

Ethylene Oxide Monitoring - Characterization of South Charleston and Institute, West Virginia and Surrounding Areas

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WV DAQ EtO Monitoring Study

- Background
- Purpose
- Sampling
- Facility Emissions
- Monitoring Results
- National Comparison
- Challenges
- Monitoring Event Modeling
- Conclusions
- Recommendations



Background

- 2016 – EPA revised the toxicity value for Ethylene Oxide (EtO) and changed its classification
- 2018 – EPA released the National Air Toxics Assessment (NATA)
 - Based on 2014 data
 - Used new toxicity value for EtO
- 4 census tracts in West Virginia (WV) were identified as having estimated risk levels above 100 in a million for cancer risk



Background

Institute

- Union Carbide Corporation
- Specialty Products US, LLC

South Charleston

- Union Carbide Corporation
- Covestro LLC



Background

- After release of 2018 NATA, WVDEP immediately requested the state Department of Health and Human Resources (DHHR) Bureau of Public Health (BPH) to review rates of cancers associated with EtO in the Kanawha Valley
 - No elevated levels of breast, lymphoma, or leukemia cancers found for Kanawha County as a whole
 - Kanawha County is not significantly higher than other counties in the state



Background

In 2019:

- Visited facilities and requested most recent and accurate emissions data and onsite weather data
- Used updated information for modeling, which changed the locations and level of risk
- Issued press release identifying the elevated risk factor of EtO (December)

Jan. 2020:

- Formally requested EPA to prioritize the review of 40 CFR 63 Subpart PPP (Polyethers Polyols Production)



Purpose

- The purpose of the short-term monitoring project was to determine the presence of EtO in the Institute and South Charleston areas
- The project was NOT used to assess long term risk



Sampling

- DAQ used the most recent modeling data to determine the locations of the monitors
- DAQ developed a Standard Operating Plan (SOP) and an EPA-approved Quality Assurance Project Plan (QAPP) and Field Sampling Plan (FSP) for this project
- EPA provided grant funding for this project
- DAQ placed monitors in seven locations (plus background) for four 24-hour sampling events
- DAQ coordinated with the four facilities to operate at their maximum production levels during the events
- DAQ requested information on the amounts and locations of the emissions for each facility

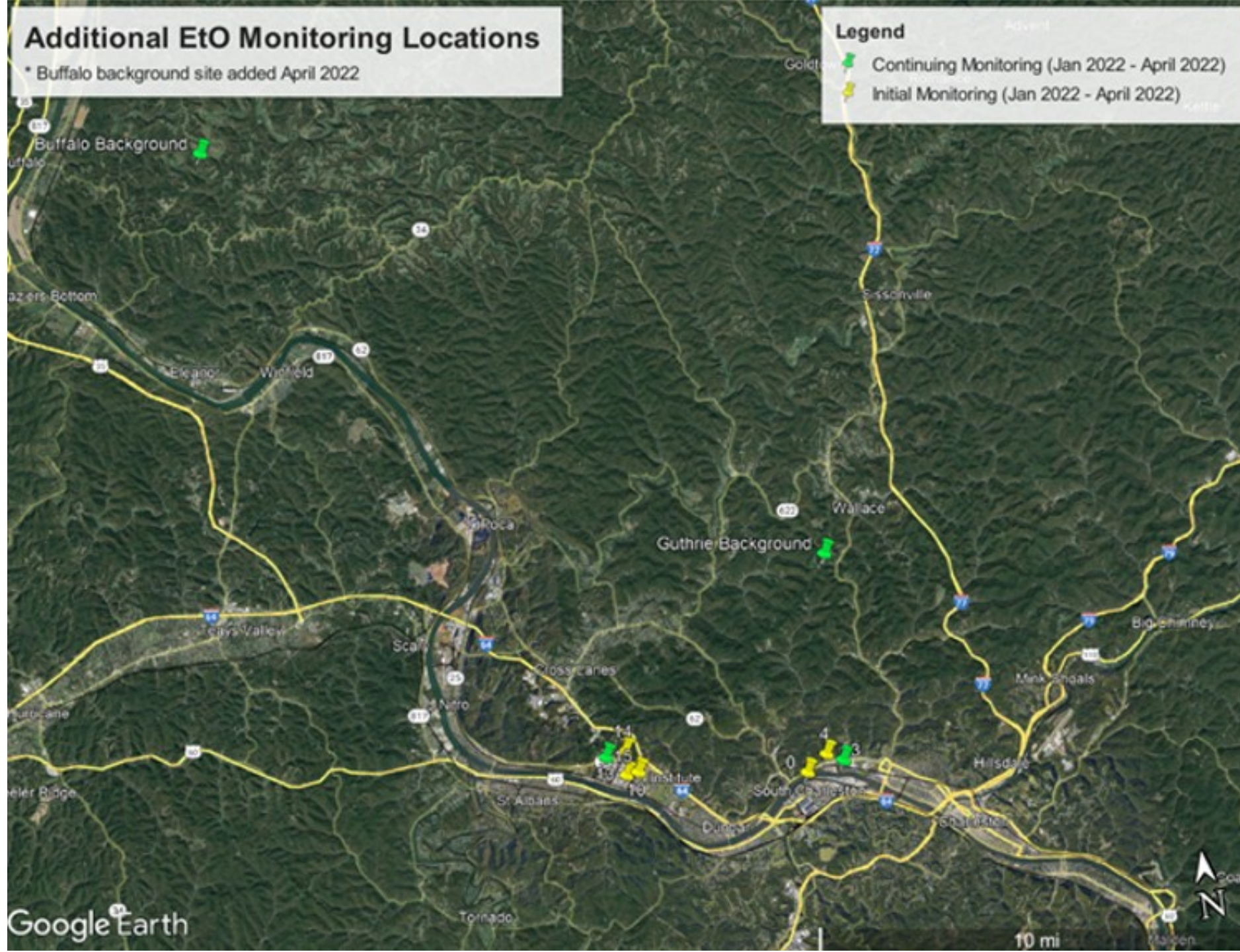


Additional EtO Monitoring Locations

* Buffalo background site added April 2022

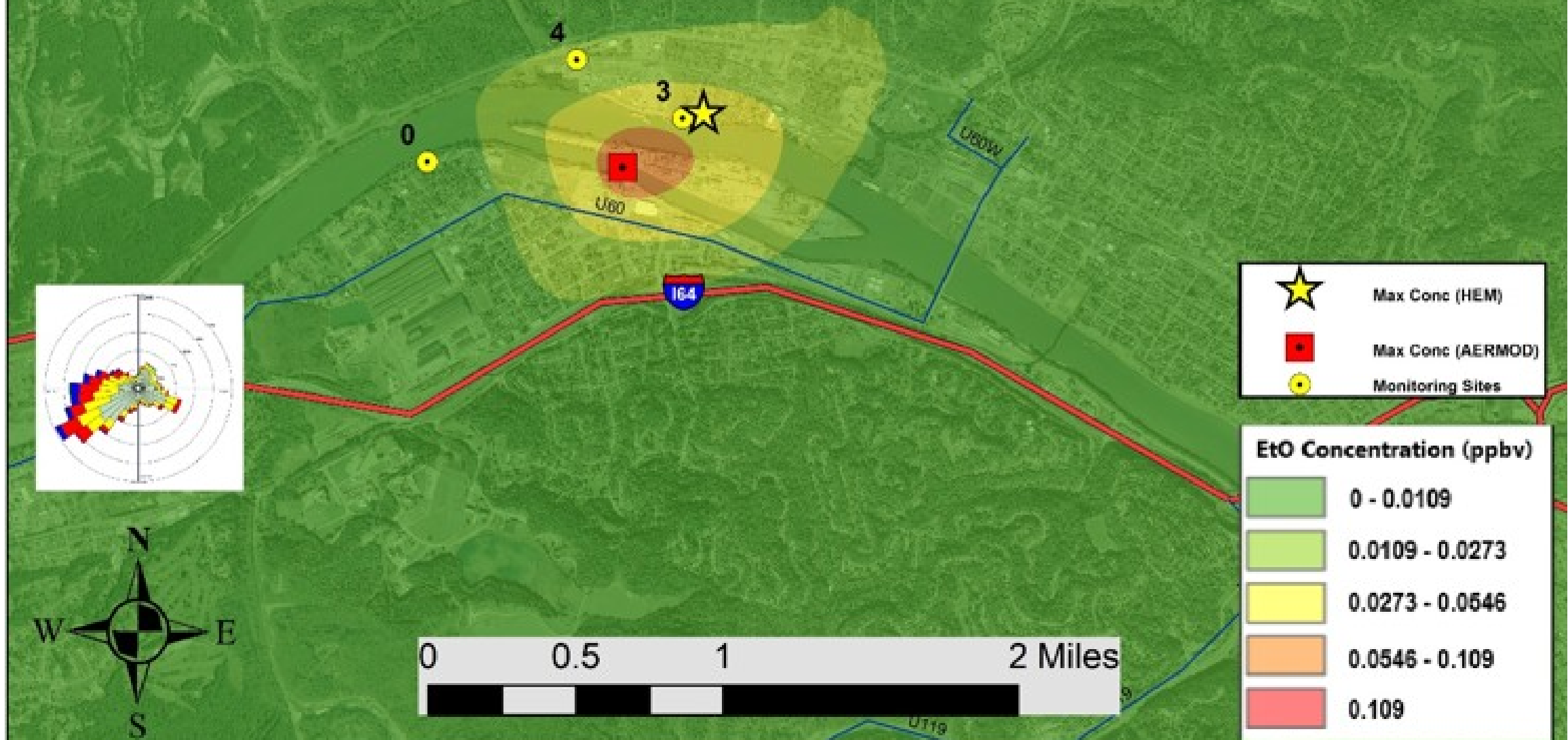
Legend

- Continuing Monitoring (Jan 2022 - April 2022)
- Initial Monitoring (Jan 2022 - April 2022)



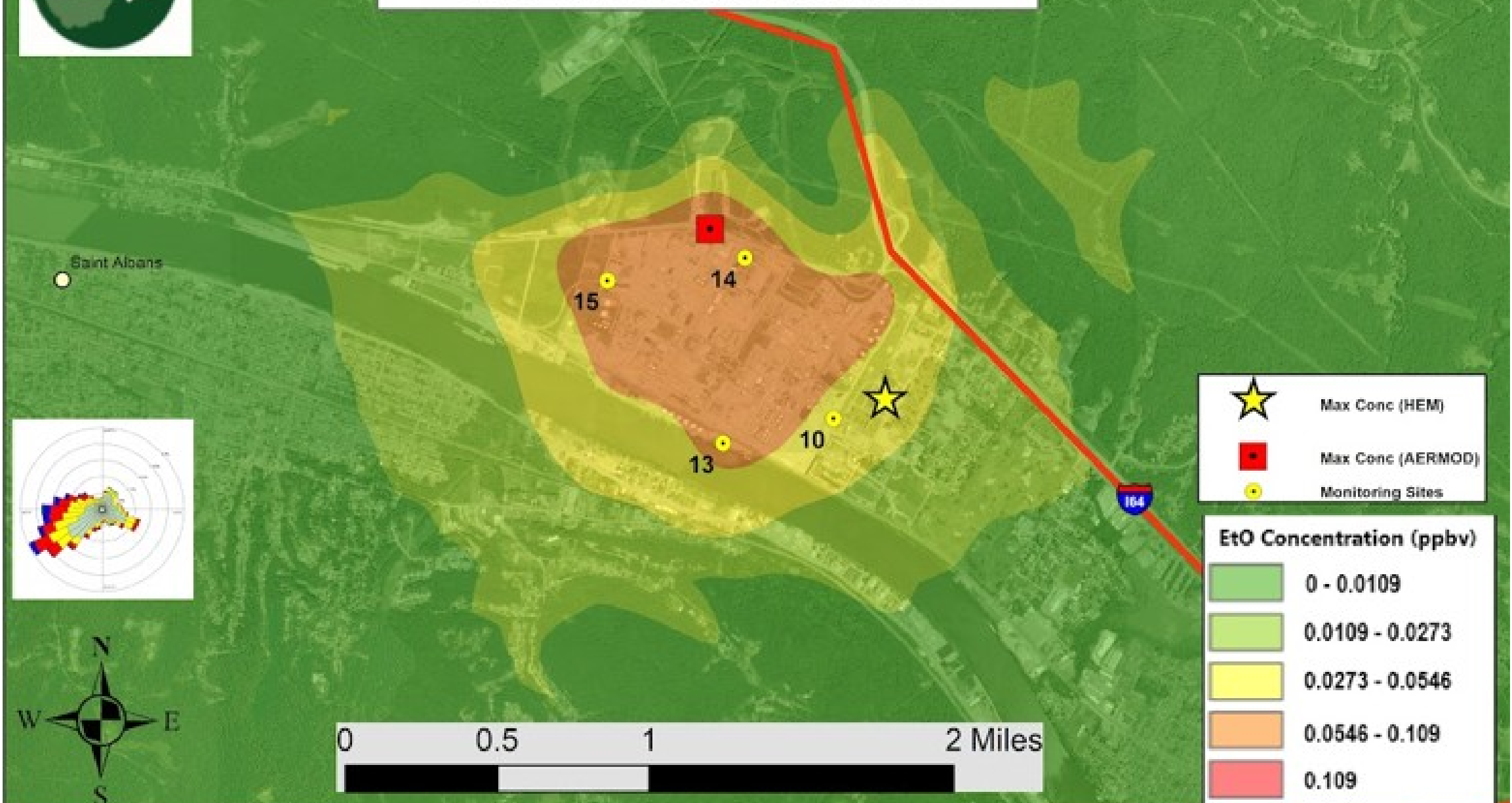


South Charleston, WV Ethylene Oxide Risk
WVDAQ 2020 Emissions - 2019 Meteorology
Union Carbide Corporation plus Covestro



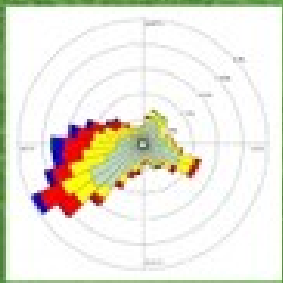
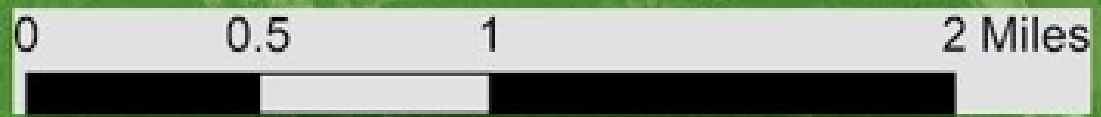
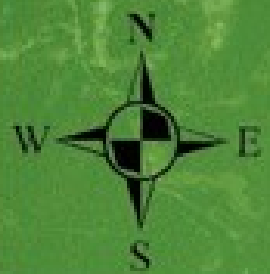


Institute, WV Ethylene Oxide Risk
WVDAQ 2020 Emissions - 2019 Meteorology
Union Carbide Corporation plus IFF



	Max Conc (HEM)
	Max Conc (AERMOD)
	Monitoring Sites

EtO Concentration (ppbv)	
	0 - 0.0109
	0.0109 - 0.0273
	0.0273 - 0.0546
	0.0546 - 0.109
	0.109



Saint Albans

Facility Emissions

- DAQ coordinated with the four facilities to operate at their maximum production levels during the events
- DAQ requested information on the amounts and locations of the emissions for each facility



Facility	First Sampling Event	Second Sampling Event	Third Sampling Event	Fourth Sampling Event
	January 25-26, 2022	February 15-16, 2022	March 23-24, 2022	April 25-26, 2022**
	Emissions (pounds)	Emissions (pounds)	Emissions (pounds)	Emissions (pounds)
UCC SC	0.5242	1.9896	2.404	0.756
Covestro SC	0.3690	0.429	0.379	0.369
South Charleston Total	0.8932	2.419	2.783	1.125
UCC Institute	2.0056	2.3363	2.4316	2.3762
Specialty Products Institute	4.2988	4.4887	5.0621	0.0929*
Institute Total	6.3044	6.8250	7.4937	2.4691

* Production was down. Only fugitive emissions were reported

** The South Charleston emissions were for April 26-27 due to a different sampling day



Monitoring Results

- DAQ used Eastern Research Group (ERG) to analyze the results
- The canisters were deployed by DAQ and mailed to ERG



Ethylene Oxide Monitoring Results

Sample Location	Jan. 25-26, 2022	Feb. 15-16, 2022	March 23-24, 2022	April 25-26, 2022***
	Results (ppbv)*	Results (ppbv)*	Results (ppbv)*	Results (ppbv)*
Guthrie Background **	0.0361	0.0884	0.0321	0.271
#0 South Charleston, WV	Nondetect	Not exposed	0.08	0.146
#3 North Charleston, WV	0.0165	0.0227	0.155	0.221
#4 North Charleston, WV	0.0121	0.088	0.0794	0.277
#10 Institute, WV	0.0821	0.0996	0.182	0.674
#13 Institute, WV	0.0375	0.204	0.0714 (co-located)	0.124
#14 Institute, WV	0.0376	0.0958	0.119	0.514
#15 Institute, WV	0.0505	1.3	0.447	0.183
#16 Buffalo, WV Background**	N/A	N/A	N/A	0.365

* Concentrations measured in parts per billion by volume (ppbv)

** Background site: This is an area with no known emitters of Ethylene Oxide

*** April 26-27, 2022 for #0 South Charleston, #3 North Charleston and #4 North Charleston

Method Detection Level (MDL) for the January through March sampling = 0.0261 ppb

Method Detection Level (MDL) for the June sampling = 0.048 ppb

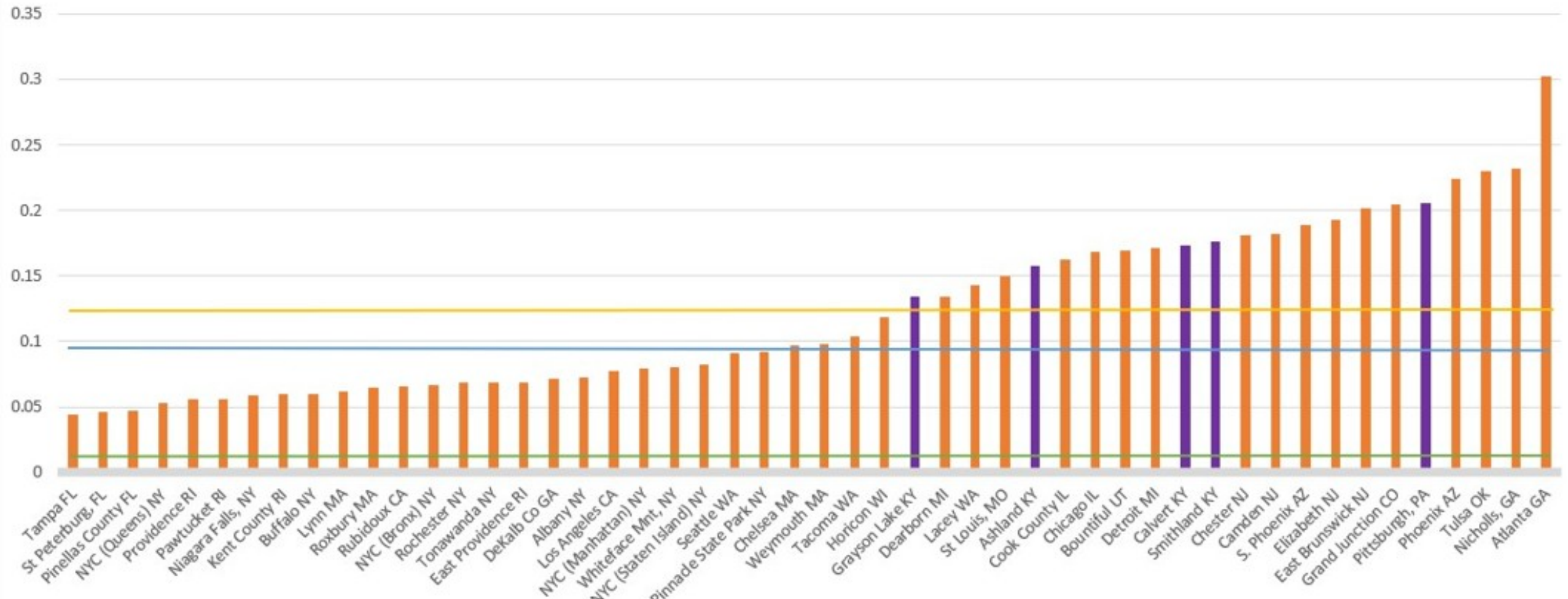
MDL is the minimum concentration of a substance that can be measured and reported with 99% confidence that the concentration is greater than zero.

National Comparison

- DAQ looked at monitors across the country to look at average concentrations of EtO
- These include areas with no known sources of EtO



National Air Toxics Trends Stations (NATTS) and non-NATTS Sites EtO Average Concentration (ppbv) non-zeros



*Number of samples for each site range from 6 to 437 (2018-November 2021)

— Average Concentration - 0.122 ppbv
— Highest MDL Concentration - 0.092 ppbv
— Lowest MDL Concentration - 0.008 ppbv

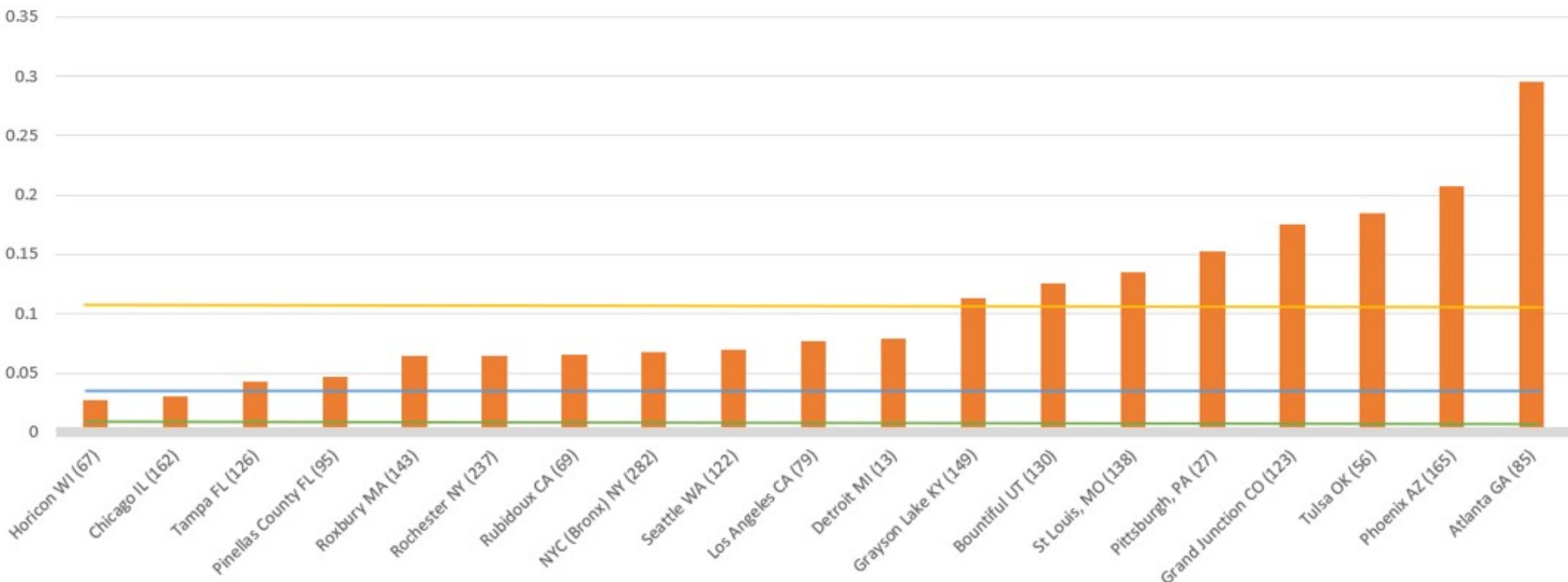
● Neighboring States

National Comparison

- During discussions with DAQ staff, EPA questioned the accuracy of the previous graphs for the following reasons:
 - The non-NATTS sites may not use EPA approved QAPPS
 - Chemists may use zeros to report levels below the MDL
 - Not including zeros in the average acknowledges possible concentrations below method of detection
 - The number of samples at some of the non-NATTS sites were extremely low
- To account for these issues, the non-NATTS sites were removed, zeros were added in the averaging, and the number of samples for each of the NATTS sites are identified



National Air Toxics Trends Stations (NATTS) EtO Average Concentration (ppbv)



() - Number of samples for each site
(2018-November 2021)

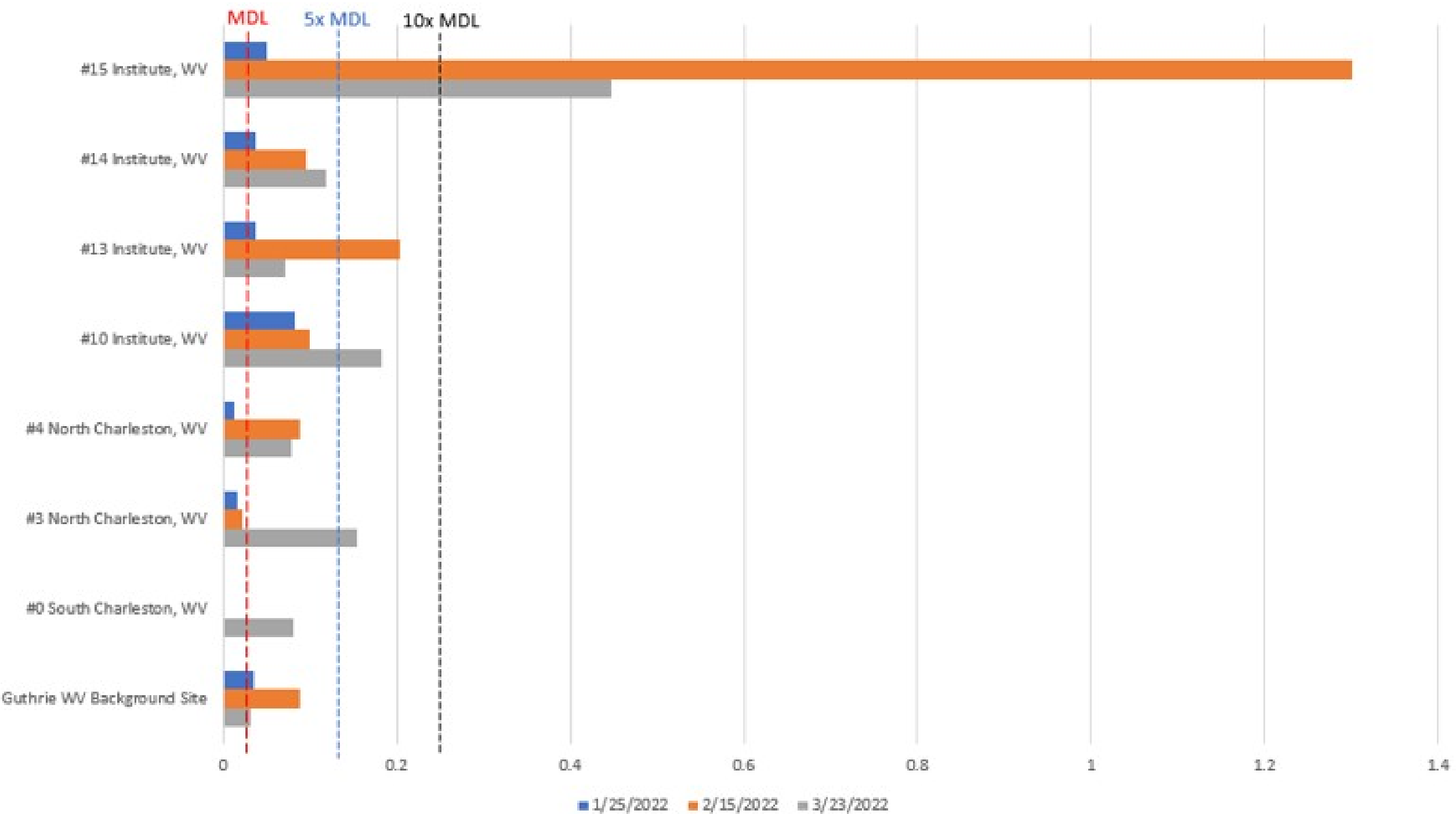
— Average Concentration - 0.107 ppbv
— Highest Current MDL Concentration - 0.034 ppbv
— Lowest Current MDL Concentration - 0.008 ppbv

May 27, 2022

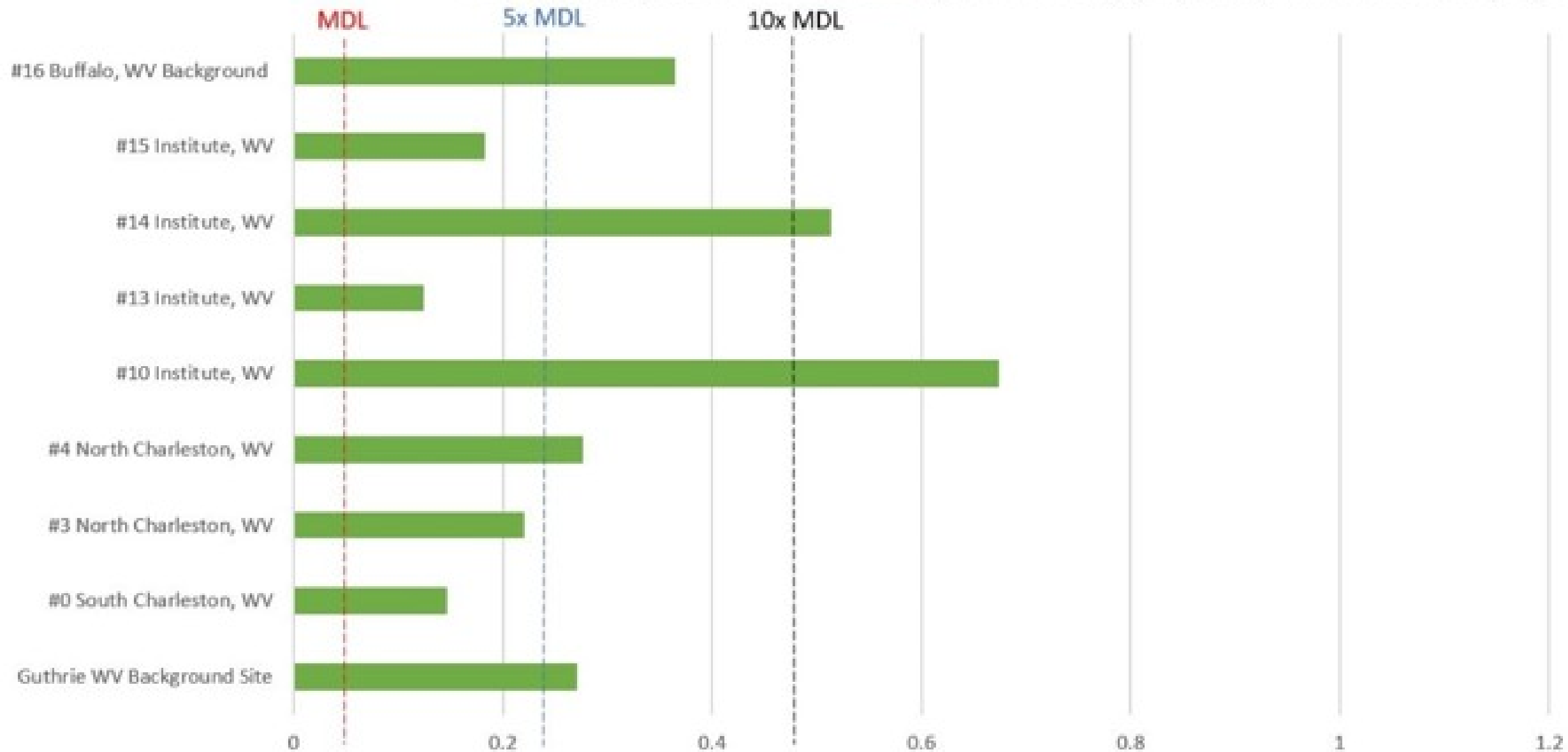
Challenges

- Method Detection Limit
 - The NATTS Technical Assistance Document (TAD) establishes a 5 times MDL for precision used to characterize data quality
- Canister Effect
 - Canisters could have positive measurement bias due to the type of canister lining and cleaning methods
- Interference
 - Certain chemicals including methanol could be mistaken for EtO
- Air Sampling Assembly Cleaning
 - DAQ did not clean the assemblies in between sampling





Kanawha Valley EtO Results **MDL 0.048** (24 hour PPBV) 4/25/2022 (North Charleston 4/26/2022)



Monitoring Event

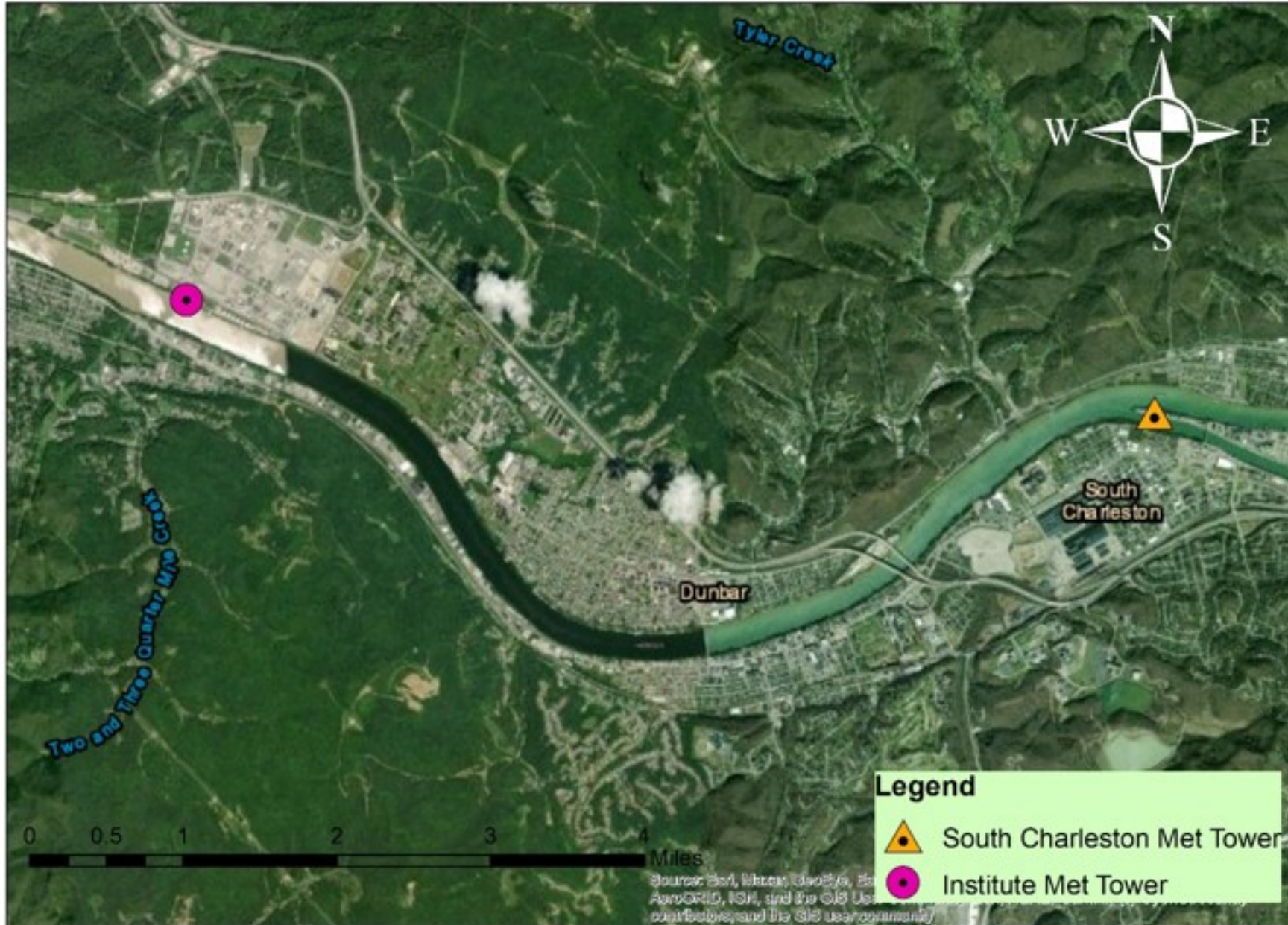
Modeling

- DAQ performed air modeling for each of the 24-hour monitoring events in order to compare the results
- EPA-recommended AERMOD was used for the model
 - On-site meteorological towers were used
 - The amounts and locations of the emissions from the four facilities were used





West Virginia Ethylene Oxide Modeling Onsite Met Tower Locations





Monitoring Event

Modeling

January 2022 Monitoring Event Modeling Results and Comparison to Monitor Values
(Paired in Space and Time)

ID Tag	Area	Modeled Max Results (ppb)	Monitoring Results (ppb)	Percent Difference
Project Background	Guthrie	0.00001	0.0361	199.9
0	SC	0.01975	NonDetect	N/A
3	SC	0.02186	0.0165	27.9
4	SC	0.01142	0.0121	5.8
10	I	0.27439	0.0821	107.9
13	I	0.09127	0.0375	83.5
14	I	0.11176	0.0376	99.3
15	I	0.04484	0.0505	11.9



Monitoring Event

February 2022 Monitoring Event Modeling Results and Comparison to Monitor Values (Paired in Space and Time)

ID Tag	Area	Modeled Max Results (ppb)	Monitoring Results (ppb)	Percent Difference
Project Background	Guthrie	0.00062	0.0884	197.2
0	SC	0.01696	VOID	N/A
3	SC	0.01420	0.0227	46.1
4	SC	0.02132	0.0880	122.0
10	I	0.08315	0.0996	18.0
13	I	0.35646	0.2040	54.4
14	I	0.06410	0.0958	39.6
15	I	0.35205	1.3000	114.8



Monitoring Event

Modeling

March 2022 Monitoring Event Modeling Results and Comparison to Monitor Values
(Paired in Space and Time)

ID Tag	Area	Modeled Max Results (ppb)	Monitoring Results (ppb)	Percent Difference
Project Background	Guthrie	0.00068	0.0321	191.7
0	SC	0.03445	0.0800	79.6
3	SC	0.08091	0.1550	62.8
4	SC	0.05202	0.0794	41.7
10	I	0.19290	0.1820	5.8
13	I	0.18192	0.0714	87.3
14	I	0.39799	0.1190	107.9
15	I	0.31781	0.4470	33.8



Monitoring Event

Modeling

April 2022 Monitoring Event Modeling Results and Comparison to Monitor Values
(Paired in Space and Time)

ID Tag	Area	Modeled Max Results (ppb)	Monitoring Results (ppb)	Percent Difference
Project Background	Guthrie	0.00007	0.2710	199.9
0	SC	0.00186	0.1460	195.0
3	SC	0.00951	0.2210	183.5
4	SC	0.00374	0.2770	194.7
10	I	0.07890	0.6740	158.1
13	I	0.02942	0.1240	123.3
14	I	0.09148	0.5140	139.6
15	I	0.08292	0.1830	75.3
Project Background	Buffalo	0.00016	0.3650	199.8



Conclusions

- Monitoring showed detectable levels of EtO at all locations sampled
- In several cases, background locations had higher EtO concentrations than fenceline and on-site
- Long term EPA approved modeling is the better tool to determine concentrations of EtO
- The western end of Institute showed relatively higher concentrations than the other locations



Recommendations

- WV DAQ recommends EPA to do the following:
 - Continue to develop monitoring methods with lower detection limits
 - Test to identify and if found quantify potentially naturally occurring EtO sources
 - Use long-term dispersion modeling in future rulemaking



Recommendations

- WV DAQ recommends the EtO emitting facilities in Institute and South Charleston areas do the following:
 - Work with DAQ and EPA to develop a fenceline monitoring project to obtain greater accuracy
 - Reduce potential long-term risk by reducing emissions which includes performing enhanced Leak Detection And Repair (LDAR)
 - Reduce their Potential to Emit (PTE)
 - UCC Institute to inspect rail cars as they come onsite



Collaborative Agreement

- A Collaborative Agreement was signed January 18, 2023 between the Director of the Division of Air Quality and Union Carbide Corporation (UCC) Institute
- Meetings are set up with Specialty Products US, LLC in Institute and Covestro LLC in South Charleston to discuss enforceable, voluntary reductions in both actual and potential EtO emissions
- These facilities are currently in compliance with state and federal air regulations applicable to EtO



UCC Institute Collaborative Agreement

- The Collaborative Agreement is governed by the existing enforcement and penalty provisions of West Virginia's environmental protection law (Chapter 22, Article 5, Section et seq.)
- The Collaborative Agreement represents unique site-specific enforceable commitments that were designed by the parties to specifically respond to local community comments about UCC Institute as it relates to EtO emissions



UCC Institute Collaborative Agreement

- UCC Institute has agreed to work with the DEP to modify its EtO emissions limitations to reflect its current business plan(s)

Emissions Summary

Logistics (Group 2 of 2) Emissions Summary [Tons per Year]		
Regulated Pollutants	Facility-Wide Potential Emissions	2021 Facility-Wide Actual Emissions
Carbon Monoxide (CO)	10.66	5.19
Nitrogen Oxides (NOx)	40.10	4.80
Particulate Matter (PM _{2.5})	6.27	0.53
Particulate Matter (PM ₁₀)	6.27	0.53
Total Particulate Matter (TSP)	6.27	0.53
Sulfur Dioxide (SO ₂)	1.21	<0.01
Volatile Organic Compounds (VOC)	24.38	6.64

PM₁₀ is a component of TSP.

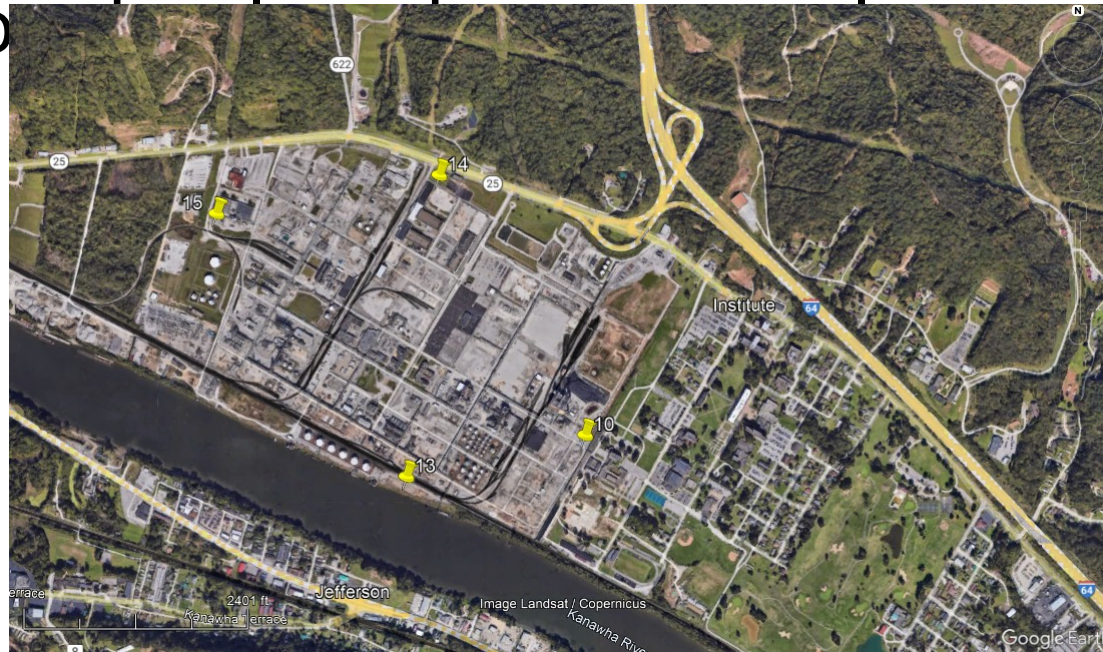
Hazardous Air Pollutants	Facility-Wide Potential Emissions	2021 Facility-Wide Actual Emissions
Ethylene Oxide	3.00	0.41
Ethylene Glycol	<1	0.12
Total HAPs	5.00	0.53

Some of the above HAPs may be counted as PM or VOCs.



UCC Institute Collaborative Agreement

- UCC Institute has agreed to develop and implement a unique site-specific EtO emissions screening program for rail cars it has in EtO service. Each rail car shall be screened for EtO emissions within twelve (12) hours of arriving at the facility. Upon a reading indicating potential rail car emissions, appropriate action will be initiated based on



UCC Institute Collaborative Agreement

- UCC Institute has agreed to formalize its action threshold program for EtO fugitives, in addition to maintaining compliance with the federal LDAR program. For readings above the action thresholds of 10 ppm, an attempt at repair will be made, after which re-

Component Type	Frequency	Leak Definition
Agitator	Monthly	10,000 ppm
Connector - NTM*	Annual	500 ppm
Connector DTM**	Annual	500 ppm
Pump	Monthly	1,000 ppm
Relief	Monitored After Release	500 ppm
Valve - NTM*	Quarterly	500 ppm
Valve - DTM**	Annual	500 ppm
* NTM - Normal to Monitor		
** DTM - Difficult to Monitor		



UCC Institute Collaborative

Agreement

- UCC Institute has agreed to continue its ongoing cooperation with the U.S. EPA and the DAQ by providing in-kind or other tangible resources to assist with the development of air quality related data collection, air quality modeling, development of fenceline monitoring protocols concerning EtO, to include securing meteorological data related to such research



Resources & Contact

- The WVDEP has a webpage dedicated to EtO:
<https://dep.wv.gov/daq/Air%20Toxics/EthyleneOxide/Pages/default.aspx>
- Learn more about WVDEP actions to address EtO
- View past presentations and materials
- Sign up for EtO mailing list

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