RAMBOLL

ENVIRONMENT
& HEALTH

# THUNDER MOUTAIN ENVIRONMENTAL SERVICES LLC
# MODELING PROTOCOL

| | |
|---|---|
| Project name | **Air Dispersion Modeling Protocol** |
| Project no. | **1139560\1940103088** |
| Recipient | **West Virginia DEP – Division of Air Quality** |
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| Version | **2** |
| Date | **November 10, 2022** |
| Prepared by | **Helena Kubarycz** |
| Checked by | **Abhishek Bhat** |
| Approved by | **Matthew Traister, P.E.** |

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# 1. Introduction

On June 3, 2022 Thunder Mountain Environmental Services, LLC (TMES) submitted an application for a minor New Source Review (NSR) Permit for the construction of a new regulated medical waste (RMW) treatment facility located in Jackson County, West Virginia. On August 25, 2022, Mr. Edward Andrews of the West Virginia Department of Environmental Protection (WVDEP) requested TMES submit an air dispersion modeling protocol for evaluation of the impacts from the affected facility to further support the siting analysis required pursuant to 40 Code of Federal Regulations (CFR) Subpart 60.54c(a). This modeling protocol has been developed to satisfy the WVDEP's request.

This modeling protocol outlines the methodologies that will be used to conduct the air dispersion modeling analysis required by WVDEP. As requested, compliance will be demonstrated by meeting the National Ambient Air Quality Standards (NAAQS) for criteria pollutants, nitrogen oxides ($NO_X$), carbon monoxide (CO), sulfur dioxide ($SO_2$), particulate matter with an aerodynamic diameter less than 10 microns ($PM_{10}$), and particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$), lead, and ozone.

## 1.1 Project Discussion

TMES is proposing to construct a new solid RMW gasification waste to energy facility. This facility will consist of a single thermal gasification system, a Vista Thermal Gasifier, that will be used for the treatment of RMW. The thermal gasification system will convert the RMW into high British Thermal Unit (BTU) synthetic gas (syngas).

To demonstrate that the impacts from the facility will not be a potential risk to public health or the environment, TMES will conduct air dispersion modeling for nitrogen oxides ($NO_X$), carbon monoxide (CO), sulfur dioxide ($SO_2$), $PM_{10}$, $PM_{2.5}$ and lead. Impacts for these criteria pollutants will be compared to their respective NAAQS to show compliance with the requirement.

## 1.2 Site Location and Description

The waste to energy facility will lease space in an existing industrial building located at 5334 Point Pleasant Road, Ravenswood, West Virginia. A site location map is provided in **Figure 1**. The site is bounded by a mix of undeveloped herbaceous land and rural residential homes on all sides. The Ohio River is located approximately 0.45 km to the northeast.

## 1.3 Stack Parameters and Buildings

Preliminary stack parameters for the emission point that will be included in the modeling analysis is provided in **Table 1** (English Units) and **Table 2** (Metric Units). A site layout map with building heights and stack location is included in **Figure 2**. Base elevations for the building and sources will be based on the grade elevation of the existing facility. Please note emissions from material handling will be exhausted through the same emission point as the emissions from the thermal gasifier (EP-001).

Please note, there is an emergency generator that will be limited to emergency and maintenance use only and a maximum of 100 hours per year. However, the affected facility to which 40 CFR 60.54c applies is the individual waste incinerators. Emissions from the emergency generator are not considered part of the affected facility under 40 CFR 60.54c and therefore, will not be included in the modeling analysis.

The emergency bypass vent is a damper that will be open in an emergency situation when there is power failure and failure of the backup emergency generator. The emergency vent will only be utilized in an emergency overpressure situation which otherwise can cause severe damage to process equipment. The emergency vent is a pressure relief valve which will not be activated in the process of maintenance, startup, or shutdown purposes. In the event the emergency release is required, the situation will qualify for accidental release and would release in excess emissions. For the purposed of demonstrating compliance with 40 CFR 60.54c, malfunctions which may result in excess emissions are not considered to be a normal operating condition. If such an event occurred, the WVDEP can request the excess emissions be modeled at that time.

### 1.4 Emission Rates

A summary of emission rates to be used in the modeling analysis is provided in **Table 3**. Please note the emission rates were previously provided in Table 9.2.1 and Table 9.4.1 of the submitted permit application.

## 2. Air Dispersion Modeling Methodology

This section of the modeling protocol describes the procedures and data resources that will be used in the air quality modeling analyses. In general, the air dispersion modeling analyses will be conducted in accordance with the following guidance documents:

- United States (US) Environmental Protection Agency's (EPA) Guideline on Air Quality Models 40 CFR 51, Appendix W (Revised, January 17, 2017), herein referred to as Appendix W
- USEPA's AERMOD Implementation Guide (Revised June 1, 2022)
- USEPA, Office of Air Quality Planning and Standards, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. Additional Clarification Regarding Application of Appendix W Modeling Guidance for the 1-hour $NO_2$ National Ambient Air Quality Standard (March 1, 2011)
- USEPA, Office of Air Quality Planning and Standards. Guidance for Ozone and Fine Particulate Matter Permit Modeling. EPA-454/R-22-005. (July 29, 2022)
- USEPA, Office of Air Quality Planning and Standards. Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier I Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program. EPA-454/R-19-003. (April 30, 2019)

### 2.1 Air Dispersion Model Selection

Air dispersion models predict pollutant concentrations downwind of a source by simulating the evolution of the pollutant plume over time and space given data inputs that include the quantity of emissions and the initial exhaust release conditions (*e.g.*, velocity, flow rate, and temperature). The latest version of the AERMOD model (Version 22112) will be utilized for the modeling demonstration. AERMOD is a refined, steady-state, multiple source dispersion model and was promulgated in December 2005 as the preferred model to use for industrial sources in this type of air quality analysis. The AERMOD analysis will be conducted using the regulatory default options as provided in Appendix W. The final modeling analysis will be performed using the single processor model executable code provided by USEPA without any modification to the code for parallel processing.

### 2.2 Urban/Rural Classification

USEPA guidance in 40 CFR 51, Appendix W, Section 7.2.3 allows for either a land use procedure or a population density procedure to evaluate whether urban or rural dispersion coefficients will be used in a modeling analysis. Appendix W also states that the land use procedure is considered more definitive. Therefore, the land use procedure was chosen for this analysis.

The land use procedure involves evaluating the presence of various industrial, commercial, residential and agricultural/natural areas within a three-kilometer radius circle centered on the site (Auer scheme). If more than fifty percent of the area within this circle were designated industrial, commercial and compact residential, urban dispersion parameters would be used; otherwise, the modeling would use rural dispersion parameters. Based on the 2016 National Land Cover Data (NLCD), the majority of the surrounding area is categorized as rural. Therefore, rural dispersion curves will be used in the analysis.

### 2.3 Good Engineering Practice Stack Height Analysis

USEPA provides specific guidance for calculating Good Engineering Practice (GEP) stack height and for evaluating whether building downwash will occur (USEPA, 2003). GEP stack height is defined by USEPA as the height of the structure plus 1.5 times the lesser of the structure height or projected width. If the stack height for a source is less than the height identified using GEP guidelines, based on the dimensions of nearby buildings, then the potential for building downwash to occur exists and is to be considered in the modeling analysis. The stacks to be modeled in this analysis will be less than GEP stack height.

The AERMOD model incorporates Plume Rise Modeling Enhancements (PRIME) to account for downwash. The direction-specific building downwash dimensions used as inputs will be determined by the latest version (04274) of the Building Profile Input Program, PRIME (BPIP-PRIME). BPIP-PRIME uses building downwash algorithms incorporated into AERMOD to account for the plume dispersion effects of the aerodynamic wakes and eddies produced by buildings and structures.

### 2.4 Meteorological Data

The closest National Weather Service (NWS) station to the TMES facility is the Mason County Airport (K3I2), which is located approximately 26 km to the west of the facility. However, this station is not considered to have suitable meteorological data for air quality analyses since the station does not have an automated surface observing station (ASOS) and therefore one-minute data are not available.

The remaining nearest NWS stations with the appropriate ASOS is the Parkersburg Mid-Ohio Valley Airport (KPKB), located approximately 43 km to the northeast. Figures of the area surrounding the TMES facility and the Parkersburg NWS are provided in **Figure 3** and **Figure 4**. Both the sites are located in rural areas in rolling terrain. **Table 4** presents a comparison of the albedo, Bowen ratio, and surface roughness for each location. The albedo and Bowen ratio are similar at both sites. The surface roughness varies between the two sites, which is typical when comparing undeveloped herbaceous land to airports. Based on review of the terrain and land use surrounding the Parkersburg NWS and the TMES facility, meteorological conditions at the Parkersburg NWS are considered representative of those expected at the TMES facility. Preprocessed, AERMOD-ready meteorological station data will be obtained from Lakes Software for the most recent full five years (2017-2021).

When processing the meteorological data for KPKB, it was identified that the third quarter (Q3) of 2018 has 18.3% missing hours. However, this does not affect the completeness of the data set. The total number of missing hours from 2018 is 5.5%, which is less than 10%. Furthermore, the overall missing data of the five-year data set is 4.03% which meets the completeness requirement provided in the USEPA's Meteorological Monitoring Guidance for Regulatory Modeling Application (February 2000), which states that meteorological data must be 90% complete in order to be acceptable for use in regulatory dispersion modeling[1].

### 2.5 Coordinate System

The location of emission sources, building structures, and receptors will be represented in the Universal Transverse Mercator (UTM) coordinate system. The datum for the modeling analysis is based on North American Datum 1983 (NAD 83). UTM coordinates for this analysis reside within UTM Zone 17 which will serve as the reference point for regional receptors and sources.

### 2.6 Receptor Locations

The modeling analysis will utilize a set of nested Cartesian grids of receptors with a spacing of 50, 100, and 500, meters extending to a distance of 1, 3, and 5 kilometers, respectively, from the facility. The facility will not have restricted access; therefore, on-site receptors inside the property boundary will be included. If maximum impacts occur beyond 1 km from the facility, an additional grid will be placed around the maximum impact with receptors spaced 50 meters apart. Additionally, if the concentration contours display higher gradient towards the edge of the receptor grid, the receptor grid will be expanded.

The current version of the AERMOD terrain preprocessor called AERMAP (version 18081) will be used to calculate the receptor elevations and appropriate hill height values. Ten-meter resolution National Elevation Dataset (NED) data will be used in the analysis.

## 3. NAAQS Analysis

To assess compliance with the NAAQS, sources at the facility will be modeled and a representative background concentration will be added to the modeled concentrations and compared against the applicable NAAQS. **Table 5** summarizes the specific model output for each pollutant and averaging periods that will be used for assessing compliance with the NAAQS.

### 3.1 Background Concentrations

For the NAAQS Analysis, background monitoring data will be used for $NO_2$, $PM_{10}$, and $PM_{2.5}$, $SO_2$, CO, and ozone collected from monitoring sites in West Virginia, Kentucky, and Ohio based on proximity to the facility and the conservative nature of the concentrations measured by these monitors. Monitoring data for a three year period will be used for the analysis are summarized in **Table 6**. The following sections discuss the monitor selection for each pollutant.

#### 3.1.1 $NO_2$ Monitor Selection

The Ashland Primary Site (Ashland) monitor in Boyd County, KY (AQS Site ID 21-019-0017) is proposed for estimating the 1-hour and annual $NO_2$ background concentrations. This site is located approximately 92 km southwest of the TMES facility. The Ashland Primary Site is the closest $NO_2$ monitor to the facility. The Ashland monitor is located in an area that is more urban than the TMES facility and is thus expected to be influenced by higher levels of emissions. According to the 2022 Kentucky Annual Ambient Air Monitoring Network Plan, the Ashland monitor represents maximum concentrations on an urban scale for nitrogen dioxide. As such, this monitor is expected to provide a conservative approximation of $NO_2$ background concentrations. The 98th percentile of 1-hour daily maximum concentrations from 2019 to

[1] According to a telephone conversation, regarding the number of missing hours in Q3 of 2018, between Mr. Jon McClung of WVDEP and Ms. Helena Kubarycz of Ramboll on October 5, 2022, the 2017-2021 meteorological data for KPKB are acceptable.

2021 were averaged to establish the 1-hour background concentration. The highest annual average concentration across the three years (2019-2021) was selected as the annual background concentration.

### 3.1.2 CO Monitor Selection

The Charleston monitor in Kanawha County, WV (AQS Site ID 54-039-0020) is proposed for estimating the 1-Hour and 8-hour CO background concentrations. This monitor is located approximately 64 km south from the TMES facility and is the closest CO monitor to the facility. The monitor is located in an area that is more urban than the TMES facility and is thus expected to be influenced by higher levels of emissions. According to the 2022 WVDEP Ambient Air Monitoring Annual Network Plan, the Charleston monitor represents maximum concentrations on an urban scale for CO. As such, this monitor is expected to provide a conservative approximation of CO background concentrations. The second highest 1-hour average concentration from 2020 and the second highest 8-hour average concentration from 2021 will be used as the representative background concentrations in the NAAQS analysis.

### 3.1.3 $PM_{2.5}$ Monitor Selection

The Vienna monitor (AQS Site ID 54-107-1002), located approximately 48 km northeast from the TMES facility in Wood County, WV, is proposed for estimating the 24-hour and annual $PM_{2.5}$ background concentrations. This monitor is the closest monitor to the facility and the monitor is located in an area that is more urban than the area surrounding the TMES facility and is thus expected to be influenced by higher levels of emissions. As such, this monitor is expected to provide a conservative approximation of $PM_{2.5}$ background concentrations. The $98^{th}$ percentile of the 24-hour average concentrations in a given year was averaged over three years (2018, 2020, and 2021) for the 24-hour background concentration. The annual arithmetic mean averaged across the three years was selected as the annual average concentration for use in the NAAQS analysis. The annual arithmetic mean for 2019 does not satisfy minimum data completeness criteria so therefore 2019 data were not used.

Please note the Gilford monitor in Athens County, OH (AQS Site ID 39-009-0003) was evaluated for data completeness. Similarly, the Gilford monitor did not meet the minimum data completeness criteria for the 2020 annual mean. The Gilford monitor is located in a similar rural area as the TMES facility and is considered to be representative of the surrounding area as the TMES facility. However, to be conservative, the background concentrations from the Vienna monitor (which is higher than Gilford monitor) will be used.

### 3.1.4 $PM_{10}$ Monitor Selection

The Ironton monitor in Lawrence County, OH (AQS Site ID 39-087-0012) is proposed for estimating the 24-hour $PM_{10}$ background concentration. This site is located approximately 88 km southwest of the TMES facility. The Ironton monitor is the closest monitor to the facility and has a similar geographic location adjacent to the Ohio River. The Ironton monitor is expected to provide a representative background concentration for the TMES facility. The second highest 24-hour average concentration from 2020 was used as the representative background concentration in the NAAQS analysis.

### 3.1.5 $SO_2$ Monitor Selection

The Vienna monitor (AQS Site ID 54-107-1002), located approximately 48 km northeast from the TMES facility in Wood County, WV, is proposed for estimating the 1-hour $SO_2$ background concentration. The Vienna monitor is located in an area that is more urban than the TMES facility and is thus expected to be influenced by higher levels of emissions. As such, this monitor is expected to provide a conservative approximation of $SO_2$ background concentrations. Background 1-hour SO2 will be based on the average

$99^{th}$ percentile monitored value from years 2019-2021. Background 3-hour $SO_2$ will be based on the 2019 $99^{th}$ percentile 1-hour monitored value, which is the highest value from the 2019-2021 dataset.

#### 3.1.6 Ozone Monitor Selection

The Vienna monitor (AQS Site ID 54-107-1002), located approximately 48 km northeast from the TMES facility in Wood County, WV, is proposed for estimating the 8-hour ozone background concentration. This monitor is the closest ozone monitor to the facility. The Vienna monitor is located in an area that is more urban than the TMES facility and is thus expected to be influenced by higher levels of emissions. According to the 2022 WVDEP Ambient Air Monitoring Annual Network Plan, the Vienna monitor represents maximum concentrations on an urban scale for ozone. As such, this monitor is expected to provide a conservative approximation of ozone background concentrations. The Annual fourth-highest daily maximum 8-hour concentration was averaged over three years (2018-2020) for the 8-hour background concentration.

### 3.2 $NO_2$ Modeling Approach

$NO_2$ emissions from the thermal gasifier will be included in the modeling analysis.

Appendix W provides a tiered approach to $NO_2$ NAAQS modeling. The current recommended tiered methods are:

- Tier 1 – assume full conversion of NO to $NO_2$
- Tier 2 – assume ambient equilibrium between NO and $NO_2$ and apply the Ambient Ratio Method 2 (ARM2)
- Tier 3 – Use detailed screening techniques that estimate the NO to $NO_2$ conversion (OLM and PVMRM)

The tiers are designed to start with the most conservative and work up to the least conservative. The modeling analysis will use a Tier 2 $NO_2$ modeling approach using the regulatory-approved default settings. Should additional refinement be necessary, a Tier 3 modeling approach be used and the appropriate inputs will be outlined in the modeling report.

### 3.3 $PM_{2.5}$ Modeling Approach

USEPA's guidance document *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* (April 30, 2019) provides a detailed framework for permit applicants to estimate single source impacts of secondary pollutants. Additionally, USEPA has generated empirical relationships between single sources and $PM_{2.5}$ impacts for hundreds of hypothetical sources that vary in stack height, emission rate, and geographic location.

For the NAAQS analysis, the MERPs VIEW Qlik application will be used to estimate secondarily formed $PM_{2.5}$ concentrations. The secondarily formed $PM_{2.5}$ concentrations will be added to the modeled concentrations and the representative background concentrations to demonstrate compliance with the NAAQS.

### 3.4 Ozone Modeling Approach

USEPA's guidance document *Guidance on the Development of Modeled Emission Rates for Precursors (MERPs) as a Tier 1 Demonstration Tool for Ozone and $PM_{2.5}$ under the PSD Permitting Program* (April 30, 2019) provides a detailed framework for permit applicants to estimate single source impacts on secondary pollutants. Additionally, USEPA has generated empirical relationships between single sources and ozone impacts for hundreds of hypothetical sources that vary in stack height, emission rate, and geographic location.

For the NAAQS analysis, the MERPs VIEW Qlik application will be used to estimate secondarily formed ozone concentrations. The secondarily formed ozone concentrations will be added to the representative background concentrations to demonstrate compliance with the NAAQS.

## 4. Modeling Results

A modeling report will be submitted to the WVDEP. The modeling analysis will provide the maximum predicted concentrations plus representative background concentrations for the appropriate averaging periods for compliance with the NAAQS. Results will be presented in a tabular format. Additionally, a figure of the concentration contours will be provided for each pollutant and averaging period. The figures will display the extent of the air quality impacts.

Electronic copies of AERMOD input and output files, BPIP input and output files, AERMAP input and output files, and meteorological data files will be submitted with the modeling report. Meteorological data processing control input, output, and the raw data files used to process the meteorological data will be requested from Lakes Software to be included with electronic modeling files.

# TABLES

## Table 1

## Thunder Mountain Environmental Services LLC
## Ravenswood, West Virginia

### Stack Parameter Table (English Units)

| Emission Point | Emission Point Description | Stack Location X-Coordinate (m) | Stack Location Y-Coordinate (m) | Release Type | Base Elevation (ft) | Stack Height[(a)] (ft) | Inside Diameter[(a)] (in) | Inside Diameter (ft) | Exit Temperature[(a)] (°F) | Flowrate[(a)] (cfm) |
|---|---|---|---|---|---|---|---|---|---|---|
| EP-001 | Thermal Gasifier & Material Handling | 431,034 | 4,308,611 | Vertical | 640 | 60.0 | 26.0 | 3.00 | 200 | 6,000 |

**Notes:**

(a) Stack parameters provided by Iron Construction and provided in the air permit application submitted June 2022

*Source: Ramboll*

## Table 2

### Thunder Mountain Environmental Services LLC
### Ravenswood, West Virginia

### Stack Parameter Table (Metric Units)

| Emission Point | Emission Point Description | Stack Location X-Coordinate (m) | Stack Location Y-Coordinate (m) | Release Type | Base Elevation (m) | Stack Height[(a)] (m) | Inside Diameter[(a)] (m) | Exit Temperature[(a)] (°C) | Flowrate[(a)] ($m^3/s$) |
|---|---|---|---|---|---|---|---|---|---|
| EP-001 | Thermal Gasifier & Material Handling | 431,034 | 4,308,611 | Vertical | 195 | 18.3 | 0.914 | 93 | 2.83 |

**Notes:**

(a) Stack parameters provided by Iron Construction and provided in the air permit application submitted June 2022

*Source: Ramboll*

## Table 3

## Thunder Mountain Environmental Services LLC
## Ravenswood, West Virginia

### Summary of Emission Rates [a]

| Emission Point | Emission Point Description | $PM_{10}$ (lb/hr) | $PM_{2.5}$ (lb/hr) | CO (lb/hr) | $SO_2$ (lb/hr) | $NO_X$ (lb/hr) | Lead (lb/hr) | VOC (lb/hr) |
|---|---|---|---|---|---|---|---|---|
| EP-001 | Thermal Gasifier | 0.087 | 0.087 | 0.286 | 0.00146 | 0.069 | 5.03E-07 | 0.880 |
| EP-001 | Material Handling | 0.0739 | 0.0261 | -- | -- | -- | -- | -- |

**Notes:**
(a) Emission rate calculations were developed by Iron Construction and provided in the air permit application submitted June 2022

## Table 4

## Thunder Mountain Environmental Services LLC
## Ravenswood, West Virginia

## Comparison of Land Use Parameters - TMES Facility vs. Parkersburg Airport

| Sector | TMES Facility | | | Parkersburg NWS | | | Percent Difference[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Albedo | Bowen Ratio | Surface Roughness (meters) | Albedo | Bowen Ratio | Surface Roughness (meters) | Albedo | Bowen Ratio | Surface Roughness |
| 1 | 0.160 | 0.580 | 0.0170 | 0.160 | 0.660 | 0.209 | 0% | -14% | -1129% |
| 2 | 0.160 | 0.580 | 0.0170 | 0.160 | 0.660 | 0.132 | 0% | -14% | -676% |
| 3 | 0.160 | 0.580 | 0.0160 | 0.160 | 0.660 | 0.0690 | 0% | -14% | -331% |
| 4 | 0.160 | 0.580 | 0.155 | 0.160 | 0.660 | 0.109 | 0% | -14% | 30% |
| 5 | 0.160 | 0.580 | 0.235 | 0.160 | 0.660 | 0.125 | 0% | -14% | 47% |
| 6 | 0.160 | 0.580 | 0.341 | 0.160 | 0.660 | 0.180 | 0% | -14% | 47% |
| 7 | 0.160 | 0.580 | 0.0940 | 0.160 | 0.660 | 0.404 | 0% | -14% | -330% |
| 8 | 0.160 | 0.580 | 0.131 | 0.160 | 0.660 | 0.338 | 0% | -14% | -158% |
| 9 | 0.160 | 0.580 | 0.145 | 0.160 | 0.660 | 0.230 | 0% | -14% | -59% |
| 10 | 0.160 | 0.580 | 0.123 | 0.160 | 0.660 | 0.223 | 0% | -14% | -81% |
| 11 | 0.160 | 0.580 | 0.171 | 0.160 | 0.660 | 0.256 | 0% | -14% | -50% |
| 12 | 0.160 | 0.580 | 0.0500 | 0.160 | 0.660 | 0.285 | 0% | -14% | -470% |
| Average[b][c] | 0.160 | 0.580 | 0.125 | 0.160 | 0.660 | 0.213 | 0% | -14% | -71% |

**Notes:**

(a) Percent Difference = (TMES Facility - Parkersburg NWS) / TMES Facility

(b) Average = average land use parameter averaged over the 12 sectors

(c) Average Percent Difference = (average TMES facility surface roughness - average Parkersburg NWS surface roughness) / average TMES facility surface roughness

# Table 5

## Thunder Mountain Environmental Services LLC
## Ravenswood, West Virginia

### Summary of Modeling Output for NAAQS Compliance Demonstration

| Pollutant | Averaging Period | Design Standard | AERMOD Output |
|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 1-Hour | 98$^{th}$ percentile of 1-hour daily maximum concentrations, averaged over 3 years | Maximum 5-year daily average of the 8$^{th}$ highest concentration, on a receptor-by-receptor basis |
| | Annual | Annual mean | Maximum annual average across 5-year period |
| Carbon monoxide (CO) | 1-Hour | Not to be exceeded more than once per year | 2$^{nd}$ highest across 5-year period |
| | 8-Hour | Not to be exceeded more than once per year | 2$^{nd}$ highest across 5-year period |
| Particulate matter 2.5 ($PM_{2.5}$) | 24-Hour | 98$^{th}$ percentile, averaged over 3 years | 8$^{th}$ highest 24-hour concentration in a given year, averaged across 5-year period |
| | Annual | Annual mean, averaged over 3 years | Average across 5-year period |
| Particulate matter 10 ($PM_{10}$) | 24-Hour | Not to be exceeded more than once per year on average over 3 years | 6$^{th}$ highest across 5-year period [(a)] |
| Sulfur dioxide ($SO_2$) | 1-Hour | 99$^{th}$ percentile of 1-hour daily maximum concentrations, averaged over 3 years | Maximum 5-year daily average of the 4$^{th}$ highest concentration, on a receptor-by-receptor basis |
| | 3-Hour | Not to be exceeded more than once per year | 2$^{nd}$ high across 5 year period |
| Lead | 3-Month | Rolling 3-month average, not to be exceeded | Monthly average output will be used to calculate the rolling 3-month average across 5-year period |

**Notes:**
(a) The high-6th-high (high-N+1-High) over five years will be used.

# Table 6

## Thunder Mountain Environmental Services LLC
## Ravenswood, West Virginia

## Summary of Background Concentrations for NAAQS Analysis

| Pollutant | Averaging Period | Design Value | Units of Measure | AQS Site ID | City |
|---|---|---|---|---|---|
| Nitrogen dioxide ($NO_2$) | 1-Hour | 26.7 | ppb | 21-019-0017 | Ashland, KY |
| | Annual | 5.23 | ppb | | |
| Carbon monoxide (CO) | 1-Hour | 1.00 | ppm | 54-039-0020 | Charleston, WV |
| | 8-Hour | 0.6 | ppm | | |
| Particulate Matter 2.5 ($PM_{2.5}$) | 24-Hour | 17 | $\mu g/m^3$ | 54-107-1002 | Vienna, WV |
| | Annual | 7.53 | $\mu g/m^3$ | | |
| Particulate Matter 10 ($PM_{10}$) | 24-Hour | 30 | $\mu g/m^3$ | 54-011-0007 | Ironton, OH |
| Sulfur dioxide ($SO_2$) | 1-Hour | 19 | ppb | 54-107-1002 | Vienna, WV |
| | 3-Hour | | ppb | | |
| Ozone | 8-Hour | 0.06 | ppm | 54-107-1002 | Vienna, WV |

**Notes:**

FIGURES

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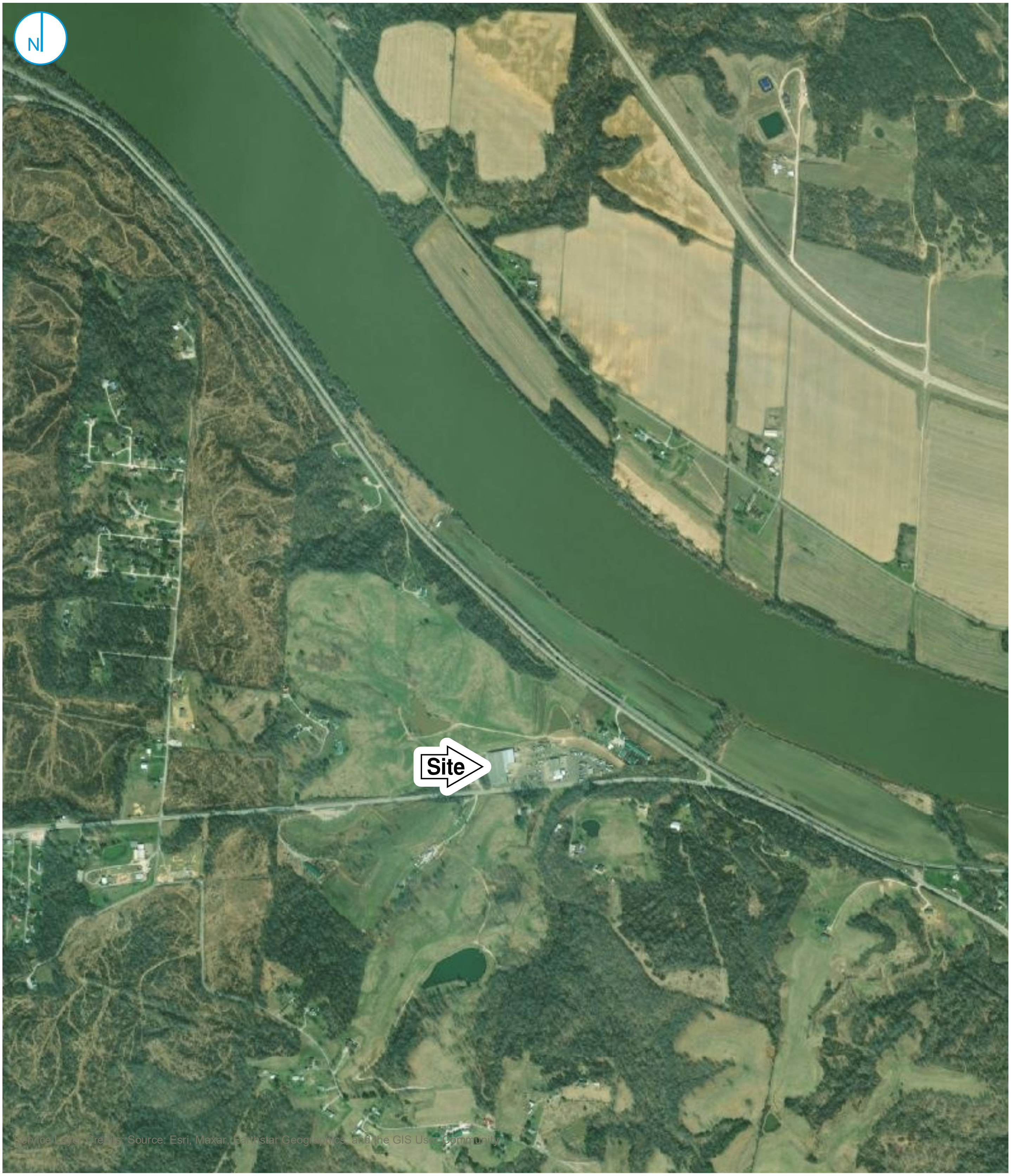
PROJECT: 1940103088 | DATED: 10/5/2022 | DESIGNER: YOUNGAS




Map Scale: 1:20,000 | Map Center: 80°12'46"W 38°44'47"N

## SITE LOCATION

## FIGURE 01

KEY MAP

0 1,000 2,000 Feet

**Thunder Mountain Environmental Services LLC**
5334 Point Pleasant Rd,
Ravenswood, WV 26164

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

RAMBOLL

PROJECT TITLE:

**Figure 2 - Site Layout Map**


| COMMENTS: | SOURCES: | COMPANY NAME: | |
|---|---|---|---|
| | **1** | | |
| | RECEPTORS: **5233** | MODELER: | |
| | | SCALE: 1:1,000<br>0 — 0.03 km | |
| | | DATE: **10/10/2022** | PROJECT NO.: |

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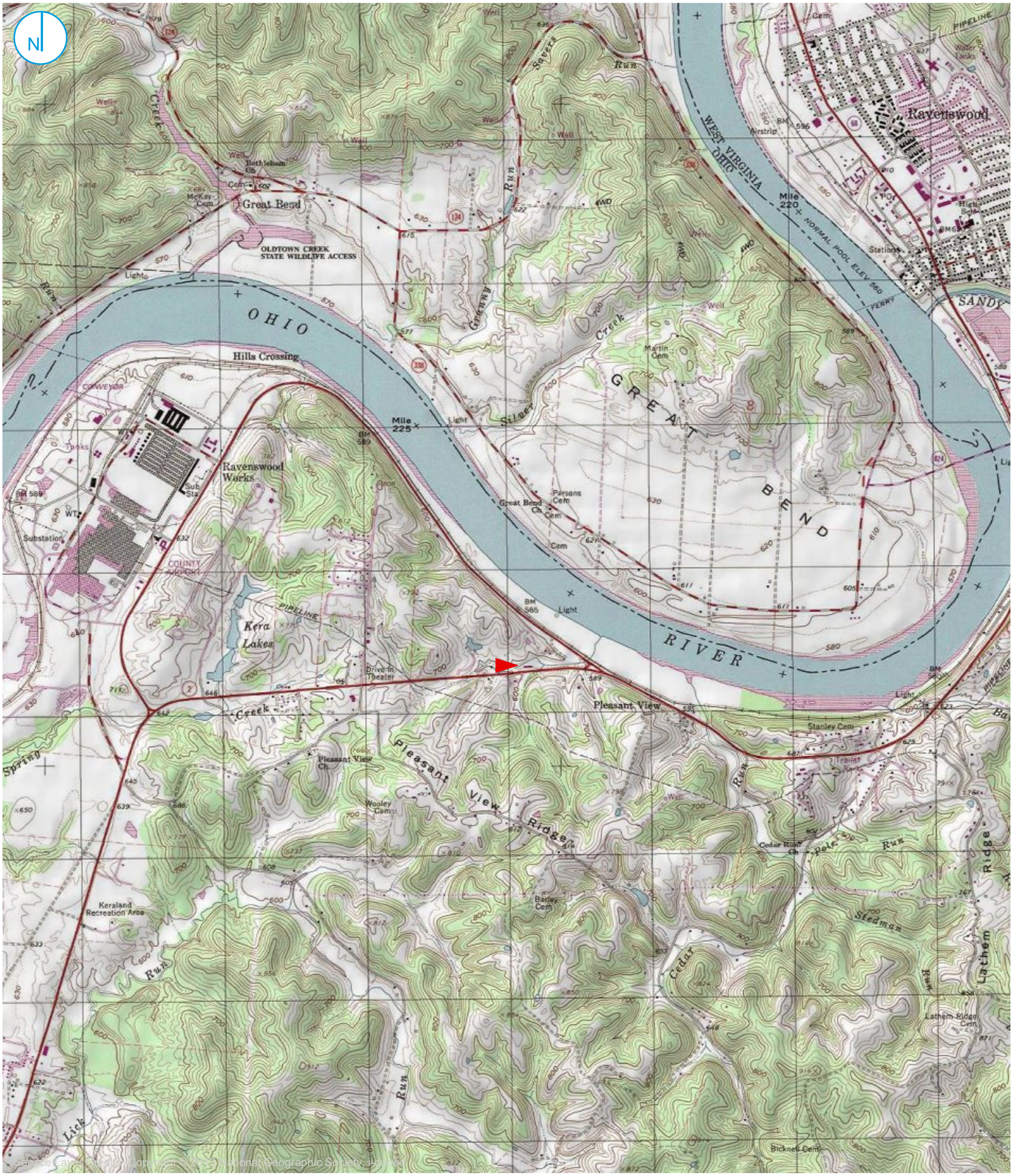
PROJECT: 1940103088 | DATED: 10/5/2022 | DESIGNER: YOUNGAS




## TOPOGRAPHIC MAP
### FACILITY

## FIGURE 03

0 2,000 4,000
Feet

**Thunder Mountain Environmental Services LLC**
5334 Point Pleasant Rd,
Ravenswood, WV 26164

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

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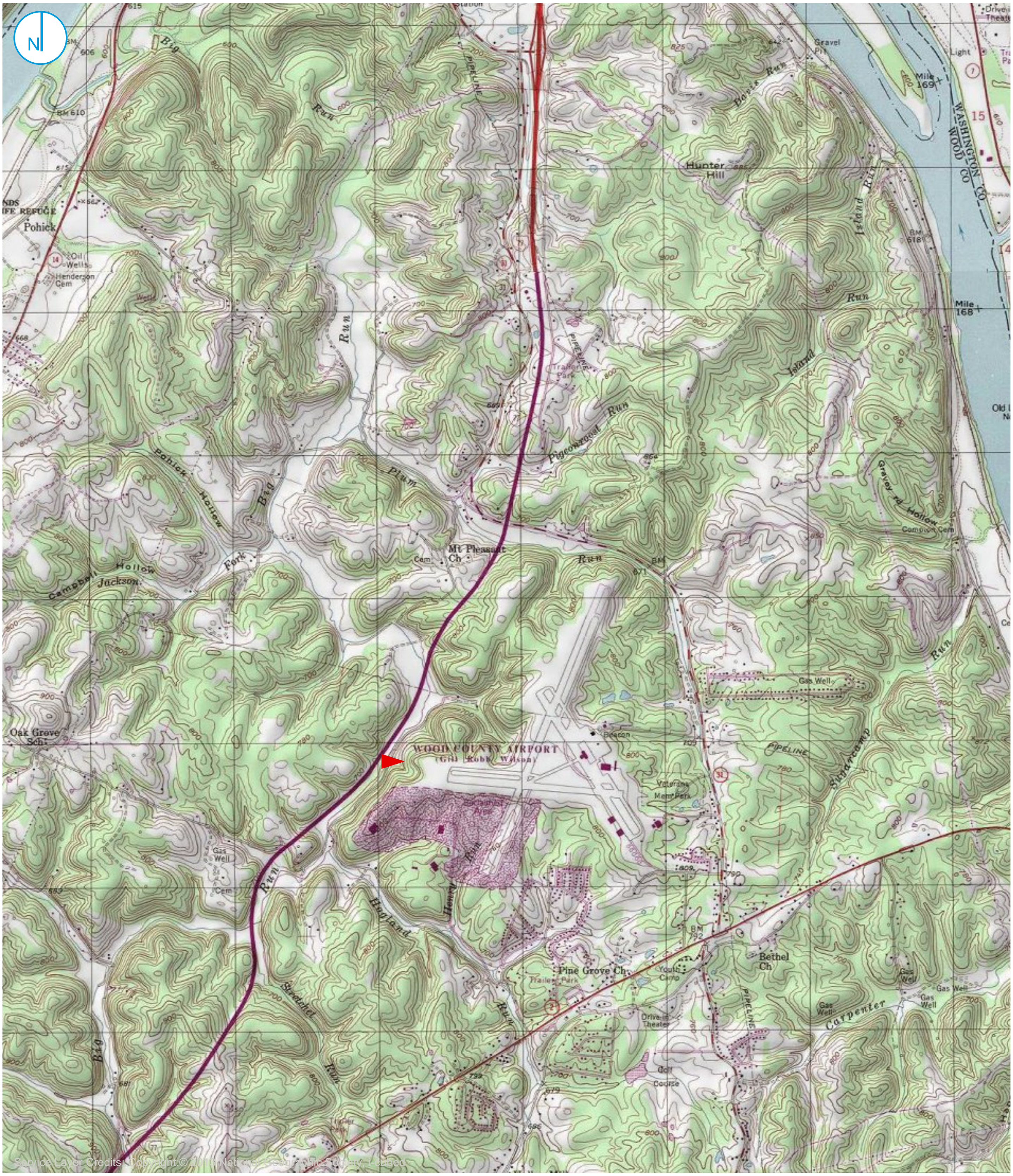
PROJECT: 1940103088 | DATED: 10/5/2022 | DESIGNER: YOUNGAS




## TOPOGRAPHIC MAP
### AIRPORT

## FIGURE 04

RAMBOLL AMERICAS
ENGINEERING SOLUTIONS, INC.
A RAMBOLL COMPANY

0 2,000 4,000
Feet

**Mid-Ohio Valley Regional Airport**
543 Co Rte 31/1,
Williamstown, WV 26187

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