

Technical Memorandum

November 29, 2023

To	CSX Transportation	Tel	
Prepared By	GHD	Email	
Reviewed By	GHD, CSX Transportation	Ref. No.	12628999
Approved By	CSX Transportation	Distributed By	CSX Transportation
Subject	Memo 9 – Summary of Real-Time Air Monitoring Results November 28, 2023, 00:00 to 23:59 Eastern Time Livingston, Kentucky – Train Derailment		

The purpose of this memorandum is to provide CSX Transportation (CSXT) with a summary of the real-time air monitoring activities, results, and observations from real-time air monitoring being performed at the location of a train derailment, and subsequent fire near the town of Livingston, Kentucky at approximate Mile Post (MP) 138.2 on the Cincinnati Corbin (CC) subdivision (Site). The derailment occurred on November 22, 2023, and involved approximately sixteen (16) mixed freight rail cars containing various commodities including multiple tank cars containing molten sulfur.

This memorandum summarizes the real-time air monitoring data collected between 00:00 and 23:59 Eastern Time (ET) on November 28, 2023 (monitoring period). GHD collected remotely monitored real-time air monitoring data from stationary locations around the perimeter of the Site and within the surrounding community. GHD mobile industrial hygiene (IH) professionals also manually recorded real-time air monitoring data using hand-held instruments throughout the work areas, Site perimeter, and within the surrounding community.

Real-time air monitoring was used primarily as a screening tool to quickly indicate the presence of elevated airborne concentrations of Site-specific constituents of interest (COI) associated with molten sulfur: flammability as a percentage of the lower explosive limit (%LEL), hydrogen sulfide, and sulfur dioxide. Oxygen was monitored in conjunction with flammability. Oxygen rich or deficient environments may shift the LEL or upper explosive limit (UEL) and cause erroneous readings for flammable gases.

The Site-specific COIs were adjusted as required based on Site conditions/observations, and monitoring results. GHD and stakeholders (CSX, United States Environmental Protection Agency, Kentucky Department of Environmental Protection) reviewed the air monitoring data collected over the previous monitoring periods and adjusted the Site-specific COI for the purpose of achieving the objectives outlined in the Air Monitoring Plan (AMP). The following adjustments to the Site-specific COI have been enacted:

- **Effective November 26, 2023, at 09:37 ET:** The COIs associated with a potential fire (total particulate matter (PM₁₀), respirable particulate matter (PM_{2.5}), and nitrogen dioxide) were discontinued following completion of the source area excavation activities.
- **Effective November 26, 2023, at 15:37 ET:** Methanol air monitoring activities related to tank car NATX 303953 were discontinued following the completion of cleaning and purging of tank car NATX 303953.

Real-time air monitoring activities and strategies were performed in accordance with the Site-specific AMP, developed by GHD, reviewed by a certified industrial hygienist (CIH), and provided to CSXT on November 22, 2023. An amendment to the AMP (AMP – Version 2) was provided to CSX on November 23, 2023. AMP –

Version 2 provides air analytical sampling procedures for hydrogen sulfide, and sulfur dioxide and includes Acute Exposure Guideline Levels (AEGL), protective action criteria (PAC), and National Ambient Air Quality Standards (NAAQS) standards and guidelines for community air monitoring for sulfur dioxide. A second amendment including standards, guidelines, and monitoring tactics for methanol based on a revised list of Site-specific COI was provided to CSXT on November 25, 2023 (AMP – Version 3).

Evaluation of readings relative to established action levels were based on an approximate 1-minute average of concentrations measured by the air monitoring instruments. When readings of a COI were sustained at a concentration at, or above, the action level for the appropriate time period (generally one minute), they were considered an exceedance. Conversely, instantaneous readings that dispersed quickly and were not sustained for over one minute represent transient concentrations and are not representative of ambient conditions over a sustained duration.

GHD identified the following Site activities with potential exposures to the Site-specific COI during the monitoring period:

- Tank car inspection, and assessment activities
- Tank car cleaning and purging activities
- Ground disturbance activities

The remotely monitored and manually collected real-time air monitoring data and tactics are summarized below.

Remotely Monitored Real-Time Air Monitoring System

GHD has established a real-time remotely monitored air monitoring system to measure ambient air at locations with potential airborne exposures to the Site-specific COI. GHD deployed instruments **Honeywell AreaRAE monitors (AreaRAE)** equipped with a catalytic bead sensor specific for measuring %LEL, and electrochemical sensors specific for hydrogen sulfide, sulfur dioxide, and oxygen.

Each remotely monitored real-time air monitoring instrument was deployed approximately 4.5 feet above the ground to represent the air quality within the typical breathing zone of personnel in the area. AreaRAE units continuously monitor airborne concentrations of COI and using radio telemetry transmit instantaneous readings (approximately every 20-60 seconds) to a host computer for simultaneous monitoring from a central location.

During the monitoring period, GHD maintained four (4) stationary air monitoring locations, the locations of the stationary meters are described below:

- **Location 2: AreaRAE 02056** – Rail Car Staging
- **Location 4: AreaRAE 02103** – Residential Property
- **Location 6: AreaRAE 01871** – Rail Car Staging Area (North)
- **Location 7: AreaRAE 01234** – Rail Car Staging Perimeter (South)

Remotely monitored real-time air monitoring locations are shown on Figure 1. During this monitoring period, the remotely monitored air monitoring system recorded 73,628 real-time air monitoring readings for sulfur dioxide, %LEL, hydrogen sulfide, and oxygen. The details of each location, monitoring period, and a summary of the remotely logged monitoring data are summarized in Table 1.

Table 1 *Remotely Monitored Real-Time Air Monitoring Data Summary*

Location / Meter ID	Total Number of Readings ¹	COI Number of Readings Above Action Level (Action Levels) ²
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		SO ₂ (≥0.2 ppm)	% LEL (≥1%)	H ₂ S (≥0.5 ppm)	%Oxygen (≤19.5 or ≥ 23.5%)
Location 2: AreaRAE 02056 – Rail Car Staging	18,643	0	0	0	0
Location 4: AreaRAE 02103 – Residential Property	18,625	0	0	0	0
Location 6: AreaRAE 01871 – Rail Car Staging Perimeter (North)	18,557	0	0	52	0
Location 7: AreaRAE 01234 – Rail Car Staging Perimeter (South)	17,803	0	0	0	0
Definitions: COI – Constituent of interest SO ₂ – Sulfur dioxide LEL – Lower explosive limit H ₂ S – Hydrogen sulfide ppm – Parts per million % – percent ≥ – greater than or equal ≤ – less than or equal ET – Eastern time					
Notes: 1. AreaRAE units continuously monitor airborne concentrations of COI and transmit instantaneous readings (approximately every 20-60 seconds) to a computer for simultaneous monitoring using radio telemetry. 2. The evaluation of airborne concentrations relative to the established action levels for the associated COI were based on the approximate one-minute average. As such, the number of readings displayed may have represented transient concentrations but may not represent a one-minute action level exceedance.					

Manually Collected Real-Time Air Monitoring Data

A GHD mobile teams manually collected real-time air monitoring data at the perimeter of the work areas, inside active work areas, and in the surrounding community. The manually collected real-time air monitoring data was collected at breathing zone height (approximately 4.5 feet) using handheld instruments. The data collected from these handheld devices was logged into an electronic handheld data collection device. The purpose of the manually logged data was to characterize exposures in real-time during the various operations throughout the Site, as well as identify any potential fugitive emissions related to mitigation activities.

GHD used handheld **Honeywell MultiRAE** (MultiRAE) instruments to measure airborne concentrations of the Site-specific COI. Each MultiRAE was equipped with catalytic bead sensor specific for %LEL, and electrochemical sensors specific for sulfur dioxide, hydrogen sulfide, and oxygen.

GHD mobile teams logged over 300 real-time air monitoring readings during the monitoring period. The manually collected real-time air monitoring data locations are shown on Figure 1. A summary of the manually logged data for the monitoring period is provided below in Table 2.

Table 2 Manually Logged Real-Time Air Monitoring Data

COI	Action Level ¹	Reading Type	Result
Hydrogen Sulfide	≥0.5 ppm	Number of Readings	300
		Number of Readings Above Action Level	1
		Maximum Reading	1.1 ppm
Sulfur Dioxide	≥0.2 ppm	Number of Readings	280
		Number of Readings Above Action Level	0
		Maximum Reading	<0.1 ppm
%LEL	≥1% LEL	Number of Readings	299
		Number of Readings Above Action Level	0
		Maximum Reading	<1%
Oxygen	≤19.5% or ≥23.5%	Number of Readings	300
		Number of Readings Above Action Level	0

Definitions:

COI – Constituent of interest

LEL – Lower explosive limit

ppm – Parts per million

% – percent

mg/m³ – milligrams per cubic meter

≥ – greater than or equal

≤ – less than or equal

Notes:

1. The evaluation of airborne concentrations relative to the established action levels for the associated COI were based on the approximate one-minute average.

Real-Time Air Monitoring Data Evaluation and Summary of Results

The **remotely monitored** real-time air monitoring data for the monitoring period indicated the following:

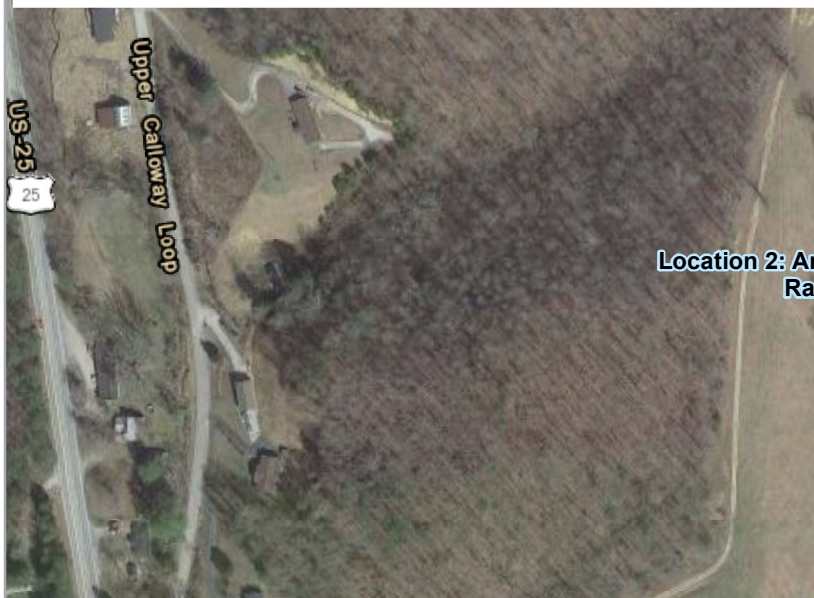
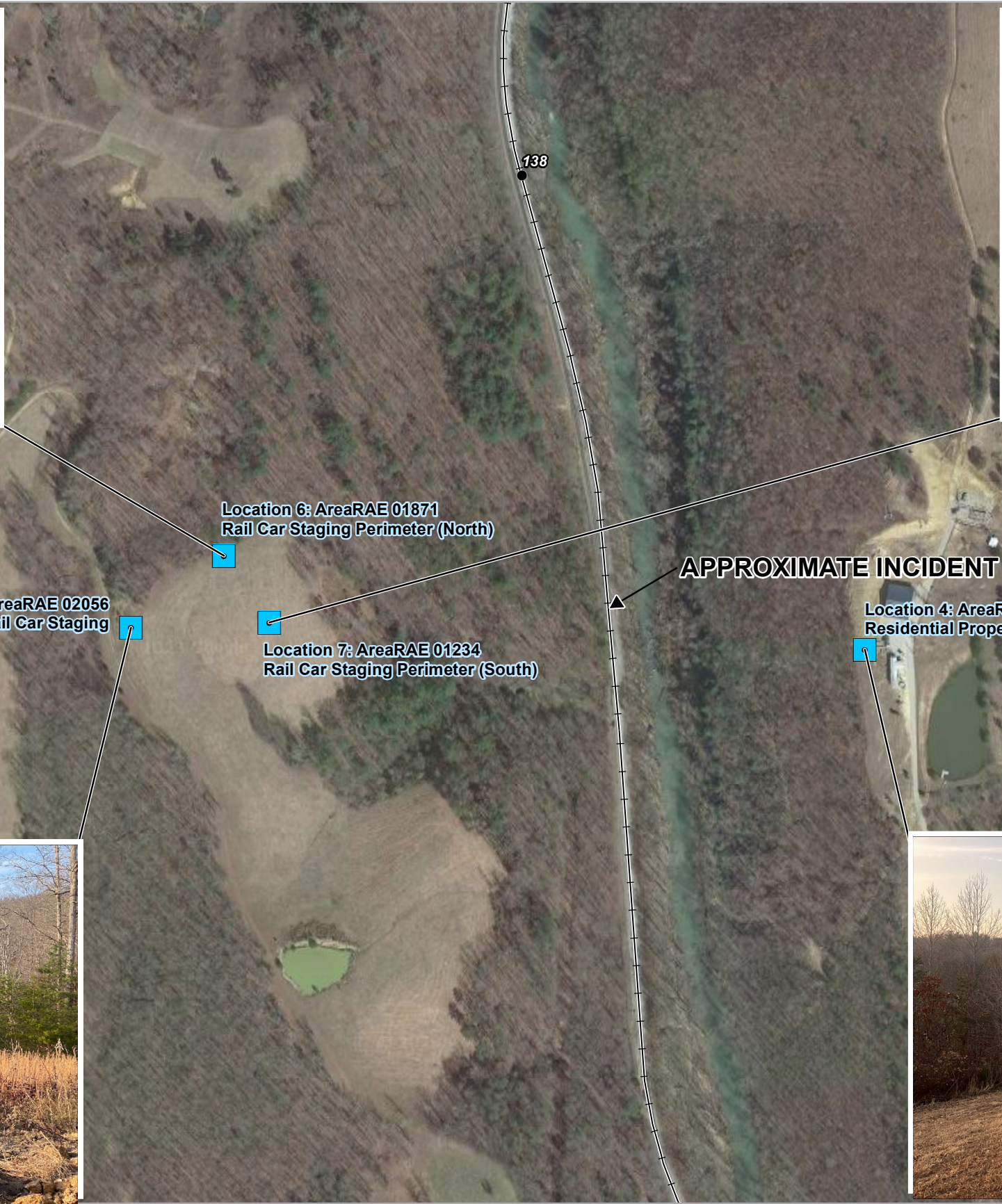
- **Hydrogen Sulfide (Action Level 0.5 ppm)**
 - Location 6 AreaRAE 01871: Between 03:41 and 20:29 ET, 52 readings were documented above the action level of 0.5 ppm at the Staging Area North. Due to a damaged seal on the tank car's pressure release excess vapors were instead vented through the manway of the tank car. The readings dispersed quickly and were not sustained over the approximate averaging period of 60-seconds. As such, the readings were not representative of ambient conditions over a sustained duration and did not qualify as an action level exceedance as defined in the AMP – Version 3. However, as a proactive measure, mitigation measures were implemented when readings were detected above 0.5 ppm. These measures included:
 - Personnel in the work area were notified of the vapors releasing and instructed to stay upwind of the tank car during work activities.
 - Continuous handheld real-time air monitoring was conducted on the south side of the tank car where personnel had the potential to be present.
- **Sulfur Dioxide (Action Level of 0.2 ppm)**
 - No sulfur dioxide readings were documented above the action level.
- **%LEL (Action Level of 1% LEL)**
 - No %LEL readings were documented above the action level.
- **Oxygen (Normal Range 19.5-23.5%)**
 - No oxygen readings were documented outside the normal range.

The **manually collected** real-time air monitoring data for the monitoring period indicated the following:

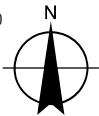
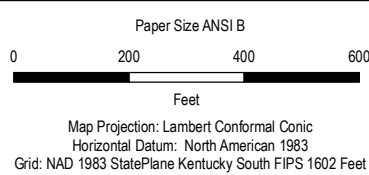
- **Hydrogen Sulfide (Action Level 0.5 ppm)**
 - At 22:47 ET one (1) reading was documented above the action level of 0.5 ppm; this was within the staging area near tank car SHQX 8050.
 - Personnel were advised to stay upwind of the tank car.
- **Sulfur Dioxide (Action Level of 0.2 ppm)**
 - No sulfur dioxide readings were documented above the action level.
- **%LEL (Action Level of 1% LEL)**
 - No %LEL readings were documented above the action level.
- **Oxygen (Normal Range 19.5-23.5%)**
 - No oxygen readings were documented outside the normal range.

Quality Assurance and Quality Control

The information contained in this memorandum will be considered preliminary, as a final Quality Assurance / Quality Control (QA/QC) of the data has not been completed. At the completion of the project, a report will be prepared in which the data collected through real-time air monitoring will be compiled, summarized, and reported to CSXT. Data contained in the final report will have been through the final QA/QC process, will be reviewed by a GHD Certified Industrial Hygienist (CIH), and will be considered final.



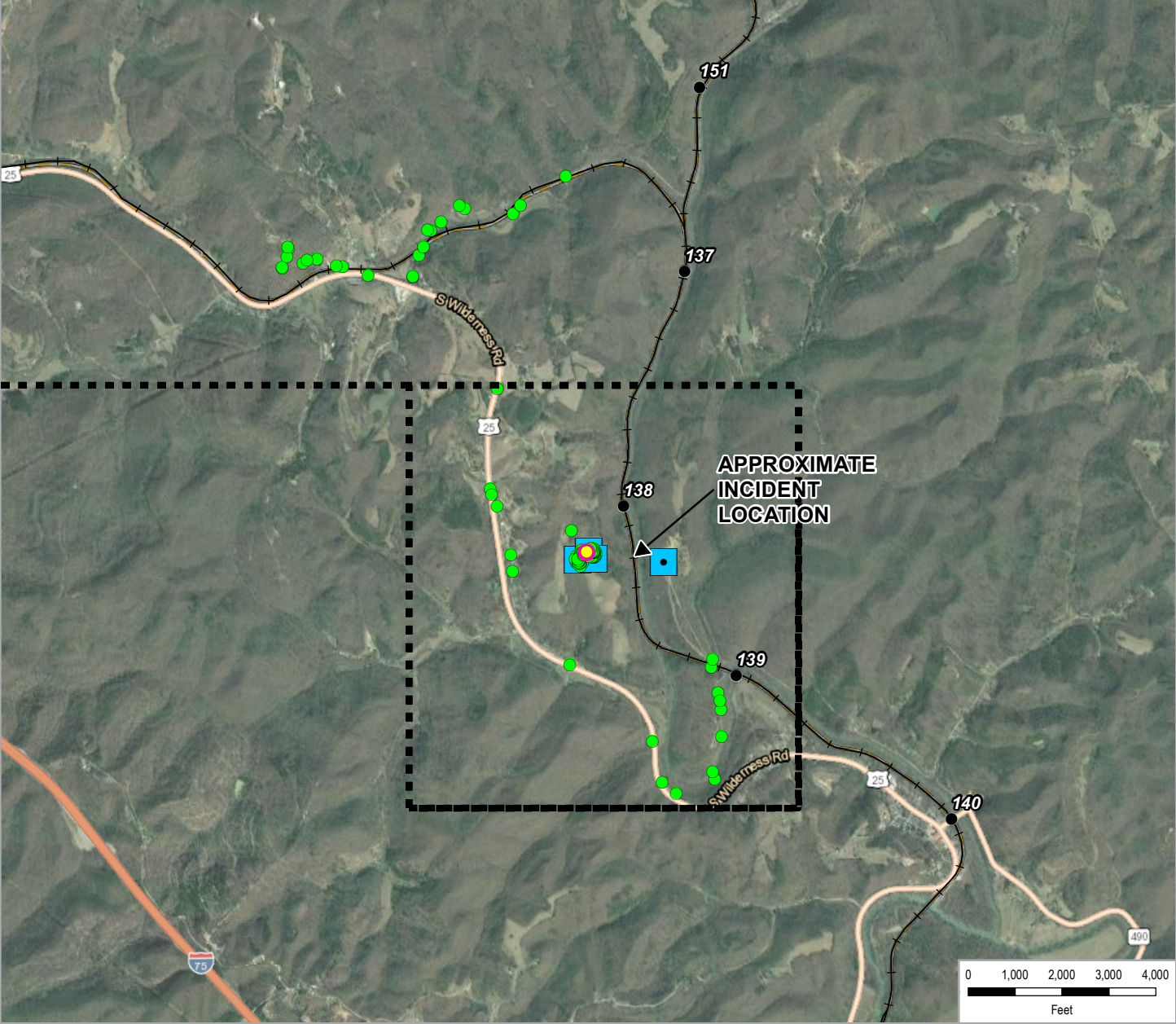
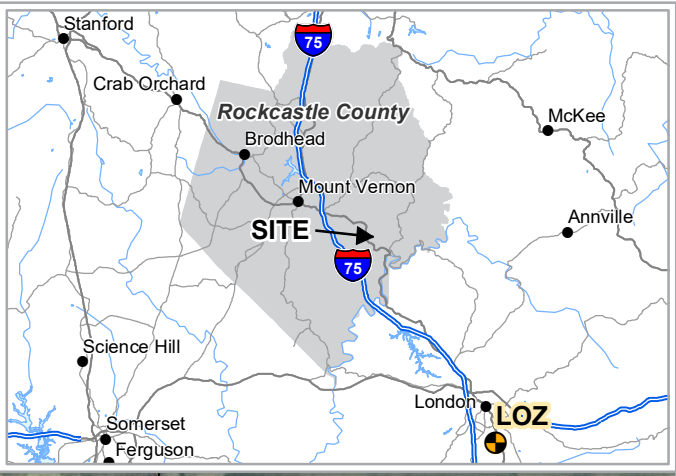
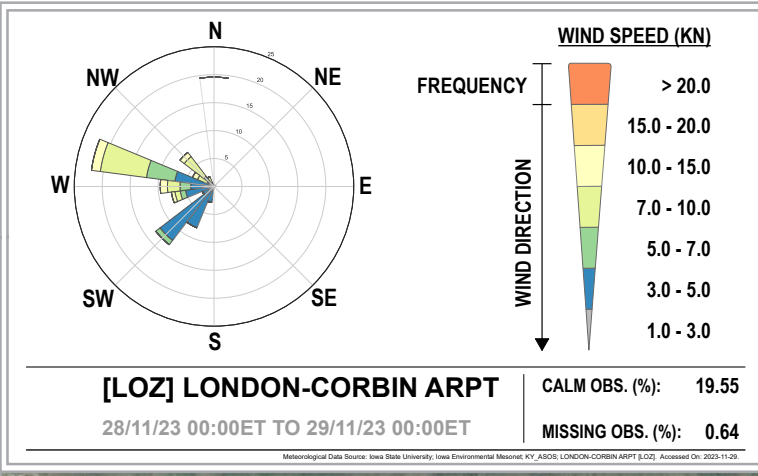
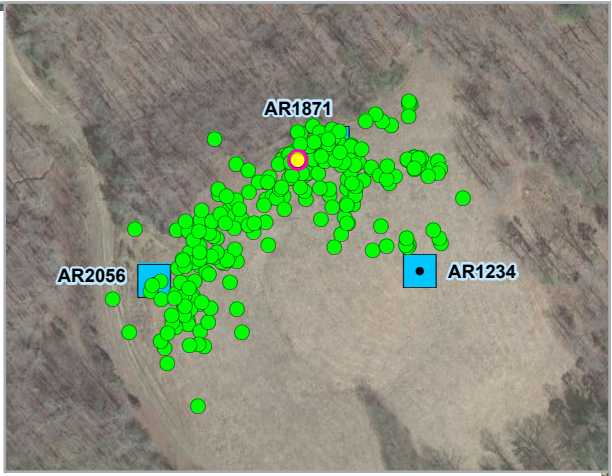
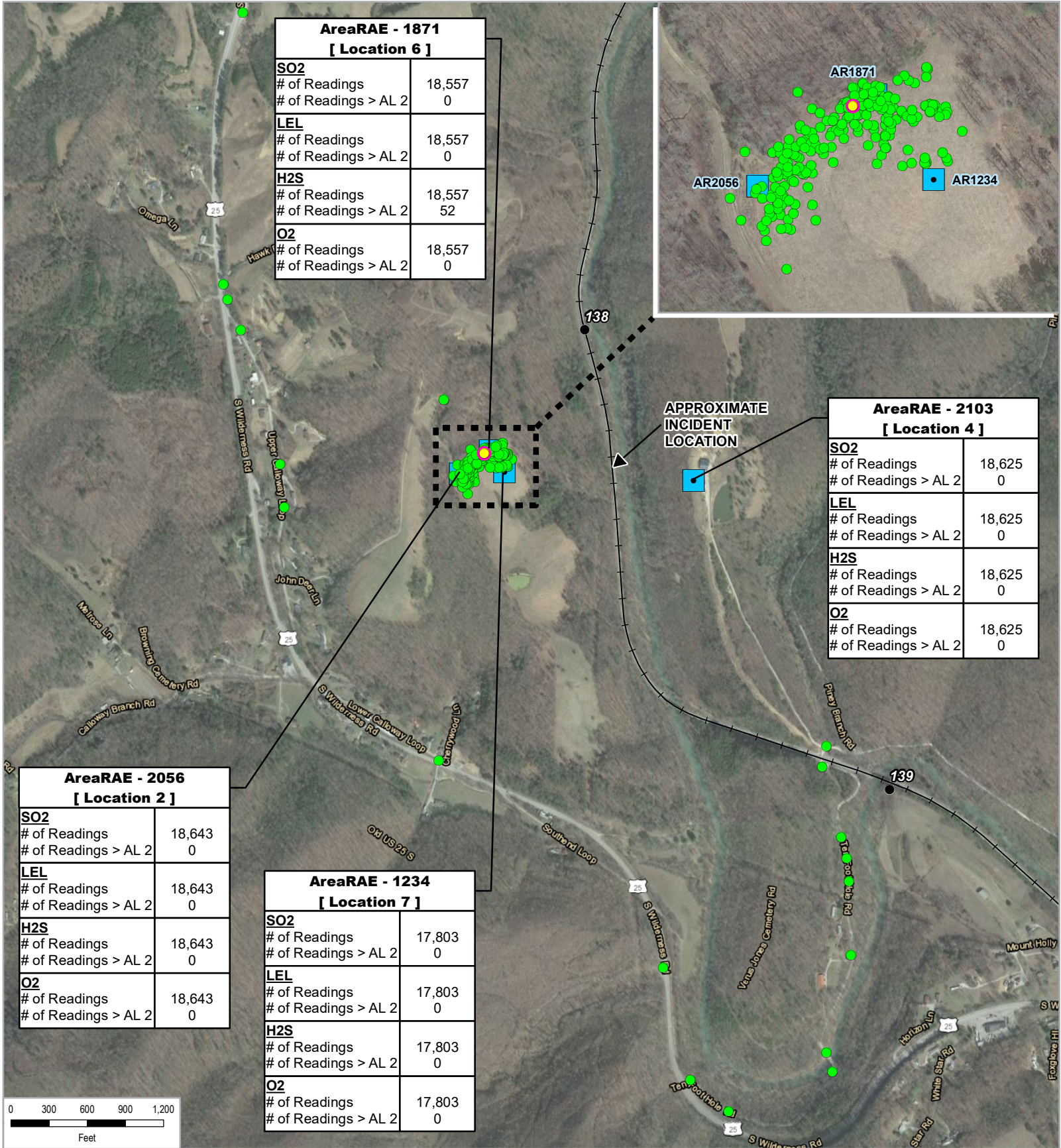
- Legend
- Stationary Monitoring Location (4)
 - Mile Post
 - Track Centerline



CSXT FIRE
CINCINNATI CORBIN SUB - MP 138.2
LIVINGSTON, KENTUCKY

2023/11/26 - 21:00 (ET)
AREARAE DEPLOYMENT LOCATIONS

Project No. 12628999
Date Nov 27, 2023



Legend

Real Time Air Monitoring Location (Above Action Level) (1)

Real Time Air Monitoring Location (Below Action Level) (299)

Stationary Monitoring Location (4)

Real Time Methanol Monitoring Location (Above Action Level) (0)

Real Time Methanol Monitoring Location (Below Action Level) (0)

Weather Station (LOZ)

Mile Post

Track Centerline

NOTES:

1. > AL = Above Action Level 2

2. Action Level for Hydrogen Sulfide is ≥ 0.5 ppm

3. Action Level for Sulfur Dioxide is ≥ 0.2 ppm

4. Action Level for Methanol is ≥ 100.0 ppm

5. Action Level for LEL is ≥ 1.0 %

6. Action Level for PM2.5 is ≥ 2.5 mg/m3

7. Action Level for PM10 is ≥ 5.0 mg/m3

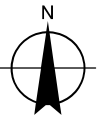
8. Action Level for Oxygen is $\leq 19.5\%$ or $\geq 23.5\%$

Paper Size ANSI B

Map Projection: Lambert Conformal Conic

Horizontal Datum: North American 1983

Grid: NAD 1983 StatePlane Kentucky South FIPS 1602 Feet



CSXT FIRE

CINCINNATI CORBIN SUB - MP 138.2

LIVINGSTON, KENTUCKY

2023/11/28 - 00:00 TO

2023/11/28 - 23:59 (ET)

AIR MONITORING RESULTS SUMMARY

Project No. **12628999**

Date **Nov 29, 2023**

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Print date: 29 Nov 2023 - 16:37

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Meteorological Data Source: Iowa State University; Iowa Environmental Mesonet; ASOS Network; North Dakota ASOS; GAF Grafton; Hutson Field Airport.