From: McGill, Richard
To: Brown, Don
Cc: Fox, Tim; Pauley, Daniel
Subject: docket as PC in R20-18; FW: Stop EtO"s Response
Date: Wednesday, December 30, 2020 12:16:01 PM
Attachments: US EPA IL EPA Presentation Apr 2 - StopEtO - V2A .pdf

Good afternoon, Mr. Clerk:

Please docket—as a public comment in R20-18—these forwarded email exchanges, including the attached PDF.

Thank you.

Richard R. McGill, Jr.
Illinois Pollution Control Board
Senior Attorney for Research & Writing
richard.mcgill@illinois.gov
(312) 814-6983

From: Eastvold, Jonathan C. <JonathanE@ilga.gov>
Sent: Wednesday, December 30, 2020 10:20 AM
To: Bloomberg, David E. <David.Bloomberg@Illinois.gov>; Vetterhoffer, Dana <Dana.Vetterhoffer@Illinois.gov>; McGill, Richard <Richard.McGill@illinois.gov>
Cc: j_aldrin@yahoo.com; Stop EtO in Lake County Team <stopetoinlakecounty@gmail.com>
Subject: [External] FW: Stop EtO's Response

Dear Colleagues:

I received the following reply from Stop EtO. I'm especially interested in your answers to the following questions:

1. What is your response to Stop EtO's argument concerning the limitations of the AERMOD model?
2. Why was St. Anthony's Hospital in Alton missing from the list of EtO sources furnished by EPA at the 6/25 hearing? Is it no longer emitting EtO?
3. Given the controversy over 3 of the testing sites, is there a reason not to switch to less controversial locations?

Thanks so much.

Sincerely,

Jonathan C. Eastvold, Ph.D.
Rules Analyst III

Illinois General Assembly
Joint Committee on Administrative Rules
700 Stratton Building
Springfield IL 62706

During the COVID-19 emergency, please call or text my mobile at 217-816-9481
JonathanE@ilga.gov

From: Stop EtO in Lake County Team [mailto:stopetoinlakecounty@gmail.com]
Sent: Monday, December 28, 2020 11:04 PM
To: Eastvold, Jonathan C. <JonathanE@ilga.gov>; Jcar Public <Jcar@ilga.gov>
Cc: John Aldrin <j_aldrin@yahoo.com>
Subject: Stop EtO's Response

Dear Jonathan,

Thanks for sharing your concerns on this important issue for our community.

For many, many months, we have struggled to get people to pay attention to testing data and model results. For reference, attached is a talk we gave to US EPA Region 5 and IL EPA scientist/engineers in April 2020 with the goal of trying to pinpoint key observations regarding background levels and model discrepancies.

From our perspective, once you get beyond 0.5 mile or more, the AERMOD model greatly underestimates the impact of EtO around these facilities. Also of concern, the Northbrook and Schiller Park sites are only a short 3.5 to 4.7 miles distance from EtO emitters. In Georgia, testing was conducted at further distances around EtO facilities and we have regularly seen high readings within 2 miles, and one high reading up to 6 miles from the BD Covington plant. (Note - that was in a location directly downwind of the facility that day. If you need specific reference and data sources to support this, let us know). EtO fugitive emissions (relative to stack emissions) appear to stay near the ground and don't mix with the upper atmosphere well like the AERMOD model assumes, thus underestimating EtO decay and exposure at greater distances.

As well, the Schiller Park site, adjacent to O'Hare, is also an outlier location in terms of high hydrocarbon emissions (due to heavy air and vehicle traffic) relative to the rest of Illinois. The Schiller Park and Northbrook sites are useful to understand what high levels might remain in Illinois after the highest EtO emission sources have (hopefully) been addressed, but they do not provide a full picture of the background level of EtO in Chicago and the surrounding suburbs, which was the objective of the testing portion of the bill.

It is interesting to see St. Anthony's Hospital in Alton is not on the list of sources in Attachment A. Can you provide a source for this list? St. Anthony's Hospital was present in

the most recent NATA survey, which failed to include Vantage at the time. Has the use of EtO at St. Anthony's Hospital in Alton actually stopped or could there be an oversight with this list? We did a quick search online, but could not verify this. We would like to get confirmation on this change at St. Anthony's hospital in Alton. (That would be positive and make testing in Alton less controversial for us.)

We believe the sites we have suggested, in particular - replacing Schiller Park and Northbrook with Lisle and Zion, would provide new data and a much clearer picture of the background levels of EtO in the state.

If you have any additional questions we could help with, please let us know.

Thank you,
Stop EtO
--
stopeto.com

We demand an end to the emission of ethylene oxide near schools and residential areas. There is no safe level to this known human carcinogen.

Stop EtO in Lake County

April 2, 2020

Agenda

- Understanding Ethylene Oxide (EtO) Air Monitoring Results Using Statistical Models
- Ambient EtO Levels
  - Illinois / Lake County Ambient EtO Levels
  - US EPA AQS EtO Ambient 18 City Data Report Issues
- Vantage AERMOD Emission Model and Test Data Comparison / Conclusions
- Technique to Estimate EtO Emissions Directly from Test Data
- AERMOD Model Discrepancies
- Medical Equipment Warehouses and EtO Emissions
- Indoor Ambient Air Quality Near High EtO Emitters Concerns
- EtO Leak Reporting
- Recommendations and Questions

First, Thank You!

- Thank you for all of your work on this issue for the State of Illinois
- Thank you for taking time today to meet with our community group

Background: Dr. John Aldrin

- Education:
  - PhD (2001) at Northwestern University in Theoretical and Applied Mechanics (TAM)
  - BS (1994) and MS (1996) in Mechanical Engineering at Purdue University
- Consultant / Principal of Computational Tools (in Gurnee, IL) since 2001
  - *Specialize in modeling, data analysis, inverse methods, and reliability assessment* with focus on Nondestructive Evaluation (NDE)
  - Work as Visiting Scientist at Air Force Research Laboratory – WPAFB, Ohio, USA, since 2001
  - Participate as member of NASA Engineering and Safety Center (NESC) TDT on NDE, since 2004
  - Co-authored over 170 journal, conference and book publications in NDE
  - Fellow of ASNT and Associate Technical Editor of *Materials Evaluation* journal
  - Fellow Customers: USAF/AFRL, SAIC, NASA, UTC, UDRI, Iowa State Univ., TRI/Austin, KBR, Vibrant, Southern Research, Victor Technologies, Orbital Transports, and BP

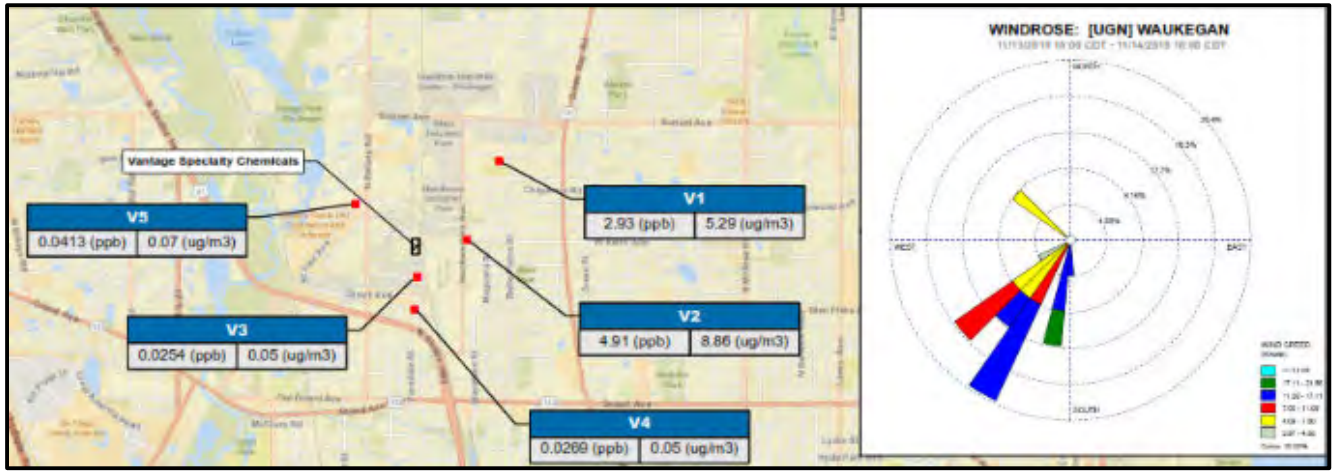
August 2019: Why I Got Involved

- Surprised by high June/July 2019 Lake County air monitoring numbers
- Wanted to explain data observations not being discussed
- Third neighbor with possible EtO related cancer went public August 30th in Lake County News-Sun [1].
  - Since learned of a 4th neighbor who died of cancer
- ~300 hours spent studying this issue since August

[1] https://www.chicagotribune.com/suburbs/lake-county-news-sun/ct-lns-medline-vantage-eto-lawsuits-st-0830-20190829-p4ipczijpraypod3lzvh744rpq-story.html

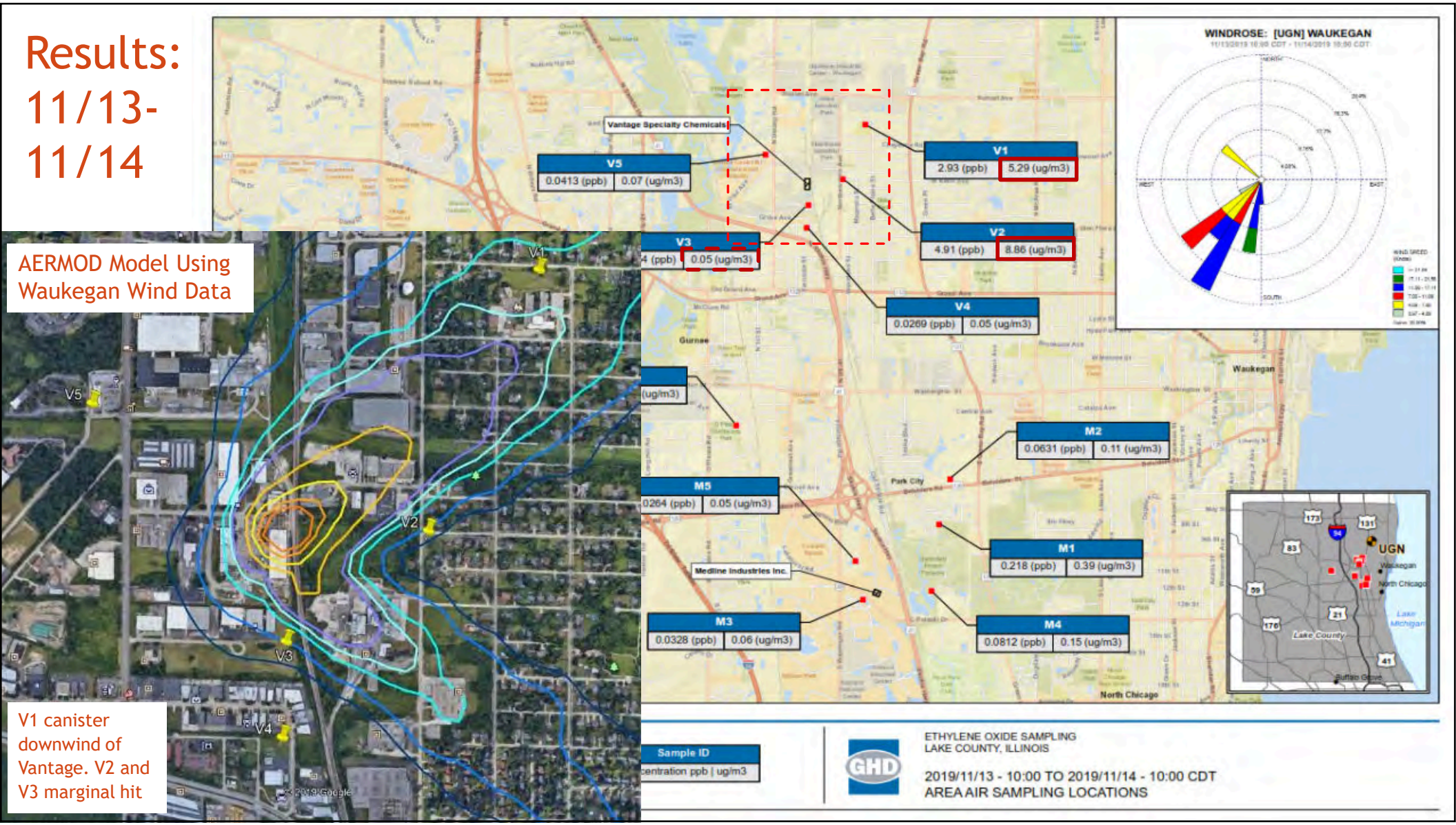
Understanding Air Monitoring Results

- Typical canister testing practice: to evaluate <u>average EtO levels</u> experienced by local population over time → Use for risk assessment
- <u>Challenge:</u> with (1) limited test sites, (2) varying wind direction and (3) possible emission variation, limited test period data can *be difficult to interpret, given the small sample set*

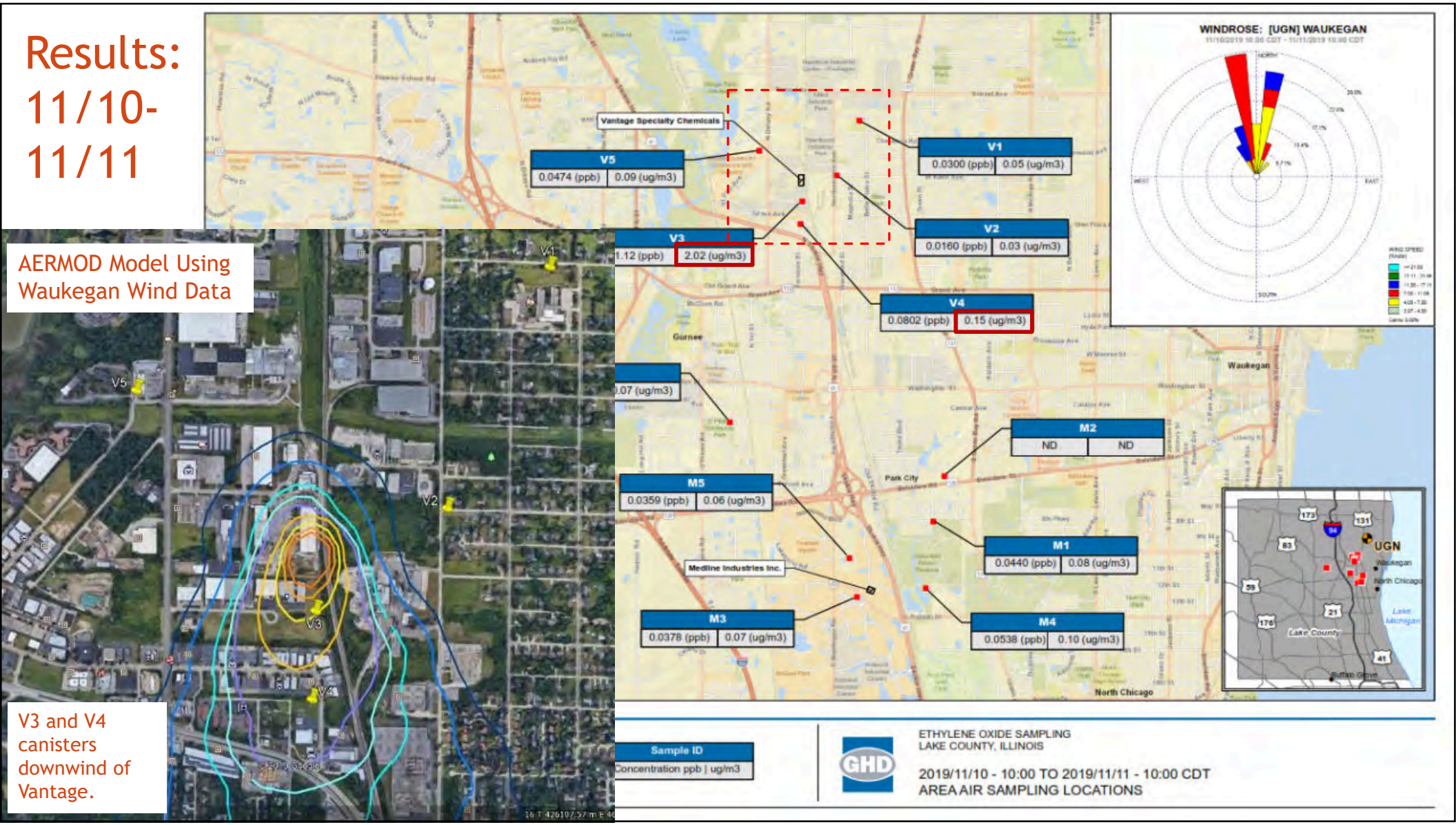


Example GHD Air Testing Report: 11/13-11/14

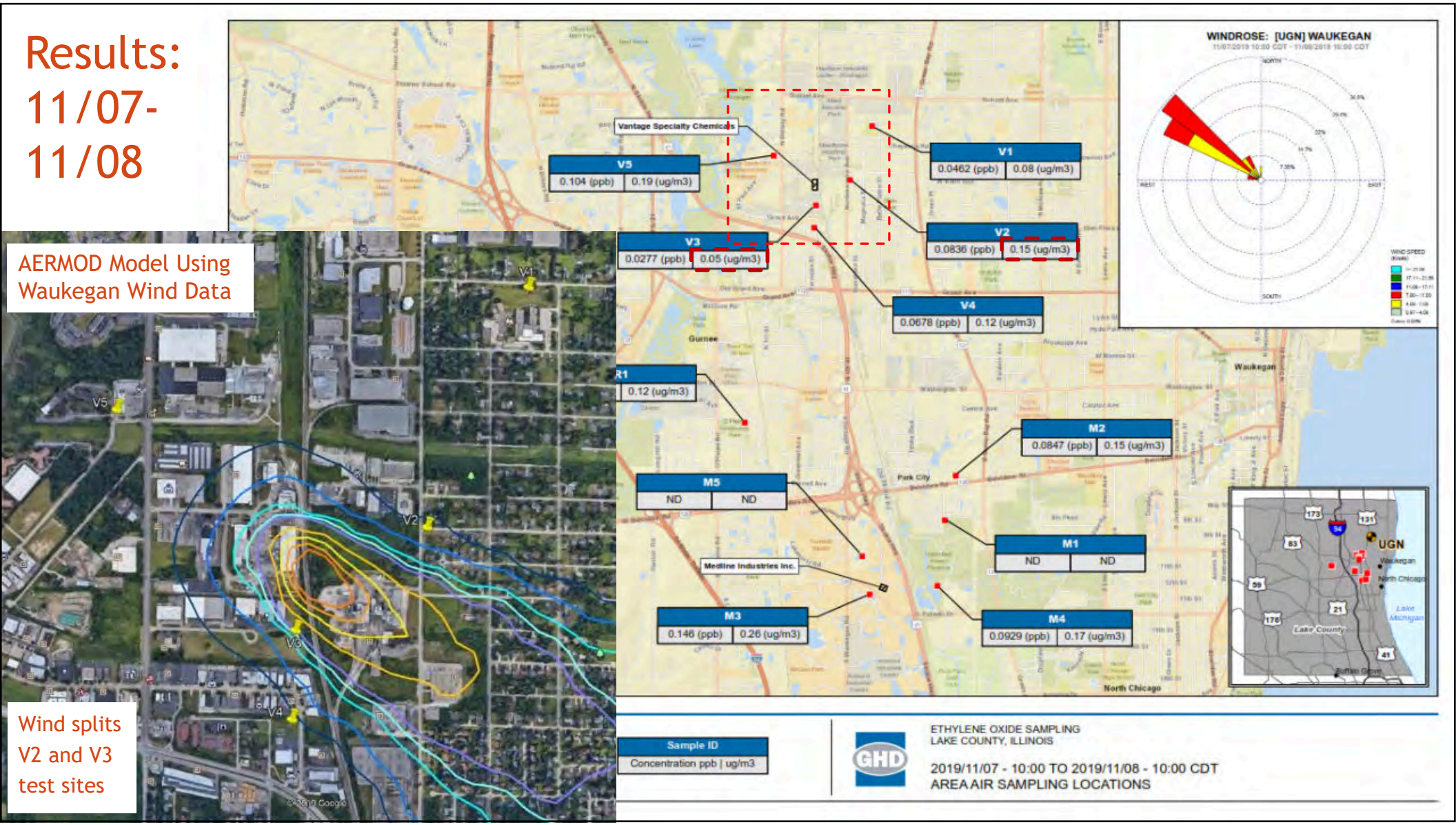
Results: 11/13-11/14



Results: 11/10-11/11

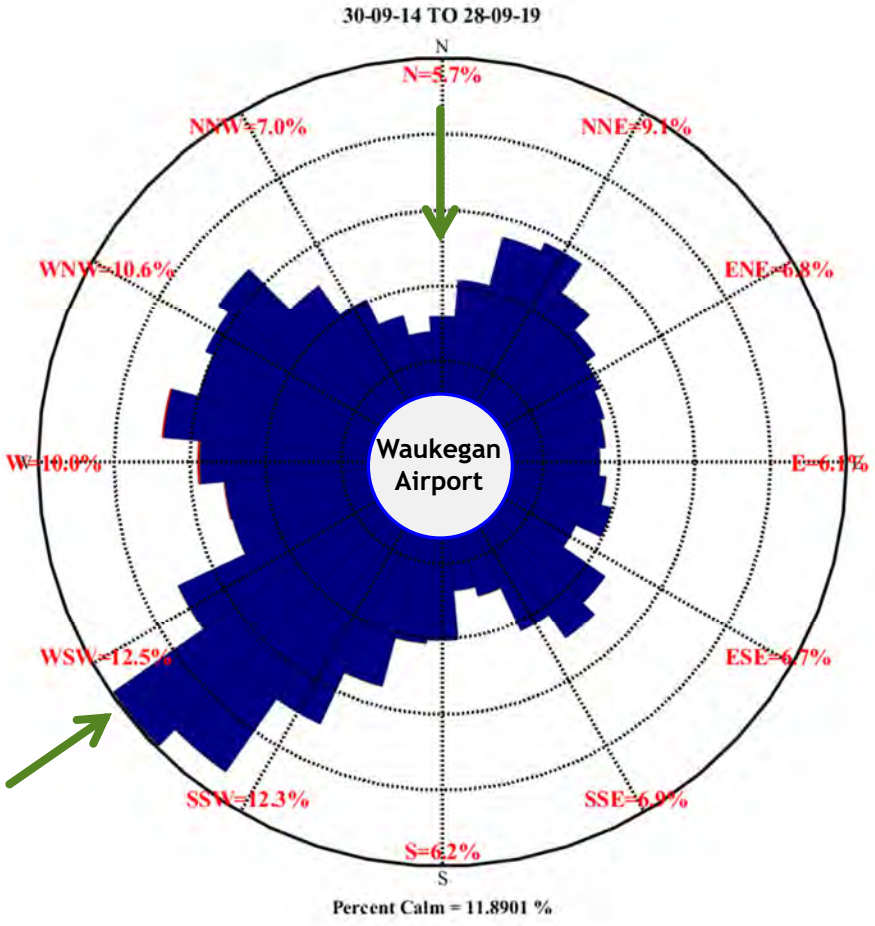


Results: 11/07-11/08



5 Year Wind Rose Plot (9/2014 - 19)
Chicago/Waukegan Regional Airport (KUGN)

- **Wind rose plot shows wind directions**
- (a) Maximum direction:
  - WSW Winds 12.5% of time
- (b) Minimum direction:
  - North Winds 5.7% of time
- **All directions experience emissions at some time**



Understanding Air Monitoring Results

- Use statistical analysis and models to better understand EtO testing results:
  1. Use wind data with knowledge of possible EtO sources to identify downwind canister locations.
  2. Ideally, **classify test data** for each day into three groups: **[assessment used wind data/AERMOD]**
     - **3 = wind hits canister**
     - **2 = wind marginal hit**
     - **1 = wind misses canister**
  3. Compare levels at downwind canisters with upwind (miss) canisters to assess level of *emissions from possible sources* relative to *local background*.
  4. Evaluate *possible testing outliers*, observed at a low rate.
     - Canister locations lacking clear EtO source may be test outliers

Understanding Air Monitoring Results – Near Vantage [Oct. 26 – Dec. 2, 2019]

- Good correlation between wind hitting canisters (2 and 3) and higher results

Site #	Location	26-Oct / 27-Oct	29-Oct / 30-Oct	1-Nov / 2-Nov	4-Nov / 5-Nov	7-Nov / 8-Nov	10-Nov / 11-Nov	13-Nov / 14-Nov	16-Nov / 17-Nov	19-Nov / 20-Nov	22-Nov / 23-Nov	25-Nov / 26-Nov	28-Nov / 29-Nov	1-Dec / 2-Dec		
R1	O'Plaine Rd & Russell Ave, Gurnee	0.18	0.18	0.21	0.16	0.12	0.07	0.18	0.32	0.2	0.17	0.17	0.24	0.13		
R2	7000 Washington Street, Gurnee	0.19	0.06	ND	0.11	0.03	0.12	0.07	0.14	0.28	0.18	0.24	0.24	0.12		
V1	2000 Belle Plaine Ave, Gurnee	0.26	0.3	0.4	0.11	0.08	0.05	5.29	0.23	0.21	0.4	0.15	0.08	0.08		
V2	SE corner Northwestern and Keith, Gurnee	Invalid	0.25	3.66	1.34	0.15	0.03	8.86	0.05	Invalid	0.23	0.36	0.09	0.14		
V3	3886 Morrison Drive, Gurnee	0.12	0.33	0.12	0.22	0.05	2.02	0.05	0.16	0.19	0.05	0.29	1.28	0.23		
V4	1200 Estes Drive, Gurnee	ND	0.17	0.22	0.06	0.12	0.15	0.05	0.14	0.16	0.36	0.13	0.29	0.13	distance	
V5	36016 N DELANY RD	Invalid	0.14	0.22	0.2	0.19	0.09	0.07	0.27	0.11	0.2	0.14	0.24	0.13	(miles)	
R1	O'Plaine Rd & Russell Ave, Gurnee	1	1	1	1	1	1	1	2	1	1	1	1	1	2.01	
R2	7000 Washington Street, Gurnee	1	1	1	1	1	1	1	1	1	1	1	1	1	3.88	
V1	2000 Belle Plaine Ave, Gurnee	1	1	3	1	1	1	3	1	2	3	2	1	1	0.57	
V2	SE corner Northwestern and Keith, Gurnee	1	2	3	3	1	1	2	1	2	1	2	1	1	0.25	
V3	3886 Morrison Drive, Gurnee	1	2	1	1	1	3	1	1	1	2	1	3	2	0.17	
V4	1200 Estes Drive, Gurnee	1	1	1	1	1	3	1	1	1	2	1	3	2	0.33	
V5	36016 N DELANY RD	1	1	1	1	1	1	1	2	1	2	1	1	1	0.40	
R1	O'Plaine Rd & Russell Ave, Gurnee	0.18	0.18	0.21	0.16	0.12	0.07	0.18	0.32	0.2	0.17	0.17	0.24	0.13	2.01	
R2	7000 Washington Street, Gurnee	0.19	0.06	0.045	0.11	0.03	0.12	0.07	0.14	0.28	0.18	0.24	0.24	0.12	3.88	
V1	2000 Belle Plaine Ave, Gurnee	0.26	0.3	0.4	0.11	0.08	0.05	5.29	0.23	0.21	0.4	0.15	0.08	0.08	0.57	
V2	SE corner Northwestern and Keith, Gurnee	999	0.25	3.66	1.34	0.15	0.03	8.86	0.05	999	0.23	0.36	0.09	0.14	0.25	aveargе
V3	3886 Morrison Drive, Gurnee	0.12	0.33	0.12	0.22	0.05	2.02	0.05	0.16	0.19	0.05	0.29	1.28	0.23	0.17	distance
V4	1200 Estes Drive, Gurnee	0.045	0.17	0.22	0.06	0.12	0.15	0.05	0.14	0.16	0.36	0.13	0.29	0.13	0.33	(miles)
V5	36016 N DELANY RD	999	0.14	0.22	0.2	0.19	0.09	0.07	0.27	0.11	0.2	0.14	0.24	0.13	0.40	0.34

Understanding Air Monitoring Results – Analysis by Canister Location to Wind

	October 26 to December 2 2019	mean	median	N samples	p-value
	Near Vantage	ug/m3	ug/m3	()	(t-test)
1	Wind missed canisters	0.150	0.140	72	
2	Marginal hit	1.490	0.270	8	3.8E-04
3	Wind hits canisters	1.648	1.280	9	8.7E-11

	October 26 to December 2 2019	mean	median	N samples	p-value
	Near Medline	ug/m3	ug/m3	()	(t-test)
1	Wind missed canisters	0.140	0.120	73	
2	Marginal hit	0.480	0.325	9	5.2E-08
3	Wind hits canisters	0.493	0.530	7	1.4E-13

- Analysis Demonstrates Vantage and Medline are Emitting EtO During Period

ATSDR Summary of Ambient Levels in US

Comparison of Ambient EtO Concentrations with other areas without a known EtO source

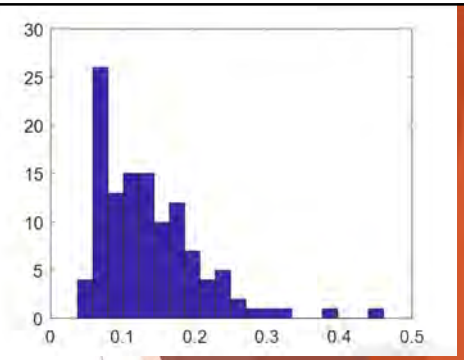
Station	Number samples	Concentration (µg/m³)
California (1989-1990)	55	**0.05 - 0.08[a] (range)**
Colorado (2018)	16[b]	**0.25[b] (mean)**
Illinois (Chicago area-2018)	69	**0.19 - 0.20 (median)**
Massachusetts (1999-2016)	1,433	**0.15 - 0.18 (median)**
Michigan (2018 and 2019)	9[c]	**0.12 - 0.37[c] (range)**
New Hampshire (2002-2008)	578	**0.22 - 0.27 (median)**
Rhode Island (1999-2010)	11,288	**0.14 - 0.20 (median)**
Willowbrook, IL (non-operational)	139	**0.09-0.17 (median)**
Willowbrook, IL (operational)	265	**0.21-1.78 (median)**

[a] Only offsite samples for Phase 2 are represented here, and the range of detections at the background locations are presented because only one sample was collected at each site.

[b] The arithmetic mean was reported as an average background concentration in this report; nine samples were reported as half the detection limit of 0.082 ug/m³ because they were below detection limits. Data are too limited to determine whether this average is a representative estimate of long-term exposures.

[c] Only "outlying" distant sample locations for Phase 2 are presented here.

Sterigenics (Willowbrook) After Shutdown – Distribution of All Outdoor Measurements



- Study trends in data after 2019 Willowbrook Shutdown
  - *8 Outdoor Locations*
  - *15 '24 hour' Periods*
  - ***118 Data Points** (2 NA)*
  - *26 Values below 0.072 ug/m³ (Limit of Early Testing)*

Sample Start Date	Day (after shutdown)	Willowbrook Village Hall	EPA Willowbrook Warehouse	Gower Middle School	West Neighborhood	Water Tower	Willow Pond Park	Hinsdale South High School	Gower Elementary School	MEDIAN (for Date)
2/19/2019	4	0.239	0.15	0.202	0.298	0.222	0.072	0.162	0.072	0.212
2/20/2019	5	0.26	0.159	0.072	0.072	0.072	0.111	0.072	0.148	0.092
2/23/2019	8	0.128	0.132	0.164	0.165	0.179	0.171	0.282	NA	0.168
2/26/2019	11	0.166	0.119	0.072	0.114	0.084	0.072	0.188	0.072	0.117
3/1/2019	14	0.072	0.103	0.072	0.072	0.142	0.148	0.125	0.145	0.114
3/4/2019	17	0.161	0.072	0.072	0.113	0.072	0.108	0.122	0.124	0.111
3/7/2019	20	0.099	0.096	0.093	0.112	0.165	0.122	0.072	0.072	0.106
3/10/2019	23	NA	0.075	0.171	0.201	0.081	0.244	0.102	0.097	0.171
3/13/2019	26	0.204	0.122	0.246	0.195	0.219	0.147	0.139	0.394	0.200
3/16/2019	29	0.461	0.171	0.267	0.109	0.072	0.322	0.102	0.056	0.219
3/19/2019	32	0.136	0.056	0.082	0.037	0.079	0.206	0.082	0.215	0.082
3/22/2019	35	0.06	0.117	0.068	0.197	0.075	0.177	0.224	0.181	0.147
3/25/2019	38	0.078	0.134	0.084	0.102	0.093	0.13	0.133	0.106	0.116
3/28/2019	41	0.114	0.181	0.233	0.12	0.092	0.151	0.175	0.174	0.163
3/31/2019	44	0.057	0.072	0.099	0.242	0.087	0.136	0.072	0.138	0.093

Trans -2- butene detected although concentration is too low to quantify .

Below 0.072 ug/m3

Illinois & Lake County Ambient EtO Levels

- Upwind canister data in Lake Country matches Willowbrook levels after shutdown

	February 19 - March 31, 2019	mean	median	N samples
	Willowbrook, IL	ug/m3	ug/m3	()
0	*No EtO Emissions (Sterigenics Closed)*	*0.138*	*0.122*	*118*

	October 26 to December 2 2019	mean	median	N samples	p-value
	Near Vantage	ug/m3	ug/m3	()	(t-test)
1	Wind missed canisters	0.150	0.140	72	
2	Marginal hit	1.490	0.270	8	3.8E-04
3	Wind hits canisters	1.648	1.280	9	8.7E-11

	October 26 to December 2 2019	mean	median	N samples	p-value
	Near Medline	ug/m3	ug/m3	()	(t-test)
1	Wind missed canisters	0.140	0.120	73	
2	Marginal hit	0.480	0.325	9	5.2E-08
3	Wind hits canisters	0.493	0.530	7	1.4E-13

- These values are near avg. results for Medline after shutdown: 0.153 $\mu g/m^3$ (N =30)

AQS EtO Ambient 18 City Data Report (10/2018 – 3/2019)

- Compare:
  - *Willowbrook post shutdown lower than all 18 sites*
  - *Why?*

Willowbrook, IL After Sterigenics Shutdown [2/19-3/19]

- EtO_median = 0.122 ug/m^3
- **EtO_mean = 0.138 ug/m^3**

  - *ISSUE 1: Should not be using averages*
  - *Median is better metric*

Site Name	City	State	Network	AQS Site ID	Average by Site (in micrograms per cubic meter) [National average = 0.297]
PXSS	Phoenix	AZ	National Air Toxics Trends	04-013-9997	0.397
SPAZ	Phoenix	AZ	Urban Air Toxics	04-013-4003	0.345
GPCO	Grand Junction	CO	National Air Toxics Trends	08-077-0018	0.261
NBIL	Northbrook	IL	National Air Toxics Trends	17-031-4201	0.294
SPIL	Chicago	IL	Urban Air Toxics	17-031-3103	0.365
ASKY	Ashland	KY	Urban Air Toxics	21-019-0017	0.286
BLKY	Smithland	KY	Urban Air Toxics	21-139-0004	0.312
GLKY	Grayson lake	KY	National Air Toxics Trends	21-043-0500	0.185
TVKY	Calvert City	KY	Urban Air Toxics	21-157-0014	0.363
DEMI	Dearborn	MI	National Air Toxics Trends	26-163-0033	0.242
S4MO	St. Louis	MO	National Air Toxics Trends	29-510-0085	0.270
CHNJ	Chester	NJ	Urban Air Toxics	34-027-3001	0.361
CSNJ	Camden	NJ	Urban Air Toxics	34-007-0002	0.350
ELNJ	Elizabeth	NJ	Urban Air Toxics	34-039-0004	0.305
NRNJ	East Brunswick	NJ	Urban Air Toxics	34-023-0011	0.298
BTUT	Bountiful	UT	National Air Toxics Trends	49-011-0004	0.338
LAWA	Lacey	WA	Urban Air Toxics	53-067-0013	0.192
SEWA	Seattle	WA	National Air Toxics Trends	53-033-0080	0.185

https://www.epa.gov/sites/production/files/2019-11/documents/data_summary_stations.pdf

AQS EtO Ambient 18 City Data Report (10/2018 – 3/2019)

- Compare:
  - *ISSUE 2: Null / Non-detect values were DROPPED from average statistics*
  - *Re-evaluation shows many cities' median levels are below Willowbrook*

Willowbrook, IL After Sterigenics Shutdown [2/19-3/19]

- EtO_median = 0.122 ug/m^3
- EtO_mean = 0.138 ug/m^3

AQS Site ID	City, State	count	average - DROP ALL NON-DETECTS / ZEROS (Poor Practice!)	count	%	average - (DROP AS/BH Nulls, replace 0 with 0.036)	medain V1 (DROP 'AS' Nulls)	median V2 (include all zeros / nulls)
		ALL	ug/m3	NON-ZERO	DROPPED	ug/m3	ug/m3	ug/m3
4-13-4003	Phoenix, AZ	14	0.365	6	57%	0.365	< threshold	< threshold
4-13-9997	Phoenix, AZ	29	0.373	22	24%	0.373	0.254	0.220
8-77-18	Grand Junction, CO	18	0.259	8	56%	0.234	< threshold	< threshold
17-31-3103	Chicago, IL (near O'Hare)	21	0.363	17	19%	0.345	0.238	0.238
17-31-4201	Northbrook IL	31	0.293	23	26%	0.226	0.171	0.171
21-19-17	Ashland, KY	8	0.284	6	25%	0.284	0.230	0.134
21-139-4	Smithland, KY	15	0.310	12	20%	0.289	0.216	0.200
21-43-500	Grayson Lake, KY	20	0.184	15	25%	0.153	0.131	0.117
21-157-14	Calvert City, KY	22	0.322	16	27%	0.277	0.218	0.211
26-163-33	Dearborn, MI	16	0.233	14	13%	0.233	0.186	0.186
29-510-85	St. Louis, MO	19	0.268	14	26%	0.239	0.207	0.203
34-23-11	East Brunswick, NJ	18	0.296	16	11%	0.281	0.265	0.230
34-27-3001	Chester, NJ	16	0.344	15	6%	0.344	0.382	0.370
34-39-4	Elizabeth, NJ	19	0.304	8	58%	0.231	< threshold	< threshold
34-7-2	Camden, NJ	19	0.348	18	5%	0.348	0.311	0.302
49-11-4	Bountiful, UT	27	0.336	20	26%	0.267	0.174	0.174
53-33-80	Seattle, WA	19	0.184	13	32%	0.165	0.137	0.113
53-67-13	Lacey, WA	19	0.196	13	32%	0.152	0.157	0.153
	Totals	350	0.292	256	27%	0.267	0.197	0.180
						AS = POOR QUALITY ASSURANCE RESULTS		

Raw data available at:

Vantage AERMOD Report [1]

ILLINOIS ENVIRONMENTAL PROTECTION AGENCY
1021 North Grand Avenue East, P.O. Box 19276, Springfield, Illinois 62794-9276 • (217) 782-3397
JB Pritzker, Governor — John J. Kim, Director

MEMORANDUM

DATE: December 17, 2019

TO: File, Construction Permit Application No. 19100015

FROM: Steven King, Modeling Unit, Air Quality Planning Section, Bureau of Air

SUBJECT: Vantage Specialties, Inc. (ID No. 097035AAQ)

Objective: Use model report to estimate what levels of EtO have been emitted near Vantage during cannister testing periods

Residential Area Max Predicted 5-Year Avg. Canister Readings = 0.0142 µg/m³

for 110 lb/year emissions (60 lb/year fugitive)

Table 1
Maximum Predicted Average Ethylene Oxide Concentration by Scenario

Averaging Period	Scenario	Receptor Location of Domain Maximum		Maximum Predicted 5-Year Average Concentration (µg/m³)		
		UTM Easting (m)	UTM Northing (m)	Entire Domain	Off-Property	Entire Domain Highest Residential
5-years	64'	421967.1	4622473.0	0.01975*	0.00781	0.00182
5-years	113'	421919.0	4622256.0	0.00123	0.00123	0.00048
5-years	Fugitive Only	425980.4	4692829.0	0.23679	0.13560	0.01238

* Maximum predicted concentration for 64' stack only "scenario" is within Vantage's property.

[1] https://www2.illinois.gov/epa/topics/community-relations/sites/ethylene-oxide/Documents/MEMO_IEPA%20_Review_Air%20Quality_Impact%20Analysis_Vantage_097035AAQ_Permit%20App19100015_FINAL%20Dec%2017%202019.pdf

Average Canister Results Near Vantage

	Period 1	Period 2	Period 3	All Periods
START	June 6 – 7, 2019	October 26 - 27, 2019	December 13 - 14, 2019	June 6 – 7, 2019
END	July 3 – 4, 2019	December 10 - 11, 2019	December 25 - 26, 2019	December 25 - 26, 2019

	Period 1 Average	Period 2 Average	Period 3 Average	All Periods Average
R1	0.165	0.171	0.168	0.169
R2	0.205	0.125	0.120	0.150
V1	0.178	0.503	0.156	0.323
V2	0.156	**1.194**	0.126	**0.652**
V3	0.272	0.351	0.155	0.295
V4	0.121	0.147	0.090	0.130
V5		0.155	0.152	0.154
Total	ND -> Used 0.045 ug/m3			
	Dropped High Likely False Call at V4 (June 30 / July 1)			

Residential Area Max Predicted 5-Year Avg. Canister Readings = 0.0142 µg/m³

for 110 lb/year emissions (60 lb/year fugitive)

Subtract Background Level for Difference Coming from Vantage (Average – Background)

	Period 1	Period 2	Period 3	All Periods
START	June 6 – 7, 2019	October 26 - 27, 2019	December 13 - 14, 2019	June 6 – 7, 2019
END	July 3 – 4, 2019	December 10 - 11, 2019	December 25 - 26, 2019	December 25 - 26, 2019

		Average EtO - Background EtO			
Background EtO Average	in ug/m3	Period 1 Average	Period 2 Average	Period 3 Average	All Periods Average
0.153	R1				
0.153	R2				
0.153	V1		0.350		0.170
0.153	V2		**1.041**		**0.499**
0.153	V3	0.119	0.198		0.142
0.153	V4				
0.153	V5				

Residential Area Max Predicted 5-Year Avg. Canister Readings = 0.0142 µg/m³

for 110 lb/year emissions (60 lb/year fugitive)

Dropped Results Near Ambient

Subtract Background Level for Difference Coming from Vantage (Average – Background)

	Period 1	Period 2	Period 3	All Periods
START	June 6 – 7, 2019	October 26 - 27, 2019	December 13 - 14, 2019	June 6 – 7, 2019
END	July 3 – 4, 2019	December 10 - 11, 2019	December 25 - 26, 2019	December 25 - 26, 2019

Formula:

Estimated Emission Rate =

(Avg EtO - Back EtO) * 110 lb/yr

0.0142 μg/m³

		Average EtO - Background EtO			
Background EtO Average	**in ug/m3**	**Period 1 Average**	**Period 2 Average**	**Period 3 Average**	**All Periods Average**
0.153	R1				
0.153	R2				
0.153	V1		0.350		0.170
0.153	V2		**1.041**		**0.499**
0.153	V3	0.119	0.198		0.142
0.153	V4				
0.153	V5				

Max Predicted Residential Area 5-Year Avg. Canister Readings = 0.0142 μg/m³

for 110 lb/year emissions (60 lb/year fugitive)

Dropped Results Near Ambient

What Emissions Would Produce These Levels?

	Period 1	Period 2	Period 3	All Periods
START	June 6 – 7, 2019	October 26 - 27, 2019	December 13 - 14, 2019	June 6 – 7, 2019
END	July 3 – 4, 2019	December 10 - 11, 2019	December 25 - 26, 2019	December 25 - 26, 2019

(assume canister at max residential location)

Location	EtO Emissions - Fugitive + Stack			
	Period 1	Period 2	Period 3	All Periods
	lbs/yr	lbs/yr	lbs/yr	lbs/yr
R1				
R2				
V1		2707		1317
V2		**8066**		**3865**
V3	923	1531		1102
V4				
V5				

Observation: Max. Canister Readings Indicated Emissions
3865 lb/yr >> 110 lb/yr

Formula:

Estimated Emission Rate =

$$\text{(Avg EtO - Back EtO)} * \frac{110 \text{ lb/yr}}{0.0142\ \mu g/m^3}$$

Max Predicted Residential Area
5-Year Avg. Canister Readings
= 0.0142 µg/m³
for 110 lb/year emissions
(60 lb/year fugitive)

What is Expected Cancer Risk for These Levels of EtO Exposure? [1-2]

Memorandum on Vantage Model – Max. Residential Risk

Testing: 'Ambient' Near Medline After Shutdown (Dec 13-26)

Testing Near Vantage: Averages
- V1 (Oct 26 – Dec. 11)
- V2 (all dates)
- V2 (Oct 26 – Dec. 11)

Based on U.S. EPA issued report which supported Integrated Risk and Assessment System (IRIS) upgrade of ethylene oxide from "probably carcinogenic to humans" to "carcinogenic to humans"

[1] Evaluation of Inhalation Carcinogenicity of Ethylene Oxide. December 2016 U.S. Environmental Protection Agency Office of Research and Development. https://cfpub.epa.gov/ncea/iris/iris_documents/documents/subst/1025_summary.pdf

[2] Technical Support Document; EPA's 2014 National Air Toxics Assessment. Office of Air Quality Planning and Standards. August 2018

New Approach to Estimate Emissions Directly From Test Data [1]

International Journal of *Environmental Research and Public Health*

MDPI

Article

Ethylene Oxide Exposure Attribution and Emissions Quantification Based on Ambient Air Measurements near a Sterilization Facility

Eduardo P. Olaguer *, Amy Robinson, Susan Kilmer, James Haywood and Doreen Lehner

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* Correspondence: olaguerj@michigan.gov

Received: 20 November 2019; Accepted: 14 December 2019; Published: 19 December 2019

check for updates

Abstract: Ethylene oxide (EtO) is a known carcinogen and mutagen associated with increased incidence of breast and blood cancers. The largest medical sterilization facility in Michigan had been assessed by the U.S. Environmental Protection Agency as imposing an additional cancer risk greater than one in one thousand in nearby neighborhoods. This prompted the Michigan Department of Environmental Quality (now referred to as the Department of Environment, Great Lakes, and Energy) to conduct an air quality modeling study of the ambient EtO impacts of the sterilization facility, followed by 24 h Summa canister sampling and TO-15 analysis in two phases. Inverse modeling of the measured 24 h EtO concentrations during the second phase yielded estimates of 594 lbs/year for the facility's total emissions of EtO and 0.247 $\mu g/m^3$ for the urban background concentration. The inverse-modeled emissions are similar to reported emissions by the facility operator based on indoor air measurements and simple mass balance assumptions, while the inferred background concentration agrees with estimates from other field investigations. The estimated peak 24 h exposure to EtO caused by the sterilization facility in nearby neighborhoods was 1.83 $\mu g/m^3$ above the background level, corresponding to an additional cancer risk of approximately one in one hundred, if assumed to represent annual mean exposure.

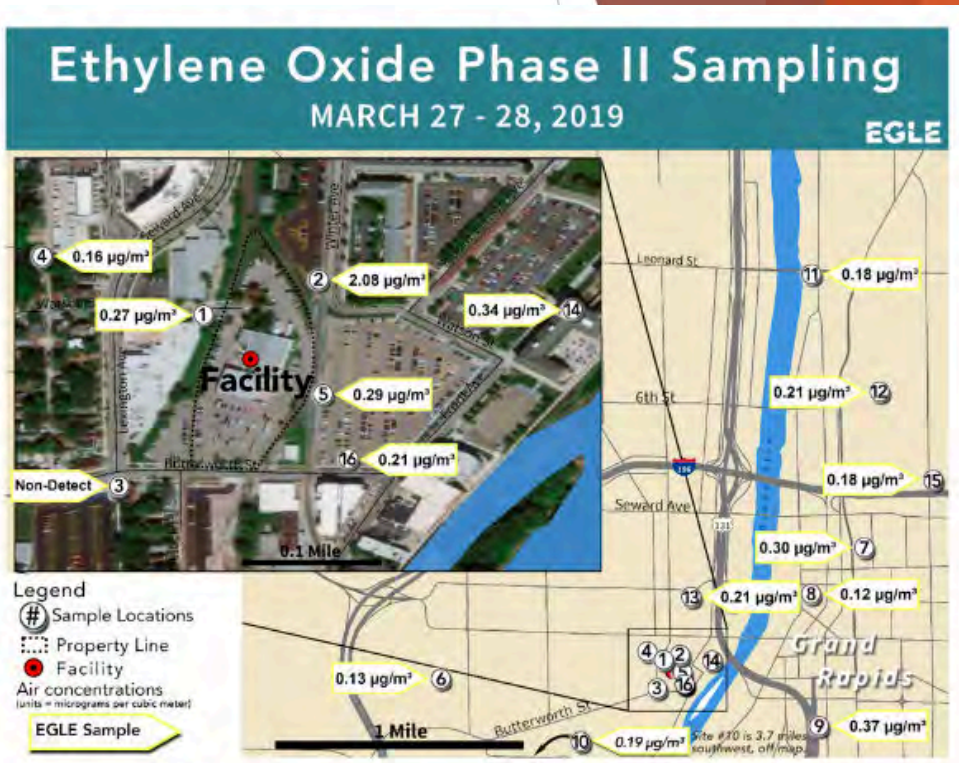
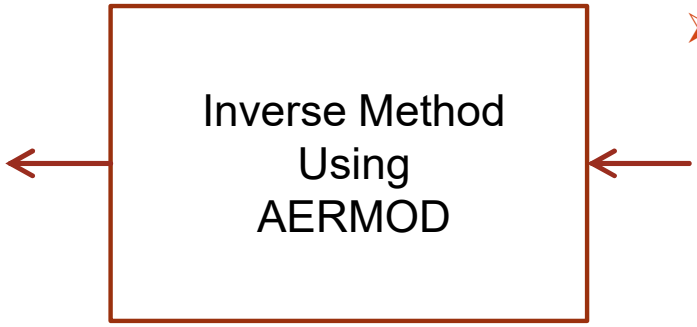


Figure 4. Phase II sampling sites and corresponding ambient air measurements of EtO.

[1] https://www.mdpi.com/1660-4601/17/1/42

Estimating Emission Levels Using Testing Data, AERMOD and Inverse Methods

- **AERMOD Inverse Modeling Approach:**

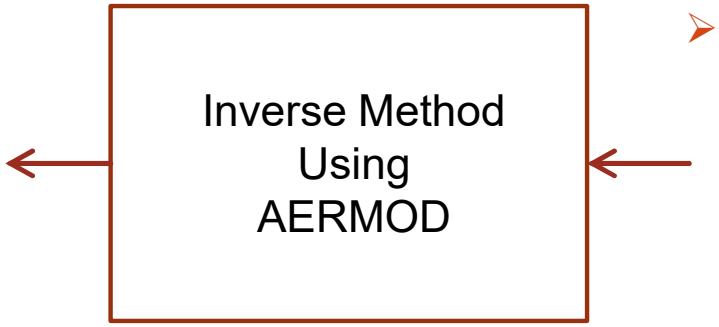


Approach:

1. Use 'upwind' canister data to create model (distribution) for local ETO_BACKGROUND levels
2. Build AERMOD model for local EtO sources / canisters and assume emission rate: 100 lb/year
3. Evaluate linear factor, X, to correct model emission rate to fit canister test data
4. Minimize Error: X(i) * ETO_AERMOD(i) + ETO_BACKGROUND(j) - ETO_CANISTER(i)
   - For i canister tests
5. Use Monte Carlo simulation (repeated j runs) to build distribution of emission rate
   - X(j) = median_i tests [(ETO_CANISTER(i) - ETO_BACKGROUND(j)) / ETO_AERMOD(j)]

Estimating Emission Levels Using Testing Data, AERMOD and Inverse Methods

- **AERMOD Inverse Modeling Approach:**
  - Output (Unknown):
    - Emission rate (g/s)
  - Inputs (Knowns):
    - Emission levels (µg/m3) from canister test data



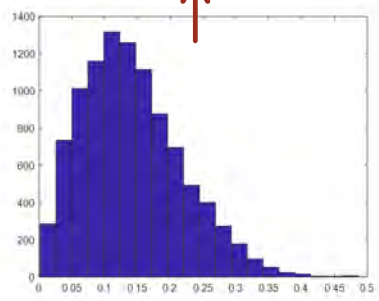
EVALUATE X FACTOR
to MINIMIZE PROBLEM: X(i,j) * ETO_AERMOD(i) + ETO_BACKGROUND(j) - ETO_CANISTER(i)

Use Monte Carlo simulation (repeated j=100,000 runs) to build distribution of estimate of emission rate

- **Run in Matlab Script**

[I would be happy to work with you on this.]

AERMOD



GHD
Test Data

Problem: Significant Model Discrepancies, *Especially at Far Distances from Source Sites*, Impacts Accuracy of Quantifying Emission Levels

Model / Company Claims:

- Based on Becton Dickinson's submittal, 2017 annual ethylene oxide emissions were 101.7 lbs from RTO and 555.7 lbs from 14 exhaust fans (fugitives). (**657.4 lbs claimed**)
- Modeled Maximum 5-year Annual Average Ground-level Concentrations: **0.144 ug/m^3**.
- Modeled Maximum 5-year Annual Average Ground-level Concentrations – in Nearest Residential Area: **0.028 ug/m^3.**

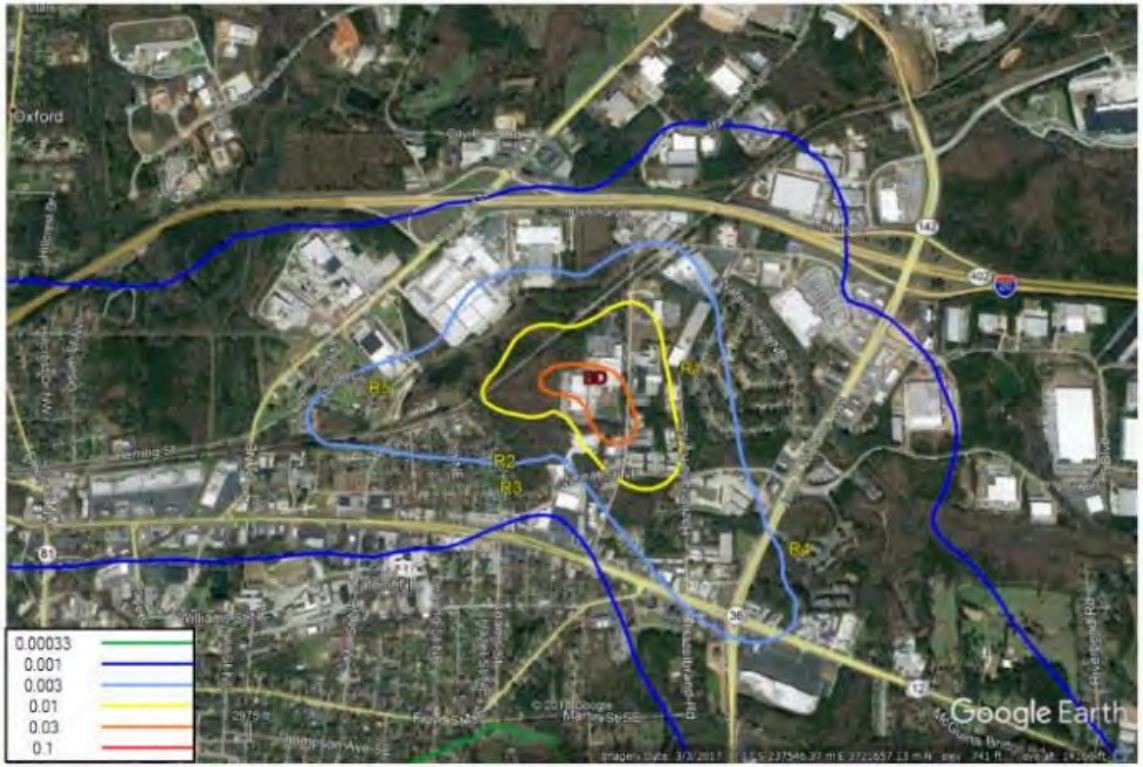


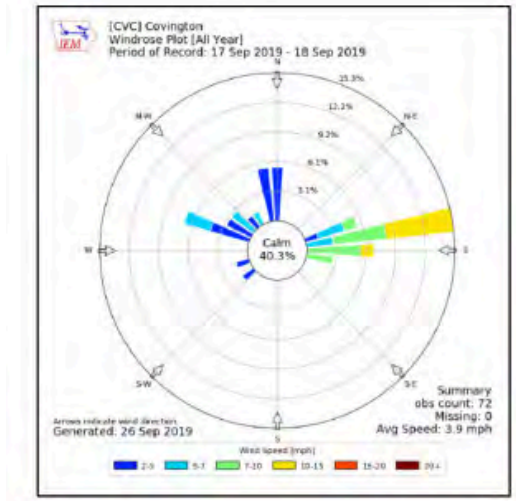
Figure 2. A close-up look of Figure 1 with the closest residential areas labeled.

Problem: Significant Model Discrepancies, *Especially at Far Distances from Source Sites - Observation 1: Errors Near Source*

Actual Data on Ground:

- Average of All 24 Hour Concentrations measurements around BD Facility: **3.63 ug/m^3.**
- Average of All 24 Hour Concentrations measurements in Settlers Grove Neighborhood (Nearest Residential Area): **4 ug/m^3.**
- Average of All 24 Hour Concentrations measurements in Rural SE Newton County (8 Miles Away): **0.222 ug/m^3.**

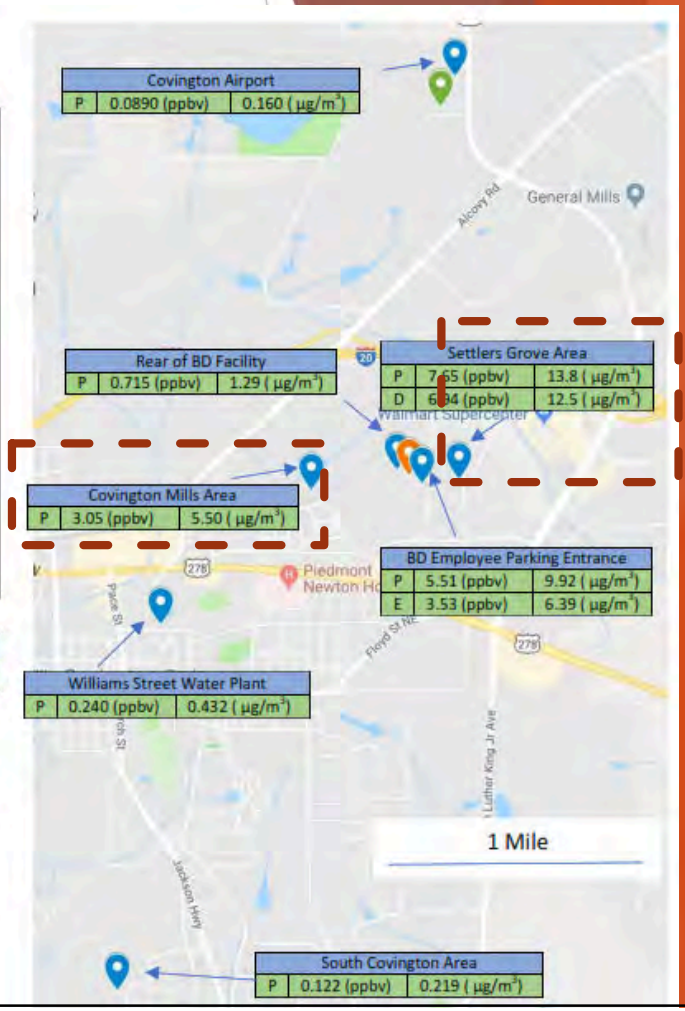
Likely Issue with Calm Day Error



Sampling Location	
Sample Type	Concentration ppbv | µg/m^3

Legend

- Air Sample Location
- Weather Station
- Facility
- P Primary Sample
- D Duplicate Sample
- E ERG Analyzed Duplicate

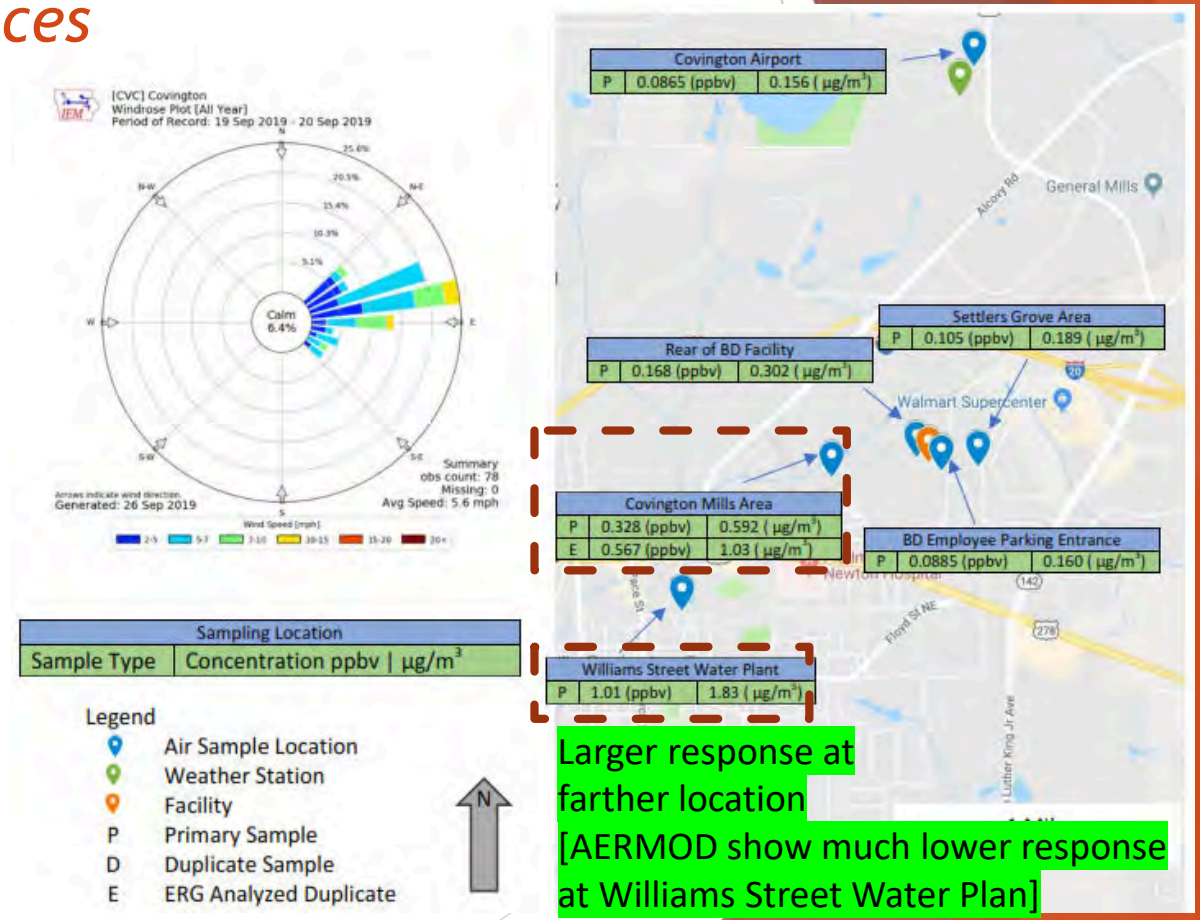


Problem: Significant Model Discrepancies, *Especially at Far Distances from Source Sites – Observation 2: Errors at Moderate Distances*

Actual Data on Ground:

- Average of All 24 Hour Concentrations measurements around BD Facility: **3.63 ug/m^3.**
- Average of All 24 Hour Concentrations measurements in Settlers Grove Neighborhood (Nearest Residential Area): **4 ug/m^3.**
- Average of All 24 Hour Concentrations measurements in Rural SE Newton County (8 Miles Away): **0.222 ug/m^3.**

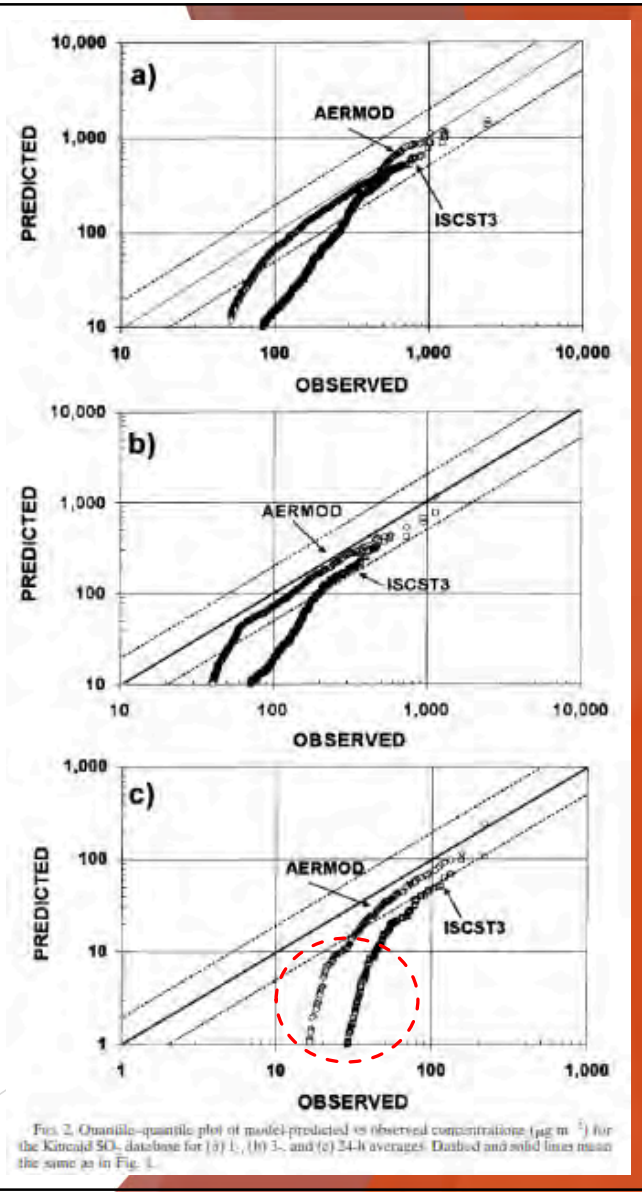
Likely Issue with Error at Distance



AERMOD Error At Far Distances

- **AERMOD is a Good Model at Higher Test Concentrations and Incorporates Corrections for Local Buildings / Topology:**
- **However, AERMOD has issues with some conditions (ex: calm days) and lower emissions levels (found in the far-field from sources)**
- **Key literature on AERMOD performance:**

1. Brode, R.W., 2002. Implementation and Evaluation of PRIME in AERMOD-Panel Presentation.
2. Perry, S.G., Cimorelli, A.J., Paine, R.J., Brode, R.W., Weil, J.C., Venkatram, A., Wilson, R.B., Lee, R.F. and Peters, W.D., 2005. "AERMOD: A dispersion model for industrial source applications. Part II: Model performance against 17 field study databases," *Journal of Applied Meteorology*, *44* (5), pp.694-708.
3. Hurley, P., Edwards, M. and Luhar, A., 2008. TAPM V4. Part 2: Summary of some verification studies. *CSIRO Marine and Atmospheric Research Internal Report No. 26*.
4. Langner, C. and Klemm, O., 2011, "A comparison of model performance between AERMOD and AUSTAL2000," *Journal of the Air & Waste Management Association*, *61*(6), pp.640-646.



AERMOD Error At Far Distances

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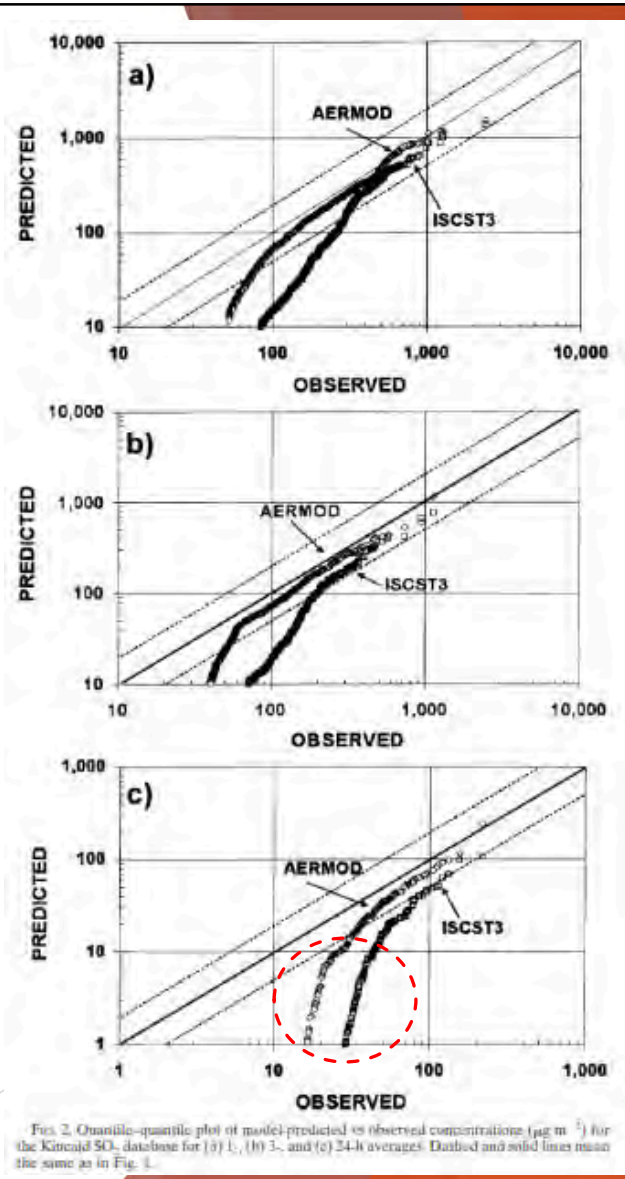
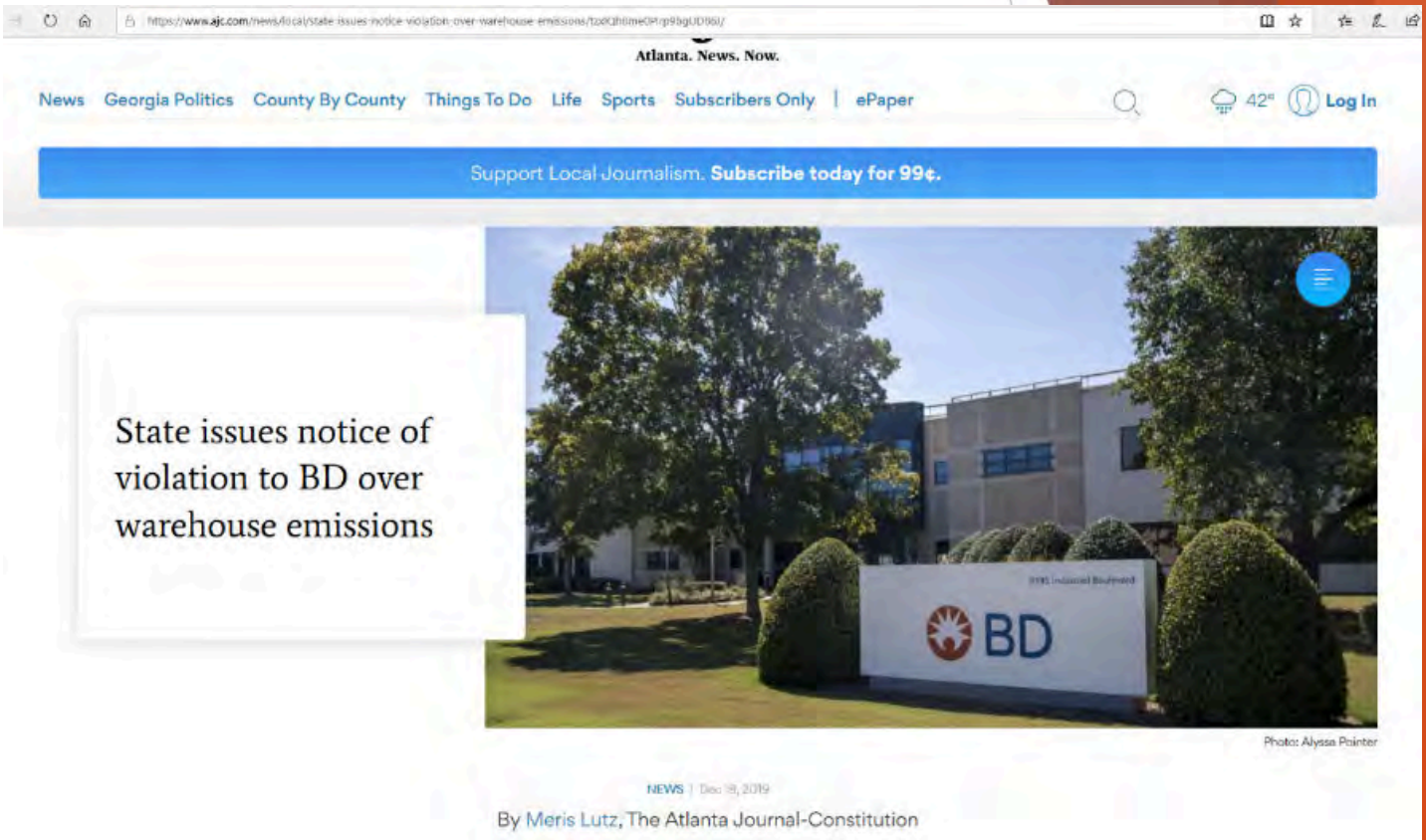
- [2] Perry, S.G., Cimorelli, A.J., Paine, R.J., Brode, R.W., Weil, J.C., Venkatram, A., Wilson, R.B., Lee, R.F. and Peters, W.D., 2005. "AERMOD: A dispersion model for industrial source applications. Part II: Model performance against 17 field study databases," *Journal of Applied Meteorology*, *44* (5), pp.694-708.
  - Figure 2(c): Shows *severe trend at low concentrations for the 24 hour average data*
  - **"All of the Q-Q plots reflect a drop-off in the modeled distributions for the low concentrations. This has obvious implications for the annual average estimates. ….Both ISCST3 and AERMOD have some problems with the annual average estimates. For flat and simple terrain, the models underpredict the observed annual averages."**
- **Why is a model that greatly underpredicts 24hr / annual average emissions being used to evaluate the *emissions area of impact*?**
  - **RLINE is under development but focused on improved near-field dispersion.**
  - **CALPUFF has been recommended to better predict far-field emission levels.**



Medical Equipment Warehouses EtO Emissions

AJC (Dec 18, 2019): State regulators issued a notice of violation Wednesday to a Newton County sterilization plant after air sampling showed its off-site warehouse could be **emitting 5,600 pounds a year of ethylene oxide**, a carcinogenic gas.

Fact: ***Warehouses Storing EtO Sterilized Medical Supplies Emit Large Quantities of EtO***



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State issues notice of violation to BD over warehouse emissions

Photo: Alyssa Pointer

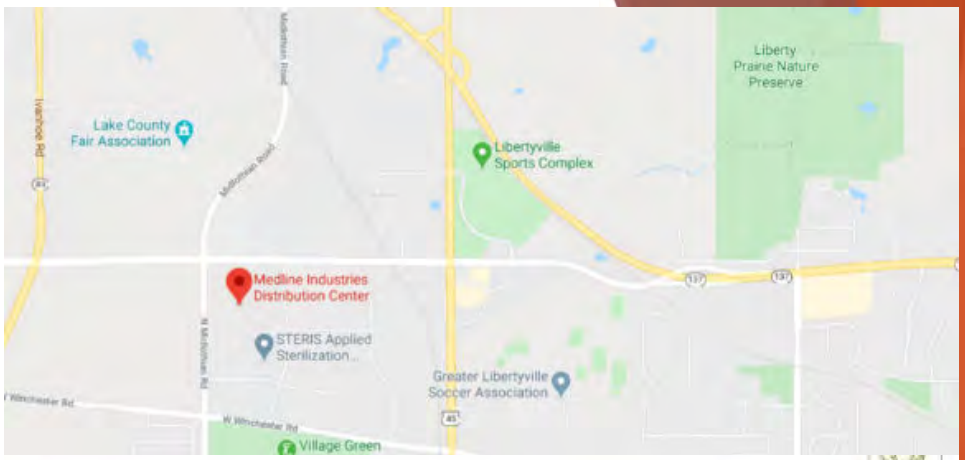
NEWS

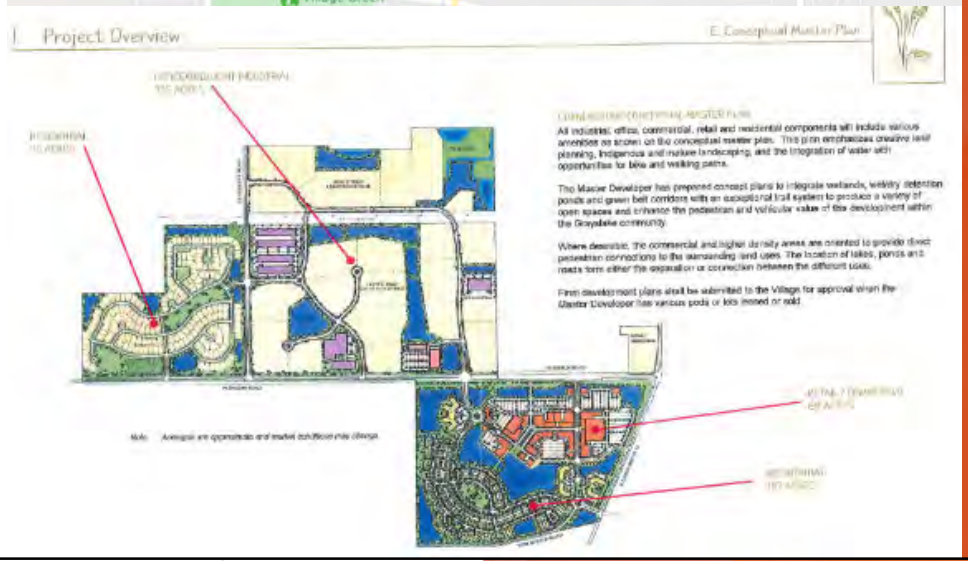
By Meris Lutz, The Atlanta Journal-Constitution

Medical Equipment Warehouses EtO Emissions

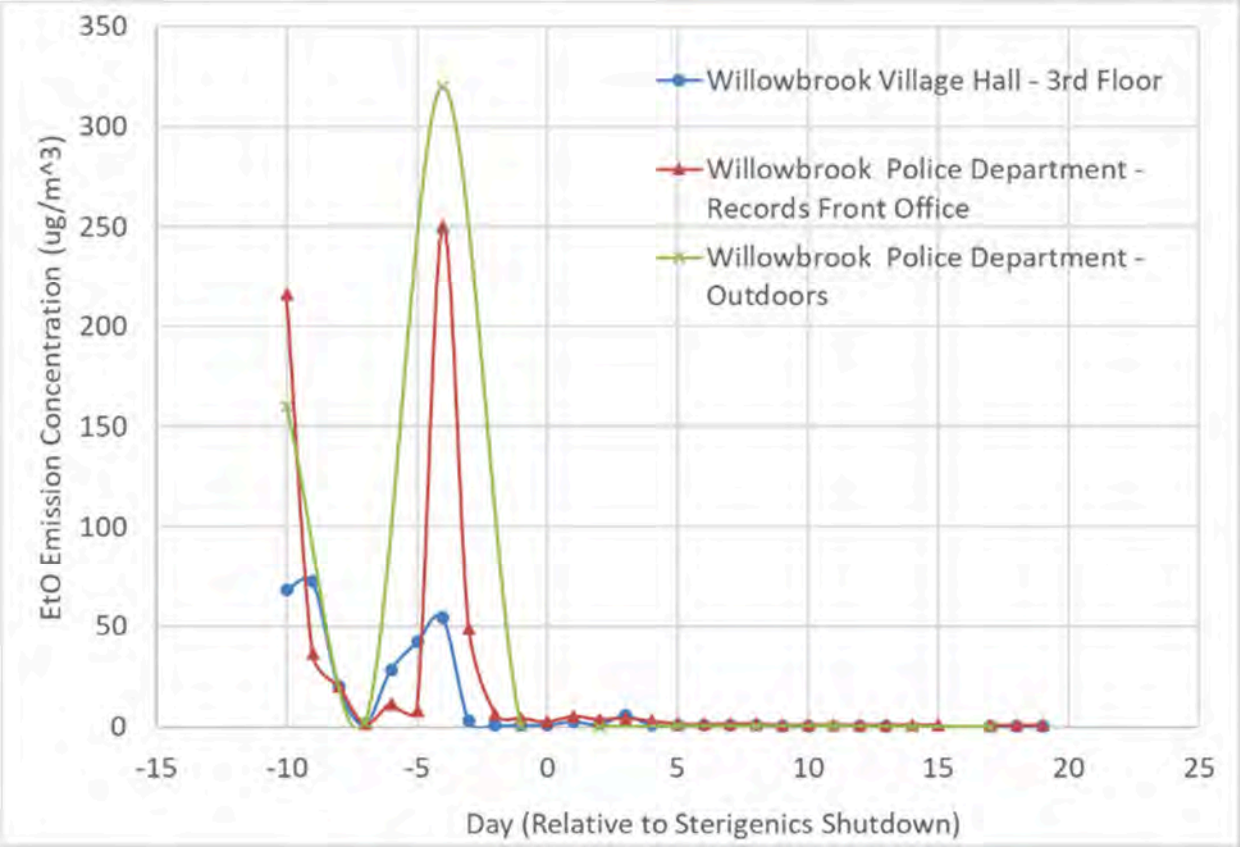
Lake County Warehouses:

1. **Does Medline's Industries Distribution Center in Libertyville produce emissions?**
   - **Has IL EPA Investigated this?**
2. **A new large Medline warehouse and office facility will be first development built on the long-delayed Cornerstone project planned for far southern Grayslake.**
   - **We've received no answer whether this site will store EtO sterilized devices.**





Sterigenics Before and After Shutdown – Comparison of Outdoor and Indoor Measurements [1]



[1] https://www.willowbrookil.org/DocumentCenter/View/1897/ETO-V-2?fbclid=IwAR0K5nBIxYm99v3jTq0JzTp4-u9mhajVytA9fqGg-UW_7gNbdcq3Tx0VKns

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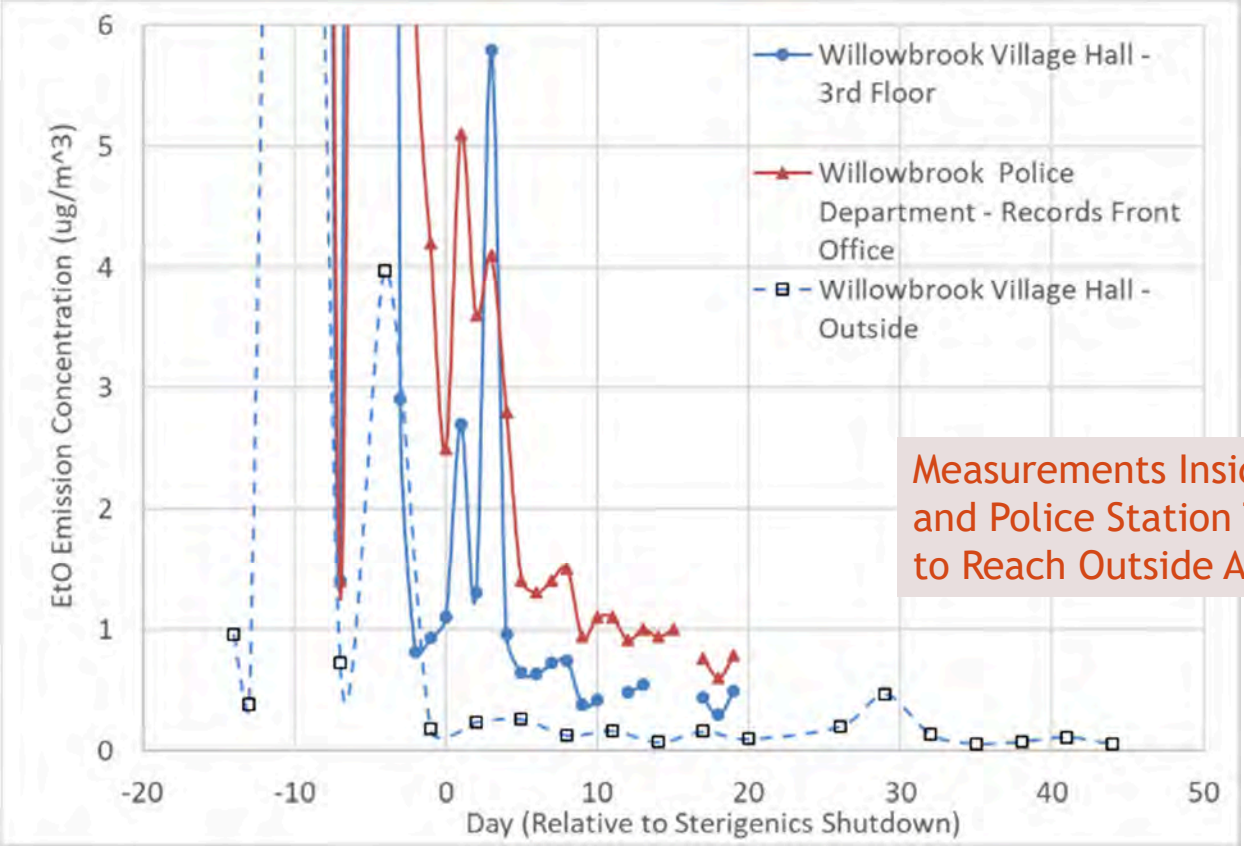
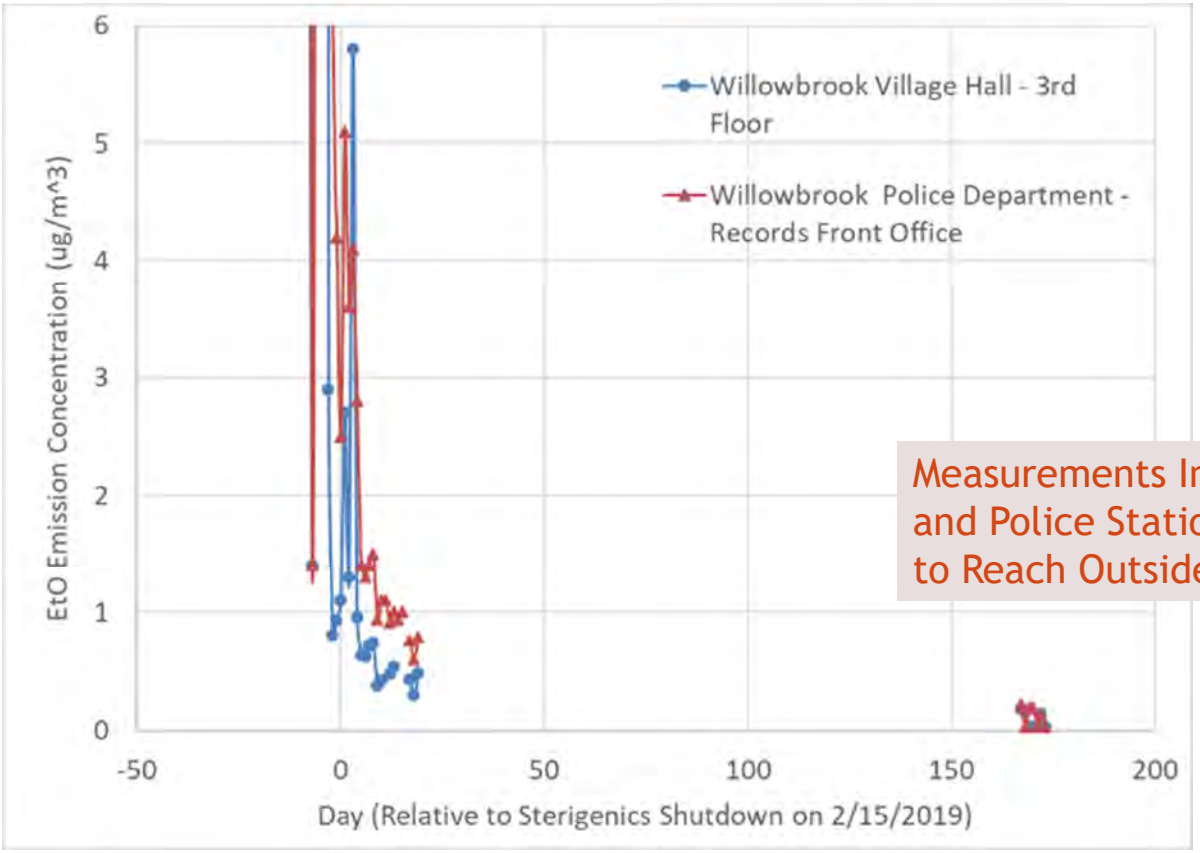


Measurements Inside Village Hall and Police Station Took Many ***Weeks*** to Reach Outside Ambient Levels

Outdoor Levels Experienced Immediate Drop After Shutdown

[1] https://www.willowbrookil.org/DocumentCenter/View/1897/ETO-V-2?fbclid=IwAR0K5nBIxYm99v3jTq0JzTp4-u9mhajVytA9fqGg-UW_7gNbdcq3Tx0VKns

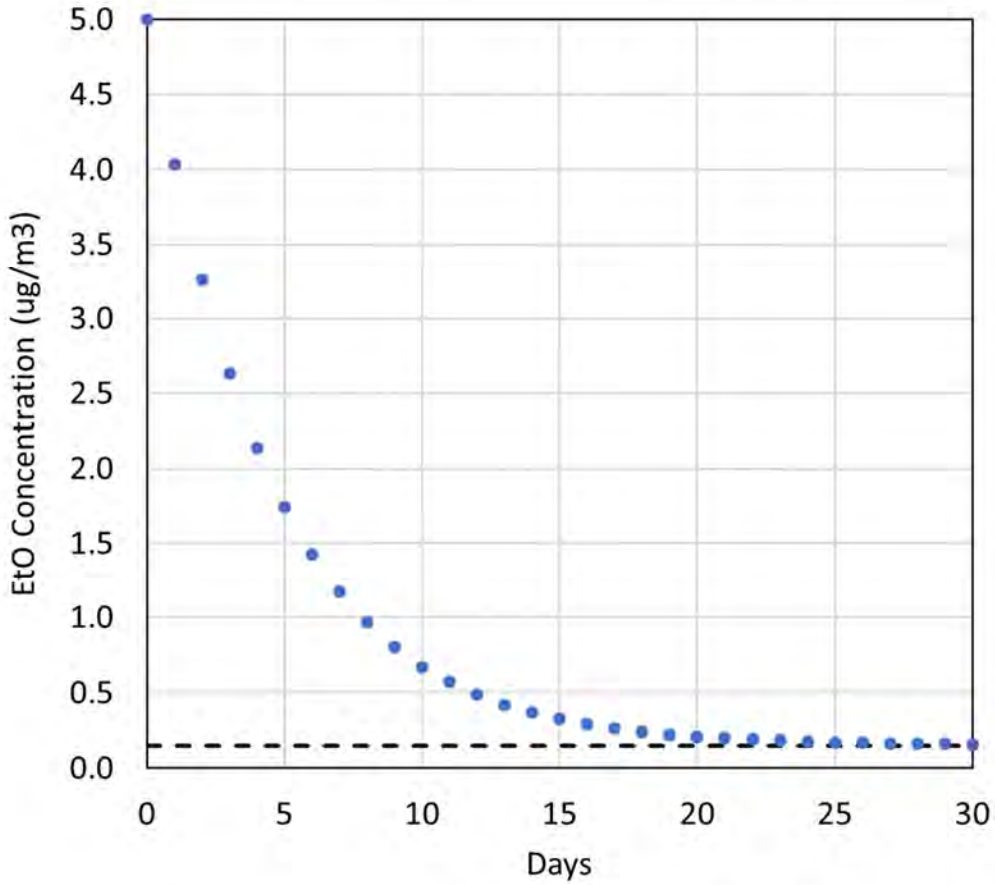
Sterigenics Before and After Shutdown – Comparison of Outdoor and Indoor Measurements [1]



Measurements Inside Village Hall and Police Station Took Many ***Weeks*** to Reach Outside Ambient Levels

[1] https://www.willowbrookil.org/DocumentCenter/View/1897/ETO-V-2?fbclid=IwAR0K5nBIxYm99v3jTq0JzTp4-u9mhajVytA9fqGg-UW_7gNbdcq3Tx0VKns

Model of Dilution from High Indoor Level over Time (Assume 20% Mix of Ambient Air Each Day)



- Initial Concentration:
  - 5.0 μg/m^3
- Ambient Air:
  - 0.153 μg/m^3
- Mixing Rate:
  - 20% Ambient Air per day

Leak Reporting


ILLINOIS ENVIRONMENTAL PROTECTION AGENCY

CONSTRUCTION PERMIT
MESS SOURCE

PERMITTEE

Vantage Specialties, Inc.
Attn: Jon Lafferty
3938 Porett Drive
Gurnee, Illinois 60031

Application No.: 19100015
Applicant's Designation:
Subject: Annual Cap on Emissions of Ethylene Oxide
Date Issued: December 17, 2019
I.D. No.: 097035AAQ
Date Received: October 22, 2019
Source Location: 3938 Porett Drive, Gurnee, Lake County

This Construction Permit is hereby granted to the above-designated Permittee for the source at the above location setting an annual cap on the emissions of ethylene oxide of this source and requirements related to this emissions cap pursuant to the above-referenced permit application. This Permit is subject to standard conditions attached hereto and the following conditions:

If you have any questions on this permit, please contact Daniel Rowell.

Raymond E. Pilapil

Raymond E. Pilapil
Manager, Permit Section
Bureau of Air

REP:DBR:tas

DBR 12/17/19

- **Why No Leak Report from Vantage In November 2019?**
  - Vantage Permit: 7(b)(iii) is a provision that basically says any ethylene oxide emission not accounted for by regular operations or another reporting requirement requires notification to the ILEPA. They have to account for all EtO emitted.
  - Note: Vantage Permit did not technically take effect until December 18, 2019.
- Vantage should have treated the November 2019 results as if the permit was in place
- The high emissions detected required an immediate response to both the IL EPA and local community.
  - If citizens are aware of a leak, actions can be taken to mitigate the effect.
  - If Vantage doesn't follow best reporting practices during the testing phase, how are we expected to trust them in the future when they are not being monitored?
- Since recent past testing didn't appear to count for both Vantage and Medline, we absolutely require a full 90 days of testing with permits and systems in place in order to make a fair determination that these companies are indeed acting as good corporate citizens.

Recommendations and Questions

1. Use statistical models to support understanding of Ethylene Oxide (EtO) test results
2. Upwind data provides good estimate of local ambient EtO Levels
3. Republish US EPA AQS EtO Ambient 18 City data report with corrected results
4. Develop procedure for evaluating whether companies are meeting EtO emission limits using canister test data, per Illinois Law
   - Recommend using technique following Michigan Department of Environment
5. Don't use AERMOD for estimating EtO emission impact / risk extent
   - Study alternative emission models to AERMOD for far-field emissions modeling
6. Test medical equipment warehouses for possible EtO emissions (see Georgia EPD)
7. Vantage appears to have exceeded permit during November testing.
   - What has been done? Why is the community unaware of what has been done?
8. Address gaps in EtO leak reporting process -> get information quickly to public
   - Immediate notifications especially needed for locations near high EtO emitters
9. Request full 90 days of EtO cannister testing for Medline and Vantage in 2020