FIELD SAMPLING PLAN

Ethylene Oxide Monitoring – Additional Characterization of South Charleston and Institute, West Virginia

Revision 0
May 23, 2022

West Virginia Department of Environmental Protection
Division of Air Quality
601 57th Street, SE
Charleston, WV 25304
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Alice Chow, Chief, Air Quality Analysis Branch, ARD, EPA Region 3

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Verena Joerger, Project QA Coordinator - Air Quality Analysis Branch, ARD, EPA Region 3

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Executive Summary

The West Virginia Department of Environmental Protection (WVDEP) Division of Air Quality (DAQ) will conduct additional short-term ethylene oxide (EtO) air sampling in South Charleston and Institute, West Virginia (WV) for subsequent laboratory analysis by the Unites States Environmental Protection Agency (EPA) national contract laboratory, to assess atmospheric concentrations. A prior Field Sampling Plan (FSP) addressed four (4) sampling sets of EtO conducted by DAQ, and which has now been completed. The purpose of this additional project is to obtain EtO sampling data in coordination with Union Carbide Corporation/DOW's own EtO summa canister monitoring being conducted at the Institute, WV and South Charleston, WV facilities per a January 18, 2022 Section 114 data request from EPA. DAQ's sampling will be conducted using a summa canister sampler. Each sample will be collected over a 24-hour period. Weekly sampling over seven (7) weeks is anticipated to begin the week of May 23, 2022. Sampling will consist of four (4) canisters deployed at four locations:

- Guthrie, WV background;
- Buffalo, WV background;
- A site on the perimeter of the Institute, WV facility; and
- a site in North Charleston on the perimeter of the South Charleston, WV facility

The sampling sites near the two (2) facilities will be near sampling locations by UCC/DOW. DAQ's sampler, supplied by the contract laboratory, will be equipped with an air sampling assembly consisting of a filter, sample tube, critical orifice, flow regulator and vacuum gauge. The exposed canister will be shipped to the EPA contract laboratory (ERG) for analysis by gas chromatography mass spectrometry (GC-MS).

DAQ will review the sampling results to determine any presence of EtO, and compare the results with those obtained by the company to aid in characterizing the data. The EPA will re-direct agency grant funds towards lab analyses, and provide advisory assistance in technical matters and quality review.

Field Sampling Plan Identifying Information

Site Name: South Charleston, WV, 437 MacCorkle Avenue SW, 25303
Union Carbide Corporation, DOW (03-54-039-00003) - 440.026 km Easting, 4,246.927 km Northing, Zone 17
Covestro LLC (03-54-039-00102) - 439.65 km Easting, 4,247.000 km Northing, Zone 17

Site Name: Institute, WV, 250 Carbide Road, Dunbar, WV 25064, ALTIVIA Institute Industrial Park
Union Carbide Corporation (03-54-039-00005) – 432.189 km Easting, 4,248.754 km Northing, Zone 17
Specialty Products US, LLC (03-54-039-00682) – 432.189 km Easting, 4,248.754 km Northing, Zone 17

Lead Organization/Air Monitoring Agency: USEPA/WV Department of Environmental Protection Division of Air Quality
Contract Laboratory Name: Eastern Research Group, Inc. (ERG)
Contract Laboratory Address: 601 Keystone Park Drive 700, Morrisville, NC 27560-9998

Table 1 List organizational partners (stakeholders) and identify the connection with lead organization (WVDEP-DAQ):

Organization Partners/Stakeholders	**Connection/ Role**
EPA Region 3	Review and approval of Quality Assurance Project Plan (QAPP) & FSP; re-direct agency grant funding for lab analyses, advice on technical issues and Quality Assurance
Eastern Research Group (ERG), Inc. National Contract Lab	Provide summa canisters and intake assemblies; perform EtO analysis of collected summa canisters
Union Carbide Corporation/DOW	Provide sampling schedule in advance to allow coordination of DAQ sampling

Table 2 Distribution List

FSP Recipients	Title	Phone Number	E-mail Address & Phone Number
EPA Region 3 - Air & Radiation Division			
Alice Chow	Chief, Air Quality Analysis Branch	(215) 817-4380	chow.alice@epa.gov
Verena Joerger	Air Quality Analysis Branch	(215) 814-2218	joerger.verena@epa.gov
Howard Schmidt	Air Quality Analysis Branch	(215) 814-2133	schmidt.howard@epa.gov
Jessica Fry Chamberlin	Air Quality Analysis Branch	(215) 814-2121	fry.jessica@epa.gov
Carol Ann Gross-Davis, Ph.D.	Air Quality Analysis Branch	(215) 814-5738	gross-davis.carolann@epa.gov
WVDEP-DAQ			
Renu Chakrabarty	Assistant Director of Air Monitoring, Lab & Air Toxics	(304) 414-1249	renu.m.chakrabarty@wv.gov
Mike Egnor	Air Toxics Coordinator	(304) 414-1255	michael.egnor@wv.gov
Mark Drake	Environmental Resources Program Manager 1	(304) 414-1254 (304) 389-7530	s.mark.drake@wv.gov
Tyler Fewell	Environmental Resource Specialist 1	(304) 389-6720	tyler.fewell@wv.gov
Jason Thomas	Chemist 3	(681) 587-1172	jason.thomas@wv.gov
Keith Foreman	Micro Computer Support Specialist 2	(304) 414-1260	keith.m.foreman@wv.gov
Facility Contacts			
Jay Fedczak	EH&S Delivery Manager Union Carbide Corporation (UCC)	(304) 747-1354	JPFedczak@dow.com
Tim Skiles	EH&S Manager, ALTIVIA Services, LLC	(304) 759-1245	tskiles@altivia.com

Field Sampling Plan Project Personnel

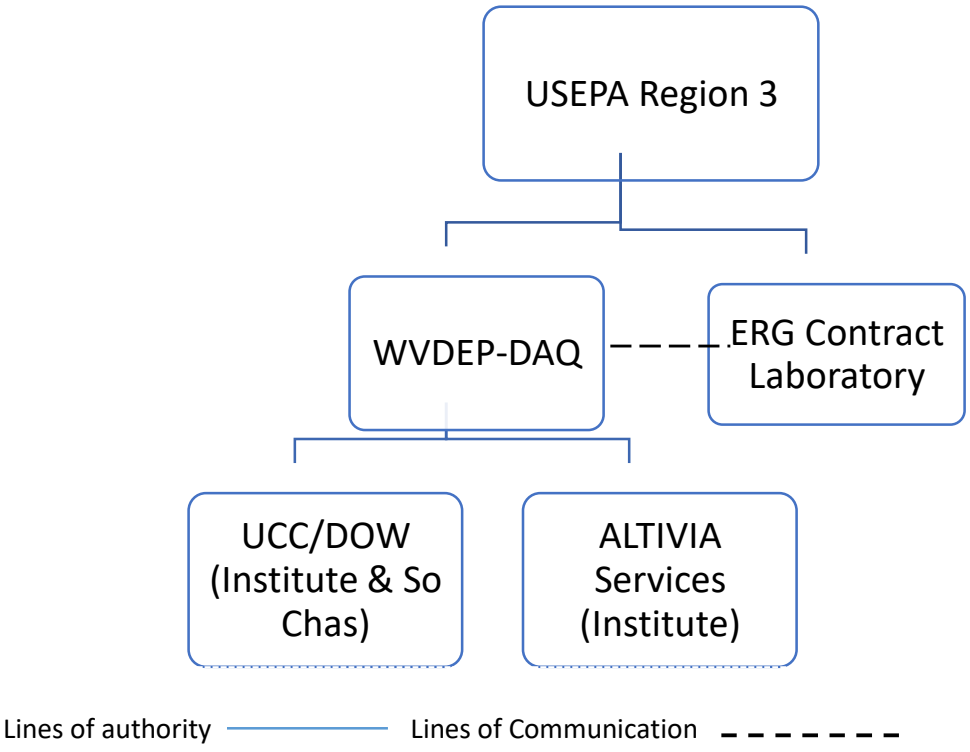
Table 3 This table identifies key project personnel for each organization performing tasks defined in this FSP.

Name	**Project Title/Role**
Alice Chow, USEPA Region 3	EPA regional liaison for project coordination
Verena Joerger, USEPA Region 3	EPA Project Quality Assurance coordinator
Howard Schmidt, USEPA Region 3	EPA Project Technical Lead
Julie Swift, ERG laboratory	ERG Laboratory program manager
Renu Chakrabarty	WVDEP DAQ coordination of state ambient sampling, FSP and QAPP updates
Mike Egnor	WVDEP DAQ air toxics coordinator and facility liaison
Mark Drake	WVDEP DAQ coordination of field sampling operations & backup operator
Tyler Fewell	WVDEP DAQ Site Operator - coordination of sampler installation and operation, field Quality Assurance, sample tracking and shipping
Jason Thomas	WVDEP DAQ sampler installation and operation at background site & backup operator; Standard Operating Procedure (SOP) author; QA review
Keith Foreman	WVDEP DAQ Quality Assurance review
Jay Fedczak	Union Carbide Corporation (UCC) facility contact
Tim Skiles	ALTIVIA Institute site contact

Project Organizational Chart

Provide a concise organizational chart for the project, including reporting relationships between all organizations involved in the project. Charts must include lines of responsibility and lines of communication.

Figure 1 Project organizational chart



Field Sampling Plan Communication Pathways

This worksheet documents specific issues (communication drivers) that will trigger the need to communicate with other project personnel or stakeholders. Its purpose is to ensure there are procedures in place for providing the appropriate notifications and generating the appropriate documentation when handling important communications.

Table 4 Communication Pathways

Communication Driver	Organization	Name	Procedure (timing, pathway, documentation, etc.)
Field/sampling issue	WVDEP-DAQ	Tyler Fewell, Jason Thomas	Notify Mark Drake & Renu Chakrabarty
Canister shipment/receiving issue/ Chain of Custody (COC)	WVDEP-DAQ	Tyler Fewell, Mark Drake	Notify ERG & Renu Chakrabarty
Site access issue at South Charleston Sampling scheduling notification	UCC/DOW	Jay Fedczak	Contact Tyler Fewell, Mark Drake, Renu Chakrabarty
Site access issue at Institute	ALTIVIA	Tim Skiles	
FSP changes prior to field work	WVDEP-DAQ	Renu Chakrabarty	Communicate with EPA R3 & ERG on any changes to the FSP
FSP changes during project execution	WVDEP-DAQ	Renu Chakrabarty	
Field equipment corrective actions	WVDEP-DAQ	Tyler Fewell, Jason Thomas, Mark Drake	Notify ERG and Renu Chakrabarty of any equipment issues
Laboratory issue	ERG	Julie Swift	Notify Renu Chakrabarty of any lab issues
Quality Assurance field issue	WVDEP-DAQ	Tyler Fewell, Mark Drake, Jason Thomas, Keith Foreman	Notify Renu Chakrabarty

Table 5 Key personnel

Title/Role	Organization	Responsibilities
Site Operator	WVDEP-DAQ	Operate & maintain air sampling site, perform quality assurance activities
Field Operations Supervisor	WVDEP-DAQ	Identify, coordinate/perform corrective actions
Laboratory Analyst	ERG	Task Lead for EtO/ERG
Laboratory Project officer	Julie Swift – ERG	Program Manager/ERG
EPA R3 Project QA and Technical Lead	Verena Joerger Howard Schmidt	Review QAPP, SOP and field sampling plans; QA review
EPA R3 point of contact	Alice Chow	Provide project review and serve as a liaison for funding between ERG contract laboratory and agency
Facility points of contact:	UCC, ALTIVIA	Site access (fenceline), sampling scheduling notification

FSP Conceptual Model

The West Virginia Department of Environmental Protection (WVDEP) Division of Air Quality (DAQ) will conduct additional short-term Ethylene Oxide (EtO) air sampling in South Charleston and Institute, West Virginia (WV) for subsequent laboratory analysis by the United States Environmental Protection Agency (EPA) national contract laboratory, to assess atmospheric concentrations. A prior Field Sampling Plan (FSP) addressed four (4) sampling sets of EtO conducted by DAQ, and which has now been completed. The purpose of this additional project is to obtain EtO sampling data in coordination with Union Carbide Corporation/DOW's own EtO summa canister monitoring being conducted at the Institute, WV and South Charleston, WV facilities per a January 18, 2022 Section 114 data request from EPA.

This additional monitoring by DAQ follows the Quality Assurance Project Plan (QAPP) associated with this project (Ethylene Oxide Monitoring Study, December 2021, Revision 0) regarding quality assurance (QA). However, there will be no short-term dispersion modeling or final report containing such with respect to this additional data. There will be a table providing the results of this additional sampling, along with the results obtained by UCC/DOW (when this data is made available).

Sampling will be conducted using a summa canister sampler. To the extent possible, the canister will be situated at an approximate breathing height (5-6 feet from the ground). Each sample will be collected over a 24-hour period. Weekly sampling over seven (7) weeks is anticipated to begin the week of May 23, 2022. Sampling will consist of four (4) canisters deployed at four locations:

- Guthrie, WV background;
- Buffalo, WV background;
- A site on the perimeter of the Institute, WV facility; and
- a site in North Charleston on the perimeter of the South Charleston, WV facility

The sampling sites near the two (2) facilities will be near sampling locations by UCC/DOW. See Appendix A for additional details on the sampling locations.

DAQ's sampler, supplied by the contract laboratory, will be equipped with an air sampling assembly consisting of a filter, sample tube, critical orifice, flow regulator and vacuum gauge. The exposed canister will be shipped to ERG Inc., for analysis by gas chromatography mass spectrometry (GC-MS).

DAQ will review the sampling results to determine any presence of EtO, and compare the results with those obtained by the company to aid in characterizing the data. The EPA will re-direct agency grant funds towards lab analyses, and provide advisory assistance in technical matters and quality review.

EPA-Required EtO Canister Sampling for UCC/DOW

EPA requested that Union Carbide Corporation/DOW perform on-site summa canister monitoring for EtO as part of an information request issued pursuant to Section 114 of the 1990 Clean Air Act Amendments. EPA's January 18, 2022 request included the Institute, WV and South Charleston, WV facilities. DAQ recently conducted short-term EtO monitoring near and around these facilities, and is conducting this additional monitoring to provide supplementary information to that being collected by the facilities.

The DAQ has identified the monitoring sites herein to provide background sampling around the facilities, as well as next to a facility sample location at the Institute and South Charleston areas. All of these sampling locations in this additional monitoring effort, were also part of the initial sampling effort.

For all samples, ERG's chain of custody sheets will be used to document sample custody. An example ERG COC can be found in the SOP. The DAQ will be solely responsible for sampler operation and sample collection. USEPA's contract laboratory, ERG Inc., will be responsible for analysis of the samples for EtO.

Project Background Sampling

A location in Guthrie, WV was chosen as a project background site where there are no known sources of EtO emissions. This location is approximately 5.25 air miles from the South Charleston facility, and approximately 7 air miles from the Institute facility.

A second project background location was chosen in Buffalo, WV where there are no known sources of EtO emissions. This location is approximately 20 air miles from the South Charleston facility, and approximately 17 air miles from the Institute facility.

Sample Scheduling

To the extent possible, sampling will occur in coordination with the sampling being conducted by UCC/DOW, while prioritizing available resources to maintain the National Ambient Air Quality Standards (NAAQS) and State or Local Air Monitoring Stations (SLAMS) statewide network.

Site Selection

The sampling locations on the perimeter of the facilities were selected to be near a location UCC/DOW plans to sample, and for ease of access.

EPA Region 3 has indicated concerns with the summa canister timers, and therefore, a manual setup and takedown will occur for this limited sampling effort. This manual operation is resource and time intensive, and site selection must consider ensuring the 24 hr ±2hr timeline is met for each sample. Timely access to the sampling locations is important to maintain data integrity.

Figure 2 shows the monitoring locations, including the project background sites in Guthrie and Buffalo West Virginia. A scale is provided, on the map, which shows an area approximately 24 miles by 16 miles. A Table in Appendix A provides details on each of the EtO monitoring sites, including location and property ownership providing access to the site. Photos of each site are also provided in Appendix A.

Figure 2 Short-term EtO monitoring locations including project background sites.

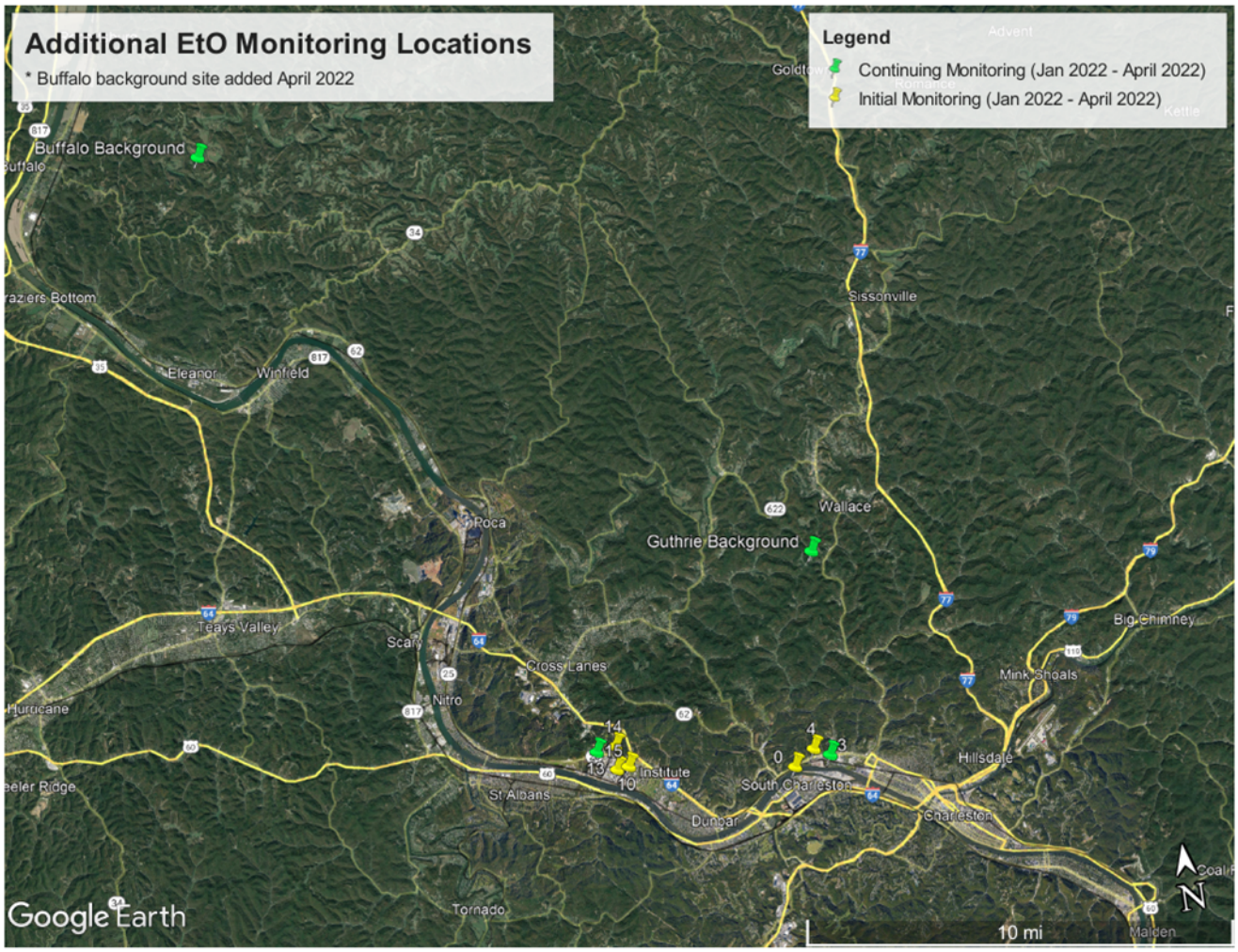


Figure 3 shows the EtO monitoring sites in South Charleston overlayed on the modeled risk isopleths from UCC's 2017 EtO emissions and 2019 meteorological data.

Figure 3 EtO monitoring sites in South Charleston shown with modeled risk isopleths based on 2017 emissions and 2019 meteorological data. Only Location 3 will be continued from January 2022 – July 2022.

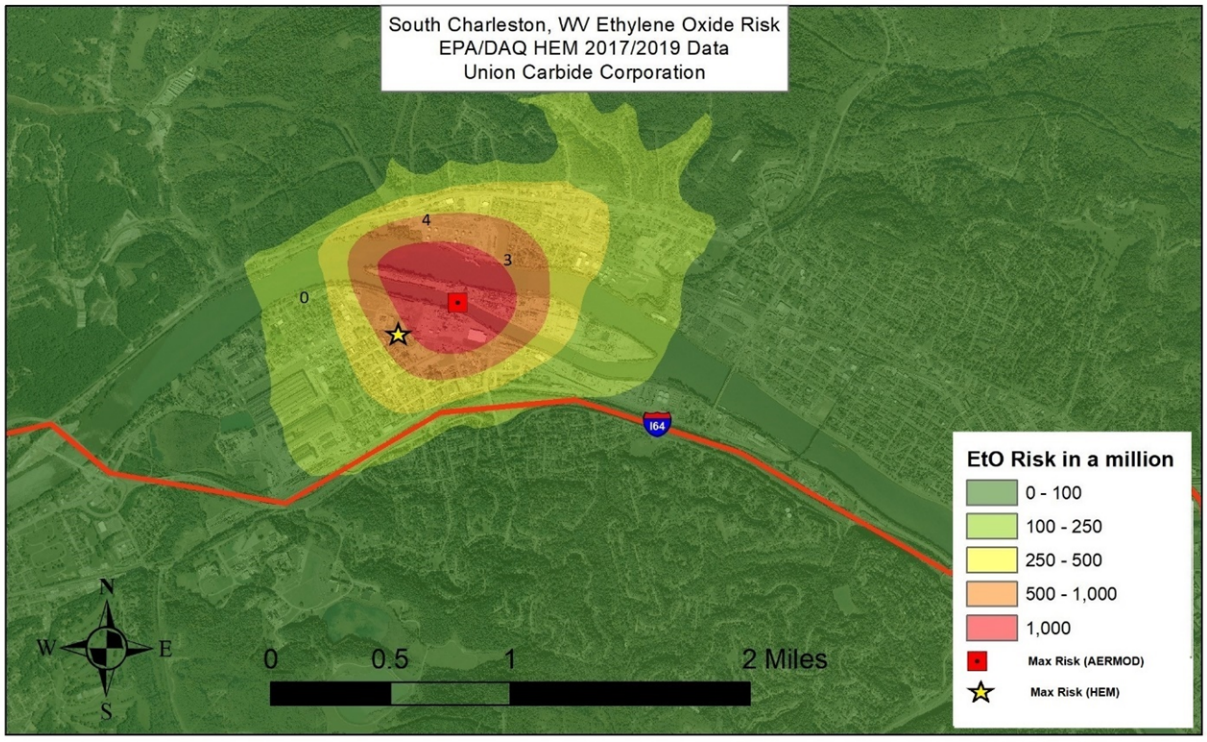


Figure 4 is a wind rose from the South Charleston facility indicating the wind generally comes *from* the North and North-Northeast at lower speeds, and higher wind speeds tend to come *from* the West-Southwest. Air dispersion modeling was performed using one year of meteorological data – the four months from the South Charleston site and the remainder of the data from the Institute site. While there are gaps in this meteorological data, it provides general information regarding this portion of the project area.

Figure 4 Wind rose from South Charleston facility.

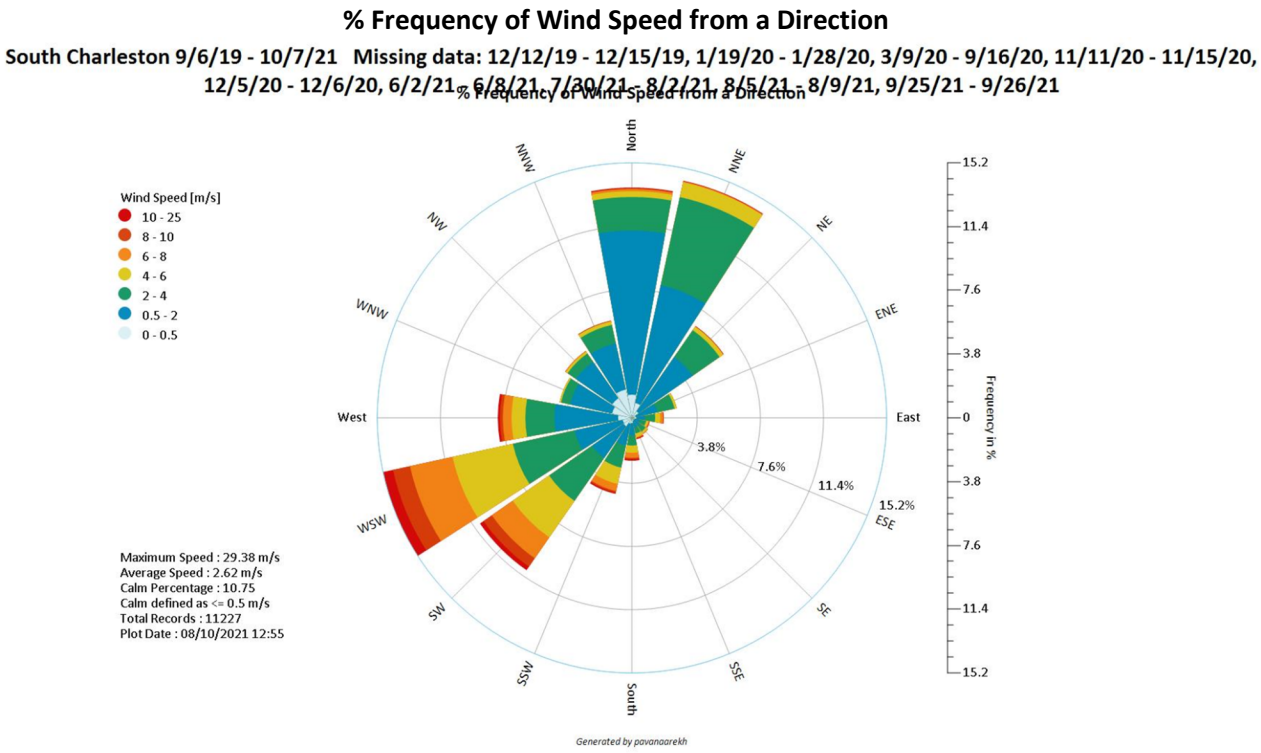


Figure 5 shows the EtO monitoring sites in Institute overlayed on the modeled risk isopleths from UCC's 2017 EtO emissions and 2019 meteorological data.

Figure 5 EtO monitoring sites in Institute shown with modeled risk isopleths based on 2017 emissions and 2019 meteorological data. Only Location 15 will be continued from January 2022 – July 2022.

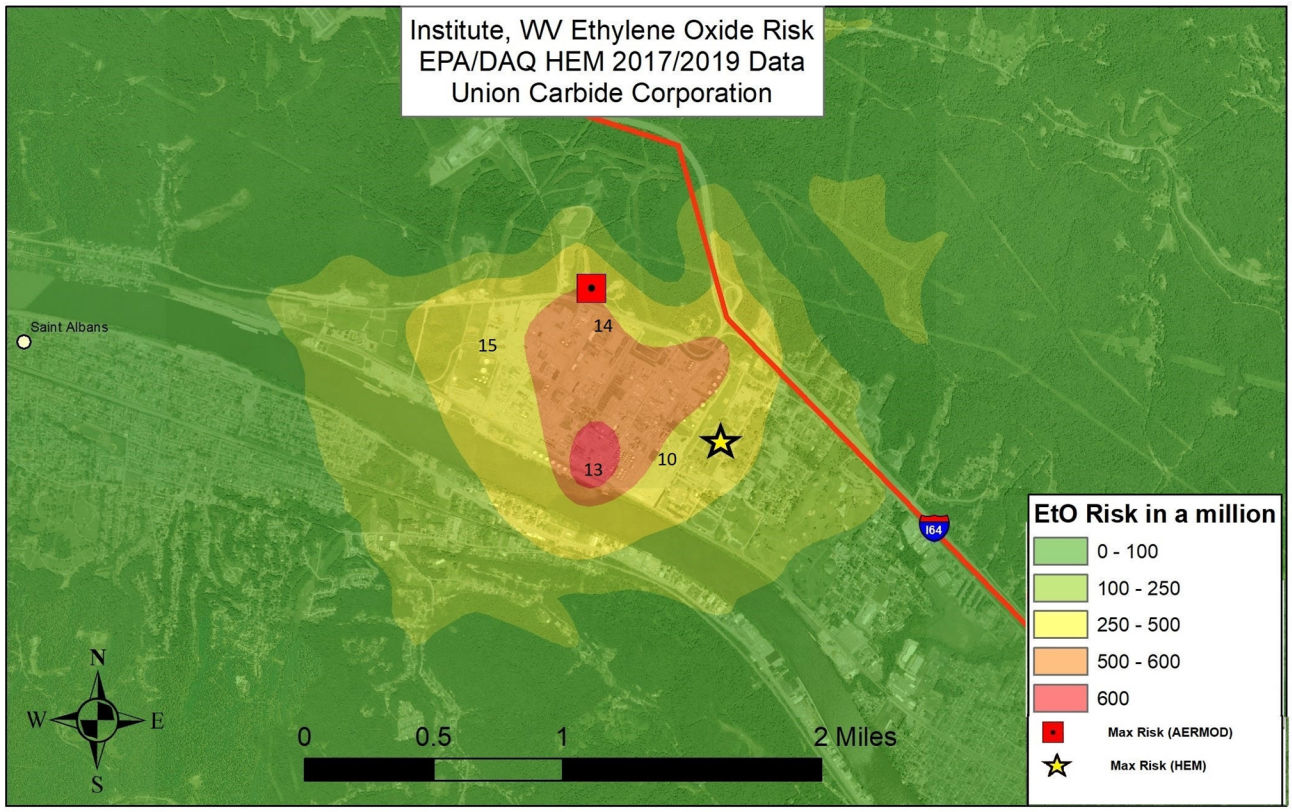
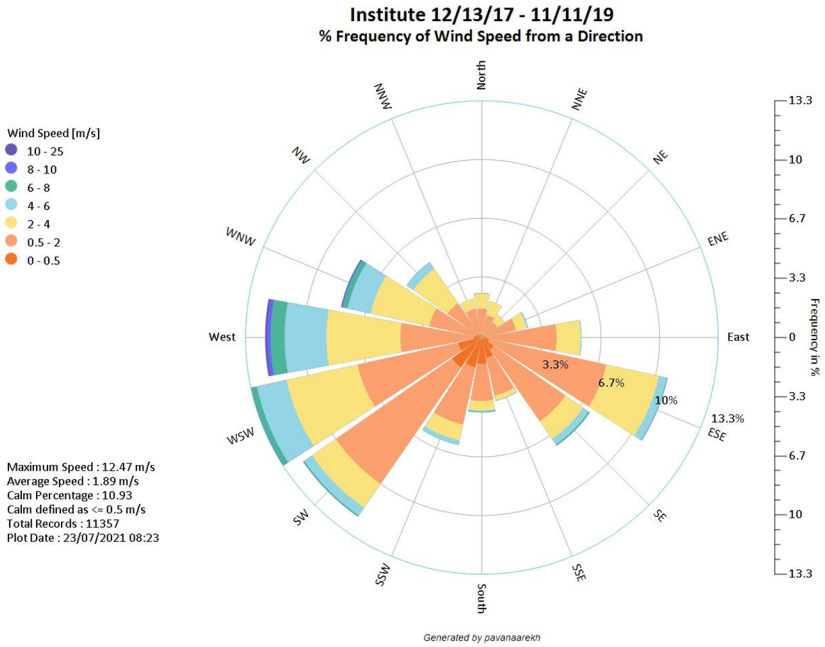


Figure 6 is a wind rose from the Institute facility indicating the majority of the wind comes *from* the westerly direction, and there is portion of the time that wind comes *from* the East-Southeast.

Figure 6 Wind rose from Institute facility.



National Ambient Concentrations and Method Detection Limit

In 2018 EPA added EtO to the suite of pollutants to be monitored at National Air Toxics Trends Stations (NATTS) sites as well as other locations. EPA established the NATTS network to obtain high-quality, long-term monitored air toxics trends data across the country. Based on data available in EPA's Air Quality System (AQS), EtO appears to be present across the county (sometimes at extremely low levels), even when no known sources of emissions are nearby. The AQS data is periodically updated, and can be obtained at https://www.epa.gov/aqs.

The EPA has established a generally acceptable threshold of 100 in one million lifetime cancer risk (NATA FAQ: https://www.epa.gov/national-air-toxics-assessment/nata-frequent-questions). One challenge in monitoring for EtO is that the method detection limit (MDL) – the lowest concentration that can be measured with confidence – is above EPA's generally acceptable lifetime cancer threshold. Reported MDLs range from 0.022 part per billion by volume (ppbv) – 0.092 ppbv, which equates to 201 – 842 excess cancer risk probability in one million over a 70 year lifetime. The currently available monitoring method cannot show that an area is exposed to a level lower than the MDL that can be achieved. ERG's EtO MDL is 0.0262 ppbv which equates to approximately 273 in one million 70 year lifetime inhalation cancer risk. The current analytical MDL is not low enough to evaluate 100 in one million risk.

Starting in 2018, EPA added a requirement that NATTS sites analyze and report EtO. Figure 7 shows the average EtO concentrations at various NATTS and non-NATTS sites across the country. While there is a range of concentrations and number of samples per site, the national average ambient concentration of EtO based on data currently available is 0.104 ppbv. Figure 8 shows national EtO concentrations in terms of excess lifetime cancer risk. Figure 8 shows that the national average excess lifetime cancer risk from EtO inhalation would be approximately 954 in one million if exposed to this concentration over a 70 year lifetime. For example, at Grayson Lake, KY, where there are no known sources of EtO emissions, the average EtO concentration of 0.111 ppbv would be equivalent to approximately 1,016 in one million cancer risk if exposure occurred at this level over a 70 year lifetime.

Figure 7 National average EtO concentrations at various locations across the US.

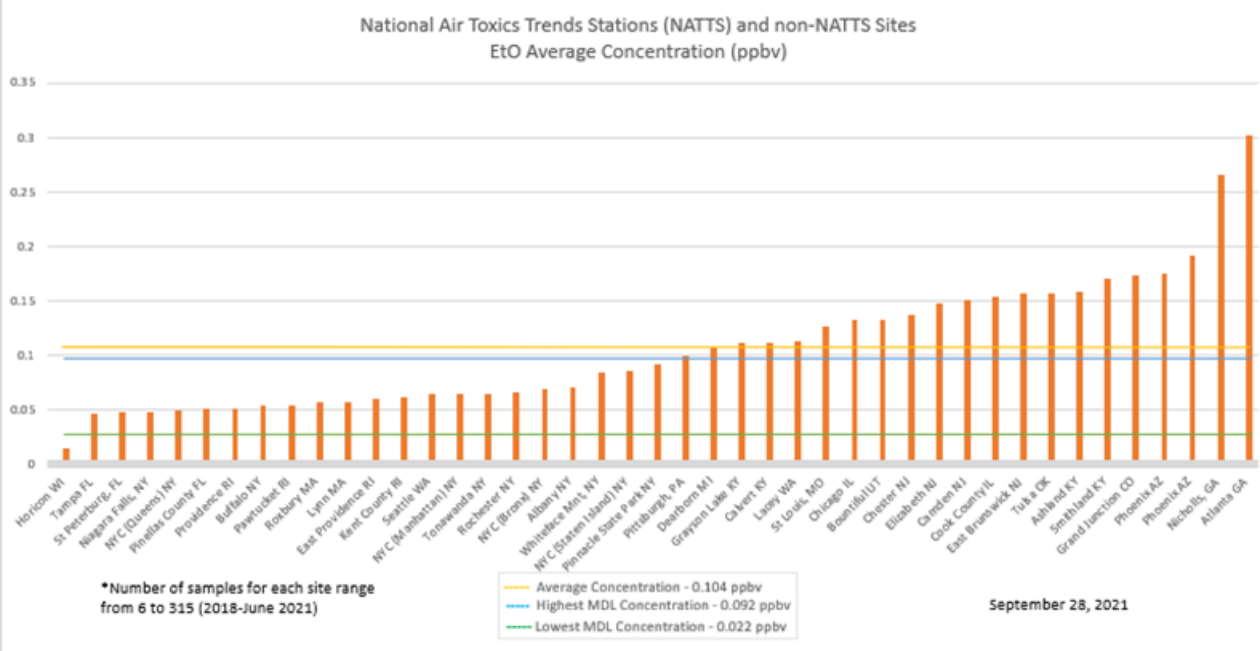
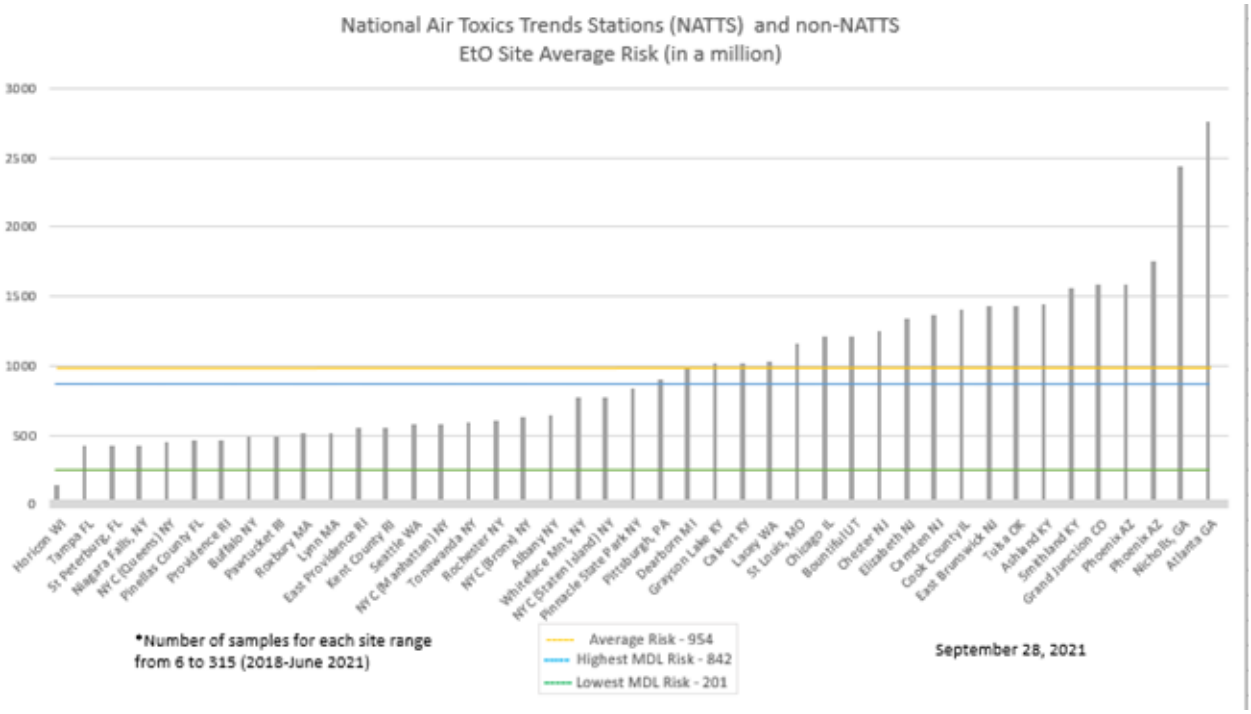


Figure 8 National average EtO excess lifetime cancer risk from inhalation at various locations across the US.



FSP Field Quality Control

The Quality Assurance/Quality Control (QA/QC) procedure for this project will meet the requirements in the Ethylene Oxide Monitoring Study QAPP; Collection of Ethylene Oxide Samples Using Passive Sampling Technique SOP; and ERG's Support for the EPA National Monitoring Programs (UATMP, NATTS, CSATAM, PAMS, and NMOC Support) QAPP, 2020. Critical elements of the FSP Field Quality Control are listed below.

Please note that this additional EtO sampling effort does not contain collocated samples or trip blanks, as was the cased for the initial sampling effort, and as included in the QAPP.

Table 6 Field quality control from the QAPP and SOP.

Parameter	Description/ Frequency	Acceptance Criteria	Corrective Action
Canister starting pressure	Each field sample	Vacuum ≥ -28 inHg or per ERG QAPP/ SOP	If criteria not met, use spare canister.
Sample leak check	Each field sample	≤1 inHg over 5 minutes or per ERG QAPP/DAQ SOP	Tighten connectors and try test again. If fails again, replace canister sampler assembly and re-test.
Final canister pressure	Each field sample	Ideally between 2 to 8 inHg. Field sample compared to ERG received sample should be < 3 in Hg per ERG QAPP	Note final pressure on COC
Sampling duration	Each field sample	24 hours ± 2 hour	Note sample duration on COC

FSP Analytical Services

Analytical Services

Laboratory Name: EPA contract laboratory Eastern Research Group, Inc. (ERG)
Laboratory Contact Name: Julie L. Swift
Analytical Instrument: Gas Chromatograph - Mass Spectrometer
Analysis Method: Compendium Method TO-15
Lab Reference QAPP: ERG-QAPP-0344-6; 2020
Data Storage Location: ERG, 601 Keystone Park Drive, Suite 700, Morrisville, NC 27560
Lab MDL: 0.0262 ppbv (approximately 273 in one million lifetime inhalation cancer risk).

Target Compound

EtO results will be reviewed to determine its presence and concentration.

EtO has both chronic cancer and noncancer inhalation health benchmarks.

EPA's Health Effects Notebook for Ethylene Oxide provides additional information on various health benchmarks from chronic and acute inhalation: https://www.epa.gov/sites/default/files/2016-09/documents/ethylene-oxide.pdf

FSP Sample Handling System and Data

This worksheet identifies components of the project-specific sample handling system. Record personnel (and their organizational affiliations) who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to laboratory delivery, to final sample disposal.

Table 7 Sample Handling and Data Management

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT		
Activity	**Personnel/Organization Responsible**	**Comment**
Canister and sampler assembly	Julie Swift ERG, Inc	
Sample Collection	Tyler Fewell, Jason Thomas, Mark Drake	24-hour samples, manual on/off
Coordination of Shipment	Mark Drake	
Type of Shipment/Carrier	Mark Drake	
Sample Chain of Custody	Julie Swift ERG, Inc	
SAMPLE RECEIPT AND ANALYSIS		
Activity	**Personnel/Organization Responsible**	**Comment**
Sample Receipt	Julie Swift ERG, Inc	
Sample Custody and Storage	Julie Swift ERG, Inc	
Sample Preparation	Julie Swift ERG, Inc	
Sample Determinative Analysis	Julie Swift ERG, Inc	
SAMPLE ARCHIVING AND DISPOSAL		
Activity	**Personnel/Organization Responsible**	**Comment**
Sample Disposal	Julie Swift ERG, Inc	Sample is consumed in analysis
DATA MANAGEMENT		
Activity	**Personnel/Organization Responsible**	**Comment**
Data Package	Julie Swift ERG, Inc	Excel and PDF file

Appendix A – Monitoring Site Photos

Monitoring Site Photos

The table below provides details on each of the EtO monitoring sites for this project, including location and property ownership providing access to the site.

EtO additional monitoring location details (January 2022 – July 2022) *

ID Tag	Area	Latitute	Longitude	Onsite	Fenceline	Property Owner	Nominal Location
-	Guthrie Background	38.4425	-81.680556	Yes	No	State of WV	367 Gus Douglas Lane, Charleston
3	South/North Charleston	38.373236	-81.685719	No	Yes	UCC	33rd Street W Blaine Blvd Charleston
15	Institute	38.386078	-81.785634	No	Yes	Altivia	1 road west of Malcolm Lane, Rt 25 Institute
16	Buffalo Background *			Yes	No	Private Property	Buffalo, WV
* Buffalo Background site added April 2022							

Overview of Project Background – Guthrie, WV area

Project Background - Guthrie

This site is located at the WV Department of Agriculture Guthrie Complex. It is gated and electronically accessible. The summa canister is anticipated to be situated within the lowest cross-sectional support, and secured with a chain and combination lock. There are no known sources of EtO air emissions nearby. Sampling at this site started in January 2022.

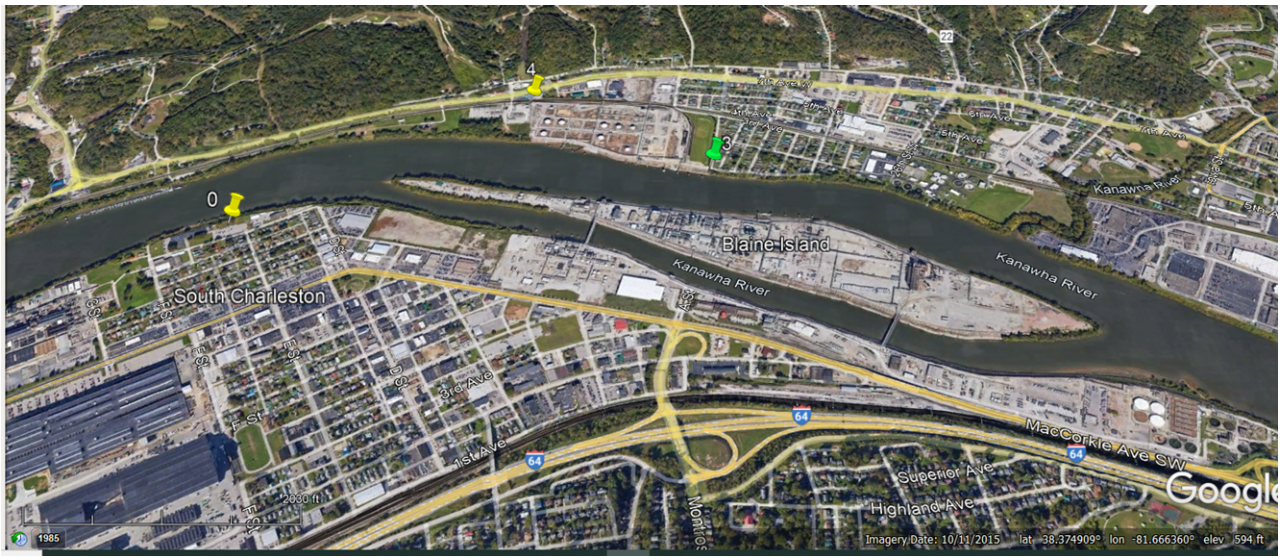
Overview of Project Background – Buffalo, WV area

Project Background - Buffalo

This site is located at a rural family farm in the Buffalo, WV area. The property is gated. The summa canister is attached on a hook to the pole, and secured with bungee cord. There are no known sources of EtO air emissions nearby. Sampling at this site started in April 2022.

Overview of South Charleston Area

Additional sampling from January 2022 – July 2022 will continue for site location 3 (green pin). The other locations marked (yellow pins) were sampled from January 2022 – April 2022.



South Charleston Area – ID Tag 3

This site is located outside of the facility, along the fenceline, of the North Charleston operations side of the UCC facility. The canister will be secured with a chain and combination lock.

Overview of Institute Area

Additional sampling from January 2022 – July 2022 will continue for site location 15 (green pin). The other locations marked (yellow pins) were sampled from January 2022 – April 2022.

Institute Area – ID Tag 15

This site is located outside of the facility, along the fenceline, of the Institute facility. The canister will be secured with a chain and combination lock.