

Globe Metallurgical, Inc.
Beverly, Ohio

Air Quality SO_2 Modeling Report

Globe Beverly

May 2022

Project No.: 0444556

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Document details	The details entered below are automatically shown on the cover and the main page footer. PLEASE NOTE: This table must NOT be removed from this document.
Document title	Air Quality SO_2 Modeling Report
Document subtitle	Globe Beverly
Project No.	0444556
Date	May 2022
Version	V3
Authors	Olga Samani and Andrew Desrosiers
Client Name	Globe Metallurgical, Inc.

Document history

				ERM approval to issue		
V	Revision	Author	Reviewed by	Name	Date	Comments
V1	1.0	Olga Samani/ Mark Garrison	Mark Garrison	Gary Keating		
V2	1.0	Olga Samani/ Mark Garrison	Mark Garrison	Gary Keating		
V3	1.0	Olga Samani/ Andrew Desrosiers	Olga Samani	Gary Keating		

Signature Page

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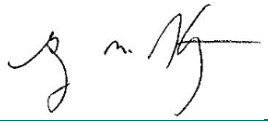
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CONTENTS

1. INTRODUCTION 3
1.1 Ambient Air Boundary for the Globe Facility 6
2. MODELING METHODOLOGY 7
2.1 Facility Location 8
2.2 Meteorology 8
2.2.1 Meteorological Data Processing 13
2.2.2 Surface Parameters 13
2.3 Ambient Background Concentrations 16
2.4 Source Characterization and Emission Rates 17
2.5 Receptors 23
3. URBAN DESIGNATION FOR THE GLOBE BEVERLY FACILITY 24
3.1 Satellite Images 27
3.2 Heat Release and Effective Population Calculation 31
3.3 Model Performance 34
3.4 Summary 37
4. MODEL RESULTS PRESENTATION 38

APPENDIX A BEVERLY FACILITY – SHOP 1 AND 2 PHOTOGRAPHS
APPENDIX B SATELLITE ANALYSIS OF THE URBAN-RURAL TEMPERATURE DIFFERENCE FOR THE GLOBE METALLURGICAL BEVERLY FACILITY

List of Tables

Table 2-1: Hackney Seasonal Hour-of-Day Monitoring Data Based on 2018-2020 Period 17
Table 2-2: Exhaust Flow Calculation Illustration 20
Table 2-3: Model Inputs 22
Table 3-1: Description of Urban Land Use Categories 26
Table 3-2: Results of the Satellite Image Analysis 30
Table 3-3: Derivation – Simplification of MFD Equation 108 32
Table 3-4: Calculate Heat Released from Baghouse Exhaust 33
Table 3-5: Calculate Effective Population 34
Table 4-1: Daily Actual Emissions April 6, 2021 to April 6, 2022 38
Table 4-2: SO_2 Emission Limit Sets – Modeled and 2022 DFFOs Limits 39
Table 4-3: Model Results Based on Hourly SO_2 Emission Limit Sets 41

List of Figures

Figure 1-1: Hourly SO_2 Concentrations at the Hackney Monitor, 2014-2021 5
Figure 2-1: Beverly Facility SO_2 Emission Sources, Fence Line, Meteorological Tower Locations 8
Figure 2-2: Terrain Elevations near the Globe Beverly Facility 10
Figure 2-3: Terrain Elevations near the Parkersburg Airport 11
Figure 2-4: Globe Monitor Site-Specific Wind Rose (April 2021 to April 2022) 12
Figure 2-5: Parkersburg Airport Wind Rose (April 2021 to April 2022) 12
Figure 2-6: Land-use Characteristics 15
Figure 2-7: Hourly SO_2 2018-2020 by Wind Direction 16
Figure 2-8: Receptor Locations (Close) 23

Figure 3-1: Background Rural and Facility Urban Areas for Satellite Analysis 28
Figure 3-2: Temperature Differences for 6/3/2018 31
Figure 3-3: Q-Q Plot of Predicted and Observed Concentrations at the Hackney Monitor 35
Figure 3-4: Q-Q Plot of Predicted and Observed Concentrations at the Globe Monitor 36
Figure 4-1: Model Results Contours - Actual Daily Emissions 42
Figure 4-2: Model Results Contours – Hourly Emissions 43

1. INTRODUCTION

Environmental Resources Management (ERM), on behalf of Globe Metallurgical, Inc. (Globe) has conducted air quality modeling to determine the air quality impact of SO_2 emissions from the Globe Beverly, Ohio facility. The methodology followed in the modeling and described in this report differs from the report and modeling files submitted to the Ohio Environmental Protection Agency (Ohio EPA) in May, 2020[1] in the following areas:

- The ambient air boundary now starts at the facility fence line.
- Updated source characteristics were used for the No.1 Shop baghouse to account for an increased release height resulting from the planned installation of a vertical release roof monitor on the baghouse as required by the 2022 Ohio EPA Director's Final Findings and Orders (2022 DFFOs).[2]
- More representative, site-specific meteorology (12 months of data) was used instead of data obtained from the Parkersburg, WV airport (PKB).
- Ambient concentrations of SO_2 measured at the Hackney, Ohio monitor (i.d. 39-115-0004) for the years 2018-2020 were used to develop seasonal, hour-of-day concentrations to define background concentrations used by AERMOD. This is an update from the previous 3-year period, 2016-2018.
- In addition to modeling conducted to demonstrate compliance with the 2010 1-hour SO_2 NAAQS based on the 26 combinations of emission limits from Shop 1 and Shop 2 as required in Table 1 of the 2022 DFFOs, additional modeling was conducted using actual emissions (April 2021-April 2022) from the Beverly facility (using the same 12 months of site-specific meteorological data) to further demonstrate compliance with the 2010 1-hour SO_2 NAAQS.

This document presents the results of SO_2 impacts based on the methodology presented here. The Beverly facility is located in an area that is currently designated non-attainment for the 2010 1-hour NAAQS for SO_2. The area described in 40 CFR Part 81.336 as Muskingum River, OH includes part of Morgan County (Center Township) and part of Washington County (Waterford Township), and was designated non-attainment in October 2013. The Beverly facility is located in Washington County, approximately 5 kilometers (km) northwest of the town of Waterford. The non-attainment designation was the result of measured 1-hour SO_2 concentrations that exceeded the NAAQS at the Hackney monitor (i.d. 39-115-0004), approximately 5 km north of the Beverly facility. The 99th percentile maximum daily 1-hour concentrations measured at the Hackney monitor were 124, 148, 91 for 2013-2015 and, 18, 17, and 13 parts per billion (ppb) for 2018-2020. The 1-hour SO_2 NAAQS is 75 ppb (196.2 micrograms/cubic meter – $\mu g/m^3$); compliance with the NAAQS is evaluated against the 3-year average of the 99th percentile maximum daily 1-hour concentration (this average is referred to as the "design value"). The design value in 2015 was 121 ppb, 161% of the NAAQS, but by 2020 the design value was 16 ppb, 21% of the NAAQS.

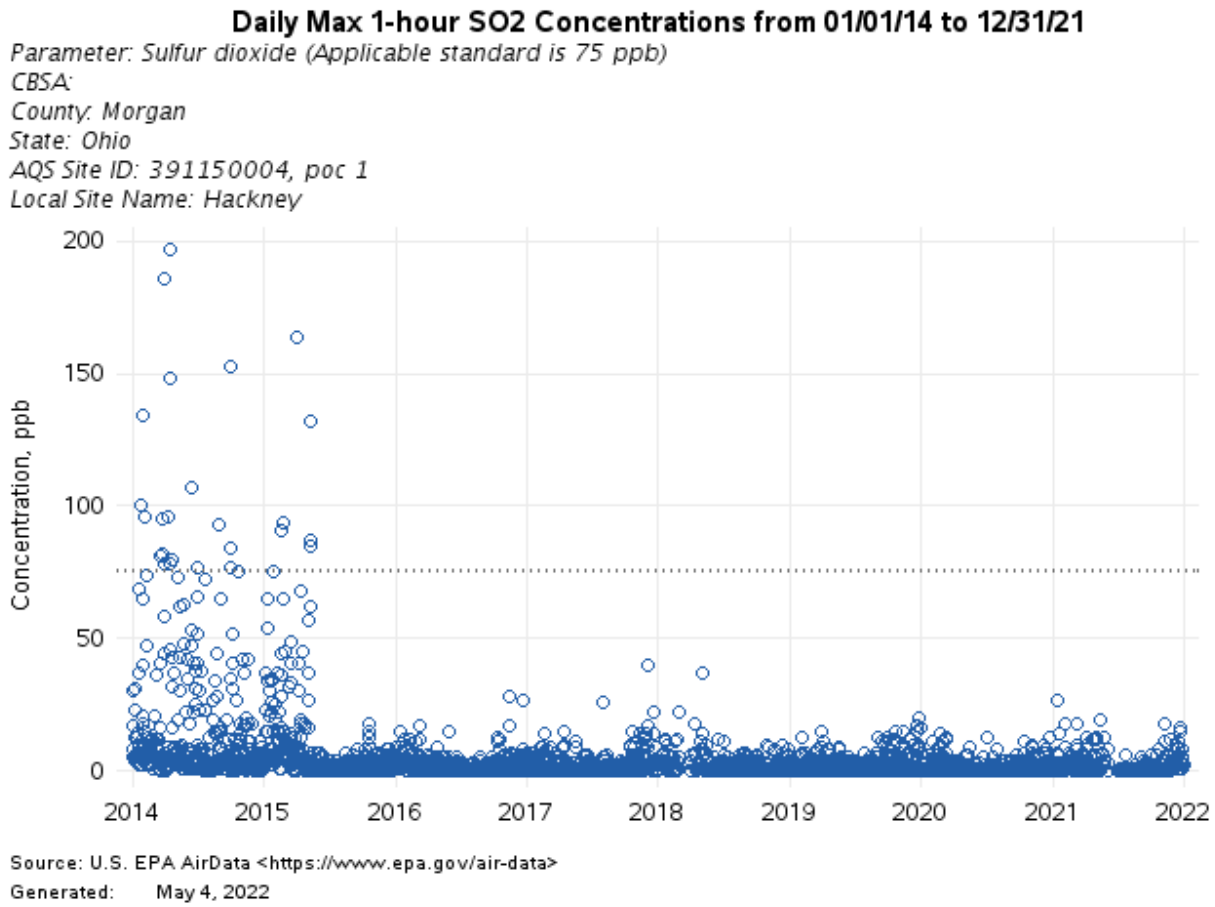
The significant reduction in measured concentration that occurred after 2015 was the result of the shutdown of the Muskingum River coal-fired power plant, located in the same industrial area as the Beverly facility. Muskingum River had annual SO_2 emissions of approximately 100,000 tons/year, and was shut down in June 2015. Figure 1-1 displays a time series of SO_2 concentrations recorded at the

[1] The May 2020 report was included as Appendix F in Ohio's June 23, 2020 State Implementation Plan submittal.

[2] On June 23, 2000, Ohio EPA issued a Director's Final Findings and Orders for the Beverly facility (2020 DFFOs), In 2022, Ohio EPA updated the 2020 DFFOs to require installation of the vertical release roof monitor on the No. 1 Shop baghouse, in addition to other minor updates (the 2022 DFFOs). Hereinafter, this modeling report shall refer to the 2022 DFFOs.

Hackney monitor for 2014-2021; the reduction in measured concentrations after June 2015 is clearly evident.

Figure 1-1: Hourly SO_2 Concentrations at the Hackney Monitor, 2014-2021



The large reduction in SO_2 emissions has resulted in a significant decrease in measured concentrations to the point where the Hackney monitor complies with the 1-hour SO_2 NAAQS by a significant margin based on measurements through 2021. While the Hackney monitor provides over 3 years of data demonstrating attainment of the 1-hour SO_2 NAAQS in the nonattainment area, U.S. EPA guidance recommends the use of air quality modeling "using *actual* emissions and meteorological information for the most recent 3 calendar years" [3] in conjunction with existing monitoring data to demonstrate attainment (particularly in circumstances where the existing air quality monitor has not been demonstrated to be located in the area of maximum SO_2 concentration). Air quality modeling using actual emissions can also be used to "determine the representativeness of the monitoring data, and/or to provide needed information where there is nonexistent or inadequate monitoring data for the affected area." [4]

As further described in Section 4 of this report, the modeling results demonstrate attainment of the 2010 SO_2 NAAQS when using actual emissions (April 2021-April 2022) from the Beverly facility (using 12 months of site-specific meteorological data). Attainment of the 2010 SO_2 NAAQS is also demonstrated when emissions based on the 26 combinations of emission limits contained in the 2022 DFFOs (using 12 months of site-specific meteorological data and the updated BH1 release height) are modeled.

[3] *See* U.S. EPA Memorandum: Guidance for 1-Hour SO_2 Nonattainment Area SIP Submissions, April 23, 2014, at pg. 62 *available at* https://www.epa.gov/sites/production/files/2016-06/documents/20140423guidance_nonattainment_sip.pdf (emphasis added).
[4] *See id.* at pg. 63

Subsequent sections describe the methodology including the use of the most recent version of the AERMOD model (21112) in the urban mode, and describe receptor, source, and meteorological inputs for use with AERMOD.

1.1 Ambient Air Boundary for the Globe Facility

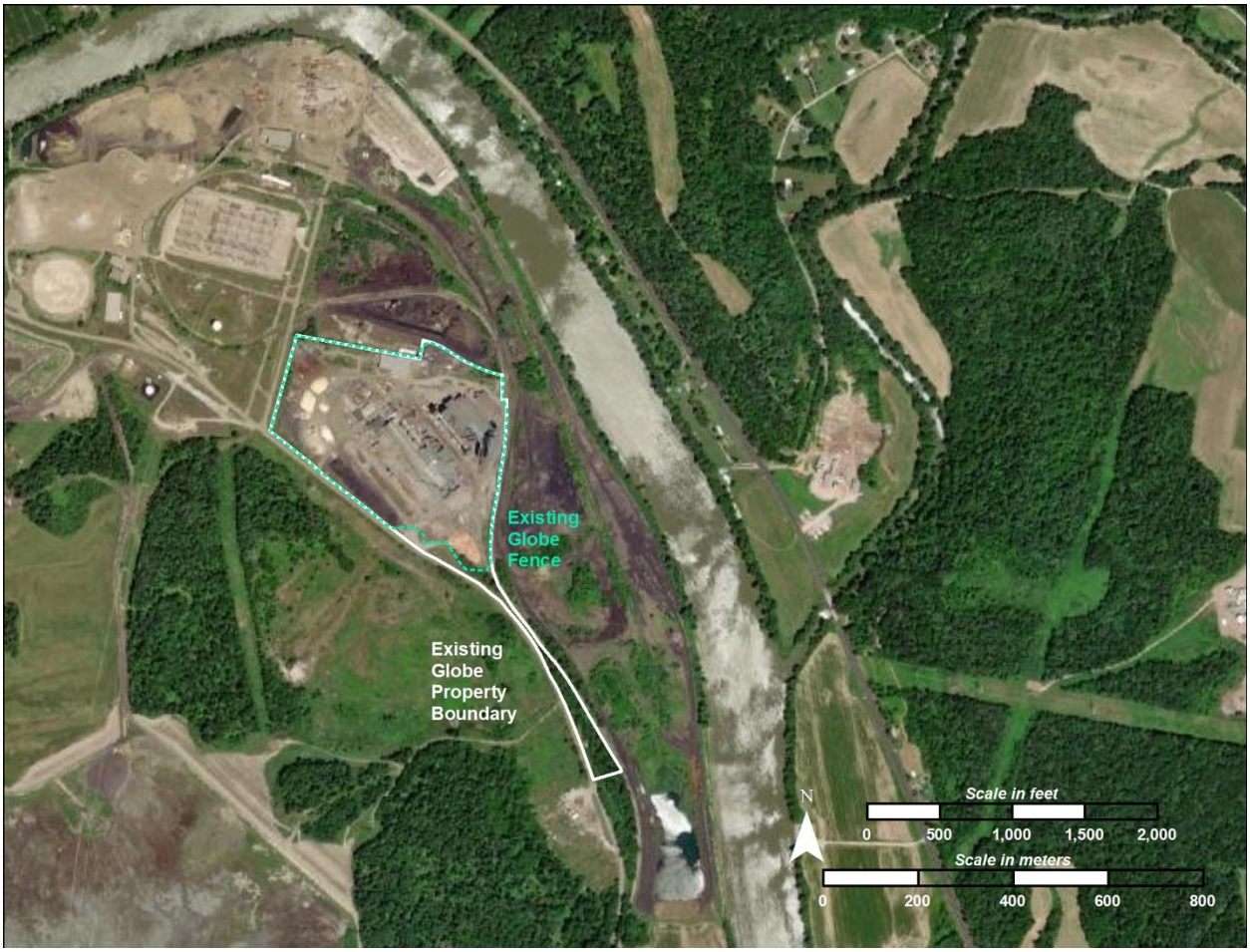
Receptors used to carry out this analysis were developed in a grid pattern (described in Section 2.5) to identify maximum impacts in areas considered ambient air. The ambient air boundary, depicted in Figure 1-2, identifies the non-ambient area where receptors were excluded. The non-ambient area is located exclusively within the existing Beverly facility property and fence lines (indicated by white and green lines in Figure 1-2), which, as discussed below, excludes access to the general public in accordance with U.S. EPA regulation and applicable guidance.[5]

U.S. EPA regulation defines ambient air as comprising only "that portion of the atmosphere, external to buildings, to which the general public has access." See 40 CFR 50.1(e). U.S. EPA has accepted a variety of mechanisms that preclude physical access, including fences, walls or natural obstructions. See, e.g., U.S. EPA Memorandum, Interpretation of Ambient Air in Situations Involving Leased Land Under the Regulations for Prevention of Significant Deterioration (PSD), June 22, 2007. To preclude physical access, U.S. EPA has clarified that public access need not be "absolutely impossible, but rather that the likelihood of such access is small." More recently, U.S. EPA has acknowledged that other measures such as video surveillance, signage and security patrols can also be offered as measures that preclude, or help to prevent, physical access. See U.S. EPA Revised Policy on Exclusions from Ambient Air, December 2, 2019 ("2019 Ambient Policy"). Thus, the "measures proposed by the source [must be] adequate to assure that the general public will not have access under reasonably anticipated circumstances that could occur in the area." *Id.*

Globe will employ a variety of measures that adequately preclude public access under "reasonably anticipated circumstances" over the portion of the excluded property referenced above and depicted in Figure 1-2. Specifically, public access to the existing Beverly facility property is precluded by a secure barbed wire fence that runs along the entire perimeter of the facility. Facility security employed by Globe patrol the facility, including along the fence line, several times a day. The Beverly facility also has video surveillance. Together, these measures preclude unauthorized access onto the Beverly facility property in accordance with the 2019 Ambient Policy.

[5] Globe previously contemplated gaining control over a portion of the property located generally to the East of the facility property and fence line.

Figure 1-2: Ambient Air Boundary



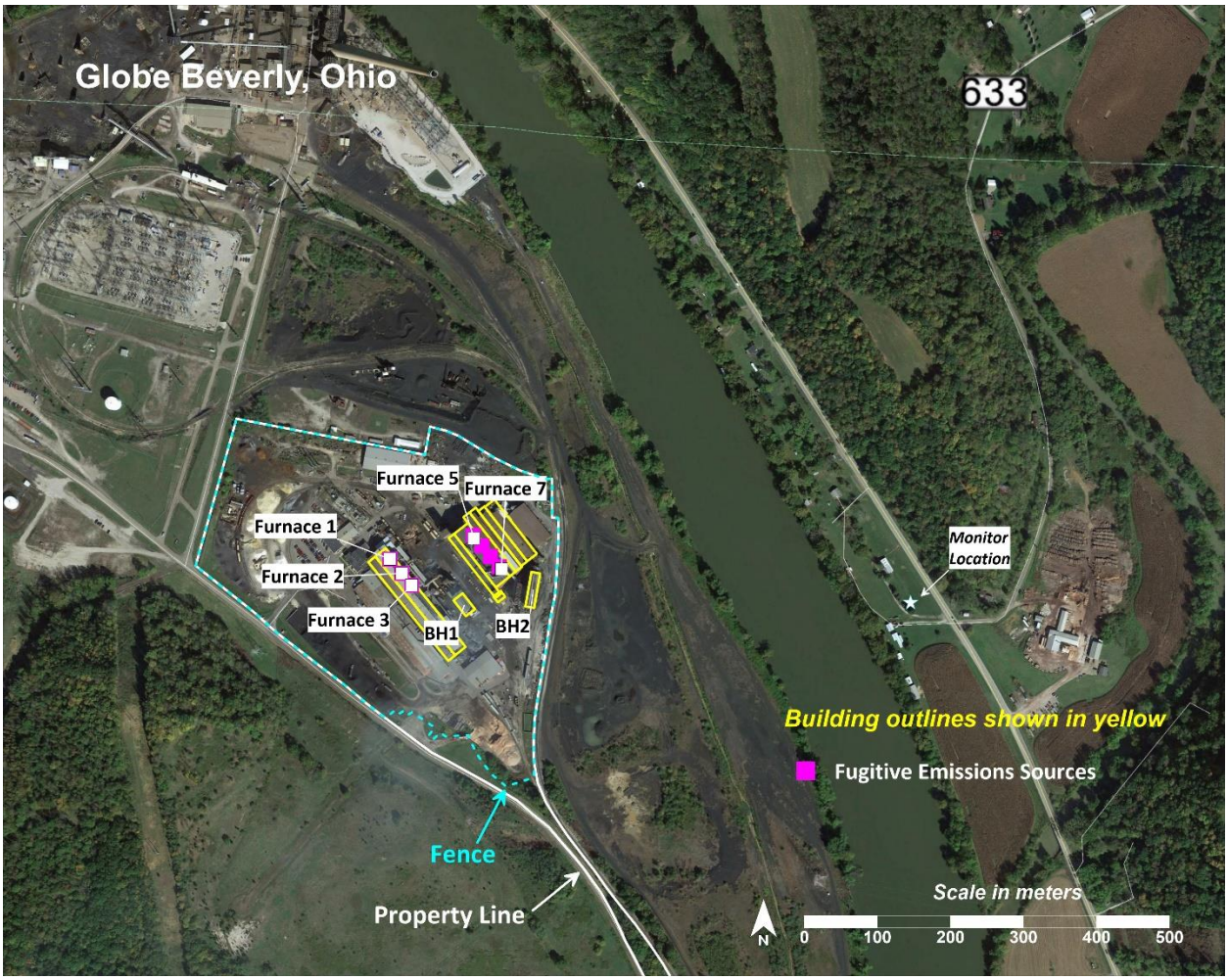
2. MODELING METHODOLOGY

The most recent version of U.S. EPA's AERMOD model (21112) was used to conduct this modeling analysis. The meteorological, background, source, and receptor information that was used to complete the modeling are described in the following sections. The model results presented in Section 4 of this document are based on the methodology described here.

2.1 Facility Location

The locations of the Beverly facility SO_2 emission sources, fence and property lines, and the meteorological (MET) tower, are presented in Figure 2-1.

Figure 2-1: Beverly Facility SO_2 Emission Sources, Fence Line, Meteorological Tower Locations



2.2 Meteorology

In connection with the 2010 1-hour NAAQS for SO_2, and as required by the 2020 DFFOs, Globe installed a single station monitor ("Globe monitor") to collect ambient air data for SO_2 and meteorological data. Globe commissioned ERM to install the monitor. A draft planning document that describes the site selection, establishment, operation, recordkeeping and reporting obligations for such an ambient air-monitoring program (AAMP) was prepared and submitted to Ohio EPA in March 2020 (the monitor site selection was approved by Ohio EPA by letter dated July 9, 2020).

The Globe monitor was installed across the river, about 0.5 km east from the Beverly facility, as shown in Figure 2-2. The base elevation of the Globe monitor is about 193 meters amsl, similar to the Beverly

facility elevation of about 205 meters amsl. The hourly meteorological data recording starting on April 6, 2021 and is ongoing. The following parameters are recorded: wind speed, wind direction at the 10-meter level, and (starting 8/24/2021) ambient temperature. To complete the data set for processing with AERMET, measurements of ambient temperature (prior to 8/24/2021), pressure, and cloud cover were obtained from measurements taken at the Parkersburg airport.

The Beverly facility and the Globe monitor are both located at the lower levels of a river valley (The Muskingum River). Terrain on both sides of the river rises nearly 60 meters above the base elevation of the tower, as shown in Figure 2-2. A wind rose based on the site-specific wind measurements is shown in Figure 2-4. When compared to a wind rose from the Parkersburg airport for the same time period (Figure 2-5), terrain effects on both wind direction and wind speed are quite evident. A plot of the terrain surrounding the Parkersburg airport (Figure 2-3) reveals that the airport is situated on elevated terrain and is likely not influenced by terrain effects. Considering the close proximity and similar orientation and elevation with respect to terrain of the Globe facility and the Globe monitor, the winds measured at the Globe monitor are more representative of the effects of emissions from Globe than winds measured at the Parkersburg airport.

Figure 2-2: Terrain Elevations near the Globe Beverly Facility

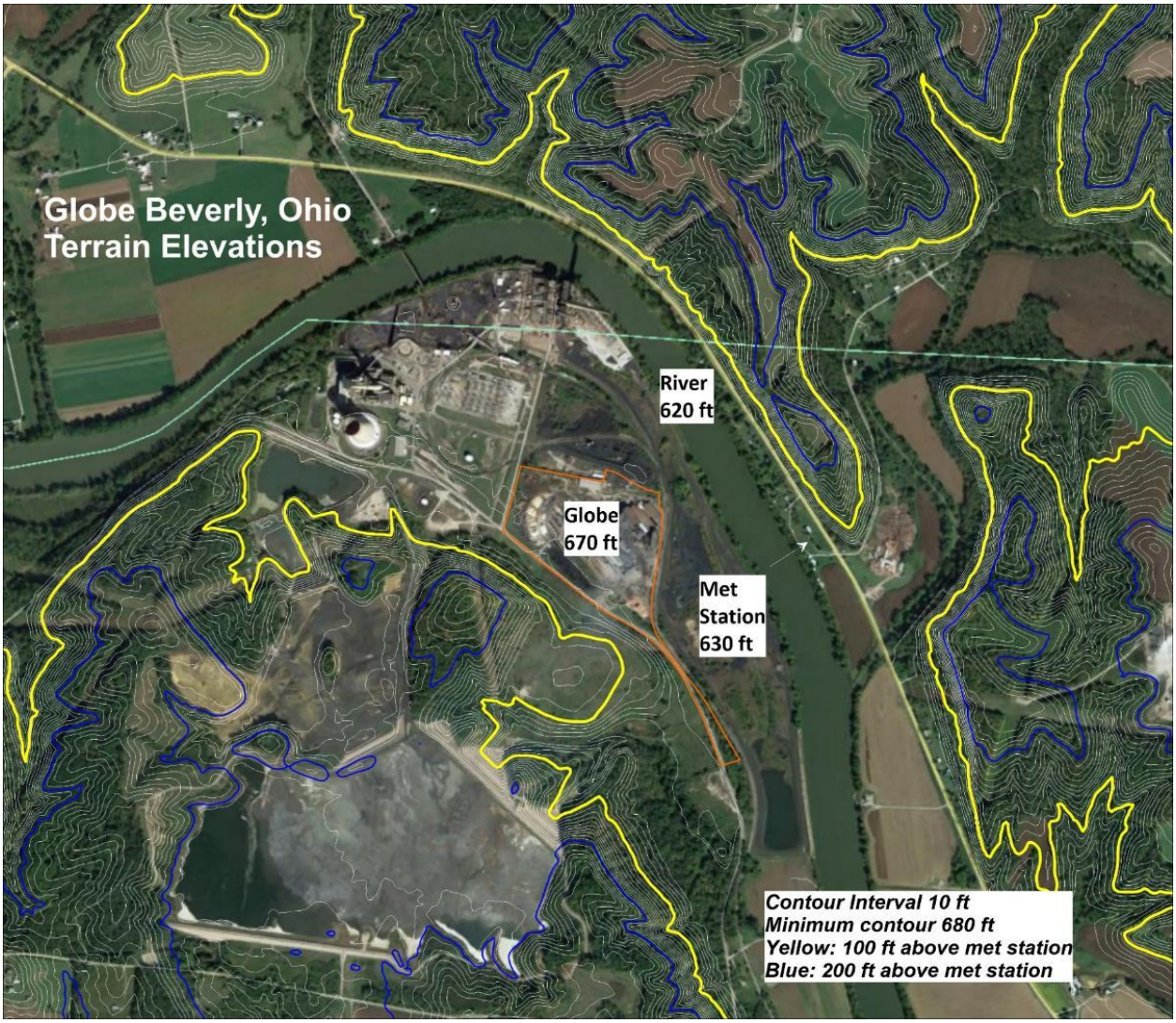


Figure 2-3: Terrain Elevations near the Parkersburg Airport

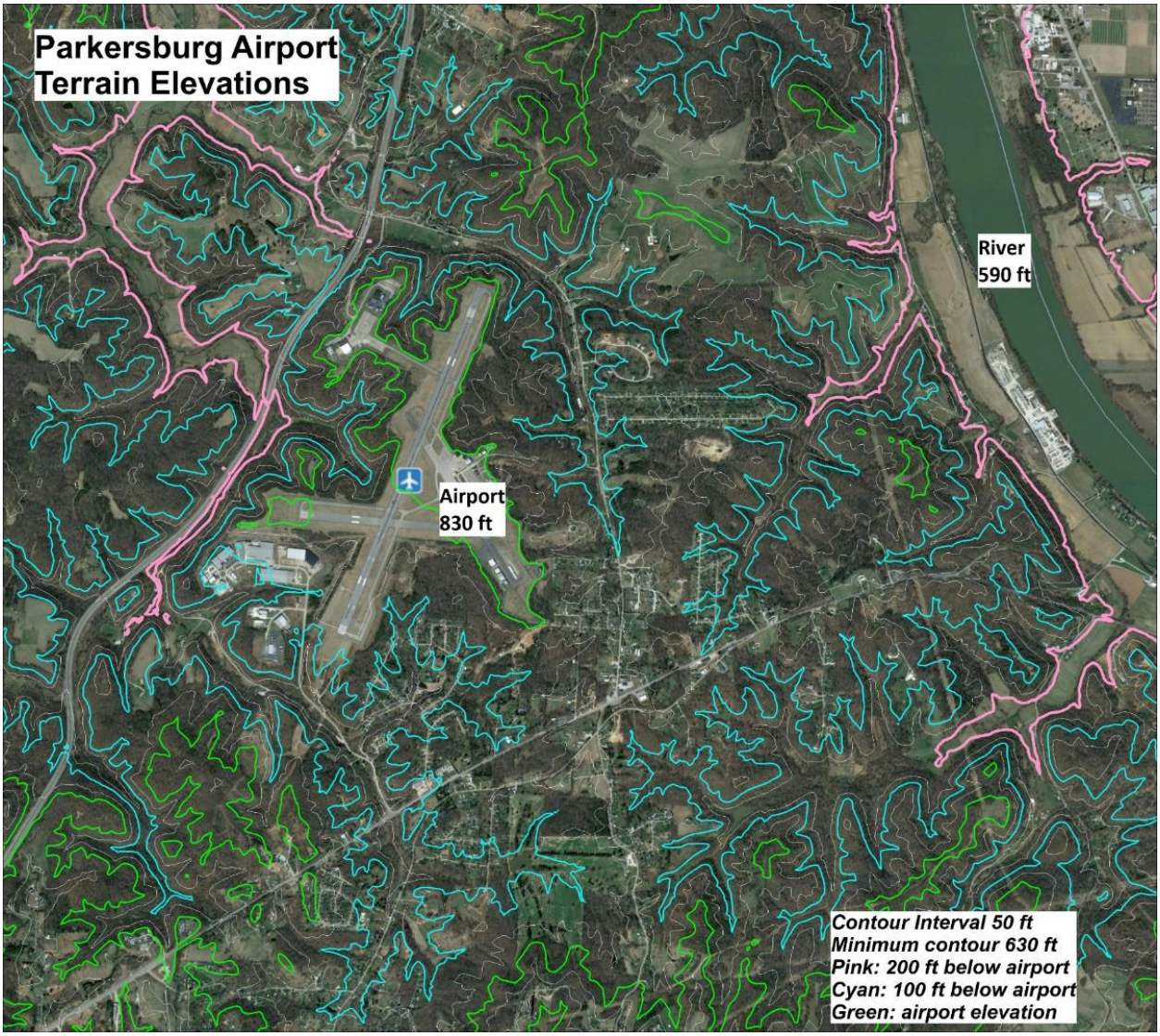


Figure 2-4: Globe Monitor Site-Specific Wind Rose (April 2021 to April 2022)

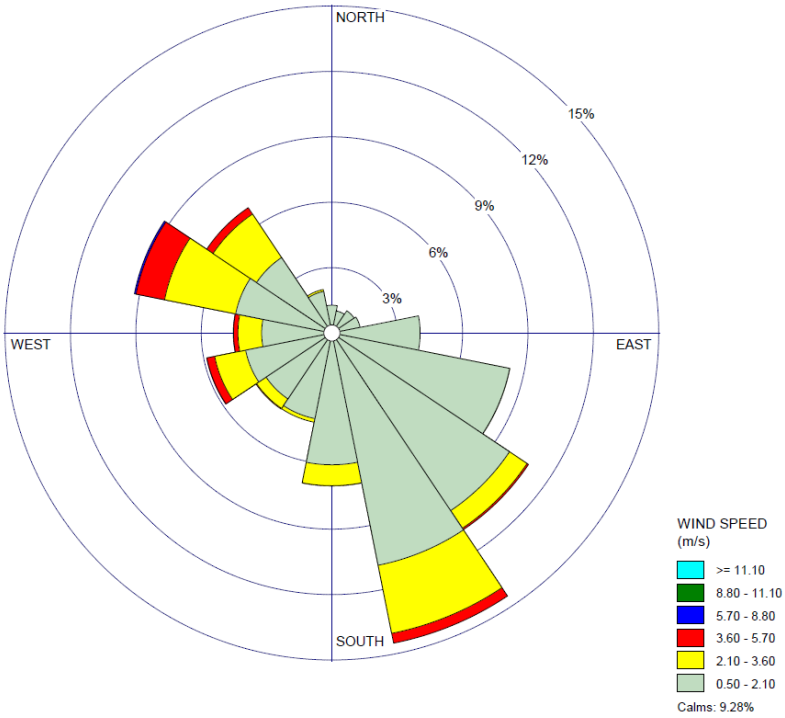
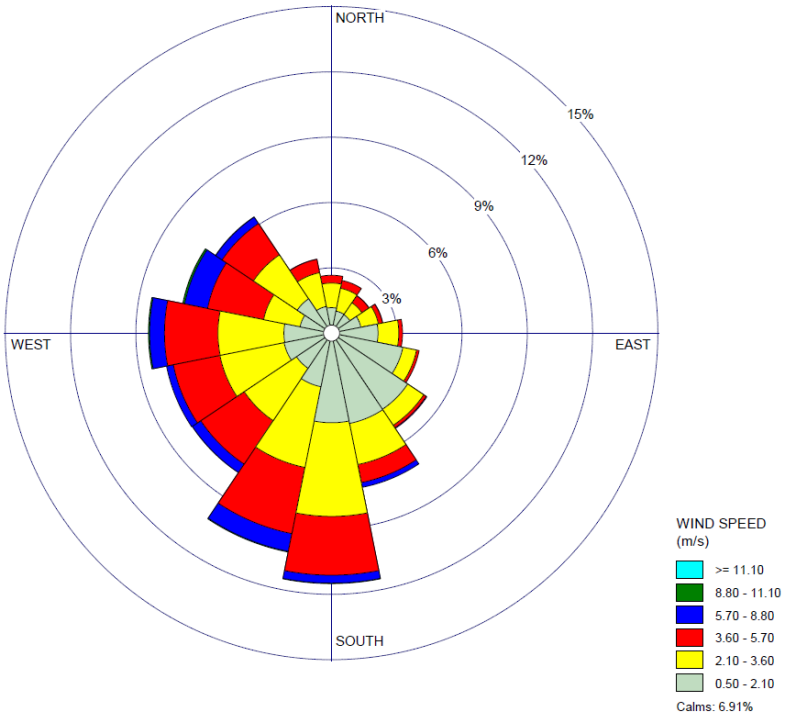


Figure 2-5: Parkersburg Airport Wind Rose (April 2021 to April 2022)



2.2.1 Meteorological Data Processing

Site-specific wind speed and wind direction from the Globe monitor were processed along with the temperature (April 6, 2021 to August 23, 2021), pressure and cloud cover from the Parkersburg, West Virginia airport for the period of April 6, 2021 to April 6, 2022. The airport is located about 33 km southeast of the Globe Beverly facility. A period of wind sensor malfunction at the site-specific tower from November 2, 2021 to November 18, 2021 occurred and the site-specific data during that period was appropriately nullified (as confirmed by Ohio EPA by email dated November 22, 2021) and is therefore not included in the data set. Despite the anemometer's malfunction, data capture remained above Ohio EPA's completeness threshold of 90%.

Upper air data for the period of April 6, 2021 to April 6, 2022 came from the Pittsburgh, Pennsylvania upper air station. Missing upper air soundings (a total of 31 days) were filled utilizing data from a nearby station, Wilmington, OH.

The wind anemometer's minimum threshold of 0.2 m/s was used in AEMET Stage 1 processing, thus any reported winds below 0.2 m/s are treated as calm. Meteorological data processing was accomplished using the latest version of AERMET (21112) to create AERMOD model-ready data sets. AERMET processing of the original five-years of Parkersburg data did not use the ADJ-U* option in AERMET because there was no tendency of over prediction during light wind and stable conditions. Wind speeds recorded at the Globe monitor, however, are considerably lower than wind speeds recorded at Parkersburg for the same time period. For this reason, the ADJ-U* option in AERMET was used for processing the site-specific data, in order to ensure that low wind speed effects are accounted for consistent with EPA guidance regarding low wind speeds [6].

2.2.2 Surface Parameters

Surface parameters, such as albedo, Bowen ratio, and surface roughness length are used for dispersion calculations. These parameters are based on the land-use features and moisture conditions. They are calculated as part of the hourly meteorological data processing with AERSURFACE and AERMET.

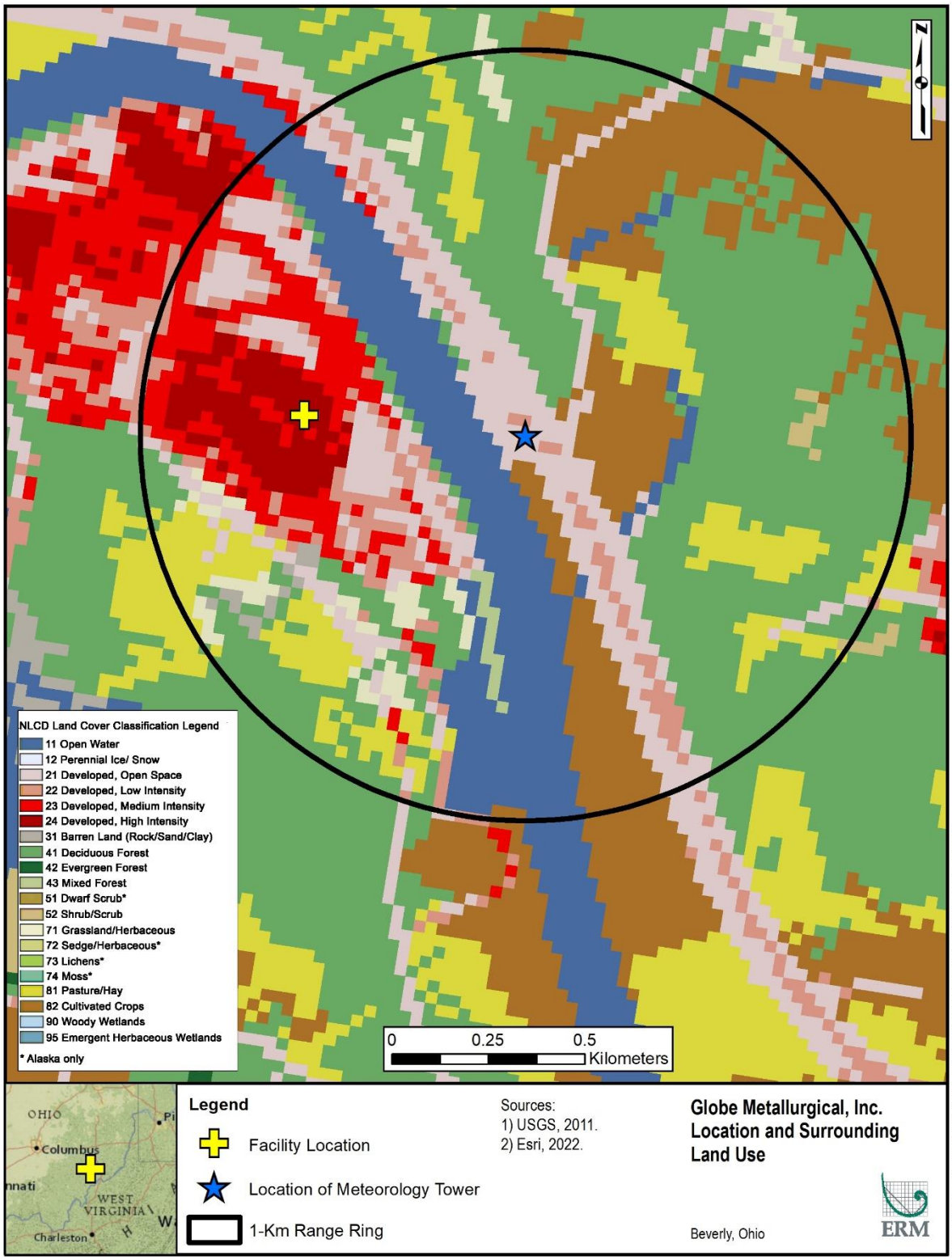
The surface parameters for this application were calculated using the latest version of AERSURFACE (20060). AERSURFACE was run centered on the site-specific tower to compute the primary surface roughness, Bowen ratio and albedo around 1 km of the tower using 2011 National Land Cover Database (NLCD) found here https://www.mrlc.gov/data/nlcd-2011-land-cover-conus. These surface characteristics were inputs to Stage 3 AERMET processing via "AERSURF" option. Note that AERSURFACE was also run using the 2016 NLCD data; however, for an important wind direction (winds from the west), the 2011 NLCD produced a more accurate representation of the ash disposal area immediately to the east of the Globe fence line (2016 NLCD incorrectly characterized that area as "Developed, High Intensity"). 2011 NLCD impervious layer and canopy data was also input to AERSURFACE along with the land cover data. The 2011 land use around the monitor is shown in Figure 2-6.

The radius of the surface roughness domain was set to 1 km and the domain was divided into twelve 30-degee sectors starting at 0 degrees north and moving eastward. All sectors were at the monitor were treated as "non-airport" (AERSURFACE assumes airports have lower roughness due to the presence of roads, runways, and other paved surfaces while non-airport sites are assumed to have higher roughness due to the presence of more buildings and other structures). A default method (ZORAD) for determining surface roughness length was used in AERSURFACE and is based on the inverse distance-weighted geometric mean of individual cell roughness length values. The climate settings in AERSURFACE were

[6] *See* pg. 5187 https://www.govinfo.gov/content/pkg/FR-2017-01-17/pdf/2016-31747.pdf

chosen as non-arid and with average surface moisture. The site-specific surface characteristics were inputs to Stage 3 AERMET processing via “AERSURF” option.

Figure 2-6: Land-use Characteristics



2.3 Ambient Background Concentrations

Hourly SO_2 concentrations measured at the Hackney monitor for the three years 2018-2020 were used to develop season/hour-of-day concentrations for inclusion in the modeling for comparison to the NAAQS. The data were first analyzed by wind direction to determine whether emissions from the Beverly facility have an influence on the measured values. Figure 2-7 displays a plot of hourly SO_2 concentrations as a function of wind direction (winds are from the Parkersburg data set were used for this analysis because there are no wind measurements at the site monitor for three complete years 2018-2020).

Figure 2-7: Hourly SO_2 2018-2020 by Wind Direction

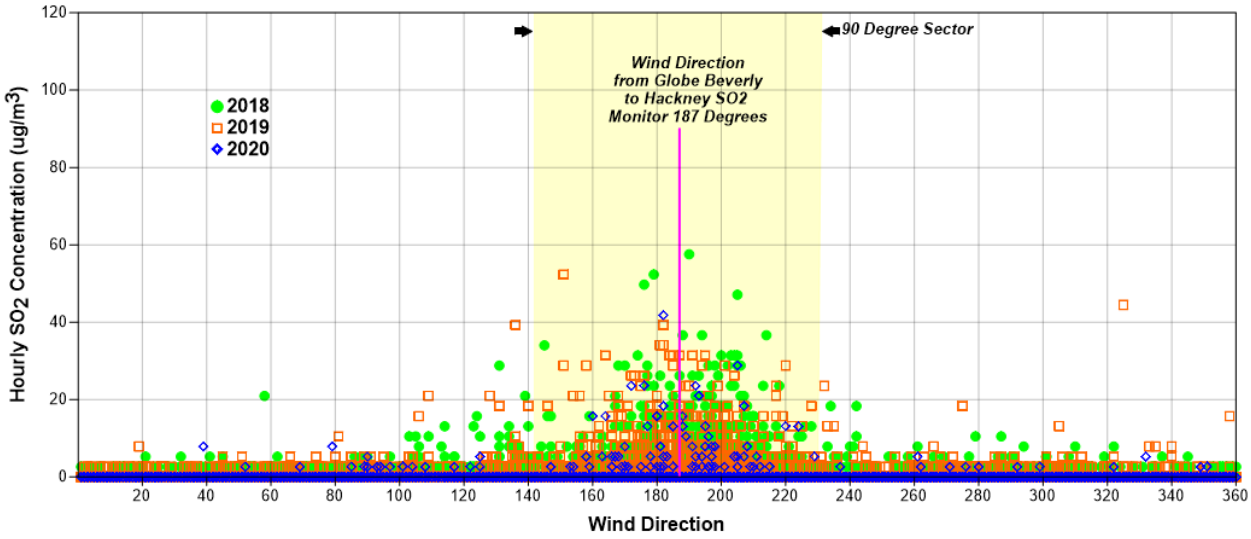


Figure 2-7 also identifies a 90-degree sector that represents direction from the Beverly facility plus or minus 45 degrees; the elevated concentrations within this sector suggest that emissions from the Beverly facility do influence measured concentrations - concentrations in this sector are all less than 50% of the NAAQS. An apparent secondary peak occurs between wind directions 120 to 150; the source of these impacts is not clear, but the data points outside of the 90 degree sector were included in the determination of background values. The hourly values that fell within the 90 degree sector were replaced with the average of all hours in that sector prior to processing the season/hour-of-day background concentrations. Table 2-1 tabulates the resulting monitoring values that were used for background values.

Table 2-1: Hackney Seasonal Hour-of-Day Monitoring Data Based on 2018-2020 Period

Hour	Concentration (μg/m³)			
	Winter	Spring	Summer	Fall
1	8.73	2.62	5.24	9.61
2	6.11	6.11	3.49	9.61
3	5.24	6.99	3.49	6.11
4	6.99	9.61	2.62	7.86
5	9.61	13.97	2.32	9.61
6	9.61	6.11	2.16	3.49
7	9.61	5.24	2.47	3.49
8	4.37	6.11	4.37	4.37
9	4.37	4.37	7.86	5.24
10	5.24	5.24	6.99	7.86
11	6.11	7.86	8.73	8.73
12	9.61	4.37	4.37	6.99
13	18.34	3.34	4.37	4.37
14	13.97	4.21	2.62	6.99
15	8.73	4.37	4.37	4.37
16	10.48	3.49	3.49	4.37
17	9.61	4.37	2.47	6.11
18	8.73	3.49	3.34	3.49
19	9.61	4.21	2.47	10.48
20	6.99	3.49	3.49	11.35
21	10.48	6.11	4.21	13.97
22	15.72	5.24	3.49	13.97
23	25.33	6.99	6.11	17.47
24	13.10	5.24	4.37	11.35

2.4 Source Characterization and Emission Rates

The Beverly facility consists of two submerged arc furnace shops (Shop). The No. 1 Shop contains furnaces 1, 2 and 3. The No. 2 Shop contains furnaces 5 and 7. The primary sources of SO_2 emissions at the Beverly facility are two positive pressure baghouses which control furnace particulate emissions – baghouse 1 (BH1) controls emissions from furnaces 1, 2, and 3; baghouse 2 (BH2) controls emissions from furnaces 5 and 7. Each of the furnaces have a dedicated hood to capture the furnace exhaust which is routed to cyclone collectors and then to the baghouses. The hoods are estimated to capture 98% of the exhaust; while the remaining 2% escapes the buildings housing the furnaces as fugitive emissions, primarily through roof monitors (refer to the document entitled, “Capture Efficiency Analysis – Globe

Beverly, Ohio Facility," May 2020[7], which substantiates the 98% capture efficiency of furnace emissions at the Beverly facility).

Each of the control devices (BH1 and BH2) exhaust through a roof monitor. Exhaust from BH1 currently discharges horizontally; exhaust from BH2 discharges vertically. Globe is the process of installing a roof emissions diverter on BH1 that will redirect the exhaust discharge from a horizontal to a vertical release. Installation involves placing a 3-meter high parabolic-shaped enclosure on top of the baghouse to redirect emissions from BH1 to a vertical release. The planned installation of a vertical release for BH1 is similar in design to the existing vertical release at BH2. After installation of the BH1 vertical release, the projected release height from BH1 will be increased by 3 meters from the current 19.263 to 22.263. No other parameters, such as exhaust flow or temperature, will be affected.

Both of these sources were modeled as point sources to preserve the total buoyancy of the release and, since the exhaust for both sources are subject to aerodynamic downwash, to ensure that the building downwash algorithms in AERMOD are used to characterize downwash. Based on the exhaust flow and temperature that have been determined for these two sources, the buoyancy of the release contributes to plume rise that adds plume height to the height of the physical release point. Accounting for the effect of plume rise lowers modeled ground-level concentrations and provides a more accurate estimate of the impacts from BH1 and BH2.

The point source characterization for BH1 and BH2 is further supported by a review of source types available in AERMOD. AERMOD has three source configuration options available that can potentially simulate the dispersion of emissions from BH1 and BH2: (1) VOLUME source configuration; (2) BUOYLINE configuration; and (3) POINT/POINTHOR configuration. The following discussion addresses the different source configuration options and possible applicability to BH1 and BH2 and to the fugitive emissions releases, and concludes that the POINT configuration is the best approach to model the types of releases from BH1 and BH2.

The first source configuration (designated by AERMOD as the VOLUME source type) is used most frequently for fugitive emissions sources that have no buoyancy and no clearly defined stack. Configuring a source to be modeled with the VOLUME configuration requires the specification of a release height, and optionally initial dispersion parameters (sigma-y and sigma-z). Dispersion from a VOLUME source is not assigned any plume rise that may result from a heated release, therefore using this configuration for a heated release is inherently conservative. For the Beverly facility, the VOLUME source configuration was applied to emissions that are not captured by the hoods over each furnace, which direct emissions generated by the furnaces to the baghouses. For these fugitive emissions, a series of volume sources were configured and arranged along the roof monitors for Shop 1 and 2 in the location of the furnaces. These releases do have some buoyancy since they are generated by operating furnaces. Nonetheless, the VOLUME source configuration was used to maintain a degree of conservatism in the model results for the fugitive emissions (see the further discussion below). For BH1 and BH2, however, with large heated releases, the VOLUME source is not appropriate since it does not consider the effect of buoyancy on plume rise.

The second source configuration (designated by AERMOD as the BUOYLINE source type) does account for plume rise from heated fugitive releases. This source type was added to recent versions of AERMOD by adapting the methodology contained in the Buoyant Line and Point (BLP) model. BLP is a model developed in the late 1970's to address emissions from aluminum reduction plants. These sources in many cases have "potlines" that are typically many hundreds of meters in length with heated exhaust from roof monitors, and the BLP model contains algorithms that account for plume rise based on the buoyancy in the exhaust. BLP inputs also expect that there are multiple, parallel potlines. The BLP

[7] *See* https://epa.ohio.gov/static/Portals/27/sip/SO2/G1_MuskRiv_MassBalCompDemoApproach.PDF.

algorithms implement methods that account for atmospheric stability, terrain treatment, and downwash that have been replaced by newer methods in AERMOD – however, AERMOD does not apply these newer methods to the BUOYLINE source configuration. In addition, the original BLP and the BUOYLINE configuration in AERMOD are limited to incorporating only one buoyant line source. The limitations of the implementation of BLP in AERMOD are noted in the user's guide to AERMOD, page 3-85:

> The current implementation is based on the buoyant line source algorithm in the Buoyant Line and Point Source (BLP) dispersion model (Schulman and Scire, 1980) with very little modification and similar limitations.

The BUOYLINE source configuration has nonetheless been used and approved by EPA in some circumstances, and approval has also been granted in cases where unique approaches, involving post-processing, have been used to model more than one BUOYLINE source with AERMOD. For the Beverly Facility, however, the BUOYLINE source configuration is not appropriate for a number of reasons.

- The baghouse exhaust for Shops 1 and 2 are considerably shorter than typical potline lengths (for which BLP was developed), and each exhaust consists of a single roof monitor thus dissimilar from the source types that BLP was developed to model.
- The outdated algorithms from BLP that were incorporated into AERMOD do not account for the updated and more scientifically current algorithms in AERMOD for treating plume rise, dispersion, downwash, and interaction with terrain.
- Modeling both baghouses together would require specialized post-processing and specific review and approval by the model clearinghouse in EPA/OAQPS.
- The BUOYLINE source configuration does not allow for the use of the Urban option, which is critical for accurately modeling the effect of the heat island, caused by operations at the facility, on the dispersion of emissions from BH1 and BH2.

The third source configuration (designated by AERMOD as the POINT or POINTHOR source type), treats BH1 and BH2 as point sources, which is the preferred way to account for the unique characteristics of these releases, particularly given the shortcomings of any other configuration. Note that POINT configuration was used for both BH1 and BH2 (as noted above, BH2 exhaust already releases vertically, and Globe is in the process of installing a vertical release for the exhaust from BH1).

Engineering drawings and photos provided by Globe were used to determine the physical dimensions of the baghouse exhaust and of the nearby buildings and structures for the purpose of providing source inputs, and inputs for the downwash analysis. Exhaust characteristics (temperature and flow) for the two sources were determined based on measurements taken at a point close to the outlet of the furnace, measurements taken by Globe at the inlet and outlet to the baghouse, and a calculation to estimate the exhaust flow. Both BH1 and BH2 are designed to add dilution air through the bottom of the structure; this dilution air provides cooling of the exhaust to protect the fabric filters, and adds to the total exhaust flow to the atmosphere. Table 2-2 illustrates the calculations performed to estimate exhaust flow. This illustration uses an ambient temperature of 15.6 degree C for the dilution air.

Table 2-2: Exhaust Flow Calculation Illustration

Description	Source	Baghouse 1	Baghouse 2	Units
Heated Flow from Furnace:	Calculation	483,957	541,706	acfm
Temperature:	Ventilation Study	535	602	F
	Calculation	995	1062	R
standard flow:	Ventilation Study	257,786	270,442	scfm
Temperature at Baghouse Inlet:	Measurement	440	430	F
	Calculation	900	890	R
Target Temperature:	Measurement	310	250	F
		770	710	R
Dilution air needed:	Calculation	134,228	256,208	scfm
Total Flow:	Calculation	392,014	526,650	total scfm
Total Flow:	Calculation	569,283	705,513	acfm
Additional Inputs	Ambient Temp	Standard Temp		
	60	70	F	
	520	530	R	
Formulas:				
Weighted temperature:	Tw = (scf1*t1+addscf*tadd)/(scf1+addscf)			
	where:			
	Tw	temperature of mixture		
	scf1,t1	standard flow and temperature of air flow 1		
	addscf,tadd	standard flow and temperature of added air flow		
Solve for addscf:	addscf = (t1-targett)*scf1/(targett-tadd)			
	where:			
	targett	target temperature		

For both BH1 and BH2, the exhaust flow and physical dimensions of the roof monitor exhaust were used as follows to calculate an effective diameter and exit velocity for input to AERMOD:

Step 1: Calculate the area of the roof monitor exhaust
BH1: 90 x 5.67 = 510.3 ft^2 x .3048^2 = 47.41m^2
BH2: 157 x 10 = 1570 ft^2 x .3048^2 = 145.86 m^2

Step 2: Calculate the exit velocity
BH1: 569,283 acfm /60 = 9448 acfs /510.3 = 18.59 fps x .3048 = 5.667 m/s
BH2: 705,513 acfm /60 = 11758 acfs /1570 = 7.49 fps x .3048 = 2.283 m/s

Step 3: Calculate the effective diameter
BH1: SQRT[510.3/(Pi)] x 2 = 25.49 ft x .3048 = 7.769 m
BH2: SQRT[1570/(Pi)] x 2 = 44.71 ft x .3048 = 13.628 m

SO_2 emissions for BH1 and BH2 were developed to represent both actual and allowable emissions. Actual emissions were based on daily mass balance calculated values (in accordance with the 2022

DFFOs) for the time period April 6, 2021 to April 6, 2022. Allowable emissions were based on 26 emission limit sets of 1-hour SO_2 emission limits (lbs/hr) for BH1 and BH2 that demonstrate compliance with the 1-hour SO_2 NAAQS. Globe is required under the 2022 DFFOs to use mass balance calculations to demonstrate compliance with these emission limit sets (*note:* as further discussed in Section 4, below, the SO_2 emission limit sets in the 2022 DFFOs apply a 7% reduction factor to reflect use of a 24-hour averaging period). The fugitive emissions also have some buoyancy, but were conservatively modeled as static volume sources placed along the roof monitor of the buildings housing the furnaces.

Characterization of volume sources that are used to model fugitive emissions requires considerable judgment – more so than for stacks, for which physical parameters are well-defined. The goal of the characterization is to ensure as much as possible that the actual source of emissions is reasonably represented in the model. Fugitive emissions from Shop 1 and Shop 2, those that escape the furnace hoods, have elevated temperature due to the heat generated by the furnace. Although measurements of the actual temperature of the exhaust leaving the roof monitor are not available nor readily obtained, temperatures of the furnace exhaust in the ductwork leading from the furnaces have been measured to be between 260 and 315.6 degree C. While this does not represent a fugitive emissions exhaust temperature, it is reasonably likely that any exhaust escaping from the furnaces, which operate typically in the range of 2000°C (3632°F) would be a heated exhaust – and would therefore rise towards the roof monitor and not escape through other openings in the shop buildings. The tops of the furnaces in Shop 1 and Shop 2 (fugitive emissions escape from this point) are approximately 15-21 meters below the roof monitor.

The elevated temperature provides buoyancy to the release that will result in the plume rising above the release point (the roof monitor). Volume sources do not account for this additional plume rise, thus using the volume source configuration with the height set equal to the release height is generally conservative.

Due to the elevated temperature of the release, fugitive emissions from Shop 1 and Shop 2 will be associated with the locations of the furnaces within Shop 1 and Shop 2. The alignment of volume source locations for Shop 1 and Shop 2 were placed evenly along the roof monitors of the two shops above the furnace locations. Initial evaluation had indicated that the original configuration for Shop 1 (evenly spaced volume sources across the length of the roof monitor for Shop 1) resulted in smaller impacts for the fugitive emissions alone, than volume sources located closer to the furnaces. The total impacts, however, were higher due to the way that source impacts combine to contribute to the total modeled concentrations which are used to determine compliance with the 1-hour SO_2 NAAQS. To illustrate this point, separate sensitivity modeling was conducted with volume sources for Shop 1 located closer to the furnaces. This sensitivity modeling showed that the overall maximum impact was reduced by approximately 0.3 micrograms/cubic meter and compliance with the 1-hour SO_2 NAAQS was demonstrated. The placement of volume sources used in this compliance demonstration is therefore conservative.

Table 2-3 displays the source characteristics that were used in the modeling. The stack diameters and exit velocities for BH1 and BH2 are effective values, which were calculated based on the actual cross-sectional area of the respective roof monitors as described above (*note:* the BH1 release height is based on the use of a vertical release roof monitor). Modeled emission rates (actual and allowable) are presented in Section 4 of this report.

Table 2-3: Model Inputs

Model Units

Model i.d.	Type	UTME	UTMN	Base Elev.	Release Height	Release Temp.	Exit Velocity	Diameter
		m	m	m	m	K	m/s	m
BH1P	POINT	441837.55	4381830.00	204.83	22.263	427.409	5.667	7.769
BH2P	POINT	441931.70	4381850.80	204.22	26.318	394.261	2.283	13.628
						Sigma-y	**Sigma-z**	**Spacing**
						m	**m**	**m**
SHOP1V1[(1)]	VOLUME	441811.93	4381797.25	204.83	17.678	9.744	8.261	20.95
SHOP1V2[(1)]	VOLUME	441798.61	4381813.42	204.83	17.678	9.744	8.261	20.95
SHOP1V3[(1)]	VOLUME	441785.30	4381829.60	204.83	17.678	9.744	8.261	20.95
SHOP2V1	VOLUME	441885.23	4381882.53	204.22	28.273	8.685	13.150	18.673
SHOP2V2	VOLUME	441873.40	4381896.97	204.22	28.273	8.685	13.150	18.673
SHOP2V3	VOLUME	441861.57	4381911.42	204.22	28.273	8.685	13.150	18.673
SHOP2V4	VOLUME	441849.74	4381925.87	204.22	28.273	8.685	13.150	18.673

(1) The modeling presented in May of 2020 had seven volume sources. The seven volume sources were initially uniformly spread across the length of Shop 1. We later learned of the actual location of the furnaces in Shop 1, and re-configured the fugitive emissions/volume sources to locations more representative of the furnace locations.

English Units

Model i.d.	Type	UTME	UTMN	Base Elevation	Release Height	Release Temp.	Exit Velocity	Diameter
		m	m	ft	ft	F	fpm	ft
BH1P	POINT	441837.55	4381830.00	672.00	73.04	310	1,115.6	25.49
BH2P	POINT	441934.10	4381837.80	670.00	86.34	250	449.4	44.71
						Sigma-y	**Sigma-z**	**Spacing**
						ft	**ft**	**ft**
SHOP1V1[(1)]	VOLUME	441811.93	4381797.25	672.00	58.00	31.97	27.10	68.73
SHOP1V2[(1)]	VOLUME	441798.61	4381813.42	672.00	58.00	31.97	27.10	68.73
SHOP1V3[(1)]	VOLUME	441785.30	4381829.60	672.00	58.00	31.97	27.10	68.73
SHOP2V1	VOLUME	441885.23	4381882.53	670.00	92.76	28.49	43.14	61.26
SHOP2V2	VOLUME	441873.40	4381896.97	670.00	92.76	28.49	43.14	61.26
SHOP2V3	VOLUME	441861.57	4381911.42	670.00	92.76	28.49	43.14	61.26
SHOP2V4	VOLUME	441849.74	4381925.87	670.00	92.76	28.49	43.14	61.26

(1) The modeling presented in May of 2020 had seven volume sources. The seven volume sources were initially uniformly spread across the length of Shop 1. We later learned of the actual location of the furnaces in Shop 1, and re-configured the fugitive emissions/volume sources to locations more representative of the furnace locations.

The USEPA's Building Profile Input Program (BPIP), Version 04274, was used to calculate aerodynamic downwash effects for the modeled point emission sources. Building dimensions output from BPIP were input into AERMOD to represent downwash effects on the point sources located at the facility. Figure 2-1 displayed the locations of sources modeled and structures included in the downwash analysis.

Appendix A contains photographs of Shops 1 and 2 which provide insights to and support for the source characterizations used in the AERMOD modeling.

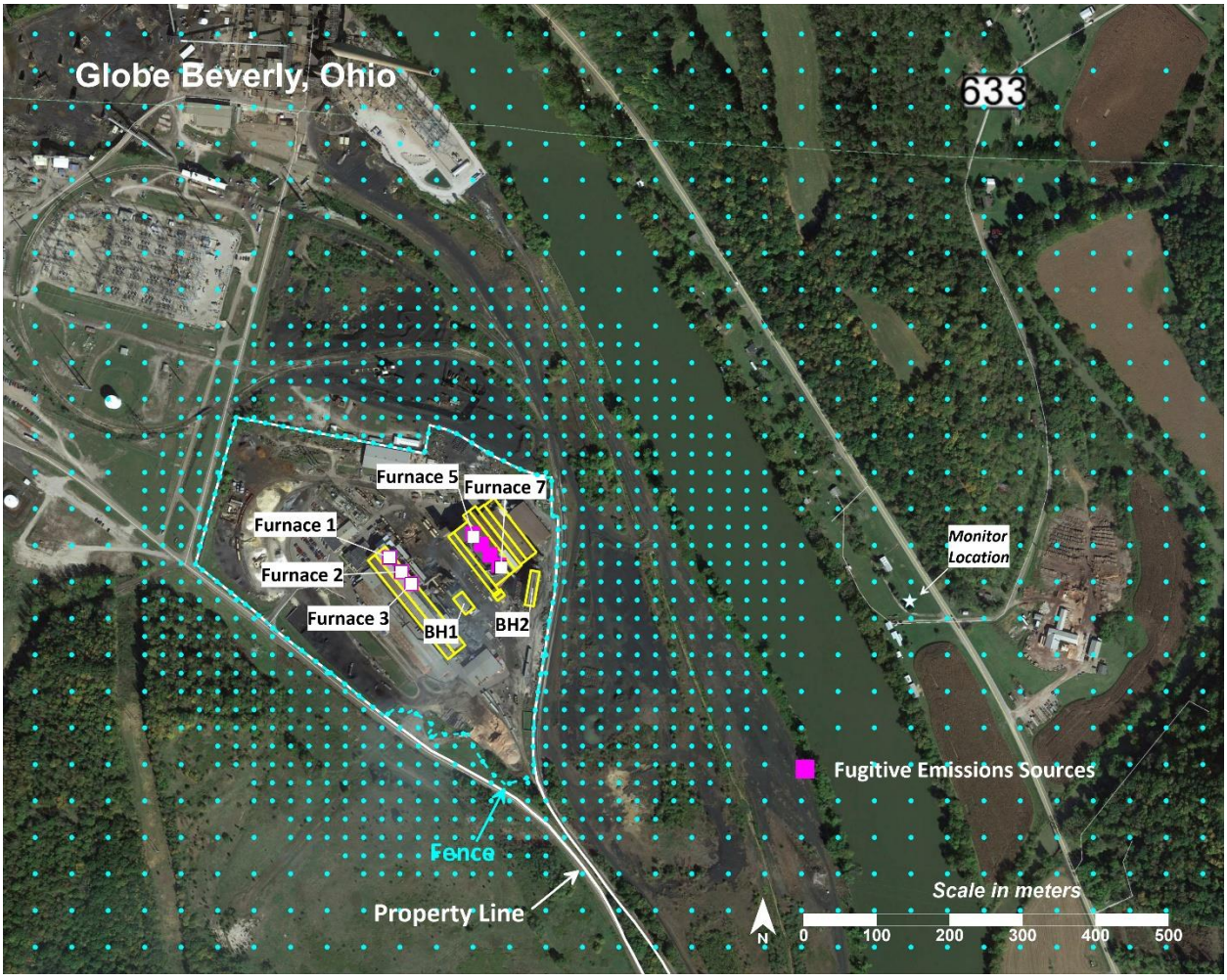
2.5 Receptors

A receptor grid extending out to approximately 5 km from the Beverly facility was developed to evaluate maximum concentrations at and beyond the ambient boundary, which is sufficient to identify maximum modeled impacts. Receptor elevations and hill scale values were developed with the latest version of the AERMAP processor (18081). Figure 2-8 displays receptor locations closest to the Beverly facility.

The receptor grid consists of the following receptor spacing:

- 25-meter spacing along the ambient boundary and out to 350 m from the closest source;
- 50-meter spacing extending from 350 to 1000 m;
- 100-meter spacing extending from 100 to 2000 m; and
- 200-meter spacing from 2000 to 5000 m.

Figure 2-8: Receptor Locations (Near Field)



3. URBAN DESIGNATION FOR THE GLOBE BEVERLY FACILITY

AERMOD requires the specification of land use type surrounding a facility being modeled as being rural or urban – this selection affects the way in which emissions from the facility are dispersed in the atmosphere. Except for the industrial area surrounding the Beverly facility, the region is rural in nature. Due to the heat island effect caused by operations at the facility, however, the facility was modeled with urban dispersion due to the heat island created by operation of the furnaces at the facility. This section presents the justification for this position. Key references for this justification are the U.S. EPA's Guideline on Air Quality Models (GAQM), found at 40 CFR Appendix W (Section 7.2.1.1); the AERMOD model formulation document (MFD, 2019)[8]; the AERMOD Implementation Guide[9]; and literature references as noted in this section[10,11,12].

For comparison purposes only, the urban approach and justification described herein are similar to a situation at the Alcoa Warrick, IN facility as presented in protocols prepared for Alcoa[13,14]. Some comparisons between the Globe and Warrick approach are presented in this section for illustration purposes only.

The GAQM contains guidance on determining whether AERMOD should be run in the rural or urban mode. The relevant parts of Section 7.2.1.1 are shown here (emphasis added):

> 7.2.1.1 Dispersion Coefficients
>
> a. For any dispersion modeling exercise, the urban or rural determination of a source is critical in determining the boundary layer characteristics that affect the model's prediction of downwind concentrations. Historically, steady-state Gaussian plume models used in most applications have employed dispersion coefficients based on Pasquill-Gifford[72] in rural areas and McElroy-Pooler[73] in urban areas. These coefficients are still incorporated in the BLP and OCD models. However, the AERMOD model incorporates a more up-to-date characterization of the atmospheric boundary layer using continuous functions of parameterized horizontal and vertical turbulence based on Monin-Obukhov similarity (scaling) relationships.[44] Another key feature of AERMOD's formulation is the option to use directly observed variables of the boundary layer to parameterize dispersion.[44,45]
>
> ***b. The selection of rural or urban dispersion coefficients in a specific application should follow one of the procedures suggested by Irwin[74] to determine whether the character of an area is primarily urban or rural (of the two methods, the land use procedure is considered more definitive.***
>
> ***i. Land Use Procedure: (1) Classify the land use within the total area, Ao, circumscribed by a 3 km radius circle about the source using the meteorological land use typing scheme proposed by Auer;[75] (2) if land use types I1, I2, C1, R2, and R3 account for 50 percent or more of Ao, use urban dispersion coefficients; otherwise, use appropriate rural dispersion coefficients.***
>
> ***ii. Population Density Procedure: (1) Compute the average population density, $\bar{p}$ per square kilometer with Ao as defined above; (2) If $\bar{p}$ is Greater than 750 people per square***

[8] Available at: https://www3.epa.gov/ttn/scram/models/aermod/aermod_mfed.pdf

[9] Available at: https://www3.epa.gov/ttn/scram/models/aermod/aermod_implementation_guide.pdf

[10] R. Paine et al. *Source characterization refinements for routine modeling applications*/ Atmospheric Environment 129 (2016) 55e67

[11] Oke, T. R., 1973: City size and the urban heat island. *Atmospheric.Environment*, 7, 769-779.

[12] Oke, T. R., 1982: The energetic basis of the urban heat island. *Quart.J.Roy.Meteor.Soc.*, 108, 124.

[13] AECOM, September 2017. Revised Modeling Protocol for the 1-hour SO_2 Data Requirements Rule/ Alcoa Warrick Operations, Warrick Power Plant, and Culley Generating Station.

[14] AECOM, February 2019. SO_2 Modeling Protocol for Alternative Operating Scenarios, Rev 2/ Alcoa Warrick Operations.

kilometer, use urban dispersion coefficients; otherwise use appropriate rural dispersion coefficients.

c. Population density should be used with caution and generally not be applied to highly industrialized areas where the population density may be low and, thus, a rural classification would be indicated. However, the area is likely to be sufficiently built-up so that the urban land use criteria would be satisfied. Therefore, in this case, the classification should be ''urban'' and urban dispersion parameters should be used.

d. For applications of AERMOD in urban areas, under either the Land Use Procedure or the Population Density Procedure, the user needs to estimate the population of the urban area affecting the modeling domain because the urban influence in AERMOD is scaled based on a user-specified population. ***For non-population oriented urban areas, or areas influenced by both population and industrial activity, the user will need to estimate an equivalent population to adequately account for the combined effects of industrialized areas and populated areas within the modeling domain. Selection of the appropriate population for these applications should be determined in consultation with the appropriate reviewing authority (paragraph 3.0(b)) and the latest version of the AERMOD Implementation Guide.[76]***

GAQM References:

(44) U.S. Environmental Protection Agency, 2016. AERMOD Model Formulation. Publication No. EPA–454/B–16–014. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

(45) Cimorelli, A. et al., 2005. AERMOD: A Dispersion Model for Industrial Source Applications. Part I: General Model Formulation and Boundary Layer Characterization. Journal of Applied Meteorology, 44(5): 682–693.

(72) Turner, D.B., 1969. Workbook of Atmospheric Dispersion Estimates. PHS Publication No. 999–AP–26. U.S. Department of Health, Education and Welfare, Public Health Service, Cincinnati, OH. (NTIS No. PB–191482).

(73) McElroy, J.L. and F. Pooler, Jr., 1968. St. Louis Dispersion Study, Volume II— Analysis. National Air Pollution Control Administration Publication No. AP–53, U.S. Department of Health, Education and Welfare, Public Health Service, Arlington, VA. (NTIS No. PB–190255).

(74) Irwin, J.S., 1978. Proposed Criteria for Selection of Urban Versus Rural Dispersion Coefficients. (Draft Staff Report). Meteorology and Assessment Division, U.S. Environmental Protection Agency, Research Triangle Park, NC. (Docket No. A–80–46, II–B–8).

(75) Auer, Jr., A.H., 1978. Correlation of Land Use and Cover with Meteorological Anomalies. Journal of Applied Meteorology, 17(5): 636–643.76. U.S. Environmental Protection Agency, 2016. AERMOD Implementation Guide. Publication No. EPA–454/B–16–013. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

(76) U.S. Environmental Protection Agency, 2016 [updated 2019]. AERMOD Implementation Guide. Publication No. EPA–454/B–16–013. Office of Air Quality Planning and Standards, Research Triangle Park, NC.

The latest version of the AERMOD implementation guide (reference 76 in the GAQM) describes the urban effect in terms of a heat island, stemming primarily from the fact that buildings and concrete surfaces in the urban area retain heat from daytime solar radiation and release it more slowly than surrounding rural areas, causing an increase in temperature that in turn affects atmospheric dispersion. The effect of the heat released at night is to create what is referred to in the MFD as a “convective-like” boundary layer, with a higher effective mixing depth and greater turbulence than in rural areas. These effects on boundary layer characteristics, noted in the MFD, are not present during the daytime.

In order to determine whether an area has the potential to create this convective-like boundary layer, the GAQM as outlined above recommends one of two techniques – the first based on land use (USEPA’s preferred option) and the second based on population density. Both of these techniques are applied within an area defined as a circle with radius of 3 km around the source that is the subject of the modelling exercise. Discussions in the literature indicate that this area is appropriate since the heat from

radiation at any single point (from “distributed” sources as opposed to single large heat sources) is not sufficient to modify the boundary layer - it takes some distance (set at 3 km) for the radiation to build up enough to create the convective-like boundary layer.

It is instructive to consider the land use technique recommended by the GAQM, which relies on five land use categories as described by Auer (1978, GAQM reference 75). The categories shown in Table 3-1 are named in the GAQM and are considered to contribute to the urban effect (descriptions are from the Auer paper).

Table 3-1: Description of Urban Land Use Categories

Type	Use and Structures	Vegetation
I1	Heavy industrial	
	Major chemical, steel and fabrication industries; generally 3-5 story buildings, flat roofs	Grass and tree growth extremely rare; <5% vegetation
I2	Light-moderate industrial	
	Rail yards, truck depots, warehouses, industrial parks, minor fabrications; generally 1-3 story buildings, flat roofs	Very limited grass, trees almost totally absent; <5% vegetation
C1	Commercial	
	Office and apartment buildings, hotels; >10 story heights, flat roofs	Limited grass and trees; <15% vegetation
R2	Compact Residential	
	Single, some multiple, family dwelling with close spacing; generally < 2 story, pitched roof structures; garages (via alley), no driveways	Limited lawn sizes and shade trees; <30% vegetation
R3	Compact Residential	
	Old multi-family dwellings with close (< 2 m) lateral separation; generally 2 story, flat roof structures; garages (via alley) and ash pits, no driveways	Limited lawn sizes, old established shade trees; <35% vegetation

These descriptions support the concept that the largest contributors to the urban heat island effect within 3 km are “distributed” sources as opposed to single large heat sources. The second technique referenced by the GAQM, based on population, also supports the concept that the 3 km radius circle is based on the need for an upwind fetch to generate enough heat release to develop a “convective-like” boundary layer. Oke (1973, reference 4) speaks of an “…urban boundary layer model based on the progressive warming of rural air as it moves across an urban area.” Reference 3, a peer-reviewed paper published in Atmospheric Environment, provides additional rationale for considering the heat created by industrialized areas to be an acceptable surrogate for the GAQM approaches.

The Beverly facility requires a great deal of energy to operate Beverly’s five electric arc furnaces - approximately 70 MW when the five furnaces are operating. The night-time source of heat at the Beverly facility is a function of some land-use related factors (concrete and buildings retaining daytime heat) but the primary source is the heat released into the environment by operation of the furnaces. The Beverly facility does not resemble a large city, but the heat generated is commensurate with heat release in an urban area, concentrated in a smaller footprint than a typical urban area. It stands to reason that the effect of the heat release on dispersion, through the formation of a “convective-like” boundary layer, is similar to an urban area with equivalent heat release, without the need for a 3-km “fetch’ to allow the

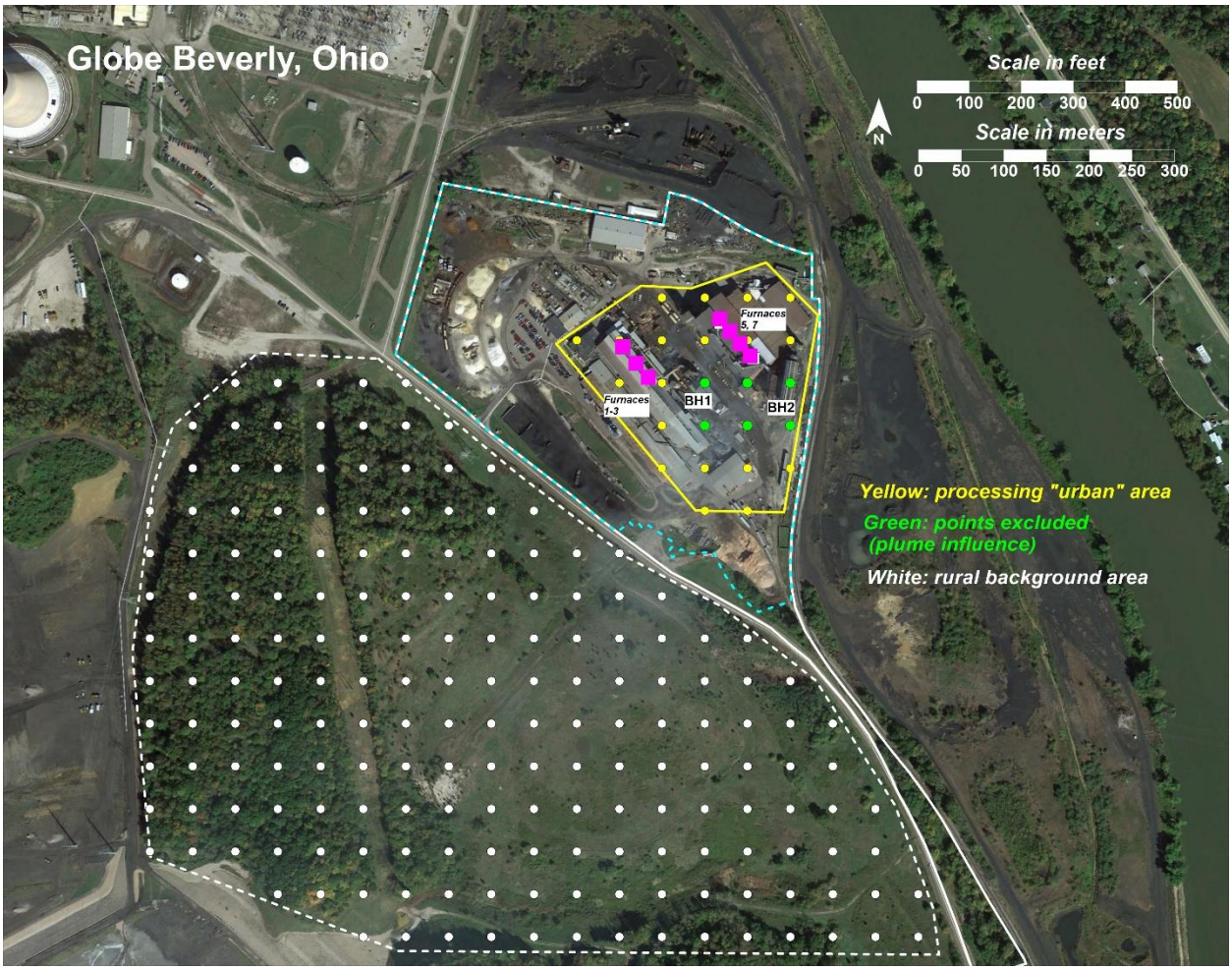
radiative effects to build up. This is especially true for facilities where the sources subject to modeling are within the same area where the heat is being released – excluding the heat released through exhaust flow as described below.

Whether the amount of heat released through operation of the furnaces is sufficient to create a convective-like boundary layer in the vicinity of the Beverly facility is examined in two ways: first, by obtaining and analyzing satellite thermal images to estimate the urban-rural temperature difference (ΔT_{u_r}) and second, by estimating ΔT_{u_r} using formulas documented in the MFD. The urban-rural temperature difference is then used to calculate an "effective population" for input to AERMOD.

3.1 Satellite Images

Advanced Spaceborne Thermal Emission and Reflection radiometer (ASTER) satellite images were used to examine the surface temperature difference between the surrounding rural area and the urban-like Beverly facility. Twelve images were identified starting in June 2015 (the date that the Muskingum River coal-fired power plant was shut down), and eight images were selected that reflect a range of operations at the Beverly facility and were not subject to interference from clouds. Appendix B provides details of the identification, selection, and processing of these images. To summarize, for each image a background rural temperature was determined for the grassy/forested area to the south and west of the facility, and an urban temperature was determined for the processing area where the furnaces are located. For each of these areas, an average temperature was calculated based on a grid of 50-meter spaced points (with temperature interpolated from the 90-meter satellite cells). Figure 3-1 shows the points associated with each area. The background area was selected to reflect the worst-case wind directions for the facility, namely from the west and from the south. The processing area was selected to represent the area where most of the facility heat is generated. Figure 3-1 also shows a subset of the processing area points, which represent the most likely area where a satellite image might capture heat in the plume from BH1 and BH2. As discussed further in Section 3.2, the temperature signature of the plumes from the baghouses are excluded from determination of the urban-rural temperature difference as this heat may not contribute as significantly to the heat island effect as radiation from the furnaces and other features and activities that contribute to the convective-like boundary layer.

Figure 3-1: Background Rural and Facility Urban Areas for Satellite Analysis



The results of the satellite image analysis are presented in Table 3-2. This table shows the rural and processing area temperatures based on the satellite images, the calculated ΔT_{u_r}, and the average ΔT_{u_r} over all images. The calculation of the processing area temperature excluded the points shown in Figure 3-1 as potentially influenced by the baghouse plumes. The average ΔT_{u_r} over all images is 8.7 degree C. Table 3-2 also documents the number of furnaces operating and the energy usage at the facility on the date and at the time of the selected images. The range of furnaces operating (3 to 5) and the range of energy use (60 to 80 MW) represent typical operating levels at the Beverly facility.

Table 3-2 identifies the dates and times of four images that were not included in the averaging. Notes in this table provide some qualitative evaluation of the reasons for not using these images. Appendix B contains a more detailed quantitative evaluation that shows, in summary, that these four images were taken when the area was under cloudy skies – the satellite cannot accurately determine surface temperatures when there is cloud cover. The quantitative evaluation was carried out by obtaining and analyzing surface meteorological measurements from the Parkersburg, WV and Zanesville, OH airports. The Parkersburg airport ASOS station was the source of representative surface meteorological data processed by AERMET to create model-ready files for AERMOD. It is located approximately 34 km from Globe to the south-southeast; the Zanesville ASOS station is located approximately 44 km to the north-northwest. The purpose of examining data from two sites is to demonstrate that conditions relevant to this evaluation (specifically cloud cover) when the images were taken were widespread across a large area and therefore reasonably representative of the Globe facility site.

The quantitative analysis is supplemented by satellite cloud images, which are also shown in Appendix B. The meteorological conditions and the satellite cloud images are subject to some uncertainties. It is not possible to obtain cloud images at the precise time that the satellite thermal images were taken, however cloud images were available representing each of the days when the thermal images were taken. It is possible that cloud conditions might have changed between the times that the two images were taken. The meteorological conditions at Parkersburg and Zanesville are recorded at hourly (and occasionally more frequent) intervals. These are more likely to reflect conditions at the time the thermal images were taken, but there is still the potential for some changes in between observations. These uncertainties notwithstanding, taken together the data and images presented in Appendix B support the conclusion that the four images not used were subject to interference from clouds and that the eight images used were not subject to interference.

Table 3-2: Results of the Satellite Image Analysis

Appendix Figure	Date (Local)	Time (Local)	Season	Average Processing Area Site Temperature	Average Background Temperature	Excess Temperature	Number of Furnaces Operating	Energy Use
				(deg K); Tu	(deg K); Tr	(deg C); ΔTu_r		MW
Figure B-3	9/22/2015	11:30 AM	Autumn	*Excluded (Note 1)*			2	36.7
Figure B-4	9/24/2016	11:30 AM	Autumn	316.1	304.6	11.5	4	70.9
Figure B-5	10/10/2016	11:30 AM	Autumn	303.9	294.4	9.5	4	72.6
Figure B-6	9/27/2017	11:30 AM	Autumn	318.4	308.3	10.1	3	60.8
Figure B-7	10/29/2017	10:30 PM	Autumn	*Excluded (Note 2)*			4	61.6
Figure B-8	6/3/2018	11:30 AM	Summer	316.4	302.5	13.9	5	81.8
Figure B-9	11/10/2018	10:30 PM	Autumn	275.0	269.4	5.7	3	67.0
Figure B-10	4/26/2019	11:30 AM	Spring	*Excluded (Note 3)*			3	52.8
Figure B-11	5/21/2019	11:30 AM	Spring	288.4	280.6	7.8	3	59.6
Figure B-12	5/28/2019	11:30 AM	Spring	*Excluded (Note 4)*			3	57.6
Figure B-13	6/22/2019	10:30 PM	Summer	293.2	287.3	5.9	3	60.0
Figure B-14	10/28/2019	10:30 PM	Autumn	287.3	281.8	5.5	5	80.0
					Average ΔTu_r:	8.7	Average Load:	69.1
Note 1	*Low energy use, no heat signature*							
Note 2	*Heat signature displaced (facility colder than surroundings)*							
Note 3	*No heat signature (facility colder than surroundings)*							
Note 4	*No heat signature (facility colder than surroundings)*							

Some additional perspective on the calculations is provided in Figure 3-2, which illustrates the temperature patterns recorded in the satellite image for 6/3/2018. This image is associated with the highest ΔT_{u_r} and the highest energy use. This figure was developed by first calculating the average temperature across the area shown, and then calculating the deviation from average at each point. The contours shown in the figure are labeled with the calculated deviation, and provide a detailed look at the effect of heat release at the Beverly facility compared to the temperature of the upwind rural area for this date and time.

Figure 3-2: Temperature Differences for 6/3/2018

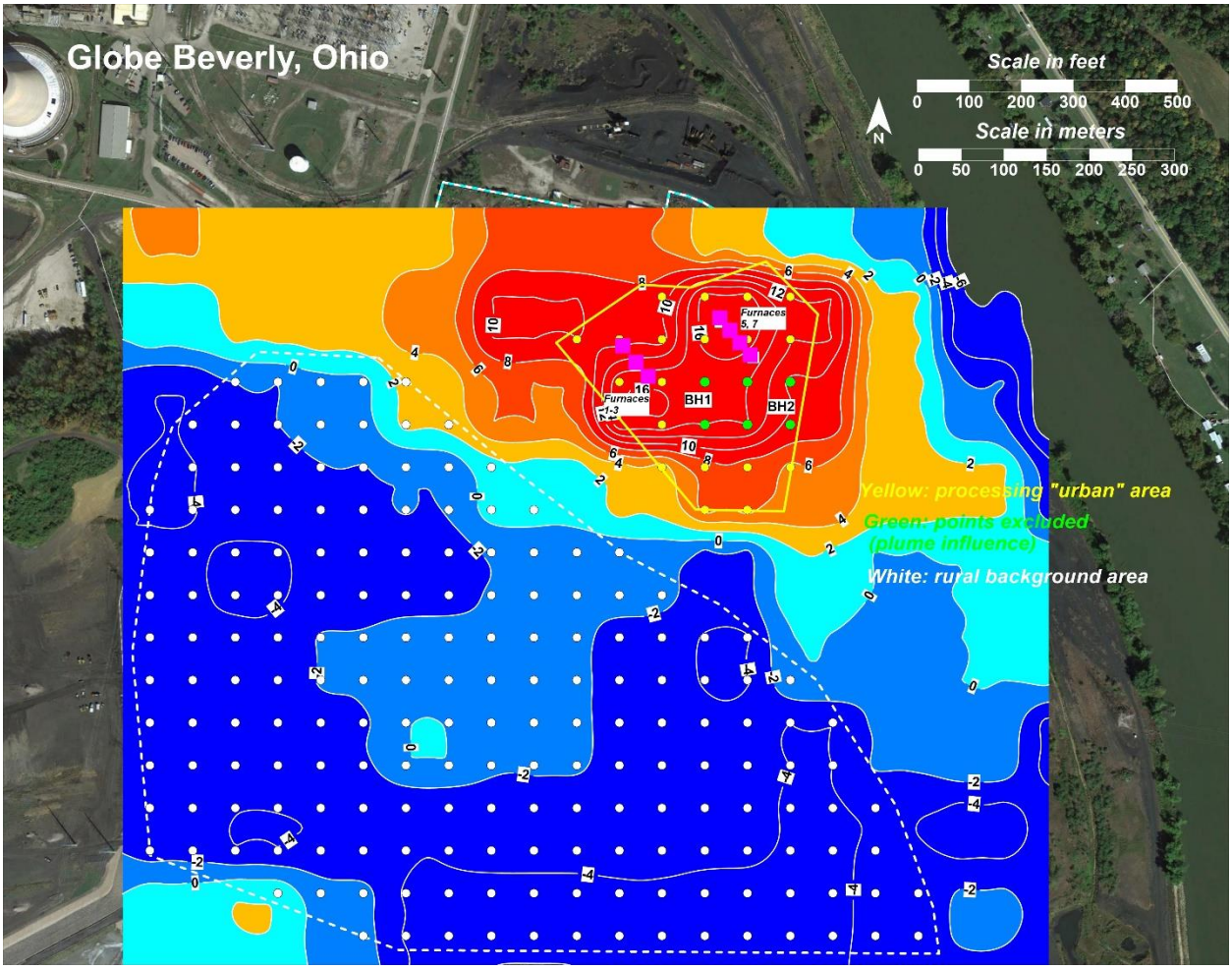


Table 3-2, Figure 3-2, and the presentation found in Appendix B illustrate that the calculated ΔT_{u_r} values fluctuate with energy usage, with the highest value associated with the highest energy use. Average energy use during these events was close to the nominal value of 70 MW. Collectively these data and images provide a demonstration of the effect of the facility heat production on increased temperature, within the urban-like Beverly facility, above the temperature of the upwind rural area.

3.2 Heat Release and Effective Population Calculation

The AERMOD MFD (reference 1, section 5.9) contains a description of the urban boundary layer and the inter-relationships between heat flux, population, and the urban-rural temperature difference (ΔT_{u_r}) that are described here, followed by a description of the calculations performed for Beverly. Ultimately the goal is to develop an appropriate surrogate population for input to AERMOD. Relevant formulas from the MFD include a formula relating ΔT_{u_r} and heat flux:

$$Hu = \alpha * \rho * Cp * \Delta T_{u_r} * U^* \quad \text{(MFD Equation 108)}$$

Where: Hu is the heat flux;

α is an empirical constant;

ρ is the density of air;

C_p is the specific heat of air at constant pressure;

U^* is the friction velocity.

As explained in the MFD, α has a value of 0.03. Assuming typical values for the other parameters, this equation can be simplified to:

$$\Delta T_{u_r} \sim Hu/4 \qquad (1)$$

Table 3-3 illustrates this derivation:

Table 3-3: Derivation – Simplification of MFD Equation 108

Convert Heat Flux to Delta-T (urban/rural) Equation 108 in AERMOD Model Formulation Document (MFD, 2019)		
Hu = alpha*rho*cp* ΔT_{u_r} *(U*)		
value	**name**	**units**
0.03	alpha	unitless
1.19	rho	kg/m3
1.00584	Cp	kws/kg-C
1005.84	Cp	ws/kg-C
variable	ΔT_{u_r}	C
0.1	U*	m/s
3.6	factor to convert Hu to ΔT_{u_r}	watts/m^2-C
4	rounded	watts/m^2-C

Another MFD equation relates ΔT_{u_r} to population. This is an empirical formula developed from data presented by Oke (1973, reference 4), which reported urban-rural temperature differences for several North American cities with populations ranging from 21,000 to 2,000,000.

$$\Delta T_{u_r} = \Delta T_{max}[0.1\ln(P/P_0)+1.0] \text{ (MFD Equation 107)}$$

Where: ΔT_{max} = 12 degree C (the largest temperature difference reported by Oke);
P_0 = 2,000,000 (the largest population reported by Oke);
P = population associated with the calculated ΔT_{u_r}.

This equation can be solved to relate population to ΔT_{u_r}:

$$P = P_0 \exp[10(\Delta T_{u_r}/\Delta T_{max}) - 1.0] \qquad (2)$$

The MFD provides additional explanation of the treatment of urban dispersion, through the calculation of an urban mixing depth and vertical temperature gradient, and the calculation of the turbulence parameters - the friction velocity u* and the convective velocity scale w*. These parameters are calculated internally by AERMOD and used in place of the values contained in the meteorological inputs (which are calculated by AERMET).

Based on this discussion it is possible to calculate an effective population based on ΔT_{u_r} through the use of equation (2). A value of ΔT_{u_r} can be determined either by satellite thermal images (Section 3.1) or by the calculation of heat flux and the use of equation (1). For the present analysis a value of the heat flux was calculated based on consideration of the Beverly facility heat release. This calculation considered the total heat released when all five furnaces are operating. It is important to note however that a conservative approach was used where the heat released to the atmosphere from the baghouse exhaust was not counted as part of the heat contribution to creating a “convective-like” boundary layer. The

reason for this is that the baghouse exhaust flow and temperature are used to calculate plume rise and should not be "double-counted" as part of the heat island effect. If exhaust temperature and flow were considered as part of the heat island effect, virtually any power plant would need to be modeled with urban dispersion.

The first step in the calculation of an effective population is to determine how much heat is released through the exhaust flows from the two baghouses, in order to exclude the heat in the exhaust from the determination of heat in subsequent processing. Table 3-4 shows how this calculation was carried out.

Table 3-4: Calculate Heat Released from Baghouse Exhaust

Calculate heat in exhaust flow for Baghouses 1 and 2			
Formula: Q = V*Rho*Cp*delta-T			
where:	Q = Heat content, in kCal/hour.		
	V = Is the flow in m^3/hour.		
	Rho = is the density of the flue gas, in kg/m^3.		
	Cp = Is the specific heat of air (constant pressure) in kCal/kg °C.		
Calculation			
BH1	BH2	Units	Description
268.67	332.96	m^3/s	Exhaust flow
9.67E+05	1.20E+06	m^3/hour	Exhaust flow
427.41	394.26	K	Exhaust temperature
0.83	0.90	kg/m^3	Density of the flue gas
0.24	0.24	kCal/kg-°C	Specific heat, constant pressure
129.41	96.26	C	Delta-T
2.49E+07	2.49E+07	kCal/hr	Heat content
	4.98E+07	kCal/hr	Total both baghouses
	59.8	MW	Convert

The effective population was calculated with the use of equations (1) and (2), considering the total energy requirement without the heat lost in the baghouse exhaust. The calculation is shown in Table 3-5. The calculation used for the Warrick protocol is shown in this table for the purpose of illustration. The calculated ΔT_{u_r} of 8.5 degree C is consistent with the value derived from satellite images of 8.7 degree C.

Table 3-5: Calculate Effective Population

Warrick	Beverly	Units	Description
450	70	MW	Total load required for all furnaces
22%	15%	pct released	Not including baghouse exhaust
100	10.2	MW	Heat released to the environment (70-59.8)
2,000,000	300,000	m2	Area with urban characteristics approx. 500x500 meters
50.0	34.0	watts/m2	calculation
12.5	8.5	delta-T r-u	calculation equation (1)
3,033,794	108,318	effective population	calculation equation (2)
2,000,000	**108,000**	rounded	population value used as input to AERMOD
70,736	3,820	population density	effective population density/sq km in a 3-km radius

The calculations shown in Table 3-5 demonstrate that the heat released by the Beverly facility has an effect on the environment equivalent to a city with population of 108,000. This is equivalent to a population density of 3,820 per square km – greater than 750 per square km, which means that a city of this size would be modeled with urban characteristics according to the criterion contained in the GAQM.

3.3 Model Performance

The Hackney monitor, measuring SO_2 concentrations, is located approximately 5 km north of the Beverly facility. Although Hackney was not designed as a source-oriented monitor for Globe Beverly, as demonstrated in Section 2.2 the measurements at Hackney are influenced by emissions from the Beverly facility. Modeling was conducted using AERMOD (21112) with the meteorological and source inputs described here (actual emissions), at a single receptor placed at the Hackney monitor, with both urban (population 108,000) and rural designations, and with the site-specific meteorological data. The facility was modeled with source inputs for baghouse 1 consistent with the period of the monitoring data, meaning that baghouse 1's stack orientation was modeled as a horizontal release at 19.263 meters in height. The resulting concentrations were processed to determine rank-ordered values of the 99th percentile of maximum daily SO_2 concentrations, averaged over 3 years. Similar processing was carried out for the hourly measured values at the Globe monitor, and quantile-quantile ("Q-Q") plots were created as displayed in Figures 3-3 and 3-4.

Figures 3-3 and 3-4 demonstrate that in the rural mode (blue dots), AERMOD over-predicts the design value of 1-hour SO_2 concentrations at both the Hackney and the Globe monitors by more than a factor of 2. This suggests that AERMOD in rural mode is significantly over-predicting (resulting in concentrations that are too high) and provides support for the use of the urban mode for the Beverly facility. The urban option (green dots) has a better performance with slight over-prediction tendency with higher concentrations.

Figure 3-3: Q-Q Plot of Predicted and Observed Concentrations at the Hackney Monitor

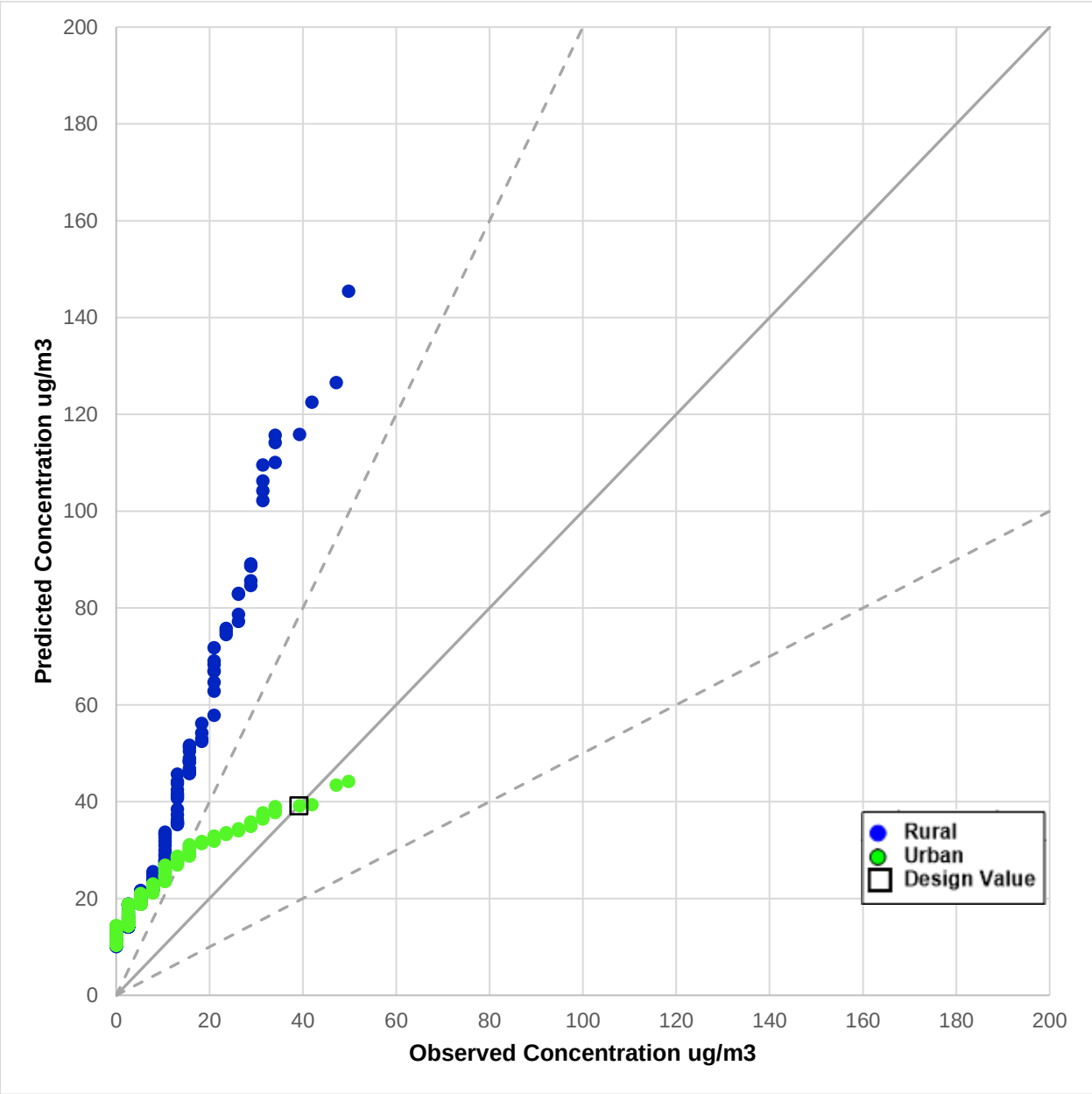
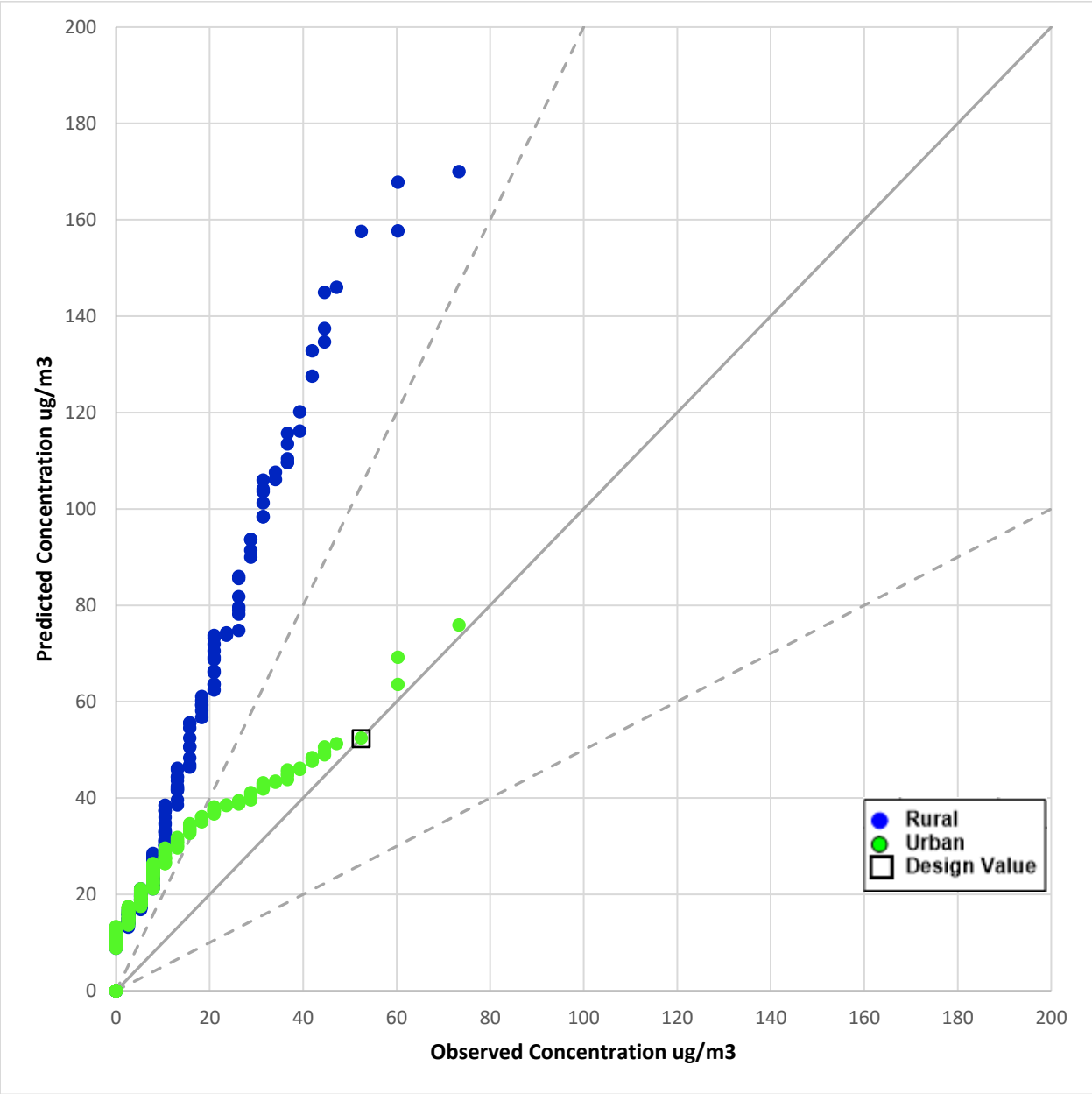


Figure 3-4: Q-Q Plot of Predicted and Observed Concentrations at the Globe Monitor



3.4 Summary

The urban designation for the Beverly facility is justified based on the following key points:

- The heat created by the Beverly furnaces (excluding heat contained in the baghouse exhaust) affects the atmosphere, creating a convective-like boundary layer in the same location as the sources to be modeled;
- Due to the intense local nature of the heat created by the Beverly furnaces, a 3-km fetch is not needed to build up heat release as with a more traditional urban area;
- Satellite imagery provides evidence of the heat island effect of the Beverly facility, with an urban-rural temperature difference (ΔT_{u_r}), on average, of 8.7 degree C;
- Calculations based on the heat requirements of running the five Beverly furnaces provide a demonstration that ΔT_{u_r} is 8.5 degree C;
- Calculation of an effective population based on ΔT_{u_r} of 8.5 degree C result in an effective population of 108,000. A city with population 108,000 would be classified as urban based on the GAQM population criterion.

4. MODEL RESULTS PRESENTATION

Modeling was conducted with AERMOD (21112) with the meteorological, source (including the planned installation of the BH1 vertical release as required under the 2022 DFFOs), and receptor inputs described in previous sections. AERMOD was configured in the urban mode with a population of 108,000 and DEFAULT settings. Modeling was conducted for two different scenarios: (i) actual daily emissions from April 6, 2021 through April 6, 2022, determined via mass balance SO_2 calculations in accordance with the 2022 DFFOs (Table 4-1); and (ii) allowable emissions based on 26 1-hour SO_2 emission limit sets (Table 4-2).

Table 4-1: Daily Actual Emissions April 6, 2021 to April 6, 2022

SO_2 Daily Emissions lbs/hr			
April 6, 2021 – April 6, 2022			
	Shop 1	Shop 2	Total
Average:	125.5	132.1	257.6
Maximum:	152.8	176.5	313.0

Table 4-2: SO_2 Emission Limit Sets – Modeled and 2022 DFFOs Limits

i.d.		Hourly (Modeled)			24-hour (2022 DFFOs Compliance)	
		BH1	BH2		BH1	BH2
		lbs/hr	*lbs/hr*		*lbs/hr*	*lbs/hr*
1		210.0	0.0		195.3	0.0
2		205.0	60.0		190.6	55.8
3		200.0	80.0		186.0	74.4
4		195.0	110.0		181.3	102.3
5		190.0	125.0		176.7	116.2
6		185.0	140.0		172.0	130.2
7		180.0	155.0		167.4	144.1
8		175.0	170.0		162.7	158.1
9		170.0	180.0		158.1	167.4
10		165.0	190.0		153.4	176.7
11		160.0	200.0		148.8	186.0
12		155.0	205.0		144.1	190.6
13		150.0	210.0		139.5	195.3
14		145.0	215.0		134.8	199.9
15		140.0	220.0		130.2	204.6
16		135.0	230.0		125.5	213.9
17		130.0	235.0		120.9	218.5
18		125.0	240.0		116.2	223.2
19		120.0	240.0		111.6	223.2
20		115.0	245.0		106.9	227.8
21		95.0	250.0		88.3	232.5
22		80.0	255.0		74.4	237.1
23		65.0	260.0		60.4	241.8
24		45.0	265.0		41.8	246.4
25		30.0	270.0		27.9	251.1
26		0.0	280.0		0.0	260.4

Table 4-2 displays: (i) SO_2 emission rates for BH1 and BH2 on a 1-hour average basis modeled to demonstrate compliance with the SO_2 NAAQS ("Hourly (Modeled)"); and (ii) corresponding SO_2 emission rates (using a 7% reduction factor) for BH1 and BH2 on a 24-hour average calendar day basis used to determine emissions compliance for the Beverly facility under the 2022 DFFOs ("24-hour (2022 DFFOs Compliance)"). Where a calculated rate for one baghouse falls in-between the rates shown in Table 4-2, the complying rate for the other baghouse will be the more stringent of the two corresponding rates for that baghouse. To illustrate, if the calculated emission rate for BH1 is 170.0 lbs/hr (in between i.d. 6 and 7 in Table 4-2), the corresponding rate for BH2 to ensure compliance with the SO_2 NAAQS will be 130.2 lbs/hr. The calculated rate for BH2 would have to be less than or equal to 130.2 lbs/hr in order to demonstrate compliance.

The 24-hour rates required by the 2022 DFFOs were calculated using a 7% reduction factor, which is based on the 23 April 2014 USEPA Guidance Memorandum titled Guidance for 1-Hour SO_2

Nonattainment Area SIP Submissions. This memorandum establishes a DEFAULT ratio for the 24-hour averaging period of 0.93 (or a 7% reduction), based on an analysis of emissions from 315 sources. According to the memorandum (Appendix D), development of the DEFAULT ratio was based on "SO_2 24-hour average values (computed on a calendar day basis)". The 24-hour rates displayed in Table 4-2 were developed by applying the default ratio of 0.93, then truncating the result to the nearest tenth. When calculating emission rates to determine compliance with Table 4-2, Globe will round the calculated value to the nearest tenth (e.g., 130.26 lbs/hr will become 130.3 lbs/hr).

The use of a 24-hour calendar day emission rate to determine compliance with the 1-hour NAAQS for SO_2 recognizes that variability in hourly rates, including some hourly rates greater than and some rates less than the average, does not compromise attaining the standard. This recognition is based in part on the nature of the form of the standard – namely, the 99th percentile maximum daily 1-hour concentration averaged over 3 years – which specifically allows for some exceedances of the numerical value of the NAAQS. Modeled exceedances of the NAAQS occur only when meteorological conditions are conducive to creating higher predicted impacts. Consideration of the form of the standard and the infrequent occurrence of unfavorable meteorological conditions provide justification for relying on a longer averaging period for emissions compliance, and the factor provided in EPA's memorandum provides the quantitative basis for the 24-hour calendar day rates. The Beverly facility's compliance with emissions based on the 24-hour average calendar day rates will therefore ensure compliance with the 1-hour NAAQS for SO_2.

Modeling conducted to demonstrate compliance with the SO_2 NAAQS used the methodology described in this document for each combination of 1-hour emissions listed in Table 4-2, not the 24-hour rates. This modeling also accounted for fugitive emissions based on the ratio described previously – 98% of the total from the baghouses (the rates reflected in Table 4-2), and 2% of the total from the volume sources used to simulate fugitive emissions from each of Shop 1 and Shop 2.

Table 4-3 provides a summary of model results based on each of the 26 1-hour emission limit sets of emission limits contained in the 2022 DFFOs with a maximum design value of 189.6 $\mu g/m^3$ using available meteorology for the period of April 6, 2021 to April 6, 2022 and the increased release height from the planned installation (as required by the 2022 DFFOs) of the 3-meter vertical release on BH1. The peak design concentration of 189.6 $\mu g/m^3$ results from the first emission combination of BH1 at 210.0 lb/hr and BH2 at 0.0 lb/hr.

Additional modelling was also conducted using the average actual daily emission rates (determined from mass balance calculations under the 2022 DFFOs for the period of April 6, 2021 to April 6, 2022). The modelling results produced a design value of 138.3 $\mu g/m^3$.

Figure 4-1 displays contours based on modeling results of the actual daily emissions for the period of April 6, 2021 to April 6, 2022. Figure 4-2 displays contours base on the maximum of the 26 1-hour emission limit sets modeled.

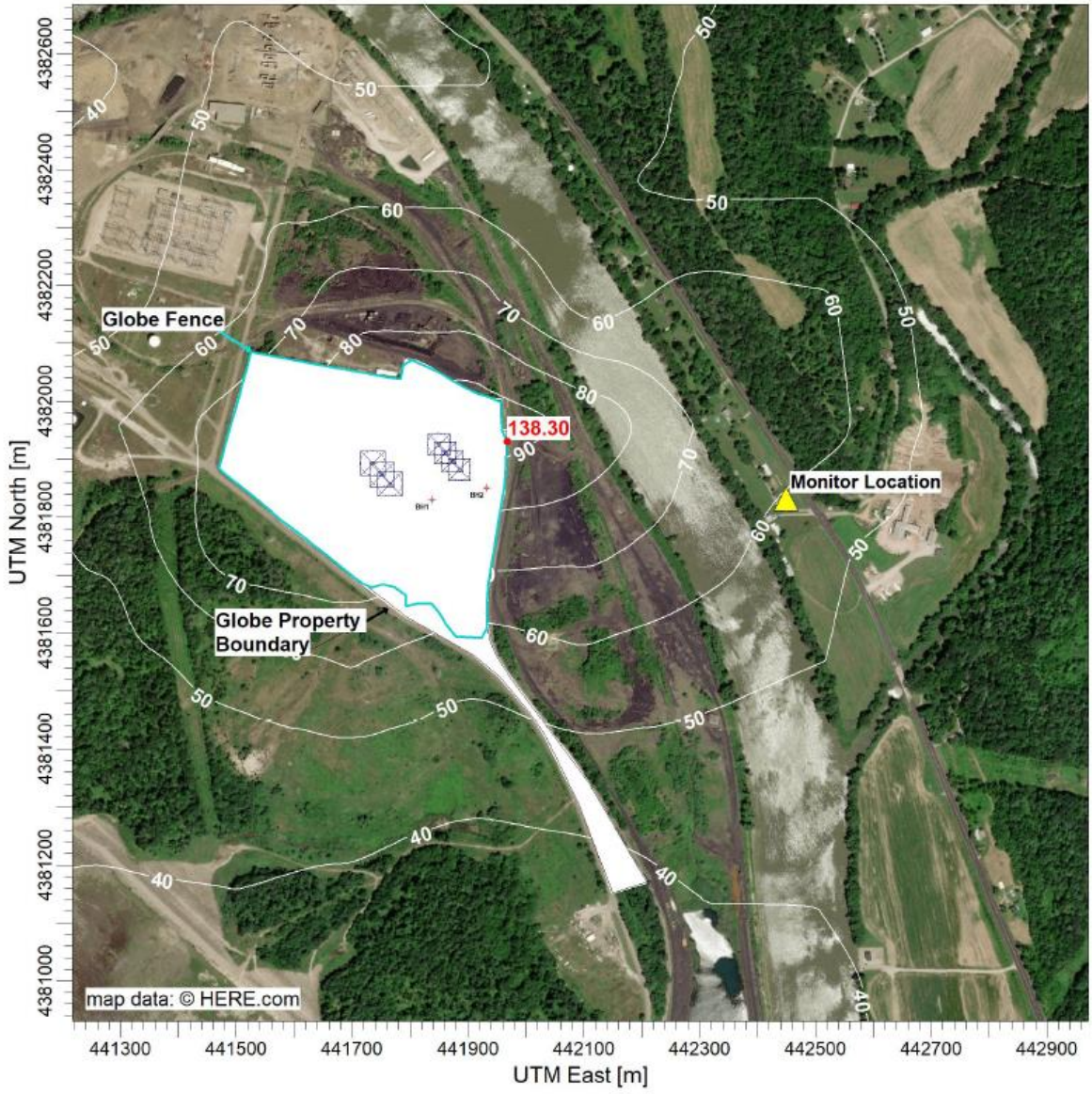
The results of the modeling conducted as described in this report, summarized in Table 4-3 and as illustrated in these figures, demonstrate that compliance with the 24-hour SO_2 emission limit sets required under the 2022 DFFOs will result in compliance with the 1-hour NAAQS for SO_2 for all of the 26 SO_2 1-hour emission limit sets.

Table 4-3: Model Results Based on Hourly SO_2 Emission Limit Sets

i.d.		Hourly (Modeled)		Design Value		24-hour (2020 DFFOs Compliance)	
		BH1	BH2			BH1	BH2
		lbs/hr	*lbs/hr*	*$\mu g/m^3$*		*lbs/hr*	*lbs/hr*
1		210.0	0.0	189.6		195.3	0.0
2		205.0	60.0	186.9		190.6	55.8
3		200.0	80.0	183.2		186.0	74.4
4		195.0	110.0	179.7		181.3	102.3
5		190.0	125.0	175.8		176.7	116.2
6		185.0	140.0	171.9		172.0	130.2
7		180.0	155.0	168.0		167.4	144.1
8		175.0	170.0	168.9		162.7	158.1
9		170.0	180.0	173.4		158.1	167.4
10		165.0	190.0	173.5		153.4	176.7
11		160.0	200.0	168.9		148.8	186.0
12		155.0	205.0	164.1		144.1	190.6
13		150.0	210.0	159.3		139.5	195.3
14		145.0	215.0	155.9		134.8	199.9
15		140.0	220.0	153.0		130.2	204.6
16		135.0	230.0	158.7		125.5	213.9
17		130.0	235.0	160.0		120.9	218.5
18		125.0	240.0	162.3		116.2	223.2
19		120.0	240.0	162.7		111.6	223.2
20		115.0	245.0	165.0		106.9	227.8
21		95.0	250.0	166.5		88.3	232.5
22		80.0	255.0	168.4		74.4	237.1
23		65.0	260.0	170.3		60.4	241.8
24		45.0	265.0	171.8		41.8	246.4
25		30.0	270.0	173.7		27.9	251.1
26		0.0	280.0	177.5		0.0	260.4

Figure 4-1: Model Results Contours - Actual Daily Emissions

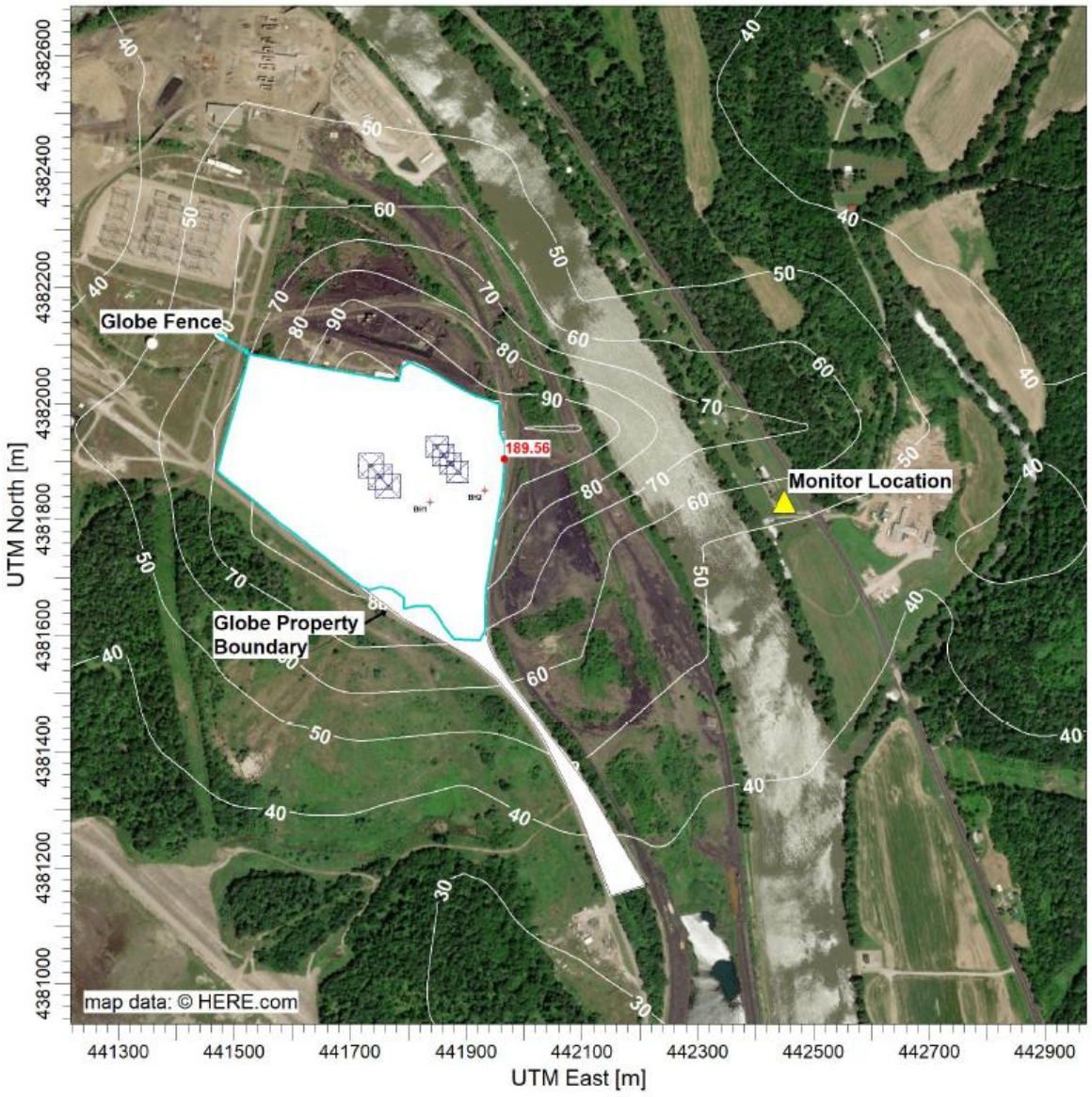
PROJECT TITLE:
Actual Emissions, Site-Specific Meteorology



COMMENTS:	SOURCES: 9		
	RECEPTORS: 1815		
	OUTPUT TYPE: Concentration	SCALE: 1:11,034 — 0 — 0.4 km	
	MAX: 138 ug/m^3	DATE: 5/4/2022	PROJECT NO.:

Figure 4-2: Model Results Contours – Hourly Emissions

PROJECT TITLE:
DFFO Scenario: Shop 1 = 210 lb/hr, Shop 2 = 0 lb/hr



COMMENTS:	SOURCES: 9		
	RECEPTORS: 1815		
	OUTPUT TYPE: Concentration	SCALE: 1:11,034 0 0.4 km	
	MAX: 190 ug/m^3	DATE: 5/4/2022	PROJECT NO.:

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APPENDIX A BEVERLY FACILITY – SHOP 1 AND 2 PHOTOGRAPHS



Photo 1: Shop 1 Furnace Bay – Roof Ventilator at top of photo. Furnaces 1 and 2 shown on right side.



Photo 2: Shop 1 Casting Bay – Roof ventilator at top of photo. Windows shown on right and left sides at the top of the wall.



Photo 3: Shop 2 Casting Bay. Casting emissions vent through the furnace bay roof vent out of frame to the left.

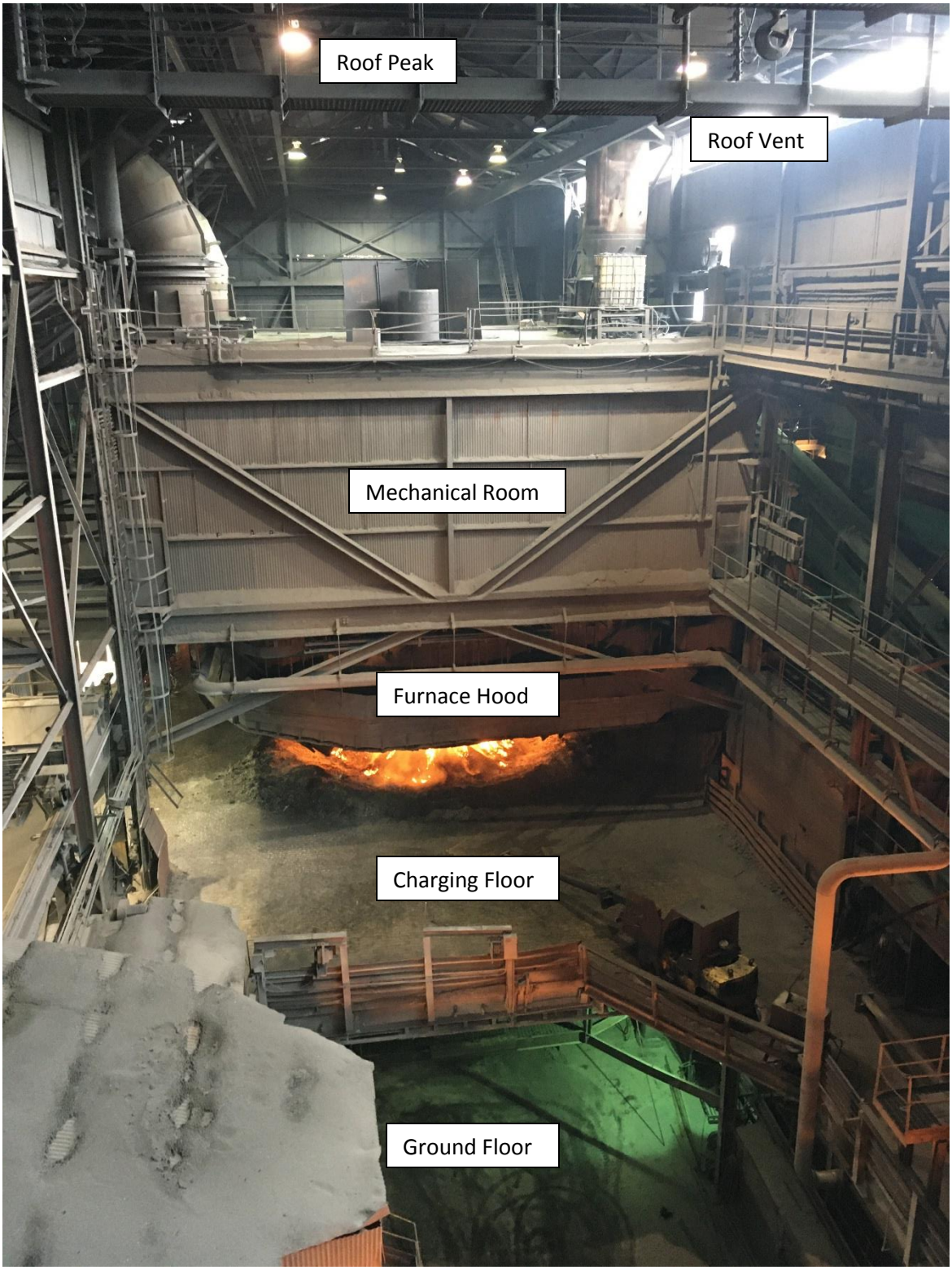


Photo 4: Furnace 7 Floor to Roof



Photo 5: Shop 2 External, furnace bay roof vent shown at center

APPENDIX B SATELLITE ANALYSIS OF THE URBAN-RURAL TEMPERATURE DIFFERENCE FOR THE GLOBE METALLURGICAL BEVERLY FACILITY

The industrial heat island effect at the Globe Metallurgical site, shown in Figure B-1, was evaluated using Advanced Spaceborne Thermal Emission and Reflection radiometer (ASTER) satellite images. These images are free and available to download from the NASA EarthData website at https://search.earthdata.nasa.gov/search.

The ASTER L2 Surface Kinetic Temperature product (AST08) is generated using the five TIR bands acquired either during day-time or night-time in the spectral range between 8 and 12 microns. The AST08 images contain surface temperatures at 90 m spatial resolution. The Surface Kinetic Temperature is determined by applying Planck's Law using the emissivity values from the temperature emissivity separation (TES) algorithm[1], which uses atmospherically corrected ASTER Surface Radiance (TIR) data. In response to changes in certain input variables, some modifications were implemented in the TES algorithm.

All available images starting on June, 2015 (the date when the neighboring Muskingum River Power Plant was shut down) through the present were downloaded (12 images). The images taken on days corresponding to a range of typical facility operations, and in which the facility heat signature was not obscured by apparent interferences, were selected for processing (8 images). The selected images represent three seasons with one for spring, two for summer, and 5 for autumn. A grid of 50-meter spaced points was placed over the Beverly facility area and the surface temperatures were extracted from the satellite images using ArcMap software. Figure B-2 shows the selected areas for image processing and shows the points associated with each area. The background area was selected to reflect the worst-case wind directions for the facility, namely from the west and from the south. The processing area was selected to represent the area where most of the facility heat is generated. Figure B-2 also shows a subset of the processing area points, which represent the most likely area where a satellite image might capture heat in the plume from BH1 and BH2. The temperature signature of the plumes from the baghouses are excluded from determination of the urban-rural temperature difference, as this heat may not contribute as significantly to the heat island effect as radiation from the furnaces and other features and activities that contribute to the convective-like boundary layer.

The results of the satellite image analysis are presented in Table B-1. This table shows the rural and processing area temperatures based on the satellite images, the calculated ΔTu_r, and the average ΔTu_r over all images. The calculation of the processing area temperature excluded the points shown in Figure B-2 as potentially influenced by the baghouse plumes. The average ΔTu_r over all images is 8.7 degrees C. Table B-1 also documents the number of furnaces operating and the energy usage at the facility on the date and at the time of the selected images. The range of furnaces operating (3 to 5) and the range of energy use (60 to 80 MW) represent typical operating levels at the Beverly facility.

Table B-1 identifies the dates and times of four images that were not included in the averaging. Notes in this table provide some qualitative evaluation of the reasons for not using these images. Further analysis was conducted to evaluate the exclusion or inclusion of the satellite images. A quantitative evaluation was carried out by obtaining and analyzing surface meteorological measurements from the Parkersburg, WV and Zanesville, OH airports. The Parkersburg airport ASOS station was the source of representative surface meteorological data processed by AERMET to create model-ready files for AERMOD. It is located approximately 34 km from Globe to the south-southeast; the Zanesville ASOS station is located approximately 44 km to the north-northwest. The purpose of examining data from two sites is to demonstrate that conditions relevant to this evaluation (specifically cloud cover) when the images were taken were widespread across a large area and therefore reasonably representative of the Globe facility site.

[1] Gillespie, A.R., Rokugawa, S., Matsunaga T., Cothern, S., Hook, S.J., and Kahle, A.B. (1998) A temperature and emissivity separation algorithm for Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) images. IEEE Transactions on Geoscience and Remote Sensing, 36, 1113–1126.

The quantitative analysis is supplemented by satellite cloud images obtained from NASA's Worldview website, https://worldview.earthdata.nasa.gov/. Figures B-3 through B-14 display meteorological conditions, the satellite thermal image, and the cloud cover image for each of the twelve available thermal image.

The meteorological conditions and the satellite cloud images are subject to some uncertainties. It is not possible to obtain cloud images at the precise time that the satellite thermal images were taken, however cloud images were available representing each of the days when the thermal images were taken. It is possible that cloud conditions might have changed between the times that the two images were taken. The meteorological conditions at Parkersburg and Zanesville are recorded at hourly (and occasionally more frequent) intervals. These are more likely to reflect conditions at the time the thermal images were taken, but there is still the potential for some changes in between observations. These uncertainties notwithstanding, taken together the data and images presented in Figures B-3 through B-14 support the conclusion that the four images not used were subject to interference from clouds and that the eight images used were not subject to interference.

Table B-1 List of Selected Satellite Images and Corresponding Surface Temperatures

Appendix Figure	Date (Local)	Time (Local)	Season	Average Processing Area Site Temperature	Average Background Temperature	Excess Temperature	Number of Furnaces Operating	Energy Use
				(deg K); Tu	(deg K); Tr	(deg C); ΔTu_r		MW
Figure B-3	9/22/2015	11:30 AM	Autumn	*Excluded (Note 1)*			2	36.7
Figure B-4	9/24/2016	11:30 AM	Autumn	316.1	304.6	11.5	4	70.9
Figure B-5	10/10/2016	11:30 AM	Autumn	303.9	294.4	9.5	4	72.6
Figure B-6	9/27/2017	11:30 AM	Autumn	318.4	308.3	10.1	3	60.8
Figure B-7	10/29/2017	10:30 PM	Autumn	*Excluded (Note 2)*			4	61.6
Figure B-8	6/3/2018	11:30 AM	Summer	316.4	302.5	13.9	5	81.8
Figure B-9	11/10/2018	10:30 PM	Autumn	275.0	269.4	5.7	3	67.0
Figure B-10	4/26/2019	11:30 AM	Spring	*Excluded (Note 3)*			3	52.8
Figure B-11	5/21/2019	11:30 AM	Spring	288.4	280.6	7.8	3	59.6
Figure B-12	5/28/2019	11:30 AM	Spring	*Excluded (Note 4)*			3	57.6
Figure B-13	6/22/2019	10:30 PM	Summer	293.2	287.3	5.9	3	60.0
Figure B-14	10/28/2019	10:30 PM	Autumn	287.3	281.8	5.5	5	80.0
					Average ΔTu_r:	8.7	Average Load:	69.1

Note 1 *Low energy use, no heat signature*

Note 2 *Heat signature displaced (facility colder than surroundings)*

Note 3 *No heat signature (facility colder than surroundings)*

Note 4 *No heat signature (facility colder than surroundings)*

Figure B-1 Aerial Photo of the Globe Metallurgical Site

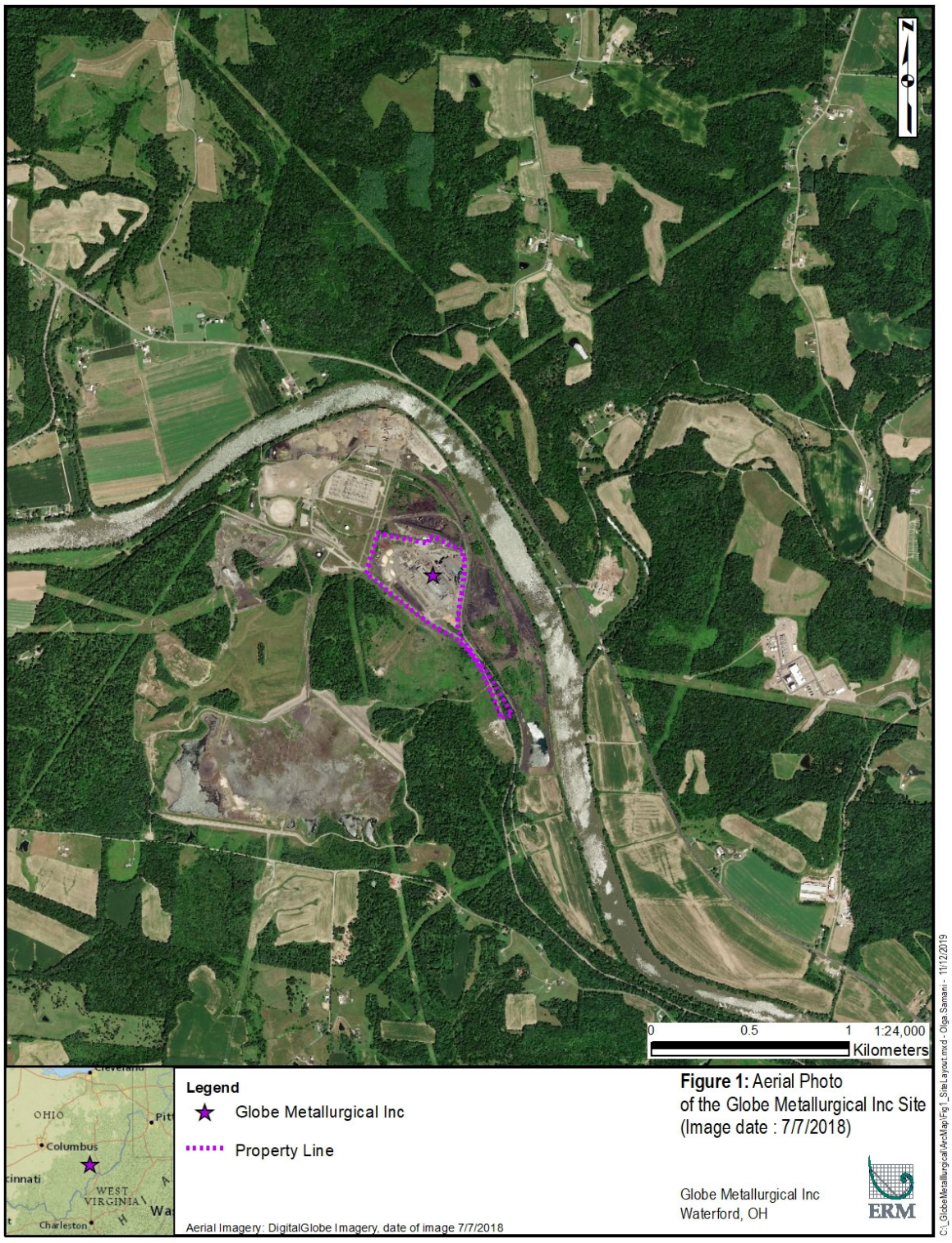
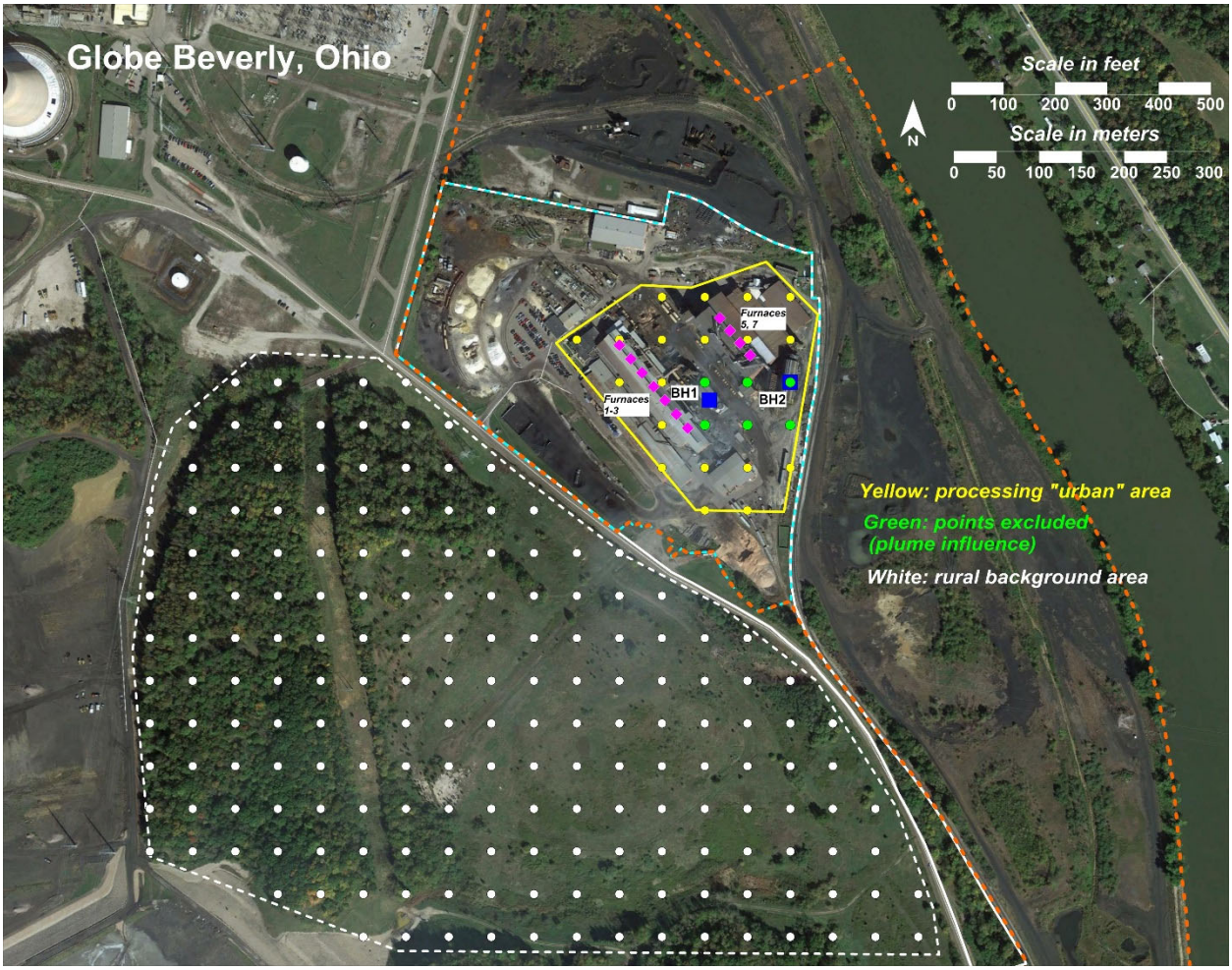


Figure B-2 Selected Areas for the Surface Temperature Determination

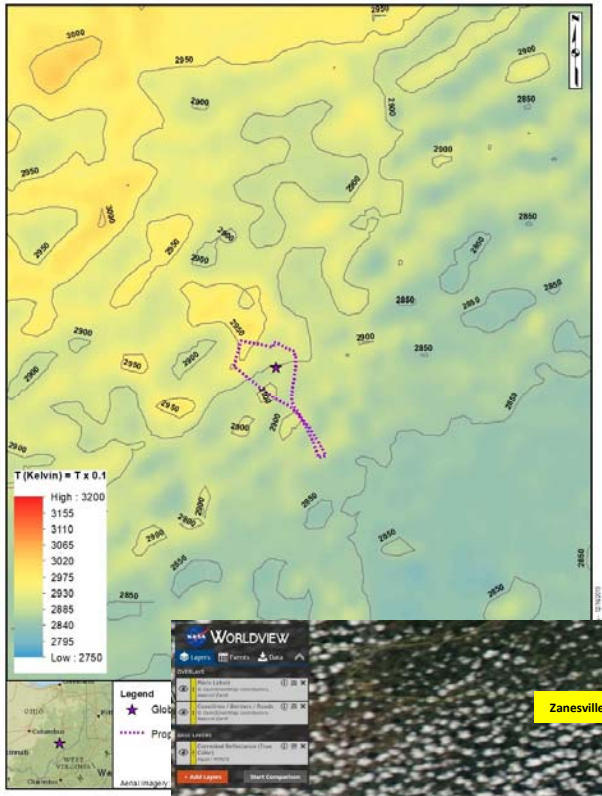


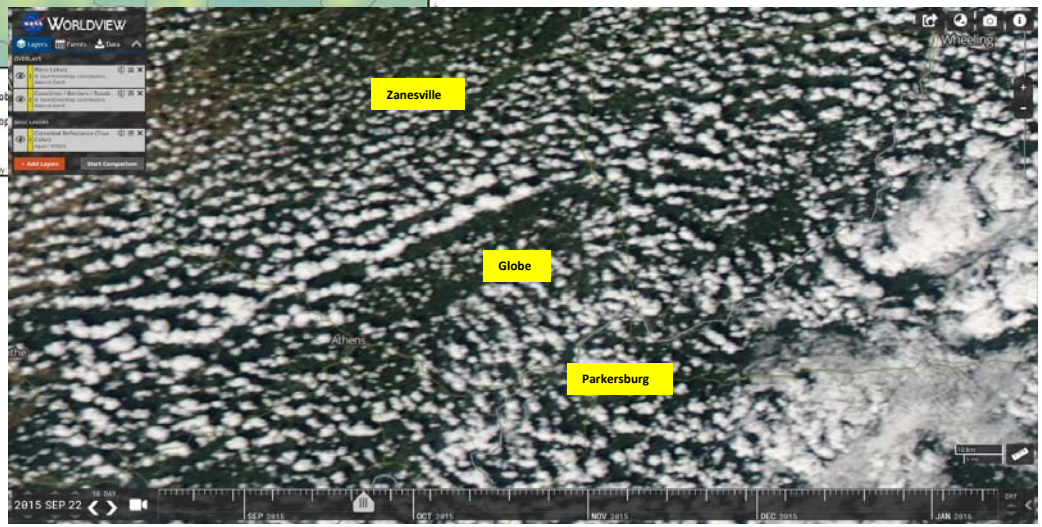
Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
9/22/2015	12:53 AM	56	286	54 F	93%	CALM	0 mph	0 mph	29.23 in	0.0 in	Mostly Cloudy
9/22/2015	1:53 AM	57	287	54 F	89%	CALM	0 mph	0 mph	29.23 in	0.0 in	Cloudy
9/22/2015	2:53 AM	58	288	56 F	93%	CALM	0 mph	0 mph	29.23 in	0.0 in	Cloudy
9/22/2015	3:53 AM	58	288	55 F	90%	CALM	0 mph	0 mph	29.24 in	0.0 in	Cloudy
9/22/2015	4:53 AM	57	287	55 F	93%	CALM	0 mph	0 mph	29.25 in	0.0 in	Cloudy
9/22/2015	5:53 AM	58	288	56 F	93%	CALM	0 mph	0 mph	29.27 in	0.0 in	Cloudy
9/22/2015	6:53 AM	59	288	57 F	93%	CALM	0 mph	0 mph	29.30 in	0.0 in	Cloudy
9/22/2015	7:53 AM	60	289	58 F	93%	CALM	0 mph	0 mph	29.30 in	0.0 in	Cloudy
9/22/2015	8:53 AM	65	291	58 F	78%	E	5 mph	0 mph	29.31 in	0.0 in	Partly Cloudy
9/22/2015	9:53 AM	70	294	58 F	65%	NNE	7 mph	0 mph	29.32 in	0.0 in	Mostly Cloudy
9/22/2015	10:53 AM	72	295	59 F	64%	ENE	6 mph	0 mph	29.32 in	0.0 in	Cloudy
9/22/2015	11:42 AM	72	295	59 F	64%	NNE	5 mph	0 mph	29.31 in	0.0 in	Cloudy
9/22/2015	11:53 AM	73	296	59 F	61%	VAR	5 mph	0 mph	29.31 in	0.0 in	Cloudy
9/22/2015	12:29 PM	75	297	59 F	57%	N	7 mph	0 mph	29.30 in	0.0 in	Mostly Cloudy
9/22/2015	12:53 PM	76	298	58 F	54%	NW	6 mph	0 mph	29.29 in	0.0 in	Partly Cloudy
9/22/2015	1:53 PM	76	298	58 F	54%	ENE	6 mph	0 mph	29.28 in	0.0 in	Partly Cloudy
9/22/2015	2:53 PM	78	299	58 F	50%	ENE	5 mph	0 mph	29.27 in	0.0 in	Partly Cloudy
9/22/2015	3:53 PM	78	299	56 F	46%	VAR	3 mph	0 mph	29.26 in	0.0 in	Fair
9/22/2015	4:53 PM	74	296	58 F	57%	NE	7 mph	0 mph	29.27 in	0.0 in	Partly Cloudy
9/22/2015	5:53 PM	74	296	58 F	57%	E	5 mph	0 mph	29.27 in	0.0 in	Fair
9/22/2015	6:53 PM	67	293	60 F	79%	CALM	0 mph	0 mph	29.27 in	0.0 in	Fair
9/22/2015	7:53 PM	64	291	59 F	84%	CALM	0 mph	0 mph	29.29 in	0.0 in	Fair
9/22/2015	8:53 PM	61	289	58 F	90%	CALM	0 mph	0 mph	29.30 in	0.0 in	Fair
9/22/2015	9:53 PM	60	289	57 F	90%	CALM	0 mph	0 mph	29.30 in	0.0 in	Fair
9/22/2015	10:53 PM	59	288	56 F	90%	CALM	0 mph	0 mph	29.30 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
9/22/2015	12:53 AM	55	286	53 F	93%	CALM	0 mph	0 mph	29.17 in	0.0 in	Fair
9/22/2015	1:53 AM	54	285	52 F	93%	CALM	0 mph	0 mph	29.17 in	0.0 in	Fair
9/22/2015	2:29 AM	53	285	52 F	96%	CALM	0 mph	0 mph	29.17 in	0.0 in	Fair
9/22/2015	2:37 AM	53	285	52 F	96%	CALM	0 mph	0 mph	29.18 in	0.0 in	Fog
9/22/2015	2:44 AM	53	285	52 F	96%	CALM	0 mph	0 mph	29.18 in	0.0 in	Fog
9/22/2015	2:51 AM	54	285	52 F	94%	CALM	0 mph	0 mph	29.18 in	0.0 in	Mostly Cloudy
9/22/2015	2:53 AM	52	284	51 F	97%	CALM	0 mph	0 mph	29.18 in	0.0 in	Mostly Cloudy
9/22/2015	3:00 AM	52	284	51 F	97%	CALM	0 mph	0 mph	29.18 in	0.0 in	Partly Cloudy
9/22/2015	3:53 AM	53	285	51 F	93%	CALM	0 mph	0 mph	29.19 in	0.0 in	Mostly Cloudy
9/22/2015	4:53 AM	53	285	52 F	96%	N	3 mph	0 mph	29.20 in	0.0 in	Partly Cloudy
9/22/2015	5:53 AM	52	284	50 F	93%	CALM	0 mph	0 mph	29.22 in	0.0 in	Partly Cloudy
9/22/2015	6:53 AM	53	285	51 F	93%	CALM	0 mph	0 mph	29.24 in	0.0 in	Fair
9/22/2015	7:53 AM	57	287	54 F	89%	CALM	0 mph	0 mph	29.26 in	0.0 in	Fair
9/22/2015	8:53 AM	62	290	58 F	86%	CALM	0 mph	0 mph	29.27 in	0.0 in	Partly Cloudy
9/22/2015	9:53 AM	67	293	59 F	76%	ENE	5 mph	0 mph	29.27 in	0.0 in	Fair
9/22/2015	10:53 AM	70	294	59 F	68%	CALM	0 mph	0 mph	29.27 in	0.0 in	Fair
9/22/2015	11:53 AM	73	296	58 F	59%	N	7 mph	0 mph	29.25 in	0.0 in	Fair
9/22/2015	12:53 PM	75	297	57 F	53%		0 mph	0 mph	29.24 in	0.0 in	Fair
9/22/2015	1:53 PM	76	298	58 F	54%	WNW	6 mph	0 mph	29.23 in	0.0 in	Partly Cloudy
9/22/2015	2:53 PM	76	298	56 F	50%	ENE	8 mph	0 mph	29.22 in	0.0 in	Mostly Cloudy
9/22/2015	3:53 PM	78	299	55 F	45%	NNE	5 mph	0 mph	29.21 in	0.0 in	Fair
9/22/2015	4:53 PM	77	298	55 F	46%	NNE	6 mph	0 mph	29.21 in	0.0 in	Fair
9/22/2015	5:53 PM	75	297	54 F	48%	NE	3 mph	0 mph	29.21 in	0.0 in	Fair
9/22/2015	6:53 PM	68	293	57 F	68%	CALM	0 mph	0 mph	29.22 in	0.0 in	Fair
9/22/2015	7:53 PM	64	291	57 F	78%	CALM	0 mph	0 mph	29.24 in	0.0 in	Fair
9/22/2015	8:53 PM	62	290	58 F	86%	CALM	0 mph	0 mph	29.24 in	0.0 in	Fair
9/22/2015	9:53 PM	60	289	57 F	90%	CALM	0 mph	0 mph	29.25 in	0.0 in	Fair
9/22/2015	10:53 PM	56	286	55 F	97%	CALM	0 mph	0 mph	29.25 in	0.0 in	Fair





September 22, 2015

11:30 a.m.

Image excluded

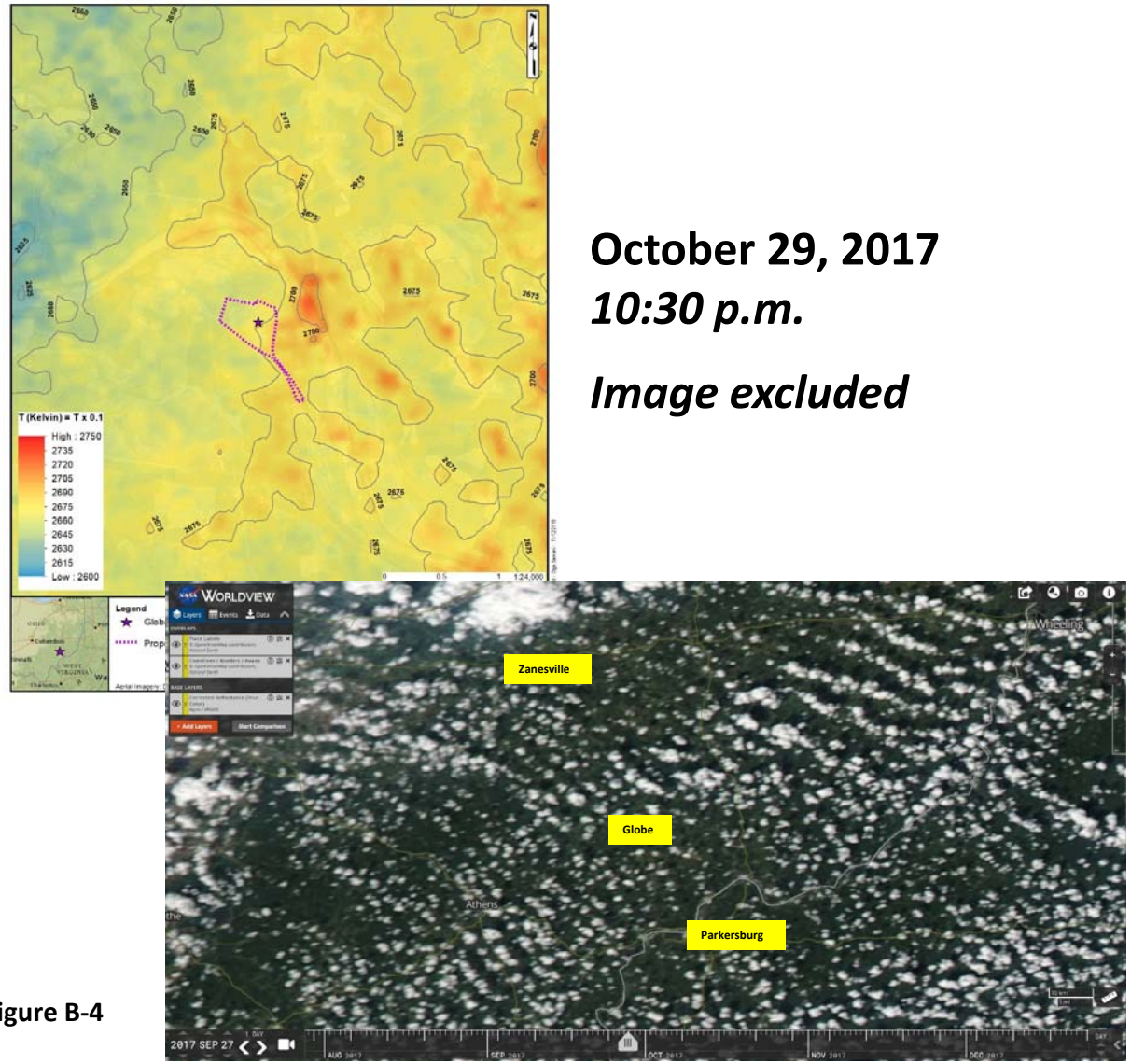
Figure B-3

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10/29/2017	12:16 AM	39	277	37 F	93%	CALM	0 mph	0 mph	28.98 in	0.0 in	Light Rain
10/29/2017	12:53 AM	38	276	37 F	97%	VAR	6 mph	0 mph	28.97 in	0.1 in	Light Rain
10/29/2017	1:12 AM	37	276	34 F	89%	VAR	5 mph	0 mph	28.96 in	0.0 in	Light Rain
10/29/2017	1:36 AM	37	276	34 F	89%	VAR	5 mph	0 mph	28.95 in	0.0 in	Cloudy
10/29/2017	1:53 AM	37	276	35 F	93%	VAR	5 mph	0 mph	28.95 in	0.0 in	Light Rain
10/29/2017	2:18 AM	37	276	35 F	93%	VAR	5 mph	0 mph	28.95 in	0.0 in	Cloudy
10/29/2017	2:53 AM	36	275	35 F	97%	VAR	3 mph	0 mph	28.96 in	0.0 in	Cloudy
10/29/2017	3:07 AM	37	276	35 F	93%	VAR	5 mph	0 mph	28.94 in	0.0 in	Cloudy
10/29/2017	3:21 AM	36	275	34 F	93%	VAR	6 mph	0 mph	28.93 in	0.0 in	Cloudy
10/29/2017	3:53 AM	36	275	34 F	93%	NW	5 mph	0 mph	28.94 in	0.0 in	Cloudy
10/29/2017	4:53 AM	36	275	34 F	93%	VAR	5 mph	0 mph	28.93 in	0.0 in	Cloudy
10/29/2017	5:53 AM	37	276	35 F	93%	VAR	5 mph	0 mph	28.93 in	0.0 in	Cloudy
10/29/2017	6:53 AM	36	275	34 F	93%	VAR	5 mph	0 mph	28.91 in	0.0 in	Cloudy
10/29/2017	7:53 AM	37	276	34 F	89%	WNW	5 mph	0 mph	28.92 in	0.0 in	Cloudy
10/29/2017	8:00 AM	37	276	34 F	89%	CALM	0 mph	0 mph	28.92 in	0.0 in	Cloudy
10/29/2017	8:53 AM	38	276	34 F	86%	VAR	3 mph	0 mph	28.92 in	0.0 in	Cloudy
10/29/2017	9:17 AM	39	277	35 F	86%	CALM	0 mph	0 mph	28.91 in	0.0 in	Cloudy
10/29/2017	9:27 AM	38	276	35 F	89%	VAR	6 mph	0 mph	28.91 in	0.0 in	Cloudy
10/29/2017	9:50 AM	37	276	36 F	93%	VAR	7 mph	0 mph	28.91 in	0.0 in	Light Rain
10/29/2017	9:53 AM	38	276	35 F	89%	WSW	8 mph	0 mph	28.91 in	0.0 in	Light Rain
10/29/2017	10:53 AM	39	277	36 F	89%	NNW	5 mph	0 mph	28.90 in	0.0 in	Cloudy
10/29/2017	11:53 AM	38	276	35 F	89%	NNW	6 mph	0 mph	28.88 in	0.0 in	Cloudy
10/29/2017	12:53 PM	39	277	36 F	89%	VAR	6 mph	0 mph	28.85 in	0.0 in	Cloudy
10/29/2017	1:24 PM	40	278	35 F	83%	WNW	10 mph	0 mph	28.85 in	0.0 in	Cloudy
10/29/2017	1:53 PM	39	277	34 F	82%	NNW	8 mph	0 mph	28.85 in	0.0 in	Cloudy
10/29/2017	2:53 PM	39	277	36 F	89%	VAR	7 mph	0 mph	28.84 in	0.0 in	Cloudy
10/29/2017	3:53 PM	39	277	35 F	86%	VAR	7 mph	17 mph	28.84 in	0.0 in	Cloudy
10/29/2017	4:53 PM	38	276	35 F	89%	W	10 mph	0 mph	28.82 in	0.0 in	Light Rain
10/29/2017	5:09 PM	38	276	35 F	89%	WSW	10 mph	0 mph	28.82 in	0.0 in	Light Rain
10/29/2017	5:53 PM	38	276	35 F	89%	WSW	8 mph	0 mph	28.82 in	0.0 in	Cloudy
10/29/2017	6:10 PM	38	276	36 F	93%	WSW	8 mph	0 mph	28.83 in	0.0 in	Cloudy
10/29/2017	6:53 PM	38	276	36 F	93%	WSW	6 mph	0 mph	28.83 in	0.0 in	Cloudy
10/29/2017	7:33 PM	38	276	36 F	93%	WSW	9 mph	0 mph	28.82 in	0.0 in	Cloudy
10/29/2017	7:53 PM	39	277	35 F	86%	WSW	10 mph	0 mph	28.81 in	0.0 in	Cloudy
10/29/2017	8:53 PM	39	277	35 F	86%	WSW	12 mph	0 mph	28.81 in	0.0 in	Cloudy
10/29/2017	9:46 PM	40	278	35 F	83%	WSW	10 mph	0 mph	28.81 in	0.0 in	Cloudy
10/29/2017	9:53 PM	40	278	35 F	83%	WSW	10 mph	0 mph	28.81 in	0.0 in	Cloudy
10/29/2017	10:53 PM	41	278	34 F	76%	W	9 mph	20 mph	28.82 in	0.0 in	Cloudy
10/29/2017	11:53 PM	40	278	34 F	79%	W	13 mph	22 mph	28.82 in	0.0 in	Cloudy

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10/29/2017	11:53 PM	37		32 F	82%	NNW	3 mph	0 mph	28.93 in	0.0 in	Cloudy
10/29/2017	12:53 AM	37		32 F	82%	CALM	0 mph	0 mph	28.92 in	0.0 in	Cloudy
10/29/2017	1:53 AM	37		32 F	82%	NW	3 mph	0 mph	28.90 in	0.0 in	Cloudy
10/29/2017	2:53 AM	37		32 F	82%	NW	3 mph	0 mph	28.89 in	0.0 in	Cloudy
10/29/2017	3:53 AM	37		31 F	79%	NW	3 mph	0 mph	28.88 in	0.0 in	Cloudy
10/29/2017	4:53 AM	37		31 F	79%	NW	5 mph	0 mph	28.87 in	0.0 in	Cloudy
10/29/2017	5:53 AM	37		32 F	82%	NW	6 mph	0 mph	28.88 in	0.0 in	Cloudy
10/29/2017	6:53 AM	36		32 F	86%	NNW	6 mph	0 mph	28.85 in	0.0 in	Cloudy
10/29/2017	7:53 AM	37		32 F	82%	NW	5 mph	0 mph	28.86 in	0.0 in	Cloudy
10/29/2017	8:53 AM	37		33 F	86%	NW	7 mph	0 mph	28.86 in	0.0 in	Cloudy
10/29/2017	9:53 AM	38		33 F	83%	NW	6 mph	0 mph	28.85 in	0.0 in	Cloudy
10/29/2017	10:21 AM	39		33 F	79%	VAR	6 mph	0 mph	28.85 in	0.0 in	Cloudy
10/29/2017	10:53 AM	39		33 F	79%	NW	6 mph	0 mph	28.84 in	0.0 in	Cloudy
10/29/2017	11:53 AM	40		34 F	79%	NW	8 mph	0 mph	28.82 in	0.0 in	Cloudy
10/29/2017	12:50 PM	41		34 F	76%	WNW	7 mph	0 mph	28.80 in	0.0 in	Cloudy
10/29/2017	12:53 PM	41		34 F	76%	WNW	9 mph	0 mph	28.80 in	0.0 in	Cloudy
10/29/2017	1:53 PM	41		33 F	73%	WNW	9 mph	0 mph	28.78 in	0.0 in	Cloudy
10/29/2017	2:15 PM	41		34 F	76%	WNW	12 mph	0 mph	28.78 in	0.0 in	Cloudy
10/29/2017	2:53 PM	42		34 F	73%	WNW	7 mph	0 mph	28.77 in	0.0 in	Cloudy
10/29/2017	3:43 PM	43		34 F	71%	WNW	8 mph	0 mph	28.77 in	0.0 in	Cloudy
10/29/2017	3:53 PM	43		33 F	68%	WNW	7 mph	0 mph	28.76 in	0.0 in	Cloudy
10/29/2017	4:53 PM	43		34 F	71%	WNW	7 mph	0 mph	28.76 in	0.0 in	Cloudy
10/29/2017	5:53 PM	43		34 F	71%	WNW	8 mph	0 mph	28.75 in	0.0 in	Cloudy
10/29/2017	6:53 PM	43		33 F	68%	WNW	7 mph	0 mph	28.76 in	0.0 in	Cloudy
10/29/2017	7:53 PM	43		33 F	68%	WNW	8 mph	0 mph	28.75 in	0.0 in	Cloudy
10/29/2017	8:53 PM	42		33 F	70%	WNW	9 mph	0 mph	28.75 in	0.0 in	Cloudy
10/29/2017	9:01 PM	42		33 F	70%	WNW	12 mph	18 mph	28.75 in	0.0 in	Cloudy
10/29/2017	9:25 PM	41		33 F	73%	NW	10 mph	21 mph	28.75 in	0.0 in	Cloudy
10/29/2017	9:53 PM	40		33 F	77%	WNW	10 mph	0 mph	28.75 in	0.0 in	Fair
10/29/2017	10:53 PM	40		34 F	79%	WNW	10 mph	0 mph	28.75 in	0.0 in	Cloudy



October 29, 2017

10:30 p.m.

Image excluded

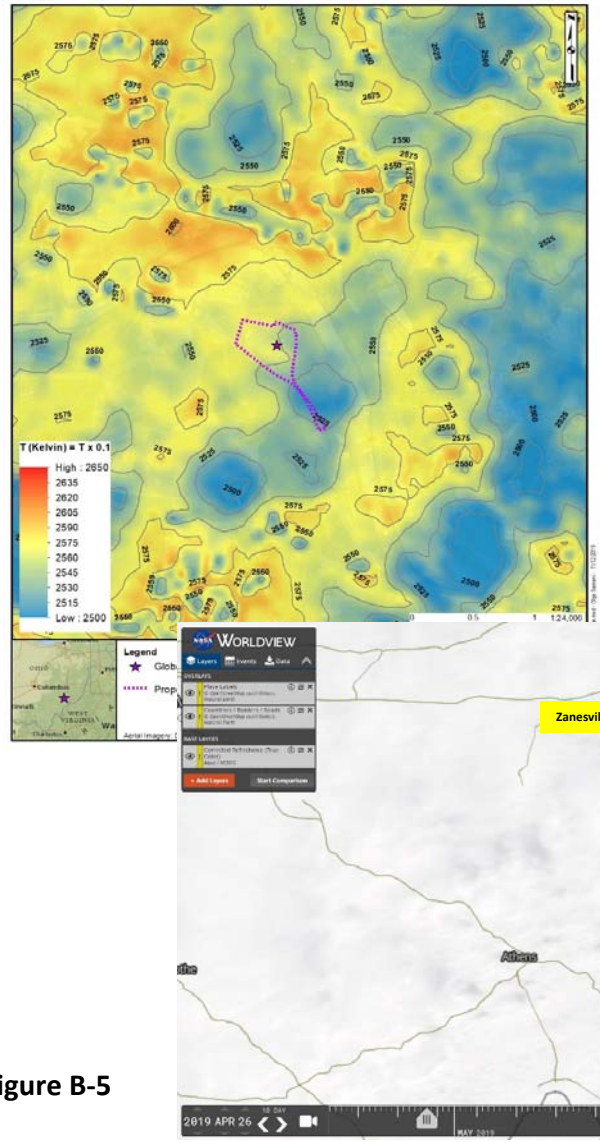
Figure B-4

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
4/26/2019	12:46 AM	65	291	56 F	73%	SW	13 mph	23 mph	28.73 in	0.0 in	Light Rain
4/26/2019	12:53 AM	64	291	56 F	75%	WSW	9 mph	21 mph	28.73 in	0.0 in	Light Rain
4/26/2019	1:29 AM	61	289	57 F	87%	SW	12 mph	23 mph	28.72 in	0.1 in	Rain
4/26/2019	1:37 AM	61	289	57 F	87%	SSW	8 mph	0 mph	28.71 in	0.1 in	Rain
4/26/2019	1:53 AM	61	289	58 F	90%	SSW	8 mph	0 mph	28.70 in	0.2 in	Rain
4/26/2019	2:53 AM	60	289	57 F	90%	S	8 mph	0 mph	28.66 in	0.1 in	Light Rain
4/26/2019	3:53 AM	60	289	57 F	90%	S	10 mph	0 mph	28.63 in	0.0 in	Mostly Cloudy
4/26/2019	4:22 AM	60	289	57 F	90%	SSW	8 mph	0 mph	28.62 in	0.0 in	Light Rain
4/26/2019	4:53 AM	60	289	57 F	90%	SSW	12 mph	0 mph	28.61 in	0.1 in	Light Rain
4/26/2019	5:53 AM	60	289	57 F	90%	SSW	12 mph	0 mph	28.59 in	0.0 in	Cloudy
4/26/2019	6:13 AM	60	289	57 F	90%	SSW	12 mph	0 mph	28.59 in	0.0 in	Cloudy
4/26/2019	6:53 AM	60	289	57 F	90%	S	10 mph	0 mph	28.58 in	0.0 in	Light Rain
4/26/2019	7:22 AM	60	289	57 F	90%	SSW	10 mph	0 mph	28.56 in	0.0 in	Rain
4/26/2019	7:32 AM	60	289	57 F	90%	SSW	12 mph	0 mph	28.56 in	0.0 in	Light Rain
4/26/2019	7:44 AM	60	289	57 F	90%	S	12 mph	0 mph	28.55 in	0.0 in	Light Rain
4/26/2019	7:53 AM	60	289	57 F	90%	SSW	12 mph	0 mph	28.54 in	0.1 in	Light Rain
4/26/2019	8:00 AM	60	289	57 F	90%	SSW	12 mph	22 mph	28.54 in	0.0 in	Light Rain
4/26/2019	8:24 AM	60	289	57 F	90%	SSW	9 mph	0 mph	28.53 in	0.1 in	Rain
4/26/2019	8:27 AM	60	289	57 F	90%	SW	8 mph	0 mph	28.52 in	0.1 in	Rain
4/26/2019	8:48 AM	57	287	54 F	88%	W	14 mph	28 mph	28.55 in	0.2 in	Rain
4/26/2019	8:53 AM	57	287	54 F	89%	W	14 mph	0 mph	28.55 in	0.2 in	Light Rain
4/26/2019	9:53 AM	58	288	55 F	90%	W	12 mph	0 mph	28.58 in	0.1 in	Light Rain
4/26/2019	10:04 AM	58	288	55 F	90%	W	15 mph	23 mph	28.59 in	0.0 in	Light Rain
4/26/2019	10:53 AM	55	286	51 F	86%	WNW	14 mph	26 mph	28.64 in	0.0 in	Light Rain
4/26/2019	11:09 AM	55	286	51 F	86%	WNW	15 mph	23 mph	28.65 in	0.0 in	Cloudy
4/26/2019	11:29 AM	54	285	51 F	90%	WNW	12 mph	0 mph	28.66 in	0.0 in	Light Rain
4/26/2019	11:53 AM	54	285	51 F	90%	W	12 mph	18 mph	28.68 in	0.0 in	Light Rain
4/26/2019	12:36 PM	53	285	49 F	86%	W	15 mph	25 mph	28.71 in	0.0 in	Light Rain
4/26/2019	12:51 PM	54	285	48 F	82%	W	16 mph	24 mph	28.71 in	0.0 in	Light Rain
4/26/2019	12:53 PM	52	284	49 F	89%	W	13 mph	24 mph	28.71 in	0.0 in	Light Rain
4/26/2019	1:53 PM	52	284	48 F	86%	W	16 mph	21 mph	28.76 in	0.0 in	Light Rain
4/26/2019	2:05 PM	51	284	48 F	89%	WNW	16 mph	25 mph	28.77 in	0.0 in	Rain
4/26/2019	2:53 PM	49	283	46 F	90%	WNW	10 mph	0 mph	28.81 in	0.1 in	Light Rain
4/26/2019	3:53 PM	50	283	46 F	86%	W	6 mph	0 mph	28.83 in	0.0 in	Cloudy
4/26/2019	4:53 PM	52	284	48 F	86%	WSW	5 mph	0 mph	28.82 in	0.0 in	Fair
4/26/2019	5:53 PM	53	285	48 F	83%	W	5 mph	0 mph	28.82 in	0.0 in	Light Rain
4/26/2019	6:53 PM	52	284	49 F	89%	W	5 mph	0 mph	28.83 in	0.0 in	Cloudy
4/26/2019	7:21 PM	52	284	49 F	89%	SSW	5 mph	0 mph	28.84 in	0.0 in	Light Rain
4/26/2019	7:29 PM	52	284	48 F	86%	WSW	6 mph	0 mph	28.84 in	0.0 in	Cloudy
4/26/2019	7:53 PM	51	284	47 F	86%	W	9 mph	0 mph	28.86 in	0.0 in	Partly Cloudy
4/26/2019	8:53 PM	50	283	43 F	77%	W	9 mph	0 mph	28.90 in	0.0 in	Fair
4/26/2019	9:53 PM	49	283	39 F	69%	W	8 mph	0 mph	28.92 in	0.0 in	Fair
4/26/2019	10:53 PM	48	282	36 F	63%	W	12 mph	16 mph	28.93 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
4/26/2019	11:53 PM	66		54 F	65%	SW	20 mph	33 mph	28.66 in	0.0 in	Rain
4/26/2019	12:42 AM	60		57 F	90%	WSW	9 mph	0 mph	28.64 in	0.2 in	Heavy Rain
4/26/2019	12:49 AM	61		57 F	88%	VAR	5 mph	0 mph	28.63 in	0.2 in	Rain
4/26/2019	12:53 AM	60		57 F	90%	SSW	5 mph	0 mph	28.63 in	0.2 in	Light Rain
4/26/2019	1:53 AM	60		57 F	90%	SSE	8 mph	0 mph	28.58 in	0.0 in	Light Rain
4/26/2019	2:50 AM	61		57 F	88%	S	10 mph	0 mph	28.55 in	0.0 in	Cloudy
4/26/2019	2:53 AM	60		57 F	90%	S	10 mph	0 mph	28.54 in	0.0 in	Cloudy
4/26/2019	3:36 AM	60		57 F	90%	S	9 mph	0 mph	28.52 in	0.0 in	Light Rain
4/26/2019	3:53 AM	60		57 F	90%	S	12 mph	0 mph	28.51 in	0.0 in	Light Rain
4/26/2019	4:39 AM	60		57 F	90%	S	12 mph	0 mph	28.50 in	0.1 in	Heavy Rain
4/26/2019	4:53 AM	60		57 F	90%	S	10 mph	0 mph	28.49 in	0.1 in	Light Rain
4/26/2019	5:17 AM	60		57 F	90%	S	12 mph	0 mph	28.48 in	0.0 in	Light Rain
4/26/2019	5:39 AM	60		57 F	90%	SSW	12 mph	0 mph	28.48 in	0.0 in	Light Rain
4/26/2019	5:53 AM	60		57 F	90%	SSW	13 mph	0 mph	28.48 in	0.0 in	Light Rain
4/26/2019	6:07 AM	60		57 F	90%	SSW	13 mph	0 mph	28.47 in	0.0 in	Cloudy
4/26/2019	6:17 AM	60		57 F	90%	SSW	9 mph	0 mph	28.47 in	0.0 in	Light Rain
4/26/2019	6:19 AM	60		57 F	90%	SSW	9 mph	0 mph	28.47 in	0.0 in	Rain
4/26/2019	6:35 AM	60		57 F	90%	SSW	9 mph	0 mph	28.47 in	0.1 in	Heavy Rain
4/26/2019	6:37 AM	60		57 F	90%	SSW	10 mph	0 mph	28.47 in	0.1 in	Heavy Rain
4/26/2019	6:48 AM	61		57 F	88%	SW	7 mph	0 mph	28.47 in	0.2 in	Light Rain
4/26/2019	6:53 AM	60		57 F	90%	SW	7 mph	0 mph	28.47 in	0.2 in	Light Rain
4/26/2019	7:01 AM	60		57 F	90%	SW	7 mph	0 mph	28.46 in	0.0 in	Light Rain
4/26/2019	7:18 AM	60		57 F	90%	W	7 mph	0 mph	28.46 in	0.0 in	Rain
4/26/2019	7:22 AM	59		56 F	90%	W	12 mph	0 mph	28.46 in	0.0 in	Light Rain
4/26/2019	7:29 AM	59		55 F	87%	WNW	10 mph	0 mph	28.46 in	0.0 in	Light Rain
4/26/2019	7:36 AM	59		55 F	87%	WNW	9 mph	0 mph	28.46 in	0.0 in	Cloudy
4/26/2019	7:53 AM	58		55 F	90%	WNW	13 mph	0 mph	28.47 in	0.1 in	Rain
4/26/2019	8:00 AM	58		55 F	90%	WNW	10 mph	0 mph	28.47 in	0.0 in	Rain
4/26/2019	8:07 AM	58		54 F	87%	WNW	13 mph	22 mph	28.47 in	0.1 in	Heavy Rain
4/26/2019	8:21 AM	58		54 F	87%	WNW	12 mph	20 mph	28.47 in	0.1 in	Rain
4/26/2019	8:30 AM	57		54 F	89%	WNW	13 mph	0 mph	28.48 in	0.1 in	Light Rain
4/26/2019	8:53 AM	57		53 F	87%	WNW	10 mph	20 mph	28.49 in	0.1 in	Rain
4/26/2019	9:01 AM	56		53 F	90%	WNW	15 mph	25 mph	28.49 in	0.0 in	Rain
4/26/2019	9:09 AM	55		51 F	86%	WNW	17 mph	28 mph	28.50 in	0.0 in	Rain
4/26/2019	9:26 AM	54		50 F	86%	WNW	16 mph	25 mph	28.51 in	0.1 in	Light Rain
4/26/2019	9:40 AM	54		50 F	86%	W	14 mph	22 mph	28.51 in	0.1 in	Light Rain
4/26/2019	9:50 AM	54		50 F	88%	W	10 mph	22 mph	28.52 in	0.1 in	Light Rain
4/26/2019	9:53 AM	54		50 F	86%	W	13 mph	22 mph	28.52 in	0.1 in	Light Rain
4/26/2019	10:53 AM	53		49 F	86%	WNW	17 mph	25 mph	28.56 in	0.0 in	Light Rain
4/26/2019	11:03 AM	53		49 F	86%	WNW	16 mph	0 mph	28.57 in	0.0 in	Light Rain
4/26/2019	11:17 AM	52		48 F	86%	WNW	16 mph	25 mph	28.58 in	0.0 in	Light Rain
4/26/2019	11:38 AM	52		47 F	83%	WNW	15 mph	24 mph	28.59 in	0.0 in	Light Rain
4/26/2019	11:53 AM	52		48 F	86%	W	12 mph	0 mph	28.60 in	0.0 in	Light Rain
4/26/2019	12:05 PM	52		48 F	86%	WNW	13 mph	0 mph	28.61 in	0.0 in	Light Rain
4/26/2019	12:39 PM	51		46 F	83%	NW	13 mph	0 mph	28.64 in	0.1 in	Light Rain
4/26/2019	12:53 PM	51		46 F	83%	WNW	10 mph	21 mph	28.65 in	0.1 in	Light Rain
4/26/2019	1:39 PM	50		45 F	83%	WNW	12 mph	18 mph	28.69 in	0.0 in	Light Rain
4/26/2019	1:53 PM	50		45 F	83%	WNW	10 mph	0 mph	28.70 in	0.0 in	Light Rain
4/26/2019	2:04 PM	50		46 F	86%	WNW	12 mph	0 mph	28.71 in	0.0 in	Light Rain
4/26/2019	2:53 PM	50		46 F	86%	WNW	8 mph	0 mph	28.72 in	0.0 in	Light Rain
4/26/2019	3:53 PM	53		47 F	80%	SW	3 mph	0 mph	28.71 in	0.0 in	Fair
4/26/2019	4:53 PM	56		48 F	75%	WSW	6 mph	0 mph	28.72 in	0.0 in	Cloudy
4/26/2019	5:53 PM	53		44 F	71%	W	8 mph	20 mph	28.73 in	0.0 in	Mostly Cloudy
4/26/2019	6:53 PM	56		43 F	62%	WNW	14 mph	24 mph	28.74 in	0.0 in	Partly Cloudy
4/26/2019	7:53 PM	54		35 F	49%	WNW	16 mph	26 mph	28.79 in	0.0 in	Fair
4/26/2019	8:53 PM	52		34 F	50%	WNW	14 mph	0 mph	28.82 in	0.0 in	Fair
4/26/2019	9:53 PM	51		32 F	48%	WNW	14 mph	0 mph	28.83 in	0.0 in	Fair
4/26/2019	10:53 PM	50		32 F	50%	WNW	13 mph	22 mph	28.84 in	0.0 in	Fair



April 26, 2019

11:30 a.m.

Image excluded

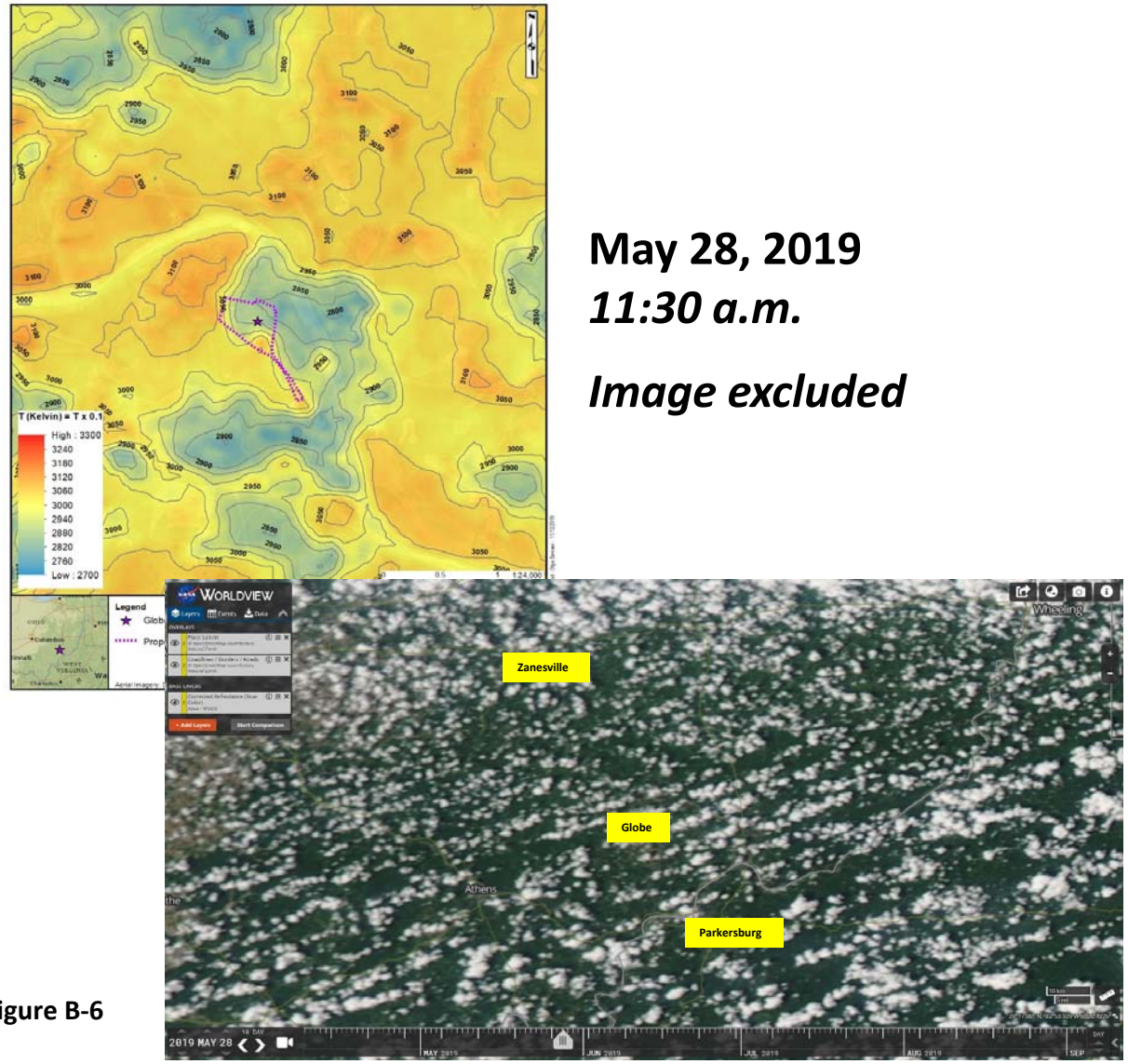
Figure B-5

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
5/28/2019	12:53 AM	69	294	65 F	87%	S	7 mph	0 mph	28.96 in	0.0 in	Light Rain
5/28/2019	1:41 AM	68	293	65 F	90%	E	5 mph	0 mph	28.97 in	0.0 in	T-Storm
5/28/2019	1:53 AM	68	293	66 F	93%	CALM	0 mph	0 mph	28.97 in	0.1 in	Light Rain
5/28/2019	2:07 AM	67	293	66 F	97%	CALM	0 mph	0 mph	28.96 in	0.0 in	T-Storm
5/28/2019	2:53 AM	67	293	65 F	93%	S	7 mph	0 mph	28.95 in	0.1 in	Mostly Cloudy
5/28/2019	3:01 AM	69	294	65 F	87%	S	12 mph	21 mph	28.94 in	0.0 in	Thunder in the Vicinity
5/28/2019	3:26 AM	68	293	65 F	90%	S	8 mph	0 mph	28.93 in	0.0 in	Partly Cloudy
5/28/2019	3:53 AM	67	293	64 F	90%	SSW	8 mph	0 mph	28.93 in	0.0 in	Fair
5/28/2019	4:53 AM	68	293	65 F	90%	SSW	7 mph	0 mph	28.93 in	0.0 in	Mostly Cloudy
5/28/2019	5:46 AM	70	294	66 F	87%	SW	8 mph	0 mph	28.94 in	0.0 in	Mostly Cloudy
5/28/2019	5:53 AM	70	294	66 F	87%	SW	8 mph	0 mph	28.94 in	0.0 in	Mostly Cloudy
5/28/2019	6:53 AM	71	295	67 F	87%	SSW	9 mph	0 mph	28.95 in	0.0 in	Mostly Cloudy
5/28/2019	7:53 AM	75	297	68 F	79%	SW	13 mph	20 mph	28.95 in	0.0 in	Fair
5/28/2019	8:53 AM	78	299	68 F	71%	WSW	12 mph	18 mph	28.95 in	0.0 in	Fair
5/28/2019	9:53 AM	80	300	68 F	67%	WSW	9 mph	20 mph	28.94 in	0.0 in	Fair
5/28/2019	10:53 AM	82	301	67 F	60%	W	14 mph	24 mph	28.93 in	0.0 in	Mostly Cloudy
5/28/2019	11:53 AM	84	302	67 F	56%	WSW	17 mph	25 mph	28.93 in	0.0 in	Partly Cloudy
5/28/2019	12:53 PM	85	303	66 F	53%	W	17 mph	28 mph	28.91 in	0.0 in	Partly Cloudy
5/28/2019	1:53 PM	86	303	66 F	51%	W	12 mph	23 mph	28.91 in	0.0 in	Fair
5/28/2019	2:53 PM	85	303	65 F	51%	WSW	13 mph	26 mph	28.90 in	0.0 in	Partly Cloudy
5/28/2019	3:53 PM	84	302	65 F	53%	WSW	14 mph	26 mph	28.89 in	0.0 in	Mostly Cloudy
5/28/2019	4:53 PM	85	303	65 F	51%	VAR	6 mph	21 mph	28.89 in	0.0 in	Fair
5/28/2019	5:53 PM	83	301	64 F	53%	W	12 mph	0 mph	28.90 in	0.0 in	Fair
5/28/2019	6:53 PM	82	301	64 F	54%	VAR	5 mph	0 mph	28.90 in	0.0 in	Fair
5/28/2019	7:53 PM	79	299	64 F	60%	SW	5 mph	0 mph	28.91 in	0.0 in	Fair
5/28/2019	8:53 PM	78	299	64 F	62%	SSW	9 mph	0 mph	28.90 in	0.0 in	Fair
5/28/2019	9:53 PM	76	298	64 F	67%	SSW	10 mph	0 mph	28.89 in	0.0 in	Fair
5/28/2019	10:53 PM	75	297	64 F	69%	SSW	8 mph	0 mph	28.89 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
5/28/2019	12:04 AM	69		64 F	84%	VAR	6 mph	0 mph	28.91 in	0.2 in	Heavy Rain
5/28/2019	12:11 AM	69		65 F	87%	SSE	8 mph	0 mph	28.89 in	0.2 in	T-Storm
5/28/2019	12:14 AM	68		65 F	90%	SE	7 mph	0 mph	28.89 in	0.2 in	Heavy T-Storm
5/28/2019	12:22 AM	69		65 F	87%	E	6 mph	0 mph	28.90 in	0.2 in	T-Storm
5/28/2019	12:29 AM	69		65 F	87%	NNE	3 mph	0 mph	28.92 in	0.3 in	Light Rain with Thunder
5/28/2019	12:37 AM	68		65 F	90%	NNE	7 mph	0 mph	28.91 in	0.3 in	Heavy T-Storm
5/28/2019	12:46 AM	68		65 F	90%	VAR	3 mph	0 mph	28.91 in	0.4 in	T-Storm
5/28/2019	12:53 AM	68		65 F	90%	VAR	6 mph	0 mph	28.90 in	0.4 in	Heavy T-Storm
5/28/2019	12:57 AM	68		65 F	90%	SSE	12 mph	16 mph	28.90 in	0.0 in	T-Storm
5/28/2019	1:17 AM	68		65 F	90%	S	7 mph	0 mph	28.88 in	0.1 in	Light Rain
5/28/2019	1:53 AM	68		65 F	90%	S	3 mph	0 mph	28.87 in	0.1 in	Cloudy
5/28/2019	2:11 AM	68		65 F	90%	SSE	6 mph	0 mph	28.86 in	0.1 in	T-Storm
5/28/2019	2:43 AM	67		65 F	93%		0 mph	0 mph	28.86 in	0.1 in	Cloudy
5/28/2019	2:53 AM	67		65 F	93%	SE	6 mph	0 mph	28.84 in	0.1 in	Mostly Cloudy
5/28/2019	3:53 AM	67		65 F	93%	S	3 mph	0 mph	28.83 in	0.0 in	Mostly Cloudy
5/28/2019	4:53 AM	68		65 F	90%	S	6 mph	0 mph	28.83 in	0.0 in	Fair
5/28/2019	5:53 AM	69		66 F	90%	SSW	8 mph	0 mph	28.84 in	0.0 in	Fair
5/28/2019	6:53 AM	72		67 F	84%	SW	8 mph	0 mph	28.84 in	0.0 in	Fair
5/28/2019	7:53 AM	75		68 F	79%	SW	7 mph	0 mph	28.85 in	0.0 in	Mostly Cloudy
5/28/2019	8:53 AM	77		67 F	71%	WSW	12 mph	0 mph	28.84 in	0.0 in	Mostly Cloudy
5/28/2019	9:53 AM	80		67 F	64%	WSW	10 mph	20 mph	28.84 in	0.0 in	Mostly Cloudy
5/28/2019	10:53 AM	83		67 F	58%	WSW	9 mph	22 mph	28.83 in	0.0 in	Partly Cloudy
5/28/2019	11:53 AM	84		67 F	56%		0 mph	0 mph	28.82 in	0.0 in	Mostly Cloudy
5/28/2019	12:53 PM	84		66 F	55%	WSW	16 mph	24 mph	28.82 in	0.0 in	Partly Cloudy
5/28/2019	1:53 PM	85		66 F	53%	SW	12 mph	23 mph	28.82 in	0.0 in	Fair
5/28/2019	2:53 PM	86		63 F	46%	WSW	15 mph	28 mph	28.81 in	0.0 in	Fair
5/28/2019	3:53 PM	85		63 F	48%	SW	13 mph	23 mph	28.79 in	0.0 in	Partly Cloudy
5/28/2019	4:53 PM	84		64 F	51%	SW	10 mph	22 mph	28.79 in	0.0 in	Fair
5/28/2019	5:53 PM	83		63 F	51%	SW	10 mph	17 mph	28.79 in	0.0 in	Fair
5/28/2019	6:53 PM	81		63 F	54%	SW	5 mph	0 mph	28.80 in	0.0 in	Fair
5/28/2019	7:53 PM	80		63 F	56%	SW	8 mph	0 mph	28.80 in	0.0 in	Fair
5/28/2019	8:53 PM	78		63 F	60%	SSW	7 mph	0 mph	28.79 in	0.0 in	Fair
5/28/2019	9:53 PM	75		63 F	66%	SSW	8 mph	0 mph	28.78 in	0.0 in	Fair
5/28/2019	10:53 PM	75		63 F	66%	W	5 mph	0 mph	28.81 in	0.0 in	Fair



May 28, 2019

11:30 a.m.

Image excluded

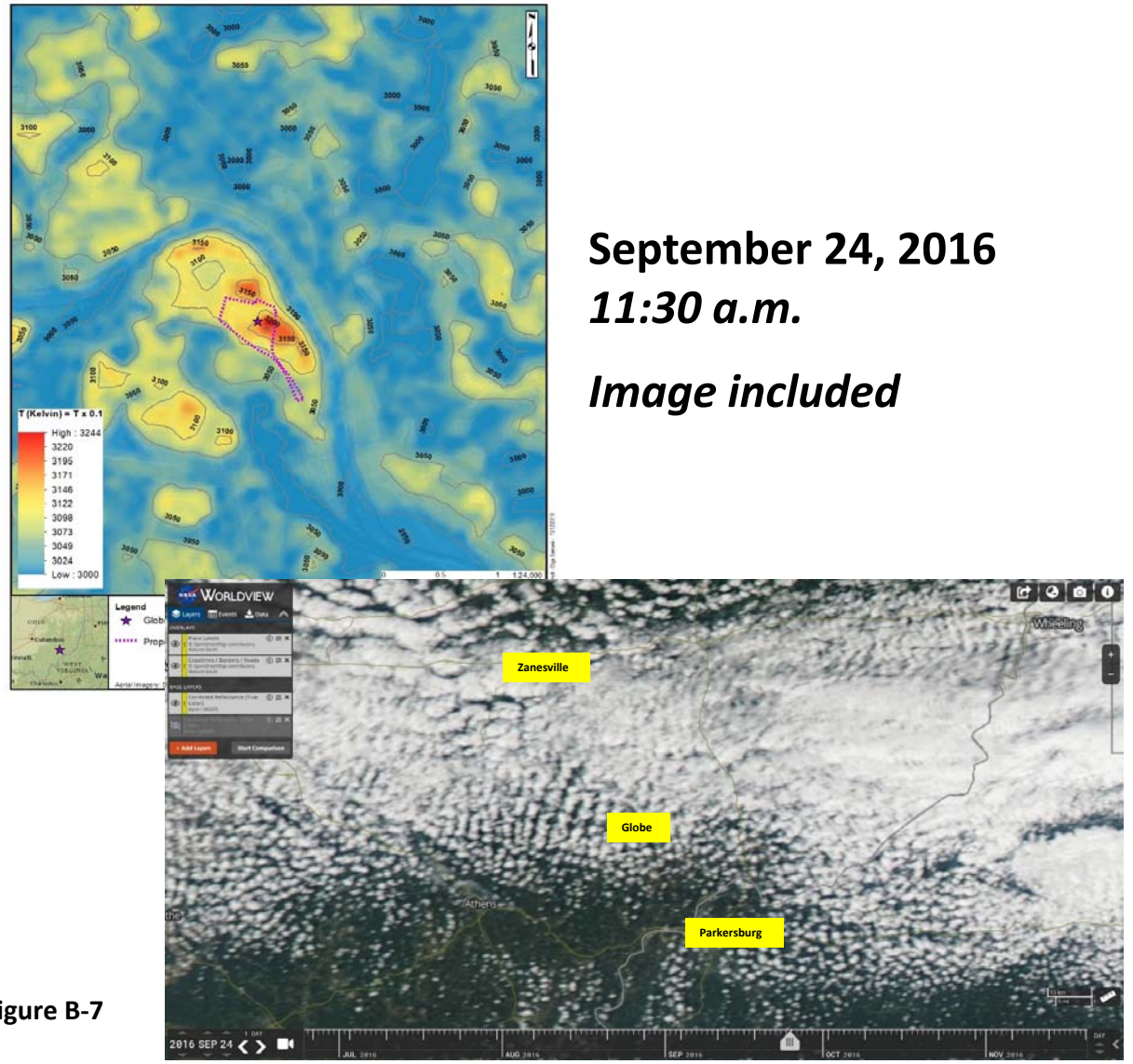
Figure B-6

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
9/24/2016	12:53 AM	65	291	62 F	90%	CALM	0 mph	0 mph	29.17 in	0.0 in	Partly Cloudy
9/24/2016	1:53 AM	64	291	62 F	93%	CALM	0 mph	0 mph	29.16 in	0.0 in	Fair
9/24/2016	2:53 AM	63	290	61 F	93%	CALM	0 mph	0 mph	29.17 in	0.0 in	Fair
9/24/2016	3:53 AM	63	290	61 F	93%	CALM	0 mph	0 mph	29.18 in	0.0 in	Fair
9/24/2016	4:53 AM	65	291	62 F	90%	CALM	0 mph	0 mph	29.19 in	0.0 in	Partly Cloudy
9/24/2016	5:53 AM	65	291	63 F	93%	NNE	5 mph	0 mph	29.20 in	0.0 in	Fair
9/24/2016	6:53 AM	64	291	62 F	93%	CALM	0 mph	0 mph	29.21 in	0.0 in	Fog
9/24/2016	7:08 AM	64	291	62 F	93%	CALM	0 mph	0 mph	29.22 in	0.0 in	Fair
9/24/2016	7:53 AM	68	293	65 F	90%	NNW	7 mph	0 mph	29.23 in	0.0 in	Fair
9/24/2016	8:07 AM	69	294	64 F	84%	VAR	6 mph	0 mph	29.23 in	0.0 in	Fair
9/24/2016	8:53 AM	70	294	63 F	78%	N	7 mph	0 mph	29.24 in	0.0 in	Haze
9/24/2016	9:21 AM	70	294	63 F	78%	VAR	6 mph	0 mph	29.25 in	0.0 in	Haze
9/24/2016	9:37 AM	73	296	64 F	73%	VAR	7 mph	0 mph	29.25 in	0.0 in	Partly Cloudy
9/24/2016	9:53 AM	73	296	63 F	71%	N	8 mph	0 mph	29.25 in	0.0 in	Fair
9/24/2016	10:53 AM	76	298	64 F	67%	N	7 mph	0 mph	29.25 in	0.0 in	Fair
9/24/2016	11:53 AM	80	300	64 F	58%	N	9 mph	0 mph	29.24 in	0.0 in	Fair
9/24/2016	12:53 PM	83	301	63 F	51%	NNE	12 mph	0 mph	29.23 in	0.0 in	Partly Cloudy
9/24/2016	1:53 PM	82	301	63 F	52%	NNW	9 mph	0 mph	29.21 in	0.0 in	Partly Cloudy
9/24/2016	2:53 PM	84	302	63 F	49%	NW	7 mph	0 mph	29.21 in	0.0 in	Partly Cloudy
9/24/2016	3:53 PM	80	300	62 F	54%	N	8 mph	0 mph	29.21 in	0.0 in	Mostly Cloudy
9/24/2016	4:53 PM	80	300	62 F	54%	N	9 mph	0 mph	29.21 in	0.0 in	Mostly Cloudy
9/24/2016	5:53 PM	76	298	60 F	58%	NNE	6 mph	0 mph	29.22 in	0.0 in	Mostly Cloudy
9/24/2016	6:53 PM	73	296	59 F	61%	N	5 mph	0 mph	29.21 in	0.0 in	Fair
9/24/2016	7:53 PM	69	294	61 F	75%	N	3 mph	0 mph	29.22 in	0.0 in	Fair
9/24/2016	8:53 PM	68	293	58 F	70%	NE	6 mph	0 mph	29.23 in	0.0 in	Fair
9/24/2016	9:53 PM	67	293	57 F	70%	NE	7 mph	0 mph	29.24 in	0.0 in	Fair
9/24/2016	10:53 PM	65	291	55 F	70%	NE	5 mph	0 mph	29.24 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
9/24/2016	12:53 AM	42	279	32 F	67 %	W	8 mph	0 mph	28.97 in	0.0 in	Cloudy
9/24/2016	1:53 AM	42	279	32 F	67 %	W	9 mph	0 mph	28.98 in	0.0 in	Cloudy
9/24/2016	2:53 AM	42	279	32 F	67 %	WSW	9 mph	0 mph	29.01 in	0.0 in	Cloudy
9/24/2016	3:53 AM	39	277	29 F	67 %	W	13 mph	23 mph	29.04 in	0.0 in	Partly Cloudy
9/24/2016	4:53 AM	38	276	28 F	68 %	W	14 mph	0 mph	29.07 in	0.0 in	Cloudy
9/24/2016	5:53 AM	38	276	26 F	62 %	WNW	15 mph	21 mph	29.10 in	0.0 in	Cloudy
9/24/2016	6:53 AM	36	275	25 F	64 %	WNW	9 mph	0 mph	29.12 in	0.0 in	Mostly Cloudy
9/24/2016	7:53 AM	34	274	25 F	70 %	W	6 mph	0 mph	29.15 in	0.0 in	Fair
9/24/2016	8:53 AM	35	275	26 F	70 %	W	8 mph	0 mph	29.18 in	0.0 in	Partly Cloudy
9/24/2016	9:04 AM	35	275	25 F	67 %	W	9 mph	0 mph	29.18 in	0.0 in	Mostly Cloudy
9/24/2016	9:53 AM	36	275	26 F	67 %	WSW	10 mph	0 mph	29.20 in	0.0 in	Mostly Cloudy
9/24/2016	10:35 AM	37	276	27 F	67 %	W	10 mph	0 mph	29.21 in	0.0 in	Partly Cloudy
9/24/2016	10:53 AM	38	276	27 F	65 %	W	9 mph	18 mph	29.21 in	0.0 in	Fair
9/24/2016	11:53 AM	39	277	26 F	60 %	WSW	12 mph	0 mph	29.20 in	0.0 in	Fair
9/24/2016	12:53 PM	40	278	26 F	58 %	WSW	9 mph	0 mph	29.18 in	0.0 in	Fair
9/24/2016	1:53 PM	42	279	27 F	55 %	WSW	7 mph	0 mph	29.15 in	0.0 in	Fair



September 24, 2016

11:30 a.m.

Image included

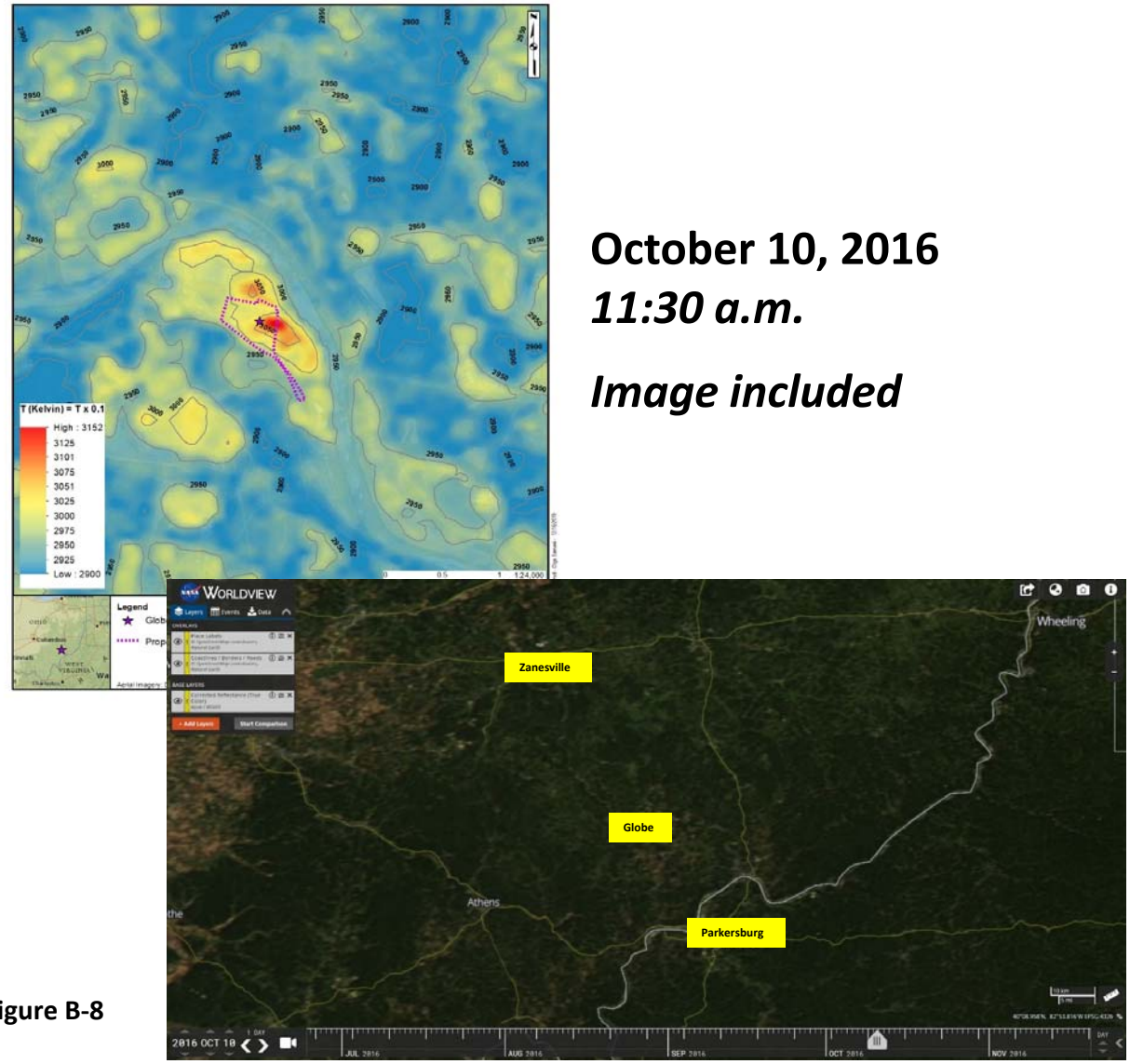
Figure B-7

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10/10/2016	12:53 AM	42	279	39 F	89%	CALM	0 mph	0 mph	29.44 in	0.0 in	Fair
10/10/2016	1:53 AM	40	278	38 F	93%	CALM	0 mph	0 mph	29.45 in	0.0 in	Fair
10/10/2016	2:53 AM	40	278	37 F	89%	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	3:53 AM	39	277	36 F	89%	CALM	0 mph	0 mph	29.47 in	0.0 in	Fair
10/10/2016	4:53 AM	38	276	35 F	89%	CALM	0 mph	0 mph	29.49 in	0.0 in	Fair
10/10/2016	5:53 AM	37	276	34 F	89%	CALM	0 mph	0 mph	29.50 in	0.0 in	Patches of Fog
10/10/2016	6:29 AM	37	276	34 F	89%	CALM	0 mph	0 mph	29.51 in	0.0 in	Fog
10/10/2016	6:53 AM	36	275	34 F	93%	CALM	0 mph	0 mph	29.52 in	0.0 in	Fog
10/10/2016	7:37 AM	38	276	37 F	97%	CALM	0 mph	0 mph	29.53 in	0.0 in	Mist
10/10/2016	7:53 AM	40	278	39 F	97%	CALM	0 mph	0 mph	29.53 in	0.0 in	Patches of Fog
10/10/2016	8:53 AM	48	282	43 F	83%	CALM	0 mph	0 mph	29.54 in	0.0 in	Patches of Fog
10/10/2016	9:53 AM	53	285	43 F	69%	ENE	8 mph	0 mph	29.55 in	0.0 in	Fair
10/10/2016	10:53 AM	57	287	42 F	57%	VAR	6 mph	0 mph	29.54 in	0.0 in	Fair
10/10/2016	11:53 AM	59	288	41 F	51%	ENE	8 mph	0 mph	29.53 in	0.0 in	Fair
10/10/2016	12:53 PM	62	290	41 F	46%	VAR	6 mph	0 mph	29.50 in	0.0 in	Fair
10/10/2016	1:53 PM	63	290	39 F	41%	ENE	7 mph	0 mph	29.48 in	0.0 in	Fair
10/10/2016	2:53 PM	65	291	40 F	40%	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	3:53 PM	66	292	39 F	37%	NNE	3 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	4:53 PM	63	290	38 F	40%	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	5:53 PM	59	288	40 F	49%	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	6:53 PM	51	284	42 F	71%	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	7:53 PM	48	282	42 F	80%	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	8:53 PM	44	280	41 F	89%	WNW	3 mph	0 mph	29.48 in	0.0 in	Fair
10/10/2016	9:53 PM	43	279	40 F	89%	NE	3 mph	0 mph	29.47 in	0.0 in	Fair
10/10/2016	10:53 PM	44	280	40 F	85%	CALM	0 mph	0 mph	29.47 in	0.0 in	Cloudy

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10/10/2016	12:53 AM	41	278	39 F	93 %	NNE	3 mph	0 mph	29.39 in	0.0 in	Fair
10/10/2016	1:53 AM	40	278	38 F	93 %	CALM	0 mph	0 mph	29.39 in	0.0 in	Fair
10/10/2016	2:53 AM	39	277	37 F	93 %	CALM	0 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	3:53 AM	37	276	36 F	96 %	CALM	0 mph	0 mph	29.41 in	0.0 in	Fair
10/10/2016	4:53 AM	37	276	35 F	93 %	CALM	0 mph	0 mph	29.42 in	0.0 in	Partly Cloudy
10/10/2016	5:53 AM	37	276	35 F	93 %	CALM	0 mph	0 mph	29.43 in	0.0 in	Partly Cloudy
10/10/2016	6:53 AM	35	275	34 F	96 %	CALM	0 mph	0 mph	29.45 in	0.0 in	Partly Cloudy
10/10/2016	7:53 AM	40	278	38 F	93 %	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
10/10/2016	8:53 AM	48	282	42 F	80 %	CALM	0 mph	0 mph	29.48 in	0.0 in	Fair
10/10/2016	9:53 AM	52	284	44 F	74 %	VAR	3 mph	0 mph	29.49 in	0.0 in	Fair
10/10/2016	10:53 AM	57	287	42 F	57 %	NE	5 mph	0 mph	29.47 in	0.0 in	Fair
10/10/2016	11:53 AM	58	288	41 F	53 %	VAR	3 mph	0 mph	29.45 in	0.0 in	Fair
10/10/2016	12:53 PM	61	289	40 F	46 %	CALM	0 mph	0 mph	29.43 in	0.0 in	Fair
10/10/2016	1:53 PM	63	290	37 F	38 %	NE	8 mph	0 mph	29.42 in	0.0 in	Fair
10/10/2016	2:53 PM	63	290	38 F	40 %	E	6 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	3:53 PM	64	291	37 F	37 %	VAR	3 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	4:53 PM	63	290	37 F	38 %	CALM	0 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	5:53 PM	59	288	38 F	46 %	SE	3 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	6:53 PM	54	285	38 F	55 %	CALM	0 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	7:53 PM	49	283	41 F	74 %	CALM	0 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	8:53 PM	45	280	40 F	82 %	CALM	0 mph	0 mph	29.41 in	0.0 in	Fair
10/10/2016	9:53 PM	43	279	40 F	89 %	CALM	0 mph	0 mph	29.40 in	0.0 in	Fair
10/10/2016	10:53 PM	42	279	39 F	89 %	CALM	0 mph	0 mph	29.41 in	0.0 in	Fair



October 10, 2016

11:30 a.m.

Image included

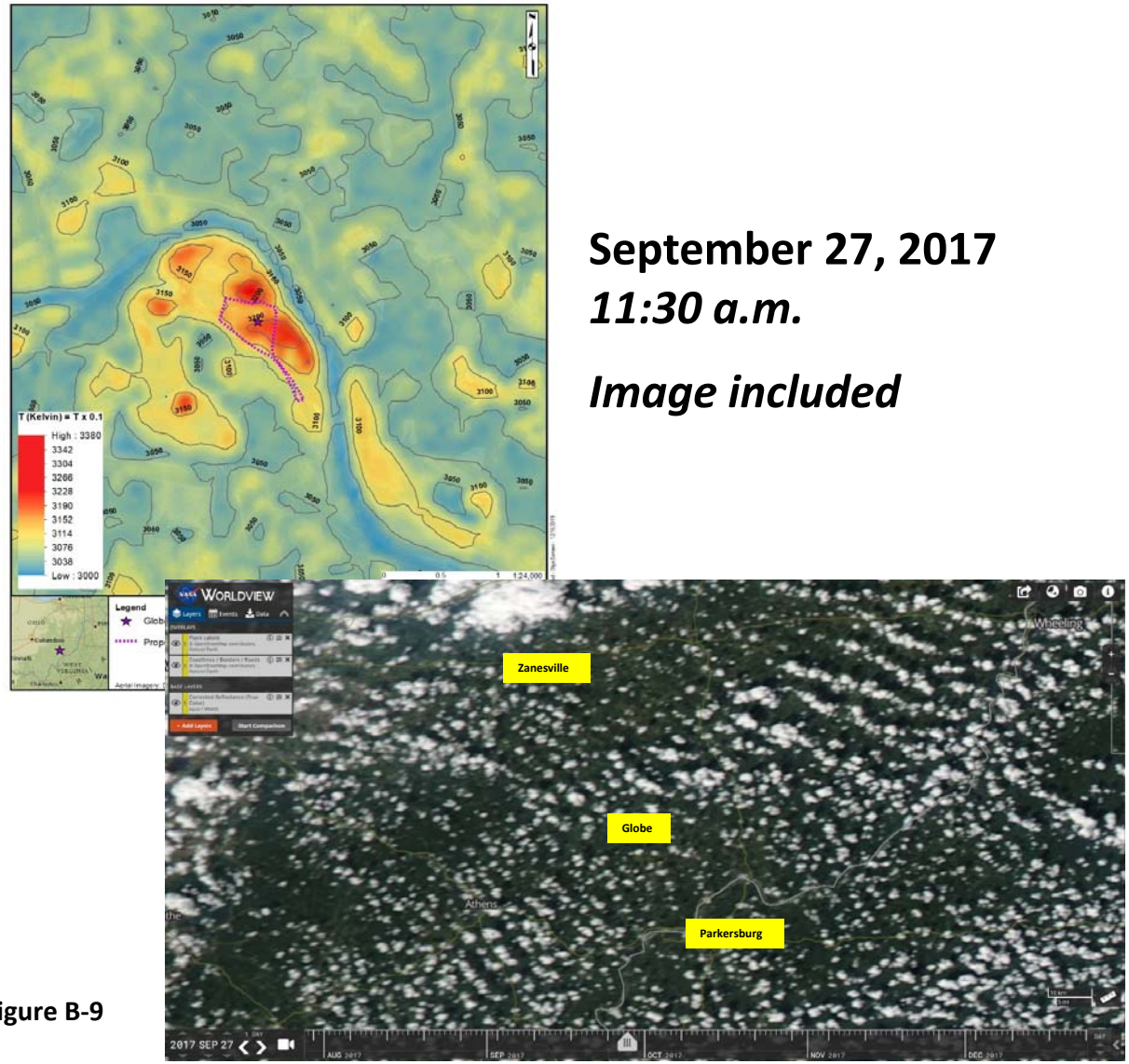
Figure B-8

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
9/27/72017	12:53 AM	66	292	64 F	93%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fair
9/27/72017	1:53 AM	65	291	63 F	93%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fair
9/27/72017	2:53 AM	64	291	62 F	93%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fair
9/27/72017	3:39 AM	63	290	62 F	97%	CALM	0 mph	0 mph	29.06 in	0.0 in	Partly Cloudy
9/27/72017	3:53 AM	63	290	62 F	97%	CALM	0 mph	0 mph	29.06 in	0.0 in	Fog
9/27/72017	4:25 AM	62	290	61 F	96%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fog
9/27/72017	4:44 AM	62	290	62 F	100%	CALM	0 mph	0 mph	29.07 in	0.0 in	Cloudy
9/27/72017	4:53 AM	62	290	62 F	100%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fog
9/27/72017	5:02 AM	62	290	61 F	96%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fog
9/27/72017	5:18 AM	62	290	61 F	96%	CALM	0 mph	0 mph	29.08 in	0.0 in	Fog
9/27/72017	5:32 AM	62	290	61 F	96%	CALM	0 mph	0 mph	29.08 in	0.0 in	Fog
9/27/72017	5:37 AM	61	289	61 F	100%	CALM	0 mph	0 mph	29.08 in	0.0 in	Mostly Cloudy
9/27/72017	5:53 AM	62	290	61 F	96%	CALM	0 mph	0 mph	29.08 in	0.0 in	Fog
9/27/72017	6:01 AM	61	289	60 F	97%	CALM	0 mph	0 mph	29.08 in	0.0 in	Fog
9/27/72017	6:18 AM	61	289	60 F	97%	CALM	0 mph	0 mph	29.08 in	0.0 in	Mist
9/27/72017	6:34 AM	61	289	60 F	97%	CALM	0 mph	0 mph	29.09 in	0.0 in	Mist
9/27/72017	6:53 AM	61	289	61 F	100%	CALM	0 mph	0 mph	29.09 in	0.0 in	Mist
9/27/72017	6:58 AM	61	289	61 F	100%	CALM	0 mph	0 mph	29.09 in	0.0 in	Mist
9/27/72017	7:07 AM	62	290	62 F	100%	CALM	0 mph	0 mph	29.09 in	0.0 in	Mist
9/27/72017	7:50 AM	64	291	63 F	94%	SE	6 mph	0 mph	29.09 in	0.0 in	Fog
9/27/72017	7:53 AM	64	291	63 F	96%	SE	6 mph	0 mph	29.09 in	0.0 in	Fog
9/27/72017	8:00 AM	64	291	64 F	100%	SSE	3 mph	0 mph	29.09 in	0.0 in	Fog
9/27/72017	8:08 AM	65	291	65 F	100%	CALM	0 mph	0 mph	29.09 in	0.0 in	Fair
9/27/72017	8:53 AM	72	295	67 F	84%	CALM	0 mph	0 mph	29.09 in	0.0 in	Patches of Fog
9/27/72017	9:53 AM	78	299	66 F	66%	CALM	0 mph	0 mph	29.09 in	0.0 in	Fair
9/27/72017	10:53 AM	84	302	62 F	47%	CALM	0 mph	0 mph	29.07 in	0.0 in	Fair
9/27/72017	11:53 AM	87	304	64 F	46%	VAR	5 mph	0 mph	29.06 in	0.0 in	Fair
9/27/72017	12:53 PM	89	305	63 F	42%	VAR	3 mph	0 mph	29.04 in	0.0 in	Fair
9/27/72017	1:53 PM	86	303	60 F	41%	WNW	6 mph	0 mph	29.03 in	0.0 in	Fair
9/27/72017	2:53 PM	90	305	61 F	38%	VAR	5 mph	0 mph	29.02 in	0.0 in	Fair
9/27/72017	3:53 PM	88	304	61 F	40%	W	3 mph	0 mph	29.01 in	0.0 in	Partly Cloudy
9/27/72017	4:53 PM	88	304	63 F	43%	W	6 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	5:53 PM	81	300	66 F	60%	CALM	0 mph	0 mph	29.01 in	0.0 in	Partly Cloudy
9/27/72017	6:53 PM	78	299	64 F	62%	CALM	0 mph	0 mph	29.02 in	0.0 in	Cloudy
9/27/72017	7:53 PM	76	298	66 F	71%	CALM	0 mph	0 mph	29.02 in	0.0 in	Cloudy
9/27/72017	8:53 PM	73	296	66 F	79%	CALM	0 mph	0 mph	29.02 in	0.0 in	Mostly Cloudy
9/27/72017	9:53 PM	73	296	64 F	73%	NNW	9 mph	0 mph	29.04 in	0.0 in	Fair
9/27/72017	10:53 PM	73	296	64 F	73%	NNW	7 mph	16 mph	29.05 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
9/27/72017	12:53 AM	65	291	62 F	90 %	CALM	0 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	1:53 AM	64	291	62 F	93 %	CALM	0 mph	0 mph	29.02 in	0.0 in	Fair
9/27/72017	2:53 AM	63	290	60 F	90 %	CALM	0 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	3:53 AM	62	290	60 F	93 %	CALM	0 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	4:53 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	5:53 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	29.02 in	0.0 in	Fair
9/27/72017	6:53 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	29.02 in	0.0 in	Fair
9/27/72017	7:53 AM	65	291	62 F	90 %	CALM	0 mph	0 mph	29.03 in	0.0 in	Fair
9/27/72017	8:53 AM	73	296	65 F	76 %	CALM	0 mph	0 mph	29.03 in	0.0 in	Fair
9/27/72017	9:53 AM	81	300	65 F	58 %	W	3 mph	0 mph	29.02 in	0.0 in	Fair
9/27/72017	10:53 AM	86	303	62 F	44 %	W	6 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	11:53 AM	89	305	62 F	40 %	VAR	5 mph	0 mph	28.99 in	0.0 in	Fair
9/27/72017	12:53 PM	90	305	60 F	37 %	CALM	0 mph	0 mph	28.98 in	0.0 in	Fair
9/27/72017	1:53 PM	92	306	60 F	34 %	W	9 mph	0 mph	28.96 in	0.0 in	Partly Cloudy
9/27/72017	2:53 PM	84	302	63 F	49 %	ENE	5 mph	0 mph	28.96 in	0.0 in	Cloudy
9/27/72017	3:53 PM	79	299	70 F	74 %	CALM	0 mph	0 mph	28.95 in	0.0 in	Cloudy
9/27/72017	4:53 PM	82	301	69 F	65 %	CALM	0 mph	0 mph	28.95 in	0.0 in	Cloudy
9/27/72017	5:53 PM	79	299	70 F	74 %	CALM	0 mph	0 mph	28.95 in	0.0 in	Fair
9/27/72017	6:53 PM	77	298	68 F	74 %	CALM	0 mph	0 mph	28.96 in	0.0 in	Fair
9/27/72017	7:53 PM	77	298	65 F	66 %	NNW	12 mph	0 mph	28.98 in	0.0 in	Fair
9/27/72017	8:53 PM	74	296	64 F	71 %	N	8 mph	0 mph	29.01 in	0.0 in	Fair
9/27/72017	9:53 PM	72	295	59 F	64 %	NNW	6 mph	0 mph	29.02 in	0.0 in	Mostly Cloudy
9/27/72017	10:53 PM	70	294	60 F	71 %	NNW	7 mph	0 mph	29.02 in	0.0 in	Fair



September 27, 2017

11:30 a.m.

Image included

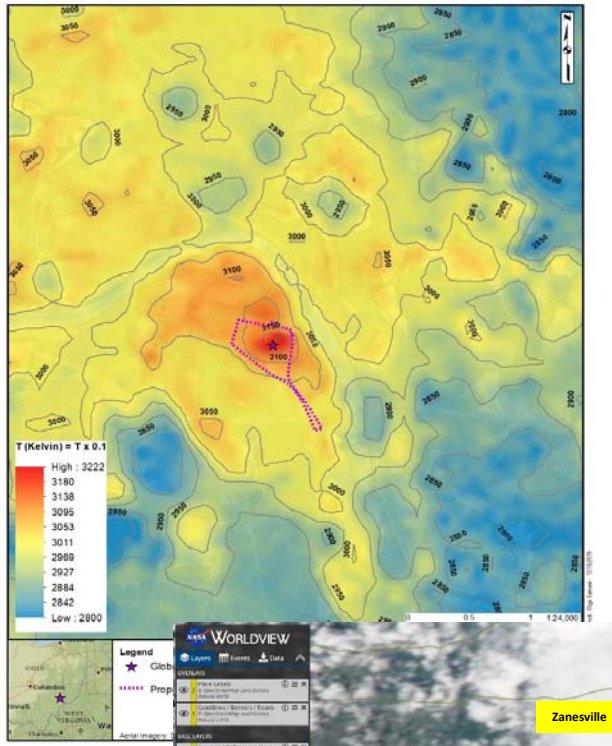
Figure B-9

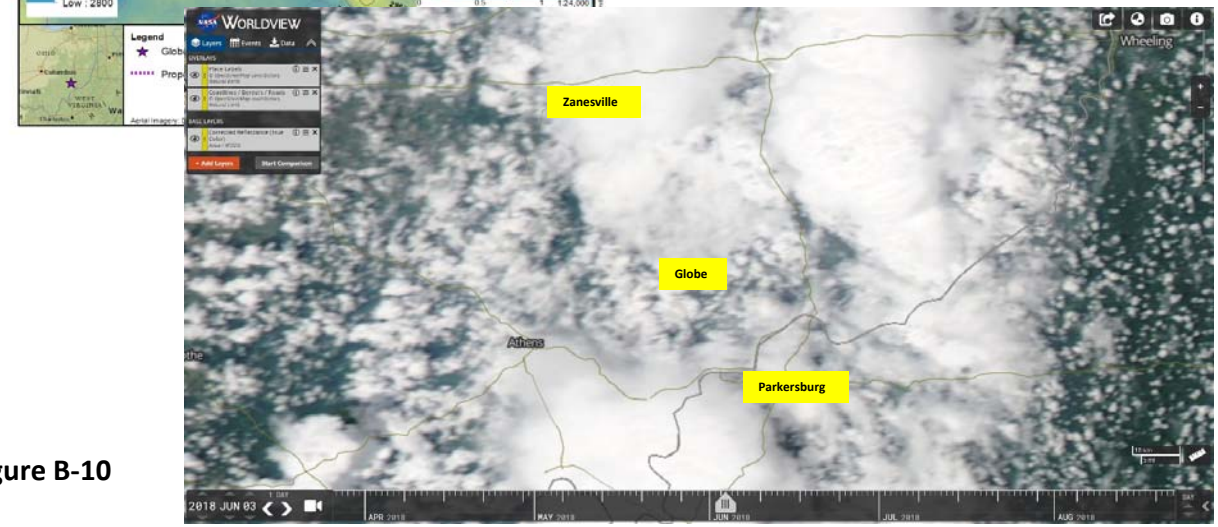
Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
6/3/2018	12:21 AM	64	291	63 F	96%	CALM	0 mph	0 mph	28.98 in	0.0 in	Fog
6/3/2018	12:31 AM	64	291	63 F	96%	WNW	5 mph	0 mph	28.98 in	0.0 in	Fair
6/3/2018	12:40 AM	64	291	62 F	93%	WNW	3 mph	0 mph	28.99 in	0.0 in	Fog
6/3/2018	12:53 AM	64	291	63 F	96%	CALM	0 mph	0 mph	28.99 in	0.0 in	Mostly Cloudy
6/3/2018	1:53 AM	65	291	63 F	93%	CALM	0 mph	0 mph	28.98 in	0.0 in	Cloudy
6/3/2018	2:45 AM	64	291	63 F	96%	CALM	0 mph	0 mph	28.96 in	0.0 in	Fog
6/3/2018	2:53 AM	64	291	62 F	93%	CALM	0 mph	0 mph	28.96 in	0.0 in	Fog
6/3/2018	3:02 AM	64	291	62 F	93%	CALM	0 mph	0 mph	28.96 in	0.0 in	Fog
6/3/2018	3:15 AM	64	291	62 F	93%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fair
6/3/2018	3:28 AM	63	290	62 F	97%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	3:32 AM	63	290	61 F	93%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	3:43 AM	63	290	61 F	93%	CALM	0 mph	0 mph	28.95 in	0.0 in	Mostly Cloudy
6/3/2018	3:53 AM	63	290	62 F	97%	CALM	0 mph	0 mph	28.95 in	0.0 in	Mostly Cloudy
6/3/2018	4:07 AM	63	290	61 F	93%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	4:15 AM	63	290	61 F	93%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	4:22 AM	63	290	62 F	97%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	4:31 AM	63	290	62 F	97%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	4:38 AM	63	290	62 F	97%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	4:48 AM	63	290	63 F	100%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	4:53 AM	63	290	62 F	97%	CALM	0 mph	0 mph	28.95 in	0.0 in	Fog
6/3/2018	5:53 AM	64	291	63 F	96%	CALM	0 mph	0 mph	28.96 in	0.0 in	Fog
6/3/2018	6:53 AM	64	291	64 F	100%	CALM	0 mph	0 mph	28.96 in	0.0 in	Fog
6/3/2018	7:20 AM	65	291	65 F	100%	CALM	0 mph	0 mph	28.96 in	0.0 in	Fog
6/3/2018	7:23 AM	66	292	65 F	96%	CALM	0 mph	0 mph	28.96 in	0.0 in	Mist
6/3/2018	7:40 AM	67	293	65 F	93%	CALM	0 mph	0 mph	28.97 in	0.0 in	Mist
6/3/2018	7:53 AM	67	293	66 F	97%	CALM	0 mph	0 mph	28.97 in	0.0 in	Fair
6/3/2018	8:53 AM	75	297	65 F	71%	SSE	6 mph	0 mph	28.96 in	0.0 in	Fair
6/3/2018	9:53 AM	77	298	66 F	69%	SSW	7 mph	0 mph	28.95 in	0.0 in	Partly Cloudy
6/3/2018	10:53 AM	79	299	67 F	66%	WSW	6 mph	0 mph	28.93 in	0.0 in	Fair
6/3/2018	11:53 AM	80	300	69 F	69%	WSW	7 mph	0 mph	28.93 in	0.0 in	Mostly Cloudy
6/3/2018	12:53 PM	81	300	69 F	67%	VAR	6 mph	0 mph	28.90 in	0.0 in	Partly Cloudy
6/3/2018	1:44 PM	75	297	69 F	82%	SW	12 mph	24 mph	28.90 in	0.0 in	Heavy Rain
6/3/2018	1:48 PM	73	296	68 F	83%	VAR	5 mph	24 mph	28.90 in	0.0 in	Rain
6/3/2018	1:53 PM	74	296	68 F	82%	SW	3 mph	0 mph	28.90 in	0.0 in	Light Rain
6/3/2018	2:53 PM	79	299	70 F	74%	SW	6 mph	0 mph	28.89 in	0.0 in	Mostly Cloudy
6/3/2018	3:53 PM	81	300	70 F	69%	WSW	9 mph	0 mph	28.87 in	0.0 in	Fair
6/3/2018	4:53 PM	82	301	68 F	62%	WNW	7 mph	0 mph	28.87 in	0.0 in	Partly Cloudy
6/3/2018	5:53 PM	82	301	61 F	49%	W	13 mph	22 mph	28.88 in	0.0 in	Fair
6/3/2018	6:53 PM	78	299	54 F	43%	WNW	8 mph	0 mph	28.90 in	0.0 in	Fair
6/3/2018	7:53 PM	75	297	51 F	43%	WNW	8 mph	0 mph	28.92 in	0.0 in	Fair
6/3/2018	8:53 PM	72	295	48 F	43%	W	5 mph	0 mph	28.95 in	0.0 in	Fair
6/3/2018	9:53 PM	70	294	49 F	47%	WNW	6 mph	0 mph	28.98 in	0.0 in	Fair
6/3/2018	10:53 PM	68	293	50 F	52%	CALM	0 mph	0 mph	28.99 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
6/3/2018	12:53 AM	64	291	61F	90%	CALM	0mph	0mph	28.93in	0.0in	Fair
6/3/2018	1:53 AM	63	290	60F	90%	CALM	0mph	0mph	28.92in	0.0in	Fair
6/3/2018	2:53 AM	62	290	60F	93%	CALM	0mph	0mph	28.90in	0.0in	Fair
6/3/2018	3:09 AM	61	289	59F	93%	CALM	0mph	0mph	28.90in	0.0in	Partly Cloudy
6/3/2018	3:18 AM	62	290	59F	90%	CALM	0mph	0mph	28.89in	0.0in	Mostly Cloudy
6/3/2018	3:28 AM	61	289	59F	93%	CALM	0mph	0mph	28.89in	0.0in	Fog
6/3/2018	3:30 AM	61	289	59F	93%	CALM	0mph	0mph	28.89in	0.0in	Fog
6/3/2018	3:53 AM	61	289	59F	93%	CALM	0mph	0mph	28.89in	0.0in	Fog
6/3/2018	4:53 AM	60	289	58F	93%	CALM	0mph	0mph	28.89in	0.0in	Fog
6/3/2018	5:20 AM	60	289	59F	96%	CALM	0mph	0mph	28.89in	0.0in	Fog
6/3/2018	5:25 AM	60	289	59F	96%	CALM	0mph	0mph	28.89in	0.0in	Cloudy
6/3/2018	5:53 AM	60	289	59F	96%	CALM	0mph	0mph	28.89in	0.0in	Partly Cloudy
6/3/2018	6:06 AM	60	289	59F	96%	CALM	0mph	0mph	28.89in	0.0in	Fog
6/3/2018	6:33 AM	62	290	61F	96%	CALM	0mph	0mph	28.89in	0.0in	Partly Cloudy
6/3/2018	6:53 AM	63	290	61F	93%	CALM	0mph	0mph	28.89in	0.0in	Fair
6/3/2018	7:53 AM	69	294	64F	84%	SSE	5mph	0mph	28.89in	0.0in	Fair
6/3/2018	8:53 AM	74	296	66F	76%	S	7mph	0mph	28.88in	0.0in	Fair
6/3/2018	9:53 AM	76	298	67F	74%	S	6mph	0mph	28.87in	0.0in	Mostly Cloudy
6/3/2018	10:53 AM	79	299	67F	66%	SSW	9mph	0mph	28.86in	0.0in	Cloudy
6/3/2018	11:30 AM	78	299	67F	68%	SW	7mph	0mph	28.85in	0.0in	Cloudy
6/3/2018	11:53 AM	78	299	68F	71%	SW	8mph	0mph	28.85in	0.0in	Cloudy
6/3/2018	12:53 PM	76	298	69F	79%	SW	8mph	0mph	28.83in	0.0in	Light Rain
6/3/2018	1:53 PM	79	299	69F	72%	WSW	12mph	18mph	28.82in	0.0in	Mostly Cloudy
6/3/2018	2:53 PM	81	300	68F	65%	W	12mph	0mph	28.81in	0.0in	Partly Cloudy
6/3/2018	3:53 PM	83	301	62F	49%	W	17mph	29mph	28.80in	0.0in	Partly Cloudy
6/3/2018	4:53 PM	82	301	60F	47%	WNW	9mph	0mph	28.81in	0.0in	Fair
6/3/2018	5:53 PM	81	300	53F	38%	WNW	14mph	21mph	28.82in	0.0in	Fair
6/3/2018	6:53 PM	78	299	48F	35%	WNW	12mph	0mph	28.84in	0.0in	Fair
6/3/2018	7:53 PM	73	296	49F	42%	W	6mph	0mph	28.87in	0.0in	Fair
6/3/2018	8:53 PM	71	295	51F	49%	NW	6mph	0mph	28.90in	0.0in	Fair
6/3/2018	9:53 PM	69	294	52F	54%	CALM	0mph	0mph	28.91in	0.0in	Fair
6/3/2018	10:53 PM	63	290	54F	72%	CALM	0mph	0mph	28.90in	0.0in	Fair





June 3, 2018

11:30 a.m.

Image included

Figure B-10

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Temperature (F)	Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
11/10/2018	12:53 AM	35	275	26 F	70 %	W	15 mph	23 mph	29.21 in	0.0 in	Cloudy
11/10/2018	1:25 AM	35	275	25 F	67 %	W	14 mph	26 mph	29.22 in	0.0 in	Cloudy
11/10/2018	1:33 AM	35	275	25 F	67 %	W	16 mph	23 mph	29.22 in	0.0 in	Cloudy
11/10/2018	1:53 AM	34	274	25 F	70 %	WNW	17 mph	26 mph	29.22 in	0.0 in	Light Snow
11/10/2018	2:53 AM	32	273	22 F	66 %	WNW	16 mph	24 mph	29.24 in	0.0 in	Fair
11/10/2018	3:53 AM	31	273	19 F	61 %	W	10 mph	0 mph	29.26 in	0.0 in	Fair
11/10/2018	4:53 AM	30	272	20 F	66 %	W	9 mph	0 mph	29.28 in	0.0 in	Fair
11/10/2018	5:53 AM	29	271	20 F	69 %	W	6 mph	0 mph	29.30 in	0.0 in	Fair
11/10/2018	6:53 AM	29	271	20 F	69 %	W	8 mph	0 mph	29.32 in	0.0 in	Mostly Cloudy
11/10/2018	7:53 AM	29	271	20 F	69 %	W	9 mph	0 mph	29.35 in	0.0 in	Mostly Cloudy
11/10/2018	10:53 AM	30	272	10 F	44 %	W	10 mph	18 mph	29.45 in	0.0 in	Fair
11/10/2018	11:53 AM	34	274	12 F	41 %	W	10 mph	17 mph	29.46 in	0.0 in	Fair
11/10/2018	12:53 PM	36	275	14 F	41 %	WNW	14 mph	23 mph	29.46 in	0.0 in	Fair
11/10/2018	2:53 PM	36	275	16 F	44 %	WNW	9 mph	0 mph	29.46 in	0.0 in	Fair
11/10/2018	3:53 PM	36	275	16 F	44 %	NW	9 mph	16 mph	29.46 in	0.0 in	Fair
11/10/2018	4:53 PM	34	274	16 F	48 %	SE	9 mph	0 mph	29.47 in	0.0 in	Fair
11/10/2018	5:53 PM	30	272	16 F	55 %	NW	3 mph	0 mph	29.46 in	0.0 in	Fair
11/10/2018	6:53 PM	28	271	18 F	64 %	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
11/10/2018	7:53 PM	27	270	19 F	74 %	CALM	0 mph	0 mph	29.46 in	0.0 in	Fair
11/10/2018	8:53 PM	27	270	19 F	74 %	CALM	0 mph	0 mph	29.47 in	0.0 in	Fair
11/10/2018	9:53 PM	25	269	21 F	86 %	CALM	0 mph	0 mph	29.50 in	0.0 in	Fair
11/10/2018	10:53 PM	25	269	19 F	80 %	CALM	0 mph	0 mph	29.50 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
11/10/2018	12:53 AM	64	291	61 F	90 %	CALM	0 mph	0 mph	28.93 in	0.0 in	Fair
11/10/2018	1:53 AM	63	290	60 F	90 %	CALM	0 mph	0 mph	28.92 in	0.0 in	Fair
11/10/2018	2:53 AM	62	290	60 F	93 %	CALM	0 mph	0 mph	28.90 in	0.0 in	Fair
11/10/2018	3:09 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	28.90 in	0.0 in	Partly Cloudy
11/10/2018	3:18 AM	62	290	59 F	90 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Mostly Cloudy
11/10/2018	3:28 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fog
11/10/2018	3:30 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fog
11/10/2018	3:53 AM	61	289	59 F	93 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fog
11/10/2018	4:53 AM	60	289	58 F	93 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fog
11/10/2018	5:20 AM	60	289	59 F	96 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fog
11/10/2018	5:25 AM	60	289	59 F	96 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Cloudy
11/10/2018	5:53 AM	60	289	59 F	96 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Partly Cloudy
11/10/2018	6:06 AM	60	289	59 F	96 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fog
11/10/2018	6:33 AM	62	290	61 F	96 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Partly Cloudy
11/10/2018	6:53 AM	63	290	61 F	93 %	CALM	0 mph	0 mph	28.89 in	0.0 in	Fair
11/10/2018	7:53 AM	69	294	64 F	84 %	SSE	5 mph	0 mph	28.89 in	0.0 in	Fair
11/10/2018	8:53 AM	74	296	66 F	76 %	S	7 mph	0 mph	28.88 in	0.0 in	Fair
11/10/2018	9:53 AM	76	298	67 F	74 %	S	6 mph	0 mph	28.87 in	0.0 in	Mostly Cloudy
11/10/2018	10:53 AM	79	299	67 F	66 %	SSW	9 mph	0 mph	28.86 in	0.0 in	Cloudy
11/10/2018	11:30 AM	78	299	67 F	68 %	SW	7 mph	0 mph	28.85 in	0.0 in	Cloudy
11/10/2018	11:53 AM	78	299	68 F	71 %	SW	8 mph	0 mph	28.85 in	0.0 in	Cloudy
11/10/2018	12:53 PM	76	298	69 F	79 %	SW	8 mph	0 mph	28.83 in	0.0 in	Light Rain
11/10/2018	1:53 PM	79	299	69 F	72 %	WSW	12 mph	18 mph	28.82 in	0.0 in	Mostly Cloudy
11/10/2018	2:53 PM	81	300	68 F	65 %	W	12 mph	0 mph	28.81 in	0.0 in	Partly Cloudy
11/10/2018	3:53 PM	83	301	62 F	49 %	W	17 mph	29 mph	28.80 in	0.0 in	Partly Cloudy
11/10/2018	4:53 PM	82	301	60 F	47 %	WNW	9 mph	0 mph	28.81 in	0.0 in	Fair
11/10/2018	5:53 PM	81	300	53 F	38 %	WNW	14 mph	21 mph	28.82 in	0.0 in	Fair
11/10/2018	6:53 PM	78	299	48 F	35 %	WNW	12 mph	0 mph	28.84 in	0.0 in	Fair
11/10/2018	7:53 PM	73	296	49 F	42 %	W	6 mph	0 mph	28.87 in	0.0 in	Fair
11/10/2018	8:53 PM	71	295	51 F	49 %	NW	6 mph	0 mph	28.90 in	0.0 in	Fair
11/10/2018	9:53 PM	69	294	52 F	54 %	CALM	0 mph	0 mph	28.91 in	0.0 in	Fair
11/10/2018	10:53 PM	63	290	54 F	72 %	CALM	0 mph	0 mph	28.90 in	0.0 in	Fair

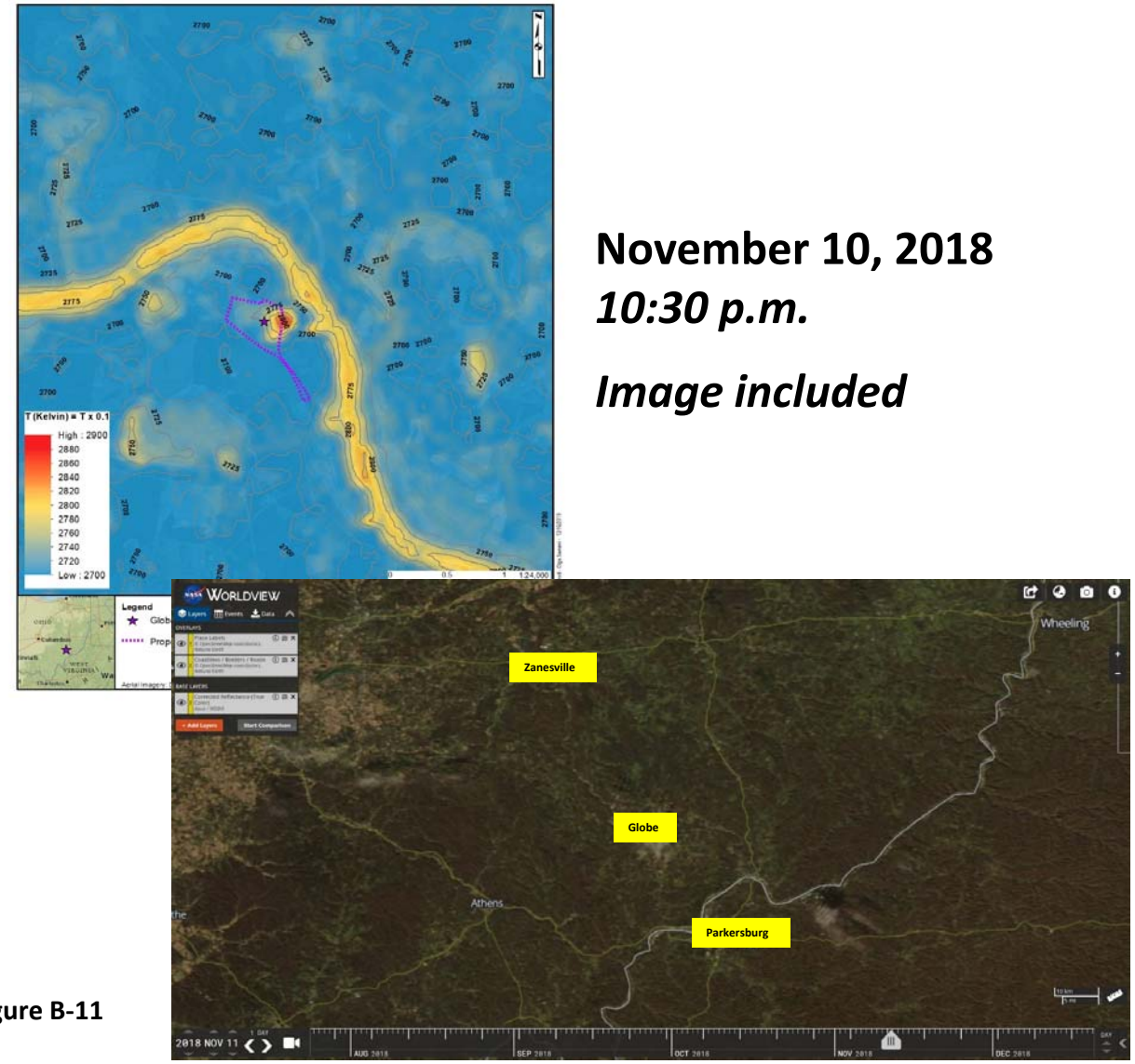


Figure B-11

November 10, 2018

10:30 p.m.

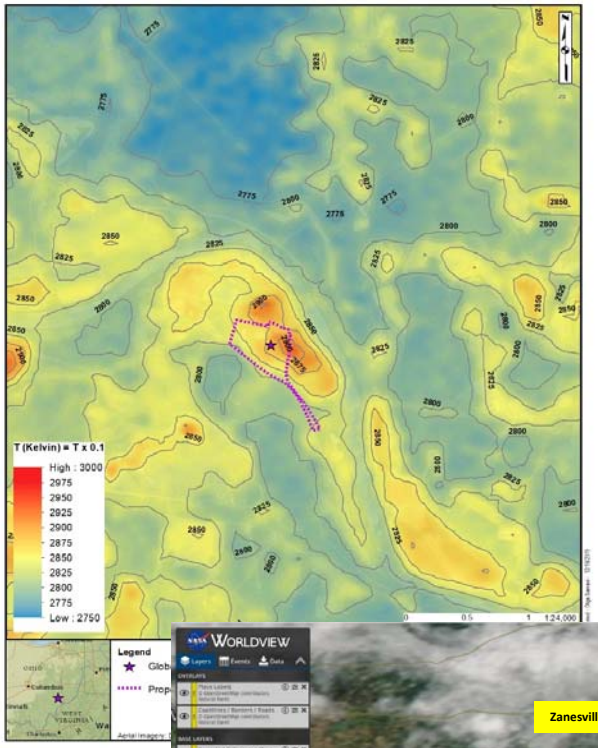
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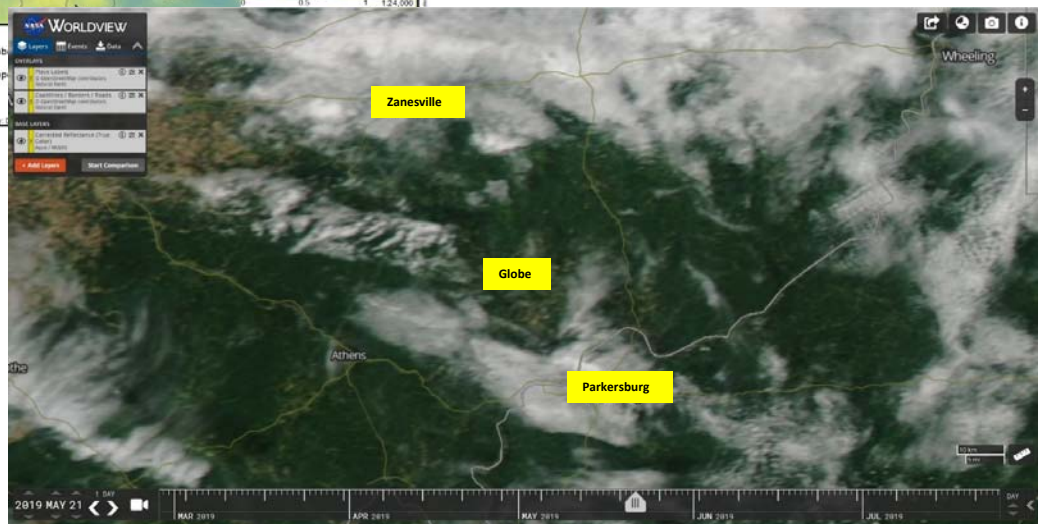
Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Temperature (F)	Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
5/21/2019	12:53 AM	0		0 F	0%		0 mph	0 mph	29.17 in	0.0 in	N/A
5/21/2019	1:53 AM	0		0 F	0%		0 mph	0 mph	29.18 in	0.0 in	N/A
5/21/2019	2:53 AM	0		0 F	0%		0 mph	0 mph	29.18 in	0.0 in	N/A
5/21/2019	3:53 AM	0		0 F	0%		0 mph	0 mph	29.19 in	0.0 in	N/A
5/21/2019	4:53 AM	0		0 F	0%		0 mph	0 mph	29.21 in	0.0 in	N/A
5/21/2019	5:45 AM	0		0 F	0%	N	5 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	5:53 AM	0		0 F	0%	N	5 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	6:53 AM	0		0 F	0%	NE	9 mph	0 mph	29.22 in	0.0 in	Fair
5/21/2019	7:53 AM	0		0 F	0%	NE	12 mph	0 mph	29.25 in	0.0 in	Fair
5/21/2019	8:53 AM	0		0 F	0%	NE	12 mph	0 mph	29.25 in	0.0 in	Fair
5/21/2019	9:53 AM	0		0 F	0%	NNE	9 mph	0 mph	29.25 in	0.0 in	Fair
5/21/2019	10:53 AM	0		0 F	0%	NE	8 mph	0 mph	29.26 in	0.0 in	Fair
5/21/2019	11:53 AM	0		0 F	0%	NE	9 mph	0 mph	29.23 in	0.0 in	Fair
5/21/2019	12:53 PM	0		0 F	0%	E	8 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	1:53 PM	65	291	42 F	43%	NNE	8 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	2:53 PM	66	292	41 F	40%	NNE	8 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	3:07 PM	68	293	42 F	39%	ENE	8 mph	0 mph	29.21 in	0.0 in	Haze
5/21/2019	3:16 PM	67	293	41 F	39%	VAR	5 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	3:48 PM	68	293	39 F	35%	N	7 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	3:53 PM	68	293	39 F	35%	N	7 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	4:53 PM	68	293	41 F	37%	E	5 mph	0 mph	29.21 in	0.0 in	Haze
5/21/2019	5:05 PM	68	293	41 F	37%	NE	7 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	5:53 PM	66	292	41 F	40%	ENE	7 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	6:53 PM	65	291	44 F	47%	NNE	3 mph	0 mph	29.21 in	0.0 in	Cloudy
5/21/2019	7:53 PM	62	290	44 F	52%	NNE	5 mph	0 mph	29.21 in	0.0 in	Cloudy
5/21/2019	8:53 PM	61	289	45 F	56%	NE	8 mph	0 mph	29.21 in	0.0 in	Cloudy
5/21/2019	9:53 PM	58	288	45 F	62%	NE	9 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	10:53 PM	57	287	44 F	62%	ENE	3 mph	0 mph	29.21 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
5/21/2019	12:53 AM	50	283	43 F	77%	N	5 mph	0 mph	29.11 in	0.0 in	Fair
5/21/2019	1:53 AM	48	282	42 F	80%	N	3 mph	0 mph	29.11 in	0.0 in	Fair
5/21/2019	2:53 AM	48	282	42 F	80%	N	3 mph	0 mph	29.12 in	0.0 in	Fair
5/21/2019	3:53 AM	48	282	42 F	80%	N	3 mph	0 mph	29.13 in	0.0 in	Cloudy
5/21/2019	4:53 AM	50	283	42 F	74%	NNE	5 mph	0 mph	29.14 in	0.0 in	Cloudy
5/21/2019	5:53 AM	49	283	40 F	71%	NNE	9 mph	0 mph	29.16 in	0.0 in	Fair
5/21/2019	6:53 AM	51	284	40 F	66%	NNE	9 mph	0 mph	29.17 in	0.0 in	Fair
5/21/2019	7:53 AM	52	284	38 F	59%	NE	12 mph	0 mph	29.21 in	0.0 in	Fair
5/21/2019	8:53 AM	54	285	37 F	53%	NE	13 mph	0 mph	29.22 in	0.0 in	Fair
5/21/2019	9:53 AM	53	285	37 F	55%	N	7 mph	0 mph	29.21 in	0.0 in	Partly Cloudy
5/21/2019	10:53 AM	56	286	38 F	51%	ENE	10 mph	0 mph	29.19 in	0.0 in	Fair
5/21/2019	11:53 AM	59	288	40 F	49%	ENE	9 mph	0 mph	29.19 in	0.0 in	Fair
5/21/2019	12:53 PM	59	288	39 F	48%	ENE	8 mph	0 mph	29.17 in	0.0 in	Fair
5/21/2019	1:53 PM	62	290	39 F	43%	VAR	5 mph	0 mph	29.16 in	0.0 in	Fair
5/21/2019	2:53 PM	64	291	41 F	43%	E	9 mph	0 mph	29.16 in	0.0 in	Mostly Cloudy
5/21/2019	3:53 PM	65	291	41 F	42%	E	9 mph	0 mph	29.15 in	0.0 in	Mostly Cloudy
5/21/2019	4:53 PM	66	292	43 F	43%	NNE	9 mph	0 mph	29.15 in	0.0 in	Partly Cloudy
5/21/2019	5:53 PM	63	290	43 F	48%	ENE	9 mph	0 mph	29.15 in	0.0 in	Cloudy
5/21/2019	6:53 PM	61	289	43 F	52%	NE	7 mph	0 mph	29.15 in	0.0 in	Cloudy
5/21/2019	7:53 PM	59	288	43 F	55%	ENE	10 mph	0 mph	29.15 in	0.0 in	Cloudy
5/21/2019	8:53 PM	58	288	43 F	58%	ENE	7 mph	0 mph	29.15 in	0.0 in	Cloudy
5/21/2019	9:53 PM	57	287	42 F	57%	ENE	7 mph	0 mph	29.15 in	0.0 in	Mostly Cloudy
5/21/2019	10:53 PM	56	286	42 F	60%	ENE	6 mph	0 mph	29.15 in	0.0 in	Fair





May 21, 2019

11:30 a.m.

Image included

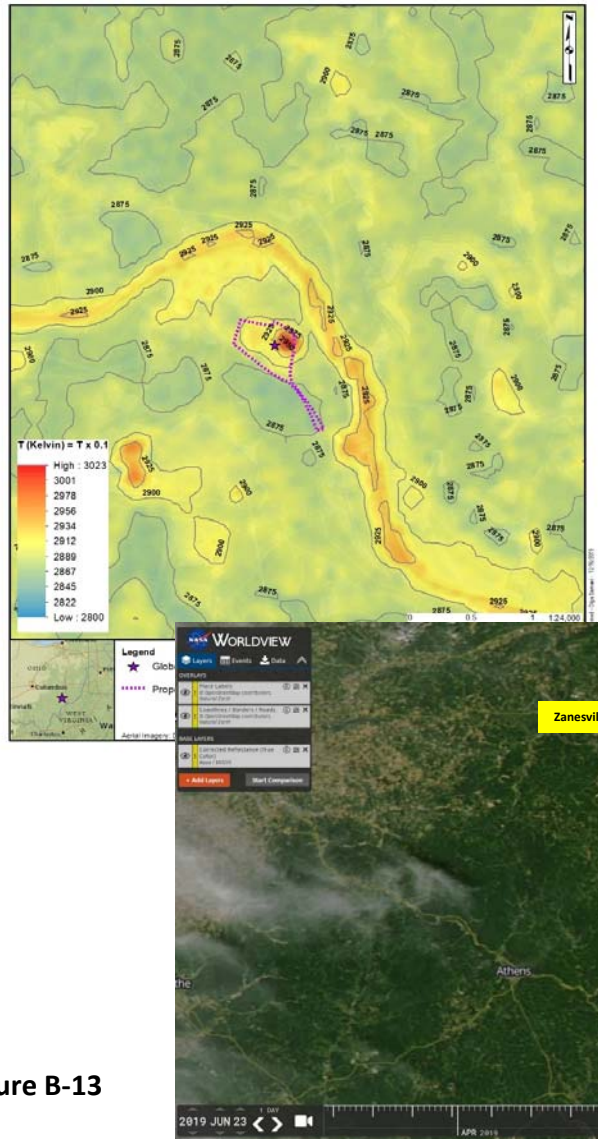
Figure B-12

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
6/22/2019	12:53 AM	62	290	59 F	90 %	CALM	0 mph	0 mph	29.14 in	0.0 in	Cloudy
6/22/2019	1:53 AM	62	290	59 F	90 %	CALM	0 mph	0 mph	29.14 in	0.0 in	Cloudy
6/22/2019	2:53 AM	62	290	59 F	90 %	CALM	0 mph	0 mph	29.14 in	0.0 in	Light Rain
6/22/2019	3:53 AM	62	290	59 F	90 %	CALM	0 mph	0 mph	29.15 in	0.0 in	Cloudy
6/22/2019	4:53 AM	62	290	59 F	90 %	CALM	0 mph	0 mph	29.15 in	0.0 in	Mostly Cloudy
6/22/2019	5:53 AM	62	290	58 F	86 %	CALM	0 mph	0 mph	29.17 in	0.0 in	Cloudy
6/22/2019	6:53 AM	64	291	58 F	80 %	CALM	0 mph	0 mph	29.20 in	0.0 in	Cloudy
6/22/2019	7:53 AM	68	293	57 F	68 %	VAR	3 mph	0 mph	29.20 in	0.0 in	Fair
6/22/2019	8:53 AM	70	294	54 F	57 %	ENE	8 mph	0 mph	29.19 in	0.0 in	Fair
6/22/2019	9:53 AM	73	296	54 F	51 %	NNE	5 mph	0 mph	29.21 in	0.0 in	Fair
6/22/2019	10:53 AM	73	296	54 F	51 %	CALM	0 mph	0 mph	29.21 in	0.0 in	Partly Cloudy
6/22/2019	11:53 AM	74	296	49 F	41 %	CALM	0 mph	0 mph	29.21 in	0.0 in	Fair
6/22/2019	12:53 PM	78	299	53 F	42 %	VAR	3 mph	0 mph	29.20 in	0.0 in	Fair
6/22/2019	1:53 PM	78	299	46 F	32 %	NNE	6 mph	0 mph	29.19 in	0.0 in	Fair
6/22/2019	2:53 PM	78	299	49 F	36 %	CALM	0 mph	0 mph	29.19 in	0.0 in	Fair
6/22/2019	3:53 PM	78	299	46 F	32 %	ENE	7 mph	0 mph	29.18 in	0.0 in	Fair
6/22/2019	4:53 PM	79	299	48 F	34 %	NE	6 mph	0 mph	29.18 in	0.0 in	Fair
6/22/2019	5:53 PM	78	299	51 F	39 %	N	5 mph	0 mph	29.18 in	0.0 in	Fair
6/22/2019	6:53 PM	75	297	46 F	36 %	N	5 mph	0 mph	29.18 in	0.0 in	Fair
6/22/2019	7:53 PM	71	295	47 F	42 %	CALM	0 mph	0 mph	29.18 in	0.0 in	Fair
6/22/2019	8:53 PM	63	290	53 F	70 %	CALM	0 mph	0 mph	29.17 in	0.0 in	Fair
6/22/2019	9:53 PM	58	288	53 F	84 %	CALM	0 mph	0 mph	29.19 in	0.0 in	Fair
6/22/2019	10:53 PM	56	286	53 F	90 %	CALM	0 mph	0 mph	29.19 in	0.0 in	Fair
6/22/2019	11:53 PM	55	286	52 F	89 %	CALM	0 mph	0 mph	29.19 in	0.0 in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
6/22/2019	12:53 AM	63	290	59 F	87 %	CALM	0 mph	0 mph	29.07 in	0.0 in	Mostly Cloudy
6/22/2019	1:53 AM	63	290	59 F	87 %	CALM	0 mph	0 mph	29.06 in	0.0 in	Fair
6/22/2019	2:53 AM	63	290	58 F	84 %	NE	3 mph	0 mph	29.06 in	0.0 in	Mostly Cloudy
6/22/2019	3:53 AM	62	290	57 F	84 %	CALM	0 mph	0 mph	29.09 in	0.0 in	Partly Cloudy
6/22/2019	4:53 AM	62	290	56 F	80 %	NNE	5 mph	0 mph	29.09 in	0.0 in	Fair
6/22/2019	5:53 AM	63	290	55 F	75 %	NNE	3 mph	0 mph	29.11 in	0.0 in	Fair
6/22/2019	6:53 AM	66	292	54 F	65 %	E	3 mph	0 mph	29.13 in	0.0 in	Partly Cloudy
6/22/2019	7:53 AM	70	294	55 F	59 %	NE	5 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	8:53 AM	70	294	52 F	53 %	ENE	7 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	9:53 AM	72	295	52 F	49 %	ENE	6 mph	0 mph	29.13 in	0.0 in	Fair
6/22/2019	10:53 AM	74	296	50 F	43 %	ENE	6 mph	0 mph	29.14 in	0.0 in	Fair
6/22/2019	11:53 AM	75	297	49 F	40 %	N	3 mph	0 mph	29.14 in	0.0 in	Fair
6/22/2019	12:53 PM	76	298	49 F	38 %	VAR	3 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	1:53 PM	77	298	49 F	37 %	N	8 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	2:53 PM	78	299	49 F	36 %	VAR	6 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	3:53 PM	78	299	51 F	39 %	NE	9 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	4:53 PM	77	298	43 F	30 %	N	6 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	5:53 PM	76	298	46 F	35 %	NNE	6 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	6:53 PM	75	297	47 F	37 %	N	3 mph	0 mph	29.12 in	0.0 in	Fair
6/22/2019	7:53 PM	71	295	50 F	47 %	CALM	0 mph	0 mph	29.11 in	0.0 in	Fair
6/22/2019	8:53 PM	63	290	53 F	70 %	CALM	0 mph	0 mph	29.11 in	0.0 in	Fair
6/22/2019	9:53 PM	60	289	54 F	80 %	CALM	0 mph	0 mph	29.11 in	0.0 in	Fair
6/22/2019	10:53 PM	57	287	53 F	87 %	CALM	0 mph	0 mph	29.11 in	0.0 in	Fair



June 22, 2019

10:30 p.m.

Image included

Figure B-13

Parkersburg, WV Weather History (39.29 °N, 81.53 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10/28/2019	12:13 AM	43	279	41F	93%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	12:17 AM	43	279	41F	93%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	12:25 AM	42	279	40F	92%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	12:32 AM	43	279	41F	93%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	12:41 AM	42	279	41F	96%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	12:53 AM	42	279	40F	92%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	1:48 AM	41	278	39F	93%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	1:53 AM	41	278	39F	93%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	2:13 AM	41	278	40F	96%	CALM	0mph	0mph	29.21in	0.0in	Fog
10/28/2019	2:21 AM	40	278	39F	97%	CALM	0mph	0mph	29.22in	0.0in	Fog
10/28/2019	2:38 AM	41	278	39F	93%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	2:53 AM	40	278	38F	93%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	3:02 AM	40	278	39F	97%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	3:21 AM	41	278	39F	93%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	3:29 AM	41	278	40F	96%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	3:33 AM	41	278	39F	93%	CALM	0mph	0mph	29.23in	0.0in	Fair
10/28/2019	3:53 AM	39	277	38F	96%	CALM	0mph	0mph	29.23in	0.0in	Mostly Cloudy
10/28/2019	3:56 AM	39	277	38F	96%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	4:02 AM	40	278	38F	93%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	4:53 AM	39	277	38F	96%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	5:53 AM	41	278	40F	96%	CALM	0mph	0mph	29.23in	0.0in	Fog
10/28/2019	6:53 AM	40	278	39F	97%	CALM	0mph	0mph	29.25in	0.0in	Fog
10/28/2019	7:53 AM	41	278	40F	96%	CALM	0mph	0mph	29.26in	0.0in	Fog
10/28/2019	8:53 AM	45	280	44F	97%	ENE	3mph	0mph	29.26in	0.0in	Fog
10/28/2019	9:32 AM	48	282	47F	96%	E	3mph	0mph	29.25in	0.0in	Fog
10/28/2019	9:53 AM	50	283	49F	96%	CALM	0mph	0mph	29.26in	0.0in	Fog
10/28/2019	10:02 AM	51	284	49F	92%	CALM	0mph	0mph	29.26in	0.0in	Fog
10/28/2019	10:11 AM	51	284	50F	96%	E	3mph	0mph	29.25in	0.0in	Partly Cloudy
10/28/2019	10:53 AM	56	286	52F	87%	CALM	0mph	0mph	29.25in	0.0in	Fair
10/28/2019	11:53 AM	64	291	52F	65%	CALM	0mph	0mph	29.23in	0.0in	Fair
10/28/2019	12:53 PM	67	293	52F	59%	VAR	3mph	0mph	29.20in	0.0in	Fair
10/28/2019	1:53 PM	69	294	51F	53%	WSW	3mph	0mph	29.18in	0.0in	Fair
10/28/2019	2:53 PM	71	295	49F	45%	SE	5mph	0mph	29.16in	0.0in	Fair
10/28/2019	3:53 PM	72	295	50F	46%	WNW	3mph	0mph	29.16in	0.0in	Haze
10/28/2019	4:53 PM	70	294	51F	51%	NW	5mph	0mph	29.16in	0.0in	Fair
10/28/2019	5:53 PM	62	290	52F	70%	CALM	0mph	0mph	29.17in	0.0in	Fair
10/28/2019	6:53 PM	57	287	51F	81%	CALM	0mph	0mph	29.17in	0.0in	Fair
10/28/2019	7:53 PM	53	285	50F	89%	CALM	0mph	0mph	29.18in	0.0in	Fair
10/28/2019	8:53 PM	52	284	49F	89%	CALM	0mph	0mph	29.19in	0.0in	Fair
10/28/2019	9:53 PM	51	284	48F	89%	CALM	0mph	0mph	29.19in	0.0in	Fair
10/28/2019	10:53 PM	49	283	47F	93%	CALM	0mph	0mph	29.19in	0.0in	Fair

ZANESVILLE MUNICIPAL AIRPORT, OH Weather History (39.98 °N, 82.02 °W)

Date LST	Time	Air Temperature (F)	Air Temperature (K)	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
10/28/2019	12:53 AM	42	279	39F	89%	CALM	0mph	0mph	29.12in	0.0in	Fog
10/28/2019	1:25 AM	41	278	39F	93%	CALM	0mph	0mph	29.12in	0.0in	Fog
10/28/2019	1:30 AM	40	278	38F	93%	CALM	0mph	0mph	29.12in	0.0in	Fog
10/28/2019	1:33 AM	40	278	38F	93%	CALM	0mph	0mph	29.12in	0.0in	Fair
10/28/2019	1:53 AM	40	278	37F	89%	CALM	0mph	0mph	29.13in	0.0in	Fair
10/28/2019	2:05 AM	39	277	37F	93%	NNW	3mph	0mph	29.13in	0.0in	Fog
10/28/2019	2:12 AM	39	277	37F	93%	CALM	0mph	0mph	29.13in	0.0in	Fair
10/28/2019	2:21 AM	38	276	36F	93%	CALM	0mph	0mph	29.13in	0.0in	Partly Cloudy
10/28/2019	2:30 AM	39	277	37F	93%	CALM	0mph	0mph	29.13in	0.0in	Mostly Cloudy
10/28/2019	2:38 AM	40	278	37F	89%	CALM	0mph	0mph	29.14in	0.0in	Fog
10/28/2019	2:42 AM	40	278	37F	89%	CALM	0mph	0mph	29.14in	0.0in	Fog
10/28/2019	2:53 AM	39	277	37F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	2:56 AM	39	277	37F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:00 AM	38	276	36F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:09 AM	39	277	37F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:14 AM	38	276	36F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:18 AM	39	277	36F	89%	CALM	0mph	0mph	29.15in	0.0in	Mostly Cloudy
10/28/2019	3:30 AM	39	277	36F	89%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:38 AM	39	277	37F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:44 AM	39	277	36F	89%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:46 AM	39	277	37F	93%	CALM	0mph	0mph	29.15in	0.0in	Cloudy
10/28/2019	3:53 AM	39	277	37F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	3:59 AM	39	277	36F	89%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	4:07 AM	38	276	36F	93%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	4:28 AM	37	276	36F	96%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	4:53 AM	38	276	35F	89%	CALM	0mph	0mph	29.15in	0.0in	Fog
10/28/2019	5:53 AM	37	276	35F	93%	CALM	0mph	0mph	29.16in	0.0in	Fog
10/28/2019	6:53 AM	37	276	34F	89%	CALM	0mph	0mph	29.17in	0.0in	Fog
10/28/2019	7:53 AM	39	277	38F	96%	CALM	0mph	0mph	29.18in	0.0in	Fog
10/28/2019	8:53 AM	44	280	42F	93%	CALM	0mph	0mph	29.19in	0.0in	Fog
10/28/2019	9:20 AM	46	281	45F	96%	CALM	0mph	0mph	29.18in	0.0in	Fog
10/28/2019	9:26 AM	47	281	46F	97%	CALM	0mph	0mph	29.18in	0.0in	Fog
10/28/2019	9:36 AM	49	283	47F	93%	CALM	0mph	0mph	29.18in	0.0in	Fog
10/28/2019	9:40 AM	49	283	47F	93%	SE	3mph	0mph	29.18in	0.0in	Mostly Cloudy
10/28/2019	9:53 AM	51	284	48F	89%	VAR	3mph	0mph	29.18in	0.0in	Partly Cloudy
10/28/2019	10:53 AM	58	288	51F	78%	SSW	5mph	0mph	29.18in	0.0in	Fair
10/28/2019	11:53 AM	62	290	48F	60%	SSE	8mph	0mph	29.15in	0.0in	Fair
10/28/2019	12:53 PM	64	291	46F	52%	SE	6mph	0mph	29.12in	0.0in	Fair
10/28/2019	1:53 PM	67	293	42F	40%	SE	7mph	0mph	29.10in	0.0in	Fair
10/28/2019	2:53 PM	68	293	44F	42%	SSE	6mph	0mph	29.10in	0.0in	Fair
10/28/2019	3:53 PM	68	293	44F	42%	VAR	3mph	0mph	29.09in	0.0in	Fair
10/28/2019	4:53 PM	66	292	46F	48%	S	3mph	0mph	29.09in	0.0in	Fair
10/28/2019	5:53 PM	62	290	46F	56%	SSW	3mph	0mph	29.10in	0.0in	Fair
10/28/2019	6:53 PM	56	286	46F	69%	CALM	0mph	0mph	29.11in	0.0in	Fair
10/28/2019	7:53 PM	52	284	46F	80%	CALM	0mph	0mph	29.12in	0.0in	Fair
10/28/2019	8:53 PM	50	283	45F	83%	CALM	0mph	0mph	29.11in	0.0in	Fair
10/28/2019	9:53 PM	48	282	45F	89%	CALM	0mph	0mph	29.12in	0.0in	Fair
10/28/2019	10:53 PM	47	281	43F	86%	CALM	0mph	0mph	29.10in	0.0in	Fair

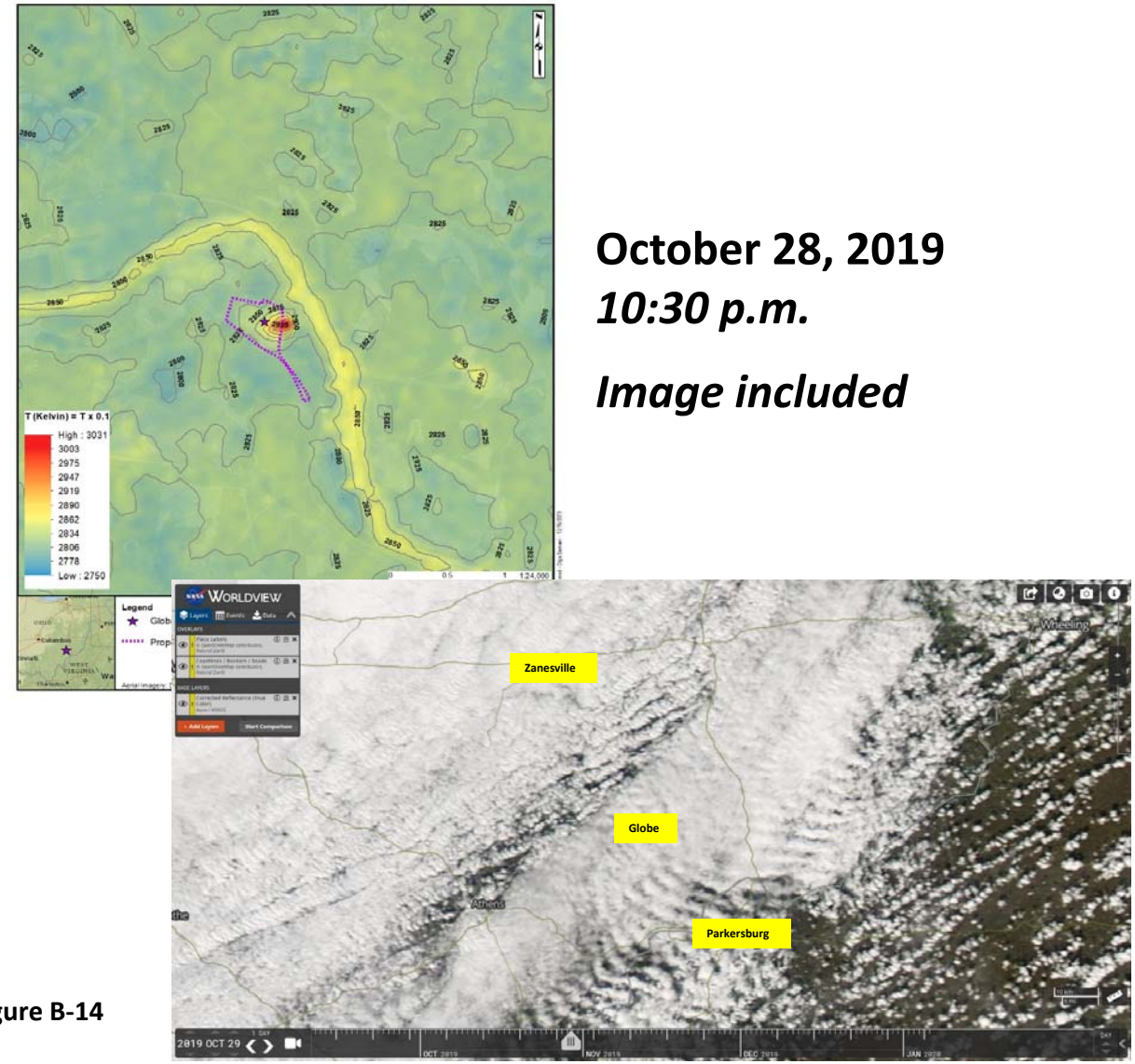


Figure B-14

October 28, 2019

10:30 p.m.

Image included