency	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)
Personal Vehicles	0.79	0.08	83%										0.13	0.01
Pickup (1/2 ton)	0.24	0.02	83%										0.04	0.00
Pickup (3/4 ton)	0.27	0.03	83%										0.05	0.00
Pickup (1 ton)	0.30	0.03	83%										0.05	0.01
Water Truck	1.11	0.11	83%										0.19	0.02
Tractor with Mower	0.05	0.01	83%										0.01	0.00
Motor Grader				0.77	0.08	61%							0.30	0.03
Dozer				0.75	0.41	61%							0.29	0.16
Pan Scraper				0.77	0.08	61%							0.30	0.03
Compactor	0.05	0.01	83%										0.01	0.00
Front End Loader				0.75	0.41	61%							0.29	0.16
Backhoe with Loader							0.04	0.04	61%				0.02	0.02
Dump Truck							1.42	1.42	61%				0.55	0.55
Trencher							0.07	0.07	61%				0.03	0.03
All Terrain Forklift	0.19	0.02	83%										0.03	0.00
Semi Delivery Truck & Trailer	4.36	0.44	83%										0.74	0.07
Concrete Delivery Truck	1.11	0.11	83%										0.19	0.02
Power Line Truck	0.74	0.07	83%										0.13	0.01
(cover storage piles)										0.10	0.02	61%	0.04	0.01

Note:

1. It is assumed that all the onsite roads are all unpaved. It is also assumed the project will do watering every 3 hours and limit the onsite vehicle speed to less than 15 mph to mitigate the fugitive dust.
2. "Watering Control Efficiency" and "Limit Maximum Speed Control Efficiency" for unpaved road from SCAQMD CEQA Handbook 2007 - Mitigation Measures and Control Efficiencies (http://www.aqmd.gov/CEQA/handbook/mitigation/fugitive/MM_fugitive.html) - 61% from watering every 3 hours, 57% from limiting speeds to 15 mph, and 83% [=1-(1-0.61)*(1-0.57)] from doing these two mitigation together. (source is readily available and representative)

Equipment/Vehicle	(1) Travel on unpaved surfaces			Total Onsite fugitive	
	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)	Mitigation Efficiency	PM_{10} EF (lbs/hr)	$PM_{2.5}$ EF (lbs/hr)
Personal Vehicles	0.05	0.01	0%	0.05	0.01
Pickup (1/2 ton)	0.02	0.00	0%	0.02	0.00
Pickup (3/4 ton)	0.02	0.01	0%	0.02	0.01
Pickup (1 ton)	0.03	0.01	0%	0.03	0.01
Water Truck	0.26	0.06	0%	0.26	0.06
Tractor with Mower	-	-	0%	-	-
Motor Grader	-	-	0%	-	-
Dozer	-	-	0%	-	-
Pan Scraper	-	-	0%	-	-
Compactor	-	-	0%	-	-
Front End Loader	-	-	0%	-	-
Backhoe with Loader	-	-	0%	-	-
Dump Truck	0.17	0.04	0%	0.17	0.04
Trencher	-	-	0%	-	-
All Terrain Forklift	-	-	0%	-	-
Semi Delivery Truck & Trailer	1.00	0.25	0%	1.00	0.25
Concrete Delivery Truck	0.26	0.06	0%	0.26	0.06
Power Line Truck	0.17	0.04	0%	0.17	0.04

Turning Point Solar Project - Construction Emission Calculations

ONSITE MONTHLY EMISSIONS

	Quantity Mo 4	Operating %	Month 4 Daily Vehicle Emissions (lb/day)							Month 4 Daily Fugitive Emissions (lb/day)	
			PM_{10}	$PM_{2.5}$	CO	VOC	NO_x	SO_2	CO_2	PM_{10}	$PM_{2.5}$
Equipment/Vehicle											
Personal Vehicles	80	6%	0.01	0.01	7.62	0.10	12.02	0.01	217.56	0.67	0.13
Pickup (1/2 ton)	6	6%	0.01	0.01	2.05	0.02	2.27	0.00	45.58	0.12	0.00
Pickup (3/4 ton)	4	6%	0.05	0.05	0.22	0.01	3.01	0.00	41.43	0.09	0.00
Pickup (1 ton)	4	6%	0.05	0.05	0.28	0.01	3.01	0.00	41.43	0.10	0.01
Water Truck	2	6%	0.03	0.02	0.53	0.00	1.72	0.00	55.17	0.19	0.05
Tractor with Mower	-	100%	-	-	-	-	-	-	-	-	-
Motor Grader	1	100%	0.21	0.20	0.56	0.02	-	0.00	186.41	2.41	0.16
Dozer	2	100%	0.43	0.42	2.76	0.07	-	0.00	1,521.27	4.70	3.23
Pan Scraper	4	100%	0.96	0.93	6.10	0.15	-	0.00	1,337.68	9.63	1.30
Compactor	2	100%	0.40	0.39	2.53	0.06	-	0.00	516.59	0.14	0.02
Front End Loader	2	100%	0.07	0.07	0.33	0.02	-	0.00	92.03	3.52	1.61
Backhoe with Loader	2	100%	0.09	0.09	0.52	0.02	-	0.00	40.91	0.21	0.17
Dump Truck	2	6%	0.05	0.04	0.78	0.00	4.79	0.00	50.73	0.42	1.38
Trencher	4	100%	0.50	0.49	4.31	0.10	-	0.00	549.66	0.42	0.52
All Terrain Forklift	4	100%	0.47	0.45	4.11	0.09	-	0.00	1,338.16	0.50	0.06
Semi Delivery Truck & Trailer	3	1%	0.01	0.01	0.14	0.00	8.73	0.00	6.61	0.07	0.04
Concrete Delivery Truck	4	6%	0.06	0.06	1.47	0.01	10.99	0.00	138.74	0.19	0.09
Power Line Truck	2	6%	0.05	0.04	0.73	0.00	5.50	0.00	69.37	0.09	0.03
Total	**128**		**3.45**	**3.32**	**35.05**	**0.68**	**52.03**	**0.02**	**6,249.34**	**23.45**	**8.82**

Note: Based on professional judgement, Month 4 was used as it consisted of the most pieces of equipment and included the largest emitting equipment.
Particulate vehicle emissions include combustion exhaust, brakewear and tire wear emissions.

ONSITE ANNUAL VEHICLE EMISSIONS

Construction Assumptions - 21 days per month

Equipment	Number of Vehicles for entire period	Operating %	Annual Vehicle Emissions (ton/year) PM_{10}	$PM_{2.5}$	CO	VOC	NO_x	SO_2	CO_2	Annual Fugitive Emissions (ton/year) PM_{10}	$PM_{2.5}$
Equipment/Vehicle											
Personal Vehicles	820	6%	0.001	0.001	0.820	0.011	1.294	0.001	23.415	0.072	0.014
Pickup (1/2 ton)	78	6%	0.002	0.001	0.280	0.003	0.309	0.000	6.221	0.016	0.001
Pickup (3/4 ton)	42	6%	0.006	0.005	0.025	0.001	0.332	0.000	4.568	0.010	0.001
Pickup (1 ton)	40	6%	0.005	0.005	0.029	0.001	0.316	0.000	4.350	0.011	0.001
Water Truck	17	6%	0.002	0.002	0.047	0.000	0.153	0.000	4.924	0.017	0.004
Tractor with Mower	1	100%	0.001	0.001	0.005	0.000	0.000	0.000	0.215	0.001	0.000
Motor Grader	12	100%	0.026	0.025	0.070	0.003	0.000	0.000	23.488	0.303	0.020
Dozer	8	100%	0.018	0.018	0.116	0.003	0.000	0.000	63.893	0.197	0.136
Pan Scraper	16	100%	0.040	0.039	0.256	0.006	0.000	0.000	56.183	0.404	0.055
Compactor	8	100%	0.017	0.016	0.106	0.003	0.000	0.000	21.697	0.006	0.001
Front End Loader	8	100%	0.003	0.003	0.014	0.001	0.000	0.000	3.865	0.148	0.068
Backhoe with Loader	24	100%	0.012	0.011	0.065	0.002	0.000	0.000	5.154	0.026	0.022
Dump Truck	24	6%	0.006	0.005	0.099	0.000	0.603	0.000	6.392	0.052	0.174
Trencher	36	100%	0.047	0.046	0.408	0.010	0.000	0.000	51.943	0.039	0.049
All Terrain Forklift	32	100%	0.039	0.038	0.345	0.008	0.000	0.000	112.406	0.042	0.005
Semi Delivery Truck & Trailer	27	1%	0.001	0.001	0.013	0.000	0.825	0.000	0.624	0.007	0.003
Concrete Delivery Truck	37	6%	0.006	0.006	0.142	0.001	1.068	0.000	13.475	0.018	0.009
Power Line Truck	14	6%	0.003	0.003	0.054	0.000	0.404	0.000	5.099	0.007	0.002
Total	**1244**		**0.2356**	**0.2261**	**2.8955**	**0.0517**	**5.3037**	**0.0016**	**407.9127**	**1.3768**	**0.5648**

Number of Vehicles per year = sum of monthly daily maximum vehicle usage
Particulate vehicle emissions include combustion exhaust, brakewear and tire wear emissions.

OFFSITE ANNUAL VEHICLE EMISSIONS

Construction Assumptions - 21 days per month
50 mph, average off iste vehicle speed

Equipment	Number of Vehicles for entire period	Maximum total off-site traveling distance	Annual Vehicle Emissions (ton/year)						
			PM_{10}	$PM_{2.5}$	CO	VOC	NO_x	SO_2	CO_2
Equipment/Vehicle									
Personal Vehicles	820	60	0.027	0.018	7.873	0.411	0.828	0.007	449.561
Pickup (1/2 ton)	78	120	0.008	0.006	3.583	0.203	0.396	0.002	119.450
Pickup (3/4 ton)	42	120	0.027	0.025	0.237	0.059	0.425	0.001	87.705
Pickup (1 ton)	40	120	0.025	0.023	0.225	0.056	0.405	0.001	83.528
Water Truck	17	240	0.022	0.019	0.182	0.038	0.392	0.001	94.543
Tractor with Mower	1	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Motor Grader	12	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dozer	8	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Pan Scraper	16	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Compactor	8	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Front End Loader	8	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Backhoe with Loader	24	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Dump Truck	24	120	0.036	0.033	0.189	0.034	0.772	0.001	122.726
Trencher	36	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
All Terrain Forklift	32	-	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Semi Delivery Truck & Trailer	27	500	0.177	0.164	0.831	0.164	4.156	0.006	786.676
Concrete Delivery Truck	37	120	0.058	0.054	0.273	0.054	1.367	0.002	258.729
Power Line Truck	14	120	0.022	0.020	0.103	0.020	0.517	0.001	97.897
Total	**1244**		**0.404**	**0.363**	**13.497**	**1.040**	**9.257**	**0.020**	**2,100.817**

Number of Vehicles per year = sum of monthly daily maximum vehicle usage
Particulate vehicle emissions include combustion exhaust, brakewear and tire wear emissions.

Operational Annual Emmisions

Description	Annual Vehicle Emissions (ton/year)						
	PM_{10}	$PM_{2.5}$	CO	VOC	NO_x	SO_2	CO_2
Personal Vehicles	0.00	0.00	0.04	0.00	0.00	0.00	2.28
Utility Vehicle							
Pickup (1/2 ton)	0.00	0.00	0.31	0.02	0.03	0.00	10.21
Pickup (1 ton)	0.00	0.00	0.02	0.00	0.03	0.00	6.96
Riding LawnMower	0.00	0.00	0.00	0.00	0.01	0.00	0.69
Total	0.00	0.00	0.37	0.02	0.08	0.00	20.14
Emergency Generator*	0.0006	0.0006	0.0039	0.0009	0.0121	0.0000	1.2638

Note: Emergency Generator assumed to be tested 12 hours per year. Also, emergency generator powers electrically-driven fire pump.

Emission Factors

MOVES OUTPUT SUMMARY TABLE 1

fuelTypeID	1

Max of g/hour	Pollutant Description																						
Source Description	Atmospheric CO2	Carbon Monoxide (	Non-metha	Oxides of Ni	Primary Exh	Primary Exl	Primary PM10	Primary PM10 - E	Primary PM10 - (	Primary PM	Primary PM	Primary PM	Primary PM	Primary PM	Primary PM	Primary PM	Sulfur Diox	Total Energy Consum	Total Gase	Volatile Org	Nitrous Oxi	Methane	Grand Total
Light Commercial Truck	27,564.87	826.91	45.27	91.36	1.31	1.21	0.34	0.18	1.13	0.00	0.26	0.09	0.17	1.04	0.00	0.06	0.41	383,557,727.73	47.98	46.87	1.84	2.71	383,557,727.73
Passenger Car	19,736.51	345.64	17.46	36.36	0.74	0.68	0.20	0.16	0.58	0.00	0.25	0.05	0.15	0.53	0.00	0.06	0.30	274,626,414.20	18.48	18.05	0.61	1.01	274,626,414.20
Passenger Truck	28,007.53	763.50	43.19	86.08	1.33	1.23	0.33	0.18	1.15	0.00	0.25	0.09	0.16	1.06	0.00	0.06	0.42	389,715,108.68	45.69	44.71	1.65	2.50	389,715,108.68

fuelTypeID	2

Max of g/hour	Pollutant Description																						
Source Description	Atmospheric CO2	Carbon Monoxide (CO)	Non-methane Hydrocarbon	Oxides of Nitrogen	Primary Exhaust PM10	Primary Exhaust PM2.5	Primary PM10 - Brakewear Particulate	Primary PM10 - Elemental Carbon	Primary PM10 - Organic Carbon	Primary PM10 - Sulfate Particulate	Primary PM10 - Tirewear Particulate	Primary PM2.5 - Brakewear Particulate	Primary PM2.5 - Elemental Carbon	Primary PM2.5 - Organic Carbon	Primary PM2.5 - Sulfate Particulate	Primary PM2.5 - Tirewear Particulate	Sulfur Dioxide	Total Energy Consumption	Total Gaseous Hydrocarbons	Volatile Organic Compounds	Nitrous Oxide	Methane	Grand Total
Combination Long-haul Truck	147,234.02	301.17	97.65	1,132.03	33.77	32.75	0.91	26.99	6.70	0.08	0.94	0.24	26.18	6.50	0.08	0.23	1.12	2,007,736,185.73	123.87	100.73	0.09	26.22	2,007,736,185.73
Combination Short-haul Truck	125,866.06	132.99	25.60	664.96	26.68	25.88	0.86	23.24	3.37	0.07	0.86	0.22	22.54	3.27	0.07	0.21	0.96	1,716,359,149.95	26.80	26.31	0.09	1.20	1,716,359,149.95
Intercity Bus	46,479.14	92.90	19.60	190.82	9.40	9.12	1.46	5.25	4.13	0.02	0.57	0.38	5.09	4.01	0.02	0.14	0.35	633,805,607.39	21.44	20.21	0.10	1.84	633,805,607.39
Light Commercial Truck	37,587.18	101.39	24.34	182.02	10.70	10.38	0.35	8.81	1.87	0.02	0.32	0.09	8.55	1.81	0.02	0.08	0.29	512,551,803.98	25.92	25.12	0.12	1.58	512,551,803.98
Passenger Truck	37,996.64	84.71	19.39	154.40	8.70	8.44	0.32	7.08	1.59	0.02	0.32	0.08	6.87	1.55	0.02	0.08	0.29	518,138,879.66	21.47	20.01	0.11	2.08	518,138,879.66
Refuse Truck	92,043.13	141.96	25.08	578.79	25.08	24.33	1.39	20.59	4.44	0.05	0.89	0.36	19.98	4.31	0.05	0.21	0.70	1,255,132,364.27	26.26	25.82	0.10	1.17	1,255,132,364.27
Single Unit Short-Haul Truck	50,051.29	96.10	19.38	207.45	9.83	9.53	1.43	5.75	4.05	0.03	0.57	0.38	5.58	3.93	0.03	0.14	0.37	682,520,456.16	21.33	19.99	0.11	1.95	682,520,456.16

MOVES OUTPUT SUMMARY TABLE 2

	Emission Factors (unit: g/hr)								
Source Description	Exhausted PM10	Exhausted PM2.5	CO	VOC	NOx	SOx	CO2	Primary PM10 -	Primary PM2.5 - Brakewear and Tirewear Particulate
Combination Long-haul Truck	33.77	32.75	301.17	100.73	1,132.03	1.12	147,234.02	1.85	0.46
Combination Short-haul Truck	26.68	25.88	132.99	26.31	664.96	0.96	125,866.06	1.72	0.43
Intercity Bus	9.40	9.12	92.90	20.21	190.82	0.35	46,479.14	2.02	0.52
Light Commercial Truck	10.70	10.38	101.39	25.12	182.02	0.29	37,587.18	0.68	0.17
Passenger Truck	8.70	8.44	84.71	20.01	154.40	0.29	37,996.64	0.63	0.16
Refuse Truck	25.08	24.33	141.96	25.82	578.79	0.70	92,043.13	2.28	0.58
Single Unit Short-Haul Truck	9.83	9.53	96.10	19.99	207.45	0.37	50,051.29	2.00	0.51
Passenger Car	0.74	0.68	345.64	18.05	36.36	0.30	19,736.51	0.45	0.11
Light Commercial Truck	1.31	1.21	826.91	46.87	91.36	0.41	27,564.87	0.60	0.15

MOVES OUTPUT SUMMARY TABLE 3

	Emission Factors (unit: lb/hr)								
Source Description	Exhausted PM10	Exhausted PM2.5	CO	VOC	NOx	SOx	CO2	Primary PM10 -	Primary PM2.5 - Brakewear and Tirewear Particulate
Passenger Truck	0.019175	0.018601	0.19	0.04	0.34	0.00	83.77	0.001398	0.000351
Intercity Bus	0.020726	0.020105	0.20	0.04	0.42	0.00	102.47	0.004463	0.001141
Single Unit Short-Haul Truck	0.021661	0.021012	0.21	0.04	0.46	0.00	110.34	0.004412	0.001128
Refuse Truck	0.055303	0.053645	0.31	0.06	1.28	0.00	202.92	0.005023	0.001272
Light Commercial Truck	0.023588	0.022882	0.22	0.06	0.40	0.00	82.87	0.001492	0.000375
Combination Short-haul Truck	0.058816	0.057053	0.29	0.06	1.47	0.00	277.49	0.003782	0.000948
Combination Long-haul Truck	0.074439	0.072209	0.66	0.22	2.50	0.00	324.60	0.004084	0.001023
Passenger Car	0.00162	0.00150	0.76201	0.03980	0.08016	0.00065	43.51156	0.00100	0.00025
Light Commercial Truck	0.00290	0.00267	1.82302	0.10332	0.20142	0.00091	60.77014	0.00132	0.00033

NOTE: the table is sorted ascending by NOx.