Appendix 1 to the Risk Assessment Report for the Sterigenics Facility in Willowbrook, Illinois:

Development of Ethylene Oxide Emissions Rates Used for Risk Assessment

Introduction

We (the EPA) developed ethylene oxide (EtO) emission estimates for the Sterigenics facility in Willowbrook, Illinois (Willowbrook 1 and Willowbrook 2 buildings), starting with information provided to us by Sterigenics regarding their operations, estimated emissions rates, and operational parameters for both the controlled and uncontrolled sources. We took this information and derived site-specific emission factors from previous stack testing results for the "controlled" sources, and estimated site-specific emission factors for the uncontrolled or "fugitive" emissions. Emission factors are calculated values that relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant and are generally assumed to be representative of long-term averages. Using dispersion modeling, we evaluated the accuracy of these site-specific emission factors and made adjustments to the factors so that the modeled results would better correspond with the ambient air concentrations measured at the monitoring sites near the facility. Tables 1 and 2 give the site-specific emission factors for each emission point type used for the risk assessment.

Table 1. Willowbrook 1 and Willowbrook 2 site-specific emission factors used for the risk assessment

Facility	Sterilizer vacuum vent (lbs EtO emitted/ton used)	Aeration room and backvent (lbs EtO emitted/ton used)	Fugitives[11] (lbs EtO emitted/ton used)
Willowbrook 1	0.9	0.5	12.0
Willowbrook 2	9.4	0.5	13.0

The EPA used the site-specific emission factors and annual EtO usage rates for each building to determine the EtO emission rate for each emission point. An emission rate is the mass of a pollutant emitted over a period of time. The emission rate for each emission point was calculated as:

$$E_R = EF * U_D * K$$

Where:

E_R = Emission Rate (lb/hr)
U_D = 2017 Facility Usage[12] (ton/year)
EF = Emission Factor (lbs EtO emitted/ton used)
K = 0.000114, conversion from lbs/year to lbs/hr

The emission rates for all sources at Willowbrook 1 and Willowbrook 2 were combined to yield the emissions estimates in Table 2.

Table 2. Willowbrook 1 and Willowbrook 2 emission estimates used for the risk assessment

	Emission Rate (lbs/hr)
Willowbrook 1	0.28
Willowbrook 2	0.19

Methodology

The emission factors in Table 1 were developed in part based upon ambient sampling that was performed by the EPA in Willowbrook, Illinois, from November 13, 2018 to March 31, 2019.

[11] Combined output for all fugitive emission sources.
[12] 2017 usage rates Willowbrook 1 (142 tons), Willowbrook (70 tons).

Sampling was conducted at eight total locations, two of which are very near the facility (Willowbrook Village Hall and EPA warehouse), and six additional sampling locations in the surrounding community. For the purposes of this analysis, only the sample data for Willowbrook Village Hall and the EPA warehouse were used, and only for the dates on which the facility was actively processing EtO.[13] The EtO samples were collected and analyzed according to EPA Compendium Method TO-15, Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS),[14] and the Quality Assurance Project Plan (QAPP) for the Field Sampling Plan for Ambient Air Ethylene Oxide Monitoring Near Sterigenics Facility, Willowbrook, IL, dated November 17, 2018.[15] The ambient air samples were collected on a 1-in-3 day schedule[16] throughout the program with the exception of periods in which sampling was collected off-schedule to accommodate holidays or when weather was not conducive to sampling.

Sterigenics provided information to the EPA regarding the locations of expected EtO emissions points for both controlled and fugitive emissions, as well as emission factors for these sources. This information included the exact location, release height above ground, exit velocity, temperature, and other parameters needed for dispersion modeling. In addition to this information, the company also provided daily EtO usage rates[17] for each building for the entire sampling period, which were used to determine the daily emission rates for the individual emission points.

Air dispersion modeling of the emission points[18] was conducted using the latest version of the American Meteorological Society/EPA Regulatory Model (AERMOD) atmospheric dispersion model (version 18081). Meteorological data used for the dispersion modeling came from a temporary weather station located on the roof of the EPA warehouse building. Where meteorological data were not available from this location due to data availability or quality concerns, alternate data were acquired from Midway Airport, located approximately 16 km east of the facility. For each day in which samples were collected, modeling runs were performed using the established modeling parameters (all emission locations), the meteorological data for that day, and calculated daily emission rates (all emission locations combined) to determine the projected impact (i.e., concentrations) of EtO in the areas surrounding the facility. The modeling does not consider any background concentrations of EtO that may be present in the ambient air; it only takes into account EtO emissions from emission points at the facility. To compare the measured ambient values against the modeled values, the EPA corrected the modeling results to include background concentrations[19] of EtO by adding the corresponding background concentration observed at the upwind location for each sampling day. Upwind locations were

[13] November 13, 2018 – February 11, 2019.
[14] USEPA. 1999. "Air Method, Toxic Organics-15 (TO-15): Compendium of Methods for the Determination of Toxic. Organic Compounds in Ambient Air, Second Edition: Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)." EPA 625/R-96/010b. https://www.epa.gov/homeland-security-research/epa-air-method-toxic-organics-15-15-determination-volatile-organic.
[15] https://www.epa.gov/sites/production/files/2018-11/documents/qapp_eto_willowbrook_v1.4_final_signed.pdf.
[16] See addendum for sampling days and the sample results for all locations (Table A-1).
[17] See addendum for EtO usage for Willowbrook 1 and Willowbrook 2 (Table A-2).
[18] See addendum for emission point details (Table A-3).
[19] See addendum for daily background EtO levels (Table A-4).

identified based on daily meteorology to determine which residential sampling location was not affected by emissions from the facility.

We made a number of assumptions regarding the other sources of EtO emissions in the area of the facility and the emissions from and modeling parameters for the Sterigenics fugitive emission points that could not be verified from previous testing. We evaluated all known sources of EtO in the area and did not identify any significant sources. To confirm this assumption, we used a diagnostic mapping tool called a polarPlot[20] that shows EtO concentrations by wind speed and direction and allows us to identify any potential sources of EtO. This tool identified no sources of EtO other than Sterigenics. Additionally, while there are no test data to verify the exact location of the fugitive sources at the company and their associated modeling parameters, the information provided by the company seemed appropriate based on our understanding of the processes at the facility.

Emission Factor Development and Evaluation

The development of the site-specific emission factors was predicated on the ability to achieve agreement between the modeled values with the observed values from the ambient sampling. To do this, we used an iterative process to evaluate different emission factors and modeling parameters to predict emissions versus the observed ambient values within the accuracy of the model (factor of +/- 2). This was done by determining the impact at the location of the ambient monitoring sites using modeling of each emission point (controlled and fugitive) at the facility. As a starting point, we performed a sensitivity analysis for each of the site-specific emission factors provided by Sterigenics against a "strawman" scenario representing a decrease in the control efficiency of those controlled sources and an increase in fugitives for a number of ambient sampling days.[21] We took the site-specific emission factors combined with the corresponding daily usage rate data for each building to determine the daily EtO emission rate for each emission point. The emission rates for each sampling day were calculated in the same manner as for the risk assessment, but the daily usage rate was used to determine an emission rate specific to the sampling day. Table 3 gives the emission factors used for the sensitivity analysis.

Table 3. Site Specific Emission Factors Used for Sensitivity Analysis

Building	Whole site emission factor (lbs/ton)	Sterilizer vacuum vent (lbs/ton)	Aeration room and backvent (lbs/ton)	Fugitives (lbs/ton)
Sterigenics Emission Factor				
Willowbrook 1	1.4	0.01	0.4	1.0
Willowbrook 2	2.5	1.1	0.4	1.0
Strawman				
Willowbrook 1	5.9	1.9	1.0	3.0
Willowbrook 2	5.9	1.9	1.0	3.0

Table 4 gives the average model-to-monitor comparison for the sensitivity analysis. The results of this analysis indicated that the results of the modeling using the emission factors used for both the Sterigenics and the EPA Strawman were significantly underpredicting the observed values.

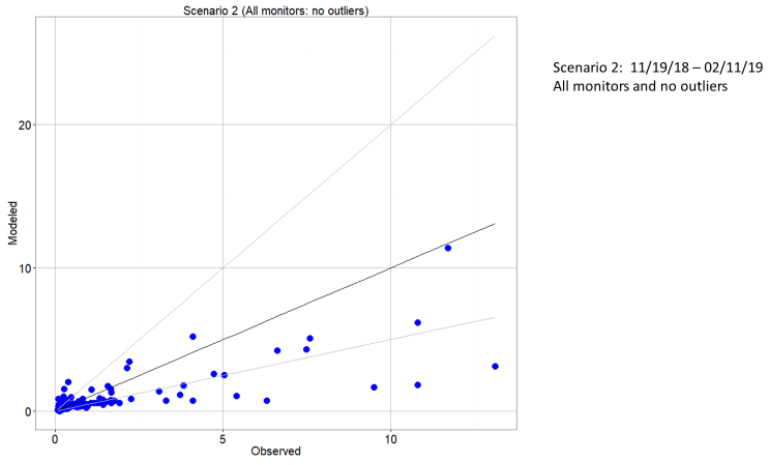
[20] See addendum of polarPlot maps (Figure A-1).
[21] December 6, 13, and 26, 2018; and January 17.

Table 4. Model to Monitor Comparison for the Sensitivity Analysis

Location	Observed ($\mu g/m^3$)	Sterigenics emission factors ($\mu g/m^3$)	Strawman emission factor ($\mu g/m^3$)
Willowbrook Village Hall	4.69	0.13	0.61
EPA Warehouse	8.41	0.49	2.23

Based on these results, we chose to modify the emission factors in Table 3 for the controlled emissions from the EPA strawman to be in-line with manufacturer guarantees for similar pollution control equipment installed at the facility. We also reviewed the modeling parameters and compared them against previous test data at the facility as well as other test data from similar sources. This review yielded some seasonal corrections to the modeling parameters to better reflect the likely exit temperatures of the exhaust points during the winter months. With the controlled emission factors set, we incrementally increased the emission factors for the fugitive sources until the objectives were met for the comparison of the modeled results to the observed values. During this period, we were in contact with the company regarding the modifications being made to the facility air handling system and how these changes would affect the fugitive sources. We made revisions to the modeling parameters as new information was received, and these revisions were used for all modeling going forward. Figure 1 gives the ambient monitoring results (observed) plotted against the values developed from the dispersion modeling (modeled) based on the final emission factors and modeling parameters, for all monitor locations. This plot compares the monitored to the modeled results in a manner consistent with past evaluations of AERMOD[22] by comparing the monitored and modeled results unpaired in time and space, called a Q-Q plot. The monitored and modeled concentration distributions are both sorted and plotted against each other based on rank, so the highest monitored concentration is compared against the highest modeled concentration, regardless of the location and time of occurrence.

Figure 1. Modeled value vs. observed value comparison (11/19/2018 – 02/11/2019)



We did a model-to-monitor comparison using a statistic called the Robust Highest Concentration (RHC) and fractional bias. This comparison focuses on the higher concentrations in the distribution. The RHC coupled with fractional bias is the preferred methodology in the EPA's

[22] USEPA. 2003. "AERMOD: Latest Features and Evaluation Results." EPA-454/R-03-003. https://www3.epa.gov/scram001/7thconf/aermod/aermod_mep.pdf.

Protocol for Determining the Best Performing Model.[23] Normally, the protocol evaluates 1-hour, 3-hour, and 24-hour average concentrations. Since the ambient monitoring data for Sterigenics are only 24-hour averages, we focused only on 24-hour averages. The RHC is calculated at each monitoring location for observed concentrations and modeled concentrations.

The RHC is calculated as:

$$RHC = \mathrm{X}(N) + [\bar{\mathrm{X}} - \mathrm{X}(N)] \times \ln\left[\frac{3N-1}{2}\right]$$

Where X(N) is the Nth highest concentration, and $\bar{\mathrm{X}}$ is the average of N-1 values where N is typically set to 26 values for most model evaluations. However, given the small sample size at each monitor, we started with N=11 and evaluated results up to N=20 (the fewest number of observations across the monitors). As stated above, the RHC is calculated at each monitor for observed concentrations and modeled concentrations. Next a fractional bias is calculated using the maximum observed RHC and maximum modeled RHC as:

$$FB = 2\left[\frac{OB - PR}{OB + PR}\right]$$

Where FB is the fractional bias, OB is the maximum observed RHC, and PR is the maximum modeled RHC. A positive (negative) fractional bias indicates model underprediction (overprediction). Fractional biases within ± 0.67 are not considered statistically different. Also, note that the two RHC values in the fractional bias may not be from the same monitor location. This is done to assess the model's ability to assess concentrations for regulatory purposes, that is, how well the model predicts maximum concentrations regardless of the spatial location. Table 5 gives the fractional biases and monitors used for the calculations for a range of values of N using the meteorology at the EPA warehouse and the estimated emissions factors.

Table 5. Fractional Bias Estimates Using All Monitors

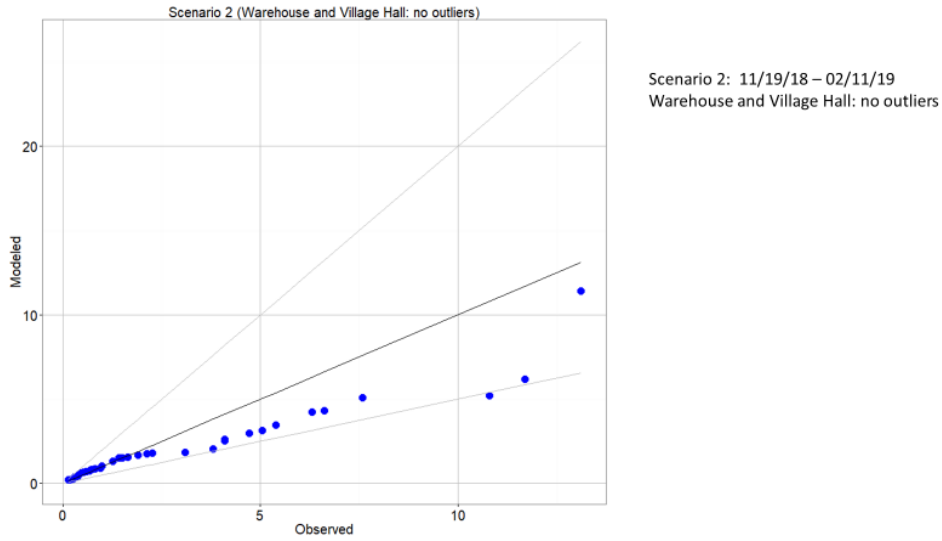
N	Observed RHC	Modeled RHC	Fractional Bias	Observed monitor location	Modeled monitor location
11	20.8	8.0	0.89	EPA Warehouse	EPA Warehouse
12	19.8	7.5	0.90	EPA Warehouse	EPA Warehouse
13	19.0	7.3	0.9	EPA Warehouse	EPA Warehouse
14	17.9	7.0	0.9	EPA Warehouse	EPA Warehouse
15	16.9	6.8	0.8	EPA Warehouse	EPA Warehouse
16	16.7	6.7	0.9	EPA Warehouse	EPA Warehouse
17	16.1	7.0	0.8	EPA Warehouse	EPA Warehouse
18	16.2	6.9	0.8	EPA Warehouse	EPA Warehouse
19	14.4	6.5	0.8	EPA Warehouse	EPA Warehouse
20	13.7	6.3	0.7	EPA Warehouse	EPA Warehouse

We also generated a Q-Q plot of the concentrations at only the Willowbrook Village Hall and the EPA warehouse, shown in Figure 2. The plot indicates good agreement on the low end of the concentration distribution, and underprediction at the middle to high end of the concentration

[23] USEPA. 1992. Protocol for Determining the Best Performing Model. EPA-454/R-92-025.

distribution, but within a factor of 2, which is acceptable performance. At the highest end of the distribution, the model is just slightly underpredicting compared to the observed maximum.

Figure 2. Q-Q plot



In addition to the RHC analysis and Q-Q plots, we also did a direct comparison of the modeled values against the observed values at Willowbrook Village Hall and the EPA warehouse. For this analysis, all data points were included in the comparison unless a sample was invalided, elevated background concentrations were observed, or when a result was considered an outlier. A total of 47 data points was used for this analysis, 26 from sampling events at the Willowbrook Village Hall monitoring location and 21 from the EPA warehouse monitoring location. The modeled value agreed (within a factor of 2) with the observed value for approximately 65 percent of the sampling events, with the model overpredicting 15 percent and underpredicting 20 percent of the time. A comparison of the means of the modeled versus the observed or monitored results, the observed mean was within the accuracy of the model, although the model appears to underpredict. The mean observed value is heavily influenced by the elevated values observed after January 12, 2019, following a maintenance event at Willowbrook 1. Tables 6 and 7 present the results of the model-to-monitor comparison for the entire sampling period and for the period prior to the maintenance event at Willowbrook 1, respectively.

Table 6. Model-to-monitor comparison 11/19/2019 – 02/11/2019

Location	Mean Observed Value ($\mu g/m^3$)	Mean Modeled Value[24] ($\mu g/m^3$)
Willowbrook Village Hall	2.83	1.53
EPA Warehouse	3.14	2.02

[24] Corrected for background.

Table 7. Model-to-monitor comparison 11/19/2019 – 01/09/2019

Location	Mean Observed Value ($\mu g/m^3$)	Mean Modeled Value[25] ($\mu g/m^3$)
Willowbrook Village Hall	2.85	2.05
EPA Warehouse	2.31	2.69

The model-to-monitor comparison showed reasonable results when comparing mean results at the monitor location, but the model had difficulty predicting the elevated results at these locations on a few of the days when samples were collected. Disparities in the modeled versus the observed results can be attributed to the model's sensitivity to errors in the meteorology or to the other activities at the facility or happening in the surrounding area that could affect plume magnitude or dispersion. This could explain the closer relationship observed at the EPA Warehouse sampling location which was near the temporary weather station located on the EPA Warehouse building.

Conclusions

The site-specific estimated emission factors from which the emission rates were derived and modeling parameters developed for the risk assessment appear to adequately predict the expected concentrations surrounding the facility and, while these factors appear to underpredict the emissions from the facility, the results are well within the acceptable performance of the model.

The results of this analysis provide an estimation of the emission of the EtO emissions for the purposes of the risk assessment. These results only provide emission estimates for the period in time when ambient samples were collected and analyzed. A more refined assessment of these emissions was problematic due to the limited number of monitoring locations near the facility and the relatively small sample size. While additional measurements were collected from the residential areas, these were not used for this analysis due to the significant proportion of EtO concentrations present in the ambient air not attributed to the company.

The tools used to perform this analysis were adequate due to the magnitude of the emissions from the facility. Any changes made to the facility or similar facilities which would result in a significant decrease in EtO emissions would result in a need to revise the way emissions are characterized. Any future assessment should incorporate direct measurement of all emission points at the facility during all aspects of operation to more effectively determine emission factors. As these sources become better controlled (e.g., improved capture and control of fugitives), emission characterization using ambient measurements will become more difficult because the contribution from the facility would be less distinguishable from levels found in the ambient air.

[25] Corrected for background.

Addendum to Appendix 1

Table A-1. Ambient monitoring results (µg/m$^{3)}$ for Willowbrook village hall and EPA warehouse locations

Sample Start Date	Willowbrook village hall	EPA warehouse	Sample Start Date	Willowbrook village hall	EPA warehouse
11/13/2018	Invalid	2.37	1/27/2019	19.3	1.11
11/16/2018	0.824	1.81	2/1/2019	0.954	0.133
11/19/2018	6.11	6.62	2/2/2019	0.383	0.228
11/23/2018	0.284	0.180	2/5/2019	17.3	26.4
11/25/2018	4.10	Invalid	2/8/2019	0.725	5.04
11/28/2018	1.83	0.248	2/11/2019	3.98	ND
12/1/2018	1.68	0.456	2/14/2019	0.178	0.745
12/6/2018	5.39	11.7	2/19/2019	0.239	0.150
12/7/2018	0.737	2.26	2/20/2019	0.260	0.159
12/10/2018	0.300	0.269	2/21/2019	0.144	ND
12/13/2018	2.04	0.436	2/22/2019	0.123	0.121
12/16/2018	0.871	2.11	2/23/2019	0.128	0.132
12/19/2018	0.521	0.345	2/26/2019	0.166	0.119
12/22/2018	0.981	3.09	3/1/2019	ND	0.103
12/26/2018	10.8	Invalid	3/4/2019	0.161	ND
12/28/2018	0.672	1.42	3/7/2019	0.099	0.096
1/2/2019	0.251	0.237	3/10/2019	Invalid	0.075
1/3/2019	0.372	ND	3/13/2019	0.204	0.122
1/6/2019	7.59	ND	3/16/2019	0.461	0.171
1/9/2019	3.81	Invalid	3/19/2019	0.136	0.056
1/12/2019	1.57	ND	3/22/2019	0.060	0.117
1/15/2019	0.672	14.2	3/25/2019	0.078	0.134
1/17/2019	0.517	13.1	3/28/2019	0.114	0.181
1/22/2019	1.51	4.10	3/31/2019	0.057	ND
1/24/2019	0.262	0.280	-	-	-

Table A-2. Daily ethylene oxide usage rates (lbs) fed to the sterilization chamber

Date	Willowbrook 1	Willowbrook 2	Date	Willowbrook 1	Willowbrook 2
11/13/2018	**755 (820)**	**482 (477)**	12/30/2018	853	0
11/14/2018	753	495	12/31/2018	510	0
11/15/2018	794	258	1/1/2019	622	0
11/16/2018	**864 (935)**	**611 (385)**	**1/2/2019**	**598 (491)**	**0 (0)**
11/17/2018	877	489	**1/3/2019**	**732 (718)**	**0 (0)**
11/18/2018	938	465	1/4/2019	795	151
11/19/2018	**880 (981)**	**517 (529)**	1/5/2019	703.3	420
11/20/2018	1057	413	**1/6/2019**	**110 (517)**	**279 (487)**
11/21/2018	946	694	1/7/2019	0.3	485
11/22/2018	808	339	1/8/2019	0	274
11/23/2018	**827 (1036)**	**690 (593)**	1/9/2019	0	338
11/24/2018	844	538	1/10/2019	0	242
11/25/2018	**665 (729)**	**131 (487)**	1/11/2019	613.9	485
11/26/2018	844	0	**1/12/2019**	**940 (895)**	**315 (468)**
11/27/2018	789	0	1/13/2019	693.7	489
11/28/2018	**851 (864)**	**0 (0)**	1/14/2019	911.4	333
11/29/2018	902	0	**1/15/2019**	**764 (805)**	**318 (336)**
11/30/2018	943	0	1/16/2019	950.7	58
12/1/2018	**793 (908)**	**11 (11)**	**1/17/2019**	**813 (760)**	**344 (128)**
12/2/2018	837	515	1/18/2019	857.7	420
12/3/2018	975	341	1/19/2019	800.2	343
12/4/2018	1035	390	1/20/2019	803.6	484
12/5/2018	972	445	1/21/2019	1068.2	317
12/6/2018	**1054 (1105)**	**347 (317)**	**1/22/2019**	**787 (1003)**	**298 (417)**
12/7/2018	**697 (839)**	**262 (480)**	1/23/2019	862.1	373
12/8/2018	948	447	**1/24/2019**	**653 (859)**	**340 (426)**
12/9/2018	1020	415	1/25/2019	960.9	396
12/10/2018	**852 (892)**	**412 (494)**	1/26/2019	759.7	444
12/11/2018	843	414	**1/27/2019**	**888 (875)**	**286 (313)**
12/12/2018	797	416	1/28/2019	916.1	313
12/13/2018	**1064 (852)**	**476 (441)**	1/29/2019	866.4	358
12/14/2018	671	59	1/30/2019	607.1	289
12/15/2018	574	0	1/31/2019	928.1	357
12/16/2018	**626 (786)**	**293 (222)**	**2/1/2019**	**892**	**345**
12/17/2018	964	470	**2/2/2019**	**829**	**340**
12/18/2018	669	384	2/3/2019	821.5	188
12/19/2018	**826 (988)**	**402 (312)**	2/4/2019	795.1	282
12/20/2018	878	351	**2/5/2019**	**773**	**344**
12/21/2018	784	342	2/6/2019	974.6	131
12/22/2018	**685 (953)**	**0 (283)**	2/7/2019	790.4	312
12/23/2018	797.2	0	**2/8/2019**	**847**	**470**
12/24/2018	736	350	2/9/2019	929.6	352
12/25/2018	893	399	2/10/2019	657.3	553
12/26/2018	**631 (796)**	**471 (471)**	**2/11/2019**	**814**	**260**
12/27/2018	784	360	2/12/2019	69.5	302
12/28/2018	**593 (684)**	**295 (293)**	2/13/2019	818.7	442
12/29/2018	671	228	2/14/2019	852.8	408

Note: BOLD values are days in which ambient sampling was taken. Additionally, the values in (parenthesis) for sample dates from 11/13/2018 – 1/27/2019 are the estimated mass of ethylene oxide sent to the pollution controls.

Table A-3. Willowbrook 1 and Willowbrook 2 emission points and locations

Building	Source ID	Source Description	Easting (X)[26]	Northing (Y)[27]	EtO Emissions (Yes/No)	Emission Type
WB1	STK1	Deoxx	421892.07	4622242.11	Yes	Controlled emissions from the chamber vent
WB1	STK2	AAT Scrubber	421897.15	4622252.27	Yes	Controlled emissions from the aeration rooms and backvent
WB1	1EF11	1-EF-11 Work Aisle	421896.70	4622230.30	Yes	EtO fugitive emission point
WB1	1EF15	1-EF-15 Process Storage/East Aeration	421911.94	4622211.67	No	Former fugitive emission point, exhaust fan has been turned off effective January 2019 (assumed)
WB1	1EF3	1-EF-3 Shipping	421835.32	4622206.80	Yes	EtO fugitive emission point
WB1	1EF4	1-EF-4 Process Storage/Central Aeration	421868.72	4622224.47	Yes	EtO fugitive emission point
WB1	1EF10	1-EF-10 Maintenance Aisle	421897.74	4622213.58	No	Former fugitive emission point
WB1	1EF9	1-EF-9 Work Aisle/Boiler Room	421888.14	4622229.62	Yes	EtO fugitive emission point
WB1	1EF13	1-EF-13 Chamber A or 9	421904.23	4622241.98	No	Former fugitive emission point, exhaust fan has been turned off
WB1	1EF20	1-EF-20 Chamber B Cubical Exhaust	421922.88	4622241.05	No	Former fugitive emission point, exhaust fan has been turned off
WB1	1EF21	1-EF-21 Aat Scrubber Room Exhaust	421925.04	4622249.06	No	No emission expected
WB1	1EF8	1-EF-8 Pump Aisle	421879.63	4622243.03	No	No emission expected
WB1	1EF12	1-EF-12 Chamber A Gassing Room	421908.04	4622241.75	No	Former fugitive emission point, exhaust fan has been turned off
WB1	1EF16	1-EF-16 Chamber A Cubicle	421913.64	4622241.08	No	No emission expected
WB1	1EF19	1-EF-19 Chamber E Cubical Exhaust	421921.00	4622223.31	No	No emission expected
WB1	1EF18	1-EF-18 Chamber C Cubical Exhaust	421916.72	4622238.97	No	No emission expected
WB2	A	AAT Scrubber	421701.70	4622357.89	Yes	Controlled emissions from chamber vent, aeration room, and backvents
WB2	B	3 Chamber Backvent	421708.37	4622378.69	No	Former EtO emission point, routed to AAT scrubber July 2018
WB2	C	1 Chamber Backvent	421709.16	4622354.88	No	Former EtO emission point, routed to AAT scrubber July 2018
WB2	P	Chamber Room Exhaust Fan	421736.89	4622335.04	Yes	EtO fugitive emission point
WB2	Q	Work Aisle Exhaust Fan	421736.30	4622328.70	Yes	EtO fugitive emission point
WB2	T2	North Wall Vent West	421713.72	4622390.70	No	Former fugitive emission point, exhaust fan has been turned off effective January 2019 (assumed)
WB2	T3	North Wall Vent East	421742.29	4622390.70	No	Former fugitive emission point, exhaust fan has been turned off effective January 2019 (assumed)

[26] Coordinates reflect UTM NAD83, Zone 16
[27] Coordinates reflect UTM NAD83, Zone 16

Table A-4. Daily background ethylene oxide levels

Date	Background ($\mu g/m^3$)	Background Location	Modeled Background value ($\mu g/m^3$)	Corrected background value ($\mu g/m^3$)
11/19/2018	0.164	Gower ES	0.016	0.148
11/23/2018	0.197	Gower MS	0.007	0.190
11/25/2018	0.345	Willow Pond Park	0.046	0.299
11/28/2018	0.656	Gower MS	0.064	0.592
12/1/2018	0.211	Willow Pond Park	0.013	0.198
12/6/2018	0.082	Willow Pond Park	0.022	0.060
12/7/2018	0.164	Gower ES	0.030	0.134
12/10/2018	0.138	Gower ES	0.017	0.121
12/13/2018	0.211	Water Tower	0.060	0.151
12/16/2018	0.732	Gower ES	0.011	0.721
12/19/2018	0.360	Gower MS	0.028	0.332
12/22/2018	0.360	Gower ES	0.027	0.333
12/26/2018	0.082	Gower MS	0.084	-0.002
12/28/2018	0.133	Gower ES	0.010	0.123
1/2/2019	0.210	Gower ES	0.004	0.206
1/3/2019	0.082	West Neighborhood	0.040	0.042
1/6/2019	0.082	Willow Pond Park	0.006	0.076
1/9/2019	0.295	Hinsdale South High School	0.027	0.268
1/12/2019	0.082	Gower MS	0.007	0.075
1/15/2019	0.082	Gower ES	0.008	0.074
1/17/2019	0.144	Willow Pond Park	0.008	0.136
1/22/2019	0.349	Hinsdale South High School	0.059	0.290
1/24/2019	0.095	Gower ES	0.005	0.090
1/27/2019	0.155	Gower MS	0.045	0.110
2/1/2019	0.101	Gower MS	0.039	0.062
2/2/2019	0.371	Gower MS	0.016	0.355
2/5/2019	0.174	Willow Pond Park	0.006	0.168
2/8/2019	0.202	Gower ES	0.010	0.192
2/11/2019	0.089	Willow Pond Park	0.001	0.088

Figure A-1. EtO Concentration Plots for the Willowbrook Village Hall and EPA Warehouse Monitors