



TONTITOWN, ARKANSAS AIR SAMPLING STUDY

May 2, 2025 to May 12, 2025

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Prepared on Behalf of:
Arkansas Department of Energy and Environment

Prepared by:
CTEH, LLC
5120 Northshore Drive
North Little Rock, AR 72118
501-801-8500

EXECUTIVE SUMMARY

The residents of Tontitown, Arkansas, have expressed concerns regarding their air quality and the potential for adverse health effects. Previous air assessments identified volatile organic compounds (VOCs) such as acrolein, benzene, carbon tetrachloride, chloroform, and naphthalene above health-based screening levels near the Eco-Vista Landfill (the Landfill), a municipal solid waste (MSW) landfill in the region. Whereas prior data revealed elevated concentrations of these compounds, the emission source(s) could not conclusively be identified.

In response, the Arkansas Department of Energy and Environment (E&E) commissioned a new air quality study through a competitive request for proposal (RFP) process in which CTEH was selected to conduct the work. This study was designed to expand sampling in the community and assess the Landfill's potential contribution to the previously detected VOCs and other potential source(s) in the area. The specific objectives of the study were to:

1. Assess air quality in the Tontitown area, focusing on compounds of potential concern (COPCs) using both real-time and lab-based analytical techniques.
2. Determine if there was contribution of any detected COPCs from the Landfill.
3. Provide air sampling data suitable for public health risk assessment.

From May 2 to May 12, 2025, air sampling was performed at locations near the Landfill fenceline, surrounding community, and background locations. The study also incorporated fixed location and roaming odor assessments, real-time air monitoring, and a community hotline to facilitate responsive air sampling. The field teams collected: 215 24-hour air samples for volatile organic compounds (VOCs), 165 8-hour air samples for hydrogen fluoride, 30 1-hour air samples for VOCs, 1,286 odor assessments, and 4,411 real-time air measurements for benzene, hydrogen sulfide, lower explosive limit, oxygen, sulfur dioxide, and VOCs. Meteorological data were concurrently collected to assess wind patterns and classify sampling locations as upwind, downwind, or crosswind from the Landfill. Statistical modeling was used to analyze the concentration gradients of COPCs relative to wind direction and proximity to the Landfill.

Key Findings

There were 36 compounds detected out of 50 compounds (49 VOCs and hydrogen fluoride) tested in this study. Fourteen compounds were never detected. The compounds detected were classified into the following categories related to the Landfill possibly contributing to the measured concentrations:

- **Contribution most likely from Landfill:** No compounds met the criteria for this category.
- **Contribution likely from Landfill:** Two compounds (benzene and ethylbenzene) were classified in this category due to their concentration gradients and downwind and background concentrations. All detected concentrations were within ranges observed in national ambient air.

- **Contribution possibly from Landfill:** Nine compounds were classified in this category, and all detections were within range of concentrations observed in national ambient air.
- **Contribution not likely from Landfill – possibly from another emission source(s):** Six compounds were classified as in this category based on higher concentrations in background than near fenceline locations.
- **Contribution not likely from Landfill – not distinguishable from background air:** Nineteen compounds were classified in this category.

Importantly, all compounds determined as contributions likely or possibly from the Landfill were similar concentrations that Americans breathe everyday across the country, even at Landfill fenceline locations. Only one compound in the study, acrylonitrile, was measured above the range of what is observed in ambient air across the U.S. in two locations far from the Landfill and likely to be from another source. CTEH recommends further investigation into potential acrylonitrile sources in the region.

Odors were documented consistently north of the Landfill along Arbor Acres Avenue, which follows the Landfill fenceline, around the South Pianalto sewer lift station, in a parking lot near manholes at a gas station over two miles north of the Landfill, and to the south of the Landfill along Red Oak Drive. Odors were frequently described as biological (decay, rancid) and chemical (rotten eggs, natural gas). However, many odor events were spatially associated with the sewer system, and CTEH recommends further investigations into possible compounds volatilizing from the sewage in the Tontitown community.

The study provides evidence that there was contribution likely from the Landfill to benzene and ethylbenzene concentrations near the Landfill fenceline. The Landfill's contributions to benzene and ethylbenzene concentrations in the community are in the parts per trillion range. There was contribution possibly from the Landfill to concentrations of nine other compounds, but the contribution cannot be statistically confirmed. Fourteen compounds were never detected, and the other 25 detected compounds appear to be more broadly distributed or associated with another source(s).

Table of Contents

EXECUTIVE SUMMARY.....	ii
LIST OF ABBREVIATIONS AND ACRONYMS.....	viii
DEFINITIONS.....	ix
EXECUTIVE SUMMARY	2
1.0 INTRODUCTION	1
2.0 OBJECTIVES.....	1
3.0 METHODS.....	2
3.1 Identifying Compounds of Concern.....	2
3.2 Air Sampling Locations	2
Figure 1: Map of new air sampling locations compared to locations in the April 2024 air study.....	3
3.2.1 Air Sampling and Real-Time Air Monitoring.....	3
3.2.2 Meteorological Data	4
3.3 Comparing to Concentrations in U.S. Background Ambient Air.....	4
3.4 Statistical Analysis.....	4
4.0 MAIN FINDINGS.....	5
4.1 Statistical Analysis Results	6
4.1.1 Compounds at Fenceline, Community, and Background Locations	6
4.1.2 Compounds along the Haul Route Compared to not along the Haul Route	6
4.1.3 Compounds on Weekdays Compared to Weekends	7
4.2 Classification of Compounds	7
4.2.1 Contribution Most Likely from Landfill.....	7
4.2.2 Contribution Likely from Landfill.....	7
4.2.3 Contribution Possibly from Landfill.....	9
4.2.4 Contribution Not Likely from Landfill- Compound Levels Possibly from Another Emission Source(s)	9
4.2.5 Contribution Not Likely from Landfill- Compound Levels Not Distinguishable from Background	10
4.2.6 Not Detected in Any Samples	10
4.3 Odors.....	10
5.0 DISCUSSION AND LIMITATIONS	13
6.0 CONCLUSIONS	14
7.0 REFERENCES	15

Appendices

Appendix A	Detailed Methods
Appendix B	Detailed Results
Appendix C	Tables
Appendix D	Figures
Appendix E	Daily Wind Analysis
Appendix F	Scatterplots of Concentrations by Distance from the Landfill by Wind Direction and Operations with Adjusted Trendlines from Model 1
Appendix G	Quality Assurance Project Plan (QAPP)

List of Tables in Appendix C

Table 1	Fixed Analytical Air Sampling Locations.....	C1
Table 2	Fixed Odor Observation Locations.....	C2
Table 3	Summary of meteorological data during the Tontitown, AR air study from May 2 to May 12, 2025	C2
Table 4	Number of odor surveys conducted in Tontitown, AR from May 2 to May 12, 2025	C3
Table 5	Summary of Fixed Station Real-Time Monitoring Results.....	C3
Table 6	Summary of Roaming Real-Time Monitoring Results	C3
Table 7	Comparison of detected COPCs in downwind fenceline and community locations to upwind, crosswind, and background locations for 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025	C4
Table 8	Linear mixed model 1 results for benzene.....	C6
Table 9	Linear hypothesis tests for benzene using the adjusted linear mixed model in Table 8	C6
Table 10	Linear mixed model 1 results for ethylbenzene.....	C7
Table 11	Linear hypothesis tests for ethylbenzene using the adjusted linear mixed model in Table 10	C7
Table 12	Linear mixed model 2 results for benzene.....	C8
Table 13	Linear hypothesis tests for benzene using the adjusted linear mixed model in Table 12	C8
Table 14	Linear mixed model 2 results for ethylbenzene.....	C8
Table 15	Linear hypothesis tests for ethylbenzene using the adjusted linear mixed model in Table 14	C9
Table 16	Comparison of detected COPCs in locations along the haul route to the Landfill compared to locations not along the haul route and in background for 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025	C10

Table 17	Comparison of detected COPCs on weekdays compared to weekends and by location and wind direction for 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025.....	C11
Table 18	Summary of compounds with different concentrations when the Landfill was not accepting waste and the working face was covered on weekends compared to when it was accepting waste on weekdays in 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025	C13
Table 19	Summary of criteria for classification of compounds	C14
Table 20	Summary of responses to hotline complaints and deployment of 1-hour air samples in the Tontitown, AR air sampling study May 2, to May 12, 2025.....	C17
Table 21	Summary of odor surveys conducted at fixed locations in Tontitown, AR from May 2 to May 12, 2025.....	C19
Table 22	Summary of odor surveys conducted at roaming locations in Tontitown, AR from May 2 to May 12, 2025.....	C20
Table 23	Odors detected during roaming odor survey locations in Tontitown, AR from May 2 to May 12, 2025.....	C21
Table 24	Summary of odor surveys conducted during responses to hotline complaints in Tontitown, AR from May 2 to May 12, 2025.....	C23
Table 25	Summary of odor surveys conducted during deployment of 1-hour air samples at locations with prior odors in Tontitown, AR from May 2 to May 12, 2025	C24
Table 26	Comparison of detected VOCs that were determined to be COPCs in 1-hour air samples collected in locations where responses to a hotline complaints were conducted compared 1-hour and 24-hour samples collected at the Landfill’s fenceline and 24-hour background fixed air samples collected consecutively from May 2 to May 12, 2025.....	C25

List of Figures in Appendix D

Figure 1	Map of potential sources of air emissions from facilities permitted by Arkansas Department of Energy and Environment in relation to reported community complaints.....	D1
Figure 2	Map of fixed 24-hour sampling locations for COPCs that are VOCs	D2
Figure 3	Map of fixed 24-hour sampling locations for measuring hydrogen fluoride.....	D3
Figure 4	Map of fixed locations for odor surveys and real-time air monitoring	D4
Figure 5	Map of locations investigated as potential odor sources	D5
Figure 6	Map of roaming locations where odor surveys and real-time air measurements were collected.....	D6
Figure 7	Map of 1-hour air sampling and odor assessments in response to hotline complaints	D7
Figure 8	Map of one-hour air sampling and odor assessments for days when a hotline complaint was not received	D8
Figure 9	Fixed locations where odor surveys were conducted and odors detected in Tontitown, AR from May 2 to May 12, 2025	D9
Figure 10	Roaming locations where odor surveys were conducted and odors detected in Tontitown, AR from May 2 to May 12, 2025.....	D10
Figure 11	Locations where odors were observed in Tontitown, AR from May 2 to May 12, 2025.....	D11
Figure 12	Location of two 1-hour samples collected on May 4, 2025 where 1,2-dichloroethane was detected along Red Oak Drive south of the Landfill	D12

List of Abbreviations and Acronyms

ACRONYM/ ABBREVIATION	COMPLETE NAME/ PHRASE
ATSDR	Agency for Toxic Substances and Disease Registry
COPC	Compound of Potential Concern
CSM	Conceptual Site Model
CTEH	Center for Toxicology and Environmental Health, LLC
LEL	Lower Explosive Limit
MDL	Method Detection Limit
ppb	Parts per billion
ppt	Parts per trillion
PID	Photoionization Detector
QAPP	Quality Assurance Project Plan
RPD	Relative Percent Difference
RSL	Regional Screening Level
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TIC	Tentatively Identified Compound
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

Definitions

The following terms, as used in this report, are defined for clarity and readability.

TERM	DEFINITION
Air sampling	The process of collecting samples of air to identify and quantify airborne compounds like gases.
Source	Specific, identifiable points of air emission discharges.
Evacuated canister	A sealed, leak-free container that has had air removed to create a vacuum. The canisters are used to collect whole-air samples. The vacuum allows ambient air to be drawn into the canister when the valve is opened.
Sewer Lift Station	A mechanical system that pumps wastewater or sewage from lower elevations to higher elevations when gravity flow isn't possible.
Mobile source	Moving sources of emissions (vehicles, equipment).
Parts per billion (ppb)	A unit of concentration of a compound, representing one part of a compound in one billion parts of a total mixture.
Parts per trillion (ppt)	A unit of concentration of a compound, representing one part of a compound in one trillion parts of a total mixture.
Real-time air monitoring	Immediate and continuous measurements of air concentrations using handheld equipment.
Statistically significant	Indicates whether the results of a statistical test of a study question are likely due to a real effect rather than random chance. In this study, an alpha level of 0.05 was used as the threshold for statistical significance; therefore, a statistical test resulting in a <i>p</i> value at or below 0.05 indicates a statistical difference.
95% Upper confidence limit	The highest value in a range that, with 95% confidence, the true value would not exceed if the sampling process was repeated many times.

1.0 INTRODUCTION

In recent years, the residents of Tontitown, Arkansas, have raised air quality and health concerns. There are multiple mobile sources and state-regulated point sources near the complaint area (**Figure 1**). The closest upwind source to a cluster of odor complaints is the Eco-Vista Landfill, a Waste Management active municipal solid waste facility at 2210 Waste Management Drive in Springdale. The Arkansas Department of Energy and Environment (E&E) Division of Environmental Quality (DEQ) issues and enforces solid waste, air, and stormwater permits for this facility.

On January 23, 2023, the Arkansas Department of Health (ADH) Chronic Disease Cluster Investigation Team found no excess cancers in zip code 72762, which includes Tontitown (ADH, 2023, 2024b). In December 2023, E&E requested National Guard assistance for air testing; the 61st Civil Support Team detected possible sulfur dioxide and advised further sampling (Thomen, 2023). On February 5-8, 2024, CTEH personnel conducted an air quality assessment, which included collection of air samples for laboratory analysis of hydrogen sulfide, sulfur dioxide, and volatile organic compounds (VOCs). During this assessment, both CTEH and the National Guard conducted air monitoring. While the National Guard again reported possible sulfur dioxide using their air monitors, CTEH air monitoring did not result in detectable levels of sulfur dioxide, and laboratory analysis for CTEH samples showed no sulfur dioxide or hydrogen sulfide. However, benzene and acrolein were detected in CTEH air samples above the EPA Resident Air Regional Screening Levels (RSLs) which are developed for chronic exposure (CTEH, 2024b).

Following these findings, E&E retained CTEH for expanded monitoring with ADH input. From April 28 to May 1, 2024, CTEH personnel conducted air sampling at 14 locations. Benzene, acrolein, and carbon tetrachloride were detected above RSLs at upwind, crosswind, downwind, and background locations. Chloroform and naphthalene were also detected above RSLs in limited samples (CTEH, 2024a). In July 2024, ADH concluded the data did not identify a source and noted other potential sources may contribute, recommending more comprehensive testing (ADH, 2024a).

In January 2025, E&E issued a Request for Proposals (RFP) for further study. In April 2025, CTEH was retained to conduct an air sampling study informed by past investigations, community complaints, and potential emissions sources, with the goal of identifying contaminant origins and odor sources. This report describes the findings of the CTEH May 2025 air study.

2.0 OBJECTIVES

The primary objective of the air study was to determine if the Landfill is contributing to the compounds of potential concern (COPCs) detected during previous sampling events in Tontitown. Secondly, the study aimed to characterize where odors were occurring and describe the type and intensity of the odors. To do this there were three objectives:

Objective 1. Collect air samples in Tontitown, Arkansas to quantify concentrations of COPCs at sampling locations selected based on community complaints, past air quality studies, known emission sources, and

Landfill permit records. The study also used real-time monitoring, odor surveys, and quick-response sampling when odors or health complaints were reported.

Objective 2. Use the results of the air study to determine the contribution of the Landfill to COPCs found in the fenceline and community air samples. The air concentrations from the study were analyzed statistically to look for patterns while considering wind direction and other factors like the haul route and days the Landfill working face was covered.

Objective 3. Collect and provide high-quality air sampling data that can be used to examine potential exposures in a public health risk assessment.

3.0 METHODS

The Tontitown air sampling study was designed to assess whether the Landfill may be contributing to air quality concerns in the community. The study followed a source-to-outcome model, which looked at what compounds were present at the Landfill fenceline, whether those same compounds were found in the nearby community and normal background air, and how the levels compared across these areas (USEPA, 2004a, 2004b, 2006). Additional method details are provided in **Appendix A – Detailed Methods** and the **QAPP**.

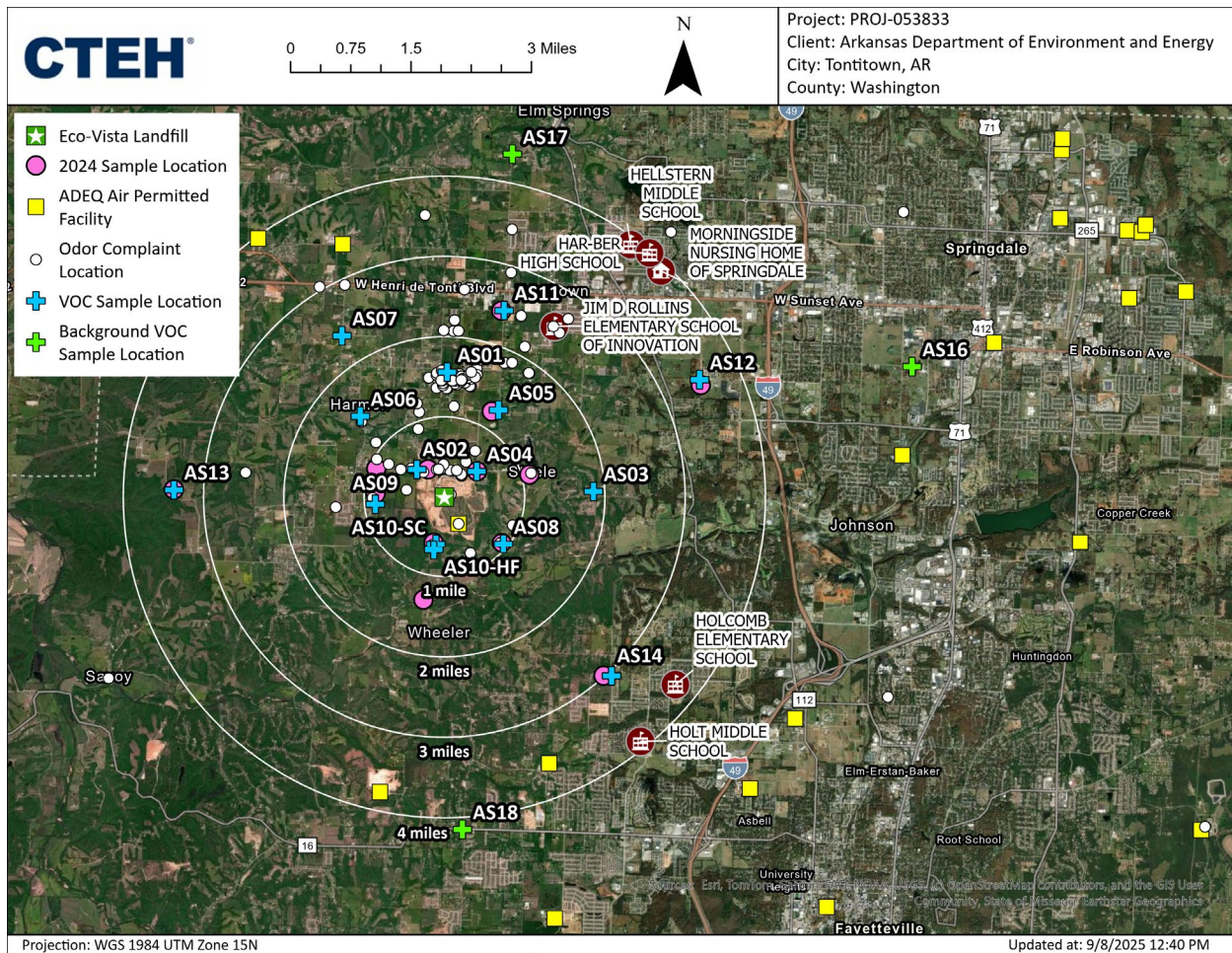
3.1 Identifying Compounds of Concern

First, CTEH personnel worked with E&E to develop a list of “compounds of potential concern” (COPCs) based on Landfill permit records, emissions inventories, past air sampling data, and EPA’s standard list of volatile organic compounds (VOCs). CTEH and E&E narrowed the list to compounds associated with landfill emissions with established health guidelines values.

3.2 Air Sampling Locations

CTEH consulted with E&E and ADH to select 14 air sampling locations covering areas within three miles of the Landfill based on past complaints, Landfill operations, truck haul routes, and air modeling results. Ten of the fourteen prior sampling locations from the CTEH April 2024 air study were selected so that air concentrations at those locations could be analyzed with earlier sampling studies (**Figure 1**). Four additional community locations (AS01, AS03, AS06, and AS07) and four background sites (AS15, AS16, AS17, and AS18) farther than four miles away from the Landfill were selected for comparison to the community and fenceline locations.

Figure 1 Map of new air sampling locations compared to locations in the April 2024 air study



3.2.1 Air Sampling and Real-Time Air Monitoring

CTEH personnel conducted multiple air quality assessments during this study to capture regular and intermittent air conditions in Tontitown. Fixed location air sampling was conducted for 49 VOCs using evacuated canisters (Entech Instruments 6L Silonite™ canisters). Evacuated canisters were used to sample air continuously for 24-hour periods at 3 fenceline, 11 community, and 4 background sites for 11 consecutive days starting on the morning of May 2. The last sample was deployed on the morning of May 12 and picked up on the morning of May 13, 2025 (**Appendix C, Table 1** and **Appendix D, Figure 2**). The sampling period covered 7 weekdays, 2 Saturdays, and 2 Sundays. Fixed location air sampling for hydrogen fluoride was conducted at 4 fenceline and community locations and 1 background location for 11 consecutive 24-hour periods (**Appendix C, Table 1** and **Appendix D, Figure 3**). CTEH personnel also conducted real-time air monitoring using handheld instruments for VOCs, benzene, atmospheric flammability measured as a percentage of the lower explosive limit (%LEL), oxygen, sulfur dioxide, and hydrogen sulfide. A CTEH team trained to detect odors using nasal ranger olfactometer instruments conducted odor surveys at fixed and roaming locations (**Appendix C, Table 2** and **Appendix D, Figure 4**).

CTEH worked with E&E to set up a community hotline allowing residents to report odors or health issues during the study. For community complaints in areas within three miles of the Landfill, the CTEH field team responded to conduct real-time monitoring, odor surveys, and short-term 1-hour air sampling. Source investigations were conducted in the area to determine potential emissions or odor sources (**Appendix D, Figure 5**).

3.2.2 Meteorological Data

The CTEH field team set up a weather station near the Landfill to record wind direction, wind speed, temperature, and humidity every 15 minutes. Wind data were used to classify sample locations as upwind, downwind, or crosswind of the Landfill.

3.3 Comparing to Concentrations in U.S. Background Ambient Air

The Environmental Protection Agency's (EPA) Air Quality System (AQS) collects air concentrations of VOCs in areas across the country that represent ambient air conditions or background air (USEPA, 2025a) . AQS air concentrations in all states from 2020 to 2024 were used for comparison in this study. The U.S. 24-hour air samples maximum concentrations were used to compare to the 24-hour air sample maximum concentrations in this study. U.S. annual average concentrations and the range of annual average concentrations were provided for context. Not every state collects the same list of VOCs; therefore, the number of states included in the comparison varies by compound.

3.4 Statistical Analysis

Sampling locations were grouped into fenceline locations (AS02, AS04, AS10), community locations within three miles of the Landfill (AS01, AS03, AS05-AS09, AS11-AS14), and background locations more than four miles from the Landfill (AS15, AS16, AS17, AS18) (**Appendix D, Figure 2**). Sampling locations were also grouped as being along the truck haul route (AS04, AS05, AS11) that dump trucks take to deliver waste to the Landfill and compared to those not along the route. Weekdays and weekends were grouped to represent when the Landfill was accepting waste (via the truck haul route) on the weekdays compared to when the Landfill was not accepting waste and the working face was covered on the weekends. Detailed summary statistics are available in the **Supplemental Spreadsheet** and followed the ATSDR methods for exposure point estimation and 95% upper confidence limits (ATSDR, 2023). Air concentrations were statistically analyzed to:

1. List detected compounds at different locations
 - Fenceline, community, and background locations
 - Truck haul route and not along the haul route locations
 - Weekdays and weekends
2. Describe percent of compound detections and concentration levels
3. Compare concentrations downwind of the Landfill to upwind or background sites

4. Determine how compound concentrations changed with distance from the Landfill
5. Compare compound concentrations when the Landfill was accepting waste (weekdays) to not accepting waste and the working face was covered (Saturdays and Sundays)
6. Determine whether compound concentrations along the truck haul routes differed from other areas not on the route

Each detected compound was classified into one of the following groups (listed below) based on the likelihood of the Landfill contributing to the overall concentration of that compound detected in the Tontitown area. Below is a brief description of the criteria for each classification; detailed descriptions with criteria can be found **Table 13** in the **QAPP**.

Contribution most likely from Landfill: Landfill is permitted to emit the compound, and it was found in both downwind fenceline and nearby community samples. The compound was not present in any background or upwind locations. Compound concentrations have a statistical trend of decreasing concentrations with increasing distance away from the Landfill.

Contribution likely from Landfill: Landfill is permitted to emit the compound, and it was found in both downwind fenceline and nearby community samples. It was not found or found at lower concentrations at background or upwind locations. Compound concentrations have a statistical trend of decreasing concentrations with increasing distance away from the Landfill.

Contribution possibly from Landfill: The compound was found at downwind fenceline and downwind community locations. It also appeared at upwind or background locations, but usually at lower concentrations. A decrease in concentration with increasing distance from the Landfill is present but the trend is not confirmed statistically.

Contribution not likely from Landfill - Compound levels not distinguishable from background: The compound was found at the Landfill fenceline and community locations, but also in background locations at similar concentrations.

Contribution not likely from Landfill - Compound levels possibly from another emission source(s): The compound may be at the Landfill fenceline but was found in community locations. The detections may be near another potential source within three miles, and the compound may also be present in air from the four background location samples at higher levels than at Landfill fenceline locations.

Not detected in any samples: Compounds were not detected in any sample collected during the study.

4.0 MAIN FINDINGS

Air sampling was conducted from May 2, 2025 to May 12, 2025. There were 215 24-hour air samples collected for volatile organic compounds (VOCs), 165 8-hour air samples for hydrogen fluoride, and 30 1-hour air samples for VOCs. A summary of the weather conditions during the study is included in **Appendix C, Table 3**. There were 1,286 odor assessments completed, and 4,411 real-time air measurements

recorded for benzene, hydrogen sulfide, lower explosive limit, oxygen, sulfur dioxide, and VOCs. Real-time readings did not show the presence of benzene, hydrogen sulfide, lower explosive limit, sulfur dioxide, or VOCs above their respective detection limits (**Appendix C, Tables 4-6** and **Appendix D, Figure 6**). Of the 50 compounds examined upon analytical testing (49 VOCs and hydrogen fluoride), 14 compounds were not detected in 24-hour air samples at any location (1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2,4-trichlorobenzene, 1,2-dibromoethane, 1,2-dichlorobenzene, bromodichloromethane, chlorobenzene, hydrogen fluoride, naphthalene, trichloroethene, and vinyl chloride). There were 36 compounds detected in at least one sampling location and those were further analyzed and classified to determine if the Landfill was contributing to the concentrations of these detected compounds. Odors were consistently detected around the following four locations, which are described in further detail below: Sewer lift station located at 1836 South Pianalto Road, the parking lot of Braich Arrow Express (Phillips 66) gas station, Arbor Acres Avenue, and Red Oak Drive. Detailed results of the study are provided in **Appendix B**, tables in **Appendix C**, figures in **Appendix D**, and maps with wind roses of daily wind analysis in **Appendix E**.

4.1 Statistical Analysis Results

4.1.1 Compounds at Fenceline, Community, and Background Locations

Of 36 detected compounds, 28 (83.3%) detected at downwind fenceline locations were also detected in community and background locations. Eight compounds were not detected at downwind fenceline locations, but were detected at least once in a community or background location (**Appendix C, Table 7**). Compounds detected at fenceline locations were modeled to determine if there was a concentration gradient from downwind fenceline locations that decreased with increasing distance away from the Landfill. Models were also used to determine differences in concentrations between location and wind direction groups. Only benzene and ethylbenzene showed statistically higher concentrations at the downwind fenceline compared to upwind fenceline locations and both were found to have a decreasing concentration gradient from the Landfill fenceline sampling locations (**Appendix C, Tables 8 – 15**). The concentrations for both benzene and ethylbenzene were higher on weekends when the Landfill was not accepting waste and the working face was covered compared to weekdays. Additionally, benzene and ethylbenzene fenceline concentrations were statistically different from community and background, but there was not evidence that the community locations were different from background locations. All benzene and ethylbenzene concentrations detected during the study were within the range of ambient air concentrations across the U.S. including concentrations at downwind fenceline locations. More details about benzene and ethylbenzene are discussed below.

4.1.2 Compounds along the Haul Route Compared to not along the Haul Route

Of the 36 detected compounds along the haul route, 33 (91.6%) were also detected at sampling locations not along the truck haul route (**Appendix C, Table 16**). Three of the 33 compounds were detected along the haul route and in non-haul route locations, but not in background locations. There were no compounds

with evidence of higher concentrations in samples collected along the haul route compared to non-haul route locations, including background locations

4.1.3 Compounds on Weekdays Compared to Weekends

Of the 36 detected compounds, 25 (69.4%) were detected at similar concentrations in all locations regardless of weekday when the Landfill was accepting waste or weekend when they were not accepting waste and the working face was covered. Among the other 11 compounds, there was not a clear pattern between weekdays and weekends (**Appendix C, Table 17**). Using the same model as above, compound concentrations were tested for differences on days when the Landfill was accepting waste compared to when it was not accepting waste and the Landfill's working face was covered. The model tests for on-average differences in weekdays compared to weekends while holding all other variables like location and wind direction constant. Eleven analytes had statistically different concentrations on weekdays compared to weekends. Benzene, ethylbenzene, and m,p-xylenes had statistically higher concentrations on weekends by 0.027 ppb, 0.014 ppb, and 0.006 ppb respectively. Concentrations of the following analytes were statistically lower on weekends compared to weekdays: chloromethane (-0.048 ppb), freon 12 (-0.027 ppb), carbon tetrachloride (-0.006 ppb), methanol (-3.531 ppb), methylene chloride (-0.233 ppb), n-hexane (-0.084 ppb), 2-butanone (-0.070 ppb), and acetonitrile (-0.011 ppb) (**Appendix C, Table 18**).

4.2 Classification of Compounds

Detected compounds were classified into the following categories related to possible contributions from the Landfill. A summary of the criteria met for each classification is in **Appendix C, Table 18**, and the **Supplemental Spreadsheet** provides descriptive statistics by location category (fenceline, community, or background) and wind direction, and comparisons to concentrations in U.S. ambient air.

4.2.1 Contribution Most Likely from Landfill

No compounds were classified as the contribution most likely from Landfill. Each time one of the 36 detected compounds was detected at a fenceline location, it was also detected in at least one background location. Therefore, none of the compounds met this criterion.

4.2.2 Contribution Likely from Landfill

Two compounds, benzene and ethylbenzene, were classified as contribution likely from Landfill; however, this contribution was in the parts per trillion range, and all concentrations detected during the study were within the range of ambient air concentrations across the U.S.

Benzene: Benzene was detected in 100% of all air samples. Average fenceline benzene concentrations were 0.033 ppb higher than concentrations at background locations (**Supplemental Spreadsheet**) and there was a marginal statistical trend of decreasing concentration gradient from the downwind fenceline to background locations (P value=0.055) (**Appendix C, Table 9** and **Appendix F**). The downwind fenceline concentrations were estimated to decrease 0.019 ppb per mile and reach average background concentrations at approximately 1.7 miles from the Landfill fenceline. There was not a trend in upwind

fenceline locations with increasing distance from the Landfill (P value=0.997) (**Appendix C, Table 9**). Average benzene concentrations at fenceline locations downwind of the Landfill were 0.109 ppb higher than upwind fenceline locations (downwind fenceline: 0.235 ppb, upwind fenceline: 0.126 ppb) (**See Supplemental Spreadsheet for averages**). The model found on average statistically higher concentrations of benzene at downwind locations by 0.077 compared to upwind locations (P value=0.029). Average upwind fenceline benzene concentrations (0.126 ppb) were similar to concentrations at background locations (0.127 ppb) and community locations (0.113 ppb) for all wind directions. A second model showed statistically higher concentrations of benzene at downwind fenceline locations compared to downwind background (P value>0.001) and downwind community (P value=0.001), but no evidence of a difference in concentration from downwind community and downwind background locations (P value=0.958) (**Appendix C, Table 13**). Benzene concentrations on weekends were on average 0.026 ppb statistically higher than weekdays (P value=0.014) (**Appendix C, Table 18**). Importantly, the differences described in benzene concentrations are, at most, 0.213 parts per billion (ppb). Average and maximum benzene concentrations at fenceline (avg: 0.16 ppb, max: 0.34 ppb), community (avg: 0.113 ppb, max: 0.77 ppb), and background (avg: 0.127 ppb, max: 0.46 ppb) locations were within the range of benzene concentrations in ambient air across the U.S. (avg: 0.183 ppb, max: 102.56 ppb) (**See Supplemental Spreadsheet for averages**). While the Landfill is permitted to emit benzene, there are multiple mobile sources of benzene emissions in addition to point sources that include but not limited to the burning of fossil fuel through vehicle exhaust, household products like paints or solvents, and cigarette smoke (Harrison et al., 2010; NCI, 2024; USEPA, 2012).

Ethylbenzene: Ethylbenzene was detected in more than 90% of fenceline air samples downwind and crosswind of the Landfill, and between 42%-80% of samples in community and background. Average fenceline ethylbenzene concentrations were 0.015 ppb higher than in background locations (**Supplemental Spreadsheet**) and there was a statistical decreasing concentration gradient from the fenceline to background locations (P value=0.019) (**Appendix C, Table 11**). The fenceline concentrations were estimated to decrease by 0.006 ppb per mile, reaching average background concentrations at approximately 2.7 miles from the Landfill fenceline. There was not a trend in upwind fenceline locations with increasing distance from the Landfill (P value=0.943) (**Appendix C, Table 11**). Average ethylbenzene concentrations measured at fenceline locations downwind of the Landfill were 0.035 ppb higher than upwind fenceline locations (downwind fenceline: 0.056 ppb, upwind fenceline: 0.021 ppb). The model found on average statistically higher concentrations of ethylbenzene at downwind locations by 0.021 ppb compared to upwind locations (P value=0.008) (**Appendix C, Table 11**). Average upwind fenceline concentrations (0.021 ppb) were similar to concentrations at community (0.021 ppb) and background locations (0.021 ppb) for all wind directions. A second model showed statistically higher concentrations of ethylbenzene of 0.036 ppb at downwind fenceline locations compared to downwind background (P value<0.001) and downwind community (P value<0.001), but no evidence of a difference in concentration from downwind community and downwind background locations (P value=0.942) (**Appendix C, Table 15**). Ethylbenzene concentrations on weekends were on average 0.007 ppb statistically higher than weekdays

(P value=0.003). Like benzene, it is important to note all the differences described in ethylbenzene concentrations are in the parts per trillion range. Average and maximum ethylbenzene concentrations at fenceline (avg: 0.036 ppb, max: 0.11 ppb), community (avg: 0.021 ppb, max: 0.16 ppb), and background (avg: 0.021 ppb, max: 0.053 ppb) locations were within the range of average ethylbenzene concentrations in ambient air in the U.S. (avg: 0.053 ppb, max: 41.91 ppb) (**See Supplemental Spreadsheet for averages**). While the Landfill is permitted to emit ethylbenzene, there are multiple mobile and point sources of ethylbenzene emissions that are similar to sources of benzene emissions. These include the burning of fossil fuel through vehicle exhaust, household products like paints, solvents, flooring, and cigarette smoke along with industrial sources (ATSDR, 2010). Figures of modeled concentration gradients are provided in **Appendix F**, and additional detailed results can be found in **Appendix B** and in the **Supplemental Spreadsheet**.

4.2.3 Contribution Possibly from Landfill

Nine compounds were classified as the Landfill possibly contributing to the concentrations in the community: 1,1-difluoroethane, carbon disulfide, ethyl acetate, methylene chloride, propylene, n-heptane, n-hexane, n-pentane, and trans-1,2-dichloroethene. The compounds 1,1-difluoroethane, ethyl acetate, n-heptane, and propylene are not listed on the Landfill's permit but were detected in the May 2024 study (**Appendix C, Table 19**). All compounds showed on average decreasing concentrations from fenceline locations to community and background locations, but these trends were not statistically confirmed. All compounds classified as the contribution possibly from the Landfill were detected within the range of average background levels across the U.S.: 1,1-difluoroethane (study max: 3.0 ppb, U.S. max: 91 ppb), carbon disulfide (study max: 0.21 ppb, U.S. max: 22 ppb), ethyl acetate (study max: 12 ppb, U.S. max: 17.9 ppb), methylene chloride (study max: 7.8 ppb, U.S. max: 772 ppb), propylene (study max: 1.6 ppb, U.S. max: 138.79 ppb), n-heptane (study max: 0.2 ppb, U.S. max: 33.82 ppb), n-hexane (study max: 2.8 ppb, U.S. max: 955 ppb), n-pentane (study max: 4.9 ppb, U.S. max: 553.84 ppb), and trans-1,2-dichloroethene (study max: 0.032 ppb, U.S. max: 6.54 ppb). Figures of modeled concentration gradients are provided in **Appendix F**, and detailed comparisons of study and U.S. concentrations are provided in the **Supplemental Spreadsheet**.

4.2.4 Contribution Not Likely from Landfill - Compound Levels Possibly from Another Emission Source(s)

There were six compounds classified as the contribution not likely from the Landfill and the compound levels are possibly from another emission source(s): isopropanol, styrene, 4-methyl-2-pentanone, acrylonitrile, tetrachloroethene, and tetrahydrofuran. These compounds consistently had higher average concentrations in background locations compared to fenceline and the maximum concentrations were observed at community or background locations (**Appendix C, Table 19** and **Supplemental Spreadsheet**). There were consistently higher percentages of detections in the background and community air samples than the fenceline samples. Isopropanol, styrene, 4-methyl-2-pentanone, tetrachloroethene, and tetrahydrofuran concentrations were in the range of what would be expected in U.S. ambient air.

Acrylonitrile was detected above the maximum concentration detected in 24-hour air samples of background ambient air in the U.S. (3.3 ppb). Once acrylonitrile was detected at 15 ppb at AS18, four miles south and crosswind of the Landfill on May 2, 2025, and at 4.1 ppb at AS11 2.5 miles north and upwind of the Landfill on May 8, 2025.

4.2.5 Contribution Not Likely from Landfill - Compound Levels Not Distinguishable from Background

Nineteen compounds were classified as the contribution not likely from the Landfill and the compound levels were not distinguishable from background air: vinyl acetate, 1,2-dichloropropane, 1,3-butadiene, 1,2-dichloroethane, toluene, methanol, freon 12, chloromethane, carbon tetrachloride, 2-butanone, acetonitrile, freon 113, chloroform, acrolein, m,p-xylenes, 1,2,4-trimethylbenzene, o-xylene, chloroethane, and 1,3,5-trimethylbenzene. These compounds average concentrations were similar in fenceline, community, and background locations (**Appendix C, Table 19**). When only looking at the locations downwind of the Landfill, four compounds were not detected in any air samples collected at fenceline, community, or background locations: 1,2-dichloroethane, 1,3-butadiene, 1,2-dichloropropane, and vinyl acetate. Eighteen of these compounds were compared to concentrations in ambient air across the U.S. and found to have similar concentrations. Methanol was unable to be compared to air in the U.S. because EPA does not measure it in the Air Quality System. Details of this comparison are available in the **Supplemental Spreadsheet**.

4.2.6 Not Detected in Any Samples

Fourteen compounds were not detected in any air sample collected during the study: vinyl chloride, trichloroethene, naphthalene, chlorobenzene, bromodichloromethane, hydrogen fluoride, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,2-dibromoethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1,1-trichloroethane, 1,1-dichloroethene, and 1,1-dichloroethane (**Appendix C, Table 19**). No further analysis was conducted on these compounds.

4.3 Odors

There were 16 calls from community members to the hotline. Among those, 13 resulted in a response to the location of the complaint for real-time air monitoring and odor assessments, and of these, six 1-hour air samples were collected (**Appendix D, Figure 7**). A summary of each air assessment conducted is provided in **Appendix C, Table 20**. There were also odor surveys conducted at fixed stations. A team visited each of the fixed locations along the predetermined route 3-4 times a day (**Appendix C, Table 21**), and while driving the route or on break, the team conducted roaming odor surveys in the area. Roaming odor surveys were not at the predetermined fixed locations but were conducted in the same three-mile radius around the Landfill (**Appendix C, Table 22 and Table 23**). Summaries of odor surveys conducted during responses to hotline complaints are provided in **Appendix C, Table 24 and Appendix D, Figure 7** and during deployment of 1-hour samples not in response to a complaint in **Appendix C, Table 25** (sites of 1-hour samples in **Appendix D, Figure 8**). A total of 1,286 odor surveys were conducted during the study. One-

hour samples collected in response to hotline complaints had fewer detected compounds (24 compounds) than the 24-hour samples, but all compounds detected in response to a complaint were also detected at least once in a background location, except for 1,2-dichloroethane (**Appendix C, Table 26**). However, 1,2-dichloroethane was detected in community locations. These assessments showed consistent odor patterns at four locations (**Appendix D, Figure 9 to Figure 11**):

1. **Lift Station, 1836 S Pianalto Road** – In a residential area northwest of the Landfill. Eight odor assessments (IDs: 26302, 26315, 26321, 26314, 26322, 26250, 26382, and 26293) were performed at or near the lift station, two were completed due to community hotline complaints (IDs: 26382 and 26302) and eight 1-hour samples were collected at seven assessments near the lift station (IDs: 26302, 26315, 26321, 26314, 26322, 26250, 26239) (**Appendix C, Table 20**). Of note, one collocated sample (Sample ID: TOAR0510GB26314CL) collected off the road in front of the lift station on May 10, detected trichloroethene at 0.04 ppb (ID: 26315); this compound was not detected in any other fixed locations with consecutive 24-hour air sampling or in any 1-hour samples including its collocated sample. However, this sample was analyzed outside of its hold time, and due to that it is not clear at this time the relevance of this finding. All VOC concentrations from the 1-hour samples were within concentrations observed in ambient air across the U.S. The team repeatedly noted strong “rotten egg” odors believed to be coming from within the fenceline of the lift station, and the team noted equipment noise associated with the lift station. There was a fixed odor assessment location (NR06) approximately 1,240 feet to the north of the lift station on South Pianalto Road. Out of 84 odor assessments conducted there, two reported odors described as biological (rancid, decay) and sewer (rotten eggs), with D/T of 2-4 and hedonic tone of -4 to -3 indicating an unpleasant offensive odor (**Appendix C, Table 21**).
2. **Phillips 66 Gas Station, 1398 W Henri De Tonti Boulevard** – About 3 miles north of the Landfill. On several visits, teams detected “rancid decay” odors localized around manholes in the parking lot. While an odor was stronger near these manholes, no clear source of the odors was identified and the odors were localized to the gas station parking lot. There were five odor surveys conducted, four during roaming odor surveys (**Appendix C, Table 23**) and one during a 1-hour sample collected (ID: 26272) (**Appendix C, Table 20**). Odors were described as intermittent and persistent with D/T ranging from <2 to 7, intensity of faint, distinct, and strong and described consistently as biological (rancid, decay) (**Appendix C, Table 23**). The odor assessment conducted at the time the 1-hour air sample was collected did not detect unpleasant odors (**Appendix C, Table 25**). The nearest fixed 24-hour air sampling location was AS11 at 3,800 feet or about 0.7 miles to the southeast of the gas station and the nearest fixed odor assessment location was NR11 at about 4,600 feet (0.87 mile) to the southeast of the gas station. Odors were observed at 2 of the 85 assessments conducted at NR11 and described as biological (rancid, decay, urine), however, it is not believed by the teams that the odors at NR11 originated from the gas station (**Appendix C, Table 21**). The 19 compounds detected in the 1-hour sample (ID: 26272) were similar to those detected in 24-hour samples collected at AS11. All

concentrations in the 1-hour samples were within range of ambient air concentrations across the U.S. (See Supplemental Spreadsheet).

3. **Arbor Acres Avenue (north Landfill fenceline)** – At intersections near Dowell Road, South Pianalto Road, and Russell Lane, the team observed frequent odors, often stronger when winds blew from the south. Arbor Acres Avenue borders the north fenceline of the Landfill. There were five assessments (IDs: 26381, 26383, 26274, 26384, 26301) (**Appendix D, Figure 7**) conducted on Arbor Acres Avenue due to hotline complaints and five additional assessments (IDs: 26283, 26231, 26237, 26291, 26379) (**Appendix C, Table 20**). Fixed 24-hour sampling locations AS02 and AS04 were on the west and east corners of the Landfill along Arbor Acres Avenue, and fixed odor assessment locations NR01, NR02, and NR03 were along the avenue going east to west. Concentrations in the 1-hour samples (IDs: 26283, 26231, 26237, 26291, 26301, 26379) were similar to those measured at the fixed sampling locations AS02 and AS04. All concentrations in the 1-hour samples were consistent with concentrations in ambient air across the U.S. Odors were observed at NR01 in 10.6% of assessments, NR02 in 10.5% of assessments, and NR03 in 4.6% of assessments (**Appendix C, Table 21**). The odors were consistently described as biological (fecal, rancid, decay, urine), sewer (rotten eggs), and chemical (rotten eggs) with D/T ranging from <2 to 4 and hedonic tone ranging from -5 to -1 indicating an unpleasant offensive odor. In five out of the 10 roaming odor surveys conducted on Arbor Acres Avenue, the field team observed unpleasant odors similar to those described at the fixed locations except with stronger offensiveness (hedonic tone) reported as strong as -7 (**Appendix C, Table 23**).
4. **Red Oak Drive (south of Landfill)** – This location was an elevated area within a mile of the Landfill's southern fenceline. It had the highest percentage of odors observed in the study. Though they did vary with wind direction, odors were consistently observed when the wind blew from the north, and this location was downwind of the Landfill. There were five assessments with 1-hour air samples collected at this location (IDs: 26284, 26238, 26380, 26245, 26251), and one was in response to a hotline complaint (ID: 26251) (**Appendix C, Table 20** and **Appendix D, Figures 7 and 8**). Fixed 24-hour consecutive air sampling was conducted on Red Oak Drive at location AS10 and fixed odor assessments were conducted at NR10. Among the 92 odor assessments at NR10, 16.3% detected odors described as biological (rancid, decay), chemical (rotten eggs), sewer (rotten eggs), and other (burning fire). The D/T ranged from <2 to 4 and hedonic tone from -4 to -1 (**Appendix C, Table 21**). Six roaming odor assessments described intermittent and persistent odors along Red Oak Drive with intensities ranging from faint to distinct. During these roaming odor assessments odors were described as biological (skunk) and chemical (rotten eggs) (**Appendix C, Table 23**). No odors were detected during deploying 1-hour samples except for the response to the hotline complaint on May 4 (ID: 26251) (**Appendix C, Table 25**). The complaint was 0.75 miles downwind of the Landfill on Red Oak Drive (ID: 26251). The complainant described the odor as rotten eggs and rotten cabbage. The team assessing the odor described it as chemical (rotten eggs) and detected a D/T of 2 with a hedonic tone of -3 to -2 meaning an unpleasant odor was present. In the 1-hour air sample collected in response to the complaint, twenty-two compounds were detected (see detailed tables in the Supplemental Spreadsheet). All

compounds detected in this sample were also detected at AS10 except for 1,2-dichloroethane. Another 1-hour sample (ID: 26245) also collected on May 4 a few feet from sample ID 26251, and it detected 1,2-dichloroethane (**Appendix D, Figure 12**). All concentrations in the 1-hour samples were consistent with concentrations in ambient air across the U.S.

5.0 DISCUSSION AND LIMITATIONS

Though this study was comprehensive, some limitations are recognized. This study may not accurately represent long-term air quality that would represent sub-chronic or chronic exposures or Landfill operational differences in air quality due to its limited sampling duration. Sampling was conducted in May 2025, over 11 days. Results may not reflect conditions in other months or seasons. Similarly, 1-hour and 24-hour samples capture short-term conditions but may not represent long-term air quality. The study included two weekends when the Landfill was not accepting waste and the working landfill face was covered, which may limit comparisons.

The study may not include all compounds that the Landfill may be a contributor to their local concentrations. The list of compounds of potential concern (COPCs) was based on the Landfill's permitted emissions that were VOCs and able to be measured with laboratory method TO-15, and were selected based on past studies of the area. This list may not include all compounds the Landfill contributes to the air in Tontitown.

Some compounds were not detected, but this may mean levels were too low for the lab methods to measure—not necessarily that they were absent. Method detection limits (MDL) for some compounds were below health-based screening levels: 6 compounds have health-based screening levels that are lower than the laboratory reported MDLs, 5 for cancer screening levels (1,1,2,2-tetrachloroethane, 1,2-dibromoethane, bromodichloromethane, naphthalene, and acrylonitrile) and 1 compound for noncancer screening levels (acrolein).

For summary statistics and the statistical models, non-detected values were estimated as half the method detection limit, which may over- or underestimate true levels (ATSDR, 2023; USEPA, 2025b). Models were designed for hypothesis testing, not for predicting concentrations at new locations.

Short-term samples collected after hotline complaints may have missed the actual odor or chemical event reported as these could have been transient and dispersed prior to the responding team's arrival to the site.

This study relies on observed upwind–downwind concentration differences, and concentration gradients with distance from the Landfill. These indicators are consistent with a Landfill contribution to the measured compounds. However, because many of these compounds also occur in background air and from other sources, the precise fraction attributable to the Landfill cannot be determined with absolute certainty from the available data.

6.0 CONCLUSIONS

Odors were real, frequently detected, and often unpleasant, but VOCs sampled during odors or at locations with frequent odors did not show concentrations outside what would be expected in ambient air and were not detected at levels that would cause odors. Odors were concentrated at four locations: the north fenceline of the Landfill on Arbor Acres Avenue, the south fenceline of the Landfill on Red Oak Drive, the sewer lift station on South Pianalto Road, and the Braich Arrow Express gas station on West Henri De Tonti Boulevard. It is possible that the compounds measured during this study were not the same compounds causing odors at these locations. The odors detected in this study concentrate near the sewer system and lift stations north of the Landfill. Due to odors observed near the South Pianalto Road lift station, CTEH recommends that the sewage, particularly at the lift station, be tested for compounds that may be volatilizing.

The Landfill was likely contributing to benzene and ethylbenzene levels in the air, but fenceline concentrations were within range of benzene and ethylbenzene in background air across the U.S. Furthermore, this contribution was localized to fenceline locations, as concentrations at community and background locations were similar. The contribution was possibly from the Landfill for nine other compounds but could not be statistically confirmed. All 36 detected VOCs concentrations were within typical ranges for ambient air across the U.S. except for concentrations of acrylonitrile in two samples upwind or cross wind and more than two miles from the Landfill. Other compounds detected likely came from a combination of mobile, industrial, or localized sources unrelated to the Landfill. Though this study was conducted to investigate possible Landfill contributions to air in Tontitown, acrylonitrile was found above U.S. ambient air concentrations and likely to be from another source. CTEH recommends further investigation into potential acrylonitrile sources in the region.

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Appendix A

Detailed Methods

Detailed Methods

The study design and conceptual framework are detailed in the **Quality Assurance Project Plan (QAPP, Appendix G)**.

Landfill Location and Characteristics

The Eco-Vista Landfill is approximately 609 acres, and Landfill operations are contained in 417 of those acres. CTEH used the approximate center of operations and the working face of the Landfill (36.139263001, -94.258583) to calculate distance from the Landfill to each sampling location. There is a marked route for commercial dump trucks to travel through Tontitown to the Landfill. This route turns south off U.S Hwy 412 on Klenc Road. The dump truck route continues on Klenc Road until it bends west on Wc Road 857, then turns south onto Dowell Road, turns west onto Arbor Acres Avenue, and turns south onto the Landfill property on Waste Management Drive. The Landfill accepts waste on weekdays for commercial dump trucks and the public. It does not accept waste on Saturday or Sunday, and the working face of the Landfill is covered. However, normal 24-hour operations continue on weekends. Hazardous materials are not accepted at the Landfill.

Meteorological Data Analysis

The CTEH field team set up a meteorological station to record wind speed and direction near the Landfill fenceline for the duration of the study. The instrument provided an output every 15 minutes, representing an average of the previous 15-minute period. To determine whether an air sampling location was classified as upwind, downwind, or crosswind, the average wind direction (in degrees) was first calculated over the specific sampling duration (i.e., 24 hours or 1 hour) by aligning the time periods as closely as possible. For example, a meteorological reading timestamped at 08:00 reflected conditions from 07:45 to 08:00 and was matched with a sample that began at 07:45. The average wind direction for the time period was assigned to that specific air sample concentration. Details on classification of wind direction as upwind, crosswind, or downwind are available in the **QAPP**.

Air Sampling Methods

CTEH personnel collected air quality data in the community surrounding the Landfill using four strategies:

- 1) roaming, real-time air monitoring using handheld air monitoring instruments;
- 2) periodic odor surveys;
- 3) continuous 24-hour air sampling using either evacuated 6-liter canisters for VOCs or air sampling pumps for hydrogen fluoride; and
- 4) real-time air monitoring, odor surveys, and short-term 1-hour air samples using evacuated 6-liter canisters.

The first three strategies were employed at fixed locations surrounding the Landfill and at locations designated to represent regional air or background air. The fourth strategy was employed in response to

reported odor or health complaints to a hotline answered by the field team when complaint locations were within three miles of the Landfill. Air monitoring, sampling, and odor surveys were conducted from May 2, 2025 through May 12, 2025.

Continuous Fixed Air Sampling

CTEH personnel deployed air samples for VOCs at 14 fixed locations (AS01-AS14; see **Appendix D, Figure 2**) in the community within the three miles surrounding the Landfill. Three locations were along the Landfill fenceline to the north (AS02 and AS04) and to the south (AS10). In addition to these 14 fixed locations within three miles of the Landfill, CTEH personnel conducted 24-hour air sampling for VOCs at four background sample locations farther than three miles from the Landfill fenceline (AS15, AS16, AS17, AS18). CTEH personnel conducted 24-hour air sampling for VOCs listed as COPCs at each of the 14 locations for 11 consecutive days, and these samples were collected using 6-liter evacuated canisters which continuously drew air into the canisters over the course of each 24-hour sampling period.

On the first day of sampling (May 2, 2025), the proposed location for AS05 was moved approximately 3,600 feet to the east to be in the corner of Wc Road 857 and Klenc Road to represent air along the haul route to the Landfill (**Figure 7 in the QAPP** and **Appendix D, Figure 2**). The first sample for the AS05 location was placed at the originally proposed location that morning and had collected air at that location for an hour and a half when it was capped and relocated to the new location along the haul route, uncapped, and allowed to collect air for the remainder of the sampling period on May 2.

CTEH personnel used air sampling pumps to collect air samples for hydrogen fluoride at five of the same locations as the 24-hour canisters (AS02, AS04, AS07, AS10, AS18; **Appendix D, Figure 3**). CTEH personnel calibrated air sampling pumps to collect air throughout a sample duration of eight hours; thus, three consecutive 8-hour samples were collected at a sampling location for each 24-hour period. The proposed location for AS10 (**Figure 8 in the QAPP**) was moved approximately 500 feet to the south-southwest for hydrogen fluoride sampling due to logistical issues for accessing the proposed location three times within a 24-hour period. This location was renamed AS10-HF, and the corresponding 24-hour VOC sampling location was renamed AS10-SC.

CTEH consulted with E&E and ADH to select sampling locations after considering several factors including providing adequate coverage of the community surrounding the Landfill, historical complaints in the community, Landfill operations, and modeled air concentrations. To provide comprehensive coverage of the residential areas near the Landfill, locations were selected in all four cardinal directions in circles surrounding the Landfill fenceline, with distance increasing by roughly one mile until reaching three miles from the Landfill. The area within a 3-mile radius of the Landfill was considered the community. Air sampling locations selected in the community included areas where historical complaints clustered, along heavily-trafficked haul routes, and where air dispersion modeling showed highest estimated potential fugitive emissions. Ten of the fourteen prior sampling locations from the CTEH April 2024 air study were selected so that air concentrations at those locations could be analyzed with earlier sampling studies

(**Figure 1 and Appendix D, Figure 1**). In this study, background locations were expanded to farther than four miles from the Landfill (AS15, AS16, AS17, and AS18), and additional locations within the three miles of the Landfill were included that were not covered in the prior study (AS01, AS03, AS06, and AS07). Four background sampling stations were selected at locations farther than four miles from the Landfill and in areas thought to be unaffected by other potential sources like facilities with air permits from E&E. **Appendix D, Figure 2** shows the fixed sampling locations for 24-hour air samples measuring COPCs that are VOCs. **Appendix D, Figure 3** shows the sampling locations for measuring hydrogen fluoride.

Fixed and Roaming, Periodic Odor Surveys and Handheld, Real-Time Air Monitoring

Odor surveys were conducted periodically at roaming and fixed locations in accordance with the Odor Survey SOP and the E&E Odor Wheel (**Attachment A in the QAPP**) by the roaming field personnel team with day and night shifts. In summary, a team of two members conducted odor surveys with a nasal ranger instrument and reported if an odor was detected at that time and location. At each fixed and roaming location both team members conducted odor surveys to confirm the absence or presence of unpleasant odors. Only unpleasant odors were documented by the field team. For example, if the field team noticed a pleasant odor such as flowers or cut grass, then those smells were recorded as not detected. If the field team noticed an unpleasant odor, the team used the nasal ranger instrument to collect a Dilution-to-Threshold (D/T) concentration measurement of the odor, documented the hedonic tone, and used the odor wheel to describe the odor. Hedonic tone ranges from -10 to 10 with values from -1 to -10 representing increasing offensiveness, quantified by the field member's experience, of unpleasant odors and values 1 to 10 representing the scale of pleasant odors. Because pleasant odors were not evaluated during this study, only hedonic tones of -1 to -10 were documented. This team also collected real-time air monitoring readings for VOCs, benzene, %LEL, oxygen, sulfur dioxide, and hydrogen sulfide at each fixed and roaming location. **Appendix D, Figure 4** shows the locations for fixed odor surveys and real-time readings. The day and night field teams aimed to visit each fixed location 2-3 three times on their shift. While completing the route, the teams conducted roaming odor assessments and real-time air concentration readings when odors were detected in locations not on the pre-determined route, as well as neighborhoods with a dense population of houses and other locations, to provide a comprehensive coverage area surrounding the Landfill (**Appendix D, Figure 6**).

Hotline Complaint Response with Real-Time Air Monitoring, Odor Surveys, and Short-Term Air Sampling

The Tontitown community was notified of the air study through a press release and other media outreach prior to the start of sampling. The notification included a hotline number for community members to call and report any health or odor complaints during the study. CTEH field staff answered the hotline and responded to complaints. Upon notification of a community complaint via the hotline, CTEH field staff completed an intake form (**Attachment B in the QAPP**) to document the complaint, note if there were odors present, and determine if the complaint was within three miles of the Landfill. The field team responded to complaint calls for locations that were roughly within 3 miles of the Landfill and if the

complainant agreed to have the field team respond with air monitoring and sampling. At the complaint location, handheld real-time air monitoring for VOCs, benzene, LEL, oxygen, sulfur dioxide, and hydrogen sulfide was conducted. The field team also conducted an odor survey in accordance with the Odor Survey SOP (**Attachment A in the QAPP**). When supplies were available, the field team collected a 1-hour discrete sample of the VOCs on the COPC list. Per E&E, the number of 1-hour samples collected was capped at 33 field samples and 5 duplicate samples for the duration of the 11-day study. CTEH did not collect more than three field samples per day in order to have sufficient supply for collecting 1-hour samples on each day of the study.

If no complaints were received by 7 pm on any given day, CTEH personnel collected two 1-hour grab samples after 7 pm, one in a location in the downwind direction from the Landfill (or other identified source in the community) and another location in the upwind direction from the Landfill (or other identified source). The following morning, CTEH personnel then collected an additional 1-hour grab sample in the same downwind location as the day before. The meteorological station placed near the Landfill fenceline was used to determine the predominant wind direction. Whenever possible, these 1-hour samples (along with odor surveys and real-time air monitoring) were collected at locations where the field team had noticed a strong odor. If a 1-hour sample was deployed on particular day in response to a call on the hotline, no other 1-hour air samples were collected unless there was another complaint made to the hotline.

Statistical Approach to Analyzing Air Sampling Concentrations

The descriptive and statistical methods applied to the question in this study are detailed in the **QAPP**.

Appendix B

Detailed Results

Detailed Results

Odor Source Investigation

At the start of the study, an odor source investigation was completed to identify and examine any potential source in or near the Tontitown community that could be a source of odors or emitted compounds. This investigation included all facilities in the Tontitown community with air permits by the state of Arkansas, chicken houses identified by satellite imagery via google earth maps, and any identified odor source during the air sampling study. **Appendix D, Figure 5** shows the map of 19 facilities and locations that were assessed as a potential source of odors and whether an odor was detected there during the air study. The Harry D Mattison Power Plant, the Northeast Chicken Farm (4K Farms), and the Hamstring Lift station had odors detected by the investigation team, but the odors were determined to be faint and localized (meaning not likely to travel past the fenceline of the facility or to be related to historical complaints). No further air investigations were conducted at these locations. The field team observed odors repeatedly and reported the odors to be stronger at the Braich Arrow Express Phillips 66 gas station and the sewer lift station at 1836 South Pianalto Road. Details about the odors at these locations are discussed in the Main Findings section and below.

Air Study Details

CTEH personnel collected 215 24-hour VOC air samples for COPCs across the 18 sampling locations using Entech Instruments 6-Liter Silonite® canisters (**Appendix D, Figure 2**). CTEH personnel collected 165 8-hour samples for hydrogen fluoride with three 8-hour air samples per day collected through an SKC, Inc. continuous air sampling pump at 5 locations (**Appendix D, Figure 3**). CTEH personnel conducted 1,086 routine daily odor assessments and recorded 3,316 real-time air measurements for VOCs (553), benzene (553), %LEL (553), oxygen (551), sulfur dioxide (552), and hydrogen sulfide (554) using a route of 13 fixed locations spanning the fenceline of the Landfill into the community (**Appendix D, Figure 4**). The team took 130 roaming odor assessments with 879 real-time air readings recorded for VOCs (146), benzene (147), %LEL (146), oxygen (146), sulfur dioxide (147), and hydrogen sulfide (147) (**Appendix D, Figure 6**). CTEH personnel completed 13 responses to hotline complaints which included 6 one-hour air samples, 35 odor assessments with the nasal ranger, and 108 real-time air readings (**Appendix C, Table 20**). CTEH personnel collected 24 supplemental one-hour air samples. These results are described in detail below.

Continuous Fixed Air Sampling Results

Among the 215 24-hour air samples for COPCs, that are VOCs, at the fixed sampling locations, 22 were duplicate samples. The 24-hour duplicate samples maintained a relative percent difference (RPD) of $\leq 25\%$ with the study samples. Ethyl acetate in one co-located 1-hour grab sample pair (TOAR0506GB26273/TOAR0506GB26273CL) slightly exceeded the preferred 25% RPD threshold outlined in the QAPP at 25.81%. One co-located 1-hour air sample pair (TOAR0510GB26314/TOAR0510GB26314CL) was analyzed outside of holding time because the samples were lost in transit by the carrier on the way

to the laboratory and subsequently recovered. One sample was analyzed 32 days past the canister 30-day hold time, and the other was analyzed 44 days past the hold time. Results were qualified accordingly by the laboratory. There were 5 (2.3%) 24-hour samples that were unable to be analyzed due to loss of pressure. Detailed summary tables by sampling location and Landfill operations (weekdays and weekends) are available in the **Supplemental Spreadsheet**.

In addition to the 165 8-hour hydrogen fluoride samples collected at the fixed sampling locations, CTEH personnel prepared and submitted 10 field blanks and 1 media blank to the laboratory for analysis. There was no contamination in the field blanks, and all 165 air samples were able to be analyzed for hydrogen fluoride. Hydrogen fluoride was not detected in any sample collected during this study, and no further analysis was conducted.

Meteorological Data

Wind roses representing approximate the 24-hour periods from when canisters were deployed to when they were picked up are available in **Appendix E**. On average, wind speeds ranged from 0.83 to 3.41 mph during the study. There were four days during which the wind was blowing to the SSE direction. **Appendix C, Table 3** describes the meteorological conditions for each day of the air study. For specific analysis of wind direction for air samples, the exact time stamp of the air sample was aligned with the wind direction for that time period, and the average wind vector was assigned. Maps detailing the sampling locations and their wind direction (downwind, upwind, or crosswind) relative to the Landfill are available in **Appendix E**.

Statistical Analysis Results

Compounds at Fenceline, Community, and Background Locations

The 24-hour air sample locations were grouped into fenceline downwind (of the Landfill), community downwind, fenceline upwind or crosswind, community upwind or crosswind, and background. A categorical variable was created describing if compounds had ever or never been detected in each of the groups compared. This analysis was conducted to answer the question, *“Is the profile or list of detected COPCs at the fenceline downwind from the Landfill similar to those in the community or in background locations?”* In the 24-hour air samples for VOCs, 13 out of 49 compounds were never detected at any location (1,1,1-trichloroethane, 1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2,4-trichlorobenzene, 1,2-dibromoethane, 1,2-dichlorobenzene, bromodichloromethane, chlorobenzene, naphthalene, trichloroethene, and vinyl chloride). Of the 36 of 49 compounds detected, 27 of the 36 were detected in at least one 24-hour air sample in each location and wind direction grouping (1,1-difluoroethane, 1,2,4-trimethylbenzene, 2-butanone, 4-methyl-2-pentanone, acetonitrile, acrolein, acrylonitrile, benzene, carbon disulfide, carbon tetrachloride, chloroform, chloromethane, ethyl acetate, ethylbenzene, freon 113, freon 12, isopropanol (IPA), m,p-xylenes, methanol, methylene chloride, n-heptane, n-hexane, n-pentane, o-xylene, propylene, styrene, and toluene). These compounds were further analyzed for gradients from the downwind fenceline into the community. There were 9 out of 36 compounds that were not similar across locations groups. The

compound trans-1,2-dichloroethene was detected at least once in downwind fenceline, upwind/crosswind community, and background locations. The compounds 1,3,5-trimethylbenzene and chloroethane were not detected at downwind fenceline locations but were detected at least once in all other location and wind direction groupings. The compound 1,2-dichloropropane was detected at least once in upwind/crosswind community and background locations. Tetrachloroethene was detected at least once in downwind and upwind/crosswind community and background locations. Vinyl acetate was detected at least once in upwind/crosswind community locations. Tetrahydrofuran, 1,2-dichloroethane, and 1,3-butadiene were detected at least once in upwind/crosswind fenceline and community locations. These compounds were not examined for gradients from the Landfill. In summary, 28 of the 36 detected compounds were detected at a downwind fenceline location and also in community and background locations. Eight compounds were not detected at downwind fenceline locations but were detected at least once in a community or background location. There was not a pattern of VOCs only detected at downwind fenceline locations and not in background locations as every compound detected at least once at the downwind fenceline locations was also detected at least once in background locations (**Appendix C, Table 7**).

To answer the question, *“Do average COPC concentrations change from downwind locations with increasing distances from the fenceline of the Landfill?”*, a statistical model was built. First, an indicator variable was made for operational changes at the Landfill by grouping days when the Landfill was accepting waste (Monday-Friday or weekdays) compared to when the Landfill was not accepting waste and the working face of the Landfill was covered (Saturday and Sunday or weekends). Another categorical variable was made to indicate whether a fixed air sampling locations was situated along the haul route for the trucks to follow to the Landfill (AS04, AS05, and AS11). Wind direction was also grouped into downwind, upwind, and crosswind. Then, a linear mixed model (model 1) was fit for each of the 36 detected compounds to estimate air concentration (ppb) gradients with increasing distance from the Landfill. This model included covariates for distance from the Landfill (as continuous miles), wind direction in relation to the Landfill (downwind, upwind, and crosswind), weekday versus weekend Landfill activities, and haul route locations versus not a haul route location. The interaction between wind direction and distance was included to be able to estimate whether the effect of distance from the Landfill on concentration was the same upwind as downwind, allowing for downwind locations to have higher concentrations than a site located at the same distance, but upwind. A random intercept was included for each fixed sampling site, as samples from the same site are more highly correlated due to the unique geographic features of the location.

There was a significant decreasing downwind concentration gradient from the Landfill fenceline for ethylbenzene and a marginally significant decreasing downwind concentration for benzene. Details of the adjusted models for these compounds are in **Appendix C, Tables 8 and 10**, and scatterplots of concentrations for compounds examined are available in **Appendix F**¹. No other compounds showed

¹ Scatterplots were made only for compounds classified as contribution likely and possibly from Landfill

significant decreasing downwind concentration gradient from the Landfill (models not shown). Simultaneous linear hypothesis testing (single-step method for P-value adjustment) using the model described in **Appendix C, Table 8** showed the change in concentrations of benzene was significant, with concentrations decreasing by 0.0189 ppb for a 1-mile increase in distance from the Landfill (95% CI: 0.0035, 0.0343, $P_{adj}=0.0552^2$) (**Appendix C, Table 9**). For ethylbenzene using the model in **Appendix C, Table 10**, concentrations decreased by 0.0056 ppb for a 1 mile increase in distance from the Landfill (95% CI: 0.0017, 0.0096; $P_{adj}=0.0194$) (**Appendix C, Table 11**). For benzene and ethylbenzene, there was not a decreasing concentration gradient with increasing distance from in the Landfill in the upwind direction, nor was the decreasing gradient observed in the downwind direction significantly different from the concentration gradient in the upwind direction. Of note, these differences, while statistically significant, measure in the parts per trillion range.

The same model was used to answer the question, *“Are the mean COPC concentrations from downwind locations similar to upwind locations from the Landfill?”*, by conducting a hypothesis test comparing concentrations at downwind locations to upwind locations holding all other covariates constant. For benzene and ethylbenzene, there was a significant difference in concentration in upwind versus downwind samples, holding other variables constant. Hypothesis testing showed that, on average, benzene concentrations downwind from the Landfill were 0.0769 ppb higher compared to upwind concentrations (95% CI: 0.0209, 0.1329; $P_{adj}=0.0294$) (**Appendix C, Table 9**). The difference was 0.0207 ppb higher for ethylbenzene concentrations downwind of the Landfill compared to upwind (95% CI: 0.0075, 0.0340, $P_{adj}=0.0083$) (**Appendix C, Table 11**), holding all other variables constant. Of note, these differences, while statistically different, are in the parts per trillion range.

To answer the question, *“Are the mean COPC concentrations from locations downwind from the Landfill similar to COPC concentrations in background air?”*, a second model (model 2) was built that categorized 24-hour air sampling locations by distances from the Landfill: fenceline (AS02, AS04, AS10-SC), community (AS01, AS03, AS05-AS09, AS11-AS14), and background (AS15-AS18) (**Appendix C, Table 12 and Table 14**). The model included the same covariates weekdays versus weekends, locations on the haul route versus not on the haul route, but included multi-level factor combinations for community and fenceline locations by relative wind direction (fenceline/crosswind, fenceline/downwind, fenceline/upwind, community/crosswind, community, downwind, community upwind) were created, and all background locations were combined. Benzene and ethylbenzene were the only compounds with statistically significant differences by location/relative wind direction factor combinations. Downwind community sampling locations had benzene concentrations 0.1084 ppb (95% CI: 0.0527, 0.1642, $P<0.001$) lower than downwind fenceline locations, on average. Background locations had benzene concentrations 0.1028 ppb lower (95% CI: 0.0528, 0.1529, $P<0.001$) than downwind fenceline locations, on average (**Appendix C, Table 13**). Downwind community locations had ethylbenzene concentrations 0.0340 ppb (95% CI: 0.0199, 0.0482; $P<0.001$) lower than downwind fenceline locations, on average. Background sites had

² P_{adj} are the p values from the hypothesis testing using the adjusted linear mixed model.

ethylbenzene concentrations 0.0357 ppb lower (95% CI: 0.0221, 0.0493; $P < 0.001$) than downwind fenceline locations, on average (**Appendix C, Table 15**). Neither compound had significant differences in concentrations between community and background locations ($P = 0.9580$ for benzene; $P = 0.9423$ for ethylbenzene) (**Appendix C, Table 13 and Table 15**).

Compounds along the Haul Route Compared to not along the Haul Route

To answer the question, *“Is the list of COPCs detected along the haul route to the Landfill similar to those in the community not along the haul route or in background locations?”*, the 24-hour air sample locations were grouped into air sampling locations along the haul route for trucks going to the Landfill (AS04, AS05, and AS11), non-haul route locations in the community (AS01-AS03, AS06-AS10, AS12-AS14), and background (AS15-AS18). The compounds detected along the haul route were similar to non-haul route locations for 33 out of 36 (91.6%) compounds. There were 30 compounds that were detected at least once along the haul route, non-haul route, and background locations (**Appendix C, Table 16**). Six compounds had varying detections across the three locations groupings for the haul route. The compounds 1,3,5-trimethylbenzene and trans-1,2-Dichloroethene were not detected in air samples along the haul route but were detected in non-haul route community and background locations. Vinyl acetate was detected at least once only in non-haul route community locations. The compounds 1,2-dichloroethane, 1,3-butadiene, and tetrahydrofuran were not detected in background, but were detected at least once in locations along the haul route and in the community not along the haul route (**Appendix C, Table 16**).

To answer the question, *“Are the mean COPC concentrations from locations along truck the haul route to the Landfill similar to locations not along the haul route?”*, the compound concentrations along the haul route were tested for differences compared to compound concentrations in locations not along the haul route (including background locations AS15-AS18) using models 1 and 2. Evidence for differences was determined by a model p value of less than 0.05 when the covariate not haul route vs haul route was added to the model. All 36 compounds in model 1 and in model 2 showed no statistical evidence for a difference in concentrations along the haul route compared to not along the haul route.

Compounds on Weekdays Compared to Weekends

Of the 36 detected compounds, 25 (69.4%) were detected in all locations regardless of weekday when the Landfill was accepting waste or weekend when they were not accepting waste and the working face was covered: 1,1-difluoroethane, 1,2,4-trimethylbenzene, 2-butanone, acetonitrile, acrolein, benzene, carbon disulfide, carbon tetrachloride, chloroform, chloromethane, ethyl acetate, ethylbenzene, freon 113, freon 12, isopropanol, methanol, methylene chloride, propylene, styrene, toluene, m,p-xylenes, n-heptane, n-hexane, n-pentane, and o-xylene. Among the other 11 compounds, there was not a clear pattern between weekdays and weekends (**Appendix C, Table 17**).

To answer the question, *“Are the mean COPC concentrations from downwind locations from the Landfill and in the community on weekdays (when the Landfill is accepting waste) similar to those on weekends*

(when the Landfill is not accepting waste and the working face is covered)?,” the covariate of weekends vs weekdays was assessed in model 1. If the model p value was less than 0.05 for the covariate then that was evidence of statistical difference in concentrations on the weekends compared to weekdays while adjusted for distance, wind direction, and haul route locations. Concentrations on weekends compared to weekdays were tested for all 36 detected compounds. Eleven compounds were determined to have statistically different concentrations when the Landfill was accepting waste on weekdays compared to when the Landfill was not accepting waste and the working face was covered on weekends. Benzene, ethylbenzene, and m,p-xylenes had statistically higher concentrations on weekends compared to weekdays. The following compounds were statistically lower on weekends compared to weekdays: chloromethane, freon 12, carbon tetrachloride, methanol, methylene chloride, n-hexane, 2-butanone, and acetonitrile (**Appendix C, Table 18**).

Odors

Across the air study period, 1,291 odor surveys were conducted by both day shift and night shift field teams at fixed locations, roaming locations, in response to community complaints made to the hotline, and when deploying 1-hour air samples (**Appendix C, Tables 20 to 25**). There were 5 odor surveys marked as not usable (testing equipment or calibrations), leaving 1,286 (99.6%) odor surveys documenting the presence or absence of odors in the Tontitown community.

Fixed and Roaming, Periodic Odor Surveys and Handheld, Real-Time Air Monitoring Results

There were no detections of VOCs (553), benzene (553), %LEL (553), sulfur dioxide (552), or hydrogen sulfide (554) in the 3,316 real-time air measurements recorded during the route of 13 fixed locations (**Appendix C, Table 5**) spanning from the fenceline of the Landfill into the community. Oxygen (551) was consistently detected at 20.9% along the fixed locations route. Also, there were no detections of VOCs (146), benzene (147), %LEL (146), sulfur dioxide (147), or hydrogen sulfide (147) among the 879 real-time air readings when the team was conducting the 130 roaming odor surveys (**Appendix C, Table 6**). Again, during these roaming assessments, oxygen (146) was detected at 20.9%. Not detecting compounds using real-time air monitoring instrumentation does not mean they are not present in the air, but that they were not present at levels above the equipment detection limits and would not be at levels concerning for acute health effects.

Among the 1,086 odor assessments conducted at the fixed pre-determined locations, there were 61 (5.6%) observed odors using the nasal ranger and the odor survey protocol in **Attachment A of the QAPP**. Odors were detected at all locations except NR08, NR12, and NR13 (**Appendix D, Figure 9**), and detected odors were concentrated at the three fixed locations (NR01, NR02, NR03) on the northern fenceline along Arbor Acres Avenue. The majority of odors were described as Biological (Fecal, Rancid, Decay) (45, 4.1%), Sewer (Rotten Eggs) (7, 0.6%), Chemical (Rotten Eggs) (7, 0.6%), and Other (burning fire) (2, 0.2%) (**Appendix C, Table 21**). There were 16 (12.3%) odors identified while the field teams were conducting 130 roaming odor surveys in the area around the Landfill (**Appendix C, Tables 22 and 23; Appendix D, Figure 6**). These 16

odors were concentrated at three locations shown in **Appendix D, Figure 11**: 12246 Red Oak Drive (south fenceline, AS10 location), 1398 Hwy 412 (Phillips 66 gas station), and 1836/1851 South Pianalto Road. The locations at 1836 and 1851 South Pianalto Road are in close proximity to a sewer lift station. The odors identified at the Phillips 66 gas station off Hwy 412 were in relation to a manholes in the parking lot. The odors identified in the roaming odor surveys were described similarly to those at the fixed locations as Biological (Rancid, Decay, Skunk) (5, 3.9%), Chemical (Rotten Eggs) (8, 6.2%), Natural Gas (Rotten Eggs) (2, 1.5%) and Sewer (Fecal) (1, 0.8%). Most odors ranged in D/T values of <2 to 4 and hedonic tone of -5 to -1 (%). The highest D/T (7) was documented at two locations while conducting roaming odor surveys. Odors were described as Biological (Rancid, Decay) at 1398 Hwy 412 and Natural Gas (Rotten Eggs) at 1851 South Pianalto Road. Both odors had a hedonic tone of -6 indicating an offensive unpleasant odor as -10 is the most offensive on the hedonic tone scale (**Appendix C, Table 23**).

Hotline Complaint Response with Real-Time Air Monitoring, Odor Surveys, and Short-Term Air Sampling Results

During the air study a hotline was made available for the community to call and report an odor or health complaint. If these complaints were within three miles of the Landfill the field team responded with an air investigation. When there were no complaints made by 7pm that day, the field team deployed a 1-hour air sample in a location where odors had been documented during the study and/or there were frequent complaints in downwind locations from the Landfill and another sample in an upwind location to represent air potentially not impacted by the Landfill. The on-site meteorological station was used to determine the wind direction in real-time. The following morning, another 1-hour air sample was collected in the same downwind community location as the sample collected the night before. In total, 33 air assessments were conducted, and 30 1-hour air samples were collected, including four (13.3%) duplicates. **Table 20** summarizes the responses to hotline complaints and the deployment of 1-hour air samples.

There were 16 calls made to the hotline, and 13 calls resulted in a response to the location to conduct odor surveys, real-time air monitoring, and/or collect 1-hour air samples (**Table 20**). Six (46.2%) responses had a 1-hour air sample collected at the location of the complaint. Calls made after 7pm were not able to have 1-hour air samples collected due to the allocated samples for that day already being deployed. However, three call responses (IDs: 26252, 26264, and 26274) were made after 7pm due to few calls to the hotline at the start of the study. Once a response to a hotline call was made, there were no more canisters deployed for that day if there were not any additional hotline complaints. On May 12, two 1-hour samples were deployed at approximately 6pm, and four complaints were called into the hotline the hour the samples were deployed. Therefore, staff were not available to respond with 1-hour air sampling at the complaint locations but did respond with odor surveys and real-time monitoring. Summaries of the detected compounds are detailed below, and the sample results are available in the **Supplemental Spreadsheet**. VOCs, benzene, %LEL, sulfur dioxide, or hydrogen sulfide were not detected via real-time air monitoring during air investigations at the complaint locations. Odors were confirmed with odor surveys at 6 of the 13 hotline complaint responses totaling in 15 odor surveys. These odors were described as

Chemical (Rotten Eggs) (2, 33.3%), Natural Gas (Rotten Eggs) (2, 33.3%), Biological (Skunk) (1, 16.7%), and Sewer (Fecal) (1, 16.7%) according to the E&E Odor Wheel. Three of the response locations with odors detected (assessment IDs: 26302, 26381, and 26383) were within 0.75 miles of the Pianalto Lift Station (**Table 23**).

The CTEH field team deployed 20 1-hour samples during the air study that were not in response to a complaint made on the hotline (**Table 24**). Summaries of the detected compounds are detailed below, and the sample results are available in the **Supplemental Spreadsheet**. Odor surveys and real-time air monitoring were conducted at 17 of the 20 1-hour sample deployments. There were no detections of VOCs, benzene, LEL, sulfur dioxide, or hydrogen sulfide via real-time air monitoring. Three odors were detected at locations within 0.88 miles of the Pianalto Lift Station (IDs: 26283, 26291, and 26315, **Table 24**). The odors were described as Chemical (Rotten Eggs) (2, 66.7%), Natural Gas (Rotten Eggs) (1, 33.3%), and Biological (Rancid, Decay) (1, 33.3%) according to the E&E Odor Wheel.

To address the question, *“Are the compounds detected during a complaint response similar to the those detected at fenceline locations downwind from the Landfill or to those detected in background locations?”*, the detected compounds in 1-hour samples collected during a hotline response were compared to the detected compounds in 1-hour samples collected downwind of the Landfill fenceline, 24-hour samples collected at downwind fenceline locations, and 24-hour samples collected at background locations. There were six 1-hour air samples collected in response to complaints made to the hotline, and nine 1-hour air samples collected at fenceline (**Table 26**). There were 24 (48.9%) compounds detected in 1-hour air samples collected at locations with community complaints made to the hotline during the air study: 1,1-difluoroethane, 1,2-dichloroethane, 2-butanone, 1,2,4-trimethylbenzene, acetonitrile, acrolein, benzene, carbon tetrachloride, chloroform, chloromethane, ethyl acetate, ethylbenzene, freon 113, freon 12, isopropanol (IPA), m,p-xylenes, methanol, methylene chloride, n-heptane, n-hexane, n-pentane, o-xylene, propylene, and toluene. Among these 24 detected compounds, 23 were also detected at least once in 1-hour samples collected at downwind fenceline locations, downwind 24-hour air samples at fixed fenceline locations, and in 24-hour air samples collected at background locations. One compound, 1,2-dichloroethane, was detected in a 1-hour air sample collected in response to a complaint (ID: 26251) and in 1-hour air samples collected downwind of the Landfill at fenceline, but not in the 24-hour background air samples. However, it was detected in other 24-hour air samples collected at community locations. That complaint was made at a location directly south of the Landfill (**Table 26**).

Appendix C

Tables

Table 1 Fixed Analytical Air Sampling Locations

Location Code	Location Description	Location Category	Latitude	Longitude
AS01	Street light pole between 1163 and 1179 Ruscello Ave	Community	36.1618452	-94.2583139
AS02†	Power pole at intersection of Russell Lane and Arbor Acres	Fenceline	36.144173	-94.264793
AS03	Intersection of W Steele Road Westminster Lane/Callihan Lp	Community	36.1406258	-94.22540833
AS04*†	Telephone pole of Arbor Acres and Dowell intersection	Fenceline	36.143964	-94.251448
AS05*‡	Truck Haul Route on Klenc Road	Community	36.155117	-94.24675652
AS06	Stop sign at intersection of Harmon Rd and WC Rd 753	Community	36.153664	-94.277541
AS07†	Electric pole on Intersection of Harmon Rd. And Gray Dr	Community	36.168172	-94.281871
AS08	Reed Valley and S Barrington	Community	36.13085723	-94.24529679
AS09	18702 Clear Water Road (Lovette residence)	Community	36.1377975	-94.27394035
AS10-HF†	Wooden Fence line near property entrance at 12246 Red Oak Drive (Russ Green)	Fenceline	36.129585	-94.260796
AS10-SC	Wooden Fence line on 12246 Red Oak Drive (Russ Green Property)	Fenceline	36.130661	-94.260324
AS11*	Stop sign at intersection of Klenc Rd. And Morsani Pl.	Community	36.17310669	-94.2457925
AS12	S 64th street and Watkins Ave	Community	36.16104882	-94.2020742
AS13	White Oak Rd	Community	36.13990423	-94.3188425
AS14	Leirly and Hughmount Rd	Community	36.10721946	-94.22083102
AS15	Approx. 30 ft off Robinson Road/Wc848	Background	36.134478	-94.358371
AS16	Chapman Ave, across street from baseball fields	Background	36.16388949	-94.15475617
AS17	On tree at entrance to 21935 Ardemagni Road	Background	36.20140616	-94.24441312
AS18†	Telephone pole at intersection of Double Springs and Wedington	Background	36.07919341	-94.25360639

*Along Haul Route

† Hydrogen fluoride and TO-15 Location

‡ Station AS05 was relocated approximately 2/3 mile due east to the curve in Kelly Road and Klenc Road shortly after deployment on 5/2/2025 to capture the truck haul route.

Table 2 Fixed Odor Observation Locations

Location Code	Location Description	Location Category	Latitude	Longitude
NR01	Intersection of Arbor Acres Ave and Dowell Rd	Fenceline	36.144080	-94.251244
NR02	Intersection of Arbor Acres Ave and S Pianalto Road	Fenceline	36.144143	-94.260362
NR03	Intersection of Arbor Acres Ave and Russell Ln	Community	36.144240	-94.264840
NR04	Next to driveway of 18552 Clear Water Rd	Community	36.139725	-94.273924
NR05	20 feet East of intersection of Harmon Rd and Clear Water Rd	Community	36.150026	-94.276407
NR06	Intersection of S Pianalto Rd and Kelly Rd	Community	36.155188	-94.264138
NR07	50 feet west of driveway for 797 Kelly Rd	Community	36.154961	-94.254505
NR08	In parking lot of Swamp Ox business at 2049 S Barrington Rd	Community	36.148038	-94.238996
NR09	In parking lot of Full Gospel Harbor church at 715 W Steele Rd	Community	36.139702	-94.228756
NR10	Next to driveway of 12064 Red Oak Drive	Community	36.128802	-94.254978
NR11	Next to driveway of 874 S Pianalto Rd	Community	36.165749	-94.263984
NR12	Wheeler Fire Department	Community	36.114775	-94.260692
NR13	On Reed Valley Rd, 20 yards East of intersection of S Barrington Rd	Community	36.131020	-94.245626

Table 3 Summary of meteorological data during the Tontitown, AR air study from May 2 to May 12, 2025

Day	Average Wind Speed (mph)	Average 24-hour Wind Vector (°)	Wind Direction (blowing to)	Average Rain (in)	Average Humidity (%)	Average Temperature (°F)	Average Relative Pressure (inHg)
May 2	1.76	88.9	E	0.76	83.07	58.52	29.97
May 3	2.52	151.5	SSE	0	72.44	53.44	30.06
May 4	1.46	167.7	SSE	0	71.68	55.33	30.04
May 5	0.83	162.6	SSE	0	66.14	61.31	30.01
May 6	3.17	248.1	WSW	0.06	82.29	59.49	30.01
May 7	1.46	16.6	NNE	0.02	92.89	59.58	30
May 8	1.3	150.3	SSE	0.08	89.43	59.86	30.09
May 9	3.41	187.0	S	0.01	66.99	64.19	30.15
May 10	2.79	184.8	S	0	61.1	60.2	30.19
May 11	1.9	197.8	SSW	0.01	70.81	60.3	30.07
May 12	1.37	195.5	SSW	0	75.82	67.08	29.86

Table 4 Number of odor surveys conducted in Tontitown, AR from May 2 to May 12, 2025

Day	No. of Odor Surveys
May 2	70
May 3	93
May 4	112
May 5	118
May 6	114
May 7	131
May 8	127
May 9	131
May 10	140
May 11	133
May 12	122

Table 5 Summary of Fixed Station Real-Time Monitoring Results

Analyte	Instrument	Number of Readings	Number of Detections	Concentration Range
Benzene	UltraRAE	553	0	<0.01 ppm
Hydrogen sulfide	MultiRAE Pro	554	0	<0.1 ppm
Lower Explosive Limit (%LEL)	MultiRAE Pro	553	0	<1%
Oxygen	MultiRAE Pro	551	551	20.9%
Sulfur dioxide	MultiRAE Pro	552	0	<0.1 ppm
VOCs	MultiRAE Pro	553	0	<0.1 ppm

Table 6 Summary of Roaming Real-Time Monitoring Results

Analyte	Instrument	Number of Readings	Number of Detections	Concentration Range
Benzene	UltraRAE	147	0	<0.01 ppm
Hydrogen sulfide	MultiRAE Pro	147	0	<0.1 ppm
Lower Explosive Limit (%LEL)	MultiRAE Pro	146	0	<1%
Oxygen	MultiRAE Pro	146	146	20.9%
Sulfur dioxide	MultiRAE Pro	147	0	<0.1 ppm
VOCs	MultiRAE Pro	146	0	<0.1 ppm

Table 7 Comparison of detected COPCs in downwind fenceline and community locations to upwind, crosswind, and background locations for 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025

COPC ¹	Cas No	Detected vs Not Detected				
		Fenceline (Downwind)	Community (Downwind)	Fenceline (Upwind/Crosswind)	Community (Upwind/Crosswind)	Background
1,1-Difluoroethane	75-37-6	Detected	Detected	Detected	Detected	Detected
1,2,4-Trimethylbenzene	95-63-6	Detected	Detected	Detected	Detected	Detected
1,2-Dichloroethane	107-06-2	ND	ND	Detected	Detected	ND
1,2-Dichloropropane	78-87-5	ND	ND	ND	Detected	Detected
1,3,5-Trimethylbenzene	108-67-8	ND	Detected	Detected	Detected	Detected
1,3-Butadiene	106-99-0	ND	ND	Detected	Detected	ND
2-Butanone	78-93-3	Detected	Detected	Detected	Detected	Detected
4-Methyl-2-Pentanone	108-10-1	Detected	Detected	Detected	Detected	Detected
Acetonitrile	75-05-8	Detected	Detected	Detected	Detected	Detected
Acrolein	107-02-8	Detected	Detected	Detected	Detected	Detected
Acrylonitrile	107-13-1	Detected	Detected	Detected	Detected	Detected
Benzene	71-43-2	Detected	Detected	Detected	Detected	Detected
Carbon Disulfide	75-15-0	Detected	Detected	Detected	Detected	Detected
Carbon Tetrachloride	56-23-5	Detected	Detected	Detected	Detected	Detected
Chloroethane	75-00-3	ND	Detected	Detected	Detected	Detected
Chloroform	67-66-3	Detected	Detected	Detected	Detected	Detected
Chloromethane	74-87-3	Detected	Detected	Detected	Detected	Detected
Ethyl Acetate	141-78-6	Detected	Detected	Detected	Detected	Detected
Ethylbenzene	100-41-4	Detected	Detected	Detected	Detected	Detected
Freon 113	76-13-1	Detected	Detected	Detected	Detected	Detected
Freon 12	75-71-8	Detected	Detected	Detected	Detected	Detected
Isopropanol (IPA)	67-63-0	Detected	Detected	Detected	Detected	Detected
m,p-Xylenes	179601-23-1	Detected	Detected	Detected	Detected	Detected
Methanol	67-56-1	Detected	Detected	Detected	Detected	Detected

		Detected vs Not Detected				
COPC ¹	Cas No	Fenceline (Downwind)	Community (Downwind)	Fenceline (Upwind/Crosswind)	Community (Upwind/Crosswind)	Background
Methylene Chloride	75-09-2	Detected	Detected	Detected	Detected	Detected
n-Heptane	142-82-5	Detected	Detected	Detected	Detected	Detected
n-Hexane	110-54-3	Detected	Detected	Detected	Detected	Detected
n-Pentane	109-66-0	Detected	Detected	Detected	Detected	Detected
o-Xylene	95-47-6	Detected	Detected	Detected	Detected	Detected
Propylene	115-07-1	Detected	Detected	Detected	Detected	Detected
Styrene	100-42-5	Detected	Detected	Detected	Detected	Detected
Tetrachloroethene	127-18-4	ND	Detected	ND	Detected	Detected
Tetrahydrofuran	109-99-9	ND	ND	Detected	Detected	ND
Toluene	108-88-3	Detected	Detected	Detected	Detected	Detected
trans-1,2-Dichloroethene	156-60-5	Detected	ND	ND	Detected	Detected
Vinyl Acetate	108-05-4	ND	ND	ND	Detected	ND

¹COPC: Compound of Potential Concern

ND: Not Detected

Table 8 Linear mixed model 1 results for benzene

Covariate	Benzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
(Intercept)	0.10272	0.06488	0.14056	0.00001
Weekend vs Weekday	0.02647	0.00559	0.04735	0.01395
Not Haul Route vs Haul Route	-0.00894	-0.04220	0.02433	0.60702
Distance from Landfill in Miles	0.00151	-0.00723	0.01024	0.74061
Downwind from Landfill vs Crosswind	0.09497	0.04469	0.14526	0.00049
Upwind from Landfill vs Crosswind	0.01807	-0.02544	0.06157	0.42565
Distance from Landfill (mi) x Downwind from Landfill	-0.02043	-0.03752	-0.00334	0.02507
Distance from Landfill (mi) x Upwind from Landfill	0.00026	-0.01523	0.01575	0.97485

Table 9 Linear hypothesis tests for benzene using the adjusted linear mixed model in Table 8

Linear Hypothesis Test	Benzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
Downwind Conc. vs Upwind Conc. ^a	-0.0769	-0.1329	-0.0209	0.0294
Downwind Conc. Gradient with Increased Distance ^b	-0.0189	-0.0343	-0.0035	0.0552
Upwind Conc. Gradient with Increased Distance ^c	0.0018	-0.0121	0.0156	0.9965
Distance Conc. Gradient Downwind vs Conc. Gradient Upwind ^d	-0.0385	-0.0887	0.0117	0.3665

^a A negative estimate means the average downwind concentration of benzene is higher than the average upwind concentration.

^b A negative estimate means there is a decreasing concentration gradient with increasing distance downwind of the Landfill.

^c A negative estimate means there is a decreasing concentration gradient with increasing distance upwind of the Landfill.

^d A negative estimate means the downwind concentration gradient is greater than the upwind concentration gradient.

Table 10 Linear mixed model 1 results for ethylbenzene

Covariate	Ethylbenzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
(Intercept)	0.01806	0.00718	0.02893	0.00361
Weekend vs Weekday	0.00692	0.00239	0.01145	0.00311
Not Haul Route vs Haul Route	0.00488	-0.00559	0.01536	0.37585
Distance from Landfill in Miles	-0.00172	-0.00428	0.00084	0.20313
Downwind from Landfill vs Crosswind	0.01881	0.00700	0.03063	0.00253
Upwind from Landfill vs Crosswind	-0.00190	-0.01172	0.00791	0.70749
Distance from Landfill (mi) x Downwind from Landfill	-0.00390	-0.00791	0.00012	0.06365
Distance from Landfill (mi) x Upwind from Landfill	0.00274	-0.00085	0.00634	0.14314

Table 11 Linear hypothesis tests for ethylbenzene using the adjusted linear mixed model in Table 10

Linear Hypothesis Test	Ethylbenzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
Downwind Conc. vs Upwind Conc. ^a	-0.02071	-0.03398	-0.00745	0.0083
Downwind Conc. Gradient with Increased Distance ^b	-0.00562	-0.00956	-0.00168	0.0193
Upwind Conc. Gradient with Increased Distance ^c	0.001019	-0.00256	0.0046	0.9433
Distance Conc. Gradient Downwind vs Conc. Gradient Upwind ^d	-0.002	-0.01335	0.0094	0.9891

^a A negative estimate means the average downwind concentration of ethylbenzene is higher than the average upwind concentration.

^b A negative estimate means there is a decreasing concentration gradient with increasing distance downwind of the Landfill.

^c A negative estimate means there is a decreasing concentration gradient with increasing distance upwind of the Landfill.

^d A negative estimate means the downwind concentration gradient is greater than the upwind concentration gradient.

Table 12 Linear mixed model 2 results for benzene

Covariate	Benzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
(Intercept)	0.12343	0.08530	0.16157	0.00001
Weekend vs Weekday	0.02537	0.00467	0.04608	0.01738
Not Haul Route vs Haul Route	-0.00593	-0.03615	0.02429	0.70703
Community Location, Crosswind vs Background	-0.03015	-0.05889	-0.00141	0.05495
Community Location Downwind vs Background	-0.00557	-0.04504	0.03390	0.78561
Community Location Upwind vs Background	0.00328	-0.02897	0.03553	0.84550
Fenceline Location, Crosswind vs Background	0.00142	-0.04795	0.05080	0.95538
Fenceline Location, Downwind vs Background	0.10285	0.05277	0.15293	0.00087
Fenceline Location, Upwind vs Background	-0.00668	-0.05600	0.04265	0.79360

Table 13 Linear hypothesis tests for benzene using the adjusted linear mixed model in Table 12

Linear Hypothesis Test	Benzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
Downwind, Fenceline vs Background	0.10285	0.05277	0.15293	0.00017
Downwind, Fenceline vs Downwind Community	0.10842	0.05267	0.16417	0.00051
Downwind, Community vs Background	-0.00557	-0.04504	0.03390	0.95797

Table 14 Linear mixed model 2 results for ethylbenzene

Covariate	Ethylbenzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
(Intercept)	0.01147	0.00059	0.02235	0.05719
Weekend vs Weekday	0.00676	0.00237	0.01114	0.00291
Not Haul Route vs Haul Route	0.00725	-0.00141	0.01591	0.12298
Community Location, Crosswind vs Background	-0.00330	-0.01134	0.00474	0.43309
Community Location Downwind vs Background	0.00166	-0.00835	0.01167	0.74787
Community Location Upwind vs Background	0.00782	-0.00091	0.01654	0.09566
Fenceline Location, Crosswind vs Background	0.01527	0.00261	0.02794	0.02528
Fenceline Location, Downwind vs Background	0.03570	0.02213	0.04928	0.00004
Fenceline Location, Upwind vs Background	0.00095	-0.01183	0.01373	0.88576

Table 15 Linear hypothesis tests for ethylbenzene using the adjusted linear mixed model in Table 14

Linear Hypothesis Test	Ethylbenzene			
	ppb			P-value
	Estimate	95% LCL	95% UCL	
Downwind, Fenceline vs Background	0.03570	0.02213	0.04928	<0.00001
Downwind, Fenceline vs Downwind Community	0.03404	0.01987	0.04821	0.00001
Downwind, Community vs Background	0.00166	-0.00835	0.01167	0.94229

Table 16 Comparison of detected COPCs in locations along the haul route to the Landfill compared to locations not along the haul route and in background for 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025

Compound	Cas No.	Haul Route Location	Non-Haul Route Location	Background
1,1-Difluoroethane	75-37-6	Detected	Detected	Detected
1,2,4-Trimethylbenzene	95-63-6	Detected	Detected	Detected
1,2-Dichloroethane	107-06-2	Detected	Detected	ND
1,2-Dichloropropane	78-87-5	Detected	Detected	Detected
1,3,5-Trimethylbenzene	108-67-8	ND	Detected	Detected
1,3-Butadiene	106-99-0	Detected	Detected	ND
2-Butanone	78-93-3	Detected	Detected	Detected
4-Methyl-2-Pentanone	108-10-1	Detected	Detected	Detected
Acetonitrile	75-05-8	Detected	Detected	Detected
Acrolein	107-02-8	Detected	Detected	Detected
Acrylonitrile	107-13-1	Detected	Detected	Detected
Benzene	71-43-2	Detected	Detected	Detected
Carbon Disulfide	75-15-0	Detected	Detected	Detected
Carbon Tetrachloride	56-23-5	Detected	Detected	Detected
Chloroethane	75-00-3	Detected	Detected	Detected
Chloroform	67-66-3	Detected	Detected	Detected
Chloromethane	74-87-3	Detected	Detected	Detected
Ethyl Acetate	141-78-6	Detected	Detected	Detected
Ethylbenzene	100-41-4	Detected	Detected	Detected
Freon 113	76-13-1	Detected	Detected	Detected
Freon 12	75-71-8	Detected	Detected	Detected
Isopropanol (IPA)	67-63-0	Detected	Detected	Detected
Methanol	67-56-1	Detected	Detected	Detected
Methylene Chloride	75-09-2	Detected	Detected	Detected
Propylene	115-07-1	Detected	Detected	Detected
Styrene	100-42-5	Detected	Detected	Detected
Tetrachloroethene	127-18-4	Detected	Detected	Detected
Tetrahydrofuran	109-99-9	Detected	Detected	ND
Toluene	108-88-3	Detected	Detected	Detected
Vinyl Acetate	108-05-4	ND	Detected	ND
m,p-Xylenes	179601-23-1	Detected	Detected	Detected
n-Heptane	142-82-5	Detected	Detected	Detected
n-Hexane	110-54-3	Detected	Detected	Detected
n-Pentane	109-66-0	Detected	Detected	Detected
o-Xylene	95-47-6	Detected	Detected	Detected
trans-1,2-Dichloroethene	156-60-5	ND	Detected	Detected

COPC: Compound of Potential Concern; ND: Not Detected

Table 17 Comparison of detected COPCs on weekdays compared to weekends and by location and wind direction for 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025

		Weekday (Landfill Accepting Waste)					Weekend (Landfill Not Accepting Waste and Working Face Covered)				
		Downwind		Upwind			Downwind		Upwind		
Compound	Cas No	Fenceline	Community	Fenceline	Community	Background	Fenceline	Community	Fenceline	Community	Background
1,1-Difluoroethane	75-37-6	D	D	D	D	D	D	D	D	D	D
1,2,4-Trimethylbenzene	95-63-6	D	D	D	D	D	D	D	D	D	D
1,2-Dichloroethane	107-06-2	ND	ND	ND	D	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	78-87-5	ND	ND	ND	D	ND	ND	ND	ND	ND	D
1,3,5-Trimethylbenzene	108-67-8	ND	D	ND	D	D	ND	D	ND	ND	ND
1,3-Butadiene	106-99-0	ND	ND	D	ND	ND	ND	ND	ND	ND	ND
2-Butanone	78-93-3	D	D	D	D	D	D	D	D	D	D
4-Methyl-2-Pentanone	108-10-1	D	D	D	D	D	ND	D	D	D	D
Acetonitrile	75-05-8	D	D	D	D	D	D	D	D	D	D
Acrolein	107-02-8	D	D	D	D	D	D	D	D	D	D
Acrylonitrile	107-13-1	ND	D	ND	D	D	D	ND	ND	D	ND
Benzene	71-43-2	D	D	D	D	D	D	D	D	D	D
Carbon Disulfide	75-15-0	D	D	D	D	D	D	D	D	D	D
Carbon Tetrachloride	56-23-5	D	D	D	D	D	D	D	D	D	D
Chloroethane	75-00-3	ND	D	D	D	D	ND	D	ND	D	D
Chloroform	67-66-3	D	D	D	D	D	D	D	D	D	D
Chloromethane	74-87-3	D	D	D	D	D	D	D	D	D	D
Ethyl Acetate	141-78-6	D	D	D	D	D	D	D	D	D	D
Ethylbenzene	100-41-4	D	D	D	D	D	D	D	D	D	D
Freon 113	76-13-1	D	D	D	D	D	D	D	D	D	D
Freon 12	75-71-8	D	D	D	D	D	D	D	D	D	D
Isopropanol (IPA)	67-63-0	D	D	D	D	D	D	D	D	D	D
Methanol	67-56-1	D	D	D	D	D	D	D	D	D	D
Methylene Chloride	75-09-2	D	D	D	D	D	D	D	D	D	D
Propylene	115-07-1	D	D	D	D	D	D	D	D	D	D
Styrene	100-42-5	D	D	D	D	D	D	D	D	D	D
Tetrachloroethene	127-18-4	ND	D	ND	D	D	ND	ND	ND	D	D

		Weekday (Landfill Accepting Waste)					Weekend (Landfill Not Accepting Waste and Working Face Covered)				
		Downwind		Upwind			Downwind		Upwind		
Compound	Cas No	Fenceline	Community	Fenceline	Community	Background	Fenceline	Community	Fenceline	Community	Background
Tetrahydrofuran	109-99-9	ND	ND	D	ND	ND	ND	ND	ND	ND	ND
Toluene	108-88-3	D	D	D	D	D	D	D	D	D	D
Vinyl Acetate	108-05-4	ND	ND	ND	D	ND	ND	ND	ND	ND	ND
m,p-Xylenes	179601-23-1	D	D	D	D	D	D	D	D	D	D
n-Heptane	142-82-5	D	D	D	D	D	D	D	D	D	D
n-Hexane	110-54-3	D	D	D	D	D	D	D	D	D	D
n-Pentane	109-66-0	D	D	D	D	D	D	D	D	D	D
o-Xylene	95-47-6	D	D	D	D	D	D	D	D	D	D
trans-1,2-Dichloroethene	156-60-5	D	ND	ND	ND	D	ND	ND	ND	ND	ND

COPC: Compounds of Potential Concern; ND: Never Detected; D: Detected

Table 18 Summary of compounds with different concentrations when the Landfill was not accepting waste and the working face was covered on weekends compared to when it was accepting waste on weekdays in 24-hour fixed air samples collected consecutively from May 2 to May 12, 2025

Compound	ppb			P value
	Difference in ppb on Weekend vs Weekday	95% LCL	95% UCL	
Methanol	-3.53060	-6.56999	-0.49121	0.02411
Methylene Chloride	-0.23302	-0.45050	-0.01554	0.03732
n-Hexane	-0.08447	-0.15845	-0.01048	0.02663
2-Butanone	-0.07024	-0.13593	-0.00455	0.03768
Chloromethane	-0.04762	-0.08780	-0.00745	0.02139
Freon 12	-0.02680	-0.03659	-0.01701	<0.00001
Acetonitrile	-0.01122	-0.01925	-0.00319	0.00682
Carbon Tetrachloride	-0.00596	-0.00791	-0.00400	<0.00001
Ethylbenzene	0.00692	0.00240	0.01145	0.00311
m,p-Xylenes	0.01439	0.00499	0.02379	0.00306
Benzene	0.02647	0.00559	0.04735	0.01395

Table 19 Summary of criteria for classification of compounds

Classification	Compound	Landfill permitted to emit	Downwind Fenceline			Downwind Community			Background			Model Estimates (95% CI) (ppb)
			# of Samples	% Detected	Avg (Max) (ppb)	# of Samples	% Detected	Avg (Max) (ppb)	# of Samples	% Detected	Avg (Max) (ppb)	
Contribution Likely from Landfill	Ethylbenzene	Y	11	91%	0.06 (0.082)	20	55%	0.022 (0.058)	47	64%	0.02 (0.053)	-0.0056 (-0.0096, -0.0017)
	Benzene	Y	11	100%	0.23 (0.34)	20	100%	0.119 (0.23)	47	100%	0.13 (0.46)	-0.0189 (-0.0343, -0.0035)
Contribution Possibly from Landfill	1,1-Difluoroethane	N	11	91%	0.3 (0.54)	20	45%	0.226 (0.88)	47	62%	0.15 (1.7)	-0.0269 (-0.0801, 0.0262)
	Carbon Disulfide	Y	11	73%	0.03 (0.052)	20	50%	0.027 (0.12)	47	38%	0.02 (0.07)	-0.0025 (-0.0073, 0.0022)
	Ethyl Acetate	N	11	100%	0.93 (2.3)	20	100%	0.895 (5)	47	100%	0.75 (12)	-0.0626 (-0.2902, 0.1651)
	Methylene Chloride	Y	11	100%	0.48 (2.2)	20	100%	0.344 (1.4)	47	100%	0.36 (0.95)	-0.0341 (-0.1841, 0.1159)
	Propylene	N	11	100%	0.21 (0.36)	20	80%	0.136 (0.46)	47	74%	0.11 (0.33)	-0.0172 (-0.0442, 0.0099)
	n-Heptane	N	11	82%	0.04 (0.053)	20	35%	0.024 (0.082)	47	40%	0.03 (0.18)	-0.001 (-0.0055, 0.0035)
	n-Hexane	Y	11	100%	0.12 (0.36)	20	100%	0.127 (0.46)	47	100%	0.13 (0.39)	-0.0022 (-0.0532, 0.0488)
	n-Pentane	Y	11	100%	0.52 (1.1)	20	100%	0.236 (0.41)	47	100%	0.33 (4.9)	-0.063 (-0.148, 0.0221)
	trans-1,2-Dichloroethene	Y	11	9%	0.01 (0.0093)	20	0%	ND	47	4%	0.01 (0.032)	-0.0003 (-0.0011, 0.0005)
Contribution Not Likely from Landfill - Compound Levels Possibly from Another Emission Source(s)	4-Methyl-2-Pentanone	Y	11	9%	0.04 (0.32)	20	20%	0.117 (0.85)	47	23%	0.1 (0.91)	-0.0017 (-0.057, 0.0537)
	Acrylonitrile	Y	11	18%	0.05 (0.24)	20	5%	0.118 (2.1)	47	9%	0.37 (15)	-0.0706 (-0.2994, 0.1582)
	Isopropanol (IPA)	Y	11	100%	3.15 (16)	20	100%	3.738 (15)	47	100%	9.29 (140)	-0.7113 (-6.0975, 4.675)
	Styrene	Y	11	27%	0.01 (0.025)	20	30%	0.019 (0.079)	47	30%	0.02 (0.038)	-0.0002 (-0.0032, 0.0028)

Classification	Compound	Landfill permitted to emit	Downwind Fenceline			Downwind Community			Background			Model Estimates (95% CI) (ppb)
			# of Samples	% Detected	Avg (Max) (ppb)	# of Samples	% Detected	Avg (Max) (ppb)	# of Samples	% Detected	Avg (Max) (ppb)	
	Tetrachloroethene	Y	11	0%	ND	20	5%	0.01 (0.021)	47	9%	0.01 (0.058)	-0.0001 (-0.0012, 0.001)
	Tetrahydrofuran	N	11	0%	ND	20	0%	ND	47	0%	ND	-0.0006 (-0.0048, 0.0035)
Contribution Not Likely from Landfill - Compound Levels Not Distinguishable from Background	1,2,4-Trimethylbenzene	Y	11	64%	0.02 (0.036)	20	75%	0.026 (0.12)	47	66%	0.03 (0.12)	0.0009 (-0.0034, 0.0051)
	1,2-Dichloroethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	-0.0002 (-0.0008, 0.0003)
	1,2-Dichloropropane	Y	11	0%	ND	20	0%	ND	47	2%	0.01 (0.019)	-0.0003 (-0.0009, 0.0003)
	1,3-Butadiene	Y	11	0%	ND	20	0%	ND	47	0%	ND	-0.0004 (-0.0013, 0.0006)
	1,3,5-Trimethylbenzene	Y	11	0%	ND	20	10%	0.011 (0.03)	47	2%	0.01 (0.023)	-0.0004 (-0.0019, 0.001)
	2-Butanone	Y	11	100%	0.3 (0.7)	20	100%	0.308 (0.75)	47	100%	0.32 (0.89)	-0.0115 (-0.058, 0.0349)
	Acetonitrile	N	11	91%	0.11 (0.14)	20	100%	0.114 (0.14)	47	100%	0.12 (0.22)	0.0017 (-0.0047, 0.0082)
	Acrolein	Y	11	73%	0.11 (0.19)	20	60%	0.116 (0.45)	47	79%	0.13 (0.38)	-0.0001 (-0.0143, 0.014)
	Carbon Tetrachloride	Y	11	100%	0.07 (0.085)	20	100%	0.077 (0.085)	47	100%	0.08 (0.088)	0 (-0.0013, 0.0014)
	Chloroethane	Y	11	0%	ND	20	15%	0.024 (0.11)	47	6%	0.02 (0.18)	-0.0016 (-0.0083, 0.0051)
	Chloromethane	Y	11	100%	0.54 (0.63)	20	100%	0.578 (0.84)	47	100%	0.58 (1.4)	-0.0005 (-0.0282, 0.0272)
	Chloroform	Y	11	82%	0.02 (0.025)	20	100%	0.024 (0.051)	47	96%	0.02 (0.038)	0.0008 (-0.0011, 0.0028)
	Freon 113	N	11	100%	0.06 (0.064)	20	100%	0.061 (0.066)	47	100%	0.06 (0.066)	0.0004 (-0.0008, 0.0015)
	Freon 12	Y	11	100%	0.53 (0.59)	20	100%	0.544 (0.61)	47	100%	0.54 (0.59)	0.0012 (-0.0055, 0.008)

Classification	Compound	Landfill permitted to emit	Downwind Fenceline			Downwind Community			Background			Model Estimates (95% CI) (ppb)
			# of Samples	% Detected	Avg (Max) (ppb)	# of Samples	% Detected	Avg (Max) (ppb)	# of Samples	% Detected	Avg (Max) (ppb)	
	Methanol	Y	11	100%	9.5 (18)	20	100%	11.98 (43)	47	100%	12.25 (40)	0.1031 (-1.9929, 2.1991)
	Toluene	Y	11	100%	0.25 (0.41)	20	100%	0.282 (0.98)	47	100%	0.31 (3.1)	0.0018 (-0.0558, 0.0595)
	m,p-Xylenes	Y	11	82%	0.06 (0.085)	20	55%	0.057 (0.19)	47	68%	0.06 (0.15)	0.0016 (-0.0069, 0.01)
	o-Xylene	Y	11	73%	0.03 (0.039)	20	50%	0.022 (0.071)	47	62%	0.03 (0.056)	0.0011 (-0.0042, 0.0064)
	Vinyl Acetate	N	11	0%	ND	20	0%	ND	47	0%	ND	-0.0009 (-0.0032, 0.0013)
Not Detected in Any Samples	1,1,1-Trichloroethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,1,2,2-Tetrachloroethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,1,2-Trichloroethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,1-Dichloroethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,1-Dichloroethene	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,2,4-Trichlorobenzene	N	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,2-Dibromoethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	1,2-Dichlorobenzene	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	Bromodichloromethane	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	Chlorobenzene	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	Naphthalene	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	Trichloroethene	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC
	Vinyl Chloride	Y	11	0%	ND	20	0%	ND	47	0%	ND	NC

*Averages calculated by substituting ½*Method Detection Limit for non detections; ND: Not Detected; NC: Not Calculated

Table 20 Summary of responses to hotline complaints and deployment of 1-hour air samples in the Tontitown, AR air sampling study May 2, to May 12, 2025

Assessment ID	Date and Time	Wind Direction	Location	Latitude	Longitude	Distance From Landfill (mi)	No. of 1-Hour Samples	Odor Survey	Real-Time Monitoring
26231	5/2/2025 6:48:00 PM	89.2	Fenceline	36.144072	-94.251765	0.5	1	Y	Y
26232	5/2/2025 6:50:00 PM	89.2	Community	36.168289	-94.2818825	2.4	1	Y	Y
26237	5/3/2025 7:38:00 AM	161.5	Fenceline	36.14397759	-94.25151937	0.5	1	N	N
26238	5/3/2025 6:33:00 PM	143	Fenceline	36.128832	-94.25512	0.7	1	Y	Y
26239	5/3/2025 7:05:00 PM	143	Community	36.154964	-94.256509	1.1	1	Y	Y
26245	5/4/2025 7:32:00 AM	153	Fenceline	36.1287525	-94.2550415	0.8	1	Y	Y
26249	5/4/2025 6:59:00 PM	153	Community	36.13965893	-94.22910264	1.6	2	Y	Y
26250	5/4/2025 7:02:00 PM	153	Community	36.15529921	-94.2642013	1.1	1	N	N
26251	5/4/2025 5:30:00 PM	153	Complaint Response	36.12873217	-94.25554959	0.7	1	Y	Y
26252	5/4/2025 7:58:00 PM	S ¹	Complaint Response	36.148887	-94.274351	1.1	0	Y	Y
26258	5/5/2025 4:12:00 PM	116.8	Complaint Response	36.18563	-94.2412285	3.3	1	Y	Y
26264	5/5/2025 7:38:00 PM	S ¹	Complaint Response	36.147673	-94.284995	1.6	0	Y	Y
26272	5/6/2025 6:41:00 PM	240	Community	36.1776655	-94.25787	2.6	1	Y	Y
26273	5/6/2025 6:55:00 PM	240	Community	36.16181325	-94.25840025	1.6	2	Y	Y
26274	5/6/2025 7:44:00 PM	W ¹	Complaint Response	36.143153	-94.274111	0.9	0	Y	Y
26279	5/7/2025 7:43:00 AM	251.1	Community	36.1618515	-94.258341	1.6	1	N	N
26283	5/7/2025 6:40:00 PM	243.9	Fenceline	36.14438145	-94.25151879	0.5	1	Y	Y
26284	5/7/2025 6:43:00 PM	243.9	Fenceline	36.12956557	-94.2607832	0.7	2	Y	Y
26290	5/8/2025 7:56:00 AM	329	Complaint Response	36.1591445	-94.255671	1.4	1	Y	Y
26291	5/8/2025 7:44:00 AM	110.6	Fenceline	36.144101	-94.2519965	0.5	1	Y	Y
26301	5/9/2025 8:18:00 AM	180	Complaint Response	36.144179	-94.2739705	0.9	1	Y	Y
26302	5/9/2025 3:04:00 PM	184.9	Complaint Response	36.1516665	-94.2644255	0.9	1	Y	Y
26313	5/10/2025 7:09:00 AM	Calm	Complaint Response	36.161001	-94.252262	1.5	1	Y	Y

Assessment ID	Date and Time	Wind Direction	Location	Latitude	Longitude	Distance From Landfill (mi)	No. of 1-Hour Samples	Odor Survey	Real-Time Monitoring
26314	5/10/2025 5:19:00 PM	179.4	Community	36.1552375	-94.2642315	1.1	2	Y	Y
26315	5/10/2025 5:26:00 PM	179.4	Community	36.151571	-94.2644575	0.9	1	Y	Y
26321	5/11/2025 6:27:00 PM	226.4	Community	36.151741	-94.264404	0.9	1	Y	Y
26322	5/11/2025 6:34:00 PM	226.4	Community	36.1552635	-94.262626	1.1	1	Y	Y
26379	5/12/2025 6:00:00 PM	171.9	Fenceline	36.1444685	-94.260161	0.4	1	Y	Y
26380	5/12/2025 6:03:00 PM	171.9	Fenceline	36.1287305	-94.255003	0.8	1	Y	Y
26381	5/12/2025 6:17:00 PM	NW/N ¹	Complaint Response	36.1457395	-94.25381133	0.5	0	Y	Y
26382	5/12/2025 6:22:00 PM	NW ¹	Complaint Response	36.156128	-94.2647545	1.2	0	Y	Y
26383	5/12/2025 6:38:00 PM	NW/N ¹	Complaint Response	36.144309	-94.2684695	0.7	0	Y	Y
26384	5/12/2025 7:19:00 PM	N/SE ¹	Complaint Response	36.14312233	-94.27407817	0.9	0	Y	Y

¹Wind direction (blowing to) was determined by the field team conducting odor surveys using handheld Kestrel™ weather meters

Table 21 Summary of odor surveys conducted at fixed locations in Tontitown, AR from May 2 to May 12, 2025

Fixed Location	Distance to Landfill (mi)	Number of Odor Assessments	Number of Observed Odors	Range of Nasal Ranger D/T	Range of Hedonic Tone	Odor Wheel Descriptors
NR01	0.53	85	9	<2 – 2	-5 to -1	Biological (Fecal, Rancid, Decay); Chemical (Rotten Eggs)
NR02	0.35	86	9	<2 – 2	-4 to -1	Biological (Rancid, Decay, Urine, Skunk); Chemical (Rotten Eggs)
NR03	0.49	87	4	2 – 4	-5 to -3	Biological (Rancid, Decay, Skunk); Sewer (Rotten Eggs)
NR04	0.86	90	6	<2 – 4	-3 to -2	Biological (Fecal, Rancid, Decay); Sewer (Rotten Eggs)
NR05	1.24	88	6	<2 – 4	-7 to -1	Biological (Skunk, Fecal); Sewer (Rotten Eggs)
NR06	1.14	84	2	2 – 4	-4 to -3	Biological (Rancid, Decay); Sewer (Rotten Eggs)
NR07	1.11	86	4	<2	-2 to -1	Biological (Rancid, Decay)
NR08	1.25	83	0	ND	ND	ND
NR09	1.67	84	4	<2	-3 to -1	Biological (Rancid, Decay)
NR10	0.75	92	15	<2 – 4	-4 to -1	Biological (Rancid, Decay); Chemical (Rotten Eggs); Sewer (Rotten Eggs); Other (burning fire)
NR11	1.85	85	2	<2	-4 to -2	Biological (Rancid, Decay, Urine)
NR12	1.69	72	0	ND	ND	ND
NR13	0.92	64	0	ND	ND	ND
Total		1,086	61			

ND: Not Detected

Table 22 Summary of odor surveys conducted at roaming locations in Tontitown, AR from May 2 to May 12, 2025

Number of Odor Assessments	Number of Observed Odors	Range of Nasal Ranger D/T	Range of Hedonic Tone	Odor Wheel Descriptors
130	16	<2 – 7	-7 to -2	Biological (Rancid, Decay, Skunk); Chemical (Rotten Eggs); Natural Gas (Rotten Eggs); Sewer (Fecal)

Table 23 Odors detected during roaming odor survey locations in Tontitown, AR from May 2 to May 12, 2025

Observed At	Location Description	Nasal Ranger D/T	Odor Duration	Odor Intensity	Primary Odor	Wind Direction Blowing From	Comments
5/5/2025 7:03:41 AM	Near 12246 Red Oak Drive	2	Intermittent	2 - Faint	Biological - Skunk	N	
5/5/2025 7:05:31 AM	Near 12246 Red Oak Drive	2	Intermittent	2 - Faint	Chemical - Rotten Eggs	N	
5/6/2025 2:32:45 PM	In parking lot of Phillips 66 gas station at 1398 hwy 412	7	Persistent	3 - Distinct	Biological - Rancid, Decay	SE	Smells like rotting seafood
5/6/2025 2:34:06 PM	In parking lot of Phillips 66 gas station at 1398 hwy 412	4	Persistent	4 - Strong	Biological - Rancid, Decay	SE	
5/9/2025 7:20:08 AM	Near 12246 Red Oak Drive	2	Persistent	2 - Faint	Chemical - Rotten Eggs	NE	
5/9/2025 7:20:12 AM	Near 12246 Red Oak Drive	<2	Intermittent	2 - Faint	Chemical - Rotten Eggs	NE	
5/9/2025 7:55:51 PM	30 feet north of low spot by creek in front of 1851 S Pianalto Rd, next to potential water/gas processing sub station	4	Persistent	3 - Distinct	Natural Gas - Rotten Eggs	NE	
5/9/2025 7:45:20 PM	30 feet north of low spot by creek in front of 1851 S Pianalto Rd, next to potential water/gas processing sub station	7	Persistent	3 - Distinct	Natural Gas - Rotten Eggs	NE	
5/11/2025 3:42:49 AM	1836 South Pianalto Road	2	Persistent	2 - Faint	Chemical - Rotten Eggs	NE	
5/11/2025 3:43:25 AM	1836 South Pianalto Road	2	Persistent	4 - Strong	Chemical - Rotten Eggs	NW	
5/12/2025 7:20:29 AM	Near 12246 Red Oak Drive	2	Persistent	2 - Faint	Chemical - Rotten Eggs	N	

Observed At	Location Description	Nasal Ranger D/T	Odor Duration	Odor Intensity	Primary Odor	Wind Direction Blowing From	Comments
5/12/2025 7:29:45 AM	Near 12246 Red Oak Drive	2	Intermittent	3 - Distinct	Chemical - Rotten Eggs	W	
5/12/2025 4:15:38 PM	In parking lot of Braich Arrow Express (Phillips 66) gas station (1398 Hwy 412), 20 feet from southeast corner of building	<2	Intermittent	3 - Distinct	Biological - Rancid, Decay	N	
5/12/2025 4:25:15 PM	In parking lot of Braich Arrow Express (Phillips 66) gas station (1398 Hwy 412), 20 feet from southeast corner of building	<2	Intermittent	2 - Faint	Biological - Rancid, Decay	N	Odor is intermittent depending on wind direction. When odor is detected, it is very offensive and smells similar to rotting seafood.
5/13/2025 1:32:54 AM	1836 South Pianalto Road	<2	Persistent	2 - Faint	Chemical - Rotten Eggs	NE	
5/13/2025 1:31:43 AM	1836 South Pianalto Road	<2	Intermittent	2 - Faint	Sewer - Fecal	SE	

N: North; NE: Northeast; W: West; SE: Southeast; NW: Northwest

Table 24 Summary of odor surveys conducted during responses to hotline complaints in Tontitown, AR from May 2 to May 12, 2025

Assessment ID	Number of Odor Assessments	Number of Observed Odors	Range of Nasal Ranger D/T	Range of Hedonic Tone	Odor Wheel Descriptors	Nearest potential non-landfill odor source (mi) ¹	Distance to the Landfill (mi)
26251	2	2	2	-3 to -2	Chemical (Rotten Eggs)	Pianalto Lift Station (1.66)	0.8
26252	2	2	2	-4 to -2	Biological (Skunk)	Pianalto Lift Station (0.59)	1.1
26258	4	0	ND	ND	ND	Phillips 66 on Hwy 412 (1.09)	3.3
26264	2	0	ND	ND	ND	Pianalto Lift Station (1.18)	1.6
26274	2	0	ND	ND	ND	Pianalto Lift Station (0.8)	0.9
26290	4	0	ND	ND	ND	Pianalto Lift Station (0.71)	1.4
26301	4	0	ND	ND	ND	Pianalto Lift Station (0.75)	0.9
26302	5	5	2 – 7	-6 to -4	Natural Gas (Rotten Eggs)	Pianalto Lift Station (0.01)	0.9
26313	2	0	ND	ND	ND	Pianalto Lift Station (0.93)	1.5
26381	2	2	2	-5 to -3	Sewer (Fecal)	Pianalto Lift Station (0.73)	0.5
26382	2	0	ND	ND	ND	Pianalto Lift Station (0.3)	1.2
26383	2	2	2	-7 to -2	Chemical (Rotten Eggs)	Pianalto Lift Station (0.56)	0.7
26384	2	2	<2 – 2	-5 to -3	Natural Gas (Rotten Eggs)	Pianalto Lift Station (0.8)	0.9
Total:	35	15					

¹These potential sources were only of active facilities; non-active sources, like the retired chicken houses, were excluded as there were no activities that would result in odors.

ND: Not Detected

Table 25 Summary of odor surveys conducted during deployment of 1-hour air samples at locations with prior odors in Tontitown, AR from May 2 to May 12, 2025

Assessment ID	Number of Odor Assessments	Number of Observed Odors	Range of Nasal Ranger D/T	Range of Hedonic Tone	Odor Wheel Descriptors	Nearest potential non-landfill odor source where odors were observed (mi)	Distance to the Landfill (mi)
26231	1	0	ND	ND	ND	Pianalto Lift Station (0.89)	0.5
26232	2	0	ND	ND	ND	Harry D Mattison Power Plant (1.12)	2.4
26238	2	0	ND	ND	ND	Pianalto Lift Station (1.67)	0.7
26239	2	0	ND	ND	ND	Pianalto Lift Station (0.49)	1.1
26245	2	0	ND	ND	ND	Pianalto Lift Station (1.67)	0.8
26249	2	0	ND	ND	ND	4K Chicken Farm (1.65)	1.6
26272	2	0	ND	ND	ND	Phillips 66 on Hwy 412 (0.04)	2.6
26273	2	0	ND	ND	ND	Pianalto Lift Station (0.77)	1.6
26283	2	1	ND - <2	-2	Chemical (Rotten Eggs)	Pianalto Lift Station (0.88)	0.5
26284	2	0	ND	ND	ND	Pianalto Lift Station (1.54)	0.7
26291	2	2	<2	-3 to -2	Biological (Rancid, Decay)	Pianalto Lift Station (0.87)	0.5
26314	2	0	ND	ND	ND	Pianalto Lift Station (0.24)	1.1
26315	4	4	4	-6 to -4	Chemical (Rotten Eggs); Natural Gas (Rotten Eggs)	Pianalto Lift Station (0.01)	0.9
26321	2	0	ND	ND	ND	Pianalto Lift Station (0)	0.9
26322	2	0	ND	ND	ND	Pianalto Lift Station (0.26)	1.1
26379	2	0	ND	ND	ND	Pianalto Lift Station (0.56)	0.4
26380	2	0	ND	ND	ND	Pianalto Lift Station (1.67)	0.8
Total:	35	7					

ND: Not Detected

Table 26 Comparison of detected VOCs that were determined to be COPCs in 1-hour air samples collected in locations where responses to a hotline complaints were conducted compared 1-hour and 24-hour samples collected at the Landfill's fenceline and 24-hour background fixed air samples collected consecutively from May 2 to May 12, 2025

Compounds	Cas No.	1-Hour Hotline Complaint	1-Hour Fenceline ¹	24-Hour Fenceline (Downwind)	24-Hour Background
1,1-Difluoroethane	75-37-6	Detected	Detected	Detected	Detected
1,2,4-Trimethylbenzene	95-63-6	Detected*	Detected	Detected	Detected
1,2-Dichloroethane	107-06-2	Detected	Detected	ND	ND
1,2-Dichloropropane	78-87-5	ND	ND	ND	Detected
1,3,5-Trimethylbenzene	108-67-8	ND	Detected	ND	Detected
2-Butanone	78-93-3	Detected	Detected	Detected	Detected
4-Methyl-2-Pentanone	108-10-1	ND	ND	Detected	Detected
Acetonitrile	75-05-8	Detected	Detected	Detected	Detected
Acrolein	107-02-8	Detected	Detected	Detected	Detected
Acrylonitrile	107-13-1	ND	Detected	Detected	Detected
Benzene	71-43-2	Detected	Detected	Detected	Detected
Carbon Disulfide	75-15-0	ND	Detected	Detected	Detected
Carbon Tetrachloride	56-23-5	Detected	Detected	Detected	Detected
Chloroethane	75-00-3	ND	Detected	ND	Detected
Chloroform	67-66-3	Detected	Detected	Detected	Detected
Chloromethane	74-87-3	Detected	Detected	Detected	Detected
Ethyl Acetate	141-78-6	Detected	Detected	Detected	Detected
Ethylbenzene	100-41-4	Detected	Detected	Detected	Detected
Freon 113	76-13-1	Detected	Detected	Detected	Detected
Freon 12	75-71-8	Detected	Detected	Detected	Detected
Isopropanol (IPA)	67-63-0	Detected	Detected	Detected	Detected
m,p-Xylenes	179601-23-1	Detected	Detected	Detected	Detected
Methanol	67-56-1	Detected	Detected	Detected	Detected
Methylene Chloride	75-09-2	Detected	Detected	Detected	Detected

Compounds	Cas No.	1-Hour Hotline Complaint	1-Hour Fenceline ¹	24-Hour Fenceline (Downwind)	24-Hour Background
n-Heptane	142-82-5	Detected	Detected	Detected	Detected
n-Hexane	110-54-3	Detected	Detected	Detected	Detected
n-Pentane	109-66-0	Detected	Detected	Detected	Detected
o-Xylene	95-47-6	Detected	Detected	Detected	Detected
Propylene	115-07-1	Detected	Detected	Detected	Detected
Styrene	100-42-5	ND	Detected	Detected	Detected
Tetrachloroethene	127-18-4	ND	Detected	ND	Detected
Toluene	108-88-3	Detected	Detected	Detected	Detected
trans-1,2-Dichloroethene	156-60-5	ND	ND	Detected	Detected

COPC: Compound of Potential Concern; ND: Not Detected

¹One-hour samples includes those collected when no complaints were made and the field team places canisters near locations where odors had previously been detected by the field team along the Landfill fenceline locations to be used as comparisons. Three out of the eight of the 1-hour fenceline samples were downwind of the Landfill.

Appendix D

Figures

Figure 1 Map of potential sources of air emissions from facilities permitted by Arkansas Department of Energy and Environment in relation to reported community complaints

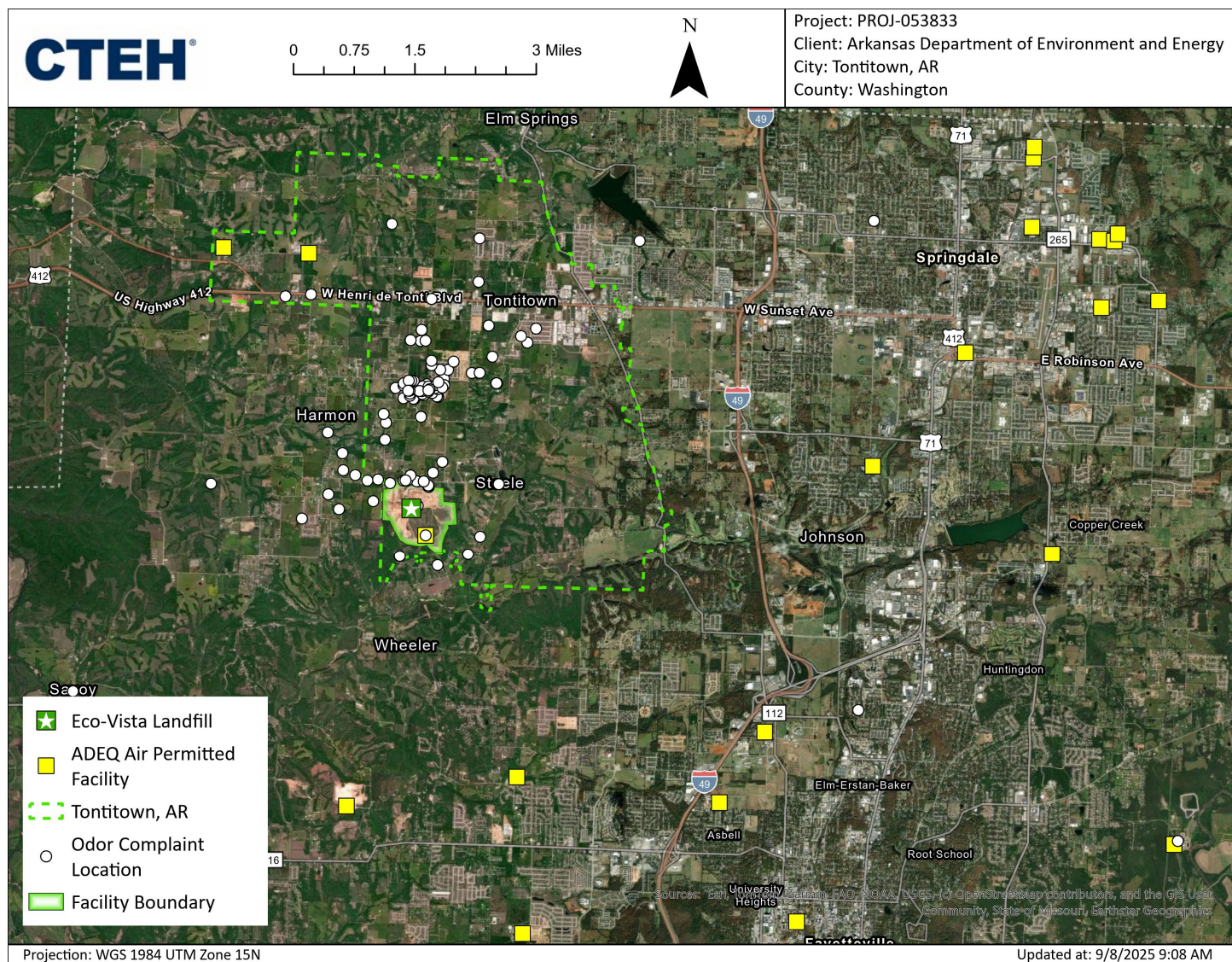


Figure 2 Map of fixed 24-hour sampling locations for COPCs that are VOCs

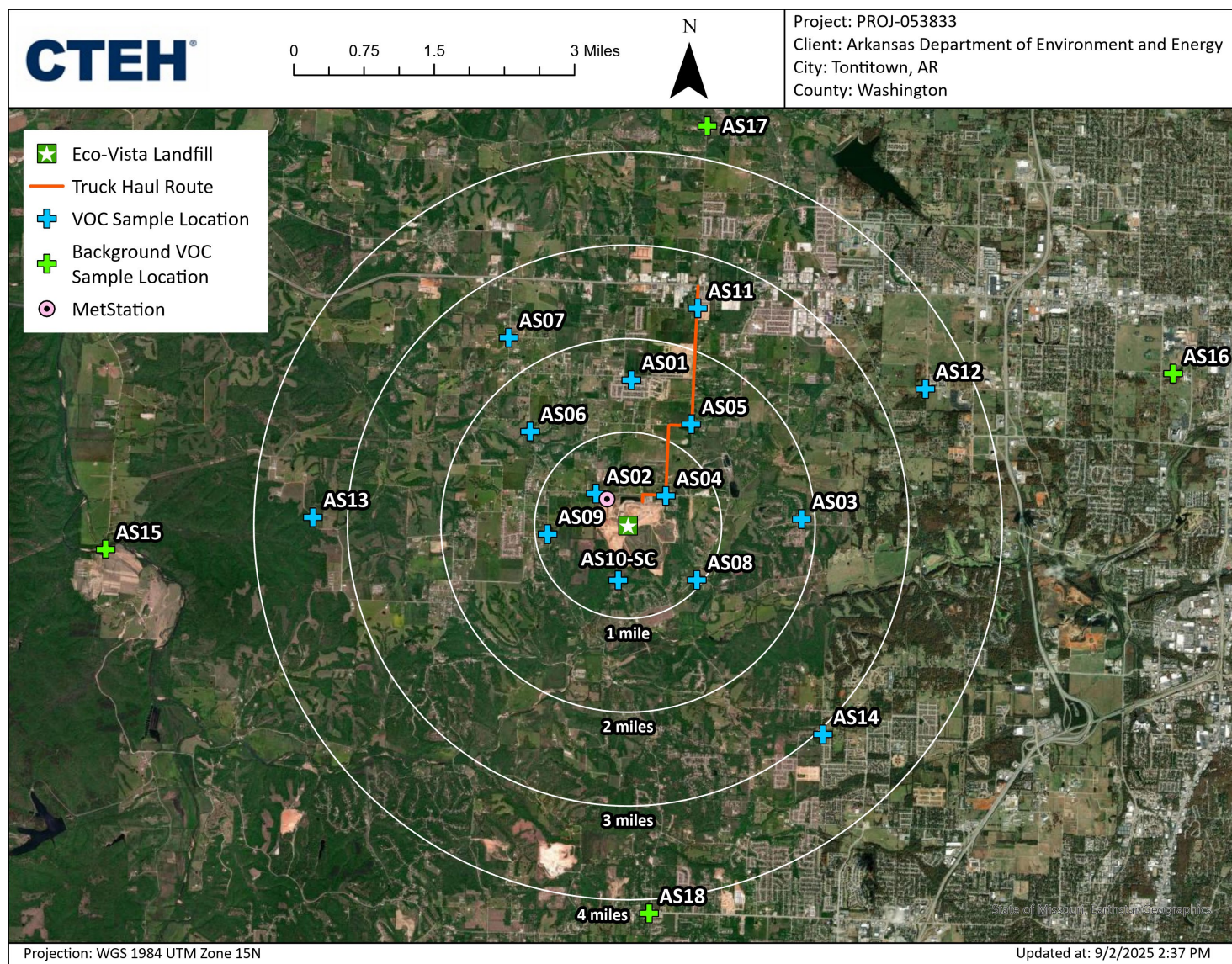


Figure 3 Map of fixed 24-hour sampling locations for measuring hydrogen fluoride

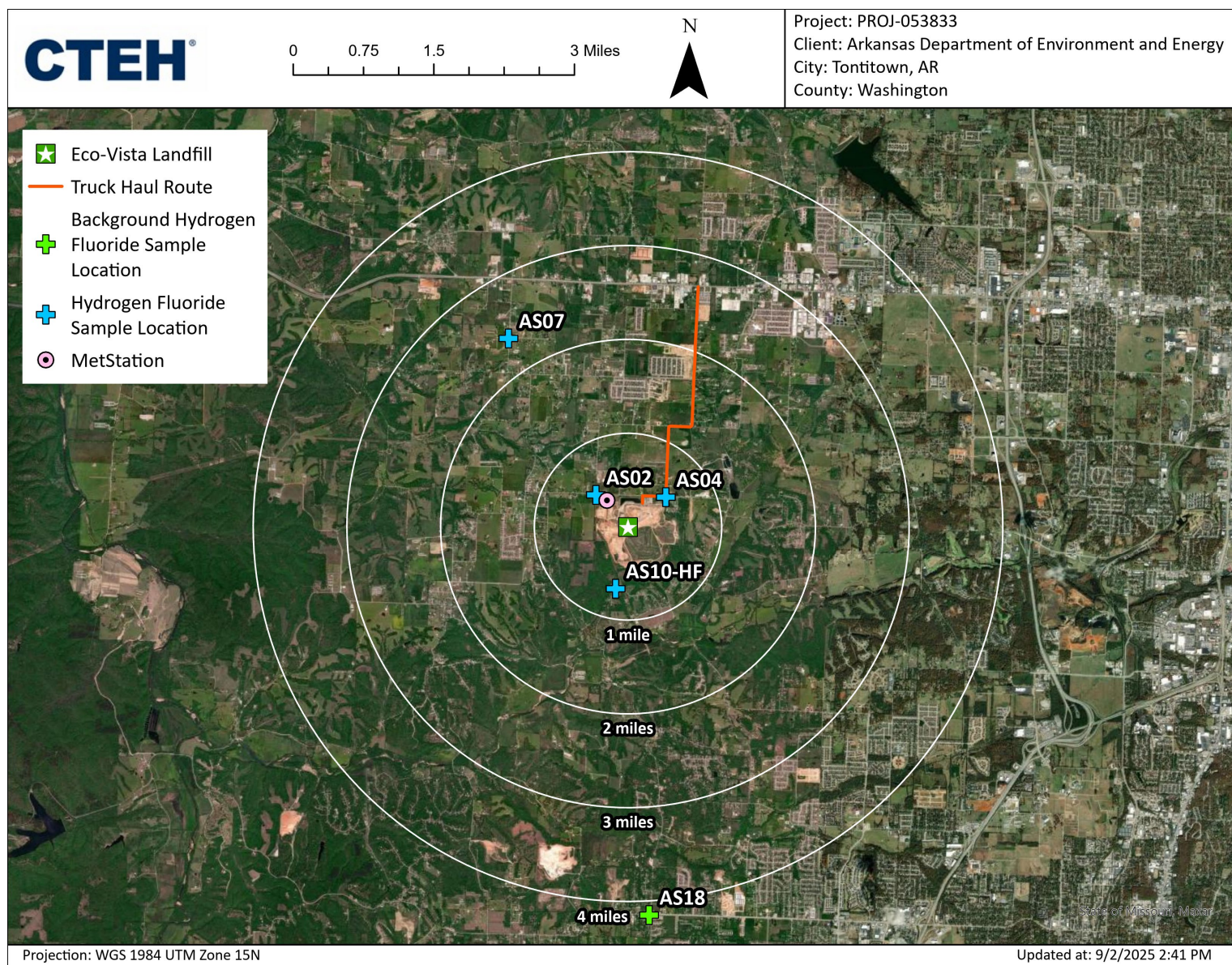


Figure 4 Map of fixed locations for odor surveys and real-time air monitoring

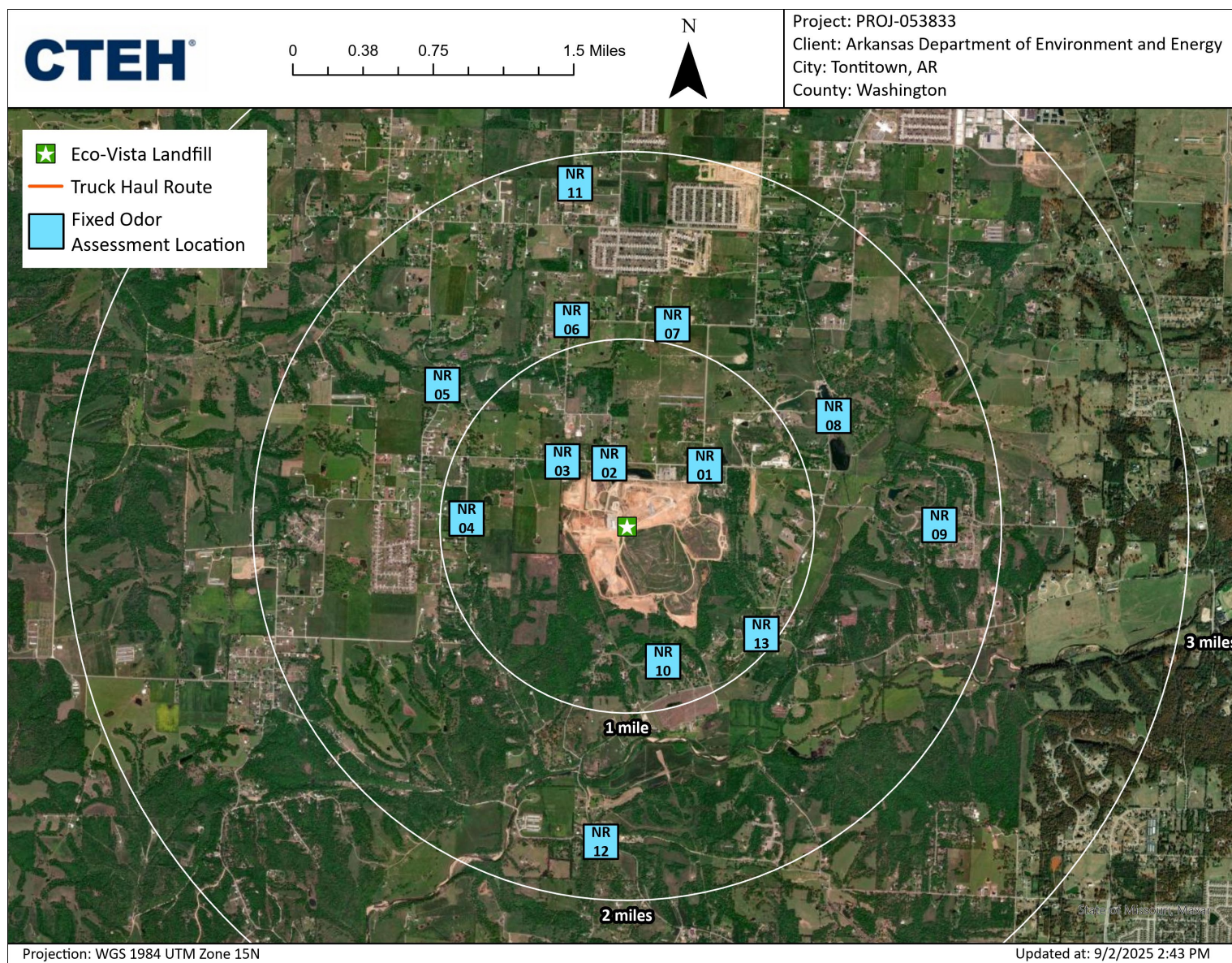
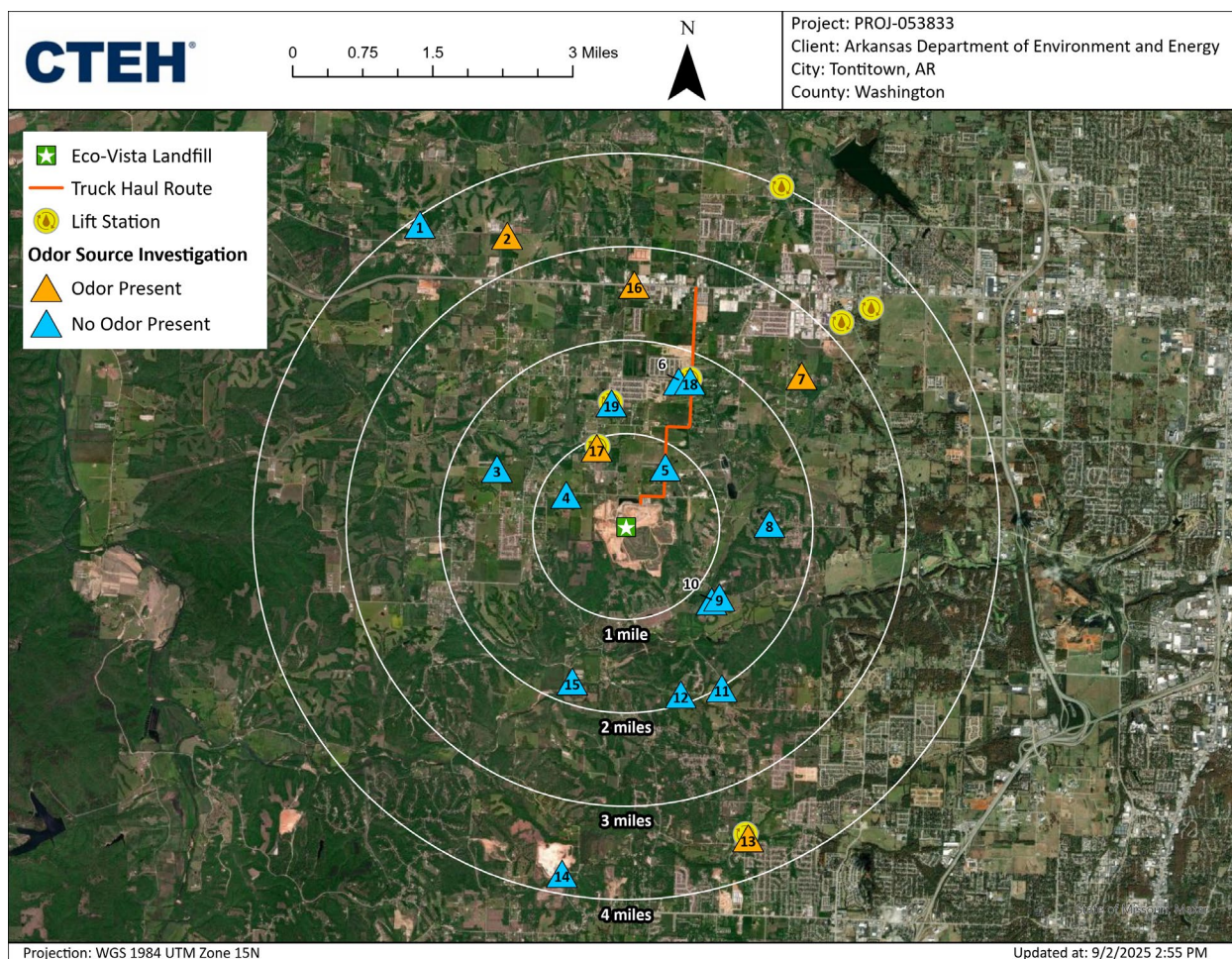


Figure 5 Map of locations investigated as potential odor sources



Odor Source Index	Location Description
1	Harvest Oil LLC
2	Harry D Mattison Power Plant LLC
3	Northwest Chicken House 2
4	West Retired Chicken Houses
5	North Retired Chicken Houses
6	Retired Chicken House north of Landfill near subdivision
7	Northeast Chicken Farm (4K Farms)
8	East Chicken Farm
9	Southeast Chicken Farm
10	Southeast Chicken Farm 2
11	South Chicken Farm 2
12	South Chicken House 3
13	Hamstring Lift Station
14	Quarry
15	South Chicken Farm
16	Manholes in parking lot of Phillips 66 gas station (Braich Arrow Express) on Henri De Tonti Blvd (Hwy 412)
17	Lift station on 1836 South Pianalto
18	Outside of Lift Station at Klenc Road and Wildcat Creek Blvd
19	Lift Station on Bausinger Rd behind pool

Figure 6 Map of roaming locations where odor surveys and real-time air measurements were collected

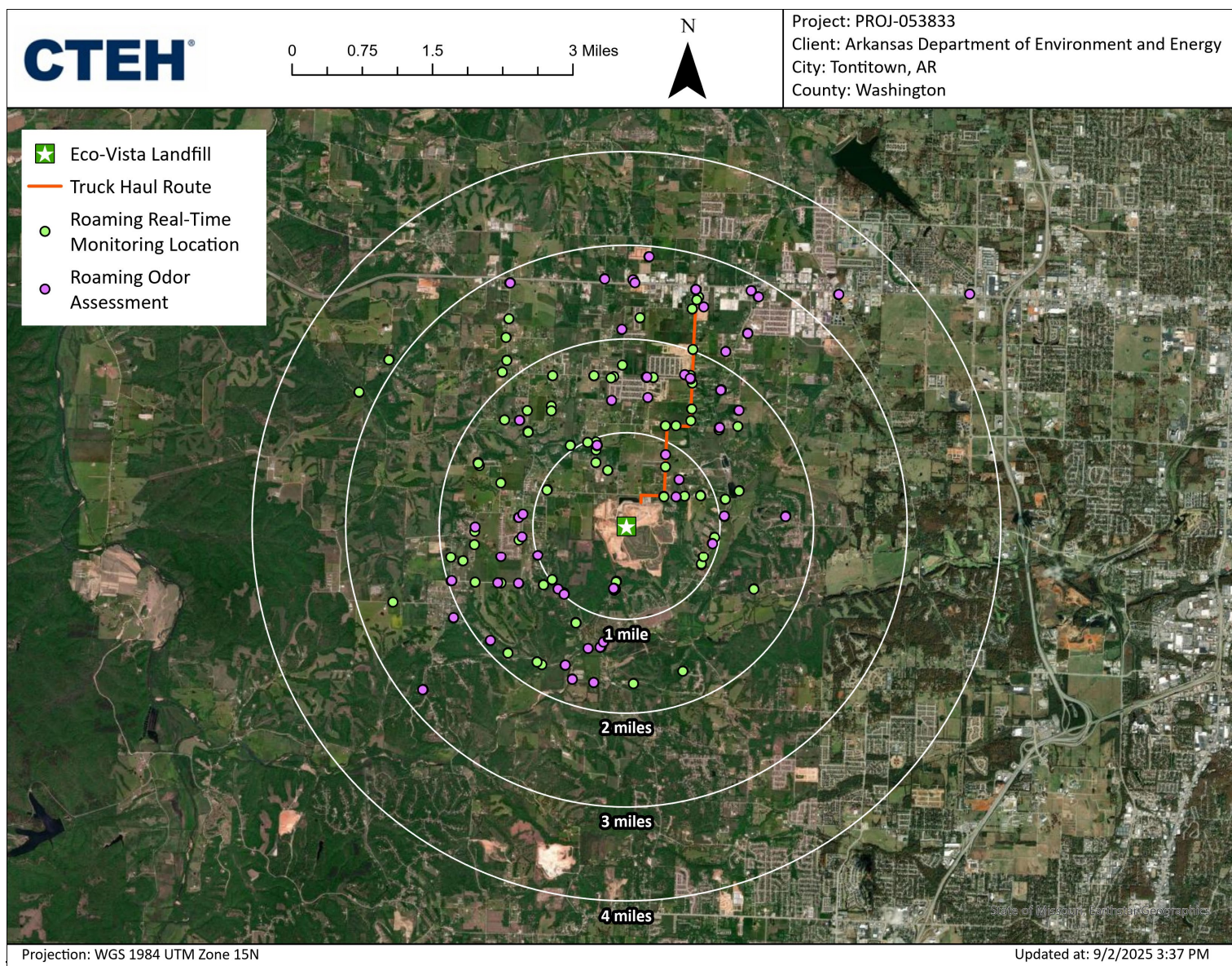


Figure 7 Map of 1-hour air sampling and odor assessments in response to hotline complaints

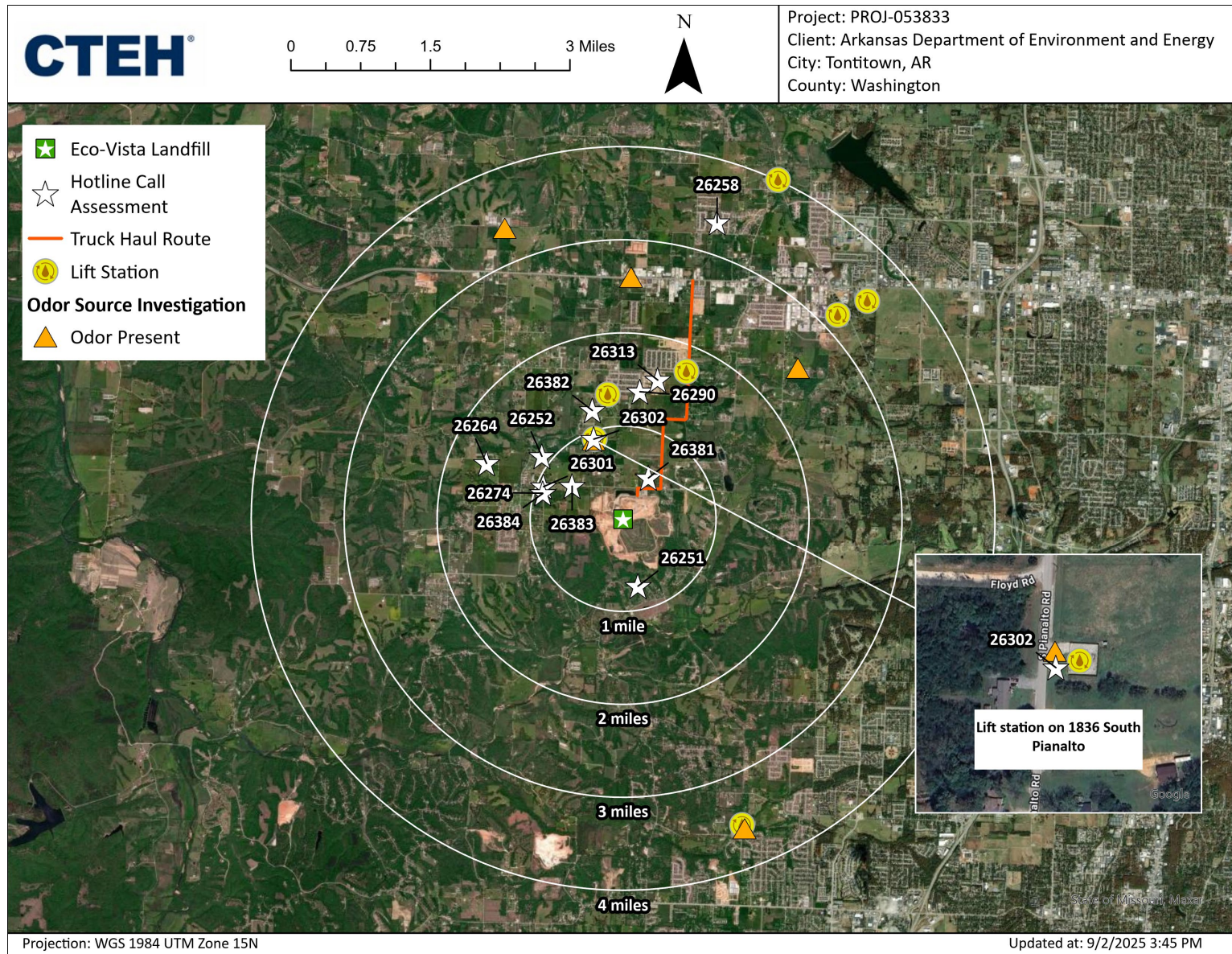


Figure 8 Map of one-hour air sampling and odor assessments for days when a hotline complaint was not received

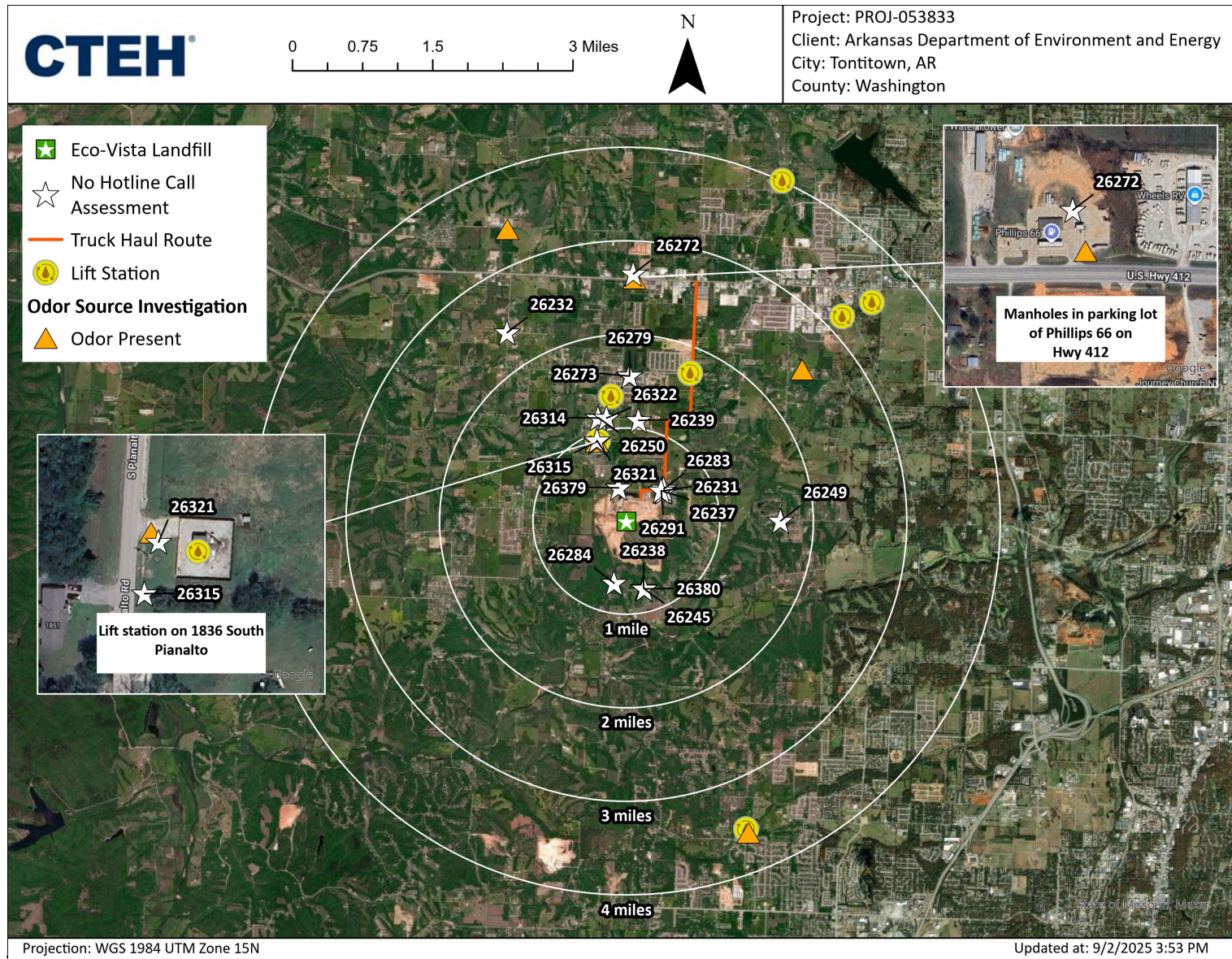


Figure 9 Fixed locations where odor surveys were conducted and odors detected in Tontitown, AR from May 2 to May 12, 2025

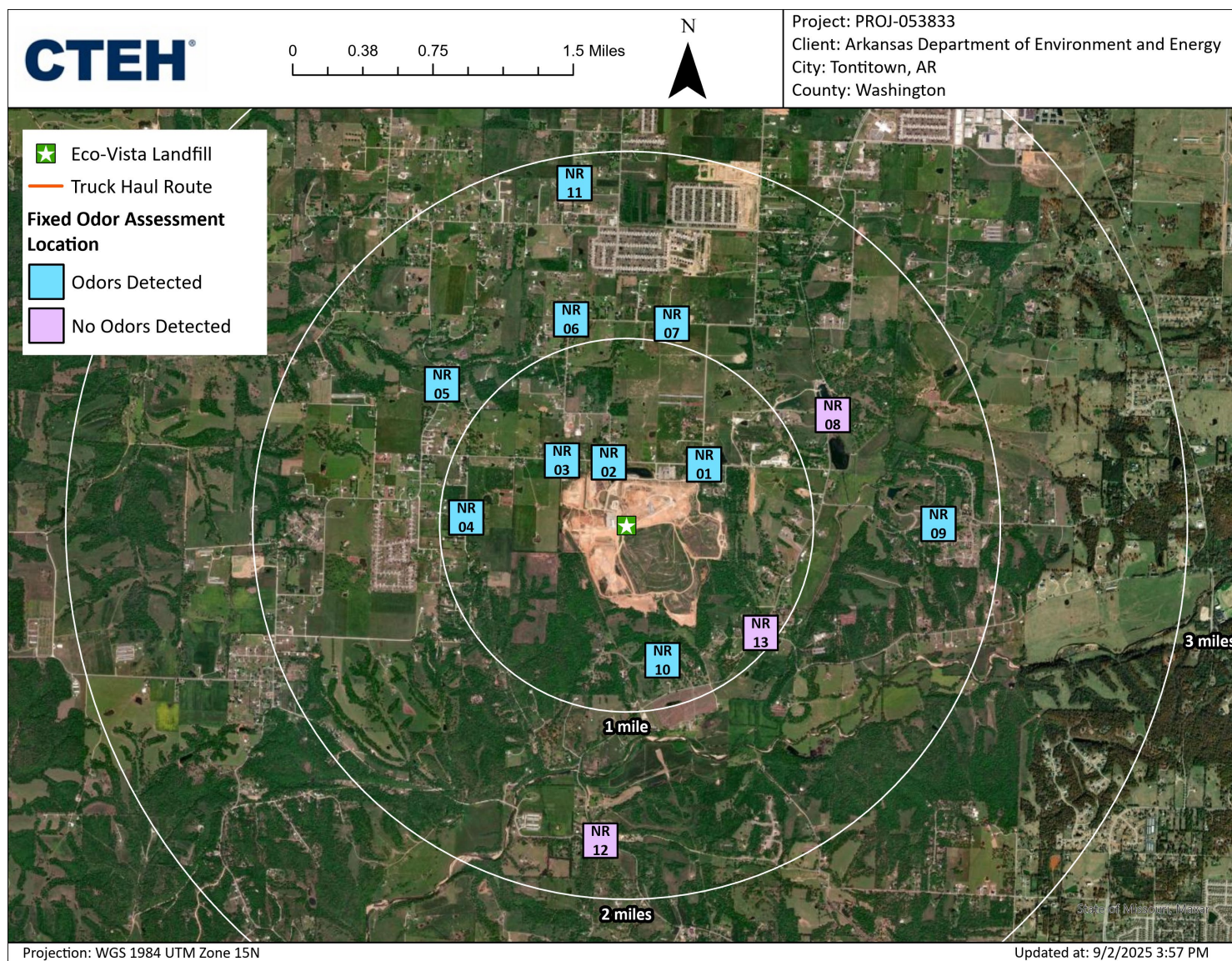


Figure 10 Roaming locations where odor surveys were conducted and odors detected in Tontitown, AR from May 2 to May 12, 2025

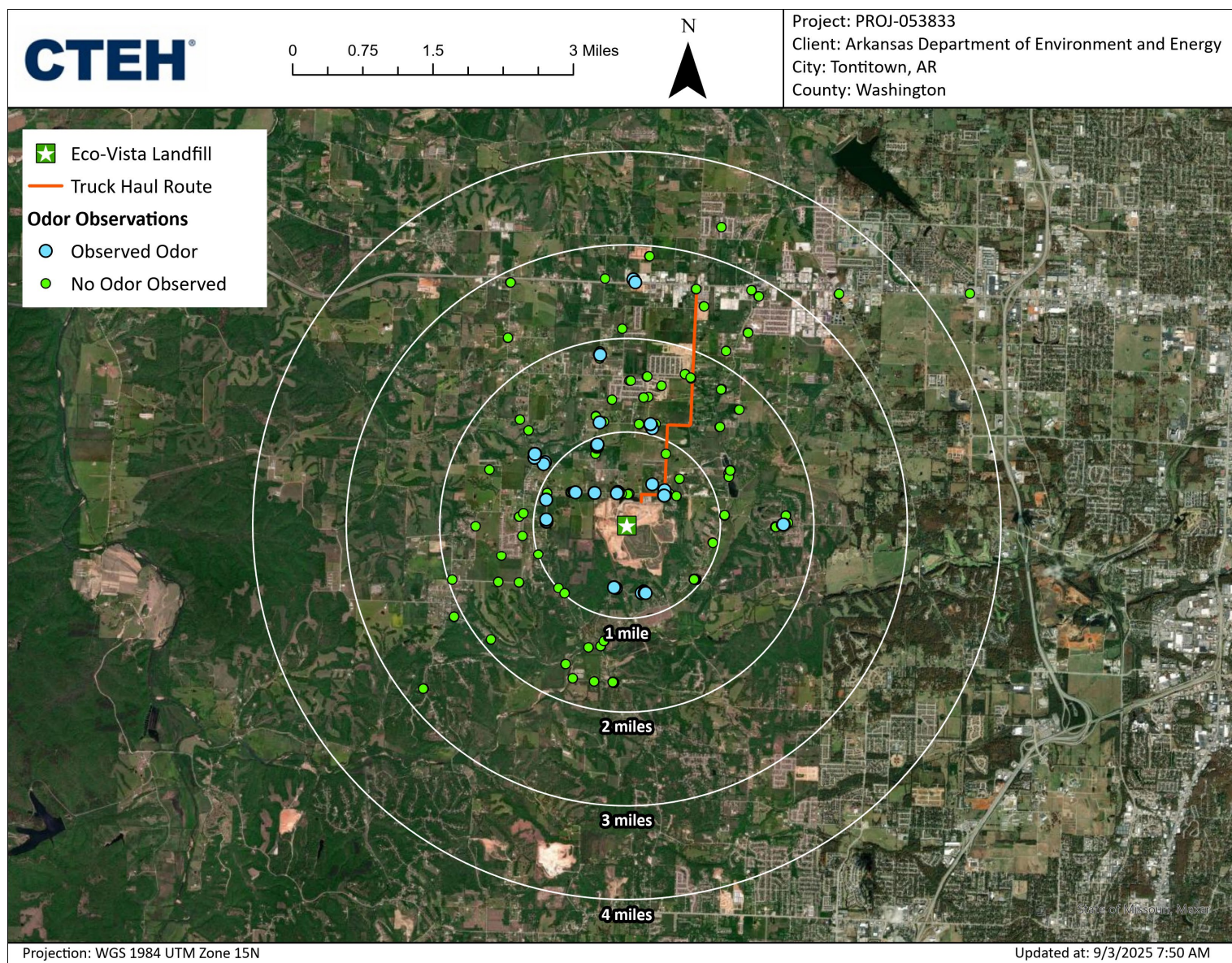


Figure 11 Locations where odors were observed in Tontitown, AR from May 2 to May 12, 2025

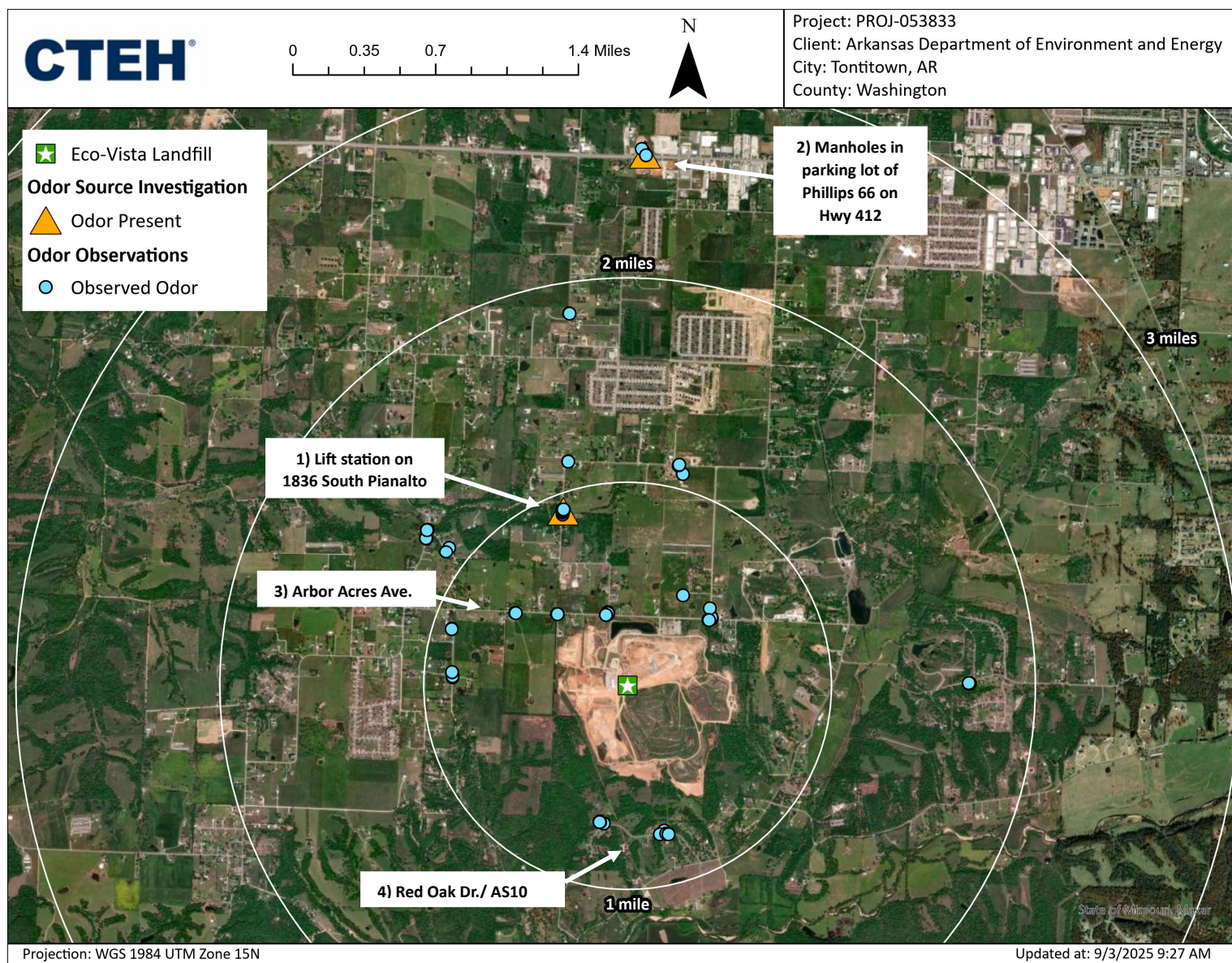


Figure 12 Location of two 1-hour samples collected on May 4, 2025 where 1,2-dichloroethane was detected along Red Oak Drive south of the Landfill



Appendix E

Daily Wind Analysis

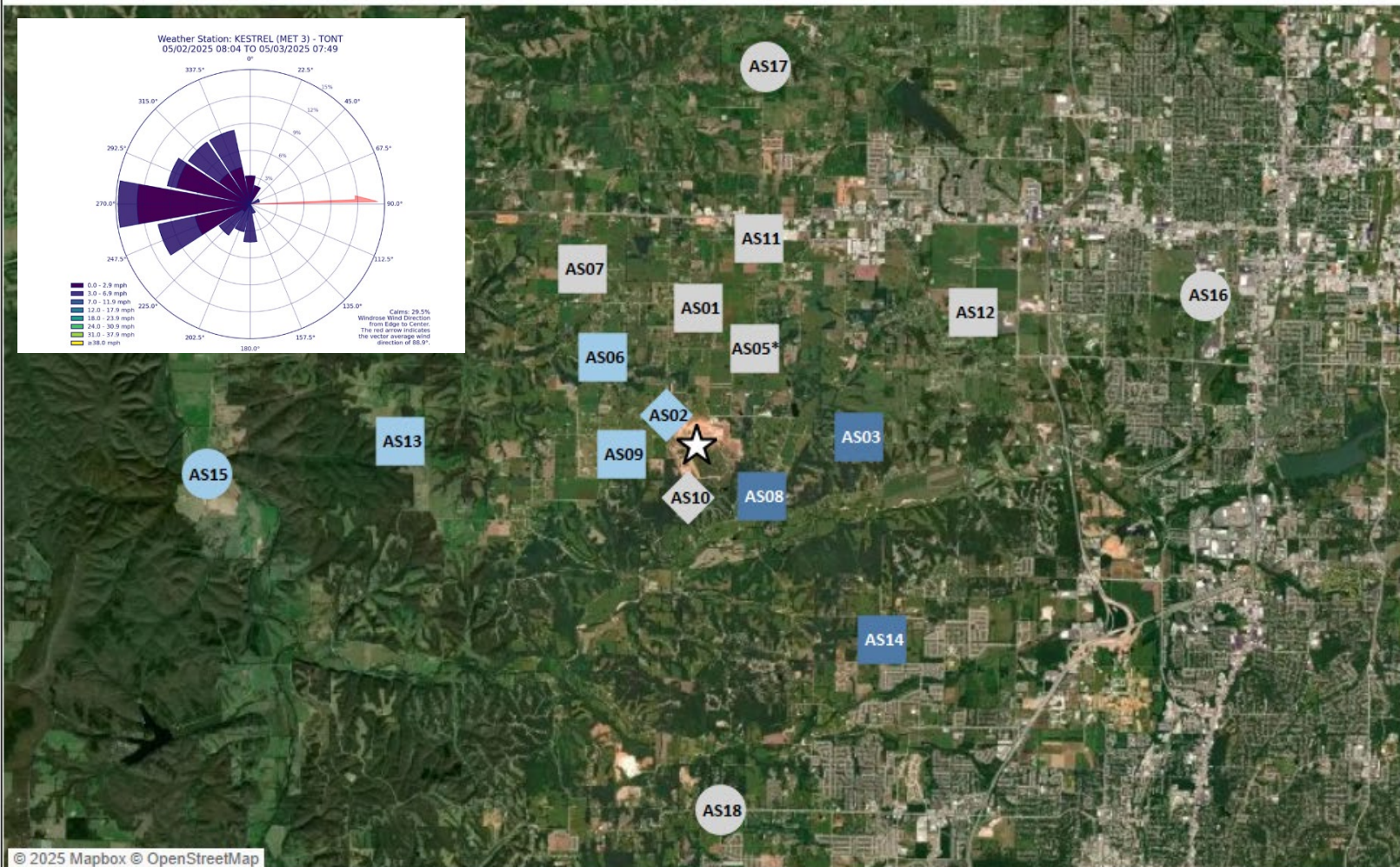
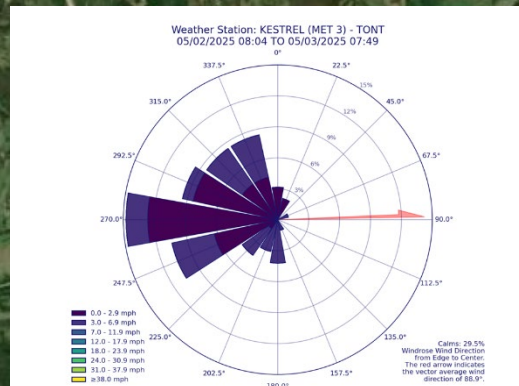
Analytical Air Sampling Stations Wind Analysis - May 2, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



*The first sample for the AS05 location was placed at the proposed location that morning and collected air at that location for an hour and a half when it was capped and relocated to the new location along the haul route (roughly 3,600 ft to the east to be in the corner of Wc Rd 857 and Klenc Road), uncapped, and allowed to collect the remainder of the sampling period.

NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

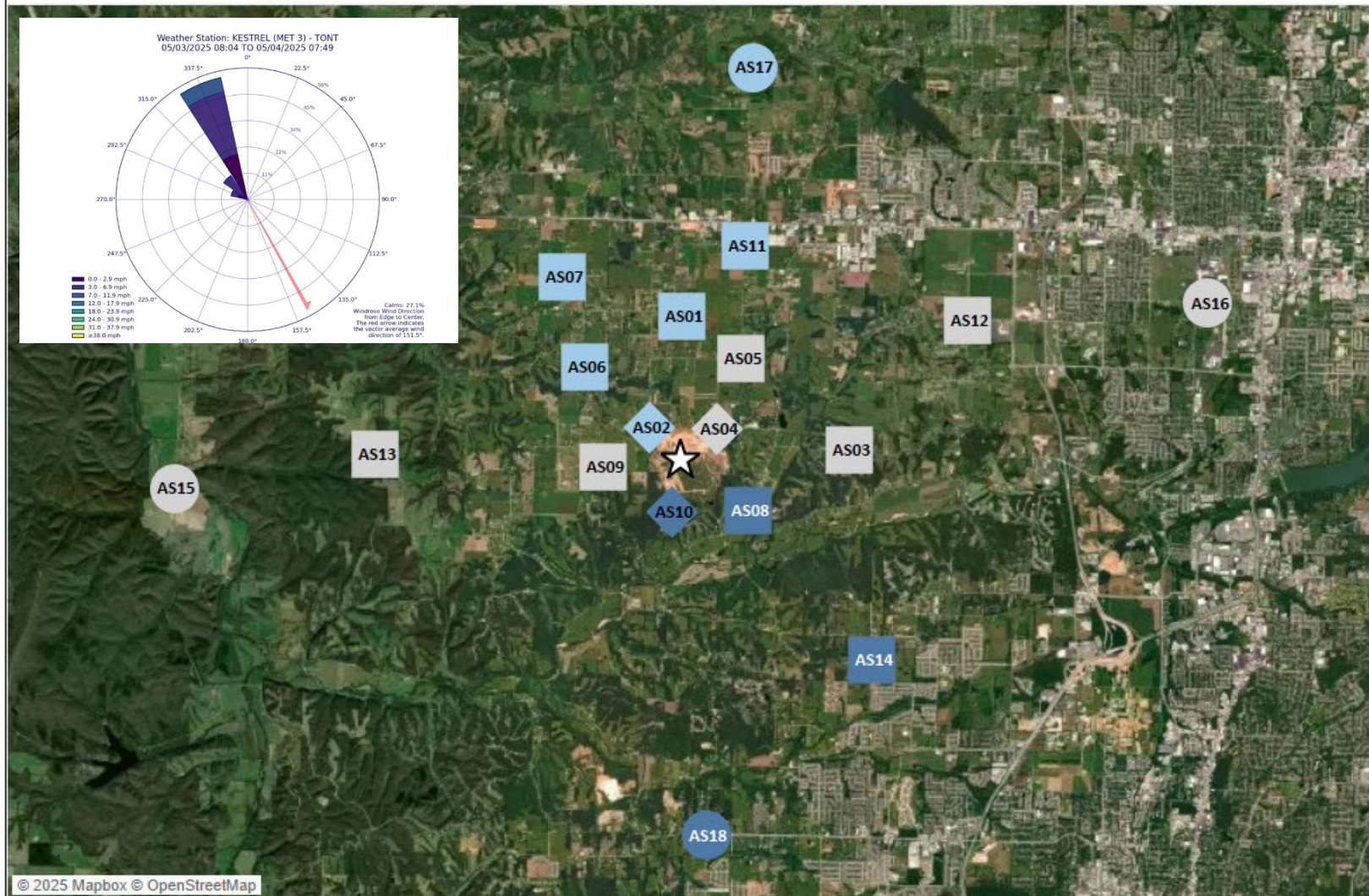
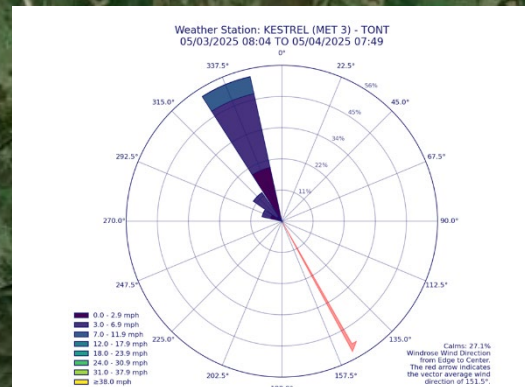
Analytical Air Sampling Stations Wind Analysis - May 3, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

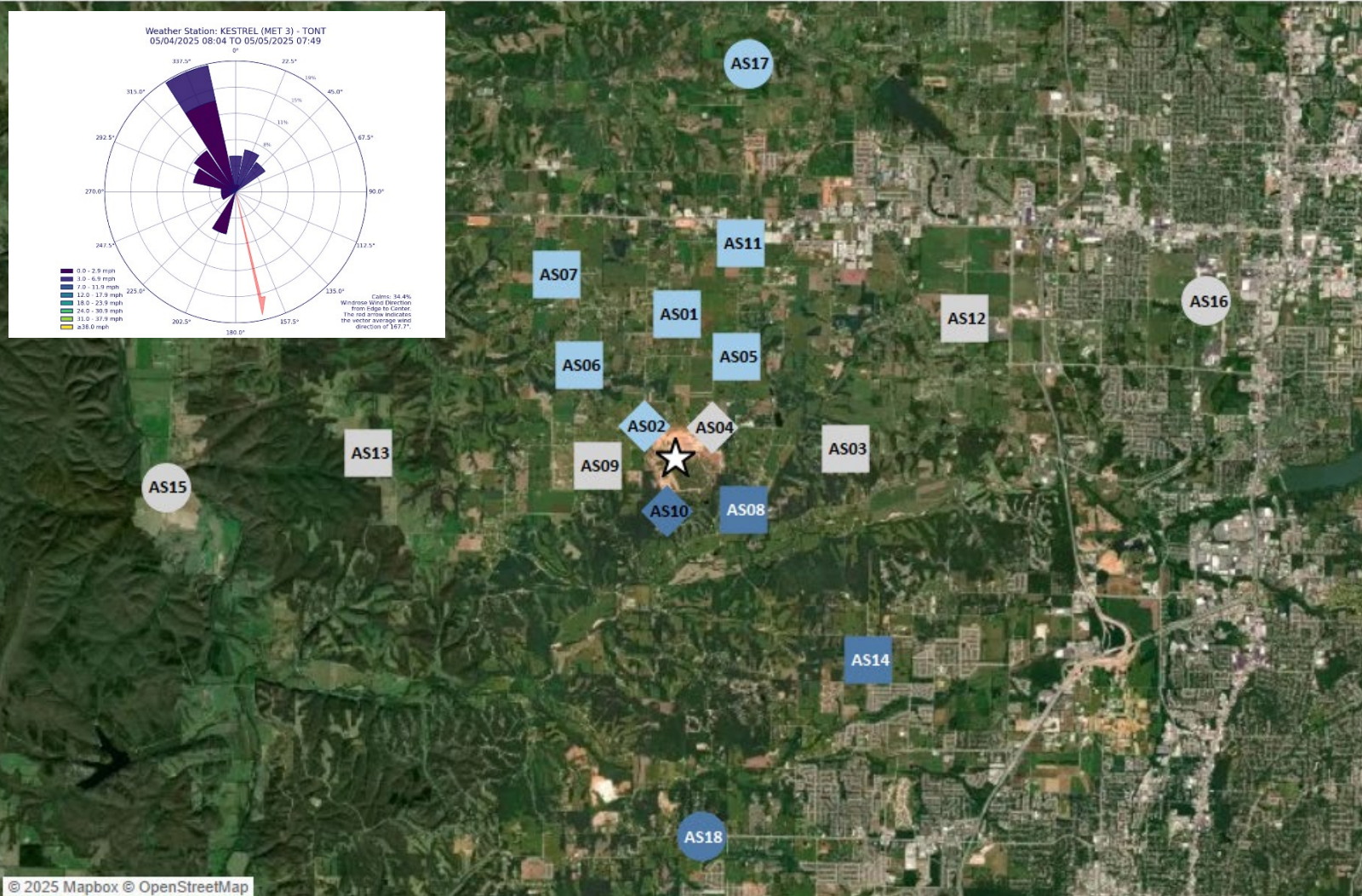
Analytical Air Sampling Stations Wind Analysis - May 4, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

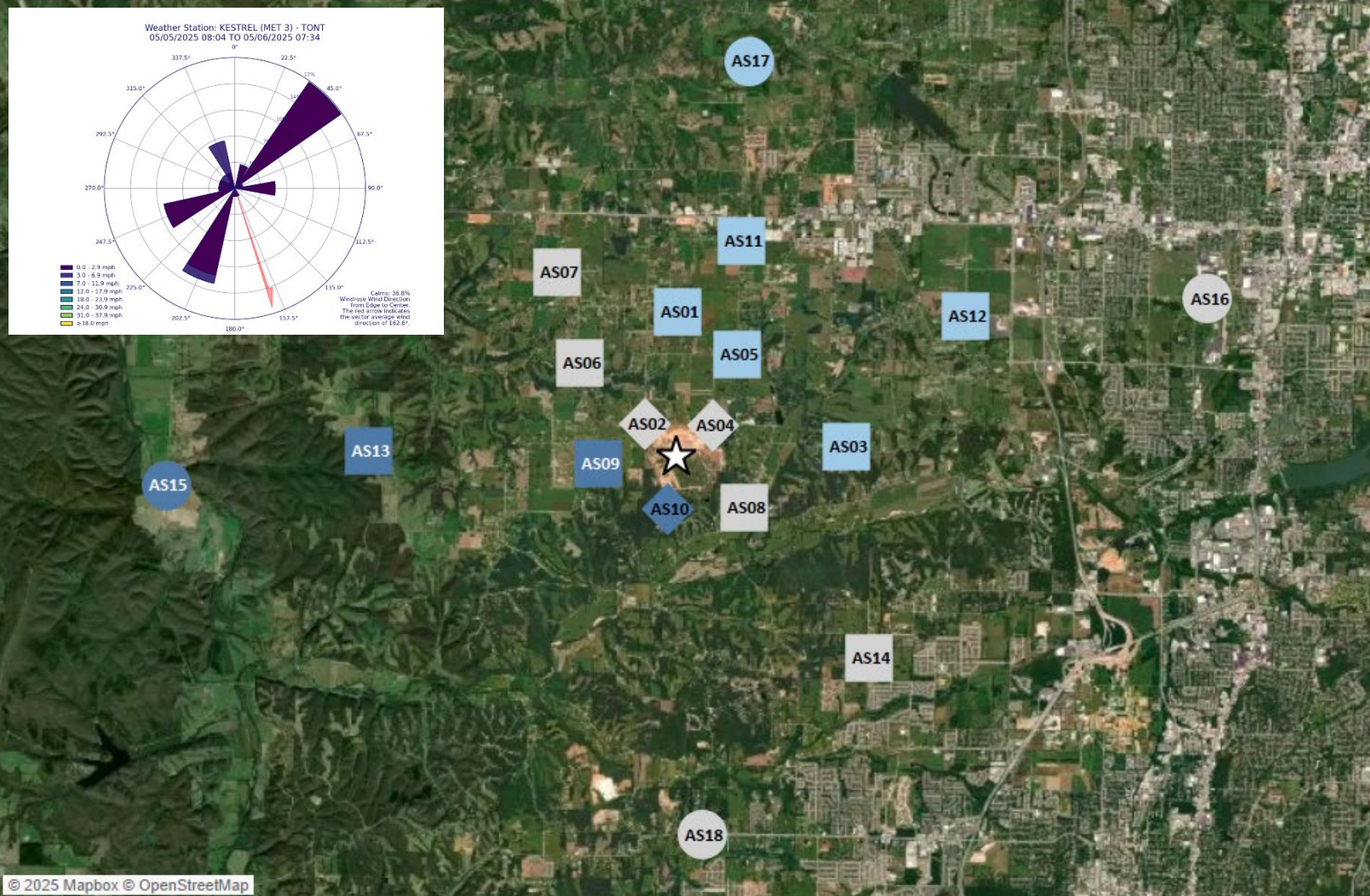
Analytical Air Sampling Stations Wind Analysis - May 5, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

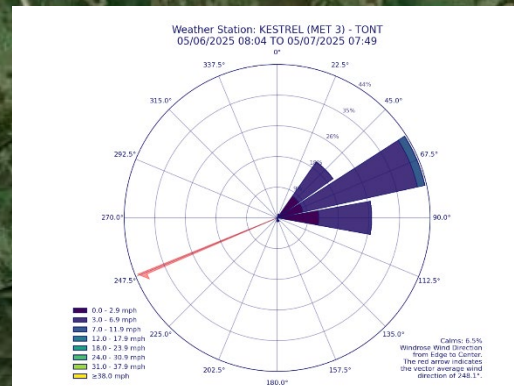
Analytical Air Sampling Stations Wind Analysis - May 6, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

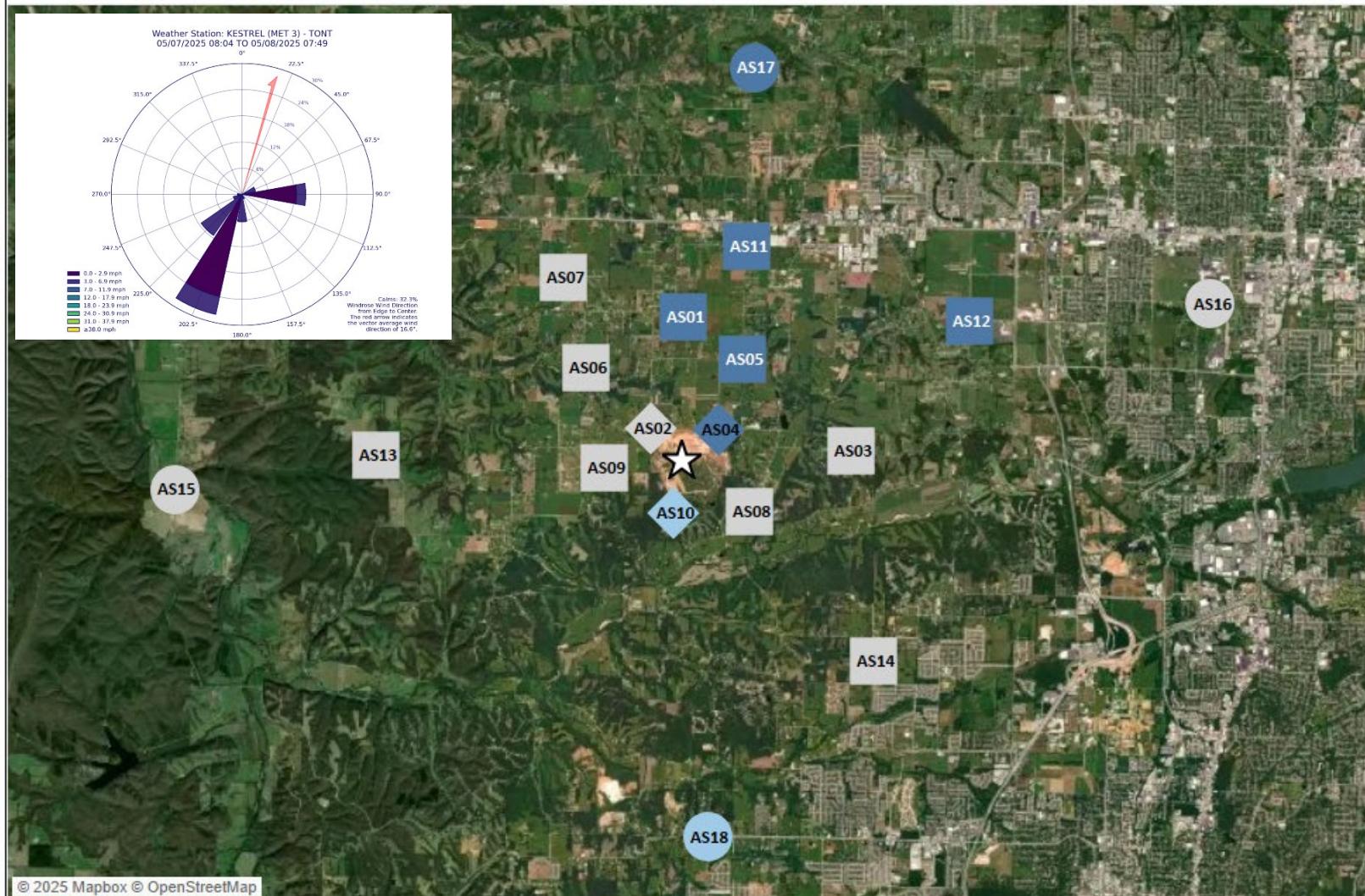
Analytical Air Sampling Stations Wind Analysis - May 7, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



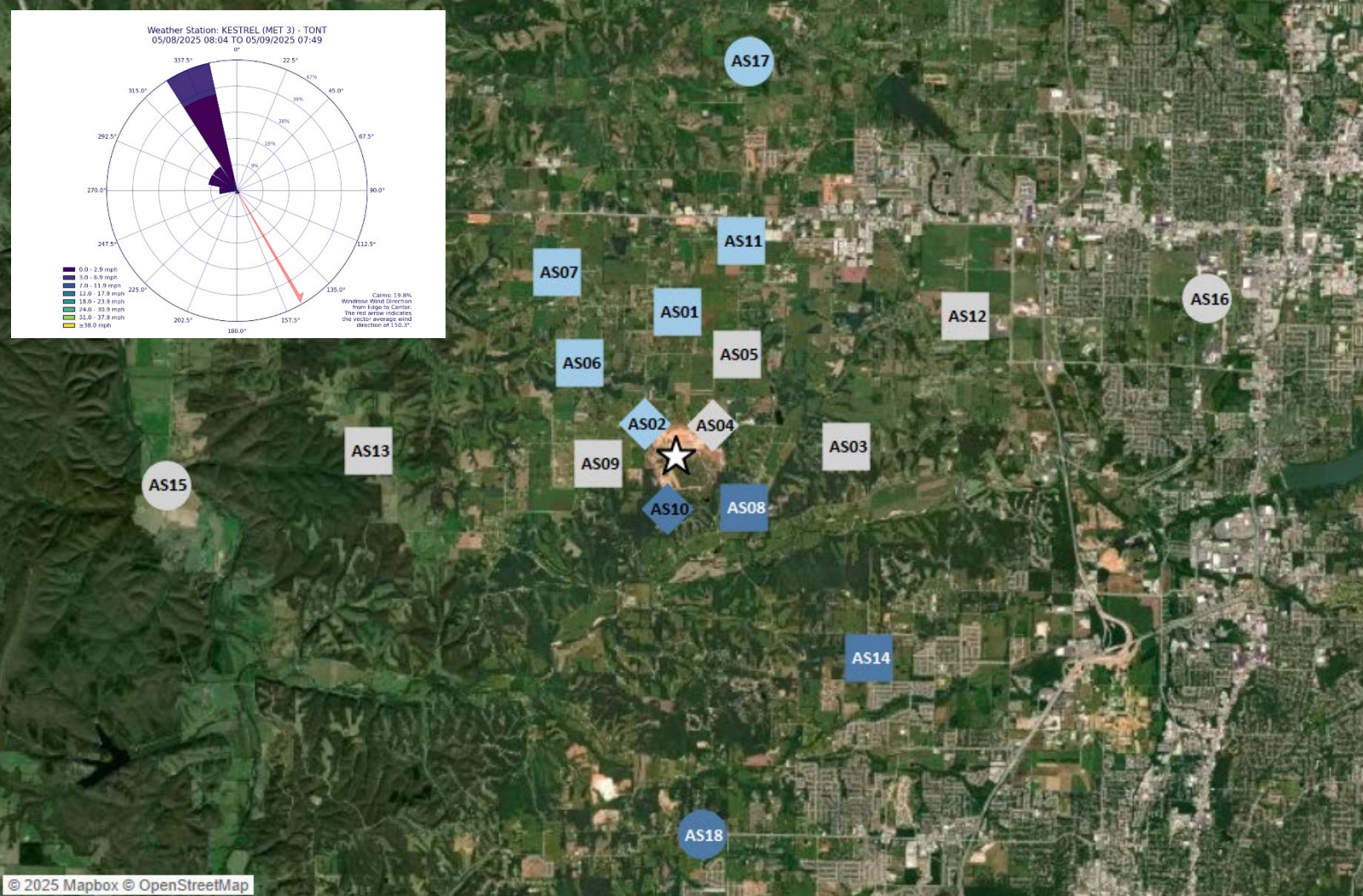
Analytical Air Sampling Stations Wind Analysis - May 8, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

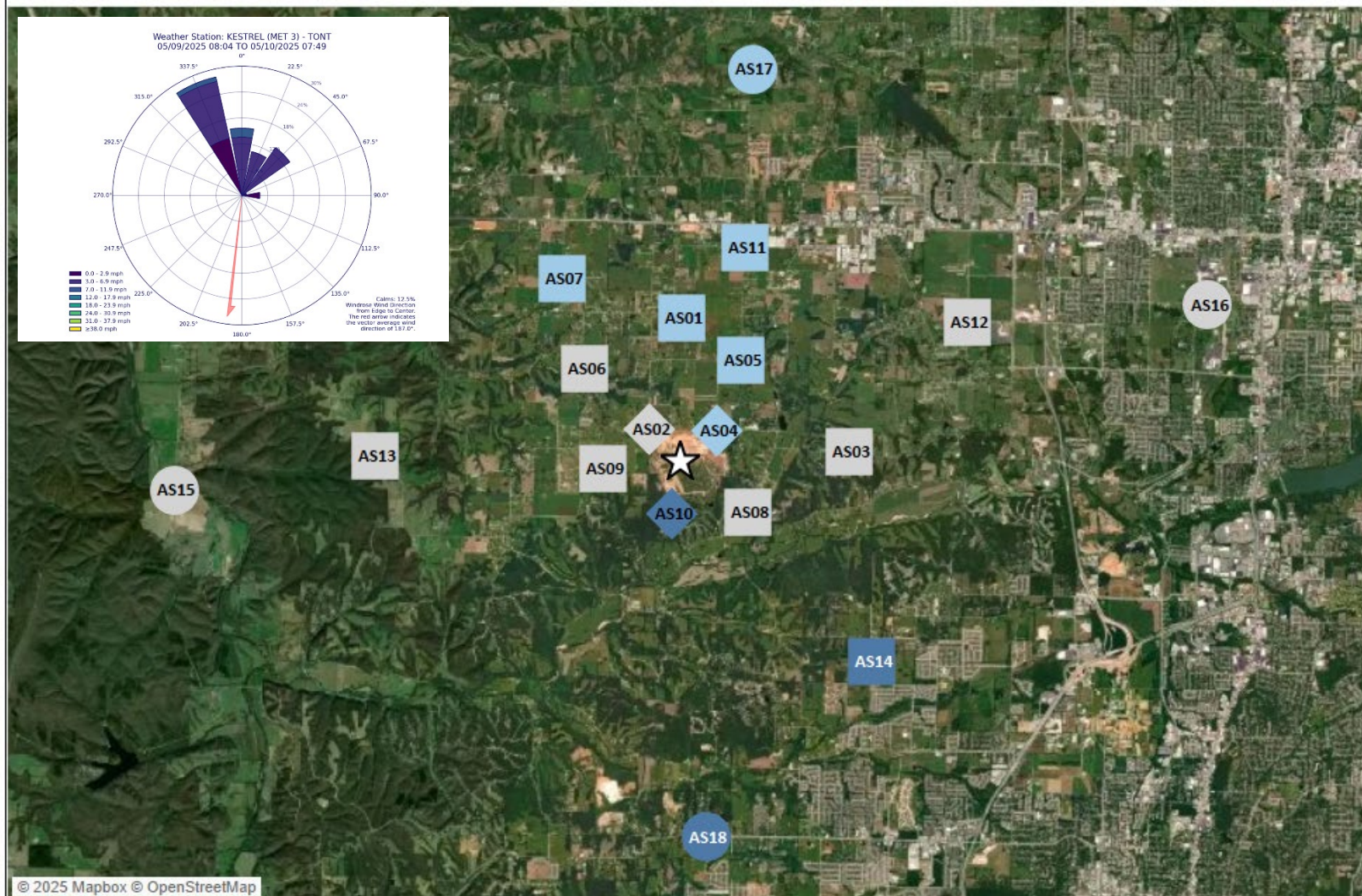
Analytical Air Sampling Stations Wind Analysis - May 9, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

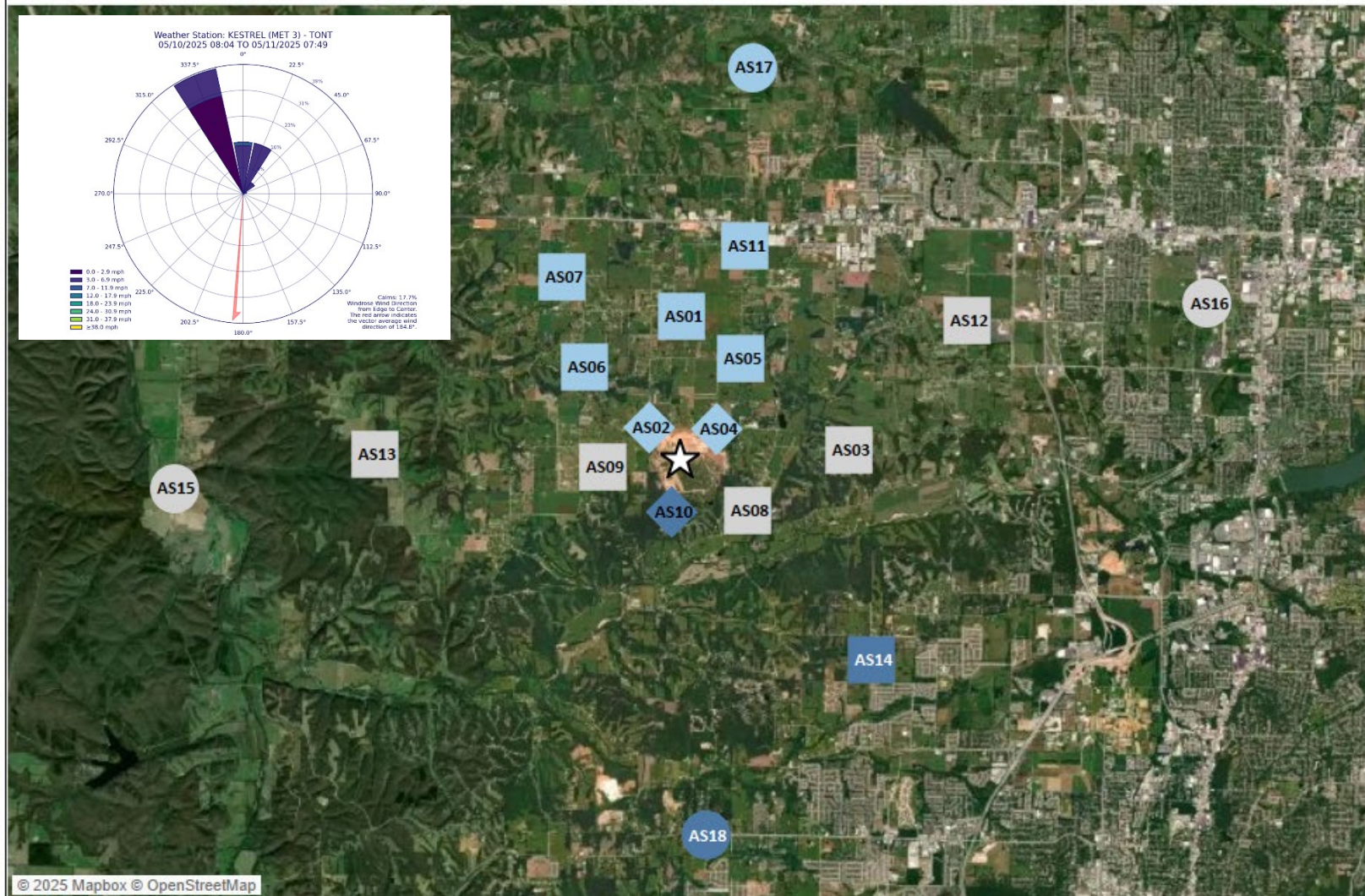
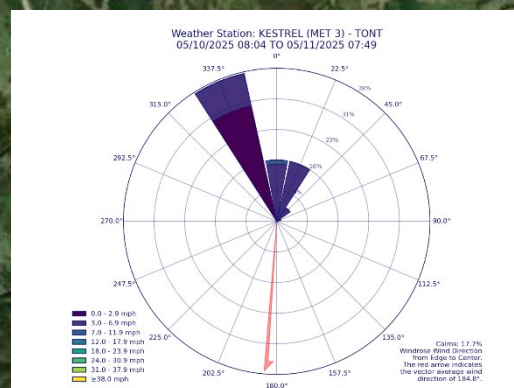
Analytical Air Sampling Stations Wind Analysis - May 10, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

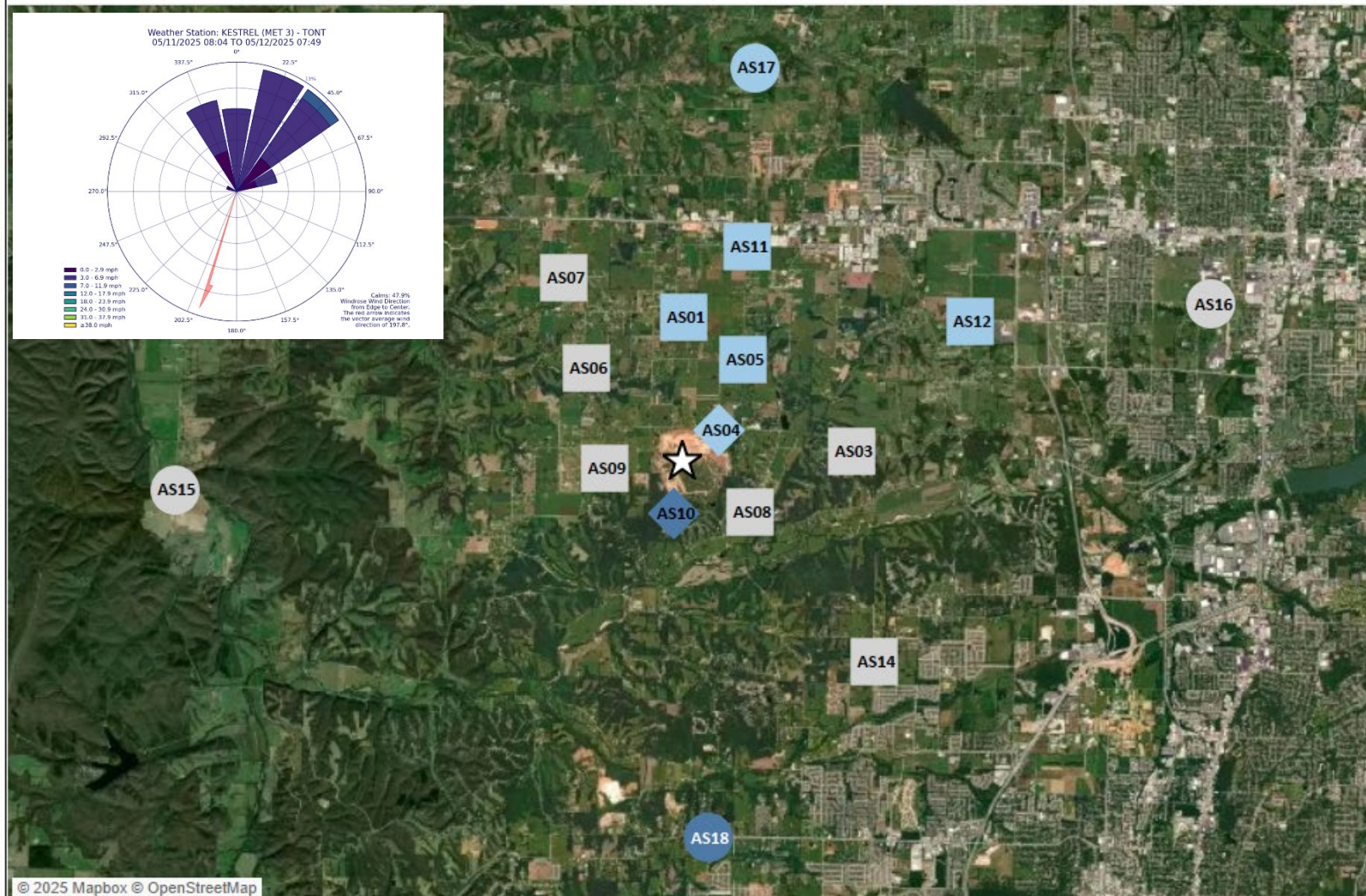
Analytical Air Sampling Stations Wind Analysis - May 11, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind



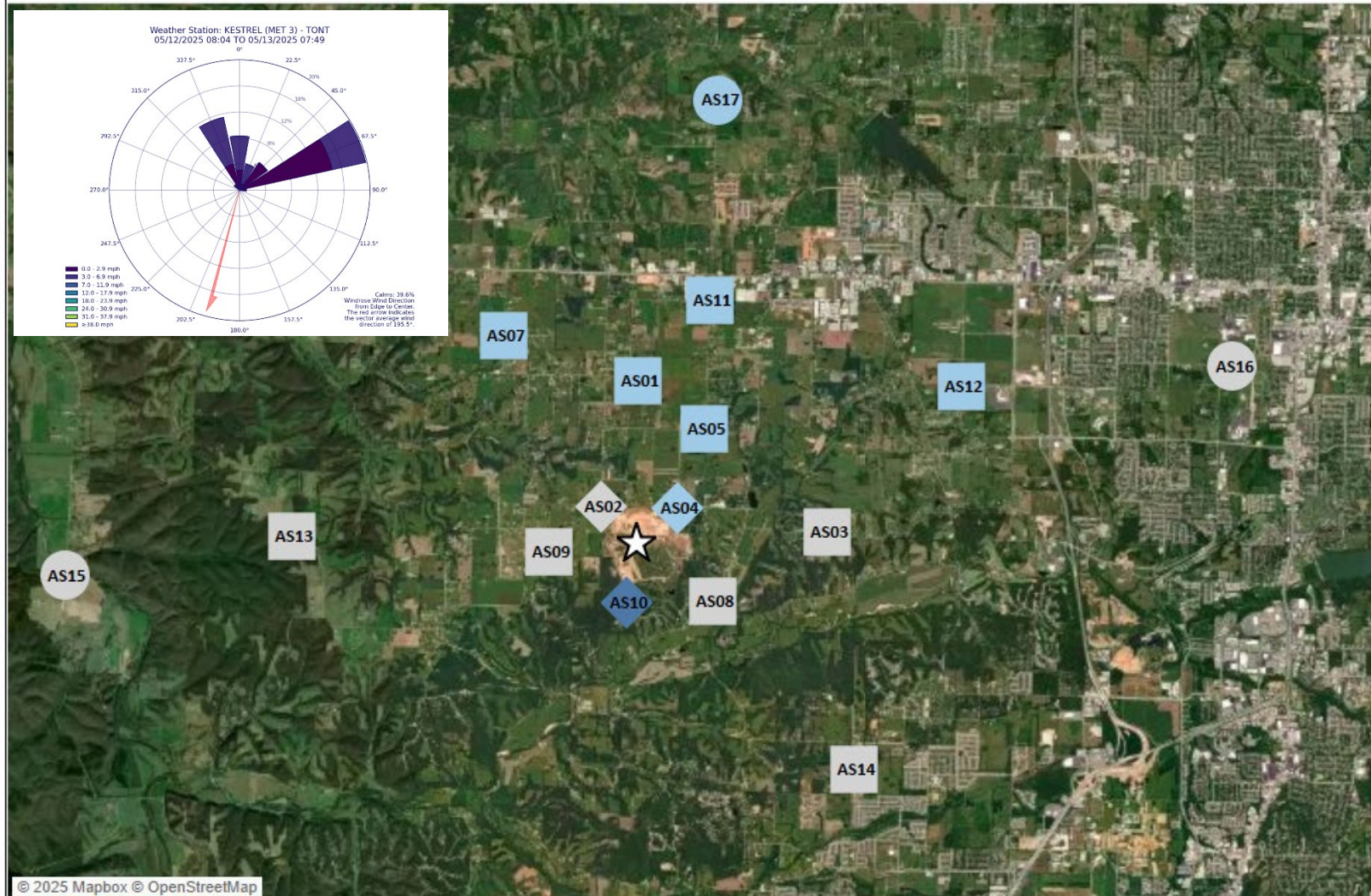
Analytical Air Sampling Stations Wind Analysis - May 12, 2025 Tontitown, AR

Location Category

- Background
- Community
- ◆ Fenceline

Relative Wind Direction

- Crosswind
- Downwind
- Upwind

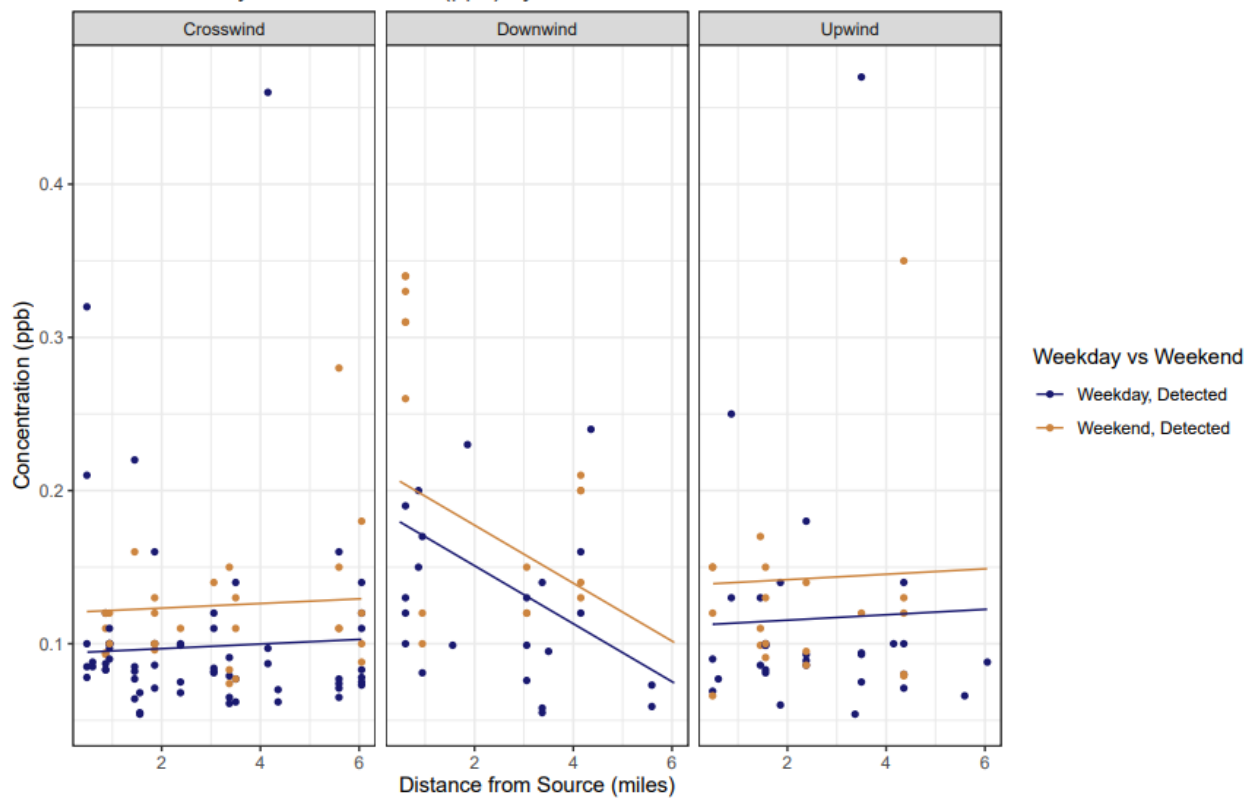


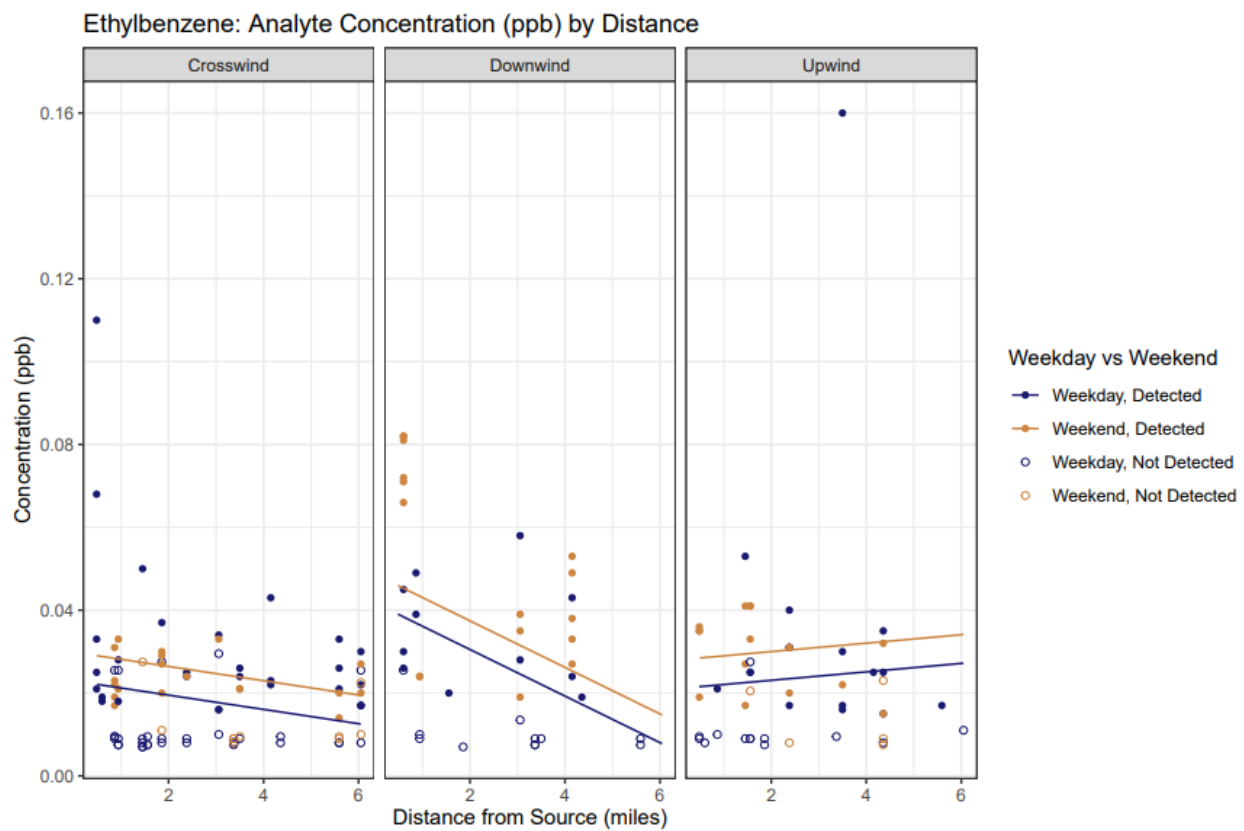
NOTE: Wind roses represent the twenty-four hours from approximately 8am to 8am and do not reflect the average wind vector for each sampling location as those were calculated based on the specific deployment and pick up times for each canister.

Appendix F

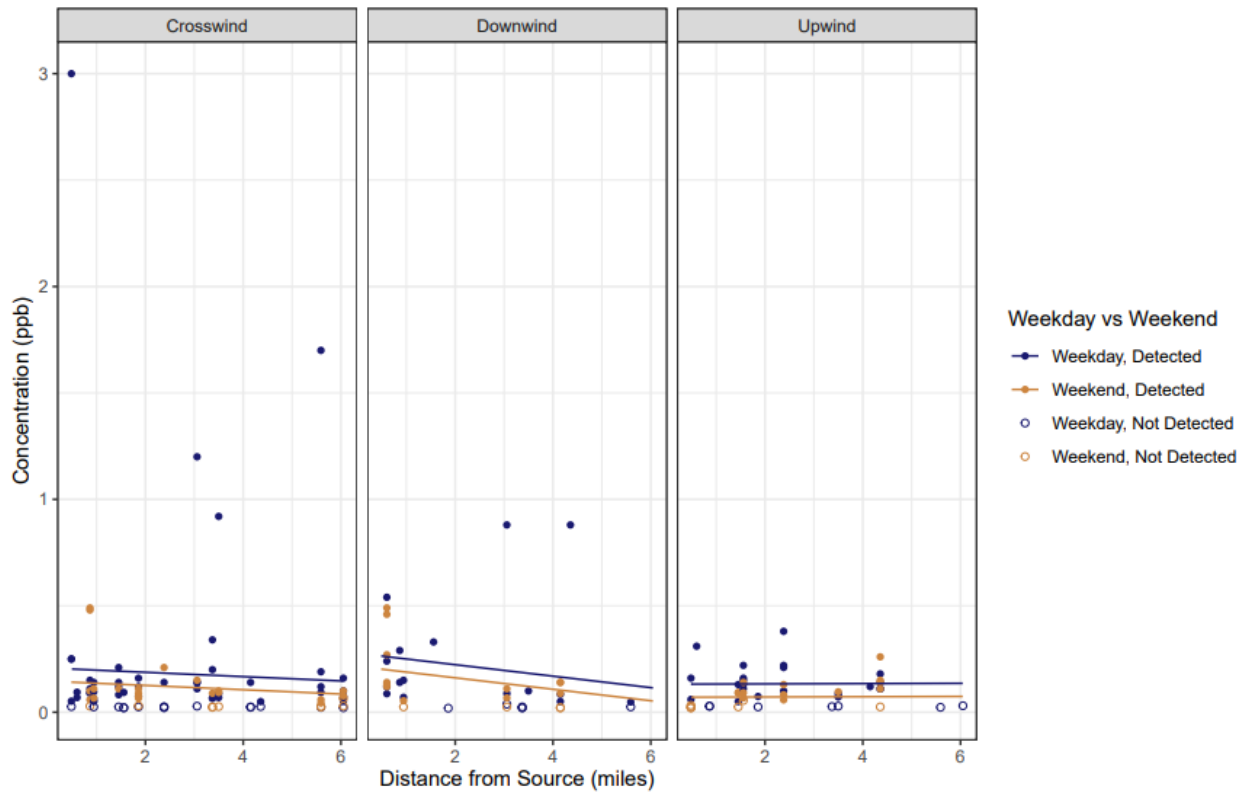
Scatterplots of Concentrations by Distance from the Landfill by Wind Direction and Weekday/Weekend with Adjusted Trendlines from Model 1

Benzene: Analyte Concentration (ppb) by Distance

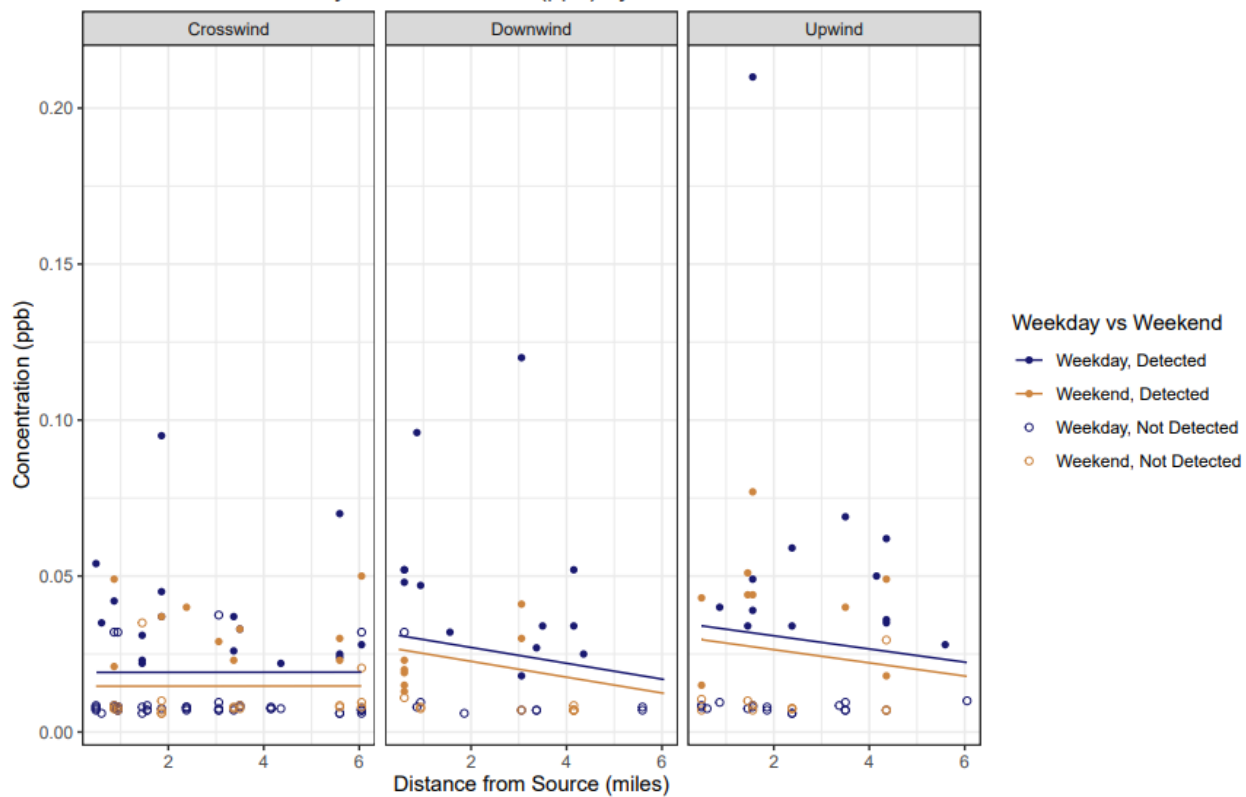


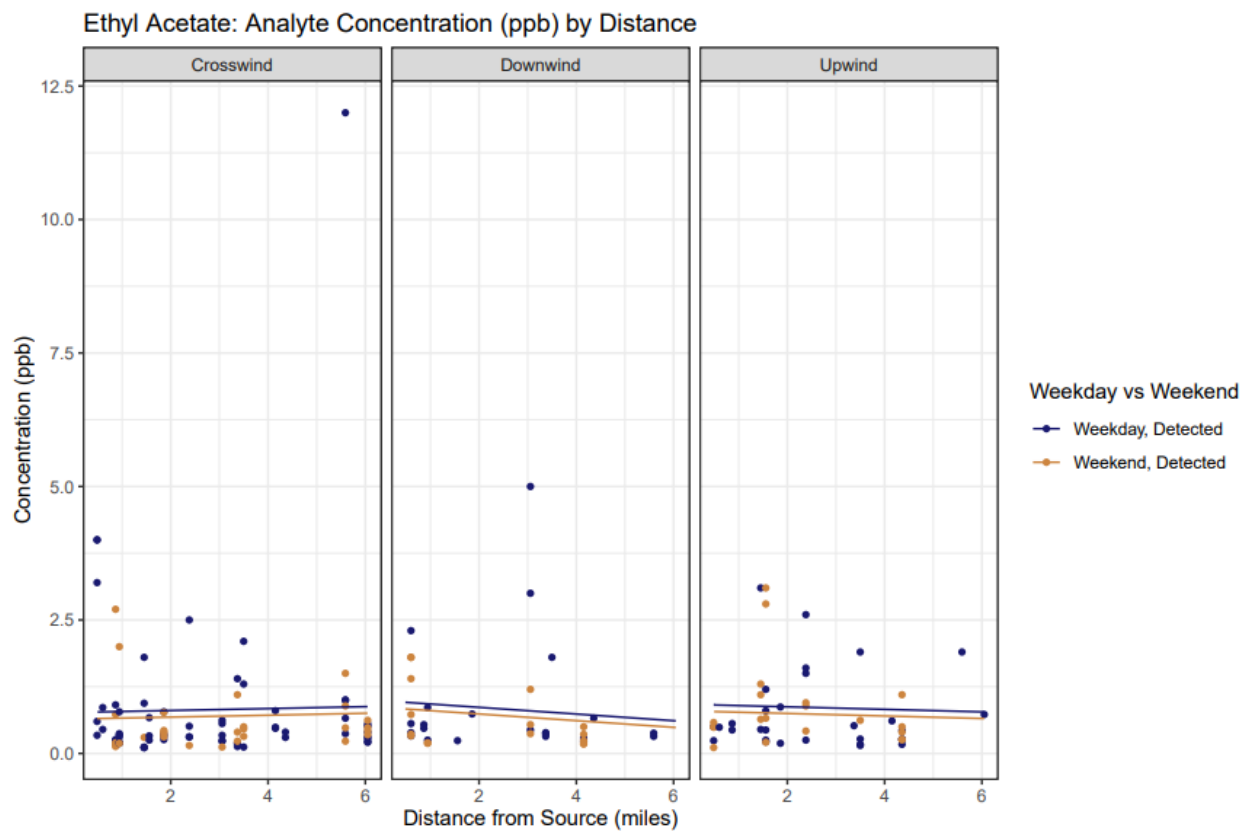


1,1-Difluoroethane: Analyte Concentration (ppb) by Distance

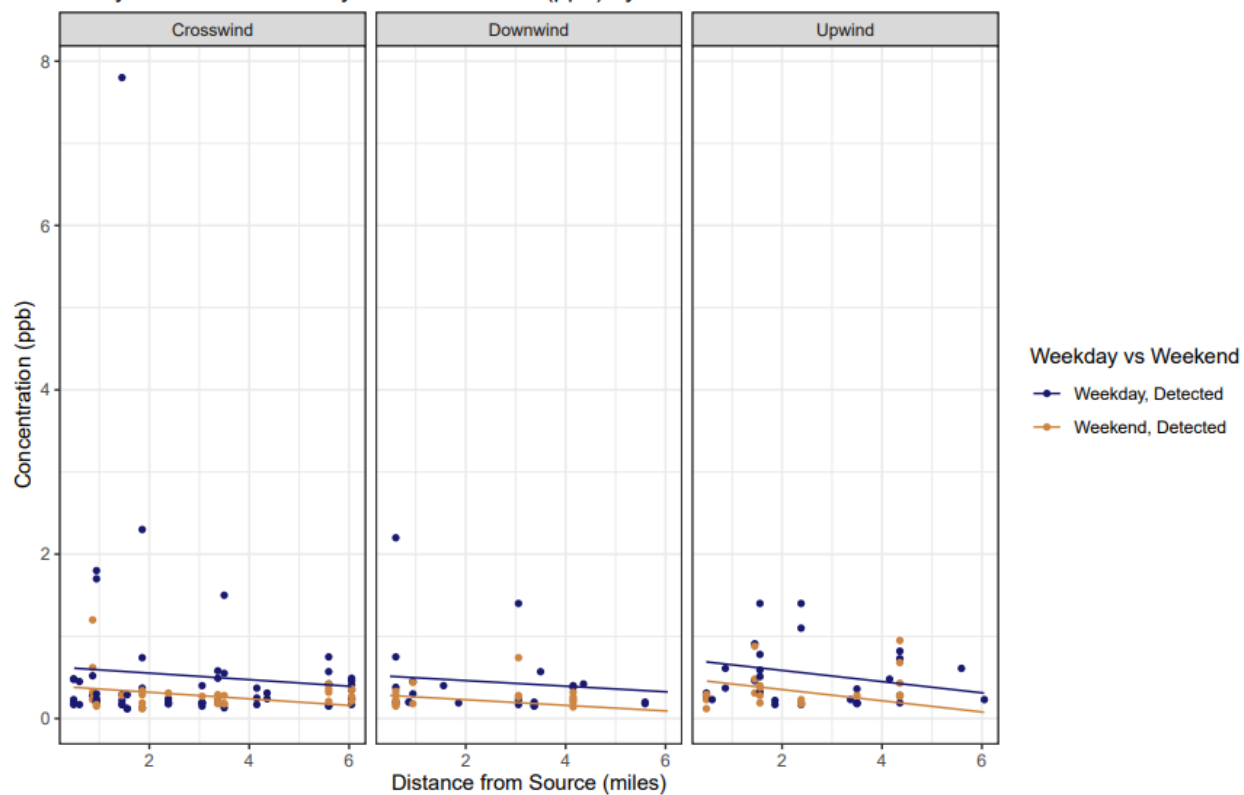


Carbon Disulfide: Analyte Concentration (ppb) by Distance

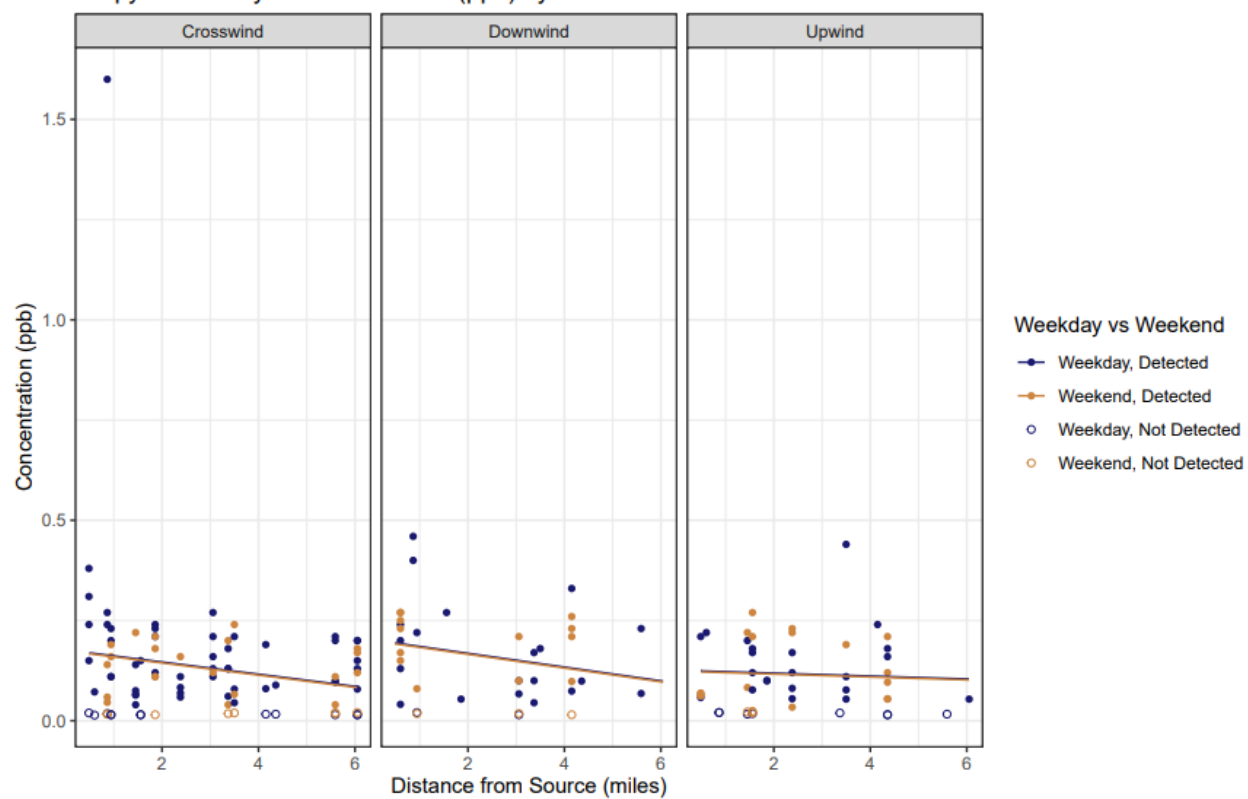


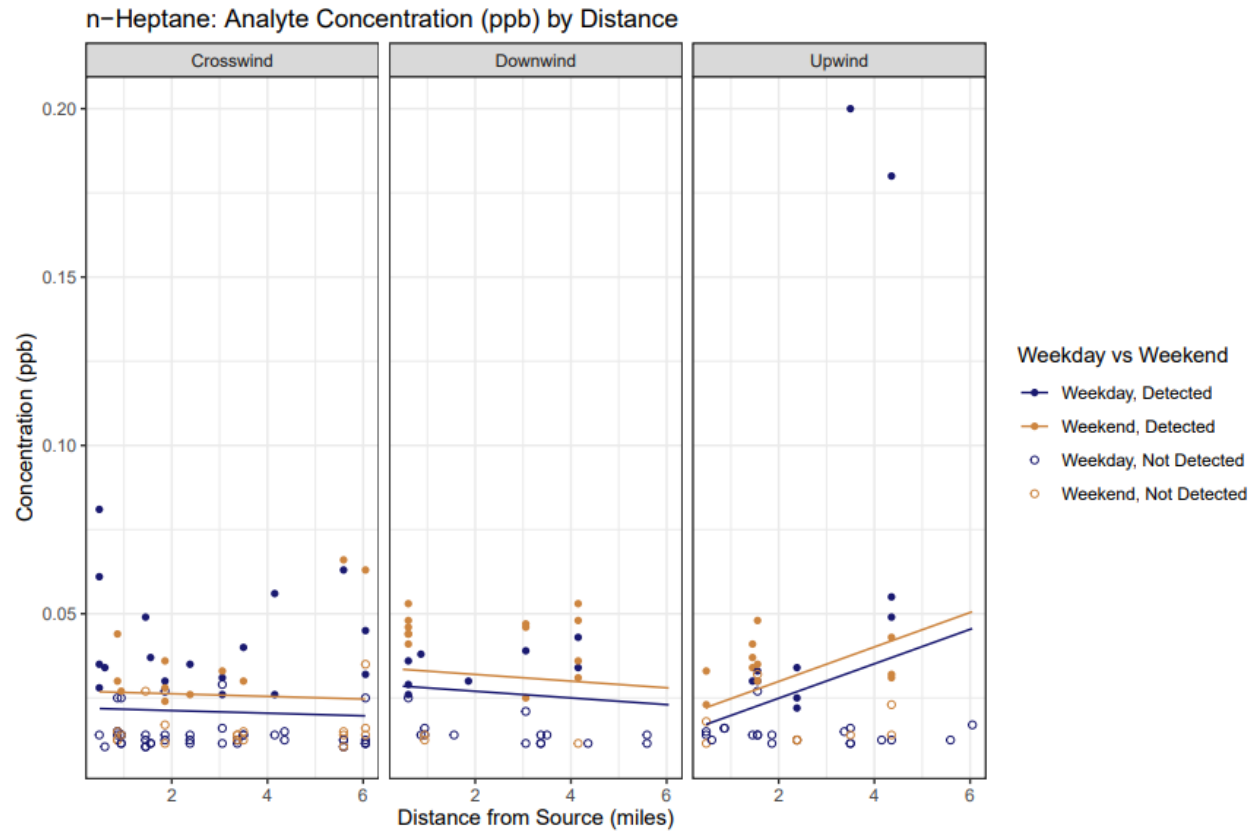


Methylene Chloride: Analyte Concentration (ppb) by Distance

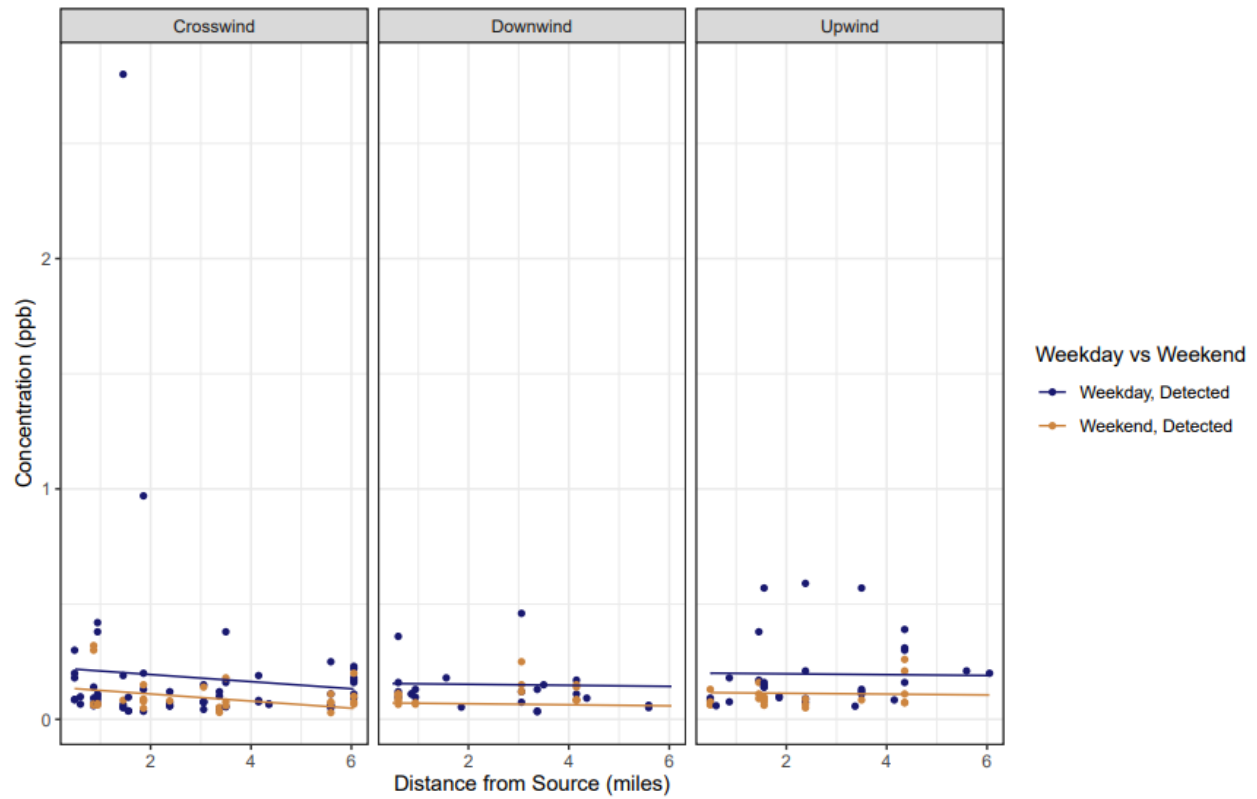


Propylene: Analyte Concentration (ppb) by Distance

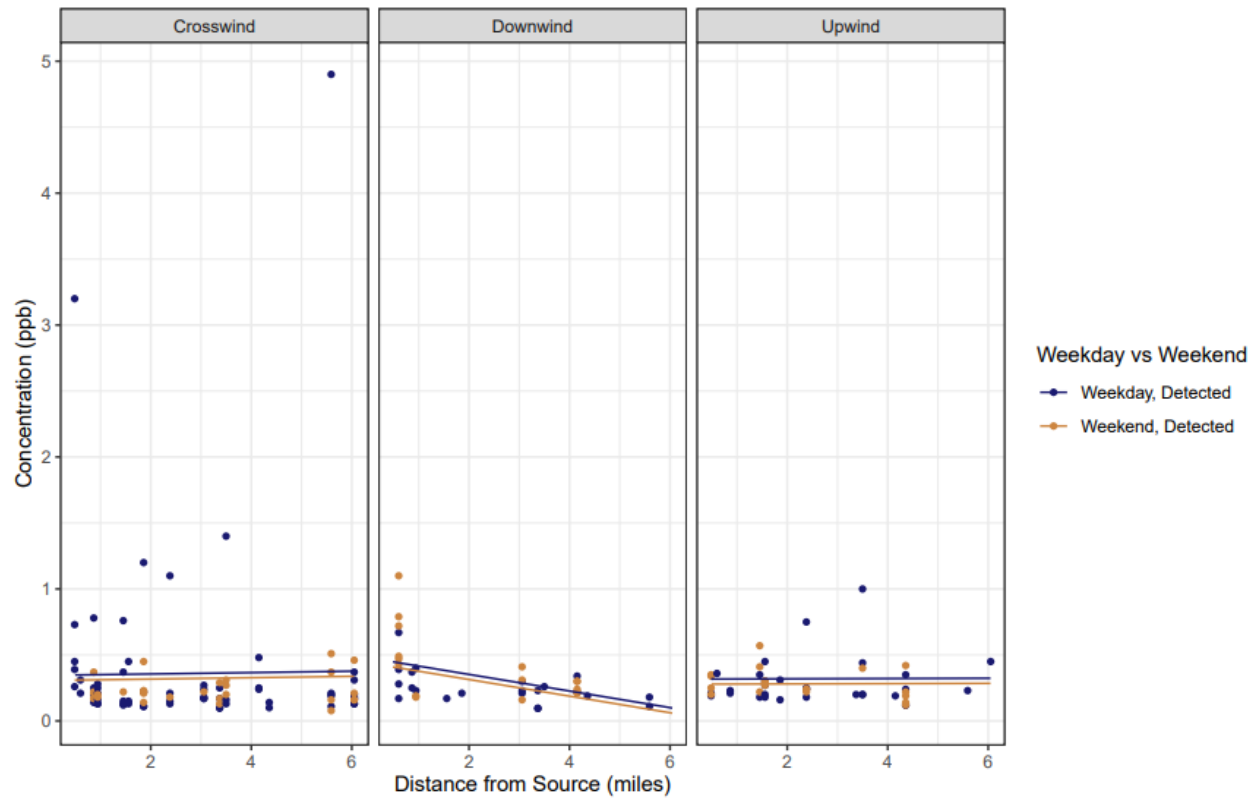




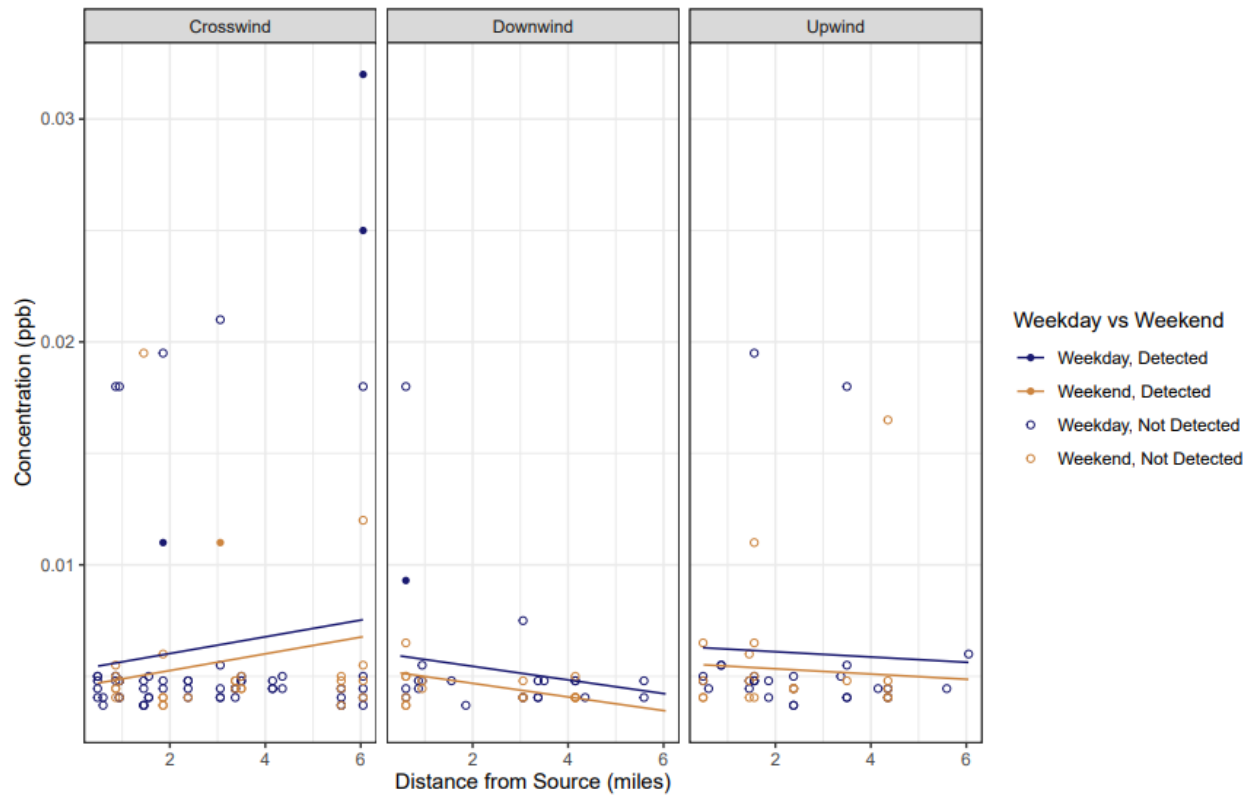
n-Hexane: Analyte Concentration (ppb) by Distance



n-Pentane: Analyte Concentration (ppb) by Distance



trans-1,2-Dichloroethene: Analyte Concentration (ppb) by Distance



Appendix G

Quality Assurance Project Plan (QAPP)



TONTITOWN, ARKANSAS AIR SAMPLING STUDY

QUALITY ASSURANCE PROJECT PLAN

Version 2.0

Prepared on Behalf of:
Arkansas Department of Energy and Environment

Prepared By:
CTEH, LLC
5120 Northshore Drive
Little Rock, AR 72118
501-801-8500

PROJ-053833

May 2025

EXECUTIVE SUMMARY

The residents of the Tontitown, Arkansas community have voiced concerns about air quality and health effects in recent years. There are multiple point sources regulated by the State of Arkansas that may have potential emissions located near the area of these complaints. The closest point source upwind and to the south of a large cluster of mostly odor complaints is the Eco-Vista Landfill (the Landfill), located at 11979 Arbor Acres Road in Springdale, Arkansas on the border of Tontitown, Arkansas.¹ It is an active municipal solid waste (MSW) landfill owned by Waste Management and serves as both a residential and commercial waste landfill for Washington County and surrounding areas. The Arkansas Department of Energy and Environment (E&E) oversees and enforces solid waste permits, air permits, and stormwater permits for this facility.

Prior studies of the area surrounding this Landfill have been conducted. The most recent assessment observed benzene, acrolein, and carbon tetrachloride concentrations above their respective health-based screening levels at locations upwind, cross wind, and downwind of the Landfill and also at the four background air sampling locations. Chloroform and naphthalene were also detected in air samples at concentrations above their health-based screening levels. In a letter dated July 18, 2024, the Arkansas Department of Health (ADH) provided their evaluation of the air sampling data, concluding that they cannot conclusively determine the source of the contaminants detected. ADH noted that it is possible that local businesses or other activities not associated with the Landfill are contributing to these levels, and they recommended obtaining more comprehensive air quality data.²

To address ADH's recommendations, E&E released a competitive request for proposals to conduct a study that could further evaluate the source of the previously detected compounds in the Tontitown community. E&E retained CTEH through this process to provide an air sampling study designed to determine, to the best extent possible, the source of contaminants detected in the prior studies using an expanded sampling design and statistical inference. This study has the overall objectives of:

- 1. Conduct an air sampling study to determine air conditions of targeted compounds of potential concern in the community surrounding potential emissions sources in Tontitown, Arkansas.*
- 2. Determine if the Landfill is likely the source for detected compounds of potential concern.*
- 3. Provide air sampling data of appropriate quality for conducting a public health assessment to ADH.*

This plan describes the air sampling study design, objectives, quality assurance metrics, laboratory analysis, and data analysis plan for this study. Field work, data collection, laboratory analysis, data validation and data analysis will be conducted in accordance with this Quality Assurance Project Plan (QAPP) and the Sampling and Analysis Plan (SAP).

QAPP WORKSHEET #1 AND #2: TITLE AND APPROVAL PAGE

Site Name: Tontitown Arkansas
Project Name: Tontitown Air Sampling Study
CTEH Project Number: PROJ-053833
Site Location: Tontitown, Arkansas

This Quality Assurance Project Plan (QAPP) refers to the Air Monitoring and Sampling Plan for the 11-Day Air Quality Study that is being conducted by CTEH to support Arkansas Department of Energy and Environment's evaluation of the source of previously detected airborne contaminants in the Tontitown community.

The main objective of this air sampling study is to evaluate air concentrations of targeted compounds of potential concern in the community surrounding potential emission sources in Tontitown, AR, and to evaluate the potential source of any identified compounds.

This QAPP was prepared in accordance with the "Guidance for Quality Assurance Project Plans (US EPA QA/G-5)" (EPA/240/R-02/009; December 2002), "EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)" (EPA 240/B-01/003; March 2001, reissued May 2006), and "Uniform Federal Policy for Quality Assurance Project Plans" (Parts 1-3 EPA-505-B-04-900A-900C; March 2005).

Organizational Stakeholders and Connections

ORGANIZATIONAL STAKEHOLDERS	CONTACT
Arkansas Department of Energy and Environment	Demetria Kimbrough, MPH Associate Director, Division of Environmental Quality, Office of Air Quality
Arkansas Department of Health	Rebecca Davis, M.S. Epidemiology Supervisor, ATSDR Health Assessor and Public Health Outreach Coordinator
Tontitown	Angie Russell, Mayor, Tontitown Arkansas
18 th District of Arkansas	Robin Lundstrum, Arkansas State Representative, 95 th General Assembly
19 th District of Arkansas	Steven Unger, Arkansas State Representative, 95 th General Assembly
Senate District 35	Tyler Dees, Arkansas Senator
Senate District 31	Clint Penzo, Arkansas Senator

APPROVAL PAGE

	NAME/ORGANIZATION	SIGNATURE	DATE SIGNED
Prepared by:	Katelyn Hall Senior Epidemiologist and Biostatistician CTEH		May 1, 2025
Prepared by:	Chris Kuhlman Principal Toxicologist CTEH		May 1, 2025
Approved by:	Amanda Vanlandingham QA Project Manager CTEH		May 1, 2025
Approved by:	Demetria Kimbrough, MPH Associate Director Division of Environmental Quality Office of Air Quality Arkansas Department of Energy and Environment		
Approved by:	Rebecca Davis, M.S. Epidemiology Supervisor ATSDR Health Assessor and Public Health Outreach Coordinator Arkansas Department of Health		May 1, 2025

CHANGE MANAGEMENT

The purpose of this section is to document revisions, additions, and/or addendums made to the approved QAPP. Descriptions of the changes with section and page numbers are detailed below along with the reasons for the revision where appropriate. Amendments to the QAPP may be made in the following circumstances: when new information is presented; specific chemicals or parameters of interest are added or eliminated; site conditions change; activities change, are initiated, or ceased; or when the project moves into a new phase. After revisions are adopted, the QAPP's revision number and revision date are updated. The title page of subsequent versions of the QAPP will include the revision number, revision date, and original approval date. The template for incorporating revisions is provided below.

Change 001		
Description of Change: v1.1 – editorial updates for clarity		
	Name/Position	Date Signed
Prepared By:	Katelyn Hall	May 1, 2025
Change 002		
Description of Change: v1.2 – updated WS #3 and #5; added media blank for HF sampling		
	Name/Position	Date Signed
Prepared By:	Amanda Bates	May 9, 2025
Description of Change: v2.0 – updated changes to statistical methods		
	Name/Position	Date Signed
Prepared By:	Katelyn Hall	August 25, 2025

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TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	II
APPROVAL PAGE	IV
CHANGE MANAGEMENT	V
LIST OF ACRONYMS AND ABBREVIATIONS	XII
INTRODUCTION	1
DATA QUALITY OBJECTIVES (DQOS).....	9
PROJECT OBJECTIVES.....	9
PROJECT BOUNDARIES	10
QUALITY ASSURANCE PARAMETERS.....	11
REPRESENTATIVENESS	11
PRECISION	11
ACCURACY	11
COMPLETENESS.....	12
COMPARABILITY	12
SENSITIVITY	12
COMMUNITY HANDHELD REAL-TIME AIR MONITORING DATA QUALITY OBJECTIVES.....	14
ODOR SURVEY DATA QUALITY OBJECTIVES	19
COMMUNITY AIR SAMPLING DATA QUALITY OBJECTIVES.....	20
COMMUNITY COMPLAINT AIR MONITORING AND SAMPLING DATA QUALITY OBJECTIVES...	22
CONCEPTUAL MODEL AND STATISTICAL METHODS	34
DETERMINING COMPOUNDS OF POTENTIAL CONCERN	34
METEOROLOGICAL DATA ANALYSIS	35
STATISTICAL APPROACH TO ANALYZING AIR SAMPLING CONCENTRATIONS	35
QUALITATIVE ASSESSMENT OF COMPLAINTS AND ODORS	42
LIMITATIONS	42
REFERENCES	80

WORKSHEET LIST

QAPP WORKSHEET #1 AND #2: TITLE AND APPROVAL PAGE	III
QAPP WORKSHEET #3 & 5: PROJECT ORGANIZATION AND QAPP DISTRIBUTION.....	4
QAPP WORKSHEETS #5 & 6: PROJECT ORGANIZATIONAL CHART AND COMMUNICATIONS PATHWAYS	5
QAPP WORKSHEET #4 & 8: KEY PROJECT PERSONNEL QUALIFICATIONS	6
QAPP WORKSHEET #7: PROJECT ROLES AND RESPONSIBILITIES	6
QAPP WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY	8
QAPP WORKSHEET #10: PROBLEM DEFINITION.....	9
QAPP Worksheet #11-A: Project Data Quality Objectives.....	13
QAPP WORKSHEET #30- ANALYSES AND LABORATORY CONTACTS.....	24
QAPP WORKSHEET #12-A: MEASUREMENT PERFORMANCE CRITERIA	25
QAPP WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS.....	28
QAPP WORKSHEET #14-A AND #16-A: PROJECT TASKS & SCHEDULE	30
QAPP WORKSHEET #15-A AND 28.3-A: LABORATORY-SPECIFIC REPORTING LIMITS, QUANTITATION LIMITS AND QUALITY CONTROL LIMITS.....	32
QAPP WORKSHEETS #17-A: SAMPLING DESIGN AND RATIONALE	34
QAPP WORKSHEETS #18-A: SAMPLING LOCATIONS AND METHODS.....	44
QAPP WORKSHEET #19-A AND #30-A: SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES.....	50
QAPP WORKSHEET #20-A: FIELD QUALITY CONTROL SUMMARY	50
QAPP WORKSHEETS #21-A: FIELD SAMPLING SOP REFERENCES	51
QAPP WORKSHEETS #22-A: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION	52
QAPP WORKSHEET #23-A: ANALYTICAL SOPS	53
QAPP WORKSHEET #24-A: ANALYTICAL INSTRUMENT CALIBRATION	54
QAPP WORKSHEET #24-B: ANALYTICAL INSTRUMENT CALIBRATION	55
QAPP WORKSHEET #25-A: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION	56
QAPP WORKSHEET #25-B: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION	56
QAPP WORKSHEET #26 AND #27: SAMPLE HANDLING, CUSTODY, AND DISPOSAL	57
QAPP WORKSHEET #28.1-A: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION – VOCs IN AIR	61
QAPP WORKSHEET #28.3-A: LABORATORY-SPECIFIC QUANTITATION LIMITS AND QUALITY CONTROL LIMITS	63
QAPP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS.....	65

QAPP WORKSHEET #31, #32, AND #33: ASSESSMENTS AND CORRECTIVE ACTION	67
QAPP WORKSHEETS #34: DATA VERIFICATION AND VALIDATION INPUTS	69
QAPP WORKSHEETS #35: DATA VERIFICATION PROCEDURES	71
QAPP WORKSHEET #36: DATA VALIDATION PROCEDURES	73
QAPP WORKSHEET #37: USABILITY ASSESSMENT	75

LIST OF TABLES

Table 1	Community Real-Time Air Monitoring with Handheld Instruments Data Quality Objectives	14
Table 2	Protective Action Criteria for Community Real-Time Air Monitoring	18
Table 3	Odor Survey Evaluation Data Quality Objectives	19
Table 4	Community Air Sampling Data Quality Objectives	20
Table 5	One-hour Sample Data Quality Objectives	23
Table 6	Analyses and Laboratory Contacts	24
Table 7	Measurement Performance Criteria– Field QC Samples for Air	25
Table 8a	Measurement Performance Criteria for VOCs in Air Samples	26
Table 9	Secondary Data Used to Design the Tontitown Arkansas Air Sampling Study	28
Table 10	Project Tasks & Schedule	30
Table 11	RLs and MDLs for COPCs by EPA Method TO-15 for 24-Hour and 1-Hour Canisters	32
Table 12	RL and MDL for Hydrogen Fluoride 24-Hour Samples	33
Table 13	Logic for Classifying Potential Source Categories of COPCs	41
Table 14	Sample Containers, Preservation, And Hold Times	50
Table 15	Field Quality Control Summary	50
Table 16	CTEH SOPs, Technical Notes and Manufacturer References	51
Table 17	Field Equipment Calibration and Maintenance Schedules	52
Table 18	Laboratory Analytical SOP References	53
Table 19	Sample Nomenclature Description	58
Table 20	Sample Handling, Storage, Custody, and Disposal*	59
Table 21	Data Sources and Data Management	60
Table 22	Analytical QA/QC for Enthalpy Labs for VOCs by US EPA METHOD TO-15	61
Table 23	Quality Control Limits for COPCs by EPA Method TO-15	63
Table 24	Quality Control Limits for Hydrogen Fluoride by OSHA ID-165SG	64
Table 25	Sample Collection and Field Records	65
Table 26	Project Assessment Records	65
Table 27	Laboratory Documentation Records	66
Table 28	Laboratory Assessments and Responsibilities	68
Table 29	Data Verification and Validation Inputs	69
Table 30	Analytical Air Sampling Data Verification Procedures Including Inputs	71
Table 31	Real-Time Air Monitoring Data Verification Procedures	72

Table 32	Data Validation Procedures Including Inputs	73
Table 33	Data Usability Indicator Description.....	76
Table 34	Data Qualification Reason Codes	77

LIST OF FIGURES

Figure 1	Map of potential sources of air emissions from facilities permitted by Arkansas Department of Energy and Environment in relation to reported community complaints.....	1
Figure 2	Organizational Chart and Communication Pathways for Air Sampling Study.....	5
Figure 3	The Source to Outcome Conceptual Model	34
Figure 4	Visual Representation of Classifying Air Samples As Downwind, Upwind, or Crosswind from the Landfill.....	37
Figure 5	Map of Sampling Locations in the CTEH April 28-May 1, 2024 Air Assessment with Air Model of Benzene Emissions	45
Figure 6	Map of Sampling Locations from the CTEH April 28-May 1, 2024 with Reported Complaints and Proposed 2025 Locations	46
Figure 7	Map of Proposed Fixed Analytical Sampling Locations for VOCs.....	47
Figure 8	Map of Proposed Fixed Sampling Locations for HF with Reported Complaints	48
Figure 9	Map of Proposed Nasal Ranger and Real-Time Air Monitoring Route.....	49

LIST OF ACRONYMS AND ABBREVIATIONS

ATSDR	Agency for Toxic Substances and Disease Registry
CA	Corrective Action
CCV	Continuing Calibration Verification
COC	Chain of Custody
COI	Compound of Interest
COPC	Compound of Potential Concern
CSM	Conceptual Site Model
CTEH	Center for Toxicology and Environmental Health, LLC
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	Electronic Data Deliverable
FB	Field Blank
GC	Gas Chromatograph
GIS	Geographic Information System
GPS	Global Positioning System
ICAL	Initial Calibration
ICV	Initial Calibration Verification
LCS	Laboratory Control Sample
LEL	Lower Explosive Limit
LIMS	Laboratory Information Management Systems
LOD	Limit of Detection
LOQ	Limit of Quantitation
MB	Method Blank
MDL	Method Detection Limit
MPC	Measurement Performance Criteria
MS/MSD	Matrix Spike/Matrix Spike Duplicate
PDF	Portable Document Format
PID	Photoionization Detector
PM	Project Manager
PT	Proficiency Testing (previously known as performance evaluation (PE) sample)
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
RL	Reporting Limit
RPD	Relative Percent Difference
RSD	Relative Standard Deviation
SAP	Sampling and Analysis Plan
SD	Standard Deviation
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
SQL	Sample Quantitation Limit
TBD	To Be Determined

LIST OF ACRONYMS AND ABBREVIATIONS

THQ	Target Hazard Quotient
TIC	Tentatively Identified Compound
TNI	The NELAC Institute
TO-15	Air Method Toxic Organics - 15
TR	Target Cancer Risk
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compound

The residents of the Tontitown, Arkansas community have voiced concerns about air quality and health effects in recent years. There are multiple point sources regulated by the State of Arkansas that may have potential emissions located near the area of these complaints, as illustrated in **Figure 1**. The closest point source to the south (and in the predominant upwind direction) of a large cluster of mostly odor complaints is the Eco-Vista Landfill (the Landfill), located at 11979 Arbor Acres Road in Springdale, Arkansas on the border of Tontitown, Arkansas.¹ It is an active municipal solid waste (MSW) landfill owned by Waste Management and serves as both a residential and commercial waste landfill for Washington County and surrounding areas. The Arkansas Department of Energy and Environment (E&E) Division of Environmental Quality (DEQ) oversees and enforces solid waste permits, air permits, and stormwater permits for this facility.

Project: PROJ-053833
Client: Arkansas Department of Environment and Energy
City: Tontitown, AR
County: Washington

0 0.5 1 2 Miles

N

○ Complaint Location
■ ADEQ Air Permitted Facility
--- Tontitown, AR

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Projection: WGS 1984 UTM Zone 15N Updated at: 4/30/2025 10:14 PM

Tontitown, Arkansas Air Sampling Study Quality Assurance Project Plan

specific type of cancer over what was expected as compared to other Arkansas areas, the State, and the U.S. E&E requested assistance from the Arkansas National Guard to conduct air quality testing in December 2023. The 61st Civil Support Team advised that overnight real-time air monitoring readings detected the potential presence of sulfur dioxide and recommended additional testing for sulfur dioxide to be confirmed with air sampling and laboratory analysis.³

On February 5, 2024, CTEH conducted air monitoring and sampling at four locations near the Landfill. Air sampling was performed for hydrogen sulfide, sulfur dioxide, and U.S. Environmental Protection Agency (EPA) Toxic Organics – 15 (TO-15) volatile organic compounds (VOCs), selected at the direction of E&E. The 61st Civil Support Team performed another round of real-time air monitoring during this time and reported potential detections of sulfur dioxide. CTEH's more sensitive analytical air sampling did not detect sulfur dioxide or hydrogen sulfide. However, CTEH's air sampling for VOCs detected benzene and acrolein at concentrations above their respective EPA Resident Air Regional Screening Levels (RSLs).⁴

E&E issued an emergency procurement and retained additional services from CTEH to conduct additional air monitoring and sampling in the area of concern. E&E selected ten sampling locations around the Landfill and four background sampling locations. From April 28 to May 1, 2024, CTEH conducted air sampling for hydrogen sulfide and EPA TO-15 VOCs, at the direction of E&E and ADH. The investigation observed benzene, acrolein, and carbon tetrachloride concentrations above their respective EPA Resident Air RSLs at locations upwind, cross wind, and downwind of the Landfill. Additionally, these analytes were detected above EPA Resident Air RSLs at the four background air sampling locations. Chloroform and naphthalene were also detected in air samples at concentrations above their respective EPA Resident Air RSLs. Chloroform was detected in two analytical air samples collected at one crosswind location southwest of the Landfill, and naphthalene was detected in one background sample location.⁵ In a letter dated July 18, 2024, ADH provided their evaluation of the CTEH air sampling data collected from April 28 to May 1, 2024, concluding that they cannot conclusively determine the source of the contaminants detected. ADH noted that it is possible that local businesses or other activities not associated with the Landfill are contributing to these levels, and they recommended obtaining more comprehensive air quality data.²

To address ADH's recommendations, E&E released a competitive request for proposals to conduct a study that could further evaluate the source of the previously detected compounds in the Tontitown community. E&E retained CTEH through a competitive RFP process to provide an air sampling study designed with the knowledge of these prior studies, complaints in the area, and other potential emission sources to determine, to the best extent possible, the source of contaminants detected in the prior studies. This plan describes the air sampling study design, objectives, quality assurance metrics, laboratory analysis, and data analysis plan for collected data. Field work, data collection, laboratory analysis, data validation and data analysis will be conducted in accordance with this Quality Assurance Project Plan (QAPP) and the Sampling and Analysis Plan (SAP).

This section summarizes the overall objectives and scope of the study.

Objective 1. Conduct a comprehensive air sampling study to determine air conditions of targeted compounds of potential concern in the community surrounding potential emissions sources in Tontitown Arkansas: Conduct an air monitoring and sampling study designed with considerations of locations and types of community complaints, information from prior air quality assessments in the area, and knowledge of other potential emissions sources nearby to determine the concentrations of compounds of potential concern in the Tontitown, AR community. This air sampling design will include responding with real-time air monitoring, odor surveys, and air sampling in near real time to reported community odor or health complaints.

Objective 2. Determine if the Landfill is likely the source for detected compounds of potential concern in the air in communities near the Landfill in Tontitown, Arkansas: If compounds of potential concern are detected in the community air sampling, then statistical evaluations of air sampling concentration gradients will be performed to determine if the Landfill is likely the source of compounds of potential concern in the community.

Objective 3. Provide air sampling data of appropriate quality for conducting a public health risk assessment: Data collected from this study may be used for a public health risk assessment that could include the characterization of potential health risks due to acute, intermediate, or chronic exposure to air concentrations of compounds of potential concern in the Tontitown community.

QAPP WORKSHEET #3 & 5: PROJECT ORGANIZATION AND QAPP DISTRIBUTION

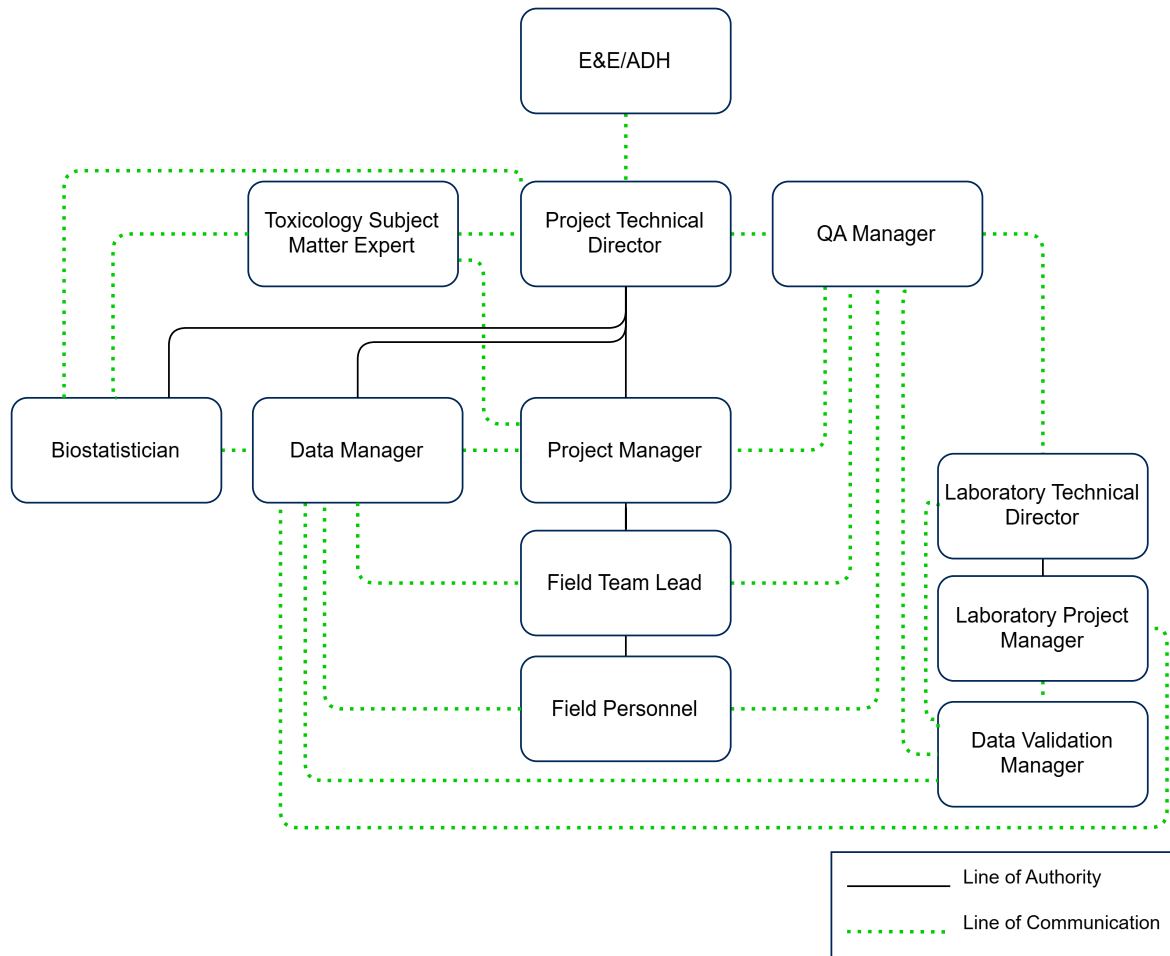
This QAPP and future revisions will be distributed to key personnel at each organization listed below.

RECIPIENTS	TITLE	ORGANIZATION	PROJECT ROLE
Katelyn Hall, PhD, MPH	Epidemiologist, Biostatistician	CTEH	Project Technical Director
Chris Kuhlman, PhD	Principal Toxicologist	CTEH	Toxicology Subject Matter Expert
Amanda Vanlandingham, M.S.	QA Manager	CTEH	QA Project Manager
Cassandra Smythe	Consultant	CTEH	Project Manager/Field Team Lead
April Costa	IT Project Manager	CTEH	Data Manager
Marcus Hueppe	Technical Director	Enthalpy - Orange	Laboratory Technical Director
Richard Villafania	Senior Project Manager	Enthalpy – Orange	Laboratory Project Manager
Matt Loftis	Laboratory Director	Enthalpy – Durham	Laboratory Technical Director
Ashley Thomas	Senior Project Manager	Enthalpy – Durham	Laboratory Project Manager
Dana Hebert	Data Validation Project Manager	eQAQC	Data Validation Manager
Demetria Kimbrough	Associate Director	ADEE, Division of Environmental Quality, Office of Air Quality	Arkansas Department of Energy & Environment (E&E)
Rebecca Davis	Epidemiology Supervisor	ADH, ATSDR Health Assessor and Public Health Outreach Coordinator	Arkansas Department of Health (ADH)

QAPP WORKSHEETS #5 & 6: PROJECT ORGANIZATIONAL CHART AND COMMUNICATIONS PATHWAYS

Project organization for the QAPP implementation is presented in **Figure 2**, which further identifies lines of authority and lines of communication within the QA Program structure.

Figure 2 Organizational Chart and Communication Pathways for Air Sampling Study



QAPP WORKSHEET #4 & 8: KEY PROJECT PERSONNEL QUALIFICATIONS

All CTEH personnel, including key personnel and field personnel, have received training to be qualified for their specific project tasks and functions. Training records including field personnel safety training records, certifications, licenses, and some task-specific training are stored on CTEH secure servers. Personnel are trained using instrument-specific and task-specific standard operating procedures (SOPs) referenced in **Worksheet #21**. No further specialized training has been identified for this Study.

NAME	PROJECT ROLE	ORGANIZATION	EDUCATION/EXPERIENCE
Katelyn Hall, PhD, MPH	Project Technical Director	CTEH	PhD Epidemiology, Toxicology Specialty, MPH Epidemiology, 10 years experience in epidemiology, biostatistics, exposure sciences, and public health
Chris Kuhlman, PhD, CIH, DABT	Toxicology SME	CTEH	PhD Toxicology, Toxicology and Industrial Hygiene Board-Certifications (DABT, CIH), 11 years experience in toxicology, industrial hygiene, and risk assessment
Amanda Vanlandingham, M.S.	QA Manager	CTEH	M.S., Biology, 12 years experience
Mikaela Miller	Biostatistician	CTEH	MPH Epidemiology, MS Biostatistics, 10 years experience
April Costa	Data Manager	CTEH	B.S., Biology, 10 years experience
Cassie Smythe	Project Manager/ Field Team Lead	CTEH	10 years CTEH experience

*Field staff are assigned within one week of the study start date.

QAPP WORKSHEET #7: PROJECT ROLES AND RESPONSIBILITIES

A description of project roles and responsibilities for the air sampling study personnel is provided below.

PROJECT ROLE	RESPONSIBILITIES
Project Technical Director (PTD)	The PTD is the primary point of contact for the project team. The PTD is responsible for developing and coordinating the study design. The PTD implements and communicates monitoring plans, identifies, and recommends action levels and communicates data to appropriate parties. Reviews and provides data summaries and reports.
Toxicology Subject Matter Expert	Subject matter expert supports the PTD by providing input and review of monitoring plans, action levels, data summaries and reports. Can provide assistance to the PTD with communication of data to appropriate parties.
Project Manager	The project manager plans and coordinates project-specific activities including field activities. The project manager coordinates with laboratory staff for scheduling analyses, the data validators, and any other subcontractor necessary to complete the project. The project manager works with the data manager to oversee data delivery from the laboratory and data validator. The project manager plans and manages the budget, invoicing, and scope of the project. The project manager may also fill the role of the field team lead when needed.
Field Team Lead	The Field Team Lead schedules, coordinates, and oversees field sampling activities. The Field Team Lead reviews field documentation to verify compliance with the QAPP and SAP. The Field Team Lead is

PROJECT ROLE	RESPONSIBILITIES
	the primary contact in the field and is responsible for communicating issues identified during field activities. The Field Team Lead is also responsible for coordinating performance audits of field activities during data collection to assess the procedures and performance of the Field Personnel relative to the project requirements.
Field Personnel	Field Personnel are responsible for the performance of field activities as required by the QAPP and associated Air Monitoring and Sampling Plan which includes Nasal Ranger operations. Field Personnel document compliance with project requirements by recording field activities and observations in a field logbook at the time of the activity or observation. In addition, Field Personnel are responsible for collecting samples, submitting them to laboratories, and maintaining COC Records.
Laboratory Project Manager (Laboratory PM)	The Laboratory PMs are the primary point of contact for the project team at the analytical laboratory. The Laboratory PMs are responsible for reviewing project plans and communicating requirements to laboratory personnel; receiving analytical requests; identifying laboratory facilities with appropriate capacity and capability (including certification, where required) to analyze samples collected under this QAPP and associated Air Monitoring and Sampling Plan. Laboratory PMs are responsible for scheduling equipment orders; communicating issues observed upon sample receipt; tracking and communicating data reporting status; and reviewing and submitting deliverables.
Laboratory Technical Director	The Laboratory QA Director ensures analytical work is conducted in accordance with this QAPP, referenced analytical methods, and the laboratory quality system. The Laboratory QA Director is responsible for reviewing analytical data; investigating and responding to data inquiries; conducting corrective action investigations for nonconformances; preparing status reports and reports documenting completion of corrective actions; and overall administration of the laboratory QA program. The Laboratory QA Director is responsible for reviewing the QAPP and associated project plans to confirm QC requirements are met.
QA Manager	The QA PM is responsible for developing, implementing, administering, and monitoring compliance with the project QA program as defined in this QAPP. The QA PM holds overall authority for the project QA and maintains that authority independently from the operational/production aspects of the project. The QA PM prepares/reviews/updates the QAPP; initiates and directs internal observations of quality-related activities; directs the performance of QA functions described in this QAPP; requests corrective action for nonconformances; and ensures corrective actions are effective. The QA PM also acts as an advisor in coordinating laboratory analytical work and may act as a liaison between Field Manager and analytical laboratories. The QA PM is responsible for communicating issues related to data quality to the project team.
Data Validation Manager	The Data Validation Manager is responsible for ensuring analytical data are evaluated for completeness, correctness, compliance, and usability relative to the requirements in this QAPP, the associated Air Monitoring and Sampling Plan, and the published analytical methods. The Data Validation Manager is responsible for scheduling, tracking, and providing data status updates to project data users. The Data Validation Manager is responsible for reviewing and submitting data validation reports and for communicating data usability issues to data users. The Data Validation Manager is responsible for notifying the QA PM of potential analytical issues observed during data validation for investigation and corrective action where warranted.
Data Manager	Data Managers are responsible for managing the project databases, which include field- and laboratory-generated analytical data and associated metadata. Data Managers are the main point of contact for data-related issues and data reporting needs. Data Managers are responsible for ensuring compliance with the QAPP. Data Managers oversee receipt and loading of electronic data deliverables from the field personnel and project laboratories; coordinates production data validation efforts with the Data Validation Manager; defines valid values and similar controls for the database; and coordinates delivery of data to regulatory agencies and data users. Data Managers are responsible for communicating data status and potential data management issues.
Biostatistician	The Biostatistician is responsible for statistical data analysis, both descriptive and inferential. Biostatisticians evaluate analytical methodology and select an appropriate analysis based on the study design and characteristics of the data collected. This role collaborates and coordinates with the Data Manager and Data Validation Manager to ensure data usability and accuracy. Biostatisticians provide interpretation and inference based on the analysis conducted, and communicate findings with the PTD, SME, and PM. The Biostatistician prepares and/or assists in approving final analysis products (graphs, tables, model results, etc.) for sharing with stakeholders.

QAPP WORKSHEET #9: PROJECT PLANNING SESSION SUMMARY

Project Name:	PROJ-053833 -- Tontitown, Arkansas Air Sampling Study		
Projected Date(s) of Sampling:	May 2, 2025 to May 12, 2025	Site Location:	Tontitown, AR

EVENT	DATE	PARTICIPANTS	KEY DECISIONS/ACTION ITEMS
Kickoff and Planning	4/03/2025	PTD, SME, PM, E&E, ADH	Review of Objectives, Study Design
Planning Meeting 1	4/15/2025 9am-11am	PTD, SME, PM, E&E, ADH	Review of draft air sampling planning documents
Planning Meeting 2	4/22/2025 9am-11am	PTD, SME, PM, E&E, ADH	Review of draft air sampling planning documents and finalize draft for review process
Planning Meeting 3	4/30/2025 9:30am-11:30am	PTD, SME, PM, E&E, ADH	Finalize air sampling planning documents to incorporate any feedback from final review.

DATA QUALITY OBJECTIVES (DQOS)

This section defines the data quality objectives (DQOs) and quality assurance (QA) goals for air sampling conducted during this project. DQOs clarify the problem definition, the objectives of the data collection, identify the required data, define study boundaries, describe data reporting methods, and establish performance criteria. They follow EPA's *Guidance on Systematic Planning using the Data Quality Objectives Process (QA/G-4, 2006)*.⁶

QAPP WORKSHEET #10: PROBLEM DEFINITION

The source of the reported complaints from the Tontitown community is unknown. Additionally, the sources of chemicals identified in the air in the prior Tontitown air monitoring and sampling have not been identified. This study is designed to:

1. Identify compounds of potential concern (COPCs) that may be emitted from the Landfill and include chemicals detected in prior air assessments.
2. Conduct consecutive 24-hour air sampling to measure concentrations of COPCs near the fenceline of the Landfill and in increasing distances into the nearby community.
3. Conduct consecutive 24-hour air sampling to measure concentrations of COPCs in background regional ambient air at four locations not influenced by the Landfill.
4. Conduct real-time air monitoring to measure ambient concentrations of VOCs, benzene, oxygen, hydrogen sulfide, sulfur dioxide, and lower explosive limit (LEL) near the Landfill and in the surrounding community.
5. Characterize odors in the community surrounding the Landfill using quantitative and qualitative methods outlined in the Odor Surveys SOP (**Attachment A**).
6. Conduct real-time air monitoring, nasal ranger odor surveys, and collect up to 33 short-term air samples for COPCs at locations of resident complaints.
7. Collect meteorological data at the fenceline of the Landfill to characterize sampling and monitoring locations as upwind, downwind, or crosswind of the Landfill.
8. Conduct monitoring and sampling activities for 24 hours a day for 11 consecutive days spanning two weekends to cover any changes in Landfill operations on weekends.

PROJECT OBJECTIVES

The primary objectives of this air quality study are to:

1. Determine profile of detected COPCs in regional ambient air from background locations and locations upwind from the Landfill.
2. Determine profile of detected COPCs in air from locations downwind of the Landfill.

3. Determine profile of detected COPCs in air at locations with community odor or health complaints received during the study.
4. Determine if the profile of detected COPCs at locations downwind of the Landfill are similar to background regional ambient air.
5. Determine if profile of detected COPCs in air samples and readings at locations with odor or health complaints received during the study is similar to downwind fence line locations from the Landfill and/or background locations.
6. Determine if there are changes in mean COPC concentrations from downwind locations with increasing distances from the landfill.
7. Determine if there are differences in mean COPC concentrations from downwind locations compared to upwind locations from the landfill.
8. Determine if mean COPC concentrations from downwind locations from the Landfill change with weekday versus weekend Landfill operations.
9. Determine if mean COPC concentrations from downwind locations from the landfill are similar to concentrations in background air.
10. Classify detected COPCs as “likely from the landfill”, “possibly from the landfill”, “compound levels not distinguishable from background air”, or “possibly from another emission source and likely not from the Landfill.
11. Determine if the COPCs detected in the community are above health-protective exposure guidelines.
12. Provide transparent data reporting to stakeholders regarding the findings of the air sampling study.
13. Provide scientifically defensible data to inform community members, regulatory agencies, and facility operators.

PROJECT BOUNDARIES

The study geographical boundary encompasses residential and community areas within approximately three miles of the Landfill property boundary, with particular focus on downwind receptors based on predominant wind patterns and areas where the locations of historical complaints have clustered (Error! Reference source not found.). During the study period, complaints from the community that are reported at locations within three miles of the Landfill will prompt mobilization of field personnel to characterize odors and perform air monitoring and 1-hour air sampling. The temporal boundary consists of an 11-day continuous monitoring period scheduled to begin on May 2, 2025, and conclude on May 12, 2025, capturing both weekday and weekend operations at the facility. The analyte boundary for air sampling consists of hydrogen fluoride (HF) and U.S. Environmental Protection Agency (EPA) TO-15 volatile organic compounds (VOCs), selected at the direction of E&E and ADH.⁷ The air sampling boundary will be 198 24-hour air samples (discrete samples), 18 air samples taken daily using evacuated 6L canisters (four in

background locations and 14 within three miles of the Landfill fenceline). Two duplicate or collocated samples will be taken daily, totaling to 22 (11%) duplicates. This amounts to 220 24-hour air samples taken with evacuated 6L canisters for EPA TO-15 VOCs across the 11-day study. There will be 33 1-hour grab air samples (discrete samples) taken using evacuated 6L canisters at locations of complaints received during the study with 5 (15%) duplicates or collocated samples. There will be 38 total 1-hour grab air samples taken. There will be 198 consecutive eight-hour air samples taken from continuous air pumps running 24-hours (discrete samples) at 5 fixed locations to measure HF and 11 (5%) field blanks.

QUALITY ASSURANCE PARAMETERS

The following subsections outline key QA parameters: **representativeness, precision, accuracy, completeness, comparability, and sensitivity.**

1.1.1 Representativeness

Representativeness refers to how well data reflect actual environmental conditions. It depends on proper sampling design and adherence to QAPP procedures. Sample handling (e.g., storage, transport, preservation), field documentation, and calibration logs will ensure samples represent field conditions.

Laboratory representativeness is maintained through appropriate analytical methods, sample holding times, and field duplicates. Samples will be collected at the Landfill fenceline and up to three miles away to reflect community air conditions under various weather patterns. Additional samples beyond three miles will represent background air.

1.1.2 Precision

Precision measures how closely repeated measurements agree. It is assessed using duplicate samples and by evaluating relative percent differences (RPD).

- **Goal:** $\pm 30\%$ RPD for field duplicates or collocated, or within laboratory control sample/duplicate (LCS/LCSD) control limits when duplicates are not collected. These control limits are set by the laboratory.

1.1.3 Accuracy

Accuracy indicates how close a measurement is to a true or reference value. Field accuracy is supported by correct sampling procedures and calibrated equipment. Laboratory accuracy is evaluated through percent recovery (%R) of control samples.

- **Goal:** 70–130% recovery for laboratory control samples.

1.1.4 Completeness

Completeness reflects the percentage of valid data obtained versus expected data. Valid data include those qualified as estimated (e.g., “J” or “UJ”) but not rejected.

- **Goal:** ≥95% completeness for both field and lab data. For this study the goal is to have at least 191 complete 6L canister air samples, 191 complete HF air samples, and 31 6L canisters.

1.1.5 Comparability

Comparability ensures data can be meaningfully compared to other datasets. This is achieved through consistent sampling and analytical methods aligned with EPA or equivalent protocols.

1.1.6 Sensitivity

Sensitivity refers to an instrument or method’s ability to detect low concentrations of a target compound.

- **Method Detection Limit (MDL)** is defined as the minimum concentration of a substance that can be identified, measured, and reported with a 99 percent (99%) confidence that the analyte concentration is greater than zero and is determined from repeated analysis of a sample in each matrix containing the analyte.
- **Reporting Limit (RL):** Typically the lowest standard used for establishing the calibration curve, may vary based on final volume, pressure, or necessary dilutions.

Data will be reported down to MDLs, and results between the MDL and RL will be flagged as estimated (“J”). The laboratory RLs, and accuracy and precision limits cannot be pre-determined due to the variability of final volumes or ending pressure readings or potential dilutions that may be necessary. The laboratory MDLs for target compounds, when possible, will be below applicable health-based screening levels, if feasible, to support meaningful data interpretation. For this study among 50 compounds of potential concern, 10 compounds have health-based screening levels that are lower than the laboratory reported MDLs, 9 for cancer screening levels (1,1,2,2-Tetrachloroethane, 1,1,2-Trichloroethane, 1,2-Dibromoethane, 1,2-Dichloroethane, 1,3-Butadiene, 2-Propenenitrile, Bromodichloromethane, Naphthalene, and Trichloromethane (chloroform)) and 3 for noncancer screening levels (1,1,2-Trichloroethane, acrolein, and naphthalene).

QAPP WORKSHEET #11-A: PROJECT DATA QUALITY OBJECTIVES

CTEH will conduct air sampling data in the community surrounding the Landfill through four strategies. 1) CTEH air monitoring personnel will conduct roaming, real-time air monitoring using handheld air monitoring instruments and 2) conduct periodic odor surveys. 3) Continuous 24-hour air sampling using evacuated 6 L canisters (air sampling pumps for HF) will be conducted in fixed locations surrounding the Landfill and in locations designated to represent regional air or background air. 4) Real-time air monitoring, odor surveys, and up to 33 short-term 1-hour air samples using evacuated 6 L canisters will be collected in response to reported odor or health complaints from locations within three miles of the Landfill.

Air samples will be compared to the applicable screening values in **Worksheet #15**. For the purpose of the study, data will be focused on achieving sufficient sensitivity to meet applicable screening values and other data usability objectives outlined in this QAPP. The following section outlines the project-specific Data Quality Objectives (DQOs) and investigative questions that will focus CTEH air sampling and monitoring efforts to produce comparable data and provide guidance for stakeholders. DQOs are broken out into four broadly defined strategies:

1. Roaming, handheld, real-time air monitoring
2. Roaming, periodic odor surveys
3. Continuous fixed air sampling
4. Complaint response with real-time air monitoring, odor surveys, and short-term air sampling

COMMUNITY HANDHELD REAL-TIME AIR MONITORING DATA QUALITY OBJECTIVES

Handheld real-time air monitoring for total VOCs, benzene, %LEL, oxygen, sulfur dioxide, and hydrogen sulfide will be used as screening tools to detect the presence or absence of these parameters in real-time. These readings are not used for broader decision-making for long-term public health concerns, as instantaneous real-time readings are not directly comparable to long-term health-based screening levels (e.g., EPA RSLs, ATSDR MRLs). Roaming field personnel will be periodically collecting real-time VOCs, benzene, LEL, oxygen, sulfur dioxide, and hydrogen sulfide readings. If VOCs readings are detected above 0.5 parts per million (ppm) using real-time instrumentation and sustained for five (5) minutes or more, then an additional assessment at that location will be performed. Efforts will be made to characterize VOCs spatially and temporally and continue to monitor the area. Periodic roaming benzene-specific monitoring will also be performed. Refer to **Table 1** for DQOs and actions taken for community real-time monitoring using hand-held instrumentation.

Table 2 provides Protective Action Criteria (PAC) values for benzene, sulfur dioxide, and hydrogen sulfide. PAC values are emergency exposure limits which can be used to identify and evaluate accidents for the purpose of taking appropriate protective actions.⁸ If benzene, sulfur dioxide, or hydrogen sulfide are detected using real-time instrumentation and sustained for five (5) minutes or more above their respective PAC-1 values in **Table 2**, CTEH will immediately notify E&E Emergency Management via the hotline (**501-682-0716**) and communication with Steven Ratley (Stephen.ratley@arkansas.gov) for the coordination and management of a potential emergency incident in accordance with the E&E Incident Management Protocol. E&E Emergency Management will also be notified of %LEL readings sustained for five (5) minutes or more above 10%.

Table 1 Community Real-Time Air Monitoring with Handheld Instruments Data Quality Objectives

PARAMETER	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
VOCs via 10.6 eV Photoionization Detector (PID)	1	Does roaming real-time air monitoring for VOCs in the community indicate no detections (i.e., below the instrument's limit of detection)?	If real-time air monitoring results indicate that VOCs are not detected at one location (i.e., below the instrument's limit of detection (LOD)), monitoring will continue, and the person will resume roaming air monitoring for VOCs.
	2	Is there a detection of VOCs above the LOD but below 0.5 ppm via roaming real-time air monitoring in the community?	If real-time air monitoring results indicate that VOCs are detected, then environmental conditions and odors will be documented and assessed (i.e., visible dust, high traffic, smoke from fire or cigarettes). If odors are present, personnel will conduct an odor survey.

PARAMETER	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
Benzene via 9.8eV PID	3	Is there a detection of VOCs above 0.5 ppm via roaming real-time air monitoring in the community?	If real-time air monitoring results indicate that VOCs are above the LOD but below 0.5 ppm, monitoring will continue, and the person will resume roaming air monitoring for VOCs.
			If real-time air monitoring results indicate that VOCs are detected, then environmental conditions and odors will be documented and assessed (i.e., visible dust, high traffic, smoke from fire or cigarettes).
			If odors are present, personnel will conduct an odor survey.
			Personnel will stay in the area and continue monitoring to further characterize the area for at least another 5 minutes to determine if detections of VOCs are transient and intermittent or sustained.
			If VOC detections of 0.5 ppm are sustained for 5 minutes or longer, air monitoring personnel will monitor for benzene specifically to determine the absence or presence of benzene above the instrument LOD (0.01 ppm or 10 ppb).
Benzene via 9.8eV PID	4	Does roaming real-time air monitoring for benzene in the community indicate no detections (i.e., below the instrument's LOD)? Alternatively, after verifying a sustained (>5 minutes) detection of VOCs with a PID, is the roaming real-time air monitoring for benzene in the community non-detect (i.e., below the instrument's LOD)?	Field personnel will immediately relay their findings to the Field Team Lead.
			If air monitoring results for benzene are non-detect (<10 ppb), monitoring will continue and personnel will resume roaming air monitoring.
	5	Is there a detection of benzene via roaming real-time air monitoring in the community above the instrument's LOD?	If air monitoring results for benzene are detected above the instrument's LOD (10 ppb), the air monitoring personnel will continue monitoring to

PARAMETER	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
	6	Is there a detection of benzene via roaming real-time air monitoring in the community above the instrument's LOD and continues to be sustained (>5 minutes)?	evaluate whether the detection is transient or sustained (at least 5 minutes).
			Field personnel will immediately relay their findings to the Field Team Lead.
			If air monitoring results for benzene are detected above the instrument's LOD, the air monitoring personnel will continue monitoring and will record a second benzene measurement at the same location within fifteen (15) minutes of the first benzene detection to evaluate whether the detection is transient or sustained.
			If real-time air monitoring results indicate that benzene detections are sustained, then environmental conditions will be documented and assessed (i.e., visible dust, high traffic, smoke from fire or cigarettes). If odors are present, personnel will conduct an odor survey. Once documentation is complete, the personnel will continue with their air monitoring route. Field personnel will immediately relay their findings to the Field Team Lead.
Hydrogen Sulfide (H ₂ S), Sulfur Dioxide (SO ₂), Percent Lower Explosive Limit (%LEL), via MultiRAE Sensors	7	Does roaming real-time air monitoring for these individual parameters in the community indicate no detections (i.e., below the instrument's LOD)?	If these parameters are not detected, monitoring will continue and personnel will resume roaming air monitoring.
	8	Is there a detection of a parameter via roaming real-time air monitoring in the community above the instrument's LOD?	If air monitoring results for a parameter are detected above the instrument's LOD, the air monitoring personnel will continue monitoring to evaluate whether the detection is transient or sustained (at least 5 minutes). If odors are present, personnel will conduct an odor survey.

PARAMETER	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
			If air monitoring results for a parameter are detected above the instrument's LOD, the air monitoring personnel will continue monitoring and will record a second measurement at the same location within fifteen (15) minutes of the first detection to evaluate whether the detection is transient or sustained.
	9	Is there a detection of a parameter via roaming real-time air monitoring in the community above the instrument's LOD and continues to be sustained (>5 minutes)?	If real-time air monitoring results indicate that the parameter is detected, then environmental conditions and odors will be documented and assessed (i.e., visible dust, high traffic, smoke from fire or cigarettes). If odors are present, personnel will conduct an odor survey. Once documentation is complete, the personnel will continue with their air monitoring route. Field personnel will immediately relay their findings to the Field Team Lead.
Benzene, Hydrogen Sulfide, Sulfur Dioxide	10	Are levels detected and sustained for five (5) minutes or more above the protective action criteria-1 in Table 2 ?	Notify the PM immediately. The PM will notify E&E Emergency Management.
%LEL	11	Are levels detected and sustained for five (5) minutes or more above 10%	Notify the PM immediately. The PM will notify E&E Emergency Management.
Oxygen	12	Are levels less than 19.5%	Notify the PM immediately of the low oxygen atmosphere. The PM will notify E&E Emergency Management.

Table 2 Protective Action Criteria for Community Real-Time Air Monitoring

PARAMETER	PAC-1 ^{1,4}	PAC-2 ²	PAC-3 ³
Benzene	52 ppm	800 ppm	4,000 ppm
Hydrogen Sulfide (H ₂ S)	0.51 ppm	27 ppm	50 ppm
Sulfur Dioxide (SO ₂)	0.2 ppm	0.75 ppm	30 ppm

¹ PAC-1 is the airborne concentration (expressed as ppm [parts per million] of a substance above which it is predicted that the general population, including susceptible individuals, when exposed for more than one hour, could experience notable discomfort, irritation, or certain asymptomatic, nonsensory effects. However, these effects are not disabling and are transient and reversible upon cessation of exposure.

² PAC-2 is the airborne concentration (expressed as ppm) of a substance above which it is predicted that the general population, including susceptible individuals, when exposed for more than one hour, could experience irreversible or other serious, long-lasting, adverse health effects or an impaired ability to escape.

³ PAC-3 is the airborne concentration (expressed as ppm) of a substance above which it is predicted that the general population, including susceptible individuals, when exposed for more than one hour, could experience life-threatening adverse health effects or death.

⁴ E&E Emergency Management will be notified of detections sustained for five (5) minutes or more above a PAC-1 value to support the coordination and management of a potential emergency incident in accordance with the E&E Incident Management Protocol

ODOR SURVEY DATA QUALITY OBJECTIVES

Odor surveys will be conducted periodically in accordance with the Odor Survey SOP (**Attachment A**) by the roaming field personnel taking real-time air monitoring and along a pre-determined route.

Table 3 Odor Survey Evaluation Data Quality Objectives

PARAMETER	INSTRUMENT	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
Odor	Calibrated Human Nose	13	No odors present that are on the E&E Odor Wheel	Document no odors present and continue monitoring route.
		14	Odors present that are on the E&E Odor Wheel	Conduct an odor survey using the nasal ranger.
	Nasal Ranger	15	Are odors present with a dilution to threshold (D/T) of 2 but less than 7 using the nasal ranger?	Document the odor description using the E&E odor wheel, the D/T reading from the nasal ranger, and its hedonic tone in the Odor Investigation App in Mobile Data Studio. Continue periodic odor sampling.
		16	Are odors greater than or equal to a D/T of 7 using the nasal ranger?	Document the odor description using the E&E odor wheel, the D/T reading from the nasal ranger, and its hedonic tone in the Odor Investigation App in Mobile Data Studio. Relay the findings to the Field Manager and/or PTD immediately to determine if a 1-hour grab air sample can be collected.

COMMUNITY AIR SAMPLING DATA QUALITY OBJECTIVES

Consecutive 24-hour air samples will be deployed at fourteen fixed locations in the community within the three miles surrounding the Landfill. Air sampling will consist of 24-hour continuous sampling using 6 Liter (L) evacuated canisters for VOCs listed as a COPC over the course of 11 consecutive days. In addition to the fourteen fixed locations, four will be added as background sample locations placed further than three miles from the Landfill fenceline. Analytical air sampling pumps will be used for HF and will be deployed in the same locations as the 24-hour canisters. The analytical sampling pumps will be calibrated to cover a sample duration of 24 hours with a sample period of 8 hours. Meteorological conditions will be continuously recorded from a meteorological station deployed near the Landfill fenceline. **Table 4** describes the community air sampling data quality objectives.

Table 4 Community Air Sampling Data Quality Objectives

ANALYTE	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
COPCs - VOCs via USEPA TO-15	17	Are the laboratory results for the evacuated canisters non-detect (i.e., below the LOD) for VOCs that are COPCs?	Continuous 24-hour air sampling will continue the duration of the 11-day study.
	18	Pressure on a 24-hour canister is greater than -3 inHg at a pressure check (0 to-3 inHg).	Personnel will pick up the canister and immediately notify the PM. The period between canister pickup and the following scheduled deployment will not be sampled.
COPCs - VOCs via USEPA TO-15 and HF via Modified OSHA-ID-165SG	19	Are the laboratory results for the air samples at or above screening levels for any COPC?	A retrospective assessment of the sampling location, weather conditions, and landfill activities will be performed to assess potential source of the exceedance. Results will be compared against intermediate and/or chronic health-protective screening values such as the USEPA Regional Screening Levels (RSLs) or ATSDR Minimal Risk Levels (MRLs), where available.
	20	Do the laboratory results for the air samples represent variations in Landfill operations?	Collect samples for 11 days spanning two weekends to get variations in landfill operations like covering of the landfill on weekends.
	21	Do the laboratory results for the air samples represent upwind and downwind concentrations from the Landfill?	Use a met station to determine which samples are upwind and downwind of the Landfill.
	22	Do the laboratory results for the air samples represent a gradient of distances from the Landfill in the downwind direction?	Samples will be collected at locations starting near the fenceline of the Landfill in the downwind direction and at increasing approximately 0.75-1 miles distances ensuring at least 4 sampling locations in the downwind direction including fenceline to background samples. (HF samples will include three fenceline locations, one at a 1-2 miles downwind distance, and one background location to provide a maximum gradient of two samples downwind and two upwind)

ANALYTE	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
HF via Modified OSHA-ID- 165SG	23	Are the laboratory results for the air samples non-detect (i.e., below the MDL) for HF?	Sampling for HF will continue with sampling pumps calibrated to cover a sample duration of 24 hours with a sample period of 8 hours. Analytical sampling pumps will be deployed at 5 of the same locations as the 24-hour canisters and continue for the duration of the 11-day study.

COMMUNITY COMPLAINT AIR MONITORING AND SAMPLING DATA QUALITY OBJECTIVES

The Tontitown community will be notified of the study through a press release and other media sources. The notification will include a hotline number for the community member to call to report a complaint during the air sampling study. CTEH field staff will be answering the hotline and addressing complaints. Upon notification of a community complaint, field staff answering the hotline will complete an intake form (**Attachment B**) in the CTEH Carbon application to document the complaint, determine if there are odors present, and if the complaint is within three miles of the Landfill and the complainant is willing for the team to respond to the complaint with air monitoring and sampling. Upon the agreement of the complainant to have the field team respond, the two field personnel conducting real-time readings and odor surveys with the nasal ranger will respond by going to the location of the complaint. Upon arrival to the complaint location, handheld real-time air monitoring for total VOCs, benzene, LEL, oxygen, sulfur dioxide, and hydrogen sulfide will be used as screening tools to detect the presence or absence of these parameters. These readings are not used for broader decision-making for public health, as instantaneous real-time readings are not directly comparable to health-based screening levels and are not used to make definitive risk-based decisions regarding public safety and/or exposure. Refer to **Table 1** for DQOs and actions taken for community real-time monitoring using hand-held instrumentation and **Table 3** for DQOs and actions taken for odor surveys while responding to a complaint in the surrounding communities. The field team will also conduct nasal ranger sampling at the complaint location. The team will collect a 1-hour discrete sample of the VOCs on the COPC list. The number of 1-hour samples collected will be capped at 33 field samples and 5 duplicate samples for the duration of the 11-day study. CTEH will not collect more than three field samples per day in order to collect samples each day of the study. If an odor is recorded that could warrant going over the 3 sample per day benchmark, CTEH could decide to collect an additional sample on that day. When going over the benchmark of 3 samples per day is not warranted, CTEH will collect real-time air monitoring data and conduct odor surveys from the compliant location.

If no complaints are received by 7 pm on any given day, CTEH personnel will collect two 1-hour grab samples after 7 pm, one in a location with frequent complaints near the fenceline in the downwind direction from the landfill and another location in the upwind direction from the landfill. Then the following morning CTEH will take an additional 1-hour grab sample in the same downwind location as the day before (**Figure 1**). The project meteorological station placed near the Landfill fenceline will be used to determine the predominant wind directions. This sampling will provide 1-hour air concentrations for comparison between upwind versus downwind locations from the landfill. DQOs for conducting 1-hour samples during community complaint response are described in **Table 5**.

Table 5 One-hour Sample Data Quality Objectives

ANALYTE	DECISION STATEMENT #	INVESTIGATIVE QUESTION	ACTION
COPCs - VOCs via USEPA TO-15	24	Is there a complaint of an odor or health effect by a community member at a location within approximately three miles from the Landfill where the complainant agrees to a response?	Field staff completes the intake form in the CTEH Carbon application, goes to the location, conducts real-time air monitoring of VOCs, benzene, LEL, oxygen, sulfur dioxide, and hydrogen sulfide, conducts an odor survey using the nasal ranger, and collects a 1-hour grab sample at the complaint location. Field staff documents all response data collection in mobile data studio (a proprietary CTEH application).
	25	Is there a complaint of an odor or health effect by a community member at a location within approximately three miles from the Landfill where the complainant does not agree to a response?	Field staff completes the intake form in the CTEH Carbon application according to the information provided by the complainant and does not respond.
	26	Is there a complaint of an odor or health effect by a community member at a location within approximately three miles from the Landfill where the complainant agrees to a response, but three samples have already been taken today?	Field staff completes the intake form in the CTEH Carbon application, goes to the location, conducts real-time air monitoring of VOCs, benzene, LEL, oxygen, sulfur dioxide, and hydrogen sulfide, and conducts an odor survey using the nasal ranger. Field staff documents all response data collection in mobile data studio.
	27	Is there a complaint of an odor or health effect by a community member at a location within approximately three miles from the Landfill where the complainant agrees to a response, but three samples have already been taken today? And Any actions in Table 1 or Table 3 are taken.	Field staff completes the intake form in the CTEH Carbon application, goes to the location, conducts real-time air monitoring of VOCs, benzene, LEL, oxygen, sulfur dioxide, and hydrogen sulfide, and conducts an odor survey using the nasal ranger. Field staff notifies PM of the actions taken. PM consults PTD or SME for final decisions on collecting a 1-hour grab sample. If approved by PTD or SME, the field staff collects a 1-hour grab sample at the complaint location. Field staff documents all response data collection in mobile data studio.

QAPP WORKSHEET #30- ANALYSES AND LABORATORY CONTACTS

Samples will be submitted to the analytical laboratories identified in **Table 6** for analysis in accordance with the QAPP and sampling analysis plan (SAP). The 6L evacuated canisters will be analyzed for volatile organic compounds (VOCs) on the COPC list using the USEPA Toxic Organics – 15 (TO-15) method. The HF samples will use analytical air sampling pumps and be analyzed using the modified OSHA-ID-165SG method.

Table 6 Analyses and Laboratory Contacts

SAMPLING TYPE	MATRIX	ANALYSIS METHOD	LABORATORY	CONTACT
24-hour Integrated Samples	Air 6L, Evacuated canisters	VOCs via USEPA TO-15 method	Enthalpy - Orange	Marcus Hueppe
One-hour Samples	Air 6L, Evacuated canisters	VOCs via USEPA TO-15 method	Enthalpy - Orange	Marcus Hueppe
24-hour Intermittent HF Samples	Air, Analytical sampling pumps	Modified OSHA-ID-165SG	Enthalpy - Durham	Ashley Thomas

QAPP WORKSHEET #12-A: MEASUREMENT PERFORMANCE CRITERIA

Table 7 describes the measurement performance criteria to be used for 24-hour air samples in the field to ensure precision and accuracy of the air samples. **Table 8a & b** describes measurement performance criteria to be used in the laboratory and analysis of criteria set to ensure the study meets the DQOs.

Table 7 Measurement Performance Criteria– Field QC Samples for Air

QC SAMPLE	ANALYTICAL GROUP	FREQUENCY	DATA QUALITY INDICATORS (DQIS)	DESCRIPTION AND DETAIL	MEASUREMENT PERFORMANCE CRITERIA*
Field Duplicate	24-hour and 1-hour Air Samples (evacuated canisters)	One per 10 field samples, or 10% of samples	Precision	Precision is determined from the analyzed concentrations of samples collected simultaneously from the same air mass using two discrete canisters collected through the same sampling inlet	If both the original and duplicate results are $\geq 5 \times$ LOQ, the RPD should be $\leq 30\%$ for air samples; preferable $\leq 25\%$
Field Co-located	24-hour and 1-hour Air Samples (evacuated canisters)	One per 10 field samples, when duplicate is not possible	Precision	Precision is determined from the analyzed concentrations of samples collected simultaneously from the same air mass using two discrete canisters collected through two separate sampling inlets; this determines the precision of the sampling and analysis processes.	If both the original and co-located results are $\geq 5 \times$ LOQ, the RPD should be $\leq 30\%$ for air samples; preferable $\leq 25\%$ or RPD listed in Worksheet #28.3-A.
Field Blank	24-hour Intermittent Analytic Pump Samples	One per 20 field samples	Contamination (Accuracy/Bias)	NA	Not detected $>1/2$ LOQ or $>1/10$ regulatory limit, whichever is greater

*If field duplicates are not feasible, co-located samples are acceptable.

Table 8a Measurement Performance Criteria for VOCs in Air Samples

DATA QUALITY INDICATORS	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	FREQUENCY	ERROR ASSESSED BY QC SAMPLE*
Completeness	≥ 95%	$\% \text{ Complete} = \frac{\text{usable results}}{\text{results reported}} \times 100\%$	-	S&A
Sensitivity	LOD for non-detect results are less than Project-Required Quantitation Limits (PRQL)	Evaluate laboratory LOD and LOQ	-	A
Accuracy, bias, contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	Initially, every 24 hours	A
Accuracy, bias	≤ 30 %	Continuing Calibration Verification (CCV)	Initially, every 24 hours	A
Instrument performance	Tune criteria consistent with analytical method	Mass spectrometer tuning	Initially, every 24 hours	A
Sensitivity, accuracy, bias	Recoveries within 70% to 130% of ICAL midpoint standard area or the CCV on days when ICAL is not performed	Internal standards	Every field sample and QC sample, added prior to analysis	A
Precision	Relative percent difference (RPD) must be ≤ 25% or as specified in Worksheet #28.3-A.	Laboratory duplicate	One per batch of 20 samples	A

Notes: Evacuated canisters analyzed for VOCs via EPA Method TO-15

Sampling (S), Analytical (A), or Both (S&A)

LOQ = Limit of quantitation

RL = reporting limit

MB = method blank

CCV= continuing calibration verification

Table 8b Measurement Performance Criteria for HF in Air Samples

DATA QUALITY INDICATORS	MEASUREMENT PERFORMANCE CRITERIA	QC SAMPLE AND/OR ACTIVITY USED TO ASSESS MEASUREMENT PERFORMANCE	FREQUENCY	ERROR ASSESSED BY QC SAMPLE*
Completeness	≥ 95%	$\% \text{ Complete} = \frac{\text{usable results}}{\text{results reported}} \times 100\%$	-	S&A
Sensitivity	LOD for non-detect results are less than Project-Required Quantitation Limits (PRQL)	Evaluate laboratory LOD and LOQ	-	A
Accuracy, bias, contamination	No analytes detected >1/2 LOQ or >1/10 the amount measured in any sample or 1/10 the regulatory limit, whichever is greater	Method Blank	Initially, every 24 hours	A
Accuracy, bias	≤ 30 %	Continuing Calibration Verification (CCV)	Initially, every 24 hours	A
Instrument performance	TBD	TBD	TBD	TBD
Sensitivity, accuracy, bias	Recoveries within 70% to 130% of ICAL midpoint standard area or the CCV on days when ICAL is not performed	Internal standards	Every field sample and QC sample, added prior to analysis	A
Precision	Relative percent difference (RPD) must be ≤ 25% or as specified in Worksheet #28.3-A.	Laboratory duplicate	One per batch of 20 samples	A

QAPP WORKSHEET #13: SECONDARY DATA USES AND LIMITATIONS

Secondary data were used to assist with the strategy of the air monitoring and sampling design. Secondary data used to inform project decisions are provided in **Table 9** with their source, how the data are used, and limitations associated with the data.

Table 9 Secondary Data Used to Design the Tontitown Arkansas Air Sampling Study

SECONDARY DATA	DATA SOURCE	HOW DATA WILL BE USED	LIMITATIONS ON DATA USE
Historic weather conditions	CTEH Reports	Assign sampling locations in prior studies as upwind, downwind, or crosswind, to use the downwind locations to help determine the COPC list.	The wind directions in these reports were from locations approximately 10 miles from the Tontitown, AR community and may not represent local conditions.
		Approximate predominant wind directions for the Tontitown community in relation to the Landfill to propose sampling locations for this study.	These conditions represent wind directions in February and April 2024 and may not represent conditions at the time of this study.
Complaint Data Reported to E&E	E&E	Analyze the locations and type of complaints to look for clustering and consistent descriptions.	The data are self-reported and may be limited by recall or missing information
		Clustering of historical complaints informs proposed sampling locations to ensure the air samples represent the community experiencing complaints.	These complaints likely do not represent all possible odor or health effects from alleged poor air quality experienced in the area, but only reported complaints to E&E and there may be other areas in Tontitown experiencing these events and not reporting them
Estimated Emissions	National Emissions Inventory	Determine chemicals estimated as emitted from the Landfill to be considered as a COPC.	There may be emissions from the Landfill that are not reported to NEI due to qualities being below reporting requirements
Reported Emissions	Toxics Releases Inventory	Determine chemicals reported as emitted from the Landfill to be considered as a COPC. Note: no emissions were reported to TRI for the Landfill	NA, this data source did not inform the planning
National Guard December 2023 Air Monitoring Data	E&E FOIA Request "Katelyn Hall 4.16.2025"	Determine chemicals reported as detected in air monitoring to be considered as a COPC.	Air monitoring can have large variability in detected concentrations and may not represent the true concentration at that place and time.
CTEH February 2024 Air Sampling Data	CTEH	Determine chemicals reported as detected in analytic air samples to be considered as a COPC.	The chemicals detected may not represent emissions from the landfill versus other emission sources in the region

SECONDARY DATA	DATA SOURCE	HOW DATA WILL BE USED	LIMITATIONS ON DATA USE
CTEH April 2024 Air Sampling Data	CTEH	Determine chemicals reported as detected in analytic air samples in downwind from the Landfill in additional fenceline locations, and background locations, to be considered as a COPC.	The chemicals detected may not represent emissions from the landfill versus other emission sources in the region
Annual Compliance Certification	Arkansas Division of Environmental Quality Permit Data System ^a	Determine chemicals reported as emitted from the Landfill to be considered as a COPC.	May not be inclusive of all fugitive emissions from the Landfill.
Emissions Data Report to E&E from the Landfill for NEI Reporting	E&E FOIA Request "Katelyn Hall 4.16.2025"	Determine chemicals permitted to be emitted from the Landfill to be considered as a COPC.	May not be inclusive of all fugitive emissions from the Landfill.
Emissions Data in the Landfill 2024 Air Operating Permit Application	E&E FOIA Request "Katelyn Hall 4.16.2025"	Determine chemicals permitted to be emitted from the Landfill to be considered as a COPC.	May not be inclusive of all fugitive emissions from the Landfill.

^aSource https://www.adeg.state.ar.us/home/pdssql/p_facil_info.aspx?AFINDash=72-00144&AFIN=7200144

QAPP WORKSHEET #14-A AND #16-A: PROJECT TASKS & SCHEDULE

Table 10 outlines the tasks to be completed in this study and the proposed schedule with a full timeline to complete them. The tasks in the schedule are sequentially dependent, meaning a delay in a task will delay the schedule and ultimately the project timeline. Some delays may be unavoidable like weather events, shipping delays, etc. In the event of these delays CTEH will notify E&E/ADH and adjust this schedule accordingly.

Table 10 Project Tasks & Schedule

CONTRACTOR	ACTIVITY	DATES/DURATION	DELIVERABLE
E&E	Develop website	April 2, 2025 -April 25, 2025	Website with resources for the public to learn about the study and how to make a complaint during the study
CTEH	CTEH drafts study description and FAQs	April 2, 2025 -April 22, 2025	Final draft language delivered to E&E and ADH
E&E	Launch study webpage and notify the public	April 25, 2025	NA
CTEH	CTEH drafts study QAPP	April 2, 2025 -April 22, 2025	QAPP delivered to E&E and ADH for review and final approval
E&E	Review of QAPP	April 22, 2025 – April 29, 2025	Notification to CTEH of edits to and/or approval of QAPP
CTEH	Notify law enforcement in Tontitown, AR of the study	April 29, 2025	NA
CTEH	CTEH makes preparations for the air sampling study.	April 30, 2025 – May 1, 2025	Equipment shipped to location, online data collection tool set up, field team deploys
CTEH	CTEH conducts the eleven (11) day air sampling study.	May 2, 2025 – May 12, 2025	Air sampling and monitoring in Tontitown, AR
CTEH	CTEH delivers web project dashboard link	May 2, 2025	E&E and ADH can access the link to monitor active field data collection and operations.
Enthalpy	Laboratory Analysis	May 3, 2025 – May 26, 2025	Final Laboratory Reports, Data Packages and EDDs
CTEH	CTEH receives all analytical air sampling results from the laboratory.	May 26, 2025	CTEH receives all EDDs from Enthalpy
eQAQC	Level II and IV Data Validation and Verification	May 26, 2025-June 5, 2025	Final data validation reports
CTEH	CTEH receives data validation on analytical air samples.	June 5, 2025	CTEH receives all validation reports
CTEH	Meeting to present preliminary results	June 6, 2025	CTEH meets with E&E and ADH to present a summary of validated

CONTRACTOR	ACTIVITY	DATES/DURATION	DELIVERABLE
			air sampling results and preliminary findings.
CTEH	Analysis Meeting 1	June 9, 2025	Review of draft air sampling study analysis
CTEH	Analysis Meeting 2	TBD	Review of final draft air sampling study analysis.
CTEH	Reporting Meeting 3	TBD	Review of draft air sampling study report.
CTEH	Reporting Meeting 4	August 9, 2025	Finalize air sampling study report.
CTEH	Final report delivered.	August 11, 2025	CTEH delivers final report for the air sampling study to E&E and ADH.

QAPP WORKSHEET #15-A AND 28.3-A: LABORATORY-SPECIFIC REPORTING LIMITS, QUANTITATION LIMITS AND QUALITY CONTROL LIMITS

Table 11 and **Table 12** describe the laboratory-specific reporting and quantitation limits for the COPCs measured from the 24-hour fixed, discrete samples and 1-hour discrete, grab samples, and a comparison of this table including the health based screening levels in this study are found in **Attachment C**. Ultimately the reporting limit (RL) and the method detection limit (MDL) applied to the analyses of the air samples from this study may differ from these listed here due to variations. CTEH will be maintained an up to date and final list of reporting and quantitation limits used in the analysis on the Secure CTEH Servers and will be accessible to E&E or ADH upon request.

Table 11 RLs and MDLs for COPCs by EPA Method TO-15 for 24-Hour and 1-Hour Canisters

Compound	CAS No.	RL (ppbv)	MDL (ppbv)
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	0.20	0.036
1,1,2,2-Tetrachloroethane (tetrachloroethane)	79-34-5	0.20	0.046
1,1,2-Trichloroethane	79-00-5	0.20	0.047
1,1,2-Trichloroethene (trichloroethylene)	79-01-6	0.20	0.068
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	0.20	0.066
1,1-Dichloroethane (ethylidene chloride)	75-34-3	0.20	0.048
1,1-Dichloroethene (vinylidene chloride)	75-35-4	0.20	0.052
1,2,4-Trichlorobenzene	120-82-1	0.20	0.12
1,2,4-Trimethylbenzene (pseudocumene)	95-63-6	0.20	0.068
1,2-Dibromoethane (ethylene dibromide)	106-93-4	0.20	0.043
1,2-Dichloroethane (ethylene dichloride)	107-06-2	0.20	0.046
1,2-Dichloropropane (propylene dichloride)	78-87-5	0.20	0.060
1,3,5-Trimethylbenzene (mesitylene)	108-67-8	0.20	0.070
1,3-Butadiene	106-99-0	0.20	0.055
2-Butanone (methyl ethyl ketone, MEK)	78-93-3	1.0	0.075
2-Propanol (isopropanol)	67-63-0	1.0	0.095
2-Propenal (acrolein)	107-02-8	0.20	0.15
2-Propenenitrile (acrylonitrile)	107-13-1	0.20	0.070
4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK)	108-10-1	0.20	0.066
Acetonitrile (cyanomethane)	75-05-8	0.20	0.12
Benzene	71-43-2	0.20	0.041
Bromodichloromethane	75-27-4	0.20	0.041

Compound	CAS No.	RL (ppbv)	MDL (ppbv)
Carbon disulfide (methanedithione)	75-15-0	0.20	0.078
Carbon tetrachloride (tetrachloromethane)	56-23-5	0.20	0.043
Chlorobenzene	108-90-7	0.20	0.036
Chloroethane (ethyl chloride)	75-00-3	0.20	0.074
Chloroethene (vinyl chloride)	75-01-4	0.20	0.049
Chloromethane (methyl chloride)	74-87-3	0.20	0.068
Dichlorodifluoromethane (Freon 12)	75-71-8	0.20	0.049
Dichloromethane (methylene chloride)	75-09-2	0.20	0.098
Ethane, 1,1-Difluoro-	75-37-6	1.0	0.073
Ethenyl acetate (vinyl acetate)	108-05-4	1.0	0.44
Ethyl acetate	141-78-6	0.40	0.1
Ethylbenzene	100-41-4	0.20	0.068
Heptane	142-82-5	0.20	0.058
Hexane	110-54-3	0.20	0.060
m,p-Xylenes	179601-23-1	0.40	0.099
Methanol	67-56-1	5	1.6
Naphthalene (naphthene)	91-20-3	1.0	0.64
<i>o</i> -Dichlorobenzene (1,2-dichlorobenzene)	95-50-1	0.20	0.068
<i>o</i> -Xylene (1,2-xylene)	95-47-6	0.20	0.058
Pentane	109-66-0	0.20	0.063
Propene (propylene)	115-07-1	0.20	0.1
Styrene (vinylbenzene)	100-42-5	0.20	0.070
Tetrachloroethene (perchloroethylene)	127-18-4	0.20	0.069
Tetrahydrofuran (oxolane)	109-99-9	0.20	0.064
Toluene (methylbenzene)	108-88-3	0.20	0.046
<i>trans</i> -1,2-Dichloroethene (<i>trans</i> -1,2-dichloroethylene)	156-60-5	0.20	0.056
Trichloromethane (chloroform)	67-66-3	0.20	0.037

Table 12 RL and MDL for Hydrogen Fluoride 24-Hour Samples

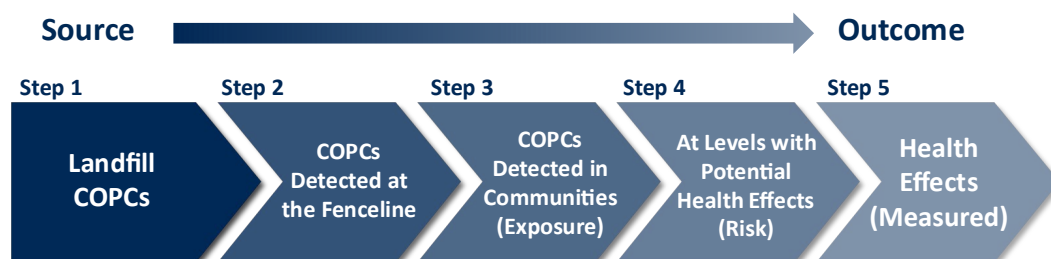
Compound	CAS No.	RL (µg/m³)	MDL (µg/m³)
Hydrogen Fluoride	7664-39-3	65.8 (80 ppb)	6.58 (8 ppb)

QAPP WORKSHEETS #17-A: SAMPLING DESIGN AND RATIONALE

CONCEPTUAL MODEL AND STATISTICAL METHODS

The source to outcome conceptual model in **Figure 3** was modified by a model described by EPA in the Air Toxics Risk Assessment Reference Library and used as the framework for designing the air sampling and statistical approach to this study.⁹⁻¹¹ To determine whether COPCs detected in the community could be associated with the Landfill, the following steps of the source-to-outcome pathway were followed:

Figure 3 The Source to Outcome Conceptual Model



1. Identify what compounds are detected at the Landfill fenceline
2. Evaluate if those specific compounds are detected away from the Landfill fenceline and how those levels compare to those measured in background ambient air.
3. Evaluate if those specific compounds are in communities near the source, where people live, work, or recreate, at levels above background.

If compounds are present in a community more than what is expected in background air, a public health assessment can be conducted to determine if the concentrations of compounds are above health-based screening levels, and if they are, further assessment can be done to evaluate potential public health risks. However, a COPC concentration exceeding a health-based screening level does not mean that there is a risk of immediate health effects, but that more investigations are needed. The sample locations and the statistical analysis were designed to address steps 1 to 3 in this conceptual model. These study results will be delivered to ADH to conduct a public health assessment based on ATSDR guidelines.

DETERMINING COMPOUNDS OF POTENTIAL CONCERN

Compounds of potential concern (COPCs) are chemicals that have been identified as emitted from the Landfill or detected in prior air sampling studies and may pose a risk to human health based on toxicity. Identifying this COPC list was done in three steps.

- 1) First compounds were focused to EPA TO-15 volatile organic compounds (VOCs) at the guidance from E&E and a list of compounds was gathered from permitted emissions reported through the most recent permit application, reporting to the National Emissions Inventory (NEI) or the Toxic Release Inventory (TRI), Title V Annual Compliance Certification reports, and compounds that were detected at downwind fenceline locations in prior air sampling assessments.^{4,5}
- 2) The compounds were narrowed to VOCs identified as being emitted from the Landfill and/or were detected in a prior air sampling study. Compounds that were not EPA TO-15 VOCs, were not reported as emitted from the Landfill, and were not detected or analyzed in prior studies were excluded from the list.
- 3) Compounds were further narrowed to only include those with established human health-protective exposure guidelines (e.g., EPA RSLs or ATSDR MRLs) to get to the list of COPCs.

At the request of E&E, hydrogen fluoride (HF) was added to the COPC list. The list of COPCs is in **Table 11**, and the data source supporting the inclusion of that compound is in **Attachment D**.

METEOROLOGICAL DATA ANALYSIS

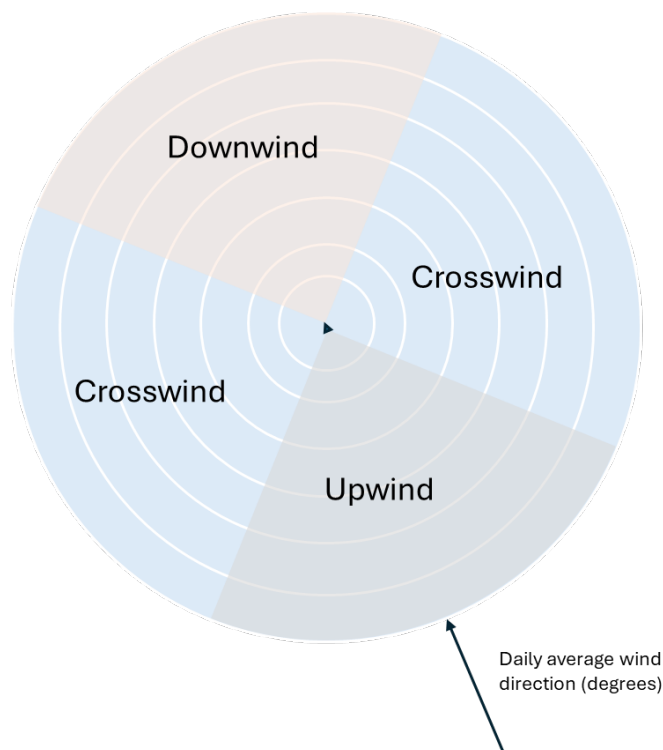
Wind direction will be recorded by the meteorological station placed near the Landfill fenceline. To determine whether a sampling location is classified as upwind, downwind, or crosswind, the average wind direction (in degrees) is first calculated over the specific sampling time period (i.e., 24 hours or 1 hour). The average wind direction for the time period is assigned to that specific air sample concentration. These average wind directions are then classified into downwind, upwind, and crosswind in relation to the sampling location to the Landfill. A location is considered **downwind** if it lies within 45 degrees clockwise or counterclockwise of the calculated average wind direction. Conversely, **upwind** refers to the sector 180 degrees opposite the average wind direction, spanning 45 degrees on either side. Locations that do not fall within either the upwind or downwind sectors are classified as **crosswind**. **Figure 4** provides a visual representation of assigning wind direction. The calculations for this can be found in **Attachment E**. This station will also collect other weather conditions like windspeed and temperature.

STATISTICAL APPROACH TO ANALYZING AIR SAMPLING CONCENTRATIONS

Data management and statistical analysis were performed using Tableau (Professional Edition 2025.1.3) and RStudio (v. 4.5.0). All air monitoring and sampling data in this study were evaluated (overall, per analyte, and per analyte by locations and wind direction) statistically by examining the total number of samples or readings, number and percent of detections and non-detections, the mean (substituting $\frac{1}{2}$ the

MDL for non-detects), standard deviation (substituting $\frac{1}{2}$ the MDL for non-detects), 95% upper confidence limit (95% UCL) (methods can accommodate non-detects without $\frac{1}{2}$ the MDL substitutions), maximum detected value, minimum detected value, and any other requested statistic by E&E or ADH as well as plotting concentrations and examining their distributions visually. Methods for handling non-detections was determined after describing the percent of non-detections and the distribution of the detected data to ensure the correct technique was applied. For a given sampling location, there were at most 13 samples (including 2 duplicates) performed on consecutive days. This sampling scenario most closely aligns with Option A (8-19 samples) as outlined in Figure 5 (no non-detects) and Figure 6 (non-detects) in the “EPC Guidance for Discrete Sampling, V6 — September 26, 2023.” As long as the percentage of non-detects for a given analyte was less than 80% and there was a minimum of 4 detected values (3 of which must be unique), the 95% UCL can be calculated per Option A guidelines. Briefly, the suggested Option A method determines the best distribution (normal, lognormal, or gamma) for the data using goodness-of-fit statistics, and calculates the 95% UCL based on the distribution selected and whether or not the data is censored (contains non-detects). In cases where the percentage of non-detects was $\geq 80\%$, fewer than 4 values were detected or have 2 or more duplicate values, the maximum detected value was reported as the 95% UCL. The analysis was conducted in R using the EnvStats(Millard, 2013) and NADA2(Julian & Helsel, n.d.) packages to calculate the 95 UCLs, and the lmer function from the lme4 package for the mixed model specification was used to test for the significance of effects of distance from the Landfill and relative wind direction.¹²

Figure 4 Visual Representation of Classifying Air Samples As Downwind, Upwind, or Crosswind from the Landfill



Comparison of the Profiles of Compounds Detected in the Tontitown Community

A binary indicator variable for each analyte of “Ever Detected vs Never Detected” was made for each sampling location and compared across groupings of locations to determine if there were consistency in compounds detected at near source (fenceline or haul route) with community and background locations. Below outlines the questions assessed and the methods to answer them.

Question 1 Is the profile of COPCs detected at the fenceline downwind from the landfill similar to those in the community or in background locations?

To answer this question, all the fixed 24-hour air sample locations were grouped into five groupings for comparisons 1) background locations representative of regional ambient air, 2) fenceline locations downwind from the Landfill, 3) community locations downwind from the Landfill, 4) fenceline locations upwind or crosswind of the Landfill, and 5) from community locations upwind or crosswind of the Landfill. The locations included in the groups that considered wind direction, changed daily dependent on the wind direction for that day. Upwind and crosswind locations can be considered as not influenced by the source,

the Landfill. A qualitative comparison of the profiles of detected COPCs in each grouped location was examined.

Question 2 Is the profile of COPCs detected along the haul route to the Landfill similar to those in the community not along the haul route or in background locations?

To examine the detected COPCs along haul route, the fixed 24-hour sampling locations were grouped by 1) haul route locations (AS04, AS05, and AS11), 2) non haul route locations (AS01-AS03, AS06-AS10-SC, AS12-AS14), and 3) background locations (AS15, AS16, AS17, and AS18). Wind direction was not considered in this analysis due to the nature of the haul route having trucks moving along it consistently throughout the day making wind direction from the source, the haul route, difficult to obtain. A qualitative comparison of the profiles of detected COPCs in each grouped location was examined.

Question 3 Is the profile of COPCs detected during a complaint response similar to the profile of COPCs detected at fenceline locations downwind from the landfill or to those detected in background locations?

To examine detected COPCs in 1-hour air samples collected during a response to a hotline complaint, 1) 1-hour complaint response samples were grouped and compared to 2) 1-hour downwind fenceline samples, 3) 24-hour air samples at downwind fenceline locations, and 4) 24-hour air samples at background locations. A qualitative comparison of the profiles of detected COPCs in each grouped location was examined.

COPC Concentration Gradients from the Landfill

In addition to describing the air concentrations and the qualitative lists, a visual inspection of how concentration levels change with distance from the landfill while accounting for wind direction was done. This was confirmed with quantitative analytics to determine concentration gradients from the Landfill. Compounds were modeled if they had at least one detection and non-detected concentrations were substituted with $\frac{1}{2}$ the method detection limit (MDL). Compounds not detected at any fixed 24-hour sampling location were not modeled. Statistical significance was determined with a $P < 0.05$.

Question 4 Do average COPC concentrations change from downwind locations with increasing distances from the fenceline of the Landfill.

We conducted a quantitative evaluation of the modeled change in COPC concentrations with distance and relative wind direction. Two models were used; one model treated distance from the landfill as a continuous measurement in miles, and the second model treated distance categorically using the location categories of “Fenceline”, “Community”, or “Background” (beyond 4 miles from the source). The two linear mixed models were developed to investigate the association between COPC concentrations and relative wind direction and distance from the source (including an interaction term), with a random intercept for

sampling location to account for repeated sampling in the same location and potential correlation due to the specific characteristics and geography of each location. The Landfill is closed on Sundays and open all other days of the week. A covariate for weekday+Saturday versus Sunday was included to account for variations due to Landfill operational differences. All covariates were assessed for significance in the model (either through *P*-value or change in other model parameters). For hypotheses that could not be tested directly from the model covariate's significance, linear hypothesis testing was used. For example, hypothesis testing was used to determine if the change in concentration with increasing distance in the downwind direction from the Landfill is significantly different from 0.

Statistical Comparisons of COPC Concentrations

To conduct statistical comparisons the same models used for determining concentration gradient were used. Like those methods, compounds were modeled if they had at least one detection and non-detected concentrations were substituted with ½ the method detection limit (MDL). Compounds not detected at any fixed 24-hour sampling location were not modeled. Statistical significance was determined with an alpha of 0.05 (or $P < 0.05$).

Question 5 Are the mean COPC concentrations from downwind locations similar to upwind locations from the Landfill.

Using the same linear mixed model that treated distance as a continuous measure, we used linear hypothesis testing to determine if the difference in concentrations at upwind sites was significantly different from those observed downwind. We also examined the interaction between distance and relative wind direction; we tested whether the difference in the effect of distance in the downwind direction vs. effect of distance in the upwind direction is significantly different from 0 with an alpha level of 0.05 for each COPC.

Question 6 Are the mean COPC concentrations from locations downwind from the landfill similar to COPC concentrations in background air?

Using the second linear mixed model, we conducted a quantitative evaluation comparing the background COPC concentrations and the COPC concentrations downwind of the Landfill.

Question 7 Are the mean COPC concentrations from downwind locations from the Landfill and in the community on weekday and Saturday (when the Landfill is open) similar to those on Sunday (when the Landfill is closed).

Linear hypothesis testing was used to determine if there was a significance difference in the beta estimate for average concentrations downwind at the fenceline and the community during weekdays and Saturday vs Sunday for each COPC.

Question 8 Are the mean COPC concentrations from locations along the haul route to the Landfill similar to locations not along the haul route and/or background air?

Linear hypothesis testing was used to determine if there was a significance difference in the beta estimate for average concentrations of locations along the haul route, not along the haul route, and background locations for each COPC.

Classification of COPCs Potential Source

Question 9 Can any detected COPCs be determined as “Landfill most likely contributing,” “Landfill likely contributing,” “Landfill possibly contributing,” “Landfill likely not contributing. Compound levels not distinguishable from background air”, “Landfill likely not contributing. Compound levels possibly from another mobile/stationary emission source(s),” or “Not detected in all samples.”

The logic in **Table 13** was applied to the analysis of COPCs to classify their potential to be from the Landfill or another source. The detected COPCs were classified as “likely from the Landfill”, “possibly from the Landfill”, “compound levels not distinguishable from background air”, or “possibly from another emission source and likely not from the Landfill.

Table 13 Logic for Classifying Potential Source Categories of COPCs

DESCRIPTION			LOGIC
Landfill most likely contributing			1) Identified as emitted from Landfill
			2) Identified in downwind fenceline sample
			3) Identified in sampling location within three miles and downwind of the Landfill
			4) Shows a statistically significant decreasing gradient in concentration from the landfill towards the sampling location
			5) Not present at all 4 background locations or upwind locations
Landfill likely contributing			1) May be identified as a compound permitted to be emitted from Landfill
			2) Identified in downwind fenceline sample identified in sampling location within three miles and downwind of the Landfill
			3) Shows a statistically significant decreasing gradient in concentration from the landfill towards the sampling location
			4) May be present in background samples but at lower concentrations than fenceline
Landfill possibly contributing			1) Identified in downwind fenceline sample, may be in an upwind fenceline sample
			2) Identified in sampling location within three miles and downwind of the Landfill
			3) No statistically significant gradient in concentration from the landfill, though the trend is decreasing with distance
			4) May be present in background samples but at lower concentrations than fenceline
Landfill likely not contributing. Compound levels not distinguishable from background			1) Identified in fenceline samples
			2) Identified in sampling location within three miles and downwind of the Landfill
			3) No statistically significant pattern in concentrations with increasing distances from the landfill.
			4) Sample location (within 3 miles of the Landfill) not within one mile of another source permitted to release that compound
			5) Identified in background locations
			6) Detections and maximum concentrations consistent at fenceline, community, and background locations
Landfill likely not contributing. Compound levels possibly from another mobile/stationary emission source(s)			1) Possibly identified in downwind fenceline sample, but not in all samples and detected less in fenceline than background or community
			2) Identified in sampling location within three miles of the Landfill
			3) Sample location within three miles of another source
			4) May be present in background samples, and may be at higher concentrations in background or community locations than fenceline locations
Not detected in all samples			Not detected in any study sample

In addition to the qualitative lists and comparisons and the quantitative model described above, a visual inspection of how concentration levels change with distance from the landfill and wind direction will be

created. Density plots for varying buffer distances will be used to convey the changes relative to distance. Wind roses will be used to display the differences in concentration with relation to wind direction. The statistics applied and the logic used in **Table 13**, are subject to changes due to unforeseen patterns in the data that arise and these methods will be tailored to best fit the characteristics of the air sampling concentrations.

QUALITATIVE ASSESSMENT OF COMPLAINTS AND ODORS

Odor surveys taken through regular daily routes and by responding to reported complaints within three miles of the Landfill will be mapped, associated with real-time readings and nearby sampling locations, and described by type and frequency of odors. Complaints will be mapped and described by type and frequency.

LIMITATIONS

COPCs were determined with secondary data sources. It is possible that there are compounds not measured in this study that are emitted from the Landfill.

The qualitative lists profiling COPCs at background and community locations are based on whether an analyte was detected at least once at the locations above the MDL. Therefore, analytes that are 100% non-detected across all samples will be assumed not present at the location.

For the quantitative linear mixed model, all non-detect concentrations will be imputed as $\frac{1}{2}$ the MDL for the given analyte. This imputation is commonly used in air sampling data, and prevents the loss of data from censoring, particularly in circumstances where an analyte may be detected at certain distances but not detected at greater distances. Imputed non-detects as $\frac{1}{2}$ the MDL may be over- or under-estimating the true concentration of the analyte. Sensitivity analysis may be conducted using parametric or non-parametric methods for censored data using the NADA2 package in R.

The model should not be used to estimate exposure at new locations. The sparseness of the data in space and the model chosen are not conducive to interpolating concentration levels at new locations.

While the linear mixed model accounts for temporal correlation of repeated measurements at the same site, it does not account for potential spatial correlation between sites in that measurements from sites that are closer to each other may be more correlated than measurements from sites located farther apart. A covariance matrix could be specified to account for this type of correlation, but it is not proposed to force a covariance structure in this model. Correlation solely by distance does not account for site differences that may be due to topographical features, meteorological conditions, or proximity to roads and highways that could modify a correlation structure. For example, two sites may be close in distance, but one is upwind near a highway and one is downwind, with a large hill separating them.

The study takes place over 11 consecutive days in a single season; it is not, therefore, possible to address season-dependent variance. For chronic exposure assessments it will be assumed that the variation in this study will be similar to variation observed throughout longer exposure periods.

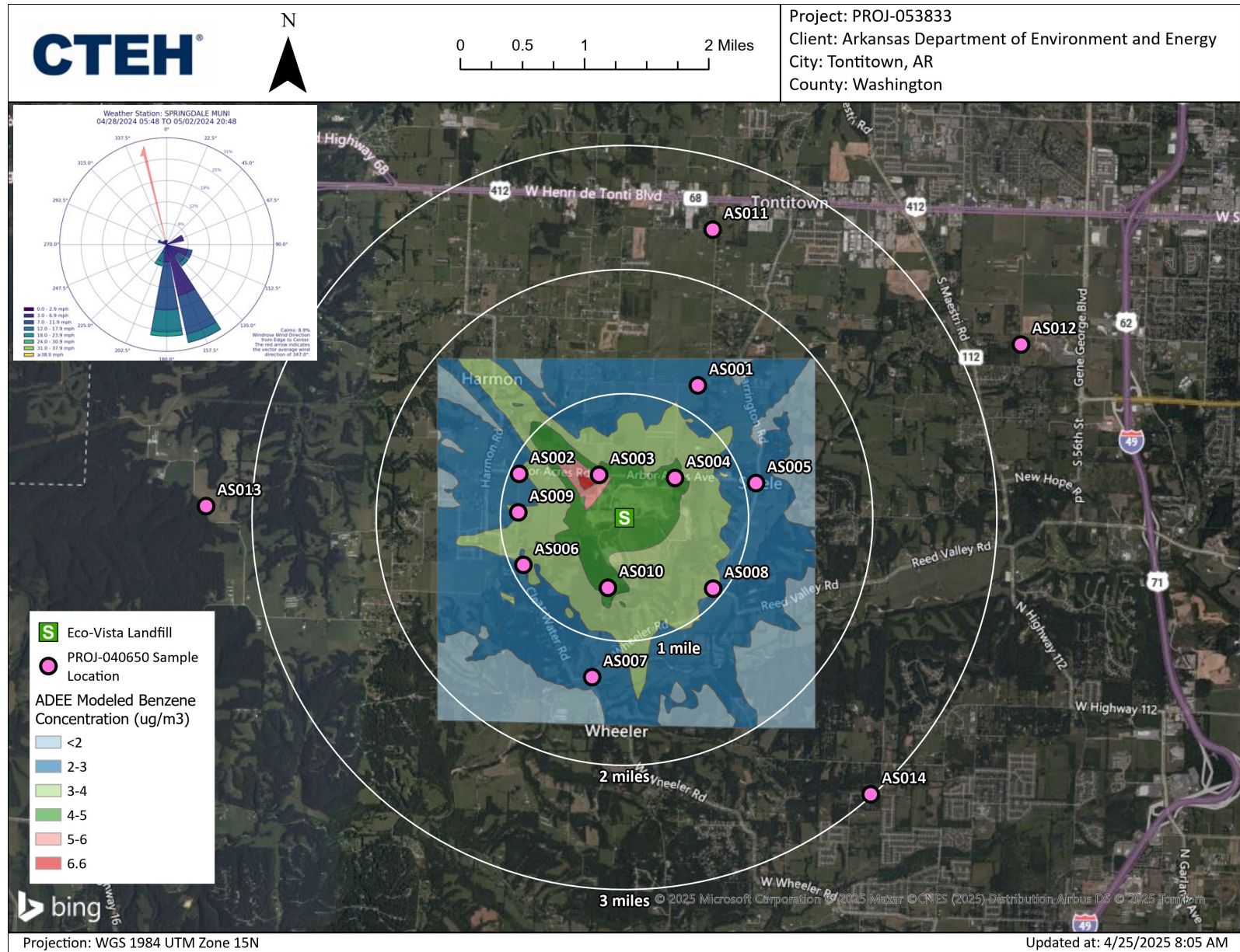
One-hour grab samples will be collected when a complaint is received. However, if the complaint is correlated with a very transient effect the delay in responding to the complaint could result in data collection that does not capture the event that precipitated the complaint.

The logic described in **Table 13** does not account for all possible combinations of detects/non-detects at fenceline, samples within three miles of the Landfill, and background sample locations and results of the statistical model evaluating the gradient. It is not possible to definitively identify if a detected compound originated from a source if it is ubiquitous in background air or there are other potential sources nearby. This study is applying conservative assumptions to the classification logic that will classify COPCs as likely or possibly from the Landfill that are supported with evidence but cannot definitely confirm that the COPC originated from the Landfill. It is also possible that logic may be added or removed from this table based on unforeseen study outcomes or results.

QAPP WORKSHEETS #18-A: SAMPLING LOCATIONS AND METHODS

Sampling locations were selected after considering several factors. The strategy to provide comprehensive coverage of the community living near the Landfill is to select locations in all four cardinal directions in circles surrounding the Landfill fenceline that increases in distance until reaching three miles from the Landfill. Selecting the sampling locations within the three miles from the Landfill were informed by historical complaint data, known haul routes to and from the Landfill, and modeling data provided by E&E (**Figure 5 & Figure 6**). Locations were chosen to represent air in areas where historical complaints clustered, along heavily trafficked haul routes, and where air dispersion modeling showed highest estimated potential fugitive emissions. When possible, prior sampling locations were selected so that data at those locations could be analyzed with earlier sampling studies. Four background locations will be selected outside the three miles from the Landfill and places in areas not affected by other potential sources of facilities with air permits from E&E. **Figure 7** shows the proposed sampling locations for measuring COPCs that are VOCs. **Figure 8** shows the proposed sampling locations for measuring HF. Sampling locations AS14 and AS18 are potential HF background locations and one will be picked when team is on site based on logistics. **Figure 9** shows the proposed locations for odor surveys and real-time readings.

Figure 5 Map of Sampling Locations in the CTEH April 28-May 1, 2024 Air Assessment with Air Model of Benzene Emissions



[illegible]

Figure 7 Map of Proposed Fixed Analytical Sampling Locations for VOCs

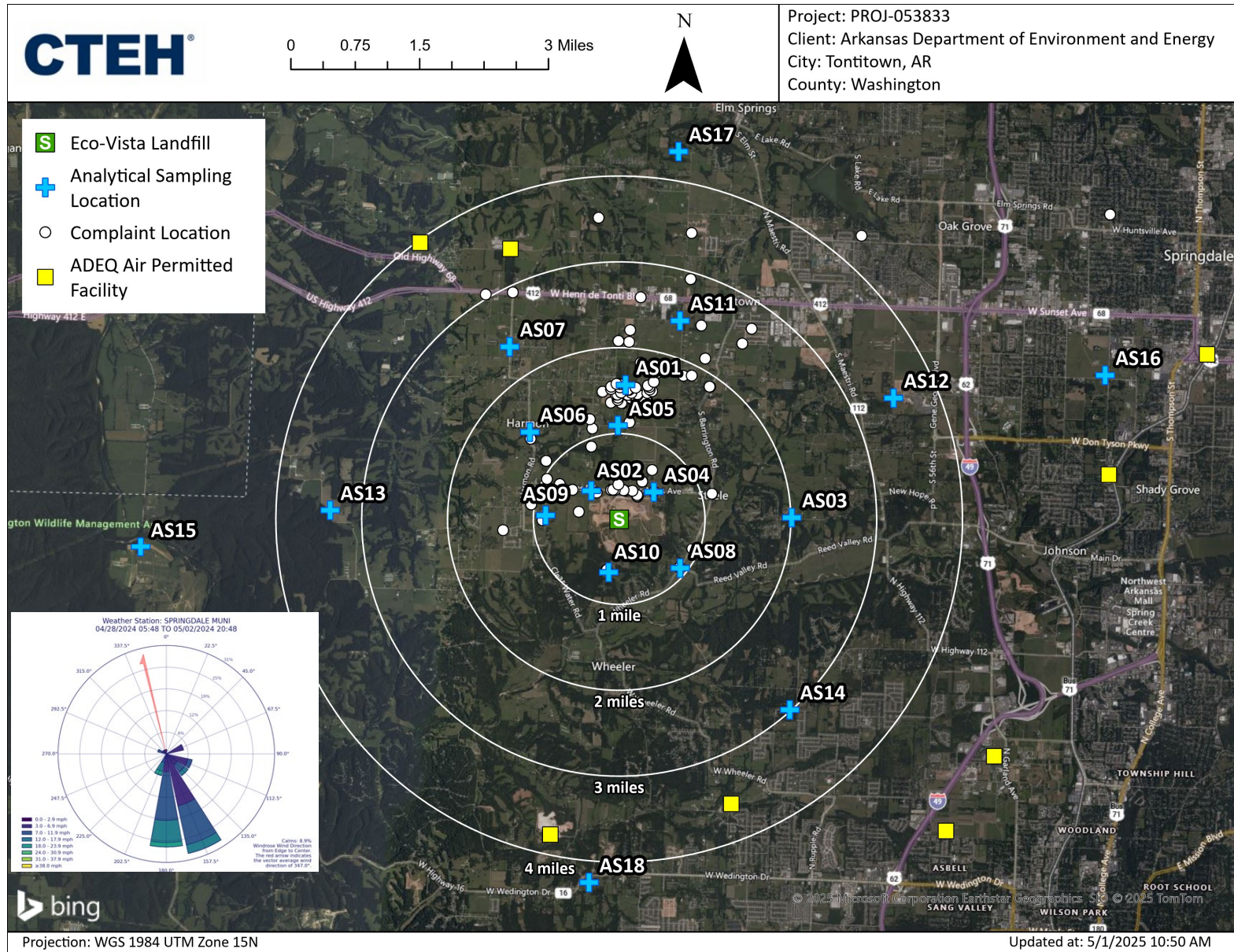


Figure 8 Map of Proposed Fixed Sampling Locations for HF with Reported Complaints

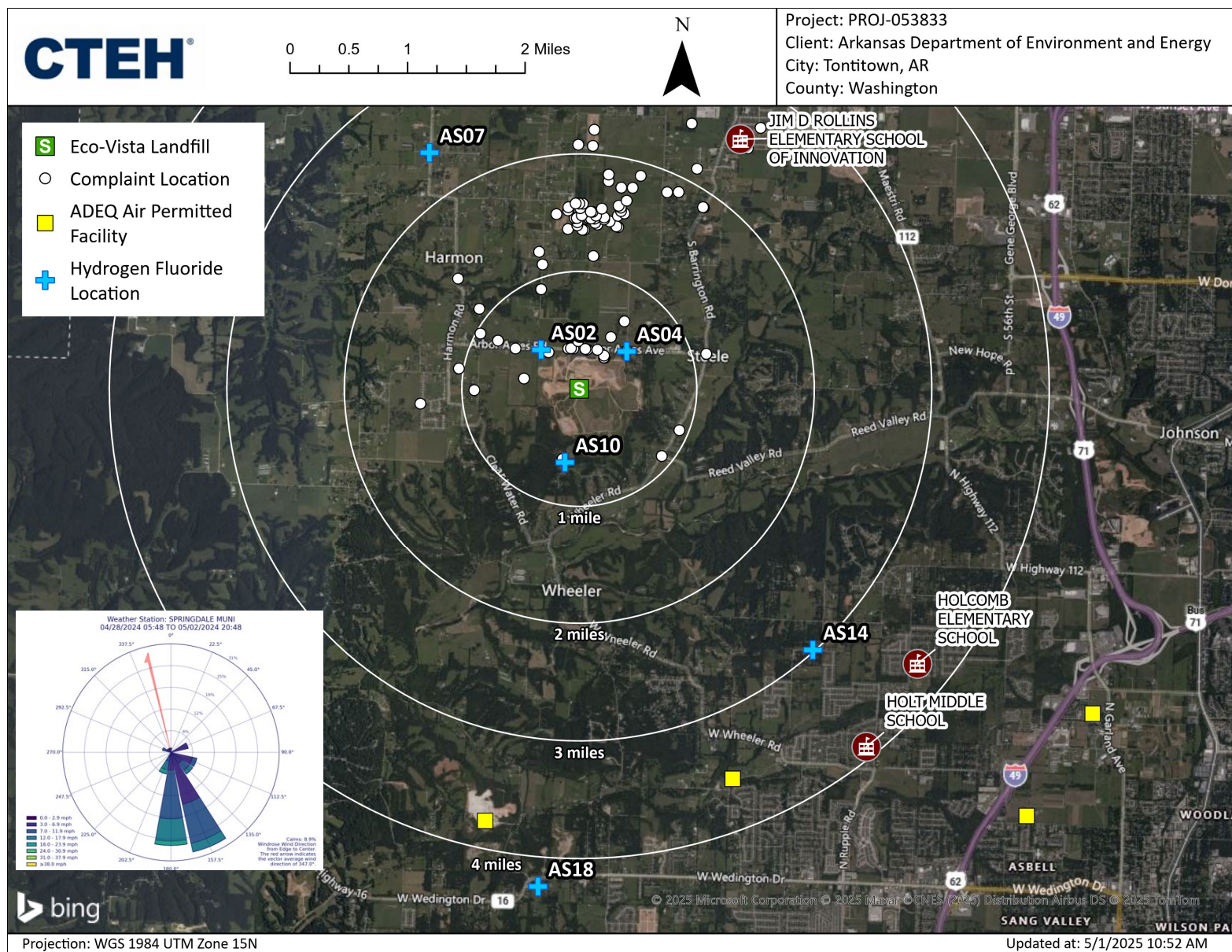
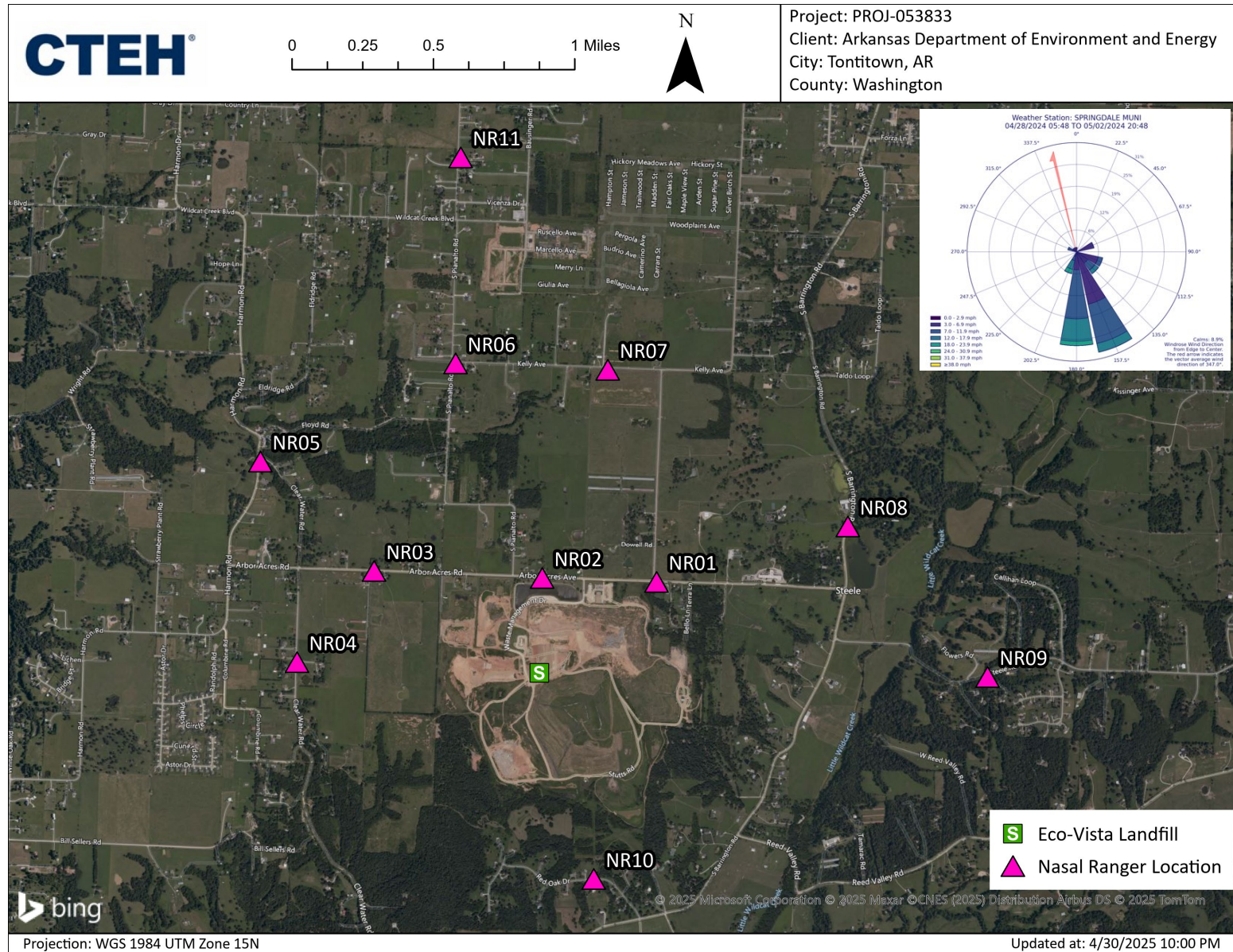


Figure 9 Map of Proposed Nasal Ranger and Real-Time Air Monitoring Route



QAPP WORKSHEET #19-A AND #30-A: SAMPLE CONTAINERS, PRESERVATION, AND HOLD TIMES

Table 14 Sample Containers, Preservation, And Hold Times

MATRIX	ANALYTICAL GROUP	ANALYTICAL METHOD	CONTAINERS OR MEDIA	PRESERVATION REQUIREMENTS	MAXIMUM HOLDING TIME ¹
Air	Selected VOCs	GC/MS EPA Method TO-15	Evacuated canister	None	Collection to Preparation: 30 days;
Air	HF	Ion Chromatography OSHA ID-165SG, modified	Silica gel sorbent tube	Store and ship tubes at ~4°C, ship overnight on ice	Collection to Preparation: 28 days when stored cold

¹Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

QAPP WORKSHEET #20-A: FIELD QUALITY CONTROL SUMMARY

During the 11-day study, two duplicate or co-located 24-hour air samples will be collected daily for a total of twenty-two duplicate 6L canister air samples. Each day the duplicate or co-located sample location will move to a new location. There will also be five duplicate or co-located 1-hour 6L canister grab air samples collected during the 11-day study. Eleven field blanks will be taken for the HF analytical sampling pumps during the 11-day study.

Table 15 Field Quality Control Summary

MATRIX	ANALYTICAL GROUP	NO. OF DUPLICATE OR CO-LOCATED SAMPLES	NO. OF MS/MSDS	NO. OF FIELD BLANKS	NO. OF TRIP BLANKS
Air (Evacuated canisters)	VOCs	Duplicate or co-located at 1/10 samples	N/A	N/A	N/A
Air (Analytical Sampling Pumps)	HF	N/A	N/A	1/20 samples	N/A

QAPP WORKSHEETS #21-A: FIELD SAMPLING SOP REFERENCES

Table 16 CTEH SOPs, Technical Notes and Manufacturer References

TITLE	DESCRIPTION	LOCATION
Evacuated Canister Air Sampling and Management SOP (includes evacuated canisters of all sizes)	CTEH SOP that outlines process for equipment checks, deployment, troubleshooting, documentation, sample pick up and shipping for analysis.	CTEH SharePoint
Odor Survey Standard Operating Procedure – Tontitown, Arkansas	CTEH SOP outlines process for obtaining nasal ranger certification, operating the nasal ranger, and documenting odors.	Attachment A
	Nasal Ranger Field Olfactometer Operations Manual	https://www.fivesenses.com/Documents/Products/NasalRanger/Nasal%20Ranger%20Operations%20Manual%20v7.1.pdf
MultiRAE w/10.6 eV PID	CTEH SOP that outlines equipment use, maintenance, calibration, data collection and storage.	CTEH SharePoint
UltraRAE 3000 SOP v2.0	CTEH SOP that outlines equipment use, maintenance, calibration, data collection and storage.	CTEH SharePoint
KestrelMet® 6000 Cellular Weather Station Instruction Manual	Manufacturers Instruction Manual that outlines equipment use, maintenance, calibration, data collection and storage.	https://kestrelinstruments.com/mwdownloads/download/link/id/1090
SKC AirChek Touch Sample Pump Operating Instructions	Manufacturer's instructions for operation and maintenance	CTEH SharePoint

QAPP WORKSHEETS #22-A: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION

This worksheet identifies the field equipment requiring calibration, maintenance, testing, or inspection for the air study, along with acceptance criteria, and corrective actions. Proper equipment management according to these specifications ensures data quality and reliability by maintaining measurement accuracy and precision throughout field operations. CTEH personnel will use equipment listed below or an equivalent with similar detection limits and sensitivity.

Table 17 Field Equipment Calibration and Maintenance Schedules

EQUIPMENT	CALIBRATION AND MAINTENANCE FREQUENCY	ACCEPTANCE CRITERIA
MultiRAE w/10.6 eV PID	At the beginning of each shift, at least once daily.	Within 10% of calibration standard
UltraRAE 3000 w/ 9.8 eV PID and Benzene sep tubes	At the beginning of each shift, at least once daily.	Within 10% of calibration standard
KestrelMet® 6000 Cellular Weather Station	Annual manufacturer recalibration of sensors (rain gauge, temperature, and humidity sensors)	Data transmission success rate: >95% success rate
	Monthly inspection of the rain gauge for debris and cleaning as needed	Wind speed accuracy: $\pm 3\%$ of reading or ± 0.1 m/s
	Quarterly inspection of solar panels to ensure they are clean and unobstructed	Wind direction accuracy: ± 5 degrees
	Regular battery checks	
SKC Touch air sampling pumps	Before (pre-calibration) and after (post-calibration) sample collection	Within method-specific flow rate range

QAPP WORKSHEET #23-A: ANALYTICAL SOPS

A listing of analytical laboratory SOPs associated with anticipated analytical work is provided below. Laboratory SOPs are available for regulatory review upon request. Additional SOPs may be required as project needs evolve and/or additional laboratories are utilized.

Table 18 Laboratory Analytical SOP References

REFERENCE NO.	TITLE, REVISION DATE/NO.	DEFINITIVE OR SCREENING DATA	ANALYTICAL GROUP	INSTRUMENT	ORGANIZATION PERFORMING ANALYSIS	DESCRIPTION	MODIFIED FOR PROJECT (Y/N)
B-0015	VOCs in Air by GC/MS, TO-15; revision 7; Nov 20, 2024	Definitive	VOCs	GC/MS	Enthalpy Analytical-Orange	Air (Evacuated Canisters)	N
OSHA ID-165SG ^a and ENT324	Acid Mist, version 1.0 December 1985 Sulfate Analysis by Ion Chromatography, revision 5.0 Apr. 16, 2024	Definitive	Acid Gases - HF	Ion Chromatography	Enthalpy Analytical-Durham	Air (Analytical Sampling Pumps)	Y

^a <https://www.osha.gov/sites/default/files/methods/osha-id165sg.pdf>

QAPP WORKSHEET #24-A: ANALYTICAL INSTRUMENT CALIBRATION

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY OF CALIBRATION	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	PERSON RESPONSIBLE FOR CA*	SOP REFERENCE
GC/MS	ICAL Multipoint calibration	At instrument setup; prior to sample analysis	Each analyte must meet the percent relative standard deviation (%RSD) for each analyte $\leq 30\%$.	Correct problem, then repeat ICAL.	Analyst/ Supervisor	B-0015 and Revision 7
GC/MS	ICV	Following ICAL curve and prior to sample analysis	$\pm 30\%$ of True Value	Correct problem, Rerun ICV. If reanalysis fails, repeat ICAL.	Analyst/ Supervisor	B-0015 and Revision 7
GC/MS	CCV	FoAt the beginning of each 24-hour shift following a passing BFB tune check.	Initial CCV $\pm 30\%$ of True Value	Perform instrument maintenance; recalibrate if necessary	Analyst/ Supervisor	B-0015 and Revision 7
GC/MS	Tune	Prior to ICAL or field sample analysis	Specific ion abundance criteria of BFB from method.	Retune instrument and verify.	Analyst/ Supervisor	B-0015 and Revision 7

Notes: The analyst initiates the corrective action, and the Laboratory QA Director and analyst are responsible for the corrective action.

*CA = Corrective Action

QAPP WORKSHEET #24-B: ANALYTICAL INSTRUMENT CALIBRATION

INSTRUMENT	CALIBRATION PROCEDURE	FREQUENCY OF CALIBRATION	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	PERSON RESPONSIBLE FOR CA*	SOP REFERENCE
HPLC/IC	ICAL multiple points calibration	After a CCV/concal begins to fail or after 24 hours of non-use	Correlation coefficient (r^2) greater than or equal to 0.995. The percent difference between the compound area responses between duplicate injections should be within 5% of mean.	Correct the source of the problem, and perform a new ICAL.	Analyst/Supervisor	Modified OSHA ID-165SG SOP #ENT324
HPLC/IC	ICV (second source)	1/batch of up to 20 samples	+/- 10% tag	Reanalyze; if the failure continues then re-prep/repeat ICAL	Analyst/Supervisor	SOP #ENT324
HPLC/IC	CCV/continuing calibration point	After every ten samples and at the end of the sequence	+/- 10% tag	Analyze a fresh aliquot; if the failure continues all samples analyzed after the last passing concal should be reanalyzed	Analyst/Supervisor	SOP #ENT324
HPLC/IC	Reagent Blank	1/sequence	Concentration must be below the LOQ (limit of quantitation)	Reanalyze; if the failure continues then re-prep/repeat ICAL	Analyst/Supervisor	SOP #ENT324

Notes: The analyst initiates the corrective action, and the Laboratory QA Director and analyst are responsible for the corrective action.

*CA = Corrective Action

QAPP WORKSHEET #25-A: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

INSTRUMENT/ EQUIPMENT	MAINTENANCE ACTIVITY	TESTING/INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE
GC/MS	Change Septum, clip column, clean/replace detector, clean injection port liners, etc.	QC samples performed before, during and with each analytical batch	As needed to meet method criteria	See SOP	Perform maintenance; recalibrate instrument	Laboratory QA Director / Analyst ¹	B-0015 and Revision 7

¹ The analyst initiates the corrective action, and the Laboratory QA Director and analyst are responsible for the corrective action.

QAPP WORKSHEET #25-B: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION

INSTRUMENT/ EQUIPMENT	MAINTENANCE ACTIVITY	TESTING/INSPECTION ACTIVITY	FREQUENCY	ACCEPTANCE CRITERIA	CORRECTIVE ACTION	RESPONSIBLE PERSON	SOP REFERENCE
HPLC/IC	Clean column stationary phase, clean conductivity detector, replace pump seals/o-rings/pistons, clean injection valve/autosampler system	Full PM every 6-8 months, other maintenance as needed, QC and other markers monitored to pinpoint needs for maintenance	As need for SOP/method criteria to be met	See SOP/worksheet 24-B	Perform maintenance and reanalyze affected sequences	Analyst/Supervisor	Modified OSHA ID-165SG SOP ENT#324

QAPP WORKSHEET #26 AND #27: SAMPLE HANDLING, CUSTODY, AND DISPOSAL

The purpose of sample custody procedures is to document the history of samples from the time of sample collection through shipment and sample receipt, analysis, and disposal. A sample is considered to be in one's custody if one of the following conditions applies:

- The sample is in an individual's actual possession;
- The sample is in view after being in an individual's physical possession;
- The sample is in possession of a sampling manager or coordinator within CTEH;
- The sample was in the physical possession of an investigator and then they secured it to prevent tampering; and/or
- The sample is placed in a designated secure area.

Each individual field sampler is responsible for the care and custody of the samples they collect until the samples are properly transferred to temporary storage or are shipped to the laboratory.

Changes or corrections to the information documented by the chain-of-custody (COC) record (including, but not limited to, field sample ID or requested analyses) must be changed by marking through the incorrect information with a single strike through line and dating and initialing the change. If the request for a change or correction comes from the Field Personnel after the COC Records have been relinquished to the laboratory, a copy of the COC Record will be revised, initialed, and forwarded to the laboratory, where the revised version will supersede the original COC Record, or the laboratory will be emailed with instructions to add information to the COC, and the email will provide traceability. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the Project File. To ensure sample and data integrity, a proper sample handling system will be followed from the start of sample collection through sample disposal. Information on sample containers, preservation, and holding times is provided in QAPP Worksheet #19-A and #30-A.

Sample labeling and nomenclature will follow guidance based on the CTEH Environmental Sample Nomenclature. In general, sample IDs will contain 12 characters, with characters 10, 14, 15, and 16 optional. Sample IDs will contain no spaces; all zeros will contain lines and a strikethrough on the letter.

Table 19 Sample Nomenclature Description

	CHARACTER	DESCRIPTION	EXAMPLE
All samples	1, 2, 3, 4	Four Character Site Prefix (City, State or Client Specific Prefix)	TOAR for Tontitown, Arkansas
	5, 6, 7, 8	Two Digit Month and Two Digit Day	0502 for May 2
	9, 10	Matrix Code and Sample Types	SC for 24-hour Summa Canister HF for SKC Air Pump GB for 1-hour Grab Sample
	11, 12	Two digit serial ID*	01-18 (For GB 11-14 will be the ATR ID)
For SC and GB	13, 14	QC Sample Code	CL for collocated, FD for field duplicate
For HF	13	Sample Sequence	A, B, or C , A for the first 8 hour sample of the 24 hour period, B for the second 8 hour period, and C for the third 8 hour sample
	14, 15	QC Sample Code	FB for field blank

* Field teams may use a two- or three-digit serial ID. If using a two-digit serial ID, then 13+ will be used for QC sample codes. If using a three-digit sample code, then 14+ will be used for QC sample codes.

Matrix Codes and Sample Types*

Examples:

CL – Co-located

FD – Field Duplicate

Duplicates will not be submitted as blind samples to the laboratory unless stated on the chain-of-custody (COC) record. This is done so the laboratory can provide %D or %RPD values and report the duplicate as a QC sample. Samples suspected to contain high concentrations of contaminants will be indicated on the COC to prevent damage to laboratory equipment. Changes or corrections to the information documented by the COC record (including, but not limited to, field sample ID or requested analyses) must be changed by marking through the incorrect information with a single strikethrough line and dating and initialing the change. If the request for a change or correction comes from the Field Personnel after the COC records have been relinquished to the laboratory, a copy of the COC record will be revised, initialed, and forwarded to the laboratory, where the revised version will supersede the original COC record, or the laboratory will be emailed with instructions to add information to the COC, for which the email will provide traceability. This record will be used to document sample custody transfer from the sampler to the laboratory and will become a permanent part of the project files.

Air monitoring and sampling field logs, notebooks, photographs, and data will be accounted for in accordance with the data sources, data management, and sampling documentation guidance listed in Table 20.

Table 20 Sample Handling, Storage, Custody, and Disposal*

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT (PERSONNEL/ORGANIZATION) *	
Sample Collection	CTEH; Field Personnel
Sample Packaging	CTEH; Field Personnel
Coordination of Shipment	CTEH; Field Personnel
Type of Shipment/Carrier	Laboratory Courier or FedEx or similar express carrier
SAMPLE RECEIPT AND ANALYSIS (PERSONNEL/ORGANIZATION)	
Sample Receipt	Enthalpy; Lab Analyst
Sample Custody and Storage	Enthalpy; Lab Personnel
Sample Preparation	Enthalpy; Lab Analyst
Sample Determinative Analysis	Enthalpy; Lab Analyst
SAMPLE ARCHIVING (NUMBER OF DAYS FROM SAMPLE COLLECTION OR EXTRACTION / DIGEST)	
Field Sample Storage	If the sample analysis meets criteria, sample canisters will be cleaned after analysis. If a sample requires additional attention (i.e. dilution or an additional injection/extraction), the laboratory will contact the QA Project Manager and/or PTD, prior to running additional analysis and prior to disposal. After this review, sample canisters will be cleaned and prepped for redeployment
SAMPLE DISPOSAL	
Personnel/Organization	Enthalpy; Various Personnel
Number of Days from Analysis	Sample results will be reviewed to check the data meet criteria. After this review, sample canisters will be cleaned and prepped for redeployment.

*List organization and personnel, as appropriate

Table 21 Data Sources and Data Management

DATA SOURCE	REQUIRED INFORMATION	PROCESSING INSTRUCTIONS	PROCESSING FREQUENCY	PROCESSING RESPONSIBILITY	STORAGE LOCATION	FINAL OUTPUT
Study Documents	Study Files, Plans, Addendums	File Hard Copies and Electronic Copies In Indicated Storage Location	Beginning Of Project and As Needed	Field Manager	Digital: CTEH Projects Secure Server; Hard Copy: Project Secure File	.pdf And Other Image Formats
Field Forms	Sample No., Date, Time, Sampler, Location, Field Conditions	File Hard Copies and Electronic Copies in Indicated Storage Location	Per Sampler, Location, Equipment, And Date	Field Manager	Digital: CTEH Projects Secure Server; Hard Copy: Project Secure File	.pdf And Other Image Formats
Field Activity Documentation	Sample information; Photo documentation; GPS Locations; Digital logbook	Upload Into Mobile Data Studio (MDS) Software	Daily	Field Personnel; Data Manager	CTEH Secure Server	Tabular data files; image files
Real-Time Monitoring Data	Instrument Data with Time, Date, And GPS Location	Upload Into Mobile Data Studio (MDS) Software	Daily	Data Manager	CTEH Secure Server	.pdf And Other Image Formats
Analytical Air Samples Data	EDD and Pdf with analytical lab reports with chemical concentrations, MDLs, and laboratory controls data	EDDs uploaded onto CTEH proprietary projects website.	As received	Data Manager	CTEH Secure Server	.xls, SQL, and Other Data Formats

QAPP WORKSHEET #28.1-A: ANALYTICAL QUALITY CONTROL AND CORRECTIVE ACTION

Table 22 Analytical QA/QC for Enthalpy Labs for VOCs by US EPA METHOD TO-15

QC SAMPLE	FREQUENCY & NUMBER	METHOD OR SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CA	DQI	MEASUREMENT PERFORMANCE CRITERIA
Tune	Prior to ICAL and prior to each 24-hour period of analysis	Refer to Method SOP for specific ion abundance of BFB	Retune instrument; no samples shall be analyzed without a valid tune.	Analyst/ Supervisor		Method SOP
Surrogates	All field and QC samples	80-120%	Evaluate matrix, then analytical data, then reprepare and reanalyze all affected samples. If the surrogate(s) fail high and the sample is non detect (ND) for all target analytes, the sample can be reported. Qualify and narrate outliers. If obvious chromatographic interference with surrogate is present, contact the client as to additional measures to be taken.	Analyst/ Supervisor	Accuracy / bias / sensitivity	80-120%
Method Blank	One per preparatory batch	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample. Common contaminants must be less than LOQ	Verify instrument clean (evaluate calibration blank and samples prior to method blank), then reanalyze. Evaluate to determine if systematic issue within laboratory, correct, then reprepare and reanalyze the method blank and all samples processed with the contaminated blank	Analyst/ Supervisor	Accuracy / bias / contamination	No analytes detected > 1/2 RL or > 1/10 the amount measured in any sample or > 1/10 the regulatory limit, whichever is greater. Common laboratory contaminants, no target analytes ≥ RL
LCS	One per preparatory batch	Laboratory-generated statistically derived control limits	Reanalyze the LCS once. If acceptable, report. Analytes in the LCS that fail high and are ND in the samples can be reported. Qualify and narrate outliers. All others are reprepared/reanalyzed.	Analyst/ Supervisor	Accuracy / bias	Laboratory-generated statistically derived control limits

Table 23b Analytical QA/QC for Enthalpy Labs for HF by OSHA ID-165SG

QC SAMPLE	FREQUENCY & NUMBER	METHOD OR SOP QC ACCEPTANCE LIMITS	CORRECTIVE ACTION	PERSON(S) RESPONSIBLE FOR CA	DQI	MEASUREMENT PERFORMANCE CRITERIA
Media Blank	One per batch*	No analytes detected > 1/2 LOQ or > 1/10 the amount measured in any sample	Verify instrument clean (evaluate calibration blank and samples prior to media blank), then reanalyze. Evaluate to determine quality of sampling media. Contact client and media manufacturer if media is thought to be compromised	Analyst/ Supervisor	Accuracy / bias / contamination	No analytes detected > 1/2 RL or > 1/10 the amount measured in any sample or > 1/10 the regulatory limit, whichever is greater
LCS	One per preparatory batch	Laboratory-generated statistically derived control limits	Reanalyze the LCS once. If acceptable, report. Analytes in the LCS that fail high and are ND in the samples can be reported. Qualify and narrate outliers. All others are reprepared/reanalyzed.	Analyst/ Supervisor	Accuracy / bias	Laboratory-generated statistically derived control limits

*Media blanks should be submitted with same lot number as media used for field samples for a given group of samples. If media with multiple lot numbers are used for any SDG, one tube from each lot should be submitted with samples.

QAPP WORKSHEET #28.3-A: LABORATORY-SPECIFIC QUANTITATION LIMITS AND QUALITY CONTROL LIMITS

Analytical accuracy and precision goals are also presented below. Laboratory-generated statistically derived control limits are used to assess accuracy and precision for some methods; these limits are periodically updated by the laboratory.

Table 24 Quality Control Limits for COPCs by EPA Method TO-15

Compound	CAS No.	DUPLICATE RPD	LCS %REC	LCS RPD
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	25	70-130	25
1,1,2,2-Tetrachloroethane (tetrachloroethane)	79-34-5	25	70-130	25
1,1,2-Trichloroethane	79-00-5	25	70-130	25
1,1,2-Trichloroethene (trichloroethylene)	79-01-6	25	70-130	25
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	25	70-130	25
1,1-Dichloroethane (ethylidene chloride)	75-34-3	25	70-130	25
1,1-Dichloroethene (vinylidene chloride)	75-35-4	25	70-130	25
1,2,4-Trichlorobenzene	120-82-1	25	70-130	25
1,2,4-Trimethylbenzene (pseudocumene)	95-63-6	25	70-130	25
1,2-Dibromoethane (ethylene dibromide)	106-93-4	25	70-130	25
1,2-Dichloroethane (ethylene dichloride)	107-06-2	25	70-130	25
1,2-Dichloropropane (propylene dichloride)	78-87-5	25	70-130	25
1,3,5-Trimethylbenzene (mesitylene)	108-67-8	25	70-130	25
1,3-Butadiene	106-99-0	25	70-130	25
2-Butanone (methyl ethyl ketone, MEK)	78-93-3	25	70-130	25
2-Propanol (isopropanol)	67-63-0	25	70-130	25
2-Propenal (acrolein)	107-02-8	25	70-130	25
2-Propenenitrile (acrylonitrile)	107-13-1	25	70-130	25
4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK)	108-10-1	25	70-130	25
Acetonitrile (cyanomethane)	75-05-8	25	70-130	25
Benzene	71-43-2	25	70-130	25
Bromodichloromethane	75-27-4	25	70-130	25
Carbon disulfide (methanedithione)	75-15-0	25	70-130	25
Carbon tetrachloride (tetrachloromethane)	56-23-5	25	70-130	25
Chlorobenzene	108-90-7	25	70-130	25
Chloroethane (ethyl chloride)	75-00-3	25	70-130	25
Chloroethene (vinyl chloride)	75-01-4	25	70-130	25
Chloromethane (methyl chloride)	74-87-3	25	70-130	25

Compound	CAS No.	DUPLICATE RPD	LCS %REC	LCS RPD
Dichlorodifluoromethane (Freon 12)	75-71-8	25	70-130	25
Dichloromethane (methylene chloride)	75-09-2	25	70-130	25
ETHANE, 1,1-DIFLUORO-	75-37-6	25	70-130	25
Ethenyl acetate (vinyl acetate)	108-05-4	25	70-130	25
Ethyl acetate	141-78-6	25	70-130	25
Ethylbenzene	100-41-4	25	70-130	25
Heptane	142-82-5	25	70-130	25
Hexane	110-54-3	25	70-130	25
m,p-Xylenes	179601-23-1	25	70-130	25
Methanol	67-56-1	25	70-130	25
Naphthalene (naphthene)	91-20-3	25	70-130	25
o -Dichlorobenzene (1,2-dichlorobenzene)	95-50-1	25	70-130	25
o -Xylene (1,2-xylene)	95-47-6	25	70-130	25
Pentane	109-66-0	25	70-130	25
Propene (propylene)	115-07-1	25	70-130	25
Styrene (vinylbenzene)	100-42-5	25	70-130	25
Tetrachloroethene (perchloroethylene)	127-18-4	25	70-130	25
Tetrahydrofuran (oxolane)	109-99-9	25	70-130	25
Toluene (methylbenzene)	108-88-3	25	70-130	25
trans -1,2-Dichloroethene (trans -1,2-dichloroethylene)	156-60-5	25	70-130	25
Trichloromethane (chloroform)	67-66-3	25	70-130	25
Xylene (total)	1330-20-7	25	70-130	25

Table 25 Quality Control Limits for Hydrogen Fluoride by OSHA ID-165SG

ANALYTE	CAS NO.	DUPLICATE RPD	LCS %REC	LCS RPD
Hydrogen Fluoride	7664-39-3	25	70-130	25

QAPP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS

Electronic files, including but not limited to final documents, and laboratory analytical reports are maintained on secure CTEH servers.

Applicable electronic field and laboratory data collected during sampling will be archived electronically. Online cloud backups of databases and programs or software utilities will be maintained in a secure location. CTEH mainly uses electronic records, but in the event hardcopy data are generated, including but not limited to field logbooks, laboratory logbooks, instrument calibration records, these will be maintained by the originator for inclusion in the project file.

Table 26 Sample Collection and Field Records

RECORD	GENERATION	VERIFICATION	STORAGE LOCATION ARCHIVAL
Project Log – CTEH Projects Dashboard	Field Personnel	Field Team Lead	Secure CTEH Servers
Site Maps	Field Personnel	Field Team Lead	Secure CTEH Servers
Field instrument maintenance records	Field Personnel	Field Team Lead	Secure CTEH Servers
Monitoring Instrument Readings including calibration records (PID, etc.)	Field Personnel	Field Team Lead	Secure CTEH Servers
Field Forms	Field Personnel	Field Team Lead	Secure CTEH Servers
COC Records	Field Personnel	Field Team Lead	Laboratory data package & copy on Secure CTEH Servers

Table 27 Project Assessment Records

RECORD	GENERATION	VERIFICATION	STORAGE LOCATION ARCHIVAL
Field Audit Checklists (for field operations, logbooks, etc.)	QA Project Manager	Field Team Lead	Secure CTEH Servers
Data validation reports	Data Validation Manager	Data Manager	Secure CTEH Servers
Progress Reports (Project Logbook)	Field Team Lead	PTD	Secure CTEH Servers

Table 28 Laboratory Documentation Records

RECORD*	GENERATION	VERIFICATION	STORAGE LOCATION ARCHIVAL
Laboratory data packages (Level II and Level IV)	Laboratory personnel	Laboratory PM	Secure CTEH Servers
Laboratory electronic data deliverable (EDD)	Laboratory personnel	Laboratory PM	Secure CTEH Servers
Laboratory records*	Laboratory personnel	Laboratory PM	Laboratory project file

* Laboratory records include the following:

- Internal COC documentation
- Standards preparation records and traceability records (including certificates)
- Laboratory Quality Manual
- Instrument Maintenance records
- Non-Conformance Records
- Communication records (i.e., Project specific email communication with CTEH)
- Laboratory personnel training records
- LOD/RL studies
- Laboratory Accreditations/Certifications
- Analytical SOPs
- Control Charts
- Accreditation audit reports
- PT study results

QAPP WORKSHEET #31, #32, AND #33: ASSESSMENTS AND CORRECTIVE ACTION

One of the goals of the project QA program is to quickly identify, correct, and resolve errors and to prevent recurrence. A description of assessments conducted as part of the project QA program and parties responsible for the corrective action response are presented below.

CTEH's QA PM or designee will receive nonconformances by CTEH personnel through cteh.com/quality, other electronic means (i.e., email, project portal, daily briefing logs, field logs, etc.). Nonconformances are issues regarding failure to meet the requirements¹ or simply, something that went wrong. These nonconformances are tracked in a log² and when issues arise (based on severity of the issue against the task or process) that require root cause analysis (RCA), the corrective actions process will take place. The investigation will include a root cause analysis tool (e.g., Ishikawa or 5-whys) and be documented on a corrective actions report (CAR). Nonconformances that impact data integrity or usability (i.e., major finding) will be documented in a CAR and provided to the QA Coordinator for distribution. Both the log and report will note corrective action(s) and preventative action(s) as well as a timeline and responsible individual. Furthermore, the nonconformance will not be closed out until the execution of the improvement(s) are monitored and effective at preventing recurrence. For minor items, the goal is to close out the nonconformance within five (5) days. For major findings, the goal is to complete the CAR within 48 hours. The CTEH QA PM will adjust these timelines based on the number of actions, difficulty to implement (e.g., programming, new equipment needed, etc.) and note the deadline on the nonconformance log. All these records will be retained.

¹ Requirements include but not limited to processes, data, practices, or performance that are provided in SOP(s), best management practices, standards, manufacturers manual.

² The nonconformance log lists the issue, issue type, date of occurrence, severity (i.e., provided as opportunity for improvement, minor, or major), who is assigned the tasks for corrective actions (which can be multiple people), due date(s), status, completion date, actions implemented, and monitoring of effectiveness. A copy of the non-conformance log can be provided upon request with severity scale.

Table 29 Laboratory Assessments and Responsibilities

ASSESSMENT TYPE	FREQUENCY	INTERNAL OR EXTERNAL	ORGANIZATION PERFORMING ASSESSMENT	PERSON(S) RESPONSIBLE FOR PERFORMING ASSESSMENT	PERSON(S) RESPONSIBLE FOR RESPONDING TO ASSESSMENT FINDINGS	PERSON(S) RESPONSIBLE FOR IDENTIFYING AND IMPLEMENTING CA	PERSON(S) RESPONSIBLE FOR MONITORING EFFECTIVENESS OF CA
Onsite Lab. Systems Audit	During certification period, at discretion of the Accreditation Officer	External	TNI	TNI Auditor	Lab QA Director	Lab QA Director	Lab QA Director
QC of Daily Field readings, summaries, field forms, review against SAP requirements	Each sample event	Internal	CTEH	Field Manager	QA PM	Sampling Contractor PM	Sampling Contractor PM
Lab Report Deliverables – verification of data package completeness, analytical compliance, and data correctness (also see Worksheet #35)	Each SDG	Internal	Laboratory	Lab PM	Lab QA Director	Lab QA Director	Lab QA Director
Data Validation (also see Worksheet #36 & 37)	Each SDG	Internal	eQAQC	Data Validation PM	Lab PM or Lab QA Director	QA PM and Lab QA Director	QA PM
Lab. CA Investigation	As needed	Internal	Enthalpy Analytical	QA PM	Lab QA Director	Lab QA Director	QA PM
Performance Evaluation Samples	May be performed to further assess data quality	External		QA PM	Lab QA Director	Lab QA Director	QA PM

QAPP WORKSHEETS #34: DATA VERIFICATION AND VALIDATION INPUTS

This worksheet lists the inputs that will be used during data verification and validation. Inputs include planning documents, field records, and laboratory records. To confirm that scientifically sound data of known and documented quality are used in making project decisions, the following three-step data review will be performed:

- Verification will confirm that all specified activities involved in collecting and analyzing samples have been completed and documented and that the necessary records (objective evidence) are available to proceed to data validation.
- Validation will assess whether the sampling and analytical processes comply with the project-specific and QAPP-specific requirements.
- Usability assessment will determine whether the resulting data are suitable as a basis for the decision being made.

Worksheet #35 (Data Verification Procedures), **Worksheet #36** (Data Validation Procedures), and **Worksheet #37** (Data Usability Assessment) describe the processes to be followed for the above three steps, respectively. This worksheet establishes the procedures that will be followed to verify and validate project data, including, but not limited to, sampling documents and analytical data packages.

Table 30 Data Verification and Validation Inputs

DESCRIPTION	VERIFICATION (COMPLETENESS)	VALIDATION (CONFORMANCE TO SPECIFICATIONS)
Planning Documents/Records		
Approved QAPP	X	
Approved SAP	X	
Field SOPs	X	
Laboratory SOPs	X	
Sampling Methods	X	X
Analytical Methods	X	X
List of project-specific analytes	X	X
Field Documents		
Field Logbooks	X	X
Equipment Calibration Records	X	X
COC Records	X	X
Identification of QC samples	X	X
Sampling diagrams/surveys	X	X
Monitoring Reports / Documents	X	X
Relevant Correspondence	X	X
Change Orders/Deviations	X	X
Field Audit Reports	X	X
Field Corrective Action Reports	X	X

DESCRIPTION	VERIFICATION (COMPLETENESS)	VALIDATION (CONFORMANCE TO SPECIFICATIONS)
Analytical Data Package		
Cover sheet (Laboratory identifying information)	X	X
Case Narrative	X	X
Internal Laboratory COC Record	X	X
Sample Receipt Records	X	X
Sample Chronology (e.g., dates and times of receipt, preparation,	X	X
Communication records	X	X
LOD/LOQ establishment and verification	X	X
Standards Traceability	X	X
Instrument Calibration Records	X	X
Definition of Laboratory Qualifiers	X	X
Results Reporting forms	X	X
QC Sample Results	X	X
Corrective Action Reports	X	X
Raw data	X	X
Electronic Data Deliverables	X	X
External Reports		
External Audit Report	X	X
Laboratory Assessment	X	X
Laboratory QA Plan	X	X
LOD study information	X	X
Laboratory Accreditation	X	X

QAPP WORKSHEETS #35: DATA VERIFICATION PROCEDURES

Data will be verified in accordance with **Worksheet #35**.

Table 31 Analytical Air Sampling Data Verification Procedures Including Inputs

DATA REVIEW INPUT	DESCRIPTION	RESPONSIBLE FOR VERIFICATION	STEP I / IIA / IIB*
Verification Chain-of-Custody Records	Chain-of-Custody Records will be reviewed upon completion and verified against the packed samples. The Chain-of-Custody Records will be relinquished by the sampler prior to shipment. A copy of the COC Record will be retained in the project file, while the original and all necessary copies will be shipped with the samples (in a waterproof bag, as appropriate)	Field Manager	I
Verification Chain-of-Custody Records Sample Receipt Records	Review the sample shipment for completeness and integrity; sign to accept the shipment. All sample labels will be checked against the Chain-of-Custody Record; any discrepancies will be identified, investigated, and corrected. The samples will be logged in at every storage area and workstation required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms. Verification of sample login/receipt and Chain-of-Custody Records will be documented on the Laboratory Sample Receipt Record.	Laboratory PM	I
Verification Chain-of-Custody Records	Check that the Chain-of-Custody Records was signed/dated by the sampler relinquishing the samples and by the laboratory sample custodian receiving the samples for analyses. Verification of Chain-of-Custody Records will be documented in the validation workbook.	Data Validators	I
Verification Field SOPs	Verify that all applicable sampling SOPs were followed.	QA PM	I
Verification QAPP sample tables	Verify that all proposed samples listed in the QAPP tables have been collected. Sample completeness will be documented in the validation workbook and validation report.	QA PM	I
Verification Field Documentation	Verify that information recorded in Field Logbooks, Equipment Calibration Records, etc., the log sheets and field notes are accurate and complete. Field data verification will be documented by dated signature on the last page or page immediately following the review material.	Field Manager	I
Verification Field QC samples	Check that field QC samples, described in Worksheet #12, and listed in Worksheet #20, were collected as required. QC sample completeness will be documented in the validation workbook and validation report.	QA PM	I
Verification Laboratory SOPs	Verify that all applicable analytical SOPs were followed.	Data Validators	I
Verification Analytical data package	Verify that all analytical data packages are complete. Each laboratory data package must contain a Case Narrative. The Case Narrative must identify and document any problems or anomalies observed during the receipt, handling, preparation, and/or analysis of a sample. The Case Narrative must briefly and concisely identify/describe all deviations from analytical methods, the QAPP, and relevant laboratory SOPs. Reportable data will include the following information at minimum: field chains-of-custodies, sample ID cross-references, test reports (dilution factors, preparation methods, etc.), surrogate recoveries, test reports/summary forms for blank samples, laboratory control sample/laboratory control sample duplicates (LCS/LCSDs), project MS/MSDs, duplicates, and associated method quantitation limits. The laboratory PM (or designee) will sign each data package.	Laboratory PM	I

DATA REVIEW INPUT	DESCRIPTION	RESPONSIBLE FOR VERIFICATION	STEP I / IIA / IIB*
Verification Analytical data package	Verify the data package for completeness. The Case Narrative should contain enough information to allow the data validators to independently assess the magnitude of any potential inaccuracy or imprecision, the direction of potential bias, and other potential effects on the quality of the reported data. Data package completeness will be documented in the validation reports.	Data Validation PM	I

* II_A = compliance with methods, procedures, and contracts [see Table 10, page 117, QAPP manual, V.1, March 2005]; II_B = comparison with measurement performance criteria in the QAPP [see Table 11, page 118, QAPP manual, V.1, March 2005]

Table 32 Real-Time Air Monitoring Data Verification Procedures

REAL-TIME DATA TYPE	VERIFICATION PROCESS
Handheld Real-Time Air Monitoring Data	Each measurement record is reviewed by CTEH personnel experienced in real-time data collection for errors and accuracy (e.g., appropriate location category, instrument, detection limit, etc.) in accordance with the Real-Time QAQC SOP (CTEH SharePoint). The CTEH reviewer will correct the record as appropriate or mark it with a “NU” (not usable) qualifier. If it is marked “NU,” it is excluded from the dataset.

QAPP WORKSHEET #36: DATA VALIDATION PROCEDURES

Data will be validated in accordance with **Worksheet #36**.

Table 33 Data Validation Procedures Including Inputs

DATA REVIEW INPUT	DESCRIPTION	STEP I / II _A / II _B *
Validation Chain-of-custody	Examine the traceability of the data from the time of sample collection until reporting of data. Ensure that the custody and integrity of the samples were maintained from collection to analysis and that the custody records are complete with any deviations recorded. Chain-of-Custody verification will be documented in the validation workbook.	IIA
Validation Holding times	Review that the samples were shipped and stored at the required temperature and sample pH for chemically preserved samples to meet the requirements listed in Worksheet #19 & #30. Ensure that the analyses were performed within the holding times. If holding times were not met, confirm that deviations were documented. Holding time examination will be documented in the validation workbook and validation report.	IIA
Validation Sample results for representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from collection to analysis. Sample receipt and preservation will be documented in the validation workbook and validation report.	IIA/IIIB
Validation Field Documentation	Review field documentation to ensure the sampling processes comply with the project requirements.	IIA
Validation Laboratory data results for accuracy	Ensure that the laboratory QC samples were analyzed and that the measurement performance criteria (MPC) listed in Worksheets #24 and #28 were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed, as listed in Worksheet #12, and that the analytical QC criteria were met. Accuracy will be documented in the validation report.	IIA/IIIB
Validation Field and laboratory duplicate analyses for precision	Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory's precision by reviewing the RPD or percent-difference values from laboratory duplicate analyses, MS/MSDs, and LCS/ LCSD. Ensure compliance with the precision goals listed in Worksheets #12 and #28. Precision will be documented in the validation workbook and validation report.	IIA/IIIB
Validation Project quantitation limits for sensitivity	Assess and document the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminants; assess and document the impact on the other target compounds reported as undetected.	IIA/IIIB
Validation Data quality assessment report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all data qualifications. Present tabular qualified data and data qualifier codes and summarize data qualification outliers. Determine whether the data met the MPC. Determine the impact of any deviations on the data's technical usability. Result qualification will be documented in the validation report.	IIA/IIIB
Validation QC sample documentation	Ensure that all QC samples specified in the QAPP were collected and analyzed and that the associated results were within acceptance limits. QC sample completeness and assessment will be documented in the validation report.	IIA/IIIB

DATA REVIEW INPUT	DESCRIPTION	STEP I / II _A / II _B *
Validation Analytical data deviations	Determine the impact of any deviation from sampling or analytical methods and the effect of laboratory SOP requirements and matrix interferences on the analytical results. Data deviations will be documented in the validation workbook and validation report.	II _B
Validation Matrices – Air	Assess data against MPC identified in Worksheets #12, #19 & #30, #24, and #28. 100% of the data will undergo verification and Level II data validation and 20% will undergo verification and EPA Stage IV data validation. All data validation findings will be documented in a validation report.	II _A /II _B
Validation Qualifiers	U This result should be considered “non-detect” because it was not detected > the detection limit, or it was detected in a field blank or laboratory blank at a similar level. R Unreliable positive or non-detect result; analyte may or may not be present in sample. J Quantitation is approximate due to limitations identified during data validation. UJ This analyte was not detected, but the reporting limit may or may not be higher due to a bias identified during data validation. NJ The analysis indicates the presence of a compound that has been “tentatively identified” and the associated numerical value represents its approximate concentration.	II _A /II _B

* II_A = compliance with methods, procedures, and contracts [see Table 10, page 117, QAPP manual, V.1, March 2005]; II_B = comparison with measurement performance criteria in the QAPP [see Table 11, page 118, QAPP manual, V.1, March 2005]

QAPP WORKSHEET #37: USABILITY ASSESSMENT

Analytical data generated will be subjected to data usability assessment as described below. The purpose of analytical data verification and validation is to ensure data completeness, correctness, and method compliance/conformance, and to identify data quality issues, including unusable data that would not be sufficient to support environmental decisions. In addition to the laboratory QA review, the data presented in Level IV data packages will be verified and validated by the Data Validators, eQAQC. eQAQC has been hired as the data validation firm for CTEH to ensure the:

- Compliance with requested testing requirements.
- Compliance with this QAPP.
- Analytical data completeness.
- Reporting accuracy (including hardcopy to EDD).
- Review of data against laboratory reporting limits and acceptance criteria.
- Confirmation of receipt of requested items, and
- Traceability, sensibility, and usability of the data.

Data review will be performed with guidance from the National Functional Guidelines for Organic Data Review (US EPA). These validation guidance documents specifically address analyses performed in accordance with the Contract Laboratory Program (CLP) analytical methods and are not completely applicable to the type of analyses and analytical protocols performed for the USEPA methods utilized by the laboratory for these samples. Therefore, data validators will use professional judgment to determine the usability of the analytical results and compliance relative to USEPA methods used by the laboratory. Furthermore, data will be provided by the analytical laboratory to validate and verify that they can identify the compound, provide LODs and reporting limits, studied and/or reported quality control limits, and provide performance criteria. Validators will review these data against this QAPP, method requirements, and laboratory control limits. Validators will also validate whether the laboratory has provided sufficient data to prove and verify that the correctness and/or accuracy of compounds are identified and reported, LODs, control limits, result values, duplicates RPD, spikes %R, and exports of the data.

Data Review

Data usability directly affects whether project objectives can be achieved. The results of these evaluations will be included in the project report. Data characteristics will be evaluated for multiple concentration levels if the evaluator determines that it is necessary to do so. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound assessments of the data characteristics outlined in Table 33. Furthermore, project DQOs are outlined in Worksheets #10 and #11 to drive decision statements. Validators performing data review will ensure that data reported (after their review) can be used to answer decision statements.

Table 34 Data Usability Indicator Description

DATA USABILITY INDICATOR	DESCRIPTION
Precision	The degree of agreement between the numerical values of a set of duplicate samples performed in an identical fashion constitutes the precision of the measurement. During the collection of data using field methods and/or instruments, precision is checked by reporting measurements at one location and comparing results. $\%RPD = abs \left[\frac{A-B}{\left(\frac{A+B}{2}\right)} \right] \times 100$ Where: A = Value of original sample B = Value of duplicate sample
Accuracy	Accuracy is the degree to which a given result agrees with the true value. The accuracy of an entire measurement system is an indication of any bias that exists. Spiked sample results provide information needed to assess the accuracy of analyses. Surrogate spike, MS/MSD, and LCS %Rs are used to assess accuracy. Every organic sample is spiked with known quantities of non-target surrogate compounds. The formula used to calculate accuracy for all accuracy indicators, except MS, is: $\% R = \left(\frac{A_T}{A_F} \right) \times 100$ Where: A_T = Total concentration of the analyte measured or recovered A_F = Concentration of the analyte spiked The formula used to calculate accuracy for the MS is: $\% R = \left(\frac{A_T - A_O}{A_F} \right) \times 100$ Where: A_T = Concentration of the analyte measured or recovered A_O = Unspiked concentration of the analyte A_F = Concentration of the analyte spiked
Representativeness	Representativeness expresses the degree to which sample data are accurate and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter associated with the proper design of the sampling program.
Completeness	Completeness is a measure of the degree to which the amount of sample data collected meets the needs of the sampling program and is quantified as the relative number of analytical data points that meet the acceptance criteria (including accuracy, precision, and any other criteria required by the specific analytical method used). Completeness is defined as a comparison between actual numbers of usable data points expressed as a percentage of expected number of points.

DATA USABILITY INDICATOR	DESCRIPTION
	The minimum goal for completeness is 95%; the ability to exceed this goal is dependent on the applicability of the analytical methods to the sample matrix analyzed. If data cannot be reported without qualifications, project completion goals may still be met if the qualified data (data of known quality, even if not perfect) are suitable for specified project goals. $\%C = \frac{\text{total number of usable results}}{\text{total number of results}} \times 100$
Comparability	Comparability is a qualitative parameter used to express the confidence with which one data set can be compared with another. The comparability of the data, a relative measure, is influenced by sampling and analytical procedures. By providing specific protocols for obtaining and analyzing samples, data sets will be comparable regardless of who collects the sample or who performs the sample analysis.
Sensitivity	Analytical sensitivity is a measure of an analytical technique's capability to reliably detect a positive signal compared to background noise. Sensitivity is measured in terms of laboratory-specific LODs. The Detection and reporting limits will be compared to project ALs and DQOs to ensure sufficient sensitivity to meet project objectives. If sensitivity goals are not achieved, the limitations on the data will be described.

Accuracy and precision will be quantitatively assessed by comparing recoveries and relative percent difference to the goals identified in **Worksheets #12** and **#28**. Data associated with accuracy or precision indicators that do not meet these goals will be assigned data usability qualifiers as identified in **Worksheet #36**. These data usability qualifiers, along with data qualification reason codes, will be stored as attributes to the analytical results in the project database.

Data qualification reason codes are defined in the following table.

Table 35 Data Qualification Reason Codes

REASON CODE ¹	DESCRIPTION
+	The associated quality control item indicates a potential high bias in the sample result
-	The associated quality control item indicates a potential low bias in the sample result
AST	Compound not quantitated against an authentic standard; potential bias indeterminate
BF	Contamination present in a field blank (e.g., Field Blank, etc.); evaluation criteria exceeded
BL	Contamination present in a laboratory blank (e.g., Method Blank, Instrument Blank, etc.); evaluation criteria exceeded
BN	Elevated detection limit or estimated result due to negative instrument drift (e.g., negative instrument blank result with an absolute value > 2× the MDL or LOD)
C	Initial and/or Continuing calibration issue
CC	Possible contamination due to carryover from a previous sample
CR	Calculated result in which one or more of the components has been qualified
CRQ	Calculated result flagged due to reporting protocol
E	Result exceeds calibration range
EP	Estimated Maximum Possible Concentration (EMPC)

REASON CODE ¹	DESCRIPTION
FD	Field duplicate imprecision; potential bias indeterminate
FG	Total versus dissolved imprecision
FP	Target compound identification criteria not met; potential false positive
H	Holding time exceeded
I	Internal standard evaluation criteria not met
L	Laboratory control sample/laboratory control sample duplicate recovery criteria not met
LP	Laboratory control sample/laboratory control sample duplicate precision criteria not met; potential bias indeterminate
LD	Laboratory duplicate precision criteria not met; potential bias indeterminate
LM	The lock mass selected ion current profiles indicate that ion suppression is evident
LR	Linear range exceeded; potential bias indeterminate
M	Matrix spike/matrix spike duplicate recovery criteria not met
MDP	Laboratory deviated from the method for a method-defined parameter, based on regulatory requirements
MP	Matrix spike/matrix spike duplicate precision criteria not met; potential bias indeterminate
NQC	Absence of supporting quality control samples
P	Post-digestion spike recovery criteria not met
PM	Performance evaluation mixture criteria not met
PT	Chromatographic pattern in sample does not match pattern of calibration standard
Q	Chemical preservation issue
QCI	Quantitation/confirmation ion ratios in sample are inconsistent with reference spectra; potential bias indeterminate
QCP	Quantitation/qualification ion transition ratio did not meet criteria; potential bias indeterminate
RA	Replicate/multiple analyses criteria not met; potential bias indeterminate
RL	The analysis meets all qualitative identification criteria, but the measured concentration is between the MDL and the quantitation or reporting limit; potential bias indeterminate
RM	Reference material recovery criteria not met
R	Reporting limit standard(s) outside of acceptance limits
S	Surrogate recovery criteria not met
SA	Method of standard additions criteria not met; potential bias indeterminate
SC	Relative percent difference between two columns exceeds criteria; potential bias indeterminate
SCC	Second column confirmation was not performed as required by the analysis method
SD	Serial dilution results did not meet evaluation criteria
SS	Second source calibration verification/initial calibration verification criteria not met
ST	Sample container type incorrect
SW	Sample switch suspected
T	Temperature preservation issue
TIC	Tentatively identified compound, quantified using an assumed calibration factor; potential bias indeterminate

REASON CODE ¹	DESCRIPTION
TN	Instrument tune criteria not met
Y	Potential bias due to the y-intercept in the calibration curve significantly affecting the analyte response
ZZ	Other

¹For any Reason Code that does not indicate that the potential bias is indeterminate, the “+” or “-” reason code may be appended to the qualification reason code in order to indicate a direction of bias (e.g., MS+ would be used to indicate potential high bias due to a high matrix spike recovery)

The Data Validation PM will review data generated by the laboratories for analyses of project samples. Any issues observed during data validation will be brought to the attention of the QA PM; the Laboratory PM will be contacted to determine and implement an appropriate corrective action if warranted.

Data validation reports will be prepared and reviewed by the Data Validation PM. The data validation reports will summarize the data reviewed, the level of review, any issues observed, and any data qualification. Data validation reports will be submitted to the Secure CTEH servers.

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Attachment A

Odor Surveys SOP

STUDY PURPOSE

This odor survey evaluation protocol is designed to characterize the frequency, strength, hedonic tone, and character of odors in ambient air throughout the community within three miles surrounding the Eco-Vista landfill (the Landfill) in Springdale, Arkansas.

BACKGROUND

Ambient odor evaluations present a challenge due to the low concentrations at which certain odors can be detected by the human nose, the complex composition of some odors, and the rapid fluctuation of conditions that can occur over time. Whereas laboratory instrumentation can provide information regarding the concentration of individual compounds (i.e., hydrogen sulfide, mercaptans, ammonia), analytical instrumentation does not provide information regarding the intensity or hedonic tone (offensiveness or pleasantness) of the odors. The human nose, on the other hand, can integrate the odors of hundreds of compounds from a single source to be experienced as a unitary odor.

Furthermore, the human nose is the most reliable way to obtain data on odor intensity and tone; thus, human olfactory measurements (i.e., olfactometry) are currently the only reliable, well-established method for sensory quantification, and remain the ultimate determinant for nuisance odor episodes³. Olfactometry strategies can be classified into two categories – laboratory based olfactometry, and on-site field olfactometry (scentometry), both of which involve controlling the mixture of odorous air with non-odorous air to achieve known dilutions that can be evaluated by a trained technicians (i.e., odor panelists).

While laboratory-based olfactometry offers the benefit of having multiple panelists characterize one sample of air that can be diluted and evaluated in parallel, field scentometry offers a major benefit over laboratory-based olfactometry in that this technique provides the ability for trained odor panelists to objectively quantify odor intensity in real-time, offering the ability to characterize a multitude of conditions, scenarios and locations a few minutes apart.

Scentometry is established as an accepted methodology to quantify and characterize odors that may contribute to a nuisance. It is recognized in the scientific literature as a useful technique for the assessment of field odors and the evaluation of odor offensiveness downwind of known odorant sources such as animal feeding operations, wastewater treatment plants, industrial pulp and ethanol plants, and

³ Brandt et al., 2011

others⁴⁵⁶⁷⁸⁹¹⁰. In addition to its use in the field, scentometry is reported as a technique for comparison of ambient odors in controlled environments¹¹⁻¹².

Scentometry is a method of measuring odor strength based on the ability to smell the odor after diluting the ambient air with a known concentration of carbon filtered (odorless) air. The amount of carbon filtered air dilutions required before an odor is no longer detectable by an odor panelist is termed the “dilution to threshold” or D/T. The D/T is a unitless ratio calculated as:

$$\frac{D}{T} = \frac{\text{Volume of filtered air}}{\text{Volume of odorous air}}$$

The greater number of dilutions needed before reaching the odor threshold indicates the presence of a stronger odor. Conversely, detection at low dilution (low D/T) indicates a relatively weak odor. Perceived odor strength is often referred to as the odor intensity. Odor intensity will increase as a function of odorant concentration; however, when the concentration of an odorant is increased, the perceived odor intensity will always increase less sharply. This is largely because it takes larger and larger increases in odorant concentrations to maintain a constant increase in perceived odor intensity.

Scentometry was developed in the late 1950s through project grants from the U.S. Public Health Service (Huey et al., 1960).¹¹ This led to the development of the first Scentometer by the Barnebey-Cheney Company. During the development of scentometry, Huey et al. (1960) established the following odor concentration categories corresponding to dilution to threshold ratios¹³:

⁴ Brandt et al., 2011

⁵ Dalton et al., 2011

⁶ Kosmider and Krajewska, 2007

⁷ SRF, 2004

⁸ Sheffield et al., 2004

⁹ Witherspoon and Barnes, 2004

¹⁰ Zhang et al., 2002

¹¹ Henry et al., 2011

¹² McGinley and McGinley, 2004

¹³ Huey et al., 1960

Table 1. Dilution to Threshold Levels and their Corresponding Odor Descriptors

Dilution to Threshold (D/T)	Odor Concentration Descriptor
2-4	Noticeable
7	Objectionable
15	Nuisance
>30	Nauseating

QUALIFICATIONS

Air quality panelists go through training from St. Croix, the manufacturers of the Nasal Ranger instrument. Panelists are trained on how to systematically identify and describe odor character using tools such as the Arkansas Department of Energy and Environment (E&E) odor wheel. Once training is complete, training certifications are provided for each panelist who has completed the training and has undergone an odor sensitivity test. Their odor sensitivity score is assessed prior to beginning an odor study and maintained on file.

Individuals have varying sensitivity to odors. Some individuals have a low sensitivity whereas others are hypersensitive. The odor sensitivity of the individual odor technicians is assessed with a test kit consisting of 14 odorous and 2 non-odorous pens that contain increasing concentrations of 1-butanol. The odor sensitivity test is conducted in a near odorless room with the test subject blindfolded. The tester presents three different pens to the odor panelist. One of the pens contains a concentration of 1-butanol and the other two pens are blank odorless pens. The tester asks the odor panelist to determine which pen contains the odor of 1-butanol. The presentation of the pens continues in increasing concentration until two positive detections of 1-butanol are identified in two consecutive tests. The odor sensitivity is determined by averaging the sums of each separate test. The concentration of 1-butanol in the pens is directly comparable to the odor panelist's odor sensitivity. A study performed by St. Croix Sensory, Inc. identified that an odor sensitivity score of 7.33 would represent the 50th percentile odor sensitivity in the general population¹⁴.

SCOPE OF ODOR SURVEY EVALUATION

Prior to beginning the odor survey evaluation, CTEH will establish a number of pre-defined odor monitoring locations within a three mile radius of the Eco Vista Landfill. In addition, discrete odor readings may be collected downwind of potential odor sources to characterize odor intensity and tone. Meteorological conditions including temperature, humidity, and wind speed will be collected from each

¹⁴ Lay and McGinley, 2004

location where odor evaluations are conducted. Topographical features of the area along with meteorological conditions will be used to determine locations for odor monitoring.

Odor panelists will follow the preestablished route and visit each of those sites regularly to characterize the frequency, strength, hedonic tone, and character of odors (or absence of odors) in ambient air throughout the day, daily from May 2, 2025 to May 12, 2025.

METHODS AND PROCEDURE

The device intended for the odor survey evaluation around communities near the Eco Vista Landfill is the Nasal Ranger, manufactured by St. Croix Sensory, Inc. The Nasal Ranger is an olfactometer that allows an odor panelist to dilute ambient air with non-odorous carbon-filtered air and obtain a dilution to threshold ratio.

Odor measurements will be conducted per St. Croix Sensory protocols for the Nasal Ranger. An odor reading will be recorded at each of the monitoring locations. Odor monitoring readings will be taken as instructed during Nasal Ranger training. Two teams of 2 odor panelists, one team on the day shift and one team on the night shift, will be equipped with Nasal Ranger instruments and hand-held weather monitoring equipment. These teams of two will work together and will take independent, simultaneous co-located readings. For each reading, odor monitors will record the following information:

- Date & Time
- Location description and GPS
- Odor intensity (D/T dilution)
- Hedonic tone
- Odor group (character, descriptor in accordance with E&E odor wheel)
- Meteorological information (cloud conditions, temperature, precipitation, humidity, barometric pressure and wind speed)
- Additional comments (observations, site conditions)

Each shift will consist of one odor monitoring period of no more than four hours, followed by a two-hour break, and another four-hour period of odor monitoring. A supervisor may also be present as one of the panelists, and/or to oversee odor monitoring activities. Monitoring personnel will follow the St. Croix Sensory protocol related to personal conduct, including not wearing scented personal products on the day of monitoring, not eating or drinking anything but water from one hour prior to the beginning of shift until the shift is over.

Prior to quantifying the odorous air, the panelist will breathe carbon-filtered air through their nose for one minute to clear their nasal palette of any odors (referred to as zeroing the nose). If an odor is detected in the ambient air after the nose is zeroed, the panelist will utilize the dilution settings (2, 4, 7, 15, 30, 60) that control the amount of odorous air entering the panelist's nose and six blank carbon filtered positions.

The amount of carbon-filtered air required to dilute the odorous air is synonymous with the odor strength for that measurement. The odor dilution settings on the instrument range from 2 (slightly noticeable odor) to 60 (very strong odor). Collection of an odor concentration measurement involves the following steps:

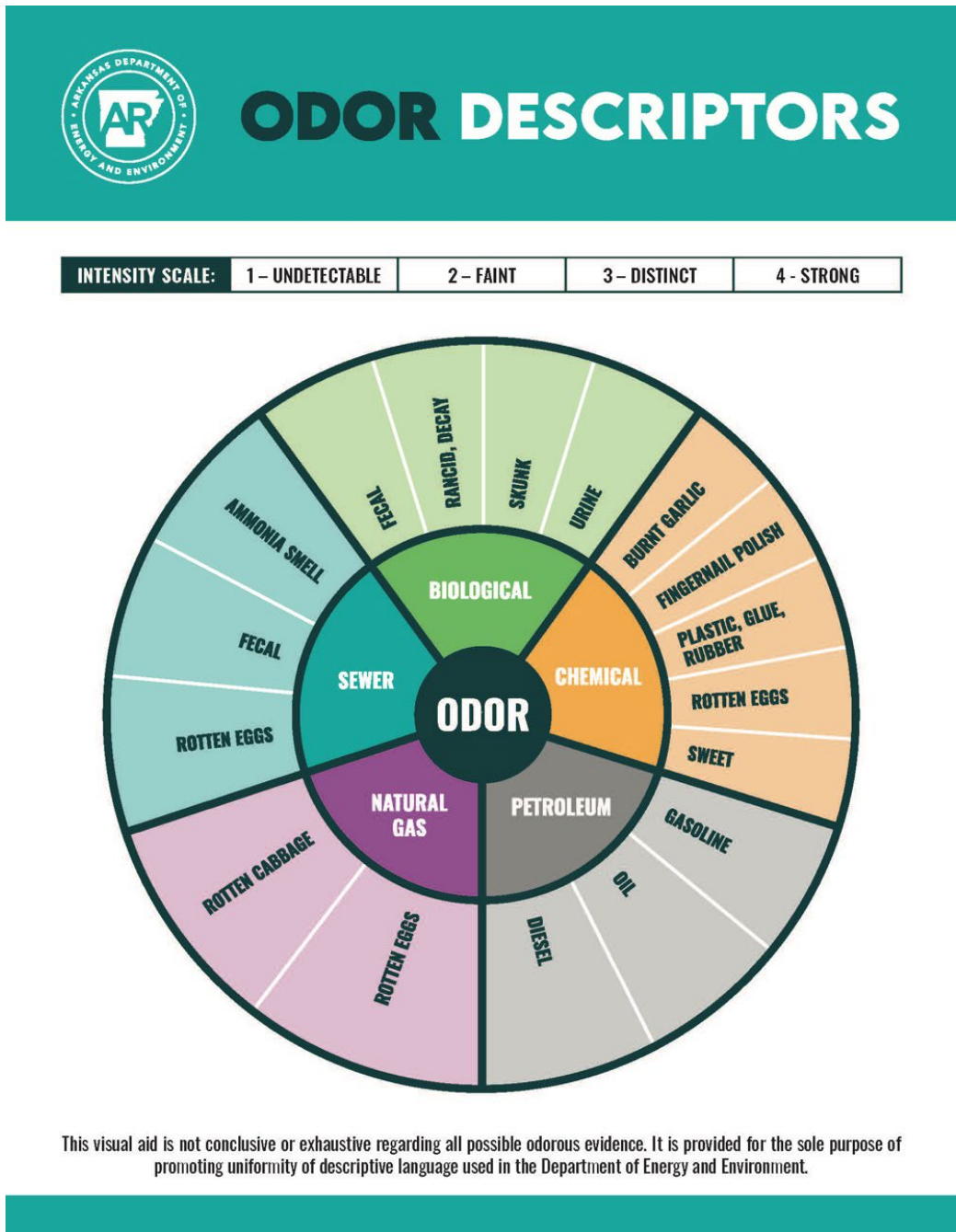
1. The odor panelist will arrive at a pre-determined location and begin breathing through carbon-filtered air utilizing the Nasal Ranger to clear the nasal palette of any odors and to “zero out” their nose.
2. The odor panelist will place their shoulder into the wind and maintain the Nasal Ranger on their nose, then turn the D/T dial clockwise to the 60-D/T position.
3. The odor panelist will inhale twice at the target inhalation rate of 16 to 20 liters per minute through the nasal mask, as indicated by the instrument. If an odor is detected, the odor concentration is recorded as greater than or equal to 60 D/T (≥ 60 D/T).
4. If no odor is detected at 60 dilutions, the odor panelist will then proceed to the next blank position and re-zeroes their nose by inhaling carbon-filtered air twice.
5. After re-zeroing their nose, the odor panelist will turn the dial to the 30 D/T position and inhale twice.
6. The odor panelist will continue this sequence of dilutions until an odor is detected. If no odor is detected through the instrument, yet an odor is perceived by the panelist upon removal of the Nasal Ranger® from the nose, the odor strength is recorded as less than 2 D/T (< 2 D/T).
7. Upon completion of every odor monitoring event, the odor panelist will record the D/T observed at that location and time, along with GPS coordinates and meteorological information at the time. Comments and photography may be collected by the odor panelists to record additional details if warranted.
8. The panelist will conduct odor readings for a maximum continuous period of 4 hours, followed by rest at least two hours before resuming additional odor reading sessions.
9. All collected odor readings will undergo quality assurance and quality control checks to ensure accuracy and completeness.

The odor panelist will utilize standardized descriptor terms in accordance with the E&E Odor Descriptors (**Figure 10**). This allows for consistency between odor panelists to report odor character. In addition to an odor description, the odor panelist will classify an odor based on its inherent pleasant or unpleasant characteristics. This classification is typically referred to as hedonic tone. This is accomplished by ranking

the odor on a numeric scale from -10 (unpleasant odor) to +10 (pleasant odor) with zero being neutral, to classify an odor as pleasant or unpleasant based on the odor panelist's experience.

CTEH will use the E&E odor wheel to describe and document odors.

Figure 10Arkansas Department of Energy and Environment Odor Wheel.



DOCUMENTATION AND REPORTING

Data collected by the odor panelists will be recorded through mobile data studio and stored electronically on secure servers.

Attachment B

Complaint Intake Form

Thank you for calling the Tontitown Air Sampling Study Hotline, this is [NAME] a field technician from CTEH. Are you calling with a complaint?

1. **Is this an air complaint?** Yes/No/Unsure
2. **Is the location of the complaint approximately three miles from the Eco-Vista Landfill?**
Yes/No/Unsure

3. Please describe the problem to me.:

NOTE: Do not ask details about the individuals health status or diagnoses of the individual except for describing the reported health complaint, if one is reported.

4. Do you smell any odors? Yes/No

If odors are reported in the description of the problem proceed with odor questions:

5. What are you smelling?

NOTE: Document how the complainant describes what they are smelling.

6. **How strong is the smell?** 1-Undetectable, 2-Faint, 3-Distinct, 4-Strong
7. **How long has the smell been happening?** Just started, less than an hour, a few hours, about a day, several days, or not sure.
8. **Where is the odor occurring?**
9. **Is the odor transient or sustained?**
10. **Any additional information to add?**
Users can optionally list any additional information related to the odor.

11. Do you want to remain anonymous?

NOTE: If the location of the complaint is within a reasonable distance to respond with air sampling (approximately 3 miles) proceed with the next question.

12. Would you like the field team to respond with air sampling at the location of your complaint?
Yes/No

Caller First Name:

Caller Last Name:

Address of where the complaint is taking place:

Residence Address:

Callback Phone Number:

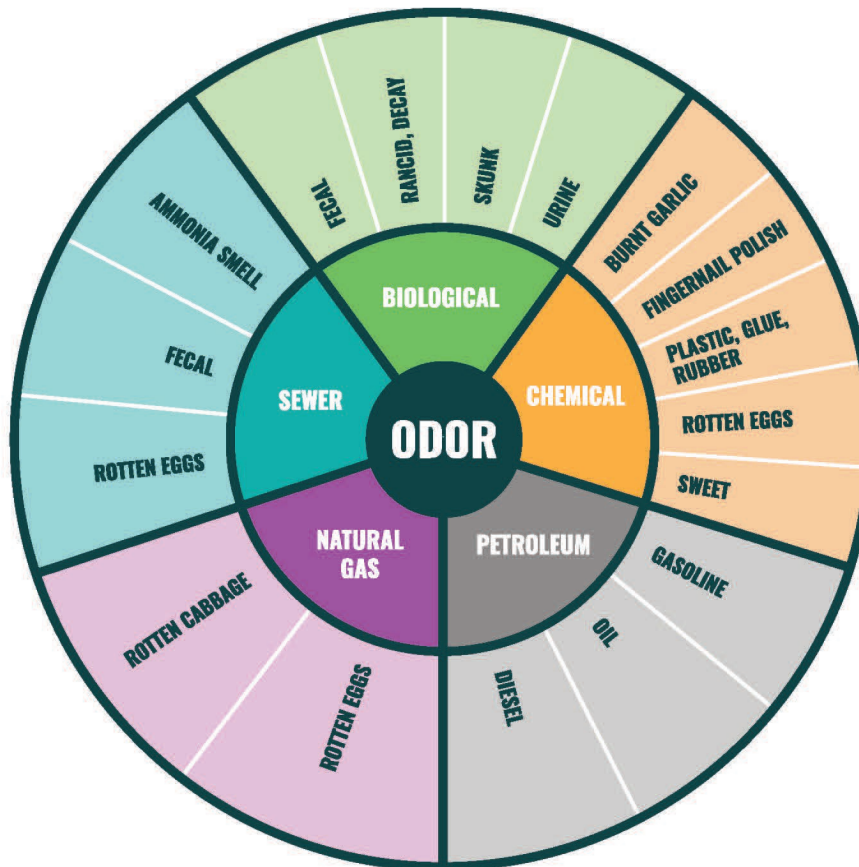
Email Address:

Thank you for calling the Hotline, you can find more information at [website].



ODOR DESCRIPTORS

INTENSITY SCALE: 1 – UNDETECTABLE 2 – FAINT 3 – DISTINCT 4 – STRONG



This visual aid is not conclusive or exhaustive regarding all possible odorous evidence. It is provided for the sole purpose of promoting uniformity of descriptive language used in the Department of Energy and Environment.

Source: Arkansas Department of Energy and Environment.

Attachment C

COPCs and Health Based Screening Levels

Human Health-based Screening Levels for Compounds of Potential Concern

COPC	CAS No.	RL (ppbv)	MDL (ppbv)	Carcinogenic Screening Levels TR=1E-06 (ppbv) ¹	Carcinogenic Screening Levels TR=1E-04 (ppbv) ²	Noncarcinogenic Screening Levels THQ=0.1 (ppbv) ¹	Noncarcinogenic Screening Levels THI=1 (ppbv) ¹
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	0.20	0.036			95.307	953.073
1,1,2,2-Tetrachloroethane (tetrachloroethane)	79-34-5	0.20	0.046	0.007	0.699		
1,1,2-Trichloroethane	79-00-5	0.20	0.047	0.033	3.299	0.004	0.038
1,1,2-Trichloroethene (trichloroethylene)	79-01-6	0.20	0.068	0.089	8.932	0.039	0.391
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	0.20	0.066			67.844	678.442
1,1-Dichloroethane (ethylidene chloride)	75-34-3	0.20	0.048	0.445	44.455		
1,1-Dichloroethene (vinylidene chloride)	75-35-4	0.20	0.052			0.103	1.035
1,2,4-Trichlorobenzene	120-82-1	0.20	0.12			0.028	0.283
1,2,4-Trimethylbenzene (pseudocumene)	95-63-6	0.20	0.068			1.281	12.815
1,2-Dibromoethane (ethylene dibromide)	106-93-4	0.20	0.043	0.001	0.061	0.122	1.223
1,2-Dichloroethane (ethylene dichloride)	107-06-2	0.20	0.046	0.027	2.717	0.18	1.803
1,2-Dichloropropane (propylene dichloride)	78-87-5	0.20	0.060	0.164	16.444	0.091	0.909
1,3,5-Trimethylbenzene (mesitylene)	108-67-8	0.20	0.070			1.281	12.815
1,3-Butadiene	106-99-0	0.20	0.055	0.042	4.249	0.095	0.949
2-Butanone (methyl ethyl ketone, MEK)	78-93-3	1.0	0.075			176.338	1763.384

COPC	CAS No.	RL (ppbv)	MDL (ppbv)	Carcinogenic Screening Levels TR=1E-06 (ppbv) ¹	Carcinogenic Screening Levels TR=1E-04 (ppbv) ²	Noncarcinogenic Screening Levels THQ=0.1 (ppbv) ¹	Noncarcinogenic Screening Levels THI=1 (ppbv) ¹
2-Propanol (isopropanol)	67-63-0	1.0	0.095			8.543	85.433
2-Propenal (acrolein)	107-02-8	0.20	0.15			0.001	0.009
2-Propenenitrile (acrylonitrile)	107-13-1	0.20	0.070	0.019	1.888	0.097	0.967
4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK)	108-10-1	0.20	0.066			75.644	756.437
Acetonitrile (cyanomethane)	75-05-8	0.20	0.12			3.748	37.478
Benzene	71-43-2	0.20	0.041	0.113	11.270	0.97	9.705
Bromodichloromethane	75-27-4	0.20	0.041	0.011	1.134		
Carbon disulfide (methanedithione)	75-15-0	0.20	0.078			23.454	234.540
Carbon tetrachloride (tetrachloromethane)	56-23-5	0.20	0.043	0.075	7.472	1.59	15.897
Chlorobenzene	108-90-7	0.20	0.036			1.129	11.291
Chloroethane (ethyl chloride)	75-00-3	0.20	0.074			159.209	1592.093
Chloroethene (vinyl chloride)	75-01-4	0.20	0.049	0.067	6.650	2.073	20.734
Chloromethane (methyl chloride)	74-87-3	0.20	0.068			4.551	45.511
Dichlorodifluoromethane (Freon 12)	75-71-8	0.20	0.049			2.022	20.223
Dichloromethane (methylene chloride)	75-09-2	0.20	0.098	28.799	2879.859	18.143	181.431
ETHANE, 1,1-DIFLUORO-	75-37-6	1.0	0.073			1554.731	15547.313

COPC	CAS No.	RL (ppbv)	MDL (ppbv)	Carcinogenic Screening Levels TR=1E-06 (ppbv) ¹	Carcinogenic Screening Levels TR=1E-04 (ppbv) ²	Noncarcinogenic Screening Levels THQ=0.1 (ppbv) ¹	Noncarcinogenic Screening Levels THI=1 (ppbv) ¹
Ethenyl acetate (vinyl acetate)	108-05-4	1.0	0.44			5.963	59.634
Ethyl acetate	141-78-6	0.40	0.1			2.026	20.259
Ethylbenzene	100-41-4	0.20	0.068	0.253	25.325	23.023	230.226
Heptane	142-82-5	0.20	0.058			10.249	102.485
Hexane	110-54-3	0.20	0.060			20.706	207.059
Hydrogen fluoride	7664-39-3	80	8			1.83	18.29
m,p-Xylenes	179601-23-1	0.40	0.099			2.303	23.031
Methanol	67-56-1	5	1.6			1602.428	16024.281
Naphthalene (naphthene)	91-20-3	1.0	0.64	0.016	1.583	0.059	0.591
o -Dichlorobenzene (1,2-dichlorobenzene)	95-50-1	0.20	0.068			3.493	34.929
o -Xylene (1,2-xylene)	95-47-6	0.20	0.058			2.302	23.023
Pentane	109-66-0	0.20	0.063			33.887	338.873
Propene (propylene)	115-07-1	0.20	0.1			180.036	1800.356
Styrene (vinylbenzene)	100-42-5	0.20	0.070			23.464	234.645
Tetrachloroethene (perchloroethylene)	127-18-4	0.20	0.069	1.622	162.214	0.619	6.194
Tetrahydrofuran (oxolane)	109-99-9	0.20	0.064			71.214	712.136

COPC	CAS No.	RL (ppbv)	MDL (ppbv)	Carcinogenic Screening Levels TR=1E-06 (ppbv) ¹	Carcinogenic Screening Levels TR=1E-04 (ppbv) ²	Noncarcinogenic Screening Levels THQ=0.1 (ppbv) ¹	Noncarcinogenic Screening Levels THI=1 (ppbv) ¹
Toluene (methylbenzene)	108-88-3	0.20	0.046			138.046	1380.456
trans -1,2-Dichloroethene (trans -1,2-dichloroethylene)	156-60-5	0.20	0.056			1.06	10.598
Trichloromethane (chloroform)	67-66-3	0.20	0.037	0.025	2.457	0.041	0.410

¹Source: U.S. EPA Resident Air Regional Screening Levels: <https://www.epa.gov/risk/regional-screening-levels-rsls-generic-tables>

²Screening levels with target cancer risk of 1 in 10,000 (1E-04). Per the U.S. EPA, the acceptable risk range for exposure to known or suspected carcinogens is between 1 in 10,000 (1E-4) and 1 in 1,000,000 (1E-6): <https://semspub.epa.gov/work/11/176250.pdf>

COPC: Compound of Potential Concern, RL: Reporting Limit, MDL: Method Detection Limit, THQ: Target Hazard Quotient, THI: Target Hazard Index, SL: Screening Level, TR: Target Risk

Attachment D

COPCs and Data Sources

Compound (alternative name)	CAS Number	2020 National Emissions Inventory	FOIA - 2023 Facility Emissions	Title V Annual Compliance Certification	FOIA – 2024 HAP Emissions	FOIA – 2024 SN-01 Fugitives	FOIA – 2024 SN-04 - SN-08 Emissions	CTEH May 2024 Study (downwind fenceline)	CTEH May 2024 Study (upwind/crosswind background)	CTEH February 2024 Study (all locations)
1,1,1-Trichloroethane (methyl chloroform)	71-55-6	NO	NO	NO	YES	YES	NO	ND	ND	ND
1,1,2,2-Tetrachloroethane (tetrachloroethane)	79-34-5	NO	NO	NO	YES	YES	YES	ND	ND	ND
1,1,2-Trichloroethane	79-00-5	NO	NO	NO	YES	NO	YES	ND	ND	ND
1,1,2-Trichloroethene (trichloroethylene)	79-01-6	NO	NO	NO	YES	YES	NO	ND	ND	ND
1,1,2-Trichlorotrifluoroethane (Freon 113)	76-13-1	NO	NO	NO	NO	NO	NO	DETECT	DETECT	ND
1,1-Dichloroethane (ethylidene chloride)	75-34-3	YES	YES	YES	YES	YES	YES	ND	ND	ND
1,1-Dichloroethene (vinylidene chloride)	75-35-4	YES	YES	YES	YES	YES	NO	ND	ND	ND
1,2,4-Trichlorobenzene	120-82-1	NO	NO	NO	NO	NO	NO	ND	ND	DETECT
1,2,4-Trimethylbenzene (pseudocumene)	95-63-6	NO	NO	NO	NO	NO	YES	DETECT	ND	ND
1,2-Dibromoethane (ethylene dibromide)	106-93-4	NO	NO	NO	YES	YES	YES	ND	ND	ND
1,2-Dichloroethane (ethylene dichloride)	107-06-2	NO	NO	NO	YES	YES	YES	ND	ND	ND
1,2-Dichloropropane (propylene dichloride)	78-87-5	NO	NO	NO	YES	YES	YES	ND	ND	ND
1,3,5-Trimethylbenzene (mesitylene)	108-67-8	NO	NO	NO	NO	NO	YES	ND	ND	ND
1,3-Butadiene	106-99-0	NO	NO	NO	YES	NO	YES	ND	ND	ND
2-Butanone (methyl ethyl ketone, MEK)	78-93-3	NO	NO	NO	NO	YES	NO	DETECT	DETECT	DETECT
2-Propanol (isopropanol)	67-63-0	NO	NO	NO	NO	YES	NO	DETECT	DETECT	DETECT
2-Propenal (acrolein)	107-02-8	NO	NO	NO	YES	NO	YES	DETECT	DETECT	DETECT

Compound (alternative name)	CAS Number	2020 National Emissions Inventory	FOIA - 2023 Facility Emissions	Title V Annual Compliance Certification	FOIA – 2024 HAP Emissions	FOIA – 2024 SN-01 Fugitives	FOIA – 2024 SN-04 - SN-08 Emissions	CTEH May 2024 Study (downwind fence line)	CTEH May 2024 Study (upwind/cross wind background)	CTEH February 2024 Study (all locations)
2-Propenenitrile (acrylonitrile)	107-13-1	NO	NO	NO	YES	YES	NO	ND	ND	ND
4-Methyl-2-pentanone (methyl isobutyl ketone, MIBK)	108-10-1	NO	NO	NO	YES	YES	NO	ND	ND	ND
Acetonitrile (cyanomethane)	75-05-8	NO	NO	NO	NO	NO	NO	ND	DETECT	DETECT
Benzene	71-43-2	NO	NO	NO	YES	YES	YES	DETECT	DETECT	DETECT
Bromodichloromethane	75-27-4	NO	NO	NO	NO	YES	NO	ND	ND	ND
Carbon disulfide (methanedithione)	75-15-0	NO	NO	NO	YES	YES	NO	ND	ND	DETECT
Carbon tetrachloride (tetrachloromethane)	56-23-5	NO	NO	NO	YES	YES	YES	DETECT	DETECT	ND
Chlorobenzene	108-90-7	NO	NO	NO	YES	YES	YES	ND	ND	ND
Chloroethane (ethyl chloride)	75-00-3	NO	NO	NO	YES	YES	YES	ND	ND	ND
Chloroethene (vinyl chloride)	75-01-4	YES	YES	YES	YES	YES	YES	ND	ND	ND
Chloromethane (methyl chloride)	74-87-3	NO	NO	NO	YES	YES	NO	DETECT	DETECT	DETECT
Dichlorodifluoromethane (Freon 12)	75-71-8	NO	NO	NO	NO	YES	NO	DETECT	DETECT	DETECT
Dichloromethane (methylene chloride)	75-09-2	NO	NO	NO	YES	YES	YES	DETECT	DETECT	DETECT
ETHANE, 1,1-DIFLUORO-	75-37-6	NO	NO	NO	NO	NO	NO	DETECT	ND	ND
Ethenyl acetate (vinyl acetate)	108-05-4	NO	NO	NO	NO	NO	NO	DETECT	DETECT	DETECT
Ethyl acetate	141-78-6	NO	NO	NO	NO	NO	NO	DETECT	DETECT	DETECT
Ethylbenzene	100-41-4	YES	YES	YES	YES	YES	YES	DETECT	ND	DETECT
Heptane	142-82-5	NO	NO	NO	NO	NO	NO	DETECT	DETECT	DETECT

Compound (alternative name)	CAS Number	2020 National Emissions Inventory	FOIA - 2023 Facility Emissions	Title V Annual Compliance Certification	FOIA – 2024 HAP Emissions	FOIA – 2024 SN-01 Fugitives	FOIA – 2024 SN-04 - SN-08 Emissions	CTEH May 2024 Study (downwind fenceline)	CTEH May 2024 Study (upwind/cross wind background)	CTEH February 2024 Study (all locations)
Hexane	110-54-3	NO	NO	NO	YES	YES	YES	DETECT	DETECT	DETECT
Hydrogen fluoride	7664-39-3	NO	NO	NO	YES	NO	NO	NA	NA	NA
m,p-Xylenes	179601-23-1	NO	NO	NO	NO	NO	NO	DETECT	DETECT	DETECT
Methanol	67-56-1	NO	NO	NO	YES	NO	YES	NA	NA	NA
Naphthalene (naphthene)	91-20-3	NO	NO	NO	YES	NO	YES	ND	ND	ND
<i>o</i> -Dichlorobenzene (1,2-dichlorobenzene)	95-50-1	NO	YES	YES	NO	YES	NO	ND	ND	ND
<i>o</i> -Xylene (1,2-xylene)	95-47-6	NO	NO	NO	NO	NO	NO	DETECT	ND	DETECT
PENTANE	109-66-0	NO	NO	NO	NO	YES	YES	DETECT	DETECT	DETECT
Propene (propylene)	115-07-1	NO	NO	NO	NO	NO	NO	DETECT	DETECT	DETECT
Styrene (vinylbenzene)	100-42-5	NO	NO	NO	YES	NO	YES	ND	ND	ND
Tetrachloroethene (perchloroethylene)	127-18-4	NO	NO	NO	YES	YES	NO	ND	ND	ND
Tetrahydrofuran (oxolane)	109-99-9	NO	NO	NO	NO	NO	NO	DETECT	DETECT	DETECT
Toluene (methylbenzene)	108-88-3	YES	YES	YES	YES	YES	YES	DETECT	DETECT	DETECT
<i>trans</i> -1,2-Dichloroethene (<i>trans</i> -1,2-dichloroethylene)	156-60-5	NO	NO	NO	NO	YES	NO	ND	DETECT	DETECT
Trichloromethane (chloroform)	67-66-3	NO	NO	NO	YES	YES	YES	ND	ND	ND

ND: Not Detected; NA: Not Analyzed

Attachment E

Wind Direction Calculations

1. Calculate average wind direction (Resultant Vector)

- a. Convert wind direction angle A from degrees to radians using:

$$\theta \text{ (radians)} = \frac{A \text{ (degrees)} \times 180}{\pi}$$

- b. For sampling location s on day d , calculate the average of the cosines of the n wind direction measurements (in radians), and the average of the sines of the n wind direction measurements (in radians)

$$C_{sd} = \sum_{i=1}^n \cos(\theta_i)$$
$$S_{sd} = \sum_{i=1}^n \sin(\theta_i)$$

- c. To calculate wind direction W_{sd} (blowing from) and then convert back to degrees, the following transformations are applied:

IF ($C_{sd} < 0$) THEN

$$W_{sd} = \tan^{-1} \left(\frac{S_{sd}}{C_{sd}} \right) \times \frac{180}{\pi} + 180$$

IF ($S_{sd} < 0$) THEN

$$W_{sd} = \tan^{-1} \left(\frac{S_{sd}}{C_{sd}} \right) \times \frac{180}{\pi} + 360$$

ELSE

$$W_{sd} = \tan^{-1} \left(\frac{S_{sd}}{C_{sd}} \right) \times \frac{180}{\pi}$$

- d. Final resultant vector V_{sd} of wind direction (blowing from):

IF ($W_{sd} \geq 180$) THEN

$$V_{sd} = W_{sd} - 180$$

ELSE

$$V_{sd} = W_{sd} + 180$$

2. Calculate bearing from source site to sample location (Bearing to Sample Location), given the sampling location coordinates of (Lat_l , $Long_l$) and source site coordinates (Lat_s , $Long_s$)

- a. Convert (Lat , $Long$) to radians using equations:

$$Lat_{l,rad} = \frac{Lat_l \times 180}{\pi}$$

$$Long_{l-s,rad} = \frac{(Long_l - Long_s) \times 180}{\pi}$$

$$Lat_{s,rad} = \frac{Lat_s \times 180}{\pi}$$

- b. Bearing X:

$$X = \cos(Lat_{l,rad}) \times \sin(Long_{l-s,rad})$$

- c. Bearing Y:

$$Y = [\cos(Lat_{s,rad}) \times \sin(Lat_{l,rad})] \\ - [\sin(Lat_{s,rad}) \times \cos(Lat_{l,rad}) \times \cos(Long_{l-s,rad})]$$

- d. To calculate the bearing $\theta_{X,Y}$ (in radians) to the sample location, the four-quadrant arctangent function is used.

$$atan2(X,Y) = \theta_{X,Y}$$

- e. Convert back to degrees and add 360 so all measurements are positive, then use the modulo function to calculate the remainder when dividing by 360.

$$A_{X,Y} = MOD \left(\left[\theta_{X,Y} \times \frac{180}{\pi} \right] + 360, 360 \right)$$

Assign Upwind/Downwind/Crosswind (relative wind direction from source)

- a. Calculate the relative wind direction in degrees using the following

$$Relative\ Wind\ Direction\ (degrees) = 180 - \left| |V_{sd} - A_{X,Y}| - 180 \right|$$

Downwind: $Relative\ Wind\ Direction \leq 45$

Crosswind: $45 < Relative\ Wind\ Direction \leq 135$

Upwind: $135 < Relative\ Wind\ Direction \leq 180$