Quarterly Report of Air Quality Monitoring January 1 to June 30, 2024, at the Gregory – Portland Community Air Monitoring Stations

Prepared by

Vincent M. Torres, PE
Project Manager

David W. Sullivan, Ph.D.
Data Analyst and Quality Assurance Manager

Center for Energy & Environmental Resources
The University of Texas at Austin
Austin, Texas

July 22, 2024

Contents

Executive Summary

There are three continuous air quality monitoring stations operating in the Gregory-Portland area. The Gregory Fresnos Community Air Monitoring Station on Fresnos St. began continuous monitoring operations October 1, 2019. Two additional air-monitoring stations in Portland, TX, one near the intersection of Buddy Ganem Dr. and Wildcat Dr. on the campus of the Gregory-Portland High School and the other on Broadway Blvd. on the campus of the old East Cliff Elementary School, began operations on January 1, 2020. The U.S. Environmental Protection Agency (EPA) generally uses three years of data collection to assess attainment with the National Ambient Air Quality Standards (NAAQS). This project has now collected and validated data for more than four years at all three stations.

Since monitoring began, some measured pollutant concentrations have exceeded the concentration levels of NAAQS; however, these values have not been sustained long enough or measured frequently enough to violate a NAAQS. Furthermore, measured hydrocarbon concentrations have not exceeded the levels of concern published by the Texas Commission on Environmental Quality (TCEQ). In fact, the measured concentrations of two EPA criteria pollutants – sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) are among the lowest NAAQS concentration averages in the state over the 2021 to 2023 three-year period, and average hydrocarbon concentrations are among the lowest of the Texas automated gas chromatograph monitors (auto-GCs) operated or funded by the TCEQ across the state.

The public website developed as the community's source for information about the community air monitors continues to provide information about air quality and monitoring data from the three air monitoring stations (https://gpair.ceer.utexas.edu accessed July 2024).

UT Austin would be happy to answer any questions or conduct additional analysis at the community's or sponsors' requests. Contact Vincent Torres at vmtorres@mail.utexas.edu for information on the website or Dave Sullivan at sullivan231@mail.utexas.edu with questions about the monitoring data and analyses in this report.

1.0 Introduction

This report is jointly funded by Cheniere Energy and Gulf Coast Growth Ventures LLC (GCGV) as part of their separate Gregory-Portland community air-monitoring programs. This report includes reviews and analyses conducted by The University of Texas at Austin (UT) of the air monitoring data obtained at the three stations since their continuous monitoring operations began. UT established the Gregory Fresnos (GF) station for Cheniere Energy and has managed the station since continuous monitoring operations began on October 1, 2019. AECOM, an engineering company, established the Portland Buddy Ganem (PBG) and Portland Broadway (PBway) stations for GCGV and has managed the stations since continuous monitoring operations began on January 1, 2020. The primary emphasis in this report is the examination of data collected and validated for the period January 1 to June 30, 2024, and some comparisons to earlier data.

2.0 Summary of Activities January 1 through June 30, 2024

The data completeness acceptable minimum for regulatory monitoring of criteria air pollutants is 75 percent. These three non-regulatory air monitoring stations have generally reported quality assured data at a greater than 75% data completeness.

As was noted in recent quarterly reports, the GCGV ethane-cracking and derivatives facility has been fully operational since January 2022. Operations at the GCGV facility and the Cheniere Energy facility do not appear to have affected the level of pollutants measured at project stations. One exception to this last statement was a short period of two hours when elevated concentrations of ethylene oxide (EtO) were detected by the new continuous EtO monitor that has been running since February 2024 at the Portland Buddy Ganem station. This is described later in this report.

The United States Environmental Protection Agency (EPA) announced on February 7, 2024, that the new level of the PM2.5 NAAQS for the average annual concentration would be reduced from 12 $\mu g/m^3$ at 9.0 $\mu g/m^3$. Currently, the three-year average concentrations at all three stations have averaged lower than this 9.0 $\mu g/m^3$ level.

This report focuses on the data collected at the three air monitoring stations during the period January 1 through June 30, 2024, and includes some summaries from earlier monitoring.

3.0 Air Monitoring Station Locations & Information

As noted earlier in this report, there are three air monitoring stations in the Gregory-Portland area in operation, one station operated by UT in Gregory, TX and two operated by AECOM in Portland, TX. The locations of the three stations and parameters measured are summarized in Table 1. The locations of the three stations are shown in satellite view in Figure 1. Also shown in Figure 1 are the locations of the Cheniere liquefied natural gas facility and the GCGV ethane-cracking and derivatives facility.

Table 1. Gregory-Portland Community Air Monitoring Stations and Parameters Measured

Air Monitoring Station Name & Address	Volatile Organic Compounds (VOCs) compounds	Ethylene oxide (EtO) 24 hr canister every 6th day	Nitrogen Oxides (NOx, NO, & NO_2)	Sulfur Dioxide (SO_2)	Particulate Matter (PM) Mass, particles ≤ 2.5 micron diameter	Wind Speed (WS), Wind Direction (WD), Ambient Temperature (T), Relative Humidity (RH), & Barometric Pressure (BP)
Gregory Fresnos Stephen Austin Elementary 401 Fresnos St. Gregory, TX	Yes	No	Yes	Yes	Yes	Yes
Portland Buddy Ganem 307 Buddy Ganem St. GP High School Portland, TX	Yes	Yes, also continuous hourly data	No	No	Yes	Yes. + precipitation
Portland Broadway 175 Broadway Blvd. Old East Cliff Elementary School Portland, TX	Yes	Yes	No	No	Yes	Only WS, WD

Figure 1. Location of Gregory-Fresnos Community Air Monitoring Station (GF, pin G), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG, pin 1) and on Broadway (PBway, pin 2) and the Cheniere Energy and GCGV industrial facilities

4.0 Summary of Measurement Data

As described in each report, the reader is reminded that pollutant concentrations are affected by several factors. One, of course, is the emission of a gas or smoke from an emission source or the availability of dust to become airborne. Another is the weather. Regarding weather, rain can reduce concentrations of several pollutants, especially particulate matter. The "mixing height" is the lower level of the atmosphere wherein gases and particles mix vertically. Temperature inversions such as those experienced at night have low mixing heights and can lead to air pollutants emitted near the surface being trapped at lower altitudes, thus allowing concentrations to increase. The converse is midday periods when the mixing height of the lower atmosphere rises, and air pollutants are diluted in a larger volume of air. The wind plays a significant role in moving air pollutants from an emission source to other locations. For this reason, a large majority of air monitoring stations operated by the TCEQ and all three Gregory-Portland stations measure wind speed and wind direction. Under high wind speeds, many gas pollutants are dispersed and diluted; however, under high-speed winds, dust on the surface can be picked up and transported, leading to higher particulate concentrations. Higher speed winds passing over the roof of a storage tank can lower the atmospheric pressure on that roof, leading to vapors being drawn out of the tank and into the air. However, in general, low speed winds and stagnation often lead to higher concentrations of pollutants. Figure 2 shows how higher concentrations of NO_2 and propane at the GF station are associated with low-speed winds, with lower concentrations under higher speed winds. Winds can be thought of as being local – near the surface – and regional – at higher altitudes. The local wind direction affects pollutant concentrations in terms of whether a pollution source is in the upwind direction, or along the local upwind path of the air if wind directions are changing. Similarly, but on a larger scale, the regional wind direction affects pollutant concentrations in terms of whether or not a source such as another major city, a large power plant, a forest fire, etc., is along the regional upwind path of the air. In the graphs that follow, some short-term concentration measurements are significantly higher than the balance of the data. In some cases, this is likely the combination of emission and meteorological (Met) factors, and in other cases, normal emissions can result in unusually high concentrations owing to a source being nearby under low wind speeds or air stagnation.

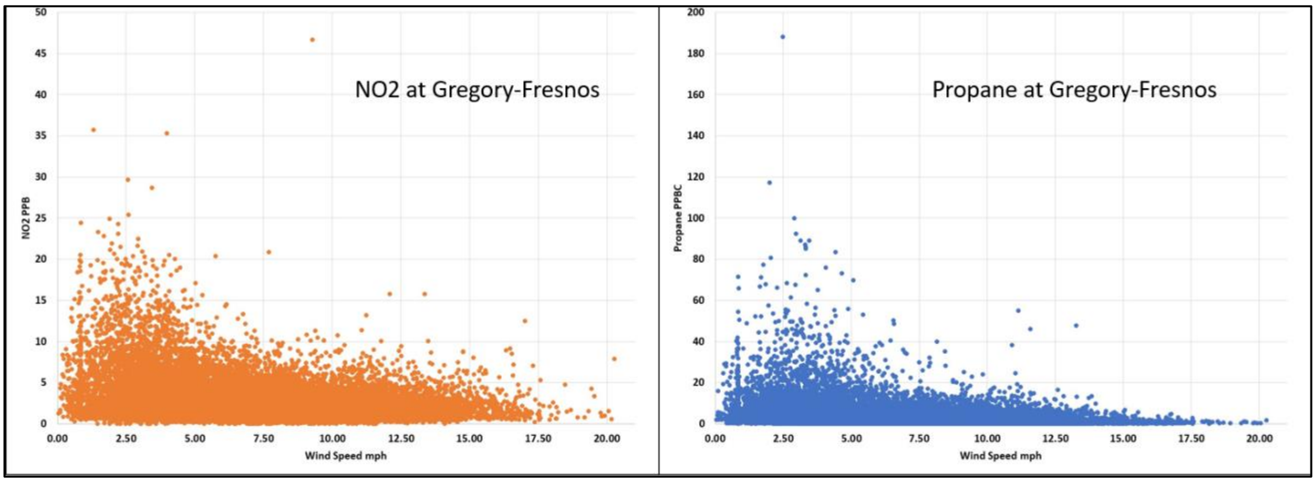

Figure 2. Effect of wind speed on primary pollutants

Please note that the measurement data in this report are quality-assured station data made available at different submission frequencies:

- NOx, NO, & NO_2, SO_2, PM2.5 & Met measurements – weekly;
- Auto-GC VOC measurements – generally within 60 days of the measurement; and
- EtO canister data – generally within 60 days of the date the sample was collected.

Although all these measurements, except canister EtO, are made in near-real time, the nature of the complexity in quality assuring the auto-GC target hydrocarbons among the thousands of different organic compounds that exist in the air leads to a lengthy delay in releasing the quality-assured target species data. Air samples for EtO data are collected at the station and then sent to a laboratory where EtO concentrations are then derived upon analysis of the air samples. Hence, the data available at the time this report was written will not all have the same date ranges. Auto-GC and EtO data are available through April or May 2024, and all other data were available through June 30, 2024.

4.1 Gregory Fresnos Station Hydrocarbon Data

Figure 3 shows the time series graph for hourly concentrations of benzene at the Gregory-Fresnos (GF) station in 2023. The graph shows benzene hourly average concentrations for each hour from January 1, 2024, through May 31, 2024. The date and concentration of the highest value in the graph is shown in the graph. Concentrations early in the year tended to be higher owing to work being done on the nearby school building. Benzene concentrations in the air can be of health concern but to date benzene concentrations have been much lower than TCEQ Air Monitoring Comparison Values (AMCV) of 1,080 ppbC for a single one-hour value or 8.4 ppbC for an annual hourly average concentration. Other AMCVs for auto-GC hydrocarbons can be found on the TCEQ Website at https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_amcvs.pl (accessed July 2024).

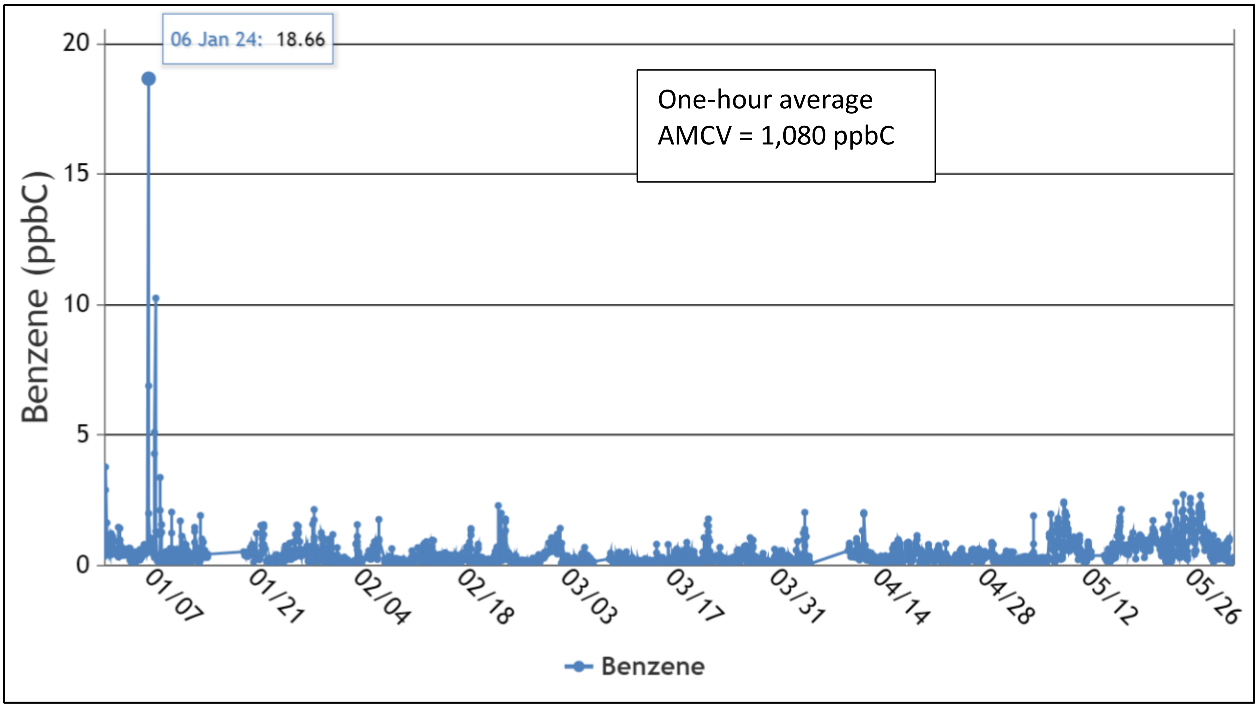

Figure 3. Hourly benzene concentrations at GF station, Jan. 1, 2024 – May 31, 2024, ppbC units

Note that a straight line or a gap in a time series graph in this report represents missing data. Data may be missing owing to equipment failure, planned equipment or site maintenance, or external factors such as power loss or severe weather.

Table 2 lists all target hydrocarbon species measured and reported by the GF auto-GC in 2024 through May, with the peak one-hour concentration, maximum 24-hour day concentration, and the January through May 2024 average hourly concentration for each species. Note that the total sum of the target species (TNMTC) and the total sum of the hydrocarbons (target species plus non-target species and unknown species) (TNMHC) are included in the table. In addition, the TCEQ's Air Monitoring Comparison Values (AMCV) are shown in the table. From the TCEQ's Air Monitoring Comparison Values website[1]:

> "AMCVs are used to evaluate the potential for effects to occur as a result of exposure to concentrations of constituents in the air. AMCVs are based on data concerning health effects, odor, and vegetation effects. They are not ambient air standards. If predicted or measured airborne levels of a constituent do not exceed the comparison level, adverse health or welfare effects would not be expected to result. If ambient levels of constituents in air exceed the comparison levels, it does not necessarily indicate a problem, but rather, triggers a more in-depth

[1] https://www.tceq.texas.gov/cgi-bin/compliance/monops/agc_amcvs.pl accessed July 2024.

review. If you have any questions about the potential for health, odor, or vegetation effects from exposure to reported concentrations of any of these compounds, please contact the Toxicology Division by telephone at (512) 239-3900 or by email at tox@tceq.texas.gov."

Data completeness for auto-GCs is based on the planned collection of 22 hours per day – as two hours per day are reserved for quality assurance activities. The GF station has collected data on the individual hydrocarbon compounds with 76 to 87 percent data completeness of the planned collection hours for early 2024.

Time series graphs of other hydrocarbon species are also available upon request and any graphs can be made with timescale (x-axis) or concentration-scale (y-axis) adjustments. Also, concentrations can be averaged by day, month, or other time period upon request. A user can also make graphs of data on the project website at https://gpair.ceer.utexas.edu/custom-data-request.php (accessed July 2024). To make a request, contact Dr. Dave Sullivan at sullivan231@mail.utexas.edu or 512-471-7805.

Table 2. Gregory-Fresnos Auto-GC statistics for Jan. – May 2024

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term AMCV	Mean ppbC	Long-term AMCV
TNMHC	2,914	2,192.23	268.96	N/A	44.72	N/A
TNMTC	2,914	2,052.42	253.94	N/A	40.78	N/A
Ethane	2,914	560.13	46.76	N/A	10.99	N/A
Ethylene	2,914	77.64	6.06	1,000,000	1.03	10,600
Propane	2,914	363.33	54.00	N/A	8.34	N/A
Propylene	2,914	13.25	2.81	N/A	0.92	N/A
Isobutane	2,914	133.70	17.55	132,000	2.47	40,000
n-Butane	2,914	516.52	51.27	368,000	5.46	40,000
Acetylene	2,839	5.84	1.21	50,000	0.60	5,000
trans-2-Butene	2,914	85.41	4.83	60,000	0.20	2,800
1-Butene	2,914	3.39	0.51	108,000	0.20	9,200
cis-2-Butene	2,914	2.77	0.27	60,000	0.07	2,800
Cyclopentane	2,914	18.17	1.54	29,500	0.14	2,950
Isopentane	2,914	218.96	21.80	340,000	2.53	40,500
n-Pentane	2,914	260.70	23.31	340,000	2.12	40,500
1,3-Butadiene	2,914	149.89	12.29	6,800	0.14	36
trans-2-Pentene	2,914	4.46	0.29	60,000	0.04	2,800
1-Pentene	2,914	2.30	0.21	60,000	0.05	2,800
cis-2-Pentene	2,914	3.33	0.40	60,000	0.03	2,800
2,2-Dimethylbutane	2,914	3.88	0.44	32,400	0.11	1,140
Isoprene	2,914	1.50	0.29	7,000	0.04	700
n-Hexane	2,914	93.45	8.20	32,400	0.80	1,140
Methylcyclopentane	2,914	45.96	3.85	4,500	0.35	450
2,4-Dimethylpentane	2,914	3.33	0.84	58,100	0.02	15,400
Benzene	2,914	18.66	1.80	1,080	0.45	8.4
Cyclohexane	2,914	45.83	3.81	6,000	0.33	600
2-Methylhexane	2,914	9.26	0.73	58,100	0.08	15,400
2,3-Dimethylpentane	2,914	5.96	0.35	58,100	0.02	15,400
3-Methylhexane	2,914	14.68	1.28	58,100	0.16	15,400
2,2,4-Trimethylpentane	2,914	16.08	1.49	32,800	0.19	3,040
n-Heptane	2,913	30.47	2.29	58,100	0.25	15,400
Methylcyclohexane	2,914	48.69	3.54	28,000	0.36	2,800
2,3,4-Trimethylpentane	2,914	0.83	0.13	32,800	0.02	3,040
Toluene	2,914	94.72	7.78	28,000	0.62	7,700
2-Methylheptane	2,914	12.15	0.65	32,800	0.06	3,040
3-Methylheptane	2,914	5.65	0.30	32,800	0.04	3,040
n-Octane	2,914	15.78	0.87	32,800	0.13	3,040
Ethyl Benzene	2,914	4.62	0.83	160,000	0.06	3,520
p-Xylene + m-Xylene	2,914	8.21	1.00	13,600	0.22	1,120
Styrene	2,914	0.83	0.07	41,600	0.00	880
o-Xylene	2,914	2.69	0.27	13,600	0.06	1,120
n-Nonane	2,914	7.59	0.51	27,000	0.07	2,520
Isopropyl Benzene -	2,914	0.57	0.05	4,590	0.01	459
n-Propylbenzene	2,914	1.15	0.23	4,590	0.02	459
1,3,5-Trimethylbenzene	2,562	1.48	0.12	27,000	0.01	333
1,2,4-Trimethylbenzene	2,538	2.60	0.66	27,000	0.20	333
n-Decane	2,562	6.16	0.57	10,000	0.09	1,900
1,2,3-Trimethylbenzene	2,562	1.09	0.15	27,000	0.02	333

4.2 Portland Buddy Ganem & Portland Broadway Stations Hydrocarbon Data

Figure 4 shows the time series graph for hourly concentrations of benzene at the Portland Buddy Ganem (PBG) station, and Figure 5 shows the time series graph for the hourly concentrations of benzene at the Portland Broadway (PBway) station. Both graphs show benzene hourly average concentrations for each hour from January 1, 2024, through May 31, 2024.

As was the case at the Gregory Fresnos station, hydrocarbon concentrations to date are much lower than the TCEQ AMCVs. Table 3 lists the target hydrocarbon species measured and reported by the Portland Buddy Ganem (PBG) auto-GC and Table 4 lists the target hydrocarbon species measured and reported by the Portland Broadway (PBway) auto-GC with the peak one-hour concentration, maximum 24-hour day concentration, and average hourly concentration for each species for January through May 2024. Also shown in the two tables are the TCEQ's AMCVs.

Based on the 22 hours per day planned ambient measurements, the PBG station has collected data with 85 to 89 percent data completeness based on planned collection hours for early 2024, with exception of acetylene, which was at 65 percent. The PBway station had 87 percent data completeness of the planned collection hours for early 2024, also with the exception for acetylene at 63 percent. Acetylene is a particularly difficult species to measure by the auto-GC.[2]

Time series graphs of other hydrocarbon species are also available upon request, and any graphs can be made with timescale (x-axis) or concentration-scale (y-axis) adjustments. In addition, concentrations can be averaged by day, week, or month upon request. As mentioned earlier in the report, a user can also make graphs on the project website.

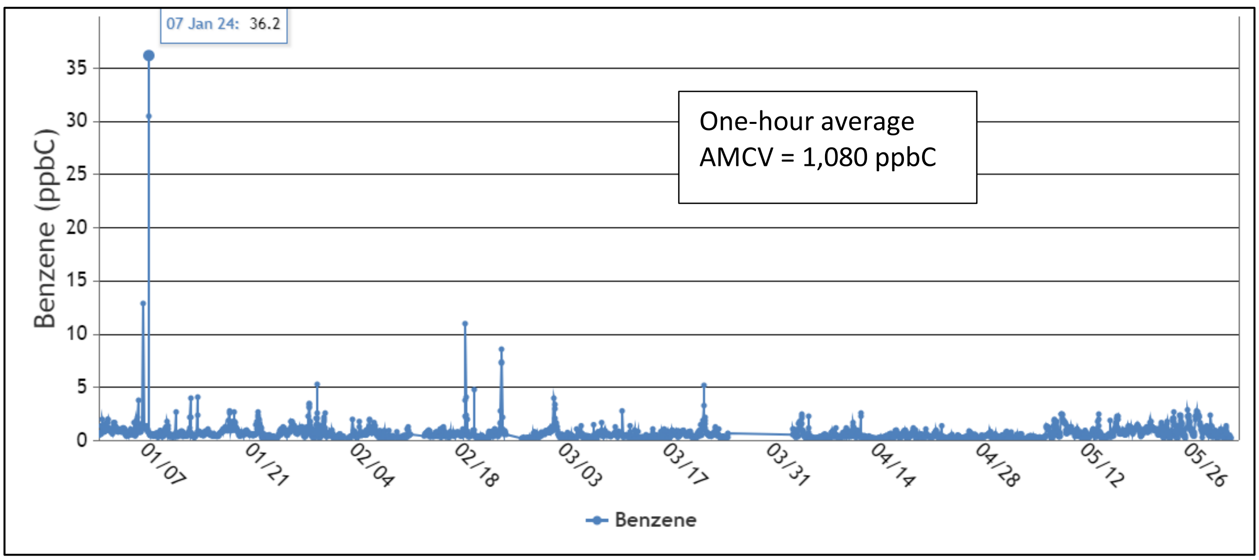

Figure 4. Hourly benzene concentrations at PBG station, Jan. 1, 2024 – May 31, 2024, ppbC units

[2] See https://www.tceq.texas.gov/downloads/air-quality/air-monitoring/auto-gcs/tceq-agc-audit.pdf accessed July 2024

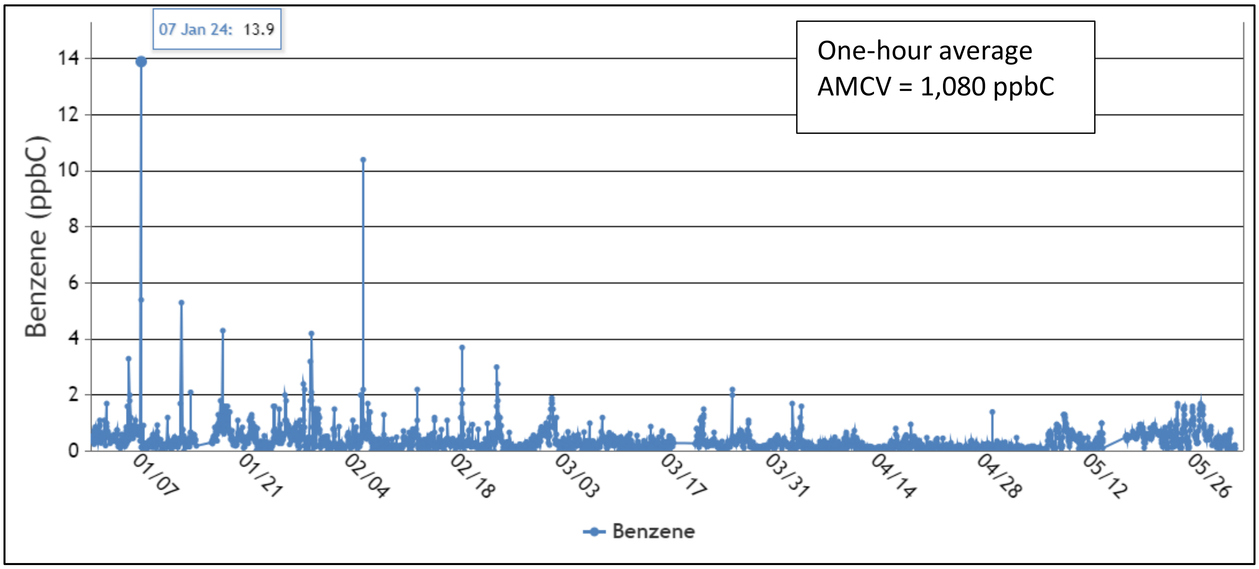

Figure 5. Hourly benzene concentrations at PBway station, Jan. 1, 2024 – May 31, 2024, ppbC units

Table 3. PBG Auto-GC statistics for Jan. – May 2024

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term	Mean ppbC	Long-term AMCV
TNMHC	2,965	1,736	243.94	N/A	55.99	N/A
TNMTC	2,965	1,475	230.47	N/A	52.34	N/A
Ethane	2,965	278	77.89	N/A	18.17	N/A
Ethylene	2,965	88.5	6.01	1,000,000	1.27	10,600
Propane	2,965	241	54.69	N/A	10.31	N/A
Propylene	2,965	13.6	1.95	N/A	1.03	N/A
Isobutane	2,965	156	25.24	132,000	2.89	40,000
n-Butane	2,965	258	34.07	368,000	6.08	40,000
Acetylene	2,176	9.6	1.09	50,000	0.50	5,000
trans-2-Butene	2,963	0.99	0.19	60,000	0.09	2,800
1-Butene	2,965	2.7	0.47	108,000	0.21	9,200
cis-2-Butene	2,965	0.79	0.11	60,000	0.06	2,800
Cyclopentane	2,965	21	2.06	29,500	0.16	2,950
Isopentane	2,965	143	15.70	340,000	2.83	40,500
n-Pentane	2,965	207	20.65	340,000	2.43	40,500
1,3-Butadiene	2,965	11.8	0.64	6,800	0.06	36
trans-2-Pentene	2,859	2.6	0.13	60,000	0.03	2,800
1-Pentene	2,864	1.4	0.13	60,000	0.04	2,800
cis-2-Pentene	2,864	0.93	0.05	60,000	0.01	2,800
2,2-Dimethylbutane	2,864	2.6	0.42	32,400	0.06	1,140
Isoprene	2,864	1.8	0.69	7,000	0.11	700
n-Hexane	2,965	120	11.21	32,400	0.62	1,140
Methylcyclopentane	2,965	57.7	5.40	4,500	0.24	450
2,4-Dimethylpentane	2,965	9.9	0.88	58,100	0.01	15,400
Benzene	2,965	36.2	4.05	1,080	0.71	8.4
Cyclohexane	2,965	93.4	8.79	6,000	0.42	600
2-Methylhexane	2,965	22	2.13	58,100	0.16	15,400
2,3-Dimethylpentane	2,965	12.6	1.20	58,100	0.06	15,400
3-Methylhexane	2,965	35.6	3.37	58,100	0.22	15,400
2,2,4-Trimethylpentane	2,965	31.9	3.18	32,800	0.29	3,040
n-Heptane	2,962	66.2	6.38	58,100	0.39	15,400
Methylcyclohexane	2,965	119	11.25	28,000	0.54	2,800
2,3,4-Trimethylpentane	2,963	8.1	0.54	32,800	0.05	3,040
Toluene	2,965	58.6	5.36	28,000	0.89	7,700
2-Methylheptane	2,930	17.6	1.59	32,800	0.06	3,040
3-Methylheptane	2,930	13.2	0.81	32,800	0.05	3,040
n-Octane	2,930	30.5	2.90	32,800	0.24	3,040
Ethyl Benzene	2,930	12	0.88	160,000	0.12	3,520
p-Xylene + m-Xylene	2,930	58.6	3.87	13,600	0.39	1,120
Styrene	2,914	1.8	0.27	41,600	0.03	880
o-Xylene	2,914	20.8	1.28	13,600	0.09	1,120
n-Nonane	2,914	8.8	0.72	27,000	0.12	2,520
Isopropyl Benzene -	2,914	3.7	0.25	4,590	0.02	459
n-Propylbenzene	2,949	4.9	0.32	4,590	0.03	459
1,3,5-Trimethylbenzene	2,903	10.2	0.63	27,000	0.03	333
1,2,4-Trimethylbenzene	2,921	20.7	1.31	27,000	0.09	333
n-Decane	2,921	3.5	0.58	10,000	0.21	1,900
1,2,3-Trimethylbenzene	2,921	4.5	0.30	27,000	0.03	333

Table 4. PBway Auto-GC statistics for Jan. – May 2024

Species	Num. Samples	Peak 1-hr ppbC	Peak 24-hr ppbC	Short-term	Mean ppbC	Long-term AMCV
TNMHC	2,925	2,906	290.81	N/A	49.48	N/A
TNMTC	2,925	2,748	277.36	N/A	45.66	N/A
Ethane	2,925	273.00	46.66	N/A	12.81	N/A
Ethylene	2,924	30.20	4.26	1,000,000	0.85	10,600
Propane	2,925	133.00	44.90	N/A	9.70	N/A
Propylene	2,925	12.00	3.11	N/A	1.15	N/A
Isobutane	2,925	431.00	31.33	132,000	3.17	40,000
n-Butane	2,925	1084.00	74.64	368,000	6.80	40,000
Acetylene	2,116	20.10	2.23	50,000	0.52	5,000
trans-2-Butene	2,916	31.10	2.08	60,000	0.26	2,800
1-Butene	2,924	5.10	0.59	108,000	0.21	9,200
cis-2-Butene	2,925	12.20	0.77	60,000	0.10	2,800
Cyclopentane	2,925	8.70	1.39	29,500	0.51	2,950
Isopentane	2,925	523.00	34.17	340,000	3.22	40,500
n-Pentane	2,925	150.00	15.11	340,000	2.39	40,500
1,3-Butadiene	2,925	4.90	0.31	6,800	0.07	36
trans-2-Pentene	2,925	23.80	1.12	60,000	0.04	2,800
1-Pentene	2,923	24.30	1.22	60,000	0.08	2,800
cis-2-Pentene	2,925	8.40	0.38	60,000	0.01	2,800
2,2-Dimethylbutane	2,925	7.50	0.89	32,400	0.13	1,140
Isoprene	2,925	5.60	1.79	7,000	0.21	700
n-Hexane	2,925	57.60	4.80	32,400	0.43	1,140
Methylcyclopentane	2,925	27.00	2.07	4,500	0.18	450
2,4-Dimethylpentane	2,925	8.70	0.45	58,100	0.00	15,400
Benzene	2,925	13.90	1.39	1,080	0.38	8.4
Cyclohexane	2,925	36.80	2.89	6,000	0.26	600
2-Methylhexane	2,925	8.50	0.57	58,100	0.05	15,400
2,3-Dimethylpentane	2,925	7.60	0.43	58,100	0.03	15,400
3-Methylhexane	2,925	12.50	0.92	58,100	0.08	15,400
2,2,4-Trimethylpentane	2,925	22.70	1.46	32,800	0.15	3,040
n-Heptane	2,925	21.60	1.50	58,100	0.13	15,400
Methylcyclohexane	2,925	39.00	3.00	28,000	0.30	2,800
2,3,4-Trimethylpentane	2,925	3.20	0.20	32,800	0.02	3,040
Toluene	2,925	114.00	9.86	28,000	0.64	7,700
2-Methylheptane	2,925	3.60	0.29	32,800	0.03	3,040
3-Methylheptane	2,925	2.40	0.18	32,800	0.02	3,040
n-Octane	2,925	7.20	0.76	32,800	0.09	3,040
Ethyl Benzene	2,925	1.60	0.17	160,000	0.02	3,520
p-Xylene + m-Xylene	2,925	6.00	1.32	13,600	0.25	1,120
Styrene	2,925	0.49	0.10	41,600	0.01	880
o-Xylene	2,925	1.70	0.29	13,600	0.03	1,120
n-Nonane	2,925	2.50	0.42	27,000	0.04	2,520
Isopropyl Benzene -	2,925	0.71	0.07	4,590	0.01	459
n-Propylbenzene	2,925	1.50	0.14	4,590	0.01	459
1,3,5-Trimethylbenzene	2,925	1.80	0.09	27,000	0.01	333
1,2,4-Trimethylbenzene	2,923	5.90	0.69	27,000	0.20	333
n-Decane	2,925	3.20	0.50	10,000	0.07	1,900
1,2,3-Trimethylbenzene	2,925	0.97	0.19	27,000	0.02	333

4.3 Ethylene Oxide Measurements

As was noted earlier in this report, the GCGV ethane-cracking and derivatives facility began operating in late 2021 through early 2022. One of the chemicals produced at this facility is EtO, which has been found to be a human carcinogen. It is used to make many other products like antifreeze, textiles, plastics, detergents and adhesives. It is also used to sterilize some medical equipment that cannot be sterilized using steam or radiation. Hence it can be found in the air at very low levels in many locations, not just where it is made.[3] As shown in Figure 6 through Figure 9, the levels of EtO measured in every sixth-day canister samples at the two GCGV stations have remained low, with no discernable trends. The value obtained is an average concentration for the 24-hour period. Note that values of 0.0 ppbC were recorded from the laboratory as non-detects. The TCEQ effects screening level (ESL) and Air Monitoring Comparative Value (AMCV) for chronic exposure to EtO is 2.4 ppbV or 4.8 ppbC. The terms AMCV and ESL are defined in Appendix A.2. The TCEQ report on EtO toxicity can be found at https://www.tceq.texas.gov/downloads/toxicology/dsd/final/eto.pdf (accessed July 2024). It is notable that there has been no change in the EtO 24-hour average concentrations over the past two years while the GCGV industrial facility has been in operation. In fact, there has been an increased frequency of non-detects over time.

In February 2024, EtO measurements with a continuous monitoring instrument began at the PBG station. A discussion of this data appears later in Section 5.0 Data Analysis.

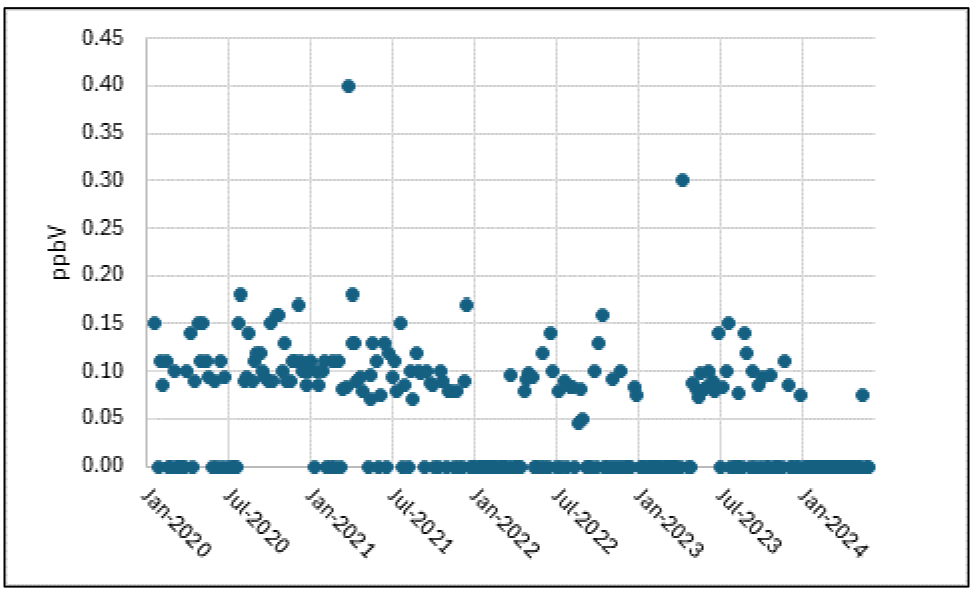

Figure 6. PBG EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through May 2024

[3] https://www.epa.gov/hazardous-air-pollutants-ethylene-oxide/our-current-understanding-ethylene-oxide-eto accessed July 2024

TEXAS
The University of Texas at Austin

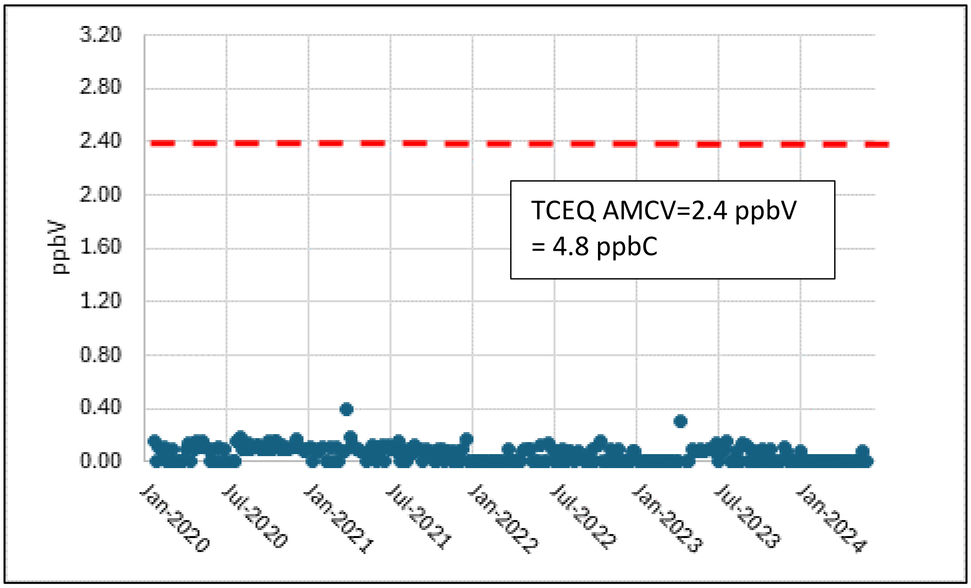

Figure 7. PBG EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through May 2024 in comparison to TCEQ Air Monitoring Comparative Value

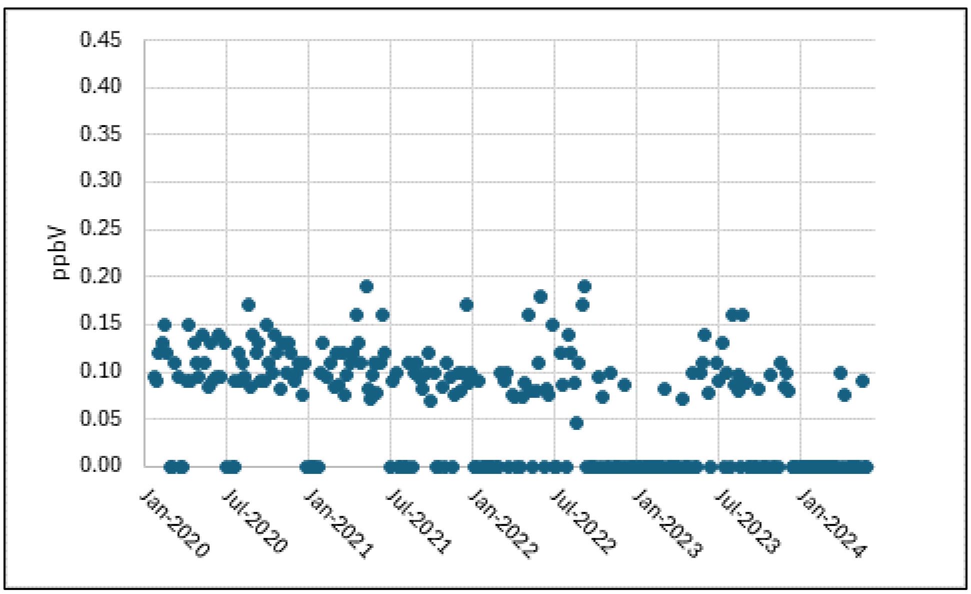

Figure 8. PBway EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through May 2024

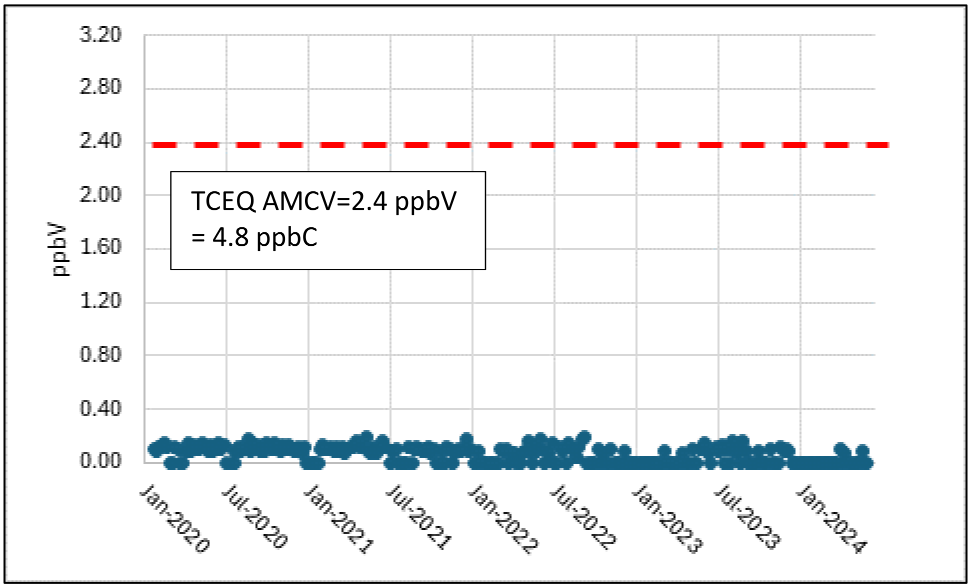

Figure 9. PBway EtO 24-hour average concentrations, every 6th day samples Jan. 2020 through May 2024 in comparison to TCEQ Air Monitoring Comparative Value

4.4 Comparing Hydrocarbon Data between Stations

Figure 10 shows a bar graph comparison between the average concentrations for early 2024 of the hydrocarbons measured by auto-GC, including TNMTC and TNMHC, at the three stations. The graph shows relatively close correlation among the three stations, although the Portland Buddy Gamen (PBG) is trending higher than the other two stations. A close examination of PBG benzene concentrations compared to the other two stations was presented in the October 2023 Quarterly Report, and it was shown that wind speed had a big effect on the concentrations, and adjusting for it made the difference between PBG and the other stations smaller.

Figure 11 is a similar graph excluding TNMTC and TNMHC. This second graph allows for a better comparison of the similarity among the stations. The most common nonmethane hydrocarbons in the atmosphere in urban areas are ethane and propane, followed by other alkane species such as butanes and pentanes. These species have low chemical reactivities and thus can persist in the air longer than more reactive species. Based on modeled back-trajectories using both upper air and surface wind direction and speed data, some ethane, propane, and other light alkanes are likely transported into the region from nearby oil and gas extraction fields.

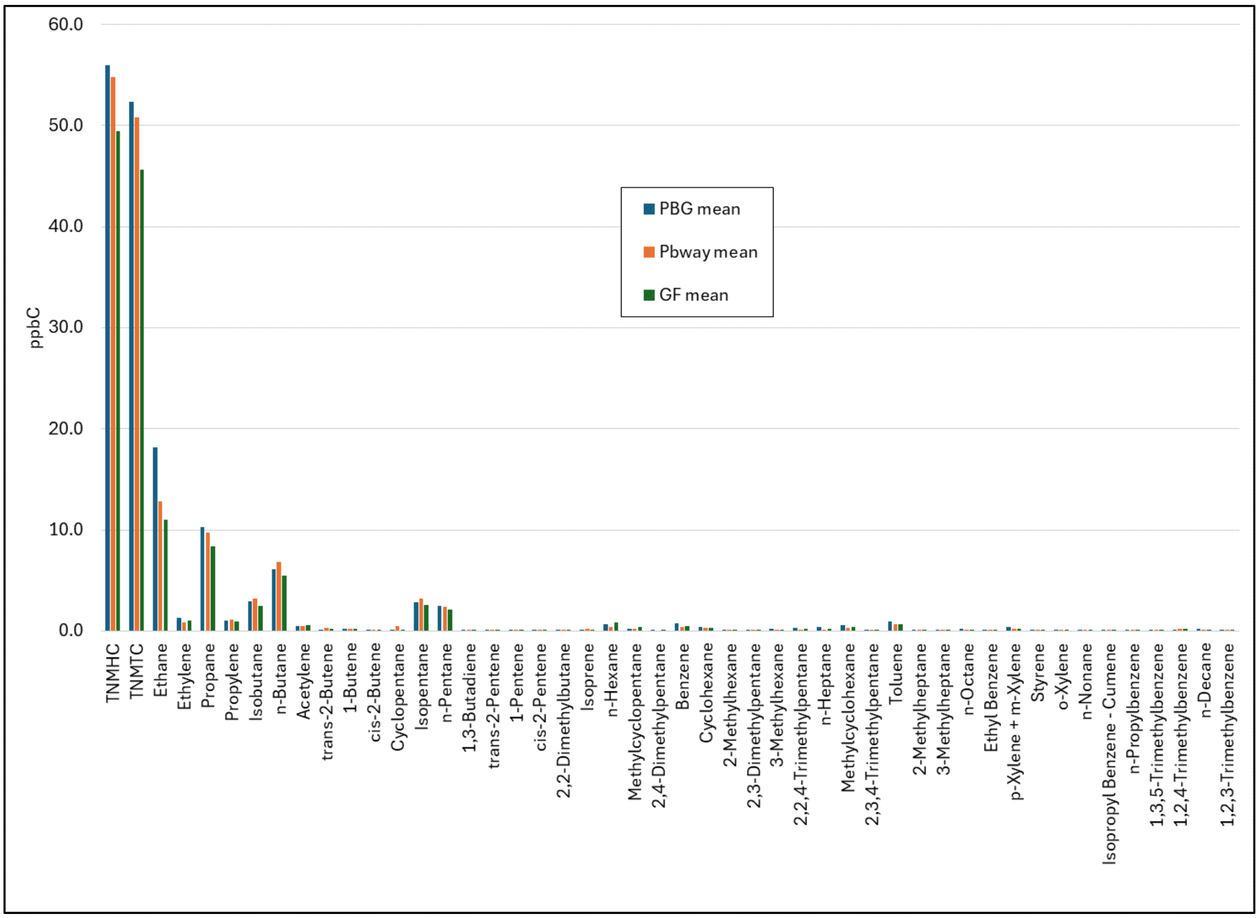

Figure 10. January through May 2024 mean concentrations of TNMTC, TNMHC, and hydrocarbon species at three stations.

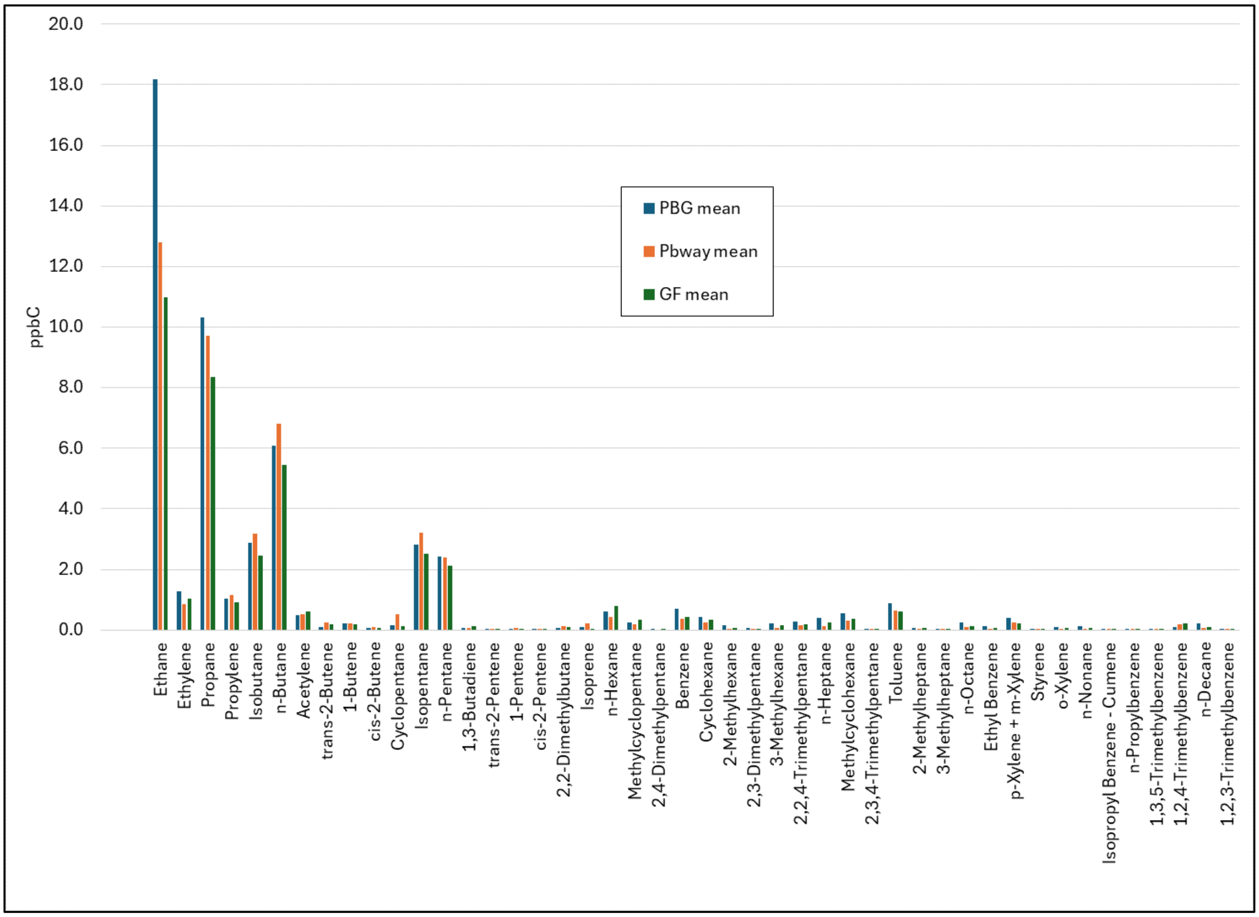

Figure 11. January through May 2024 mean concentrations of hydrocarbon species at three air monitoring stations.

4.5 Gregory Fresnos Station Criteria Pollutant Data

Sulfur dioxide (SO_2), fine particulate matter (PM2.5), and nitrogen dioxide (NO_2) are three pollutants measured at the GF site that are regulated by the U.S. Environmental Protection Agency (EPA). These pollutants, along with ozone, lead, combined coarse and fine particulate matter (PM10), and carbon monoxide are referred to as "criteria pollutants" and are governed by National Ambient Air Quality Standards (NAAQS). Some NAAQS are based on annual average concentrations, and some are based on the frequency with which very high concentrations are measured. The rationale is that different pollutants affect human health in different ways.

- PM2.5 has both an annual average NAAQS and 24-hour NAAQS. For the PM2.5 24-hour NAAQS, the three-year average of the 98th percentile 24-hour (midnight to midnight, using standard time) concentration each year must be less than 35 micrograms per cubic meter ($\mu g/m^3$). The annual average, averaged over three years, is calculated by first averaging 24-hour averages by quarter and then averaging the four quarters, must be less than 9 $\mu g/m^3$, which is the new standard, and is stricter than the previous 12 $\mu g/m^3$ standard.
- The NAAQS for NO_2 is for the one-hour values to average less than 53 ppb in a calendar year averaged over three years and for the three-year average of the 98th percentile daily maximum values to be less than 100 ppb.
- SO_2 has a 1-hour NAAQS, based on ranking the daily maximum one-hour values for

each day in a year, selecting the 99th percentile daily maximum values, and then calculating a three-year average, which must be less than 75 ppb.

No concentrations high enough, of sufficient duration or frequent enough to violate the NAAQS have been seen at the GF station. Several recorded PM2.5 one-hour values exceeded the level of the 24-hour NAAQS, 35 μg/m^3, but as noted above, the NAAQS is not violated unless the 98th percentile of 24-hour averaged concentrations in a year, averaged over three years violates the 24-hour NAAQS, or unless the overall annual average, averaged over three years, exceeds the level of the annual NAAQS (9 μg/m^3).

Figure 12 shows the 24-hour averaged daily PM2.5 concentrations since the start of monitoring in October 2019. This graph is provided to illustrate the roughly seasonal pattern of PM2.5, with higher concentrations in the summers associated with transported dust from Northern Africa. The average concentration for 2023 was 8.4 μg/m^3. In the first half of 2024, the average was 10.4 μg/m^3. During early 2024, a significant amount of smoke from agricultural fires in Southern Mexico and Central America affected South and Central Texas. Table 5 lists the annual mean PM2.5 concentration from each of the past four years and first half of 2024 and the most recent three-year average for the GF station.

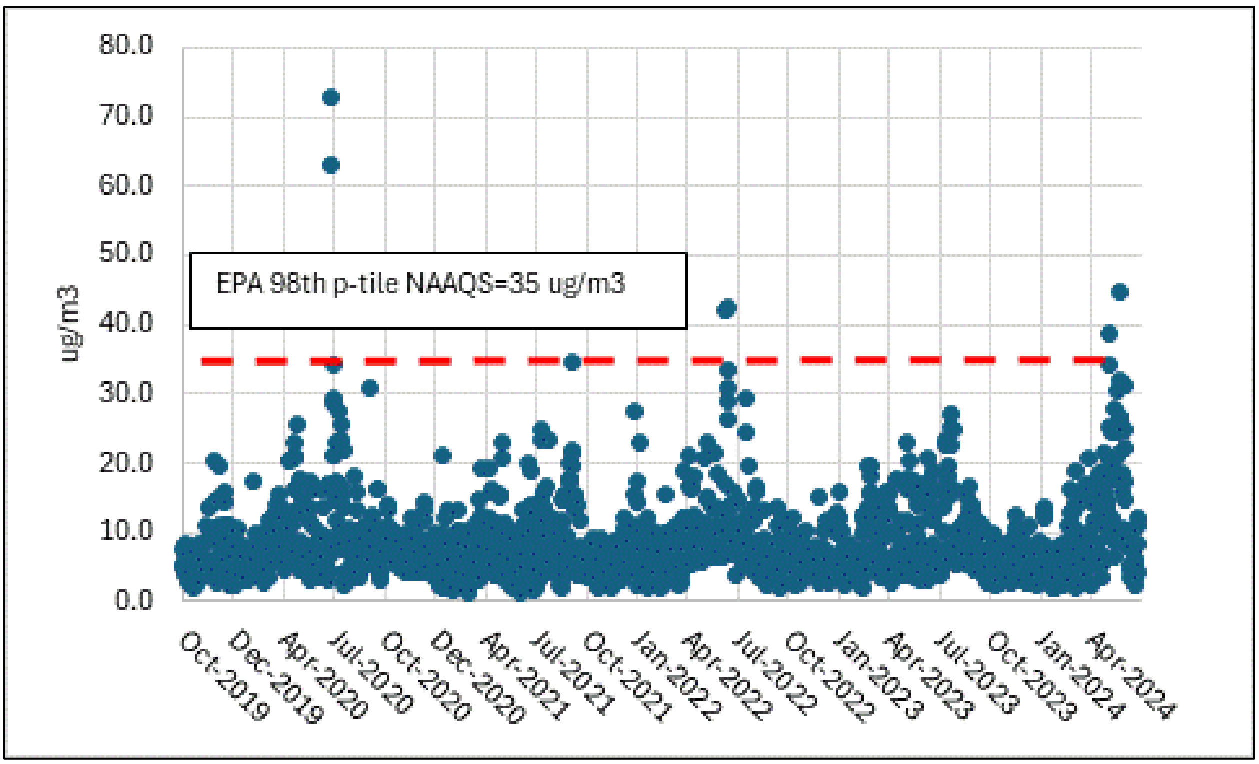

Figure 12. Averaged 24-Hour PM2.5 at GF, Oct. 1, 2019 – Jun. 30, 2024, with NAAQS

Table 5. GF PM2.5 annual means and three-year averages showing NAAQS compliance.

Year	Annual Mean $\mu g/m^3$	NAAQS 3-Year Annual Average Value, $\mu g/m^3$	Annual 98th Percentile Value $\mu g/m^3$	NAAQS 3-Year 98th Percentile Average Value, $\mu g/m^3$
2020	8.9		27.4	
2021	7.6		21.7	
2022	8.1		24.3	
2023	8.4		20.9	
Q1&2, 2024	10.4		31.5	
2021-2023 3-year average	8.0	9.0	22.3	35.0

Figure 13 shows the hourly average time series graph for daily maximum NO_2 at the Gregory Fresnos station from October 1, 2019, through June 30, 2024. The figure also shows the 24-hour 100 ppb NAAQS level. The figure shows measured concentrations have been well below the level of the NAAQS. Table 6 lists for the past four years the NO_2 annual 98th percentile and the annual averages showing NAAQS compliance of these standards by large margins.

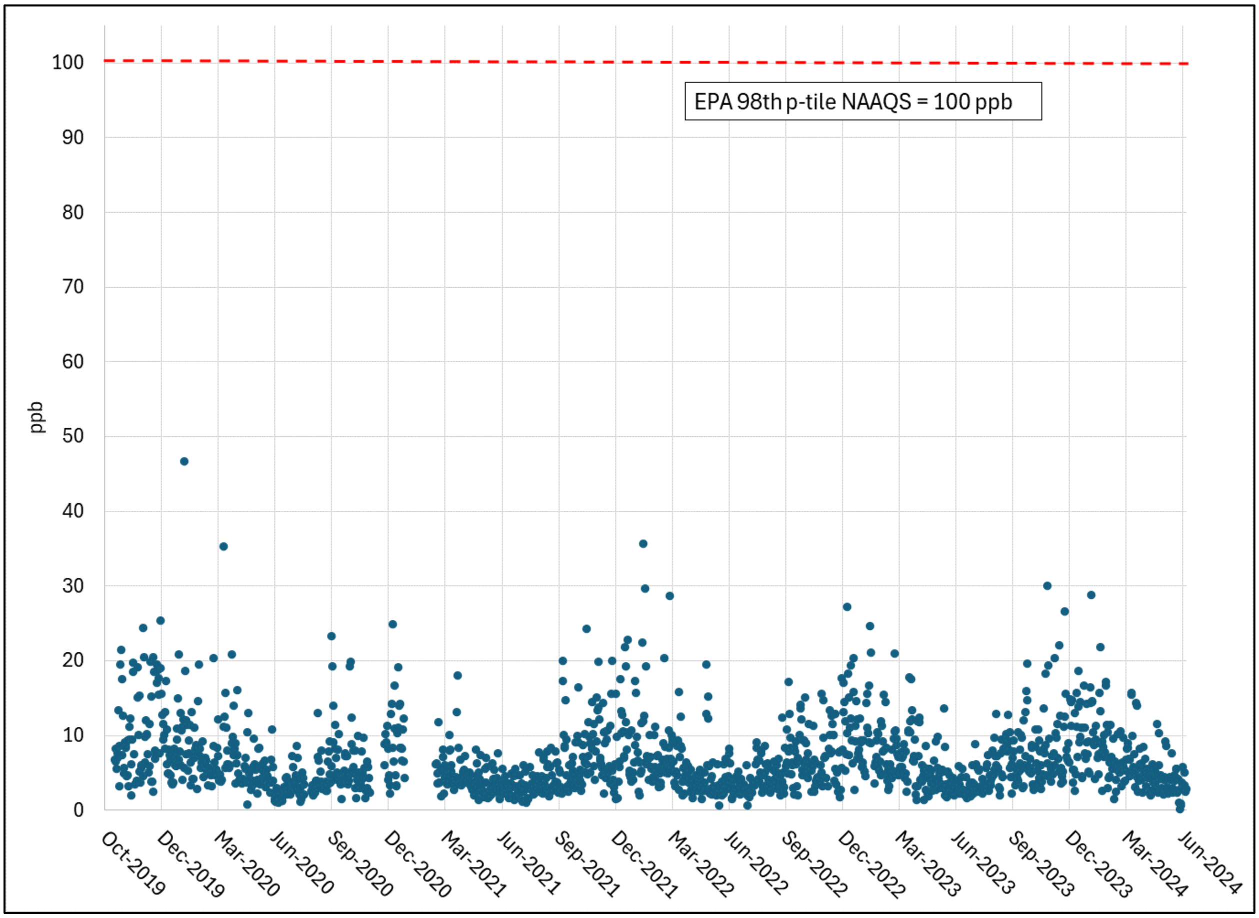

Figure 13. Daily maximum NO_2 at GF, ppb units, Oct. 1, 2019 – Jun. 30, 2024, with NAAQS

Table 6. GF NO_2 annual 98th p-tile values, three-year mean showing NAAQS compliance.

Year	Annual Average Values, ppb	NAAQS Annual Average Value, ppb	Annual 98th percentile ppb	NAAQS 3-Year 98th Percentile Average Value, ppb
2020	6.4		19.4	
2021	5.7		18.5	
2022	6.5		19.7	
2023	7.3		20.6	
Q1&2, 2024	6.9		17.0	
3-year Avg 2021-2023	6.5	53	19.6	100

SO_2 is rarely found in ambient air, and the SO_2 instruments are calibrated to accurately measure high concentrations that are a risk to public health. As a result, the large majority of SO_2 concentrations measurements are close to 0.0. Many instruments measuring low concentrations will produce time series with much scatter near 0.0 owing to the nature of carrying out the chemical or electrical reaction that is associated with the measurement and converting that to a number representing the concentration. When an instrument has been calibrated to accurately measure high concentrations to safeguard public health, generally at low concentrations near zero there can be high relative error. The time series graph for SO_2 since Oct. 2019 at the GF station is shown in Figure 14. The graph is scaled to illustrate how low the concentrations have been compared to the 75-ppb level of the NAAQS. Table 7 lists the annual 99th percentile values of daily maximum SO_2 for the past three complete years, again showing compliance between the level of the NAAQS and measured concentrations by a margin more than 70 ppb.

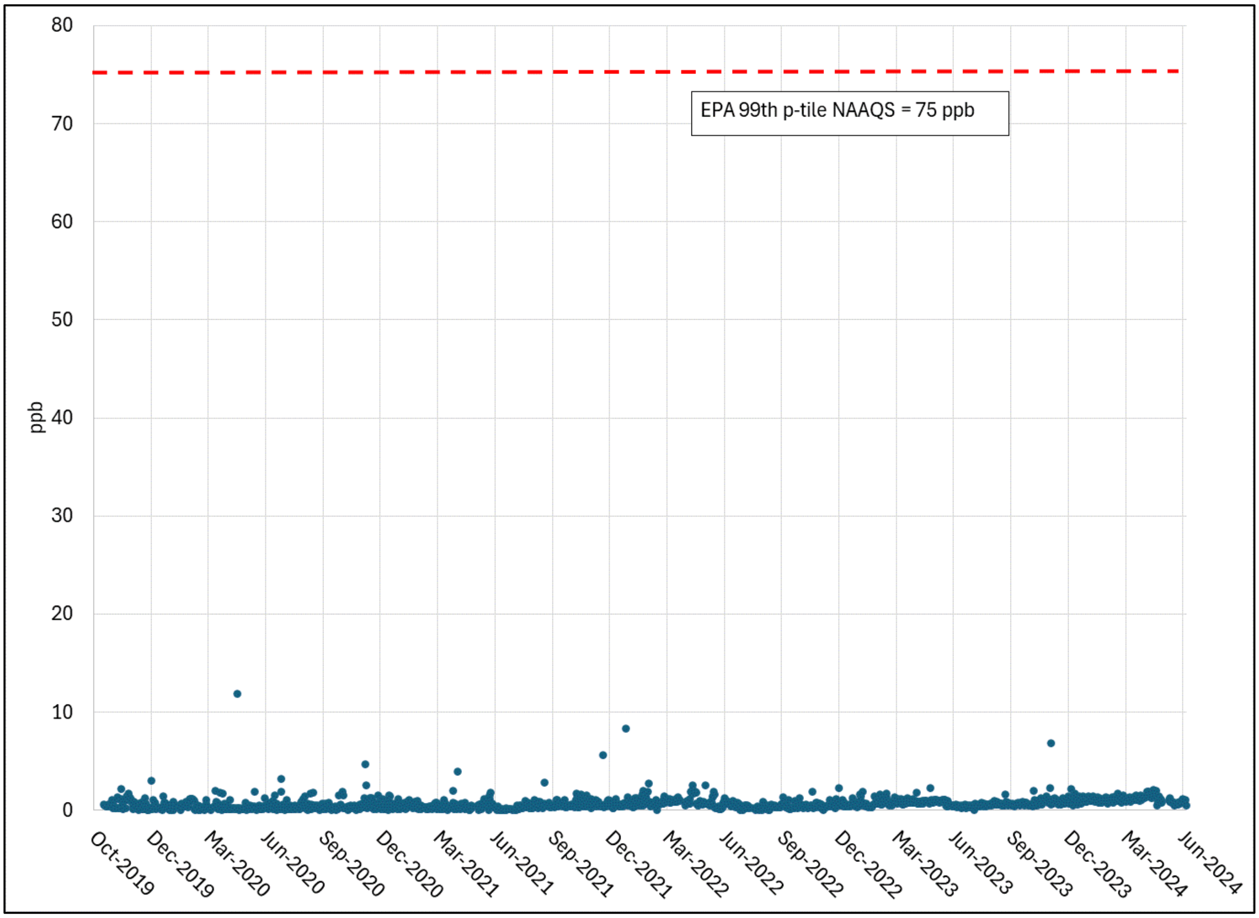

Figure 14. Daily maximum SO_2 at GF, Oct. 1, 2019 – Jun. 30, 2024, with NAAQS at 75 ppb

Table 7. GF SO_2 annual 99th percentile values of daily maximums three-year average showing NAAQS compliance.

Year	Annual 99th percentile ppb	NAAQS 99th Percentile Average Value, ppb
2020	2.5	
2021	2.0	
2022	2.3	
2023	1.9	
Q1&2, 2024	1.9	
3-year Avg. 2021 - 2023	2.1	75

4.6 Portland Buddy Ganem & Portland Broadway Stations Criteria Pollutant Data

Fine particulate matter (PM2.5) is the only NAAQS-regulated pollutant measured at the PBG and PBway stations. Figure 15 shows the 24-hour average concentrations at the PBG site from January 2020 through May 2024, and Figure 16 shows the same time series for the PBway site. The most recent 3-year average concentration PBG is 7.4 μg/m^3 and is 8.0 μg/m^3 at PBway. Table 8 and Table 9 summarize the average annual PM2.5 concentrations for the PBG and PBway stations and the three-year average annual concentrations. Table 8 and Table 9 also show the average PM2.5 concentration for the first half of 2024 with 11.7 μg/m^3 at PBG and 10.1 μg/m^3 at PBway. As was noted earlier in this report, a significant amount of smoke from agricultural fires in Southern Mexico and Central America has affected South and Central Texas this springtime.

To a large extent, PM2.5 concentrations are of a regional nature, in that transported dust or smoke, or locally formed aerosols generally affect a multi-county or larger area. As was the case with the GF station, there have been periods of elevated PM2.5 in summer months associated with transported dust from Northern Africa and in spring months associated with transported smoke from Central America and Southern Mexico. As an example of the regional nature of PM2.5, all three stations exceeded the 35 μg/m^3 24-hour NAAQS on the same two dates, June 12, 2022, and June 16, 2022, owing to the transported North African dust. Across the State of Texas, with 66 regulatory PM2.5 monitors, 22 stations had elevated PM2.5 on June 12, 2022, and 48 stations had elevated PM2.5 on June 16, 2022. Among TCEQ regions, all parts of the state had some elevated concentrations between June 12 and June 16, 2022.

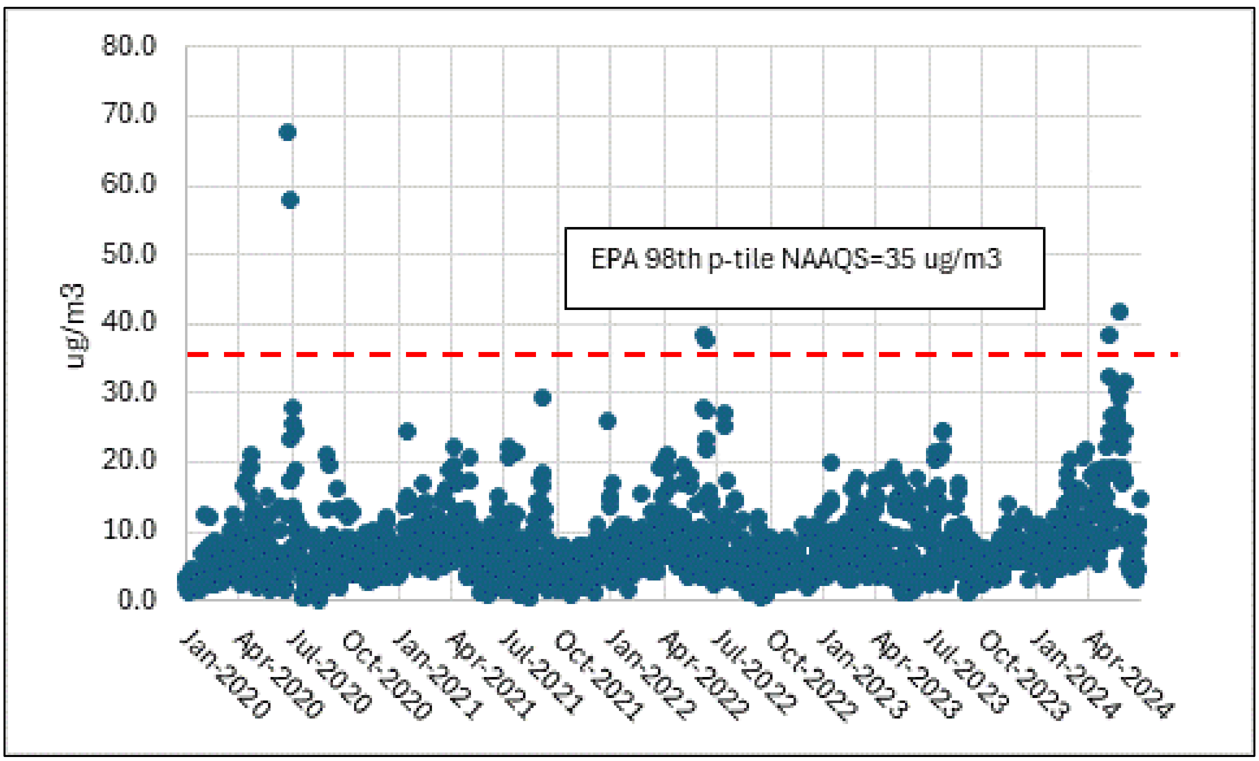

Figure 15. Mean 24-Hour PM2.5 at PBG, Jan. 1, 2020 – Jun. 30, 2024, NAAQS scale.

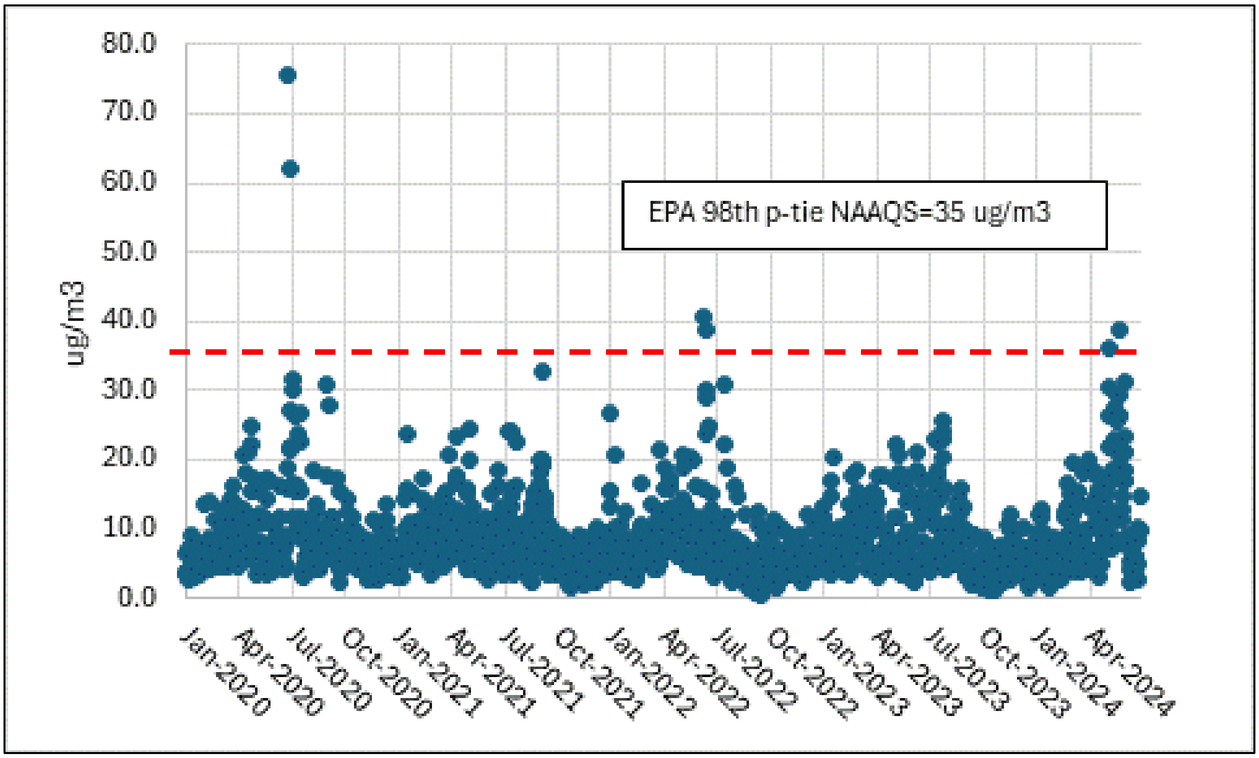

Figure 16. Mean 24-Hr PM2.5 at PBway, Jan. 1, 2020 – May 31, 2024, with NAAQS value

Table 8. PBG PM2.5 annual means and 3-year averages showing NAAQS compliance.

Year	Annual Mean μg/m^3	NAAQS 3-Year Annual Average Value, μg/m^3	Annual 98th Percentile Value μg/m^3	NAAQS 3-Year 98th Percentile Average Value, μg/m^3
2020	6.6		20.8	
2021	7.2		20.5	
2022	7.4		21.3	
2023	7.6		19.3	
Q1&2, 2024	11.7		31.0	
3-year Avg. 2021-2023	7.4	9.0	20.4	35.0

Table 9. PBway PM2.5 annual means and 3-year averages showing NAAQS compliance.

Year	Annual Mean μg/m^3	NAAQS 3-Year Annual Average Value, μg/m^3	Annual 98th Percentile Value μg/m^3	NAAQS 3-Year 98th Percentile Average Value, μg/m^3
2020	8.7		26.9	
2021	8.2		20.5	
2022	7.8		22.5	
2023	8.1		20.7	
Q1&2, 2024	10.1		29.9	
3-year Avg. 2021-2023	8.0	9.0	21.2	35.0

5.0 Data Analysis

5.1 Ethylene Oxide Measurements

As was noted earlier in this report, the operators of the Portland Buddy Ganem station began operating an AROMA continuous EtO[4] monitor in February of 2024 that reports average EtO concentrations every hour. This instrument can discern concentrations at lower levels than the canister samples, measuring concentration as low as 0.05 ppbC (0.025 ppbV). Figure 17 shows the time series for the hourly February, March, and April 2024 EtO data, which shows most data points are less than 2.4 ppbV, the TCEQ Effects Screening Level for EtO, with two exceptions on April 10, 2024. At 7 p.m. CST, the EtO concentration was 0.5 ppbV, and an hour later reached 5.0 ppbV. An examination of the winds at the time suggested the winds were out of the north-northwest at 340 - 350 degrees and around 9 miles per hour. Figure 18 shows an aerial map of the area with red lines to reflect the direction of the likely upwind source area and dots on the map showing modeled NOAA HySplit back-trajectory points started at 8 p.m. CST from the PBG station. In addition to the elevated EtO concentrations, the next hour of auto-GC measurements at PBG had the highest ethane and ethylene concentrations measured this year through May, with the same coincident wind direction and wind speed as the preceding hours. These data are shown in Table 10. One means of producing EtO is to react ethylene with oxygen, and ethylene itself is often produced from ethane.[5]

The 24-hour average EtO concentration on April 10, 2024, comes out to 0.71 ppbV, which is still well below the TCEQ 2.4 ppbV screening value, but is still high compared to the second highest 24-hour average from the AROMA instrument at 0.035 ppbV and highest value measured by a canister sample at PBG at 0.4 ppbV.

[4] See https://entanglementtech.com/products/aroma-eto/ accessed July 2024.

[5] See *J. Chem. Health Saf.* 2008, 15, 6, 30−32 November 1, 2008 https://doi.org/10.1016/j.jchas.2008.09.010

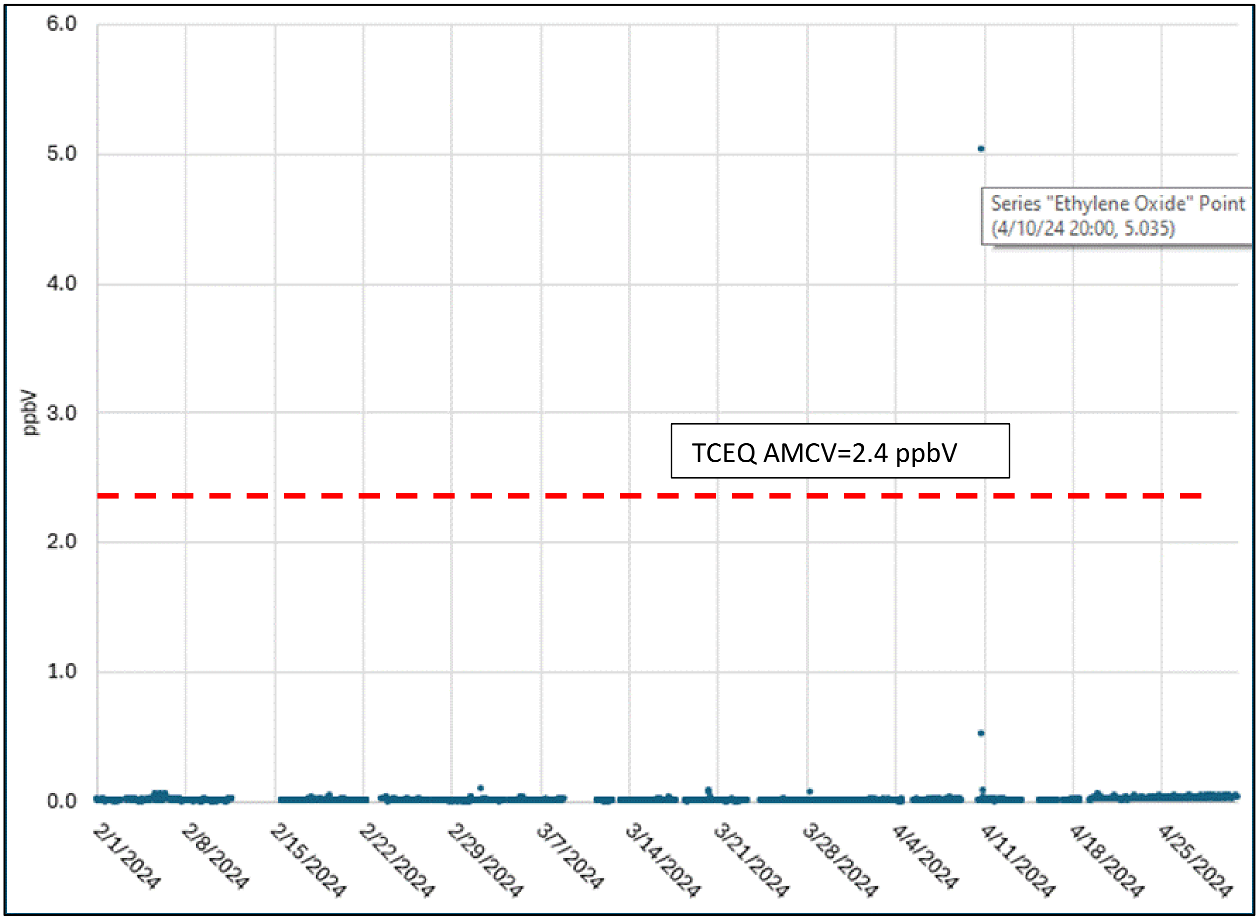

Figure 17. AROMA instrument hourly EtO measurements at PBG for Feb. 2024 – Apr. 2024

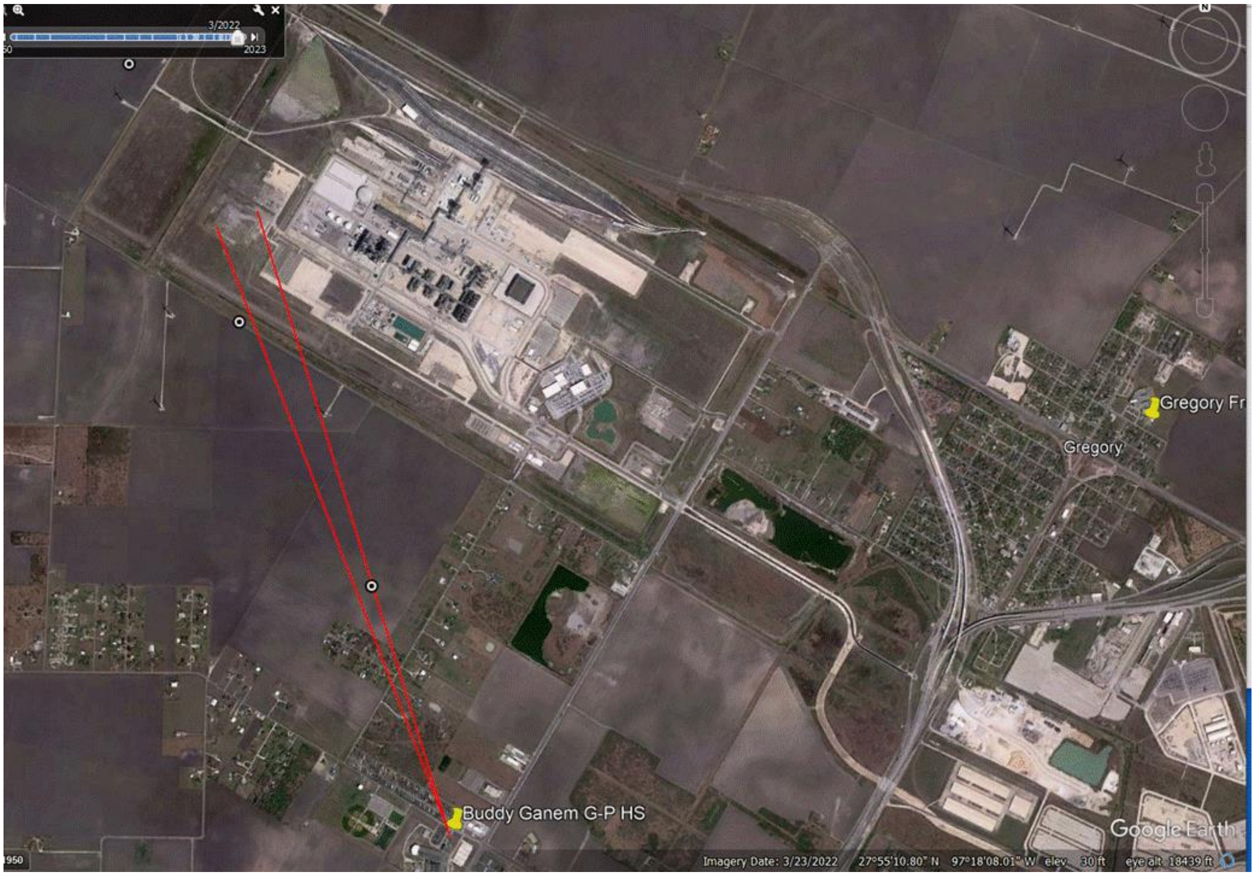

Figure 18. Rays showing likely upwind path of air on Apr. 10, 2024, at 8p.m. CST from the PBG station, and dots representing a 2-hour HySplit back-trajectory path

Table 10: Ethane, ethylene, and EtO concentrations and wind measurements on the evening of April 10, 2024

CST	Ethane ppbC	Ethylene ppbC	EtO ppbV	Wind Direction	Wind speed mph
18:00	21.00	0.33	missing	325.2	10.08
19:00	21.60	0.73	0.524	337.6	9.03
20:00	32.90	8.30	**5.035**	339.1	8.75
21:00	**278.00**	**88.50**	0.09	337.4	8.74
22:00	27.80	2.80	0.012	346.8	10.37

5.2 Hydrocarbon Data Analysis

In examining the ethane and ethylene data seemingly associated with the AROMA EtO elevated values on April 10, a question arose as to the frequency of coincidentally elevated compounds that may be a clue to an upwind source. In the appendix to this report, there is a discussion of the term "elevated concentrations". Here, we consider the top 5 percent of values to be "elevated concentrations". One recent analysis UT performed looked at instances of ethane being elevated at all three San Patricio County stations in the same hour. Such a coincident event is likely to have been caused by ethane having been transported into the county from somewhere outside the county. A local source is unlikely to have affected all three stations in the same hour owing to the time it would take a gas plume to move over the area. On the other hand, a pollutant released into the atmosphere far upwind would be diluted in a large air mass and could blow into the neighborhood and affect all monitors simultaneously. Since January 1, 2020, there have been 53 months of monitoring, or about 38,712 hours, but owing to calibrations, down time for maintenance, and other factors, there have been 22,247 hours with all three stations reporting data. What we observed with ethane was that if data were independent among the stations, then by random chance, the probability that one would have 3 stations in one hour over the 95th percentile value would be 0.05 * 0.05 * 0.05 = 0.000125. So in the 22,247 hours for which all three stations have data, we would expect around 3 occurrences of this happening (0.000125*22,247 = 2.8). It turned out that the data are not independent, however, and there are 545 hours on 174 dates with ethane at three stations simultaneously in the top 5 percent of concentrations. That's 2.4 percent of the hours that have ethane measurements from all three stations simultaneously in the top 5 percent. In this case, ethane was selected as the species due to its very low chemical reactivity, and we used the top 5 percent of each combination hour of the day and quarter of the year, to take daily and seasonal effects into account.

More recently, based on the April 10 data, we looked at coincident elevated ethane and ethylene at each station by themselves. In the April 10 case, the values of ethane and ethylene shown in the preceding section are the highest validated values in 2024, putting them in the top upper 1/10 of a percentage point of all validated observations to date in 2024. This suggested looking at instances when, since the start of 3 station monitoring in 2020, the stations recorded simultaneous values for ethane and ethylene in the top one percentile of all their values. In order to account for meteorological effects, each ethane and ethylene value was adjusted by multiplying by wind speed and dividing by the overall average wind speed to normalize the impact of wind speed on concentrations.

Since January 1, 2020, there have been approximately 32,000 hours of monitoring at each station. If measurements were independent, then in 32,000 hours, one would expect two samples (one ethane, the other ethylene) to both be in their top 1 percent only 0.01 * 0.01 * 32,000 = 3.2 times. It turned out, that at the Gregory Fresnos station, that is exactly the outcome, only 3 cases of both species in their top 1 percentile. However, at the Buddy Ganem and Broadway stations, there were 33 and 31 cases, respectively, or ten times the naïve expected outcome. Figure 19 which shows the most prominent upwind direction at the PBG station is close to due north, which is the general upwind direction of the GCGV facility.

We will continue to monitor the frequency of occurrence of elevated values of ethane and ethylene for changes in frequency and level as needed to assist in confirming the direction and source of EtO.

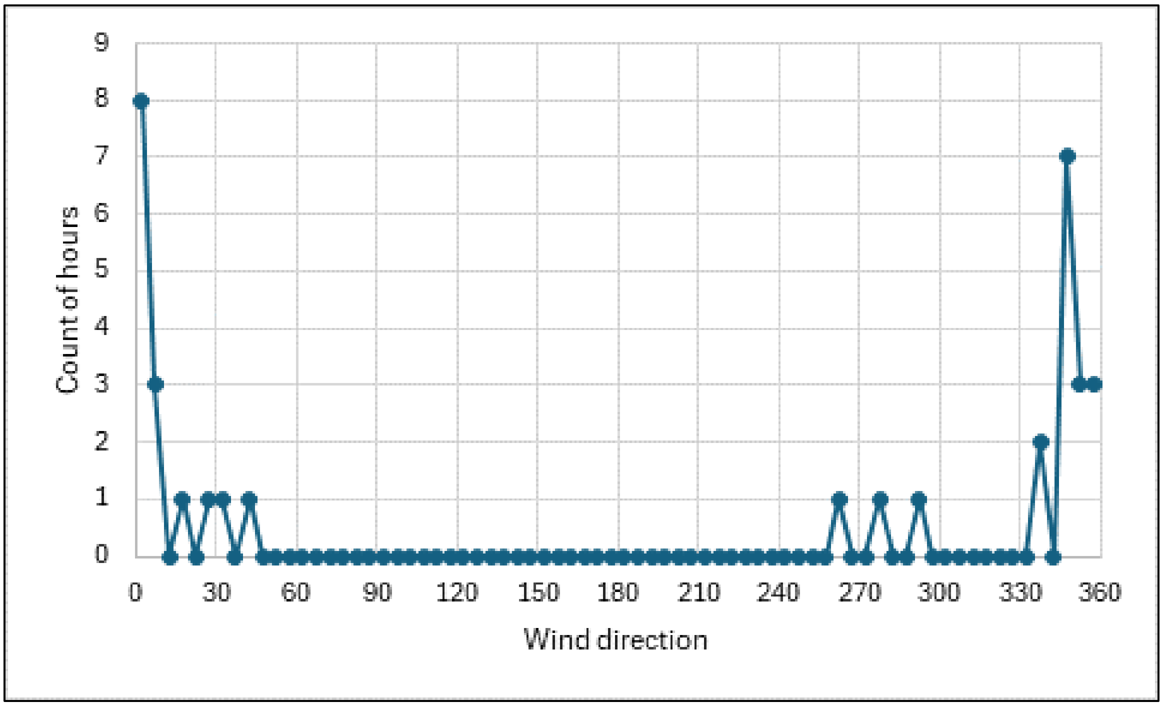

Figure 19. Count of hours with coincident elevated ethane and ethylene by 5-deg. wind bins

6.0 Conclusions

The air monitoring to date has been very successful. Although some concentrations have occasionally exceeded the concentration levels of the NAAQS, to date, the NAAQS have not been violated. Furthermore, measured hydrocarbon concentrations have not exceeded TCEQ long- term or short-term AMCVs. To date, operations at the GCGV facility and the Cheniere Energy facility do not appear to have significantly affected the level of pollutants measured at project stations. UT Austin would be happy to answer any questions or conduct additional analysis at the community's or sponsors' requests.

Appendices

A.1 Air Monitoring Station Locations & Information

Table A-1. Gregory-Portland Community Air Monitoring Stations and Parameters Measured

Air Monitoring Station Name & Address	Volatile Organic Compounds (VOCs) 46 compounds	Ethylene oxide (EtO) 24 hr canister every sixth day	Nitrogen Oxides (NOx, NO, & NO_2)	Sulfur Dioxide (SO_2)	Particulate Matter (PM) Mass, particles < 2.5 micron diameter	Wind Speed (WS), Wind Direction (WD), Ambient Temperature (T), Relative Humidity (RH), & Barometric Pressure (BP)
Gregory Fresnos Stephen Austin Elementary 401 Fresnos St. Gregory, TX	Yes	No	Yes	Yes	Yes	Yes
Portland Buddy Ganem 307 Buddy Ganem St. GP High School Portland, TX	Yes	Yes, also continuous hourly data	No	No	Yes	Yes. + precipitation
Portland Broadway 175 Broadway Blvd. Old East Cliff Elementary School Portland, TX	Yes	Yes	No	No	Yes	Only WS, WD

Figure 20. Location of Gregory-Fresnos Community Air Monitoring Station (GF, pin G), and two Portland community stations on GPISD campuses on Buddy Ganem (PBG, pin 1) and on Broadway (PBway, pin 2) and the Cheniere Energy and GCGV industrial facilities

A.2 Glossary of Terms and Terminology

Pollutant concentrations – Concentrations of most gaseous pollutants are expressed in units denoting their "mixing ratio" in air, i.e., the ratio of the number molecules of the pollutant to the total number of molecules per unit volume of air. Because concentrations for all gases other than molecular oxygen, nitrogen, and argon are very low, the mixing ratios are usually scaled to express a concentration in terms of "parts per million" (ppm) or "parts per billion" (ppb).

Sometimes the units are explicitly expressed as ppm-volume (pp<u>mV</u>) or ppb-volume (pp<u>bV</u>) where 1 ppmV indicates that one molecule in one million molecules of ambient air is the compound of interest and 1 ppbV indicates that one molecule in one billion molecules of ambient air is the compound of interest. In general, air pollution standards and health effects screening levels are expressed in ppmV or ppbV units. Because hydrocarbon species may have a chemical reactivity related to the number of carbon atoms in the molecule, mixing ratios for these species are often expressed in ppb-carbon (ppbV times the number of carbon atoms in the molecule), to reflect the ratio of carbon atoms in that species to the total number of molecules in the volume. This is relevant to our measurement of auto-GC species and TNMHC, which are reported in ppbC units. For the purpose of relating hydrocarbons to health effects, this report notes hydrocarbon concentrations in converted ppbV units. However, because TNMHC is a composite of all species with different numbers of carbons, it cannot be converted to ppbV. Pollutant concentration measurements are time-stamped based on the start time of the sample, in Central Standard Time (CST), with sample duration noted.

Auto-GC – The automated gas chromatograph collects a sample for 40 minutes, and then automatically analyzes the sample for a target list of 46 hydrocarbon species. These include benzene and 1,3-butadiene, which are air toxics, various species that have relatively low odor thresholds, and a range of gasoline and vehicle exhaust components.

Total non-methane hydrocarbons (TNMHC) – TNMHC represent a large fraction of the total volatile organic compounds released into the air by human and natural processes. TNMHC is an unspeciated total of all hydrocarbons, and individual species must be resolved by other means, such as with canisters or auto-GCs.

Canister – Electro-polished stainless-steel canisters are filled with 24-hour air samples on a regular every sixth-day schedule, or, at some monitoring stations, when an independent sensor detects that *elevated* (see below) levels of hydrocarbons (TNMHC or a specific chemical species) are present. Event-triggered samples are taken for a set time period to capture the chemical make-up of the air.

Air Monitoring Comparison Values (AMCV) – The TCEQ uses AMCVs in assessing ambient data. Two valuable online documents ("Fact Sheet" and "Uses of ESLs and AMCVs Document") that explain AMCVs are at https://www.tceq.texas.gov/toxicology/amcv/about (accessed July 2024). The following text is an excerpt from the TCEQ "Fact Sheet" document:

> Effects Screening Levels are chemical-specific air concentrations set to protect human health and welfare. Short-term ESLs are based on data concerning acute health effects, the potential for odors to be a nuisance, and effects on vegetation, while long-term ESLs are based on data concerning chronic health and vegetation effects. Health-based ESLs are set below levels where health effects would occur whereas welfare-based ESLs (odor and

vegetation) are set based on effect threshold concentrations. The ESLs are screening levels, **not ambient air standards.** Originally, the same long- and short-term ESLs were used for both air permitting and air monitoring.

There are significant differences between performing health effect reviews of air permits using ESLs, and the various forms of ambient air monitoring data. The Toxicology Division is using the term "air monitoring comparison values" (AMCVs) in evaluations of air monitoring data in order to make more meaningful comparisons. "AMCVs" is a collective term and refers to all odor-, vegetative-, and health-based values used in reviewing air monitoring data. Similar to ESLs, AMCVs are chemical-specific air concentrations set to protect human health and welfare. Different terminology is appropriate because air *permitting* and air *monitoring* programs are different.

On October 10, 2023, the TCEQ announced:

> The National Academies is seeking suggestions for experts to conduct a scientific review of the Texas Commission on Environmental Quality's carcinogenic dose-response assessment for ethylene oxide, a carcinogenic air pollutant. The study will review the methods, results, and conclusions of the assessment document developed for ethylene oxide by the Texas Commission on Environmental Quality.

Rationale for Differences between ESLs and AMCVs – A very specific difference between the permitting program and monitoring program is that permits are applied to one company or facility at a time, whereas monitors may collect data on emissions from several companies or facilities or other source types (e.g., motor vehicles). Thus, the protective ESL for permitting is set lower than the AMCV in anticipation that more than one permitted emission source may contribute to monitored concentrations.

National Ambient Air Quality Standards (NAAQS) – U.S. Environmental Protection Agency (EPA) has established a set of standards for several air pollutions described in the Federal Clean Air Act. NAAQS are defined in terms of *levels* of concentrations and particular *forms*. For example, the NAAQS for particulate matter with size at or less than microns (PM2.5) has a *level* of 12 micrograms per cubic meter averaged over 24- hours, and a *form* of the annual average based on four quarterly averages, averaged over three years. Individual concentrations measured above the level of the NAAQS are called *exceedances*. The number calculated from a monitoring site's data to compare to the level of the standard is called the site's *design value,* and the highest design value in the area for a year is the regional design value used to assess overall NAAQS compliance. A monitor or a region that does not comply with a NAAQS is said to be *noncompliant*. At some point after a monitor or region has been in noncompliance, the U.S. EPA may choose to label the region as *nonattainment*. A nonattainment designation triggers requirements under the Federal Clean Air Act for the development of a plan to bring the region back into compliance. A more detailed description of NAAQS can be found on the EPA's Website at https://www.epa.gov/criteria-air-pollutants#self (accessed July 2024)

One species measured by this project and regulated by a NAAQS is sulfur dioxide (SO_2). EPA set the SO_2 NAAQS to include a level of 75 ppb averaged over one hour, with a form of the three-year average of the annual 99th percentiles of the daily maximum one- hour averages. If measurements are taken for a full year at a monitor, then the 99th percentile would be the fourth highest daily one hour maximum. There is also a secondary SO_2 standard of 500 ppb over three hours, not to be exceeded more than once in any one year.

Elevated Concentrations – In the event that measured pollutant concentrations are above a set threshold they are referred to as "elevated concentrations." The values for these thresholds are summarized by pollutant below. As a precursor to reviewing the data, the reader should understand the term "*statistical significance*." In the event that a concentration is higher than one would typically measure over, say, the course of a week, then one might conclude that a specific transient assignable cause may have been a single upwind pollution source, because experience shows the probability of such a measurement occurring under normal operating conditions is small. Such an event may be labeled "statistically significant" at level 0.01, meaning the observed event is rare enough that it is not expected to happen more often than once in 100 trials. This does not necessarily imply the failure to meet a health-based standard. A discussion of "elevated concentrations" and "statistical significance" by pollutant type follows:

- For SO_2, any measured concentration greater than the level of the NAAQS, which is 75 ppb over one hour, is considered "elevated." Note that the concentrations of SO_2 need not persist long enough to constitute an exceedance of the standard to be regarded as elevated. In addition, any closely spaced values that are statistically significantly (at 0.01 level) greater than the long-run average concentration for a period of one hour or more will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest the existence of unmonitored concentrations closer to the source area that are potentially above the state's standards.
- For TNMHC, any measured concentration greater than the threshold of 2000 ppbC is considered "elevated."
- For benzene and other air toxics in canister samples or auto-GC measurements, any concentration above the AMCV is considered "elevated." Note that 40-minute auto-GC measurements are compared with the short-term AMCV.
- Some hydrocarbon species measured by the auto-GC generally appear in the air in very low concentrations close to the method detection level. Similar to the case above with SO_2, any values that are statistically significant (at 0.01 level) greater than the long-run average concentration at a given time or annual quarter will be considered "elevated" because of their unusual appearance, as opposed to possible health consequence. The rationale for doing so is that unusually high concentrations at a monitor may suggest an unusual emission event in the area upwind of the monitoring site.